DAMAGE CASES AND ENVIRONMENTAL RELEASES FROM MINES AND MINERAL PROCESSING SITES

1997

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Discussion and Summary of Environmental Releases and Damages

In its continuing efforts of collecting information on the mining and mineral processing industry, EPA obtain detailed information to develop approximately 62 summaries illustrating recent mining and mineral processing damage cases in a variety of mineral commodity sectors and states. While these cases should not be viewed as the results of an exhaustive survey or as a statistically representative body of knowledge, EPA does believe they demonstrate that releases of constituents to the environment with consequent environmental damages have been and are occurring from many different types of mineral production sites and activities across the U.S.

Table 1 provides summary information on the cases of documented damages and contaminant releases described in this report. Additional detail on the specific facility can be found in the body of the report. In the accompanying tables, the cases are organized according to the primary mineral commodity sectors involved. In addition, the table describes the general source of constituent releases, and provide supporting information on the nature and severity of any resulting environmental damages. Review of this information provides several general findings, as discussed below.

In addition to the damage cases presented in this report, the following discussion also takes into consideration data collected from prior EPA efforts. EPA has conducted several studies identifying human health and environmental damages caused by mining and mineral processing waste management activities:

- *Report to Congress on Special Wastes from Mineral Processing*, July 1990, U.S. Environmental Protection Agency.
- *Mining Waste Release and Environmental Effects Summaries, Draft*, March 1994, U.S. Environmental Protection Agency.
- *Mining Sites on the National Priorities List: NPL Summary Report*, U.S. Environmental Protection Agency, June 21, 1991.
- *Human Health and Environmental Damages from Mining and Mineral Processing Wastes, Technical Background Document Supporting the Supplemental Proposed Rule Applying Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes*, U.S. Environmental Protection Agency, December 1995.
- *Mining Sites on the NPL*, U.S. Environmental Protection Agency, August 1995.
- *Mining Sites on the NPL*, U.S. Environmental Protection Agency, 1997

This latest information collection effort documents 95 release incidents that have occurred since 1990 at facilities within eight states. Some of the facilities had more than one release. These facilities operate in 19 distinct mineral commodity sectors (e.g., copper, lead, etc). These incidents involve management of secondary and waste materials in addition to spills or other releases of feedstocks, in-process materials, intermediates, or products. A number of the release incidents involve a combination of materials. Affected media include ground water, surface water, and soils, with the most common impacts comprising elevated concentrations of heavy metals, increased acidity, and in a few cases, biotic impacts such as fish kills.

The releases documented in this report have arisen from both extraction/beneficiation operations, and mineral processing operations. In a few cases, the releases occurred from integrated facilities that engage in both beneficiation and mineral processing. Of the 49 release incidents occurring from extraction/beneficiation operations, most involved inadequate containment of tailings, clay ponds, waste

rock, process water, process solution (e.g., cyanide), wastewater, acid mine drainage, and stormwater. Many of the releases occurred through spills resulting from equipment failure, and operator error while others resulted from unusually heavy rains and, consequently, the generation of high stormwater volumes. In a number of other cases, however, use of unlined storage units resulted in seepage of contaminated waters and down gradient ground water and surface water impacts. In addition, EPA found several instances of releases of hazardous substances to the environment from the loss of beneficiation feedstocks or in-process materials through failure of containment tanks or storage units or through failure of transport devices such as pipelines.

The typical management practice used for storage or disposal of mineral processing secondary materials and wastes was found to have created or exacerbated ground water contamination in the immediate area. In some cases, a combination of feedstock, in-process materials, secondary materials, and wastes contributed to ground water, surface water, or soil contamination. Finally, in a limited number of cases, contamination occurred through episodic or continuing mismanagement of hazardous and other solid wastes (e.g., commercial chemical spills).

This report refers to the terms “extraction/beneficiation” and “mineral processing” based upon applicable EPA definitions found at 54 FR 36618-36620 (September 1, 1989). In some cases, both activities occur at the same site or in contiguous operations that share the same facilities. For these cases, it is sometimes difficult to discern where beneficiation ends and mineral processing begins. References to the terms extraction/beneficiation and mineral processing are not intended to be regulatory determinations or final decisions of the status of these materials; rather, EPA did a subjective evaluation based upon available information. The information on damages cases where beneficiation operations occur are intended to support the discussions regarding Bevill wastes (see Risks Posed by Mining and Mineral Processing Wastes, EPA, 1997). Some of the site listed as beneficiation may have, in fact, mineral processing operations, especially gold mining sites that have furnaces that produce gold dore. However, the damage incidents from gold sites are focused primarily on beneficiation and non-exempt commercial chemicals.

In Table 1, the columns under the heading of source of release are divided in three categories (1) feedstock, in process materials, or product; (2) waste streams; and (3) secondary materials. These categorizations are not intended to be regulatory determinations or final decisions of the status of these materials; rather, EPA did a subjective evaluation based upon available information. The detailed summary of each of these incidents should be examined, as well as the correspond references, to understand the context for which these materials are categorized.

For purposes of this table only, and in the context of providing a technical basis for solicitation of public input on issues presented in the January 25, 1996 and April 15, 1997 proposals, the Agency has made the following categorizations: a feedstock or in-process material or is an input or ingredient used in the production of a product, as part of normal operations. A waste stream is typically discarded and unlikely to be recycled or reclaimed (some exceptions may exist). A secondary material is derived from a mineral processing operation and may be wholly or partially recovered not only for minerals but for acid values, heat or cooling properties, make-up water, or other purposes. In many cases, process wastewater is stored in impoundments and either discharged or a portion may be used as process water. Also, solids are often found in process wastewaters and in the surface impoundments due to settling.

This effort also documented 42 releases from mineral processing operations. Many of the incidents involved process and wastewater systems, equipment and/or operator failure, and releases from tanks, piles, and surface impoundments. In many of these cases, the secondary material is typically recycled in part or in whole for mineral value, acid value or water. In addition to the cases presented in

this report, EPA reviewed environmental data collected at the Kennecott Copper facility in Utah. Because the site was proposed to be placed on the National Priorities List and is currently undertaking remedial actions under an agreement with EPA, a significant amount of information regarding contamination from secondary materials is available. For example, secondary materials from electrolytic refining, smelter and furnace flue dusts, acid plant blowdown, and process water all stored in surface impoundments or piles have contributed to groundwater contamination[1]. EPA has developed an extensive administrative record indicating that the source of groundwater contamination may not be from the massive tailings ponds, which are waste from beneficiation activities, but rather the contamination may originate from mineral processing land-based units from the electrolytic refinery and smelter.

In some cases, the value of product-like materials is questionable, and further, land placement of products, byproducts, in-process materials, and intermediates can result in environmental problems. For example, some secondary material is sold as a byproduct for other uses. In Louisiana-Pacific v Asarco, 24 F.3d 1565 a smelter sold copper slag, a hazardous byproduct of the smelting process, to logging companies for use as gravel ballast in their logyards. The placement of the slag on the ground resulted in environmental damage. The Court held that the slag was a "byproduct with nominal commercial value, "which the smelter wanted to get rid of" whether it could sell the slag or not. Id. at 1575. In other cases, in-process, intermediates, and commercial products stored in land based units have contributed to environmental problems. For example, copper concentrate was disposed of in a surface impoundment at the Kennecott smelter; lead concentrate was found disposed of at a site in Missouri (see Case Files, Kennecott and Burlington Northern, respectively). Flue dusts, a secondary mineral processing material commonly recycled, have been found to be a source of contamination not only at Kennecott, an operating smelter, but also at historic mineral processing NPL sites such as Bunker Hill and the Anaconda Smelter. It is not known why some flue dusts and spilled metal concentrates are fully recycled at some facilities but not at others.

[1] Site Background Document, Kennecott Bingham Canyon Area, January 26, 1996, EPA Region VIII.

TABLE 1. ENVIRONMENTAL RELEASE DAMAGE CASE SUMMARY

Commodity Sector	Facility		Production Operations		Source of Constituent Release(s)			Notes/Supporting Information
	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Copper	Phelps Dodge New Cornelia Branch Facility	AZ		X			Insulated copper wire and scrap metals	Heavy metals soil contamination from ash and fugitive emissions produced during scrap metals burning salvage operations (not clear if copper wire used as an input following burning)
Copper	BHP Copper Mine (formerly Magma Copper Mine)	AZ		X		Non-process wastewater	unknown origin	Heavy metal contamination of surface water from pipe seam leak
Copper	BHP Copper Mine (formerly Magma Copper Mine)	AZ	X			Mill tailings		Metal, fluoride, and TSS contamination of ground water and surface water from effluent overflow from tailings impoundment dam
Copper	BHP Copper Mine (formerly Magma Copper Mine)	AZ	X			Mill tailings and leaching wastes		Acidic, heavy metal contamination of surface water and fish kills from tailings dam failure, overtopping of dam by leaching wastes
Copper	BHP Copper Mine (formerly Magma Copper Mine)	AZ	X			Mill tailings		Heavy metals and TSS contamination of surface water from multiple tailings dam failures

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Copper	Phelps Dodge Morenci, Inc.	AZ	X			Waste rock		Heavy metals, acidic and TSS contamination of ground water from spring water and storm water flowing through low-grade development rock stockpile upgradient of unlined impoundment of storm water collection system
Copper	Phelps Dodge Morenci, Inc. Mine	AZ	X			Waste rock dump leachate		Acidic, heavy metal contamination of ground water from seepage from unlined impoundment below waste rock dump
Copper	ASARCO Silver Bell Mine	AZ	X		Leach dump solution	Waste rock dump leachate		Acidic, heavy metal contamination of ephemeral streams that intersect the base of a beneficiation and a waste management unit
Copper	Cyprus Twin Buttes Mine	AZ	X		Electrowinning solution			Possible acid and metal contamination of soils and ground water from leaking indoor storage tanks
Copper	Cyprus Sierrita Corporation	AZ	X			Process wastewater and storm water		Heavy metals ground water and surface water contamination from pipeline leaks and breaks, overflows, and underground seepage from process wastewater, wastewater, and storm water surface impoundments

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Copper	ASARCO, Inc. Ray Complex	AZ	X		Ore schists	Mill tailings		Fugitive air emissions, particulate matter, tailings, and dust from insufficient emissions controls and maintenance measures
Copper	ASARCO, Inc. Ray Complex	AZ	X			Mill tailings		Copper, sulfate, and soluble solids contamination of surface water and river sediments from a breach of a tailings impoundment following heavy rainfall
Copper	ASARCO, Inc. Ray Complex	AZ	X		Copper sulfate solution	Tailings reclaim water		Heavy metals contamination of sediment and surface water, and suspected loss of aquatic life from multiple spills and ruptured pipelines
Copper	ASARCO, Inc. Ray Complex	AZ	X	X	Smelter and acid plant gases	Mill tailings		Impacts on community from opacity and sulfur dioxide fugitive and stack emissions from design deficiencies, and operation and maintenance problems
Copper	ASARCO, Inc. Ray Complex	AZ	X		Copper leachate solution	Copper sludge		Copper and beryllium contamination of surface water and ground water from seepage from leaching facilities and releases from impoundments following heavy rainfall

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Copper	ASARCO, Inc. Ray Complex	AZ	X		Pregnant leach solution	Mill tailings and storm water		Acidic, heavy metals, sulfate, and TDS contamination of surface water and ground water from chronic infiltration and seepage from multiple process waste impoundments
Copper	ASARCO, Inc. Ray Complex	AZ	X		Copper sulfate solution, process water			Acidic, copper discharges from pipeline leaks and breaks stress downstream aquatic life and wildlife
Copper	BHP Copper, Inc. San Manuel Facility	AZ	X	X		Unknown	Unknown	Heavy metals soil contamination from unspecified activities
Copper	Cyprus Bagdad Mine	AZ	X		Pregnant leach solution			Copper and low pH releases to ground and surface waters, hazards to aquatic life from solution releases beneath and over containment system dam
Precious metals	Cyprus Copperstone Gold Corporation	AZ	X	X	Empty sodium cyanide drums	Waste oil and used tires		Possible trichloroethylene and sodium cyanide soil contamination from improper hazardous and solid waste disposal
Ilmenite	Associated Minerals (USA), Inc.	FL	X			Tailings and reclamation soils		High turbidity and sedimentation in surface water from washout of reclaimed area; dam removed and not replaced
Lightweight clay aggregate	Florida Solite Company	FL		X			Kiln scrubber water	Heavy metal contamination of soil, surface and ground waters from pond overflow

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	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Magnesium hydroxide	Premier Services Corporation	FL		X		Process wastewater	Process water	Ionic imbalance, high pH, acute toxicity to aquatic species from insufficient wastewater treatment
Phosphate	IMC-Agrico Hopewell Phosphate Mine	FL	X			Clays and effluent		Vegetation killed and wetland impacts from high turbidity discharge from dam failure (constructed 1994)
Phosphate	Cargill Fertilizer, Inc. Forte Meade Mine	FL	X		Phosphate rock slurry			Elevated phosphorus, iron, and radioactivity in surface water from pipeline failure
Phosphate	Mobil Mining and Minerals Company Nichols Phosphate Mine	FL	X			Tailings and effluent		Elevated turbidity and TSS in surface water from tailings dam failure, use of unauthorized discharge pipes
Phosphate	IMC-Agrico Co. Payne Creek Phosphate Mine	FL	X			Clays and effluent		Impacts on reclaimed wetlands, elevated phosphorus and TSS from clay pond dam breach
Phosphate	Occidental Chemical Corporation, Swift Creek Chemical Complex and Mine, Suwannee River Chemical Complex and Mine	FL		X	Sulfuric acid and molten sulfur	Contaminated refractory		Soil contamination from spills of reagent and product, release of spent materials from corroding drums, disposal of waste on-site with no hazardous waste determination

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Phosphate	Occidental Chemical Corporation, Swift Creek Chemical Complex and Mine, Suwannee River Chemical Complex and Mine	FL		X		Process and non-process wastewater	Process water	Degradation of aquatic community from inadequate wastewater treatment
Phosphoric acid	CF Industries, Inc. Bartow Phosphate Complex	FL		X		Process wastewater	Process water	Heavy metal and radionuclide contamination of ground water from gypsum stack seepage
Phosphoric acid	Mulberry Phosphates, Inc. Mulberry Phosphates Plant	FL		X		Process wastewater	Process water	Elevated acidity, fluoride, and iron in ground water from overland flow of process wastewater from gypsum stack
Phosphoric acid	IMC-Agrico New Wales Chemical Plant	FL		X		Process wastewater	Process water	Contamination of underground drinking water supply with orthophosphate, sodium, sulfate, and dissolved solids from sinkhole formation under gypsum stack
Phosphoric acid	IMC Fertilizer, Inc. Noralyn/Phosphoria Mine P-21 Gypsum Disposal Area	FL		X		Process wastewater	Process water	Contamination of ground and surface waters and soils with heavy metals, radionuclides, and salts from gypsum stack seepage
Phosphoric acid	Cargill Fertilizer, Inc. Riverview Chemical Complex	FL		X		Process wastewater	Process water	Fish and crab kills from acidic discharge to surface water from piping, due to operator error
Titanium/ Titanium dioxide	E. I. DuPont de Nemours and Co., Inc. Highland Mine	FL	X			Storm water		Turbid, acidic discharges to surface water from inadequate containment (berm and swale) of partially treated storm water

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Titanium/ Titanium dioxide	E. I. DuPont de Nemours and Co., Inc. Highland Mine	FL	X			Process wastewater and storm water	Process water	Kills of aquatic biota, terrestrial impacts from acidic, turbid seepage through ditch
Cadmium	SCM Chemicals St. Helena Plant	MD		X		Process wastewater	Process water	Acute and chronic toxicity from ammonia in treated process wastewater
Cadmium	SCM Chemicals St. Helena Plant	MD		X	Raw materials and cadmium liquor	Process wastewater	Process water	Cadmium contamination of surface water due to operator error at the wastewater treatment plant
Cadmium	SCM Chemicals St. Helena Plant	MD		X		Process wastewater	Process water	Zinc contamination of surface water from operator error and leaching of the filter cake in the wastewater treatment process
Manganese	Chemetals ,Inc.	MD		X		Process wastewater, scrubber water, cadmium, and tower blowdown	Process water, scrubber water, cadmium, and tower blowdown	Acute toxicity to a mycid and minnow from ammonia and manganese in discharges from wastewater treatment settling ponds and wastewater treatment effluent
Silica	SCM Chemicals Corporation St. Helena Plant	MD		X	Sodium silicate	Process wastewater	Process water	Total suspended solids contamination of surface water from leaking gasket on gel tank door of wastewater treatment facility and from a worn filter or weather induced start-up problems in the wastewater treatment facility

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Steel	Bethlehem Steel Corporation Sparrows Point Facility	MD		X	Chlorinated process water	Chlorinated process wastewater	Process water	Total residual chlorine contamination of surface water from facility chlorine feed rate meter and from difficulty determining appropriate chlorination level in wastewater treatment system
Titanium/ Titanium dioxide	SCM Chemicals Corporation Hawkins Point Plant	MD		X		Sulfate process wastes and process wastewater	Sulfate process water	Heavy metals contamination of ground water and surface water from Batch Attack lagoon containing historic acid wastes from the sulfate process and current batch attack scrubber wastewater
Titanium/ Titanium dioxide	SCM Chemicals Corporation Hawkins Point Plant	MD		X	Chlorine gas			Unreacted chlorine gas released to atmosphere from malfunction in chlorination process
Titanium/ Titanium dioxide	SCM Chemicals Corporation Hawkins Point Plant	MD		X	Acidified sulfate process feedstock	Process wastewater	Process water	Acidic wastewater contamination of surface water from a leak in a sulfate processing unit, from failure of a level controller, and from frozen caustic treatment lines
Titanium/ Titanium dioxide	SCM Chemicals Corporation Hawkins Point Plant	MD		X	Titanium tetrachloride			Titanium tetrachloride fumes released from leaks and spills in a titanium tetrachloride tank treatment reactor and in the process duct work of the chlorination process

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	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Gold	Alligator Ridge Mine	NV	X		Cyanide contain-ing process solution Muratic acid			Cyanide and acid contamination of soils caused by equipment failure, operator error, and freezing conditions.
Gold	Aurora Gold Project	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by equipment failure and freezing conditions.
Gold	Bald Mountain Mine	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by operator error, and equipment failure.
Gold	Barrick Goldstrike and Meikle Mine	NV	X		Cyanide Ammonia vapor Mercury			Releases caused by improper materials handling procedures and equipment failure.
Gold/ Copper	Battle Mountain Mine	NV	X		Barren leachate			Releases caused by equipment failure.
Gold/Silver	Candelaria Mine	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by equipment failure and freezing conditions.

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Gold/Silver	Coeur Rochester	NV	X		Ore Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by power outage and equipment failure.
Gold	Cortez Gold Mine	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by equipment failure and operator error.
Gold/Silver	Crofoot Project	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by equipment failure and operator error.
Gold	Jerritt Canyon	NV	X		Barren process solution	Tailings slurry		Cyanide, chlorine, and sodium hypochlorite contamination of surface soils caused by equipment failure and operator error.
Tungsten	Kennametal, Inc.	NV		X	Sulfuric acid			Sulfuric acid contamination of surface soils caused by operator error.
Gold	Lone Tree Mine	NV	X		Cyanide contain-ing process solution	Tailings slurry		Cyanide contamination of surface soils caused by equipment failure and operator error.
Gold	Northumberland Project	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by a combination of equipment failure and freezing conditions.

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	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Copper/ Gold	Magma Nevada Mining Co.	NV	X		Cyanide contain-ing process solution	Flotation slurry		Cyanide contamination of surface soils caused by equipment failure.
Gold	Smoky Valley Common Operation	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by improper operation of the leach pad, flawed reparis to the liner, and equipment failure.
Gold	Sleeper Project	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by equipment failure.
Silver/Gold	Wind Mountain Project	NV	X		Cyanide contain-ing process solution			Cyanide contamination of surface soils caused by operator error.
Copper/ Molyb-denum	Phelps Dodge Chino Branch	NM	X	X	Spent electrolyte	Tailings slurry	Electrolyte	Releases caused by pipeline failures, pump failures, and a damaged raffinate pond liner. Surface waters impacted with elevated metals and TDS.
Copper	Continetal Mine	NM	X			Tailings slurry Acid rock drainage		ARD seep (ph 3.5), caused by high precipitation, impacted surface waters. Equipment failure or operator error caused release of tailings slurry to surface waters.

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	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Gold	Ortiz Project IV	NM	X			Spent ore leachate, Acid rock drainage		Leachate and drainage generated from old mine workings. New operations awaiting permit approval.
Molyb-denum	Questa Mine	NM	X			Tailings slurry		Releases caused by pipeline ruptures. Impacted soils remediated by removal to tailings disposal area.
Beryllium	NGK Metals Corporation	PA		X		Spent sulfuric acid		Fish kills and surface water contamination from tank rupture
Ferrous metals	Shenango, Inc. Coke and Iron	PA		X	Oil			Surface water contamination from numerous cases of operator error
Ferrous metals	Reading Alloys, Inc.	PA		X		Slag	Slag	Ground water affected by acidic, metal-bearing storm water allowed to contact slag, then discharged to drain field
Ferrous metals	Reading Alloys, Inc.	PA		X	Process water		Process water	Soil contamination with dissolved salts from tank rupture caused by soil settling
Tin	LTV Steel Company Aliquippa Tin Mill	PA		X		Process wastewater	Process water	Surface water contamination with sulfuric acid due to series of equipment failures and operator errors
Zinc	Zinc Corporation of America	PA		X		Process wastewater	Process water	Copper and zinc contamination of surface water from inadequate treatment and process upsets

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	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Cadmium	Savage Zinc, Inc. Clarksville Plant	TN		X		Process wastewater	Process water	Contamination of surface water and sediments with zinc, lead, and cadmium from inadequate wastewater treatment and operator error
Manganese	Chemetals, Inc. Manganese Dioxide Plant	TN		X		Process residue and process wastewater	Process residue and process water	Contamination of surface water and sediments, aquatic life impacts from manganese and suspended solids in releases from dam overflows and pipe break
Phosphate	ICI Specialists Phosphorus Plant	TN		X	Sodium hydrosulfide			Surface water contamination and fish kill from raw material spill from rail car
Thorium	W. R. Grace and Co.	TN		X		Wastewater, wastewater sludge, and storm water		A white, oily seepage through a thorium holding pond to surface water and ground water from pump failure of ground water collection system
Titanium/ Titanium dioxide	E. I. DuPont de Nemours and Company, Inc. Titanium Plant	TN		X		Process wastewater	Process water	Metal contamination of ground water from probable sedimentation pond seepage
Titanium/ Titanium dioxide	E. I. DuPont de Nemours and Company, Inc. Titanium Plant	TN		X		Process wastewater	Process water	Acidic discharge to surface water due to valve failure

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	Name	State	Extraction/ Beneficiation	Mineral Processing	Feedstock, In-Process Material, or Product	Waste Streams	Secondary Materials	
Antimony	Anzon Incorporated	TX		X	Various raw and in-process materials	Process wastewater	Process water	Contamination of soil and ground water with antimony from uncontrolled releases from process and material handling operations
Copper	ASARCO El Paso Plant	TX		X	Copper concentrate	Air pollution control residues, treated and untreated wastewater	Sludge	Cadmium and lead contamination of soil, ongoing improper waste management practices, and unauthorized product and waste discharges
Copper	ASARCO El Paso Plant	TX		X		Contaminated blasting media		Cadmium and lead soil contamination from abandonment of spent blasting media on-site by contractor
Copper	ASARCO El Paso Plant	TX		X	Copper concentrate			Arsenic contamination of ground water and surface water from unauthorized discharges and subsequent seepage on facility property
Gem-quality minerals	American Minerals, Inc.	TX	X		Product and gangue fines			Heavy metal contamination of soil, and possibly of ground water, by fugitive dust from grinding operations
Talc	Dal-Tile/Dal-Minerals	TX	X			Sludge from tile manufacturing		Lead contamination of soil from illegal disposal of characteristic manufacturing waste at mine site

Methodology for Developing Environmental Release Cases

In preparing these cases, EPA sought to collect information on environmental releases and damages resulting from the extraction, beneficiation, and processing of ores and minerals occurring since 1990. The Agency has previously collected environmental release information at mining and mineral processing sites. The results of that evaluation have been placed in the RCRA docket supporting prior rulemaking activities addressing mineral processing wastes. In identifying new data, EPA conducted research, including file searches, across a wide range of mineral commodity sectors and throughout the United States. Further, the Agency looked not only at releases resulting from waste management, but also included in the scope of its investigation material processing, storage, and handling operations (e.g., releases of mineral processing feedstocks, and from storage and handling of characteristic by-products and sludges, and spent materials).

EPA conducted three steps to assemble this document:

1. Identifying mining and mineral processing sites with potential releases and/or damages;

2. Contacting selected Regional EPA and state agency representatives to identify specific sites for review and to establish the existence of documentation of releases and/or damages; and

3. Conducting detailed searches of relevant inspection, enforcement, permitting, and other files for mining and mineral processing facilities in selected states.

Each of these steps is discussed in more detail below. While EPA solicited assistance from Regional staff to identify potential sites and state contacts, file searches were not conducted in all Regions.

Identifying Mining and Mineral Processing Sites

EPA relied on information used in the preparation of these documents to develop a preliminary list of potential sites in Arizona, Florida, Maryland, Missouri, Nevada, New Jersey, New Mexico, Ohio, Pennsylvania, Tennessee, and Texas. As a result, the Agency initially identified a large number of potential mining and mineral processing sites within the specified states for review. These sites were categorized by state and commodity sector to facilitate a focused identification of sites that would most likely provide tangible, documented evidence of environmental releases. The results of this search do not represent an exhaustive search of all releases from mines and mineral processing facilities in these states. Rather, EPA used best efforts given the time and resources available. Further, in the states that were examined a comprehensive examination of all information was not performed. In some cases only selected state regional offices were contacted due to limited resources.

Contacting EPA Regional and State Representatives

Initially, EPA contacted Regional offices and state environmental protection agencies in eight states to obtain information on potential mining and mineral processing sites with associated releases and/or damages occurring since 1990. The states listed below were selected to ensure diversity in the mining and mineral processing sectors examined as well as geographic breadth:

- Arizona
- Florida
- Missouri
- Nevada

- New Mexico
- Ohio
- Pennsylvania
- Texas

In each state, the Agency contacted a variety of representatives in different offices. Further, the Agency contacted representatives in the EPA Regional offices in which the selected states were located. The table below identifies the various agencies contacted initially as part of the scoping effort for this research.

Ohio contacts did not provide sufficient information to develop damage case summaries. State representatives indicated that the complaints documented in their files related more to water quantity issues rather than the release of contaminants into the environment. Based on this information, EPA did not conduct a file search in the State of Ohio. Subsequently, EPA determined that three additional states should be contacted to ensure adequate representation of the industry. These additional states were Maryland, New Jersey, and Tennessee.

State/Region	Agencies Contacted
Arizona	C Department of Environmental Quality - Remedial Project Section - Water Enforcement - Permitting/Surface Water - Hazardous Waste - Ground Water Permitting - Mine Permitting - Pollution Prevention Unit - Superfund
Florida	C Department of Environmental Protection - Phosphogypsum Management Program - Industrial Wastewater Division - Emergency Response Division - Air Quality Program - Hazardous Waste Division - Northeast District Office - Northwest District Office
Maryland	C Department of Environmental Protection - Waste Management Division - Water Management Division - Air Management Division
Missouri	C Division of Environmental Quality - Director's Office
Nevada	C Division of Environmental Protection - Air Quality Bureau - Mining Regulation and Reclamation Bureau - Corrective Actions Bureau - Solid Waste Bureau
New Jersey	C Department of Environmental Protection - Hazardous and Solid Waste Division - Legal Affairs Office

State/Region	Agencies Contacted
New Mexico	C Environment Department - Groundwater Protection and Remediation Bureau - Ground Water Section - Superfund Oversight Section - Surface Water Quality Bureau - Nonpoint Source Section - Point Source Regulation Section - Air Quality Bureau
Ohio	C Department of Natural Resources - Division of Mines and Reclamation C Ohio Environmental Protection Agency - Solid and Infectious Waste Division - Emergency Remedial Response Enforcement, Technical Assistance - Emergency Remedial Response Division
Pennsylvania	C Department of Environmental Protection - Pittsburgh Regional Office - Harrisburg Regional Office - Bureau of Land Recycling and Waste Management
Tennessee	C Department of Environment and Conservation - Solid and Hazardous Waste Management Division - Water Pollution Control Division - Surface Mining Division
Texas	C Texas Natural Resources Conservation Commission - Enforcement Division - Region 6 Compliance - Wastewater Program - Region 15 Compliance
EPA Region 3	C Superfund Programs Branch C RCRA Programs Branch
EPA Region 4	C Waste Management Division C Waste Programs Branch C South Superfund Remedial Branch C North Superfund Remedial Branch
EPA Region 5	C Waste Management Division C RCRA Enforcement Branch
EPA Region 6	C Superfund Division C Water Quality Protection Division
EPA Region 7	C Air, RCRA, and Toxics Divisioni C Superfund Division C Environmental Services Division
EPA Region 9	C Air and Toxics Division C Hazardous Waste Management Division

Conducting Detailed File Searches

Based on the results of telephone contacts with state representatives, EPA conducted detailed searches of state files in Arizona, Florida, Missouri, Nevada, New Mexico, Pennsylvania, Tennessee, and Texas. File searches were conducted for all states from November 1996 to January 1997. A file search was not conducted in New Jersey or Missouri.

For the States of Florida and Pennsylvania, environmental and human health information is maintained within regional offices. Because of the small number of sites located within each region, EPA selected only those regions with the most sites and the greatest potential for documentation of environmental releases and/or damages. In all states in which file searches were conducted, relevant documents were obtained indicating environmental releases and/or damages resulting from waste and material management practices at mining and mineral processing facilities.

Further, EPA limited its search only to environmental releases that have occurred in these selected states since 1990. The Agency chose this time cutoff because it represents a reasonable reflection of modern practices and is indicative of normal operating procedures under modern regualtory scrutiny. Indeed, while many mining and mineral processing practices have not changed significantly since inception, the subjection of many of these waste to Subtitle C regulations has been relatively recent given the promulgation of the 1988-91 Bevill rules.

The degree to which the results of EPA's file searches provide a complete assessment of environmental releases and damages resulting from mining and mineral processing sites is limited by several factors:

- Results of inspections, sampling events, responses to complaints, and environmental studies for releases occurring in the recent past may not be reflected in state files, due to the significant time necessary to update and maintain complete files.

- EPA was directed, in most cases, to state file rooms to search files. In past experience conducting such reviews, active files are often not contained in file rooms, but are rather held by the responsible staff person. Further, active files may be held as enforcement confidential and not available for review outside the regulatory agency.

- Although EPA did attempt to identify individuals who may have relevant files in their possession, it is probable that files on some releases from mining and mineral processing sites were not available for review by EPA during the file searches. In particular, the Director of the Texas Natural Resource Conservation Commission's (TNRCC) Enforcement Division declined to provide information or other support to develop damage cases beyond allowing research of the central files that are available to the general public. In addition, the director declined to allow TNRCC enforcement staff to be contacted for questions on behalf of EPA.

- Prior to 1990, many facilities and specific waste streams associated with mining and mineral processing operations were not subject to the rigorous controls of RCRA Subtitle C. Although some are now explicitly regulated under Subtitle C, there may be remaining uncertainty as to the statutory and regulatory authority of state agencies over these facilities and wastes. Even where the state's authority is clear, the relatively recent (post-1990) changes in the RCRA status of mineral industry wastes may have, in the short term, oustripped the ability of some state

agencies to effectively regulate them. As a result, some facilities may not, as yet, have been fully subjected to the requirements of RCRA Subtitle C (e.g., permitting, monitoring, and recordkeeping/reporting).

- While some releases are documented as having been identified during inspections by state agencies, a number of these incidents were described as having been reported to the regulatory agency by the facility owner or operator.

- For many of the releases described in this report, the fact that a waste or material was released does not necessarily mean that there was significant damage to human health or the environment. Nor does it make an assessment or determination as to the adequacy of the response on behalf on the respective regulatory agencies.

ASARCO Silver Bell Mine: "Waste and Process Water Discharges Contaminate Three Washes and Ground Water"

Sector(s): Copper

Facility: ASARCO Silver Bell Mine, Pima County, Arizona

Facility Overview: This 20,000 acre mine started operations in 1952. The mine consists of two open pits, an abandoned mill site, a leachate precipitation plant, two tailings impoundments and a starter dike for a third, and seven unlined PLS containment ponds.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: The Silver Bell Mine occupied 20,000 acres in 1993, including an abandoned mine site known as the BS&K mine, which was an underground lead-zinc mine that operated for most of the 1950s. Open pit mining operations at Silver Bell stopped in 1982, but were resumed two years later, only to stop again in 1994. Active open pit mining, milling, and leaching operations were scheduled to resume in 1995, pending finalization of all required permits. No information existed in the available files concerning whether open pit activities have actually resumed. Leaching operations at Silver Bell have been continuous since 1960. The files available for review covered the mine's activities through 1993. At that time, the mine had neither an NPDES permit nor an Arizona Aquifer Protection Permit (APP). No information was available concerning the issuance of either of these permits to the Silver Bell Mine.

The topography and drainage of the mine site, which is situated to the west and south of the Silver Bell Mountains, is complex. The mine is segregated into four primary areas, including the El Tiro and Oxide open pits, the leach dumps and overburden piles, the abandoned mill site, and the tailings impoundments. The El Tiro Pit, the BS&K abandoned mine, and the leach dumps are located near the headwaters of three ephemeral washes, the El Tiro, Mammoth, and Silver Bell. The Oxide Pit drains to several unnamed washes and to the Cocio Wash, which also drains the mill site and the tailings impoundments. Both open pits intersect an aquifer located within the Silver Bell Mountains, which is 100 to 150 feet below ground. ASARCO uses the water that collects in the pits as make-up water for the leaching operations.

During site inspections of the mine conducted in January and March 1993, the Arizona Department of Environmental Quality (ADEQ) observed water flowing in three unnamed washes below Silver Bell Mine. One stream flowed into Mammoth Wash, while the other two flowed into El Tiro Wash. The water in two of the streams was found to flow directly under one of the waste rock dumps, while the third stream originated at the base of an active leach dump near the El Tiro Pit.

Type of Impact/Media Affected: During the site inspection, ADEQ documented with a series of photographs the water flowing in these washes immediately downstream of ASARCO's facilities. The photographs and diagrams show where the samples were collected in March. ASARCO also collected samples at the same and other points, but the files contained no documentation of the sample results.

Samples taken from the two streams flowing under the waste rock dump showed violations of standards for total selenium, with one stream also violating standards for dissolved copper. The water in one of these streams was intermittently flowing in the subsurface in parts of the stream bed and resurfacing in other parts.

The third stream, which flows from the leach dump, showed a broader range of exceedances. In addition, concentrations of dissolved copper in this stream were several orders of magnitude greater than the concentrations in the other streams. Analyses showed violations of standards for four parameters, including pH, total zinc, total cadmium, and dissolved copper. The exceedances of surface water quality standards documented in the stream flowing to El Tiro Wash, which began flowing 420 feet below the PLS pond, are listed below. The applicable standard for dissolved copper in this stream is 0.69 mg/l, which was established by Arizona to protect aquatic life and wildlife based on an ephemeral stream with a hardness of 3,500 mg/l.

Cadmium, total	1.4 mg/l
Copper, dissolved	120.0 mg/l
pH (minimum)	3.41
Zinc, total	78.0 mg.l

Type of Release: Waste and process water

Affected Media: Surface water, ground water, and soils

Type of Contamination: Cadmium, copper, selenium, zinc, and low pH

Environmental Damage(s): Surface water quality

Regulatory Action/Response: On May 17, 1993, U.S. EPA Region 9 NPDES Compliance Section sent a letter to ASARCO in Tucson notifying them of "observed evidence of past unauthorized discharges of process water from the Silver Bell Mine." In an attached inspection report, EPA made several recommendations. These included that ASARCO take measures to immediately cease all surface and subsurface discharges to the three ephemeral streams, and that ASARCO should conduct a survey of the entire mine to identify all other potential sources of unauthorized discharges and take measures to cease or prevent those discharges. EPA asked ASARCO to respond to these recommendations within three weeks. There was no follow-up information in the files concerning any response from ASARCO or any further developments.

The principal permit required by Arizona for new facilities, such as ASARCO's planned third open pit, is an Aquifer Protection Permit (APP). This permit program was designed by Arizona in part to identify and remediate environmental concerns that could adversely affect ground water in the vicinity of mines, such as those at the Silver Bell Mine. The types of violations and the concerns described above could be dealt with as part of an APP application by Silver Bell and ADEQ's review of that application. Part of the APP permitting process involves State permit writers working with facility owners/operators to correct historical degradation of ground water quality. Periodic site inspections including compliance monitoring occur at permitted facilities to ensure that each facility is maintained and operated to restore and maintain ground water quality. As of June 1993, ASARCO had reportedly begun the process of obtaining from ADEQ an APP for its proposed North Silver Bell Pit, the new open pit and its associated dump sites. In November 1996, at the time State files were reviewed, there was no information present in the files concerning the status of the permit or Silver Bell's APP application.

References:

Arizona Department of Environmental Quality. *Draft Internal Memorandum from Hyde, P.* March 10, 1993.

U.S. Environmental Protection Agency. *Letter from Greenberg, K. to Maley, P. J., ASARCO Inc.* May 17, 1993.

U.S. Environmental Protection Agency Region 9. *NPDES Compliance Monitoring Report*. August 19, 1992.

U.S. Environmental Protection Agency Region 9. *NPDES Compliance Monitoring Report*. March 19, 1993.

Cyprus Bagdad Mine:
"Acidic, Copper-Bearing Solution Seeps to Boulder Creek"

Sector(s): Copper and molybdenum

Facility: Cyprus Bagdad Mine, Yavappi County, Arizona

Facility Overview: The Cyprus Bagdad Mine is an open pit copper mine that consists of the East Pit and associated components. The mine encompasses approximately 40,000 acres.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: Cyprus Bagdad Copper Corporation (Cyprus) operates a large open pit copper mine approximately 40 miles west of Prescott, Arizona. In 1995, the mine produced 208 million pounds of copper and 10 million pounds of molybdenum. The mine crushes high grade ore and uses a froth flotation process to concentrate copper and molybdenum values. The concentration process results in large quantities of water-laden tailings which Cyprus discards into tailings ponds. Cyprus leaches the lower grade ores with a sulfuric acid mixture. The leachate is collected in basins. The facility uses solvent extraction and electrowinning to extract copper from the pregnant leachate solution. Cyprus channels the process water to holding facilities for reuse.

Cyprus has several NPDES permits for discharging into three streams that are tributaries to the Big Sandy River. The most important of these discharges goes into Boulder Creek or its tributaries, including Copper Creek. Outfall 001 is a spillway located at the top of the dam that holds the Copper Creek Flood Control Basin. It is the sole point from which Cyprus is authorized to discharge from its Copper Creek Leaching System into Copper Creek. Discharges from Outfall 001 are authorized only when there has been a storm event in which a 3-inch rainfall in the vicinity of the Copper Creek watershed has occurred during a 24-hour period. In May 1991, seepage of pregnant leach solution from the Copper Creek Leaching System was discovered in a receiving pool in Boulder Creek.

Type of Impact/Media Affected: Studies indicated that instead of being contained by the Copper Creek Flood Basin, the heavily contaminated solution seeped under the dam. The concentration of total copper in samples collected in the pool in Boulder Creek were as high as 76.4 mg/l. Out of 18 samples collected from the pool during the month that the seepage was discovered, every sample exceeded background levels by more than 0.5 mg/l of total copper, the State's Agricultural Livestock Watering Standard for total recoverable copper. No information was available in the files reviewed that clearly documented the source of the infiltration; however, several documents referred to "repairs" to various HDPE liners. It was not clear from information in the files precisely which units were lined, when they were lined, or the capacity or dimensions of the units.

Type of Release: Seepage and overflow

Affected Media: Ground water and surface water

Type of Contamination: Copper and low pH

Environmental Damage(s): Impaired surface water and ground water

Environmental Risk: Hazards to downgradient aquatic life, wildlife, and livestock

Regulatory Action/Response: On March 29, 1993, U.S. EPA issued a Finding of Violation and Order against Cyprus. That order was not present in the State files made available for review, but it was referred to by other documents in the files. On September 13, 1996, in the U.S. District Court for the District of Arizona, the U.S. Department of Justice (DOJ) brought civil action against Cyprus for discharging contaminated water in violation of the Clean Water Act (CWA)

and Arizona law. The civil action cited discharges from tailings ponds, pipelines, leach dumps, other facilities, and a sewage treatment plant. The largest discharges cited, however, came from the mine's Copper Creek Leaching Basin. In a Consent Decree, Cyprus agreed to pay a civil penalty totaling $760,000. Of that amount, $475,000 was to be paid to U.S. EPA and $285,000 was to be paid to the Arizona Department of Environmental Quality (ADEQ). ADEQ received $285,000 from Cyprus on September 25, 1996. As of November 1996, ADEQ had ended all enforcement activities against Cyprus. Although there were no other terms specified in the Consent Decree, there may have been additional terms or recommendations included in the Notice of Violation and Order. Several remedial actions, which are summarized below, along with the resultant change in ground water quality were undertaken by Cyprus following the discovery of the seep.

Based on the relatively small amount of follow-up information available in State files, the facility had generally achieved compliance by January 1991. That informal determination was made by ADEQ personnel based on a comprehensive water quality monitoring program to determine the net contribution of copper to Boulder Creek from the Copper Creek Leach Basin. During a water quality sampling period that extended from shortly after the seepage was discovered in May 1991 through September 1993, concentrations of copper above background levels dropped dramatically. In May of 1991, Cyprus repaired the HDPE liner in the PLS channel. The following September, the mine repaired the soil liners in the Copper Creek Leach Basin. Cyprus also completed construction of a cutoff wall in Copper Creek in November 1992.

Of 143 samples of water collected from January 1992 until October 1993, all of which were collected from sumps installed in the alluvial gravels of Boulder Creek downgradient from the facility, not one sample showed any elevation above background concentrations of copper. The cutoff wall was credited with reducing total copper concentrations in shallow ground water 400 feet downgradient of the wall from 7.2 mg/l before the wall was constructed to 0.8 mg/l afterwards. ADEQ personnel concluded in an internal 1995 memorandum that the overall effectiveness of the remedial measures undertaken by Cyprus was amply demonstrated by the consistently low concentrations of copper measured in sumps downgradient of the wall and the consistently within-standard copper values achieved in the receiving pool. At the time of the file review in November 1996, the available water quality enforcement files did not contain any more information regarding how Cyprus is managing its PLS pond and other structures.

References:

Arizona Department of Environmental Quality. *Internal Memorandum from Black, J. to File*. November 5, 1996.

Arizona Department of Environmental Quality. *Interoffice Memorandum from Hyde, P. to R. Best, Re: Effectiveness of the Cyprus Bagdad Cutoff Wall in Copper Creek*. January 23, 1995.

Arizona Republic, "Cyprus to pay big penalty." September 17, 1996.

U.S. Department of Justice. *Civil Action in the U.S. District Court for the District of Arizona, USA and State of Arizona versus Cyprus Bagdad Mining Corporation*. September 11, 1996.

U.S. Environmental Protection Agency Region 9. *Environmental News [Newsletter]*. September 16, 1996.

U.S. Environmental Protection Agency. *Findings of Violation and Order*. March 29, 1993 (not in files reviewed).

Cyprus Twin Buttes Mine: "Tank Leaks Acidic Metal Solution Resulting in Possible Soil and Ground Water Contamination"

Sector(s): Copper

Facility: Cyprus Twin Buttes Mine, Pima County, Arizona

Facility Overview: The mine was operated by Anamax Mining Company as an open pit copper mine and ore processing operation from 1964 through 1985. At present, however, only the electrowinning plant is operated. The extent of any previous operations at the mine are not clear from the available files

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ

Waste and Material Management Practices: Although the majority of past operations at the Cyprus Twin Buttes Mine in Pima County have been discontinued, Cyprus still operates an electrowinning (EW) facility that is used in the production of copper from ore mined at the Cyprus Sierrita Mine. Cyprus also operates a thickener associated with the EW plant, acid tanks, several septic systems, two reservoirs for temporary storage of pumped ground water, storm water run-off catchments, and a heavy equipment shop. The dates on which the EW plant or other facilities began operation were not specified in the available files. Operation of the mine's solvent extraction plant were discontinued in 1993. During the previous year, the tailings processing and agitated vat leaching were discontinued. On March 28, 1995, Arizona Department of Environmental Quality (ADEQ) staff conducted a site inspection of the Cyprus Twin Buttes Mine operations in Pima County. This inspection showed that the EW plant operations were likely to be adversely affecting ground water quality.

Type of Impact/Media Affected: During the site inspection, ADEQ documented with photographs the severely corroded concrete floor in the basement of the EW tank house that provided secondary containment for the tank house. On a subsequent visit in January 1996, the corroded concrete remained unchanged and unlined. Leakage from the tanks above the floor had caused fluid to pool extensively on the floor. This situation also was documented with a series of detailed photographs showing the state of the corroded concrete floor and the liquid from the tanks above the unlined floor that was pooling on the floor. Based on the condition of the floor, ADEQ concluded that there was no way to prevent the pooling fluid from infiltrating the underlying soil and ground water because the crumbling and corroded concrete floor was not capable of providing an effective barrier between the soil and the pooling fluid.

Type of Release: Tank leaks

Affected Media: Soil and ground water

Type of Contamination: Heavy metal-containing and low pH solutions

Environmental Damage(s): Adversely affected ground water quality is considered likely by ADEQ but not demonstrated

Environmental Risk: Contamination of ground water and soils (No analytical data available)

Following meetings with ADEQ staff, in June 1995, Cyprus proposed to document that past releases from the EW plant have not contributed to or caused an exceedance of aquifer water quality standards. Further status reports or findings were not present in the files available in ADEQ offices. Based on informal conversations with the ADEQ site inspector, the facility has not yet reported the results of any ground water monitoring.

Regulatory Action/Response: ADEQ staff met with Cyprus staff following the site inspections.

Cyprus subsequently installed an HDPE liner on the floor of the EW tank house in order to provide secondary containment for any of the highly corrosive and metal-containing solutions that leak to the floor of the tank house. The presence of this new liner was documented with photographs. No additional information was found in the files regarding further ADEQ or Cyprus responses to this situation.

References:

Arizona Department of Environmental Quality. *Facility Site Inspection Report*, including notes and photographs. April 28, 1995.

Arizona Department of Environmental Quality. *Facility Site Inspection Report*, including notes and photographs. January 8, 1996.

Cyprus Sierrita Corporation. *Letter from Comi, T., Environmental Affairs Supervisor to Olsen, G., ADEQ/APP Project Officer*. March 28, 1996.

Olsen, Greg, ADEQ/APP Mining Unit Project Officer. Personal Communication, November 18, 1996.

Magma Copper Mine:
"Broken Pipeline Seam Causes Discharge to Pinal Creek"

Sector(s): Copper and molybdenum

Facility: BHP Copper Mine, Gila County, Arizona (formerly Magma Copper Company)

Facility Overview: The BHP Copper Mine is an open pit mine with pregnant leach solution and raffinate processing facilities, seepage and storm water retention facilities, surface run-off facilities, tailings impoundments and ponds, leach dumps, waste rock dumps, a concentrator area, and ancillary facilities. No information was present in the files documenting the dates of operation of the mine or the facilities' sale to BHP.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: The BHP Copper Mine is an 8,000-acre open pit copper mine located eight miles west of Miami, Arizona. The mine is part of Arizona's Globe-Miami mining district which has been mined for copper, silver, and gold since 1874. The mine is located in a mountainous area between two creeks, Pinto Creek and Pinal Creek. BHP Copper recently purchased the mine from Magma Copper Co. (Magma). Because the environmental release described in this summary occurred during Magma's ownership of the mine, this summary focuses on Magma's operations.

Magma mined low-grade copper and molybdenum ore at a combined rate of approximately 87,600 to 160,000 tons per day. Both millable and leach-grade ore were mined, with the millable ore crushed and concentrated in on-site facilities. Copper and molybdenum concentrates were shipped to off-site facilities at Magma's San Manuel facility, located 40 miles northeast of Tucson, for smelting and refining. Magma deposited low-grade ore in the dump leaching area referred to as Gold Gulch. Raffinate solutions consisting of weak sulfuric acid were sprayed over the low-grade ore. Magma collected the pregnant leach solution (PLS) in a double-lined facility with leak detection. The solution was pumped to the SX/EW plant where it was processed using an organic solvent and electrowinning process. Magma shipped the resulting cathode copper off-site for further refining. During an inspection conducted on March 24, 1994, U.S. EPA Region 9 personnel noticed water flowing towards Pinal Creek in Tinhorn Wash at a rate of about 100 gallons per minute. There were no authorized discharge points upstream of the area where the discharge was observed.

Type of Impact/Media Affected: The purpose of the EPA site inspection was to monitor compliance with a NPDES permit (AZ0020419) and a Finding of Violation and Order issued in January 1992. During the inspection, the effluent was determined to be coming from a broken seal in a pipeline carrying non-process water from the Burch Pump Station. Magma indicated that the pipeline had not been used for approximately three months prior to the discharge. On the day of the discharge, the pipeline was being used in connection with the testing of a new well pump. The pipeline's failure resulted in the loss of about 108,000 gallons of water over a period of 83 minutes to a tributary of Pinal Creek. Chemical analyses of the water showed arsenic, chromium, copper, mercury, lead, and zinc. The copper concentration was 1.02 mg/l, almost seven times higher than the Arizona Surface Water Quality Standard of 0.150 mg/l.

Type of Release: Pipeline leak

Affected Media: Surface water

Type of Contamination: Copper, arsenic, chromium, mercury, lead, and zinc

Regulatory Action/Response: In April 1994, U.S. EPA sent a compliance monitoring inspection report to Magma's Pinto Valley Division which contained several recommendations. EPA recommended inspection of the pipeline, replacement of defective portions, and installation

of automatic shutdown controls to minimize any future discharges. EPA also requested that Magma respond to the recommendations. Magma had previously indicated in writing that the pipeline would be thoroughly inspected before the next maintenance check or use. No additional information was present in the files.

References:

Arizona Department of Environmental Quality. *Letter from Browne, K.L. to Clawson, R., U.S. Environmental Protection Agency Region 9 and R. Frey. Magma Copper*. November 2, 1994.

Notice of Preliminary Decision to Issue an Individual Aquifer Protection Permit. ADEQ. June 17, 1996.

U.S. Environmental Protection Agency. *Letter from Greenberg, K. to Browne, K.L., Magma Copper*. April 25, 1994.

U.S. Environmental Protection Agency Region 9. *NPDES Compliance Monitoring Report*. April 19, 1994.

Magma Copper Mine: "Multiple Discharges of Polluted Effluents Released to Pinto Creek and Its Tributaries"

Sector(s): Copper and molybdenum

Facility: BHP Copper Mine, Gila County, Arizona (formerly Magma Copper Company)

Facility Overview: The BHP Copper Mine is an open pit mine with pregnant leach solution and raffinate processing facilities, seepage and storm water retention facilities, surface run-off facilities, tailings impoundments and ponds, leach dumps, waste rock dumps, a concentrator area, and ancillary facilities. No information was present in the files documenting the dates of operation of the mine or the facilities' sale to BHP.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: BHP Copper purchased this facility from Magma Copper Company (Magma). Magma mined low-grade copper and molybdenum ore at this facility at a combined rate of 87,600 to 160,000 tons per day. Both millable and leach-grade ore was mined. Millable ore was crushed and concentrated in on-site facilities. Copper and molybdenum concentrates were shipped to off-site facilities for smelting and refining. Low-grade ore was deposited in the dump leaching area referred to as Gold Gulch. Raffinate solutions consisting of weak sulfuric acid were sprayed over the low-grade ore. Magma collected the pregnant leach solution (PLS) in a double-lined facility with leak detection. The solution was pumped to the SX/EW plant where it was processed using an organic solvent and an electrowinning process. The facility shipped the resulting cathode copper off-site for further refining.

Gold Gulch Dam No. 2, located in Gold Gulch, a tributary of Pinto Creek, is a clay core/rock fill dam that impounds surface precipitation and process solutions that overflow from Gold Gulch Dam No. 1, which is approximately one mile upstream of Gold Gulch Dam No. 2. The dam is 410 feet long and has a seepage collection caisson equipped with pumps located at its toe. The seepage is pumped from the caisson to the impoundment behind Gold Gulch Dam. No. 2. Water contained there is pumped to the mill for use in process operations. There was no mention in the available files concerning the presence of a liner to reduce infiltration to ground water. Based on EPA's review of discharge monitoring reports between January 1990 and September 1991, Magma reportedly discharged effluent to Pinto Creek or its tributaries in excess of allowable effluent limitations on numerous occasions, and/or did not collect and analyze samples, in violation of permit conditions.

Type of Impact/Media Affected: EPA found that these types of violations occurred at least once in each of at least nine months during this period, including releases in August and December 1990, and in January, February, March, May, July, August, and September 1991. Each of these discharges is likely to have transported contaminants to Pinto Creek or its tributaries.

In August and September 1991, a ditch in the vicinity of a tailings pond, the Miller Springs ditch, became plugged, causing the ditch to overflow several times. Each of the discharges entered Pinto Creek. During the first episode, a total of approximately 3,000 gallons of effluent containing total suspended solids and copper of unknown concentrations was discharged from the ditch. A similar discharge of 24,000 gallons occurred on September 5, 1991. An estimated 39,000 gallons of effluent in exceedance of Arizona Surface Water Quality Standards and Aquifer Water Quality Standards for copper, zinc, and lead were discharged from the ditch on September 23, 1991.

EPA also conducted a site inspection on January 16, 1991, during which an EPA inspector observed several unauthorized discharges of effluent in various areas of the facility. One discharge surfaced in the Gold Gulch alluvium about 50 yards below the Gold Gulch No. 2 Dam, flowing towards Pinto Creek. The effluent surfaced from the mine's Gold Gulch No. 2 reservoir, which contained water and copper dump leach solution that overflowed from the Gold Gulch No. 1 Dam. Ground water samples in 1988 from nearby wells showed concentrations of fluoride and mercury in exceedance of State water quality standards. In addition, water collected from the caisson sump at the Gold Gulch No. 2 Dam in 1992 showed a dissolved copper concentration of 0.175 mg/l, as compared to the Arizona Surface Water Quality Standard of 0.150 mg/l. Dissolved copper concentrations from a 1992 sample collected in the impoundment behind the dam at Gold Gulch No. 2 were 3.7 mg/l.

The EPA inspector also observed two other discharges. Concentrations of copper in both samples exceeded Arizona Surface Water Quality Standards and Aquifer Water Quality Standards. One discharge was an effluent surfacing below the toe of Tailings Dam No. 3 and flowing towards Pinto Creek. Magma collected a sample of that seepage. The sample contained 0.42 mg/l of total copper. Another discharge observed was a mixture of storm water run-off and industrial water that surfaced below the Miller Springs Catchment Dam and flowed towards Pinto Creek. A sample of that discharge solution was found to contain 0.0023 mg/l of total copper.

The EPA inspector also observed evidence of a recent discharge from a permitted discharge point in the form of damp soil and water near a discharge pipe at the base of a contingency pond located below Tailings Dam No. 2. Magma had not monitored the discharge on the first day as required by permit conditions. Magma also failed to monitor intermittent discharges on at least two other days in January from another discharge point.

Type of Release: Industrial water and storm water run-off

Affected Media: Surface water and ground water

Type of Contamination: Copper, fluoride, mercury, and total suspended solids

Environmental Damage(s): Elevated levels of contaminants documented in ground water

Regulatory Action/Response: On November 27, 1991, U.S. EPA Region 9 issued a Findings of Violation and Order based on authority granted under the Clean Water Act (CWA). In the Order, EPA directed Magma to complete the following actions:

- Comply with all NPDES permit conditions;
- Cease all unauthorized discharges of pollutants into Pinto Creek immediately;
- Submit, by January 29, 1992, a preliminary engineering plan outlining steps and a schedule for modifications necessary to ensure consistent compliance with effluent limits and prevent unauthorized discharges;
- Begin construction of any needed modifications by March 1, 1992;
- Complete all needed modifications by July 15, 1992;
- Submit quarterly reports summarizing progress;
- Monitor and limit all discharges so as not to cause violations of Arizona Water Quality Standards;

- Report any noncompliance with this Order; and
- Submit, by February 15, 1992, a detailed report including a compilation of all water quality and sediment data collected by Magma on Pinto Creek and its tributaries since March 15, 1987, a comparison of the results to applicable water quality standards, and descriptions of any observed fish kills and degradation of the flora and fauna of Pinto Creek since March 15, 1987.

Although the Order explicitly did not preclude further administrative, civil, or criminal action to seek penalties, fines, or other appropriate relief under the CWA, there was no follow-up information in the files as to whether any additional action had been taken or whether all conditions stipulated in the Order had been met by Magma. Magma did commission a hydrogeologic investigation in the vicinity of the unauthorized discharge downstream of Gold Gulch Dam No. 2. The investigator was unable to find the seep observed during the site visit on January 16, 1991, or to sample the water quality of that seep, or determine its source. Another seep approximately one-quarter mile downstream was observed during the hydrogeologic investigation. Magma's analysis of the water quality of the downstream seep failed to show any exceedances of water quality standards. Magma's hydrogeological consultants recommended relocating the NPDES discharge point, modifying the permit for continual discharge, and setting effluent standards for the discharge. No information was available in the files concerning any changes in permit conditions.

References:

Arizona Department of Environmental Quality. *Notice of Preliminary Decision to Issue an Individual Aquifer Protection Permit*. June 17, 1996.

Hargis and Associates, Inc. *Hydrogeologic Investigation, Gold Gulch Dam No. 2*. April 15, 1992.

U.S. Environmental Protection Agency. *Findings of Violation and Order*. November 27, 1991.

Magma Copper Mine: "Multiple Overflows Result in Major Fish Kill in Pinto Creek"

Sector(s): Copper and molybdenum

Facility: BHP Copper Mine, Gila County, Arizona (formerly Magma Copper Company)

Facility Overview: The BHP Copper Mine is an open pit copper mine with pregnant leach solution and raffinate processing facilities, seepage and storm water retention facilities, surface run-off facilities, tailings impoundments and ponds, leach dumps, waste rock dumps, a concentrator area, and ancillary facilities. No information was present in the files documenting the dates of operation of the mine or the facilities' sale to BHP.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: BHP Copper now operates this 8,000-acre open pit copper mine, which is eight miles west of Miami, Arizona. The mine site is located in a mountainous area between two creeks, Pinto Creek and Pinal Creek. Pinto Creek, which receives discharges from the mine, is one of Arizona's few perennial streams and is one of the State's major recreational areas. The creek flows into Roosevelt Lake, which supplies drinking water for the Phoenix area.

BHP Copper recently purchased the mine from Magma Copper Company (Magma). The mine is part of Arizona's Globe-Miami mining district, which has been mined for copper, silver, and gold since 1874. Because the environmental releases described in this summary occurred during Magma's ownership of the mine, this summary focuses on Magma's operations. In the almost four years since the releases occurred, significant engineering and operational changes have been put in place at the mine to help ensure that no repeat incidents of the magnitude of the 1993 releases occur.

Magma mined low-grade copper and molybdenum ore at the mine at a combined rate of approximately 87,600 to 160,000 tons per day. Both millable and leach-grade ore were mined, with the millable ore crushed and concentrated in on-site facilities. Copper and molybdenum concentrates were shipped to off-site facilities at Magma's San Manuel facility, located 40 miles northeast of Tucson, for smelting and refining. Magma deposited low-grade ore in the dump leaching area referred to as Gold Gulch. Raffinate solutions consisting of weak sulfuric acid were sprayed over the low-grade ore. Magma collected the pregnant leach solution (PLS) in a double-lined facility with leak detection. The solution was pumped to the SX/EW plant where it was processed using an organic solvent and electrowinning process. Magma shipped the resulting cathode copper off-site for further refining.

During January 1993, exceptionally heavy rainfall combined with precipitation in December 1992 that was 250 percent above the monthly norm overwhelmed the mine's water management capabilities. The area received over 19 inches of rainfall in December and January, or nearly 90 percent of its annual rainfall over a seven week period. During the rainfall event, a reservoir overflowed the tailings pile, tore out a levee, and carried tailings to Pinto Creek. In addition, a retention pond that held storm water and mineral wastes from the mine's acidic leaching process discharged material into the creek after its dam was breached.

Type of Impact/Media Affected: Critical water containment structures in place at the mine in 1992 were reportedly designed to hold a 100-year, 24-hour storm event. Nonetheless, the mine discharged hundreds of tons of tailings and millions of gallons of contaminated water into Pinto Creek. In spite of the dilution that occurred following mixing with the water in the creek, water quality sampling by Magma during January and

February 1993 indicated 286 exceedances of daily and monthly water quality parameters. The total number of exceedances reported by Magma are summarized below for 10 parameters:

Cadmium, dissolved	15
Cadmium, total	4
Copper, dissolved	50
Copper, total	71
Lead, total	22
Mercury, total	21
pH (minimum)	21
Total suspended solids	21
Zinc, dissolved	39
Zinc, total	22

Fish surveys collected before and after the discharges showed a marked decline in populations of the desert sucker (*Pantosteus clarki*) following the discharges. Though abundant in 1992, a summer survey in 1993 found only one adult in Pinto Creek. Several months later, a small number of young were found.

Type of Release: Dam failure

Affected Media: Surface water

Type of Contamination: Metals (cadmium, copper, lead, mercury, and zinc), low pH, and total suspended solids

Environmental Damage(s): Fish kills and contaminated surface water

Location of Affected Populations: General recreational use; also, Pinto Creek feeds Roosevelt Lake, one of the Phoenix Valley's largest sources of drinking water

Regulatory Action/Response: Immediately following the spill, Magma voluntarily undertook widespread cleanup efforts. The breach in the levee was filled with hundreds of tons of rock and dirt. Water used in the mining process is no longer stored on top of the tailings levee that breached. A series of catchment areas were constructed below the leach-water pond that overflowed. Magma reportedly may spend up to $15 million in cleanup costs and facility upgrades following the spill.

On November 8, 1994, the U.S. Department of Justice (DOJ) issued a Consent Decree signed by DOJ, the State of Arizona, and Magma Copper Co. The decree was negotiated during a series of meetings that occurred in 1993 and 1994. The decree contained a number of penalties, tasks, and reporting requirements. Magma agreed to pay $5,000 to the U.S. Forest Service (USFS) for a fisheries study in Pinto Creek and/or reintroduction of native fish, $20,000 to the Arnett Creek Native Fish Reestablishment Project, and $25,000 to construct a fence along Pinto Creek to restrict livestock movement into the Creek. Magma also agreed to pay a $625,000 civil penalty, with $385,000 going to the U.S. and $240,000 going to the State of Arizona. Magma agreed, by December 31, 1998, to collect, contain, and store water for process use, and to minimize discharges of pollutants by ensuring that any discharges are from approved outfalls and are in compliance with the NPDES permit. Magma also agreed to submit three plans for the Pinto Valley Operations; a Compliance Plan; an Engineering Plan; and a Best Management Practices (BMP) Plan. The former would include, at a minimum, compliance measures for the Gold Gulch area, the Miller Springs area, and the No. 3 Tailings Impoundment area of the Pinto Valley Mine. Magma also voluntarily agreed to perform a Supplemental Environmental Project (SEP) for its Old Dominion inactive mine site. The goal of the SEP is to mitigate the contribution of contaminants from that inactive mine into the Pinal Creek drainage.

References:

Arizona Department of Environmental Quality. *Interoffice Memorandum from Swanson, E. to Munson, B.* February 24, 1993.

Arizona Department of Environmental Quality. *Notice of Preliminary Decision to Issue an Individual Aquifer Protection Permit*. June 17, 1996.

Arizona Game and Fish Department. *Letter from Riley, L. to Clawson, R., U.S. Environmental Protection Agency Region 9*. September 23, 1993.

Golfen, B. "Magma doing monumental, expensive cleanup of Pinto Creek." *The Arizona Republic*. February 7, 1993.

Magma Copper. *Letter from Browne, K.L. to Clawson, R., U.S. Environmental Protection Agency Region 9*. April 8, 1993.

Magma Copper. *Letter from Browne, K.L. to Clawson, R., U.S. Environmental Protection Agency Region 9 and R. Frey, ADEQ*. November 2, 1994.

Magma Copper Co. Pinto Valley Operations. *Report No. 4 NPDES Upset Condition Starting January 8, 1993*. April 1993.

U.S. Department of Justice. *Consent Decree among the United States, the State of Arizona, and Magma Copper Co.* November 8, 1994.

Magma Copper Mine:
"Repeated Release of Tailings to Pinto Creek"

Sector(s): Copper and molybdenum

Facility: BHP Copper Mine, Gila County, Arizona (formerly Magma Copper Company)

Facility Overview: The BHP Copper Mine is an open pit mine with pregnant leach solution and raffinate processing facilities, seepage and storm water retention facilities, surface run-off facilities, tailings impoundments and ponds, leach dumps, waste rock dumps, a concentrator area, and ancillary facilities. No information was present in the files documenting the dates of operation of the mine or the facilities' sale to BHP.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: The BHP Copper Mine is an 8,000-acre open pit mine approximately 60 miles east of Phoenix in Arizona's Globe-Miami mining district. Mining for copper, silver, and gold has occurred in the district since 1874. This mine is located in a mountainous area between two creeks, Pinto Creek and Pinal Creek.

BHP Copper Co. recently purchased the mine from Magma Copper Company (Magma). Because the environmental releases described in this summary occurred during 1991 while Magma owned the mine, this summary focuses on Magma's operations.

Magma mined molybdenum ore and both millable and leach-grade copper ore at this facility. Millable ore was crushed and concentrated in on-site facilities. Copper and molybdenum concentrates were shipped to off-site facilities for smelting and refining. Low-grade ore was deposited in the dump leaching area referred to as Gold Gulch. Raffinate solutions consisting of weak sulfuric acid were sprayed over the low-grade ore. Magma collected the pregnant leach solution (PLS) in a double-lined facility with leak detection. The solution was pumped to the SX/EW plant where it was processed using an organic solvent and an electrowinning process. The facility shipped the resulting cathode copper off-site for further refining. On several occasions in 1991, the mine released various quantities of tailings to the stream beds near the mine.

On January 4, 1991, the face of Tailings Dam No. 3 failed, allowing 150 to 250 tons of tailings to enter Pinto Creek. The tailings discharge was accompanied by approximately two million gallons of water which were released over a period of 16 hours.

Type of Impact/Media Affected: The tailings releases contaminated receiving surface waters with at least five heavy metals in exceedance of Arizona's surface and ground water quality standards. Both shoreline and bottom deposits of tailings were observed in the creek. The following analytical results were reported for seven parameters from a sample collected at the time of the release:

Cadmium	0.036 mg/l
Copper, total	35.1 mg/l
pH	3.6 SU
Lead, total	1.52 mg/l
Mercury, total	0.0017 mg/l
Zinc, dissolved	5.78 mg/l

Beginning on March 1, 1991, another large quantity of tailings was released from the same pile. This release occurred from an over-saturation of the tailings face benches due to heavy precipitation. An estimated 3.4 million gallons of water also were discharged. Based on a sample collected on March 1, values for three parameters exceeded Arizona Surface Water Quality Standards and Aquifer Water Quality Standards, as indicated below:

Copper, total	10.8 mg/l
pH	5.7 SU
Lead, total	0.296 mg/l

The following analytical results, which also exceeded standards, were reported for seven parameters from a sample collected on March 2:

Cadmium	0.025 mg/l
Copper, dissolved	9.13 mg/l
Copper, total	9.13 mg/l
pH	5.9 SU
Lead, total	0.2140 mg/l
Mercury, total	0.0018 mg/l
Zinc, dissolved	3.58 mg/l

Type of Release: Tailings dam failure

Affected Media: Surface water

Type of Contamination: Copper, lead, mercury, cadmium, zinc, and total suspended solids

Regulatory Action/Response: On November 27, 1991, U.S. EPA Region 9 issued a Findings of Violation and Order based on authority granted under the Clean Water Act (CWA). In the Order, EPA directed Magma to undertake the following actions:

- Cease all unauthorized discharges of pollutants into Pinto Creek immediately;
- Submit, by January 29, 1992, a preliminary engineering plan outlining steps and a schedule for modifications necessary to prevent unauthorized discharges;
- Begin construction of any needed modifications by March 1, 1992;
- Complete all needed modifications by July 15, 1992;
- Submit quarterly reports summarizing the progress;
- Report any noncompliance with this Order; and
- Submit, by February 15, 1992, a detailed report including a compilation of all water quality and sediment data collected by Magma on Pinto Creek and its tributaries since March 15, 1987, a comparison of the results to applicable water quality

standards, and descriptions of any observed fish kills and degradation of the flora and fauna of Pinto Creek since March 15, 1987.

Although the Order explicitly did not preclude further administrative, civil, or criminal action to seek penalties, fines, or other appropriate relief under the CWA, there was no follow-up information in the files as to whether any additional action had been taken or whether all conditions stipulated in the Order had been met by Magma. The files did contain at least one report of an EPA site inspection conducted to monitor compliance with the Finding of Violation and Order issued in January 1992. This report noted that Magma had been in compliance with its NPDES permit and the Finding of Violation and Order. However, during an inspection on March 16, 1993, an unauthorized discharge from a broken seam in a pipeline was noted. (Information on this discharge is contained in Magma Copper Mine: "Broken Pipeline Seam Causes Discharge to Pinal Creek.")

References:

Arizona Department of Environmental Quality. *Notice of Preliminary Decision to Issue an Individual Aquifer Protection Permit*. June 17, 1996.

Arizona Department of Environmental Quality, Office of Water Quality. *Internal Memorandum*. July 30, 1992.

U.S. Environmental Protection Agency. *Findings of Violation and Order*. January 24, 1992.

Phelps Dodge Morenci Mine: "Contaminated Storm Water Seeps to Ground Water and Surface Water"

Sector(s): Copper

Facility: Phelps Dodge Morenci Inc., Greenlee County, Arizona

Facility Overview: A mine has been operating at this site since 1872. The Morenci Mine is an open pit copper mine, which also has milling and concentrating, solvent extraction, and electrowinning operations. The erection of Gold Gulch Dam created an unlined storm water impoundment to control run-off from a rock dump that has been inactive since 1986.

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ

Waste and Material Management Practices: Previous ore extraction activities at the Morenci Mine have produced several inactive waste rock dumps that consist of what is referred to by Phelps Dodge Morenci Inc.(PDMI) as development rock. The rock dump, known as the Producer Pile, is located in Gold Gulch, an intermittent stream bed. The pile has been at its current location since 1986. The pile roughly bisects the watershed of the gulch, with approximately 40 percent of the watershed's total run-off falling below the pile and the remainder of the run-off coming from or flowing through the pile. PDMI has constructed berms near the crest of the pile to contain potential run-off.

In order to contain all run-off from a 100-year, 24-hour storm event, PDMI constructed a 20-foot tall concrete dam approximately 200 feet from the toe of the stockpile. The dam created an unlined surface impoundment with a natural creek bed and has a storage capacity of approximately 4.7 acre-feet. The estimated 6.7 acre-feet of run-off from the portion of the watershed above the pile is delayed as it infiltrates through the pile. Studies have shown that precipitation on a large portion of the pile itself does not contribute to the run-off to the dam. Any run-off from the pile travels approximately 200 feet overland to the dam. All run-off from the portion of the watershed below the pile but above the dam flows directly to the dam. Automatic controls are designed to keep the volume of the pond at 0.5 acre-feet and at a depth of 10 feet to minimize hydraulic head. The dam effectively prevents any storm water from discharging off-site. The depth to ground water below the dam is reported to be 5 to 10 feet.

All water collected at the impoundment that does not infiltrate the ground is pumped through an HDPE pipeline to the top of the Lone Star Stockpile. The pumped water then filters through the stockpile, after which it flows overland to the upgradient edge of the Southwest Stockpile. It infiltrates through the Southwest Stockpile and is collected at the Stargo Sump. This pregnant leachate solution is then pumped several miles on top of tailings through a pipeline overlying the Gila Conglomerate to the mine's SX/EW facility for extraction and electrowinning.

The Producer Pile dam and resulting impoundment were constructed to protect surface water from storm water run-off from the pile. The Arizona Department of Environmental Quality (ADEQ) has made visual observations and collected data indicating that infiltration from the pile and the impoundment may be adversely affecting the quality of both ground water and surface water.

Type of Impact/Media Affected: Ground water issues from several intermittent springs along the gulch, including several seeps located downstream from the dam that issue from fracture zones and faults at flow rates of one gallon per minute (gpm). Approximately 2,500 feet downstream from the dam, ADEQ personnel observed and documented with photographs a several-hundred-foot-long surface seep with a

distinct blue-green color indicative of a copper-bearing precipitate. Neither ADEQ nor PDMI collected samples of the precipitate. Although not yet demonstrated, the observed contamination of the surface seep is considered by ADEQ to be reasonably attributable to the Gold Gulch impoundment. There is currently only limited documentation regarding the quality of the ground water down gradient of the impoundment in the Gold Gulch watershed. There are no monitoring wells upgradient of the rock dump. In April 1996, however, ADEQ collected water quality data from a monitoring well that is downgradient of the waste rock dump and impoundment located in Gold Gulch, but in another drainage. Although the standard for antimony is 0.006 mg/l, the reported concentration in the collected sample from the nearby well was 0.0092 mg/l. All other parameters evaluated by ADEQ for samples from this well were below applicable standards. Without additional wells being constructed, it is not possible to attribute the observed ground water quality directly to the Gold Gulch impoundment.

PDMI has evaluated an alternative control option for this impoundment that would entail lining the pond behind the dam with a 60-mil HDPE liner. PDMI has concluded that the dam's design and the operational discharge controls and site characteristics provide "significant resistance to infiltration and constitute Best Available Demonstrated Control Technology."

Type of Release: Storm water impoundment discharge and seepage

Affected Media: Ground water, surface water, and dry stream bed

Type of Contamination: Heavy metals

Environmental Damage(s): Contaminated surface water and ground water are considered likely by ADEQ but not yet demonstrated

Location of Affected Populations: Six private residences relying on ground water for drinking water are less than one mile from the ground water seep

Regulatory Action/Response: Arizona is managing these ground and surface water quality concerns through its new Aquifer Protection Permit (APP) program. The State designed the APP process to implement a cooperative approach to identifying, preventing, and remediating potential environmental concerns that could adversely affect ground water in the vicinity of specific types of facilities, including mines, industrial plants, and municipal wastewater facilities. The permitting process involves State permit writers working with facility owners/operators to prepare detailed State-issued permits specifying facility design requirements, monitoring requirements, self-reporting requirements, additional steps to correct historical degradation of ground water quality, and possible re-evaluation of permit conditions to address any environmental or facility/operational changes. Compliance monitoring and periodic site inspections occur at permitted facilities to ensure that each facility is maintained and operated to restore and maintain ground water quality. The APP application for this facility is currently undergoing technical review by ADEQ.

References:

Arizona Department of Environmental Quality. *Facility Site Inspection Report*, including notes and photographs. March 10, 1995.

Olsen, Greg, ADEQ/APP Mining Unit Project Officer. Personal Communication. November 18, 1996.

Phelps Dodge Morenci Inc. and Dames and Moore. *Aquifer Protection Permit Application*. March 28, 1996.

Phelps Dodge Morenci Inc.: "Contaminated Ground Water Beneath an Unlined Impoundment is Discovered"

Sector(s): Copper

Facility: Phelps Dodge Morenci Inc., Greenlee County, Arizona

Facility Overview: A mine has been operating at this site since 1872. The Morenci Mine is an open pit copper mine associated with milling and concentrating, solvent extraction, and electrowinning operations.

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ

Waste and Material Management Practices: Phelps Dodge Morenci Inc. (PDMI) operates an open pit copper mine in southeastern Arizona. PDMI constructed an impoundment in the Rocky Gulch drainage well above the confluence of the gulch with the river following the discovery of contaminated water flowing from Rocky Gulch to the San Francisco River. The Rocky Gulch Dam is a storm water collection system located approximately 200 feet downgradient of the toe of the Rocky Gulch Stockpile. The Rocky Gulch Stockpile is a development rock stockpile containing low-grade development rock that was closed prior to 1986. The dam system consists of a 25-foot high roller-compacted concrete dam and spillway, an unlined impoundment, and a pump bay. The impoundment has a maximum storage capacity of approximately 34 acre-feet at the spillway crest elevation. The pump bay consists of a pit, approximately 40 feet by 40 feet by 10 feet deep, excavated into the foundation rock. The pump bay is equipped with two 3,000 gallon-per-minute rated pumps and is located approximately 150 feet upstream of the dam. The pump bay collects seepage flow from the excavated impoundment area to keep the impoundment empty during normal operating conditions. It also pumps storm water collected in the impoundment to the top of the Placer Stockpile. The impoundment has a slight slope that promotes drainage to the pump bay. The pumps are set to maintain the fluid level in the bay at less than 3 feet. Overflow from the pump bay into the impoundment occurs only during storm events that exceed the capacity of the pumps in the pump bay. The dam, with the pumps operating, is designed to contain run-off from a 100-year, 24-hour storm event.

The dam captures spring water that seeps from the toe of the stockpile and storm water run-off from areas unimpacted by mining activities upgradient and downgradient of the stockpile. Most of the precipitation that falls onto the stockpile is retained within the stockpile. The storm water run-off from areas upgradient of the stockpile is delayed as it infiltrates through the stockpile and exits at the toe. The potential discharge from the impoundment is natural spring water and storm water run-off that percolate through the development rock stockpile. PDMI claims that most of the upgradient run-off does not report to the toe of the stockpile. The primary source of discharge is the unlined pump bay. The impoundment is reportedly empty except when storm water flow exceeds the capacity of the pumps. Thus, it is not a source of surface water or ground water discharge under normal conditions.

On April 25, 1996, Arizona Department of Environmental Quality (ADEQ) staff collected samples from the point-of-compliance monitor well for Rocky Gulch Dam. The samples collected from the well violated Maximum Contaminant Levels (MCLs) for seven parameters.

Type of Impact/Media Affected: The water quality standard violations documented by ADEQ on April 25, 1996, are displayed below.

Parameter	Maximum Observed Concentration (mg/l)	Applicable Standard (mg/l)
Beryllium	0.0166	0.004
Cadmium	0.0202	0.005
Fluoride	8.55	4.0
Iron	42	0.3
pH (standard units)	4.37	6.5 - 9
Sulfate	706	500(proposed)
Total dissolved solids	1270	500

Because the contamination was discovered in 1996, the size of the contaminated plume of ground water beneath Rocky Gulch is not yet known. There are no drinking water wells within one mile of the impoundment. However, the municipal supply of the town of Clifton is downgradient of the impoundment. Clifton maintains two public water wells in the alluvium of the San Francisco River near the river's confluence with Rocky Gulch. The wells provide an alternative water supply for the town's approximately 3,000 residents. To date, no contamination of the ground water supplied by these two intakes has been documented. The distance from the dam to the wells was not documented in the available files.

Type of Release: Infiltration

Affected Media: Ground water

Type of Contamination: Beryllium, cadmium, fluoride, low pH, sulfate, and TDS

Environmental Damage(s): Ground water contamination

Environmental Risk: Alternative supply wells for Clifton are downgradient from the impoundment

Regulatory Action/Response: The regulatory mechanism in place in Arizona to deal with ground water quality issues at mines is the State's Aquifer Protection Permit (APP) program. The program's application development and review process was designed to achieve a cooperative approach to identifying, preventing, and remediating potential environmental concerns that could adversely affect water quality in the vicinity of mines as well as other types of facilities, including industrial plants and municipal wastewater facilities. The APP permitting process involves permit writers working with facility owners and operators to prepare detailed state-issued permits specifying facility design requirements, monitoring requirements, self-reporting requirements, additional steps to correct historical degradation of ground water quality, and possible re-evaluation of permit conditions to address any environmental or facility/operational changes.

ADEQ received PDMI's APP application for the Morenci Mine on March 28,1996. ADEQ worked with PDMI to ensure that a complete application, including all hydrogeology, well construction, and engineering requirements, were submitted. At the time of the file review, ADEQ's APP section was performing an in-depth technical review of PDMI's application prior to issuing a permit. To ensure that the mine's facilities are maintained and operated to restore and maintain ground water quality, compliance monitoring and periodic site inspections will occur once all the mine's facilities are permitted. There was no

indication in the files concerning the issuance date of PDMI's permit or what conditions the permit would stipulate.

Based on PDMI's APP application, several alternatives that could affect the discharge of contaminants to ground water at Rocky Gulch have been considered by PDMI. Although PDMI claimed that the impoundment's existing discharge control technologies minimize loading to the aquifer, ADEQ subsequently discovered violations of water quality standards in samples collected from the monitoring well for the impoundment. Based on the application, PDMI considered lining the Rocky Gulch Dam impoundment and the pump bay with 60-mil HDPE liners. PDMI concluded that lining the pump bay would not be effective because seepage flow to the pump bay would "float" the liner. PDMI did acknowledge in its APP application that lining the impoundment would constitute prescriptive Best Available Discharge Control Technology (BADCT). They had calculated that a liner would reduce the equivalent daily discharge rate from the impoundment by approximately 477 gallons per day, or 97 percent. At the time the application was submitted, however, PDMI claimed that lining the impoundment was not warranted. PDMI's argument against installing the lining was based, in part, on the high associated cost which PDMI estimated to be approximately $665,000. There was no indication in the available files concerning how ADEQ and PDMI ultimately will resolve the aquifer degradation situation that has been discovered, or whether PDMI still maintains that the lining is unwarranted. At the time of the file search, the source of the contamination of the ground water had not been definitively documented.

References:

Arizona Department of Environmental Quality. *Notice of Violation.* October 24, 1994.

Arizona Department of Environmental Quality. *Inter-Office Memorandum Re: Phelps Dodge Discharge of August 12, 1996.* August 14, 1996.

Arizona Department of Environmental Quality. *Notice of Violation.* November 1, 1996.

Arizona Department of Environmental Quality. *Letter from Finton, P., to Beardsley, W.* February 2, 1996

Arizona Department of Environmental Quality. *Letter from Hyde, P., to Mohr, R., Phelps Dodge Morenci.* March 11, 1994.

Arizona Department of Environmental Quality. *Letter from Hyde, P., to Pope, G., USGS.* March 16, 1994.

Phelps Dodge Morenci. *Letter from Mohr, R., to Strauss, A., U.S. Environmental Protection Agency, Region 9.* August 16, 1996.

Phelps Dodge Morenci Inc. *Aquifer Protection Permit Application.* March 28, 1996.

Phelps Dodge Morenci Inc.: "Contaminated Ground Water Beneath an Unlined Impoundment is Discovered"

Sector(s): Copper

Facility: Phelps Dodge Morenci Inc., Greenlee County, Arizona

Facility Overview: A mine has been operating at this site since 1872. The Morenci Mine is an open pit copper mine associated with milling and concentrating, solvent extraction, and electrowinning operations.

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ

Waste and Material Management Practices: Phelps Dodge Morenci Inc. (PDMI) operates an open pit copper mine in southeastern Arizona. PDMI constructed an impoundment in the Rocky Gulch drainage well above the confluence of the gulch with the river following the discovery of contaminated water flowing from Rocky Gulch to the San Francisco River. The Rocky Gulch Dam is a storm water collection system located approximately 200 feet downgradient of the toe of the Rocky Gulch Stockpile. The Rocky Gulch Stockpile is a development rock stockpile containing low-grade development rock that was closed prior to 1986. The dam system consists of a 25-foot high roller-compacted concrete dam and spillway, an unlined impoundment, and a pump bay. The impoundment has a maximum storage capacity of approximately 34 acre-feet at the spillway crest elevation. The pump bay consists of a pit, approximately 40 feet by 40 feet by 10 feet deep, excavated into the foundation rock. The pump bay is equipped with two 3,000 gallon-per-minute rated pumps and is located approximately 150 feet upstream of the dam. The pump bay collects seepage flow from the excavated impoundment area to keep the impoundment empty during normal operating conditions. It also pumps storm water collected in the impoundment to the top of the Placer Stockpile. The impoundment has a slight slope that promotes drainage to the pump bay. The pumps are set to maintain the fluid level in the bay at less than 3 feet. Overflow from the pump bay into the impoundment occurs only during storm events that exceed the capacity of the pumps in the pump bay. The dam, with the pumps operating, is designed to contain run-off from a 100-year, 24-hour storm event.

The dam captures spring water that seeps from the toe of the stockpile and storm water run-off from areas unimpacted by mining activities upgradient and downgradient of the stockpile. Most of the precipitation that falls onto the stockpile is retained within the stockpile. The storm water run-off from areas upgradient of the stockpile is delayed as it infiltrates through the stockpile and exits at the toe. The potential discharge from the impoundment is natural spring water and storm water run-off that percolate through the development rock stockpile. PDMI claims that most of the upgradient run-off does not report to the toe of the stockpile. The primary source of discharge is the unlined pump bay. The impoundment is reportedly empty except when storm water flow exceeds the capacity of the pumps. Thus, it is not a source of surface water or ground water discharge under normal conditions.

On April 25, 1996, Arizona Department of Environmental Quality (ADEQ) staff collected samples from the point-of-compliance monitor well for Rocky Gulch Dam. The samples collected from the well violated Maximum Contaminant Levels (MCLs) for seven parameters.

Type of Impact/Media Affected: The water quality standard violations documented by ADEQ on April 25, 1996, are displayed below.

Parameter	Maximum Observed Concentration (mg/l)	Applicable Standard (mg/l)
Beryllium	0.0166	0.004
Cadmium	0.0202	0.005
Fluoride	8.55	4.0
Iron	42	0.3
pH (standard units)	4.37	6.5 - 9
Sulfate	706	500 (proposed)
Total dissolved solids	1270	500

Because the contamination was discovered in 1996, the size of the contaminated plume of ground water beneath Rocky Gulch is not yet known. There are no drinking water wells within one mile of the impoundment. However, the municipal supply of the town of Clifton is downgradient of the impoundment. Clifton maintains two public water wells in the alluvium of the San Francisco River near the river's confluence with Rocky Gulch. The wells provide an alternative water supply for the town's approximately 3,000 residents. To date, no contamination of the ground water supplied by these two intakes has been documented. The distance from the dam to the wells was not documented in the available files.

Type of Release: Infiltration

Affected Media: Ground water

Type of Contamination: Beryllium, cadmium, fluoride, low pH, sulfate, and TDS

Environmental Damage(s): Ground water contamination

Environmental Risk: Alternative supply wells for Clifton are downgradient from the impoundment

Regulatory Action/Response: The regulatory mechanism in place in Arizona to deal with ground water quality issues at mines is the State's Aquifer Protection Permit (APP) program. The program's application development and review process was designed to achieve a cooperative approach to identifying, preventing, and remediating potential environmental concerns that could adversely affect water quality in the vicinity of mines as well as other types of facilities, including industrial plants and municipal wastewater facilities. The APP permitting process involves permit writers working with facility owners and operators to prepare detailed state-issued permits specifying facility design requirements, monitoring requirements, self-reporting requirements, additional steps to correct historical degradation of ground water quality, and possible re-evaluation of permit conditions to address any environmental or facility/operational changes.

ADEQ received PDMI's APP application for the Morenci Mine on March 28,1996. ADEQ worked with PDMI to ensure that a complete application, including all hydrogeology, well construction, and engineering requirements, were submitted. At the time of the file review, ADEQ's APP section was performing an in-depth technical review of PDMI's application prior to issuing a permit. To ensure that the mine's facilities are maintained and operated to restore and maintain ground water quality, compliance monitoring and periodic site inspections will occur once all the mine's facilities are permitted. There was no indication in the files concerning the issuance date of PDMI's permit or what conditions the permit would stipulate.

Based on PDMI's APP application, several alternatives that could affect the discharge of contaminants to ground water at Rocky Gulch have been considered by PDMI. Although PDMI claimed that the impoundment's existing discharge control technologies minimize loading to the aquifer, ADEQ subsequently discovered violations of water quality standards in samples collected from the monitoring well for the impoundment. Based on the application, PDMI considered lining the Rocky Gulch Dam impoundment and the pump bay with 60-mil HDPE liners. PDMI concluded that lining the pump bay would not be effective because seepage flow to the pump bay would "float" the liner. PDMI did acknowledge in its APP application that lining the impoundment would constitute prescriptive Best Available Discharge Control Technology (BADCT). They had calculated that a liner would reduce the equivalent daily discharge rate from the impoundment by approximately 477 gallons per day, or 97 percent. At the time the application was submitted, however, PDMI claimed that lining the impoundment was not warranted. PDMI's argument against installing the lining was based, in part, on the high associated cost which PDMI estimated to be approximately $665,000. There was no indication in the available files concerning how ADEQ and PDMI ultimately will resolve the aquifer degradation situation that has been discovered, or whether PDMI still maintains that the lining is unwarranted. At the time of the file search, the source of the contamination of the ground water had not been definitively documented.

References:

Arizona Department of Environmental Quality. *Notice of Violation.* October 24, 1994.

Arizona Department of Environmental Quality. *Inter-Office Memorandum Re: Phelps Dodge Discharge of August 12, 1996.* August 14, 1996.

Arizona Department of Environmental Quality. *Notice of Violation.* November 1, 1996.

Arizona Department of Environmental Quality. *Letter from Finton, P., to Beardsley, W.* February 2, 1996

Arizona Department of Environmental Quality. *Letter from Hyde, P., to Mohr, R., Phelps Dodge Morenci.* March 11, 1994.

Arizona Department of Environmental Quality. *Letter from Hyde, P., to Pope, G., USGS.* March 16, 1994.

Phelps Dodge Morenci. *Letter from Mohr, R., to Strauss, A., U.S. Environmental Protection Agency, Region 9.* August 16, 1996.

Phelps Dodge Morenci Inc. *Aquifer Protection Permit Application.* March 28, 1996.

ASARCO Ray Complex: "Airborne Fugitive Dust and Tailings Result from Improper Management and Maintenance"

Sector(s): Copper

Facility: ASARCO, Inc. Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Mike Traubert, Office of Air Quality, Compliance Unit, ADEQ

Waste and Material Management Practices: The ASARCO Incorporated Ray Complex, located in Arizona's Pinal County, comprises one of the largest mineral extraction and processing operations in Arizona. The complex is two separate sites, with Arizona Highway 177 passing through or running adjacent to both sites. ASARCO's open pit copper mine, known as the Ray Mine, is located at the northernmost of the two sites. This unit of ASARCO's complex is called the Ray Unit at which most of the operations are carried out. The concentrator at the Ray Unit processes most of the lower grade ore mined at the Ray Unit. The resulting tailings and wastewater are transported to the Elder Gulch tailings impoundment. The ore processed by the Ray concentrator plus some of the higher grade ore from the mine is shipped by rail to ASARCO's other site in the county, near the town of Hayden. The Ray concentrator processes approximately 32,000 tons of ore daily, while the concentrator in Hayden processes 15,000 tons a day. The Ray concentrator produces 180 tons of copper concentrate per day, and the Hayden concentrator produces 80 tons to copper concentrate per day. ASARCO's smelter also is located at the Hayden site.

On May 8, 1991, Arizona Department of Environmental Quality (ADEQ) staff conducted an inspection of ASARCO's Ray Unit. Inspectors noted that several areas were not being maintained in accordance with conditions stipulated in ASARCO's permit.

On December 5, 1995, Arizona Department of Environmental Quality (ADEQ) staff conducted an inspection of the concentrator at the Ray Complex. The inspectors observed fugitive emissions at the facility while ore schists were being unloaded. The dump hopper spray system was not being operated.

Type of Impact/Media Affected: Air Permit No. 036293 requires ASARCO to maintain and control emissions from tailings piles, ponds, and associated roadways. In order to control fugitive emissions, roadways are required to be capped using decomposed granite, and the mine must use a water truck to achieve a 90 percent dust control efficiency. Similarly, tailings pond surfaces must be wet down or encrusted to control emissions. During the inspection, May 8, 1991, ADEQ inspectors noted numerous strips of drifting tailings on roadways on the property. In addition, many of the roadways were not encrusted, some were missing permit-required decomposed granite caps, and powdery dust up to three inches thick covered portions of many of the roadways. The talcum-powder-like dust on some of the roadways was easily entrained by any passing vehicles.

During any operations likely to result in significant amounts of airborne dust, Arizona's Administrative Code requires that reasonable precautions be taken to prevent excessive amounts of particulate matter from becoming airborne, such as using spray bars, wetting agents or dust suppressants, covering loads, and using hoods. In addition, Arizona's air pollution control operating permit for the ASARCO Ray Complex's Hayden concentrator requires the reduction of fugitive emissions from the

crushing plant by operating a spray system. The system is required to spray no less that 1.4 gallons per minute from each of at least four spray heads located at each side of the dump hopper. The heavy dust plumes on December 5, 1995, were not monitored because of the short duration of the emissions.

Type of Release: Fugitive emissions

Affected Media: Air

Type of Contamination: Particulate matter, tailings, and dust

Regulatory Action/Response: On May 23, 1991, ADEQ issued a Notice of Violation (NOV) to ASARCO for the failure of the facility's operators to observe the permit requirements and the State Implementation Plan at the Ray Unit.

ADEQ's Air Quality Division issued a NOV on December 11, 1995, to the ASARCO Ray Complex as a result of the violations observed during the December 5, 1995 inspection. The NOV's corrective action provisions required the Ray Complex always to operate the Rail Road Dump Hopper when conducting materials unloading operations. ADEQ also required a written summary or compliance plan to assure proper operation of the spray system to reduce fugitive dust emissions. ADEQ did not levy a civil penalty against the facility as part of the NOV, but cautioned that achieving compliance does not preclude ADEQ from imposing a fine. Further, ADEQ stated that an unilateral enforcement action would result if compliance was not achieved. Such an action may impose a civil penalty for each violation for the entire non-compliance period. No additional information pertinent to this violation was present in the available state files.

References:

Arizona Department of Environmental Quality. *Letter from Jasper, W., to B. Malone, ASARCO Ray Unit*. March 25, 1991.

Arizona Department of Environmental Quality. *Letter from Olson, S., to N. Gambell, ASARCO Ray Technical Services*. December 11, 1995.

ASARCO Ray Complex: "Emissions from Multiple Sources Result in Opacity Violations and Impacts on Community"

Sector(s): Copper

Facility: ASARCO, Inc. Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Mike Traubert, Office of Air Quality, Compliance Unit, ADEQ

Waste and Material Management Practices: The ASARCO Incorporated Ray Complex, located in Arizona's Pinal County, comprises one of the largest mineral extraction and processing operations in Arizona. The complex is two separate sites, with Arizona Highway 177 passing through or running adjacent to both sites. ASARCO's open pit copper mine, known as the Ray Mine, is located at the northernmost of the two sites. This unit of ASARCO's complex is called the Ray Unit at which most of the operations are carried out. The concentrator at the Ray Unit processes most of the lower grade ore mined at the Ray Unit. The resulting tailings and wastewater are transported to the Elder Gulch tailings impoundment. The ore processed by the Ray concentrator plus some of the higher grade ore from the mine is shipped by rail to ASARCO's other site in the county, near the town of Hayden. The Ray concentrator processes approximately 32,000 tons of ore daily, while the concentrator in Hayden processes 15,000 tons a day. The Ray concentrator produces 180 tons of copper concentrate per day, and the Hayden concentrator produces 80 tons of copper concentrate per day. ASARCO's smelter also is located at the Hayden site.

On March 19, 1991, Arizona Department of Environmental Quality (ADEQ) staff conducted an inspection of mineral tailings piles at the Ray Complex. The inspectors observed major fugitive emissions coming from the tailings piles.

ASARCO continuously monitors emissions from both the reverberator and roaster (R&R) flue and the acid stack. Opacity is monitored from both plants, with sulfur dioxide (SO_2) emissions also being monitored at the acid plant. During the first and second quarters of 1991, ASARCO reported opacity and SO_2 violations. In 1991 and 1992, ADEQ found opacity violations of the main smelter stack in Hayden.

Type of Impact/Media Affected: Arizona's Administrative Codes require mine operators to control emissions from mineral tailings piles. During the inspection, a six-minute average opacity of 78 percent was noted, violating the Arizona Administrative Code.

Arizona's Administrative Code requires the control of stack emissions. Air pollution equipment, process equipment, and processes must be maintained and operated at all times to minimize emissions. Arizona requires that opacity levels of ASARCO's R&R flue and the acid plant SO_2 stack not exceed 20 percent. ASARCO submits quarterly excess emissions reports to ADEQ on these two sources. ASARCO's smelter also is required to meet an opacity limit of 20 percent. ASARCO reported that in the first quarter of 1991 the R&R flue operated in excess of the 20 percent opacity standard 30 percent of the time. In the second quarter, the flue exceeded the opacity standard 40 percent of the time. For the acid plant, opacity standards were exceeded eight percent of the time in the first quarter and two percent of the

time in the second quarter. The six-hour average SO_2 standard of 650 ppm was self-reported by ASARCO as having been violated eight percent of the time in the first quarter and two percent of the time in the second quarter.

On several occasions in late 1991 and early 1992, ADEQ staff observed and monitored emissions from the main smelter stack of ASARCO's operations in Hayden. On September 25, 1991, ADEQ observed an average opacity reading of 52 percent for the stack. On October 9, 1991, the observed opacity reading of the stack was 41 percent. On January 17, 1992, the average observed reading was 44 percent. On January 30 and February 28, the average observed readings of the stack were 59 percent. Each of these readings was more than double the allowable opacity limit.

Type of Release: Fugitive emissions

Affected Media: Air

Type of Contamination: Opacity and sulfur dioxide

Environmental Damage(s): Potential human health impacts

Environmental Risk: Potential public health impacts

Regulatory Action/Response: On March 25, 1991, ADEQ issued a Notice of Violation (NOV) to ASARCO. The NOV cited the March 19 incident as well as the mine's long history of violations and the associated severity and impact on the community. On the basis of the mine's history of emissions from the tailings piles, ASARCO's lack of commitment to control tailings pile emissions and the historical impact on the community, ADEQ levied the maximum possible statutory civil penalty allowed, $10,000. There was no information present in state files reviewed that discussed the severity or impact of ASARCO's emissions either from this incident or historically.

Sighting apparent design deficiencies or operational and maintenance problems associated with the reverberator and roaster and acid plants, ADEQ issued a NOV to ASARCO on August 26, 1991, for violating Arizona Administrate Codes. ASARCO was not subjected to a civil penalty for these violations; however, ADEQ required a compliance activity plan with interim and final compliance dates stipulated. This NOV requested ASARCO to comply voluntarily.

On October 4, and October 20, 1991, and again on January 29, 1992, ADEQ issued NOVs concerning the excess emissions from the main smelter. ADEQ required ASARCO to state the circumstances relating to the violation and provide detailed plans of how ASARCO would achieve prompt and continuous compliance. This NOV also was a request for ASARCO to comply voluntarily. At the time of the file review, documentation describing ASARCO's responses to these NOVs, if any, was missing from the files available. Follow-up telephone calls may help determine the nature of ASARCO's responses and whether any additional enforcement actions were taken by the state.

References:

Arizona Department of Environmental Quality. *Letter from Jasper, W., to B. Malone, ASARCO Ray Unit*. March 25, 1991.

Arizona Department of Environmental Quality. *Letter from Jasper, W., to B. Malone, ASARCO Ray Unit*. August 26, 1991.

Arizona Department of Environmental Quality. *Letter from Jasper, W., to B. Malone, ASARCO Ray Unit*. October 4, 1991.

Arizona Department of Environmental Quality. *Letter from Jasper, W., to B. Malone, ASARCO Ray Unit*. August 26, 1991.

Arizona Department of Environmental Quality. *Letter from Kempson, D., to B. Malone, ASARCO Ray Unit*. October 20, 1991.

Arizona Department of Environmental Quality. *Letter from Kempson, D., to B. Malone, ASARCO Ray Unit*. January 29, 1992.

Arizona Department of Environmental Quality. *Letter from Kempson, D., to B. Malone, ASARCO Ray Unit*. February 11, 1992.

Arizona Department of Environmental Quality. *Letter from Kempson, D., to B. Malone, ASARCO Ray Unit*. March 9, 1992.

ASARCO Ray Complex: "Mine Discharges Degrade Ground Water and Surface Water"

Sector(s): Copper

Facility: ASARCO Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ; Cathy O'Connell, Water Quality Enforcement Team Leader, ADEQ

Waste and Material Management Practices: ASARCO Incorporated extracts approximately 300,000 tons of ore per day as part of an open pit copper mine operation in south central Arizona's Pinal County. This mine, known as the Ray Mine, consists of four pits; the Pearl Handle, Amanda, Calumet, and West pits, with the Pearl Handle being the largest. The site is drained by Mineral Creek and its principal tributary, Elder Gulch. The creek is a perennial stream most years, but is occasionally dry. The creek joins the Gila River south of the Ray Unit.

ASARCO collects pregnant leach solution (PLS) in ponds located in the washes below the leach dumps. The electrowinned leach solution produces 90 tons of copper cathode per day. The ore processed at the Ray concentrator, plus some of the raw higher grade ore, is shipped by rail car to ASARCO's Hayden site, where ASARCO's smelter and another concentrator are located. The Ray concentrator crushes and processes approximately 32,000 tons of sulfide ore daily, producing 180 tons of copper concentrate per day. ASARCO transports the tailings from the concentrator to the Elder Gulch tailings impoundment. The tailings derived from crushing, milling, and floatation are deposited at a rate of 30,000 to 36,000 dry tons per day. They are transported to the impoundment as a slurry and are deposited through a single discharge point located on the rockfill dam crest and from several other points on the perimeter of the impoundment.

The floor of the electrowinning plant was lined with HDPE plastic in 1995. Old and leaking concrete cells were replaced with polycrete cells. The electrowinning dam, which ASARCO planned to enlarge, may contain storm water and overflow from various tanks in addition to PLS. The mine's routine operations are chronically affecting the quality of both surface and ground waters in the mine's vicinity. In April 1995, EPA reported that six ground water wells situated downgradient of the electrowinning plant and the electrowinning dam were continuously pumping PLS. EPA concluded that it is likely that contaminants are escaping from the Ray Unit and entering Mineral Creek via ground water.

Type of Impact/Media Affected: In July 1996, the Arizona Department of Environmental Quality (ADEQ) reported that approximately one-half mile of the Mineral Creek stream bed below the Ray Mine was visibly affected by mining activities. The cobble and gravel substrate in this stretch of the stream bed was coated with a blue-green layer of copper oxides. These toxic materials are believed to be the result of precipitation of the dissolved copper with increasing alkalinity. According to ADEQ, visible environmental damage to Mineral Creek constitutes a violation of narrative surface water quality standards.

Water quality degradation also is detectable in the chemical make-up of Mineral Creek as a result of violations of numeric surface water quality standards, as documented by ADEQ in April 1996. ADEQ termed the violations a dramatic degradation of water quality by mining activities. The surface water quality

standards violated based on samples collected in April 1996 in Mineral Creek immediately downstream of ASARCO's Ray Unit are summarized below.

Parameter	Maximum Observed Concentration (mg/l)	Applicable Standard (mg/l)
Beryllium	0.0112	0.00021
Cadmium	0.0615	0.05
Copper, total	6.54	0.5

Some of the violations of aquifer water quality standards that ADEQ documented based on samples collected from three ground water monitoring wells are summarized below.

Parameter	Maximum Observed Concentration (mg/l)	Applicable Standard (mg/l)
Arsenic	0.104	0.05
Beryllium	0.110	0.004
Cadmium	0.482	0.005
pH (standard units)	5.99	6.5 - 9

As a result of these documented violations, ADEQ has inferred numerous subsurface discharges at various points with respect to the mining facilities.

Type of Release: Infiltration and seepage

Affected Media: Ground water and surface water

Type of Contamination: Arsenic, beryllium, cadmium, copper, low pH, potassium, sodium, sulfate, and TDS

Environmental Damage(s): Adverse affects on aquatic life and wildlife assumed, but not yet adequately documented by biological sampling

Regulatory Action/Response: EPA's NPDES permit for ASARCO's Ray Unit expired on August 3, 1993. Although no new permit was present in the available files, the files did contain correspondence concerning the development of draft conditions for the permit's reissuance. EPA planned to include provisions for annual biological sampling of Mineral Creek downstream of the site. The results of that sampling were to be compared to an appropriate reference site to provide an indication of the degree to which ASARCO's pollution control measures were improving receiving water quality over the effective life of the permit. This provision was written into the draft report as a result of the U.S. Fish and Wildlife service (FWS) having consulted formally with EPA concerning the effect of mine discharges on Endangered Species Act (ESA) listed species. In tandem with the Arizona Department of Game and Fish, FWS had notified EPA that Mineral Creek below the Ray Mine was severely depleted of fish and aquatic insect populations as compared with an upstream station, and that

downstream riparian habitat values were low. EPA intended to work closely with both ASARCO and FWS to develop a practical approach to reissuing the permit. Prior to issuing the permit, EPA recommended the following compliance measures:

- All necessary efforts should be taken by ASARCO to determine the sources of copper solutions that are entering Mineral Creek and to stop those discharges;
- To stop unauthorized discharges of pollutants to Mineral Creek from transite pipelines; transite pipelines carrying solutions in the vicinity and over Mineral Creek should be located and replaced with HDPE piping;
- An interim containment structure should be constructed at the base of the 4G Rock Deposition Area to prevent storm water run-off from reaching Mineral Creek;
- A pump should be installed in the monitor well located in the flood plain of Mineral Creek downgradient of the 4D Rock Deposition Area (Adit seep) to intercept pollutants flowing toward Mineral Creek. Additional hydrologic studies should be conducted in the 4D Rock Deposition Area to determine if low pH, high copper solutions are entering Mineral Creek;
- Water quality monitoring of Mineral Creek above and below the electrowinning plant for the presence of copper should be performed to determine the effectiveness of the six cut-off wells. If the cut-off wells are ineffective, additional hydrogeological and or engineering studies will be necessary;
- Water quality monitoring of Mineral Creek above and below the Big Dome Pond for the presence of copper should be conducted to determine the effectiveness of the four slotted caisson pumping systems. If the caissons are ineffective, additional hydrogeological and or engineering studies will be necessary; and
- Cemented gravels located in the bed of Mineral Creek should be collected and tested to determine the solubility of copper in the gravels to Mineral Creek water. If these gravels are found to be contributing copper to Mineral Creek, then they should be removed.

In addition to the NPDES permit covering direct discharges to Mineral Creek, the Ray Unit was required to secure a permit for discharges that could affect ground water quality. ADEQ issued an Aquifer Protection Permit (APP) to ASARCO on September 25, 1991. Arizona's APP is the principal permit required by Arizona for operations such as this copper mine. The APP program was designed to deal with ground water quality concerns by identifying and remediating those that could adversely affect ground water quality in the vicinities of permitted mines. The permitting process involves correcting the known historical degradation of ground water quality. The permit included the Elder Gulch impoundment and required ground water monitoring, as well as design and operational requirements for the site. The permit requirements included a response protocol in the event of the exceedance of permit-established Alert Levels (AL) for ground water quality. The permit required ASARCO to meet the following objectives:

- Evaluate the source, extent, and magnitude of contamination causing AL exceedances and the potential for an Aquifer Quality Limit (AQL) violation;

- Evaluate any possible malfunction of impoundment design, pollution control devices, or other equipment processes that may have caused or contributed to AL exceedances; and

- Provide recommendations for corrective action, additional monitoring, and point-of-compliance (POC) wells, and operations records and data.

Several AL exceedances for multiple constituents have been observed. In 1995, ASARCO's consultant responding to the AL exceedances observed in wells in the vicinity of the tailings impoundment concluded that the water levels and chemical quality of ground water from wells in the vicinity of the Elder Gulch impoundment were influenced by seepage from the impoundment. They determined that the primary cause of the seepage was pressurization of the base of the tailings by direct flow of tailings pond water into the impoundment's drain system. That flow increased the hydraulic gradients of seepage outside the impoundment. Recommendations for corrective measures included the following:

- Slime seal the backs of ponds by dredging slimes. Extending the sealing over the entire floor of the ponds and increasing the minimum thickness of the slime sealing may be necessary in order to adequately reduce drain flow;

- Reduce the size of the ponds to as small as practicable;

- Extend the peripheral spigotting system for the full length of the dam perimeter to provide longer drying periods between deposition cycles to achieve beach desiccation and minimize infiltration;

- Draw down the main tailings pond by reducing make-up water flow into the system;

- Install three porous tip piezometers at each of two locations along the tailings beach for confirmation of depressurization of the base of the tailings;

- Measure the tailings pond water surface area, drain discharge, water reclaim volumes, and tailings slurry inflow volumes and percent solids on a monthly basis, and reevaluate the water budget; and

- Measure water levels in existing wells at a frequency of at least every six weeks.

Work on many of these corrective measures was underway in mid-1995. ASARCO's consultant concluded that completion of these corrective measures will reduce the probability of AQLs being exceeded.

ASARCO notified ADEQ's APP Section of AL exceedances in four wells in April and July 1996, as required by the facility's APP. The constituents were potassium, sodium, sulfate, and total dissolved solids. ASARCO contends that these AL exceedances were forecast in the consultant's 1995 report. They requested that the operational measures be given a chance to work prior to additional changes being implemented. ASARCO also is concerned as to the progress that ADEQ was making on calculating ALs. No information was identified in the state files available for review that addressed the establishment of ALs for the Ray Unit or that identified the costs of the corrective measures recommended by ASARCO's consultant. In addition, no information was available concerning assessments of the effectiveness of any of the corrective measures that ASARCO has taken to date.

References:

AGRA Earth & Environmental, Inc. *Elder Gulch Tailings Impoundment Alert Level Response*. June 26, 1995.

Arizona Department of Game and Fish. *Investigation of Fisheries Resources and Habitat of Mineral Creek Arizona*. September 30, 1993.

Arizona Department of Game and Fish. *Mineral Creek/Ray Mine Fisheries and Habitat Survey Arizona*. September 30, 1993.

ASARCO Ray Complex Technical Services. *Letter from Gambell, N., to J. Bruneau, APP Section, ADEQ*. April 10, 1996.

ASARCO Ray Complex Technical Services. *Letter from Gambell, N., to R. Azizi, APP Section, ADEQ.* July 26, 1996.

Hyde, P. *Case development memorandum on the ASARCO Ray Complex.* July 1, 1994.

U.S. Environmental Protection Agency. *Letter from Greenberg, K., to T. Scartaccini, ASARCO Ray Complex.* April 14, 1995.

U.S. Environmental Protection Agency. *Letter from Landy, J., to T. Scartaccini, ASARCO Ray Complex.* February 12, 1996

ASARCO Ray Complex: "Breaches in Tailings Impoundment Containment Dike Contaminates Eleven Miles of River Sediment"

Sector(s): Copper

Facility: ASARCO, Inc. Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ; Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: ASARCO Incorporated's Ray Complex is located in south central Arizona's Pinal County. ASARCO mines approximately 300,000 tons of ore per day at the Ray Mine, located at the northernmost site. Approximately 15,000 tons of ore is sent from the Ray Unit via railcar to the ASARCO Complex's other site, which is located in Hayden. Hayden also is the site of ASARCO's smelter. A concentrator at the Hayden site produces 80 tons of concentrate copper per day. ASARCO's Hayden mill began operations in 1911. It discharges tailings to an impoundment known as the AB-BC tailings pond, which is located next to the Gila River. The impoundment and surrounding dike is approximately 14,000 feet long, 3,600 feet wide, and 150 feet high.

Type of Impact/Media Affected: In December 1992, 5.38 inches of rain were measured in Hayden, which was a record. Another 6.78 inches of rain fell on Hayden in January 1993, on ground that was already saturated. By comparison, average rainfall for the month is 1.05 inches. The rainfall led to a prolonged flooding event during which the Gila River underwent numerous channel changes, scouring vegetation and lowing the base level an estimated 15 feet. Swollen out of its banks by the heavy rains, the Gila River breached the AB-BC tailings impoundment containment dike on the night of January 9, 1993. Continued flooding over the next several days resulted in a total of 13 separate breaches of the dike, three of which eroded through the dike and into the toe of the tailings pile. The total discharge was approximately 292,000 tons of tailings, which was about 216,000 cubic yards of material.

Sampling of the river showed that elevated concentrations of pollutants occurred at least 11 miles downstream of the spill. The tailings formed bank and bottom deposits in the river, impairing both recreational uses and the quality of habitat for plants and animals. The discharge also had an adverse effect on the sediment loading of the river, the flow morphology, and the erosional patterns.

A 1995 Arizona Department of Environmental Quality (ADEQ) internal memorandum documented a 1994 ADEQ study that had been undertaken approximately 17 months after the tailings release. The study found that the tailings had been diluted by the river's flow and had been deposited over the river's entire flood plain. The study concluded that a vast area the riverbed's sands contained approximately 1.5 percent tailings. Although the tailings were no longer concentrated sufficiently in any one spot to the point of visual recognition, chemical analyses of the sediments found that tailings were present in every sample collected for many miles downstream of the breached dike. River sediments were enriched by as much as 300 percent above background levels, with an average enrichment of 111 percent for three parameters -- sulfate, soluble solids, and copper. The study also concluded that the tailings-enriched sands were likely to stress bottom feeders, the metabolisms of which are adversely affected by the ingestion of excessively fine-grained inorganic sediments.

Type of Release: Spill

Nature of Contamination: Surface water

Type of Contamination: Copper, sulfate, and soluble solids

Environmental Damage(s): Tailings-enriched river sediments

Location of Affected Populations: Adverse affects on aquatic life, particularly bottom feeders, and wildlife assumed, but none were documented

Regulatory Action/Response: The U.S. Army Corps of Engineers sent a nationwide permit verification letter to ASARCO on March 9, 1993, including four special conditions:

- Provide estimates of the total cubic yards of material eroded by the flood;
- Provide results of representative samples of the tailings material and compare them to ADEQ's Health Based Guidance Levels (HBGLs) for solids;
- Speculate on the likelihood that future floods will erode additional portions of the dike; and
- Provide cost estimates for providing stabilization of the entire dike and other alternatives for preventing future erosion of the tailings facility.

ASARCO responded to these requests item by item. ASARCO's most precise estimate of the volume of material eroded was 216,400 cubic yards. Sediment sampling results showed that only concentrations of beryllium were above the HBGL. However, because comparable concentrations of beryllium (i.e., also above the applicable HBGL) were noted from a sample collected above the tailings, ASARCO contended that background conditions were responsible. ADEQ agreed and concluded in a 1995 report that nowhere were the concentrations of any toxics above the HBGLs. ASARCO acknowledged that future flood events of the same magnitude or greater than the 1993 event are likely, but claimed to be unable to predict how those future floods could impact the tailings because of so many variables. ASARCO repaired the points where the flood impacted the tailings and protected them with heavy rip-rap. The estimated cost of the repairs was $1,416,157. Cost estimates for placing light rip-rap on the river side of the tailings containment dike are $1,000,000. ASARCO also suggested that the Corps undertake re-channelization of the river in the Hayden area. Based on the state files available for review, no further information was available concerning further communications relative to these four permit conditions. Follow-up phone calls to ADEQ or EPA Region 9 staff may help clarify whether any additional actions have been taken or are under consideration.

ADEQ sent a letter to ASARCO on September 28, 1993, notifying ASARCO that the discharge of tailings to the river was a violation of the Clean Water Act. To remedy the effects on the river and to prevent a repeat of the discharge, ADEQ requested that ASARCO comply with the following requests:

- Prepare plans for the protection of the tailings during a 500-year flood;
- Prepare plans to dredge approximately 250,000 tons of sediment from the river downstream of the tailings;
- Present the dredging plans, costs, and a schedule to ADEQ; and
- Reimburse ADEQ for costs incurred for investigating and preparing the case.

The February 1995 draft report of a subsequent study conducted by ADEQ made several recommendations and conclusions that differed from the requests described above. The major contradictory recommendation of the study was that given the extent of redeposition of natural sediments and the lack of tailings concentrations in toxic amounts, the dredging of 250,000 tons of sediment from the river channel was not advisable. Because the flood waters cut new channels and deepened cutbanks, ADEQ's study also concluded that the amount of soil redeposited by natural forces far outweighed the amount of tailings released. According to the 1995 study, no recovery of the river's sediment is feasible because of the thorough dispersal of the tailings. As a result of the deposition of the tailings throughout the sediments in non-toxic concentrations, ADEQ termed their present environmental detriment as "nil." It argued that any attempt to remove the tailings would cause extensive damage to the riparian habitat while producing marginal benefits. The study also concluded that the only effective remediation along the affected stretch of the river, enlarging and improving the containment dikes, had already been accomplished by ASARCO. Lastly, the study recommended that ASARCO perform a supplementary environmental project costing $250,000. No further information on how ASARCO responded to ADEQ's requests was available in the state files available for review.

References:

Arizona Department of Environmental Quality. *Internal (draft) memorandum from Hyde, P., to R. Best on ASARCO Hayden tailings spill of January, 1993 and the extent of tailings downstream along the Gila River.* February 6, 1995.

Arizona Department of Environmental Quality. *Inter-Office memorandum from Matt, J., on ASARCO Hayden Tailings Spill.* July 8, 1993

Arizona Department of Environmental Quality. *Inter-Office memorandum from Matt, J., on ASARCO Hayden Tailings Spill.* September 2, 1993.

ASARCO. *Letter from Gambell, N., to R. Dummer, U.S. Army Corps of Engineers.* February 18, 1993.

ASARCO. *Letter from Gambell, N., to R. Dummer, U.S. Army Corps of Engineers.* September 7, 1993.

Arizona Department of Environmental Quality. *Letter from Hyde, P., to T. Scartaccini, ASARCO Ray Complex.* September 28, 1993

Hyde, P. *Case development memorandum on the ASARCO Ray Complex.* July 1, 1994.

U.S. Environmental Protection Agency. *Letter from Greenberg, K., to T. Scartaccini, ASARCO Ray Complex*. April 21, 1995

ASARCO Ray Complex: "Discharges from Mine Threaten Water Quality in a Sensitive Stream"

Sector(s): Copper

Facility: ASARCO, Inc. Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: ASARCO Incorporated maintains several mineral extraction and processing operations at two large sites in Arizona's Pinal County. The two sites are separated by several miles, with the northernmost site located about one and a quarter miles north of Kelvin, Arizona. In addition to being the location of ASARCO's open pit copper mine, the Ray Mine, this site includes milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, a concentrator, a water treatment plant, and numerous impoundments. All the facilities at this site are collectively known as the Ray Unit. The mine consists of the Pearl Handle, Amanda, Calumet, and West pits. The Pearl Handle is the largest pit. The site is drained by Mineral Creek, which is a perennial stream most years, with one of its principal tributaries, Elder Gulch, also draining the site. The creek joins the Gila River south of the Ray Unit. High grade ore from the mine is shipped to ASARCO's southernmost site, which is near the town of Hayden, for smelting.

Approximately 300,000 tons of material is mined per day. The higher grade ores are processed at two concentrators, one at each of the two sites. The Ray concentrator crushes and processes approximately 32,000 tons of sulfide ore daily, and 15,000 tons is sent via railcar to the Hayden concentrator. The tailings and wastewater produced at the Ray concentrator are transported to the Elder Gulch tailings impoundment. The Ray concentrator produces 180 tons of copper concentrate per day, and the Hayden concentrator produces 80 tons of concentrate per day.

Approximately 7,000 tons per day of low grade silicate ore is dump leached with sulfuric acid at the Ray Unit. In addition, lower grade sulfide ore is dump leached. Pregnant leach solution (PLS) is collected in ponds located in the washes below the leach dumps. An electrowinning plant on-site processes the PLS from the leach ponds and produces 90 tons of copper cathode per day.

Unauthorized discharges of Ray Unit process waters to Mineral Creek and Elder Gulch have occurred many times in recent years, including numerous violations of permit effluent limits. During one eight month period from January to August 1993, nine spill events occurred at the mine that resulted in unauthorized discharges to Mineral Creek. The specific causes have included overflows, equipment failures, and damage caused by heavy machinery.

Type of Impact/Media Affected: The Ray Unit is occasionally subject to torrential rains. One such rain event occurred on August 28, 1993, when 1.9 inches of rain fell in thirty minutes. After the rain had stopped, a bulldozer that ASARCO had dispatched to shore up an eroding berm struck a 16-inch leachate solution pipeline. An estimated 7,200 gallons of copper sulfate solution was spilled into the flooding water. The mixture had a copper concentration of 410 mg/l. The mixture overflowed a storm water catchment basin and entered Mineral Creek. The raging water also drove several boulders into a 12-inch tailings

reclaim water line, resulting in a rupture that spilled approximately 30,000 gallons of reclaim water into the creek.

On January 29, 1993, a bulldozer struck and broke a sump overflow pipeline, discharging copper sulfate solution to Mineral Creek. A year earlier, on March 12, 1992, another impact to a pipeline by an ASARCO bulldozer caused a discharge to the creek of reclaim water. The amount of that discharge and the concentrations of any pollutants were not documented in the available files.

Ambient water quality sampling data have documented non-compliance with water quality standards in Mineral Creek for a variety of metals. Copper concentrations as high as 2.7 mg/l were reported in creek waters below the mine. In 1993, copper concentrations in the creek above 1 mg/l were recorded in May, June, July, August, and September. Water quality violations were documented in the same stretch of the creek for beryllium. In March 1993, discharges from a tributary of Mineral Creek that also drains the Ray Unit, Elder Gulch, exceeded standards for hexavalent chromium, sulfides, and total arsenic.

ASARCO's discharges affect a reach of Mineral Creek that typically flows, but on occasion becomes completely dry. Arizona's Department of Game and Fish believes that the discharges from the Ray Unit have negatively affected both the water quality and the aquatic life of Mineral Creek. The Department conducted a biosurvey of Mineral Creek in July 1993. In a report dated September 30, 1993, the Department found that although the numbers and diversity of aquatic insects and fish were high above the Ray Unit, an almost complete absence of aquatic life at sampling stations was observed directly downstream of the mine.

Arizona's designated beneficial uses of the creek are Warm Water Fishery, Full Body Contact, Fish Consumption, and Agricultural Livestock Watering. Of these, the most protective uses, which are those with the most stringent water quality standards, are Fish Consumption and Warm Water Fishery. Water quality standards for the latter use category include provisions for protection from acute and chronic toxic effects. In addition, protection of native fish populations is viewed by the Department of Game and Fish as essential to the creek. For example, the Colorado Roundtail Chub, which is a native fish found in the creek, is listed as a state threatened species.

Type of Release: Spills

Affected Media: Surface water

Type of Contamination: Heavy metals, copper, and beryllium

Environmental Damage(s): Contaminated sediment and surface water, loss of aquatic life suspected, but not documented as attributable to mining practices

Regulatory Action/Response: EPA has determined that the effluent from ASARCO's Ray Unit has the potential to cause the water of Mineral Creek to exceed standards for toxics and that the discharges may cause acute and chronic toxicity impacts to the creek. However, the dilution effects of the creek and the resulting effect of the dilution on the toxicity of the discharge are unknown. Based on the information available at the time of file review, the severity of the water quality and aquatic life impact had not been definitively determined. In mid-1994, the Arizona Department of Environmental Quality (ADEQ) was evaluating the civil penalty that would be levied against ASARCO for these illegal discharges. At that time, ADEQ was considering penalties ranging from $1,625,000 to $18,775,000. The later figure was calculated based on the number of violations *expected* during the period and the documented number of discharges. The former penalty figure was based on the *documented* numbers of violations and discharges. Other considerations in establishing penalty amounts would include the severity of the pollution and the economic benefit of avoiding an environmental remedy. No additional information was available concerning

regulatory responses against ASARCO for these discharges. Also, no information was available on the cleanup cost associated with repairing the pipeline breakage or other discharges.

References:

Arizona Department of Game and Fish. *Investigation of Fisheries Resources and Habitat of Mineral Creek Arizona*. September 30, 1993.

Arizona Department of Game and Fish. *Mineral Creek/Ray Mine Fisheries and Habitat Survey Arizona*. September 30, 1993.

ASARCO Ray Complex. *Letter from Scartaccini, T., to U.S. EPA*. August 31, 1993.

Hyde, P. *Memorandum on ASARCO Hayden tailings spill of January 1993 and the extent of tailings downstream along the Gila River*. February 6, 1995.

Hyde, P. *Case development memorandum on the ASARCO Ray Complex*. July 1, 1994.

U.S. Department of Justice. *Letter from Kwasny, I., to J. Johnson, Fennemore Craig, Attorney for ASARCO*. May 4, 1994.

U.S. Environmental Protection Agency. *Letter from Greenberg, K., to T. Scartaccini, ASARCO Ray Complex*. April 21, 1995.

U.S. Environmental Protection Agency. *Draft Fact Sheet Permit No. AZ0000035*. Undated.

ASARCO Ray Complex: "Leachate Solution Overflows Collection Dams to Mineral Creek and Elder Gulch"

Sector(s): Copper

Facility: ASARCO, Inc. Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: ASARCO Incorporated has a large mineral processing operation in south central Arizona that is split into two major sites. The mine is located near Kearny, in Pinal County, at the site referred to as the Ray Unit. Dump leaching, solvent extraction, electrowinning, and high grade ore concentrating are among ASARCO's operations at the Ray Unit. Several impoundments at the Ray Unit are used to collect copper leach solutions. A series of pipelines provide the mechanism for transporting the collected leachate solution throughout the facility. In recent years, the operation and maintenance of several of these leachate collection systems has been unable to prevent releases to the environment during major rainfall events. In addition, ASARCO has neither monitored nor reported several recent releases to streams draining its properties. A water treatment plant at the Ray Unit is permitted under the National Pollutant Discharge Elimination System (NPDES) to discharge treated wastewater into Mineral Creek, subject to discharge limitations and monitoring requirements. The discharges must not cause any violations of narrative or numeric state water quality standards.

From August 1990 through November 1993, at least 19 spills of hazardous materials were reported at the ASARCO Ray Mine. The majority of spills were from dams, pipelines, and ponds. The discharges typically resulted from either accidental discharges associated with heavy rain or from chronic seepage from leaching facilities into the ground water, which then entered the creek. As a result, surface water quality has been significantly affected. A total of 41 violations of total copper, dissolved copper, and beryllium numeric surface water quality standards were documented by the Arizona Department of Environmental Quality (ADEQ), EPA, and ASARCO in Mineral Creek below the Ray Mine.

Type of Impact/Media Affected: In August 1990, a storm that dropped 3.05 inches of rain in 24 hours caused greater storm water run-off than ASARCO's facilities were designed and maintained to handle. The run-off overwhelmed several of ASARCO's dams and at least one basin, including the Electrowinning, Lower Slimes, and Stacker solution collection dams, and the Contingency Basin. As a result of the run-off, the screens leading to the solution collection pipelines became clogged with debris. The inability to use the pipelines led to copper-laden leachate solutions overflowing the dams. The combined volume of solution that overflowed from the three dams was estimated at approximately 324,000 gallons. The overflow reached Mineral Creek and Elder Gulch, a tributary to the creek. Copper sludge in the Contingency Basin, which had not been cleaned out for several years, also was washed into Mineral Creek during the storm. The amount of sludge discharged is unknown. Improper placement and maintenance of the Contingency Basin's berms led to that release.

In January 1991, the overflow of another storm water run-off collection dam, the Stacker East dam, caused another discharge to a tributary of Elder Gulch. As with the previous overflows, ASARCO failed to notify EPA of the 695-gallon discharge. EPA site inspectors discovered evidence of the discharge on

January 15. They observed discolored pools of water in the stream bed and unsightly deposits on the stream's bank that had been left by the discharge. The concentration of copper in that release was reported to be 690 mg/l.

On April 19, 1991, a broken pipeline coupling caused another 150,000 gallons of copper solution to be discharged to Mineral Creek. A few months later, ASARCO discharged more leach solution to the creek. On June 18, 1991, an electrical failure led to a release of 1,500 gallons of solution.

Total copper concentrations in Mineral Creek exceeded the state standard for Agricultural Livestock Watering; dissolved copper exceeded the standard for Aquatic and Wildlife, warm water, acute; and total beryllium exceeded the standard for Fish Consumption.

Type of Release: Overflows, seepage, and leaks

Affected Media: Surface water and ground water

Type of Contamination: Copper and beryllium

Environmental Damage(s): Surface water contamination

Regulatory Action/Response: Citing multiple discharges of copper solution and sludge containing copper to surface water bodies, EPA issued a Finding of Violation and Order to ASARCO on July 1, 1991. The Order required ASARCO to comply with its NPDES permit requirements, take all measures necessary to prevent future unauthorized discharges to Mineral Creek and its tributaries, and submit an engineering plan outlining improvements to ensure compliance with effluent limits. The plan was to address pipeline repairs, modifications, and replacements, equipment installation, construction, operating procedures, and other measures necessary to achieve consistent compliance. Modifications were required by the Order to begin by September 1, 1991, and to be complete by July 1, 1992. EPA also required ASARCO to submit quarterly reports summarizing the progress made. Further, ASARCO was required to limit discharges resulting from 3.05 inches of rain during a 24-hour period so as not to cause violations of Arizona Water Quality Standards or NPDES permit limits. The facility's current NPDES permit allows the discharge of run-off when rainfall exceeds 3.05 inches in 24 hours. Other conditions of the Order imposed on ASARCO included the following:

- Report all unauthorized discharges;
- Report any non-compliance with the terms of the order;
- Tabulate all discharges of pollutants to Mineral Creek and its tributaries, including dates, quantities discharged, description of the pollutants, concentrations, laboratory chemical results;
- Describe all measures taken to achieve compliance with limitations, and the associated capital, operational, and maintenance costs;
- Describe all measures taken to stop discharges of pollutants into Mineral Creek and its tributaries, and the associated capital, operational, and maintenance costs;
- Compile water quality and sediment data collected on Mineral Creek;
- Interpret water quality and sediment data;
- Compare results to Arizona Water Quality Standards; and

- Describe any observed fish kills and degradation of the flora and fauna of Mineral Creek and its tributaries.

On January 7, 1992, ASARCO provided a cost estimate for 46 elements of an engineering plan and program plan for improving and modifying facilities and procedures to ensure compliance with effluent limits. ASARCO estimated that approximately $1.2 million would be required to implement all planned changes which were to be completed by July 1, 1992. These changes included training, replacing many steel fixtures with stainless steel, replacing or upgrading piping, enlarging or constructing secondary containment and berms, and repairing or constructing concrete containment, such as retaining walls, sumps, and diversion boxes. No additional information could be found in the available files that confirmed the final costs of these elements.

References:

ASARCO Technical Services. *Letter from Gambell, N., to R. Clawson, U.S. EPA*. January 7, 1992.

Hyde, P. *Case development memorandum on the ASARCO Ray Complex*. July 1, 1994.

U.S. Environmental Protection Agency. *Letter from Seraydarian, H., to K. Morano, ASARCO Ray Complex*. July 1, 1991.

ASARCO Ray Complex: "Pipeline Breaks Lead to Contamination of Mineral Creek and Stressed Aquatic Life and Wildlife"

Sector(s): Copper

Facility: ASARCO, Inc. Ray Complex, Pinal County, Arizona

Facility Overview: The ASARCO Ray Complex consists of two sites located several miles apart. The complex includes an open pit copper mine, milling operations, a solvent extraction plant, an electrowinning plant, an acid plant, two concentrators, a water treatment plant, numerous impoundments, and a smelter.

Data Sources: State files

Agency Contact: Kimberly MacEachern, Water Quality Division, ADEQ; Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: ASARCO Incorporated's Ray Complex is located in Pinal County, Arizona. The complex encompasses two sites separated by several miles. ASARCO's open pit copper mine is located at the northern site, known as the Ray Unit. The Ray Mine consists of four pits, the Pearl Handle, Amanda, Calumet, and West pits, with the Pearl Handle being the largest. ASARCO mines approximately 300,000 tons of ore per day at the mine. Milling operations, solvent extraction, electrowinning, ore concentrating, and water treatment also occur at the Ray Unit. The Ray concentrator processes ore and produces tailings and wastewater that are transported to a tailings impoundment. The Ray concentrator crushes and processes approximately 32,000 tons of sulfide ore daily and produces 180 tons of copper concentrate per day. Approximately 7,000 tons per day of low grade silicate ore plus lower grade sulfide ore is dump leached. Pregnant leach solution (PLS) is collected in ponds located in the washes below the leach dumps. The electrowinning plant produces about 90 tons of copper cathode per day. Approximately 15,000 tons of sulfide ore daily is sent from the Ray Unit via railcar to the ASARCO Complex site in Hayden, which also is the location of ASARCO's smelter. The Hayden concentrator produces 80 tons of copper concentrate per day.

The Ray Unit is drained by Mineral Creek, which is a perennial stream most years. The creek joins the Gila River several miles south of the Ray Unit. Arizona's designated beneficial uses of Mineral Creek are Warm Water Fishery, Full Body Contact, Fish Consumption, and Agricultural Livestock Watering. Of these, the most protective uses, which are those with the most stringent water quality standards, are Fish Consumption and Warm Water Fishery. Water quality standards for the latter use category include provisions for protection from acute and chronic toxic effects. The Agricultural Livestock Watering water quality standard for copper is 0.5 mg/l. Arizona's Department of Game and Fish has stated that the protection of native fish populations in the creek, including the threatened Colorado Roundtail Chub, is essential.

On March 30, 1995, ASARCO noted a low pH reading in Mineral Creek. Upon investigation, ASARCO discovered that a 30-inch gravity flow transite pipeline was leaking. The next day, an HPDE line to the Ray concentrator came apart at the flanged end and released approximately 150,000 gallons of fresh water.

Type of Impact/Media Affected: In response to the pipeline leak, ASARCO constructed an emergency pond and a pumpback sump to contain the release. The sump/pumpback was able to successfully contain the discharge. ASARCO estimated that the pipeline had discharged to the creek for approximately 3.5 hours and that a total of 21,000 gallons of solution had reached Mineral Creek and the Gila River, with an estimated 1,033 pounds of copper sulfate released to Mineral Creek.

On the following day, some of the water from the broken HDPE line flowed through the storm drain system and eventually overcame the sump/pumpback system put in place the previous day. Because the pumpback still contained leach solution at the time of the second pipeline failure, it caused approximately 900 gallons of water with a pH of 2.96 and a copper concentration of 90 mg/l to discharge to Mineral Creek. That discharge caused a visible plume of sediment in the water. ASARCO diverted the creek on an emergency basis in order to prevent the spread of any additional contamination associated with the plume. About seven hours after diverting the creek and following the completion of pipeline repairs, ASARCO returned the creek to its normal channel. ASARCO verbally notified both the Arizona Department of Environmental Quality (ADEQ) and EPA within 24 hours of each release.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Low pH and copper

Environmental Damage(s): Short term stresses on aquatic life and wildlife downstream of the discharge, long term stress suspected but not yet documented

Regulatory Action/Response: Approximately seven weeks after receiving written notification of the incidents by ASARCO, ADEQ informed ASARCO in writing that the emergency pond ASARCO had constructed to contain the release was an unpermitted facility. ADEQ advised ASARCO that either a temporary emergency waiver (TEW) request or an Aquifer Protection Permit (APP) was required for this new facility. ASARCO responded two weeks later in writing, assuring ADEQ that the intent in constructing the sump was to protect the environment by stopping a discharge in the shortest time possible. ASARCO pointed out that the sump was in existence for 24 hours only, and as such, should be considered a minor modification to the overall operations of the Ray Mine. ASARCO stated that the sump did not result in a significant change in the volume or characteristic of the pollutants discharged to the aquifer. ASARCO also pointed out that there was little benefit in requesting a TEW for a sump two months after the incident and requested that ADEQ forego requesting ASARCO to seek a TEW.

ADEQ responded to ASARCO's request in writing three months later. At that time, ADEQ advised ASARCO that the release had been determined to be a technical issue because it was specifically related to the design and/or operation and maintenance of the pipeline. As such, ADEQ had determined that the incident did not qualify for a TEW and was instead a violation of State law requiring an APP. ADEQ further stated that it is required to issue a Notice of Violation (NOV) whenever it becomes aware of a violation.

On December 9, 1995, ADEQ issued an NOV to ASARCO. The NOV stated that the calculated copper concentration in Mineral Creek during the March 30 incident was 49.5 mg/l, which is 100 times the surface water quality standard for Agricultural Livestock Watering of 0.5 mg/l. ADEQ also stated that the pH standard had, in all likelihood, also been violated because it was low enough to have prompted a search for a leak. Thus, the discharge had caused at least two violations of water quality standards and stressed the aquatic life and wildlife downstream of the mine.

As a corrective action, ADEQ required ASARCO to submit a written description of the options considered to minimize exposure from the 30-inch gravity flow line. ADEQ also stipulated that ASARCO should describe the final action taken within 60 days of the NOV. An emergency action plan also was required so that ADEQ could be assured that a comprehensive and adequate response to these unforeseen discharges would occur in the event of any future breaks from this and similar pipelines.

ASARCO responded to the NOV on February 29, 1996, by reviewing the design, construction, and maintenance of the pipeline and submitting an emergency action plan. ASARCO decided to replace the pipeline with HDPE. The replacement was completed on September 18, 1995, three months before ADEQ had issued the December 19 NOV. The reported cost of the replacement with the new 31-inch line was

$841,000. The new line has no couplings and has a 2.5 inch wall thickness, providing greater strength. ASARCO believes that the new line qualifies for an APP exemption. ADEQ agreed that an exemption should be granted and commended ASARCO on its quick and effective response as well as the substantial improvement of replacing the older pipeline.

References:

Arizona Department of Environmental Quality. *Letter from Hyde, P., to N. Gambell, ASARCO*. September 8, 1995.

Arizona Department of Environmental Quality. *Letter from Hyde, P., to T. Scartaccini, ASARCO Ray Complex*. December 19, 1995.

Arizona Department of Environmental Quality. *Letter from Hyde, P., to N. Gambell, ASARCO Ray Mine Technical Services*. March 6, 1996.

Arizona Department of Environmental Quality. *Letter from Wood, M., to T. Scartaccini, ASARCO Ray Complex.* May 24, 1995.

ASARCO Technical Services. *Letter from Gambell, N., to P. Hyde, ADEQ*. February 29, 1996.

ASARCO Ray Complex. *Letter from Scartaccini, T., to U.S. EPA*. April 4, 1995.

ASARCO Ray Complex. *Letter from Scartaccini, T., to P. Hyde, ADEQ*. June 8, 1995.

Fennemore Craig. *Letter from Johnson, J., to G. Hess, U.S. EPA*. June 19, 1995.

Hyde, P. *Case development memorandum on the ASARCO Ray Complex*. July 1, 1994.

Hyde, P. *ADEQ Memorandum on ASARCO Hayden tailings spill of January 1993 and the extent of tailings downstream along the Gila River*. February 6, 1995.

Hyde, P. *ADEQ Memorandum on Mineral Creek Water Quality at the ASARCO Ray Mine on April 1-5, 1996*. July 1, 1996.

U.S. Environmental Protection Agency. *Letter from Greenberg, K., to T. Scartaccini, ASARCO Ray Complex*. April 21, 1995.

Phelps Dodge New Cornelia Branch Facility: "Soil Contamination Results from Improper Disposal of Scrap Metals"

Sector(s): Copper

Facility: Phelps Dodge New Cornelia Branch Facility, Ajo, Pima County, Arizona

Facility Overview: A facility description was not available at the time of file review.

Data Sources: State files

Agency Contact: Patrick Kuefler, Hazardous Waste Compliance Unit, ADEQ

Waste and Material Management Practices: The Phelps Dodge New Cornelia Branch Facility is a copper mine in the vicinity of Ajo, Arizona, approximately 130 miles west of Tucson. At the time of the file search, no documentation was available in the files reviewed providing a general description of the mine or summarizing the facility's processes and waste management activities. The files did contain information on compliance inspections and subsequent correspondence.

On May 23, 1994, the Sheriffs Department investigated a complaint about smoke arising from the Phelps Dodge Slag Pile. Officers observed two piles of burning wire. Phelps Dodge had an independent contractor that performed various salvage activities, such as recycling and disposing of scrap metal, including insulated copper wire. On June 22, 1994, at the request of the County Attorneys Office and the Sheriffs Department, Arizona Department of Environmental Quality (ADEQ) staff conducted a hazardous waste inspection at the Phelps Dodge Slag Pile. Samples from the burn areas indicated soil contamination with cadmium, chromium, and lead.

Type of Impact/Media Affected: ADEQ collected nine soil samples from the burn areas, all from within six inches of the surface. Three contaminants of concern were identified; cadmium, chromium, and lead. Six of the samples collected demonstrated levels of Toxicity Characteristic Leaching Procedure (TCLP) lead over the regulatory limit, and one sample demonstrated levels of TCLP cadmium over the regulatory limit. Based on the analyses conducted, ADEQ determined that there was reason to believe that the slag pile itself was contaminated from the open burning and open dumping of insulated copper wire.

Type of Release: Ash and fugitive emissions

Affected Media: Soil and air

Type of Contamination: Cadmium, copper, and lead

Environmental Damage(s): Soil contamination

Regulatory Action/Response: On May 12, 1995, ADEQ issued a Notice of Violation (NOV) to the independent contractor working for Phelps Dodge. The NOV required (1) all contaminated soil and ash from the site be placed into closed, labeled drums that are in good condition; (2) a hazardous waste contractor remove the contaminated soil to a licensed TSD facility; (3) TCLP testing by a certified laboratory be conducted for metals; (4) test results be provided to ADEQ; (5) MSDS sheets for any pyro-accelerants be provided to ADEQ; and (6) use of all equipment used in copper-wire burning be discontinued.

Although Phelps Dodge reportedly did not approve of the copper wire burning at the site, the company agreed to address the residual impacts of the burning. ADEQ granted Phelps Dodge a 30-day extension until July 17, 1995, to file a response. Field screening was performed by an environmental contractor to determine the amount of material to be excavated. The excavated materials were treated as hazardous waste and were stored in containers before being shipped to the Chemical Waste Management

Facility in Kettleman Hills, California. Phelps Dodge subsequently took confirmatory samples of the excavated areas to ensure that the residual levels of cadmium, chromium, and lead did not exceed the state's non-residential health based guidance level (HBGL) for each contaminant. On October 25, 1995, Phelps Dodge submitted a Voluntary Environmental Mitigation Use Restriction (VEMUR) because the soil remediation levels achieved were not considered by the state to be protective of residential use. The non-residential HBGLs for cadmium, chromium, and lead are 244, 5,950, and 1,400 mg/kg, respectively. A VEMUR may be canceled where soil remediation standards achieve levels protective of residential use.

Phelps Dodge determined that there was no likelihood that ground water could be impacted due to the absence of ground water in the area. The nearest ground water drinking wells are five miles from the site. Phelps Dodge pumps ground water from a depth of 800 feet from a well field six miles north of the site.

References:

Arizona Department of Environmental Quality. *Letter from Anderson, D., to Arnold Harraway*. May 22, 1995.

Arizona Department of Environmental Quality. *Letter from Kuefler, P., to John Zamar, Phelps Dodge*. August 8, 1995.

Arizona Department of Environmental Quality. *Letter from Kuefler, P., to John Zamar, Phelps Dodge*. October 17, 1995.

Arizona Department of Environmental Quality. *Letter from Kuefler, P., to John Zamar, Phelps Dodge*. November 16, 1995.

Arizona Department of Environmental Quality. *Letter from Kuefler, P., to John Zamar, Phelps Dodge*. December 15, 1995.

Phelps Dodge. *Letter from Zamar, J., to Lupe Buys, ADEQ*. July 17, 1995.

Phelps Dodge. *Letter from Zamar, J., to Lupe Buys, ADEQ*. September 18,1995.

Phelps Dodge. *Letter from Zamar, J., to Patrick Kuefler, ADEQ*. October 25, 1995.

Phelps Dodge. *Letter from Zamar, J., to Patrick Kuefler, ADEQ*. December 5, 1995.

BHP Copper, Inc. San Manuel Facility: "Heavy Metals Contaminate Soil at Five Locations"

Sector(s): Copper

Facility: BHP Copper, Inc., San Manuel, Pinal County, Arizona

Facility Overview: This facility includes a copper mine with an acid plant, a smelter, and a tank house.

Data Sources: State files

Agency Contact: Patrick Kuefler, Hazardous Waste Compliance Unit, ADEQ

Waste and Material Management Practices: This facility includes a large copper mine located in southeastern Arizona, near the town of San Manuel, in Pinal County. The facility was recently purchased from Magma Copper Company by BHP Copper, Inc. At the time of the file search, documentation describing the facility's history, processes, and waste management practices was missing from the available files. The files did contain information on the general objectives, rationales, and procedures for specific remedial action programs at the facility which were initiated as part of a required hazardous waste generator cleanup. A description of the practices that led to the contamination of soils with heavy metals was not present in the files.

Type of Impact/Media Affected: Past unspecified practices at several areas in BHP's San Manuel facility have resulted in soil heavily contaminated with metals. To date, soil in the vicinity of at least five areas of the facility has been documented as exhibiting the characteristics of a RCRA hazardous waste for at least one heavy metal. The most severe contamination of soil was documented by analysis of samples collected on August 23, 1996, near the smelter waste bunker. Maximum total metals concentrations for three metals that exceeded the regulatory threshold for characteristic hazardous waste found in soil excavated from the smelter bunker were as follows: cadmium (120 mg/kg), lead (60,000 mg/kg), and selenium (18,000 mg/kg). Soil and debris at the tank house were contaminated with lead and selenium above the regulatory threshold for characteristic hazardous waste. Soil at the acid plant also was heavily contaminated with both cadmium and lead above the regulatory threshold for characteristic hazardous waste. Soil at the truck stop has been found to be heavily contaminated with cadmium above the regulatory threshold for characteristic hazardous waste. Lead contamination has occurred in soil in the vicinity of the paint shop. The regulatory threshold (RT) for cadmium and selenium is 1 mg/l, while the RT for lead is 5 mg/l.

Type of Release: Not available

Affected Media: Soil

Type of Contamination: Cadmium, lead, and selenium

Environmental Damage(s): Soil contamination

Regulatory Action/Response: The specific circumstances that led BHP to undertake remediation projects at the five sites identified above was not clear from state files available for review. On September 16, 1994, Arizona Department of Environmental Quality (ADEQ) and Magma Copper Company entered into a Consent Order to address the temporary storage of hazardous waste at the San Manuel facility. No information was present in the files concerning any other regulatory action initiated by EPA Region 9 or ADEQ. On September 13, 1996, BHP's contractor proposed a method to stabilize the D006, D008, and D0010 contaminated soils on-site to comply with appropriate Land Disposal Restriction (LDR) standards. The estimated quantities of excavated soils to be stabilized at four of the sites are as follows:

- Smelter bunker: 300 tons

- Acid plant: 170 tons
- Truck shop: 80 tons
- Paint shop: 30 tons

The precise technology that will be used to stabilize the estimated 300 tons of soil excavated from the smelter bunker had not been determined at the time of the file search. The stabilization method to be used on the soils excavated from the remaining four sites had been determined; BHP's contractor plans to use a five to ten percent Portland cement recipe. Once non-hazardous levels of leachable metals have been achieved for each of the five waste soils, BHP plans to dispose of the stabilized waste in a RCRA Subtitle D landfill facility. Any debris that will not pass through a six-inch screen prior to stabilization procedures will be disposed of at a licensed hazardous waste facility if the debris is found to contain leachable metal concentrations above TCLP criteria. The estimated costs of these remediation activities was not available.

References:

ADEQ, Hazardous Waste Compliance Unit. *Letter from Kuefler, P., to J. McCain, Magma Copper Co*. April 20, 1995.

Zenitech Corporation. *"Waste Analysis Plan for On-Site Stabilization of the Tank House Waste Pile."* November 21, 1994.

Zenitech Corporation. *"Waste Analysis Plan for On-Site Stabilization of Metals Contaminated Soil."* May 6, 1996.

Zenitech Corporation. *"Waste Analysis Plan for On-Site Stabilization of Metals Contaminated Soil."* September 13, 1996.

Cyprus Copperstone Gold Corporation: "Disposal of Non-Mine Related Waste Materials in Mine Tailings Piles"

Sector(s): Precious metals

Facility: Cyprus Copperstone Gold Corporation, La Paz County, Arizona

Facility Overview: The Cyprus Copperstone Gold Corporation precious metals mine includes a cyanide heap leaching operation which began in 1987.

Data Sources: State files

Agency Contact: Patrick Kuefler, Hazardous Waste Compliance Unit, ADEQ

Waste and Material Management Practices: The Cyprus Copperstone Gold Mine is a precious metals mine located in La Paz County, approximately 120 miles west of Phoenix. The Bureau of Land Management (BLM) owns the land the mine is on, and Cyprus Copperstone Gold Corporation (CCGC) owns the operating permit for extracting precious metals.

CCGC contracts out its heavy equipment operations to Morrison-Knudsen (MK). MK subcontracts its waste oil disposal to All Western Oil (AWO). CCGC contracted with AWO to dispose of waste oil in both 1990 (6,300 gallons) and 1991 (33,410 gallons). Information obtained during an Arizona Department of Environmental Quality (ADEQ) inspection of the facility conducted on August 28, 1992, disclosed that approximately 30 drums buried in the "hoosier piles" located on site contained waste oil that was possibly contaminated with trichloroethylene (TCE) levels above the Maximum Contaminant Level (MCL). The drums were placed in over-pack containers and buried with approximately four feet of alluvial cover.

CCGC also had disposed of used tires for several years by burying them in waste piles located on-site. The facility also stacked empty drums of sodium cyanide near the front of the facility before disposing of them in the tailings pile located on-site.

Type of Impact/Media Affected: Because the situation was corrected when the state's regulatory agency became aware of it, no effects on the environment could be documented.

Type of Release: Improper hazardous and solid waste disposal

Affected Media: Soil

Type of Contamination: Trichloroethylene

Environmental Damage(s): None

Regulatory Action/Response: Following the site inspection in August 1992, ADEQ's Office of Waste Programs, Hazardous Waste Inspections Unit issued "Instructions to Responsible Parties" on January 26, 1993. Although not a formal Administrative Order, the Instructions included specific steps that CCGC was expected to follow to make corrections:

- Properly handle, clean up, and dispose of waste oil;
- Control, contain, clean up, and dispose of properly emptied cyanide drums and used tires;
- Perform hazardous waste determinations for all wastes generated; and

C Excavate, sample, and determine if the waste oil is hazardous.

In response to the Instructions, CCGC notified ADEQ that the TCE content of the waste oil was less than 180 parts per billion (ppb), which is well below the 500 ppb leachability limit under the TCLP test. CCGC agreed to voluntarily excavate the drums and dispose of them at an appropriate off-site facility. CCGC maintained that used mine truck tires generated at the site have not been buried since 1990. Further, CCGC maintained that the past practice of burying on-site cleaned, empty drums qualified as disposal of inert solid waste material produced in connection with mining operations. Although they are shipped off-site, CCGC believes that Arizona solid waste facility provisions exempt the on-site disposal of inert solid waste material produced in connection with mining operations. As such, CCGC's position is that the practice was exempted from Arizona solid waste facility provisions. That disposal practice ceased in 1991.

Following ADEQ's receipt of a written status report defining the measures that CCGC took to correct the violations and a submittal containing a certificate of disposal and manifest for the 30 drums of waste oil, ADEQ determined that no additional action was required. As of November 1996, no information present in state files available for review indicated that any further actions had been taken against CCGC. Follow-up phone calls may help ascertain this type of information.

References:

Arizona Department of Environmental Quality, Hazardous Waste Inspections Unit. *Letter from Anderson, D., to G. Burns, Cyprus Copperstone Gold Corp.* January 26, 1993.

Arizona Department of Environmental Quality, Office of Waste Programs, Waste Compliance Unit. *Letter from Camp, S., to G. Burns, Cyprus Copperstone Gold Corp.* July 22, 1993.

Cyprus Copperstone Gold Corp. *Letter from Burns, G., to P. Nixon.* March 9, 1993.

Cyprus Sierrita Corporation: "Leaks and Seepage Affect Ground Water and Two Nearby Washes"

Sector(s): Copper

Facility: Cyprus Sierrita Corp., Pima County, Arizona

Facility Overview: At this site, Cyprus Sierrita Corp. operates two open pit copper mines, two mills for ore crushing, a tailings pond, a leach dump operation, a solvent extraction facility, and an electrowinnning facility.

Data Sources: State files

Agency Contact: Cathy O'Connell, Water Quality Enforcement Team, ADEQ

Waste and Material Management Practices: Cyprus Sierrita owns and operates an open pit copper mine in southern Arizona, in Pima County, near the town of Green Valley. The facility includes two open pit copper mines known as the Sierrita and Esperanza pits. Higher grade ore is crushed and concentrated in one of two mills located at the mine. The concentrate is then shipped off-site for smelting. The concentration process produces a concentrated waste slurry that is disposed of in a tailings pond. Lower grade ore is processed through a leach dump operation in which the ore is dumped in a massive pile and leached with a mixture of water and sulfuric acid. Copper is extracted from these solutions through a solvent extraction and electrowinning process. The process water used in these operations is channeled to holding facilities and eventually recycled and reused.

From the summer of 1992 until December 1994, Cyprus Sierrita discharged contaminated process water and storm water run-off to Demetrie Wash and its tributaries from various overflows, seepages, and pipeline leaks and breaks.

Type of Impact/Media Affected: During the summer of 1992, as a result of storm water run-off, Cyprus Sierrita discharged into the principal wash draining the site, Demetrie Wash, an unknown quantity of contaminated sediment. The sediment originated from a pile of dredged material that had been removed from the bottom of a surface impoundment known as Pond C. Pond C received storm water and washwater run-off from crusher and concentrator areas. Sediment discharged from the pile accumulated behind a dam in the wash known as the Caterpillar Road Dam. On August 4, the dam overflowed and discharged sediment into the wash. Analyses showed the presence of copper and other pollutants. No information was available in the files reviewed that reported the concentrations of pollutants based on the sediment samples, with the exception of a maximum concentration of total copper. Based on samples collected in November 1992 and reported by Cyprus Sierrita, levels of total copper ranged from less than 1.0 mg/l to 4.6 mg/l.

From August or September 1992 into January 1993, Cyprus Sierrita discharged contaminated water to the wash. The apparently continuous discharge originated from an underground seepage believed to be derived from two surface impoundments. The impoundments contained a mixture of process-related water, mill site washdown water, and storm water. Cyprus attributed the surfacing of the discharge to heavy rainfall events during August 1992 and the erosion of alluvial material from the side of a canal that crosses the wash. The seepage was intercepted first by a stream known as Amargosa Wash. The gravel bed in that stream provided a conduit for the contaminated flow to reach Demetrie Wash.

On January 24 and 25, 1993, a leak in a pipeline transporting process water discharged approximately 200,000 gallons of a mixture of process wastewater and storm water run-off to an unnamed

tributary of Demetrie Wash. Again, in July 1993, Cyprus Sierrita discharged approximately 2,700,000 gallons into the same wash as a result of another pipeline break. Approximately 450,000 gallons were released to the wash in October 1993 by a broken pipeline. Several months later, in March 1994, another pipeline break allowed a discharge into Demetrie Wash of approximately 120,000 gallons. In December 1994, approximately 5,000 gallons were released as a result of a pipeline break. Each release involved contaminated water derived from a mixture of tailings reclaim water and ground water pumped from an interceptor well.

Type of Release: Seepage, discharges, overflows, and pipeline breaks

Affected Media: Ground water and surface water

Type of Contamination: Heavy metals

Regulatory Action/Response: On November 6, 1992, EPA issued a letter to Cyprus Sierrita requesting information on operation and maintenance activities of Pond C and the adjacent dam, a chemical and physical description of Pond C dam material, and cost estimates and a schedule for removing the material discharged from Pond C to Demetrie Wash. EPA issued a Finding of Violation and Order for Compliance to Cyprus Sierrita on March 16, 1993. The Order required Cyprus Sierrita to cease all unauthorized discharges of pollutants; monitor, interpret, and report to EPA weekly on concentrations of arsenic, cadmium, chromium, dissolved copper, lead, manganese, mercury, selenium, silver, zinc, hardness, sulfates, and total suspended solids; confirm the source and cause of the discharges surfacing in Demetrie Wash; describe the work completed to cease the discharges; provide a detailed cost breakdown for the work required to stop the discharges; and prevent any future unauthorized discharges of pollutants.

Cyprus Sierrita has reportedly undertaken extensive work to remove the accumulated material from near Pond C and the area of the tributary. The work was completed in December 1992. The facility also constructed a catchment basin to retain solids in the event of rainfall during the removal period. In January 1993, Cyprus Sierrita reported to EPA that the costs associated with the removal of the material were approximately $78,400. The mine-related materials that had accumulated in the wash were removed by the end of April 1993. Costs for that removal activity could not be determined during the file search and appear not to have been reported yet by Cyprus Sierrita. The mine's management maintains that "it is impossible to provide a breakdown of the portion of the total costs attributable to discharge prevention" because the costs are not accounted for separately. As an example, mine managers claim that only a small portion of the costs of collecting and processing leach solutions for the recovery of copper can be attributed solely to prevention of discharges.

Cyprus Sierrita also reported acting on several fronts to control the discharge of ground water that surfaced in Demetrie Wash in August and September 1992. Short term corrective actions involved studying conductivity to determine the discharge's origin, excavating a series of trenches, and operating pumps in the trenches. The longer term efforts included a ground water investigation, the lining of the canal, the construction of trenches in an attempt to intercept any subsurface flows towards the wash, a geotechnical investigation, and construction of a hydraulic barrier. Although the facility apparently did provide EPA with the expenditures for complying with this item of the order, those costs were not present in the files reviewed.

On March 25, 1996, the U.S. Department of Justice issued a civil claim against Cyprus Sierrita on behalf of the State of Arizona and the United States pursuant to the Clean Water Act. Cyprus Sierrita entered into a binding Consent Decree to pay a total civil penalty of $88,000. No further information concerning the decree was present in the available files at the time of file review.

References:

Cyprus Sierrita Corp. *Letter from Scott, R.J., to U.S. EPA*. April 19, 1993.

Cyprus Sierrita Corp. *Letter from Shinn, M., to U.S. EPA*. January 13, 1993.

U.S. Department of Justice. *Consent Decree Among the United States, the State of Arizona, and Cyprus Sierrita Corp*. March 25, 1996.

U.S. Department of Justice. *The State of Arizona, Complaint and Civil Action vs. Cyprus Sierrita Corp.* March 25, 1996.

U.S. Environmental Protection Agency. *Letter from Serayadarian, H., to Cyprus Sierrita Corp*. March 16, 1993.

Associated Minerals (USA), Inc.: "Turbid Discharge Enters Nearby Creek"

Sector(s): Ilmenite, rutile, leucoxene, zircon, and monazite

Facility: Associated Minerals (USA), Inc., Green Cove Springs, Clay County, Florida

Facility Overview: Associated Minerals (USA), Inc. is now called RGC (USA) Mineral Sands, Inc. The facility occupies a 12,000 acre site used to mine and process ilmenite, rutile, leucoxene, zircon, and monazite to produce titanium dioxide, refractory bricks, and polishing agents.

Data Source(s): State files

Agency Contact: Vincent Seibold, Industrial Wastewater Section, Northeast District, FDEP

Waste and Material Management Practices: Because this incident occurred while the facility was owned by Associated Minerals, Inc., the practices used by them are described. Following bulldozer clearing operations, the minerals are mined using a floating dredge and processing barge. A centrifuge is used to separate the heavy minerals from the soil fraction. High volume waste materials that are generated during the mining process consist of four percent humus and 96 percent tailings (quartz sands). These materials are deposited behind the excavator in the mining pond and are allowed to dry, after which they undergo reclamation. Reclamation involves replacing the topsoil and reforesting with pine trees. Mining wastewater from the dredging and separation operations are heavily laden with dissolved and suspended solids. The wastewater treatment system at the facility consists of flocculation with alum and/or sulfuric acid before the treated effluent is released to a series of settling ponds on 180 acres. The effluent from the ponds is neutralized with caustic and discharged through a Parshall flume to a ditch which flows to Clark's Creek.

On March 9, 1990, an earthen dam in front of two steel culverts was removed and not replaced during reclamation operations. From March 10 to 11, 1990, a rainfall event caused a washout of the reclamation soils. The washout reached Terrel Creek and Greens Creek.

On August 27, 1990, an unpermitted discharge from the facility mining area reclamation activities to a tributary of Green's Creek occurred, following a rainfall event.

Type of Impact/Media Affected: Terrel Creek is a tributary to Greens Creek, which is classified as a Class III water in Florida. Class III waters are to be used for recreation and for the propagation and maintenance of healthy, well-balanced populations of fish and wildlife (Ch. 17-3.161, FAC). The washout affected Terrel Creek, according to Saint Johns Water District Officials. The nature of the impact (e.g., siltation), however, was not documented in the Compliance Evaluation Inspection or in the Performance Audit Inspection.

The turbidity of the discharge from the mining area to the tributary of Greens Creek on August 27, 1990, was 204.0 Nephelometric Turbidity Units (NTUs). The turbidity on August 30, 1990, was 140 NTUs, at which time Florida Department of Environmental Regulation (FDER) investigators noted that the tributary was being affected by the turbidity. The discharge violated State surface water quality criteria (Rule 17-302.510(3)(r)) prohibiting a discharge which elevates the receiving waters to greater than 29 NTUs over background levels. The background level of the receiving waters was not noted in the documents addressing this release. The discharge also violated three Consent Orders, OGC Case No.'s IW-003-81-SJRS, 82-0205, and 86-0130 from March 4, 1981, April 1, 1982, and July 18, 1988, respectively.

Type of Release: Wastewater and reclamation soil washout

Affected Media: Surface water

Type of Contamination: High turbidity

Environmental Damage(s): Siltation

Location of Affected Populations: Terrel Creek (a tributary of Greens Creek) and Greens Creek (a tributary to South Fork Black Creek)

Regulatory Action/Response: The March 1990 violation was noted in U.S. EPA Region IV's August 1990 Compliance Evaluation Inspection which required a response from the facility describing any actions taken to remedy the situation. Facility personnel diked the area in front of the culverts and installed a sump pump to drain the area. The culverts were capped several weeks later.

A Warning Notice was issued in response to the August 1990 discharge by FDER and was sent on September 7, 1990. A Consent Order was drafted requiring the facility to take the necessary steps to prevent further violations of State water quality standards (e.g., treatment prior to release, preventing the release of turbid waters). In addition, the facility was required to submit a feasibility study identifying methods to prevent any future unpermitted discharges to waters of the State. The elevation of a perimeter road at the site was raised to halt the flow of the discharge to the creek.

References:

Florida Department of Environmental Regulation, Office of the Northeast District. *State of Florida Department of Environmental Protection, Complainant, vs. Associated Minerals (USA), Inc., Respondent, Consent Order - 1st Draft, OGC Case No. 90-1753*.

Florida Department of Environmental Regulation. *Interoffice Memorandum from Jay Carver to Files*. January 13, 1982.

Florida Department of Environmental Regulation. *Interoffice Memorandum from Jay Carver to Mary Jean O'Neil, with attached Performance Audit Inspection Report*. January 21, 1985.

U.S. Environmental Protection Agency Region IV, Water Compliance Unit, Environmental Compliance Branch. *Letter from Ronald L. Barrow to Steve Gilman, Associated Minerals (USA) Inc., with attached Compliance Evaluation Inspection*. November 5, 1990.

Bartow Phosphate Complex: "Ground Water Contaminated at CF Complex"

Sector(s): Phosphoric acid

Facility: Bartow Phosphate Complex, CF Industries, Inc., Bartow, Polk County, Florida

Facility Overview: The Bartow Complex is a phosphate fertilizer and related product facility. It includes sulfuric acid, phosphoric acid, and diammonium phosphate (DAP) plants.

Data Source(s): State files

Agency Contact: Sam Zamani, Phosphogypsum Management Program, FDEP

Waste and Material Management Practices: The Bartow facility gypsum stack receives phosphogypsum in slurry form, a waste from the phosphoric acid production process. The slurry is pumped to impoundments located on top of the stack, where the gypsum is allowed to settle. The liquid is either directly removed from the settling pond and sent to a cooling pond or collected in seepage ditches that circumscribe the gypsum stack. In 1993, portions of the gypsum stack were as high as 120 feet.

The Bartow Chemical Complex is underlain by three aquifers: (1) the surficial aquifer system which underlies essentially all of Polk County and is utilized primarily for domestic and low volume irrigation uses; (2) the intermediate aquifer system which is semi-confined to confined throughout most of Polk County and is used mainly for low-volume irrigation wells; and (3) the Floridan aquifer which is generally 1,000 feet thick and can be found starting at depths of approximately 200 feet. The Floridan is the major source of potable water in Polk County and central Florida.

Ground water quality data collected from a monitor well located near the facility boundary in August 1984 showed exceedances in the surficial aquifer over state limits for eight constituents.

Type of Impact/Media Affected: The exceedances in the surficial aquifer of State limits were for the following constituents (Florida standards are shown in parentheses): arsenic, 1.1 mg/l (0.05 mg/l); cadmium, 0.024 mg/l (0.01 mg/l); chromium, 1.7 mg/l (0.05 mg/l); sodium, 2,090 mg/l (160 mg/l); fluoride, 4,780 mg/l (1.4-2.4 mg/l); gross alpha, 5,830 pCi/l (15 pCi/l); radium 226/228, 7.5 pCi/l (5 pCi/l). Ground water samples collected quarterly between 1989 and 1990 showed similar values. Maximum concentrations observed in these samples were as high as 1.8 mg/l of arsenic, 0.38 mg/l of cadmium, 3.0 mg/l of chromium, 0.15 mg/l of lead, 2,530 mg/l of sodium, 4,960 mg/l of fluoride, 6240+/-500 pCi/l of gross alpha, and 18+/-1.7pCi/l of radium 226/228.

As part of a monitoring program implemented to assess contamination, water quality data collected between 1992 and 1996 at wells located approximately 1,750 feet from the gypsum stack toe and 1,250 feet from the gypsum management system toe have shown ground water impacts. For example, well SW-11 in March 1996 showed a pH of 5.17, sodium at 698 mg/l, sulfate at 2,950 mg/l (The Florida Department of Environmental Protection (FDEP) secondary drinking water standard is 250 mg/l), gross alpha at 62.0+/-21 pCi/l, and radium 226/228 at 9.6 pCi/l.

Type of Release: Seepage from gypsum stack

Affected Media: Ground water

Type of Contamination: Arsenic, cadmium, chromium, sodium, fluoride, gross alpha, radium 226/228, lead, and sulfate

Regulatory Action/Response: FDEP issued a warning Notice in July 1985. CF Industries submitted a request for an extension of its Zone of Discharge in January 1987. The zone of discharge is defined in state regulations as the volume underlying or surrounding the

phosphogypsum stack or cooling pond, and extending to the base of a specifically designated aquifer within which an opportunity for the treatment, mixture, or dispersion of wastes into receiving ground water is afforded. FDEP denied the extension request in March 1990. A Consent Order was executed in July 1991. As part of the conditions of the Consent Order, CF Industries agreed to pay the sum of $44,800 to the FDEP Pollution Recovery Fund in settlement. CF Industries also agreed to install a slurry wall along the north property line as an interim remedial measure. Finally, CF Industries agreed to take corrective actions to mitigate the ground water impacts.

As part of the mitigation action plan, CF Industries presented a Contamination Assessment Plan which was approved by FDEP in July 1992, a Quality Assurance Project Plan which was approved in December 1992, and a Contamination Assessment Report which was approved in June 1995. The Consent Order was amended in November 1995 to allow for alternative options to the slurry wall. One such proposal included capping of the northern section of the gypsum stack, following the criteria established in 17-673, FAC, a run-off management system, and an east-west trending cut-off ditch to isolate the northern section from the rest of the stack. The goal of these measures was to reduce the source of contamination.

In October 1995, CF Industries presented a Feasibility Study in which a monitoring-only plan was proposed for the area beyond the facility's zone of discharge. Additional ground water and surface water data from the Skinned Sapling Creek, a Class III surface water stream, presented in a July 1996 summary report, indicated impacts to ground water but no impacts to surface water.

References:

Ardaman & Associates. *Letter from Rajendra K. Shrestha and Nadim F. Fuleihan to Parker Keen, CF Industries, Re: Amendments to Conceptual Interim Remediation Plan, CF Industries, Inc., Bartow Phosphate Complex, Polk County, Florida*. September 10, 1993.

Ardaman & Associates. *Letter from John P. Bunch and Nadim F. Fuleihan to Craig Kovach, CF Industries, Re: Water Quality Data; Bartow Phosphate Complex*. June 11, 1996.

CF Industries. *Letter from Parker W. Keen to Sam Zamani, FDEP, Re: Summary of Meeting with DEP at CF Industries and Amendment to the Conceptual Interim Remediation Plan*. September 13, 1993.

CF Industries. *Letter from M. Lynne Vadelund to Sam Zamani, FDEP, Re: Modified Interim Remedial Action Plan; Bartow Phosphate Complex (Consent Order 90-1396)*. July 15, 1994.

Florida Department of Environmental Protection. *Consent Order 90-1396. The State of Florida Department of Environmental Regulation v. CF Industries, Inc.* July 19, 1990.

Florida Department of Environmental Protection. *Letter from Nancy Deskins to Parker Ken, CF Industries, Re: Bartow Phosphate Complex, Conceptual Interim Remediation Plan*. July 22, 1993.

Florida Department of Environmental Protection. *Memorandum from Thomas Douglas to Sam Sahebzamani, Southwest District, Re: CF Industries IRAP; Bartow Phosphate Complex Consent Order 90-1396*. September 7, 1993.

Florida Department of Environmental Protection. *Amendment to Consent Order 90-1396. The State of Florida Department of Environmental Regulation v. CF Industries, Inc.* November 2, 1995.

Florida Department of Environmental Protection. *Memorandum from David Clowes to Vishwas Sathe, Re: Feasibility Study (FS), per Consent Order No. 90-1396*. October 27, 1995.

Florida Solite Company: "Contaminated Discharge Enters Marsh and Creek"

Sector(s): Lightweight clay aggregate

Facility: Florida Solite Company, Green Cove Springs, Clay County, Florida

Facility Overview: This facility is currently inactive. Florida Solite company extracted raw clay, slate, shale, sand, dust, and other materials for processing into lightweight aggregate.

Data Source(s): State files

Agency Contact: Ashwin Patel, Hazardous Waste Section, Northeast District, FDEP

Waste and Material Management Practices: Previously, raw clay, slate, shale, sand, dust, and other materials were extracted using a dragline at an on-site mine approximately 3,000 feet from the process area. The materials were transported to the raw feed storage area in dump trucks. In the feeder, the materials were cut into lumps and fed to a conveyor system, which transported them to the kilns. The kilns used hazardous and non-hazardous waste fuel sources. Water sprayers were used with the wet scrubbers on the kilns to cool and condense gases and lightweight aggregate kiln dust (LAKD). The scrubber water was discharged to the Scrubber Pond. After further processing of the clay, the product was stored in piles near the Scrubber Pond and was sprayed with water which flowed to the Scrubber Pond by overland flow. Under high flow conditions, the Scrubber Pond was designed to discharge to an Overflow Pond, a 21-acre surface impoundment that contained storm water, scrubber water, and sediment soils.

In April, June, July, and October 1991, heavy rainfall caused the Overflow Pond to discharge scrubber water, sediment soils, and storm water through the emergency spillway to an adjacent marsh.

Type of Impact/Media Affected: In 1990 sediment samples of the Scrubber Pond, which enters the Overflow Pond, indicated that hazardous constituents, such as lead, PCB-1260, seven extractable organic compounds including napthalene and ethyldimethylbenzene, and five purgeable organic compounds including ethyl benzene and ethylmethylbenzene, were present. The volumes of the discharges are not known, but the elevations of overflows were recorded. The pH following the April 1991 discharge was monitored. However, the data were reported as a range, including a pH from 2.98 to 10.41, without mean or median values. In a 1992 report, ground and surface water contamination were reported as a result of the acidic releases in April. The discharge reached Black Creek. Data on concentrations of constituents in Black Creek and the affected marsh were not documented in the files reviewed. However, the Administrative Order on Consent indicated that the hazardous constituents from the Overflow Pond may have been carried to the marsh.

Type of Release: Process wastewater, sediment, and storm water

Affected Media: Ground water, surface water, and soil

Type of Contamination: Heavy metals and organic compounds

Location of Affected Populations: Nearby marsh and local streams

Regulatory Action/Response: A Warning Notice (No. WN91-0028-IW10-NED) was issued following the April 1991 discharge because Florida Solite was unauthorized to discharge contaminated process water and storm water from the Overflow Pond, and the discharge violated surface water quality standards for pH. In addition, an Administrative Order on Consent was

issued by the U.S. EPA requiring the facility to (1) perform confirmatory sampling to identify and investigate solid waste management units and areas of concern that may have released hazardous wastes, (2) submit to a RCRA Facility Inspection to determine the nature and extent of the releases, (3) conduct a corrective measures study to identify alternatives to prevent, mitigate, or remediate any releases, (4) implement any corrective measures selected by EPA, and (5) implement any other activities to correct or evaluate potential impacts on human health or the environment. The progress of these requirements was not noted in the files reviewed.

References:

Boehnke, D.N. *Cement Kiln Incineration of Hazardous Wastes and the Solite Corporation of Florida*. Jacksonville University. 1992.

Florida Department of Environmental Protection. *Hazardous Waste Inspection Report*. May 29, 1996.

Florida Department of Environmental Regulation. *Warning Notice (No. WN91-0028-IW10-NED)*. June 10, 1991.

Florida Solite Company. *Letter from Tony Saunders to Robert Leech, Florida Department of Environmental Regulation*. May 19, 1991.

U.S. Environmental Protection Agency Region IV. *Administrative Order on Consent (U.S. Environmental Protection Agency Docket No. 95-05-R), In the Matter of Carolina Solite Corporation d/b/a Florida Solite Company*.

Fort Meade Mine:
"Phosphate Pipeline Spills to Peace River Tributary"

Sector(s): Phosphate

Facility: Fort Meade Mine, Cargill Fertilizer, Inc., Polk County, Florida

Facility Overview: This site includes phosphate mining and beneficiation facilities, draglines, phosphate matrix slurry pipelines, and settling areas

Data Source(s): State files

Agency Contact: Vishwas Sathe, Industrial Waste Compliance/Enforcement, FDEP

Waste and Material Management Practices: At the Ft. Meade Mine, draglines remove ore from mining areas and water is added. The slurried phosphate matrix is piped to a washer plant for sizing and testing prior to sending it to the beneficiation plant. Tailings are used for reclamation by pumping them to fill voids left by the mining of phosphate. Tailings also are used for settling pond construction.

On October 8, 1992, a failure of a 16-inch diameter pipeline was detected by an operator. The pipeline was part of a pumping system used to transport phosphate slurry from the active mining operation to the beneficiation facility approximately five miles away. Once detected, the pumping system was shut down and the area inspected for possible spillage. The spillage was reported to be limited to a railroad ditch that parallels the pipeline. The inspector did not notice that the ditch eventually drained to a box culvert and entered a tributary to Peace River, a Class III waterbody. An estimated 100,000 to 200,000 gallons of slurry were released.

Type of Impact/Media Affected: The Florida Department of Environmental Protection (FDEP) personnel took water quality samples on October 8 and 9 at points upstream and downstream of the spill area. Total phosphorous was as high as 9.5 mg/l (compared to background levels of 1.0 mg/l) in areas downstream of the spill. Iron levels at two sampling stations downstream from the spill were 1.28 and 1.09 mg/l, above the State standard of 1.0 mg/l. Gross alpha levels were as high as 72 pCi/l, in violation of the 15 pCi/l State standard. One station showed radium 226/228 levels of 7.3 pCi/l, above the 5 pCi/l standard. Turbidity levels measured by Cargill in the affected tributary, 150 feet upstream of the creek mouth to Peace River, were as high as 410 Nephelometric Turbidity Units (NTU) and dropped to 14 NTU on October 12. The total suspended solids (TSS) level at that station was 477 mg/l on October 8, above the NPDES permit daily maximum of 60 mg/l.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Total phosphorus, iron, gross alpha, radium 226/228, and turbidity

Regulatory Action/Response: Two warning letters were submitted by FDEP on December 23 and 28, 1992. Remedial actions started on October 8 by placing over 200 staked hay bales in various locations across the tributary. On October 10, cleanup activities were initiated, including sediment extraction with hand tools from the banks of the tributary, sediment removal with heavy equipment from the railroad right of way, culvert and road cleanup with water tankers and vacuum trucks, and sand bag placement across the tributary near the mouth of the Peace River to hold back any slurry laden waters in the event of a large rainfall. Over $45,000 was spent in cleanup related activities.

Other initiatives taken at the mine included a pipeline inspection program, installation of emergency stop buttons in the pit control center, and impact release devices upstream of booster pumps to relieve

excess pressure in case of a water hammer. Over $87,000 was spent on these and related initiatives to prevent future incidents of a similar nature.

References:

Cargill Fertilizer. *Draft Environmental Incident Report*, January 12, 1993.

Florida Department of Environmental Protection. *Memorandum from Kathy Hicks to Vishwas Sathe, Industrial Waste Compliance/Enforcement, Re: Cargill Slurry Spill Results; Polk County*. November 24, 1992.

Florida Department of Environmental Regulation. *Warning Letter No. 92-058-DF53SWD*. December 23, 1992.

Florida Department of Environmental Regulation. *Warning Letter No. 92-0041-IW53SWD*. December 28, 1992.

Highland Mine:
"Contaminated Storm Water Enters Tiger Branch Creek"

Sector(s): Titanium dioxide

Facility: Highland Mine, Clay County, Lawtey, Florida

Facility Overview: E.I. DuPont de Nemours and Co., Inc. operates the Highland Mine, which is a heavy mineral sands mine, producing a heavy mineral concentrate. During the process, mining wastewater and contaminated storm water are generated

Data Source(s): State files

Agency Contact: James R. Maher, Northeast District, FDEP

Waste and Material Management Practices: E.I. DuPont de Nemours and Company, Inc. (DuPont) operates a heavy mineral sands mining and mineral processing facility called the Highland Mine. Heavy mineral sands are extracted and processed to produce titanium dioxide, a white pigment. Mining wastewater and contaminated storm water generated at the mine site are treated at the on-site wastewater treatment facility. The treatment process includes acidification with ferric chloride or sulfuric acid for flocculation of colloidal material, settling in a series of 13 sedimentation basins and pH adjustment stations, neutralization with hydrated lime to a pH between 6.0 and 8.5, and additional settling. The treated waters are discharged through a Parshall flume to Boggy Branch, which connects with the North Fork of Black Creek, a navigable water. Both Boggy Branch and the North Fork of Black Creek are Class III Florida waters which are for recreation and propagation and maintenance of a healthy, well-balanced population of fish and wildlife (Ch. 17-3.161, FAC).

Beginning on November 15, 1995, an unreported and unpermitted surface water discharge of partially treated (water had undergone some settling and treatment) storm water occurred due to inadequate berm and swale. Information on the construction, height, or maintenance of the berm and swale was not available in the files reviewed.

Type of Impact/Media Affected: The unpermitted discharge of contaminated storm water to Tiger Branch Creek exceeded State surface water quality standards for pH and turbidity (FAC 62-302.530). Sampling by the Florida Department of Environmental Protection (FDEP) on December 6, 1995, indicated that the pH was 5.6 and the turbidity was 114 Nephelometric Turbidity Units (NTUs). At the reference site, pH was 6.6 and turbidity was 0.8 NTU. In addition, conductivity in Tiger Branch Creek was 47 umhos/cm, versus 35 umhos/cm at the reference site. The flow of the discharge was estimated at approximately 100 gallons per minute (gpm) and was continuous for 11 days.

Type of Release: Contaminated storm water

Affected Media: Surface water

Type of Contamination: High turbidity, low pH, and elevated conductivity

Environmental Damage(s): Turbid and acidic waters

Location of Affected Populations: Tiger Branch Creek

Regulatory Action/Response: A complaint was received by FDEP on December 1, 1995, from an officer of the Florida Game and Fresh Water Fish Commission regarding an observed unpermitted surface water discharge.

A Consent Order was issued requiring DuPont to fill the berm and swale with clean fill and then compact the area to completely eliminate the release of residual contaminated waters. DuPont Highland also was required to prepare a site assessment report to address all outfall structures within the facility and throughout the property. In addition, monthly inspections and

reports of the perimeter and internal discharge structures were required. A settlement payment of $4,100 was made according to the Consent Order.

References:

Florida Department of Environmental Protection. *Interoffice Memorandum from Daniel Hull, Industrial Wastewater Section, to Ernest E. Frey*. December 22, 1995.

Florida Department of Environmental Protection. *Letter from Daniel Hull, Industrial Wastewater Section, to David E. Wright, E.I. DuPont de Nemours & Co., Inc.* December 11, 1995.

Office of the Northeast District. *State of Florida Department of Environmental Protection, Complainant, vs. E.I. DuPont de Nemours & Co., Inc., Respondent. Consent Order. OGC Case No. 95-2905.*

Office of the Northeast District. *State of Florida Department of Environmental Protection, Complainant, vs. E.I. DuPont de Nemours & Co., Inc., Respondent. Notice of Violation and Orders for Corrective Action. OGC Case No. 90-0517.*

Highland Mine: "Release of Turbid Wastewater Results in Siltation and Fish Kill"

Sector(s): Titanium dioxide

Facility: Highland Mine, Clay County, Lawtey, Florida

Facility Overview: E.I. DuPont de Nemours and Co., Inc. operates the Highland Mine, which is a heavy mineral sands mine, producing a heavy mineral concentrate. During the process, mining wastewater and contaminated storm water are generated. The on-site wastewater treatment facility treats and discharges this water.

Data Source(s): State files

Waste and Material Management Practices: E.I. DuPont de Nemours and Company, Inc. (DuPont) operates a heavy mineral sands mining and mineral processing facility called the Highland Mine. Heavy mineral sands are extracted and processed to produce titanium dioxide, a white pigment. Mining wastewater and contaminated storm water generated at the mine site are treated at the on-site wastewater treatment facility. The treatment process includes acidification with ferric chloride or sulfuric acid for flocculation of colloidal material, settling in a series of 13 sedimentation basins and pH adjustment stations, neutralization with hydrated lime to a pH between 6.0 and 8.5, and additional settling. The treated waters are discharged through a Parshall flume to Boggy Branch, which connects with the North Fork of Black Creek, a navigable water. Both Boggy Branch and the North Fork of Black Creek are Class III Florida waters which are for recreation and propagation and maintenance of a healthy, well-balanced population of fish and wildlife (Ch. 17-3.161, FAC).

On February 10, 1990, a discharge of highly turbid industrial wastewater (from the dredge pond) mixed with storm water occurred. The water was overflowing from a system of settling ponds and entering Tiger Branch, a tributary to Boggy Branch and the North Fork of Black Creek. The discharge was a result of a culvert being plugged by a build-up of sediment. The duration of the discharge is not known, however, it had ceased by February 15, 1990.

From June 9, 1990, through September 30, 1991, discharge of process water without a NPDES permit occurred. An investigation by the Florida Department of Environmental Regulation (FDER) personnel indicated that the discharge was not from the permitted outfall but was from the process water perimeter ditch. Seepage from the process water perimeter ditch to the south of the North Arm of Boggy Branch formed a small creek outside, but parallel to, the process water perimeter ditch. An additional discharge occurred from seepage along the toe of the levee surrounding ponds 11, 12, and 13 which entered a perimeter ditch north of the ponds. This perimeter ditch was not designed to carry process water. It discharged to a channel which entered the bay head. Just outside the facility property boundary, the two unpermitted discharges along with two other small creeks from the bay head joined to form a single stream before entering Boggy Branch.

Type of Impact/Media Affected: A Florida Fish and Game Officer notified DuPont of the discharges after which FDER received a telephone notification from DuPont on February 14, 1990, of a storm water discharge to Tiger Branch. Following the notification, St. Johns River Management District personnel sampled the containment lagoon, which indicated turbidity violations. Turbidity was greater than 200 Nephelometric Turbidity Units (NTUs) whereas, at a reference site, turbidity was only 2 NTU. On February 16, 1990, DuPont again assured FDER that the discharge consisted only of storm water.

During a mine inspection by FDER on February 29, 1990, FDER was told that the storm water had mixed with untreated industrial wastewater before draining from the Mine and entering Tiger Branch. This discharge violated Section 376.302 F.S., which prohibits the discharge of pollutants into or upon any waters of the State and/or violates a FDER standard. The turbid discharge affected approximately 25 miles of a high quality river system. Further study of the area indicated that Boggy Branch was being affected by deposition of materials in the stream bed, including alumina from the mine, silt, and rotting material as thick as 1.5 to 2.5 feet.

A noticeable change in the water quality of the North Fork of Black Creek occurred around June 11, 1990. No significant rainfall had occurred in the area that would contribute to run-off, and DuPont had not recorded a discharge since June 7. However, water was flowing (as described above) from the area of the Highlands Mine into Boggy Branch. Sampling by FDER from June 10 to 18, 1990, indicated that this water had a significantly lower pH, higher sulfuric acid content, and higher conductivity than the background levels in Tiger Creek and the North Fork of Black Creek. The pH of the seepage in the channel and several downstream sampling locations ranged from 3.3 to 5.1, however, the permit specifies that effluent pH should not fall below 6.0. Specific conductivity at the same sampling locations ranged from 270 to 620 umhos/cm, in contrast to a range of 28 to 68 umhos/cm in upstream reference areas. Sulfate, which was zero to six mg/l in the upstream areas, ranged from 116 to 295 mg/l at the sampling locations.

The impacts on Boggy Creek included destruction of all life forms in the stream as far as 10 miles downstream of the permitted outfall, including the benthic community and at least 1,368 fish. Species removed from Boggy Branch as a result of the unpermitted discharge included redfin pickerel, spotted sunfish, yellow bullhead, lake chubsucker, pirate perch, flier, dollar sunfish, gambusia, and brown bullhead. On June 9, at a popular swimming hole downstream of the mine, at least two dozen dead bream and bass were noted. Fish population samples on June 26, 1990, yielded only one fish in the sample area - a yellow bullhead of three inches in length. Terrestrial and wetland ecosystems also were affected by the impact on Boggy Branch because plants and animals depend on the water and food provided by the stream. In addition to the human health impacts from the polluted waters, such as the eye and skin irritation experienced by children swimming in the water as reported in *The Flordia Times-Union*, the discharge impaired the recreational enjoyment provided by the stream. Further study of the area indicated that Boggy Branch was being affected by deposition of materials in the stream bed, including alumina from the mine, silt, and rotting material as thick as 1.5 to 2.5 feet.

Type of Release: Process wastewater and storm water

Affected Media: Surface water

Type of Contamination: Turbidity, sulfuric acid, low pH, and high conductivity

Environmental Damage(s): Siltation, fish kills, macroinvertebrate kills, benthic community kills, human health impacts, and impacts on terrestrial and wetland ecosystems

Location of Affected Populations: Tiger Branch and Boggy Branch, which enter the North Fork of Black Creek

Regulatory Action/Response: As a result of the February 10, 1990, discharge, FDER issued a Notice of Violation and Orders for Corrective Action on April 11, 1990. The Notice of Violation required DuPont to cease all discharges expected to cause a violation of water quality minimum criteria and standards in FAC Ch. 17-3 and to install and implement any actions needed to cease these discharges.

In response to the June 1990 to September 1991 discharges, FDER received and investigated a complaint of a fish kill in the North Fork of Black Creek from citizens of Clay County, Florida, on June 9 and 11, 1990, respectively. An Administrative Complaint was issued to DuPont by U.S. EPA Region IV for discharging without a valid NPDES permit, in which 476 violations of the Clean

Water Act are alleged. A Consent Agreement and Order Assessing Administrative Penalties were issued. DuPont was ordered to pay $86,333 to U.S. EPA Region IV for alleged violations of the Clean Water Act.

DuPont began to pump the discharge in the north channel back into the neutralization ponds ten days after the discovery. However, sheet flow from the south side of the North Arm of Boggy Branch continued until the perimeter ditch construction project was completed. The discharge was treated with caustic for neutralization. DuPont also applied for a NPDES permit modification to add a new discharge point at the unpermitted outflow.

References:

Florida Department of Environmental Regulation. *Consent Order (OGC Case No. 90-1096), FDER, complainant, vs. E.I. DuPont de Nemours and Co., Respondent.*

Florida Department of Environmental Regulation. *Interoffice Memorandum from Bob Leetch to Files*. March 6, 1990.

Florida Department of Environmental Regulation. *Interoffice Memorandum from Steve Swann to Jerry Owen, Water Programs Administrator*. June 13, 1990.

Florida Department of Environmental Regulation. *Memorandum from Gary Byerley, Fisheries Biologist to Ernie Frey*. June 10, 1990.

Florida Department of Environmental Regulation. *Interoffice Memorandum from Steve Swann to Richard Drew, Wastewater Facilities Administration Section*. March 25, 1991.

Florida Department of Environmental Regulation. *Memorandum from Gary Byerley, Fisheries Biologist to Steve Swann*. July 17, 1990.

Florida Department of Environmental Regulation. *Notice of Violation and Orders for Corrective Action (OGC Case No. 90-0517), FDER, complainant, vs. E.I. DuPont de Nemours and Co., Respondent.*

Florida Department of Environmental Regulation-Resource Management. *Memorandum from Carolyn Wirz to Wayne Flowers, FDER-Legal Services*. February 26, 1990.

Strieder, B. "DER probes Black Creek Fish Kill." *The Florida Times-Union*. June 12, 1990.

U.S. Environmental Protection Agency Region IV. *Administrative Complaint. In the Matter of E.I. DuPont de Nemours & Co., Inc. Docket No. CWA-IV 92-518.*

U.S. Environmental Protection Agency Region IV. *Consent Agreement and Order Assessing Administrative Penalties. In the Matter of E.I. DuPont de Nemours & Co., Inc. Docket No. CWA-IV 92-518.*

Hopewell Phosphate Mine: "Mine Water Spill Damages Wetlands and Alafia River"

Sector(s): Phosphate

Facility: Hopewell Phosphate Mine, IMC-Agrico, Hillsborough County, Florida

Facility Overview: Production facilities at the site include beneficiation plants, clay settling areas, and phosphate rock storage and shipping facilities.

Data Source(s): Hillsborough County files

Agency Contact: Sam Elrabi, Environmental Protection Commission, Hillsborough County, Tampa, Florida

Waste and Material Management Practices: Mined phosphate ore consists of about one-third phosphate, one-third sand, and one-third clay. During the beneficiation process at Hopewell Mine, the clay and sand are removed and the phosphate is recovered for further processing. The sand is stockpiled and frequently used in reclamation projects. The clays are slurried and routed to the settling basins. After the clay settles, the water is decanted and reused by the plant to slurry more clay. If the basin takes on more water than is required for efficient operations, excess water is discharged through permitted outfalls. Discharged water must meet Florida Class III water quality standards.

The Hopewell Mine operates two clay settling ponds, HL-1 and HL-2. On November 19, 1994, the earthen berm immediately surrounding the spillway discharge structure in the southeast corner of the dam failed along a section of approximately 100 feet. Approximately 482 million gallons of water were lost, and most of it traveled over adjacent private property to the North Prong of the Alafia River, which feeds into Tampa Bay. The incident occurred at pond HL-2, a pond of approximately 191 acres with 11,600 linear feet of dike embankment, that entered into operation in July 1994. The crest elevation for the perimeter dike is 130.0 feet and the impoundment has a maximum design fluid elevation of 125.0 feet. The clay settling area HL-2 received a construction permit from the Florida Department of Environmental Protection (FDEP) in January 1994, and was built after the enactment of Chapter 62-672, FAC, that regulates construction of earthen dams.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Turbidity and TSS

Environmental Damage(s): Vegetation kills and wetland impacts

Type of Impact/Media Affected: The spilled effluent affected nearby wetlands where channels were scoured at least 10 feet deep, wetland forest trees were laid flat by the force of the flow, and up to several feet of clay and sand were deposited. At least 1.74 acres of wetlands needed restoration. The spill also affected nearby private property, including a small bridge, a culvert, two crossings, and a pond weir. Water quality data indicated turbidity and total suspended solids (TSS) exceedances of State water quality standards at several sampling points in the Alafia River. Samples taken at the Alafia River, approximately eight miles downstream from the Hopewell Mine, indicated that turbidity rose as high as 308 Nephelometric Turbidity Units (NTUs) at SR39. Turbidity returned to less than 29 NTUs about 24 to 36 hours after the incident. TSS at the same sampling point on the Alafia River peaked at 330 mg/l, whereas the maximum daily standard is 60 mg/l.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Turbidity and TSS

Environmental Damage(s): Vegetation kills and wetland impacts

Regulatory Action/Response: On November 21, 1994, the Hillsborough County Environmental Protection Commission (HCEPC) issued a

Warning Notice for unpermitted turbid water discharges to the North Prong of the Alafia River resulting in turbidity and siltation within the riverine flood plains. A second Warning Notice was issued by HCEPC for impacts to both herbaceous and forested wetlands. FDEP also issued a Warning Letter on November 23. The clay settling area HL-2 was repaired and received recertification on April 7, 1995. In June 1995, IMC-Agrico submitted for review an Emergency Response and Contingency Plan for dam failure cases. A Consent Order was signed between HCEPC and IMC-Agrico on August 9, 1995. As part of this Consent Order, IMC Agrico was required to restore 1.74 acres of wetlands, perform restoration work to affected private properties ($30,000), and contribute $110,000 to the Hillsborough County Pollution Recovery Fund. Restoration of the wetlands started in May 1996.

References:

Florida Department of Environmental Protection. *Permit/Certification IC29-239858. Project: Construction of Clay Settling Area HL-2 for the Hopewell Mine.* January 24, 1994.

Florida Department of Environmental Protection. *Warning Letter No. WN94-0040IW29SWD.* November 23, 1994.

Hillsborough County Environmental Protection Commission. *Consent Order. The Environmental Protection Commission of Hillsborough County vs. IMC-Agrico Company GP, Inc.* August 9, 1995.

Hillsborough County Environmental Protection Commission. *Inspection Report. IMC-Agrico Company, Hopewell Mine*. November 1994.

Hillsborough County Environmental Protection Commission. *Memorandum from Chuck Courtney to Roger Stewart, Re: Status of IMC spill investigation - Ecosystems Management*. November 22, 1994.

Hillsborough County Environmental Protection Commission. *Memorandum from Woodrow Batchelor to Roger Stewart, Re: IMC HL-2 Dam Failure, Chronology of Events*. November 22, 1994.

Hillsborough County Environmental Protection Commission. *Warning Notice No. 17877.* November 21, 1994.

IMC Fertilizer, Inc.: "Gypsum Stack Contaminates Surface Water, Ground Water, and Soil"

Sector(s): Phosphoric acid

Facility: P-21 Gypsum Disposal Area, Noralyn/ Phosphoria mine, IMC Fertilizer, Inc., (IMCF),Polk County, Florida

Facility Overview: Beginning in the late 1950's, the P-21 gypsum disposal area received waste gypsum from a chemical processing plant. A cooling pond located on the southern edge of the gypsum area received wastewater from the chemical plant. Placement of gypsum and cooling water was discontinued in 1963. From the 1980's to the present, IMCF has conducted phosphate mining to the east and south of the P-21 gypsum area.

Data Source(s): State files

Agency Contact: Vishwas Sathe, Phosphogypsum Management Program, FDEP

Waste and Material Management Practices: In the 1930's, the land beneath the P-21 gypsum stack was mined for phosphate as part of the Oakridge Mine. As this mining occurred prior to the development of the flotation processing technology, only the upper portion (pebble) of the matrix was removed. The lower matrix zone (concentrate) remains beneath the gypsum. Beginning in the late 1950's waste gypsum from a chemical processing plant (at what is now the C.F. Industries complex) was deposited in the P-21 gypsum stack. Water derived from the chemical plant also was deposited on-site in a cooling pond located on the southern edge of the gypsum area.

Placement of gypsum and cooling water was discontinued in 1963. No waste has been disposed of in this stack since that time. The P-21 gypsum stack did not have any liners beneath it. The cooling pond also was unlined.

The site is underlain by three principal hydrogeologic units: (1) the surficial aquifer system, approximately 25 feet thick in the P-21 area, which underlies essentially all of Polk County and is used primarily for domestic and low volume irrigation uses; (2) the intermediate aquifer system, which is semi-confined to confined throughout most of Polk County and is used mainly for low-volume irrigation wells; and (3) the Floridan aquifer, which is generally 1,000 feet thick and is the major source of potable water in Polk County. A downward vertical gradient exists between the intermediate aquifer system and the Floridan aquifer.

Previous activities at the site resulted in contaminated surface water, soils, and ground water in the surficial aquifer.

Type of Impact/Media Affected: Ground water monitoring reports submitted by the facility between 1987 and 1990 show levels of fluoride, arsenic, gross alpha radiation, and radium-226/228 in excess of State ground water quality standards, at the edge of the zone of discharge. The zone of discharge is defined in State regulations as the volume underlying or surrounding the phosphogypsum stack or cooling pond and extending to the base of a specifically designated aquifer, within which an opportunity for the treatment, mixture or dispersion of wastes into receiving ground water is afforded. Constituent concentrations were measured in this period as high as (Florida standards are shown in parentheses) 8.7 ppm of fluoride (standard 4 ppm), 0.061 ppm of arsenic (standard 0.05 ppm), 0.061 187 pC/L of gross alpha (standard 15 pC/L), and 132 pC/L of radium-226/228 (standard 5 pC/L).

In 1989, IMCF contracted for the preparation and implementation of a preliminary contamination assessment plan for the investigation of the soil, ground water, and surface water associated with the north and west portions of the P-21 gypsum area. Surface water samples collected in 1989 and 1990 at points between 500 and 1,000 feet from the gypsum pile indicated violations of State surface water quality standards. These samples were collected from small tributaries to Skinned Sapling Creek, located north of the gypsum area, which were influenced by ground water seepage. Fluoride levels were observed as high as 20.6 ppm (standard 10 ppm), and pH levels as low as 4.0 (standard 6.0). Ground water data also indicated State standards contraventions at the edge of the zone of discharge. Gross alpha values were as high as 87.5+/-27 pC/L; fluoride, 5.5 ppm; and radium-226, 19.7+/-4 pC/L. Samples collected at various wells inside and at the edge of the zone of discharge indicated iron, total dissolved solids (TDS), sulfate, turbidity, gross alpha levels, radium-226/228, and pH levels above State maximum contaminant levels (MCLs). Maximum values listed in the report were as follows: pH, 11.0; turbidity, 450 NTU; TDS, 2,900 ppm; sulfate, 1,795 ppm; fluoride, 12.4 ppm; iron, 57.1 ppm; gross alpha 87.5+/-27 pC/L; and radium 226, 19.7+/-0.4 ppm. Soil samples showed chromium, iron, zinc, and sulfate concentrations greater than background.

Type of Release: Constituent release from gypsum waste pile

Affected Media: Ground water, surface water, and soil

Type of Contamination: Fluoride, arsenic, gross alpha radiation, radium-226/228, iron, TDS, sulfate, chromium, and zinc

Environmental Risk: No drinking water wells in the area

Regulatory Action/Response: After the gypsum pile was inactivated, the property changed hands several times with IMCF acquiring the property in 1984 from Estech, Inc. At that time, Estech had already submitted a ground water monitoring permit application to the Florida Department of Environmental Regulation (FDER) for review. The ground water permit for the P-21 gypsum area was issued in March 1986. A concern about the potential for storm water run-off from the pile to be entering the tributaries of Skinned Sapling Creek located to the immediate northwest of the pile prompted an investigation of the exact nature of the influence of the pile on the stream. IMCF selected a contractor to perform the work. Based on the results of this work and previous sampling, FDER issued a Warning Notice to the facility for ground and surface water contraventions. FDER and IMCF signed a Consent Order in March 1993. The Consent Order required IMCF to implement corrective actions, including appropriate closure of the P-21 gypsum stack. Also, IMCF was required, in cooperation with the Florida Game and Fresh Water Fish Commission, to implement a project to improve the fisheries function of a Class II reservoir, and to provide barrier-free fishing access for physically challenged individuals at Medard Park, at a total cost of $66,000.

A Contamination Assessment Plan and Quality Assurance Project Plan were presented in May 1993, and were approved in September 1994. In June 1996 a Contamination Assessment Report was submitted to the Florida Department of Environmental Protection (FDEP) for review and comment.

During mining of the areas to the east and south of the P-21 gypsum stack, the soils and sediments associated with the location of the cooling pond were removed. Water from this area was pumped to the Noralyn beneficiation plant. As part of the mined land reclamation of the area, the mined areas, including the location of the cooling pond, were being filled with sand tailings and covered with overburden in 1993, according to a report by IMCF.

References:

Florida Department of Environmental Protection. *Civil Penalty Authorization, Violator: IMC Fertilizer, Inc.* January 7, 1991.

Florida Department of Environmental Protection. *Consent Order 91-2456. The State of Florida Department of Environmental Regulation v. IMC Fertilizer, Inc.* March 12, 1993.

Florida Department of Environmental Protection. *Warning Notice No. 91-0008IW53SWD.* February 5, 1991.

Geraghty & Miller. *Letter from Kenneth Miklos to Vishwas Sathe, FDEP, Re: Status Report for August 1996, IMC-Agrico, Bartow, Florida, FDEP Consent Order 91-2456, P-21 Gypsum Disposal Area-CAP/CAR*. September 12, 1996.

Geraghty & Miller. *Letter from Kenneth Miklos to Vishwas Sathe, FDEP, Re: Status Report for June 1996, IMC-Agrico, Bartow, Florida, FDEP Consent Order 91-2456, P-21 Gypsum Disposal Area-CAP/CAR*. July 12, 1996.

Geraghty & Miller. *Preliminary Contamination Assessment Plan, prepared for IMC Fertilizer.* 1990.

IMC Fertilizer. *Contamination Assessment Plan, P-21 Gypsum Disposal Area.* Submitted to FDEP, May 18, 1993. Resubmitted, August 11, 1993.

IMC Fertilizer. *Letter from G. Greg Williams to Sam Sahebzamani, Florida Department of Environmental Regulation, Re: FDER Draft Consent Order 91-2456*. April 30, 1992

MMM Nichols Phosphate Mine: "Unauthorized Mine Water Discharges Affect Alafia River"

Sector(s): Phosphate

Facility: Nichols Phosphate Mine, Mobil Mining and Minerals (MMM) Company, Polk County, Florida

Facility Overview: The MMM Nichols Phosphate Mine is a phosphate mining and rock beneficiation plant.

Data Source(s): State files

Agency Contact: Jeff Hilton, Compliance/ Enforcement, Industrial Wastewater Program, FDEP

Waste and Material Management Practices: The MMM Nichols phosphate mine generates wastewater from mining and beneficiation of phosphate rock and from storm water run-off. One important activity at the phosphate mine is reclamation. Reclamation areas are surrounded by earthen berms designed to channel storm water into a water recovery/recirculation system. Relief pipes are installed in the berms for discharge.

A series of six incidents of releases of large volumes of turbid water into nearby surface waters occurred between December 1989 and January 1993. In December 1989, 40,000 gallons of turbid water were released into Guy Branch due to a pipeline failure. In June 1991, 400,000 gallons of turbid water were released into Guy Branch after a heavy rain. In July 1992, in two different incidents, 780,000 gallons and 1,510,000 gallons of turbid water were released into Thirty-Mile Creek. These incidents were caused by the combination of three unauthorized 12-inch pipes that were placed near the bottom of a berm separating the North Prong of the Alafia River from a reclamation site located near the northwest property boundary and by the collapse of portions of the berm in the reclamation area. In January 1993, in two different incidents, one day apart, 130,000 gallons and 150,000 gallons of turbid water were released into Thirty-Mile Creek due to inadequate storm water run-off management practices.

Type of Impact/Media Affected: Water quality samples collected on July 21, 1992, after the second incident of that month in Thirty-Mile Creek, indicated very high levels of turbidity and total suspended solids (TSS), both in violation of the Class III fresh water state standards. Turbidity was 3,000 Nephelometric Turbidity Units (NTUs). The standard is 29 NTUs above natural background conditions, which is usually around 12 NTU. TSS was 4,650 mg/l, whereas the daily standard maximum is 60 mg/l. Water quality samples collected in January 1993, after the two incidents of that month at Thirty-Mile Creek, showed turbidity levels of 129.0 and 300.0 NTUs, respectively. Measurements upstream from where the turbid water entered the stream, showed turbidity levels of 4.3 and 31.0 NTUs, respectively. TSS levels at the affected location on those same two days were as high as 10.30 and 233.0 mg/l.

Type of Release: Wastewater discharge

Affected Media: Surface water

Type of Contamination: Turbidity and TSS

Environmental Damage(s): Impacts on nearby streams

Regulatory Action/Response: The regulatory actions at the State level focused on the 1992 incidents. On July 17 and 20, 1992, the Florida Department of Environmental Protection (FDEP) received complaints concerning turbidity in the Alafia River near Riverview. Examination of aerial photographs indicated several reclamation areas near the North Prong of the Alafia River. After inspection of these areas, the unauthorized pipes were discovered at the Nichols mine. Releases from these pipes along with two breach incidents at the reclamation area berms on two days were the cause of turbid waters. FDEP issued a Warning Letter on July 24, 1992. EPA Region IV sent a Notice of Proposed Assessment of a Civil Penalty to MMM Company on August 19, 1993. On July 30, 1996, FDEP sent to MMM Company a final draft of a Consent Order for the 1992 incidents. As part of the proposed Consent Order, MMM Company would pay $100,000 in civil penalties to Hillsborough County and convey a perpetual Conservation Easement of approximately 80 acres of property to the Southwest Florida Water

Management District, or make an additional payment of $80,000. This Consent Order was under discussion at the time of preparing this report.

References:

Florida Department of Environmental Protection. *Letter from Jeff Hilton to L.D. Hinson, MMM, Re: Consent Order 92-2270*. July 30, 1996.

Florida Department of Environmental Protection. *Memorandum from Kathy Hicks to Vishwas Sathe, Industrial Waste Compliance/Enforcement, Re: Mobil Mining and Minerals -- Nichols Mine; Polk County*. September 21, 1992.

Florida Department of Environmental Protection. *Memorandum from Richard Garrity to Carol Browner, Re: Mobil Mining and Minerals -- Nichols Mine; Polk County*. January 11, 1993.

Florida Department of Environmental Protection. *Warning Letter No. 92-0027IW53SWD*. July 24, 1992.

Mobil Mining and Minerals Company. *Letter from L.D. Hinson to Vishwas Sathe, FDEP, Re: Incident Report, Nichols Mine*. July 30, 1992.

Mobil Mining and Minerals Company. *Letter from L.D. Hinson to Vishwas Sathe, FDEP, Re: Incident Report, Nichols Mine*. January 22, 1993.

Mobil Mining and Minerals Company. *Letter from L.D. Hinson to Vishwas Sathe, FDEP, Re: Warning Letter # 92-0027IW53 SWD*. August 4, 1992.

U.S. Environmental Protection Agency Region IV. *Letter from W. Ray Cunningham to L.D. Hinson, MMM, Re: Notice of Proposed Assessment of a Civil Penalty*. August 19, 1993.

Mulberry Phosphates Plant: "Fluoride Contamination at Edge of Authorized Zone of Discharge"

Sector(s): Phosphoric acid

Facility: Mulberry Phosphates Plant, Mulberry Phosphates, Inc., Mulberry, Polk County, Florida

Facility Overview: Production facilities at the site include sulfuric acid, phosphoric acid, and di-ammonium phosphate plants, as well as a phosphogypsum disposal facility. Operations have been ongoing since the early 1950s.

Data Source(s): State files

Agency Contact: Sam Zamani, Phosphogypsum Management Program, FDEP

Waste and Material Management Practices: Gypsum generated during the production of phosphoric acid at the Mulberry plant is stored in two gypsum stack areas designated as the North Stack and the South Stack. Construction of the North Stack was initiated at the start-up of the plant in the early 1950's. It is located within a mine pit left from the extraction of phosphate matrix. The North Stack is used for storage of gypsum during periods of maintenance or while flow is re-routed in the more active South Stack. The North Stack also is used to store process water to provide additional area for evaporation. The North Stack is unlined.

Ground water samples from May 1990 indicated contamination due to off-site surface drainage from the North Stack.

Type of Impact/Media Affected: Analytical tests on ground water samples obtained from temporary shallow test wells installed during a June 1990 study indicated concentrations of fluoride that exceeded the 4 mg/l minimum standard provided in 17-3.404, FAC at the edge of the zone of discharge. The zone of discharge is defined in State regulations as the volume underlying or surrounding the gypsum stack or cooling pond and extending to the base of a specifically designated aquifer, within which an opportunity for the treatment, mixture, or dispersion of wastes into receiving ground water is afforded.

Data provided as part of an application for renewal of a permit to operate a wastewater treatment and disposal system at the site indicated that samples obtained from several monitoring wells on site exhibited exceedances of primary or secondary water quality standards in 1990. For example, well MW-6 showed pH levels between 5.5 and 5.7 (standard 6.0); wells MW-3 and MW-6 had periodically exceeded the secondary standard for iron (0.3 mg/l) with measurements ranging from 3.2-7.0 mg/l and 0.6-1.4 mg/l, respectively; and well MW-1 exceeded the primary State standard for fluoride (which is more stringent than the Federal standard at 1.4-2.4 mg/l, temperature dependent) with values ranging from 1.3 to 2.3 mg/l.

Type of Release: Surface drainage

Affected Media: Ground water

Type of Contamination: Fluoride, iron, and pH

Regulatory Action/Response: After receiving the ground water quality samples taken on May 22, 1990, showing the fluoride standard exceedance at the edge of the authorized zone of discharge, the Florida Department of Environmental Protection (FDEP) issued a Warning Letter on February 5, 1991. A Consent Order was signed on this case on March 19, 1992. The Consent Order required the implementation of a Preliminary Contamination Assessment, and the implementation of appropriate corrective actions if contamination was found. As a result of off-site surface drainage water quality impacts, FDEP issued a Consent Order that required a ground water study in the area immediately north of the North Stack. Based

on the conclusions and recommendations of the ground water study, a seepage intercept drain to control seepage from the North Stack was installed. The Consent Order also required a payment of $10,000 in penalties.

A Preliminary Contamination Assessment Plan was presented to FDEP on April 1993. The plan called for the installation of six surficial aquifer monitoring wells, extending to depths of 25 to 30 feet. The Plan was approved in September 1993. A Preliminary Contamination Assessment Report was presented in December 1993. A Contamination Assessment Plan was presented in October 1994, along with a Quality Assurance Plan. After some revisions, both plans were approved in July 1995. The Contamination Assessment Report was presented in December 1995. FDEP sent comments on this report in January and April 1996. The report was modified and additional monitoring wells were installed. By August 1996, the additional contamination report activities requested by FDEP were being developed.

References:

Armac Engineers, Inc. *Preliminary Contamination Assessment Plan, FDER Consent Order No. 92-1179*. Prepared for Mulberry Phosphates, Inc. April, 1993.

Florida Department of Environmental Protection. *Consent Order 92-1179. The State of Florida Department of Environmental Regulation v. Mulberry Phosphates, Inc.* March 19, 1992.

Florida Department of Environmental Protection. *Warning Notice No. 91-0006IW53SWD*. February 5, 1991.

Royster Company. *Application for Renewal of Permit to Operate Domestic/Industrial Wastewater Treatment and Disposal Systems, submitted to FDEP*. April 11, 1991.

New Wales Chemical Complex: "Sinkhole Forms Beneath Phosphogypsum Stack"

Sector(s): Phosphoric acid

Facility: New Wales Chemical Plant, IMC-Agrico, Mulberry, Polk County, Florida

Facility Overview: The facilities at the New Wales chemical complex include sulfuric acid plants, phosphoric acid plants, granulated triple superphosphate and granulated ammonium phosphate plants, animal feed ingredient plants, and a uranium recovery plant. The gypsum stack was started in 1975 when the plant was opened.

Data Source(s): State files

Agency Contact: Sam Zamani, Phosphogypsum Management Program, FDEP

Waste and Material Management Practices: The phosphoric acid plants in the New Wales chemical complex utilize the wet dihydrate process wherein the phosphate rock is reacted with sulfuric acid to produce phosphoric acid. The production of phosphoric acid generates gypsum as a byproduct. Approximately five tons of gypsum are generated for each ton of P_2O_5 produced. The gypsum is slurried and transported at approximately 20,000 gallons per minute (gpm) to the gypsum stack where it is allowed to settle in settling compartments. Water used in the production process is circulated through a combined mixed/plug flow cooling pond and channels which completely encircle the gypsum stack. A 345-acre clay settling area is used in the non-contact process water circulation system.

The gypsum stack was started in 1975 when the plant was opened and spreads over an area of 430 acres with a height of about 200 feet (approximately 100 million tons). The cooling pond and channels occupy an area of 281 acres. The gypsum stack has no liners and has been used only intermittently since a new, lined stack was started in July 1993 south of the old stack. The last deposition of gypsum in the old stack was documented to have occurred in April 1994. Small amounts of radioactive waste material (e.g., filter cloths, scale from uranium operations, residues from Bartow Uranium Decommissioning, etc.) were buried in the center, southwest, and southeast toes of the gypsum stack.

On June 27, 1994 a site supervisor at the facility noticed a depression within the southwestern quadrant of the unlined phosphogypsum stack. The depression was approximately 160 feet in diameter and 180 feet in-depth. Further investigation revealed that the depression was caused by a sinkhole beneath the stack.

Type of Impact/Media Affected: The gypsum stack is underlain by three aquifers. The surficial aquifer averages 31 feet thick in the site. The intermediate aquifer is separated from the surficial aquifer by a confining unit and is about 75 feet thick. The intermediate aquifer is underlain by a relatively low permeability "Tampa clay" that ranges in thickness from 9 to 14 feet. Under the Tampa clay is the Floridan aquifer, a 700-foot thick U.S. Drinking Water aquifer. This aquifer is a primary source of drinking water for Central Florida.

Water quality data collected at a deep production well for the chemical complex, located approximately 1,000 feet from the stack edge and 3,600 feet from the sinkhole, started to show an increase in orthophosphate on July 10, 1994. The production wells at the plant pump water at a rate of about 6,000 gpm, effectively creating a zone of capture that encompasses the entire gypsum stack, all of the plant site, and the entire cooling pond. This zone of capture prevented off-site migration of contaminants that had affected the surficial and intermediate aquifers due to activities at the complex.

By July 27, 1994 concentrations of sulfate (309 mg/l) and total dissolved solids (TDS) (833 mg/l) at the deep production well had exceeded drinking water standards, and levels were still increasing, confirming an impact to the Floridan aquifer. By the last week of September, the concentrations were as high as (pre-sinkhole concentrations are presented in parentheses) 80 mg/l of orthophosphate (5 mg/l), 90 mg/l of sodium (45 mg/l), 480 mg/l of sulfate (255 mg/l), and 1,400 mg/l of TDS (700 mg/l). By March 1995, the sinkhole appeared to have been successfully plugged, and some parameters, particularly orthophosphate, started to decrease.

Type of Release: Sinkhole

Affected Media: Ground water

Type of Contamination: Orthophosphate, sulfate, TDS, and sodium

Environmental Damage(s): Contamination of major drinking water aquifer

Regulatory Action/Response: After the sinkhole was discovered, Florida Department of Environmental Protection (FDEP) personnel visited the site on June 28, 1994. Daily reports were produced on sinkhole related activities. A perimeter berm was built around the sinkhole to prevent water run-off. A Technical Advisory Committee (TAC) was organized by FDEP with members from various state and local agencies. A Warning Letter was sent by FDEP on July 27, 1994, for exceedance of drinking water standards at the deep production well in the plant. The facility and the TAC held periodic meetings to agree on a course of action. The field exploration program undertaken in the vicinity of the sinkhole was completed by the end of August and included the drilling of four inclined holes, two vertical holes, a gyroscopic directional survey of each inclined hole, cross hole seismic surveys, and installation of piezometers. The results of this program indicated that the diameter of the erosion cavity was on the order of 90 to 110 feet, and the diameter near the base of the confining unit was on the order of 40 to 60 feet.

A plan of action for sinkhole repair was submitted to FDEP for review on September 30, 1994. The main objective of the plan was to re-establish the structural and hydraulic integrity of the confining unit by filling the bulk of the erosion cavity with a cement grout mix. The plan was conditionally approved by FDEP on October 26. Approximately 7,200 cubic yards of grout were used. The estimated cost of repair work was on the order of six million dollars. Piezometric levels started to rise and some constituent concentrations started to decline by March 1995. After confirmation that the sinkhole was successfully plugged, FDEP approved a proposal to fill the sinkhole depression and stress relief cracks with phosphogypsum slurry on June 20, 1995. By December 1995 the sinkhole was fully remediated. Although the gypsum stack had the capacity to operate until 2001, accelerated closure of the stack was being considered in January 1996.

References:

Ardaman & Associates. *Memorandum from J.E. Garlanger and N.F. Fuleihan to G.J. Rubin, IMC-Agrico, Re: Response to Request for Additional Information, Sinkhole Investigation and Remediation at the Original Gypsum Stack at the New Wales Plant, IMC-Agrico Company, Polk County, Florida*. August 31, 1994.

Ardaman & Associates. *Memorandum from N.F. Fuleihan to G.J. Rubin, IMC-Agrico, Re: Copies of Transparencies Pertaining to Water Quality Trends as Presented at the September 28, 1994 TAC Meeting*. September 29, 1994.

Ardaman & Associates. *Memorandum from N.F. Fuleihan to G.J. Rubin, IMC-Agrico, Re: Recommended Plan of Action for Sinkhole Repair, Original Gypsum Stack at the New Wales Plant*. September 30, 1994.

Ardaman & Associates. *Memorandum from N.F. Fuleihan to G.J. Rubin, IMC-Agrico, Re: Response to FDEP's Review Comments on Recommended Plan of Action for Sinkhole Repair, Original Gypsum Stack at the New Wales Plant*. October 17, 1994.

Florida Department of Environmental Protection. *Letter from Sam Zamani to G.J. Rubin, IMC-Agrico, Re: Sinkhole Formation New Wales Chemical Complex*. July 5, 1994.

Florida Department of Environmental Protection. *Letter from Sam Zamani to G.J. Rubin, IMC-Agrico, Re: Sinkhole Formation New Wales Chemical Complex*. July 12, 1994.

Florida Department of Environmental Protection. *Letter from Sam Zamani to G.J. Rubin, IMC-Agrico, Re: New Wales Facility; Sinkhole Remediation*. June 20, 1995.

Florida Department of Environmental Protection. *Letter from Sam Zamani to G.J. Rubin, IMC-Agrico, Re: New Wales Facility; Sinkhole Remedial Action*. October 26, 1994.

Florida Department of Environmental Protection. *Letter from Sam Zamani to G.J. Rubin, IMC-Agrico, Re: New Wales Facility, Unlined Gypsum Stack*. February 21, 1996.

Florida Department of Environmental Regulation. *Warning Letter No. 94-0002PGM53SWD*. July 27, 1994.

Florida Department of Environmental Protection. *Memorandum from Sam Zamani to Sam Elrabi, Industrial Wastewater Program, Hillsborough County Environmental Protection Commission, Re: IMC-Agrico Company - Summary Report on Sinkhole Investigation*. September 12, 1994.

IMC-Agrico. *Letter from G.J. Rubin to FDEP and distribution list. Re: New Wales Gypsum Stack Weekly Sinkhole Update Through July 10, 1994*.

IMC-Agrico. *Letter from G.J. Rubin to FDEP and distribution list. Re: New Wales Gypsum Stack Weekly Sinkhole Update Through July 26, 1994*.

IMC-Agrico. *Letter from G.J. Rubin to Sam Zamani, FDEP. Re: North Gypsum Stack Sinkhole, New Wales Plant*. March 30, 1995.

IMC-Agrico. *Letter from G.J. Rubin to Sam Zamani, FDEP. Re: North Phosphogypsum Stack System, New Wales Plant*. January 10, 1996.

Payne Creek Phosphate Mine: "Settling Pond Break Releases Wastewater to Local Streams"

Sector(s): Phosphate

Facility: Payne Creek Phosphate Mine, IMC-Agrico Co., Polk County, Florida

Facility Overview: This facility includes a phosphate mine and washer/beneficiation plant

Data Source(s): State files

Agency Contact: Jeff Hilton, Industrial Waste Compliance/Enforcement, FDEP

Waste and Material Management Practices: During the beneficiation process at the Payne Creek Phosphate Mine, which separates phosphate rock from the mined matrix, large volumes of clay-laden slurry water are produced. This water is pumped to large above-grade settling ponds to allow the clay to settle from the water prior to reuse or discharge.

At 2:00 p.m. on October 2, 1994, the dike of an inactive settling area (PC-5) was breached over a section of approximately 150 linear feet, causing very rapid dewatering of the impoundment. All dams involved were constructed in accordance with Chapter 17-9, FAC, in 1981 and certified for operation in 1982. Field observations by ARMAC staff engineers indicate that the dams were well maintained and met the current shape and stability requirements of Chapter 17-672, FAC. The cause of the dam failure was not clearly indicated in the files reviewed, however, "possible weakening" of the dam was suggested. This release then caused a dike separating the inactive area from an active clay settling area (PC-9) to breach over a section of approximately 100 linear feet. The liquid from the active area also flowed out through the inactive area. The water level in PC-9 dropped 14 feet. The total area of PC-9 is approximately 600 acres. An estimated two billion gallons of mine water were lost from the Payne Creek Mine and flowed over the CF Industries Hardee Complex Operations, another phosphate mine located immediately to the south.

The majority of the water released and an undetermined amount of clay material were retained within CF Industries' mining and reclamation areas. CF Industries had four reclamation areas totaling approximately 250 acres as well as a 210-acre mined-out area. In addition, the facility had an elevated mine recirculation water ditch that crosses Hickey Branch. The volume of water spilled, however, was greater than the holding capacity of these areas. In order to protect the integrity of the mine water recirculation ditch berm and to reduce the risk of a larger spill, excess water was released through two permitted outfalls. Approximately 130 million gallons of water were discharged to Hickey Branch, a tributary of Payne Creek. The remaining natural portion of Hickey Branch, and that portion affected by the spill, is approximately two miles in length. From its confluence with Hickey Branch, Payne Creek flows approximately ten miles to Peace River.

Type of Impact/Media Affected: Water quality samples were collected by IMC Agrico in Hickey Branch, Payne Creek, and the Peace River to be analyzed for turbidity, total suspended solids (TSS), and total phosphorus (TP). Samples were collected between October 3 and 5, 1994. Turbidity levels were as high as 800 Nephelometric Turbidity Units (NTUs) which is in excess of an assumed background level of 3 NTUs from October 3 to October 5. Rule 17-302.530, FAC, defines a standard of maximum turbidity of 29 NTUs. Turbidity levels further downstream at Payne Creek remained elevated until October 4 and reached a maximum of 312 NTUs. Turbidity and TSS concentrations decreased progressing downstream, indicating some settling out of the suspended materials. Turbidity at Peace River was highest on October 4 at 17 NTUs.

TSS levels at Hickey Branch were greatest at 1,590 mg/l on October 3, decreasing thereafter. The daily maximum permitted level is 60 mg/l. Maximum levels at the Payne Creek station were 336 mg/l on

October 4. Levels of TP at Hickey Branch reached a maximum of 209 mg/l and at Payne Creek of 14 mg/l. On October 5, TP levels had decreased to 1.6 and 0.83 mg/l at these stations, respectively. Other water quality parameters, such as fluorides, sulfate, pH, and dissolved oxygen, among others, were not measured.

Four cells of reclaimed wetland areas at CF Industries were adversely affected by the spill. An assessment of ecological impacts to Hickey Branch and Payne Creek was contracted by IMC-Agrico and was performed on November 3, 1994. The vertebrate sampling indicated a greater abundance of individual fish at a reference station than at the test sites. This may indicate that the fish were temporarily displaced from the habitats affected by the spill, but the data are not conclusive.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Turbidity, TSS, and phosphorus

Environmental Damage(s): Impacts on reclaimed wetlands

Regulatory Action/Response: The Florida Department of Environmental Protection issued a Warning Letter on December 16, 1994. After the breach was contained in IMC-Agrico's ponds, work was started to remove the clay slurry and water from the CF property and the restored wetlands. Clay removal from affected wetlands occurred from October 1994 to June 1995. The wetland vegetation was enhanced afterwards by replacing upland trees, adding other plants, and maintaining water flow to wetlands during dry periods.

IMC-Agrico has agreed to pay an in-kind environmental mitigation penalty of $110,700 to be used for construction of facilities at a county park.

References:

ARMAC Engineers, Inc. *Letter from Ross T. McGillivray to Kenneth Williams, IMC-Agrico Company, Re: DEP 17-672 Analyses for Earthen Dams*. October 12, 1994.

Biological Research Associates, Inc. *Assessment of Ecological Impacts to Hickey Branch and Payne Creek (Hardee County, Florida) Resulting from Failure of a Clay Settling Pond Dam.* Prepared for IMC-Agrico. March 2, 1995.

CF Industries. *Letter from James G. Sampson to Henry Dominick, FDEP, Re: IMC-Agrico Release of Water on CF Property*. October 5, 1994.

CF Industries. *Letter from James G. Sampson to Joann Hearon, FDEP, Re: Release of IMC-Agrico Water Through CF's 001 Outfall*. October 6, 1994.

Florida Department of Environmental Regulation. *Interoffice Memorandum from JoAnn Herron to Jeff Hilton*. October 3, 1994.

Florida Department of Environmental Regulation. *Memorandum from Lisa Carter to Jeff Hilton, Industrial Waste Compliance/Enforcement, Re: IMC-Agrico Payne Creek Mine - Polk Co.* April 14, 1995.

Florida Department of Environmental Regulation. *Warning Letter No. WN94-0042IW53SWD.* December 16, 1994.

IMC-Agrico. *Letter from G. Greg Williams to Tom Plouff, Environmental Protection Agency-Region IV, and Henry Dominick, FDEP, Re: Failure of Clay Settling Area PC-5 and Subsequent Discharge of Water to Hickey Branch, IMC-Agrico Company - Payne Creek Operations*. October 5, 1994.

IMC-Agrico. *Letter from S.L. Presnell to Jeff Hilton, FDEP, Re: Settlement by Short Form Consent Order in Case of IMC-Agrico Company's Payne Creek Phosphate Mine*. October 15, 1996.

IMC-Agrico. *Letter from S.L. Presnell to Nan Baggett, FDEP, Re: IMC-Agrico Remediation Efforts*. July 19, 1995.

Potash Corporation of Saskatchewan: "Hazardous Waste Releases Result in Soil Contamination"

Sector(s): Phosphate rock

Facility: Occidental Chemical Corporation, Swift Creek Chemical Complex and Mine, Suwannee River Chemical Complex and Mine (adjacent facilities), White Springs, Hamilton County, Florida

Facility Overview: Occidental Chemical Corporation (Oxychem) is now called Potash Corporation of Saskatchewan, Inc. (PCS). The company operates two adjacent phosphate mining and mineral processing facilities which use strip mining with drag lines followed by beneficiation and processing. The two chemical complexes include process and non-process water management systems, gypsum stacks, and cooling ponds.

Data Source(s): State files

Agency Contact: Ashwin Patel, Hazardous Waste Section, Northeast District, FDEP

Waste and Material Management Practices: Occidental Chemical Corporation (Oxychem) operates two phosphate mining and mineral processing facilities near White Springs, Florida - the Swift Creek Mine and Chemical Complex and the Suwannee River Mine and Chemical Complex. The facilities occupy 144,000 acres, with the Swift Creek operation located five miles west of the Suwannee River operation. The site was opened in 1964, and mining operations began in 1965 and 1975 at the Suwannee River Mine and the Swift Creek Mine, respectively. The Suwannee River Mine has been inactive since 1992. Products include phosphoric acid, sulfuric acid, and granular products, such as fertilizers and animal feed.

Both facilities consist of a phosphate mine and a chemical complex. To access the phosphate rock, the area is strip mined using drag lines which remove the clay and overburden. Once removed, the phosphate ore is placed in a shallow pit and is slurried. The slurry is pumped to a washer plant and oversized mudballs and pebbles are removed. Beneficiation operations include a phosphatic clay settling system with recirculation to the mine's hydraulic system. Discharge includes dewatering effluent and storm water run-off. The chemical complexes include process water treatment areas, gypsum stacks, cooling ponds, process water recirculation systems, and non-process water retention systems. Treated process water and contaminated non-process water are permitted to be discharged to Swift and Hunter Creeks which flow to the Suwannee River. The site also includes rail facilities for rail car loading with phosphoric acid, two solid waste landfills, and a construction and demolition waste landfill.

During an EPA hazardous waste compliance inspection in May 1996, five waste management violations were noted, two at the Swift Creek operation and three at the Suwannee River operation.

Type of Impact/Media Affected: An EPA hazardous waste compliance inspection was conducted at the Oxychem facilities from May 18 through 20, 1993. As a result of the inspection, the following violations were identified at the Swift Creek operation: (1) overfilling of railcars with phosphoric acid which flows onto the soil, violating 40 CFR §§ 265.31 and 265.196(c); and (2) dumping unidentified gray scale, black fines, and yellow solids at the Solid Waste landfill without a hazardous waste determination. Violations also were noted at the Suwannee River operations: (1) failure to inspect and maintain the unloading system, resulting in a major spill of molten sulfur due to blockage of the channel transporting molten sulfur to the launder pit; (2) dumping gray scale at the Solid Waste landfill without a hazardous waste determination; and (3) dumping over 300 unlabeled drums containing a corrosive compound without a hazardous waste determination into the Solid Waste landfill.

Type of Release: Process wastes and spills

Affected Media: Soil

Type of Contamination: Sulfur, sulfuric acid, and sulfurous acid

Environmental Damage(s): Soil contamination

Regulatory Action/Response:
A Warning Letter was issued by the Florida Department of Environmental Protection (FDEP) on August 11, 1993, following the facility inspection, which noted the violations and advised the facility to cease any operations contributing to the violations. A response to the Warning Letter was written August 19, 1993, in which the Swift Creek facility identified the gray scale as scale from cleaning sulfur storage tanks, the black fines as blasting material used in tank cleaning or paint removal, and the yellow scale as sulfur from a spill clean-up. The facility operator refuted the violation at the loading car area because it involved a release of a product, not a waste, and was, therefore, exempt. However, a hose has been connected to the last railcar to route the overflows to a recycle sump. At the Suwannee River operations, tests on some of the corroding drums containing bricks indicated that all passed the Toxicity Characteristic Leaching Procedure (TCLP) for metals. The drums did contain bricks containing sulfur which oxidized, resulting in the formation of sulfurous acid, corrosion of the drums, and spillage to the soil. The facility proposed and FDEP approved treating this area with lime, however, no information in the files reviewed indicated that lime treatment had been completed. The gray scale at the landfill also was negative for TCLP metals. The facility is negotiating a Solid Waste Site Closure Permit which will require an earthen cap and ground and surface water monitoring. The molten sulfur spill at the unloading area was cleaned up. The facility's response to the Warning Letter was deemed acceptable by the Department.

References:

Florida Department of Environmental Protection. *Letter from Vicky G. Valade to Charles B. Pults, Occidental Chemical Corporation*. September 14, 1993.

Florida Department of Environmental Protection. *Warning Letter (WL93-0412HW24NED) from Ernest E. Frey to Eugene McNeill, Occidental Chemical Corporation*. August 11, 1993.

Occidental Chemical Corporation. *Letter from Charles B. Pults to Ashwin Patel, FDEP*. August 19, 1993.

Occidental Chemical Corporation. *Letter from Charles B. Pults to Ralph T. Cline, U.S. Environmental Protection Agency*. June 2, 1993.

Occidental Chemical Corporation. *Letter from Charles B. Pults to Vicky Valade, FDEP*. July 9, 1993.

U.S. Environmental Protection Agency Region IV. *Letter from Jeffrey T. Pallas to Eugene McNeill, Occidental Chemical Corporation, including RCRA Inspection Report*. June 15, 1993.

Potash Corporation of Saskatchewan: "Mining Effluent Degrades Nearby Stream"

Sector(s): Phosphate rock

Facility: Occidental Chemical Corporation, Swift Creek Chemical Complex and Mine, Suwannee River Chemical Complex and Mine (adjacent facilities), White Springs, Hamilton County, Florida

Facility Overview: Occidental Chemical Corporation (Oxychem) is now called Potash Corporation of Saskatchewan, Inc. (PCS). The company operates two adjacent phosphate mining and mineral processing facilities which use strip mining with drag lines followed by beneficiation and processing. The two chemical complexes include process and non-process water treatment areas, gypsum stacks, and cooling ponds.

Data Source(s): State files

Agency Contact: Vince Seibold, Industrial Wastewater Section, Northeast District, FDEP

Waste and Material Management Practices: Occidental Chemical Corporation (Oxychem) operates two phosphate mining and mineral processing facilities near White Springs, Florida - the Swift Creek Mine and Chemical Complex and the Suwannee River Mine and Chemical Complex. The facilities occupy 144,000 acres, with the Swift Creek operation located five miles west of the Suwannee River operation. The site was opened in 1964, and mining operations began in 1965 and 1975 at the Suwannee River and the Swift Creek Mines, respectively. The Suwannee River Mine has been inactive since 1992. Products include phosphoric acid, sulfuric acid, and granular products, such as fertilizers and animal feed.

Both facilities consist of a phosphate mine and a chemical complex. To access the phosphate rock, the area is strip mined using drag lines which remove the clay and overburden. Once removed, the phosphate ore is placed in a shallow pit and is slurried. The slurry is pumped to a washer plant and oversized mudballs and pebbles are removed. Beneficiation operations include a phosphatic clay settling system with recirculation to the mine's hydraulic system. Discharge includes dewatering effluent and storm water run-off. The chemical complexes include process water treatment areas, gypsum stacks, cooling ponds, process water recirculation systems, and non-process water retention systems. Treated process water and contaminated non-process water are permitted to be discharged to Swift and Hunter Creeks which flow to the Suwannee River. The site also includes rail facilities for rail car loading with phosphoric acid, two solid waste landfills, and a construction and demolition landfill.

Seven-day chronic toxicity tests on *Pimephales promelas* (a minnow) in December 1992, and in January and December 1993 indicated toxicity in the discharge from Outfall 001 entering Swift Creek. Outfall 001 is permitted to discharge treated process water and contaminated non-process water within permit limits.

Type of Impact/Media Affected: On August 15, 1994, the Florida Department of Environmental Protection (FDEP) conducted a fifth year inspection of the two Oxychem facilities. The inspection included Toxics Sampling, Compliance Biomonitoring, Impact Bioassessment, and Water Quality Inspections. The Toxics Sampling Inspection indicated that no organic priority pollutants or pesticides were present in the discharge and that levels of metals were not exceeding Class III standards. The Compliance Biomonitoring Inspections indicated that the effluents were not acutely toxic to the two test organisms.

The Impact Bioassessment Inspection, however, revealed that the benthic macroinvertebrate community at Swift Creek was moderately impaired and at Hunter Creek was severely degraded due to changes in water quality as a result of facility discharges. Degradation included decreases in taxa richness, the Ephemeroptera/Plecoptera/Trichoptera (EPT) index (e.g., only 50 percent of the reference

site value), the proportion of filter feeders, and an increase in the percent contribution of dominant taxa. Pollution sensitive organisms, such as ephemeropterans and trichopterans, were reduced or eliminated at both sites (e.g., ephemeropterans were decreased by 97 and 55 percent at Swift Creek and Hunter Creek, respectively). The algal and periphyton communities at Swift Creek and Hunter Creek, respectively, were degraded downstream of outfalls due to high nutrient conditions.

The Water Quality Inspection indicated extreme nutrient enrichment in Swift Creek with concentrations of ortho-phosphate, total phosphorus, and ammonia being higher than those in 95 percent of other Florida streams. Unionized ammonia from the Swift Creek Mine outfall violated permit limits (0.0213 mg/L) and Class III water quality standards. Hunter Creek also had phosphorous concentrations higher than those found in 75 percent of other Florida streams. Dissolved oxygen levels in effluent entering Swift Creek violated permit limits. The changes in water quality due to the discharges, particularly the nutrient enrichment, caused the degradation of the benthic communities. In general, the facility was violating the standard prohibiting imbalances of aquatic fauna and aquatic flora (Rule 62-302.560(29), FAC).

Type of Release: Process and non-process wastewater

Affected Media: Surface water

Type of Contamination: Nutrients and low dissolved oxygen

Environmental Damage(s): Aquatic macroinvertebrate and algal community degradation

Location of Affected Populations: Swift Creek and Hunter Creek, downstream of outfalls

Regulatory Action/Response: A toxicity identification evaluation (TIE) was to be conducted by an Oxychem contractor to determine the cause of toxicity. It was suspected that the test organisms were ingesting something in the discharge, such as a bacteria. As of April 24, 1995, FDEP had not received the results of the TIE. In October 1994, chronic bioassays were conducted at the reference site used in the August 1994 tests. All organisms died within 24 hours due to a pH of 4.1. Therefore, the facility requested a permit modification so the bimonthly toxicity tests would reflect the natural toxicity at the reference site. FDEP is reluctant to change the permit because toxicity testing permit requirements should not be based on background conditions. Further information, such as the TIE results, has been requested by FDEP from the facility, however, this information was not included in the files reviewed.

References:

Florida Department of Environmental Protection, Biology Section, Division of Administrative and Technical Services. *Biological Assessment of Occidental Chemical Corporation, Hamilton County, NPDES #FL0000655, Sampled August 1994*. January 1995.

Florida Department of Environmental Protection. *Letter from Leslee A. Williams to Vince Seibold, FDEP*. April 24, 1995.

Premier Services Corporation: "Ionic Imbalance in Discharge Causes Toxicity"

Sector(s): Magnesium hydroxide

Facility: Premier Services Corporation, Port St. Joe, Gulf County, Florida

Facility Overview: Premier Services Corporation was formerly called Basic Magnesia. This facility has been and still is used to process seawater to precipitate and recover magnesium hydroxide. The operating dates of the facility were not included in the files reviewed.

Data Source(s): State files

Agency Contact: William A. Evans, Water Facilities, Northwest District, FDEP

Waste and Material Management Practices: The company processes seawater to produce a magnesium hydroxide ($Mg(OH)_2$) precipitate that can be used as a pH-adjuster to precipitate heavy metals in wastewater treatment.

At this facility, $Mg(OH)_2$ is removed from seawater extracted from St. Joseph Bay and converted to magnesium oxide. Other raw materials include sulfuric acid and dolomite. The pH of the seawater is adjusted using concentrated sulfuric acid. It is pumped into an aeration tank to remove dissolved carbon dioxide. The solution flows to a 300,000 gallon agitated reactor where it is reacted with lime. The solution then flows to a thickener tank where solids are precipitated and settled. The solid $Mg(OH)_2$ is pumped through a series of three fresh water wash tanks to remove chlorides and salt impurities. The "spent" seawater and the fresh water wash water are discharged into a 200 foot by 300 foot brackish water barge basin on company property which is connected to the Gulf County Canal, a Class III Florida water entering St. Joseph Bay. Class III waters are to be used for recreation and the propagation and maintenance of healthy, well-balanced fish and wildlife populations (Ch. 17-3.161, FAC).

Under permit conditions, the facility is required to conduct annual 96-hour static-renewal toxicity tests on the effluent. The tests originally were performed on the water in the mouth of the barge basin, but now are performed on effluent from the end of the discharge pipe. Test results from 1992 to 1996 indicated toxic conditions for the test organisms, *Mysidopsis bahia* and *Menidia beryllina*. The toxicity violates Rules 62-302.530(62), FAC, 62-302.500(1)(d), FAC, and 62-4.244(3)(a), FAC.

Type of Impact/Media Affected: The discharged water had high turbidity, high pH, and an ionic imbalance. The high pH and very high levels of calcium are thought to be responsible for the toxicity. In 1992 tests, 100 percent mortality of both test organisms occurred within 72 hours. A violation occurs when greater than 50 percent mortality results during any test. In January and February 1993, acute toxicity of *M. Bahia* was observed in pH-adjusted and unadjusted samples in routine and persistence tests. In March 1993, acute toxicity was noted in *M. Bahia* in the pH-adjusted samples. In December 1994, acute toxicity was noted in *M. bahia* and *M. beryllina* in the pH-adjusted effluent. In the pH unadjusted samples, the LC_{50} was lower, at 73.7 percent and 79.8 percent effluent for *M. bahia* and *M. beryllina*, respectively. In 1995, the LC_{50} for *M. Bahia* was slightly lower in pH-adjusted samples, at 74.1 percent effluent. These test results indicated toxicity due to pH, however, another toxic constituent was possible, as indicated by the pH-adjusted test results where toxicity was relatively high. Test results from January 1996 on the raw, undiluted effluent indicated toxicity to the test organisms due to a high pH (9.7). Tests using pH-adjusted effluent (pH 7.9) indicated toxicity to *M. bahia,* but not to *M. beryllina*. These results suggest an additional toxic constituent. Water quality tests on the effluent found elevated calcium levels, with calcium being present at 370 percent of expected based on the water's salinity. The Florida Department of Environmental Protection (FDEP) has observed similar toxicity due to ionic imbalances in the effluent of reverse osmosis facilities.

A possible impact from the toxic discharge is a change in the macroinvertebrate community. At one test site, quantitative measures of the macroinvertebrate community health indicated a decrease in the pollution sensitive taxa. January 1996 tests indicated that the cause of toxicity is both the high pH level, and an ionic imbalance. The ionic imbalance results because the level of calcium is increased five times due to the addition of dolime (i.e., calcium), while the level of magnesium is reduced five times due to the removal of $Mg(OH)_2$.

Type of Release: Process wastewater

Affected Media: Surface water

Type of Contamination: Ionic imbalance, high pH

Environmental Damage(s): Acute toxicity to aquatic macroinvertebrates

Location of Affected Populations: Barge basin and Gulf County Canal

Regulatory Action/Response: The facility requested a variance for acute toxicity in their permit because no technology is available for treating ionic imbalances. FDEP is unaware of any effluent guidelines for magnesium extraction from seawater. However, because of the acute toxicity of the effluent on test organisms, FDEP is drafting a Consent Order requiring the facility to develop an appropriate testing protocol and to conduct tests to determine conclusively that the ionic imbalance and pH are the causes of toxicity. If the ionic imbalance and pH are identified as the sources of toxicity, FDEP will request that the facility alleviate these sources. This Consent Order was not included in the files searched, because it is still being drafted, according to FDEP personnel.

References:

Alvarez, Lehman, and Associates, Inc. *FDER Biomonitoring Program 96-Hour Static-Renewal Bioassay Special Studies: Menidia beryllina and Mysidopsis bahia pH-adjusted and unadjusted outfall samples December 8-12, 1994*. December 19, 1994.

Alvarez, Lehman, and Associates, Inc. *FDER Biomonitoring Program 96-Hour Static-Renewal bioassay Special Studies: Menidia beryllina and Mysidopsis bahia pH-adjusted outfall and influent samples January 27-31, 1993 and Mysidopsis bahia February 1-5, 1993*. February 11, 1993.

Alvarez, Lehman, and Associates, Inc. *FDER Biomonitoring Program 96-Hour Static-Renewal Bioassay Special Studies: Mysidopsis bahia pH-adjusted outfall sample March 25-29, 1993*. April 8, 1993.

Alvarez, Lehman, and Associates, Inc. *FDER Biomonitoring Program 96-Hour Static-Renewal Bioassay Special Studies: Mysidopsis bahia pH-adjusted outfall samples November 28-December 3, 1995*. December 14, 1995.

Florida Department of Environmental Protection, Biology Section, Division of Administrative and Technical Services, *Biological Assessment of Premier Services Corporation, Gulf County, NPDES #FL0002607, January 1996*. June 1996.

Premier Services Corporation. *Letter from Thomas F. Turpin to William A. Evans, FDEP*. April 18, 1996.

Wastewater Permit Application and Attachments for Premier Services Corporation (Facility ID#: 1023PO1340). April 16, 1996.

Riverview Chemical Complex: "Acidic Discharge Kills Fish and Crabs"

Sector(s): Phosphoric acid

Facility: Riverview Chemical Complex, Cargill Fertilizer, Inc., Riverview, Hillsborough County, Florida

Facility Overview: This facility is a phosphatic fertilizer manufacturing plant. Plant operations include sulfuric acid production, phosphoric acid production, and phosphate fertilizer production. Waste management areas at the facility include one active and one closed phosphogypsum disposal field and a process water recirculation system.

Data Source(s): State and county files

Agency Contact: Sam Zamani, Phosphogypsum Management Program, FDEP

Waste and Material Management Practices: The Riverview Chemical Complex maintains a gypsum field (stack) to manage phosphogypsum generated from the operation of the phosphoric acid plants. Approximately 90,000 tons of gypsum are deposited in the gypsum field each week. Gypsum is piped to the stack as a slurry mixture, using a pumping system that includes a 100,000-gallon rubber-lined surge tank, agitator, pumps, and valves. Water that seeps through the stack is collected in a perimeter drain, which carries the seepage water to a sump, where it is pumped to a cooling pond.

On October 12, 1993, stressed vegetation was found in a storm water ditch located west and outside of the active gypsum field recycle system. This ditch discharges to Archie Creek, a Class III water body. The cause of the stressed vegetation was a discharge of untreated wastewater from two, three-foot diameter, manway access pipes that were unbolted with the covers removed. The access pipes are connected to underground gypsum stack seepage collection conduits which convey process water seepage to a lined cooling pond.

Type of Impact/Media Affected: Water quality samples collected at the outfall of the storm water ditch to the Archie Creek Drainage Canal on October 12, showed pH levels as low as 5.79, fluoride levels as high as 29.9 mg/l, and ortho-phosphate levels as high as 59.1 mg/l. One week later, fluoride levels had dropped to 1.5 mg/l, and phosphate to 4.1 mg/l. The water quality parameters observed on October 12 exceeded surface water quality standards. A field survey of the South Archie Creek drainage canal recorded a total of 110 dead fish and crabs.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Fluoride, pH, and ortho-phosphate

Environmental Damage(s): Fish and crab kills, and stressed vegetation

Regulatory Action/Response: Upon discovery of the incident, the pipes were replaced and bolted. To prevent future discharges to Archie Creek, the facility installed a concrete flow structure with a gate valve activated by a conductivity meter in the stream. The facility also installed berms, a gypsum field critical alarm system, and a camera surveillance system.

The Environmental Protection Commission of Hillsborough County issued a Warning Notice on October 19, 1993. The Florida Department of Environmental Protection issued a Warning Letter on October 20, 1993. A Consent Order was signed on December 20, 1995. As part of the provisions of this Consent Order, Cargill Fertilizer donated as an in-kind settlement, $37,500 to the Museum of Science and Industry in Tampa to support a wetlands trail educational project.

References:

Cargill Fertilizer. *Letter from Elton Curran to Sam Zamani, Florida Department of Environmental Regulation, Re: Warning Letter #93-0032IW29SWD; Consent Order #94-3313*. March 31, 1995.

Environmental Protection Commission of Hillsborough County. *Warning Notice No. 15292*. October 19, 1993.

Florida Department of Environmental Protection. *Memorandum from Lisa Carter to Vishwas Sathe, Industrial Waste Enforcement/Compliance, Re: Cargill Fertilizer, Inc. - Hillsborough Co. Discharge Evaluation*. February 23, 1994.

Florida Department of Environmental Regulation. *Consent Order 94-3313. The State of Florida Department of Environmental Regulation v. Cargill Fertilizer, Inc.* December 20, 1995.

Florida Department of Environmental Regulation. *Warning Letter No.93-0032IW29SWD*. October 20, 1993.

Lewis Environmental Services, Inc. *Field Survey of the Effects of a Low pH Water Discharge into South Archie Creek Drainage Canal.* Prepared for Cargill Fertilizer. Prepared November 1993, Revised December 23, 1993.

Lewis Environmental Services, Inc. *Field Survey of the Effects of a Low pH Water Discharge into South Archie Creek Drainage Canal. Report 2, 1.5 Months After Discharge.* Prepared for Cargill Fertilizer. December 1993.

Bethlehem Steel Corporation Sparrows Point Facility: "Elevated Chlorine Levels in Discharge to Nearby Water Bodies"

Sector(s): Steel

Facility: Bethlehem Steel Corporation Sparrows Point Facility, Sparrows Point, Baltimore County, Maryland

Facility Overview: The Sparrows Point Facility consists of operations for producing steel, manufacturing basic rolled or formed steel products, and building ships.

Data Source(s): State files

Agency Contact: James L. Hearn, Water Management Administration, MDE

Waste and Material Management Practices: The Bethlehem Steel Sparrows Point facility is one of the largest integrated steel mills in the U.S. It is located near the mouth of the Patapsco River in Maryland. In addition to steel production, steel products, and shipbuilding operations, the facility includes electric power generating stations, a railroad system, coke making facilities, and the Humphreys Creek Treatment Plant. The coke making operation was shut down in 1991. The facility discharges 400 to 450 million gallons per day of wastewater from seven permitted major outfalls along with 40 other outfalls. The discharges enter the Patapsco River, Bear Creek, and Old Road Bay which are Use I waters of the state under COMAR 26.08.02.07.F(5).

The facility has discharged from several different outfalls from 1990 to 1992 total residual chlorine over the non-detectable limit of less than 0.1 mg/l.

Type of Impact/Media Affected: During annual NPDES Compliance Monitoring Inspections from August 1990 to August 1992, total residual chlorine levels at Outfalls 012, 013, 017, 018, and 032 were greater than the less than 0.1 mg/l limit (Exhibit 1).

Exhibit 1
Total Residual Chlorine Levels at Bethlehem Steel Outfalls

Outfall	Total Residual Chlorine (mg/l)	Date
017	0.25	8/29/90
032	1.3	8/30/90
018	0.3	10/25/90
017	0.35	10/25/90
017	0.4	12/13/90
017	0.4	3/26/91
013	0.15	4/24/91
017	0.1	4/24/91
013	0.1	6/3/91
017	0.5	6/3/91
017	0.6	6/25/91
017	0.3	8/5/91

Outfall	Total Residual Chlorine (mg/l)	Date
017	1.5	10/23/91
032	1.1	7/31/92
013	0.4	8/3/92
012	1.3	8/3/92
017	0.1	8/4/92
013	0.2	8/4/92

In addition, on August 3, 1992, monitoring point 050 had total residual chlorine levels up to 0.3 mg/l. The discharge from Outfall 012 had less than 0.1 mg/l on August 4, 1992. The facility indicated that the chlorine reading may have been due to residual bromine which is used in the cooling water system in the caster building.

Type of Release: Wastewater

Nature of Contamination: Surface water

Type of Contamination: Total residual chlorine

Environmental Damage(s): Surface water contamination

Regulatory Action/Response: Following the NPDES Compliance Monitoring Inspections of July and August 1992, a site complaint (SC-0-93-0014) was issued. The facility advised the operators of the salt water chlorination system to reduce the chlorine feed rate and to inspect the system to determine the cause of the violation. The facility found that the flow rate meter on the chlorinator was stuck, indicating a false chlorine feed rate. The system was immediately shut down and repaired.

An Administrative Order was issued by the Maryland Department of the Environment (MDE) to Bethlehem Steel citing unauthorized chlorine discharges at Outfalls 012, 013, 017, 018, and 032 from August 29, 1990, to August 4, 1992. Corrective actions included submitting to MDE a detailed plan for corrective measures to ensure compliance, a schedule for implementation and completion of measures, and a detailed plan and schedule of measures to ensure compliance with the chlorine limitations. A payment of $50,000 was made by Bethlehem Steel as part of the Order.

In response to the Administrative Order, Bethlehem Steel described the difficulty of controlling residual chlorine at outfalls because of the use of treated effluent from the Back River Sewage Wastewater Station, potable water from the City, and brackish water from the bay. Bethlehem Steel noted that the distribution system is not linear and water supply is not constant. In addition, the saltwater required chlorination to prevent biological growth and the potable water is delivered chlorinated. Bethlehem Steel proposed a one-year study to investigate the conversion of systems from one water to another to stabilize the demands and chlorine usage, the use of chlorine substitutes such as bromine or ozone, and the facility requirement at six outfalls for dechlorination units. MDE accepted the study proposal and the explanation of the system but indicated that once the study was completed, a work plan to eliminate residual chlorine was necessary. The study began in June 1993, and the first quarterly report was submitted October 14, 1993. The final report was submitted April 6, 1994. The facility began using gaseous chlorination at a reduced feed rate supplemented by liquid bromine during warmer periods. In addition, chlorine destruct systems were installed at several outfalls. The facility had fully complied with the Order on August 18, 1994.

References:

Bethlehem Steel Corporation. *Letter from E. B. Hay to James Metz, Waste Management Administration, MDE, Re: NPDES Permit MD0001201/79-DP-0064 and SC-0-93-0014*. September 14, 1992.

Bethlehem Steel Corporation. *Letter from E. B. Hay to James L. Hearn, MDE*. April 20, 1993.

Bethlehem Steel Corporation. *Letter from Erroll B. Hay to MDE*. June 18, 1993.

Bethlehem Steel Corporation. *Letter from Erroll B. Hay to James L. Hearn, MDE*. July 9, 1993.

Bethlehem Steel Corporation. *Letter form Erroll B. Hay to James L. Hearn, MDE*. August 18, 1994.

Bethlehem Steel Corporation. *Letter form Erroll B. Hay to James L. Hearn, MDE with attached quarterly report*. April 8, 1994.

Maryland Department of the Environment. *Compliance Sampling Inspection*. July 31 to September 22, 1992.

Maryland Department of the Environment, Water Management Administration. *Amended Complaint and Order in the case of State of Maryland Department of the Environment v. Bethlehem Steel Corporation*. AO-93-0071.

Maryland Department of the Environment, Water Management Administration. *Complaint in the case of State of Maryland Department of the Environment v. Bethlehem Steel Corporation*. AO-93-0071.

Maryland Department of the Environment. *Letter from James Hearn to E. B. Hay, Bethlehem Steel Corporation, Re: Administrative Order and Penalty AO-93-0071*. June 21, 1993.

Chemetals Inc.: "Toxic Effluents Released from Permitted Outfall to Arundel Cove"

Sector(s): Manganese

Facility: Chemetals Incorporated, Glen Burnie, Anne Arundel County, Maryland

Facility Overview: This facility processes manganese ore using roasting, acid leaching, precipitation, filtration, and oxidation operations.

Data Source(s): State files

Agency Contact: Melvin H. Knott, Waste Management Administration, MDE

Waste and Material Management Practices: The Chemetals Inc. facility in Anne Arundel County, in addition to roasting, acid leaching, precipitation, filtration, and oxidation operations, has a wastewater treatment system including a neutralization system and settling ponds. Process wastewater, cooling tower blowdown, and scrubber water from the plant are neutralized in a lime treatment system which is continuously monitored for pH. Once neutralized, the water is released to a series of settling ponds and then to Outfall 001. The second pond of the settling system includes a dechlorination system using sulfur dioxide to dechlorinate the wastewater. The treated wastewater is discharged through Outfall 001 to Arundel Cove, which is a tributary to Curtis Creek. Curtis Creek is classified for water contact recreation, and for fish, other aquatic life, and wildlife.

Periodically, from 1992 until 1996, bioassay toxicity tests of the Outfall 001 effluent indicated toxicity to both the mysid and the minnow tested. The cause of the toxicity was thought to be residual ammonia, manganese, or both. In addition, during an inspection in February 1992, an inspector noted foaming in the wastewater effluent. During September 1992, Chemetals reported elevated levels of total manganese in the effluent from Outfall 001A. In February 1993, the monthly average manganese effluent was 1.35 pounds per day above the NPDES permit limit. Chemetals claimed the daily maximum limit was never exceeded and was not certain of the cause.

Type of Impact/Media Affected: The 48-hour definitive bioassays conducted from April 29 to May 1, 1992, indicated the effluent from Outfall 001 was acutely toxic to the mysid (*Mysidopsis bahia*) but not to the sheepshead minnow (*Cyprinodon variegatus*), with the 48-hour LC_{50} for the mysid being 13.3 percent. The 48-hour daily renewal acute toxicity tests on *M. bahia* from June 1993 were performed on unaltered effluent and on manganese stripped effluent to determine if an upgraded wastewater treatment plant would provide non-toxic effluent. The manganese-stripped sample increased the LC_{50} from 21.1 percent to 57.0 percent. Although this indicated an improvement, it did not prove to Chemetals that upgrading the treatment system to remove manganese was a proper solution. The 48-hour, daily renewal, acute toxicity tests performed in March 1996 indicated that the effluent was toxic to *M. bahia* with an LC_{50} of 74.0 percent effluent, but was not toxic to *Palaemonetes pugio*. Tests from May 1996 indicated that the effluent was toxic to *M. bahia* and to *P. pugio* with the LC_{50}s being 62.0 percent and 67.6 percent effluent, respectively. The effect of the toxic effluent on Arundel Cove was not documented in the files available for review.

The first quarter analytical work on the wastewater discharge indicated elevated levels of residual ammonia in wastewater generated from two plant production processes that operate during the months of October to March. Residual ammonia may have been responsible for both the toxicity and the foaming observed in February 1992. Previous aquatic toxicity tests did not indicate concerns with ammonia content from these processes.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Ammonia and manganese

Environmental Damage(s): Toxicity to test organisms

Environmental Risk: Toxic effluent was discharged from permitted outfall to Arundel Cove.

Regulatory Action/Response: The files available for review did not contain any Notices of Violation, Complaints, or Consent Orders in relation to the toxic effluent. MDE and Chemetals, however, were corresponding regularly on test results and possible changes to the facility to remedy the problem. An analysis of flow rates and ammonia content was being conducted on one of the seasonal process to determine treatment options to reduce aquatic toxicity and eliminate foaming concerns. The site proposed and implemented an ammonia investigation plan and expected to resolve the ammonia problem by December 1993.

The elevated manganese levels in September 1992 were due to dredging of areas of the settling ponds by an outside contractor hired by Chemetals to increase the retention time in the ponds. This would increase the settling efficiencies in the ponds. The dredging, however, agitated the settled solids, increasing the concentration of manganese in the outfall. The facility undertook preventative measures and reactionary measures to ensure that stirred pond water is not discharged in the future. In addition, Chemetals planned to reduce the loading of manganese solids to the lime treatment system in 1993 to improve biomonitoring test results. This would be accomplished by directly removing manganese solids from the filter in the Nitrate Plant instead of slurrying the materials, allowing them to settle in the ponds, and later dredging the materials for sale to fertilizer manufacturers.

Chemetals indicated that the higher toxicity noted in May 1996 effluent may have been due to higher concentrations of effluent. It was not clear from the information available whether the toxicity levels in March and May 1996 toxicity tests was due to ammonia or another agent. Chemetals mentioned that a 1:1 dilution would eliminate the toxicity and that this dilution could be incorporated into their proposed wastewater treatment system. In August 1996, Chemetals was interviewing engineering firms for the design of the new wastewater treatment system. There was no further information in the files reviewed indicating the status of the new wastewater treatment system.

References:

Chemetals Inc. *Letter from Lawrence, T. J., to M. Knott, MDE, Re: Biomonitoring Progress Update*. August 30, 1996.

Chemetals Inc. *Letter from Myers, K., to M. Knott, MDE, Re: Biotoxicity Improvement Action Plan*. November 11, 1992.

Chemetals Inc. *Letter to M. Knott, MDE*. July 28, 1993.

Chemetals Inc. *Letter from Lawrence, T. J., to C. Coates, MDE*. March 25, 1993.

Chemetals Inc. *Letter from Myers, K., to M. Knott, MDE*. October 28, 1992.

Chemetals Inc. *Letter from Pratt, K., to J. Richmond, Re: Industrial Discharge Inspection Report*. April 16, 1992.

Maryland Institute for Agricultural and Natural Resources, Agricultural Experiment Station. *Letter from Fisher, D. to M. Knott, MDE*. May 5, 1993.

Maryland Department of the Environment. *Compliance Sampling Inspection of Chemetals Inc*. April 26, 1993.

Maryland Institute for Agricultural and Natural Resources, Agricultural Experiment Station. *Letter from Fisher, D., to M. Knott, MDE*. May 5, 1991.

SCM Chemicals Hawkins Point Plant: "Batch Attack Lagoon Contaminates Groundwater"

Sector(s): Titanium dioxide

Facility: SCM Chemicals Corp. (SCM) Hawkins Point Plant, Baltimore County, Baltimore, Maryland

Facility Overview: The SCM Hawkins Point Plant manufactures titanium dioxide, a white pigment, using a sulfate process and a chloride process.

Data Source(s): State files

Agency Contact: Margaret Chauncey, Hazardous Waste Enforcement Division, MDE

Waste and Material Management Practices: The SCM Chemicals Hawkins Point Plant manufactures titanium dioxide from two processes: 1) a sulfate process where titanium ores are ground and digested in batch attack vessels with sulfuric acid; and 2) a chloride process where titanium ore is chlorinated in the presence of carbon to produce titanium tetrachloride, which is oxidized to produce titanium dioxide. SCM produces about 70,000 tons per year of the sulfate processed pigment for sale to the paper industry. The chloride processed pigment is used in paints, paper, and in powdered sugar. Acidic wastewater is produced from both processes. Acid wastes from the chloride process are sold or neutralized with caustic and lime slurry. The solids from this process settle in a series of lagoons. Most of the acid wastes from the sulfate process were stored in the Batch Attack lagoon until 1991 when the site operators built tanks to receive the acid wastewater prior to treatment at the acid neutralization plant. Currently, the Batch Attack Lagoon is used as a settling pond for batch attack scrubber wastewater. According to a representative of Maryland Department of the Environment (MDE) Water Management Administration, a pH probe measures the pH level of the wastewater as it enters the lagoon. When the pH of the wastewater falls below 2, the wastewater is purposefully diverted from entering the lagoon, thereby bypassing any treatment system, and is discharged directly to the Patapsco River. Usually, the sulfate process wastewater is pumped from the lagoon and pH adjusted prior to discharge to the Patapsco River via Outfall 001.

SCM has three permitted outfalls to the Patapsco River. Outfall 001 consists of storm water run-off, cooling water, batch attack scrubber water, miscellaneous floor drainage from within the plant, and wastewater from a co-located Airco plant, which treats and bottles CO_2 gas produced by SCM's acid reactions. The effluent from Outfall 002 consists of process wastewater from the chloride process plant, cooling water, storm water drainage, Dorr tank (thickener) drainage from both the sulfate and chloride processes, as well as miscellaneous floor drainage. The effluent is treated with caustics and lime slurry in a series of ponds prior to discharge. Outfall 003 receives effluent from the acid neutralization plant.

In a November 29, 1995, letter to SCM, MDE noted that groundwater quality data suggested that the Batch Attack Lagoon was contaminating groundwater and possibly surface water. Monitoring wells located to the north and south of the asphaltic slurry wall indicated that groundwater was extremely acidic and contained elevated heavy metals. According to MDE, the source of the contamination is the sulfate process wastes disposed in the lagoon prior to 1991. The facility operated the lagoon under a RCRA permit prior to 1988. In 1988, SCM personnel asked that its permit application be withdrawn due to its Bevill exempt status.

MDE Water Management Administration personnel also indicated that in a recent meeting, SCM personnel had stated that very infrequently a spill or other incident causes the pH of the sulfate process wastewater to fall below 2, in which case the wastewater is diverted from entering the lagoon, thereby by-passing the treatment system, and is discharged directly to the Patapsco River. In the past year, a by-pass of the Batch Attack Lagoon has occurred once for a period of approximately 10 minutes, according to MDE personnel. In a January, 1997 meeting, a MDE representative expressed concern to SCM personnel that characteristically hazardous waste was being discharged to surface water. The facility representative assured MDE that these excursions occur very infrequently.

Type of Impact/Media Affected: Arsenic, cadmium, chromium, and lead are present in groundwater at levels above Federal Maximum Contaminant Levels (MCLs). The specific contaminant levels were not indicated in the files available for review. The location of nearby drinking water wells and the specific impact to human health or the environment were not available in the reviewed files.

Type of Release: Wastewater

Affected Media: Groundwater and surface water

Type of Contamination: Low pH and metals

Environmental Damage(s): Contamination of groundwater and surface water

Regulatory Action/Response: The Batch Attack Lagoon was never clean-closed due to the Bevill-exempt status of its wastestream. In a November 23, 1995 letter to SCM, MDE noted that the hydraulic performance of the slurry wall had not been adequately assessed. MDE asked SCM to verify the direction of groundwater flow within and outside the slurry wall. MDE recommended that the facility install additional piezometers along the northern boundary of the slurry wall. MDE also suggested that additional remedial measures may be required to contain contaminated groundwater from discharging into the Patapsco River. No response from SCM or further action on the part of MDE was indicated in the files available for review.

With regard to the possible characteristically hazardous wastewater releases to the Patapsco River, no further response or action on the part of MDE was indicated in the files available for review.

References:

Leizear, Jim, Hazardous Waste Enforcement Division, Maryland Department of the Environment. Personal communication. February 3, 1997.

McGillen, John, Water Management Administration, Maryland Department of the Environment. Personal communication. February 3, 1997.

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Chemicals, Incorporated.* May 14, 1990.

Maryland Department of the Environment. *Letter from Margaret M. Chauncey, Hazardous Waste Enforcement Division, to Sean Smith, SCM Chemicals-Americas.* November 29, 1995.

SCM Chemicals. *Letter from J.F. Bent, Hawkins Point Plant, to John A. Veil, Industrial Discharge Program, Maryland Department of the Environment.* July 24, 1990.

SCM Chemicals Hawkins Point Plant: "Chlorine Released to Air During Process Malfunction"

Sector(s): Titanium dioxide

Facility: SCM Chemicals Corp. (SCM) Hawkins Point Plant, Baltimore, Baltimore County, Maryland

Facility Overview: The SCM Hawkins Point Plant manufactures titanium dioxide, a white pigment, using a sulfate process and a chloride process.

Data Source(s): State files

Agency Contact: Parsuram Ramnarain, Air Management Administration, MDE

Waste and Material Management Practices: The SCM Chemicals Hawkins Point Plant manufactures titanium dioxide from two processes: 1) a sulfate process where titanium ores are ground and digested in batch attack vessels with sulfuric acid; and 2) a chloride process where titanium ore is chlorinated in the presence of carbon to produce titanium tetrachloride ($TiCl_4$), which is oxidized to produce titanium dioxide. SCM produces about 70,000 tons per year of the sulfate processed pigment for sale to the paper industry. The chloride processed pigment is used in paints, paper, and in powdered sugar. Acidic wastewater is produced from both processes. Most of the acid wastes from the sulfate process are stored in a lagoon and treated in an acid neutralization plant. Acid wastes from the chloride process are sold or neutralized with caustic and lime slurry. The solids from this process settle in a series of lagoons. The chloride plant is equipped with a venturi scrubber for collection of $TiCl_4$ emissions. Additional scrubbers at the chloride plant include the Peabody scrubber stack and the ferrous chloride scrubber.

SCM has three permitted outfalls to the Patapsco River. Outfall 001 consists of storm water run-off, cooling water, batch attack scrubber water, miscellaneous floor drainage from within the plant, and wastewater from a co-located Airco plant, which treats and bottles CO_2 gas produced by SCM's acid reactions. The effluent from Outfall 002 consists of process wastewater from the chloride process plant, cooling water, storm water drainage, Dorr tank (thickener) drainage from both the sulfate and chloride processes, as well as miscellaneous floor drains. The effluent is treated with caustics and lime slurry in a series of ponds prior to discharge. Outfall 003 receives effluent from the acid neutralization plant.

On November 1, 1993, chlorine gas (Cl_2) was released to the air due to a malfunction in the chlorination process. The malfunction allowed unreacted chlorine gas to exit the chlorination process and enter the residual gas stream. The Ferrous Chloride Scrubber was operating and scrubbed all but 78 pounds of the chlorine, which were released to the atmosphere.

Type of Impact/Media Affected: The chlorine release occurred for approximately 44 minutes. Chorine is designated as extremely hazardous under the SARA hazard designation. According to the facility, there were no known or expected health risks associated with the release.

Type of Release: Accidental release

Affected Media: Air

Type of Contamination: Chlorine

Regulatory Action/Response: The facility notified all regulatory agencies required. The facility shut off the process flows and discontinued productions. Additional information on facility and regulatory responses to this release were not indicated in the available files.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Chemicals, Incorporated.* May 14, 1990.

SCM Chemicals. *Letter from John F. Bent to Pam Phillips, Maryland State SARA, Emergency Response Commission, Re: Follow-up Report of an Emergency Release Notification*. November 8, 1993.

SCM Chemicals Hawkins Point Plant: "Multiple Discharges of Highly Acidic Wastewater into the Patapsco River"

Sector(s): Titanium dioxide

Facility: SCM Chemicals Corp. (SCM) Hawkins Point Plant, Baltimore County, Baltimore, Maryland

Facility Overview: The SCM Hawkins Point Plant manufactures titanium dioxide, a white pigment, using a sulfate process and a chloride process.

Data Source(s): State files

Agency Contact: Melvin Knott, Compliance and Biomonitoring Division, MDE

Waste and Material Management Practices:
The SCM Chemicals Hawkins Point Plant manufactures titanium dioxide from two processes: 1) a sulfate process where titanium ores are ground and digested in batch attack vessels with sulfuric acid; and 2) a chloride process where titanium ore is chlorinated in the presence of carbon to produce titanium tetrachloride, which is oxidized to produce titanium dioxide. SCM produces about 70,000 tons per year of the sulfate processed pigment for sale to the paper industry. The chloride processed pigment is used in paints, paper, and in powdered sugar. Acidic wastewaters are produced from both processes. Most of the acid wastes from the sulfate process are stored in a lagoon and treated in an acid neutralization plant. Acid wastes from the chloride process are sold or neutralized with caustic and lime slurry. The solids from this process settle in a series of lagoons.

SCM has three permitted outfalls to the Patapsco River. Outfall 001 consists of storm water run-off, cooling water, batch attack scrubber water, miscellaneous floor drainage from within the plant, and wastewater from a co-located Airco plant, which treats and bottles CO_2 gas produced by SCM's acid reactions. The effluent from Outfall 002 consists of process wastewater from the chloride process plant, cooling water, storm water drainage, Dorr tank (thickener) drainage from both the sulfate and chloride processes, as well as miscellaneous floor drains. The effluent is treated with caustics and lime slurry in a series of ponds prior to discharge. Outfall 003 receives effluent from the acid neutralization plant. The acid neutralization plant receives waste acid from the sulfate process. This waste is stored in a lagoon prior to treatment. Gypsum, a by-product of the neutralization process, is sold to farmers or U.S. Gypsum. Any unsold gypsum is landfilled. It was not clear from the reviewed files whether the gypsum is landfilled on-site or shipped off-site.

On February 3, 1992, the SCM Hawkins Point Plant violated its NPDES permit by discharging effluent with a pH below 2 for 15 continuous minutes through Outfall 001 into the Patapsco River. Approximately 90,000 gallons of acidic wastewater were released. The excursion was caused by the sudden failure of a processing unit in the sulfate manufacturing plant. A leak in the processing unit occurred, which permitted acidified feed stock to mix with process wastewater and flow through Outfall 001. Process instrumentation detected the leak immediately and the process unit was shut down. The acidified feedstock continued to drain from the unit until the feedstock level dropped below the area of the leak.

On June 30, 1993, the SCM Hawkins Point Plant violated its NPDES permit by discharging effluent with a pH below 2 for 11 continuous minutes through Outfall 001 into the Patapsco River. Approximately 80,000 gallons of acidic wastewater were released. The cause of the excursion was identical to the February 3, 1992 release.

On November 6, 1993, the SCM Hawkins Point Plant violated its NPDES permit by discharging effluent with a pH below 2 for 13 continuous minutes through Outfall 001 into the Patapsco River. Approximately

57,200 gallons of acidic wastewater were released. The excursion was caused by the failure of a level controller to actuate an automatic shut-off valve. The process vessel overflowed onto the building floor, out a door, and into a storm drain, which carried the solution through the 001 treatment station. When the foreman was notified of the spill, the pump filling the vessel was shut down. The acidic material on the floor was contained and neutralized.

On January 19, 1994, the SCM Hawkins Point Plant violated its NPDES permit by discharging effluent with a pH level between 4 and 6 for 100 continuous minutes through Outfall 002 into the Patapsco River. The excursion occurred when caustic treatment lines in the wastewater treatment system froze due to extremely cold weather. The plant's environmental technician increased the caustic addition at the upstream 002 neutralization plant in an attempt to increase the pH of the settling basin. The caustic lines were eventually thawed and used to balance the pH level of the discharge.

Type of Impact/Media Affected: According to the plant manager, no adverse impact to the Patapsco River was detected for any of the aforementioned excursions. Based on a visual inspection of the river, the plant manager believes that the effluent was completely neutralized within 25 yards of the outfall.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Low pH

Environmental Damage(s): Contamination of surface water

Regulatory Action/Response: Each pH excursion was reported verbally and in writing to the Maryland Department of the Environment (MDE). In each case, additional caustic was introduced to the wastewater treatment system to reduce the acidity and minimize the length of the excursion. Both the February 1992 and the June 1993 excursion reports indicated identical steps being taken to avoid a reoccurrence: a new maintenance schedule was instituted so that all process units will be inspected routinely every 120 days. The plant manager reviewed the standard operating procedure of radio communication between the shift operations foreman and the environmental shift technician to assure an expeditious response in the event of a future spill.

After the November 1993 incident, the overflow line from the process vessel was extended to a containment area that leads to a neutralization plant. Also, an alarm was installed in the overflow line.

In 1994, after the caustic lines were thawed to permit treatment at Outfall 002, additional monitoring was continued through the cold weather period.

Responses and actions taken by MDE were not included in the file available for review.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Chemicals, Incorporated.* May 14, 1990.

SCM Chemicals. *Letter from John F. Bent, Hawkins Point Plant, to Rick Collins, Hazardous and Solid Waste Management, Maryland Department of the Environment.* February 10, 1992.

SCM Chemicals. *Letter from John F. Bent, Hawkins Point Plant, to Rick Collins, Hazardous and Solid Waste Management, Maryland Department of the Environment.* July 2, 1993.

SCM Chemicals. *Letter from John F. Bent, Hawkins Point Plant, to Rick Collins, Hazardous and Solid Waste Management, Maryland Department of the Environment.* November 10, 1993.

SCM Chemicals. *Letter from John F. Bent, Hawkins Point Plant, to Mike Huether, Waste Management Inspection and Compliance Division, Maryland Department of the Environment.* January 24, 1994.

SCM Chemicals Hawkins Point Plant: "Multiple Releases of Titanium Tetrachloride to Air"

Sector(s): Titanium dioxide

Facility: SCM Chemicals Corp. (SCM) Hawkins Point Plant, Baltimore, Baltimore County, Maryland

Facility Overview: The SCM Hawkins Point Plant manufactures titanium dioxide, a white pigment, using a sulfate process and a chloride process.

Data Source(s): State files

Agency Contact: Parsuram Ramnarain, Air Management Administration, MDE

Waste and Material Management Practices: The SCM Chemicals Hawkins Point Plant manufactures titanium dioxide from two processes: 1) a sulfate process where titanium ores are ground and digested in batch attack vessels with sulfuric acid; and 2) a chloride process where titanium ore is chlorinated in the presence of carbon to produce titanium tetrachloride($TiCl_4$), which is oxidized to produce titanium dioxide. SCM produces about 70,000 tons per year of the sulfate processed pigment for sale to the paper industry. The chloride processed pigment is used in paints, paper, and in powdered sugar. Acidic wastewater is produced from both processes. Most of the acid wastes from the sulfate process are stored in a lagoon and treated in an acid neutralization plant. Acid wastes from the chloride process are sold or neutralized with caustic and lime slurry. The solids from this process settle in a series of lagoons. The chloride plant is equipped with a venturi scrubber for collection of $TiCl_4$ emissions. Additional scrubbers at the chloride plant include the Peabody scrubber stack and the ferrous chloride scrubber.

On November 5, 1991, a seepage below the crude titanium tetrachloride tank was discovered. The titanium tetrachloride was fuming, causing a release to the atmosphere. From discovery of the leak until the tank was repaired spanned more than 27 hours. The volume of titanium tetrachloride released was not indicated in the files reviewed.

On July 2, 1993, titanium tetrachloride was spilled into a containment area during the replacement of a level measuring device on a titanium tetrachloride treatment reactor. Approximately four pounds of titanium tetrachloride were released to the atmosphere.

On May 29, 1994, a titanium tetrachloride release occurred when a hole developed in the process duct work of the chlorination area, allowing 25 pounds of titanium tetrachloride to be released to the atmosphere. The release occurred over a sixteen minute period.

Type of Impact/Media Affected: Titanium tetrachloride is designated as extremely hazardous under SARA. The information in the reviewed files on the release in November 1991 did not indicate whether there was an environmental or human health impact. The 1993 and 1994 releases were not associated with any known or anticipated health risks, according to the facility.

Type of Release: Leaks and spills

Affected Media: Air

Type of Contamination: Titanium tetrachloride

Regulatory Action/Response: In response to the seepage from the crude titanium tetrachloride tank in November 1991, the facility used a HAZMAT foam cart to suppress fuming. The maintenance scrubber system also was used to remove fumes from the area and to scrub the fumes prior to release to the atmosphere. The titanium

tetrachloride was pumped from the tank, and an area of concrete below the tank was removed to access the leak. The tank was repaired using a small metal saddle covered by a large rubber patch and another larger metal saddle patch. Both the Baltimore City Fire Department and the State of Maryland Emergency Response Team were notified and were present at the plant. No information on corrective actions or enforcement actions was present in the files reviewed.

In response to the 1993 release, the pump transferring titanium tetrachloride to the treatment reactor was shut off. HAZMAT foam was applied to the spill in the containment area to stop the release. The facility contacted all the regulatory agencies required. No additional information on facility or regulatory actions was present in the files reviewed.

In response to the 1994 release, the process flows were shut off and production was discontinued. The facility notified all regulatory agencies required. No additional information on facility or regulatory actions was present in the files reviewed.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Chemicals, Incorporated.* May 14, 1990.

SCM Chemicals. *Letter from John F. Bent to Richard Collins, MDE*. November 18, 1991.

SCM Chemicals. *Letter from John F. Bent to Pam Phillips, Maryland State SARA, Emergency Response Commission*. July 21, 1993.

SCM Chemicals. *Letter from Ronald B. Root to Pam Phillips, Maryland State SARA, Emergency Response Commission*. June 2, 1994.

SCM Chemicals St. Helena Plant: "Ammonia-Contaminated Effluent Causes Toxicity"

Sector(s): Cadmium

Facility: SCM Chemicals Corp. (SCM) Colors and Silica Business (also referred to as SCM St. Helena Plant), Baltimore County, Baltimore, Maryland

Facility Overview: At the SCM St. Helena Plant, cadmium is reduced to a cadmium sulfate liquor with the addition of sulfuric and nitric acid to produce color pigments.

Data Source(s): State files

Agency Contact: Melvin Knott, Compliance and Biomonitoring Division, MDE

Waste and Material Management Practices: The SCM Chemicals St. Helena Plant manufactures color pigments from cadmium. Sulfuric acid and nitric acid are used to reduce cadmium to a cadmium sulfate liquor. From the reviewed files, it was not clear whether the facility's raw materials include cadmium ore or cadmium metal. The pigment plant manufactures two categories of pigment: pures and lithopones. Ammonium is generated in the liquor attack operation, where cadmium sulfate is purified for use in the striking operation. Striking is a process that produces a filterable slurry, which is further processed into pigments. Ammonium sulfate is an unavoidable by-product of these processes and is separated from the cadmium sulfide precipitate following striking. Ammonium carbonate is a by-product of certain red lithopone pigments and may represent 35 to 75 percent of the entire ammonia burden from the plant, according to the plant manager. All pigment process wastewater is collected in scavenger tanks and treated with ferrous sulfide. After settling, the wastewater is pumped to the scavenger presses and is then discharged through Outfall 001 to Colgate Creek. A turbidity monitoring system stops and recirculates any discharge not properly treated.

This facility also includes an Amorphous Silica Plant, which manufactures silica gel. The wastewater from the silica production is discharged through Outfall 002 to Colgate Creek. The Silica Plant does not contribute to Outfall 001.

Prior to 1990, Maryland Department of the Environment (MDE) determined that effluent from Outfall 001 failed toxicity tests. Ammonia was determined to be the cause of both acute and chronic toxicity. Detailed analysis from the toxicity tests was not available in the files reviewed.

Type of Impact/Media Affected: The specific impact to aquatic life in Colgate Creek was not available in the reviewed files.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Ammonia

Environmental Damage(s): Toxicity to aquatic life

Location of Affected Populations: Colgate Creek

Regulatory Action/Response: MDE required SCM to prepare a plan and schedule for implementing measures to eliminate acute toxicity and reduce chronic toxicity to acceptable levels. In 1990, SCM submitted a plan to MDE outlining process changes for red lithopone pigments and an effluent treatment system. The proposed effluent treatment system changes included segregating the striking process filtrate, which contains ammonium sulfate, from other plant wastewaters. The ammonia wastewater would be processed through an ammonia stripping column and commingled with all other plant wastewater. The facility also planned to install a diffuser for all wastewater. The facility manager estimated that the proposed changes would eliminate the acute toxicity of Outfall 001 and reduce ammonia

discharges to a maximum of 19.8 ppm at a pH of 6.6. Subsequently, the plant decided to cease all discharges from Outfall 001 to Colgate Creek. Since 1993, all effluent from Outfall 001 has been discharged to a publicly owned treatment works. MDE considers the toxicity reduction evaluation complete for Outfall 001.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Glidco Organics Corporation.* May 8, 1990.

Maryland Department of the Environment. *Letter from Melvin H. Knott, Biomonitoring Division, to Michael P. Shaughness, SCM Chemicals.* September, 16, 1993.

SCM Chemicals. *Letter from Michael P. Shaughness, Colors and Silica Business, to Melvin H. Knott, Compliance and Biomonitoring Division, Maryland Department of the Environment.* September 7, 1993.

SCM Chemicals. *Letter from Robert M. Mohr, P.E., Colors and Silica Business, to Melvin H. Knott, Compliance and Biomonitoring Division, Maryland Department of the Environment.* February 9, 1990.

SCM Chemicals St. Helena Plant: "Multiple Discharges of Cadmium-Contaminated Effluent into Colgate Creek"

Sector(s): Cadmium

Facility: SCM Chemicals Corp. (SCM) Colors and Silica Business (also referred to as SCM St. Helena Plant), Baltimore County Baltimore, Maryland

Facility Overview: The SCM St. Helena Plant manufactures color pigments from cadmium.

Data Source(s): State files

Agency Contact: John Beasley, Industrial Discharge Enforcement Division, MDE

Waste and Material Management Practices: The SCM Chemicals St. Helena Plant manufactures red and yellow color pigments from cadmium. Sulfuric acid and nitric acid to reduce cadmium to a cadmium sulfate liquor. From the reviewed files, it was not clear whether the facility's raw materials include cadmium ore or cadmium metal. Wastewater from the color pigment plant is discharged through Outfall 001 to Colgate Creek.

Process wastewater is sampled for soluble cadmium prior to filtration to determine if treatment is necessary. If treatment is needed, the plant operator performs the required treatment, and resamples and analyzes the wastewater. Treatment is repeated if necessary. Filtration does not begin until the plant lab determines that soluble cadmium is at an acceptably low level. During filtration, the filter operator samples the filtrate for cadmium, and this sample is held as a "retainer sample."

The facility also includes an Amorphous Silica Plant, which manufactures silica gel. The wastewater from the silica production is discharged through Outfall 002 and is not the source of cadmium exceedances.

On January 31, 1990, the SCM St. Helena Plant violated its NPDES permit by discharging effluent containing 1.569 pounds of total cadmium. The permitted daily maximum quantity for cadmium is 0.49 pounds. A strike batch was approved for filtration containing only 0.12 ppm soluble cadmium. When the plant operator learned that Outfall 001 had exceeded its daily limit for cadmium, the retainer sample was analyzed. The retainer sample contained 99 ppm soluble cadmium. The cause of the high-cadmium content filtrate was operator error. An operator did not fully close the strike tank (reaction tank) bottom outlet valve, resulting in raw materials entering the wastewater filtrate process.

On November 5, 1992, SCM again violated its NPDES permit by discharging effluent containing 1.32 pounds of total cadmium. This violation was caused by one of two scenarios at the plant's red treatment collection system. Concentrated acid was added to the plant's red treatment collection system through routine draining and cleaning. The acid reduced the pH of the wastewater in the collection system to 5.4 where the relatively low pH could cause cadmium carbonates and cadmium hydroxides in the red treatment system scavenger tank and filter press to become water soluble. Another possible cause of the cadmium exceedance was determined to be an accidental opening of the manifold drain valve, which could be opened to the red treatment system or to the metals recovery tank. The manifold pipe holds approximately 1 gallon of ionic cadmium liquor from the metals recovery tank. A release of only 1 quart of cadmium liquor into the red treatment system would account for the amount of cadmium released.

Type of Impact/Media Affected: The specific impact to aquatic life in Colgate Creek from the January 31, 1990, release was not available in the reviewed files.

According to the SCM environmental engineer, there was no threat to human health or the environment from the November 5, 1992 release. The estuary pH is naturally buffered above the point where cadmium is soluble in water and the tidal flow in Colgate Creek is 20 million gallons per day (mgd). The cadmium concentration in the receiving water on November 5, 1992, was 7.9 ppb. EPA's marine acute criteria for cadmium is 43 ppb, and the marine chronic criteria for cadmium is 9.3 ppb. The human health criteria for cadmium is 170 ppb.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Cadmium

Environmental Damage(s): Contamination of surface water

Location of Affected Populations: Colgate Creek

Regulatory Action/Response: SCM personnel verbally reported the 1990 exceedance to Maryland Department of the Environment (MDE) within 24 hours. On February 5, 1990, SCM forwarded a written report to MDE, describing the incident and probable cause. SCM's Maintenance and Engineering Manager stated that all operators would be instructed on the correct procedures for charging raw materials into the strike tank. Any response or actions taken by MDE were not documented in the files available for review.

In 1992, the release exceeded the CERCLA reportable quantity of 1 pound for cadmium compounds and was reported to state, federal, and local agencies. From the reviewed files, there was no conclusion as to which of the aforementioned scenarios actually caused the exceedance. To prevent a recurrence, the plant engineer indicated to MDE that SCM would modify the metals recovery tank manifold valves and post warning signs against acid usage in the red treatment system. The correct procedures required to prevent a recurrence would be reviewed with production and maintenance personnel. Responses of and actions taken by MDE were not available in the files reviewed.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Glidco Organics Corporation.* May 8, 1990.

SCM Chemicals. *Letter from Peter J. Cullati, Colors and Silica Business, to John Beasley, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* February 5, 1990.

SCM Chemicals. *Letter from John B. Essers, Colors and Silica Business, to John Beasley, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* November 13, 1992.

SCM Chemicals St. Helena Plant: "Multiple Discharges of Zinc-Contaminated Effluent into Colgate Creek"

Sector(s): Cadmium

Facility: SCM Chemicals Corp. (SCM) Colors and Silica Business (also referred to as SCM St. Helena Plant), Baltimore County Baltimore, Maryland

Facility Overview: The SCM St. Helena Plant manufactures color pigments from cadmium.

Data Source(s): State files

Agency Contact: John Beasley, Industrial Discharge Enforcement Division, MDE

Waste and Material Management Practices: The SCM Chemicals St. Helena Plant uses sulfuric acid and nitric acid are used to reduce cadmium to a cadmium sulfate liquor. From the reviewed files, it was not clear whether the facility's raw materials include cadmium ore or cadmium metal. Certain elements are added to the cadmium sulfate liquor in the strike tank (reaction tank), including zinc sulfate, which produce yellow pigments. After leaving the strike tanks, the pigment slurry is filtered, dried, calcined, refiltered, dried, blended, and milled into the finished product. The facility also includes an Amorphous Silica Plant, which manufactures silica gel. The silica plant associated with this facility does not discharge wastewater through Outfall 001.

Process wastewater is sampled for zinc prior to filtration to determine if treatment is necessary. If treatment is needed, the plant operator performs the required treatment, then resamples and analyzes the wastewater. Treatment is repeated if necessary. Filtration does not begin until the plant lab determines that zinc and other metals are at an acceptably low level. During filtration, the filter operator samples the filtrate, and this sample is held as a "retainer sample." Wastewater from the color pigment plant is discharged to Colgate Creek through Outfall 001.

On June 1, 1990, the SCM St. Helena Plant violated its NPDES permit by discharging effluent containing 0.14 pounds of total zinc. The permitted daily maximum discharge quantity for zinc is 0.11 pounds. The source of this exceedance was determined to be a recently installed floor scrubbing machine. The machine picked up zinc sulfate from the processing area floor. The cleaning and maintenance operator emptied the floor scrubber wastewater into the wrong tank, by-passing the site's treatment system.

On April 15, 1992, the SCM St. Helena Plant violated its NPDES permit by discharging effluent containing 0.156 pounds of total zinc. The 1992 release was due to a miscalculation by the SCM laboratory analyst. The mathematical error caused the analyst to incorrectly approve a batch of wastewater with elevated levels of zinc for discharge through Outfall 001.

On April 6, 1993, the SCM St. Helena Plant again violated its NPDES permit by discharging effluent containing 0.124 pounds of zinc. On April 7, 1993, operators checked all equipment related to the pigment process and the wastewater treatment system and found no malfunctions. On April 8, the site laboratory began sampling the discharge hourly and isolated the problem in the red pigment process. Wastewater from this process was leaching zinc from the filter cake in the wastewater filter press.

Type of Impact/Media Affected: The specific impact to aquatic life from the 1990 and 1992 incidents was not available in the reviewed files. The permitted daily maximum quantity for zinc is 0.11 pounds. According to the plant manager there was no threat to human health or the environment from the 1993 release. The tidal

flow in Colgate Creek is 20 million gallons per day (mgd). The zinc concentration at Outfall 001 was 18 ppb. EPA's marine acute criteria for zinc is 95 ppb, and the marine chronic criteria for zinc is 86 ppb.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Zinc

Environmental Damage(s): Contamination of surface water

Location of Affected Populations: Colgate Creek

Regulatory Action/Response: SCM personnel verbally reported the exceedance to MDE on April 12, 1993. On April 19, 1993, SCM forwarded a letter to MDE describing the incident and probable cause. SCM's plant manager instructed the plant supervisor and all operators to remove the filter cake from the press daily. This should reduce the build-up of zinc compounds in the press. The operators also will adjust the pH specifications on batches to minimize the amount of soluble zinc present. Correct procedures for handling zinc compounds were reviewed with all operators.

Following each NPDES permit violation, the facility notified the Maryland Department of Environment (MDE). Responses and actions taken by MDE were not included in the files available for review.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Glidco Organics Corporation.* May 8, 1990.

SCM Chemicals. *Letter from John B. Essars, SCM St. Helena Plant, to Sharon E. Talley, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* April 23, 1992.

SCM Chemicals. *Inter-Office Memo from Leonard J. Ulicny to John Essars.* April 20, 1992.

SCM Chemicals. *Letter from John B. Essars, Colors & Silica, to James W. Metz, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* May 26, 1992.

SCM Chemicals. *Letter from Peter J. Cullati, Colors & Silica Business, to John Beasley, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* June 8, 1990.

SCM Chemicals. *Letter from Peter J. Cullati, Colors & Silica Business, to James W. Metz, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* July 26, 1990.

SCM Chemicals St. Helena Plant: "Multiple Turbid Discharges Enter Colgate Creek"

Sector(s): Silica

Facility: SCM Chemicals Corp. (SCM) Colors and Silica Business (also referred to as SCM St. Helena Plant), Baltimore County, Baltimore, Maryland

Facility Overview: The SCM St. Helena Plant manufactures fine particle silica gel from silica.

Data Source(s): State files

Agency Contact: John Beasley, Industrial Discharge Enforcement Division, MDE

Waste and Material Management Practices: The SCM Chemicals St. Helena Plant, located in Baltimore, Maryland, produces fine particle silica gel, reacting sodium silicate with sulfuric acid. The silica gel is washed with hot water and aged in a dilute ammonia solution. Wastewater from this process consists of water from filtration and washing operations. The wastewater is collected in sumps where it is neutralized. The neutralized wastewater is then filtered through several screens. The filtered solids are primarily sand and are non-hazardous. After passing through a heat exchanger, the filtered wastewater is discharged through Outfall 002 to Colgate Creek.

On March 9, 1990, the SCM St. Helena Plant violated its NPDES permit by discharging effluent containing 109.57 pounds of total suspended solids (TSS). The permitted daily maximum quantity for TSS is 98 pounds. According to an SCM manager, the source of this exceedance may have been a leaking gasket on the gel tank door. The faulty gasket would have allowed sodium silicate to enter the sumps where wastewater is adjusted for pH.

On February 19, 1993, the SCM St. Helena Plant again violated its NPDES permit by discharging effluent containing 157.5 pounds of TSS. The solids were identified as sand through process knowledge and analysis. According to the site engineer, the exceedance was caused by one or both of the following: 1) the solids removal screen was uniformly worn, thus allowing micron size silica solids through the weave of the screen; and/or 2) the start-up operations on the morning of February 18, 1993, followed a record-setting nighttime freeze. Thermal contraction of the equipment and discharge piping system during the night, followed by thermal expansion from the warm process wastewater, could cause residue on the inside of the piping system to dislodge, thereby increasing the TSS levels of the discharge.

Type of Impact/Media Affected: The specific impact to aquatic life from the 1990 incident was not available in the reviewed files. The permitted daily maximum quantity for TSS is 98 pounds. According to the plant manager there was no threat to human health or the environment from the 1993 release. Sand does not have a marine criteria, fresh water criteria, or human health criteria. The State of Maryland does not have a water quality-based criteria for total suspended solids. The Maryland turbidity criteria is 150 Nephelometric Turbidity Units (NTU). The 1993 effluent composite sample had a turbidity of 7 NTU.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Total suspended solids

Environmental Damage(s): Contamination of surface water

Location of Affected Populations: Colgate Creek

Regulatory Action/Response: SCM personnel verbally reported the March 9, 1990 exceedance to Maryland Department of the Environment (MDE) on March 12, 1990. On March 15, 1990, SCM forwarded a letter to MDE describing the incident and probable cause. Once aware of the TSS exceedance at Outfall 002, the plant operator

stopped the gasket leak with a clamp and diverted the effluent flow to holding ponds. The effluent tank also was drained to the holding ponds. All equipment was cleaned to remove any silica gel. The faulty gasket was replaced. The silica-bearing effluent was reacted with acid to produce a gel. Most of this gel was captured by the filters, however, some of it passed through the filter, causing a higher than normal TSS discharge to Colgate Creek. The plant manager noted that this minor gasket leak may not explain the entire problem. The site manager planned to conduct tests to determine if certain impurities in the silicate interfere with proper crystallization. If changes in the process do not reduce TSS, then the site will add an additional treatment step to improve the filter's efficiency. No further information was available in the reviewed files.

After the February 19, 1993 incident, which was reported verbally and in writing to MDE, SCM operators replaced the screen on the solids removal equipment. The plant engineer also indicated that operators will inspect the piping system when weather or shutdown schedules suggest a potential for thermal contraction and expansion.

References:

Maryland Department of the Environment. *Compliance Sampling Inspection at SCM Glidco Organics Corporation.* May 8, 1990.

SCM Chemicals. *Letter from Peter J. Cullati, Colors & Silica Business, to John Beasley, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* March 15, 1990.

SCM Chemicals. *Letter from John B. Essars, Colors & Silica Business, to John Beasley, Industrial Discharge Enforcement Division, Maryland Department of the Environment.* February 25, 1993.

USMX, Inc., Alligator Ridge Mine: "Spills of Process Solutions to Soil Surfaces"

Sector(s): Gold

Facility: USMX, Inc., Alligator Ridge Mine, White Pine County, Nevada

Facility Overview: Operations at the Alligator Ridge Mine consist of open pit mining and leaching. Gold recovery is accomplished by carbon adsorption, carbon stripping, and electrowinning.

Data Source(s): State files

Agency Contact: Dave Gaskin, Bureau of Mining Regulation and Reclamation

Waste and Materials Management Practices: Operations at the Alligator Ridge Mine consist of open-pit mining and heap leach cyanidation. Gold recovery is accomplished by carbon adsorption, carbon stripping, and electrowinning.

The facility consists of ore pits, leach pits, leach pads (phases I and II), process solution ponds, a leachate processing facility, a crushing plant, and a tailings impoundment. Phase I pads (B through L) consist of compacted clay liners with drainage supplied by a system of PVC pipes. Phase II pads (M, N, and O) were constructed of six inches of compacted clay covered with a 40-mil HDPE liner.

A single pregnant pond exists at the facility lined with a single layer of 60-nil HDPE on top of a 12 inch compacted clay liner. A french drain is located in the lowest part of the pond and runs out to a leak detection sump. A single barren solution pond is located near the process plant. This pond was relined in 1988 with 60-mil HDPE.

The facility is capable of diverting runoff resulting from a 100-year, 24-hour storm event.

A total of five spill events occurred during 1990 to 1992 resulting in approximately 6,600 gallons of process solution containing sodium cyanide and 5,000 gallons of muratic acid being released onto surrounding soils. The majority of spill were the result of equipment failures, such as split lines, fractured fittings, and cracked pipes. Operator error, as well as freezing weather conditions were also cited as contributing factors in a number of the spills.

Type of Release: Process solution, muratic acid

Nature of Contamination: Soil surface

Type of contamination: Cyanide, muratic acid

Type of Impact/Media Affected: In January of 1990, a third spill resulted in 4,500 gallons of process solution being released. In this case, turning on the pregnant solution pump overpressurized a frozen line and caused a blowout, which sent some of the solution into a roadside ditch. On consecutive days, March 27 and again on March 28, 1990 spills occurred at the Alligator Ridge Mine. In the first case, an air bubble caused 300 gallons of process solution to be released from an extracted flow meter under repair near barren solution pumps. On the following day, freezing conditions and over-pressurization of a line caused a cracked pipe/flange weld to rupture resulting in the release of nearly 1,800 gallons of process solution onto a roadway. In February of 1991, a small spill occurred at the mine resulting in 1.43 pounds sodium cyanide being spilled. The final spill occurred in May of 1992. A fractured fitting on a tank resulted in release of 5,000 gallons of muratic acid. The spill resulted in a plume approximately 500 feet long.

Regulatory Action/Responses: In March 1990 and February 1991 spills involving sodium cyanide process solution, hydrogen peroxide was utilized to neutralize areas impacted. In the largest spill of 4,500 gallons, the spill was contained in a drainage ditch where cold temperatures froze the solution. Lack of adequate maneuvering room for equipment precluded transport of the material back onto the heap leach pad for re-leaching. The mine conducted follow-up sampling to monitor neutralization success. Remediation in the spill involving muratic acid consisted of containment of the leaking tank followed by neutralization of the acid by soda ash and caustic. Sampling performed following cleanup indicated that the soil pH within 1000 ft of the spill was above 6.9. In all cases the appropriate regulatory agencies were notified soon after spill detection.

References:

Alligator Ridge Mine. Cyanide Discharge Report. January 2, 1990.

Alligator Ridge Mine. Record of Communication Regarding Cyanide Solution Leak. January 4, 1990.

Alligator Ridge Mine. Memo Regarding January 2, 1990 Spill. January 10, 1990.

Alligator Ridge Mine. Memo Regarding Spill on January 2, 1990. January 23, 1990.

Alligator Ridge Mine. Cyanide Discharge Report. March 27, 1990.

Alligator Ridge Mine. Cyanide discharge Report. March 28, 1990.

Nevada Division of Environmental Protection (NDEP). Record of Communication with Alligator Ridge Mine. March 29, 1990

Alligator Ridge Mine. Memo to Kathy Sertic Regarding Spills on March 27 and 28, 1990. April 3, 1990.

NDEP. Spill Report Form. February 14, 1991.

NDEP. Spill Report Form. May 6, 1992.

USMX. Memo to NDEP Regarding Cleanup of Muratic Acid Spill on May 6, 1992. May 27, 1992.

Tom Card, Nevada Division of Environmental Protection (NDEP). Fact Sheet Regarding USMX, Inc., Alligator Ridge Mine. September 4, 1992.

The Aurora Partnership Auora Gold Project: "Notice of Violation and Multiple Spills"

Sector(s): Gold

Facility: The Aurora Partnership Aurora Gold Project, Mineral County Nevada

Facility Overview: Operations conducted at the facility include open pit gold mining and cyanide heap leach recovery processes. The facility is required to operate and close the facility without a waste water discharge.

Data Source(s): State files

Agency Contact: Dave Gaskin, Bureau of Mining Regulation and Reclamation

Waste and Material Management Practices: The project consists of open pit mining and cyanide heap leach recovery processes. Ore from the pit is hauled to a crushing and agglomeration area and then placed on the leach pad. The pad rests on a 40 mil PVC liner that covers a prepared subbase, compacted 95% to prevent leakage. The collection pipes rest between the liner and pad and direct flow to the HDPE-lined collection channels. The channels flow to the pregnant solution pond, that is lined with a 60 mil HDPE liner over a prepared subbase. Two layers of geotextile were placed on the prepared subbase to create a percolation zone to the sump, located at the lowest corner of the pond. The sump is monitored for fluids. If a leak develops, the fluid can be pumped to an overflow pond until the leak is repaired.

Enforcement action. On June 27, 1995, NDEP issued a Finding of Alleged Violation and an Order to Aurora. The FOAV and Order were apparently based on findings of an inspection on April 10, 1995. Neither the inspection report nor the FOAV and Order were located in the files. The information presented here was taken from a letter from NDEP to Aurora on October 5, 1995; a Bureau of Mining Regulation and Reclamation inter-office memorandum dated January 3, 1996; and Aurora's written response to the FOAV and Order, dated March 1, 1996.

In early 1995, ponding on the heap (reported by Aurora to be the result of heavy precipitation) caused the front of the heap to wash out and move process fluids and heap materials beyond the toe of the heap. The amounts were unspecified in available materials. Remediation began with moving material back to containment and undertaking unspecified detoxification of uncontained residual materials. Aurora also worked to regrade the heap and to install new piping and tubes. Most importantly, Aurora undertook efforts to clear solution ditches that are impeded or blocked by ore and fines; clearing had to be by hand-shoveling to avoid damage to liners. Finally, Aurora had to develop and implement a monitoring and maintenance plan.

The FOAV also addressed leakage of solution from carbon-in-leach piping: Aurora reported that up to 319 gallons of solution containing 0.29 pound of cyanide "may have been released from containment." Beyond repairing the piping, Aurora had to extend the concrete containment area.

Finally, the FOAV addressed acid drainage from some materials in the heap stockpiles and from the chemical storage area, the berms for which were constructed with acid-generating materials. Aurora regraded the stockpiles to prevent ponding and compacted them to reduce infiltration; they also constructed perimeter ditches to capture runoff, and these lead to sumps, where water is monitored and, if necessary, neutralized before discharge to an "event pond" or used as makeup water. The January 1996 memorandum cited above identifies some areas where Aurora had yet to come into compliance with the Order, among them the analysis of CIL-area contaminated soil and the clearing of solution ditches. A Show Cause hearing on the FOAV and Order was scheduled for February 1996. Records of the hearing were not found in the files.

The facility has reported several releases between 1992 and 1996. These releases result from equipment failures at the facility. Failures include blown pipe fittings as a result of freezing conditions and an accident involving a piece of mobile equipment.

March 6, 1995. The facility had a spill of 500 - 700 gallons of cyanide leach solution at a concentration of 50 ppm. A drip line froze and the resulting pressure caused the rupture of a pipe. Facility personnel channeled the solution back to the pregnant solution pond. They also treated any contaminated soil with calcium hypochlorite.

Type of Release: Spill

Nature of Contamination: Soil, containment berm

Type of contamination: Cyanide leach solution, sodium cyanide, cyanide, denatured alcohol, and WAD cyanide.

Environmental Damage(s): Soil

July 19, 1994. The facility had a spill of 50 gallons of cyanide at a concentration of 50 ppm. The cause of the spill was a rupture in one of the dripline feed pipes, resulting in material being washed down from the heap. The material collected in the lower containment area of the pad. A small amount of solution and fine suspended solids escaped over the containment berm. Facility personnel immediately treated the area with calcium hypochlorite to neutralize the cyanide. The contamination reached a depth of only a few inches and constituted about 600 pounds of soil. This material was shoveled up and removed to a plastic lined area.

January 11, 1994. 200 gallons of sodium cyanide solution were spilled when a pipe fitting ruptured near pad 1. Facility personnel neutralized the spill, excavated contaminated soil and moved it to a containment area behind Pad #1.

June 3, 1993. The facility had spilled of 6,400 gallons of denatured alcohol in a chemical storage area (the alcohol is used as a strip solution). The spill was caused when a bulk storage tank was struck by a piece of mobile equipment. This knocked a fitting loose, damaging a valve, and resulted in the discharge of the denatured alcohol. Facility personnel removed any potential ignition sources from the area as denatured alcohol's main hazard is ignitability. Free standing alcohol was pumped back into appropriate containers. The impacted area was then allowed to dry and was then flushed with 4000 gallons of fresh water. Any residual alcohol was allowed to evaporate.

The damaged valve was repaired to prevent additional leakage. Additional protective berms were installed to prevent any further collisions with the storage tanks.

January 16, 1992. The facility had a release of 1,000 gallons of solution with a WAD cyanide concentration of 155 mg/l. The spill was a result of the combination of a small leak in the leachate ditch liner and an increase in the operating level of the solution due to snow and ice accumulation. The solution accumulated under the ditch liner in a localized area. Facility personnel continually pumped the leakage back into the solution circuit. The area under the liner was treated with calcium hypochlorite for cyanide destruction.

References:

Steve Rosse. Fact Sheet - The Aurora Partnership, Aurora Gold Project. March 8, 1994.

The Aurora Partnership. *Written Spill Report*. March 6, 1994.

The Aurora Partnership. *Written Spill Report*. July 26, 1994.

The Aurora Partnership. *Written Spill Report*. January 11, 1994.

The Aurora Partnership. *Written Spill Report*. June 15, 1993.

Placer Dome U.S. Inc.'s Bald Mountain Mine: "Spills of Process Solution to Soil Surfaces" and "Leak in Primary Line"

Sector(s): Gold

Facility: Placer Dome U.S. Inc., Bald Mountain Mine, Elko, Nevada

Facility Overview: Operations include open pit mining and heap leaching of gold ore. Facilities consist of No. 1 and No. 2 process leach pads, associated process ponds, process buildings, crusher building, open pit mines, and waste rock dumps. All ponds possess primary and secondary liners and leak detection/collection systems.

Data Source(s): State files

Agency Contact: Dave Gaskin, Bureau of

Waste and Materials Management Practices: Operations conducted at the facility include open pit gold mining and heap leaching. Bald Mountain Mine facility consists of No. 1 and No. 2 process leach pads, associated process ponds, process buildings, crusher building, open pit mines, and waste rock dumps. The three pregnant solution ponds, barren solution pond, and settling pond in the No. 1 process area possess a leak detection system between a 60 mil HDPE primary liner and a six inch clay/soil secondary liner. Each pond has an independent leak detection sump filled with clear gravel. Any leakage from the primary liner gravity-flows between the liners to the sump where it is removed through a leak detection port. The pregnant solution pond, barren solution pond, and settling pond at No. 2 process area consist of a 60 mil HDPE primary liner and a leak collection/detection system above a 6 inch compacted secondary liner. Pond leak detection systems report to a common external sump inside the process building.

Both process areas are designed to contain 25-year/24-hour storm event flows. The facilities are required to be designed, constructed, operated and closed without discharge or release in excess of standards established in regulations except during meteorological events exceeding the design storm event.

Between 1991 and 1995 three spills at the facility released process solution containing varying concentrations of cyanide to the surrounding soils. The causes of the spills were traced to faulty or loose valves located near the process building and settling/barren ponds and operator error/improper installation of couplings.

Type of Release: Process solution

Nature of Contamination: Soil surface

Type of contamination: Cyanide

Environmental Damage(s): Soil contamination

January 6, 1991. 5,000 gallons of sodium cyanide solution containing 4 pounds of cyanide were spilled due to a loose check valve; a maintenance operator had failed to tighten the bolts. The spill affected 50 square yards of soil to a depth of 4-8 inches. About half of the solution was pumped back into the system. The remainder froze in place and was to be removed for placement on the heap. Follow up soil sampling confirmed low cyanide levels.

March 22, 1993 until unknown date. The mine reported that about 6 gallons per minute of pregnant solution was being pumped out of the sump. The cause was unknown at the time, pending drawdown

of the pond and presumably an inspection of the primary line. No further information was in the files (a notation in the file indicated that a report was to be prepared, but that was not available).

June 24, 1995. 3,000 gallons of sodium cyanide solution were spilled when a coupling came off a pipe - improper installation was the cause. No further information was available.

November 14, 1995. 500 gallons of solution containing 0.23 pounds of cyanide were spilled as a result of faulty valves on barren solution lines. Soil was removed to a depth of one foot below "stained depth."

Regulatory Action/Responses: NDEP noted the report indicates in the files that the facility repaired all causes of the reported spills (faulty valves, lines, couplings). Remedial action consisted of soil sampling and removal in all cases except one. In this case, involving a spill of process solution at a rate of 6 gallons per minute, the cause of the spill was not available. The initial spill report indicated that the pond would need to be drawn down before the case could be established. Remedial action consisted of evacuating the sump until it cavitates and restarting.

In the largest spill, involving 5,000 gallons of process solution, 50% of the spill was pumped back into the system. Calcium hypochlorite was spread on the remaining spill as a neutralizing agent. The ground at the time of the incident was frozen and the remaining frozen solution was place on top of the heap leach. In all cases, appropriate regulatory agencies were notified immediately.

References:

Nevada Division of Environmental Protection. Spill Report Form. January 7, 1991

Bald Mountain Mine. Spill Incident Report. January 15, 1991.

Bald Mountain Mine. Memo to NDEP regarding spill on January 6, 1991. March 27, 1991

Bob Carlson, Nevada Division of Environmental Protection. Fact Sheet regarding Placer Dome U.S. Inc, Bald Mountain Mine, August 1991.

NDEP. Complaint/Spill Report Form. February 16, 1993

NDEP. Spill/Release Record. February 23, 1993

Bald Mountain Mine. Memo regarding gasoline spill discovered on February 13, 1993. February 24, 1993.

NDEP. Spill Report Form. March, 29, 1993.

NDEP. Complaint/Spill Report Form. June 28, 1995.

NDEP. Spill/Release Record. January 16, 1996

Barrick Goldstrike Mines, Inc.
Barrick Goldstrike Project and Meikle Mine

Sector(s): Gold

Facility: Barrick Goldstrike Project and Meikle Mine

Facility Overview: This facility recovers gold ore from the Meikle Mine. This ore is processed at the Goldstrike facilities. The tailings are placed in an on-site impoundment. This facility was designed and operates without any discharge or release.

Data Sources: State Files

Agency Contact: Dave Crocket, BMRR

Waste and Material Management Practices: The Barrick Goldstrike Mine Project primarily consists of the AA and phase I ponds, phases I thru IIIA leach pads, tailings impoundment and seepage collection pond, milling and processing facilities, open-pits and waste dumps. The ore processed at Goldstrike is excavated from the Meikle Mine. The project also includes the Post, Bazza, West Bazza, and Long Lac Pits. Sulfidic material does exist and could result in acid drainage. The facilities within this project were constructed, and are operated without any discharge or release in excess of those standards established in regulations.

On August 30, 1996 a release of 3 pounds mercury was discovered at the wheel motor storage area. It was assumed that instrumentation containing mercury was previously stored in the area and was the source of the release.

On August 18, 1996, 4,250 gallons of reclaim water was released from Mill #2 during an unscheduled shutdown of Mill #1. The valves on top of Mill #1's reclaim water tanks failed to close causing the sumps at Mill #2 to become overwhelmed, resulting in a loss of containment.

On August 9, 1996 approximately 1,500 pounds of ammonia vapor was released from the refrigeration building through the building's ventilation system. The release was caused by the failure of a Bi-Lok type fitting on an oil tube at one of the refrigeration machines.

On February 27, 1996 2,000 gallons of diluted NaCN (86.4% cyanide) solution was released due to pump failure a the mill site.

On February 22, 1996 1,000 gallons of Bio-Leach water (pH of 2.61) overflowed due to a transfer line failure.

On January 15, 1991 approximately 200 gallons of concentrated sodium cyanide solution was released when a weld on a one inch diameter HDPE pipeline failed. This pipeline is part of a system which delivers a concentrated sodium cyanide solution from the storage tank to the ADR facility. It was estimated that 394 pounds of sodium cyanide was released.

Regulatory Action/Response: In response to the August 30, 1996 mercury release, less than one cubic yard of soil was excavated and removed. Surficial mercury was remediated using a mercury vacuum.

In response to the August 18, 1996 reclaim water release, overexcavation of impacted soils were relocated to the AA heap leach pad. The excavated area was treated with hypochlorite.

In response to the August 9, 1996 release of ammonia vapor, the equipment in the immediate area of the release was washed down with water to absorb any residual ammonia, as well as a degreasing agent and water were used to remove a film of oil from the equipment and floor. Additional protective measures and modifications were made to ensure that another release would not occur.

Type of Release: 3 lbs. of mercury, 4,250 gallons of reclaim water, 1,500 lbs. of ammonia vapor, 1,200 gallons of tailings slurry, 2,200 gallons of cyanide solution, 1,000 gallons of Bio-Leach water, 21,600 gallons of barren solution, 1,800 gallons of electrowinning solution.

Nature of Contamination/Environmental Damage(s): Surface soils, surrounding atmosphere, surface water.

In response to the February 27, 1996 cyanide solution release, the soils were excavated and put into the milling circuit.

In response to the February 22, 1996 Bio-Leach water release, the affected soils were excavated and placed in the hep leach pad. The transfer line was repaired and placed back on line.

In response to the January 15, 1991 release of sodium cyanide, the solution was pumped into the barren solution pond, the affected soil was placed onto the leach pad, and the affected area was treated with hypochlorite solution.

References:

Barrick Goldstrike Mines, Inc.. Letter to Mr. Dave Crocket, Nevada Office of Emergency Management. 5 September 1996.

State of Nevada, Division of Environmental Protection. Complaint/Spill Report Form. 30 August 1996.

Barrick Goldstrike Mines, Inc.. Letter to Mr. Dan Tecca, NDEP. 26 August 1996.

State of Nevada, Division of Environmental Protection. Complaint/Spill Report Form. 18 August 96.

Barrick Goldstrike Mines, Inc.. Letter to Mr. Dave Crockett, NDEP. 16 August 1996.

State of Nevada, Division of Environmental Protection. Complaint/Spill Report Form. 9 August 1996

Barrick Goldstrike Mines, Inc.. Letter to Mr. Quint Aninao, NDEP. 1 May 1996

State of Nevada, Division of Environmental Protection. Complaint/Spill Report Form. 19 April 1996.

State of Nevada, Division of Environmental Protection. Complaint/Spill Report Form. 28 February 1996.

Barrick Goldstrike Mines, Inc.. Letter to Mr. Dave Emme, NDEP. 15 January 1996.

Barrick Goldstrike Mines, Inc.. Fact Sheet (pursuant to NAC 445.24302). January 1993.

State of Nevada, Division of Environmental Protection. Spill/Release Record. 17 December 1991.

State of Nevada, Division of Environmental Protection. Complaint/Spill Report Form. 24 September 1991.

Barrick Goldstrike Mines, Inc.. Letter to Ms. Kathy Sertic, NDEP. 25 January 1991.

Battle Mountain Gold Company
Battle Mountain Mining Operations

Sector(s): Gold, copper

Facility: Battle Mountain Mine

Facility Overview: The facility mines ore from several open-pit mines. The ore is heap leached for precious metal recovery. The tailings are disposed of in an on-site surface impoundment.

Data Source(s): State Files

Agency Contact: Dan Tecca, BMRR

Waste and Material Management Practices: Operations conducted at this facility include; open-pit mining and milling of the Fortitude deposit; the Reona Project beneficiation operations; and ore mining from the South Canyon, Bonanza and Sunshine open-pits. Ore mined from these mines is heap leached and precious metals are recovered at the beneficiation plant (carbon columns). The loaded carbon is refined at the existing Fortitude milling facility with conventional stripping, electrowinning and further refinement. In general, the Battle Mountain Mine Company (BMMC) facility was designed, constructed, operated, and will be closed without any release or discharge from the fluid management systems.

On June 21, 1995 a strapping connection on the tailings pipeline broke, spilling approximately 3,000 gallons of spent gold plant solution onto the adjoining roadway. An area of soil approximately 10 feet wide by 400 feet long was exposed to the spilled material.

On June 19, 1995 a strapping connection on the tailings pipeline broke, spilling approximately 2,000 gallons of spent gold plant solution onto the adjoining roadway. An area of soil approximately 5 feet wide by 200 feet long was exposed to the spilled material.

On August 18, 1994 an inspection was conducted by NDEP on the BMMC facility. A leak in the tailings line was observed at the upper end of Copper Canyon below the refinery, where previous hydrocarbon contaminated soil had been removed. Also, the pump at the barren solution pond was observed leaking and ponding. The leak was not on containment and was not netted.

Type of Release: Spent gold solution (2 events spilling a total of approximately 5,000 gallons spent gold plant solution.

Nature of Contamination: Surface soils and surface waters

Type of Contamination: Spent gold plant solution

Environmental Damage(s): Surrounding soils and surface waters

Regulatory Action/Response: In response to the June 21 and June 19, 1995 spills, exposed soils were cleaned up with a motor patrol and front-end loader and transported to the tailings impoundment. A drainage ditch adjacent to the pipeline was constructed to divert flow from a damaged pipeline back into the facility. All strap connections were

replaced on the pipeline, and a down-gradient collection pond was constructed to collect any spent solution in the future.

In response to the August 18, 1994 inspection by NDEP, BMMC repaired the leaking pipeline and sent a soil sample out for analysis. The pump packing gland leak was repaired and the location was netted.

References:

Battle Mountain Gold Company. *Fact Sheet (pursuant to Nevada Administrative Code 445.24302)*. 29 June 1995

Battle Mountain Gold Company. *Hazardous Substance Release Investigation*. 21 June 1995

Battle Mountain Gold Company. *Hazardous Substance Release Investigation*. 19 June 1995

Battle Mountain Gold Company. Letter to Mr. Dan Tecca, NDEP. *Concerning August 18, 1994 Inspection*. 27 December 1994

Kinross Mining Company, Candelaria Mine: "Process Releases to Soil Surfaces"

Sector(s): Gold and Silver

Facility: Kinross Candelaria Mining Company, Mineral County, Nevada

Facility Overview: Operations at the facility include gold and silver production utilizing heap leaching of ore and the Merrill-Crowe process to recover precious metals. .

Data Source(s): State files

Agency Contact: Dave Gaskin, BMRR

Waste and Materials Management Practices: Operations at the facility include gold and silver production utilizing heap leaching of ore and the Merrill-Crowe process to recover precious metals. Facilities consist of two heap leach pads (1 & 2), barren and pregnant solution ponds, lined solution ditches, a primary crusher, and a Merrill-Crowe Plant.

Leach Pad 1 consists of 12 cells. The first five and a half cells are lined with 18 inches of compacted clay. The remainder of cells are lined with 80-mil HDPE plastic over a four-inch compacted clay base. Leak detection is provided by piezometers which are located near the pad.

Four pregnant solution ponds are located on site, each of which possess leak detection systems. Leak detection pipes are monitored weekly for the presence of liquid volumes indicative of a leak. In the case of pregnant ponds 1 & 2 detection of fluid accumulations in excess of 4 gal per pond per day may be indicative of a leak in the pond's primary liner. For pregnant ponds 3 & 4 quantities of liquid in excess of 28.5 gal per pond per day for seven consecutive days may indicate a leak.

The ponds have a total combined capacity designed to contain precipitation and runoff from leach pad 1 resulting from a 25-year, 24 hour storm event. They are also designed to handle solution build-up from a 24-hour cessation of pumping resulting from a power outage.

Type of Impact/Media Affected: A total of two spills were reported at the Candelaria Mine in 1995-96. The first spill occurred in December of 1995 and involved the release of 2,000 gallons of process solution containing 6.4 lbs of sodium cyanide. The cause of the release was identified as a sump pump failure at the Merrill-Crowe plant. The spill affected soil resources covering ½ an acre. The second spill occurred in May of 1996 and involved the release of 200,00 gallons of process solution containing 1125 lbs of sodium . Changing temperatures caused a 12 -inch main header line to burst. The solution flowed into a fill area covering 1/4 of an acre.

Type of Release: Sodium cyanide process solution

Nature of Contamination: Surface Soils

Type of contamination: Cyanide

Regulatory Action/Responses: Remediation efforts for the smaller spill involved excavating contaminated soil and its placement upon the leach pile for re-leaching of the sodium cyanide. Candelaria Mine pledged to construct an overflow port in the refinery wall to allow future spills to drain directly into process solution circuit floor drains. Regarding the large spill, the barren pumps were shut down immediately upon detection of the leak. The solution was contained and 180,000 gallons 1015 lbs of sodium cyanide) were pumped back into the process system. Contaminated soil containing 110 lbs of sodium cyanide was excavated and

place on top of the leach pad. Records indicated that soil excavation would continue until soil sampling indicates the concentration of cyanide is below 0.2 ppm.

References:

Kinross, Candelaria Mining Company. Facility Operating Plan. January, 1996.

Kinross, Candelaria Mining Company. Internal Memo Regarding December 25, 1995 Spill. December 27, 1995

Nevada Division of Environmental Protection. Record of Communication Regarding December 25, 1995 Spill. December 27, 1995.

Kinross, Candelaria Mining Company. Memo to Nevada Division of Environmental Protection Regarding December 25 Spill, January 2, 1996.

Nevada Division of Environmental Protection (NDEP). Complaint/Spill Report Form. May 3, 1996.

Kinross, Candelaria Mining Company. Internal Correspondence Regarding May 2, 1996 Spill. May 6, 1996.

Kinross, Candelaria Mining Company. Memo to NDEP regarding May 2, 1996 Spill. May 9, 1996.

Coeur Rochester, Inc. Mine: "Process Releases to Soil Surfaces"

Sector(s): Gold and Silver

Facility: Coeur Rochester, Inc Mine, Pershing County, Nevada

Facility Overview: Operations conducted at the facility include production of gold and silver from an open-pit mine with ore crushing and sizing for heap leach operations. Gold and silver are complexed and mobilized within the heap leach system by a weak cyanide solution and recovered using the Merril-Crowe zinc precipitate process.

Data Source(s): State files

Agency Contact: Dave Gaskin, BMRR

Waste and Materials Management Practices: Operations conducted at the facility include production of gold and silver. The operations consist of an open-pit mine with ore crushing and sizing for heap leach operations. Gold and silver are complexed and mobilized within the heap leach system by a weak cyanide solution and recovered using the Merril-Crowe zinc precipitate process.

Heap leach pads are of the valley fill design. Existing State I and Stage II pads consist of a compacted sub-base and an HDPE liner above. An intermediate leak detection material is present in both pads. Leakage rates from the pads must be calculated, rather than measured, since water from below the heap leach pads gathered by french drains also reports to the same leak collection sumps. Leachate is collected as pregnant solution and stored in a collection area within each pad. Stage I pregnant solution can be routed to either the process plant or the stage II pad. Stage II pregnant solution can be routed to the process plant or back to the pad if the solution grade is too low. A state IV heap leach pad is planned, consisting of an 80-mil HDPE primary synthetic liner on a compacted sub-base.

The facility is designed to contain without discharge all direct precipitation resulting from a 100-year, 24-hour storm event. A series of stormwater ditches routes flows away from the pad.

Type of Impact/Media: Two spills have been reported at the mine facility since 1994. The first reported spill occurred on February 18, 1994. As a result of a power outage, 450 tons of ore containing process solution was displaced from the leach pad. From 1.97 to 9.861 lbs of cyanide were washed out with the ore. The second spill occurred on March 6, 1996. Freezing overnight temperatures caused a line in the leach pad to rupture. Consequently, 5,500 gallons of sodium cyanide process solution escaped the heap leach pads primary containment system. 4,500 gallons of the process solution mixed with 35,000 gallons of fresh water from snowmelt. The remaining solution mixed with an unknown amount of snowmelt. Available information indicated that no surface or groundwater was impacted by the second spill. No information indicating water quality impacts was available for the first spill.

Type of Release: Cyanide containing ore, process solution

Nature of Contamination: Soil surface

Type of contamination: Cyanide

Environmental Damage(s): Soil contamination

Regulatory Action/Responses: Remedial action in the February of 1994 spill involved the placement of ore containing cyanide back upon the protected heap leach pad. In the March of 1996 spill, the 4,500 gallons of solution was recovered by vacuum truck as it mixed with the snow melt. The escaped solution was neutralized with hydrogen peroxide. Clean soil was used to soak up remaining solution and all materials, including excavated impacted soil

was placed upon the leach pile. As a result of the second spill Coeur Rochester, Inc. pledged to undertake a number of additional measures. First, all diversion ditches would be place a minimum of 75 feet from the nearest process solution application line. Second, all itches would be enlarged to ensure containment. Third, french drains would be constructed along the leach pad access road.. Finally, the amount of hydrogen peroxide available for future remediation efforts would be increase to 200 gallons.

References:

Mahmood Azad, Nevada Division of Environmental Protection (NDEP). Fact Sheet Regarding Coeur Rochester, Inc Mine. January 20, 1993.

Coeur d'Alene Mines Corporation. Memo Regarding February 18, 1994 Spill. February 18, 1994.

NDEP. Complaint/Spill Report Form. February 18, 1994.

NDEP. Complaint/Spill Report Form. March 6, 1996.

Coeur Rochester Group. Memo to NDEP Regarding March 6, 1996 Spill. March 19, 1996

Cortez Gold Mines:
"Process Releases to Surrounding Soils"

Sector(s): Gold

Facility: Cortez Gold Mines, Beowawe, Nevada

Facility Overview: Operations consist of open pit mining of ore, processing of ore by carbon-in-leach and conventional heap leach cyanidation. Precious metal recovery is accomplished by carbon adsorption and electrowinning.

Data Source(s): State files

Agency Contact: Dave Gaskin, BMRR

Waste and Materials Management Practices: Operations at the Cortez Gold Mines consist of open pit mining of ore, processing of ore by carbon-in-leach and conventional heap leach cyanidation. Precious metal recovery is accomplished by carbon adsorption and electrowinning. Facilities include 3 heap leach pads, 7 tailings impoundments, 2 pregnant ponds, 1 barren solution pond 1 pumpback pond, 1 water storage reservoir, 1 scale pond, a circulating fluid bed roaster, and a processing plant.

The heap leach pads are constructed of compacted clay overlain with six inches of gravel for drainage of process fluids. Process fluids are drained through either 60-mil HDPE or 40-mil hypalon-lined ditches and flow to either pregnant pond 2 or 3. Both ditches possess compacted clay secondary containment.

All solution ponds are constructed of 18 inches of compacted clay-silt with a 60 mil-HDPE primary liner. Only pregnant pond 2 and the pumpback pond possess leak detection. The leak detection system consists of a four-inch perforated pipe buried in a clay -lined trench in the center of each pond. Gravel covers the pipe for drainage. The pipe eventually leads to a reclaim tower from which visual inspection of leaks is performed.

Twenty-seven spills involving cyanide-containing process solutions occurred between July, 1992 and December, 1994 at Cortez. The majority of spills were caused by equipment failures or operator error.

Type of Impact/Media Affected: During the period, two spills were identified as resulting in more than ten lbs of cyanide being released to surrounding soils. In July, 1992 a ruptured line to the leach pad resulted in 50,000 gal of barren solution being sprayed across a road and collecting in a 100' x 40' gully. Twenty lbs of cyanide were released. In November, 1994 a grader hit and ruptured a hose at an inactive impoundment area releasing 140,000 gal of process solution and 50 lbs of sodium cyanide. Other noteworthy spills occurring during the period include 330,912 lbs of slurry with a concentration of 2.8 mg/l WAD CN^- at the #2 thickener in February, 1994 and 256,192 gal of toe seepage solution with a concentration of 0.042 mg/l WAD CN^- at tailings impoundment 6 in October, 1994. The remaining spills involved a total of between 225 and 100,000 gallons of roaster calcines, barren solution, pregnant solution, tailings material, reclaim solution, and cyanide containing groundwater.

Type of Release: Cyanide containing process solution

Nature of Contamination: Soil surface

Type of contamination: Cyanide

Regulatory Action/Responses: Remediation in the 50,000 gal spill consisted of standing water in the gully being pumped to the pregnant pond. All contaminated material was moved to the leach pad. Sampling conducted after material removal showed a WAD cyanide concentration below 0.25 ppm. The

140,000 gal spill flowed into an impoundment area. It was neutralized with calcium hypochlorite and pumped into nearby holding ponds. Information concerning remediation efforts was available for eight of the remaining spills. Actions taken included immediate shutdown of the spill source, neutralization of soil with calcium hypochlorite, and in two cases, removal of contaminated material to tailings impoundments.

The Nevada Department of Wildlife notified Cortez Gold Mine on January 31, 1992 that one of the tailings impoundments at the mine was not in compliance the Department's Industrial Artificial Pond Permit # 3582 due to a WAD cyanide concentration higher than that considered lethal to wildlife. Cortez was further informed by the Bureau of Land Management of the actions necessary to be in compliance, including an immediate reduction in the concentrations of cyanide discharged into the tailings ponds to non-toxic levels. On April 12, 1992 the Nevada Dept. Of Wildlife informed the Cortez Mine that as a result of sampling the tailings impoundment was found to be in compliance.

References:

Dean Mierau, Nevada Division of Environmental Protection (NDEP). Fact Sheet Regarding Cortez Gold Mines. January, 1991.

Nevada Department of Wildlife. Notice of Noncompliance with Industrial Artificial Pond Permit #3582. January 31, 1992.

Bureau of Land Management. Letter to Cortez Gold Mine Regarding Noncompliance with Artificial Pond Permit #3582. February 12, 1992.

Nevada Department of Wildlife. Notice of Compliance with Industrial Artificial Pond Permit #3582. April 13, 1992.

NDEP. Spill Report Form. July 22, 1992.

Cortex Gold Mines. Memo to NDEP Regarding Soil Samples From July 21, 1992 Spill. August 10, 1992.

Cortex Gold Mines. Spill/Release Record. October 4, 1993.

Cortex Gold Mines. Spill/Release Record. October 16, 1993.

Cortex Gold Mines. Spill/Release Record. October 23, 1993.

Cortex Gold Mines. Spill/Release Record. October 28, 1993.

Cortex Gold Mines. Spill/Release Record. November 30, 1993.

Cortex Gold Mines. Spill/Release Record. December 3, 1993.

Cortex Gold Mines. Spill/Release Record. December 12, 1993.

Cortex Gold Mines. Water Pollution Control Permit NEV0023- 1994 Annual Report, Annual Spill and Release Record. 1994.

NDEP. Complaint/Spill Report Form. November 18, 1994.

Cortex Gold Mines. Memo to NDEP Regarding November 18, 1994 Spill. November 22, 1994.

Cortex Gold Mines. Memo to NDEP Regarding October 29, 1995 Spill, October 30, 1995.

Cortex Gold Mines. Spill/Discharge Report. October 30, 1995

Hycroft Resources and Development, Inc., Crofoot Project: "Spills of Process Solutions"

Sector(s): Gold and silver

Facility: Hycroft Resources and Development, Inc., Crofoot Project, 50 air miles west of Winnemucca, Nevada

Facility Overview: Operations conducted at the facility include open pit mining, conventional cyanide leaching, and precious metal recovery via zinc precipitation. Because annual evaporation is greater than annual precipitation, the project operates under the condition that no waste water discharges will occur.

Data Source(s): State files

Agency Contact: Dave Gaskin, Bureau of Mining Regulation and Reclamation

Waste and Material Management Practices: Operations conducted at the facility include open pit mining, conventional cyanide leaching, and precious metal recovery via zinc precipitation. Lime is added to crushed ore prior to placement on one of the three clay-lined leach pads. Because annual evaporation in the region is greater than annual precipitation, the project operates under the condition that no waste water discharges will occur.

Incident No. 1: On December 4, 1994, the facility reported a spill of approximately 30 gallons (or 100 pounds) of liquid sodium cyanide with a concentration of approximately 30 percent cyanide. The spill was the result of a mechanical failure on a delivery truck.

Remedial Action/Response: The chemical supplier's (Cyanco) response team treated the spill area with hydrogen peroxide and sodium hypochlorite. Soil samples were also taken for analysis.

Incident No. 2: The facility experienced problems associated with electrical power interruptions compounded by record sub-zero temperatures. During the hours of 6 p.m. to midnight on December 20, 1990, sub-zero temperatures (near -20 F), combined with two separate power interruptions by Sierra Pacific Power, resulted in several frozen lines on the leachpads. As a result, four header system failures on Pad 1 and one header system failure on Pad 2 occurred. These failures resulted in isolated occurrences of heap saturation and resultant blow-outs once power resumed. The blow-outs on Pad 1 did not result in any discharges of solution; however, the blow-out on Pad 2 discharged 1.7 pounds of sodium cyanide contained in 5,000 gallons of solution into a man-made 100-year storm drainage ditch between Pad 1 and Pad 2.

Type of Release: Process solution

Nature of Contamination: Soil surface

Type of contamination: Cyanide

Remedial Action/Response: The discharge as a result of the blow-out on Pad 2 immediately froze along the ditch where it flowed. Approximately 200 pounds of calcium hypochlorite were spread over the frozen spill. Of the 1.7 pounds of cyanide estimated to be contained in the spill, more than 90 percent was estimated to be contained in ice and not in contact with the soil.

The facility reported the December 20, 1990, spill to the Nevada Department of Environmental Protection on December 21, 1990. It was reported as a less-than-reportable (Federal standard) spill; NDEP concurred the spill was not a permit violation.

Incident No. 3: The freezing leach lines discussed in Incident No. 2 resulted in a gradual raising of solution storage pond levels to the extent that an estimated total of 300,000 gallons containing 100-150 pounds of sodium cyanide flowed from the low-preg pond to an earthlined containment dike. Two separate flows occurred - one on December 24, 1990 (estimated 228,000 gallons) and the other on December 27-28, 1990 (estimated 72,000 gallons). These flows contained 76 pounds and 24 pounds of cyanide, respectively.

Remedial Action/Response: The facility arranged for a contractor to remove the frozen spill and contaminated soil. It also evaluated increasing the lined solution storage area to better handle a recurrence.

Both the December 24 and 27, 1990, flows occurred within the built facility boundary. As such, Hycroft responded as stated in its approved emergency response plan and mitigated as outlined in its water pollution control permit. The company concluded that no permit violation had occurred. Other reports of these events were made to the Nevada Division of Emergency Management by telephone on December 28, 1990, and by written reports dated December 31, 1990, and to the National Response Center by telephone on January 2, 1991.

References:

Memo Regarding Spills of 12/20/90, Hycroft Crofoot Mine.

Spill Report, 12/4/94, Crofoot Mine. Nevada BMRR.

Fact Sheet: Hycroft Resources and Development, Inc., Crofoot Project. Permit No. NEV60013.

Independence Mining Company Inc., Jerritt Canyon Gold Project

Sector(s): Gold

Facility: Independence Mining Company Inc., Jerritt Canyon Gold Project (formally known as the Freeport Gold Company)

Facility Overview: This facility recovers gold ore from an open pit mine. This gold ore is extracted using the conventional cyanide heap leach processes.

Data Source(s): State files

Agency Contact: Doug Zimmerman, BMRR

Waste and Material Management Practices: The facility consists of three ore bodies, heap leach pads, an autogenous/ball mill and crusher, an ore roaster carbon in leach circuit, and a carbon column recovery circuit.

Tailings are disposed of in an on-site storage pond. There are no springs or wells within the tailings pond area. The water balance in the pond is controlled by evaporation. There is one small intermittent stream that flows during the spring season for approximately 2 months. The drainage basin is nearly two square miles in size and is located to the west of the tailings pond. At the conclusion of the mines life, the water in the tailings pond will be allowed to evaporate completely, and the tailings area will be covered with topsoil and seeded. The tailings pond will ultimately contain approximately 10 million tons of solids.

Water for the project is supplied from deep wells. This water is piped to a 600,000 gallon water storage tank at the mill site. Process water, fire protection water, boiler feed water and domestic water is provided from this tank. For freeze protection, all the water lines were buried or heat traced. A 5,000 gallon-per-day sewage treatment plant is also located at the mill site. Effluent from the wastewater plant is piped to the tailing disposal pond. In the mill, all process water and leach liquors will be enclosed in steel tanks. The tanks were designed such that if leakage occurs, the spilled material flows by gravity in a ditch to the tailings pond. A 2,500 gallon-per-day sewage disposal plant is located at the mining facility. The effluent from this unit is piped to a leach field.

On May 26, 1996, 1,000 gallons of process slurry flowed out of the chlorination building after a tank valve was inadvertently left open during maintenance operations. The slurry flowed out of the east doors and into the milk of lime containment area. The slurry contained approximately 0.03% (3.2 lbs.) of sodium hypochlorite.

On January 11, 1996 IMCI experienced a power bump at the mill resulting in the overflow of a heap leach carbon column. The power bump disabled the pump at the end of the heap leach carbon column train, while the feed pump remained operating. Barren solution overflowed the last carbon column in the train and flowed out of the building into the driveway area, and into a ditch that drains to the tailings line drainage pond. Approximately 2,500 gallons of barren solution flowed onto the ground and into the ditch. The solution contained approximately one pound of cyanide.

On August 21, 1995 the south chlorination tank #2 ruptured, resulting in approximately 2,000 gallons of slurry exiting the east doors of the chlorination building and flowing onto the ground. The tank failure was attributed to corrosion. The slurry contained 15 pounds of sodium hypochlorite.

On July 11, 1995 IMCI experienced a rupture in the south tailings slurry line. The rupture occurred at a fatigued joint in the pipeline, approximately 100 yards west of the tailings line drainage pond and 50 yards north of the tailings dam. An estimated 2,400 gallons of tailings slurry was discharged to the road and surrounding ground surface. Less than 10 pounds of cyanide was involved in this spill.

On July 13, 1990 chlorine liquid under pressure was released in a gaseous state. The release consisted of 85
pounds of chlorine and occurred when a 1.25 inch vacuum drain down line developed a hole due to corrosion.

Type of Release: 5,400 gallons of process slurry, 2,500 gallons of barren solution, 85 lbs. of chlorine.

Nature of Contamination/Environmental Damages: Surrounding atmosphere, surrounding surface soil, drainage pond, containment area.

A green cloud formed and lasted for less than one minute. The release did not leave the mill site and did not enter any waterway.

Regulatory Action/Response: In response to the May 26, 1996 spill, earthen berms were immediately constructed to contain the slurry. The slurry and affected soils were excavated and placed back into the wet mill process. Soil samples were collected from the spill area and sent out for analyses.

In response to the January 11, 1996 spill, personnel immediately shut down the heap leach carbon column feed pump to prevent further release of solution. Ponded solution was vacuumed and transported to the tailings pond for disposal. Soils were collected in the vicinity of the spill and analyzed for cyanide. Low levels of cyanide, ranging from 0.3 ppm to 4.66 ppm were detected in the soil samples. The Nevada Division of Environmental Protection determined that it was unlikely that cyanide was able to penetrate below the top inch of soil since the ground was frozen at the time of the spill.

In response to the August 21, 1995 spill, IMCI personnel constructed a berm to contain the spill. The tank was repaired and placed back into service on August 22, 1995. Most of the slurry was removed and placed back into the chlorination circuit.

In response to the July 11, 1995 spill, IMCI personnel shut of the tailings pipeline. The slurry was removed and placed in the tailings pond. Residual slurry found outside the tailings line drainage pond was removed and placed in the tailings pond.

In response to the July 13, 1990 release of chlorine gas, IMCI contacted NDEP. No further information was available concerning this mishap.

References:

Independence Mining Company Inc.. Letter to Mr. Joe Guinn, Department of Emergency Management. *In Reference to the July 13, 1990 Chlorine Release*. 18 July 1990

Independence Mining Company Inc.. Letter to Mr. Doug Zimmerman, NDEP Bureau of Mining Regulation and Reclamation. *In Reference to the July 11, 1995 spill*. 21 July 1995

Independence Mining Company Inc.. Letter to Mr. Dave Gaskin, NDEP Bureau of Mining Regulation and Reclamation. *In Reference to January 11, 1996 spill*. 19 January 1996

Independence Mining Company Inc.. Letter to Mr. Doug Zimmerman, NDEP Bureau of Mining Regulation and

Reclamation. *In Reference to August 21, 1995 spill*. 31 August 1995

Independence Mining Company Inc.. Letter to Mr. Dan Tecca, NDEP Bureau of Mining Regulation and Reclamation. *In Reference to May 26, 1996 spill*. 3 June 1996

Freeport Gold Company. Letter to Mr. Wendal McCurry, NDEP. *Reference to wastewater plans*. 3 June 1980.

Freeport Gold Company. Letter to Mrs. Christine Thiel, NDEP. *Reference to groundwater permitting issues*. 28 May 1980

Kennametal Inc., Falcon Nevada: "Spill of Process Solution to Soil Surface"

Sector(s): Tungsten carbide crystal production

Facility: Kennametal Inc., Falcon, Nevada

Facility Overview: The 622 acre site is used for the production of tungsten carbide crystals, tungsten scrap reclaim mixed blends and tungsten carbide bit recovery. Tungsten carbide chrystals are produced by the "thermit" exothermic process. Iron residues in the process are removed through acid leaching. Tabling and screening is performed to obtain the desired cleaning and particle sizing.

Slag is also produced as part of the thermit process. The slag deposits were tested for a variety of constituents. The sampling results indicated that the slag presented no threat to surface or goundwater.

Data Source(s): State Files

Agency Contact: Dave Gaskin, Bureau of Mining

Type of Release:Sulfuric acid spill

Nature of Contamination: Soil

Type of contamination: Sulfuric acid

Environmental Damage(s): Soil contamination

Waste and Material Management Practices: The site is used for the production of tungsten carbide crystals, tungsten scrap reclaim mixed blends and tungsten carbide bit recovery. The production of tungsten is the primary function at this facility. Tungsten carbide crystals are produced by an exothermic reaction or by the thermit process. This consists of constructing a kiln, preparing a charge material, making aluminum bags for the charge material, reacting the thermit and after the thermit has cooled and the crystal mass growth has occurred, and separating the crystal mass from the slag. The iron residues are then removed through an acid leaching process. Tabling and screening cleans and sizes the particles. A powder mill operation produces metallurgical powders as part of the operation.

An onsite waste water management facility was constructed in 1992.

On November 12, 1991, the facility released between 2 and 4,000 gallons of 93.6% sulfuric acid to the environment. This was the result of overfilling a 15,000 gallon sulfuric acid tank that was not properly vented into a secondary containment enclosure.

Type of Impact/Media Affected: Between 2 and 4,000 gallons of 93.6 sulfuric acid were spilled when a 15,000 gallon sulfuric acid tank was overfilled. There were no impacts to waters of the state, wildlife or public health.

Regulatory Action/Response: The release site was covered with a light layer of hydrated lime and the area was cordoned off. Additional hydrated lime was placed on the remaining damp spots. The vent line on the sulfuric acid tank was modified to discharge overflow to secondary containment.

Facility personnel used a backhoe to turn contaminated soil over. The soil was tested for acidity, and where appropriate, was neutralized with lime. Deeper soil was removed and neutralized. Disturbed soil was finally smoothed over with a front endloader.

References:

Kennametal Inc. Fourth Quarter Report. January 10, 1992.

Kennametal Inc. Written Spill Report. November 27, 1991.

Santa Fe Pacific Gold Corporation's Lone Tree Mine: "Process Solution Releases"

Sector(s): Precious Metal Mining and Ore Processing

Facility: The Lone Tree Mine; SFPGC, Humboldt County, Nevada

Facility Overview: The mining and processing facilities at the site include an open pit mine and associated waste rock dumps, heap leaching facilities and associated tailings disposal facility and ancillary facilities.

Data Source(s): State Files

Agency Contact: Dave Gaskin, Bureau of Mining Regulation and Reclamation

Waste and Material Management Practices: opearations at the site include an open pit mine, waste rock dumps, heap leach pads, a carbon in pulp mill, a flotation mill, processing facilities, associated tailings disposal facility and ancillary mill and mine buildings. All existing mining and processing operations at the site are permitted through the Nevada Division of environmental Protection, Bureau of Mining Regulation and Reclamation under Water Pollution Control Permit NEV90058.

The facility has had several releases to the environment between 1990 and 1996. These releases were the results of mechanical failures and operator error.

Incident #1 On September 7, 1993, the facility released approximately 5000 gallons of barren leach solution containing 8.3 pounds of sodium cyanide. The release occurred at the heap leach pad when an 8 inch header line broke.

Type of Release: Process solution and tailings slurry spills

Nature of Contamination: Soil

Type of contamination: Sodium cyanide solution

Environmental Damage(s): Soil contamination

Type of Impact/Media Affected: Approximately 5000 gallons of solution were spilled at a concentration .4 lbs/ton , resulting in an estimated release of 8.3 pounds of NaCN.

Regulatory Action/Response: The facility excavated approximately 130 cubic yards of contaminated soil The soil was then transported to the heap leach pad.

Incident #2: On April 21, 1995, the facility released approximately 36,000 gallons of barren leach solution containing 17.4 pounds of cyanide. The release occurred at the Phase III/IV heap leach area when hugger fitting on a 4 inch barren solution pipe came apart.

Type of Impact/Media Affected: Approximately 36,000 gallons of solution were spilled resulting in an estimated release of 8.3 pounds of NaCN.

Regulatory Action/Response: The pipes were shut off, and catch basins were built to retain the released solution. Approximately 17,000 gallons of solution were returned to the pads from the catch basin. Scrapers removed the contaminated soil.

Incident #3: On November 26, 1994, the facility released 10-30,000 gallons of process solution at an approximate concentration of 0.288 g/L, resulting in between 24 and 72 pounds of sodium cyanide solution. The release occurred at the heap leach access road when hugger fitting on a 12 inch line in a ditch froze and blew its coupling. This allowed the sodium cyanide solution to spray outside the lined area.

Type of Impact/Media Affected: Approximately 10-30,000gallons of solution were spilled resulting in an estimated release of 24-72 pounds of NaCN.
Regulatory Action/Response: The contaminated soil was excavated and removed to the Sonoma Leach Pad. The coupling was replace and the damaged ends of the pipe were repaired.

Incident #4: On November 28 1994, the facility released approximately 5,000 gallons of tailings slurry, resulting in the release of 1.47 pounds of cyanide solution. The release occurred at the tailings delivery line when a contractor punctured the tailings line with the blade of a motor grader

Type of Impact/Media Affected: Approximately 5,000gallons of tailings slurry were spilled resulting in an estimated release of 1.47 pounds of NaCN.

Regulatory Action/Response: Approximately 200 yards of contaminated soil was excavated and removed to the tailings impoundment. The damaged area of the line was repaired.

References:

.SFPGC. Lone Tree Mine Acid Mine Drainage Mitigation Plan (page 1-1). September 27, 1993.

SFPGC. Written Spill Report. September 9, 1993.

SFPGC. Written Spill Report. May 1, 1995.

SFPGC. Written Spill Report. December 6, 1994.

SFPGC. Written Spill Report. December 6, 1994.

Western States Minerals Corporation, Northumberland Project

"Initiated Clean-Up Efforts"

Sector(s): Precious Metal Recovery

Facility: Northumberland Project, Western States Minerals Corporation, Eiko, NV

Facility Overview: Open pit mining accompanying ore processing by conventional heap leach cyanidation and precious metal recovery by carbon adsorption

Data Source(s): State files

Agency Contact: Thomas J. Fronapfel, Nevada DEP

Waste and Material Management Practices: This project consists of open pit mining with ore processing by conventional heap leach cyanidation as well as precious metal recovery by carbon adsorption. The facility is required to operate and close with no discharges or releases except for extraordinary meteorological or stochastic events.

The project maintains four discrete but interconnected leach pads covering approximately 42.4 acres. The subbase for leach pads 1,2, and 3 consists of compacted native soils. A leak detection and collection system consisting of a pipe network was installed beneath those portions of the 60 mil HDPE primary liner where process fluids accumulate on top of the pad. Leach pad 4 was constructed on a prepared subbase consisting of 12 inches of imported, low permeability soil. The primary liner is 60 mil HDPE and is underlain by leak detection strips on 15 foot centers. There are three process ponds on site lined by compacted native soils. This layer is overlain by 20 mil PVC on which geotextile is installed, extending up the pond side slopes. The primary liner for all three ponds is 40 mil HDPE.

On December 3, 1991, a gravity flow return line connecting leach pad 2 to the pregnant solution pond failed. Approximately 115,500 gallons of pregnant solution was lost with a total of 0.386 pounds of cyanide released. On December 17, 1991, another broken pipe was discovered near the barren pond. It was determined that approximately 12,000 gallons of pregnant solution was spilled, containing 0.160 pounds of cyanide. Both of the December spills were believed to have been caused by the cold temperatures, splitting the pipes and joints. On January 9, 1991, as a result of snow removal efforts, a raw water well was compromised. 13,500 pounds of raw water was released containing 0.0605 pounds of cyanide.

Type of Impact/Media Affected: Large quantities of raw water and pregnant solution have spilled on the Northumberland project, with most occurring in 1991. The combined total spilled in 1991 and the early portion of 1992 is 141,000 gallons. The estimated total cyanide released as a result of these spills is 0.611 pounds.

Regulatory Action/Response: In August of 1991, a U.S. Forest Service (USFS) District Ranger ordered WSMC to remove contaminated soil from diesel and oil spills by mid-November of the same year. WSMC followed these orders and disposed of the soil properly. As a result of the August field review and the supposed failure by WSMC to report cyanide spills exceeding the quantities that require a report to NDEP, USFS called the National Response Center (NRC).

On September 3, 1991, USFS ordered WSMC that any wood, plastic, metal barrels, or sludge in the make-up pond, not be removed until a disposal method was agreed upon by all responsible agencies. On September 17, 1991, a site visit was conducted by USFS and the Nevada Department of Environmental Protection (NDEP) Bureau of Waste

Management. Information gathered at the time of the visit indicated that WSMC may be in violation of various State and Federal Regulations. As a result, WSMC was ordered by NDEP to "Cease and Desist" from the discharge or disposal of hazardous waste or pollutants to the environment, and from on-site storage of such hazardous waste for greater than 90-days; by October 14, 1991 submit a letter of intent to assess and remediate violations; submit by November 8, 1991 a detailed Site Assessment Plan for review and approval; begin such Site Assessment within 30 days of approval of the Site Assessment Plan; submit a Site Assessment Report which details the assessment results and findings; submit a Site Remediation Plan; and begin site remediation within 30 days of approval of a Site Remediation Plan.

Type of Release(s): 3 spills total, (2)Pregnant solution water, (1)raw water as well as oil contaminated soils

Nature of Contamination: Surface soils, ground water

Type of Contamination: Cyanide, petroleum based wastes

Environmental Damages: Surface soils

On October 2, 1991 WSMC was ordered by the NDEP Bureau of Mining Regulation and Reclamation to make various repairs to leach pad ditches, liners, berms; remove material overtopping leach pad berms; make modifications to leak detection pipes and sumps; remove, place on containment, and sample all material in the make-up water pond; and evaluate the area of potential contamination where solution pipes converge near the barren ponds.

NDEP contacted WSMC on January 7, 1992 in response to the three successive spills in late 1991 and early 1992. It was questioned by NDEP as to whether WSMC was adequately managing their system. NDEP requested that any additional spills, regardless of the quantity of cyanide released, be reported in the future.

Regulatory Action/Responses: WSMC responded to both NDEP's Bureau of Waste Management and Bureau of Mining Regulation and Reclamation promptly. WSMC completed the aforementioned actions, and has established and maintained a cooperative relationship for the overall benefit of the general public and the various governmental and regulatory agencies.

References:

Western States Minerals Corporation, Letter to Mr. Thomas J. Fronapfel, P.E. Bureau Chief for Nevada Division of Environmental Protection. *Response to section IIIA of the Order dated October 2, 1991*. 15 November 1991.

Western States Minerals Corporation. *Facility Fact Sheet (pursuant to NAC 445.148)*. April 1989.

Western States Minerals Corporation. *Facility Fact Sheet (pursuant to NAC 445.148)*. July 1990.

Western States Minerals Corporation. *A Comprehensive Synopsis of Affairs Relating to Environmental Issues at Western States Minerals Corporation's Northumberland Mine, Nye County, Nevada*. 9 February 1992.

Western States Minerals Corporation. Letter to Mr. Mike Lucchesi, Environmental Engineer, NDEP. *Northumberland Mine Environmental Progress Report, USFS Issues*. 7 July 1992.

State of Nevada, Division of Environmental Protection. Letter to Mr. Dwight Crossland, Western States Minerals Corporation. *Findings of Alleged Violation and Order issued pursuant to Nevada Revised Statutes 445.317 and 445.324*. 2 October 1991.

BHP Copper, Magma Nevada Mining Company: "Process Releases to Surface Waters and Soils"

Sector(s): Copper, Gold, Molybdenum, and Silver

Facility: BHP Copper, Magma Nevada Mining Company, White Pine County, Nevada

Facility Overview: The project has three main components including a conventional open-pit mine, milling and flotation of sulfide ore, and leaching of mixed oxide and sulfide ore.

Data Source(s): State files

Waste and Materials Management Practices: Magma Nevada Mining Company took control of all mining operations in the Robinson District in 1991. The project has three main components including: conventional open-pit mining, milling and flotation of sulfide ore, and leaching of mixed oxide and sulfide ore. Magma has constructed new facilities including a concentrator for recovery of copper, molybdenum, gold, and silver, as well as a two-phase concentrator circuit tailings impoundment and associated collection ponds. The site includes open pit mines, waste rock dumps, a copper heap leach pad, and associated pregnant intermediate and raffinate leach solution ponds.

In the milling operations, conventional copper flotation technology is used in the concentrator circuit to process 35,000 to 45,000 tons of ore daily. The mill process water pond receives both well water and reclaim water from the tailings impoundment. The pond has primary and secondary 60-mil HDPE synthetic liners, a leak detection/collection system, a leak collection sump, and an eight inch diameter PVC evacuation pipe. Changes have been incorporated into pond design to prevent unauthorized discharge(s) during 25 year, 24 hour storm events.

The copper leaching operation consists of a three-phase leach pad constructed of an 80-mil VLDPE primary liner underlain by a six-inch leak detection layer of granular material. Perforated pipes have been placed within the detection layer beneath all pregnant solution collection pipes and channels and on the upstream side of cell separation berms. Cell seepage is routed to separate external sumps. Three process solution ponds with 80-mil HDPE primary liners and 60-mil HDPE secondary liners have been constructed. Geonet or similar material between the liners will provide a flow path to the pond leak detection sump.

BHP Copper/Magma Nevada Mining Company experienced eight reported spills during 1996. Most of these spills involved copper flotation tailing solution and reclaim water releases do to equipment failures. One spill involved release of sodium cyanide process solution due to equipment failure.

Type of Release: Copper flotation tailings, tailings reclaim solution, sodium cyanide process solution

Nature of Contamination: Surface water, soil surface

Type of contamination: Copper, cyanide

Environmental Damage(s): Water and soil contamination

Type of Impact/Media Affected: The five spills resulting in releases of copper flotation tailings had spill volumes ranging from from 1,500 gal to 66,000 gal. Four of these spills resulted in contamination of relatively small areas of soil. The largest spill resulted in contamination of a downstream drainage bed for 2.3 miles with an average flow path width of 3 ft. Two spills resulted in a combined release of 76,000 gal of reclaim water . The last spill reported involved release of 2,000 gal of sodium cyanide

process solution onto a nearby roadway and soils. A total of 0.01 lbs of CN was released.

Regulatory Action/Responses: The Nevada Division of Environmental Protect (NDEP) found that BHP Copper was in violation of Nevada Revised Statutes 445A.465 which state that "Injection of fluids through well or discharge of a pollutant without a permit is prohibited." for release of 66,000 gallons of copper flotation tailings on February 12, 1996. The spill was contained within check dams, the cyclones shut down , and the tailings diverted to an overflow channel inside the impoundment. BHP Copper contacted the BLM to identify appropriate remediation efforts. State records indicate that a remediation action plan was submitted and approved by the NDEP. Furthermore, In August of 1996 the NDEP notified BHP Copper that it was in violation of its Water Pollution Control Permit due to increased levels of Total Dissolve Solids and pH. BHP Copper presented an analysis of options for addressing levels of TDS and pH to the NDEP. Remediation measures taken for the remaining spills involved flow stoppage, removal of contaminated soil and excess solution, recycling of materials back into the process, and repair of faulty equipment.

References:

Nevada Division of Environmental Protection (NDEP). Fact Sheet regarding BHP Copper, Magma Nevada Mining Company, Robinson Mining Limited Partnership. March 15, 1993.

Magma Nevada Mining Company. Spill/Release Record. February 12, 1996.

NDEP. Inspection Follow-up Report. February 16, 1996.

NDEP. Complaint/Spill Report Form. March 21, 1996.

Magma Nevada Mining Company. Follow-up Summary Regarding March 20, 1996 Spill. March 25, 1996.

BHP. Follow-up Summary Regarding April 21, 1996 Spill. April 22, 1996

NDEP. Complaint/Spill Report Form. April 22, 1996

NDEP. Finding of Alleged Violation and Order. May 2, 1996.

NDEP. Complaint/Spill Report Form. May 10, 1996.

NDEP. Complaint/Spill Report Form. May 17, 1996.

NDEP. Complaint/Spill Report Form. May 29, 1996.

BHP. Spill/Release Record Regarding May 27, 1996 Spill. May 29, 1996.

NDEP. Complaint/Spill Report Form. June 7, 1996.

BHP. Follow-up Summary Regarding June 6, 1996 Spill. June 11, 1996

NDEP. Complaint/Spill Report Form. June 24, 1996.

Interscience Technology. Report Regarding Options for Lowering TDS and pH Levels at BHP Copper. August 2, 1996.

NDEP. Finding of Alleged Violation and Order. August 20, 1996.

BHP. Summary of Actions and Research taken by BHP Nevada Mining Company. August 21, 1996.

Round Mountain Gold Corporation, Smoky Valley Common Operation: "Process Releases to Soil Surfaces"

Sector(s): Gold

Facility: Round Mountain Gold Corporation, Smoky Valley Common Operation, Round Mountain, Nevada

Facility Overview: Facilities consist of an open pit mine, waste rock dumps, leach residue dumps, reusable, asphalt-lined heap leach pads, and existing dedicated pad, a new dedicated facility, process and storm event ponds, processing facilities, and a permanent placer plant.

Data Source(s): State files

Agency Contact: Dave Gaskin, BMRR

Waste and Materials Management Practices: The facility consists of an open pit mine, waste rock dumps, leach residue dumps, reusable, asphalt-lined heap leach pads, and existing dedicated pad, a new dedicated facility, process and storm event ponds, processing facilities, and a permanent placer plant.

The facility is divided into north and south areas; each possessing two leach pads. The north area leach pads are constructed with a five inch layer of asphaltic concrete above a rubberized membrane followed by a two inch layer of hydraulic asphaltic concrete. The asphalt liner systems are situated on top of scarified and recompacted native soils. The pads do not possess leak detection systems, but are visually inspected following off-loading of spent ore. The north area possesses barren, leak, and pregnant sumps and one event pond, all of which are lined with an asphalt-rubber membrane above compacted native soils. No leak detection system exists, but a down-gradient vadose monitoring well has been installed to monitor groundwater quality.

The south area possesses two reusable leach pads constructed of seven inches of asphaltic concrete. Solution collection pipes that run the lentgh of the pads are provided for leak detection. The southern solution pond has a primary liner of 40-mil HDPE and a secondary liner of 30-mil PVC. Barren and evaporation ponds in the south are double-lined and possess leak detection systems. Twenty-five year, 24-hour storm even flows from the southern pad are captured by a storm event pond. The Round Mountain mine possesses an older dedicated pad with associated ponds. A newer dedicated pond is being constructed in phases.

Three spills involving between 4,515 and 7,015 gallons of cyanide solution occurred at the Round Mountain mine in the period of 1992-94. Two of the spills resulted from problems with either the operation of a leach pad or flawed repairs to the leach pad. The third spill was a result of a equipment failure and operator error.

Type of Impact/Media Affected: On March 18 1992, inadequate percolation in a section of the leach pad caused ponding of leaching solution on top of the pad. A portion of the ponded solution overflowed into the collection ditch where a plug subsequently formed. As a result of the plug the ditch overflowed releasing 2,000 gal of cyanide solution in a run 200 ft south of the pad. On March 24, 1992, between 2,500 and 5,000 gal of process solution containing between 11.5 and 22.9 lbs of sodium cyanide spilled contaminating soil and a road bed. The solution leaked through the leach pad berms following operator and management error in repairs to reshape the leach lines. The last spill occurred in October of 1994 and involved 15 gallons of liquid cyanide solution containing 45 lbs of dry cyanide. The spill resulted when a gasket on an overfilled delivery truck burst.

Type of Release: Process solution

Nature of Contamination: Soil surface

Type of contamination: Cyanide

Environmental Damage(s): Soil contamination

Regulatory Action/Responses: Remediation efforts for each spill event involved removal of contaminated soil and placement of the soil on top of the leach pad for re-leaching. In the first spill, 75 lbs of calcium hypochlorite was used to neutralize the soil prior to soil removal. Remediation in the second spill event involved neutralization of remaining cyanide with calcium Hypochlorite. The plugged ditch was cleaned to allow for free-flow of solution. In addition, the solution application rate in the area of low percolation was reduced to prevent further ponding of solution. Regarding the third spill, 15 cubic yards of soil was recycled on top of the leach pad.

References:

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Round Mountain Gold Corporation, Smoky Valley Common Operation. Letter to NDEP Regarding March 24, 1992 Spill. March 26, 1992.

Bob Carson, Nevada Division of Environmental Protection (NDEP). Fact Sheet Regarding USMX, Inc., Alligator Ridge Mine. May 1994.

NDEP. Complaint/Spill Report Form. October 10, 1994.

Round Mountain Gold Corporation, Smoky Valley Common Operation. Hazardous Materials Release Follow-up Report. October 12, 1994.

NDEP. Complaint/Spill Report Form. October 13, 1994.

Round Mountain Gold Corporation, Smoky Valley Common Operation. Memo to NDEP Regarding October 7, 1994 Spill. October 13, 1994.

Nevada Gold Mining, Inc, Sleeper Project: "Spills of Process Solution to Soil Surfaces"

Sector(s): Gold

Facility: Nevada Gold Mining, Inc., Sleeper Project Facility, Humboldt County, Nevada

Facility Overview: Operations conducted at the facility include gold production using open pit mining and heap leaching of gold ore. Sleeper Project consists of two active pits, a mill/process plant, two tailings impoundments, a seepage collection pont, waste/overburden dumps, three pregnant ponds, a barren pond, two overflow ponds, heap leach phases I-IV and two proposed phases (V and VI).

Data Source(s): State files

Agency Contact: Dave Gaskin, Bureau of Mining Regulation and Reclamation

Waste and Materials Management Practices: Operations conducted at the facility include gold production using open pit mining and heap leaching of gold ore. Sleeper Project consists of two active pits, a mill/process plant, two tailings impoundments, a seepage collection pont, waste/overburden dumps, three pregnant ponds, a barren pond, two overflow ponds, heap leach phases I-IV and two proposed phases (V and VI).

Existing heap leach pad (phases I & II) consists of 60-mil HDPE primary liner on a compacted layer of natural silty sand. The phase I leach pad includes an electronic leak detection system embedded in the silty sand. Phase II leach pad has possesses no leak detection. The Pad 2 and 3, phase III & IV leach pads, consist of 6-mil HDPE primary liner on four inches of compacted lay above eight inches of compacted natural silty sand. Phase III & IV leach pads include electronic leak detection systems.

Containment for the pregnant, overflow, and barren ponds for phases I, II, II, & IV consists of a 60-mil HDPE primary liner, one foot of compacted clay, a four-inch sand layer between embankment liners, and four- and six- inch gravel layers (lower and upper, respectively) between layers. The leak detection systems consist of a six-inch diameter pipe located between the primary and secondary liners.

Two tailings impoundments have of a one-foot clay liner situated below one foot of sand. Seepage from the impoundments flows to the seepage pond via a network of four-inch perforated pipes. The seepage pond is lined with of 60-mil HDPE primary and secondary liners. Any leakage from primary containment flows via a gundnet between the liners to a sand filled leak detection sump.

Facilities are designed to contain 25-year/24-hour storm event flows. The facilities are required to be designed, constructed, operated and closed without discharge or release in excess of standards established in regulations except during meteorological events exceeding the design storm event.

Type of Release: Barren solution

Nature of Contamination: Soil surface

Type of contamination: Sodium cyanide

Environmental Damage(s): Soil contamination

Three spills occurred at the facility during 1995 and 1996. As a result of broken pipes and ruptured pumps, a total of 45,089 gallons of process barren solution containing sodium cyanide (NaCN) was released into the surrounding soils.

Type of Impact/Media Affected: In June of 1995, 748 gallons of barren solution containing 0.75 lbs NaCN was released when a hose connection failed,

soaking 100 square feet of soil to a depth of one inch. This spill was followed a month later by a release of 27,540 gallons of solution and 4.6 lbs of sodium cyanide into surrounding soils. In this case, a feeder pipe broke off the main header pipe. The third spill occurred in August of 1996 when a barren solution discharge pump ruptured. It resulted in 16,801 gallons of barren solution being discharged containing 5.8 lbs of NaCN. None of the spills resulted in contamination of surface or groundwater.

Regulatory Action/Responses: The facility repaired all causes of the reported spills (broken feeder pipes, split discharge hose, and ruptured pumps). In all cases, the source of flow was immediately shut down upon leak detection and the faulty equipment repaired. In the two largest spills, contaminated soils was removed and put on top of the leach pad. Soil samples were taken to determine the necessity of further remediation efforts. Samples from the July, 1995 spill indicated that no residual soil had cyanide over 0.2 mg/l; no data were available for the August 1996 spill. The smaller spill, the soil was treated by photodegradation and left in place pending soil analysis to determine if the remaining concentration warranted further remediation efforts. In all cases, appropriate regulatory agencies were notified soon after leak detection.

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Sleeper Mine. Spill/Release Record. June 5, 1995.

NDEP. Complaint/Spill Report Form. June 6, 1995.

Nevada Gold Mining, Inc. Memo To Duty Officer, Nevada Division of Emergency Management, Regarding June 4, 1995 Spill. June 6, 1995

NDEP. Complaint/Spill Report Form. July 10, 1995.

Sleeper Mine, Record of Communication with NDEP Regarding July 10, 1995 Spill. July 10, 1995

Sleeper Mine. Spill/Release Record. July 10, 1995.

Nevada Gold Mining, Inc. Memo to Duty Officer, Nevada Division of Emergency Management, Regarding July 10, 1995 Spill. July 19, 1995.

Sleeper Mine, Record of Communication with NDEP Regarding Spill Clean Up Analysis Results. August 3, 1995

NDEP. Complaint/Spill Report Form. August 13, 1996.

Sleeper Mine. Spill/Release Record. August 15, 1996.

Nevada Gold Mining, Inc. Memo to Bureau of Mining Regulation and Reclamation Regarding August 13, 1996 Spill. August 22, 1996.

Wind Mountain Mining's Wind Mountain Project: "Spills of Process Solution to Soil Surfaces"

Sector(s): Silver and Gold

Facility: Wind Mountain Project; Wind Mountain Mining, Empire, Nevada

Facility Overview: Operations include an open pit mine project and ore processing. The facility is required to operate without releasing or discharging wastes to the environment.

The facility operates in an area with no nearby surface waters. Depth to groundwater is greater than 100 feet.

Data Source(s): State Files

Agency Contact: Dave Gaskin, Bureau of Mining Regulation and Reclamation

Waste and Material Management Practices: The facility extracted ore from an open pit mine. The ore is processed by conventional heap leach cyanidation with precious metal recovery by zinc precipitation. Mining ceased in January 1992, die to depletion of reserves. Residual leaching is continuing.

Ore from the mine is crushed and loaded onto the heap leach pad. Buffered sodium cyanide is pumped from the barren pond and sprayed on the heap. The leachate is collected in a perforated pipe network on top of the pad liner. A valve system allows the solution to be sent to the pregnant, countercurrent or barren pond. These ponds are double lined with HDPE primary liner and compacted clay secondary liner. The liners are separated by a one-foot layer of sand that drains any fluids to a sump. All three ponds have leak detection system.

The leach pad, solution ponds and recovery facility is surrounded by a runoff diversion system. The diversion system retention ponds are designed to contain the operating volume of over 6 million gallons of process water plus the cumulative runoff from a 25-year, 24-hour storm event.

Type of Release: Spill

Nature of Contamination: Soil

Type of contamination: Sodium cyanide solution

Environmental Damage(s): Soil contamination

The facility has reported one spill of sodium cyanide between 1990 and 1996. The release occurred as a result of operator error. On October 18, 1991, an unauthorized release of sodium cyanide occurred when a valve directing barren solution to a cyanide mix tank was inadvertently left open. A bin of cyanide briquettes was dumped into the mixing tank. The tank was then filled, and (with the combined barren solution) overflowed the containment area.

Type of Impact/Media Affected: Approximately 1000 gallons of solution were spilled at a concentration 27 lbs/ton , resulting in an estimated release of 112 pounds of NaCN. The soil did not absorb much of the solution due to the clayey nature of the soil and the slope around the mix tank and solution ponds.

Regulatory Action/Response: The facility excavated the soil to a depth of 12 to 18 inches. The soil was then transported to the heaps. And, a solution of calcium hypochlorite was applied to the excavated spill areas. After testing for, and finding the presence of WAD Cyanide, Calcium hypochlorite was reapplied to the spill area.

References:

Dean Mierau. Fact Sheet. March 1990.

Wind Mountain Mining, Inc. Written Spill Report. November 5, 1991.

Phelps Dodge's Chino Branch: "Multiple Tailings Spills"

Sector(s): Copper and Molybdenum

Facility: Chino Branch, Phelps Dodge Ming Co., Hurley, NM

Facility Overview: Open pit copper and moly-bdenum mine, using dump leaching, and solvent extraction-electrowinning for bene-ficiation. A copper smelter and sulfuric acid plant are located at the site.

Data Sources: State files

Agency Contact: Karen McCormack, Groundwater Protection and Remediation Bureau

Wastes and Material Management Practices: Operations conducted at the Chino Mine include an open pit copper and molybdenum mining; dump leaching of ore; beneficiation via crushing, regrinding and froth flotation; refining; and smelting. The ore is extracted from the pit, processed in a ball mill; and separated in a five stage crushing/screening plant. The copper and molybdenum are concentrated in a froth flotation mill using raconite and pine oil as flotation re-agents. The concentrator yields a product that is 21 percent copper, 32 percent iron, and 0.5 percent molybdenum.

In addition to the crushing/flotation circuit, Chino employs a dump leach/solvent extraction-electrowinning (SX-EW) circuit for the extraction of copper, molybdenum, gold and silver. The SX-EW plant began operations in 1988 with an annual operating capacity of 45,000 standard tons (st) electrowon copper. Production in 1991 was 55,200 st. Chino also operates a smelter onsite, with an annual capacity of 550,000 st; and an acid plant producing 550,000 st annually.

The mine, mill, and waste treatment complex is located in the Whitewater Creek watershed near Hurley, NM. The creek has been diverted around the complex, but experiences flows during precipitation events.

During 1990 and 1991, Chino experienced two major releases to the environment. On November 22, 1990, 1440 gallons of raffinate escaped from the raffinate pond. The leak was determined to have been caused by several small tears in the pond liner. On August 12, 1991, 3,200 gallons of tailings were released into Whitewater Creek when a tailings pipeline ruptured. In 1993, 208 tons and 91,500 gallons of tailings in six separate incidents were accidentally released to Whitewater Creek. In each instance, degraded pipes ruptured, releasing a mix of tailings and tailings water to the Creek. Similar releases in 1994, 1995, and 1996 resulted in an additional 140,000 gallons of tailings being released to Whitewater Creek.

Type of Release: Tailings and Spent electrolyte

Nature of Contamination: Surface water and mine seepage

Type of Contamination: Solids, elevated copper and low pH

Environmental Damage: Short term impact to surface water, creekbed, and groundwater

In August of 1994, elevated levels of copper and low pH were observed in monitoring well SWIX-2 (located near the SX-EW plant). Inspection of the SX-EW circuit revealed a small fracture in a sump used to pump spent electrolyte from the plant to the raffinate pond. The crack had allowed small amounts of raffinate to escape on a periodic basis.

Type of Impact/Media Affected: The numerous tailings spills impacted surface waters and the creekbed of Whitewater Creek. Impacts included: elevated TDS and metals in surface water (when present in the stream).

Where the spent electrolyte leaked from the SW-EX circuit, the solution penetrated the soil and migrated along the bedrock surface and eventually entered the Old Tin Can Mine workings (where SWIX-2 is located.

Regulatory Action/Responses: In the case of each of the tailings spills, Chino personnel addressed the release in a similar manner. First, all pumps feeding the ruptured pipeline were shut down. Second, emergency berms were erected to contain the spill and/or prevent the fluid fraction from reaching Whitewater creek. Crews vacuumed the water and removed it to the tailings pond. The tailings, impacted surface soils, and creekbed were excavated and placed atop the tailngs pile. The New Mexico Environmental Department issued a Notice of Violation for the 8/12/91 release of 3,200 gallons of tailngs to Whitewater Creek.

The Corrective Action Report (approved by the NMED) indicated that remediation of the spent electrolyte plume detected by SWIX-2 was accomplished by conducting repairs to the damaged sump. Monitoring of well SWIX-2 indicated a return to normal parameters with 6 months of the effective date of the repair to the sump.

References:

Milovich, D., Manager, Chino Mines Co. November 28,. 1990. Letter to S. Carey, NMED Re: November 19, 1990 Tailings Spill. Chino Mines Co., Hurley, NM.

Milovich, D., Manager, Chino Mines Co. August 16,. 1991. Letter to S. Carey, NMED Re: August 12, 1991 Tailings Spill. Chino Mines Co., Hurley, NM.

Milovich, D., Manager, Chino Mines Co. September 25, 1991. Letter to S. Carey, NMED Re: Corrective Actions Taken in Response to August 12, 1991 Tailings Spill. Chino Mines Co., Hurley, NM.

Cary, S., Acting Chief, NMED, Groundwater Protection Bureau. September 6, 1991. Notice of Violation: Discharge Permit - 213, Chino Mine. NMED, Santa Fe, NM.

Milovich, D., Manager, Chino Mines Co. October 4, 1991. Letter to S. Carey, NMED Re: Response to Notice of Violation Issued September 6, 1991. Chino Mines Co., Hurley, NM.

Milovich, D., Manager, Phelps Dodge Chino Branch. August 10, 1992. Letter to S. Carey, NMED Re: August 4, 1992 Tailings Spill. Phelps Dodge Chino Branch, Hurley, NM.

Cary, S., Acting Chief, NMED, Groundwater Protection Bureau. September 2, 1992. Approval of Corrective Action Report Re: August 4, 1992 Tailings Spill. NMED, Santa Fe, NM.

Brock, W. Manager, Phelps Dodge Chino Branch. August 4, 1994. Letter to Dale Doremus, NMED Re: Anomalous Readings in SWIX-2 Monitoring Well. Phelps Dodge Chino Branch, Hurley, NM.

Brock, W. Manager, Phelps Dodge Chino Branch. November 28, 1994. Letter to Dale Doremus, NMED Re: Anomalous Readings in SWIX-2 Monitoring Well. Phelps Dodge Chino Branch, Hurley, NM.

Brock, W. Manager, Phelps Dodge Chino Branch. January 9, 1995. Letter to Karen McCormack, NMED Re: January 2, 1995 Tailings Spill. Phelps Dodge Chino Branch, Hurley, NM.

Brock, W. Manager, Phelps Dodge Chino Branch. April 16, 1996. Letter to Marchell Schuman, NMED Re: April 11, 1996 Tailings Spill. Phelps Dodge Chino Branch, Hurley, NM.

Brock, W. Manager, Phelps Dodge Chino Branch. August 5, 1996. Letter to Marchell Schuman, NMED Re: July 26, 1996 Tailings Spill. Phelps Dodge Chino Branch, Hurley, NM.

Cobre Mining Co.'s Continental Mine: "Multiple Tailings Spills and Seeps"

Sector(s): Copper

Facility: Continental Mine, Cobre Mining Co.,
Hanover, NM

Facility Overview: Underground copper mine, grinding mill, and frother flotation.

Data Sources: State files

Agency Contact: Karen McCormack, Groundwater Protection and Remediation Bureau

Wastes and Material Management Practices: the facility operates an underground copper mine, grinding mill, and a flotation mill for copper recovery. Tailings are pumped via pipeline to a tailings impoundment.

During 1995 and 1996, five separate releases were reported. These releases included 6,000 gallons of mill process water; 80,000 gallons of sediment pond water; 2,000 gallons of tailings; 30 - 50,000 gallons mill slurry discharge; and a spill of between 17,500 and 52,500 gallons of water and tailings. In each of these instances, equipment failure or human error caused the solution to escape from the waste management system and enter Hanover Creek.

In 1996, four seeps were detected at the facility. Three seeps at the magnetite pond were discovered during a compliance inspection by New Mexico State personnel. The source of the liquids causing the seeps was determined to be a broken valve in an old feed line, and seepage from under the main tailings pond, located directly up gradient from the magnetite pond. The total flow for the three seeps was less than 3 gallons per minute.

An acid seep from the west wasterock dump was discovered in July of 1996. This seep had a flow of 10 gallons per minute, and a pH of 3.5 (exceeding both surface water and groundwater standards). The seep was discharging into Blackhorn Gulch and Hanover Creek. The cause of the seep was determined to be unusually high volume precipitation events.

Type of Impact/Media Affected: the five tailings and process water spills resulted in short term impacts to Hanover Creek. Total dissolved solids, and turbidity increased, and the tailings coated the creek bed. The 17,500 - 52,500 gallon release included residue from an alcohol based frother and a hydrocarbon based collector. This spill also exceeded permittable levels of cadmium, lead, total nitrogen, and sulfate.

The seep with a pH of 3.5 from the waste rock pile contributed highly acidic water to Hanover Creek.

Type of Release: tailings water and solids; acid rock drainage to Hanover Creek

Nature of Contamination: solids, low pH water

Type of Contamination: surface water contamination

Regulatory Action/Responses: For each of the five spills, new equipment was added, and berms, and emergency spill catchment areas were constructed to prevent the same spill from recurring again. Tailings solids and impacted soils were collected via front end loader and by hand and placed on the tailings pile.

Remediation for the three seeps identified in the magnetite pond included construction of a lined containment pond and pumpback system and the installation of a monitoring well to determine if the underlying aquifer was impacted.

The remedial effort for the ARD seep discovered in the waste rock pile consisted of constructing a containment area and gravity feeding the ARD to the make up water tanks via a 2" pipe.

References:

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King, Glenn, Manager, Continental Mine. June 26,, 1996. Letter to Marchell Schuman, NMED Re: Overflow of Seep Containment Facility of June 14, 1996. Cobre Mining Co., Hanover, NM.

Leavitt, Mary, Chief, Groundwater Quality Bureau, NMED. August 30, 1996. Corrective Action Report, DP-181: Discharge of Low pH Seep in Upper Buckhorn Gulch. New Mexico Department Of Environment, Santa Fe, NM.

Bokich, John, Manager, Continental Mine. November 14,, 1996. Letter to Marchell Schuman, NMED Re: Corrective Action Report of Slurry Line Incident, November 14, 1996. Cobre Mining Co., Hanover, NM.

Ortiz Project IV: "Remediation of Groundwater Contamination and Acid Rock Drainage"

Sector(s): Gold

Facility: Ortiz Project, LAC Minerals, Cerrilos, NM

Facility Overview: Open pit gold mine with old underground workings currently awaiting permit approval to begin mining.

Data Sources: State files

Agency Contact: Karen McCormack, Groundwater Protection and Remediation Bureau

Wastes and Material Management Practices: The facility is an open pit gold mine with old underground and open pit workings and an abandoned mill. LAC Minerals (formerly in partnership with Pegasus Gold) is planning to commence production at the mine using heap leaching for gold extraction. Permits to begin operations have not been issued pending resolution of the acid rock drainage (ARD) problems at the site.

Goldfields, Inc. operated the Cunningham Mill and Mine, and the Delores mine in the 1980s. After suspending operations, the site was taken over by a partnership of Pegasus Gold and LAC Minerals. The new mine was named the Ortiz Project and encompasses the old workings.

A 45 acre spent ore pile has contaminated the groundwater with nitrate and cyanide. Pegasus/LAC was issued a permit to begin pumping groundwater near the base of the spent ore pile. The contaminated groundwater was treated by land application. A constructed wetland was installed and operated on a pilot scale basis from October of 1991 to June of 1993. Remediation of the spent ore pile involved recontouring for positive drainage; discing lime into the pile, installing a cap to prevent infiltration of oxygen and water; and revegetation. The permit to operate the land application system required Pegasus/LAC to continue to operate the system for two years after monitoring indicated that the contaminant levels in the groundwater had been reduced to permitable levels.

In October of 1992, Pegasus/LAC received permission to begin remediation of the waste rock pile, which until that time was producing ARD. Remediation of the waste rock pile included installing drainage diversions capable of handling a 100 year - 24 hour storm event around the pile; recontouring; adding drainage benches; and capping to prevent infiltration.

Type of Release: Spent ore leachate and acid rock drainage

Nature of Contamination: degradation of groundwater and acidification of surface water

Type of Contamination: nitrate and cyanide in the groundwater; low pH and elevated metals concentration in the acid rock drainage

Environmental Damage: degradation of groundwater and acidification of surface water

In order to treat the ARD then being generated in the waste rock pile, an ARD treatment system was installed. This system was composed of a cutoff trench to intercept the ARD at the toe of the pile; a pump-back system to remove the ARD to a treatment facility (located on top of the waste rock pile); a lime silo for treating the ARD, and a series of unlined evaporation trenches installed on the top of the pile. Two monitoring wells were installed down gradient of the pile to monitor groundwater quality.

In October of 1996, LAC Minerals (who took over the site after Pegasus left in late 1992) received permission to modify its ARD treatment plan. The modifications included adding a new, lined ARD collection pond;

replacing the treatment system with a new system down gradient in Delores Gulch; constructing sludge de-watering cells as part of the leachate treatment system; and constructing a half-acre evaporation pond to provide final containment and elimination of the ARD.

References:

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Boteilho, Leonard, Project Manager, Ortiz Project IV. October 8, 1996. Application of LAC Minerals for Third Modification of DP-55. LAC Minerals, Santa Fe, NM.

Molycorp's Questa Mine: "Multiple Tailings Spills"

Sector(s): Molybdenum

Facility: Molycorp, Questa Mine
Questa, New Mexico

Facility Overview: Operations conducted at the facility include underground mining of molybdenum bearing ore and beneficiation by crushing, grinding and concentrating prior to shipment to a refiner. Mine decant water, tailings decant water, and seepage from tailings impoundment is released via an NPDES permitted discharge to the Red River.

Data Sources: State files

Agency Contact: Karen McCormack, Groundwater Protection and Remediation Bureau

Wastes and Material Management Practices: Operations conducted at the facility include underground mining of molybdenum ore and beneficiation by crushing, grinding and concentrating prior to shipment to an off-site refiner.

Mill capacity at Questa is 15,000 tons per day. Three stage crushing is followed by screening for single stage rougher flotation, using cyclones for classification. Regrinding, cleaning, and recleaning stages are then employed to increase the flotation concentrate to a marketable grade. The concentrate is then filtered, dried, and packed for shipment.

Tailings from the concentrator are pumped to a tailings impoundment located 8.5 miles from the mill building. The pipeline is constantly patrolled by Molycorp personnel to prevent pollution of a recreation area. Three sources of wastewater (mine decant water, tailings decant water, and seepage from the tailings dam) are discharged to the Red River under a NPDES permit. The mine has not received a permit to discharge from the State of New Mexico. Sampling data submitted by Molycorp indicate the discharge is within the parameters of the NPDES permit. Molycorp suspended mining/milling operations at Questa in January 1992, citing a saturated world market and depressed molydenum prices. Questa resumed operations in June of 1996.

The Questa mine experienced five tailings spills in 1990 and three spills in 1991. All spills resulted from ruptures in the 8.5 mile tailings pipeline. Releases ranged from 22,500 gallons to 1,000 gallons. Reasons for the releases included ruptured pipes due to normal wear and a puncture of the pipeline during routine maintenance operations. Tailings solids and water were contained by a series of emergency sumps and berms. In several instances, tailings flowed outside the bermed areas, impacting irrigation ditches and private property bordering the mine site. In once instance, tailings covered approximately one half acre of an alfalfa field to a depth of one half inch.

Remediation of these spills involved mechanical and hand cleanup of tailings solids, which were then deposited in the tailings pond. Inspection reports submitted by New Mexico Groundwater Protection and Remediation staff indicate that the spill sites were remediated promptly.

On May 21, 1991, 139 tons of tailings were spilled when a pressure surge separated the tailings pipeline at a coupling. The tailings entered an irrigation ditch, and flowed into an arroyo that feeds the Red River. Before emergency berms were constructed, an estimated 25 gallons of tailings water entered the River.

Type of Release: Tailings

Nature of Contamination: Surface water and soils

Type of Contamination: Silver

Environmental Damage: Surface water

Type of Impact/Media Affected: The numerous tailings spills reported in 1990 and 1991 resulted in short term impacts to surrounding soils. The spill of 139 tons of tailings resulted in a release of tailings decant water to the Red River that contained 11 times the permitted 500 parts per billion limit for silver.

Regulatory Action/Responses: The mine repaired all ruptures to the tailings pipeline and instituted containment and cleanup efforts upon discovery of the spills. Cleanup efforts included removing tailings with front-end loaders, dump trucks, and shovel and wheel barrow. Tailings were deposited in the tailings pond. No mention of the water fraction of the spilled tailings is made in the initial spill reports or cleanup/remedial action plans other than to document the extent to which the water flowed (in conjunction with the tailings).

The US EPA levied a fine of $20,000 in response to the release of 25 gallons of tailings water to the Red River. The fine was based on the elevated level of silver in the sample taken (11 times the 500 ppb permitted level).

References:

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Shoemaker, D. March 26, 1991. Letter to M. Saladen, Surface Water Section, NMEID Re: March 26, 1991 Tailings Spill. Molycorp, Inc.

Shoemaker, D. May 22, 1991. Letter to M. Saladen, Surface Water Section, NMEID Re: May 21, 1991 Tailings Spill. Molycorp, Inc.

Shoemaker, D. June 3, 1991. Letter to M. Saladen, Surface Water Section, NMEID Re: Detailed Follow-up Letter Regarding the May 21, 1991 Tailings Spill. Molycorp, Inc.

Weiss, N.L., Editor. 1985. SME Mineral Processing Handbook, Volume 2: Molybdenum. Society of Mining Engineers. New York, NY. Pg. 16-4.

Reading Alloys, Inc.: "Contaminated Storm Water Released to Ground Water"

Sector(s): Ferrous, titanium, and nickel

Facility: Reading Alloys, Inc., Robesonia, Pennsylvania

Facility Overview: Ferrous and non-ferrous master alloys are produced using the themite process. The facility consists of five processing buildings utilizing several processes in the manufacture of master alloys: initial formulation of raw materials; charging of aluminothermic reactors; smelting; cool down and slag removal; master alloy preparation; and weighing and packaging for shipment. Dates of operation are not available in the files reviewed.

Data Source(s): State files

Agency Contact: Jonathan Taylor, Water Quality Specialist, PADER

Waste and Material Management Practices: Reading Alloys, Inc. produces ferrous and non-ferrous master alloys using the themite process. The facility consists of five processing buildings utilizing several processes in the manufacture of master alloys: initial formulation of raw material; charging of aluminothermic reactors; smelting; cool down and slag removal; master alloy preparation; and weighing and packaging for shipment. The facility uses water from an unnamed tributary as non-contact cooling water. The water is pumped from the tributary to the facility's upper pond (DP101) and is used to cool furnaces prior to being returned to the upper pond and discharged to Spring Creek. The facility also has two lower ponds which receive some flow from the unnamed tributary. All sanitary-use water is discharged to a septic tank/drainfield on the facility property.

The facility also produces vanadium oxide that is used for the production of vanadium master alloys. Petroleum ash is used as the feedstock material in this process. Other materials used in the production of vanadium oxide include small amounts of nitric acid, ammonia, caustic soda or potash, potassium nitrate, and sodium sulfide. The facility uses a bunker storage system for storage of vanadium ash. The bunker has a leachate collection system which collects run-off and directs it to a settling basin and then to six steel tanks where it is used as feed water.

The facility's excess storm water run-off which contacts slag in the slag-storage pits near the meltlines to discharge to a drainfield via storm sewers. The storm water in the drainfield infiltrated ground water.

Type of Impact/Media Affected: The discharge of storm water to the subsurface is a violation of the Pennsylvania Clean Streams Law and Chapters 101 and 97 of the Pennsylvania Department of Environmental Protection's Rules and Regulations. The storm water contained elevated levels of iron (143 µg/l, secondary MCL 0.03 µg/l), lead (116 µg/l, action level 0.015 µg/l), hexavalent chromium (10 µg/l), total chromium (50 µg/l, MCL 0.1 µg/l), aluminum (585 µg/l, secondary MCL 0.05-0.2 µg/l), and zinc (16 µg/l, secondary MCL 5 µg/l). The storm water was highly acidic with a pH level of 2.9.

Type of Release: Storm water discharge

Affected Media: Ground water

Type of Contamination: High acidity and heavy metals concentrations including iron, lead, chromium, aluminum, and zinc

Environmental Damage(s): Ground water contamination

Regulatory Action/Response: The Pennsylvania Department of Environmental Resources (PADER) issued a Notice of Violation to Reading Alloys on June 25, 1990, for the injection of storm water into the subsurface. The Notice required the facility operator to adequately remediate the ground water and to initiate a ground water testing program in the vicinity of the storm water disposal area to identify private water supply wells affected by the contamination. The Notice also required Reading

Alloys to hire a hydrogeologist to supervise the testing and to submit a work plan describing the scope and methods of a hydrogeologic study to determine the extent and impact of soil and ground water contamination. The work plan was required to include a corrective action schedule. The Department of Environmental Resources also indicated that the storm water must be redirected to surface water and be included as part of the facility's NPDES permit. Plans to address the storm water have been submitted with the facility's permit application.

References:

Pennsylvania Department of Environmental Resources. *Notice of Violation*. June 25, 1990.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. February 1, 1990.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. June 6, 1990.

Reading Alloys, Inc. *Preparedness, Prevention and Contingency Plan*. September 1988.

Reading Alloys, Inc.: "90,000 to 100,000 Gallons of Process Water Contaminates Soil"

Sector(s): Ferrous, titanium, and nickel

Facility: Reading Alloys, Inc., Robesonia, Pennsylvania

Facility Overview: Ferrous and non-ferrous master alloys are produced using the themite process. The facility consists of five processing buildings utilizing several processes in the manufacture of master alloys: initial formulation of raw materials; charging of aluminothermic reactors; smelting; cool down and slag removal; master alloy preparation; and weighing and packaging for shipment. Dates of operation were not available in the files reviewed.

Data Source(s): State files

Agency Contact: Jonathan Taylor, Water Quality Specialist, PADER

Waste and Material Management Practices: Reading Alloys, Inc. produces ferrous and non-ferrous master alloys using the themite process. The facility consists of five processing buildings utilizing several processes in the manufacture of master alloys: initial formulation of raw materials; charging of aluminothermic reactors; smelting; cool down and slag removal; master alloy preparation; and weighing and packaging for shipment. The facility uses water from an unnamed tributary as non-contact cooling water. The water is pumped from the tributary to the facility's upper pond (DP101) and is used to cool furnaces prior to being returned to the upper pond and discharged to Spring Creek. The facility also has two lower ponds which receive some flow from the unnamed tributary. All sanitary-use water is discharged to a septic tank/drainfield on the facility property.

The facility also produces vanadium oxide that is used for the production of vanadium master alloys. Petroleum ash is used as the feedstock material in this process. Other materials used in the production of vanadium oxide include small amounts of nitric acid, ammonia, caustic soda or potash, potassium nitrate and sodium sulfide. The facility uses a bunker storage system for storage of vanadium ash. The bunker has a leachate collection system which collects run-off and directs it to a settling basin and then to six steel tanks where it is used as feed water. Excess storm water run-off contacts slag in the slag storage pits near the meltlines. This storm water run-off is directed to a drainfield via storm sewers.

On August 29, 1991, leakage from a process tank was detected. It is estimated that approximately 90,000 to 100,000 gallons of process water was released to the surrounding area. The leakage was most likely caused by the settling of the process tank, as evidenced by significant soil settling in the contaminated area following the leakage. Facility representatives report that the settling process pulled the sections of the tank apart, thus causing the release.

Type of Impact/Media Affected: Approximately 90,000 to 100,000 gallons of treated bunker leachate were released to the surrounding areas of the process tank. The released process water contained dissolved salts, consisting primarily of potassium and sodium. Sampling results taken on September 3, 1991, from the liquor and surrounding soil showed concentrations of barium (0.2-0.5 ppm), cadmium (0.01-0.05 ppm), calcium (244-2,520 ppm), chloride (480 ppm-liquor only), chromium (0.02-0.20 ppm), copper (0.02-0.05 ppm), lead (0.005-0.012 ppm), magnesium (45-486 ppm), nickel (0.04-1.52 ppm), potassium (19.6-13,600 ppm), sodium (1,520-4,000 ppm), vanadium (0.1-18.2 ppm), and zinc (0.07-0.76 ppm). No downgradient water sources are located within the vicinity of the above-ground process tanks.

Type of Release: Process water

Affected Media: Soil

Type of Contamination: Dissolved salts, consisting of potassium, sodium, barium, cadmium, calcium, chloride, chromium, copper, lead, magnesium, nickel, vanadium, and zinc

Environmental Damage(s): Soil contamination

Regulatory Action/Response: As soon as the leak was detected on August 29, 1991, Reading Alloys began corrective measures and notified the appropriate regulatory agencies. The facility pumped the remaining water from the leaking tank into another processing tank as well as a million-gallon holding tank. The facility planned to pressure test, or hydraulically test, the process tanks when full to avoid future leakage.

References:

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. February 1, 1990.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. June 6, 1990.

Reading Alloys, Inc. *Memorandum regarding a leakage of process water from a process tank*. September 17, 1991.

Reading Alloys, Inc. *Preparedness, Prevention and Contingency Plan*. September 1988.

Shenango, Inc. Coke and Iron: "Multiple Oil Releases Contaminate Soil and Surface Water"

Sector(s): Ferrous metals

Facility: Shenango, Inc., Neville, Pennsylvania

Facility Overview: Shenango Coke and Iron consists of three divisions: the Coke Plant Division, the Blast Furnace Division, and the Steam and Power Division. Process wastewater and non-contact cooling water are generated in each of the three divisions. In addition, approximately 7,000 gallons of tar decanter sludge and 10,000 gallons of degreaser sludges, spent solvents, ignitable product residues, and desulfurization wastes are generated annually. Industrial processes have occurred on-site since 1898.

Data Source(s): State files

Agency Contact: Patricia Miller and Homer Richey, Water Quality Specialists, PADER

Waste and Material Management Practices: Shenango Coke and Iron consists of three divisions, the Coke Plant Division, the Blast Furnace Division, and the Steam and Power Division. Process wastewater and non-contact cooling water are generated in each of the three divisions. In addition, approximately 7,000 gallons of tar decanter sludge and 10,000 gallons of degreaser sludges, spent solvents, ignitable product residues, and desulfurization wastes are generated annually. Wastewater, other than non-contact cooling water, is generated in volumes from 19 to 24 million gallons per day and is treated prior to discharge through Outfall 001 into the main channel of the Ohio River. The desulfurization waste are not generated on a continuous basis; however, these wastes are stored in a sump capable of holding 6,400 gallons. The desulfurization waste is a liquid and is periodically pumped from the sump to a tanker truck for off-site shipment. Tar decanter sludge is solid and nearly insoluble in water. The tar decanter sludge is recycled back into the coking process. The various sludges and spent solvents are stored in 55-gallon drums in an on-site hazardous waste storage area to await off-site shipment. The process wastewater generated in the Byproducts Recovery Plant is treated in a physical/chemical treatment facility, and discharged to the main channel of the Ohio River. The Steam and Power Division wastewater is discharged from Outfall 002 to the back channel of the Ohio River. Between 1990 and 1996, Shenango Coke and Iron has had 14 recorded oil releases or spills to the Ohio River.

Type of Impact/Media Affected: The oil releases occurred through a variety of outfalls. All oil releases either spilled into the Ohio River or onto the ground. Elevated levels of other contaminants were found in the water with the oil including chloride, chromium, copper, phenols, organic carbon, lead, and zinc. Information on each occurrence is as follows:

Date of Spill	Amount of Spill	Description of Spill	Cause of Spill
July 31, 1990	Unknown	Oil sheen on river outside Outfall 003 and on ground outside of oil/water separator	Unknown
August 16, 1990	Unknown	Oil sheen on river	Unknown
May 2, 1990	20-50 gallons	Oil sheen on river outside Outfall 001	Unknown
August 30, 1991	Under 5 gallons	Spotty oil sheen on river outside Outfall 001; heavier sheen observed downstream;	Hot oil package boiled over during startup of unit, some oil entered drain and was discharged to Ohio River

Date of Spill	Amount of Spill	Description of Spill	Cause of Spill
June 22, 1992	Unknown	Oil sheen on river outside Outfall 001; wind blowing upstream toward West View Water intake	Process water from coking operations; leak in riser pipe at coolers sprayed water/oil over a large area; entered discharge system
October 13, 1992	Not noted	Oil on ground near steam pipe	Leak in steam pipe
April 8, 1993	3-4 feet wide	Light/spotty oil sheen on riverbank downstream from Outfall 001	Unknown
December 31, 1993	50 gallons	Wash oil spilled onto ground which migrated to the river through a storm sewer; oil sheen outside Outfall 001	Spill occurred while loading railcar; transfer was left unattended at which time an overflow occurred
January 11, 1994	1-1,500 gallons	Wash oil spilled onto ground and migrated to the river	Spill occurred while loading a truck; truck pulled away before transfer was complete
January 18, 1994	1.5 miles x 1,000 feet	Oil sheen on river; black in color with heavy rainbow in places	Unknown
May 4, 1995	10 gallons	Wash oil spilled into river through Outfall 001	Intercepting sump's (water/oil separator) oil compartments overfilled due to operator error; oil contaminated water compartment processed through wastewater treatment plant; discharged to river
July 18, 1995	Unknown	Oil sheen on river outside Outfall 001; heavy oil accumulation around the permanently stationed containment boom near the shoreline	A valve used to drain water that accumulates in gas holder oil was left open; water and oil drained into sump and siphoned for treatment in the wastewater treatment plant; discharged to river
August 27, 1995	150-200 feet x 3/4 mile	Oil sheen on river outside Outfall 001 and around left descending bank above Emsworth Lock & Dam	Unknown
September 25, 1996	12 x 20 feet	Wash oil spill from Outfall 001	Unknown

Type of Release: Oil

Affected Media: Soil and surface water

Type of Contamination: Oil

Environmental Damage(s): Surface water contamination

Regulatory Action/Response: The Pennsylvania Department of Environmental Resources has conducted multiple investigations, during which it discovered several oil discharges or releases. U.S. Environmental Protection Agency, Region III issued three memoranda to Shenango regarding violations of Section 311(b)(3) of the Federal Water Pollution Control Act on accidental oil releases occurring on May 2, 1991, August 30, 1991, and May 4, 1995. Shenango was required to complete an incident questionnaire for each violation. In all cases that noted corrective actions, Shenango attempted to identify the source, eliminate the release, and contain contamination with a containment boom. In some cases, the facility installed additional booms or used vacuum trucks.

References:

Bureau of Waste Management. *Cover letter and Potential Hazardous Waste Site Preliminary and Assessment*. March 27, 1986.

Bureau of Waste Management, Hazardous Sites Cleanup Program. *Site Inspection of Shenango Inc., Coke and Iron PA# 501.*

Pennsylvania Department of Environmental Resources. *General Inspection Report (Non-NPDES)*. August 27, 1995.

Pennsylvania Department of Environmental Resources. *Incident Notification*. January 18, 1994.

Pennsylvania Department of Environmental Resources. *Incident Notification*. August 27, 1995.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. July 31, 1990.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. August 16, 1990.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. August 30, 1991.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. June 22, 1992.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. October 13, 1992.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. April 8, 1993.

Pennsylvania Department of Environmental Resources. *NPDES Compliance Inspection Report*. January 11, 1994.

Pennsylvania Department of Environmental Resources. *Spill/Pollution Incident Report*. June 22, 1992.

Pennsylvania Department of Environmental Resources. *Telephone Incident Report*. January 18, 1994.

Pennsylvania Department of Environmental Resources. *Telephone Incident Report*. September 25, 1996.

Pennsylvania Department of Environmental Resources. *Telephone Notification Report*. December 21, 1993.

Pennsylvania Department of Environmental Resources. *Telephone Notification Report*. January 11, 1994.

Shenango Incorporated. *Cover letter and Questionnaire regarding oil discharge on May 2, 1991*. May 29, 1991.

Shenango Incorporated. *Cover letter and Questionnaire regarding oil discharge on August 30, 1991*. October 9, 1991.

Shenango Incorporated. *Memorandum regarding accidental release of wash oil on May 4, 1995*. May 22, 1995.

Shenango Incorporated. *Memorandum regarding accidental release of wash oil on May 4, 1995*. June 12, 1995.

Shenango Incorporated. *Memorandum regarding discharge of oil on December 31, 1993*. January 11, 1994.

Shenango Incorporated. *Memorandum regarding light oil discharge on January 11, 1994*. January 13, 1994.

Shenango Incorporated. *Memorandum regarding oil sheen of river on April 8, 1993*. January 14, 1994.

Shenango Incorporated. *Memorandum regarding oil spill on July 18, 1995*. August 29, 1995.

U.S. Environmental Protection Agency, Region III. *Memorandum regarding violation of Section 311(b)(3) of the Federal Water Pollution Control Act on May 2, 1991*. May 21, 1991.

U.S. Environmental Protection Agency, Region III. *Memorandum regarding violation of Section 311(b)(3) of the Federal Water Pollution Control Act on August 30, 1991*. September 24, 1991.

U.S. Environmental Protection Agency, Region III. *Memorandum regarding violation of Section 311(b)(3) of the Federal Water Pollution Control Act on May 4, 1995*. May 24, 1995.

Zinc Corporation of America Monaca Latex Facility: "Effluent Limits Exceeded"

Sector(s): Zinc

Facility: Zinc Corporation of America, Monaca, Pennsylvania

Facility Overview: Zinc Corporation of America's (ZCA) Monaca Latex Facility is an electrothermic zinc smelter. The smelter processes zinc-containing concentrates and secondary materials (recycled zinc scrap) to produce zinc metal slabs, granules and ingots, zinc oxide, zinc dust, zinc sulfate, and sulfuric acid. A coal power plant is also operated on-site to provide energy for use in the smelter. A wastewater treatment plant serves the smelter and discharges to the Ohio River. The ZCA Monaca Plant has been operating since 1931.

Data Source(s): State files

Agency Contact: Donna Wachter, Water Quality Specialist, PADER

Waste and Material Management Practices: Zinc Corporation of America's (ZCA) Monaca Latex Facility is an electrothermic zinc smelter. The smelter processes zinc-containing concentrates and secondary materials (recycled zinc scrap) to produce zinc metal slabs, granules and ingots, zinc oxide, zinc dust, zinc sulfate, and sulfuric acid. A coal power plant is also operated on the site to provide energy for use in the smelter. The three basic operations at the smelter are roasting, sintering, and smelting. The manufacture of sulfuric acid and zinc sulfate are integral coproduct operations. The smelting process begins with the zinc concentrate which is dried in a rotary kiln before going by conveyor belt to the roaster. The function of the roaster is to oxidize the concentrate to convert the zinc from sulfide to calcine. The sintering process converts the fine dust-like calcine into a hard, porous material suitable for the electrothermic furnaces. An electrothermic furnace converts the zinc to zinc metal. Both zinc oxide and zinc dust are produced from refined zinc vapor, which is generated in the production units. A wastewater treatment plant serves the smelter and discharges to the Ohio River. Due to the dynamic operating conditions of the smelter processes, the wastewater treatment plant handles a variety of influent conditions. The wastewater treatment plant also treats contact rain water from an area of approximately 60 acres. The wastewater treatment plant has a capacity of 900 gallons per minute (gpm), however, normal daily flows are in the range of 300 to 600 gpm. The five basic steps in the treatment plant's operations are flow equalization, precipitation, flocculation, sedimentation, and sand filtration. Outfall 101 is the sole discharge from the wastewater treatment facility.

ZCA exceeded its effluent limits for copper during three months between November 1991 and January 1992; and exceeded its effluent limits for zinc during the nine months between January 1992 and March 1993. All exceedances were from Outfall 101 to the Ohio River.

Type of Impact/Media Affected: Copper and zinc exceedances are shown in the table below:

Contaminant	Monitoring Date	Exceedance Level Avg./Max. (mg/l)	NPDES Permit Limit Avg./Max. (mg/l)
Cu	November 1991 December 1991 January 1992	0.97/1.47 0.62/ 0.63/	0.61/1.25

Zn	January 1992 May 1992 July 1992 August 1992 October 1992 December 1992 January 1993 February 1993 March 1993	0.85/1.18 0.51/-- 1.5/2.19 0.45/-- 0.52/1.23 0.91/1.17 0.96/1.47 0.72/-- 0.57/1.36	0.42/1.02

In addition, zinc discharges exceeded the contaminant mass NPDES permit limits during July 1992. The exceedance was 8.4 lb/day average and 13.4 lb/day maximum; the NPDES permits limits are 4.2 lb/day average and 10.2 lb/day maximum. Zinc exceedances were due to process upsets because of pH problems in a process clarifier. Overflow of the clarifier discharges to the treatment plant. When the pH of this circuit decreases, the solubility of zinc increases. The reason for the copper exceedances remains unclear. During early 1991, ZCA experienced unexplained copper elevation in the discharge. During this exceedance, ZCA requested permission to use a chemical additive called Metclear to treat the elevated discharge, however, by the time permission was granted the copper elevation ceased. Upon the reoccurrence of the copper elevations in January 1992, ZCA began conducting tests of the effects of Metclear which have proved inconclusive because of the copper elevations sporadic nature. The facility hired a contractor, Aqua Terra, Inc., to explore alternative options. All exceedances are violations of Sections 301 and 307 of the Pennsylvania Clean Streams Law.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Copper and zinc

Environmental Damage(s): Surface water contamination

Regulatory Action/Response: The Pennsylvania Department of Environmental Resources issued a Notice of Violation regarding the copper releases and two of the zinc releases on April 3, 1992. In response to the Notice of Violation, ZCA submitted a letter outlining the releases, their causes, and subsequent corrective measures. ZCA used a chemical additive, Metclear, to remove the copper at the treatment plant. The copper releases ceased without further corrective actions. To correct the zinc releases, ZCA modified the wastewater treatment plant by raising the operating pH of the clarifier from 8.8 to 9.2. Additional exceedances, however, were noted after implementation of this corrective measure. On July 22, 1993, PADER issued a Consent Assessment of Civil Penalty concerning zinc exceedances for the period of January 1992 to March 1993. The consent assessment required ZCA to pay a penalty of $17,000 to the Commonwealth of Pennsylvania Clean Water Fund.

References:

Pennsylvania Department of Environmental Resources. *Consent Assessment of Civil Penalty*. July 22, 1993.

Pennsylvania Department of Environmental Resources. *Notice of Violation*. April 3, 1992.

Zinc Corporation of America. *Commitment to Performance*.

Zinc Corporation of America. *Memorandum regarding response to Notice of Violation Dated 3 April 1992*. April 21, 1992

Zinc Corporation of America. *Unknown title*.

Chemetals, Inc. Manganese Dioxide Plant: "High Manganese-Content Wastewater Spills into the Tennessee River"

Sector(s): Manganese

Facility: Chemetals, Inc., New Johnsonville, Humphreys County, Tennessee

Facility Overview: Chemetals produces Electrolytic Manganese Dioxide (EMD) for sale primarily to domestic producers of alkaline dry cell batteries. The plant is currently capable of producing 110,000 pounds of EMD per day. The plant combines manganese dioxide ore with pulverized coal, and further processes the material to produce a manganese dioxide powder. The facility is located on a 504-acre site. Industrial activities occur on approximately 35 acres located within the eastern portion of the site. The western border of the site is adjacent to the Tennessee River/Kentucky Reservoir.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: The plant's process wastewater undergoes lime precipitation to remove metals and is then pH-adjusted. All storm flow from the industrialized area plus storm flow from 20 wooded and grassland acres surrounding the industrialized area is captured, stored, and treated on-site with the process wastewater. The remaining non-industrial area (449 acres) storm flow drainage enters the Tennessee River/Kentucky Reservoir along approximately 1.5 miles of shoreline. Since receipt of the initial NPDES permit in 1991, the site treated an increased volume of storm flow (approximately 75,000 gallons per day) through the Chemetals treatment system. The increased volume of storm flow has affected the treatment operations. The facility is finding it increasingly difficult to optimize system throughput and to maintain adequate storm surge capacity, while meeting permit limitations for manganese and total suspended solids (TSS). Modifications, such as adding aeration to the reaction tanks, have improved the capability of the treatment system to some extent.

According to the site's permit rationale, permit violations occurred in seven months over a three-year period. The site has a history of violations and near violations that appear to be related to large rainfall events in which run-off overflows a diversion dam, carrying manganese to the outfall at the Tennessee River.

On March 10 and 11, 1996, a break in a pipe conveying high manganese-content process wastewater and slurried process residues to the storage basin resulted in discharges of effluent containing manganese and suspended solids. On March 10, 1996, Chemetals violated its NPDES permit by discharging effluent containing 553.6 pounds of manganese and 411.4 pounds of suspended solids. The following day, March 11, 1995, Chemetals was again in violation of its permit, discharging 120.2 pounds of manganese and 259.0 pounds of suspended solids. The permitted daily maximum quantities for the site are 14.1 pounds for manganese and 98 pounds for suspended solids.

Type of Impact/Media Affected: The facility operator estimated that approximately 673.9 pounds of soluble manganese and 670.4 pounds of suspended solids discharged into the Tennessee River during a five-hour period. At average flow conditions for March, the spill would increase the soluble manganese concentration in the total river flow by 0.0125 parts per million (ppm) and the soluble solids concentration by 0.0124 ppm.

The Tennessee River/Kentucky Reservoir stream use classification includes 1) fish and aquatic life, 2) livestock watering and wildlife, 3) irrigation, 4) recreation, 5) domestic water supply, 6) industrial water

supply, and 7) navigation. The Tennessee River/Kentucky Reservoir supports a commercial shellfish industry, making toxicity to bottom dwelling organisms a concern.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Manganese and suspended solids

Environmental Damage: Contamination of surface water and sediments

Environmental Risk: Contamination of surface water and downgradient aquatic life

Regulatory Action/Response: Upon detection of the pipeline break, effluent treatment operations were shut down. The facility operator indicated that wastewater and storm flow would be contained in existing surge capacity until repairs and cleanup were completed.

The site used a back hoe to remove the settled process residue and approximately one foot of wet earth from the bottom of the discharge ditch. The mud was placed in the process residue storage basin for disposal. The material removed from the discharge ditch was replaced with crushed limestone.

Immediately following the pipeline break, Chemetals indicated to TDEC that it was in the process of replacing the piping that conveys process wastewater and slurried process residue. The piping system will be moved to a location that will ensure that any future spills are contained within the plant drainage system. TDEC responses were not documented in the files reviewed.

References:

Chemetals. *Internal Memorandum from H.D Robinson to J.L. Chapman and C.E. Cunningham*. March 13, 1996.

Chemetals. *Letter from C.E. Cunningham to Donald Ey, Tennessee Department of Environment and Conservation*. March 14, 1996.

Chemetals. *Letter from C.E. Cunningham to Thomas E. Roehm, Tennessee Department of Environment and Conservation*. August 15, 1996.

State of Tennessee NPDES Permit, Chemetals, Inc. Issued September 30, 1991.

Tennessee Department of Environment and Conservation. *Memorandum from Tom Yates to files*. April 7, 1992.

Cyprus Foote Mineral Company Butyllithium Plant: "High Turbidity Wastewater Discharges to Creek"

Sector(s): Lithium

Facility: Cyprus Foote Mineral Company, New Johnsonville, Humphreys County, Tennessee

Facility Overview: Cyprus Foote Mineral Company manufactures butyllithium in its New Johnsonville Plant. Butyllithium is a pyrophoric liquid sold as a catalyst and chemical intermediate. Liquid butyllithium is separated from solid lithium chloride (LiCl) in a filter system and blended to 12-15 percent concentration in a hydrocarbon solvent. It is shipped to customers in tank trucks or cylinders. The LiCl is reacted with water and shipped to a sister plant for further processing.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: The plant discharges boiler blowdown, washdown water, non-contact cooling water, drum and filter wash, and storm water run-off to the Indian Creek Embayment of the Tennessee River via an unnamed channel. Concentrated flocculent from the solvent recovery process is pumped through a catch basin return line to a wastewater settling pond. The catch basin and settling pond also receive storm water run-off.

The plant's NPDES permitted discharge exceeded the daily maximum concentration for total suspended solids (TSS) on September 22, 1990. A similar exceedance occurred in September 1989. The source of the high turbidity wastewater appears to be local clay washing into the catch basin, compounded by heavy rainfall. Correspondence from April to July, 1990, between Cyprus Foote Mineral and Tennessee Department of Environment and Conservation (TDEC) indicated that the source of solids in the site's pond water was of concern.

Type of Impact/Media Affected: On September 22, 1990, wastewater high in TSS discharged to the Indian Creek Embayment of the Tennessee River.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Suspended solids

Environmental Damage: Contamination of surface water

Regulatory Action/Response: The exceedance occurred on a day after a heavy rainfall event. The release was reported in the monthly Discharge Monitoring Report submitted to TDEC. TDEC issued a Notice of Violation to Cyprus Foote Mineral. TDEC requested that Foote Mineral provide the Agency with information detailing proposed corrective measures to bring the discharge into compliance.

The plant changed its method of adding flocculent to the wastewater pond. The plant now dilutes the flocculent with water, dropping the solids out of suspension more rapidly. The plant also is managing the pond level to eliminate an immediate discharge following a heavy rainfall event. Cyprus Foote Mineral provided documentation supporting its belief that the source of suspended solids in the plant's discharge is not related to plant operations, but is local clay washed into the catch basin. In the month following the 1990 exceedance, Cyprus Foote Mineral also compacted and spread gravel over a large area of the plant to minimize clay washing into the catch basin.

References:

Cyprus Foote Mineral. *Letter from John B. Einerson to Robert J. McKee, Tennessee Department of Environment and Conservation*. July 6, 1990.

Foote Mineral Company. *Memorandum from H.R. Grady to J.B. Einerson*. April 11, 1990.

Foote Mineral Company NPDES Discharge Monitoring Report. October 10, 1989.

State of Tennessee NPDES Permit, Foote Mineral Company. Issued August 31, 1988.

Tennessee Department of Environment and Conservation. *Notice of Violation Letter from Sims Crownover to John Einerson, Foote Mineral Company*. November 14, 1989.

DuPont New Johnsonville Titanium Plant: "Landfill Contaminates Ground Water"

Sector(s): Titanium

Facility: E.I. DuPont De Nemours and Company, Inc., New Johnsonville, Maury County, Tennessee

Facility Overview: This site manufactures titanium pigments from ilmenite ores using the chloride process.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: The Front Hollow landfill is an on-site permitted landfill that receives a mixture of powerhouse ash, coke and ore solids, and non-biological wastewater treatment sludge. The ground water monitoring system consists of one upgradient and two downgradient wells.

Type of Impact/Media Affected: Ground water had elevated levels of iron (21.5 mg/l) and manganese (0.63) in 1990 through 1992 annual sampling events. These samples were taken from the old ground water monitoring system that has since been replaced by wells that more adequately reflect the uppermost aquifer system. The Tennessee Department of Environment and Conservation (TDEC) notes that iron and manganese are most likely naturally occurring constituents of the local ground water.

In 1996, the Front Hollow monitoring wells exhibited exceedances for several metals, including beryllium (14 ppb), chromium (320 ppb), lead (100 ppb), mercury (7.1 ppb), and nickel (120 ppb). Each of these metals were sampled at levels exceeding Federal drinking water standards. The upgradient well exhibited measurable levels of these contaminants, but not as high as the levels sampled in the downgradient wells. Some metals may occur at elevated levels as part of the natural geochemistry of the local subsurface rocks. The downgradient wells also exhibited elevated levels of chloride (333 ppm). TDEC notes that some of the elevated constituents, especially chloride, could be attributed to a sedimentation pond located in close proximity to one of the downgradient wells.

Type of Release: Leak

Affected Media: Ground water

Type of Contamination: Metals

Environmental Damage: Contamination of ground water

Regulatory Action Response: DuPont indicated to TDEC that it plans to modify the sedimentation pond to eliminate infiltration into the subsurface through the bottom of the pond. TDEC notes that further monitoring events and statistical analyses are needed to verify the source of contamination. TDEC acknowledges that it would be unusual for beryllium and chromium to be present as naturally occurring constituents at the measured levels.

References:

DuPont. *Letter from Scott L. Goodman to Joe H. Walkup, Tennessee Department of Environment and Conservation*. January 3, 1992.

DuPont. *Letter from Scott L. Goodman to Wayne Harbin, Tennessee Department of Environment and Conservation*. January 7, 1993.

DuPont New Johnsonville Plant Ground Water Monitoring Program at Front Hollow and East Hollow Landfills. December, 1994.

Tennessee Department of Environment and Conservation. *Internal memorandum from J.L. Fottrell to Glen Pugh et. al.* August 7, 1996.

Tennessee Department of Environment and Conservation. *Letter from Alan Spear to Scott L. Goodman, DuPont*. January 21, 1993.

Tennessee Department of Environment and Conservation. *Trip Report from J.L. Fottrell to Glen Pugh et. al., TDEC*. August 19, 1996.

DuPont New Johnsonville Titanium Plant: "Low pH Wastewater Discharges to River"

Sector(s): Titanium

Facility: E.I. DuPont De Nemours and Company, Inc., New Johnsonville, Maury County, Tennessee

Facility Overview: This site manufactures titanium pigments from ilmenite ores using the chloride process.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: The site discharges process wastewater, finishing non-contact cooling water, storm water run-off, and RPO non-contact cooling water through a NPDES permitted outfall to the Tennessee River. The site's sewage treatment plant was taken out of service in April 1995.

On April 27, 1995, the caustic valve at the intake to the settling basin opened to provide pH control. The pH cell did not respond to the changing pH level and allowed the caustic valve to remain open, which resulted in high pH wastewater in the settling basin. Two and one half hours after the release, an alarm sounded on the settling basin outlet pH cell, indicating high pH. The operators manually closed the inlet caustic valve and added sulfuric acid to the settling basin outlet. The addition of acid continued through the night. The next morning the site operators ceased adding sulfuric acid. For several hours, the outfall pH appeared to be returning to a normal level, then the "C" pond pH dropped below 6.0, indicating that the wastewater had an excess of sulfuric acid. The low pH of the "C" pond caused the pH to reach a low of 4.3.

The facility had a few NPDES permit violations from 1988 to 1993. In each instance, DuPont submitted an explanation of the cause of the violations and a plan of action to correct the problem. There was one violation of the toxicity limit, which was caused by introduction of chlorine into the intake water to control mussels. In general, the Tennessee Department of Environment and Conservation (TDEC) Water Pollution Control Division believes that Dupont operates its treatment system satisfactorily.

Type of Impact/Media Affected: Wastewater with a pH of 4.3 was discharged to the Tennessee River. The outfall pH dropped below the permitted limit of 6.0 for approximately 4.5 hours. According to site personnel, there was no environmental damage associated with this release.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Low pH

Regulatory Action Response: All caustic valves have been reset to alarm at 90 percent output. The agitator at the settling basin outlet has been modified to ensure better mixing during sulfuric acid addition. The site is testing the efficacy of using CO_2 as a replacement for sulfuric acid. TDEC responses were not documented in the reviewed files.

References:

DuPont. *Letter from Scott L. Goodman and J.M. Edenfield to Donald J. Ey, Tennessee Department of Environment and Conservation*. May 15, 1995.

E.I. DuPont De Nemours and Company, Inc. NPDES Modified Permit. Issued May 31, 1995.

E.I. DuPont De Nemours and Company, Inc. NPDES Permit. Issued May 31, 1994.

Tennessee Department of Environment and Conservation. *Letter from Donald J. Ey to Scott L. Goodman, DuPont*. August 1, 1994.

ICI Specialists Phosphorus Plant: "Sodium Hydrosulfide Spill Causes Second Fish Kill"

Sector(s): Elemental phosphorus

Facility: ICI Specialists, Mt. Pleasant, Maury County, Tennessee (presently owned by Zeneca, Inc.)

Facility Overview: This site has processed elemental phosphorus since 1930. From 1930 to 1940, Victor Chemical Works operated a blast furnace at this site. By 1940, four new electric furnaces were built, bringing the phosphorus capacity of the plant to 34,000 tons per year. The plant operated at this level until 1960. A new kiln and furnace, constructed in 1960, increased the elemental phosphorus capacity to approximately 50,000 tons per year. Since Victor Chemical owned the plant, ownership has changed many times. Past owners include Stauffer Chemical Company, Chesebrough-Ponds, Unilever, Inc., and ICI Specialists. The facility is currently owned and operated by Zeneca, Inc. and consists of two plants: the east plant and the west plant. These plants are separated by Big Bigby Creek, which flows through the middle of the property.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: Phosphate minerals, found in the form of clay and sand, occur throughout the central region of Tennessee. Phosphate ore is shipped by truck to the Mt. Pleasant facility. Hazardous wastes generated from production are stored on-site in a hazardous waste storage tank and at the solid waste/hazardous waste drum storage area at the east plant. The drum storage area is comprised of a concrete pad with diking that is sloped to contain spills. Drums are placed on pallets and stacked. The facility disposes of its hazardous waste off-site and uses deep well injection for its non-hazardous liquid waste. The facility pretreats acidic wastewater, adjusting the pH level prior to discharge to the publicly owned treatment works. Water from the south lagoon is discharged to Big Bigby Creek through a NPDES outfall. The source of the water entering the lagoon is unclear from the files available for review.

On October 31, 1992, a spill of sodium hydrosulfide occurred during the loading of a railroad tanker car that had a faulty valve. The spill flowed into a trench system, which flows to the spill catchment basin before being immediately discharged to the creek. The spill catchment basin is equipped with a sensor that diverts water or effluent from the outfall to a compartment when the pH of the outfall is below 6 or above 9. The sensor failed to work properly during this incident. Processing areas of the plant are within a containment area, which prevents wastes or spills from entering Big Bigby Creek. This railroad tanker car was loaded outside of the containment area.

Type of Impact/Media Affected: The spill and subsequent discharge of sodium hydrosulfide through the site's permitted outfall resulted in a fish kill in Big Bigby Creek. This release was the second chemical spill resulting in a fish kill during a four month period at the plant.

Type of Release: Spill

Affected Media: Surface water

Type of Contamination: Sodium hydrosulfide

Environmental Damage: Contamination of surface water and fish kill

Location of Affected Populations: Aquatic life in Big Bigby Creek

Environmental Risk: Contamination of surface water and downgradient aquatic life

Regulatory Action Response: The incident was reported by the plant manager to the Water Pollution Control Division of Tennessee Department of Environment and Conservation (TDEC) on November 3, 1992. TDEC issued a Notice of Non-Compliance asking the facility operator to develop containment provisions for all areas where chemical transfers occur. The operator was asked by TDEC to submit a written containment and cleanup plan for future spills.

References:

ICI Specialties. *Emergency Response Report.* November 3, 1992.

Stauffer Chemical Company, Phosphorus Products Division, Mt. Pleasant, Tennessee. *Furnace Plant History.* TDEC received file on April 8, 1993.

Tennessee Department of Environment and Conservation. *Letter from Joe E. Holland, Jr. to Stanley Straker, ICI Specialists*. December 30, 1992.

Tennessee Department of Environment and Conservation, Division of Solid and Hazardous Waste. *Compliance Evaluation Inspection Report.* Undated.

Savage Zinc, Inc. Clarksville Plant: "Heavy Metals-Contaminated Wastewater Enters Cumberland River"

Sector(s): Cadmium, cobalt, copper, germanium, zinc, and sulfuric acid

Facility: Savage Zinc, Inc., Clarksville, Montgomery County, Tennessee (formerly owned by Jersey Miniere Zinc, Inc.)

Facility Overview: Savage Zinc produces high grade zinc metal from the beneficiation of zinc concentrate ore using a hydrometallurgical process. Annual production averages 110,000 tons. The plant produces approximately 450 tons per year of cadmium metal and 160,000 tons per year of sulfuric acid as co-products. The plant also produces other metallurgically valuable by-products, such as copper, lead, germanium, and cobalt. Savage Zinc is owned by Savage Resources LTD of Sydney, Australia. The Clarksville zinc production facility was constructed in 1978 by its former owner Jersey Miniere Zinc.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: The basic plant processes include 1) roasting the zinc sulfide concentrate to produce a zinc oxide, 2) dissolving zinc oxide in sulfuric acid to produce a zinc sulfate solution, 3) purifying the zinc sulfate solution to remove undesirable constituents, 4) electrowinning zinc metal from the purified solution, and 5) alloying and casting zinc metal into marketable size ingots. The site generates lead residue and miscellaneous tailings, reported as characteristically hazardous. This waste is handled on-site and has a partial exemption, which provides that it does not have to be counted in determining generator classification. Savage Zinc is a conditionally exempt small quantity generator of hazardous waste. Small amounts of isopropyl ether and carbon tetrachloride waste are generated by the facility and disposed of off-site.

The site has several permitted NPDES outfalls for treated process and domestic wastewater (Outfall 001), water treatment plant wastewater (Outfall 002), and steam condensate, non-process wastewater and storm water run-off (Outfall 003). Outfall 003 discharges storm water that comes in contact with the manufacturing portion of the plant. Run-off from this area is either discharged into a tributary of the Cumberland River at Mile 121.1 or pumped to two on-site surface impoundments for treatment in the metals recovery process. Only when there is a significant rainfall event is the overflow from this outfall discharged without treatment. The effluent samples collected at Outfall 003 have been historically high in lead, cadmium, and zinc. If high storm water flows are encountered, the pumps are turned off.

A zinc-contaminated discharge occurred on July 17, 1993. This discharge violated the site's NPDES permitted daily limit of 15 pounds for zinc. The discharge to the Cumberland River at Mile 122 resulted due to a malfunctioning pH meter in the first reactor tank, part of the metal recovery plant's lime and precipitation process. The metals recovery process neutralizes and removes metals from a low pH solution. Efficient precipitation of zinc is pH dependent. While the pH meter in this tank was being repaired, the pH level in the rest of the metals recovery process began to drop. According to site personnel, while operations personnel were repairing the malfunctioning pH meter in the first reactor tank, insufficient attention was paid to the pH level in the second reactor tank. The decrease in pH resulted in an elevated level of zinc being discharged through Outfall 001 before being diverted to one of two on-site surface impoundments.

Type of Impact/Media Affected: In February 1996, the U.S. Geological Survey (USGS) sampled water quality in the Cumberland River and forwarded the results to the Tennessee Department of Environment and

Conservation (TDEC). At Mile 124, 2.9 miles downstream from the Savage Zinc outfall, the USGS noted zinc concentrations at 558 ug/l. No further analysis of this finding was evident in the files reviewed.

The discharge on July 17, 1993, resulted in 31.92 pounds of zinc being discharged from Outfall 001.

Type of Release: Wastewater

Affected Media: Surface water

Type of Contamination: Zinc, lead, and cadmium

Environmental Damage: Contamination of surface water and sediments

Regulatory Action/Response: In a 1994 Compliance Evaluation Inspection, TDEC recommended that Savage Zinc take additional steps to limit the effluent discharged from Outfall 003 until the high concentrations of metals were reduced. Specific actions taken by the facility were not available in the reviewed files.

The facility recalibrated the alarms on the pH meters in its reactor tanks and added the pH meters to the site's computer monitoring system to allow for a prompt response in the future. In addition to the changes implemented by Jersey Miniere, TDEC recommended that the company make an effort to prevent the accumulation of solids in the effluent weir and clarifier treatment unit.

References:

NPDES Compliance Inspection Report. July 21, 1994.

State of Tennessee NPDES Permit, Savage Zinc, Inc. Issued August 31, 1995.

Tennessee Department of Environment and Conservation. *Letter from Joe E. Holland, Jr. to David Rice, Savage Zinc*. August 25, 1994.

U.S. Geological Survey. *AURAS Raw Data Report for Water Quality, Cumberland River, Mile 124.* February 23, 1996.

W.R. Grace & Co.: "Thorium Discharges to Creek"

Sector(s): Thorium

Facility: W.R. Grace & Co., Chattanooga, Hamilton County, Tennessee

Facility Overview: W.R. Grace produces specialty chemicals and catalysts for the petroleum, nylon, pharmaceutical, food, photographic, and glass industries. The Chattanooga plant separates and recovers rare earth elements. The plant performs these functions by processing incoming shipments of containerized raw material and through recovery of elements from existing settling ponds. The materials present in the settling ponds were produced and deposited as by-products from 20 years of processing operations.

Data Sources: State files

Agency Contact(s): Tom Tiesler, Solid/Hazardous Waste Management, TDEC; Paul Davis, Water Pollution Control Division, TDEC

Waste and Material Management Practices: The site is permitted to discharge storm water run-off through three main outfalls (SWA, SWD, and SWE) to the South Chickamauga Creek, approximately 1.2 miles upstream from its confluence with the Tennessee River. Outfall SWA receives storm water run-off from the administrative areas of the plant. Outfall SWD receives storm water run-off from an 11-acre lowland area, which is consistently flooded by the activity of beavers. The northern inundated portion of this area contains a titanium tailings fill created by a former owner of the site. No contamination from this area was documented in the reviewed files.

Outfall SWE includes three separate outfalls, E1, E2, and E3. All storm water from the processing areas of the plant goes to a rare earth settling pond and the "first flush" is sent to the plant's pretreatment system, then to a publicly owned treatment works. After the first 330,000 gallons have been routed to the pretreatment system, the rest is discharged through Outfall SWE. Storm water run-off from the buried titanium tailings areas and past drum disposal sites are also discharged through these outfalls.

The thorium hydroxide wastewater processes were discontinued in the early 1990s, however, the thorium holding pond still receives other process wastewater and contaminated storm water for pretreatment. During an inspection in April 1996, seepage from the ground was noted below the permitted thorium holding pond. The pond contains thorium hydroxide sludge. Since February 1996, the seepage has been captured in a ground water collection system and sent to the on-site pretreatment system.

According to site personnel, three days before the April 1996 compliance evaluation inspection, the pump had failed, sending the seepage running over the ground with potential discharge through Outfall SWE. The seepage was white and oily in nature. Site personnel failed to report the spill within 24 hours, as is required by the site's permit. Memoranda from 1995 indicate that prior to February 1996, the site operator allowed the seepage to mix with storm water and discharge to surface water.

Type of Impact/Media Affected: The extent of contamination has not been fully determined. Sampling data from Outfall SWE after the April incident were not available in the reviewed files. In 1995, the Tennessee Department of Environment and Conservation (TDEC) requested information on the material buried on-site to determine the source of the white precipitate. A map of burial areas provided by W.R. Grace indicated that a burial site containing thorium exists below the thorium pond and at an elevation just above the white precipitate seepage. Based on the site inspection, TDEC believes the source of the white precipitate to be either the unlined thorium holding pond or thorium burial site. The burial sites were closed before enactment of RCRA regulations. A 1995 memorandum states that the Division of Radiological Health reported that the discharge downgradient of the thorium pond was contaminated with thorium. Based on ground water

monitoring data from 1992 to 1996, TDEC believes that the thorium pond is resulting in contamination to ground water. TDEC is concerned that adjacent surface waters and wetlands may be affected by the thorium pond seepage. There are nearby industrial users of ground water.

Type of Release: Wastewater discharge

Affected Media: Surface water and ground water

Type of Contamination: White, oily seepage from thorium holding pond

Environmental Damage: Contamination of surface water and ground water

Regulatory Action Response: The April 1996 incident was reported by the site at the time of a compliance evaluation inspection. TDEC asked W.R. Grace to install the necessary backup or auxiliary systems to control the overflow should the pump fail in the future. TDEC also recommended some changes to the site's Storm Water Pollution Prevention Plan, which is currently being revised. The contamination of ground water at the site is under review by TDEC.

References:

State of Tennessee NPDES Permit, W.R. Grace & Co. Issued December 29, 1989.

Storm Water Permit Application, W.R. Grace & Co. Prepared by Piedmont Olsen Hensley. February 1992.

Tennessee Department of Environment and Conservation. *Letter from Terrence P. Whalen to Mallory Miller, U.S. Environmental Protection Agency, Region IV*. May 8, 1996.

Tennessee Department of Environment and Conservation. *Memorandum from April Ingle to Water Pollution Control files*. February 15, 1995.

Tennessee Department of Environment and Conservation. *Memorandum from Terry Whalen to Guy Moose*. December 21, 1995.

Tennessee Department of Environment and Conservation, Division of Solid and Hazardous Waste. *Compliance Evaluation Inspection Report.* 1996.

American Minerals, Inc.: "Fugitive Dust Is a Likely Source of Heavy Metal Soil Contamination"

Sector(s): Gem-quality minerals

Facility: American Minerals, Inc., El Paso, Texas

Facility Overview: This facility consists of a dry grinding plant that processes minerals by cutting them into smaller sizes followed by packaging for shipment.

Data Sources: State files and personal conversations

Agency Contact: Terry McMillan, Region 6 Compliance, TNRCC

Waste and Material Management Practices: This facility grinds minerals to cut them into smaller sizes prior to packaging them for shipment throughout the United States. Because the facility does not use water during the grinding operation, the process creates fugitive dust. No information was available in the State files reviewed in Austin that described the history of the site.

The soil found on a right of way adjacent to this facility's property is contaminated with heavy metals. In addition, another nearby business, Southwest Industrial Growers (SWIG), which is a cotton delinter, also has metal contamination of its soil. SWIG is located across the right of way from American Minerals.

Type of Impact/Media Affected: Based on informal verbal communications, EPA has learned that samples of soil taken from SWIG's property failed the metal Toxicity Characteristic Leaching Procedure (TCLP). There was no information in the State files available for review in Austin that indicated the dates of sampling or the concentrations of metals in the soil samples. The Texas National Resources Conservation Commission (TNRCC) staff commented that they consider fugitive dust blown from the American Minerals site as the likely source of soil contamination on adjacent and nearby properties. At the time of the file review and conversations with TNRCC staff, the source of the contamination had not yet been demonstrated.

Type of Release: Fugitive dust

Affected Media: Soil and possibly ground water

Type of Contamination: Heavy metals

Regulatory Action/Response: TNRCC's compliance manager indicated that this is an ongoing problem that has only recently begun to be investigated. Therefore, information on file was limited. One concern is that contamination of ground water may be a risk. Although the drinking water aquifer begins at approximately a 400 foot depth, a shallow aquifer that alternately is recharged by the Rio Grande or flows toward the river, depending on river water levels, is less than 10 feet below ground surface.

References:

American Minerals. *Letter from Frank Senkowsky to Mr. Lockey, Texas Water Commission, Re: letter concerning a June 20, 1986 site inspection*. July 14, 1986.

McMillan, Terry, TNRCC Region 6 Compliance Officer. *Personal Communication*. November 14, 1996.

Anzon Incorporated:
"Antimony Contaminates Soil and Ground Water"

Sector(s): Antimony

Facility: Anzon Incorporated, Laredo, Texas

Facility Overview: This facility has been a metal refining site since 1928. A blast furnace was used to process antimony-bearing ores and produce crude antimony oxide.

Data Sources: State files

Agency Contact: Tony Franco, Region 15 Compliance, TNRCC

Waste and Material Management Practices: The Anzon Incorporated facility in Laredo, Texas has been the site of metals refining operations since the Texas Mining and Smelting Company began operations in 1928. The property was sold twice in 1947, first to the United States Government, then to National Lead. After being shut down in 1977, the facility was reopened in 1978 when it was sold to Anzon Incorporated. The 102-acre site is located in an industrial, manufacturing, trucking, and warehouse area of Laredo. Approximately 28 acres in the southern portion of the property are used for plant operations, with the remaining 73 acres being undeveloped. Land west and southwest of the property is undeveloped. A 200-foot-wide railroad right-of-way forms the northern boundary of the site. A machine shop servicing heavy equipment occupies 22 acres along the plant's eastern property boundary. No property adjacent to the site now serves as residential property, nor is any adjacent property zoned for residential uses in the future.

The plant used a blast furnace to process antimony-bearing ores to produce antimony oxide until 1992 when the furnace was shut down. Anzon now imports antimony oxide as a feed material to its refining process. No additional information was available concerning the processes or waste management practices at the site.

Antimony has been detected in ground water near the plant operations portion of the site. Concentrations of antimony in the soils of the undeveloped portion of the site are elevated to a level posing a risk of ground water contamination.

Type of Impact/Media Affected: Dissolved antimony concentrations in ground water samples were as high as 2.5 mg/l in the plant operations portion of the site. Concentrations were no higher than 0.005 mg/l in samples collected from wells in the undeveloped portions of the property. The State's closure criterion for a contaminant in ground water is adjustable based on the background water quality. Given the concentration of total dissolved solids in ground water at the site, the calculated Medium Specific Concentration (MSC) for antimony, which is the allowable maximum concentration of total antimony in the site's ground water, is 0.6 mg/l. This concentration is well above the observed concentrations in wells on the undeveloped portions of the site. Thus, unacceptable antimony concentrations in ground water on the site are limited to the western property boundary area of the active plant. In addition, those concentrations were observed to attenuate rapidly before reaching the surface water body that is the hydraulic divide on the site, Manadas Creek.

Antimony concentrations in the soils of the undeveloped portion of the property are more problematic. Observed concentrations have been as high as 231 mg/kg in samples collected from zero to two feet below the land surface. Generally, the highest observed concentrations of total antimony in the near-surface soils of the undeveloped property were adjacent to the plant area and decreased with distance from the plant operations. The calculated Ground Water Cross-Media Protection Standard (GWP-Ind) for the site, adjusted based on the background quality of the ground water, is 60 mg/kg in soils. Thus, soil concentrations of antimony on approximately five acres of the undeveloped portion of the site present an environmental risk caused by the likelihood of ground water contamination.

Type of Release: Spills, wastewater, and fugitive dust

Affected Media: Soil and ground water

Type of Contamination: Antimony

Mobility of Contaminants: Antimony in soil on five acres of the undeveloped portion of the plant may be transported to ground water.

Environmental Risk: Using the synthetic precipitation leaching procedure (SPLP) to determine the potential of seven soil samples to leach antimony to ground water in excess of the adjusted Medium Specific Concentration (MSC) for antimony, three samples failed the closure criterion.

Regulatory Action/Response: The State's central files available for review in Austin, the State capital, did not contain any information on regulatory responses by EPA, the State, or any correspondence delineating the events that led to the closure studies undertaken by Anzon at this site. Several references were made to Texas Natural Resource Conservation Commission (TNRCC) designations of constituents of concern in soils and ground water; however, no copies of TNRCC memoranda or letters were present in the files. TNRCC's representative (the Enforcement Division Director) declined to provide information in support of the current effort beyond allowing research of the central files which are available to the general public. Additional information related to this site may, however, be available in the Regional Office in Harlingen, Texas.

In November 1991, nine ground water monitoring wells were installed on the active plant site. Ground water samples were collected and analyzed for nine heavy metals and other water quality parameters. As a result of the analyses, three metals, antimony, selenium, and zinc, were identified as constituents of concern. A year later, four more monitoring wells were installed along the northern perimeter of the property in anticipation of the sale by Anzon of the 200-foot-wide right-of-way. An additional six wells were installed in May 1993. Based on analysis of samples from these wells, TNRCC reduced the number of constituents of concern to two: antimony and selenium. Following an investigation based on samples collected from five more wells installed in 1994, TNRCC again reduced the constituents of concern in ground water to antimony only.

Based on the analyses conducted by Anzon's contractor, the antimony concentrations detected in the surface soil and ground water on 68 acres of the 73-acre undeveloped portion of the site do not exceed TNRCC Risk Reduction Standard 2 (RRS2) closure criteria. In 1996, Anzon indicated its intention to close that section of the site. No information was available in State files regarding TNRCC's approval or rejection of the report submitted to TNRCC by Anzon as a requirement to certify site closure. That report had been submitted to TNRCC eight months prior to the file search. The remaining five acres of the undeveloped portion of the site did not meet the RRS2-adjusted leaching protection standard for antimony.

Anzon's management has stated that it intends to close the remaining five acres of the undeveloped portion of the site using TNRCC Risk Reduction Standard Number 3. At some unspecified later date, a closure/remediation analysis will be completed in conjunction with the RRS3 analysis. This will be completed during the RRS3 analysis for the active portion of the Anzon facility.

Anzon has implemented the following plant improvements to reduce levels of discharges to the environment:

- Upgraded stack emission and industrial hygiene controls;
- Ceased all point source discharges;
- Constructed a storm water containment and evaporation pond to capture all run-off from the active plant area;

- Connected the discharge of sanitary waste to the city of Laredo, thus closing the on-site septic system;
- Ceased all outside storage of ore and other raw materials;
- Recycled all settler boxes and other antimony-bearing residues; and
- Recycled most of the inorganic slag by-product north of the plant process area.

References:

Geraghty & Miller, Inc. *Baseline Risk Assessment, Anzon Incorporated*. March, 1996.

Geraghty & Miller, Inc. *Environmental Investigation and Risk Assessment Report, Anzon Incorporated, Undeveloped Property*. June 12, 1995.

ASARCO El Paso Plant: "Contaminated Ground Water Seeps to a Canal Supplying Drinking Water"

Sector(s): Copper

Facility: El Paso Plant, ASARCO, Inc., El Paso County, Texas

Facility Overview: ASARCO's El Paso Plant is a primary copper refinery producing anodes for shipment for further refining. The plant consists of various ore handling facilities, belt conveyors, storage bins, dryers, furnaces, converters, an anode casting facility, and gas handling systems.

Data Sources: State files

Agency Contact: Terry McMillan, Region 6 Waste/ Water Program, TNRCC

Waste and Material Management Practices: ASARCO's El Paso Plant is located at the western end of El Paso County in the Rio Grande Canyon, several hundred feet immediately east of the Rio Grande River.

ASARCO's El Paso Plant is a copper smelter that generates sulfuric acid as a by-product of air emissions cleaning. The plant has unloading, crushing, bedding, and other related ore handling facilities, a system of belt conveyors leading to wet storage bins, a fluid bed dryer, cyclone separators with a product baghouse, dry storage bins, a "ConTop"-based reactor system with cyclone smelting, a furnace, copper converters, two anode furnaces, and an anode casting facility. The gas handling systems include draft fans, spray chambers, and electrostatic precipitators serving the roasters, furnace and converters, and two sulfuric acid and associated gas cleaning plants serving the roasters and converters. The slag produced by the plant is processed and shipped off-site for use as sandblast media and railroad track ballast.

Copper concentrate from Arizona, Montana, and Chile is the primary feedstock, but recycled material from other plants also is used. This material includes matte, by-product dust, anode oxide slag, blister copper, and scrap copper. The feedstock is deposited on a concrete pad next to the bedding plant and also is stored on the ground near one of the ponds. At the plant's Delumper, copper concentrate collects on bare ground with no impervious cover.

No information was available in State files concerning the history and operation dates of this facility. The site is roughly one mile long, 1,800 feet wide, and relatively flat due to landfilling with slag and gravelly soil. Depth to ground water was not described in the files available. Fill material in several arroyos on the site reaches a thickness of up to 55 feet. In addition, three ponds were constructed in two of the arroyos.

The American Canal, which originates near the facility, also is nearby. The canal distributes water diverted from the river to downstream users, including El Paso Water Utilities, via a system of canals and ditches. For approximately 1,100 feet, the canal is adjacent to ASARCO's main plant. Downstream from the ASARCO plant the canal is referred to as the Franklin Canal. El Paso's public drinking water is withdrawn from the Franklin Canal for treatment prior to distribution. The withdrawal point from the canal is approximately two miles from the dam on the river that diverts water into the canal. On December 4, 1995, the Texas Natural Resources Conservation Commission (TNRCC) conducted a case development inspection of the American Canal in the immediate vicinity of ASARCO's El Paso Plant. TNRCC collected ground water and sediment samples from three points in the canal, in which arsenic concentrations in ground water seeping into the canal from ASARCO property were 37 mg/l, which is above drinking water standards - sediment in the canal had arsenic concentrations of 13 parts per million (ppm).

Type of Impact/Media Affected: TNRCC personnel have concluded that the American Canal was affected by arsenic contamination from ground water seeping into the canal. Although not fully documented, TNRCC

personnel theorized that the arsenic in the ground water can be reasonably concluded to have originated from unauthorized discharges at the ASARCO plant. TNRCC staff also concluded that a concentration of arsenic of 1.3 ppm shows that the contamination migrated under the canal and is a direct threat to the Rio Grande River. Although TNRCC personnel indicated in January 1996 internal correspondence that additional sampling of river bank soil, river sediment, and river water would be conducted in the near future, no information was present in the files to indicate that such sampling had been undertaken.

Type of Release: Contaminated ground water seepage

Affected Media: Ground water and surface water

Type of Contamination: Arsenic

Environmental Damage(s): Affected river water quality and soil are considered likely by TNRCC but not yet demonstrated.

Regulatory Action Response: From mid-1994 through 1995, TNRCC's Industrial and Hazardous Waste (IHW) Enforcement section evaluated eight possible violations. On August 25, 1994, the IHW enforcement screening committee directed that a petition be prepared as a formal enforcement action against the plant. This was done after TNRCC's Legal Services Division concluded that the dumping of copper smelting slag or lead smelting slag was the only violation at the facility that was excluded under the Bevill amendment. Several meetings with ASARCO and TNRCC personnel occurred during 1995. No information was present in the files to indicate that any enforcement action had been taken against ASARCO or whether the concerns about the contaminated water and sediment had been resolved.

References:

Texas Natural Resource Conservation Commission. *Interoffice Memorandum to files, from Ayala, V., Re: A Compliance Evaluation Inspection*. December 14,1995.

Texas Natural Resource Conservation Commission. *Interoffice Memorandum to files, from Ayala, V., Re: A Compliance Evaluation Inspection*. August 15, 1996.

Texas Natural Resource Conservation Commission. *Interoffice Memorandum to Vickery, M., from Ayala, V., Re: A case development inspection*. January 9, 1996.

Texas Natural Resource Conservation Commission. *Interoffice Memorandum to Vickery, M., from Ayala, V., Re: A sampling inspection*. August 15, 1996.

ASARCO El Paso Plant: "Improper Management of Hazardous Waste Results in Soil Contamination"

Sector(s): Copper

Facility: El Paso Plant, ASARCO, Inc., El Paso County, Texas

Facility Overview: ASARCO's El Paso Plant produces primary copper refinery anodes for shipment for further refining. The plant uses various ore handling facilities, belt conveyors, storage bins, dryers, furnaces, converters, an anode casting facility, and gas handling systems.

Data Sources: State files

Agency Contact: Terry McMillan, Region 6 Waste/Water Program, TNRCC

Waste and Material Management Practices: ASARCO's El Paso Plant is located at the west end of El Paso County in the Rio Grande Canyon, immediately east of the river. The site is roughly one mile long and 1,800 feet wide. Several arroyos on the site were filled with slag and gravelly soil to create a relatively level surface. Three ponds were constructed in two of the arroyos. Although the thickness of the fill on the site generally varies from five to ten feet, the fill in the arroyos is up to 55 feet thick.

The plant's copper circuit consists of the unloading, crushing, bedding, and related ore handling facilities, a system of belt conveyors leading to wet storage bins and a fluid bed dryer, cyclone separators with a product baghouse, dry storage bins, a "ConTop"-based reactor system with cyclone smelting, a furnace, copper converters, two anode furnaces, and an anode casting facility. The gas handling systems include draft fans, spray chambers and electrostatic precipitators serving the roasters, furnace and converters, and two sulfuric acid and associated gas cleaning plants serving the roasters and converters. Copper concentrate is the primary feedstock, but recycled material from other plants also is used. This material includes matte, by-product dust, anode oxide slag, blister copper, and scrap copper. The feedstock is deposited on a concrete pad next to the bedding plant and is also stored on the ground near one of the ponds. No information was available concerning the history and operation dates of this facility.

Type of Impact/Media Affected: Prior to June 1993, a contractor used an abrasive blast media for an ASARCO facility project. Once the project was completed, the contractor left the site without removing all waste material. During a June 1993 U.S. EPA inspection, the waste material was sampled and determined to be a hazardous waste. Following extent of contamination tests for TCLP lead and total lead, it was determined that the wastes contaminated approximately 946 tons of soil on-site.

Type of Release: Improper management of hazardous waste

Affected Media: Soil

Type of Contamination: Lead

Regulatory Action Response: EPA issued a Notice of Violation for improperly managing a hazardous waste. After formal enforcement proceedings, ASARCO was assessed an administrative penalty of $80,000.

ASARCO proposed a closure plan to remove the residue and the underlying soil and to transport the material to an authorized hazardous waste facility. TNRCC approved the proposed plan, stipulating that soil samples to verify the extent of contamination be taken at a depth of at least six inches, and that an independent laboratory be used to analyze the samples for both TCLP lead and total lead. Between May 13 and May 22, 1996, ASARCO removed a total of 946 tons of material and transported it to USPCI's Lone

Mountain facility for disposal. The available files contained no additional information on concentrations of constituents or removal costs.

References:

Texas Natural Resource Conservation Commission. *Interoffice Memorandum from Ayala, V. to files, Re: A Compliance Evaluation Inspection*. August 15, 1996.

ASARCO El Paso Plant: "Spills and Improper Waste Management Results in Heavy Metals Soil Contamination"

Sector(s): Copper

Facility: El Paso Plant, ASARCO, Inc., El Paso County, Texas

Facility Overview: ASARCO's El Paso Plant is a primary copper refinery producing anodes for shipment for further refining. The facility uses various ore handling facilities, belt conveyors, storage bins, dryers, furnaces, converters, an anode casting facility, and gas handling systems.

Data Sources: State files

Agency Contact: Terry McMillan, Region 6 Waste/ Water Program, TNRCC

Waste and Material Management Practices: ASARCO's El Paso Plant is located at the western end of El Paso County in the Rio Grande Canyon, just east of the Rio Grande River. The site is roughly one mile long by 1,800 feet wide, and relatively flat due to landfilling with slag. This site has been actively used for mineral processing for more than 100 years. In 1887, a smelter was constructed on 1,156 acres to process lead ores from mines in Mexico and the American Southwest. In 1899, the smelter was incorporated in the newly organized American Smelting and Refining Company, which became ASARCO in 1975. Zinc operations were closed in 1982, and lead smelting ceased in 1985. An antimony plant on the site was closed in 1986.

ASARCO's current plant is a copper smelter that generates sulfuric acid as a by-product of air emissions cleaning. The plant has unloading, crushing, bedding, and related ore handling facilities, a system of belt conveyors leading to wet storage bins, a fluid bed dryer, cyclone separators with a product baghouse, dry storage bins, a "ConTop"-based reactor system with cyclone smelting, a furnace, copper converters, two anode furnaces, and an anode casting facility. The gas handling systems include draft fans, spray chambers and electrostatic precipitators serving the roasters, furnace and converters, and two sulfuric acid and associated gas cleaning plants serving the roasters and converters.

Copper concentrate from Arizona, Montana, and Chile is the primary feedstock, but recycled material from other plants also is used. This material includes matte, by-product dust, anode oxide slag, blister copper, and scrap copper. The feedstock is deposited on a concrete pad next to the bedding plant, and also is stored on the ground near one of the ponds.

Waste slag has been deposited in various dumps on-site and includes smelting slag from zinc, lead, and copper processes. Many of the plant's present structures are built on old waste slag deposits.

In 1970, the City of El Paso filed a suit charging violations of the Clean Air Act. Lead was discovered in the soil of an adjacent neighborhood and all residents were relocated.

Over a two week period in May and June of 1994, the Texas National Resource Conservation Commission's (TNRCC) Region 6 Field Operations Division conducted a detailed multi-media inspection of ASARCO's El Paso Plant. Numerous samples showed that various processes at the plant were being managed without regard for protecting the environment from releases of heavy metals. During the inspection, unauthorized discharges to soil from spills, fugitive dust, breaches in berms, and cracked monitoring well pads were observed.

Type of Impact/Media Affected: Following the TNRCC inspection, ASARCO collected samples from several of the process sites that failed the Toxicity Characteristic Leaching Procedure (TCLP) tests for cadmium and lead, including the following:

- Spilled copper concentrate from rail gondolas east of the receiving facility (samples of soil beneath the spilled concentrate failed the TCLP test for cadmium and lead);
- Dust on uncovered ground at the base of the Delumper Unit (samples of dust on the ground at the base of the unit failed the TCLP test for cadmium and lead);
- Wastewater from the treatment plant from Pond No. 1 that is spread and sprayed on roads and dirt piles (samples of the wastewater and pond water both failed the TCLP test for cadmium);
- Material from the berm behind the maintenance building west of the lead plant (samples of soil at the fence line failed the TCLP test for cadmium and lead);
- Material from the berm north of the rubber pond at the south portion of the facility (samples of soil at a breach failed the TCLP test for cadmium and lead); and
- Spillage to the ground from wastes stored in a roll-off container at the acid plant (samples of soil failed the TCLP test for cadmium and lead).

Type of Release: Spills and improper waste management

Affected Media: Soil

Type of Contamination: Cadmium and lead

Environmental Damage(s): Soil contamination

Regulatory Action/Response: As a result of the inspection, TNRCC Region 6 requested that immediate action be taken to address the releases of hazardous wastes identified. From mid-1994 through 1995, TNRCC's Industrial and Hazardous Waste (IHW) enforcement section evaluated eight possible violations at this site. ASARCO claimed that the copper concentrate and other materials with high metal content were excluded from RCRA by the Bevill Amendment. On August 25, 1994, the IHW enforcement screening committee directed that a petition be prepared to initiate formal enforcement action against the plant. This direction came after TNRCC's Legal Services Division concluded that the dumping of copper smelting slag or lead smelting slag was the only violation cited at the facility that was excluded under the Bevill Amendment. Several meetings with ASARCO and TNRCC staff occurred during 1995. There was no information present in the files to indicate that any formal enforcement action had been taken against ASARCO or whether the concerns about the handling of materials at the plant had been resolved. TNRCC's representative (the Enforcement Division Director) declined to provide information or other support to develop this case, beyond allowing research of the central files that are available to the general public. In addition, the director refused to allow TNRCC enforcement staff to be contacted for questions on behalf of U.S. EPA. Additional information related to this site might be available in the Regional Office in El Paso, Texas.

References:

Texas Natural Resource Conservation Commission. *Interoffice Memorandum from Ayala, V. to Bredehoeft, S., Re: A Multi-Media Inspection*. July 29, 1994.

Texas Natural Resource Conservation Commission. *Interoffice Memorandum from Ayala, V. to files, Re: A Compliance Evaluation Inspection*. December 14, 1995.

Dal-Tile/Dal-Minerals: "Lead-Contaminated Sludge Dumped at Seven Texas Sites Contaminates Soils"

Sector(s): Talc

Facility: Dal-Tile/Dal-Minerals, Hudspeth County, Texas

Facility Overview: This facility is a talc mining operation that has been in operation for approximately 28 years. The site is leased by Dal-Minerals to supply talc to a tile manufacturing plant in Dallas, Texas.

Data Sources: State files

Agency Contact: Terry McMillan, Region 6 Compliance, TNRCC

Waste and Material Management Practices: This site is a mine that supplies talc to the Dal-Tile tile manufacturing plant in Dallas. The mine is located approximately ten miles west of Van Horn and three miles northeast of Allamore. Talc mining and cattle ranching are the principal businesses in the region. The land at the site is locally owned, but Dal-Tile leases mineral rights on the land and operates the site for product removal. The site is not permitted or otherwise authorized to accept hazardous and industrial wastes.

At its tile manufacturing facility in Dallas, Dal-Tile generates substantial quantities of dewatered sludge. The sludge is characteristically hazardous due to leachable concentrations of lead. Dal-Tile packaged the waste in an unspecified number of polypropylene bags prior to shipping them. Dal-Tile dumped each shipment into an unlined trench at the mine and then covered the bags with 60 to 80 feet of soil overburden. Dal-Tile also disposed of this same type of waste at a gravel pit and a landfill in Dallas County.

Type of Impact/Media Affected: Sampling by the State showed that the dewatered sludge had a leachable lead concentration of 220 mg/l, which is 44 times the regulatory level of 5 mg/l. Dal-Tile made three shipments of the sludge to this mine in October 1987, with the total volume of waste sludge disposed of at the mine exceeding 1,700 cubic yards.

Type of Release: Illegal dumping

Affected Media: Soil

Type of Contamination: Lead

Environmental Damage(s): Contaminated soil

Regulatory Action/Response: Upon the discovery and subsequent investigation of the gravel pit and landfill sites by the State, Texas issued an Enforcement Order against the Dal-Tile Corporation in March 1991. Texas assessed administrative penalties of $650,000, with the deferral of $300,000 pending satisfactory completion of technical requirements of the Order. A number of technical investigations and reports, including site assessment and closure activities, also were required by the Order. However, at the time the Order was issued, neither EPA nor the State of Texas was aware of the disposal activities conducted at the site. The Order was not available at the time the files were reviewed.

Several months after the Order was issued, in August 1991, Dal-Tile notified Texas that the company also had disposed of sludge at the mine. The State named the west Texas mine as one of seven unauthorized disposal sites for the hazardous wastewater treatment sludge that was generated at the Dal-Tile tile manufacturing facility in Dallas.

Closure work began at the site in May 1992 with the excavation of the bagged sludge. Most of the bags were reported by the contractor as being intact at the time of excavation. Recovered bags of sludge that were intact were shipped to one of Dal-Tile's Texas plants for recycling. Recovered sludge mixed with soil and

debris was shipped to the Dallas plant for recycling in the tile manufacturing process. Lead-contaminated soil surrounding the waste bags, which was reportedly non-hazardous, was shipped to a landfill in New Mexico.

Final confirmation testing of the excavation and closure verification was performed by State inspectors in December 1992. In February 1993, Dal-Tile's contractor submitted a closure report to the State's compliance office. In October 1993, State compliance inspection staff visited the site to verify the closure activities stated in the report submitted by Dal-Minerals. At that time, no evidence of additional waste was found and the site was determined to have undergone complete clean closure. A recommendation was made that the site be removed from the RCRA inspections list. No information was present in the files to provide any information on further enforcement actions by the State or EPA.

References:

Texas Water Commission. *Interoffice Memorandum from McMillan, T. to Rozacky, W., Re: A Compliance Evaluation Inspection conducted on October 28, 1993*. November 19, 1993.

Texas Water Commission. *Interoffice Memorandum from Vilas, J. to Industrial and Hazardous Waste Screening Committee, Re: A Record Review*. December 7, 1992.