Five-Year Review Report

Fourth Five-Year Review Report
for
Iron Mountain Mine Superfund Site
Redding, California

July 2008

Prepared for:
Contract No. 68-W-98-225/ WA No. 280-FRFE-0917
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Approved by: **Date:**

Kathleen Salyer 7/14/08

Kathleen Salyer
Chief, Site Clean-up Branch
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Executive Summary

The interim remedies for the Iron Mountain Mine Superfund site near Redding, California, consist of a combination of source control, acid mine drainage collection and treatment, and water management components, including water diversions and coordinated releases of contaminated surface water from Spring Creek Debris Dam into releases of dilution flows from Shasta Dam. Figure 1 provides a location map for the Iron Mountain Mine site. The remedies selected in the 1986, 1992, 1993, and 1997 Records of Decision (EPA, 1986 [ROD 1]; EPA, 1992 [ROD 2]; EPA, 1993 [ROD 3]; EPA, 1997 [ROD 4]) have been implemented and are operating as intended.

The Spring Creek Arm of Keswick Reservoir sediment interim remedial action was selected in the 2004 Record of Decision (EPA, 2004 [ROD 5]), and the remedial design was completed in September 2007. Construction of the interim remedy components could begin as early as the fall of 2008. The last operable unit at the site, the Boulder Creek area-wide acid mine drainage sources, is currently in the Remedial Investigation and Feasibility Study phase of the process. EPA expects to complete the Remedial Investigation and the Feasibility Study in 2009.

This is the fourth five-year review for the Iron Mountain Mine site. The trigger for the first five-year review was the start of construction of the "partial cap" in September 1988. The first five-year review was completed September 30, 1993; the second five-year review was completed October 8, 1998; and the third five-year review was completed September 30, 2003.

The assessment of this five-year review found that the remedies implemented under RODs 1 through 4 are operating as intended, and the operation and maintenance at the site has been satisfactory over the past five years. The actions to date have resulted in over 95 percent reduction in metal loading discharges from the site.

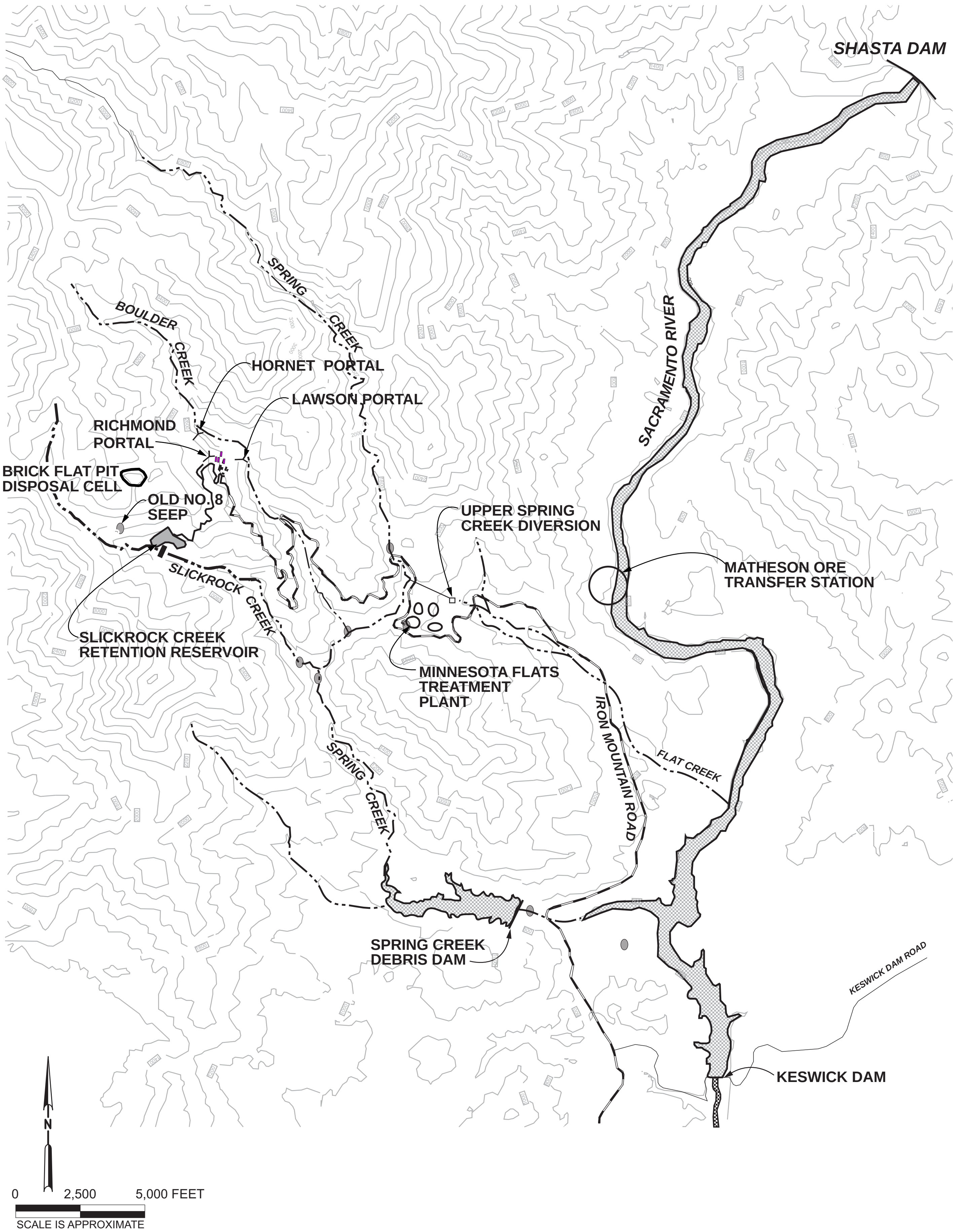

FIGURE 1
LOCATION MAP
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

ES022008008RDD_02 (4/23/08)

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Iron Mountain Mine (IMM)		
EPA ID: CAD980498612		
Region: 9	**State: CA**	**City/County: Redding/Shasta**
SITE STATUS		
NPL status: ☑ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☑ Operating ☐ Complete		
Multiple OUs?* ☑ YES ☐ NO	**Construction completion date:** N/A	
Has site been put into reuse? ☐ YES ☑ NO		
REVIEW STATUS		
Lead agency: ☑ EPA ☐ State ☐ Tribe ☐ Other Federal Agency ______________________		
Author name: Rick Sugarek		
Author title: Work Assignment Manager	**Author affiliation: EPA Region 9**	
Review period:** _12 / _10 / _2007_ to _07 / _14 / _2008_		
Date(s) of site inspection: _04 / _03 / _2008_		
Type of review: ☑ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☐ 2 (second) ☐ 3 (third) ☑ Other (specify) _4 (fourth)		
Triggering action: ☐ Actual RA Onsite Construction at OU #_1__ ☐ Actual RA Start at OU#____ ☐ Construction Completion ☑ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: _09 / _30 / _2003_		
Due date *(five years after triggering action date)*: _09 / _30 / _2008_		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

The IMM site is generally well-maintained. No operation and maintenance issue was identified during the site inspection that is expected to impact the effectiveness or protectiveness of the interim IMM remedial actions. However, CH2M HILL identified several issues related to the ongoing operation and maintenance program that require follow up actions, as summarized in Section VI "Site Inspections and Interviews."

Recommendations and Follow-up Actions:

Recommendations regarding IMM operation and maintenance should be implemented by the Site Operator or EPA as summarized in Section VI "Site Inspections and Interviews."

Protectiveness Statement(s):

The interim remedial actions implemented at IMM (selected in RODs 1-4) are protective of human health and the environment, and are consistent with the anticipated final remedy for the Site. The selected interim remedial actions have essentially eliminated the potential exposure and resultant threats to human health and the environment from acid mine drainage (AMD) discharges from contaminant sources addressed by the interim remedial actions. The IMM interim remedial actions do not address all sources of discharges from the Site. Further remedial actions are required.

The interim actions have afforded substantial protection to the valuable Sacramento River ecosystem and water supply by eliminating greater than 95 percent of the historic metal discharges from the IMM site.

During this five-year review period, the copper concentrations in the Sacramento River below Keswick Dam met the protective ambient water quality standard identified in RODs 1-4: the Basin Plan standard of 5.6 ppb for the maximum allowable dissolved copper concentration.

List of Involved Parties at Iron Mountain Mine

EPA	United States Environmental Protection Agency is the lead governmental agency for the cleanup at Iron Mountain Mine
CH2M HILL	EPA's technical contractor
State of California (DTSC and Water Board)	The State of California, through Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board (Water Board), acts as the supporting governmental agency at Iron Mountain Mine.
Reclamation	The Bureau of Reclamation has acted as EPA technical advisor at the site and is the federal land manager responsible for operating the Central Valley Project, which includes Shasta, Keswick, and Spring Creek Debris dams, which are part of the remedy for the site.
CDFG	The California Department of Fish and Game has served on the technical advisory committee as trustee for the fishery resources.
NOAA	The National Oceanic and Atmospheric Administration has served on the technical advisory committee as the federal trustee for the anadromous fishery resources in the Sacramento River (i.e. salmon and steelhead trout) and their critical habitat.
Aventis CropScience	Responsible company for cleanup. Aventis CropScience (or companies acting on its behalf) conducted various investigations and constructed some of the interim remedies until a final settlement was reached in December 2000. Aventis CropScience left the site in December 2000.
Rhone-Poulenc	Former name of Aventis CropScience
Stauffer Chemical Co.	Former owner/operator of Iron Mountain Mine who was bought by Rhone-Poulenc
AIG	Company responsible for performing Statement of Work under December 2000 IMM Consent Decree
IMO	Site Operator, under AIG
Iron Mountain Mines, Inc.	Current owner of the inactive mine property

List of Acronyms

ac-ft	acre-foot
AMD	acid mine drainage
Basin Plan	*Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin*
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
CTR	California Toxics Rule
CDFG	California Department of Fish and Game
CVP	Central Valley Project
EPA	U.S. Environmental Protection Agency
gpm	gallons per minute
IMM	Iron Mountain Mine
IMMI	Iron Mountain Mines, Inc.
IMO	Iron Mountain Operations
Matheson	Matheson Ore Transfer Station
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Marine Fisheries Service
O&M	operation and maintenance
OU	Operable Unit
ppb	parts per billion
Reclamation	Bureau of Reclamation
ROD	Record of Decision
SOW	October2000 *Statement of Work Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California*
Spring Creek Arm	Spring Creek Arm of Keswick Reservoir
State	State of California

TMDL	total maximum daily load
UAA	*Use Attainability Analysis for the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for Beneficial Uses at West Squaw Creek, Shasta County*
Water Board	Central Valley Regional Water Quality Control Board

List of Attachments

1. "Previous Five-Year Review Recommendations," John Spitzley and Sandra Shearer (CH2M HILL).
2. "List of Documents Reviewed," Sandra Shearer (CH2M HILL).
3. "Minnesota Flats Treatment Plant Effluent Discharge," John Spitzley, Eric Halpenny, and Sandra Shearer (CH2M HILL).
4. "Site Evaluation and Compliance at Keswick Dam," John Spitzley, Eric Halpenny, and Sandra Shearer (CH2M HILL).
5. "Site Inspection Checklist," John Spitzley and Sandra Shearer (CH2M HILL).
6. "Site Inspection Summary," John Spitzley, Sandra Shearer, Dave Bunte, and Eric Halpenny (CH2M HILL).
7. "Institutional Control Assessment," Sandra Shearer and Caroline Ziegler (CH2M HILL).
8. "Applicable or Relevant and Appropriate Requirement Analysis," Sandra Shearer and John Blasco (CH2M HILL).

Iron Mountain Mine, Redding, California Fourth Five-Year Review Report

I. Introduction

The purpose of this five-year review is to determine whether the interim remedial actions implemented at the Iron Mountain Mine (IMM) Superfund Site are protective of human health and the environment. The methods, findings, and conclusions of the review are documented here. In addition, this five-year review report identifies issues found during the review, if any, and recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 121 and the National Contingency Plan. CERCLA Section 121 states: "If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."

EPA interpreted this requirement further in the National Contingency Plan; 40 FAR Section 300.400(f)(4)(ii) states: "If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

EPA Region 9 has conducted a five-year review of the interim remedial actions implemented at the IMM site near Redding, CA. This review was conducted from December 2007 through July 2008. This report documents the results of the review.

This is the fourth five-year review for the IMM site. The triggering action for the first five-year review was the date of the start of construction of the "partial cap" in September 1988. Response is still ongoing at this site, and all hazardous materials, pollutants, or contaminants have not been removed. The first five-year review was completed September 30, 1993; the second five-year review was completed October 8, 1998; and the third five-year review was completed September 30, 2003.

II. Site Chronology

TABLE 1
Site Chronology

Event	Date
IMM Listed on the National Priority Listing "Superfund List"	1983
Operable Unit (OU) 1 - "Site-wide": Richmond Partial Cap, Brick Flat Pit Cap, Slickrock Creek Diversion, Upper Spring Creek Diversion	
Remedial Investigation and Feasibility Study of Options Completed	1985
Feasibility Study Addendum Completed	1986
Record of Decision (ROD1) Selecting Interim Remedy Signed	1986
Upper Spring Creek Diversion Completed (final required component of interim remedy)	1991
OU-2 - "Boulder Creek": Richmond and Lawson Adits Acid Mine Drainage Treatment, Consolidation of Seven Waste Piles and Capping, Construction of Sludge Disposal Cell	
Remedial Investigation and Feasibility Study of Options Completed	1992
Record of Decision (ROD 2) Selecting Interim Remedy Signed	1992
Aerated Simple Mix Component of Treatment Plant Completed	1994
High Density Sludge Component of Treatment Plant Completed	1997
Emergency Storage Facility for Treatment Plant Completed (final required component of interim remedy)	2000
First Five-Year Review	1993
OU-3 - "Old /No. 8 Mine Seep OU": Seep Discharge Treatment	
Remedial Investigation and Feasibility Study of Options Completed	1993
Record of Decision (ROD 3) Selecting Interim Remedy Signed	1993
Emergency Storage Facility for Treatment Plant Completed (final required component of interim remedy)	2000
OU-4 - "Water Management OU": Dam and Treat Runoff from Slickrock Creek	
Remedial Investigation and Feasibility Study of Options Completed	1994
Feasibility Study Addendum Completed	1996
Record of Decision (ROD 4) Selecting Interim Remedy Signed	1997
Slickrock Creek Retention Reservoir Completion	2004
Second Five-Year Review	1998
Third Five-Year Review	2003
Site Improvements under 2000 Settlement	
Brick Flat Pit Phase II Dam Raise	2002
Richmond Mine Adits and Drifts Rehabilitation Completed	2003
Construction of Mine Waste Disposal Cell ("muck cell")	2003
Boulder Creek Tailings Dam Improvements Completed	2004
Matheson Ore Transfer Station Restoration	2005
OU-5 – "Sediment": Remove Sediment Susceptible to Erosion from Spring Creek Arm of Keswick Reservoir	
Remedial Investigation and Feasibility Study of Options Completed	June 2004
Record of Decision (ROD5) Selecting Interim Remedy Signed	September 2004
Remedial Design Completed	September 2007
OU-6 - "Boulder Creek Area Sources"	
Remedial Investigation and Feasibility Study	Ongoing
Fourth Five-Year Review	2008

III. Background

Iron Mountain is located in Shasta County, California, approximately 9 miles northwest of the City of Redding. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number for the IMM Superfund Site is CAD980498612. The collection of mines on Iron Mountain is known as IMM. They are the southernmost mines in the West Shasta Mining District and have been periodically worked for production of silver, gold, copper, zinc, and pyrite. The mine area includes extensive underground workings, side hill and open pit mining areas, waste rock dumps, and tailings piles.

The IMM site includes approximately 4,400 acres of land that includes the mining property on Iron Mountain, several inactive underground mines, an open pit mine, areas that were mined by side hill mining activities, other areas disturbed by mining or mineral processing activities, numerous waste dumps, process tailings piles, abandoned mining facilities, mine drainage conveyance and treatment facilities, and the downstream reaches of Boulder Creek, Slickrock Creek, Spring Creek, Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River affected by drainage from IMM.

Several, and possibly all, of the mines and the waste rock and tailings piles are discharging acidic waters, typically with a high content of heavy metals. These discharges are herein referred to collectively as acid mine drainage (AMD). The largest source of heavy metal laden AMD is the Richmond Mine, and the second largest is the Hornet Mine, both of which drain into Boulder Creek. The third largest source, Old/No. 8 Mine Seep, drains into Slickrock Creek. These severe AMD discharges derive from hydro-geochemical reactions in the inactive underground mine workings and are the direct result of the mining activity that took place in these deposits over many decades.

The remaining IMM heavy metal discharges derive from widely dispersed area-wide sources. The discharges from these sources are closely associated with heavy rainfall and high runoff storm events. The IMM area discharges derive from waste piles, process tailings, sidecast spoils, ground disturbed by mining-related activities, discharges from buried workings or partially accessible workings, contaminated soil and debris, seeps, contaminated interflow and groundwater, and contaminated sediments in the Slickrock Creek, Boulder Creek, and Spring Creek watersheds at IMM.

The IMM site was listed on the National Priorities List in September of 1983. Since that time, EPA, with State of California (State) support, conducted its remedial investigation to characterize the nature and extent of contamination at the Site. EPA has issued five feasibility studies and two feasibility study addenda to support five records of decision (ROD) for the IMM site.

The EPA has identified the following as responsible parties: the former owner and operator, Aventis CropScience (the successor to Rhone-Poulenc, who in turn is the successor to Stauffer Chemical Company and Mountain Copper, Ltd.), and the current owner and operator, Iron Mountain Mines, Inc. (IMMI). Stauffer Management Company, on behalf of Aventis CropScience, performed certain cleanup work at IMM in response to seven EPA unilateral administrative orders.

EPA and the State settled cost recovery litigation with Aventis CropScience in December 2000. The settlement assures that the interim remedial actions selected in EPA's 1986, 1992, 1993, and 1997 RODs will be operated and maintained. Pursuant to the settlement, American International Group, Inc. (AIG), on behalf of Aventis CropScience, will perform the operation and maintenance (O&M) of the interim remedial actions implemented pursuant to the four IMM RODs for thirty years. Iron Mountain Operations (IMO) is the Site Operator under AIG. Aventis CropScience also entered into a Guaranteed Investment Contract with AIG to provide for a payment of $514 million to the Federal or State agency performing oversight of O&M activities at IMM at year 30 to fund the performance of O&M activities beyond the initial 30-year period. Under the terms of a memorandum of understanding with the State, EPA is currently performing oversight of AIG O&M activities.

Basis for Taking Action

The contaminants of concern identified by EPA are acidity and toxic metals, which include copper, cadmium, and zinc. All of these contaminants are present in the AMD discharges from the underground, side hill, and open pit mine workings at IMM, and the AMD discharges from area sources in the Slickrock Creek and Boulder Creek watersheds at IMM. The exceedances of water quality standards and the accumulation of toxic sediments downstream of IMM historically caused severe environmental impacts and posed a potential threat to human health.

The Sacramento River is a source of drinking water for the City of Redding. The Central Valley Project (CVP) facilities of northern California are important components of California's water supply system. CVP operates under a complex operational plan to supply agricultural and drinking water, to produce power, and to address environmental concerns.

The fishery resources, other aquatic species, and the ecosystem of Keswick Reservoir and the Sacramento River below Keswick Dam are the primary natural resources at risk to uncontrolled IMM heavy metal discharges. The National Oceanic and Atmospheric Administration (NOAA) has listed the Upper Sacramento River as the most important salmon spawning ground in California. The Sacramento River downstream of Keswick Dam contains four races of anadromous Chinook salmon and steelhead. The Chinook salmon (fall-, late-fall-, spring-, and winter-run) migrate into, spawn, incubate, and rear in the reach of the river immediately downstream of Keswick Dam. Sacramento River winter-run Chinook salmon are listed as endangered by the NOAA Marine Fisheries Service (NOAA Fisheries) and California Department of Fish and Game (CDFG) under the United States Endangered Species Act. Central Valley spring-run Chinook salmon are listed as threatened by NOAA Fisheries and CDFG. Fall-run and late-fall-run Chinook salmon are identified as species of concern by NOAA Fisheries. Central Valley distinct population segment steelhead trout and the southern distinct population segment of North American green sturgeon are listed as threatened by NOAA Fisheries.

IV. Remedial Actions

Remedial Action Objectives

Iron Mountain Mine Acid Mine Drainage Discharges

The remedial action objective identified for the interim remedial action selected in ROD4 for EPA's IMM Superfund cleanup program is to eliminate the AMD discharges that are harmful to public health and the environment. EPA did not designate remedy specific remedial action objectives in RODs 1-4, but did identify three primary cleanup goals:

- Comply with water quality criteria established under the Clean Water Act and the California Porter-Cologne Water Quality Act (standards are set forth in the *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin* [Basin Plan] and statewide plans). These standards were established to protect the valuable Sacramento fishery and aquatic ecosystems. The Basin Plan calls for a water quality standard of 5.6 parts per billion (ppb) dissolved copper as an instantaneous maximum exposure.
- Reduce the mass discharge of toxic heavy metals through application of appropriate control technologies.
- Minimize the need to rely on special releases of valuable water resources to dilute continuing IMM contaminant discharges in order to assure attainment of protective water quality criteria.

EPA has concluded that a combination of source control, treatment, and water management components are needed to assure an effective, implementable, and cost-effective cleanup program for the IMM AMD discharges.

Spring Creek Arm of Keswick Reservoir Sediment

Remedial action objectives developed in ROD 5 (EPA, 2004) for contaminated sediment in the Spring Creek Arm of Keswick Reservoir (Spring Creek Arm) are:

- Protect the Sacramento River ecosystem from releases of heavy metals originating from the Spring Creek Arm by preventing the mobilization and redeposition of contaminated sediment into important fishery spawning habitats located in the Sacramento River downstream of Keswick Dam.
- Prevent adverse impacts on water quality and beneficial uses of the Sacramento River below Keswick Dam by reducing the metal loads and suspended solids associated with contaminated sediment discharged from the Spring Creek Arm to the Sacramento River.

1986 Record of Decision (ROD 1). Site-wide

Remedy Selection

The 1986 ROD selected an interim remedy that identified a number of specific projects. These projects included the construction of a partial cap over the Richmond mineralized zone, including Brick Flat Pit (the open pit mine on top of Iron Mountain) and several subsidence areas; construction of a diversion of Slickrock Creek to avoid a mining waste slide; construction of a diversion of the Upper Spring Creek to avoid polluting its cleaner water and filling Spring Creek Reservoir; construction of a diversion of the South Fork of Spring Creek for a similar purpose; a study of the feasibility of filling mine passages with low-density Cellular Concrete; and an enlargement of Spring Creek Debris Dam, the exact size of which would be selected after a determination of the effectiveness of the other remedies.

Remedy Implementation

On July 19, 1988, EPA initiated construction of the partial cap. EPA constructed flexible soil/bentonite caps in seven subsidence areas over the Richmond mineralized zone. EPA also capped the lower portion of Brick Flat Pit, the open pit mine on top of Iron Mountain. As part of the construction of the Brick Flat Pit cap construction, EPA used tailings materials from the Minnesota Flat area, as well as several other tailings piles that contained relatively high concentrations of copper, cadmium, and zinc, as fill material beneath an impermeable membrane lining system. EPA completed construction of the partial cap in July 1989.

EPA, through an interagency agreement with Bureau of Reclamation (Reclamation), began construction of the Slickrock Creek diversion in July 1989 and completed construction in January 1990. The diversion consisted of a small stilling pool and diversion dam, a 36-inch diameter, urethane-lined concrete pipeline approximately one mile in length, and an energy-dissipation structure to remove the kinetic energy of the diverted flows prior to their return to lower Slickrock Creek.

Under order from EPA, Aventis CropScience began construction of the Upper Spring Creek diversion in July 1990 and the diversion was operational in January 1991. The Upper Spring Creek diversion consisted of a large, grated, drop-inlet structure (that prevents large rocks and debris from entering the diversion while allowing the creek flows to drop into a rock trap and then into a short tunnel), a 54-inch diameter, urethane-lined concrete pipeline several thousand feet in length, and an impact structure to dissipate the kinetic energy of the diverted flows prior to discharging them to Flat Creek.

In EPA’s 1997 ROD for the IMM site, EPA determined that a “dam and treat” remedial approach is technically practicable for the Slickrock Creek area source AMD discharges. EPA determined that significant reduction in IMM area sources of AMD discharges is preferable to the proposed South Fork of Spring Creek diversion or enlargement of the Spring Creek Debris Dam. In EPA’s 1997 ROD for the IMM site, EPA formally eliminated these two planned interim remedial activities.

Operation and Maintenance

The components of this interim remedial action, and all subsequent ones, are currently operated and maintained by AIG, pursuant to the settlement of EPA’s and the State’s cost recovery litigation for the IMM Superfund cleanup on December 18, 2000. Under the terms of a memorandum of understanding with the State, EPA is currently performing oversight of the performance of O&M activities by AIG. EPA’s contractor, CH2M HILL, regularly performs site inspections. CH2M HILL collects water quality data to assess the ongoing performance of the interim remedy on a weekly basis during the winter rainy season.

The Site Operator is performing routine inspection and maintenance activities specified in the October 2000 *Statement of Work Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW). No significant unanticipated O&M efforts were required subsequent to completion of removal of the Minnesota Flats tailing pile; the construction of the Brick Flat Pit cap, the subsidence area partial caps, and related surface water controls; and the construction of the Slickrock Creek clean water diversion.

The Upper Spring Creek diversion has functioned as designed to effectively divert up to 800 cubic feet per second (cfs) of clean water into Flat Creek, providing additional storage of contaminated water in the downgradient Spring Creek Reservoir. However, the urethane pipeline lining system has deteriorated since it was constructed and is an ongoing O&M item. The deteriorating liner does not jeopardize the effectiveness of the interim remedy. A stilling basin was excavated in the creek bed upstream of the diversion inlet trashrack in 2000 to settle out small rocks and gravels to reduce the erosion of the lining system. This stilling basin has been very effective in reducing the erosion of the lining system.

The Brick Flat Pit cap was subsequently modified to permit EPA to incorporate the cap into the landfill liner system selected in EPA's 1992 ROD, as discussed below. The Slickrock Creek diversion was subsequently modified to incorporate the diversion into the Slickrock Creek Retention Reservoir clean water diversion selected in EPA's 1997 ROD.

1992 Record of Decision (ROD 2). Boulder Creek

Remedy Selection

The 1992 ROD selected treatment of the AMD discharges from the Richmond and Lawson adits in a lime neutralization treatment plant. EPA's 1992 ROD also selected the consolidation and capping of seven waste piles in a landfill to be located on the site. The 1992 ROD provided for disposal of the IMM treatment plant sludges in a landfill to be constructed in the inactive open pit mine, Brick Flat Pit, to meet regulatory requirements for this use.

Remedy Implementation

EPA constructed the treatment plant (which includes aerated simple mix and High Density Sludge components) through a combination of an enforcement action and fund-lead design and construction. Aventis CropScience began construction of the aerated simple mix components of the treatment plant in the late summer of 1993 and completed the construction in September 1994. Aventis CropScience also constructed the associated support facilities, including the AMD collection and conveyance system, the sludge drying beds, roadway improvements, and the sludge landfill in Brick Flat Pit. Aventis CropScience did not complete the construction of required emergency storage facilities until September 2000. EPA designed the High Density Sludge modifications to the treatment plant, and constructed them from the spring of 1996 to January 1997. In 2002, the Brick Flat Pit dam was raised, which provided an additional 25 to 30 years of storage capacity for treatment sludge.

Under order from EPA, Aventis CropScience excavated, consolidated, and capped seven largely pyritic waste piles in a disposal cell located on site at IMM. The landfill was designed to comply with California mining waste requirements.

Operation and Maintenance

The treatment plant O&M was performed by representatives of Aventis CropScience until December 2000. Under the terms of the settlement, AIG has assumed responsibility for performing O&M of the treatment plant for 30 years. Under the terms of a memorandum of understanding with the State, EPA is responsible for oversight of AIG's ongoing O&M activities. EPA regularly monitors several aspects of treatment plant operation, including process parameters and influent and effluent flow rate and water quality. EPA also conducts periodic inspections of the physical condition of the treatment plant. Routine maintenance activities are ongoing.

The treatment plant has been very effective in reducing the IMM heavy metal discharge. The treatment process removes on average 99.7 percent of metals from the AMD inflow. The treatment plant meets Clean Water Act water quality discharge requirements. The copper concentrations in the Sacramento River below Keswick Dam met ambient water quality criteria selected in ROD2 during the five-year-review period (data from August 2003 to January 2008). With operation of the full-scale treatment plant beginning in September 1994, the IMM copper discharge was reduced by greater than 80 percent and the zinc and cadmium discharges were reduced by greater than 90 percent from historic levels on an overall basis. Further reductions were obtained after construction of Slickrock Creek Retention Reservoir, as discussed under the 1997 ROD below. During the period from August 2003 through January 2008, EPA's interim remedial actions at IMM prevented the discharge of approximately 600,000 pounds of copper and 2 million pounds of zinc by treating approximately 1.5 billion gallons of concentrated AMD.

1993 Record of Decision (ROD 3). Old /No. 8 Mine Seep

Remedy Selection

In the 1993 ROD, EPA selected treatment of the AMD discharges from the Old/No. 8 Mine Seep at the IMM treatment plant, as appropriately modified.

Remedy Implementation

Under Order from EPA, Aventis CropScience designed and constructed the facilities to collect and convey AMD from Old /No. 8 Mine to the treatment plant. Aventis CropScience also constructed the necessary aerated simple mix components to the treatment plant by September 1994. EPA constructed the High Density Sludge modifications to the treatment plant, which became effective in January 1997. Aventis CropScience did not complete the construction of required emergency storage facilities until September 2000.

Operation and Maintenance

See O&M section under 1992 ROD for further analysis of the O&M of the treatment of these flows.

The Old/No. 8 Mine Seep area is located on the north side of Slickrock Creek near the sedimentation basin. There are two groundwater extraction wells and two grit chambers in the Old/No. 8 Mine Seep area. Approximately 40 to 300 gallons per minute (gpm) of AMD is extracted from the Old/No. 8 Mine Seep wells, passed through one of the grit chambers, and routed to the IMM treatment plant through the 18-inch-diameter Old/No. 8 Mine Seep pipeline. The AMD from the Old/No. 8 Mine Seep pipeline and the discharge from Slickrock Creek Retention Reservoir both flow via the same pipeline to the IMM treatment plant, so the discharge from both sources must be considered for proper overall operation of the Slickrock Creek AMD control systems (CH2M HILL, 2004a).

After Slickrock Creek Retention Reservoir was completed, the Site Operator modified operation of the Old/No. 8 Mine Seep, including constructing a gravity drain system in February and March 2008. Recommendations from the April 3, 2008, site inspection were that the Site Operator continue active pumping of the Old/No. 8 Mine Seep and use the gravity drain system only as a backup collection system if the pumping wells are inoperable (see Section VI).

1997 Record of Decision (ROD 4). Water Management

Remedy Selection

The 1997 ROD focused on the Slickrock Creek watershed at Iron Mountain. Among other items, the 1997 ROD provided for design and construction of a 220-acre-foot (ac-ft)-capacity retention reservoir to collect area sources of AMD discharges in the Slickrock Creek Basin for treatment, surface-water diversion facilities, a hematite-erosion-control structure, an additional AMD-conveyance pipeline, and a tunnel for gravity discharge of treated effluent to Spring Creek. The interim remedy permits treatment of essentially all of the IMM AMD from the Slickrock Creek area sources, which comprise approximately 60 to 70 percent of the copper load and 40 to 50 percent of the zinc and cadmium load associated with the previously uncontrolled IMM discharges (EPA, 1997).

Remedy Implementation

Under an enforcement action, Aventis CropScience designed a 150-foot, earthen dam in the Slickrock Creek watershed, just downstream of the largest hematite pile. The design was completed in June 2000. As part of the settlement of EPA's and the State's cost recovery litigation in December 2000, EPA and the State agreed to assume responsibility for construction of Slickrock Creek Retention Reservoir and other remaining components of the 1997 ROD.

The hydraulic upgrades to the treatment plant, the AMD conveyance pipelines from Slickrock Retention Reservoir, the Iron Mountain roadway and culvert upgrades, and the discharge tunnel from the treatment plant to Spring Creek were completed by Aventis CropScience by September 2000.

EPA started construction in June 2001. During the spillway excavation in November and December 2001, movement of the hillslope above the planned spillway was observed. An investigation indicated an ancient landslide occupied an area of approximately 5 acres and up to 120 feet in depth above the spillway excavation. The slope was stabilized by use of a high-capacity tieback anchor system. Spillway design modifications, grout program modifications, and placement of fibercrete over a substantial portion of the right abutment were required by California's Department of Water Resources, Division of Safety of Dams. Slope stabilization and associated design modifications delayed the construction completion. The project was substantially complete on May 19, 2004, and was determined operational and functional by EPA and the State on August 26, 2004 (CH2M HILL, 2004b).

Operation and Maintenance

O&M of the interim remedies was assumed by AIG with oversight provided by EPA. The *Operations and Maintenance Manual, Slickrock Creek Retention Reservoir Project* outlines the O&M requirements for Slickrock Creek Retention Reservoir (CH2M HILL, 2004a). The O&M manual includes operation, inspection, maintenance, monitoring, and security requirements for Slickrock Creek Retention Reservoir and appurtenances, clean water diversions, AMD diversions, spillway, outlet works, sedimentation basin, and upstream hematite pile. No significant unanticipated O&M efforts were required after completion of Slickrock Creek Retention Reservoir.

The Site Operator constructed several rock check dams upstream of the Slickrock sedimentation basin. These upstream rock check dams are effectively reducing the amount of sediment accumulation in the main sediment basin (GEI Consultants, Inc., 2008). After startup and shakedown testing, the following IMM treatment plant operational guidelines were recommended for periods of high inflow from Slickrock Creek Retention Reservoir (CH2M HILL, 2005a). These are consistent with requirements in the O&M manual for the reservoir:

- Slickrock Creek Retention Reservoir inflow to the IMM treatment plant will be slowly ramped up during storm events by adjusting Slickrock Creek Retention Reservoir intake gates and using the emergency holding tank.
- The discharge from Slickrock Creek Retention Reservoir will be limited to 3,000 gpm (plus 250 gpm from the Old/No. 8 Mine), depending on water elevation within the reservoir, time of year, and forecasted weather.
- Discharge of 4,000 gpm will be avoided, unless necessary for dam operation.

Completion of Slickrock Creek Retention Reservoir and associated facilities, in combination with completed interim remedial actions to control the sources of AMD, was expected to result in a total reduction of contaminants discharged from Spring Creek Debris Dam to 5 percent of the pre-1994 discharge. For Water Years 2005 through 2007, the actual copper and zinc discharged from Spring Creek Debris Dam was only 2 percent of pre-1994 discharge.

Site Improvements under 2000 Settlement

The settlement provided funding for several site improvements, including rehabilitation of the underground workings in the Richmond Adit, construction of the phase II Brick Flat Pit dam raise to provide additional landfill capacity for treatment plant sludge, construction of a muck disposal cell for mine wastes generated by water flow through the mines, re-lining and installation of cathodic protection for the thickener tank, and construction of improvements to the Boulder Creek Tailings Dam.

The State was the lead for the design and construction of the Richmond Adit and drifts rehabilitation that will assure safe access for workers and equipment to regularly maintain the workings and assure AMD collection. This work started in September 2001 and was completed in September 2003 (North Pacific Research, 2004). The completion of this project addresses the largest identified risk for an uncontrolled spill at the site by improving the reliability of the AMD collection system at the Richmond Mine.

The Brick Flat Pit phase II dam raise, construction of the muck cell, and re-lining and installation of cathodic protection for the thickener tank were completed in 2003 under EPA oversight.

The Boulder Creek tailings dam embankment and spillway were modified to direct storm flows to the spillway and to provide spillway capacity adequate to pass the peak 100-year storm flow. The spillway capacity was increased by increasing the height of the dam crest and adding a gabion wall, anchored adjacent to the existing spillway and with shotcrete (gunite) covering exposed gabions. Improvements were also made to the Boulder Creek channel upstream of the dam. Improvements to the Boulder Creek tailings dam were completed between December 2003 and October 2004 (TRC, 2005).

2004 Record of Decision (ROD 5). Sediment

Remedy Selection

The 2004 ROD selected an interim remedial action to control release of contaminated sediment from Spring Creek Arm. A potential future release of contaminated sediment could adversely impact important downstream fisheries through the deposition of sediments containing toxic levels of metals in spawning beds of the Sacramento River. The selected interim remedy will involve the partial dredging of sediment in Spring Creek Arm that is most susceptible to erosion, and disposal of dredged sediment in an engineered disposal cell located adjacent to Spring Creek Reservoir. Dredging will remove approximately 50 to 60 percent of the volume of the existing contaminated sediment in Spring Creek Arm. Sediment that is less susceptible to erosion will not be dredged at deeper depths in the most downstream pile, Pile C. The selected interim remedy will include operational restrictions on Keswick Reservoir pool elevations during rare storm or flood events to prevent erosion of sediment remaining at deeper depths within Spring Creek Arm (EPA, 2004).

Remedy Implementation

The remedial design for the Spring Creek Arm sediment interim remedial action was completed in September 2007. Construction of the interim remedy components, including the access road to the disposal cell, could begin as early as the fall of 2008.

V. Progress Since Last Review

Protectiveness Statement from Last Review

At the time of the last five-year review, the interim response actions had not fully addressed all of the discharges of acidity, copper, cadmium, and zinc at the IMM site. Therefore, the previous team concluded that the interim remedies were fully protective of human health, but not the environment. The last five-year review summarized Site data that indicate that EPA had made substantial progress and that the interim remedial actions had afforded substantial protection to the valuable Sacramento River ecosystem and water supply.

Implemented Remedial Actions and Decision Documents

During the five-year review period, through a combination of enforcement and fund-lead approaches, EPA completed construction of the major remaining component of the ROD 4 interim remedy, Slickrock Creek Retention Reservoir. The response action selected in ROD 4 addresses the Slickrock Creek area source AMD discharges, which are estimated to account for approximately 60 to 70 percent of the copper load and 40 to 50 percent of the zinc and cadmium load associated with the previously uncontrolled IMM discharges (EPA, 1997). This interim remedy came online in 2004 and has provided for more than 95 percent control, on an overall basis, of the historic IMM AMD discharges.

EPA selected the Spring Creek Arm sediment interim remedial action in the 2004 ROD (EPA, 2004), and completed the remedial design in September 2007. The site risk evaluation indicated that interim remedial action was warranted to prevent a potential future release of contaminated sediment that could adversely impact important downstream fisheries through the deposition of sediments containing toxic levels of metals in spawning beds of the Sacramento River.

EPA anticipates that an additional remedial investigation and feasibility study will be conducted to develop and evaluate control strategies for OU-6, the area sources of AMD in Boulder Creek. As discussed in Attachment 1, EPA has continued to collect IMM surface water quality data since completion of the Slickrock Creek Retention Reservoir interim remedy and has also collected surface water quality data to monitor the progress of remediation of other mines within the West Shasta Mining District. These data will be used in support of the OU-6 remedial investigation, feasibility study, and ROD.

During the five-year-review period, the Boulder Creek tailings dam embankment and spillway were modified to direct storm flows to the spillway and to provide spillway capacity adequate to pass the peak 100-year storm flow. Improvements to the Boulder Creek tailings dam were completed between December 2003 and October 2004 (TRC, 2005).

The Matheson Ore Transfer Station (Matheson) Restoration project was substantially completed in September 2005, and final acceptance was achieved in December 2005. Reclamation, the federal land manager for the Matheson area, funded EPA to perform the interim remedial action pursuant to an Interagency Agreement. The Matheson Restoration project included removal of pyritic waste materials containing elevated levels of lead and arsenic from the former ore transfer station located adjacent to the Sacramento River. A disposal cell was constructed at the nearby IMM Site, and waste materials were hauled and placed in the disposal cell. The Matheson site was restored to allow public access and use of the adjacent Sacramento River Trail system (CH2M HILL, 2005b).

Status of Recommendations and Issues from Last Review

A technical memorandum on the status of the recommendations and issues from the previous five-year review is included as Attachment 1 and is summarized below.

Achieving Chronic Copper Standards in the Sacramento River

The water quality in the Sacramento River below Keswick Dam has improved since EPA completed construction of Slickrock Creek Retention Reservoir under ROD 4. Because the IMM remedial action is not yet complete, Reclamation controls the discharges from CVP facilities in accordance with the 1980 Memorandum of Agreement (MOU) between Reclamation and the State of California (Water Board and CDFG) to maintain compliance with the Basin Plan requirements. The copper concentrations in the Sacramento River below Keswick Dam did not exceed the Basin Plan maximum dissolved copper concentration of 5.6 ppb during the five-year-review period (data from August 2003 to January 2008).

After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the Court, and in 1998 EPA promulgated the California Toxics Rule (CTR) standards to replace the standards in that plan. The CTR left site specific standards in place for the Sacramento River above Hamilton City, but also promulgated new criteria for chronic exposures for this same reach of the Sacramento River. Because the IMM remedial action was not yet complete, Reclamation has continued to operate CVP facilities in accordance with the 1980 MOU, and was not required to control the discharges from CVP facilities to maintain compliance with the CTR water quality standards.

Although Reclamation was not required to meet the CTR criteria of 4.1 ppb as a 96-hour average chronic copper exposure level, the copper concentrations in the Sacramento River exceeded the CTR on only 4 days (only 2 percent of the days sampled) during the five-year review period, compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). EPA will evaluate the performance of the interim remedial actions implemented at IMM and the need for additional remedial actions as part of its feasibility study for OU-6 at IMM.

However, the issue identified in the previous five-year review (EPA, 2003) is still outstanding. The upgradient Shasta Lake water quality could negatively impact the water management component of the IMM remedy, especially during sustained periods of above average precipitation.

As recommended in the previous five-year review, EPA has continued to collect surface water quality data necessary to characterize the performance of the IMM interim remedies. These data will be used as part of the OU-6 Remedial Investigation, Feasibility Study, and ROD for IMM. The frequency of an uncontrolled release will be estimated under operations to meet both an instantaneous maximum standard and a 96-hour average chronic standard. The data will also be used to study the discharges from the area sources in the Boulder Creek watershed, which are estimated to constitute 5 percent or less of the overall historic IMM discharges of copper and zinc. EPA, the Water Board, and Reclamation also have continued to obtain data to characterize the sources and locations of elevated metal concentrations in Shasta Lake.

Additional discussions will be necessary among the regulatory stakeholders at IMM regarding the impact on the fishery resources in the Sacramento River from ongoing IMM and Shasta Lake metal releases. Based upon these discussions, a new memorandum of understanding should be developed to require Reclamation to meet both an instantaneous maximum standard and a 96-hour average chronic standard, and to resolve the problem of heavy metal loading in discharges from Shasta Dam impacting the water management efficiency of Spring Creek Debris Dam.

Miscellaneous Site Maintenance Issues

CH2M Hill identified items to be repaired at the site during the previous five-year review. None of the items identified impacted the effectiveness or protectiveness of remedies implemented under RODs 1 through 4. The Site Operator addressed the significant maintenance items, as summarized in Attachment 1. There are minor items that remain to be addressed, such as replacing the exposed polyvinyl chloride (PVC) pipe at the ends of the Boulder Creek Landslide horizontal drains with UV-resistant piping or placing a UV-resistant coating over the existing pipes.

The outstanding maintenance issues were communicated to the Site Operator on April 23, 2008, along with other issues and recommendations identified during the April 3, 2008, site inspection. Significant outstanding issues and observations from the April 3, 2008, site inspection are summarized under "Site Inspection and Interviews" in Section VI.

Treatment Plant Audit Recommendations

The previous five-year review concluded that the Site Operator was properly operating and maintaining the treatment plant and related facilities to meet Clean Water Act discharge requirements and to implement technology-based discharge requirements of the IMM RODs. The treatment plant effluent discharges meet Clean Water Act regulatory discharge requirements. Although the High Density Sludge technology is being properly implemented by the Site Operator, the High Density Technology has not been able to meet technology-based performance standards that EPA set in the October 2000 SOW pursuant to the December 2000 Consent Decree for the IMM Site. These numerical performance standards were set by EPA to reflect the performance expectations of the High Density Sludge technology that was selected in EPA's RODs for the site. EPA set the High Density Sludge performance standards based upon the data that were available at the time. EPA indicated in the SOW, that because the data set was limited, the treatment plant performance should be monitored and that the technology-based performance standards should be revised if warranted. The previous IMM five-year review recommended further study to determine whether the performance standards should be revised for dissolved zinc.

An evaluation of IMM treatment plant data collected between 2004 and 2007, following completion of Slickrock Creek Retention Reservoir, was performed as part of this five-year review and is documented in Attachment 3. The treatment plant was found to substantially comply with Clean Water Act effluent limits for total metals and the technology-based performance standards for dissolved copper. However, for the majority of days of operation, the IMM treatment plant effluent exceeded the technology-based performance standards for dissolved zinc and the 30-day average dissolved cadmium standard. EPA's review of the treatment plant performance data indicates that the Site Operator has properly operated the High Density Sludge treatment plant throughout the five-year review period. EPA has determined that it should formally modify the High Density Sludge technology-based performance standards (best-available-technology economically achievable) based on the metal-removal level currently achieved at the treatment plant. Recommendations for revised limits are presented in Attachment 3.

Other recommendations identified during the 2003 treatment plant audit were addressed, or are incorporated with other issues and recommendations identified during the April 3, 2008, site inspection. Significant outstanding issues and observations are summarized under the "Site Inspection and Interviews" in Section VI.

VI. Five-Year Review Process

Administrative Components

The IMM five-year review was conducted by Rick Sugarek with EPA and a CH2M HILL team of Sandra Shearer, John Spitzley, Caroline Ziegler, Dave Bunte, and Eric Halpenny. This five-year review includes site inspection reports, a review of treatment plant operational, influent and effluent analytical data, Sacramento River water quality analysis, and an update on the status of previous five-year review recommendations and issues.

Community Involvement

Stakeholders and members of the community were notified of the initiation of the five-year review process in the fact sheet dated February 2008. The IMM Five-Year Review notice was published in the Redding, California, newspaper, *Record Searchlight,* on February 21, 2008.

A telephone interview was conducted on April 22, 2008, with a downgradient property owner, Annette Rardin. Onsite interviews were conducted in March and April 2008 with the following IMO staff: Rudolph Carver, project manager; Wes Franks, site construction manager; and Bob Lindskog, IMM treatment plant operator. Issues and observations identified during the interviews are incorporated with the site inspection observations in Attachment 6.

Interviews of regulatory agency representatives were not performed during this five-year review. EPA determined that interviews were not necessary to provide additional information on site status. Interviews were performed during the previous five-year review. During the fourth five-year review performance period, EPA has been in regular contact with the IMM Technical Advisory Committee in support of the design of interim remedial actions selected in ROD 5 and the remedial investigation for OU-6.

Document Review

Attachment 2 provides a list of documents that were reviewed as part of the IMM Fourth Five-Year Review. Issues, recommendations, and conclusions from the document review were incorporated into the sections of this five-year-review report, as indicated by the citations throughout the text and attachments.

Data Review

This five-year review consisted of a review of the operational performance of the IMM treatment plant and current metal loading to the Sacramento River. Conclusions from the data review are presented below.

Treatment Plant Operational Performance

Attachment 3, "Minnesota Flats Treatment Plant Effluent Discharge" provides an evaluation of the operational performance of the IMM treatment plant in meeting the performance standards contained in the IMM SOW, dated October 2, 2000 (EPA, 2000). The IMM treatment plant has been in substantial compliance with Clean Water Act effluent limits for pH, total cadmium, total copper, total zinc, and total lead during the performance period.

Pursuant to the settlement agreement, EPA set dissolved copper, zinc, and cadmium performance standards for the effluent that were intended to reflect proper operations of the High Density Sludge treatment plant. EPA recognized at that time that there were limited data and agreed to revisit the standard once operational experience was gained. As part of this five-year review, EPA has reviewed the treatment plant performance data for the High Density Sludge technology. EPA's review of treatment plant performance data indicates that the Site Operator has properly operated the High Density Sludge treatment plant. However, the treatment plant effluent does not meet the technology-based maximum concentration limits, and the rolling 7-day and 30-day averages for dissolved zinc and the 30-day average for dissolved cadmium, even though the plant is properly operated. EPA has determined that it should formally revise the best-available-technology zinc and cadmium performance standards in the IMM SOW to more accurately reflect the amount of metals that can be removed by the High Density Sludge treatment technology.

Water Quality at Sacramento River below Keswick Dam

Attachment 4, "Site Evaluation and Compliance at Keswick Dam," evaluates the effectiveness of IMM interim remedial actions in reducing copper and zinc discharges from the site during the fourth five-year-review period. The memorandum also evaluates copper loads originating from other mines in the West Shasta Mining District and potential impacts on the protectiveness of the IMM remedy.

Reclamation routinely samples the water releases from Spring Creek Debris Dam, Shasta Dam, and Keswick Dam. Sampling is conducted on a weekly basis, and more frequently during storm events or uncontrolled releases from Spring Creek Debris Dam. During the past 5 years, the dissolved copper concentrations in the Sacramento River below Keswick did not exceed the 5.6-ppb instantaneous maximum limit for the days when samples were collected. Although Reclamation was not required to control the discharges from CVP facilities to meet CTR water quality standards, between August 2003 and January 2008, the dissolved copper concentrations in the Sacramento River below Keswick Dam exceeded the CTR 4-day average chronic exposure limit of 4.1 ppb on only 4 days (only 2 percent of the days sampled), compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). Sampling frequency was not increased to determine the number of exceedances on a 96-hour basis.

The final ROD for the IMM site will need to evaluate the effectiveness of the final proposed IMM source control remedial actions in meeting water quality objectives in the Sacramento River below Keswick Dam. This evaluation will need to consider the continuing metal loads from other mines in the West Shasta Mining District that discharge into Shasta Lake up gradient of IMM and then flow into Keswick Reservoir and the Sacramento River. Data from Water Years 2006 and 2007 show that the majority of copper load to the upper Sacramento River watershed is currently coming from the inactive copper mines in the

Shasta Lake watershed. The Water Board is working with the owner of the inactive copper mines, Mining Remedial Recovery Company. The Water Board adopted Resolution R5-2004-0090, which includes the *Use Attainability Analysis for the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for Beneficial Uses at West Squaw Creek, Shasta County* (UAA) (Water Board, 2004). The UAA proposes changing the beneficial use requirements for West Squaw Creek, and focusing future remediation efforts on mines within the Little Backbone Creek watershed. Although significant reductions have occurred in the metal loading from West Squaw Creek, EPA data collected during the five-year-review period indicate West Squaw and Little Backbone creeks are currently contributing similar copper loads to Shasta Lake (see Attachment 4).

During the five-year-review period, dissolved copper concentrations ranged from less than 1 ppb to 3.4 ppb in water discharges from Shasta Dam. The upper Sacramento River total maximum daily load (TMDL) report (Water Board, 2002) states that Water Board staff will develop additional mine remediation and other activities as needed to address dissolved copper concentrations that exceed 1.3 ppb in Shasta Dam releases. The TMDL goal was exceeded on more than 50 percent of the days recorded from August 2003 through January 2008 in the Sacramento River below Shasta Dam. This upgradient water quality may adversely impact the water management component and protectiveness of the IMM remedies.

Additional discussions will be necessary among the regulatory stakeholders at IMM regarding the impact on the fishery resources in the Sacramento River from ongoing IMM and Shasta Lake metal releases. EPA expects the 1980 Memorandum of Understanding between the State and Reclamation (State Water Resources Control Board et al., 1980) to be renegotiated to define the manner in which CVP facilities will be operated to meet water quality standards in the upper Sacramento River.

Site Inspection and Interviews

CH2M HILL conducted an overall site inspection on April 3, 2008. This inspection included onsite documents and records; AMD conveyance pipelines; the Upper Spring Creek diversion; IMM treatment plant and sludge drying beds; Boulder Creek mouth, tailings dam, landslide, and channel; Richmond Mine; Lawson Portal; Brick Flat Pit; Old/No. 8 Mine Seep; Slickrock Creek Retention Reservoir; Matheson disposal cell; and site roads, slopes, and tanks. Numerous other inspections were performed or contracted by the Site Operator during the five-year review period. The “Site Inspection Checklist” is included as Attachment 5. Observations from the site inspections are presented in Attachment 6.

CH2M HILL performed a telephone interview with an adjacent property owner regarding maintenance of the downgradient property. Onsite interviews were conducted in March and April 2008 with Site Operator staff. Issues and observations identified during the interviews are incorporated with the site inspection observations.

The IMM site is generally well-maintained. No issues or observations were identified during the April 3, 2008, site inspection that are expected to impact the effectiveness or protective-ness of interim remedies implemented under RODs 1 through 4. Issues and observations related to implementation and scope of the O&M procedures were identified during the site inspection. These are detailed in Attachment 6. The following are significant five-year-review recommendations and follow-up actions resulting from the site inspection and interviews:

- A few key Site Operator staff members are nearing retirement. The Site Operator should continue to develop strategies to decrease vulnerability to the loss of personnel.
- The Site Operator should prepare and submit management plans and reports to meet requirements of the SOW, including the Annual Operations Work Plan (Section 6.3 of the SOW) and the Landfill Management Report and Plan (Section 6.4 of the SOW). The Site Operator should use these submittals as a tool to notify the Oversight Agency of modifications to the Site planned for the next year.
- The urethane pipeline lining system for the Upper Spring Creek diversion has deteriorated since it was constructed and is an ongoing O&M item. EPA and the Site Operator should discuss plans to ensure that the deteriorating liner does not jeopardize the effectiveness of the Upper Spring Creek diversion.
- EPA should formally modify the SOW to update best-available-technology performance standards based on the metal removal level currently achieved at the treatment plant. Attachment 3 includes an assessment of the IMM treatment plant effluent discharge. The best-available-technology performance standards should also be evaluated and modified, if appropriate, every 5 years thereafter in compliance with the Section 14.2.3.2 if the SOW (EPA, 2000).
- The previous five-year review (EPA, 2003) recommended the contents of the fluid in Essential Solutions, Inc., chemical storage tanks across the road from the cementation plant be determined and proper containment be provided, if required, or the contents should be properly disposed. This recommendation should be addressed by IMMI.
- The Site Operator should monitor the effectiveness of recent drainage improvements at the Boulder Creek landslide and consider and implement further control measures, as necessary, to help control future displacement of the landslide.
- The concrete plugs in the ore chutes of the Richmond Adit continue to deteriorate. The Site Operator needs to develop a strategy to address the failing chute plugs and the associated risks to worker safety, mine access, and the AMD conveyance and treatment system.
- The Site Operator should continue to evaluate reasons for the reduced filtrate at Brick Flat Pit.
- The Site Operator should actively pump the Old/No. 8 Mine Seep for AMD collection and use the gravity discharge system constructed in March 2008 only as an emergency backup system.

VII. Technical Assessment

Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The review of site documents and water quality data and the results of site inspections indicate that the IMM interim remedies are functioning as envisioned in the decision documents. No issues or observations were identified during the April 3, 2008, site inspection that are expected to impact the effectiveness or protectiveness of interim remedial actions implemented under RODs 1 through 4.

The IMM High Density Sludge treatment plant meets Clean Water Act discharge requirements. EPA's review of treatment plant performance data indicates that the treatment plant has been operated properly. However, the High Density Sludge technology has not been able to meet technology-based performance standards for zinc and cadmium that were initially set by EPA in the IMM SOW based upon a limited data set to reflect the expected performance of the High Density Sludge technology. EPA has determined that it should revise these numeric discharge requirements to reflect available performance data.

The objective of the interim remedial actions selected in EPA's four RODs is to protect the fishery resources and ecosystem of the Sacramento River from copper, zinc, and cadmium discharges from IMM by a combination of source control, treatment, and water management to meet protective water quality criteria (5.6 ppb maximum concentration for copper). The analysis in the decision documents estimated that the interim remedial actions implemented in RODs 1-4 would provide significant protection to the Sacramento River fishery and ecosystem. However, the protective water quality criteria are expected to be exceeded in rare wet years (estimated to be 1 in every 30 years in ROD 4). During the five-year review period, the 5.6 ppb maximum concentration for dissolved copper was not exceeded.

After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the court and EPA promulgated the CTR standards to replace the standards in that plan. The CTR left site specific standards in place for the Sacramento River above Hamilton City, but promulgated new criteria for chronic exposures for this same reach of the Sacramento River. Because the IMM interim remedial action was not yet complete, Reclamation has continued to operate CVP facilities in accordance with the 1980 MOU, and was not required to control the discharges from CVP facilities to maintain compliance with the CTR water quality standards.

Although Reclamation was not required to meet the CTR criteria of 4.1 ppb as a 96-hour average chronic copper exposure level, the copper concentrations in the Sacramento River exceeded the CTR on only 4 days (only 2 percent of the days sampled) during the five-year review period, compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). EPA will evaluate the performance of the interim remedial actions implemented at IMM and the need for additional remedial actions as part of its feasibility study for OU-6 at IMM.

The collection and treatment of the AMD from the Richmond, Lawson, and Old /No. 8 Mine adits, and the area sources of AMD from the Slickrock Creek watershed, has reduced the metal loading discharge over the past 5 years by greater than 95 percent. The clean water diversions at Spring Creek and Slickrock Creek have been effective by controlling discharges from sources in the Slickrock Creek watershed and minimizing the volume of contaminated water in the Spring Creek Reservoir, thereby increasing the effectiveness of Reclamation water management operations.

EPA's interim remedial action selected in ROD 5 (EPA, 2004) is required to address outstanding risks to aquatic receptors from potential releases of hazardous substances from Spring Creek Arm to the Sacramento River ecosystem. Removal of contaminated sediment from Spring Creek Arm that is most susceptible to erosion, and disposal of dredged sediment in an upland disposal cell, will mitigate the risk for release events of contaminated sediment.

As discussed in Attachment 7, EPA has outlined IMM access controls in the SOW (EPA, 2000), and several interim actions, including fencing and security gates, have been taken at IMM. The IMM interim access controls and Spring Creek Debris Dam security measures are controlling potential human exposures and preventing adverse impacts to the integrity or protectiveness of the interim remedial measures.

Question B: Are the Exposure Assumptions, Toxicity Data, Clean-up Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

The exposure assumptions, toxicity data, surface water quality standards, and remedial action objectives are still valid, as discussed further below.

Changes in Standards and To Be Considered Criteria

Attachment 8 contains an analysis of applicable or relevant and appropriate requirements.

After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the court and EPA promulgated the CTR standards to replace the standards in that plan. The CTR left site-specific standards in place for the Sacramento River above Hamilton City, but promulgated new criteria for chronic exposures for this same reach of the Sacramento River. Because the IMM interim remedial action was not yet complete, the Reclamation has continued to operate CVP facilities in accordance with the 1980 MOU, and was not required to control the discharges from CVP facilities to maintain compliance with the CTR water quality standards.

Although Reclamation was not required to meet the CTR criteria of 4.1 ppb as a 96-hour average chronic copper exposure level, the copper concentrations in the Sacramento River exceeded the CTR on only 4 days (only 2 percent of the days sampled) during the five-year review period, compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). EPA will evaluate the performance of the interim remedial actions implemented at IMM and the need for additional remedial actions as part of its feasibility study for OU-6 at IMM.

The CTR Criteria for Freshwater Aquatic Life Protection for Inland Surface Waters were included in the ROD 5 numeric performance standards for the planned sediment interim remedial action. The State has not taken any action to implement the revised EPA National Recommended Ambient Water Quality Criteria for copper using the Biotic Ligand Model. IMM numeric surface-water standards should be reevaluated if the State implements the revised EPA National Recommended Ambient Water Quality Criteria or during the next IMM five-year review.

The dissolved zinc and 30-day dissolved cadmium technology-based performance standards set by EPA as part of the requirements in the SOW should be revised to more accurately reflect metal removal by the High Density Sludge AMD neutralization process. Changes to the technology-based performance standards should not change treatment plant operations by the Site Operator, particularly with respect to pH controls. Metal discharges during the past 5 years from the IMM treatment plant are substantially below the Clean Water Act effluent standards. Revision of the technology-based performance standards will not impact the protectiveness of the remedies originally selected in the RODs for IMM.

Risk Evaluations

No updates to the risk assessment were performed since 2003 related to RODs 1 through 4. There are no new toxicology data that impact the human health or ecological risk assessments.

Remedial Action Objectives

The interim remedial actions for the IMM Site continue to meet the remedial action objective of eliminating the AMD discharges that are harmful to public health and the environment. EPA has implemented a combination of source control, treatment, and water management components to assure an effective, implementable, and cost-effective cleanup program for the IMM AMD discharges. Performance of the interim remedial actions relative to the three primary cleanup goals for RODs 1-4 is summarized below:

- During the five-year review period the interim remedial action has complied with the water quality criteria established under the Basin Plan of 5.6 parts per billion (ppb) dissolved copper as an instantaneous maximum exposure to protect the valuable Sacramento fishery and aquatic ecosystems.
- During the five-year review period the interim remedial action has reduced the mass discharge of toxic heavy metals by greater than 95 percent from the historic IMM heavy metal discharge loads.
- During the five-year review period there has been no need to rely on special releases of valuable water resources to dilute continuing IMM contaminant discharges in order to assure attainment of protective water quality criteria.

Question C: Has any Other Information Come to Light that Could Call Into Question the Protectiveness of the Remedy?

Since the last five-year review, species present in the Sacramento River have been newly listed as threatened species. Green sturgeon was listed as a federal candidate species during the third five-year-review period (EPA, 2003). On April 7, 2006, NOAA Fisheries issued a final rule to list the Southern distinct population segment of North American green sturgeon as a threatened species. This species is present below Keswick Dam. During the IMM third five-year review, an interview was conducted with Harry Rectenwald from the California Department Fish and Game. He stated that the water quality criteria developed for IMM using winter-run Chinook salmon as the ecological receptor are protective of this newly listed species as well, because salmon is known to be the most sensitive of these receptors (EPA, 2003).

To meet water quality objectives in the Sacramento River for protection of all sensitive species living downstream of Keswick Dam, the final ROD for the IMM site will need to consider the entire water system that impacts the Sacramento River. Without further significant reduction in copper loads from other mines in the West Shasta Mining District, the upgradient Shasta Lake water quality could adversely impact the water management component and the protectiveness of IMM remedies during sustained periods of above average precipitation.

VIII. Issues

CH2M HILL identified issues and observations related to implementation and scope of O&M procedures (see Site Inspection and Interviews, Section VI). In general, the treatment plant and IMM site are properly operated and maintained. No issue was identified during the April 3, 2008, inspection that is expected to impact the effectiveness or protectiveness of remedies implemented under RODs 1 through 4.

IX. Recommendations and Follow-up Actions

Recommendations regarding O&M of the remedies and the IMM site should be implemented by the Site Operator or EPA, as specified under Section VI "Site Inspections and Interviews." None of the O&M items identified impact the effectiveness or protectiveness of interim remedies implemented under RODs 1 through 4. CH2M HILL communicated recommendations to the Site Operator in a memorandum on April 23, 2008, and during a meeting at the IMM Site on April 25, 2008. EPA will follow up with the Site Operator to develop a timeframe for the O&M tasks that are within their responsibility pursuant to the IMM SOW to assure near-term completion of the work by December 2009.

X. Protectiveness Statements

The interim remedial actions implemented at IMM (selected in RODs 1-4) are protective of human health and the environment and are consistent with the anticipated final remedy for the Site. The selected interim remedial actions have essentially eliminated the potential exposure and resultant threats to human health and the environment from AMD discharges from contaminant sources addressed by the interim remedial actions. The IMM interim remedial actions do not address all sources of discharges from the Site. Further remedial action is required.

The interim remedial actions have afforded substantial protection to the valuable Sacramento River ecosystem and water supply by eliminating greater than 95 percent of the historic metal discharges from the IMM Site.

During this five-year review period, the copper concentrations in the Sacramento River below Keswick Dam met the protective ambient water quality standard identified in RODs

1-4: the Basin Plan standard of 5.6 ppb for the maximum allowable dissolved copper concentration.

XI. Next Review

The next Five-Year Review for the IMM Site is required in 2013, five years after the date of this review.

XII. Works Cited

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Attachments

Attachment 1
Previous Five-Year Review Recommendations

Previous Five-Year Review Recommendations Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek / U.S. Environmental Protection Agency

PREPARED BY: John Spitzley / CH2M HILL
Sandra Shearer / CH2M HILL

DATE: May 9, 2008

PROJECT NUMBER: 367266.SI.03

This memorandum reviews the status of recommendations and issues provided in the U.S. Environmental Protection Agency (EPA) September 2003 *Third Five-Year Review Report for Iron Mountain Mine* (IMM) *Superfund Site, Redding, California* (IMM Third Five-Year Review) (EPA, 2003).

Achieving Chronic Copper Standards in the Sacramento River

The IMM Third Five-year Review (EPA, 2003) described an issue and provided recommendations regarding compliance with copper water quality standards within the Sacramento River. The issue and recommendations are repeated below, followed by a description of the status.

Issue: The Contribution of the Upstream Water Copper Concentration

The IMM Third Five-Year Review (EPA, 2003) identified the following issue:

> California Toxics Rule promulgated a standard of 4.1 ppb dissolved copper as a 96-hour chronic average standard to be met at the Sacramento River below Keswick Dam. The upgradient water from Shasta Dam has a dissolved copper content of under 1 ppb to 4 ppb. This upgradient water quality will make the water management component of the selected remedy difficult to achieve.

Recommendation: Exceedances of the Chronic Copper Standard at Keswick

The IMM Third Five-Year Review (EPA, 2003) provided the following recommendations in response to the issue presented above:

> After the remedy is implemented at Slickrock Creek, the water quality leaving the site will improve. This improved quality may be enough to meet protective water quality standards and to overcome the water management difficulties at Spring Creek Debris dam due, in part, to the upgradient quality of the Shasta Dam water and current Shasta Dam operations. EPA should obtain surface water quality data that is necessary to characterize the performance of the remedy once the Slickrock Creek Retention Dam is completed.

EPA should also continue to work with the Central Valley Regional Water Quality Control Board (Water Board) and the Bureau of Reclamation (Reclamation) to obtain additional data to characterize the sources and locations of metal concentrations in Shasta Lake and to evaluate operational options that could manage the metal discharges from Shasta Dam. The Water Board expects to continue to work with the Mining Remedial Recovery Company to reduce the metal discharges from several mines in the West Shasta Mining District. EPA should monitor the progress of this work.

The Records of Decision (ROD) anticipated an uncontrolled release from the site once in approximately every 30 years while meeting the instantaneous maximum copper standard in the Sacramento River. EPA should rely on the data obtained after the remedy at Slickrock Creek is operational to perform an analysis to estimate the frequency of an uncontrolled release under operations to meet both an instantaneous maximum standard and a 96-hour average chronic standard. The impact on the fishery resource in the Sacramento River from the uncontrolled releases should be discussed among the regulatory stakeholders at Iron Mountain Mine – U.S. EPA, the State of California, the Department of Fish & Game, the National Oceanic and Atmospheric Administration, the Fish and Wildlife Service and the Bureau of Reclamation. Based upon these discussions, a new Memorandum of Understanding should be developed to resolve the problem of heavy metal loading from Shasta Dam and the water management efficiency of Spring Creek Debris Dam. It is estimated that two to three years of wet season data will be needed after the 1997 ROD remedy becomes operational before the exceedance issue can be fully addressed.

Status: Exceedances of the Chronic Copper Standard in Keswick Reservoir

In the IMM Third Five-Year Review (EPA, 2003), EPA identified that upgradient Shasta Lake water quality could negatively impact the water management component of the IMM remedy. This issue is still outstanding. EPA has implemented recommendations identified in the IMM Third Five-Year Review, including collection of additional surface water quality data. However, additional action is required as discussed in this section. Attachment 4 “Site Evaluation and Compliance at Keswick Dam” of the IMM Fourth Five-Year Review (CH2M HILL, 2008a) provides an evaluation of surface water quality data collected by EPA during the fourth five-year review period to determine the effectiveness of the IMM remedial actions and to compare current loads from IMM and Shasta Lake to the Sacramento River.

The Record of Decision 4 (ROD 4) (EPA, 1997) Slickrock Creek Retention Reservoir (SCRR) remedy was determined by EPA and the state of California to be operational and functional on August 26, 2004 (CH2M HILL, 2004a). Since completion of SCRR, EPA has continued to obtain surface water quality data necessary to characterize the performance of the IMM remedy. EPA has collected weekly surface water quality data during the 2005, 2006, 2007, and 2008 water year wet seasons at locations in Boulder Creek and Slickrock Creek drainages; influent and effluent from the high-density sludge treatment plant at the Iron Mountain Mine (IMM) Superfund Site; and locations downgradient from IMM, including Spring Creek and Sacramento River below Keswick Dam. The Site Operator, Iron Mountain

Operations (IMO), collects and analyzes samples at various onsite locations to ensure that components of the IMM remedy are functioning in accordance with the requirements of the October 2000 *Statement of Work* (SOW), *Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (EPA, 2000). Attachment 3 “Minnesota Flats Treatment Effluent Discharge” (CH2M HILL, 2008b) and Attachment 4 “Site Evaluation and Compliance at Keswick Dam” of the IMM Fourth Five-Year Review (CH2M HILL, 2008a) provide evaluations of these data. Data obtained since completion of the SCRR remedy in 2004 should be used as part of the Operable Unit 6 (OU-6) remedial investigation (RI), feasibility study (FS), and ROD for IMM to estimate the frequency of an uncontrolled release under operations to meet both an instantaneous maximum standard and a 96-hour average chronic standard.

EPA, the Water Board, and Reclamation have obtained data to characterize the sources and locations of metal concentrations in Shasta Lake and to evaluate operational options that could manage the metal discharges from Shasta Dam. EPA has also collected surface water quality data to monitor the progress of remediation of mines within the West Shasta Mining District. EPA has performed discharge measurements and water quality sampling in the West Squaw and Little Backbone Creek drainages during the 2006, 2007, and 2008 water year wet seasons (CGI Technical Services, Inc. [CGI], 2008). The Water Board has collected depth-discrete samples and water quality parameter readings in and near Shasta Lake during multiple events, including June 2002, October 2002, and January 2003 (Water Board, 2003). Reclamation’s Northern California Area Office has collected water quality data in the Sacramento River below Shasta and Keswick Dams and in Spring Creek below Spring Creek Debris Dam (SCDD) and operational data for facilities, including Shasta Dam, Keswick Dam, and SCDD.

EPA and CH2M HILL prepared the *Shasta Lake Copper Input Loads Data Evaluation Report* (CH2M HILL, 2008c), which presents the data collected in West Squaw Creek, Little Backbone Creek, Sacramento River below Shasta Dam, Sacramento River below Keswick Dam, and Spring Creek below SCDD. The data will be used to develop the OU-6 RI/FS and ROD and potential revision of the 1980 memorandum of understanding for operation of SCDD. The report also provides an evaluation of data presented in the *Use Attainability Analysis for Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for Beneficial Uses at West Squaw Creek* (UAA), prepared by the Central Valley Regional Water Quality Control Board (Water Board, 2004). A discussion of outstanding issues related to Shasta Lake water quality is provided in Attachment 4 “Site Evaluation and Compliance at Keswick Dam” of the IMM Fourth Five-Year Review (CH2M HILL, 2008a).

EPA met with the Water Board and the State Water Resources Control Board on February 26, 2008, regarding the UAA and copper input loads to the Sacramento River. EPA also met with the U.S. Forest Service, Reclamation, CGI, and National Oceanic and Atmospheric Administration on April 8, 2008, regarding EPA’s IMM Superfund Site remedy, mine remediation in the West Squaw Creek watershed, and operations of the Central Valley Project. Additional discussions will be necessary among the regulatory stakeholders at IMM regarding the impact on the fishery resource in the Sacramento River from ongoing IMM and Shasta Lake metal releases. Based upon these discussions, a new memorandum of understanding should be developed to resolve the problem of heavy metal loading from Shasta Dam and the water management efficiency of SCDD.

Site Maintenance Issues

The IMM Third Five-year Review (EPA, 2003) concluded that the IMM site was generally well-maintained, but there were a few items that would need to be addressed to improve the operation of the site. The general issue and recommendations are repeated below, followed by the status of each specific site maintenance issue identified during the Third Five-year Review inspection.

Issue: Miscellaneous Site Maintenance Issues

The IMM Third Five-Year Review (EPA, 2003) identified the following issue:

> CH2M Hill identified minor items to be repaired at the site. In general, the treatment plant and related facilities are properly operated and maintained with no major issues.

Recommendation: Miscellaneous Site Maintenance Issues

The IMM Third Five-Year Review (EPA, 2003) provided the following general recommendation in response to the issue presented above:

> EPA should provide the list of maintenance issues to the Site Operator and develop a time frame for the work to be completed. The site maintenance items should be completed prior to the start of the wet season. EPA should continue the O&M oversight program and provide annual inspections and a follow-up program to ensure the recommendations are completed satisfactorily.

Status of Specific Site Maintenance Issues

The status of site maintenance recommendations and issues identified during the IMM Third Five-Year Review was obtained from a meeting between CH2M HILL and IMO on March 27, 2008 (Carver, 2008); CH2M HILL's April 3, 2008, IMM sitewide inspection; the March 2008 *Churn Creek Construction Co. Inc., Iron Mountain Job List – Per Wes Franks* (2008 Maintenance List) provided by IMO; conclusions from other site inspections performed during the IMM Fourth Five-Year Review period; and a meeting with CH2M HILL, IMO, and AIG Consultants, Inc. (AIG) on April 25, 2008. Observations and recommendations from IMM inspections are provided in Attachment 5 (CH2M HILL, 2008d) and Attachment 6 (CH2M HILL, 2008e) of the IMM Fourth Five-Year Review.

1. Recommendation: Continue follow-up with Shasta County for the repair of Iron Mountain Road between Flat Creek bridge and the entrance gate.

   IMO Response: Shasta County repaired potholes along Iron Mountain Road 2 years ago (Carver, 2008).

   Status: The road is currently in good condition, and no current issues have been identified.

2. Recommendation: Seal the pavement cracks (alligatoring) occurring along and on the plant road between the entrance gate to a location below Drying Bed 4. This is planned to occur after the sludge haul.

   IMO Response: IMO has performed crack sealing and partial pavement sealing as appropriate during the IMM Fourth Five-Year Review period (Carver, 2008).

   Status: This is a routine maintenance item. IMO performs ongoing maintenance of the IMM roads in accordance with the requirements of the SOW. The SOW requires that Iron Mountain Road from the property boundary to the Emergency Storage Tank be maintained for access for highway and two-wheel-drive vehicles, remained paved, and have "Full Maintenance" (EPA, 2000). Road maintenance is included on the 2008 Maintenance List.

3. Recommendation: Fill the gullying that is occurring on the uphill slopes of Drying Beds 1 and 2 and on the downslopes of sludge Drying Beds 3 and 4 and seed the bare areas. Improve the drainage in these areas to reduce the reoccurrence of the gullying.

   IMO Response: During the April 3, 2008, site inspection, Wes Franks / IMO stated that he regularly monitors this area, and the gullying has not increased over the last 5 to 6 years (CH2M HILL, 2008e).

   Status: Gullying continues to occur on the sludge drying bed bank below Drying Bed 4. Most of the gullying appears to be minor, but some gullies are deeper. Gullying on the sludge drying bed bank below sludge Drying Bed 4 should continue to be monitored, and if gullying worsens, drainage should be redirected or the area should be vegetated.

4. Recommendation: Complete the removal of the scale material in the acid mine drainage (AMD) conveyance pipelines.

   IMO Response: Brown's Plumbing used equipment to mechanically remove scale from the AMD pipelines before SCRR went into service (Carver, 2008).

   Status: As discussed in Attachment 6 of the IMM Fourth Five-Year Review (CH2M HILL, 2008e), IMO should make certain that AMD pipeline inspections and capacity estimates are being performed annually in accordance with the SOW and are certified in an annual letter to EPA.

5. Recommendation: Review the temporary drainage plan for the clean water diversion from the upper Slick Rock Creek basin. Provide temporary diversions to avoid damage to the access road and downstream construction particularly if the construction is not complete prior to the rainy season.

   IMO Response: The ROD 4 SCRR remedy, including the clean water diversion, was completed in 2004 (CH2M HILL, 2004a).

   Status: The recommendation was fully addressed.

6. Recommendation: Review the temporary drainage plans around the borrow and storage sites (near Road Markers 12 and 18) along Iron Mountain Road. Clean culverts and construct drainage ditches.

IMO Response: The area surrounding Road Marker 12 was used as a decomposed granite borrow area, and the area around Road Marker 18 was used for storage of earth fill, rocks, and decomposed granite, as part of the SCRR construction project. The SCRR construction project was completed in 2004 (CH2M HILL, 2004a). IMO cleans drainage control structures and ditches annually (Carver, 2008).

Status: The recommendation was fully addressed.

7. Recommendation: Complete the Boulder Creek tailings dam protection project.

   IMO Response: Improvements to the Boulder Creek tailings dam were completed in 2004, as documented in the *Final Construction Report for Spillway Improvements at the Boulder Creek Tailings Area* (TRC, 2005). The earthwork construction was implemented during January and February 2004, and the concrete and shotcrete construction was implemented during September 2004.

   Status: The recommendation was fully addressed.

8. Recommendation: Continue the study and demonstration of alternative repair materials for lining the Spring Creek diversion pipeline.

   IMO Response: In the Proposed Scope of Work and Contract Award for *Spring Creek Diversion RCCP Pipe Inspection and Repair Project* (IMO, 2003a, 2003b), IMO proposed and has implemented a pipeline inspection and repair program. The program includes annual inspection of the pipeline, preparation of a pipeline inspection report for EPA review, evaluating and selecting the appropriate pipeline repair methods and materials, and implementing the repairs with appropriate quality assurance and quality control inspection and documentation (IMO, 2003b). Studies and evaluations performed by the Site Operator have indicated that it would be costly and technically challenging to restore or replace the pipeline liner system. For these reasons, the comprehensive liner repair program, as described in the SOW, has not been conducted. IMO is continuing the annual pipeline inspection and pipeline repair process to maintain the structural integrity of the pipeline.

   Status: The Upper Spring Creek Diversion Pipeline lining continues to deteriorate with use, and as the lining is removed, the underlying concrete erodes (IMO, 2008a). The 2007 inspection report for the Upper Spring Creek Clean Water Diversion concluded that the extent and depth of erosion is not a structural concern at this time, however, the eroded concrete and liner should be monitored on an annual basis (IMO, 2008a). IMO, in consultation with their materials expert, should develop a work plan for review by EPA that details the long-term inspection and repair approach to mitigate future deterioration and maintain the pipeline to meet the requirements of the SOW. Attachment 6 of the IMM Fourth Five-Year Review (CH2M HILL, 2008e) provided considerations for improvements to the existing inspection and repair program.

9. Recommendation: Complete the scour protection on the Spring Creek Diversion impact structure.

   IMO Response: The Upper Spring Creek Diversion impact structure was covered with stainless steel during the 2004 maintenance inspection (IMO, 2008a).

Status: No issues with the Upper Spring Creek Diversion impact structure were noticed during the April 3, 2008, inspection. Stainless steel plates on the impact structure appeared to be in good condition.

10. Recommendation: Consider installing the remaining horizontal drains in the Boulder Creek slide area.

    IMO Response: IMO has implemented additional measures since the IMM Third Five-Year Review to address the continued displacement of the Boulder Creek landslide, and the landslide effects on the Lawson Mine (CH2M HILL, 2008e; IMO, 2008a). Settlement monuments (21 total) are surveyed by Pace Civil, Inc., to determine surface movements within the slope failure complex. The SOW requires annual surveys of settlement monuments, or more frequent surveys of the landslide area if movement of the landslide is observed. The most recent survey was performed on September 27, 2007. The data are reported annually in the *Boulder Creek Landslide Survey Data Report* (IMO, 2008a). The Mines Group, Inc., evaluates the data annually in the *Boulder Creek Landslide Annual Inspection and Evaluation* (2007).

    Status: The effectiveness of recent drainage improvements at the Boulder Creek land-slide area should continue to be monitored, and further control measures should be considered and implemented, as necessary, to help control future displacement of the landslide (CH2M HILL, 2008e).

11. Recommendation: Replace the exposed polyvinyl chloride (PVC) pipe at the ends of the horizontal drains with ultraviolet (UV)-resistant piping.

    IMO Response: The exposed PVC portions of the horizontal drain pipe have not been replaced.

    Status: Attachment 6 of the IMM Fourth Five-Year Review recommends that these portions of the horizontal drains on top of and surrounding the Boulder Creek landslide be covered with a UV-resistant coating or replaced with UV-resistant piping (CH2M HILL, 2008e).

12. Recommendation: Determine the contents of the fluid in the chemical storage tanks across the road from the cementation plant and provide proper containment if required or properly dispose of the contents.

    IMO Response: The tanks, equipment, and drums in this area are the property of Mr. T. W. Arman, Iron Mountain Mines, Inc. IMO discussed the contents of the tanks with Mr. Arman. The tanks were stated to contain AMD, sodium silicate, and Mr. Arman's Ag-Gel fertilizer product (Carver, 2008).

    Status: EPA will contact Mr. Arman to request that Iron Mountain Mines, Inc. provide proper containment for the tanks or properly dispose of the contents. Three 6,500-gallon poly tanks are located adjacent to the east side of the metal shed that is across the road from the cementation plant. These tanks contained approximately 8,600 gallons of fluid during the April 3, 2008, inspection. An additional poly tank of similar volume is located within the metal shed, with equipment. Many 55-gallon plastic drums are stored on the north side of the metal shed, and most appeared to be empty during the April 3, 2008, site inspection. There is no secondary containment for any of the tanks or drums.

Precipitates had formed on the pipe connection for the middle poly tank located outside of the metal shed, indicating a leak. Sand between the poly tanks and the shed was wet, but fluid was not visibly leaking from the tanks during the inspection (CH2M HILL, 2008e).

13. Recommendation: Remove sediments above the Boulder Creek sampling station and above the Upper Spring Creek diversion. These are routine planned activities.

    IMO Response: This is a routine maintenance item. Sediment that accumulated behind the weir at Boulder Creek sampling location (BCMO) was dredged in mid-March 2008, and additional cleanout is scheduled for fall 2008. IMO's 2008 Maintenance List includes removal of sediment and gravel that has accumulated in the sedimentation basins upstream from the Upper Spring Creek diversion intake and the SCRR clean water diversion intake.

    Status: Sediment and gravel that has accumulated in the sedimentation basins upstream from the Upper Spring Creek diversion intake and SCRR clean water diversion intake should be removed routinely to insure capacity at all times of the diversion structures and clean water diversion (CH2M HILL, 2008e). These items are required under Sections 9.14.6, 9.10.2.2, and 9.10.4.2 of the SOW, respectively.

Treatment Plant Audit Recommendations

The IMM Third Five-year Review (EPA, 2003) provided recommendations regarding the Minnesota Flats Treatment Plant (MFTP), using conclusions from the Attachments *Minnesota Flats Treatment Plant Audit* and *Minnesota Flats Treatment Plant Effluent Discharge* (EPA, 2003). The general issue and recommendations are repeated below, followed by a description of the status of each specific treatment plant recommendation.

Issue: Treatment Plant Audit

The IMM Third Five-Year Review (EPA, 2003) identified the following issue:

> CH2M Hill has been working with AIG Consultants, Inc. to investigate the reported water quality exceedances for dissolved copper and zinc from the treatment plant effluent. Our review indicates that the Site Operator is properly operating the treatment plant, that the treatment plant effluent is meeting the discharge requirements for dissolved copper, and that further study is required to assess whether the performance standard should be revised for dissolved zinc. Our review indicates that the analytical methodology being used by the Site Operator does not accurately measure the low dissolved copper concentrations in the treatment plant effluent. Our review also indicates that the methodology used by the Site Operator reports higher concentrations of zinc than other more accurate methodologies, but the discharges may not be able to meet the standard set by EPA. The investigation found that the zinc anodes may have been contributing to the high zinc discharges. EPA will continue its investigation of the zinc discharges to determine an appropriate response to the reported zinc water quality effluent exceedances from the treatment plant.

CH2M Hill also made recommendations in regards to updating the O&M manual, maintenance tracking program, and emergency response program.

Recommendations: Treatment Plant Audit

The IMM Third Five-Year Review (EPA, 2003) provided the following general recommendation in response to the issue presented above:

> EPA should continue to investigate the reasons and resolve in the near-term for the reported water quality exceedances from the treatment plant. Any recommendations from the investigation should be implemented and follow-up to ensure that the water quality standards leaving the treatment plant are met. The Site Operator will be directed to revise the analytical methodology used to monitor plant performance, as currently recommended. EPA should provide the list of documents that need updating to AIG Consultants, Inc. and develop a time frame for the work to be completed.

Status of Specific Treatment Plant Audit Recommendations

1. Recommendation: Update the O&M manual in anticipation of when the more dilute Slickrock Creek Retention Reservoir water is added to the current AMD for treatment. Update the O&M plan and the health and safety plan to reflect current operations and updated emergency contact information and procedures.

   Status: Onsite documents and records were verified as part of the IMM Fourth Five-Year Review, as documented in the *Site Inspection Checklist* (CH2M HILL, 2008d). IMO contracted SHN Consulting Engineers to update the health and safety plan and injury and illness prevention plan in September 2007 (SHN Consulting Engineers, 2007a and 2007b). IMO updated emergency contact information in the *Emergency Response Plan and Contingency Procedures, Iron Mountain Operations, Redding, Shasta County, California* in April 2008 (IMO, 2008b).

   CH2M HILL developed the *Operations and Maintenance Manual, Slickrock Creek Retention Reservoir Project* (CH2M HILL, 2004b).Operations at the MFTP have not changed substantially in response to the addition of SCRR inflows; therefore, IMO has not identified changes needed in the IMO O&M plan (IMO, 2001; Carver, 2008). After startup and shakedown testing, the following MFTP operational guidelines were recommended for periods of high inflow from the SCRR (CH2M HILL, 2005). These are consistent with requirements in the SCRR O&M Manual (CH2M HILL, 2004b):

   – SCRR inflow to the MFTP will be slowly ramped up during storm events by adjusting the SCRR intake gates and using the emergency holding tank.

   – The discharge from the SCRR will be limited to 3,000 gallons per minute (gpm) (plus 250 from the Old / No. 8 Mine), depending on water elevation within the reservoir, time of year, and forecasted weather.

   – Discharge of 4,000 gpm will be avoided, unless necessary for dam operation.

2. Recommendation: Create a readily accessible emergency response plan (e.g., Cardex or equivalent system) that provides concise instructions to operators on how to respond to

plant or other emergencies. This information is currently located in various sections of the O&M plan and other documents and is not readily accessible to operators during an emergency. The plan should be kept in the control room, and all plant personnel should be familiar with the contents of the plan.

Status: IMO has developed the *Emergency Response Plan and Contingency Procedures, Iron Mountain Operations, Redding, Shasta County, California* (IMO, 2008b). The 2000 SOW (EPA, 2000), IMO's O&M plan (IMO, 2001), and IMO's emergency response plan and contingency procedures (IMO, 2008b) specify procedures for emergency response and routine and non-routine O&M. IMO should look for opportunities to continue to improve their emergency preparedness, including annually updating the emergency response plan and contingency procedures, posting emergency contact numbers in a prominent location, and ensuring that IMO staff are familiar with emergency procedures (CH2M HILL, 2008e).

3. Recommendation: Install a computerized maintenance system that interfaces with the operations computer. This system would track run hours and maintenance completed on each piece of equipment. The system would also maintain a spare parts inventory. Implementing this type of system would decrease the facility's vulnerability to the loss of one or more personnel.

   Status: IMO is using Microsoft Excel spreadsheets to track MFTP maintenance and is evaluating other maintenance software that generate lists and schedules of maintenance items to complete (Carver, 2008). It is recommended that IMO and AIG continue to develop strategies to decrease the vulnerability to the loss of IMO personnel (CH2M HILL, 2008e).

4. Recommendation: Perform additional flow testing of the MFTP at a 6,500-gpm AMD influent rate to verify that the plant can process design flows after SCRR flows are added. The previous test routed AMD through both reactors to the thickener. An additional test should be conducted to route the flow from Reactor TK-1 to the thickener. The previous flow testing was conducted using very dilute AMD with the reactors at low solids content. Additional testing should be conducted for influent from the SCRR with the reactors at the operational solids content.

   Status: Startup and shakedown testing for SCRR was performed between March and June 2004 (CH2M HILL, 2004a). Guidelines to improve operations are presented in Specific Treatment Plant Audit Recommendation Number 1, and are consistent with the SCRR O&M Manual (CH2M HILL, 2004b). SCRR has been operated since 2004, and the MFTP has been in substantial compliance with Clean Water Act effluent limits for pH, total cadmium, total copper, total zinc, and total lead during the performance period (CH2M HILL, 2008b).

5. Recommendation: The IMO contract laboratory's methodology for analysis of dissolved metals and associated detection limits does not permit evaluation of compliance with best available technology (BAT) requirements. Modification of the IMO contract laboratory's methodology and detection limits should be considered.

   Status: IMO retained Basic Laboratories to provide analytical services under a revised subcontract agreement. Basic Laboratories implemented revised analytical procedures on February 1, 2004, in accordance with its new subcontract with IMO. The data collected in 2004, after revised analytical procedures were implemented, showed marked improvement in IMO's ability to demonstrate compliance with the dissolved copper standards (CH2M HILL, 2004c). The laboratory reporting limits and method detection limits for dissolved copper and dissolved zinc were significantly improved with the new analytical methods. A comparison of IMO and EPA data for the treatment plant effluent collected since operation of SCRR is presented in Attachment 3 ("Minnesota Flats Treatment Plant Effluent Discharge") to the IMM Fourth Five-Year Review (CH2M HILL, 2008b).

6. Recommendation: The investigation suggests that the exceedances of the dissolved zinc standards may be, at least in part, attributable to the zinc anodes that were recently installed to provide cathodic protection for the thickener tank. Additional data are required to determine the impact of the removal of the zinc anodes on the quality of the plant effluent.

   Status: IMO replaced zinc anodes with aluminum anodes in summer 2006 (Carver, 2008).

7. Recommendation: EPA demonstrated that MFTP substantially complies with the daily BAT effluent limitations for dissolved cadmium and dissolved copper. The data do not demonstrate compliance with the BAT requirements for dissolved zinc. Following startup of the SCRR in January 2004, the data should be reevaluated to determine whether modification of the BAT requirements is warranted.

   Status: A meeting was held with AIG, EPA, IMO, and CH2M HILL on October 26, 2005, to discuss potential modifications to Section 14.2.3.2 of the SOW. Particularly, a reevaluation of the BAT performance standards was recommended for the high-density sludge treatment process based on actual treatment plant performance after the startup of the SCRR (CH2M HILL, 2005). An evaluation of MFTP data collected between 2004 and 2007 was performed as part of the IMM Fourth Five-Year Review and is documented in Attachment 3 (CH2M HILL, 2008b). This memorandum evaluates recent data and information pertaining to the effluent discharge concentrations and provides specific recommendations for changes to the BAT effluent limitations for the MFTP.

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Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek / U.S. Environmental Protection Agency

PREPARED BY: Sandra Shearer / CH2M HILL

DATE: May 9, 2008

PROJECT NUMBER: 367266.DR.01

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Minnesota Flats Treatment Plant Effluent Discharge

Minnesota F ats reatment P ant uent isc ar e Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek / U.S. Environmental Protection Agency

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Introduction

This memorandum provides an evaluation of the operational performance of the Minnesota Flats Treatment Plant (MFTP) at Iron Mountain Mine (IMM) in meeting the Performance Standards for treatment plant effluent discharge. The evaluation focuses on the plant's performance in meeting the discharge limits contained in the IMM Scope of Work (SOW), dated October 2, 2000 (U.S. Environmental Protection Agency [EPA], 2000). This memorandum also provides recommendations for modifications to the technology-based effluent controls.

The SOW includes the requirements necessary to operate and maintain the selected CERCLA remedy at the IMM site. The IMM Remedy includes collecting, conveying, and treating acid mine drainage (AMD) from the Richmond Mine workings, the Lawson Mine workings, the Old / No. 8 Mine workings, and the disturbed portion of the Slickrock Creek watershed that is collected behind the Slickrock Creek Retention Reservoir (SCRR).

The IMM Remedy includes treatment of AMD by a high-density sludge (HDS) treatment process used at MFTP, and the long-term onsite storage of sludge generated from the treatment process. The data reviewed in this report were collected during the Fourth Five-Year Review performance period: August 1, 2003, through January 31, 2008. SCRR startup and shakedown testing occurred during this performance period.

Figure 1 presents the AMD flows treated at MFTP during the performance period. (Figures appear at the end of the document.) Approximately 4,500 acre-feet (1.5 billion gallons) of AMD were treated at MFTP during the Fourth Five-Year Review performance period. Figure 2 presents the approximate monthly copper and zinc loads removed by MFTP. Approximately 600,000 pounds of copper and 2 million pounds of zinc were removed from the site contaminant discharges during the performance period.

Effluent Discharge Requirements

Sections 8 and 14 of the SOW state the Performance Standards required for operation of MFTP. These sections include the following requirements.

The applicable or relevant and appropriate requirements (ARARs) specify that the AMD neutralization facility shall be designed and operated to maximize the removal of metals through the use of the HDS treatment process and, as a minimum, meet the Clean Water Act (CWA) Effluent Guidelines and Standards for Ore Mining and Dressing at 40 CFR 440.102(a) and 440.103(a) as specified in Table 1 (SOW Section 14.2.2.6).

TABLE 1
CWA Effluent Guidelines and Standards
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Parameter	30-day Average[a] (mg/L)	Daily Maximum[b] (mg/L)
Copper (Total)	0.15	0.30
Cadmium Total)	0.05	0.10
Zinc (Total)	0.75	1.5
Lead (Total)	0.3	0.6
TSS[c]	20	30
pH[c]	6.0 to 9.0	6.0 to 9.0

[a]Average of daily concentration values for 30 consecutive days.
[b]Maximum allowable concentration measured for any one day.
[c]Applicable for discharge to Flat Creek.

Notes:

mg/L = milligrams per liter
TSS = total suspended solids

The CWA system of technology-based effluent controls requires that discharges achieve the best practicable control technology (BPT) and the best available technology economically achievable (BAT). The existing HDS AMD neutralization facility demonstrated metal discharge levels during the past 5 years substantially below the CWA limits specified in Table 1. The HDS control technology currently employed at the facility constitutes BAT for the purpose of the SOW. BAT effluent limits should be set from metal removal levels achieved at MFTP. The BAT limits are specified in Table 2 as daily maximum, 7-day average, and 30-day average concentrations (SOW Section 14.2.2.7). These limits were set in October 2000 from the limited MFTP data available at that time.

TABLE 2
BAT Control Technology Limits
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Parameter	30-day Average[a] (µg/L)	7-day Average[b] (µg/L)	Daily Maximum[c] (µg/L)
Copper (dissolved)	5	10	15
Cadmium (dissolved)	1	2	3
Zinc (dissolved)	10	20	30

[a]Running average of daily values for 30 consecutive days.
[b]Running average of daily values for 7 consecutive days (2 x 30 day average).
[c]Maximum allowable for any one day (3 x 30-day average).

Note:

µg/L = micrograms per liter

Source: Table 14-2, *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine*, October 2, 2000.

EPA provided the following exceptions for compliance with the effluent limits given in Tables 1 and 2:

- The SOW required effluent discharged to lower Spring Creek to comply with the effluent limits specified in Tables 1 and 2, except for pH and TSS. As stated in ROD2 and ROD3, EPA determined that for the effluent discharged to lower Spring Creek, it would not be necessary to adjust the effluent pH because of the acidic nature and buffering capacity of the creek. Treatment to TSS levels prescribed in the CWA is not necessary because of the high TSS levels in Spring Creek (SOW Section 14.2.2.9).
- The Site Operator would not be responsible for exceeding effluent requirements during high wind conditions that could cause a carryover of solids in the thickener overflow and related exceedances of the total allowable metal concentrations (SOW Section 14.2.2.8). High wind conditions are considered to be maximum wind speeds greater than 20 miles per hour (mph) (Carver, 2008).
- EPA intended to re-evaluate the BAT control technology limits in 2001 or 2002, following the anticipated completion of the ROD 4 SCRR project. Because of delays in completing the SCRR project, limit re-evaluation was rescheduled for after completion of SCRR. This evaluation is presented in this technical memorandum.
- The 2000 SOW states that the BAT effluent limits will be re-evaluated and modified if appropriate every 5 years after the initial re-evaluation of limits following completion of the ROD 4 SCRR project (SOW Section 14.2.3.2).

Compliance Monitoring Data

The data used to conduct this review are maintained by CH2M HILL in electronic databases. Most of the data used to assess compliance with the SOW requirements were supplied directly by the Site Operator, Iron Mountain Operations (IMO). Additional data used for this review were collected by CH2M HILL for EPA. Although the database provides a substantially complete record of analytical data collected over the past 5 years, there were some limitations to its use. For example, the effects of operations (e.g., plant shutdowns) or natural conditions (e.g., wind) on effluent quality were not described in the database.

IMO data were used for the review except where noted otherwise. Table 3 summarizes the compliance data reported by IMO since August 1, 2003. For the purposes of this report, calculations used the method detection limit (MDL) for non-detect values.

Additional data presented include samples collected by CH2M HILL during annual wet season sampling. At the time of this report, CH2M HILL data collected from December 2007 through January 2008 are considered preliminary, because these data have not been through final validation by CH2M HILL chemists.

TABLE 3
Summary of IMO Effluent Monitoring Data, August 1, 2003, through January 31, 2008
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Parameter	No. of Results	No. of Non-detects	Percent Non-detects	Median Non-detect Value
Cadmium, Dissolved	1,511	2	0.1	0.15
Cadmium, Total	1,524	33	2.2	1.0
Copper, Dissolved	1,520	20	1.3	0.6
Copper, Total	1,519	2	0	1.5
Zinc, Dissolved	1,519	0	0	N/A
Zinc, Total	1,519	0	0	N/A
Daily pH	1,522	N/A	N/A	N/A
Daily Flow	1,635	N/A	N/A	N/A

Note:
N/A = Not Applicable

Clean Water Act Limit Compliance Summary

This section summarizes IMO compliance with CWA requirements and discusses reasons for concentrations exceeding the limits, if known. Figures showing daily metals concentrations also show CH2M HILL compliance oversight concentrations, where available.

pH

pH did not exceed CWA daily or monthly limits for MFTP plant effluent during the days reported. Figure 3 shows the MFTP effluent pH for the performance period.

Total Cadmium

Total cadmium did not exceed CWA daily or 30-day average limits for all days reported. The average of IMO concentrations equaled 2.8 µg/L, with a minimum of 0.6 g/L and a maximum of 33.6 µg/L. The maximum result of 33.6 µg/L occurred on August 13, 2004. Total copper and total zinc maximum results also occurred on that date, as discussed further below. Figure 4 shows the daily, and Figure 5 shows the 30-day rolling average of total cadmium concentrations for the performance period.

Total Copper

Total copper concentrations were within the CWA daily limit for more than 99 percent of the days reported. On 8 days (0.5 percent of IMO data), total copper concentrations exceeded the CWA daily limit. The average of all concentrations equaled 82 g/L, with a minimum of non-detect (MDL of 1 g/L) and a maximum of 1,310 g/L. Figure 6 shows the daily and Figure 7 shows the 30-day rolling average of total copper concentrations for the performance period.

The maximum result of 1,310 g/L occurred on August 13, 2004. IMO reported in the *August 2004 Monthly Progress Report* (IMO, 2004a) that high concentrations of total copper and total zinc occurred on August 7 and August 13, 2004, because of MFTP startup following thickener cleaning and inspection. Table 4 summarizes each date on which total copper and zinc exceeded the CWA daily limit, and describes likely causes as reported by IMO in monthly progress reports.

Total metals concentrations at MFTP are influenced by high winds, greater than 20 mph, as described previously. Concentrations might also have been influenced during startup of SCRR as IMO became operationally familiar with release of water from SCRR. The initial fill of SCRR began on March 12, 2004, and performance testing and dewatering of the reservoir occurred through June 25, 2004 (CH2M HILL, 2004b).

TABLE 4
Factors Influencing Total Copper Concentrations Exceeding the CWA Daily Limit[a]
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Date	Analyte	Result (µg/L)	Reason for Exceedance[b]	Maximum Recorded Wind Speed (mph)
2/25/2004	Total copper	336	Windy conditions impacted TSS and total copper	29.53
6/25/2004	Total copper	459	No assignable cause identified	NR
8/7/2004	Total copper	597	Thickener Cleaning and Inspection	12.97
8/7/2004	Total zinc	1,950	Thickener Cleaning and Inspection	12.97
8/13/2004	Total copper	1,310	Thickener Cleaning and Inspection	11.18
8/13/2004	Total zinc	4,330	Thickener Cleaning and Inspection	11.18
8/25/2004	Total copper	705	Windy conditions impacted TSS	21.9
8/25/2004	Total zinc	2,420	Windy conditions impacted TSS	21.9
9/17/2004	Total copper	376	Windy conditions impacted TSS and total copper	27.5
4/7/2005	Total copper	304	No assignable cause identified	NR
1/7/2006	Total copper	333	High TSS was measured but no assignable cause identified for high total copper	15.21

[a]Total cadmium is not included because there were no values in excess of the CWA limits.
[b]As reported in IMO Monthly Progress Reports.

Notes:
Wind speeds greater than 20 mph are considered high winds that could affect total metals concentrations (Carver, 2008)
NR = Not Reported

The CWA 30-day average limit was exceeded on 96 days (6 percent of IMO data). The date range for which the CWA 30-day average limit was exceeded generally coincided with the dates on which the CWA daily limit was also exceeded.

Total Zinc

Total zinc concentrations were within the CWA daily limit for more than 99 percent of the days reported. On 3 days (0.2 percent of IMO data), total zinc concentrations exceeded the CWA daily limit. The average of all concentrations equaled 305 g/L, with a minimum of

3 g/L and a maximum of 4,330 g/L. Figure 8 shows the daily and Figure 9 shows the 30-day rolling average of total zinc concentrations for the performance period.

The maximum result of 4,330 g/L occurred on August 13, 2004 (Table 4). IMO reported in the *August 2004 Monthly Progress Report* (IMO, 2004a) that high concentrations of total copper and total zinc occurred on August 7 and August 13, 2004, because of treatment plant startup following thickener cleaning and inspection in late July (see Table 4). Total zinc did not exceed the CWA 30-day average limit.

Total Lead

The SOW does not require IMO to collect samples to demonstrate compliance with CWA limits for lead. However, CH2M HILL (for EPA) periodically analyzes effluent grab samples for lead as part of its oversight monitoring program. CH2M HILL data were used to provide the information for this section.

During the performance period, CH2M HILL collected 79 effluent samples for lead analysis. Most of these samples were collected weekly during the winter months. The average for all the samples equaled 19 µg/L, with a minimum of non-detect (MDL of 0.0357 g/L) and a maximum of 83.2 µg/L. The maximum lead result of 83.2 µg/L occurred on February 1, 2005. This date coincides with above average results for total cadmium, copper, and zinc in samples collected by CH2M HILL and IMO (CH2M HILL, 2005a; IMO, 2005), although no assignable cause was identified. IMO reported that TSS also exceeded the CWA limit on February 1, 2005 (IMO, 2005). None of the CH2M HILL total lead data exceeded CWA daily or 30-day average limits.

Best Available Technology Limit Compliance

This section summarizes IMO compliance with BAT requirements and discusses reasons for concentrations exceeding the limits, if known. Figures showing daily metals concentrations also show CH2M HILL compliance oversight concentrations, where available.

Dissolved Cadmium

Dissolved cadmium concentrations were within the BAT daily limit for more than 99 percent of the days reported. On 1 day (less than 0.1 percent of IMO data), cadmium concentrations exceeded the daily limit. The average of all concentrations equaled 1.1 g/L, with a minimum of non-detect (MDL of 0.1 g/L) and a maximum of 4.3 g/L. The maximum result of 4.3 g/L occurred on June 1, 2004, which had recorded wind speeds above 20 mph. IMO did not report any operational anomalies on this day in the *June 2004 Monthly Progress Report* (IMO, 2004b). Figure 10 shows the daily, Figure 11 shows the 7-day rolling average, and Figure 12 shows the 30-day rolling average of dissolved cadmium concentrations for the performance period.

Table 5 summarizes each date on which dissolved cadmium, copper, and zinc exceeded the BAT daily limit, and likely causes as reported by IMO in monthly progress reports.

TABLE 5
Factors Influencing Dissolved Cadmium and Copper Concentrations Exceeding the BAT Daily Limit
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Date	Analyte	Result (µg/L)	Reason for Exceedance[b]	Maximum Recorded Wind Speed (mph)
8/15/2003	Dissolved copper	15	No assignable cause identified	11
9/3/2003	Dissolved copper	16	No assignable cause identified	28.41
9/7/2003	Dissolved copper	15	No assignable cause identified	27.51
10/1/2003	Dissolved copper	15	No assignable cause identified	13.42
10/9/2003	Dissolved copper	16	No assignable cause identified	24.38
12/15/2003	Dissolved copper	15	No assignable cause identified	9.62
12/16/2003	Dissolved copper	15	No assignable cause identified	9.17
12/17/2003	Dissolved copper	17	No assignable cause identified	7.83
12/18/2003	Dissolved copper	17	No assignable cause identified	7.83
12/19/2003	Dissolved copper	19	No assignable cause identified	10.96
12/27/2003	Dissolved copper	15	No assignable cause identified	6.71
1/13/2004	Dissolved copper	19	No assignable cause identified	10.07
1/22/2004	Dissolved copper	17	No assignable cause identified	7.38
2/26/2004	Dissolved copper	16.5	No assignable cause identified	23.71
4/1/2004	Dissolved copper	42.1	Sample preparation protocol deviation	21.47
4/8/2004	Dissolved copper	30.7	Sample preparation protocol deviation	16.33
4/15/2004	Dissolved copper	51.3	Sample preparation protocol deviation	25.28
4/22/2004	Dissolved copper	41.4	Sample preparation protocol deviation	17.22
4/29/2004	Dissolved copper	25.3	Sample preparation protocol deviation	21.03
6/1/2004	Dissolved cadmium	4.3	No assignable cause identified	22.82
11/18/2004	Dissolved copper	91.9	No assignable cause identified	11.2
12/8/2004	Dissolved copper	27.9	No assignable cause identified	15.4
2/25/2005	Dissolved copper	34.4	No assignable cause identified	8.72
11/2/2005	Dissolved copper	28.7	No assignable cause identified	17.22
7/19/2006	Dissolved copper	33.5	No assignable cause identified	9.17

[a]Dissolved zinc is not included because 97 percent of the data was above the BAT daily limit.
[b]Reported by IMO in Monthly Progress Reports.

Note:
Wind speeds greater than 20 mph are considered high winds that could affect total metals concentrations (Carver, 2008). Wind speeds are provided here for reference, but are not considered assignable causes for high dissolved metals concentrations.

On 17 days (1 percent of IMO data), dissolved cadmium concentrations exceeded the BAT 7-day average limit. Except for the June 1, 2004, data point, the days exceeding the 7-day limit coincide with the highest concentration peaks observed in the daily data (see Figure 10), which occurred between January 14 and 20, 2007, and between December 13 and 22, 2007. No operational activity was identified as related to these exceedances in the IMO Monthly Progress Reports (IMO, 2008 and 2007).

Nine hundred days (55 percent of IMO data) exceeded the BAT 30-day average limit. In general, samples collected during wet months exceeded the limit; samples collected during dry months were within the limit. Exceedances of the BAT 30-day average cadmium limit do not appear to be related to specific operational activities or meteorological conditions (i.e., high winds).

Dissolved Copper

Dissolved copper concentrations were within the BAT daily limit for more than 98 percent of the days reported. On 24 days (1.6 percent of IMO data), dissolved copper concentrations exceeded the daily limit. The average of all concentrations equaled 3.6 g/L, with a minimum of non-detect (MDL of 0.6 g/L) and a maximum of 91.9 g/L. The maximum result of 91.9 g/L occurred on November 18, 2004. The maximum dissolved zinc result also occurred on that date (see Table 5). No operational activity was identified as related to these relatively high dissolved concentrations in the IMO Monthly Progress Report (IMO, 2004c). Figure 13 shows the daily, Figure 14 shows the 7-day rolling average, and Figure 15 shows the 30-day rolling average of dissolved copper concentrations for the performance period.

On 83 days (5 percent of IMO data), dissolved copper concentrations exceeded the BAT 7-day average limit. The majority (76) of these days occurred prior to the startup of SCRR. The remaining 7 days coincide with the maximum daily concentration during the period, reported for November 18, 2004.

On 278 days (17 percent of IMO data), dissolved copper concentrations exceeded the BAT 30-day average limit. The majority (248) of these days occurred prior to the startup of SCRR. The remaining 30 days coincide with the maximum daily concentration during the period, reported for November 18, 2004.

Dissolved Zinc

Dissolved zinc concentrations exceeded BAT daily, 7-day average, and 30-day average limits for the majority of the days reported. The daily limit was exceeded on 1,477 days (97 percent of IMO data). The average of all concentrations equaled 61 g/L, with a minimum of 3.7 g/L and a maximum of 363 g/L. The maximum result of 363 g/L occurred on November 18, 2004 (see Table 5). Figure 16 shows the daily, Figure 17 shows the 7-day rolling average, and Figure 18 shows the 30-day rolling average of dissolved zinc concentrations for the performance period.

On all days, zinc concentrations exceeded BAT 7-day and 30-day average limits. Results in excess of BAT limits for dissolved zinc are not related to specific operational activities or meteorological conditions (i.e., high winds).

Best Available Technology Limit Evaluation

The 2000 SOW states that the BAT effluent limits will be evaluated after 2 years of continuous operation of SCRR, and modifications will be made to the BAT effluent limits if appropriate. The 2000 SOW also states that the BAT effluent limits will be re-evaluated every 5 years thereafter and modified if appropriate (SOW Section 14.2.3.2). The SCRR remedy implemented under ROD4 was determined operational and functional by EPA and the State of California on August 26, 2004 (CH2M HILL, 2004b). At the time of the Fourth IMM Five-Year Review, 3.5 years of data had been collected at MFTP since completion of SCRR.

In addition to the need to re-evaluate limits because of changes associated with SCRR, there is also a need to re-evaluate the limits with regard to the performance of the IMO treatment plant. Specifically, when MFTP is operating normally, the effluent frequently exceeds BAT daily, 7-day, and 30-day limits for dissolved zinc, and the BAT 30-day limit for dissolved cadmium.

AIG Consultants, Inc. (AIG), EPA, IMO, and CH2M HILL met on Wednesday, October 26, 2005, to discuss the SOW, proposed clarifications and modifications to the SOW, and other miscellaneous items (CH2M HILL, 2005b). One of the agenda items was reevaluation of BAT performance standards. At that time, EPA stated its intention to formally modify the SOW.

The available IMO and CH2M HILL effluent analytical data for cadmium, copper, and zinc were reviewed, and it was determined that the following changes to BAT limits were reasonable:

- Change from 30 to 300 g/L for daily dissolved zinc
- Change from 20 to 150 g/L for 7-day average dissolved zinc
- Change from 10 to 100 g/L for 30-day average dissolved zinc
- Change from 1 to 2 g/L for 30-day average dissolved cadmium

Figures 10 through 18 show the dissolved cadmium, copper, and zinc data for the IMM Fourth Five-Year Review period and the associated BAT limits. These data show that MFTP would be able to meet the revised BAT limits proposed at the time of the October 26, 2005, meeting.

Iron Mountain Operations and CH2M HILL Data Comparison

IMO and CH2M HILL data were statistically compared by using paired and pooled data tests. Only samples collected by IMO and CH2M HILL on the same date during the period August 1, 2003, through January 31, 2008, were used. For result values below the MDL, the MDL was used. Where statistically significant differences are evident between CH2M HILL and IMO data, this statistical comparison should be used to identify and resolve potential differences in field or laboratory techniques. However, the analysis presented earlier in this memorandum shows that both datasets result in similar conclusions of MFTP performance and compliance with CWA standards and BAT limits.

The data were paired by sample date and then compared by using the Pearson correlation, the Spearman correlation, and the Wilcoxon signed rank test. The results of the correlation tests are shown in Table 6. The values for the coefficients developed by the Pearson and Spearman correlations can range between -1 and 1. Values of the correlation coefficient close to 1 (positive correlation) imply that as one variable increases so does the other; the reverse holds for values close to -1. A value of 1 implies a perfect positive linear correlation (i.e., all the data pairs lie on a straight line with a positive slope). A value of -1 implies perfect negative linear correlation. Values close to 0 imply little correlation between the variables. The correlation coefficients for a comparison of treatment plant effluent data ranged from 0.67 to -0.14, indicating that there is not a good correlation between the IMO and CH2M HILL paired data points.

TABLE 6
Correlation Coefficients for a Comparison of Paired IMO and CH2M HILL Treatment Plant Effluent Data
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Type	Parameter	Pearson Correlation Coefficient	Spearman Correlation Coefficient
Total	Cadmium	0.417	0.390
Total	Copper	0.294	0.346
Total	Zinc	0.198	0.149
Dissolved	Cadmium	0.339	0.606
Dissolved	Copper	-0.098	-0.144
Dissolved	Zinc	0.613	0.670

The Spearman correlation is typically more robust in treating outlier data than the Pearson correlation because it does not allow outlier pairs to dominate the analysis. Because the Spearman and Pearson coefficients are similar in magnitude, except for dissolved cadmium, it can be concluded that outlier points did not have a large impact on the correlations. Figure 19 shows scatter plots for each of the analytes.

From visual interpretation, the scatter plots generally show a weaker correlation for total metals than for dissolved metals. Dissolved cadmium appears to have the strongest correlation of the dissolved metals. Dissolved zinc also has the highest Spearman and Pearson correlation coefficients (see Table 6).

The paired data were also evaluated with the Wilcoxon signed rank evaluation, as shown in Table 7. This evaluation provides the statistical probability that the datasets are not different. Probabilities less than 0.05 percent were considered statistically significant. From this evaluation, only total and dissolved cadmium were shown as having a statistical difference. The Wilcoxon signed rank test assigns less weight to distribution tails than to center points.

TABLE 7
Wilcoxon Signed Rank Comparison of Paired IMO and CH2M HILL Treatment Plant Effluent Data
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Type	Parameter	Probability that the Observed Differences Would Occur Purely by Chance	Statistical Decision with 0.05 Significance Level
Total	Cadmium	0.002	Significantly Different
Total	Copper	0.440	No Significant Difference
Total	Zinc	0.074	No Significant Difference
Dissolved	Cadmium	0.000	Significantly Different

TABLE 7
Wilcoxon Signed Rank Comparison of Paired IMO and CH2M HILL Treatment Plant Effluent Data
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Type	Parameter	Probability that the Observed Differences Would Occur Purely by Chance	Statistical Decision with 0.05 Significance Level
Total	Cadmium	0.002	Significantly Different
Total	Copper	0.440	No Significant Difference
Total	Zinc	0.074	No Significant Difference
Dissolved	Copper	0.462	No Significant Difference
Dissolved	Zinc	0.352	No Significant Difference

The following are known issues with the existing data that might cause differences in the paired datasets:

- The MDL used by CH2M HILL for dissolved copper during the December 2006 through April 2007 sampling season was higher than the IMO MDL. In the *Quality Assurance Project Plan* (CH2M HILL, 2007b), CH2M HILL requested that a more sensitive analytical method, ICP-MS (E200.8), be used for copper, which should result in better agreement between the CH2M HILL and IMO dissolved copper data.
- Laboratories previously contracted by CH2M HILL experienced zinc blank contamination. Starting in January 2007, the EPA Region 9 laboratory began analyzing samples collected by CH2M HILL. The EPA Region 9 laboratory has not had any blank contamination issues. Therefore, total and dissolved zinc analyses performed by the EPA Region 9 laboratory should have better agreement with IMO data.
- The effluent composite collected by IMO is not well mixed prior to sample collection. Because of this, solids might settle out within the composite collection container, which could increase the total cadmium, copper, and zinc concentrations at the bottom of the container as compared to the top. IMO collects an effluent sample from the top portion of the container prior to CH2M HILL collecting an effluent sample from the bottom portion of the container. This could result in lower suspended solids in IMO's sample and higher suspended solids in CH2M HILL's sample, which could bias CH2M HILL's results high, and IMO's results low.

The following recommendations could be considered to help reconcile the known differences between the datasets, and to provide data for further comparison:

- The effluent composite sample should be well mixed by IMO and by CH2M HILL prior to collecting sample. This will help to ensure that solids are distributed uniformly throughout the composite sample and possibly reduce the differences in total metals concentrations. Section 6.1.1 of the IMO O&M manual (IMO, 2001) should be modified to specify that the composite sample is well mixed.
- As sample volume allows, split sample analyses could be performed during the 2008 to 2009 wet season to help identify potential differences in laboratory methodology. CH2M HILL recommends that split samples be collected by IMO and analyzed at the EPA Region 9 laboratory.

- As sample volume allows, additional duplicate effluent samples could be collected during the 2008 to 2009 wet season to provide additional data for statistical analysis and to quantify variability resulting from sampling or analytical methodology. CH2M HILL will plan to collect duplicate effluent samples for analysis at the EPA Region 9 laboratory.
- IMO should be provided a copy of CH2M HILL's annual IMM Surface Water Sampling Summary Report.

The data were also pooled (i.e., grouped as unpaired data) and compared by using the Wilcoxon rank sum evaluation. The rank sum evaluation is a central tendency test that provides the statistical probability that the unpaired datasets are not different. As in the previous analysis, probabilities less than 0.05 percent were considered statistically significant. The results of this evaluation are shown in Table 8. Figure 20 shows box and whisker plots for the pooled data comparison for each of the analytes. From this evaluation, only total and dissolved cadmium show a statistical difference. These results agree with the Wilcoxon signed rank evaluation.

These results demonstrate that CH2M HILL and IMO data for total and dissolved copper and zinc generally agree over time.

TABLE 8
Wilcoxon Rank Sum Comparison of Pooled IMO and CH2M HILL Treatment Plant Effluent Data
Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review

Type	Parameter	Probability that the Observed Differences Would Occur Purely by Chance	Statistical Decision with 0.05 Significance Level
Total	Cadmium	0.018	CH2M HILL > IMO
Total	Copper	0.848	No Significant Difference
Total	Zinc	0.259	No Significant Difference
Dissolved	Cadmium	0.002	CH2M HILL > IMO
Dissolved	Copper	0.171	No Significant Difference
Dissolved	Zinc	0.418	No Significant Difference

Conclusions and Five-Year Review Recommendations

From this review of the treatment plant effluent data collected over the past 5 years, the following conclusions and recommendations have been made.

Clean Water Act Effluent Limits

Conclusion

The treatment plant was in substantial compliance with CWA effluent limits for pH, total cadmium, total copper, total zinc, and total lead during the performance period. The instances where CWA daily or 30-day average limits were exceeded were rare and frequently could be attributed to operational conditions or other known factors. The MFTP exceeded the 30-day average total copper discharge limit by a small amount after the startup of the SCRR.

Recommendation

In a meeting among AIG, EPA, IMO, and CH2M HILL on October 26, 2005, discussions were conducted regarding the performance of the MFTP (CH2M HILL, 2005b). EPA agreed that IMO had operated MFTP properly, and the attendees discussed several hypotheses for the cause in the increase of the total copper concentrations in the discharge and several operational strategies for reducing the total copper concentrations to meet the SOW requirements. The following IMM treatment plant operational guidelines were recommended for periods of high inflow from SCRR (CH2M HILL, 2005b). These are consistent with requirements in the Slickrock Creek Retention Reservoir O&M Manual (CH2M HILL, 2004a):

- Slickrock Creek Retention Reservoir inflow to the IMM treatment plant will be slowly ramped up during storm events by adjusting the Slickrock Creek Retention Reservoir intake gates and using the emergency holding tank.
- The discharge from the Slickrock Creek Retention Reservoir will be limited to 3,000 gallons per minute (gpm) (plus 250 gpm from the Old / No. 8 Mine), depending on water elevation within the reservoir, time of year, and forecasted weather.
- Discharge of 4,000 gpm will be avoided, unless necessary for dam operation

Best Available Technology Effluent Limits

Conclusion

EPA demonstrated that MFTP substantially complies with BAT limits for daily and 7-day average dissolved cadmium and copper, and the BAT 30-day average for dissolved copper. The data do not demonstrate compliance with BAT requirements for dissolved zinc, or the BAT 30-day average for dissolved cadmium.

Recommendation

EPA should formally revise the SOW to modify BAT effluent limits based on metal removal level currently achieved at the MFTP. The following revisions to BAT limits are recommended:

- Change daily dissolved zinc BAT limit from 30 to 300 g/L
- Change 7-day average dissolved zinc BAT limit from 20 to 150 g/L
- Change 30-day average dissolved zinc BAT limit from 10 to 100 g/L
- Change 30-day average dissolved cadmium BAT limit from 1 to 2 g/L

Iron Mountain Operations and CH2M HILL Data Comparison

Linear correlations between paired CH2M HILL and IMO data resulted in relatively low correlation coefficients. Further statistical analysis of paired and pooled CH2M HILL and IMO datasets showed that there is a statistically significant difference between the dissolved and total cadmium data. Both datasets result in similar conclusions of MFTP performance and compliance with CWA standards and BAT limits. However, the following recommendations are presented to help reconcile differences between the datasets, and to provide data for further comparison:

- The effluent composite sample should be well mixed by IMO and by CH2M HILL prior to collecting sample. This will help to ensure that solids are distributed uniformly throughout the composite sample and possibly reduce the differences in total metals concentrations. Section 6.1.1 of the IMO O&M manual (IMO, 2001) should be modified to specify that the composite sample is well mixed.
- As sample volume allows, split sample analyses could be performed during the 2008 to 2009 wet season to help identify potential differences in laboratory methodology. CH2M HILL recommends that split samples be collected by IMO and analyzed at the EPA Region 9 laboratory.
- As sample volume allows, additional duplicate effluent samples could be collected during the 2008 to 2009 wet season to provide additional data for statistical analysis and to quantify variability resulting from sampling or analytical methodology. CH2M HILL will plan to collect duplicate effluent samples for analysis at the EPA Region 9 laboratory.

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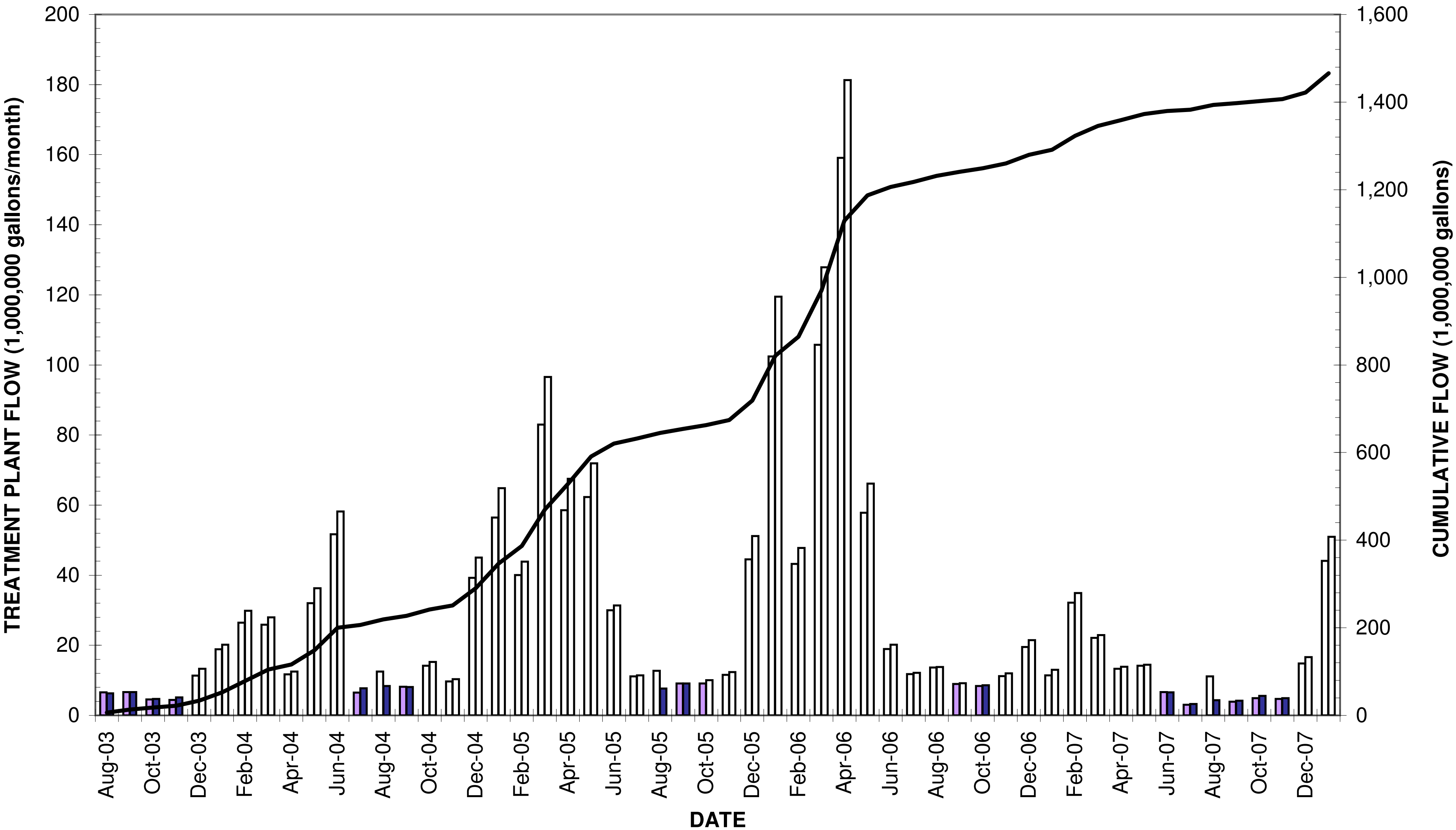

FIGURE 1
MFTP MONTHLY FLOW SUMMARY
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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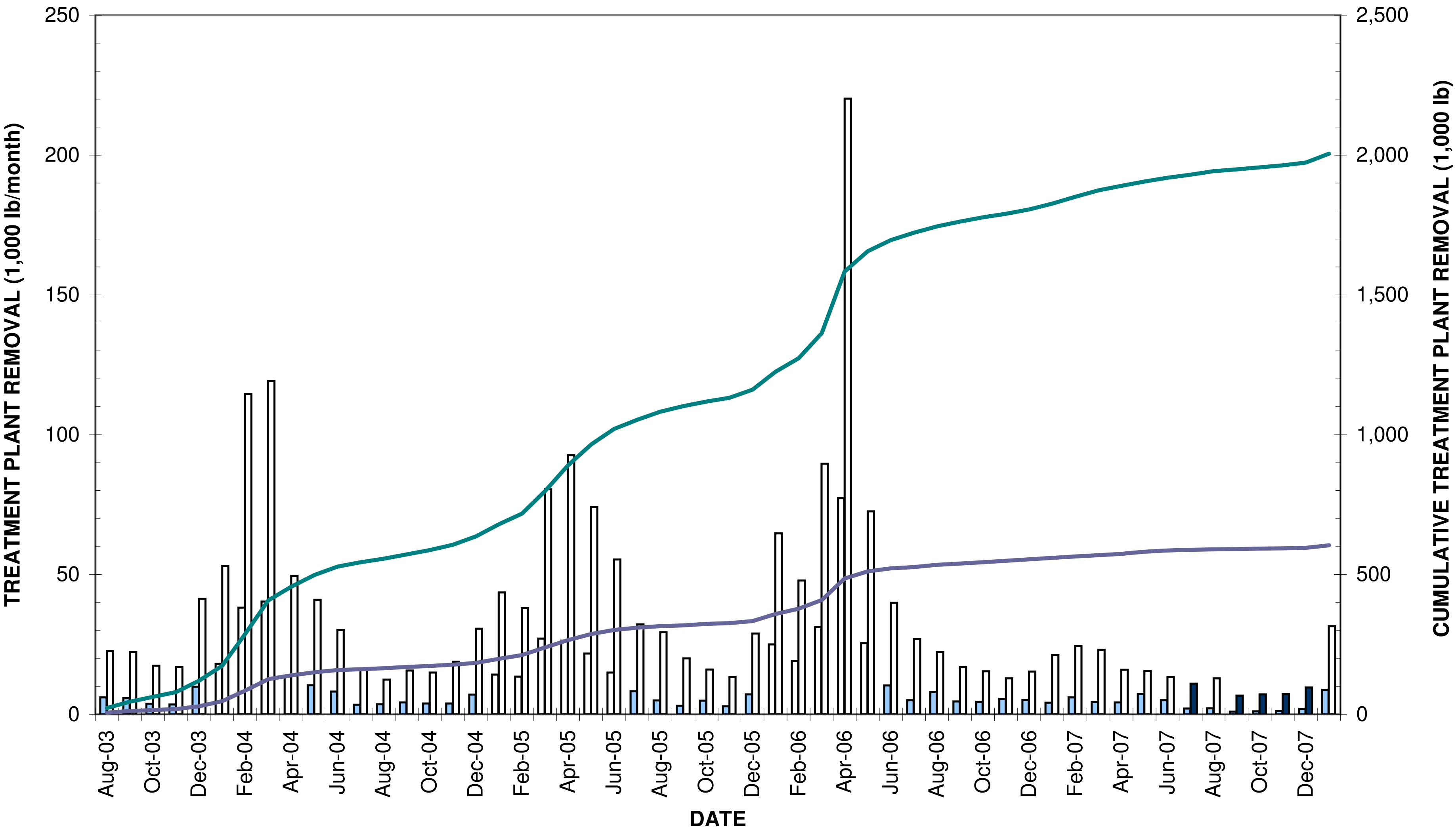

FIGURE 2
MFTP MONTHLY COPPER AND ZINC LOAD REMOVAL SUMMARY
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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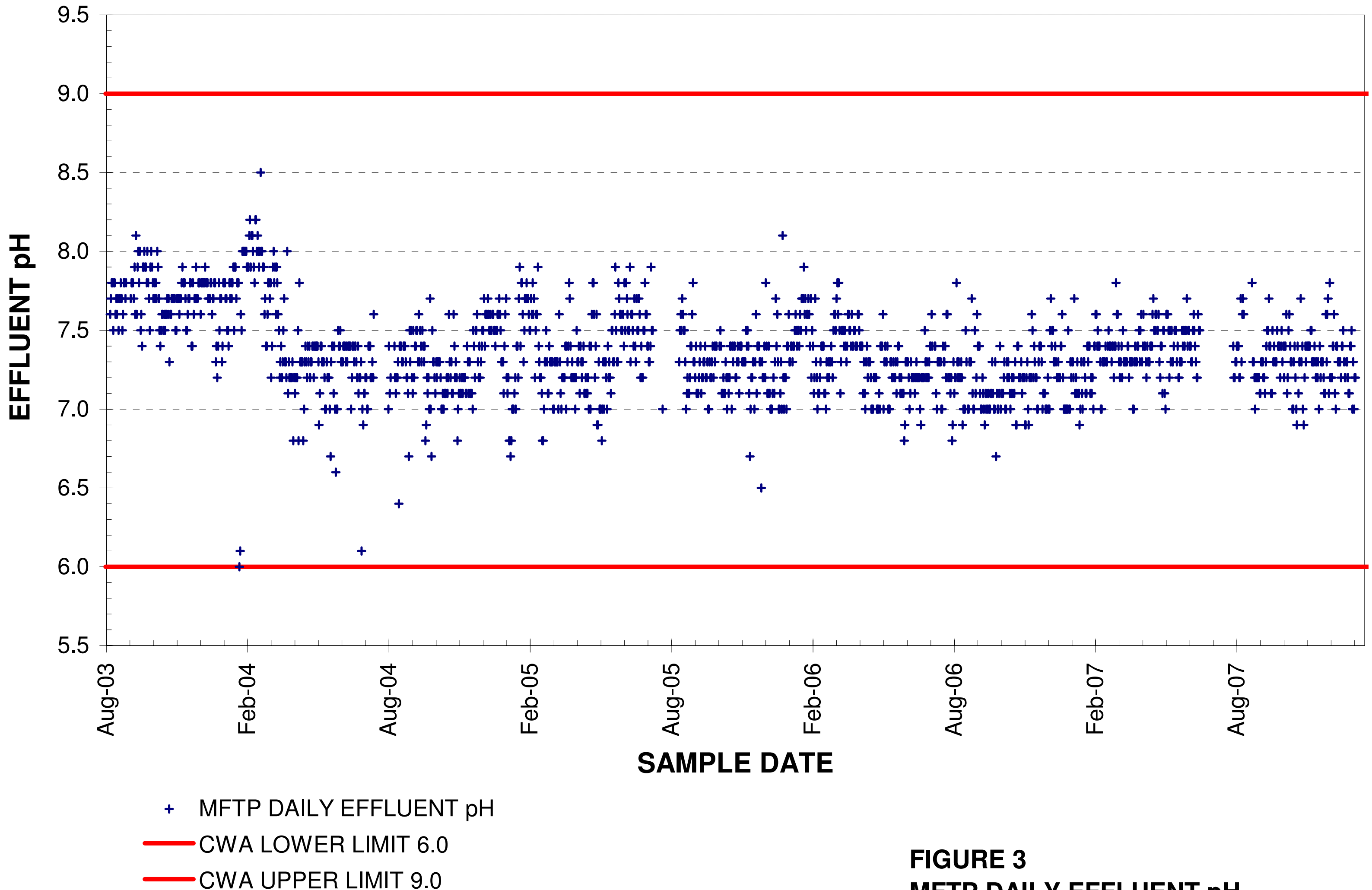

FIGURE 3
MFTP DAILY EFFLUENT pH
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

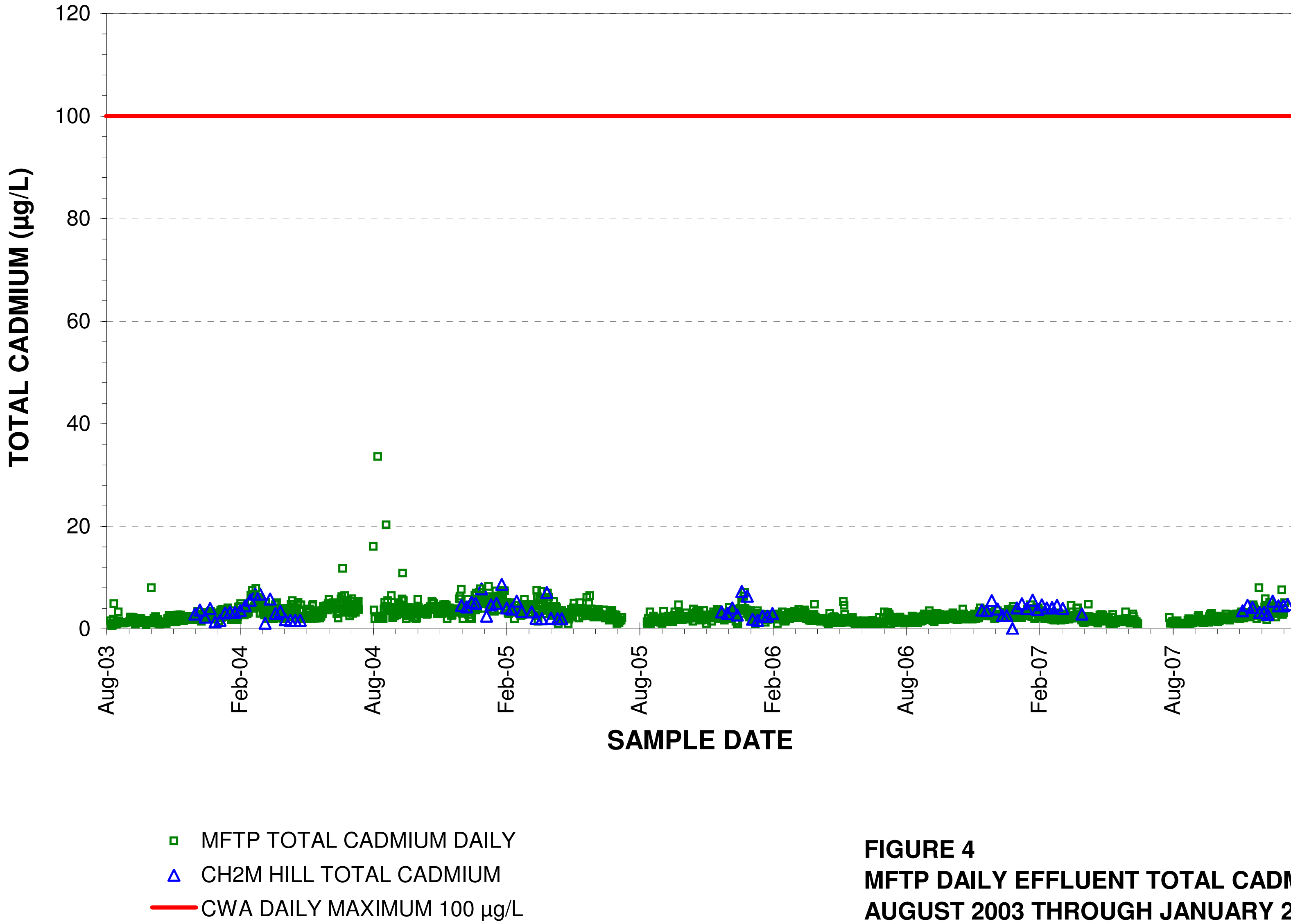

FIGURE 4
MFTP DAILY EFFLUENT TOTAL CADMIUM
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

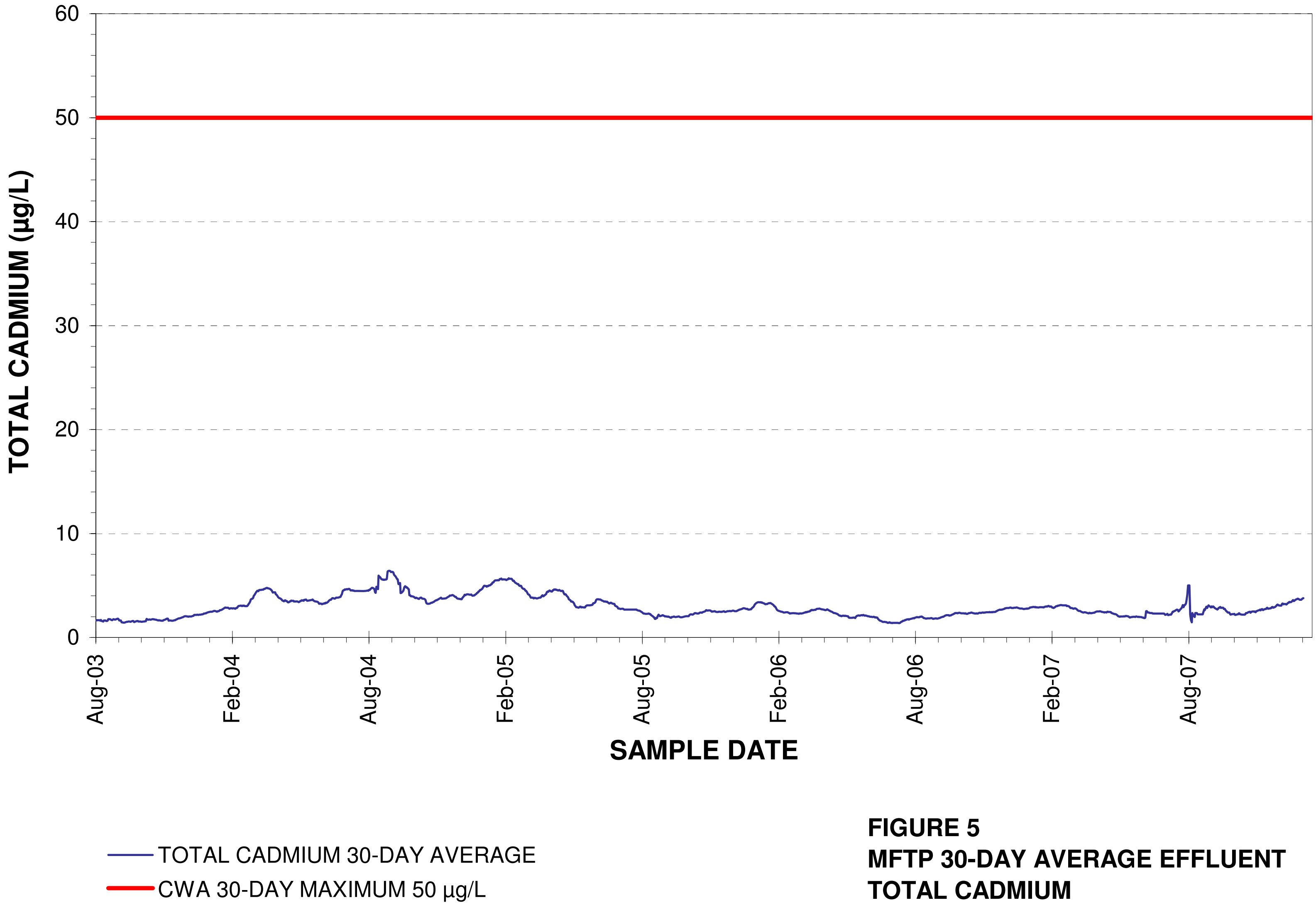

FIGURE 5
MFTP 30-DAY AVERAGE EFFLUENT
TOTAL CADMIUM
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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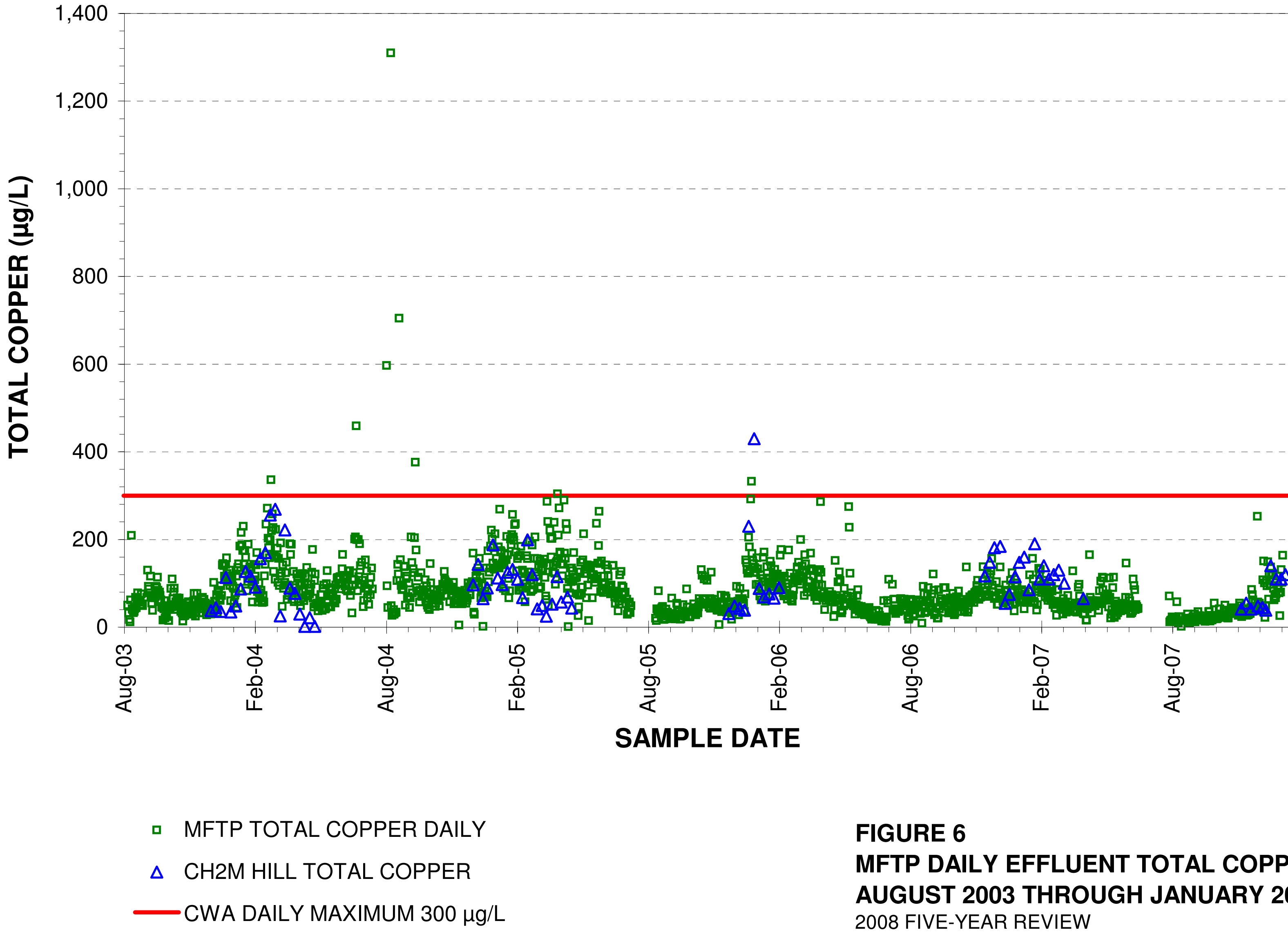

FIGURE 6
MFTP DAILY EFFLUENT TOTAL COPPER
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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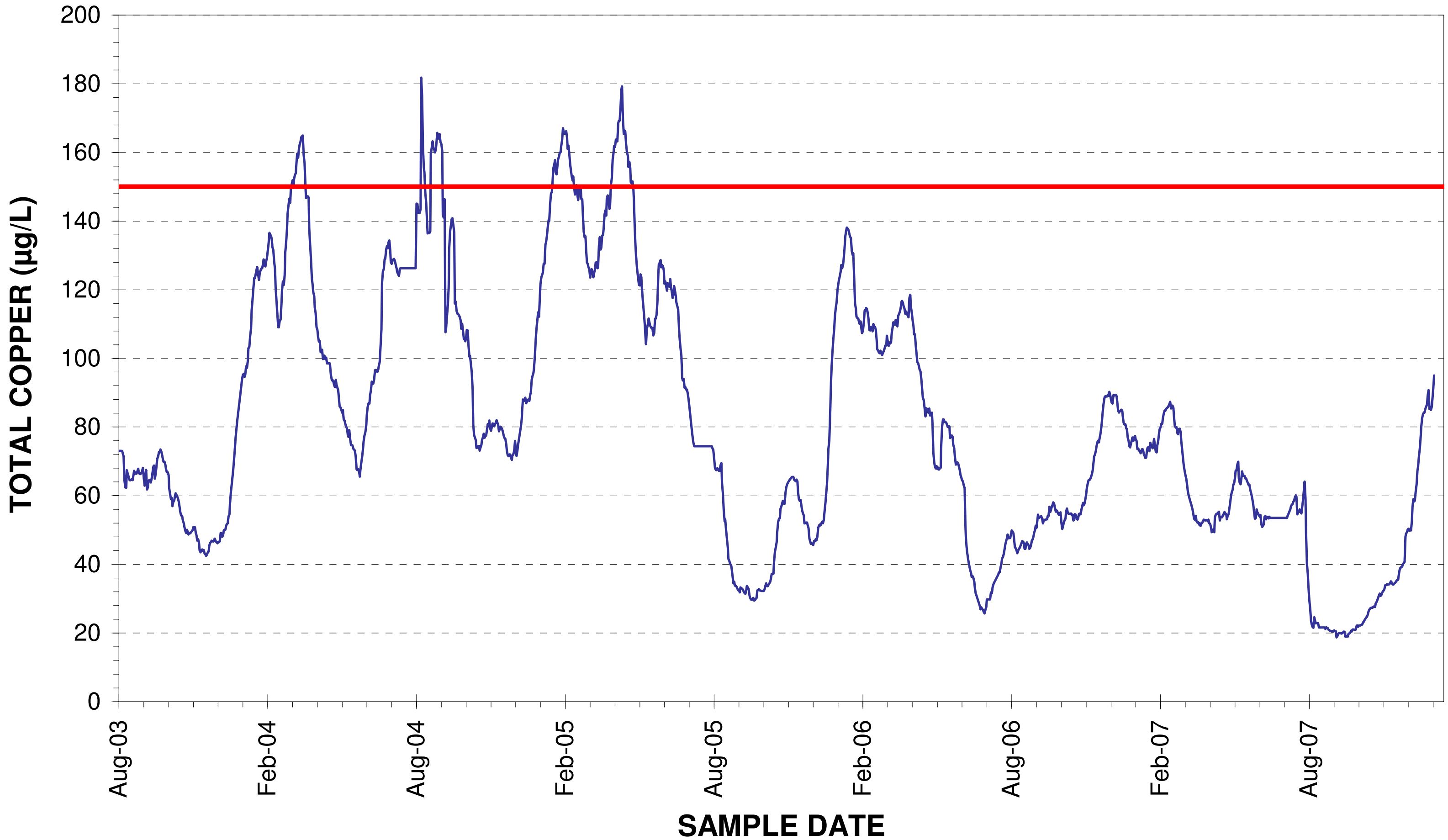

FIGURE 7
MFTP 30-DAY AVERAGE EFFLUENT
TOTAL COPPER
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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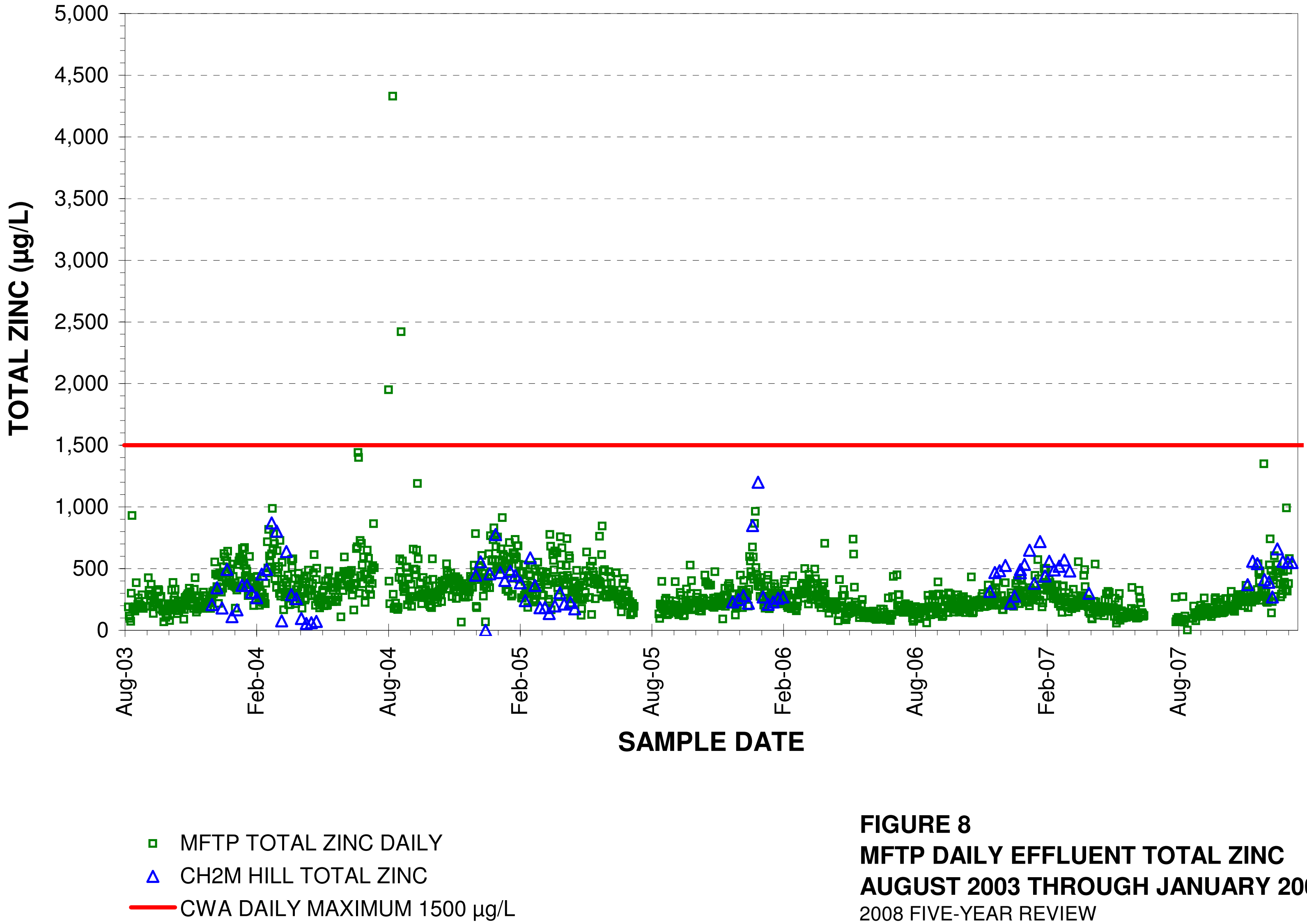

FIGURE 8
MFTP DAILY EFFLUENT TOTAL ZINC
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

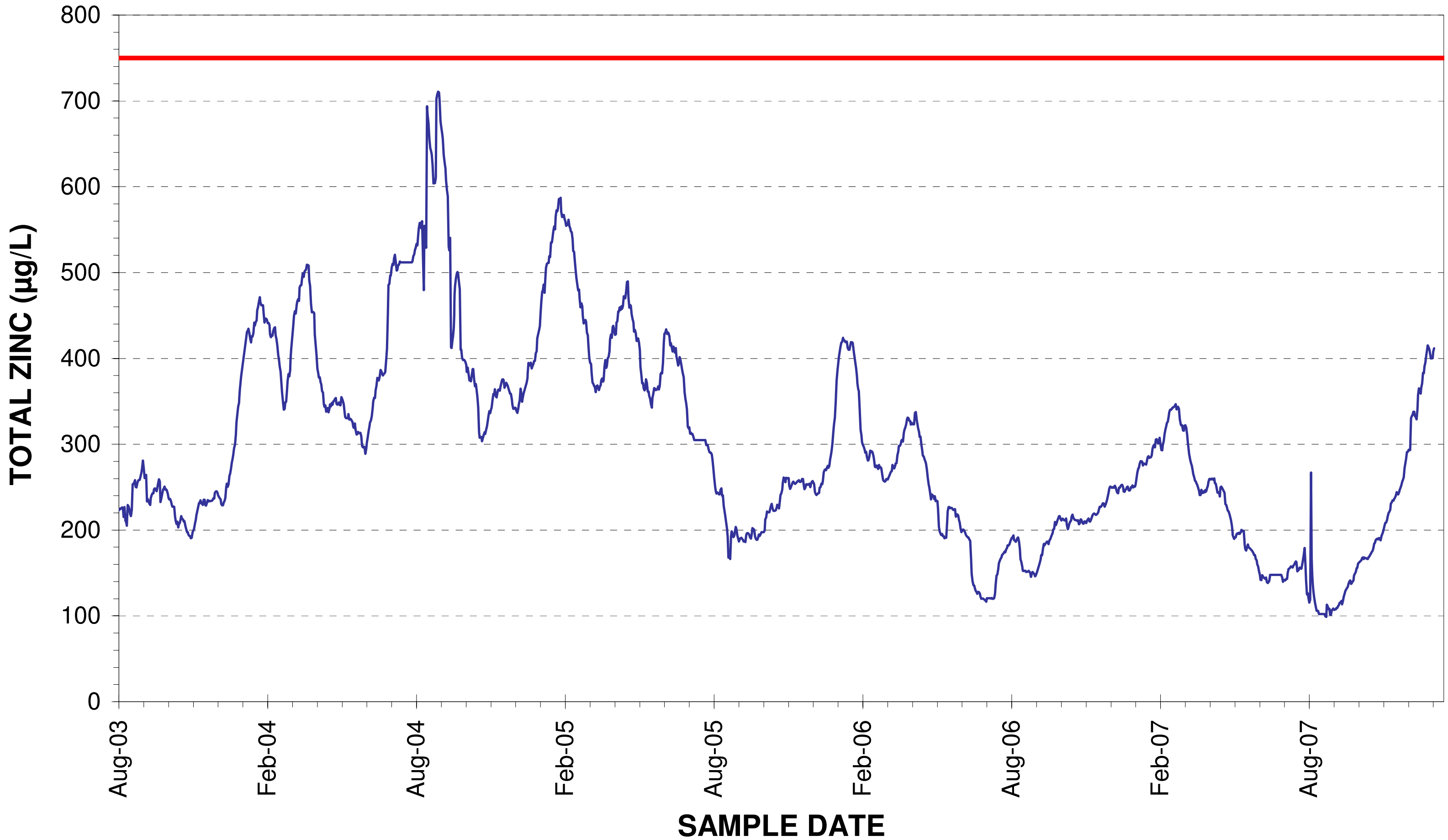

FIGURE 9
MFTP 30-DAY AVERAGE EFFLUENT
TOTAL ZINC
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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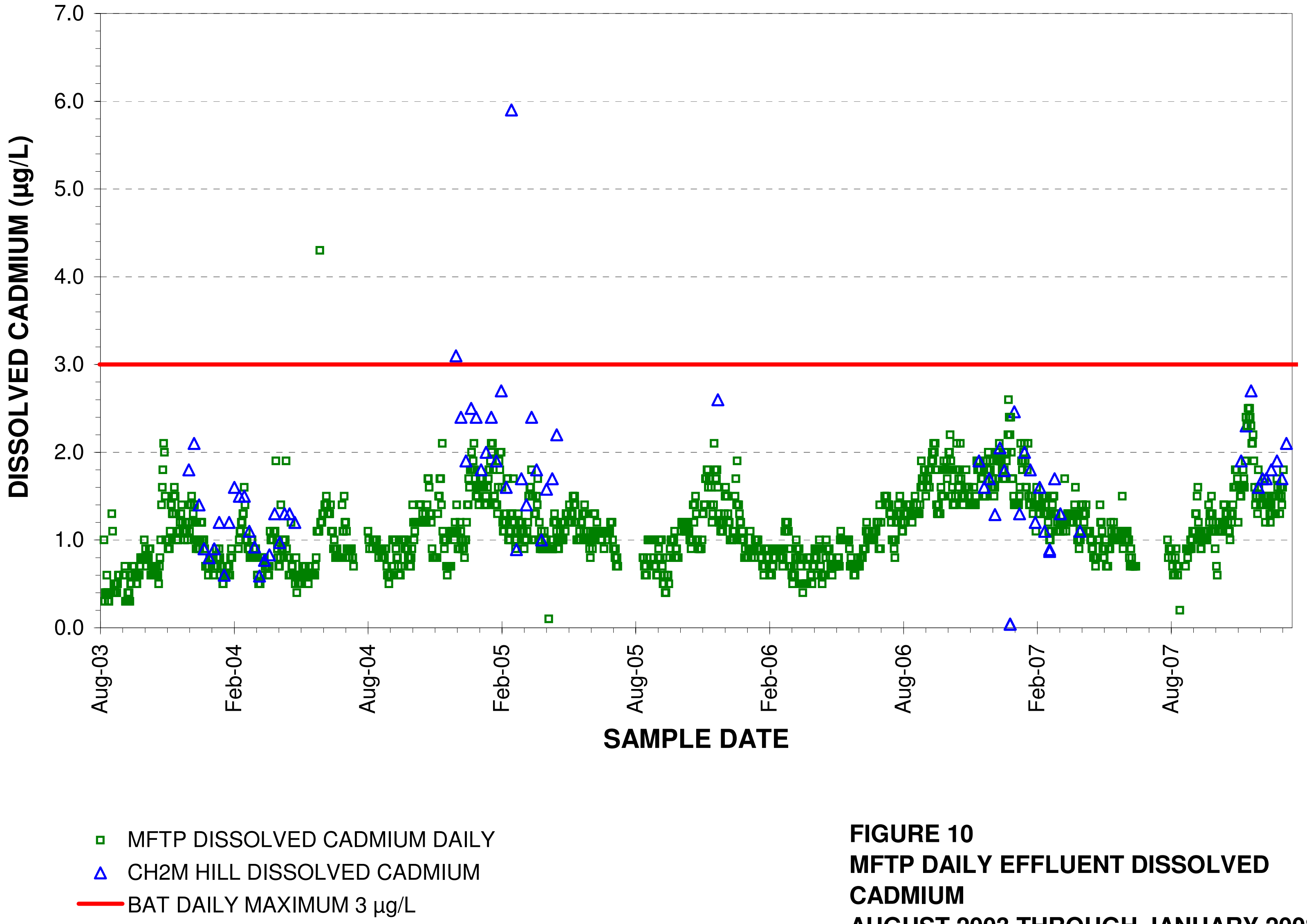

FIGURE 10
MFTP DAILY EFFLUENT DISSOLVED CADMIUM
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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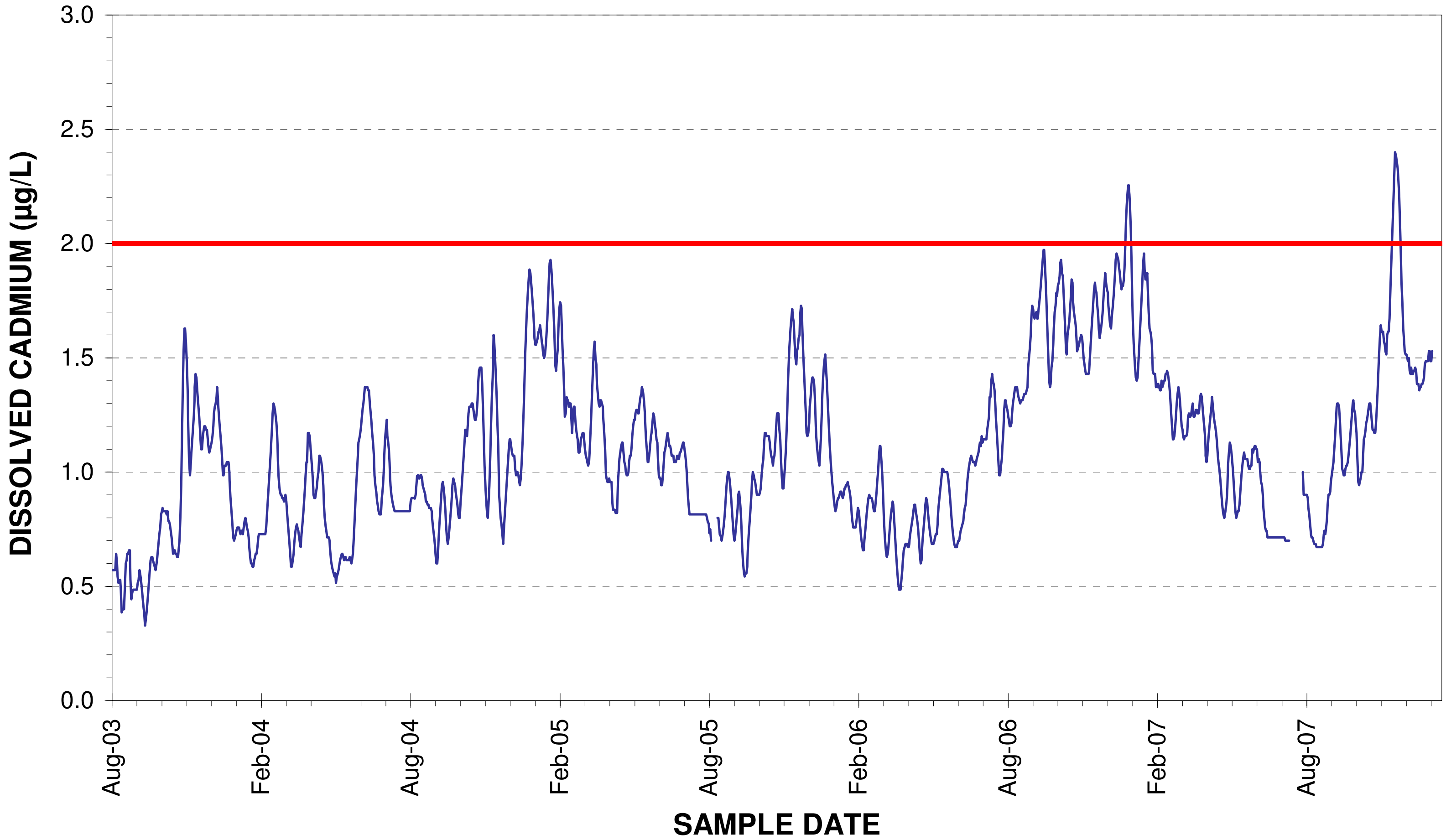

FIGURE 11
MFTP 7-DAY AVERAGE EFFLUENT
DISSOLVED CADMIUM
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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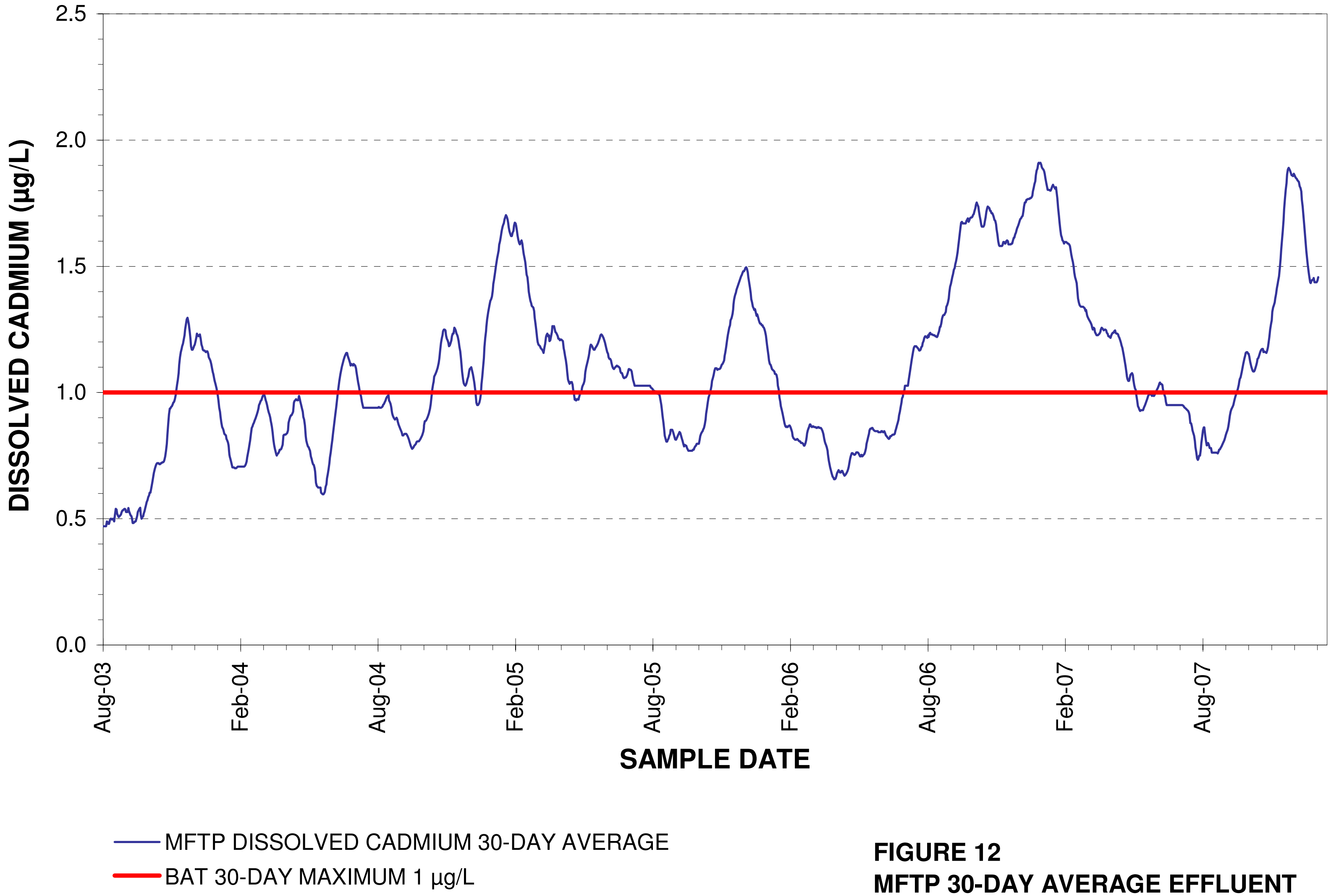

FIGURE 12
MFTP 30-DAY AVERAGE EFFLUENT DISSOLVED CADMIUM
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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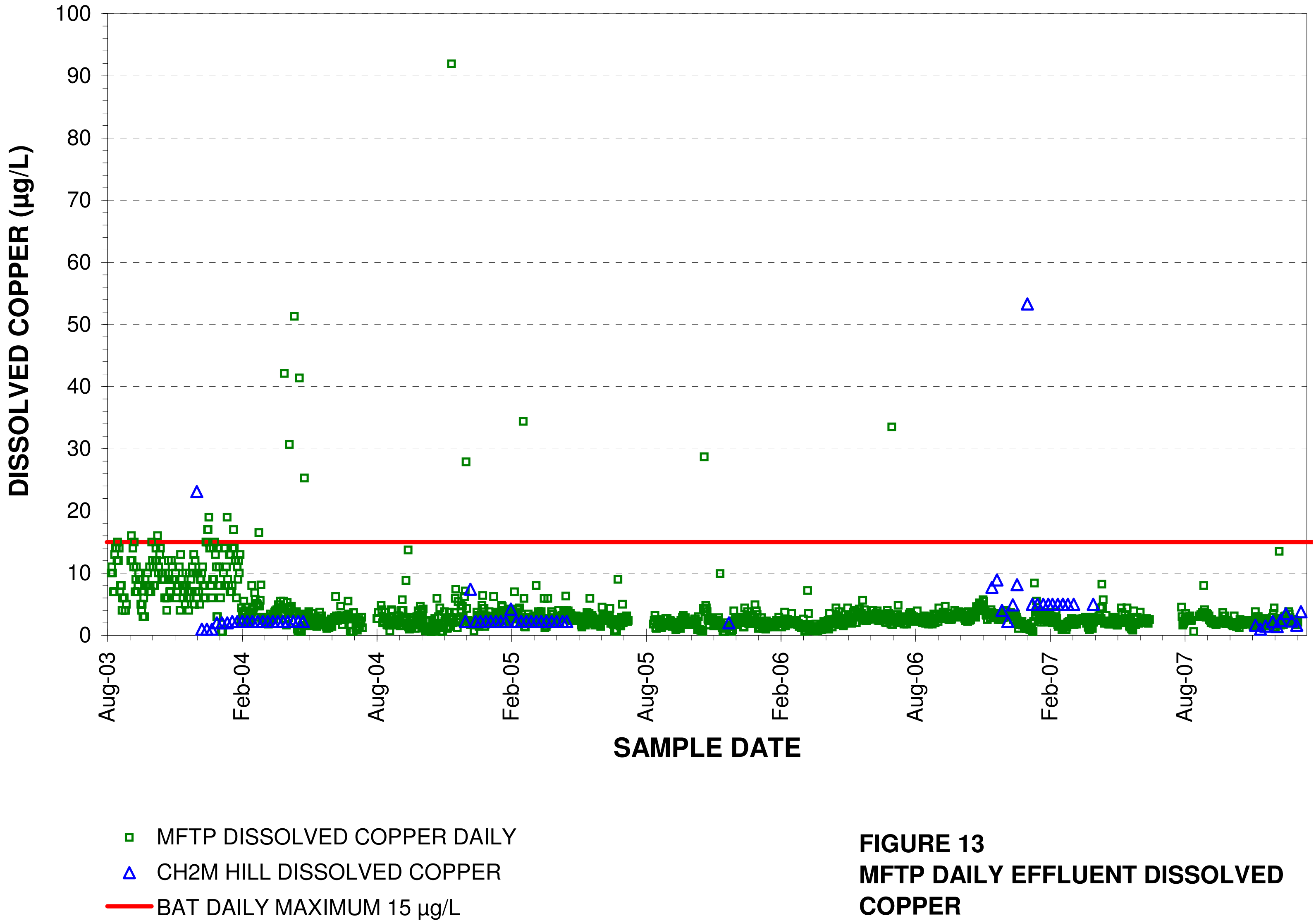

FIGURE 13
MFTP DAILY EFFLUENT DISSOLVED COPPER
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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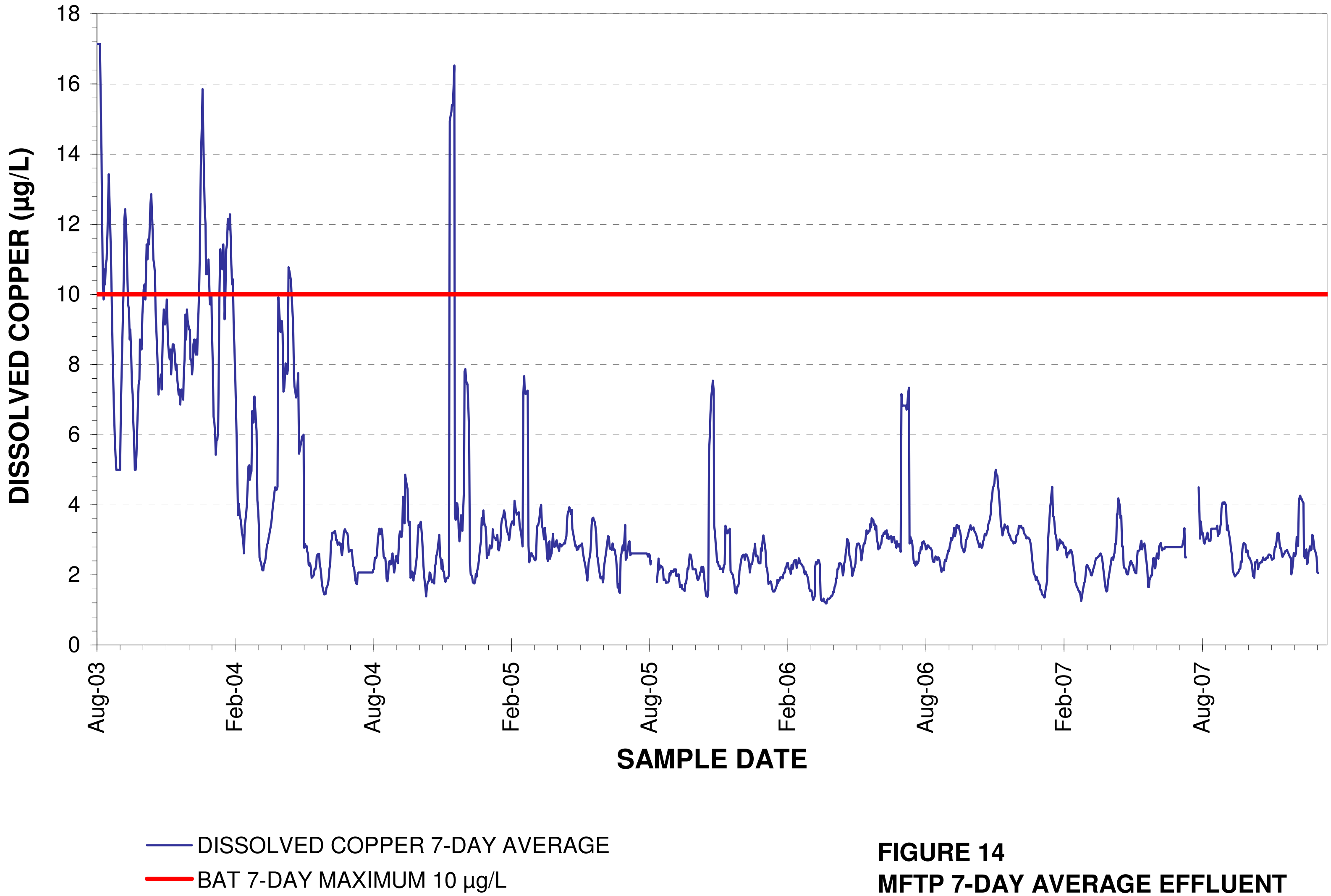

FIGURE 14
MFTP 7-DAY AVERAGE EFFLUENT
DISSOLVED COPPER
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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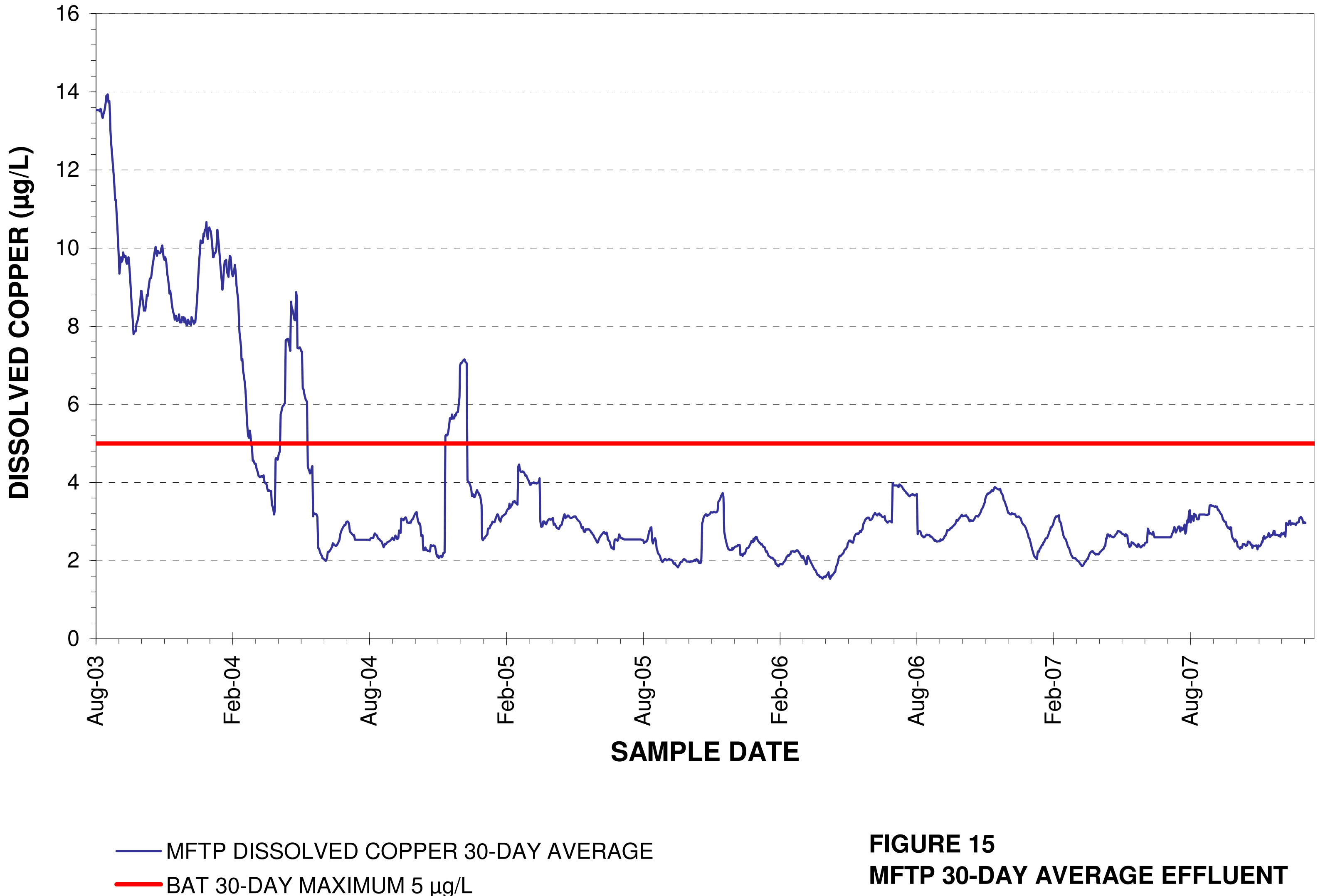

FIGURE 15
MFTP 30-DAY AVERAGE EFFLUENT DISSOLVED COPPER
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2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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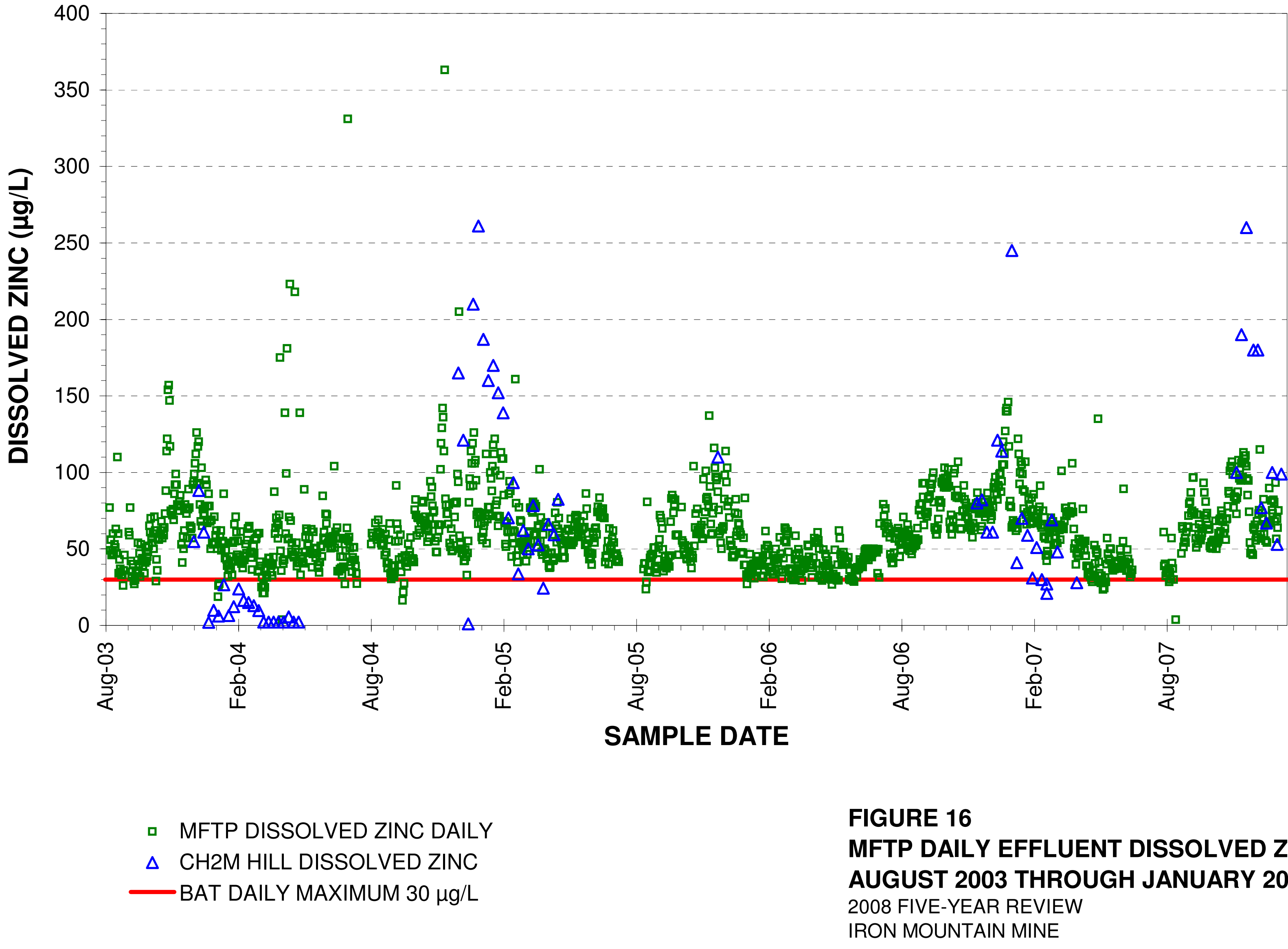

FIGURE 16
MFTP DAILY EFFLUENT DISSOLVED ZINC
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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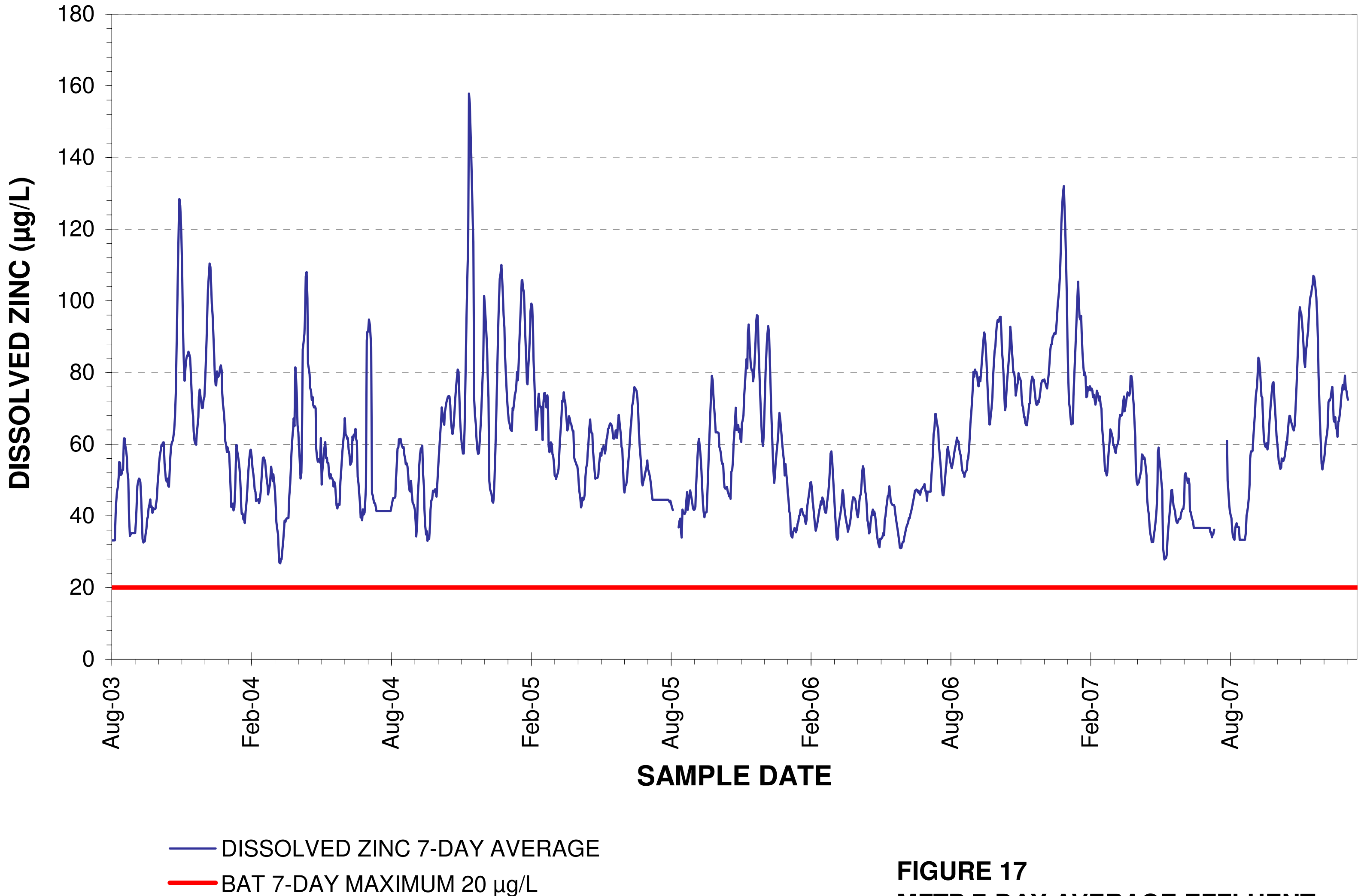


FIGURE 17
MFTP 7-DAY AVERAGE EFFLUENT
DISSOLVED ZINC
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

2003-2008_Figures-5yr-Review.xls: F17-batZn

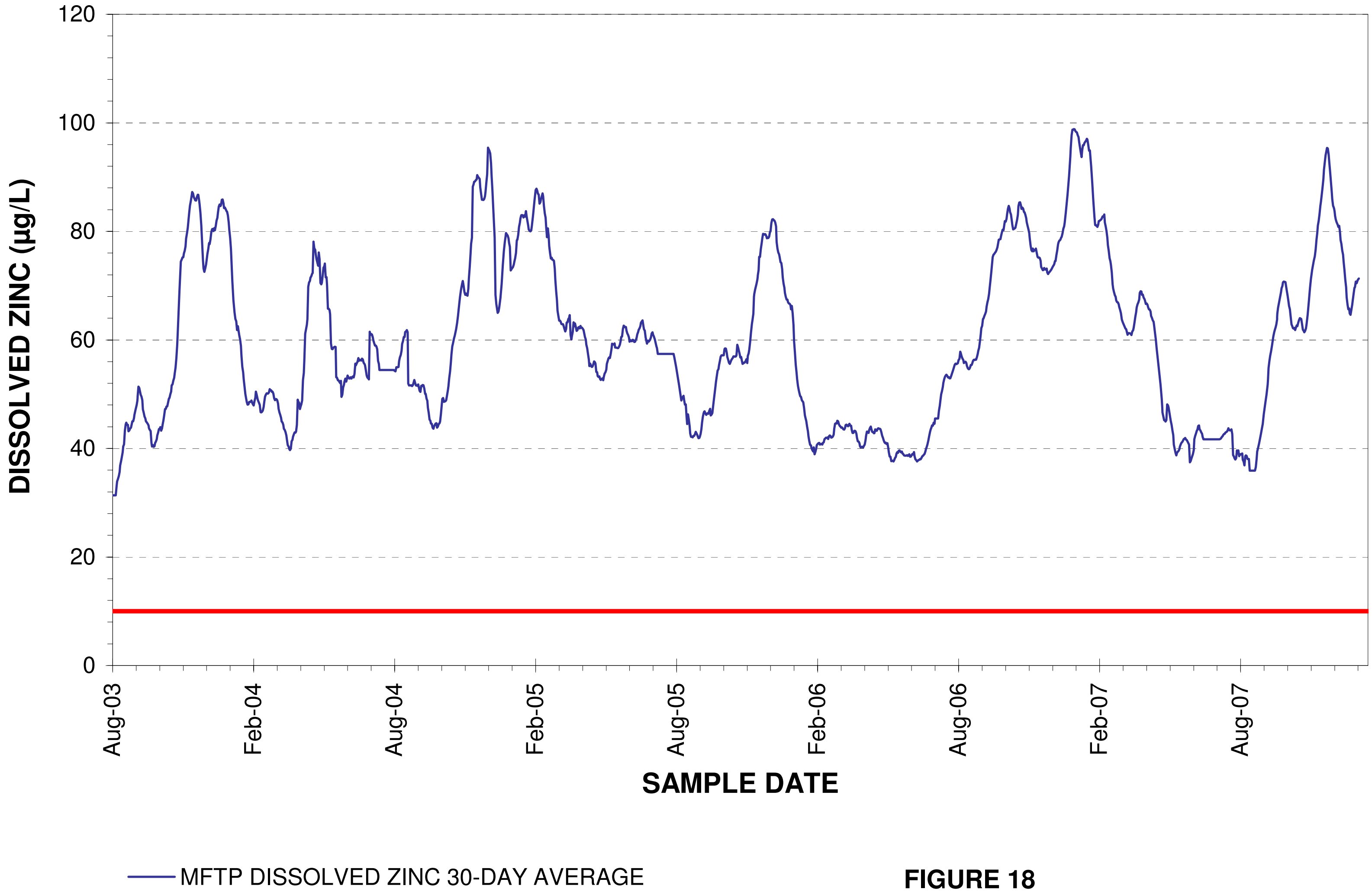
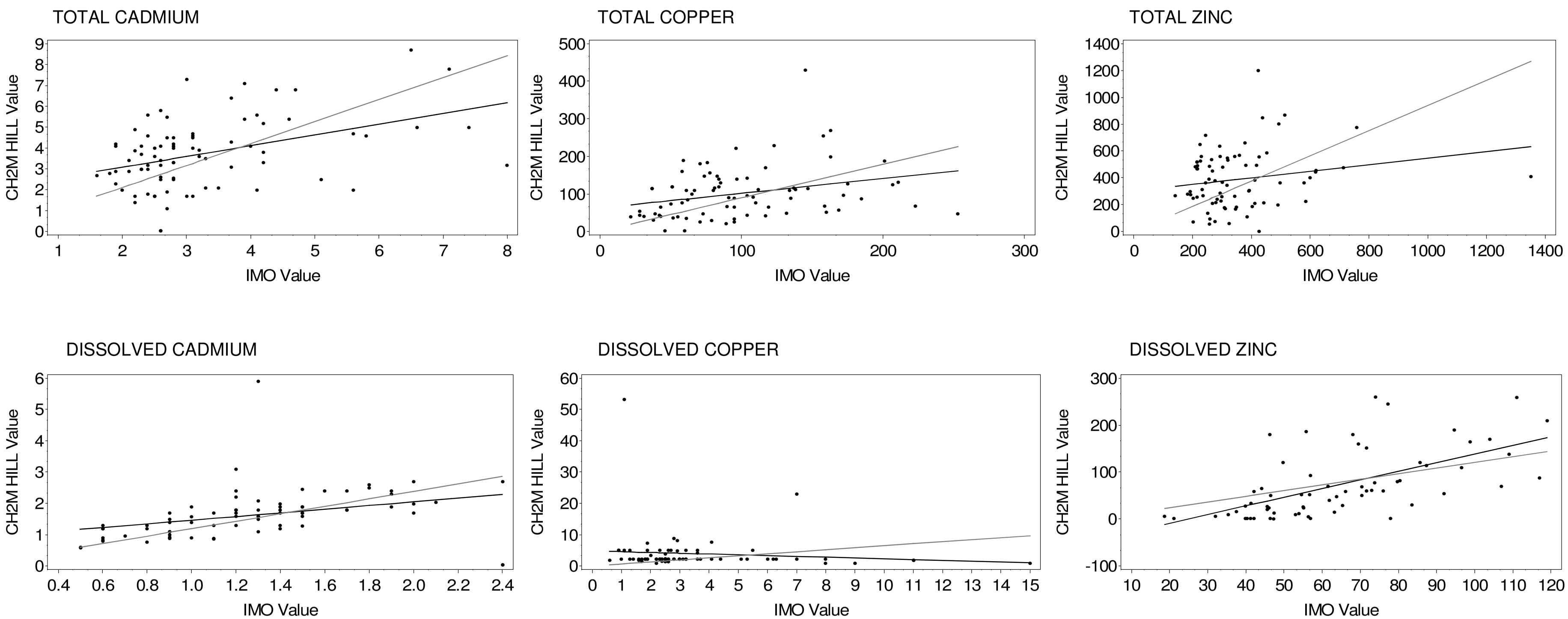


FIGURE 18
MFTP 30-DAY AVERAGE EFFLUENT DISSOLVED ZINC
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

2003-2008_Figures-5yr-Review.xls: F18-batZn



NOTES:
1. X- AND Y-AXES ARE CONCENTRATIONS IN µg/L
2. GRAY CORRELATION LINES ARE FORCED THROUGH ZERO
3. BLACK CORRELATION LINES MIGHT HAVE NON-ZERO Y-AXIS INTERCEPTS.

FIGURE 19
CORRELATION/STRAIGHT LINE REGRESSION PLOTS FOR CH2M HILL AND IMO PAIRED DATA
AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

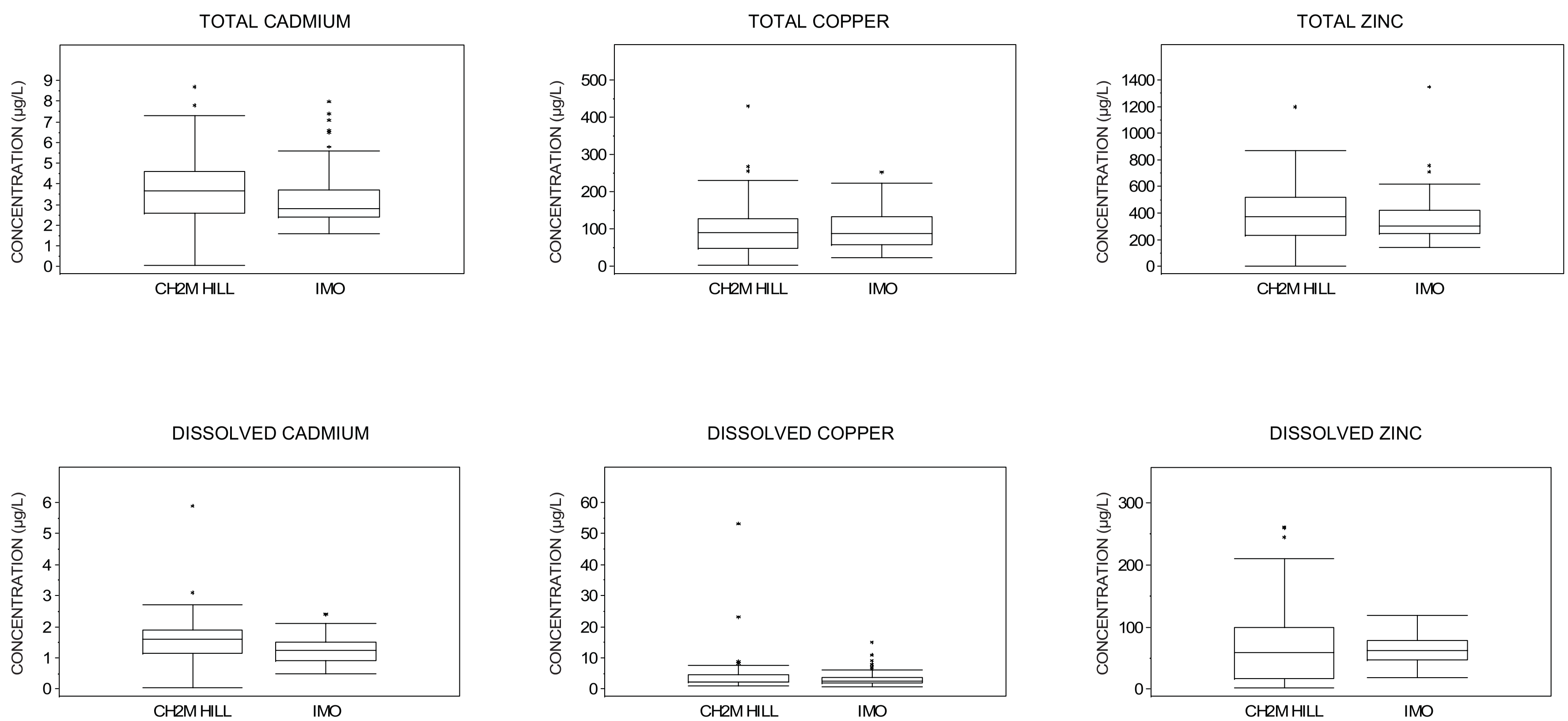


FIGURE 20
BOX AND WHISKER PLOTS FOR CH2M HILL AND IMO POOLED DATA AUGUST 2003 THROUGH JANUARY 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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Site Evaluation and Compliance at Keswick Dam

Site va uation and omp iance at eswic am Iron Mountain Mine Five-Year Review

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: June 23, 2008

PRO M RS: 367266.SR.05 and 352270.DE.01

1.0 Introduction

This technical memorandum evaluates the effectiveness of remedial actions in reducing copper and zinc discharges from the Iron Mountain Mine (IMM) site during the period from August 2003 through January 2008. Effectiveness is evaluated on the basis of the observed copper and zinc load removed from the contaminant discharges at the IMM site and the reduction in the copper and zinc discharges from Spring Creek Debris Dam (SCDD), located downstream from the IMM site. This memorandum also evaluates copper loads originating from other mines in the West Shasta Mining District.

2.0 Background

Iron Mountain is located approximately 9 miles northwest of Redding, California. The mountain is bordered to the south / southwest by Slickrock Creek and to the north / northwest by Boulder Creek, as shown on Figure 1 (all figures are located at the end of this technical memorandum). Acid mine drainage (AMD) from abandoned mine workings, waste piles, and other area sources discharges and contaminates Boulder and Slickrock Creeks. These creeks flow into Spring Creek, which subsequently flows into Spring Creek Reservoir, Keswick Reservoir, and Sacramento River.

The Bureau of Reclamation (Reclamation) constructed SCDD in the early 1960s to meter the contaminated discharge from Spring Creek into Keswick Reservoir and Sacramento River. Reclamation monitors the daily flow from SCDD and routinely performs analytical testing on the discharge waters to determine the metal concentrations of copper and zinc.

3.0 Iron Mountain Mine

Surface water from IMM is transported via Spring Creek through Spring Creek Reservoir (the impoundment created by SCDD) and into Sacramento River at Keswick Reservoir. The metal load in Lower Spring Creek, downstream from SCDD, represents the metal load contribution from IMM to Sacramento River and is composed of effluent from the IMM treatment plant and area sources of AMD in the Boulder Creek watershed.

3.1 Records of Decision

The U.S. Environmental Protection Agency (EPA) has selected and implemented several major remedial actions at the IMM site. EPA initiated a remedial investigation for the IMM site in September 1983. Since that time, the area has been intensively studied. Five Records of Decision (ROD) have been signed, and all projects authorized under the first four RODs for remediation of AMD at IMM have been completed.

ROD 1 (EPA, 1986) provided for diversion of Slickrock Creek around contaminant-bearing landslide debris, the diversion of Upper Spring Creek to the Flat Creek drainage, and a partial cap on Brick Flat Pit and seven subsidence areas. ROD 2 (EPA, 1992) and ROD 3 (EPA, 1993) provided for the treatment of AMD by using a high-density sludge (HDS) treatment process and onsite disposal of treatment residuals in Brick Flat Pit.

ROD 4 (EPA, 1997) provided for treatment of AMD discharges from IMM sources in the Slickrock Creek watershed. ROD 4 provided for the design and construction of a 220-acre-foot retention reservoir (Slickrock Creek Retention Reservoir [SCRR]) to collect AMD from IMM for treatment. ROD 4 also provided for diversion facilities for clean surface water, erosion control for arsenic-laden tailings, an additional AMD conveyance pipeline, and a tunnel for the gravity discharge of treated effluent to Spring Creek. These measures treat essentially all AMD discharges from Slickrock Creek, comprising 60 to 70 percent of the remaining uncontrolled copper and 40 to 50 percent of uncontrolled zinc and cadmium. Implementation of ROD 4 and other remedial source-control actions reduced contaminant discharges from SCDD by more than 95 percent.

ROD 5 (EPA, 2004) provided for a remedy that will prevent the migration and deposition of contaminated sediment from Spring Creek Arm of Keswick Reservoir (Spring Creek Arm) to Sacramento River and reduce metal loads and suspended solids associated with the contaminated sediment. The final remedial design for ROD 5 was submitted to EPA in September 2007 (CH2M HILL, 2007a and 2007b).

3.2 Treatment Plant Operations

In response to ROD 2 and ROD 3, the Responsible Party constructed an aerated simple mix plant at Minnesota Flats in 1993 and 1994. Because of the excessive sludge volumes and poor handling characteristics of the aerated simple mix sludge, EPA constructed the high-density sludge Minnesota Flats Treatment Plant (MFTP), with startup in January 1997. Since operations began in September 1994, MFTP has continued round-the-clock operations through the fourth five-year review period. Except for short down-time periods during heavy storm events or periods of planned maintenance during the dry season, the plant has run continuously 24 hours per day, 7 days per week. The site operator, Iron Mountain Operations (IMO), reports daily inflow and metal concentrations that are used to compute the total copper and zinc loads collected for treatment. Comparison of influent and effluent data collected since 2004 shows that the treatment process, on average, is 99.7 percent effective in removing dissolved metals from AMD.

Table 1 lists the copper and zinc loads collected from AMD at MFTP for Water Years 2004 through 2008. During this period, EPA's remedial action at the IMM site prevented the discharge of approximately 600,000 pounds of copper and 2 million pounds of zinc by treating approximately 1.5 billion gallons of AMD.

TABLE 1
AMD, and Copper and Zinc Load Inflow to MFTP
Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Water Year	AMD Inflow to MFTP (gallons)	Copper Inflow to MFTP (lb)	Zinc Inflow to MFTP (lb)
2004	214,020,000	158,000	528,000
2005	426,470,000	150,000	532,000
2006	586,810,000	222,000	661,000
2007	157,240,000	52,000	188,000
2008	68,450,000	13,000	56,000
Total	**1,452,990,000**	**595,000**	**1,965,000**

Note:

Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

3.3 Spring Creek Debris Dam Discharges

Contaminants from Boulder Creek and treated effluent from MFTP discharge through SCDD into Keswick Reservoir, as depicted on Figure 1. As reported in the second five-year review memorandum *Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review* (CH2M HILL, 2003), the State of California Regional Water Quality Control Board (Water Board), EPA, and Reclamation have routinely collected samples at SCDD to monitor pH, total copper, total zinc, and total cadmium in the reservoir discharge.

During the period 1983 through 1994, the pH of the water retained in Spring Creek Reservoir typically ranged from 2 to 3, with an average of 2.8 computed for the 264 samples collected. During the period from November 1996 through May 1998, the pH of the water ranged from 3.75 to 5.2, with an average of 4.5 computed for the 46 samples collected. From September 1999 through July 2003, the pH of SCDD discharge ranged from 3.00 to 5.45 with an average of 4.2 computed for the 356 samples collected. (CH2M HILL, 2003)

From August 2003 through January 2008, the pH of SCDD discharge ranged from 2.97 to 7.07 with an average of 4.71 for the 321 samples collected by Reclamation and EPA. A plot of the SCDD discharge pH from October 1998 through January 2008 is provided on Figure 2.

Reclamation computes the average daily discharge from SCDD by using SCDD outlet gate settings. Flows measured using the outlet gate discharge curves have been favorably compared to flows estimated using the standard broad-crested weir located just downstream of the outlet gates. Reclamation's Northern California Area Office samples SCDD discharges weekly, and more often during high-flow conditions or when the reservoir is within 75 percent of capacity. The historical metal concentrations fluctuate as a function of reservoir inflow and treatment at the IMM site.

For the metal load calculations presented in this memorandum, a linear variation between the actual reported values of daily copper and zinc concentrations was assumed.

Average daily copper and zinc discharge loads from SCDD were calculated using the computed daily concentrations and Reclamation average daily discharges for Water Year 1970 through January of Water Year 2008. The annual and cumulative copper and zinc discharges for the period are presented on Figures 3 and 4, respectively. Appendix Tables A-1, A-2, and A-3 list the datasets illustrated on Figures 3 and 4. Since 1970, approximately 5.13 million pounds of copper and 22.7 million pounds of zinc were discharged from SCDD into Keswick Reservoir and Sacramento River.

Table 2 lists the copper and zinc loads (in pounds) discharged from SCDD for Water Years 2004 through 2008. For this period, approximately 27,400 pounds of copper and 73,200 pounds of zinc were discharged from SCDD into Keswick Reservoir and Sacramento River.

TABLE 2
Copper and Zinc Discharge from Spring Creek Debris Dam
Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Water Year	SCDD Discharge (acre-ft)	Annual Copper Discharge (lb)	Annual Zinc Discharge (lb)
2004	37,200	14,500	27,900
2005	25,600	4,000	15,200
2006	28,000	5,800	21,000
2007	3,600	1,800	5,500
2008	2,400	1,300	3,600
ota	**96,800**	**27,400**	**73,200**

Note:

Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

3.4 Total Copper and Zinc Load Percent Reduction

Table 3 lists the combined copper and zinc loads for the IMM site for Water Years 2004 through 2008. The combined loads include IMM contaminant flows, collected and treated at MFTP, and SCDD discharge loads. For the fourth five-year review period, the combined loads for IMM were approximately 620,000 pounds of copper and 2 million pounds of zinc.

For the fourth five-year review period, collection and treatment of portal discharges have resulted in an average reduction in copper and zinc discharges of 96 percent. For the complete water years (2005 through 2007) since SCRR came online, reductions in copper and zinc discharges were 97 percent. The percent reduction is calculated as the load removed by treatment divided by the total load. The total load is calculated as the load discharged from SCDD and the load removed by treatment.

For Water Year 2008, the percent reductions are possibly lower than Water Years 2005, 2006, and 2007, because of first-flush events that occur early in the water year. Data for Water Year 2008 extend from October 1, 2007, through January 31, 2008. The percent reduction is expected to generally increase as the water year progresses. For Water Year 2004, the percent reduction is lower because SCRR did not come fully online until late in the water year (May).

These calculated values do not take into account the reduction in copper and zinc contaminant loads as a result of other remedial actions at the IMM site, including the construction of the Slickrock Creek clean water diversion, capping of Brick Flat Pit and subsidence areas, and removal of sulfide tailings and waste piles in Boulder Creek.

TABLE 3
MFTP and SCDD Combined Copper and Zinc Loads
Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Water Year	SCDD Discharge (acre-ft)	MFTP and SCDD Combined Copper Load (lb)	MFTP and SCDD Combined Zinc Load (lb)	Copper Discharge Reduction (%)	Zinc Discharge Reduction (%)
2004	37,200	172,300	556,000	92	95
2005	25,600	153,500	546,700	97	97
2006	28,000	227,700	681,900	98	97
2007	3,600	53,600	193,800	97	97
2008	2,400	14,400	59,600	91	94
Total	**96,800**	**621,500**	**2,038,000**	**96**	**96**

Note:
Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

3.5 Slickrock Creek Retention Reservoir

Completion of SCRR and associated facilities, in combination with completed remedial actions to control the sources of AMD, was expected to result in a total reduction of contaminants discharged from SCDD to 5 percent of the pre-1994 discharge.

For Water Years 2005 through 2007, the actual copper and zinc discharge from SCDD was approximately 2 percent of pre-1994 discharge. The annual average copper and zinc loads for Water Years 2005 through 2007 were divided by the average loads for Water Years 1970 through 1994. Annual loads are reported in Appendix Table A-2.

4.0 Water Quality Compliance at Keswick Reservoir

During the fourth five-year review period, Reclamation conducted routine discharge sampling at locations downstream of SCDD (LSC), Shasta Dam (SRS), and Keswick Dam (SRK2). The sampling locations are shown on Figure 1. Sampling and testing was typically conducted weekly during normal dam operations.

The purpose of the sampling was to assist Reclamation in regulating discharges from SCDD to meet water quality objectives for Sacramento River downstream of Keswick Dam. During the fourth five-year review period (August 2003 through January 2008), Reclamation collected approximately 263 water quality samples at LSC, 241 water quality samples at SRS, and 243 water quality samples at SRK2.

4.1 Water Quality Objectives in Sacramento River Below Keswick Dam

Two sets of water quality objectives establish criteria for protection of aquatic life in the upper Sacramento River and were identified as chemical-specific applicable or relevant and appropriate requirements in ROD 5 (EPA, 2004). These objectives are described in the *Water*

Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) (Water Board, 1998) and the California Toxics Rule (CTR) (provided in Water Board, 2003a). The Basin Plan establishes maximum concentration criteria and the CTR establishes 4-day continuous concentration criteria. In addition, the Water Board has developed a total maximum daily load (TMDL) program for dissolved cadmium, copper, and zinc in the upper Sacramento River because concentrations exceeded water quality standards (Water Board, 2002).

The specific criteria identified for total and dissolved copper include the following:

- The Basin Plan establishes the maximum dissolved copper concentration for the upper Sacramento River as 5.6 g/L.
- The CTR sets objectives for dissolved and total copper concentrations by using an assumed water hardness (as calcium carbonate) of 40 mg/L. The CTR establishes 4.1 g/L as the 4-day average continuous concentration and 5.7 g/L as the 1-hour-average maximum concentration for dissolved copper. The CTR establishes 4.3 g/L as the 4-day average continuous concentration and 5.9 g/L as the 1-hour-average maximum concentration for total copper.
- The upper Sacramento River TMDL report (Water Board, 2002) states that Water Board staff will develop additional mine remediation and other activities as needed to address dissolved copper concentrations in Shasta Dam releases that exceed 1.3 g/L. This goal is in response to expected reductions in copper concentrations from remedial actions implemented at IMM.

Table 4 shows the water quality objectives for dissolved and total copper and the number of samples that exceeded the limits of the approximately 243 samples collected by Reclamation from August 2003 to January 2008.

TABLE 4
Total and Dissolved Copper Compliance at Keswick Dam
Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Parameter	Basin Plan Maximum Limit (µg/L)	Number of Exceedances	CTR 4-Day Average (µg/L)	Number of Exceedances (Percent Exceedance)	CTR 1-Hour Average (µg/L)	Number of Exceedances
Dissolved Copper	5.6	0	4.1	4 (2 %)	5.7	0
Total Copper	N/A	N/A	4.3	7 (3%)	5.9	0

Notes:
N/A = Not applicable; the Basin Plan does not define limits for total copper.

4.2 Dissolved Copper Discharged from Shasta Lake

During the period from August 2003 through January 2008, Reclamation conducted sampling and testing on 241 days at SRS (see Figure 1). The reported total and dissolved copper concentrations are shown on Figure 5. The reported dissolved copper concentration exceeded 1.3 g/L on 128 of the 241 days reported (53 percent).

West Squaw Creek and Little Backbone Creek are the primary sources of elevated dissolved and total copper concentrations discharged from Shasta Dam as described in *Shasta Lake Copper Input Loads Data Evaluation Report* (CH2M HILL, 2008), *Metals Distribution within Shasta Lake, Shasta County California, Interim Report* (Water Board, 2003b), and the proposed Basin Plan Amendment for West Squaw Creek (Water Board, 2004b).

Mining Remedial Recovery Company, Inc. (MRRC) has implemented several remedial actions, including installation of bulkhead seals (plugs), to limit metals-laden water discharge to Shasta Lake from West Squaw Creek. These actions are described in the *Use Attainability Analysis for the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for Beneficial Uses at West Squaw Creek, Shasta County* (UAA) (Water Board, 2004a). The UAA reports that remedial actions have resulted in an estimated percent reduction of 95 percent of pre-plug copper loads from West Squaw Creek, and an estimated current annual copper load of 16 pounds per day. There is some uncertainty regarding the effectiveness of these remedial actions and the current copper loads. Data collected for EPA in West Squaw Creek during the five-year review period suggest that the remedial actions taken by MRRC have not achieved a 95 percent load reduction, and that current copper loads in West Squaw Creek are higher than estimated in the UAA (CH2M HILL, 2008).

The Water Board adopted Resolution R5-2004-0090, which includes the UAA. The UAA was conducted to demonstrate that the current beneficial uses assigned to West Squaw Creek are not achievable (Water Board, 2004). Specifically, the UAA states that the stream cannot support fish and other pH- or metal-sensitive aquatic species or the spawning of selected fish species defined in the Basin Plan (Water Board, 1998). The Basin Plan amendments do not become effective until accepted by the State Water Board, Office of Administrative Law and EPA. The UAA proposes changing the beneficial use requirements for West Squaw Creek, and to focus future remediation efforts on the Little Backbone Creek watershed (and other watersheds).

Water quality samples and creek flow rates in West Squaw Creek and Little Backbone Creek were collected by MRRC on a quarterly basis during the five-year review period and by EPA during the 2006, 2007, and 2008 water year wet seasons. Figures 6 and 7 show comparisons of copper loads calculated by MRRC and EPA in West Squaw Creek and Little Backbone Creek. In general, MRRC samples were not collected during the periods of highest flows in the creeks. Data collected for EPA during the wet season and include periods of high precipitation and high flow.

Table 5 shows EPA flow and load data for West Squaw and Little Backbone Creeks collected from December 2006 through February 2008. Discharge data presented in Table 5 are discrete measurements obtained using a constant tracer dilution injection rate method (CGI, 2008; CH2M HILL, 2008). Figures 8 through 11 present EPA copper concentration and load data for West Squaw and Little Backbone Creeks for a similar period. Continuous discharge data were obtained using a pressure transducer and data logger to record creek stage and the discharge rating curve of stage versus tracer-dilution discharge measurements. “Grab sample” loads presented on Figures 10 and 11 were calculated using the discharge rating curve, and are considered to be less accurate than the “tracer dilution” loads calculated using discrete discharge measurements.

TABLE 5
2006-2008 EPA Copper Load Comparison for West Squaw Creek and Little Backbone Creek
Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Date	West Squaw Creek				Little Backbone Creek			
	Flow (ft^3/sec)	Dissolved Copper (lb/day)	Total Copper (lb/day)	pH	Flow (ft^3/sec)	Dissolved Copper (lb/day)	Total Copper (lb/day)	pH
12/28/2006	53	45	85	5.67	18	40	42	3.79
01/11/2007	12	16	27	6.60	4	18	19	3.84
02/09/2007	40	16	37	7.17	15	35	36	3.29
02/22/2007	199	92	172	7.00	124	120	127	3.38
03/07/2007	47	33	66	6.82	14	20	21	4.71
03/27/2007	17	12	24	7.06	6	17	18	4.18
12/04/2007[a]	15	5	19	7.12	5	16	16	4.29
12/18/2007	283	101	213	5.70	67	105	108	4.16
1/4/2008[b]	388	251	355	6.51	N/A	N/A	N/A	N/A
1/28/2008[a]	159	180	240	6.64	53	71	74	5.04
2/1/2008	62	83	104	6.53	20	32	32	4.30
2/24/2008[a]	598	81	387	7.01	580	344	469	4.52

[a]One crew performed dilution testing at both creeks sequentially, beginning with West Squaw Creek. The length of the West Squaw Creek test was consistent with other events. The length of the Little Backbone Creek test was shortened to account for daylight limitations.

[b]High winds prevented sampling at LBC.

Notes:

N/A = not available

Source: CGI, 2008

Figures 8 and 9 present total and dissolved copper concentrations in West Squaw Creek and Little Backbone Creek, respectively. EPA dissolved copper concentration data collected in West Squaw Creek in 2007-2008 are elevated compared to 2003 and projected 2004 copper concentrations reported in the UAA (Water Board, 2004a). Figures 8 and 9 demonstrate that the ratio of dissolved to total copper in West Squaw Creek averaged approximately 0.5, due to the higher pH in this creek compared to Little Backbone Creek, which had a dissolved to total copper ratio of approximately 1.0. On September 28, 2007, and January 11, 2007, the pH in West Squaw Creek was lower (5.37 and 5.5 respectively), and the ratio of dissolved to total copper approached 1.0.

Both West Squaw Creek and Little Backbone Creek copper concentrations generally exhibited a seasonal trend, with higher copper concentrations in the dry season and during low flow conditions, and lower copper concentrations during periods of higher flow. The highest copper concentrations in West Squaw Creek were detected during the dry season, on September 28, 2007, and following a large storm event, on January 11, 2008. Grab sampling on January 11, 2008, was performed following 6 inches of rain at Shasta Dam between January 4th and 7th. The West Squaw Creek dissolved copper concentration was 520 µg/L, discharge was 66 cfs (obtained from stage versus discharge correlation), and dissolved copper load was calculated as 186 lb/day on January 11, 2008. The high copper concentration and load indicates the response of metal load sources to the high rainfall and flushing conditions.

Figure 10 compares West Squaw Creek and Little Backbone Creek dissolved copper loads; Figure 11 compares total copper loads. EPA 2007-2008 wet season data include dissolved copper loads up to 250 lb/day and total copper loads close to 400 lb/day from West Squaw Creek during large flushing conditions. Figures 10 and 11 demonstrate that West Squaw Creek and Little Backbone Creek are currently contributing similar copper loads.

4.3 Dissolved Copper Concentrations at Keswick Dam

During the period from August 2003 through January 2008, Reclamation conducted sampling and testing on 243 days at SRK2 (see Figure 1). The reported dissolved copper concentrations measured at SRK2 and at SRS are shown on Figure 12. The dissolved copper concentration did not exceed the Basin Plan limit of 5.6 µg/L on any of the 243 days during which samples were collected. The dissolved copper concentrations at SRK2 exceeded the CTR of 4.1 µg/L on only 4 of the 243 reported days (only 2 percent). For comparison, during the third five-year review period, the 5.6 µg/L dissolved copper standard was exceeded 15 days out of 246 days when samples were collected, and the CTR chronic exposure limit of 4.1 µg/L was exceeded more than 72 days (EPA, 2003).

Figure 13 shows total copper concentrations measured by Reclamation at LSC from October 1998 through January 2008. After SCRR began operating, the total copper concentrations at LSC decreased from an average concentration of 600 µg/L between August 2003 and February 2004 to 180 µg/L between March 2004 and January 2008. Startup and shakedown testing of SCRR began in March 2004. SCRR was completed in May 2004.

Figure 14 shows dissolved copper loads calculated using copper concentration data for samples and releases from Keswick Dam and Shasta Dam between August 2003 and January 2008. The dissolved copper loads calculated at each dam are similar and are highly dependent on the release.

Figure 15 shows the total and baseline dissolved copper loads calculated for Sacramento River below Shasta Dam, and a cumulative plot of the copper load discharged from Shasta Lake that exceeds the calculated baseline for Water Year 2006. The baseline copper load is calculated as the discharge from Shasta Dam multiplied by the TMDL goal of 1.3 µg/L for dissolved copper (Water Board, 2002). The baseline represents the copper load that would discharge from Shasta Dam if the copper concentrations were within the TMDL goal of 1.3 µg/L. The cumulative copper load exceeding the baseline for each water year represents the amount of excess metal load (in pounds) that would need to be addressed to meet the TMDL goal of 1.3 µg/L.

Figure 16 shows the total copper load discharged from SCDD from October 1998 through January 2008. From August 2003 through January 2008, copper loads averaged 21 lb/day annually and 45 lb/day during winter months (December through March). Since startup of SCRR in May 2004, copper loads averaged 14 lb/day annually and 24 lb/day during winter months. Only data from Water Years 2005 and 2006 were used in this calculation because they were the first complete water years since SCRR startup. Water Year 2007 was not included in the calculation because it had below-average precipitation.

Figures 17 through 20 show cumulative plots of the dissolved copper load discharged from Shasta Lake and Keswick Reservoir that exceed the calculated baseline for Water Years 2004, 2005, 2006, and 2007, respectively. These figures also show the cumulative total copper load discharge from SCDD. For the complete water years since SCRR came online (2005, 2006, and 2007), Shasta Lake contributed 17,000 pounds of copper above the baseline value, which is greater than the total copper load from IMM (12,000 pounds).

5.0 Summary

During the entire period between August 2003 and January 2008, Sacramento River below Keswick Dam met the Basin Plan maximum dissolved copper concentration for upper Sacramento River of 5.6 µg/L. The dissolved copper concentrations exceeded the California Toxics Rule chronic exposure limit of 4.1 µg/L on only 4 days (only 2 percent of the days sampled), compared to exceedances on 29 percent of the days sampled during the third five-year review period (EPA, 2003).

The IMM interim remedy continues to rely on Reclamation water management actions to provide for the safe release of the continuing IMM contaminant discharges from the Boulder Creek watershed, which are estimated to constitute 5 percent or less of the overall historic IMM discharges of copper and zinc. The Reclamation water management actions are necessary to reduce the likelihood of uncontrolled spills and meet the water quality objectives in Sacramento River below Keswick Dam. The final ROD for the IMM site will need to consider the entire water system that impacts Sacramento River, including discharge from IMM and SCDD, and metal loads from other mines in the West Shasta Mining District that discharge to Shasta Lake.

Data from Water Years 2006 and 2007 show that the majority of copper loads to the upper Sacramento River watershed are currently coming from the inactive copper mines in the Shasta Lake watershed. Although IMM has historically contributed the majority of copper loads to the water system, remedial actions implemented at the IMM site have reduced the magnitude of metal loads from IMM entering Sacramento River by more than 95 percent.

Table 6 shows percent reductions for copper and zinc load discharges from SCDD during the fourth five-year Review period (after startup of SCRR) as compared to the third five-year review period (before startup of SCRR). Copper loads were 70 percent lower and zinc loads were 47 percent lower during the fourth five-year review period compared to the third five-year review period. With the exception of Water Year 2006, the water years during the fourth five-year review period were at or below historical averages for precipitation (CH2M HILL, 2008), and the 2008 water year data only extends through January 31, 2008. Because of these reasons, the water discharged from SCDD was 23 percent lower during the fourth five-year period.

TABLE 6
Comparison of SCDD Load Discharges During the Third and Fourth Five-Year Review Periods
Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Review Period	Water Years	SCDD Discharge (acre-feet)	Copper Load Discharge (lb)	Zinc Load Discharge (lb)
Third Five-Year Review	1999 – 2003	125,000	90,000	137,000
Fourth Five-Year Review	2004 – 2008	96,800	27,400	73,200
Percent Difference		23%	70%	47%

Note:
Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

At the time of the fourth five-year review, the Water Board is continuing to work with MRRC to implement remedial actions at the inactive mines above Shasta Lake. During the fourth five-year review period, the water from Shasta Dam had a dissolved copper concentration of less than 1 g/L to 3.4 g/L. The TMDL goal was exceeded on more than 50 percent of the days recorded from August 2003 through January 2008 in the Sacramento River below Shasta Dam. The upgradient Shasta Lake water quality could negatively impact the water management component of the IMM remedy, especially during sustained periods of above average precipitation.

6.0 Works Cited

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CH2M HILL. 2007b. *Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action, Redding, California, Part , Drawings*. Final. September.

CH2M HILL. 2003. *Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review*. September 15.

CH2M HILL. 1998. *Site Evaluation, Iron Mountain Mine*. September 25.

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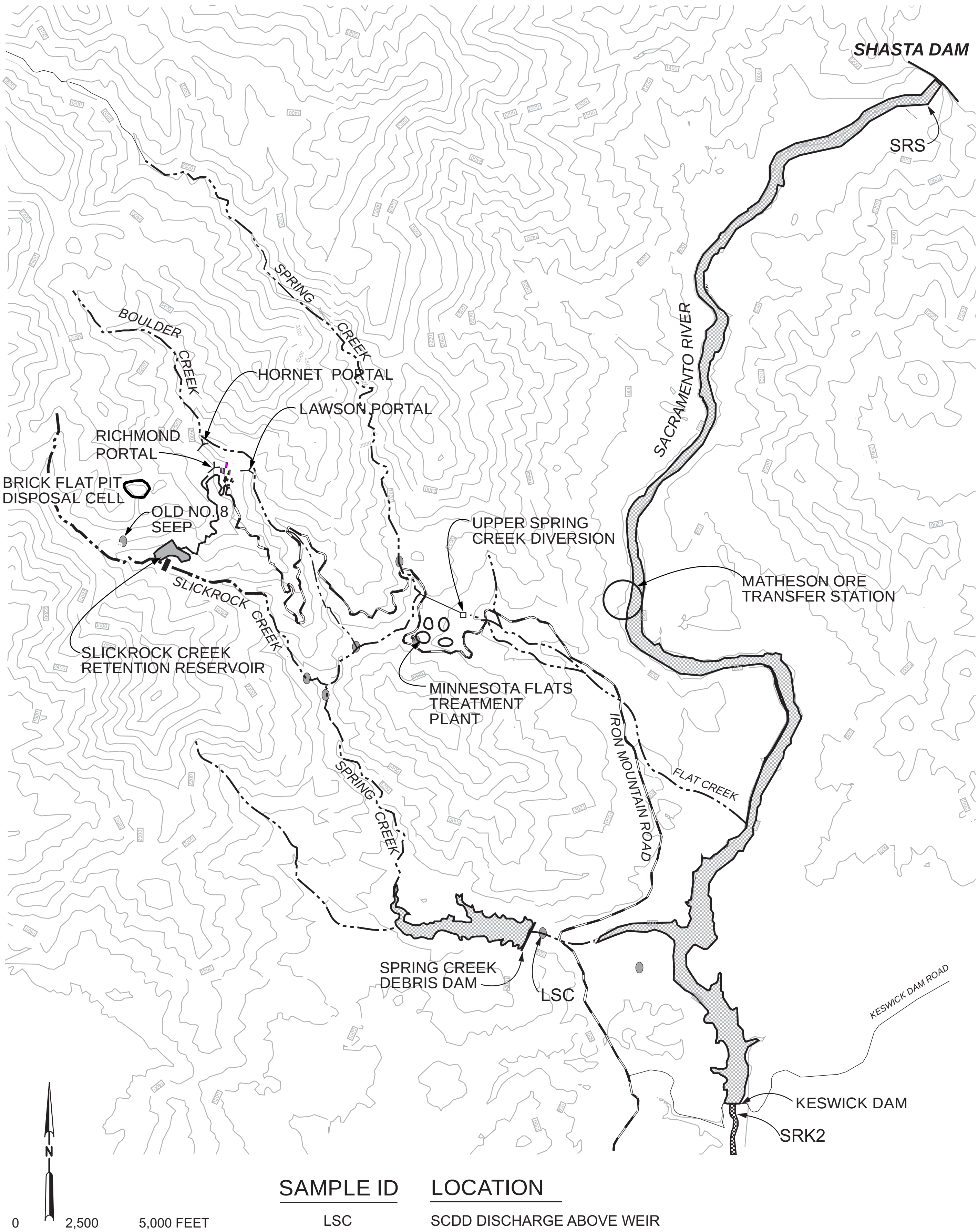
U.S. Environmental Protection Agency (EPA). 1986. *Record of Decision, Iron Mountain Mine, Redding, California* (ROD 1). October.

Fi ures



SAMPLE ID	LOCATION
LSC	SCDD DISCHARGE ABOVE WEIR
SRK2	SACRAMENTO RIVER BELOW KESWICK DAM
SRS	SACRAMENTO RIVER BELOW SHASTA DAM

FIGURE 1
LOCATION MAP
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

ES022008008RDD_01 (4/23/08)

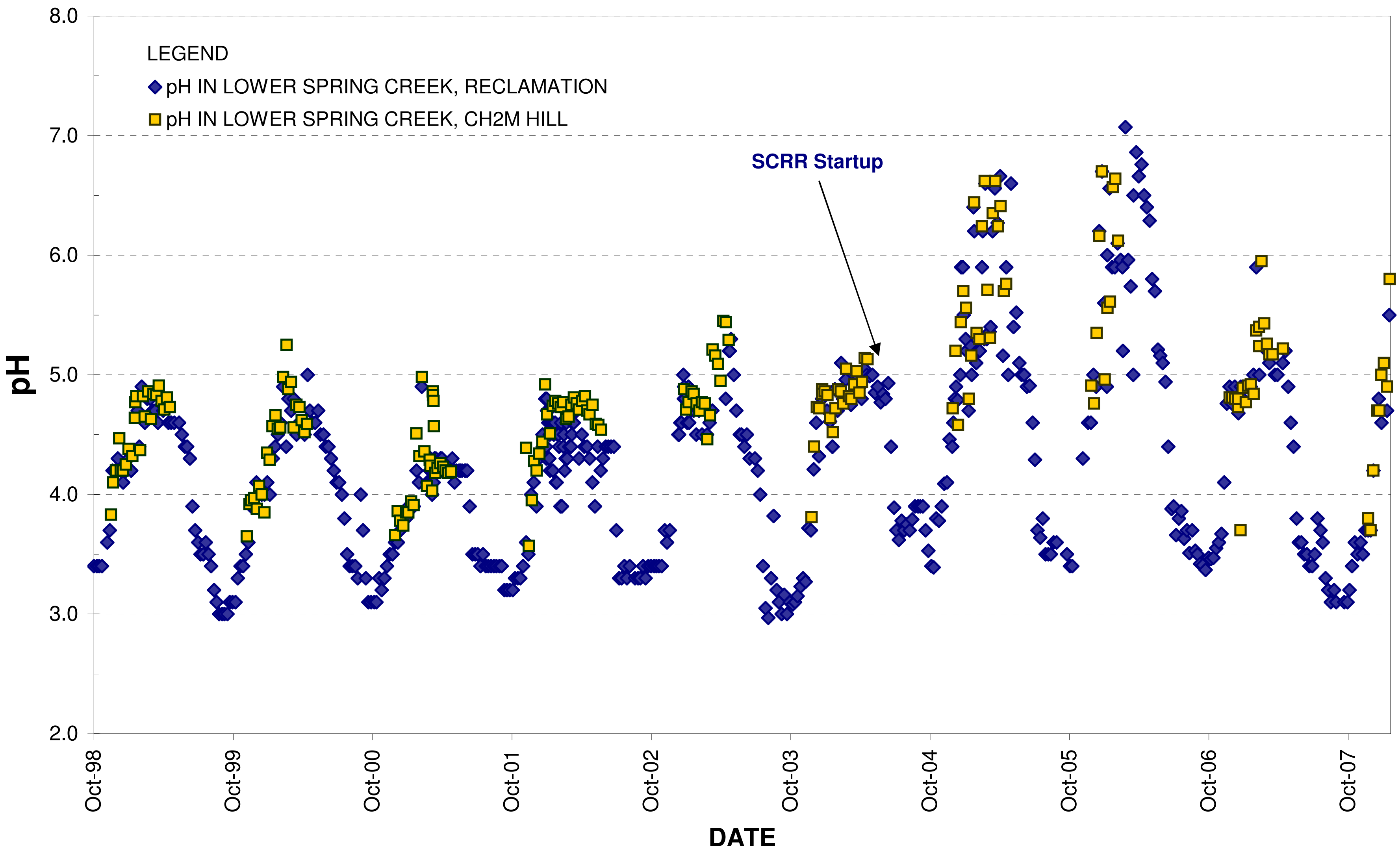
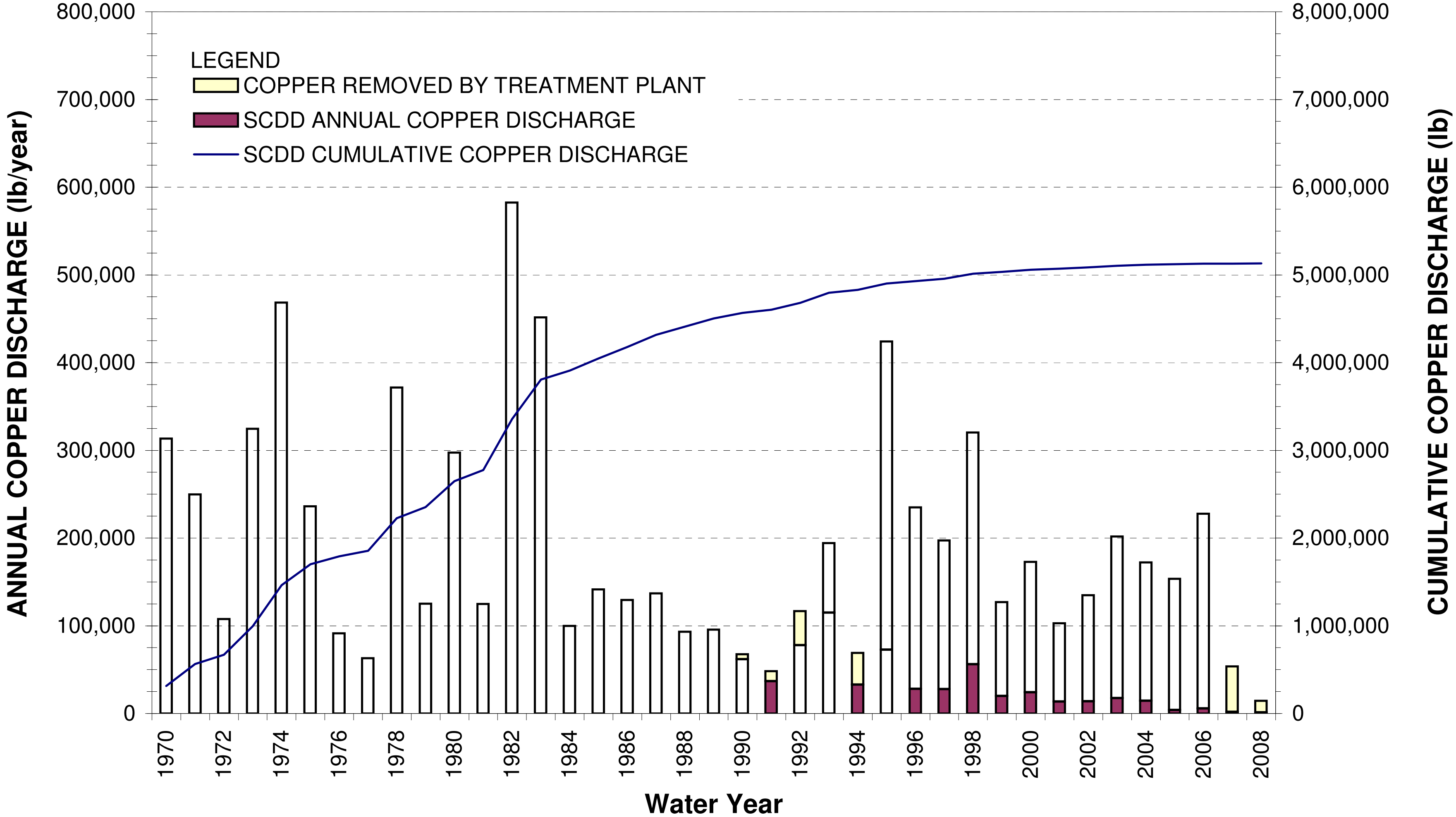


FIGURE 2
SPRING CREEK DEBRIS DAM DISCHARGE
pH MEASUREMENTS
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE



1994-2008: Copper Removed by Treatment Plant = 2,273,000 lb

Note: Water Year 2008 data extend through January 31, 2008

FIGURE 3

COPPER DISCHARGE, WATER YEARS 1970 THROUGH 2008

2008 FIVE-YEAR REVIEW

IRON MOUNTAIN MINE

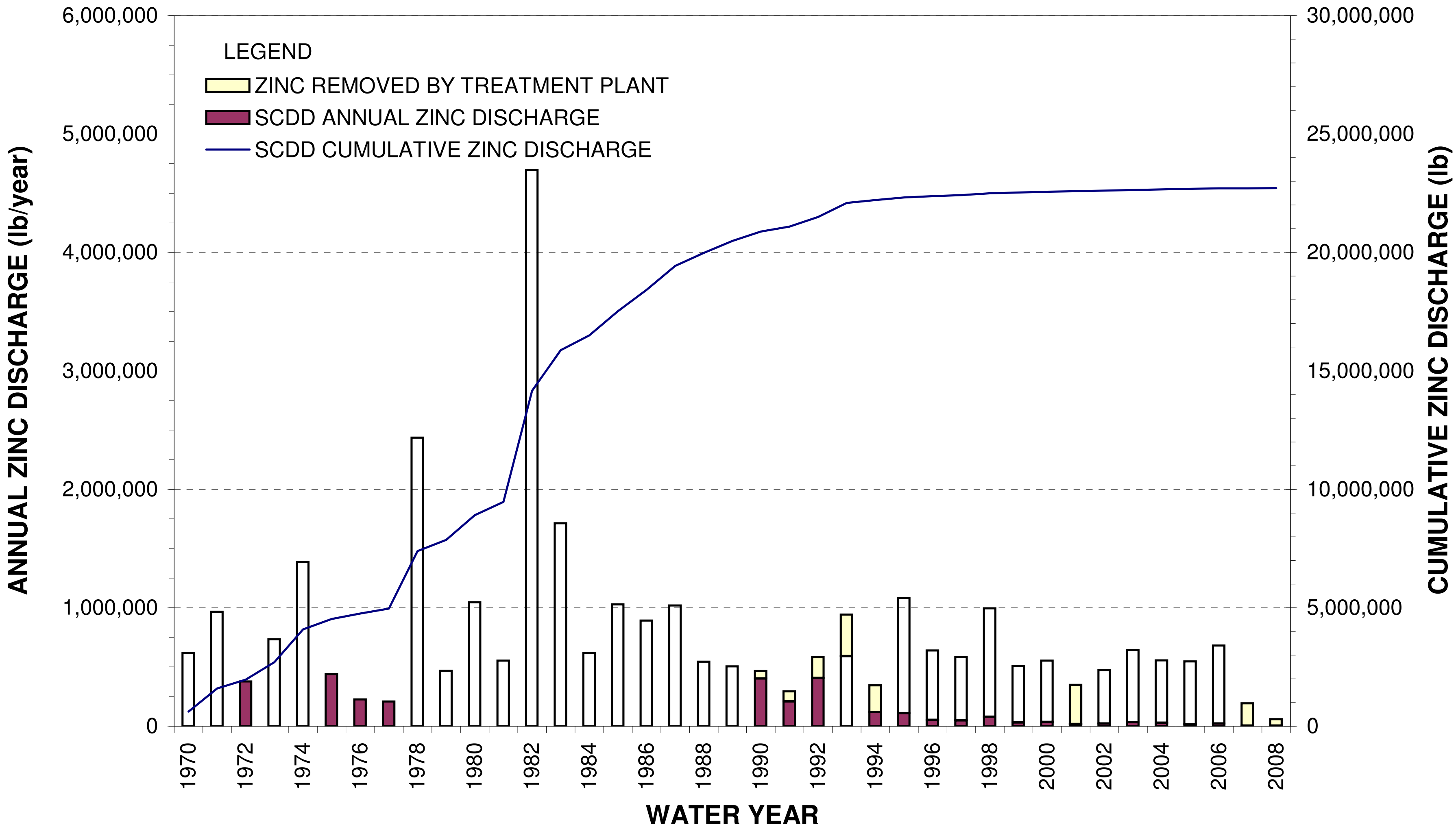
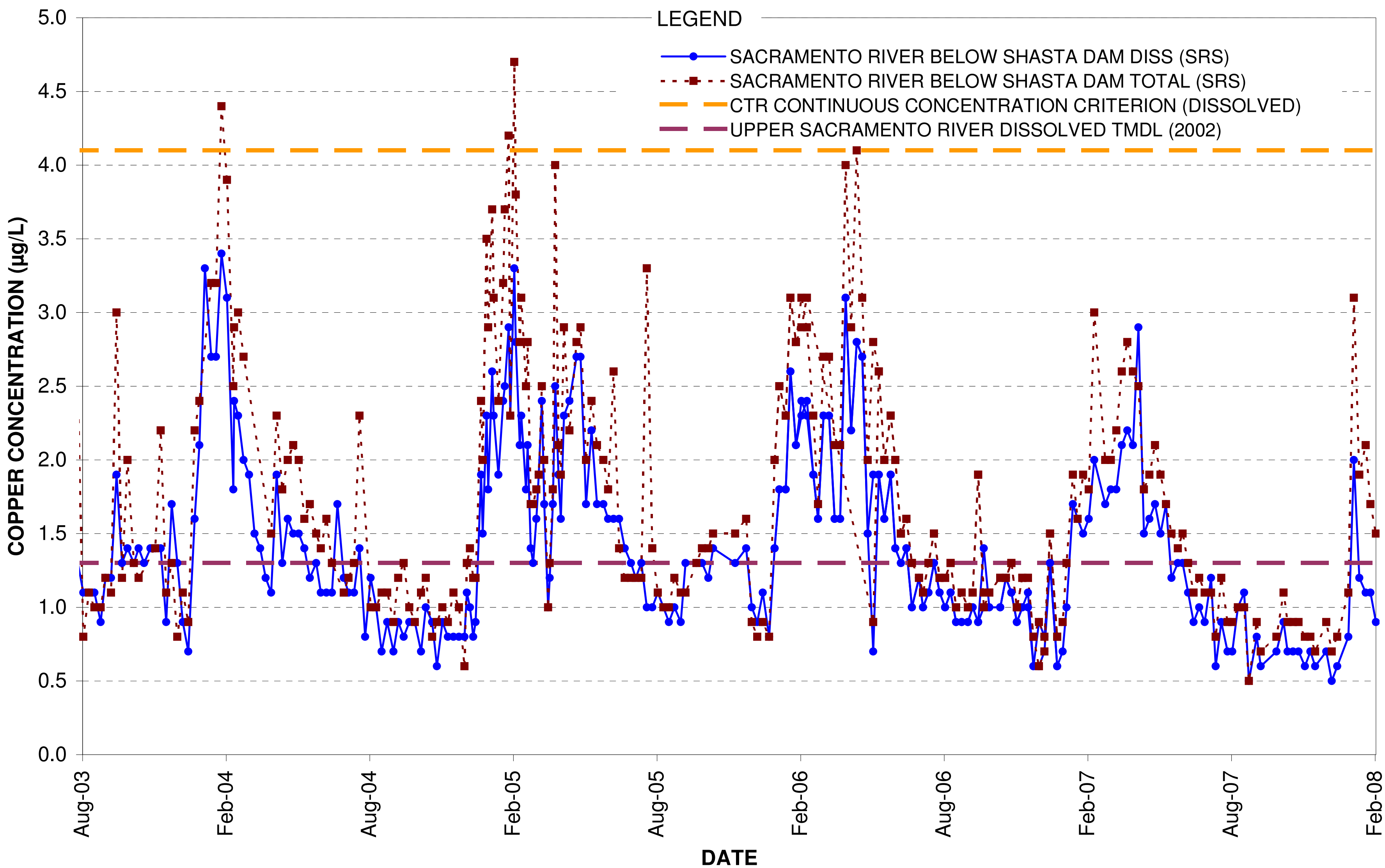


FIGURE 4
ZINC DISCHARGE, WATER YEARS 1970 THROUGH 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

1994-2008: Zinc Removed by Treatment Plant = 7,595,000 lb
Note: Water Year 2008 data extend through January 31, 2008

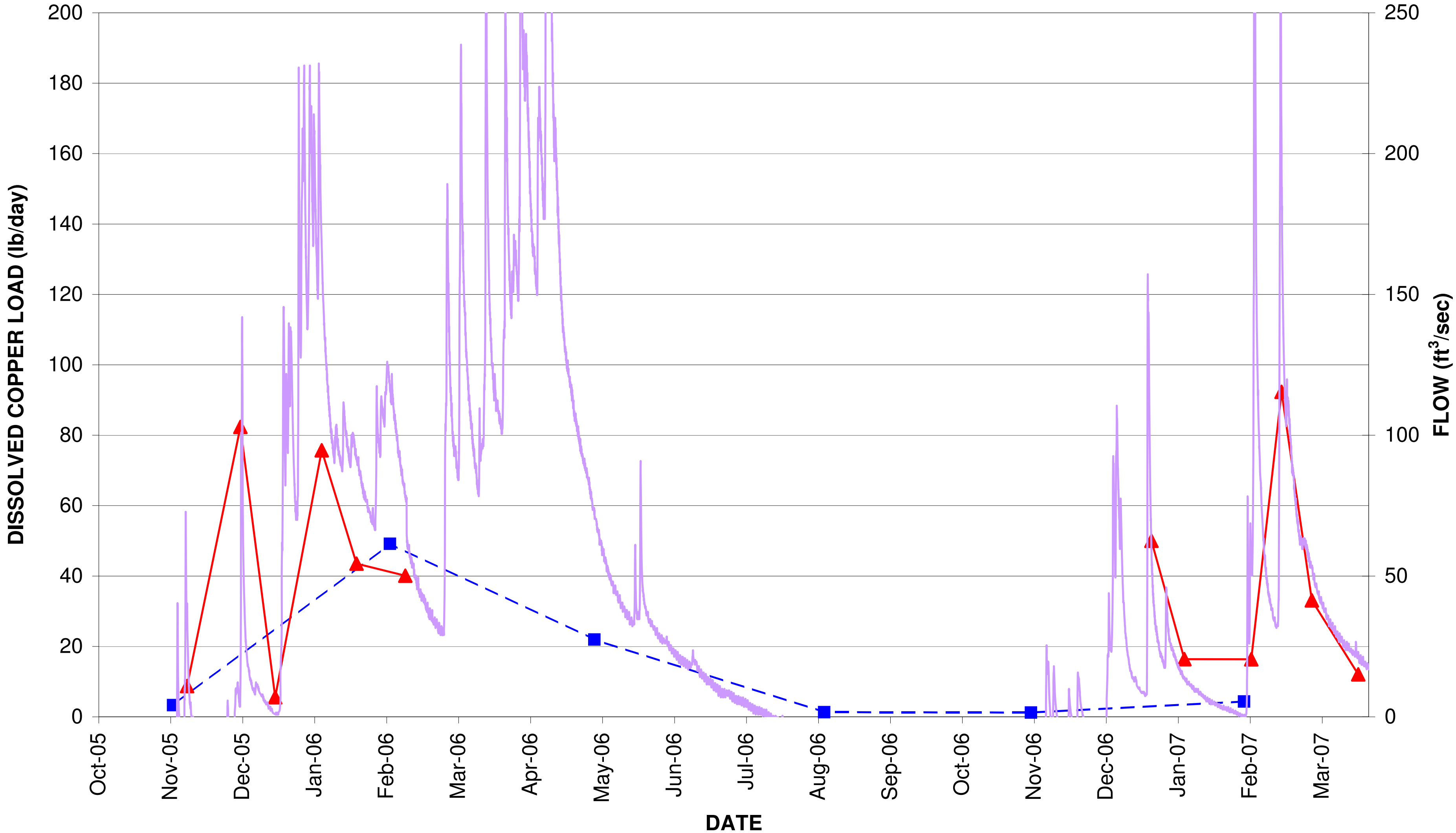
Update_Five-Year-Review.xls: FIG4



NOTES:
1. CTR = CALIFORNIA TOXICS RULE. CRITERION IS FOR A HARDNESS OF 40 mg/L.
2. TMDL = TOTAL MAXIMUM DAILY LOAD. UPPER SACRAMENTO RIVER TMDL (WATER BOARD, 2002) STATES THAT REGIONAL BOARD STAFF WILL DEVELOP ADDITIONAL MINE REMEDIATION AND OTHER ACTIVITIES AS NEEDED TO ADDRESS DISSOLVED COPPER CONCENTRATIONS IN SHASTA DAM RELEASES THAT EXCEED 1.3 µg/L.
3. DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 5
DISSOLVED AND TOTAL COPPER CONCENTRATIONS IN SACRAMENTO RIVER BELOW SHASTA DAM
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

Shasta-Keswick-5yr-Review.xls\FIG5-T&D-SRS



NOTES: EPA LOAD COMPUTED BY USING LITHIUM TRACER STUDY FOR DETERMINATION OF FLOW.

LBC_and_WSC_Vestra_Data.xls\FIG6

FIGURE 6
MRRC AND EPA DISSOLVED COPPER LOAD DATA
WEST SQUAW CREEK 2005-2007
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

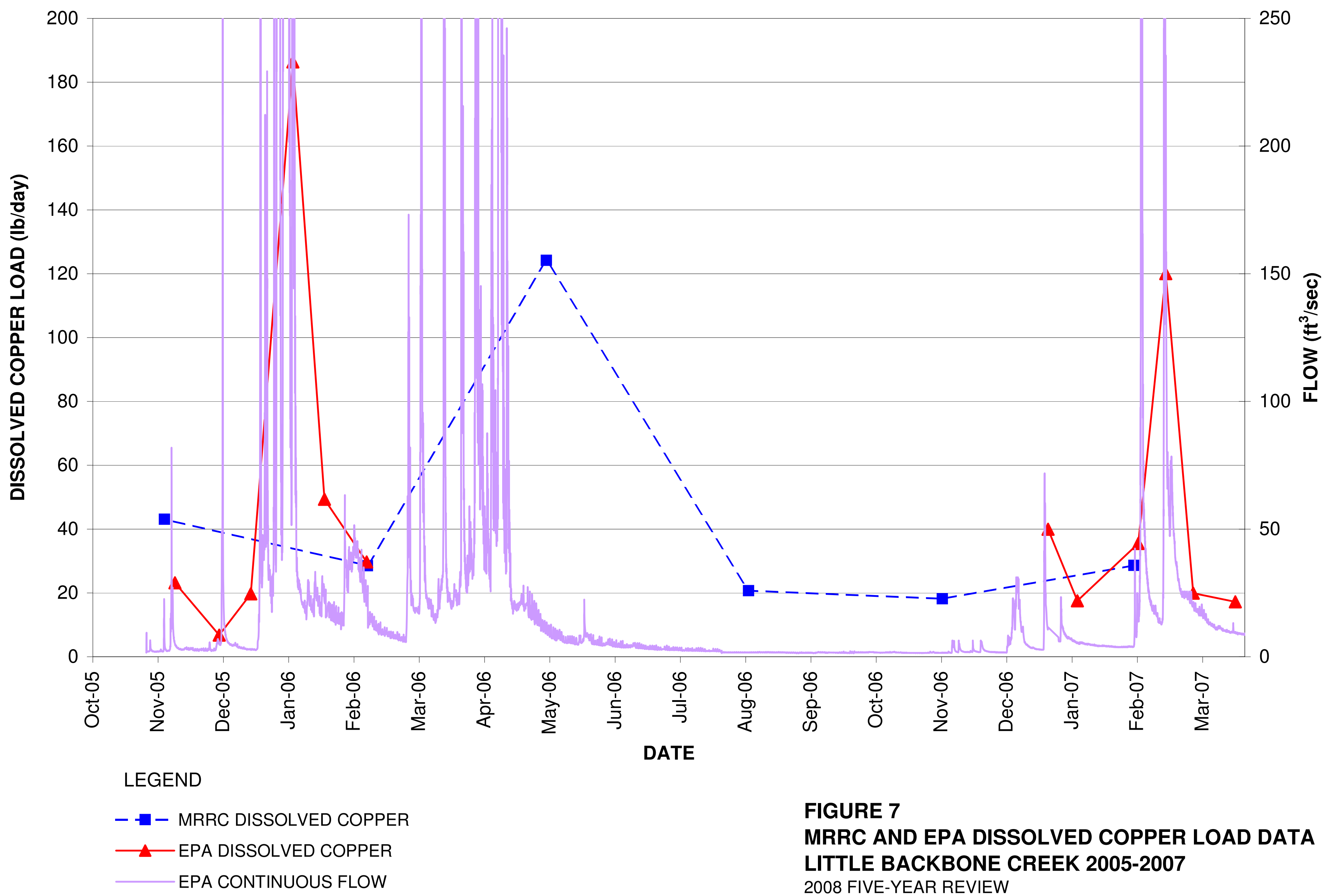


FIGURE 7
MRRC AND EPA DISSOLVED COPPER LOAD DATA
LITTLE BACKBONE CREEK 2005-2007
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

NOTES: EPA LOAD COMPUTED BY USING LITHIUM TRACER STUDY FOR DETERMINATION OF FLOW.

LBC_and_WSC_Vestra_Data.xls\FIG7

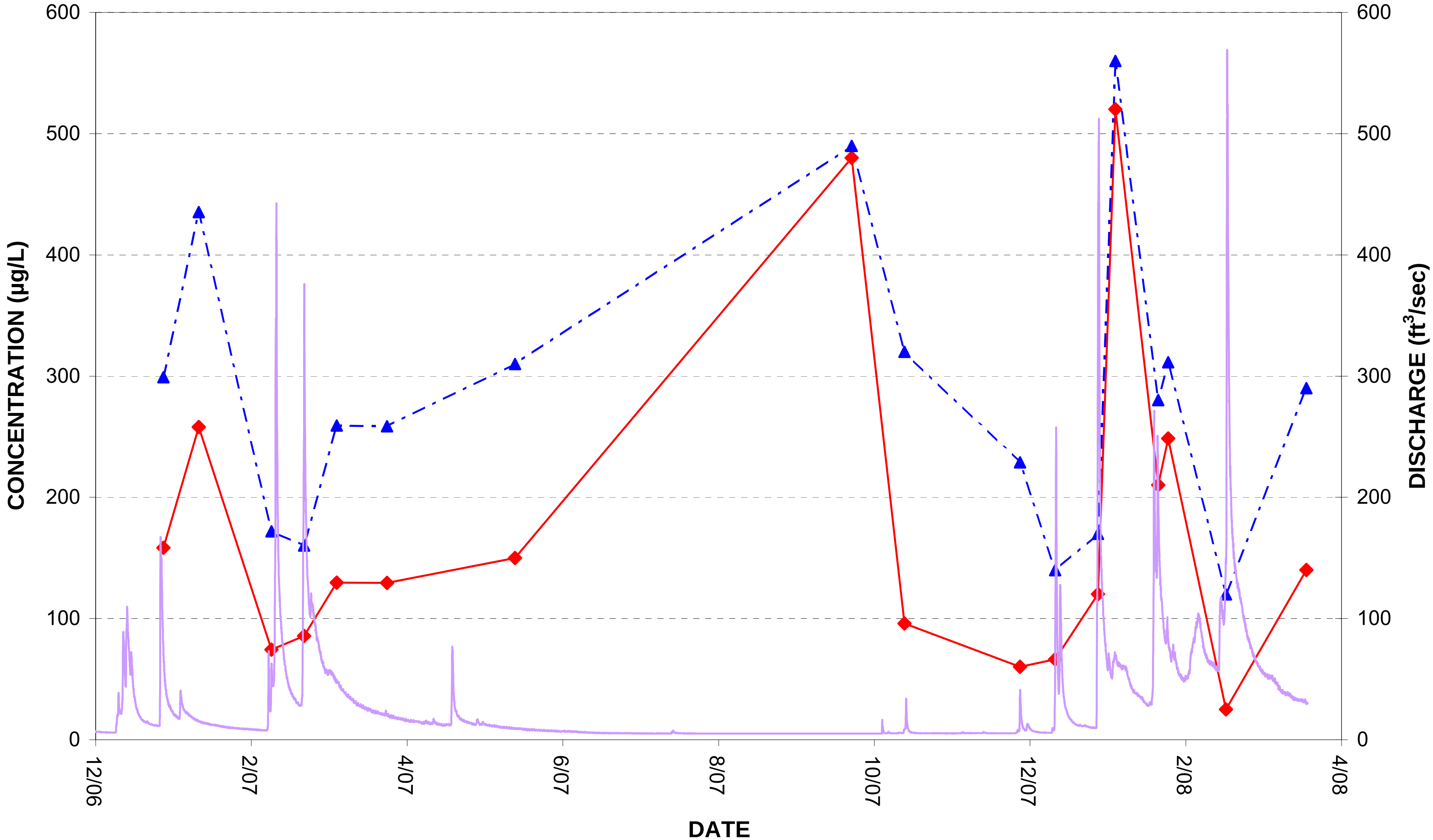
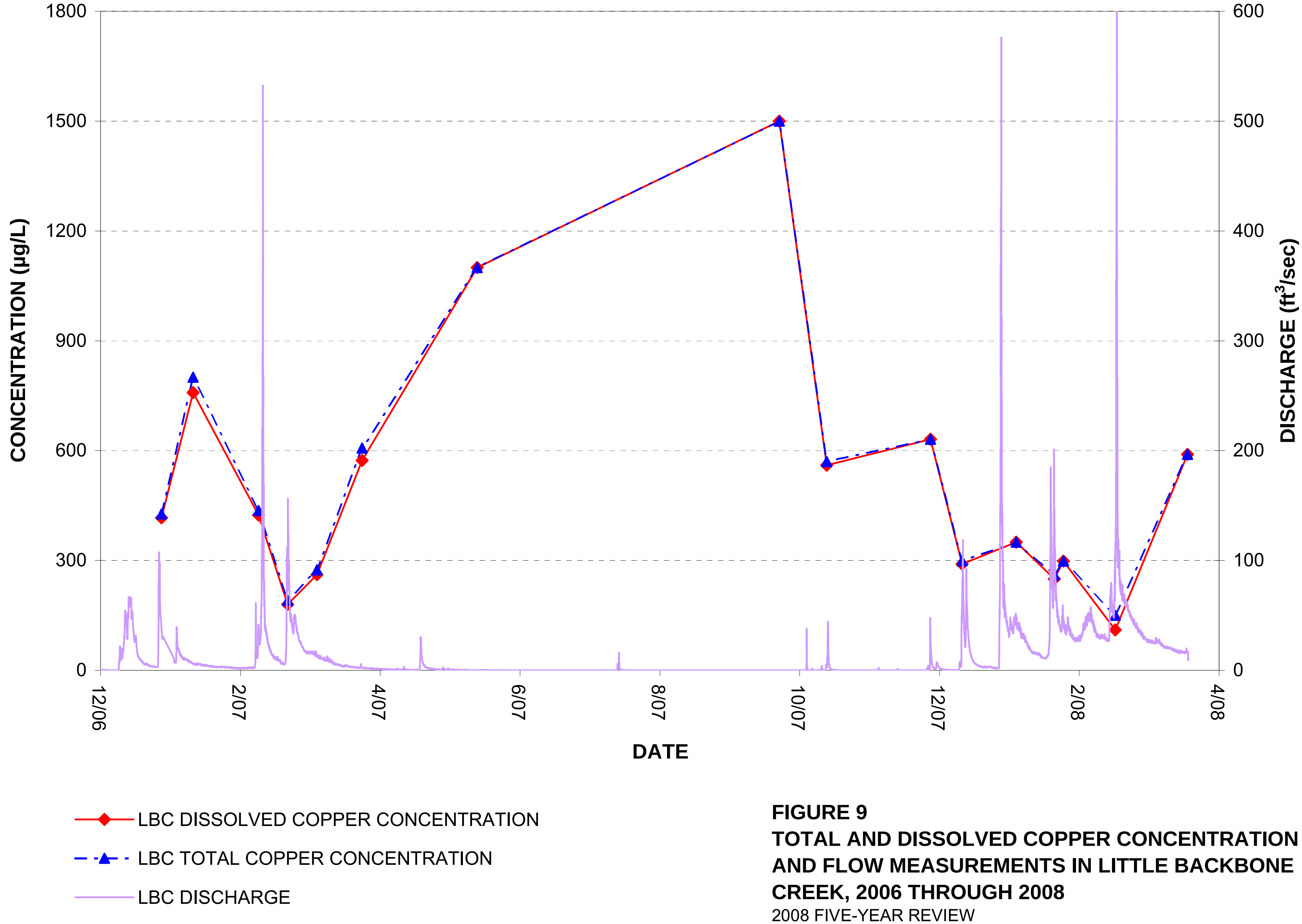


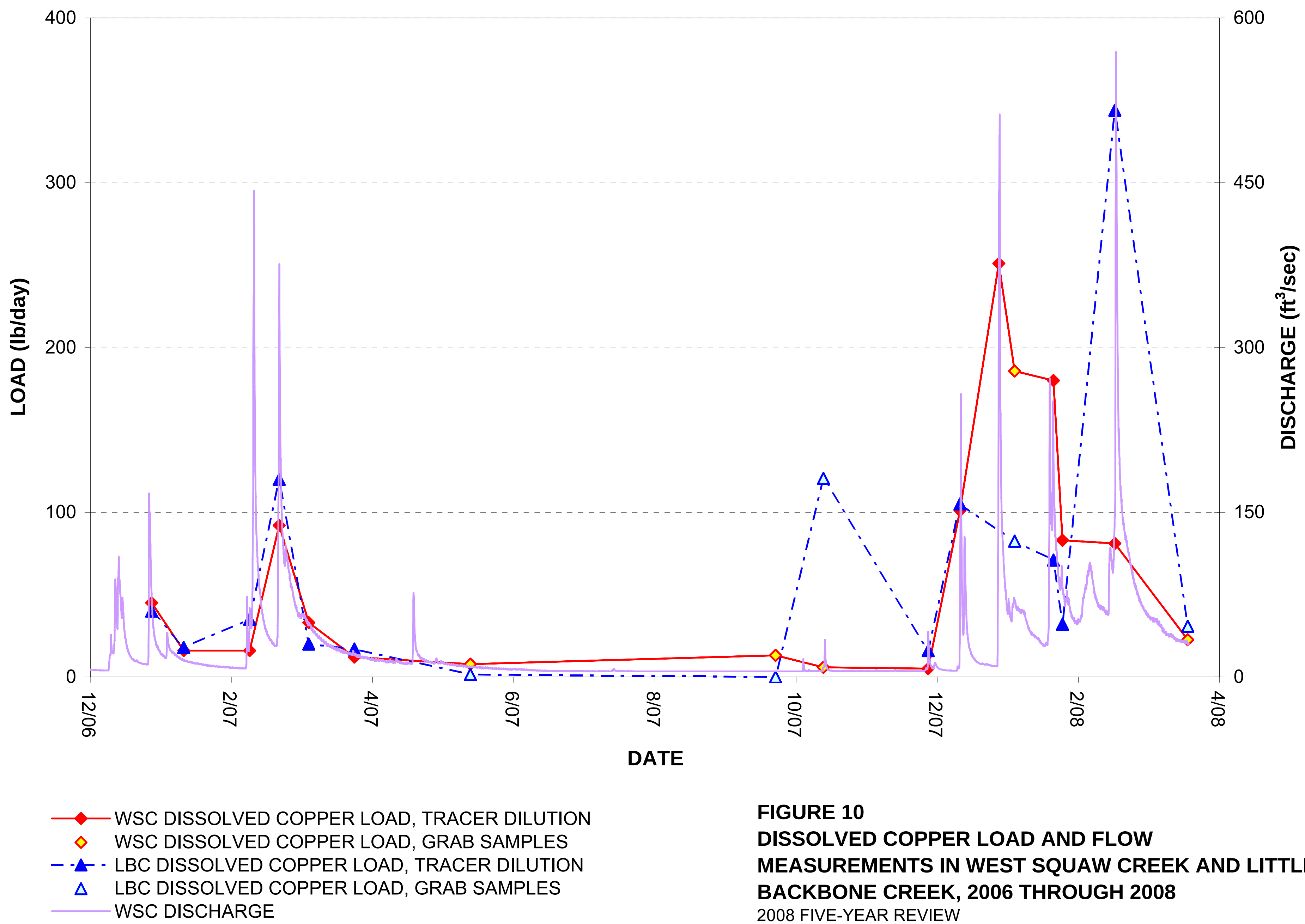
FIGURE 8
TOTAL AND DISSOLVED COPPER CONCENTRATION AND FLOW MEASUREMENTS IN WEST SQUAW CREEK, 2006 THROUGH 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

WSC-LBC-2007-2008Data.xls



WSC-LBC-2007-2008Data.xls

FIGURE 9
TOTAL AND DISSOLVED COPPER CONCENTRATION AND FLOW MEASUREMENTS IN LITTLE BACKBONE CREEK, 2006 THROUGH 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE



WSC-LBC-2007-2008Data.xls

FIGURE 10
DISSOLVED COPPER LOAD AND FLOW MEASUREMENTS IN WEST SQUAW CREEK AND LITTLE BACKBONE CREEK, 2006 THROUGH 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

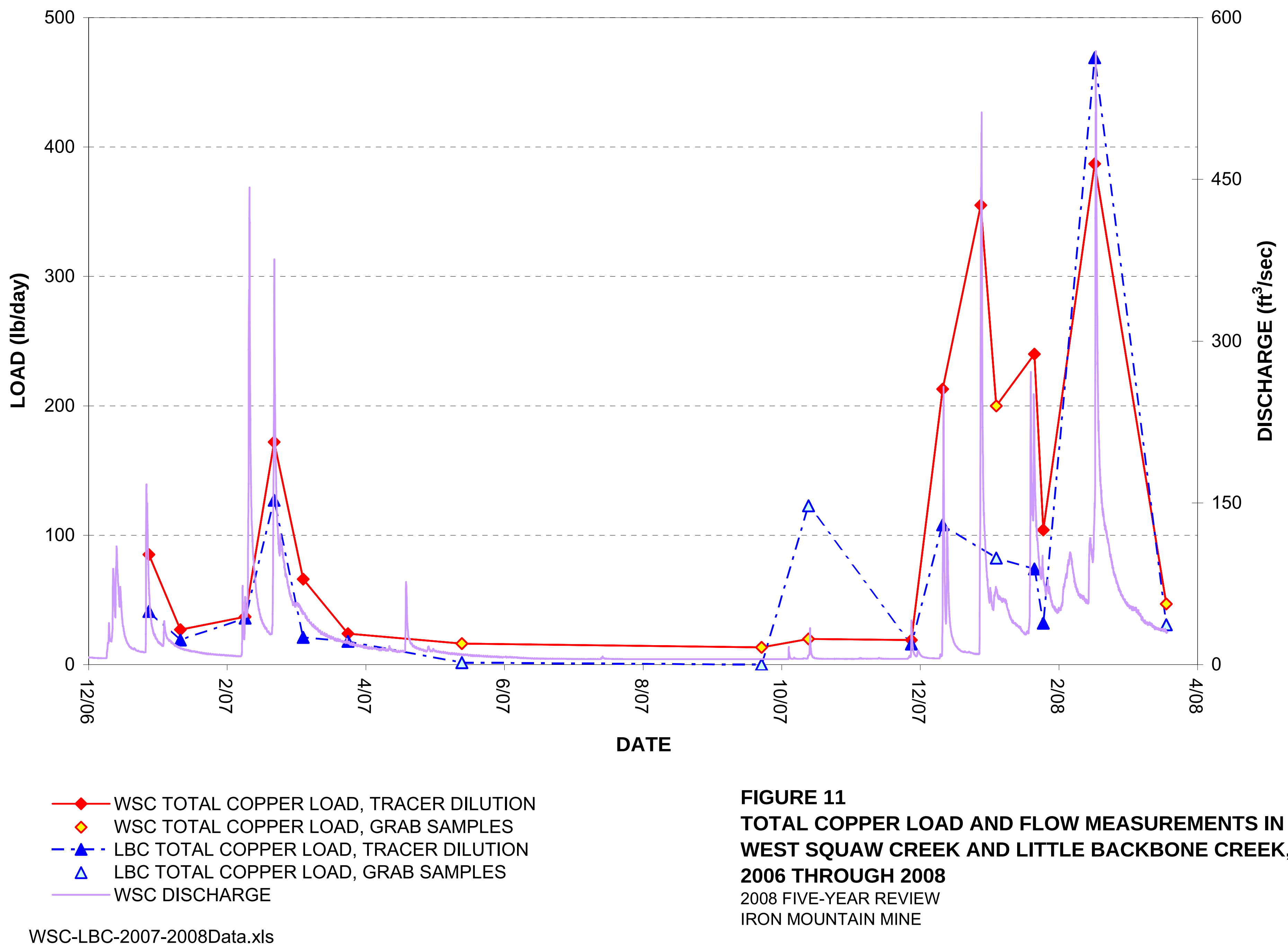
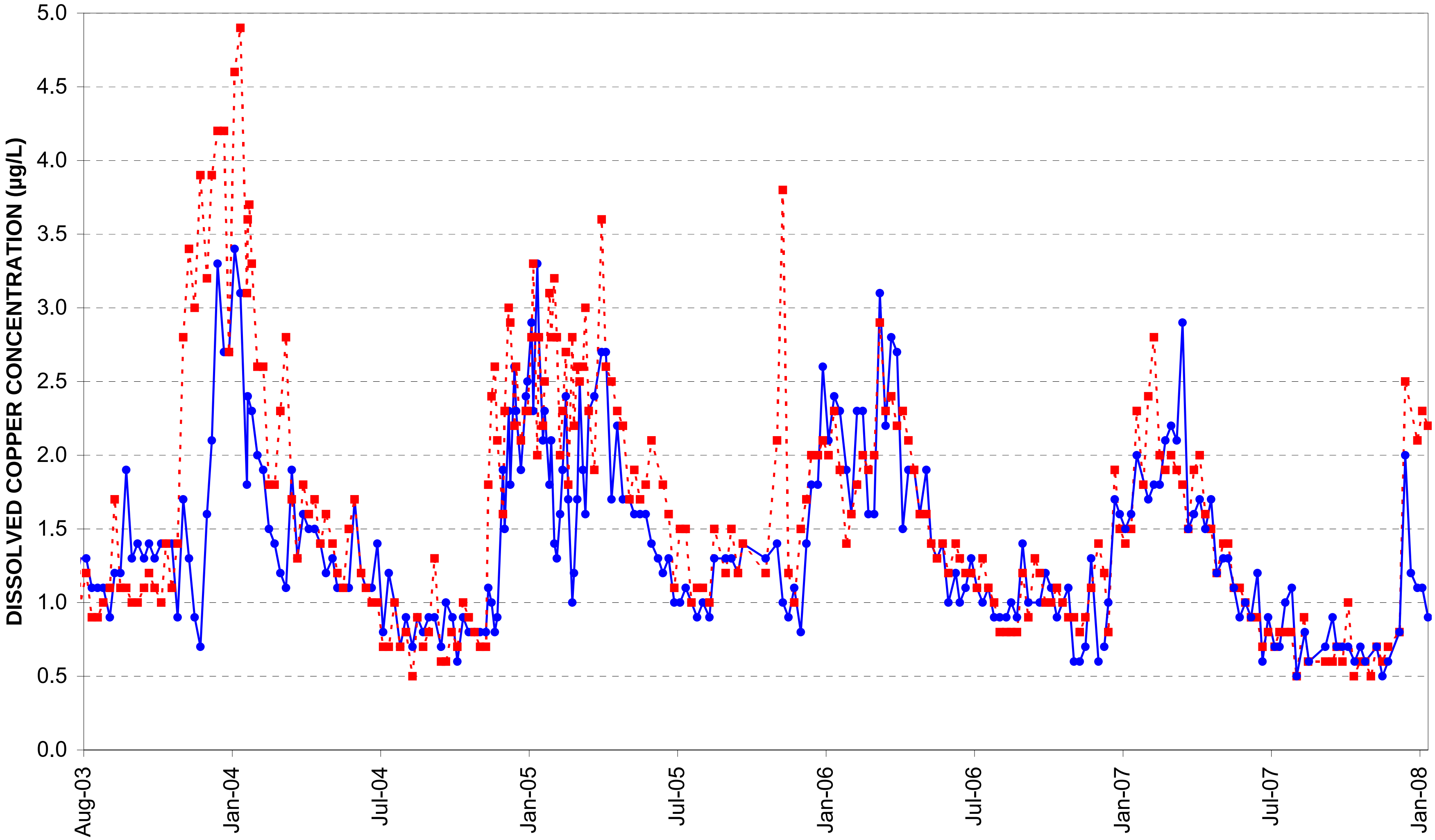


FIGURE 11
TOTAL COPPER LOAD AND FLOW MEASUREMENTS IN WEST SQUAW CREEK AND LITTLE BACKBONE CREEK, 2006 THROUGH 2008
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE



LEGEND

SACRAMENTO RIVER BELOW SHASTA DAM (SRS)

SACRAMENTO RIVER BELOW KESWICK DAM (SRK2)

NOTES:
DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 12
DISSOLVED COPPER CONCENTRATIONS IN SACRAMENTO RIVER BELOW SHASTA AND KESWICK DAMS
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

Shasta-Keswick-5yr-Review.xls\FIG12-Cu-SRS_SRK

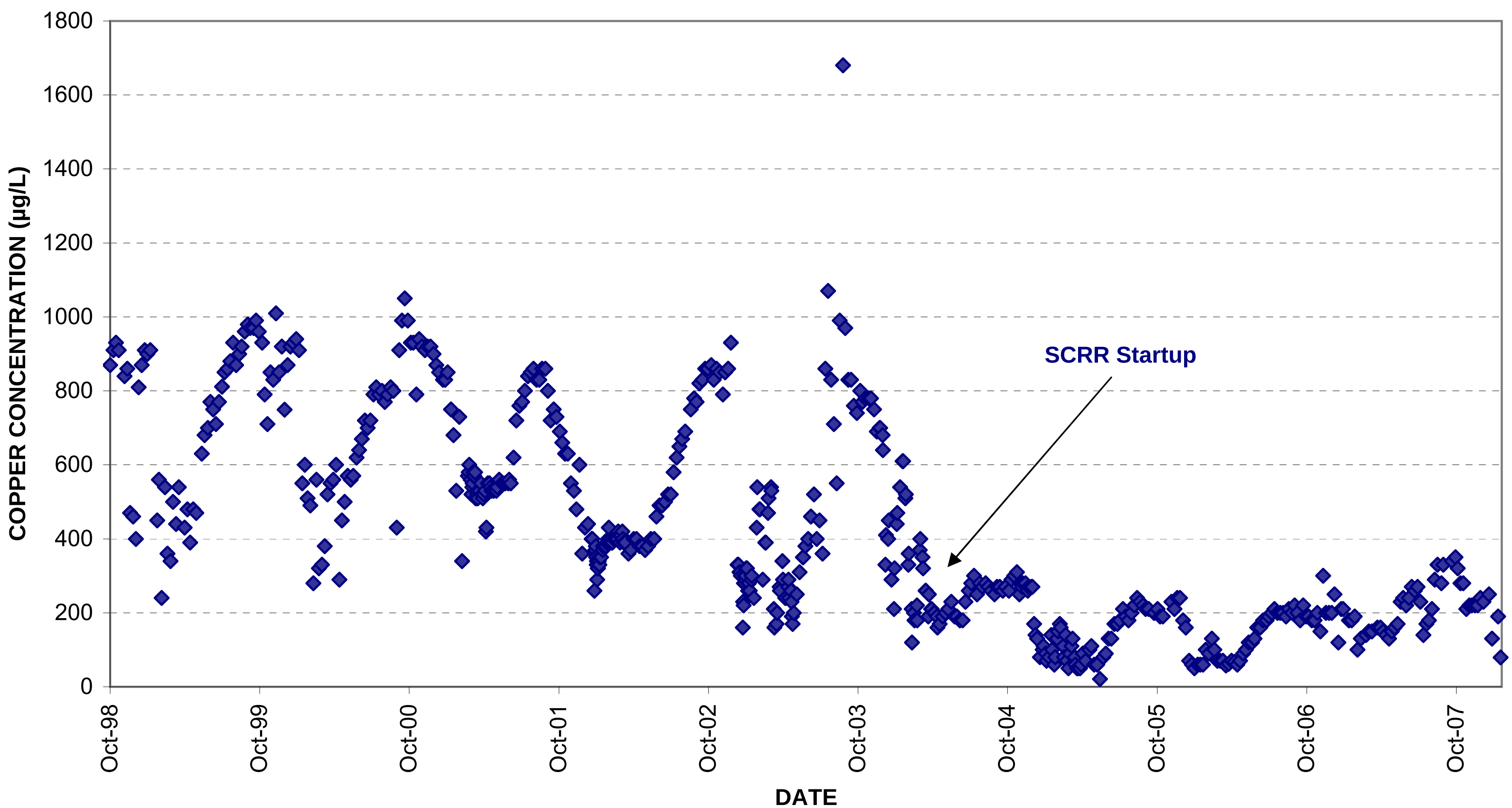
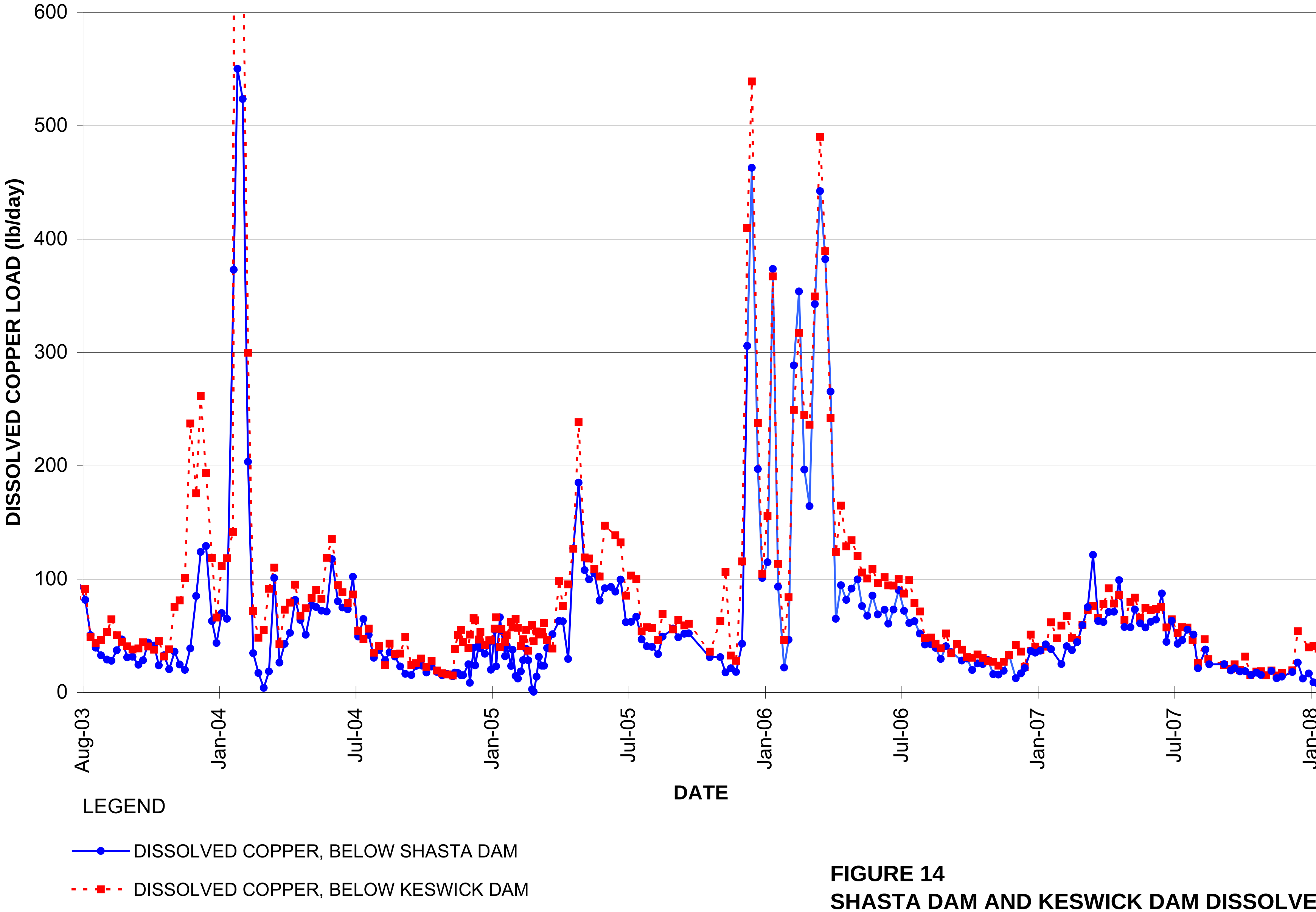


FIGURE 13
SPRING CREEK DEBRIS DAM COPPER CONCENTRATIONS
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

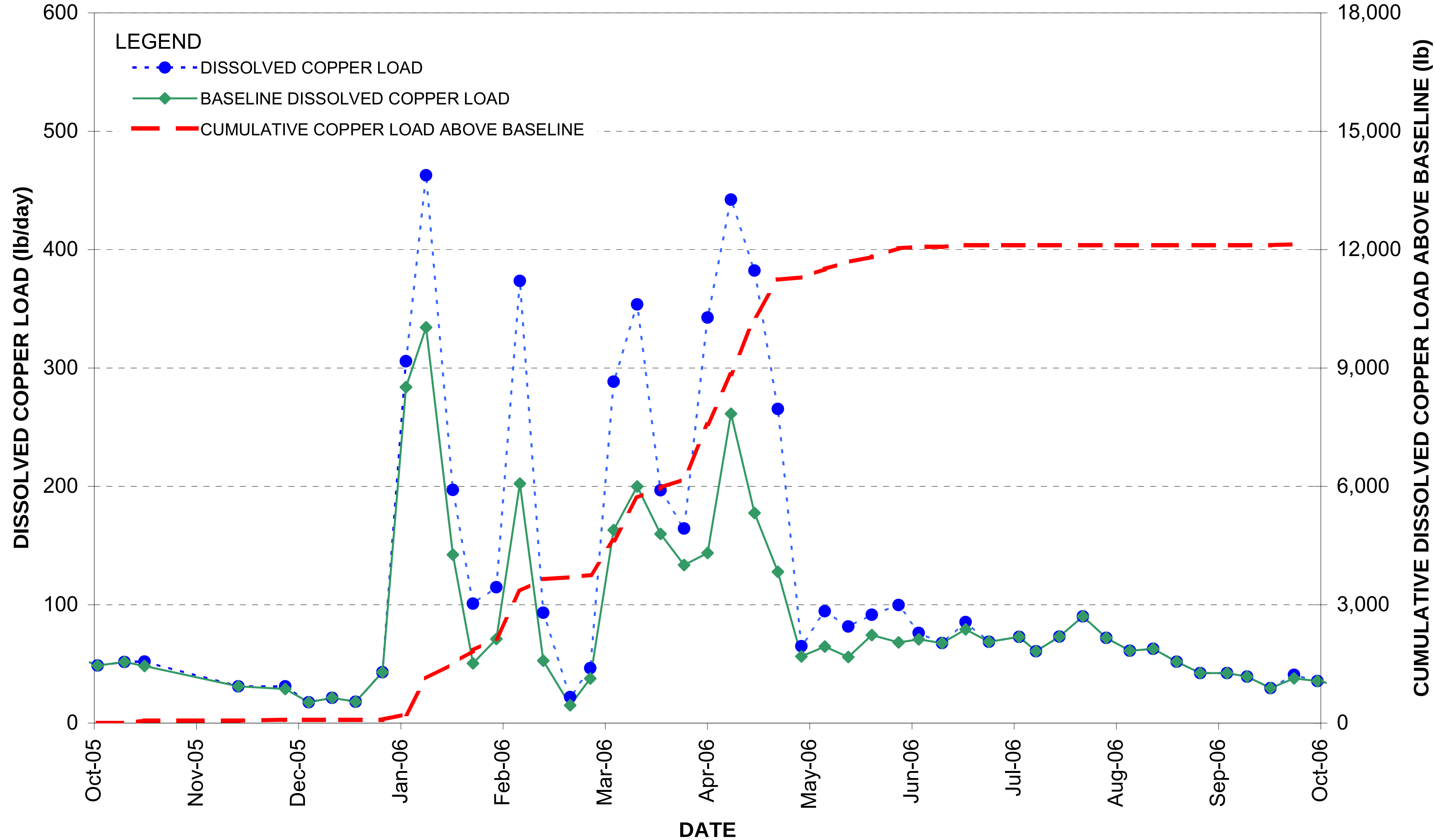
Update_Five-Year-Review.xls



NOTES:
DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 14
SHASTA DAM AND KESWICK DAM DISSOLVED COPPER LOADS
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

Shasta-Keswick-5yr-Review.xls\FIG14-SRS-SRK2-Load



NOTE:
THE BASELINE DISSOLVED COPPER LOAD IS CALCULATED AS A DISSOLVED COPPER CONCENTRATION OF 1.3 µg/L MULTIPLIED BY THE SHASTA DAM DISCHARGE. UPPER SACRAMENTO RIVER TMDL (WATER BOARD, 2002) STATES THAT REGIONAL BOARD STAFF WILL DEVELOP ADDITIONAL MINE REMEDIATION AND OTHER ACTIVITIES AS NEEDED TO ADDRESS DISSOLVED COPPER CONCENTRATIONS IN SHASTA DAM RELEASES THAT EXCEED 1.3 µg/L.
DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 15
SHASTA DAM DISSOLVED COPPER LOAD
2006 WATER YEAR
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

Shasta-Keswick-5yr-Review.xls\FIG15-SRS-Load-2006WY

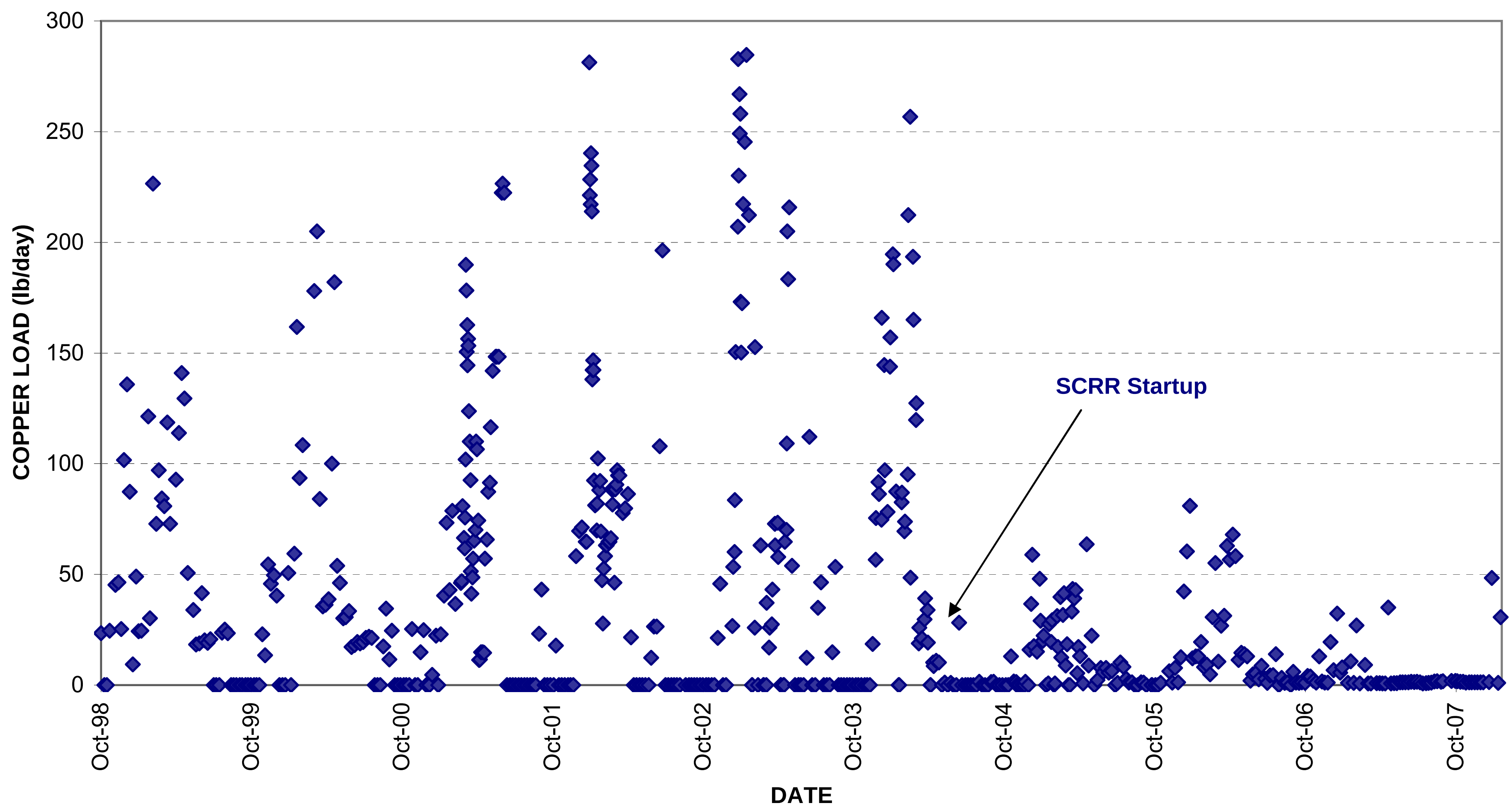
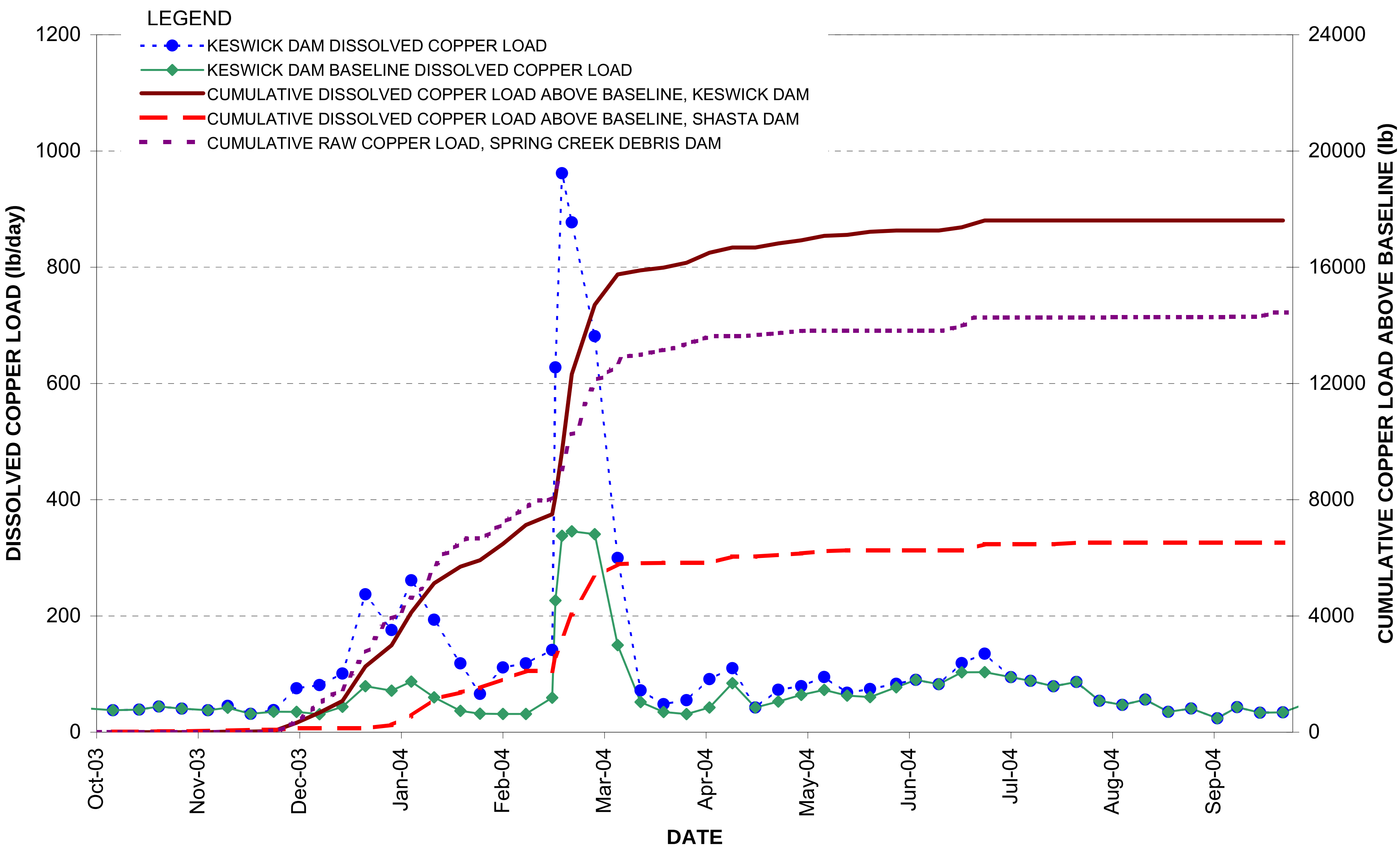


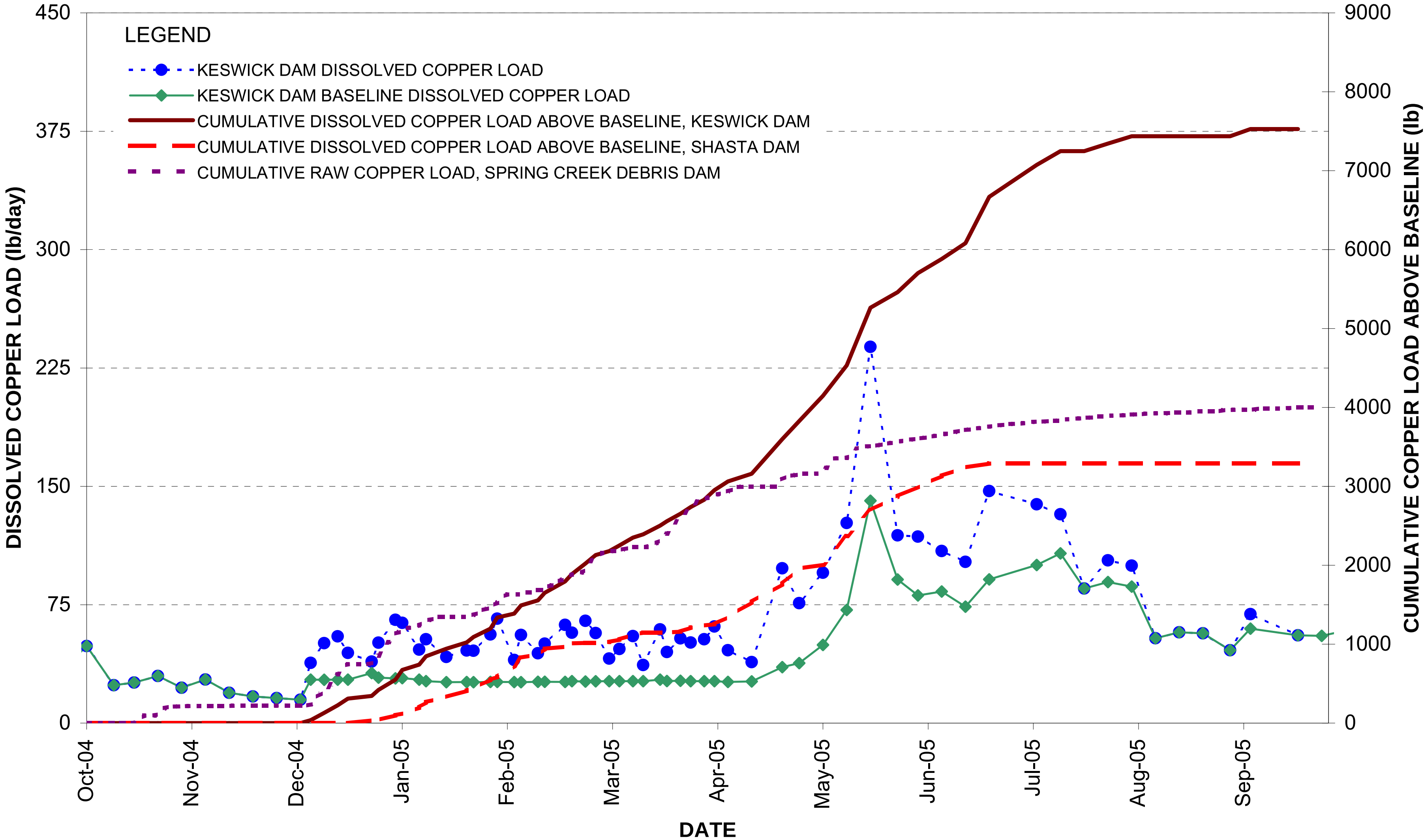
FIGURE 16
SPRING CREEK DEBRIS DAM COPPER LOADS
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE



NOTES:
1. DATA WERE COLLECTED BY BUREAU OF RECLAMATION.
2. AVERAGE RATIO OF DISSOLVED TO TOTAL COPPER FOR LSC WAS 0.95 FOR DATA COLLECTED BY CH2M HILL DURING 2005-2006 AND 2006-2007 WET SEASONS.
3. THE BASELINE DISSOLVED COPPER LOAD IS CALCULATED AS A DISSOLVED COPPER CONCENTRATION OF 1.3 µg/L MULTIPLIED BY THE DAM DISCHARGE.
4. DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 17
KESWICK DAM DISSOLVED COPPER LOAD
2004 WATER YEAR
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

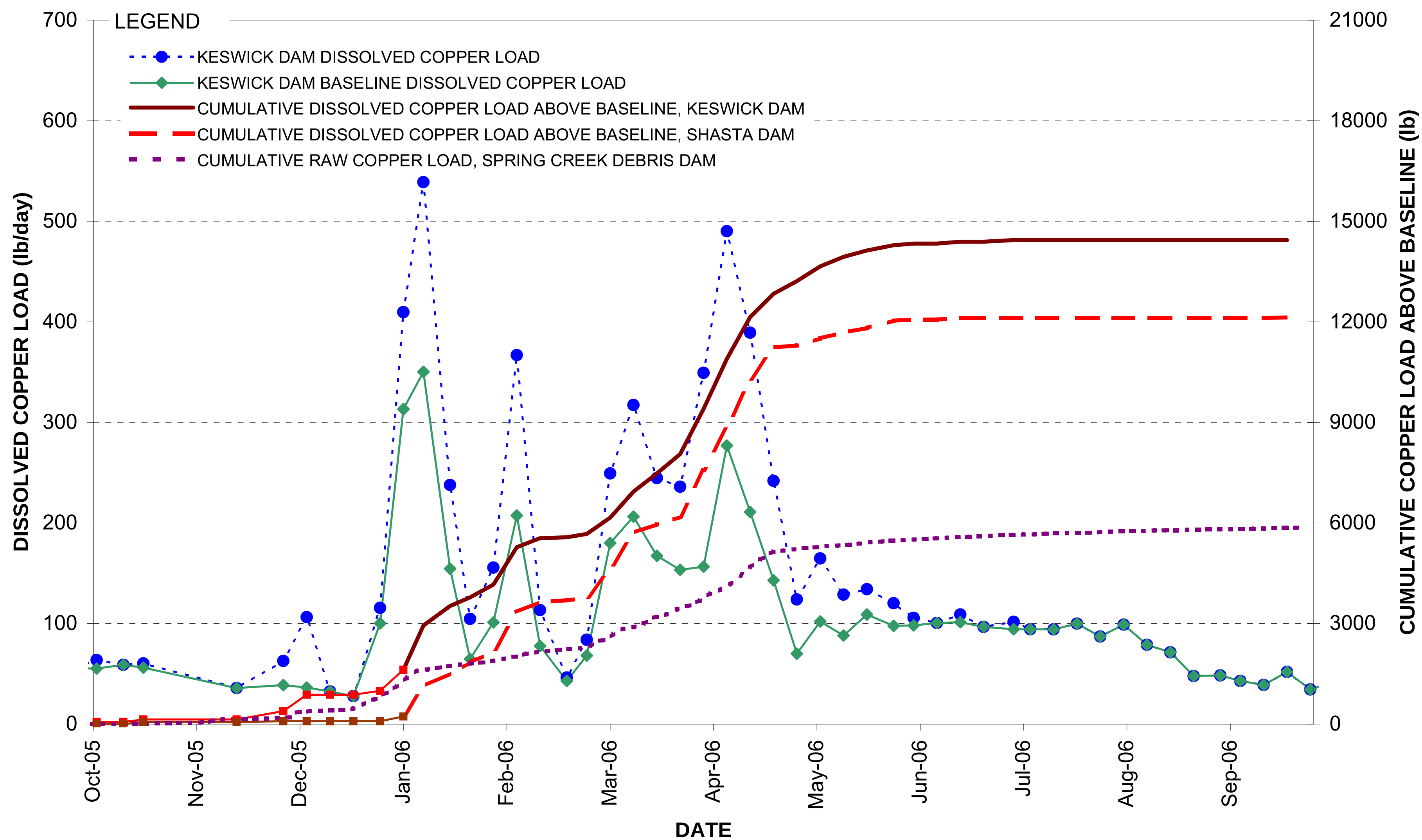
Shasta-Keswick-5yr-Review.xls\FIG17-WY2004



NOTES:
1. DATA WERE COLLECTED BY BUREAU OF RECLAMATION.
2. AVERAGE RATIO OF DISSOLVED TO TOTAL COPPER FOR LSC WAS 0.95
FOR DATA COLLECTED BY CH2M HILL DURING 2005-2006 AND 2006-2007 WET SEASONS.
3. THE BASELINE DISSOLVED COPPER LOAD IS CALCULATED AS A DISSOLVED COPPER CONCENTRATION OF 1.3 μg/L MULTIPLIED BY THE DAM DISCHARGE.
4. DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 18
KESWICK DAM DISSOLVED COPPER LOAD
2005 WATER YEAR
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

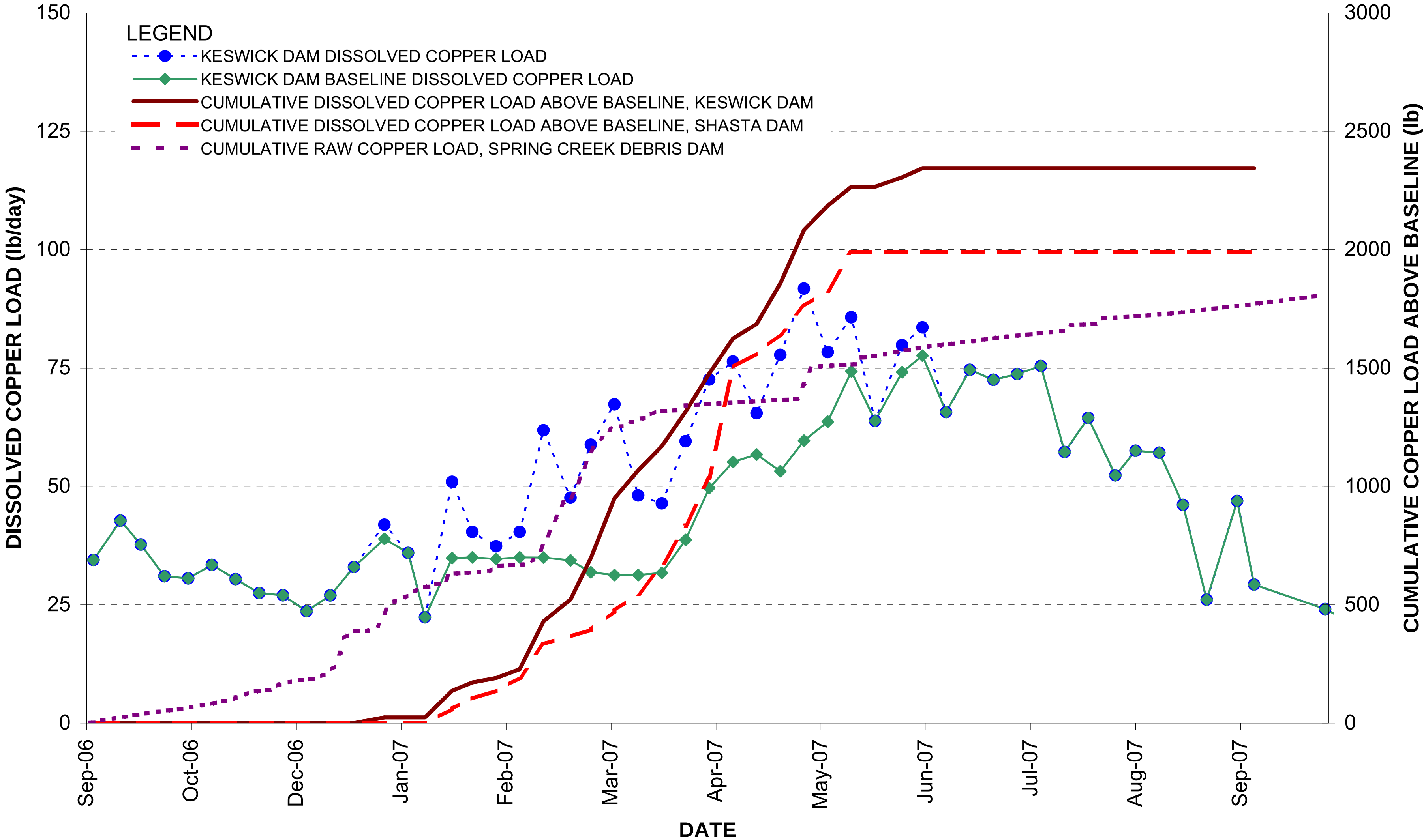
Shasta-Keswick-5yr-Review.xls\FIG18-WY2005



NOTES:
1. DATA WERE COLLECTED BY BUREAU OF RECLAMATION.
2. AVERAGE RATIO OF DISSOLVED TO TOTAL COPPER FOR LSC WAS 0.95 FOR DATA COLLECTED BY CH2M HILL DURING 2005-2006 AND 2006-2007 WET SEASONS.
3. THE BASELINE DISSOLVED COPPER LOAD IS CALCULATED AS A DISSOLVED COPPER CONCENTRATION OF 1.3 µg/L MULTIPLIED BY THE DAM DISCHARGE.
4. DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 19
KESWICK DAM DISSOLVED COPPER LOAD
2006 WATER YEAR
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

Shasta-Keswick-5yr-Review.xls\FIG19-WY2006



NOTES:
1. DATA WERE COLLECTED BY BUREAU OF RECLAMATION.
2. AVERAGE RATIO OF DISSOLVED TO TOTAL COPPER FOR LSC WAS 0.95
FOR DATA COLLECTED BY CH2M HILL DURING 2005-2006 AND 2006-2007 WET SEASONS.
3. THE BASELINE DISSOLVED COPPER LOAD IS CALCULATED AS A DISSOLVED COPPER
CONCENTRATION OF 1.3 µg/L MULTIPLIED BY THE DAM DISCHARGE.
4. DATA SOURCE: BUREAU OF RECLAMATION

FIGURE 20
KESWICK DAM DISSOLVED COPPER LOAD
2007 WATER YEAR
2008 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

Shasta-Keswick-5yr-Review.xls\FIG20-WY2007

Appendix

Table A-1

Copper and Zinc Load Discharge From SCDD

Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Water Year	SCDD Discharge (acre-ft)	Annual Copper (lb)	Cumulative Copper (lb)	Annual Zinc (lb)	Cumulative Zinc (lb)
1970	39,248	313,471	313,471	620,080	620,080
1971	32,334	249,828	563,298	967,460	1,587,539
1972	10,236	107,645	670,943	377,701	1,965,241
1973	38,853	324,551	995,494	733,315	2,698,556
1974	62,806	468,516	1,464,010	1,386,576	4,085,133
1975	31,213	236,319	1,700,329	440,408	4,525,540
1976	7,495	91,300	1,791,629	225,771	4,751,311
1977	2,955	63,044	1,854,674	208,976	4,960,288
1978	57,180	371,769	2,226,443	2,437,129	7,397,417
1979	15,156	125,212	2,351,655	468,785	7,866,202
1980	32,820	297,479	2,649,133	1,045,093	8,911,295
1981	24,276	124,935	2,774,068	554,420	9,465,715
1982	52,290	582,541	3,356,609	4,695,683	14,161,398
1983	83,856	451,591	3,808,199	1,714,696	15,876,094
1984	29,441	99,875	3,908,075	619,616	16,495,710
1985	19,680	141,365	4,049,439	1,028,050	17,523,760
1986	38,364	129,532	4,178,971	892,608	18,416,368
1987	16,813	136,958	4,315,929	1,019,126	19,435,495
1988	16,964	93,301	4,409,230	544,878	19,980,372
1989	19,579	95,706	4,504,936	504,504	20,484,876
1990	13,709	61,750	4,566,687	401,006	20,885,882
1991	4,730	36,728	4,603,414	209,692	21,095,574
1992	14,671	77,884	4,681,298	406,776	21,502,350
1993	23,240	114,970	4,796,268	591,205	22,093,556
1994	4,191	32,739	4,829,006	118,666	22,212,222
1995	40,952	72,601	4,901,607	110,379	22,322,601
1996	18,669	28,170	4,929,777	52,568	22,375,169
1997	28,856	27,851	4,957,628	47,313	22,422,483
1998	74,989	55,993	5,013,621	78,674	22,501,157
1999	25,769	19,957	5,033,578	31,465	22,532,622
2000	34,495	24,109	5,057,687	34,204	22,566,826
2001	15,831	13,561	5,071,247	18,294	22,585,120
2002	18,140	13,909	5,085,157	21,080	22,606,200
2003	31,294	17,594	5,102,751	32,708	22,638,908
2004	37,155	14,466	5,117,217	27,872	22,666,780
2005	25,593	4,001	5,121,218	15,167	22,681,948
2006	28,038	5,848	5,127,066	20,973	22,702,921
2007	3,636	1,807	5,128,872	5,483	22,708,404
2008	2,389	1,297	5,130,170	3,612	22,712,016
Total	1,077,903	5,130,170		22,712,016	

Notes:

1. Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

Table A-2

Copper and Zinc Load Collected by MFTP

Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Water Year	Plant Inflow (gal)	Influent Copper (lb)	Influent Zinc (lb)
1970			
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980			
1981			
1982			
1983			
1984			
1985			
1986			
1987			
1988			
1989			
1990	4,352,979	5,849	64,682
1991	5,380,272	11,658	85,316
1992	10,467,006	38,920	176,265
1993	25,305,355	79,182	351,492
1994	22,098,293	36,302	226,877
1995	162,372,924	351,478	972,529
1996	108,883,298	206,954	585,914
1997	107,146,938	169,516	537,979
1998	192,784,060	264,375	917,420
1999	107,791,992	107,154	477,614
2000	123,216,791	148,803	518,829
2001	86,938,235	89,408	330,862
2002	108,703,282	121,023	451,705
2003	151,703,449	184,276	610,797
2004	214,017,287	157,821	528,160
2005	426,468,214	149,546	531,520
2006	586,814,629	221,820	660,945
2007	157,239,602	51,775	188,292
2008	68,450,010	13,110	55,940
Total	2,670,134,617	2,408,970	8,273,139

Notes:

1. Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

Table A-3

Total Iron Mountain Copper and Zinc Load

Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review

Water Year	SCDD Discharge (acre-ft)	Annual Copper (lb)	Annual Zinc (lb)	Percent Reduction Water Year	Copper (%)	Zinc (%)
1970	39,248	313,471	620,080			
1971	32,334	249,828	967,460			
1972	10,236	107,645	377,701			
1973	38,853	324,551	733,315			
1974	62,806	468,516	1,386,576			
1975	31,213	236,319	440,408			
1976	7,495	91,300	225,771			
1977	2,955	63,044	208,976			
1978	57,180	371,769	2,437,129			
1979	15,156	125,212	468,785			
1980	32,820	297,479	1,045,093			
1981	24,276	124,935	554,420			
1982	52,290	582,541	4,695,683			
1983	83,856	451,591	1,714,696			
1984	29,441	99,875	619,616			
1985	19,680	141,365	1,028,050			
1986	38,364	129,532	892,608			
1987	16,813	136,958	1,019,126			
1988	16,964	93,301	544,878			
1989	19,579	95,706	504,504			
1990	13,709	67,600	465,688	1990	9%	14%
1991	4,730	48,385	295,008	1991	24%	29%
1992	14,671	116,804	583,041	1992	33%	30%
1993	23,240	194,152	942,698	1993	41%	37%
1994	4,191	69,040	345,543	1994	53%	66%
1995	40,952	424,078	1,082,908	1995	83%	90%
1996	18,669	235,124	638,483	1996	88%	92%
1997	28,856	197,367	585,292	1997	86%	92%
1998	74,989	320,368	996,094	1998	83%	92%
1999	25,769	127,111	509,079	1999	84%	94%
2000	34,495	172,912	553,033	2000	86%	94%
2001	15,831	102,969	349,156	2001	87%	95%
2002	18,140	134,932	472,786	2002	90%	96%
2003	31,294	201,871	643,505	2003	91%	95%
2004	37,155	172,287	556,032	2004	92%	95%
2005	25,593	153,547	546,687	2005	97%	97%
2006	28,038	227,667	681,918	2006	97%	97%
2007	3,636	53,582	193,775	2007	97%	97%
2008	2,389	14,407	59,553	2008	91%	94%
Total	1,077,903	7,539,139	30,985,155			

Notes:

1. Water Year 2008 includes data from October 1, 2007, through January 31, 2008.

ttac ment 5

Site Inspection Checklist

Site Inspection Checklist
Iron Mountain Mine Five-Year Review

I. SITE INFORMATION	
Site name: Iron Mountain Mine (IMM)	**Date of inspections:** Five-year review inspection on April 3, 2008, and 2007 scheduled annual inspections
Location and region: Redding, California, Region 9	**EPA ID:** CAD980498612
Agency, office, or company leading the five-year review: EPA and CH2M HILL	**Weather/temperature:** Sunny and warm (approximately 70 degrees Fahrenheit)

Remedy includes: (Check all that apply)

☑ Landfill cover/containment ☐ Monitored natural attenuation
☑ Access controls ☐ Groundwater containment
☐ Institutional controls ☐ Vertical barrier walls
☐ Groundwater pump and treatment
☑ Surface water collection and treatment
☐ Other__See Section IV of the *IMM Fourth Five-Year Review* for specifics of remedial actions implemented under Record of Decisions (ROD) 1 through 4.

Attachments: ☐ Inspection team roster attached ☑ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager**

Rudolph Carver/Iron Mountain Operation (IMO), Project Manager, 03/27/08, 04/03/08
Name/Title Date

Interviewed: ☑ at site ☐ at office ☐ by phone: 530/245-4477
Problems, suggestions; ☑ Report attached

Rudolph Carver provided a status update onsite maintenance and treatment plant audit recommendations from the *IMM Third Five-Year Review* (see Attachment 1 of the *IMM Fourth Five-Year Review*) and on recommendations from recent inspections (see Attachment 6). He also participated in the *IMM Fourth Five-Year Review* site inspection (see Attachment 6).

2. **O&M staff**

Wes Franks/IMO, Site Construction Manager 530/241-4599 04/03/08
Name/Title Phone number Date

Bob Lindskog/IMO, Minnesota Flats Treatment Plant (MFTP) Operator 530/245-4478 04/03/08
Name/Title Phone number Date

Interviewed: ☑ at site ☐ at office ☐ by phone
Problems, suggestions; ☑ Report attached

Wes Franks/IMO and Bob Lindskog/IMO participated in the April 3, 2008, site inspection. Observations and recommendations from the inspection are summarized in Attachment 6 of the *IMM Fourth Five-Year Review*.

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ____________________________

Contact ____________________________ ___________________ ________ ___________

Name Title Date Phone number

Problems; suggestions; ☐ Report attached ____

____

4. **Other interviews** (optional) ☐ Report attached.

Annette Rardin, a downgradient property owner, was interviewed on April 22, 2008, and her comments are incorporated into Attachment 6 of the *IMM Fourth-Five Year Review*.

Interviews of regulatory agency representatives were not performed during the *IMM Fourth Five-Year Review*. EPA determined that interviews were not necessary to provide additional information on site status. During the fourth five-year review performance period, EPA has been in regular contact with the IMM Technical Advisory Committee in support of the design of remedial actions selected in ROD 5 and the remedial investigation for Operable Unit 6.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☑ O&M manual	☑ Readily available	☐ Up to date	☐ N/A
☑ As-built drawings	☑ Readily available	☑ Up to date	☐ N/A
☑ Maintenance logs	☑ Readily available	☑ Up to date	☐ N/A

Remarks:

<u>O&M Manuals:</u>
IMO. 2001. *Operation and Maintenance Plan, Redding, Shasta County, California*. April.
EPA. 2000. *Statement of Work* (SOW) *Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California*. October. Modifications and clarifications to the SOW were recommended during the October 26, 2005, meeting between AIG Consultants, Inc. (AIG), EPA, IMO, and CH2M HILL. The *IMM Fourth Five-Year Review* recommends that EPA formally modify the SOW to incorporate appropriate changes.

<u>As-built Drawings:</u> IMO has the as-built drawings in the onsite trailers. The as-built drawings for Slickrock Creek Retention Reservoir (SCRR) were reviewed as an example.

<u>Maintenance Logs:</u> IMO describes maintenance in monthly reports submitted to AIG, the California Department of Toxic Substances Control (DTSC), the Central Valley Regional Water Quality Control Board (Water Board), EPA, and CH2M HILL.

2. **Site-Specific Health and Safety Plan** ☑ Readily available ☑ Up to date ☐ N/A
☑ Contingency plan/emergency response plan ☑ Readily available ☑ Up to date ☐ N/A

Remarks: IMO contracted SHN Consulting Engineers to update the health and safety plan and the injury and illness prevention plan in September 2007. The October 2000 statement of work (SOW) specifies procedures for emergency response (see SOW, Section 10), response to extreme events (see SOW, Section 11), and routine and nonroutine operations and maintenance (O&M) (see SOW, Section 9). IMO updated emergency contact information in the *Emergency Response Plan and Contingency Procedures, Iron Mountain Operations, Redding, Shasta County, California* in April 2008.

3. **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ☐ N/A

Remarks: OSHA training records were reviewed for one new employee as an example. The employee also receives hands-on O&M training.

4.	**Permits and Service Agreements** ☑ Air discharge permit ☑ Readily available ☑ Up to date ☐ N/A ☑ Effluent discharge ☑ Readily available ☐ Up to date ☐ N/A ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☑ N/A ☑ Other permits: California Department of Water Resources, Division of Safety of Dams for SCRR and Brick Flat Pit ☑ Readily available ☑ Up to date Remarks: IMO renews air discharge permits for the Minnesota Flats Treatment Plant (MFTP) (including lime storage silos, lime feed bins, associated baghouses, and lime slakers) and stand-by generators annually. IMO contracts GEI Consultants, Inc., to perform annual SCRR dam inspections, and DSOD performs annual inspections of SCRR and Brick Flat Pit to meet DSOD permit requirements. IMO maintains water usage permits with the State Water Resources Control Board. IMO does not obtain waste discharge permits; however, the October 2000 SOW specifies the Clean Water Act and best available technology (BAT) performance standards for the MFTP (see SOW, Sections 8 and 14). Modifications and clarifications to the SOW were recommended during the October 26, 2005, meeting between AIG, EPA, IMO, and CH2M HILL. The *IMM Fourth Five-Year Review* recommends that EPA formally modify the SOW to incorporate changes to the BAT standards (see Attachment 3).
5.	**Gas Generation Records** ☐ Readily available ☐ Up to date ☑ N/A Remarks____
6.	**Settlement Monument Records** ☑ Readily available ☑ Up to date ☐ N/A Remarks: Subsidence Areas: As part of ROD 1, EPA constructed partial caps in subsidence areas over the Richmond mineralized zone. IMO inspects, maintains, and repairs the capped subsidence areas. The annual survey of the subsidence areas and clay caps is documented in the applicable *Iron Mountain Operations Monthly Progress Report.* Boulder Creek Landslide: Settlement monuments (21 total) are surveyed by Pace Civil, Inc., to determine surface movements within the slope failure complex. The data are reported annually in the *Boulder Creek Landslide Survey Data Report*. The Mines Group, Inc., evaluates the data annually in the *Boulder Creek Landslide Annual Inspection and Evaluation*. Richmond Mine: Extensometer and multiple-point borehole extensometer (MPBX) readings are performed by IMO and reported annually in the *Richmond Mine Extensometer and MPBX Data Report*. Lawson Mine: Survey data are obtained by Pace Civil, Inc., and reported annually in the *Lawson Adit Survey Data*. The Mines Group, Inc., evaluates the data annually in the *Lawson Mine Annual Inspection Report*. SCRR: Data are obtained from vibrating wire piezometers, standpipe piezometers, spillway slope horizontal drains, load cells, seepage weir, dam crest settlement monuments, spillway excavation settlement monuments, and inclinometers. Evaluation is documented in the semiannual reports by GEI Consultants, Inc.
7.	**Groundwater Monitoring Records** ☑ Readily available ☑ Up to date ☐ N/A Remarks: Groundwater elevations are monitored at SCRR and Brick Flat Pit. SCRR data are documented in the semiannual reports by GEI Consultants, Inc. Brick Flat Pit groundwater elevations are included in the road operator monthly data sheets in the *IMO Monthly Progress Reports* and are reviewed by IMO staff. However, Brick Flat Pit groundwater elevations are not provided or maintained electronically. Groundwater quality data are not currently collected.
8.	**Leachate Extraction Records** ☑ Readily available ☑ Up to date ☐ N/A Remarks: Filtrate water quality analytical data are collected for Brick Flat Pit and the MFTP sludge drying beds. IMO reports the data monthly to AIG, DTSC, EPA, the Water Board, and CH2M HILL.

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ☑ N/A
☑ Water (effluent) ☑ Readily available ☑ Up to date ☐ N/A
Remarks: IMO collects MFTP influent, MFTP effluent, filtrate, and surface water analytical data and submits reports to AIG, DTSC, EPA, the Water Board, CH2M HILL monthly. An evaluation of MFTP effluent is provided as Attachment 3 of the *IMM Fourth Five-Year Review*.

10. **Daily Access/Security Logs** ☑ Readily available ☑ Up to date ☐ N/A
Remarks: A sign-in book is maintained in the IMO site trailer for all visitors as a permanent record of site access. A white board is used as a daily tracking tool for the time onsite and offsite for each visitor.

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☑ Other: A PRP-funded settlement is being used by AIG to fulfill the requirements of the 2000 SOW.

2. **O&M Cost Records**
☑ Readily available ☑ Up to date
☑ Funding mechanism/agreement in place
Original O&M cost estimate: Not readily available. ☐ Breakdown attached

Total Annual Cost by Year for Review Period (if available)

Date	Date	Total Cost	
From 12/01/06	to 11/30/0	$3,848,451	☑ Breakdown attached (see Attachment 6)
From 12/01/05	to 11/30/06	$5,640,711	☑ Breakdown attached (see Attachment 6)
From 12/01/04	to 11/30/05	$4,495,024	☑ Breakdown attached (see Attachment 6)
From 12/01/03	to 11/30/04	$4,875,511	☑ Breakdown attached (see Attachment 6)
From 12/01/02	to 11/30/03	$6,237,793	☑ Breakdown attached (see Attachment 6)

3. **Unanticipated or Unusually High O&M Costs during Review Period**
Describe costs and reasons: The costs incurred over the IMM Fourth Five-Year Review period were not unusually high or unanticipated. The costs are highly dependent on the precipitation received during each water year and the subsequent amount of acid mine drainage (AMD) generated and requiring treatment, sludge requiring dewatering, handling and disposal, and muck formation in the mine workings.

V. ACCESS AND INSTITUTIONAL CONTROLS ☑ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☑ Gates secured ☐ N/A
Remarks:____

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks: A description of current access controls is included as Attachment 7 of the *IMM Fourth Five-Year Review*.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented G Yes G No ☑ N/A
Site conditions imply ICs not being fully enforced G Yes G No ☑ N/A

Type of monitoring (e.g., self-reporting, drive by): Drive-by inspections.
Frequency ____Monthly ______________________________
Responsible party/agency: IMO contact:

Wes Franks	Site Manager	04/03/08	(530) 241-4599
Name	Title	Date	Phone number

Reporting is up-to-date G Yes G No ☑ N/A
Reports are verified by the lead agency G Yes G No ☑ N/A
Specific requirements in deed or decision documents have been met G Yes G No ☑ N/A
Violations have been reported G Yes G No ☑ N/A
Other problems or suggestions: ☑ Report attached (see Attachment 7)

If significant trespassing or vandalism occurs, IMO notifies Rick Sugarek/EPA and John Spitzley/CH2M HILL.

2. **Adequacy** G ICs are adequate G ICs are inadequate ☑ N/A
Remarks: An institutional control assessment is included as Attachment 7 of the *IMM Fourth Five-Year Review*. EPA has not yet implemented institutional controls at IMM in the five signed RODs. However, EPA has outlined IMM access controls in the October 2000 SOW; several interim actions, including fencing and security gates, have been implemented at IMM.

D. General

1. **Vandalism/trespassing** G Location shown on site map ☑ No vandalism evident
Remarks____

2. **Land use changes on site** ☑ N/A
Remarks____

3. **Land use changes off site** G N/A
Remarks: Nonmotorized trails have opened along portions of Keswick Reservoir and the Spring Creek Arm of Keswick Reservoir. These are discussed in Attachment 9 of the *IMM Fourth Five-Year Review*.

VI. GENERAL SITE CONDITIONS	
A. Roads ☑ Applicable G N/A	
1.	**Roads damaged** G Location shown on site map ☑ Roads adequate G N/A Remarks: Road maintenance requirements are detailed in the October 2000 SOW. Road maintenance needs were noted during the April 3, 2008, sitewide inspection and are currently scheduled in the 2008 maintenance list, *March 2008 Churn Creek Construction Co. Inc., Iron Mountain Job List – Per Wes Franks* (2008 Maintenance List).
B. Other Site Conditions	
	Remarks: Recommendations from the April 3, 2008, sitewide inspection and recent annual inspections are summarized in Attachment 6 of the *IMM Fourth Five-Year Review*.
VII. LANDFILL COVERS ☑ Applicable G N/A	
A. Landfill Surface	
1.	**Settlement** (Low spots) G Location shown on site map G Settlement not evident Areal extent______________ Depth____________ Remarks: IMO identified a sinkhole between two of the filtrate riser pipes in Brick Flat Pit. No settlement areas were identified at the Matheson disposal cell. As part of ROD 1, EPA constructed partial caps in subsidence areas over the Richmond mineralized zone. IMO inspects, maintains, and repairs the capped subsidence areas. The annual survey of the subsidence areas and clay caps was completed on October 16, 2007. In the *October 2007 IMO Monthly Progress Report*, IMO reported that a comparison of the 2007 and 2006 surveys indicated minimal continuing vertical movement of the monitored areas.
2.	**Cracks** G Location shown on site map ☑ Cracking not evident Lengths____________ Widths___________ Depths__________ Remarks____
3.	**Erosion** G Location shown on site map ☑ Erosion not evident Areal extent______________ Depth____________ Remarks____
4.	**Holes** G Location shown on site map ☑ Holes not evident Areal extent______________ Depth____________ Remarks____
5.	**Vegetative Cover** G Grass G Cover properly established G No signs of stress G Trees/Shrubs (indicate size and locations on a diagram) Remarks: Not applicable.
6.	**Alternative Cover (armored rock, concrete, etc.)** G N/A Remarks: The rock cover over the Matheson disposal cell is intact and no issues were identified.
7.	**Bulges** G Location shown on site map ☑ Bulges not evident Areal extent______________ Height____________ Remarks____

8. **Wet Areas/Water Damage** G Wet areas/water damage not evident
G Wet areas G Location shown on site map Areal extent______________
G Ponding G Location shown on site map Areal extent______________
☑ Seeps G Location shown on site map Areal extent______________
G Soft subgrade G Location shown on site map Areal extent______________
Remarks: Wet areas or water damage were not observed at Brick Flat Pit or the Matheson disposal cell during the April 3, 2008, site inspection. If flow occurs from the Brick Flat Pit Seep 8L, Filtrate 8R, or the spillway, the water is collected for treatment at MFTP and monitored for pH, copper, and zinc. No water was collected from Brick Flat Pit Seep 8L during the 2007 or 2008 water years.

9. **Slope Instability** G Slides G Location shown on site map ☑ No evidence of slope instability
Areal extent______________
Remarks____

B. Benches G Applicable ☑ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** G Location shown on site map ☑ N/A or okay
Remarks: Benches are present at Brick Flat Pit as a result of mining; they were not constructed for erosion control. Benches will be used for future roads as Brick Flat Pit continues to be filled with sludge from the high-density sludge treatment process.

2. **Bench Breached** G Location shown on site map ☑ N/A or okay
Remarks____

3. **Bench Overtopped** G Location shown on site map ☑ N/A or okay
Remarks____

C. Letdown Channels ☑ Applicable G N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** G Location shown on site map ☑ No evidence of settlement
Areal extent______________ Depth____________
Remarks: Letdown channels were not visually inspected by CH2M HILL during the April 3, 2008, site inspection; Wes Franks/IMO has not identified any issues in routine monthly inspections.

2. **Material Degradation** G Location shown on site map ☑ No evidence of degradation
Material type_______________ Areal extent_____________
Remarks____

3. **Erosion** G Location shown on site map ☑ No evidence of erosion
Areal extent______________ Depth____________
Remarks____

4. **Undercutting** G Location shown on site map ☑ No evidence of undercutting
Areal extent______________ Depth____________
Remarks____

5. **Obstructions** Type_____________________ ☑ No obstructions
G Location shown on site map Areal extent______________
Size____________
Remarks: IMO removes obstructions when they occur.

6. **Excessive Vegetative Growth** Type____________________
☑ No evidence of excessive growth
G Vegetation in channels does not obstruct flow
G Location shown on site map Areal extent______________
Remarks: IMO removes accumulated sediment and vegetation from the channels.

D. Cover Penetrations ☑ Applicable G N/A

1. **Gas Vents** G Active G Passive
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance
☑ N/A
Remarks____

2. **Gas Monitoring Probes**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance ☑ N/A
Remarks____

3. **Monitoring Wells** (within surface area of landfill)
G Properly secured/locked ☑ Functioning ☑ Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance ☑ N/A
Remarks: Piezometers are located at Brick Flat Pit, and water levels are recorded monthly. No water quality data is currently collected, and the monitoring wells were not inspected during the site visit.

4. **Leachate Extraction Wells**
G Properly secured/locked ☑ Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration ☑ Needs Maintenance G N/A
Remarks: If flow occurs from the Brick Flat Pit Seep 8L, Filtrate 8R, or the spillway, the water is collected for treatment at MFTP and is monitored for pH, copper, and zinc. The amount of filtrate has decreased significantly at Brick Flat Pit. No water was collected from Brick Flat Pit during the 2007 or 2008 water years. Two possible reasons for reduced filtrate flow have been identified: (1) the filtrate piping has malfunctioned, or (2) the amount of filtrate has decreased as a result of the thickness of the overlying sludge, and the water is exiting through the unlined sidewalls of the pit. The location of Brick Flat Pit was determined to be an effective sludge disposal location because drainage, if not captured, would re-enter the ore body and be captured by the AMD treatment system (see ROD 1) or would be discharged to the Slickrock Creek drainage, which is currently captured for treatment by SCRR. IMO should continue evaluations to identify the reason for the reduced filtrate at Brick Flat Pit. IMO has scheduled 4 filtrate riser pipes at Brick Flat Pit to be extended by 10 feet during the 2008 dry season.

5. **Settlement Monuments** G Located ☑ Routinely surveyed G N/A
Remarks:

<u>Brick Flat Pit</u>: Section 6.4 of the SOW requires that "by November 30 of each year, the Site Operator shall provide to the Oversight Agency, for Oversight Agency review and approval, the Landfill Management Report and Plan". The report is required to contain an updated as-built drawing of the Brick Flat Pit landfill, with updated topography. The most recent landfill management report plan submitted was the *2003 Landfill Management Report and Plant*. IMO should continue to submit an annual landfill management report and plan that addresses the requirements in the SOW.

<u>Subsidence Areas and Clay Caps</u>: The SOW requires that the site operator have annual surveys of the subsidence areas conducted by a licensed surveyor, or more frequently if changes occur in the appearance of the caps, steam vents, roadways, or drainage structures, or if the survey data indicate an increase in the rate of settlement. The most recent survey was performed on October 16, 2007.

<u>Boulder Creek Landslide</u>: The SOW requires the site operator to conduct annual surveys of settlement monuments in the Boulder Creek Landslide, or more frequent surveys if movement of the landslide is observed. The most recent survey was performed on September 27, 2007.

Lawson Mine: The SOW requires that the site operator have a licensed surveyor monitor critical adit components on an annual basis, and that the survey be conducted under the direction of a qualified engineer with mining experience. The most recent survey was performed on October 27, 2007.

SCRR: Dam crest settlement monuments and spillway slope settlement monuments are surveyed a minimum of once in the winter months and once in the summer months. If settlement is occurring, more frequent survey intervals are warranted. Surveys were performed in February and October 2007.

E. Gas Collection and Treatment G Applicable ☑ N/A

1. **Gas Treatment Facilities**
G Flaring G Thermal destruction G Collection for reuse
G Good condition G Needs Maintenance
Remarks____________________

2. **Gas Collection Wells, Manifolds and Piping**
G Good condition G Needs Maintenance
Remarks____________________

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
G Good condition G Needs Maintenance G N/A
Remarks____________________

F. Cover Drainage Layer G Applicable ☑ N/A

1. **Outlet Pipes Inspected** G Functioning G N/A
Remarks____________________

2. **Outlet Rock Inspected** G Functioning G N/A
Remarks____________________

G. Detention/Sedimentation Ponds ☑ Applicable G N/A

1. **Siltation** Areal extent______________ Depth____________ G N/A
G Siltation not evident.
Remarks: Sedimentation ponds are not located at Brick Flat Pit but are located at SCRR, and upstream from the Upper Spring Creek and Slickrock Creek clean water diversion intakes. Approximately 20 feet of material has accumulated in the SCRR main sedimentation basin. IMO constructed several upstream check dams that are effectively reducing the amount of sediment accumulating in the main sediment basin. Sediment and gravel has accumulated in the sedimentation basin at the Upper Spring Creek Diversion inlet and needs to be removed during the 2008 dry season. Sediment and gravel has accumulated upstream of the Slickrock Creek clean water diversion intake and should be removed during the 2008 dry season and routinely thereafter.

2. **Erosion** Areal extent______________ Depth____________
☑ Erosion not evident
Remarks____________________

3. **Outlet Works** ☑ Functioning G N/A
Remarks____________________

4. **Dam** ☑ Functioning G N/A
Remarks____________________

H. Retaining Walls G Applicable ☑ N/A

1. **Deformations** G Location shown on site map G Deformation not evident
Horizontal displacement____________ Vertical displacement_______________
Rotational displacement____________
Remarks____

2. **Degradation** G Location shown on site map G Degradation not evident
Remarks____

I. Perimeter Ditches/Off-Site Discharge ☑ Applicable G N/A

1. **Siltation** G Location shown on site map G Siltation not evident
Areal extent______________ Depth____________
Remarks: IMO performs routine monitoring and maintenance on perimeter ditches across the site in accordance with the SOW. Routine maintenance for several ditches was included in the 2008 Maintenance List provided by IMO during the April 3, 2008, site inspection. The 2008 Maintenance List includes O&M work to be completed during the 2008 dry season.

2. **Vegetative Growth** G Location shown on site map G N/A
G Vegetation does not impede flow
Areal extent______________ Type____________
Remarks: See discussion in Section VI-I-1 (Siltation).

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent______________ Depth____________
Remarks: See discussion in Section VI-I-1 (Siltation).
____

4. **Discharge Structure** ☑ Functioning G N/A
Remarks____

VIII. VERTICAL BARRIER WALLS G Applicable ☑ N/A

1. **Settlement** G Location shown on site map G Settlement not evident
Areal extent______________ Depth____________
Remarks____

2. **Performance Monitoring** Type of monitoring__________________________
G Performance not monitored
Frequency_______________________________ G Evidence of breaching
Head differential__________________________
Remarks____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☑ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☑ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☑ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A
Remarks: Attachment 6 of the *IMM Fourth Five-Year Review* details changes IMO has implemented to operation of Old/No. 8 Mine Seep pumping well PW3, including construction of a gravity drainage system. CH2M HILL recommends that IMO submit an as-built drawing of the Old/No. 8 gravity discharge system and a description of the intended operation for a formal review by CH2M HILL and EPA. CH2M HILL recommends using the Old/No. 8 gravity discharge only as an emergency backup system.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☑ Good condition ☐ Needs Maintenance
Remarks: See discussion in Section IX-A-1 (Pumps, Wellhead Pumping, and Electrical)

3. **Spare Parts and Equipment**
☑ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks____

B. Surface Water Collection Structures, Pumps, and Pipelines ☑ Applicable ☐ N/A

1. **Collection Structures, Pumps, and Electrical**
☑ Good condition ☐ Needs Maintenance
Remarks: Pumps include utility water, filtrate, lime slurry, and submerged thickener pumps. The hours and limits for each pump are checked weekly, and operation is frequently switched between redundant pumps. Sludge pumps submerged in TK-11 are switched daily and serviced annually.

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☑ Good condition ☐ Needs Maintenance
Remarks: The AMD collection and conveyance system is used to monitor, capture, and convey AMD to the MFTP. The system includes high-density polyethylene pipelines, grit chambers, check dams, risers, air relief valves, pumps, electrical systems, process control systems, telemetry systems, leak detection systems, and backup systems.

3. **Spare Parts and Equipment**
☑ Readily available ☑ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks: All pumps, monitoring equipment, and tanks, except the thickener, have redundancy. If the thickener is taken offline for maintenance, emergency storage can be used at SCRR, within the Old/No. 8 Mine, and the 1-million-gallon emergency storage tank (TK14). If necessary, the simple mix treatment process can be used to address AMD if the emergency storage tank fills.

C. Treatment System ☑ Applicable G N/A

1. **Treatment Train** (Check components that apply)
☑ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☐ Carbon adsorbers
☐ Filters: Filters are used for the intake process water only. No filters are currently used for the MFTP high-density sludge treatment process.
☑ Additive (*e.g.*, chelation agent, flocculent): Lime
☑ Others____
☑ Good condition ☐ Needs Maintenance
☐ Sampling ports properly marked and functional: Sampling ports are functional but labeling is needed to mark the ports
☑ Sampling/maintenance log displayed and up to date
☑ Equipment properly identified
☐ Quantity of groundwater treated annually: MFTP flow rates totaled under surface water.
☑ Quantity of surface water treated annually: During the five-year review period (2003 to 2007 water years), the annual treatment plant inflow ranged from 150 to 590 million gallons.

2. **Electrical Enclosures and Panels** (properly rated and functional)
G N/A ☑ Good condition G Needs Maintenance
Remarks: The MFTP programmable logic controller (PLC) system was updated to use Modicon Quantum controllers in 2007.

3. **Tanks, Vaults, Storage Vessels**
G N/A ☑ Good condition ☑ Proper secondary containment G Needs Maintenance
Remarks: See Attachment 6 of *IMM Fourth Five-Year Review* regarding recent tank inspection and maintenance.

4. **Discharge Structure and Appurtenances**
G N/A ☑ Good condition G Needs Maintenance
Remarks____

5. **Treatment Building(s)**
G N/A ☑ Good condition (esp. roof and doorways) G Needs repair
☑ Chemicals and equipment properly stored
Remarks____

6. **Monitoring Wells** (pump and treatment remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance ☑ N/A
Remarks____

D. Monitoring Data

1. Monitoring Data
☑ Is routinely submitted on time ☑ Is of acceptable quality (see Attachment 3)

2. Monitoring data suggests:
G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance ☑ N/A
Remarks____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A site inspection summary of remedy components is provided in Attachment 6 of the *IMM Fourth Five-Year Review*.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emission).

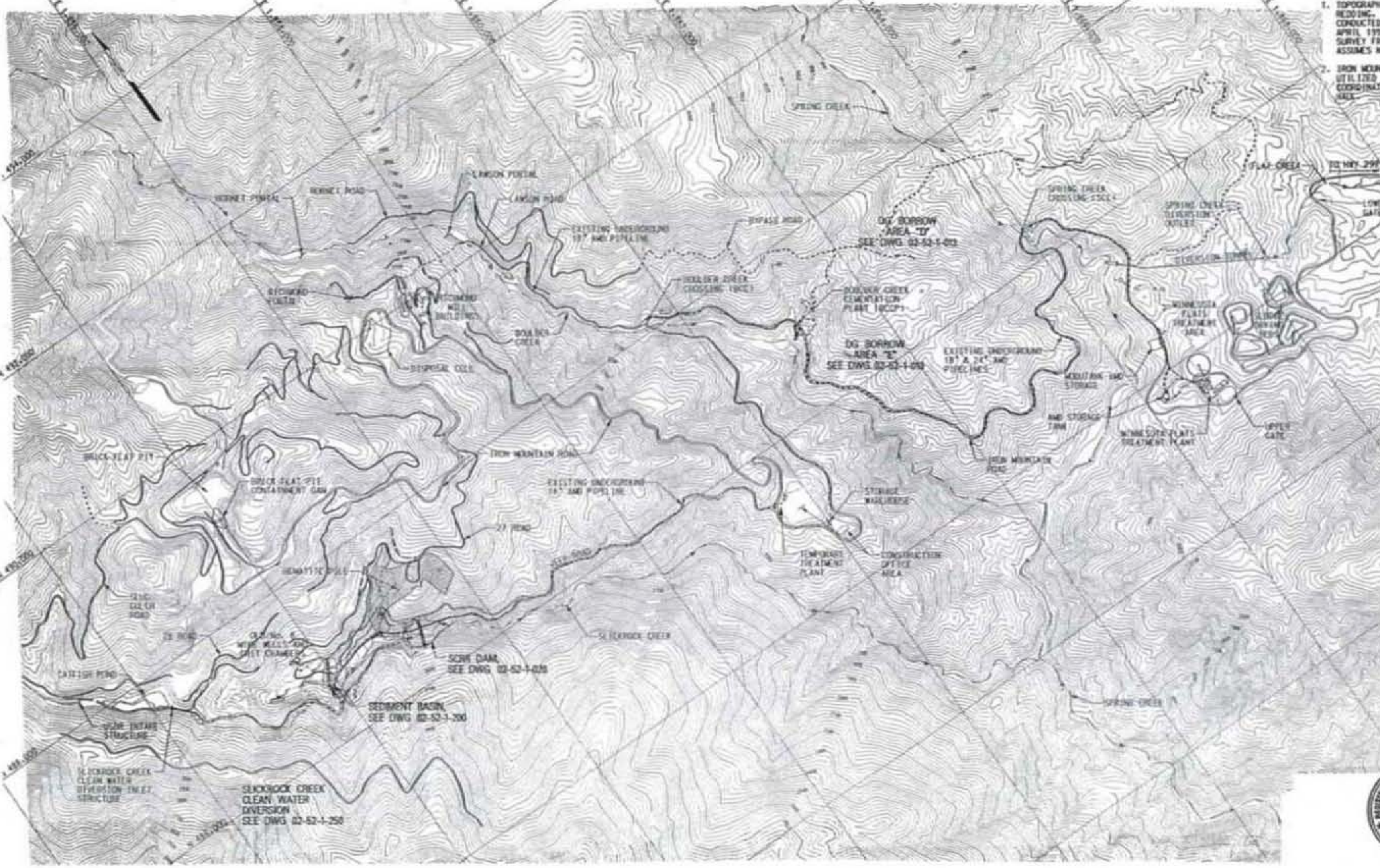
No issues or observations were identified during the April 3, 2008, site visit that would be expected to impact the effectiveness of remedies implemented under RODs 1 through 4.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Issues and observations related to implementation and scope of the O&M procedures were identified during the April 3, 2008, site visit. These are detailed in Attachment 6, and significant issues and observations were carried forward as recommendations and follow-up actions in Section VI of the *IMM Fourth Five-Year Review*.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations were identified during the April 3, 2008, site visit that indicate the protectiveness of the remedies may be compromised.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No significant opportunities for optimization were identified during the April 3, 2008, site visit.



NOTES

1. TOPOGRAPHY SHOWN WAS PROVIDED BY PACE CIVIL, REDDING, CA. BASED ON THE AERIAL SURVEYS CONDUCTED IN AUGUST 1998 AND SUPPLEMENTED BY THE APRIL 1994 SURVEY PROVIDED BY PACE AND THE 1998 SURVEY FROM CH2M HILL. MORRISON KNUDSEN CORPORATION ASSUMES NO RESPONSIBILITY FOR ITS ACCURACY.
2. IRON MOUNTAIN ROAD FROM MFTP TO BFP WILL BE UTILIZED FOR THE SLUDGE HAUL. CONTRACTOR MUST COORDINATE ACTIVITIES WITH SMC DURING THE SLUDGE HAUL.

A	ISSUED FOR CONSTRUCTION	

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL GROUP
353 SACRAMENTO STREET, SUITE 1900
SAN FRANCISCO, CA 94111

STAUFFER MANAGEMENT CO.
IRON MOUNTAIN
SHASTA COUNTY CALIFORNIA

IRON MOUNTAIN MINE - SLICKROCK CREEK RETENTION RESERVOIR
IRON MOUNTAIN
SITE PLAN

4877-02	02-52-1-010	0

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Site Inspection Summary

Site Inspection Summar
Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek / U.S. Environmental Protection Agency

PREPARED BY: John Spitzley / CH2M HILL
Sandra Shearer / CH2M HILL
Dave Bunte / CH2M HILL
Eric Halpenny / CH2M HILL

CC: Dave Sadoff / AIG
Rudy Carver / Iron Mountain Operations
Wes Franks / Iron Mountain Operations
Bob Lindskog / Iron Mountain Operations

DATE: May 9, 2008

PROJECT NUMBER: 367266.SI.01 and 338462.RO.01

This memorandum presents observations made during the April 3, 2008, sitewide inspection of Iron Mountain Mine (IMM) Superfund Site. The inspection was performed to provide oversight of Iron Mountain Operations (IMO) site activities and to fulfill site inspection requirements for the *IMM Fourth Five-Year Review*.

The following CH2M HILL staff participated in the April 3, 2008, site inspection:

- John Spitzley, IMM Project Manager
- Dave Bunte, Metallurgist
- Sandra Shearer, Environmental Engineer
- Eric Halpenny, Chemical Engineer

Rudy Carver, Wes Franks, and Bob Lindskog with IMO also participated in portions of the site inspection. Wes Franks provided the March 2008 *Churn Creek Construction Co., Inc., Iron Mountain Job List – Per Wes Franks* (2008 Maintenance List), a list of maintenance items to be completed during the 2008 dry season. Numerous other inspections were performed or contracted by IMO during the fourth five-year review period. Recent inspections are summarized in Table 1 (all tables are located at the end of this technical memorandum).

IMO continues to provide excellent maintenance of the site and is in general compliance with the requirements of the October 2, 2000, *Statement of Work for Site Operations and Maintenance* (SOW) (EPA, 2000). No issues or observations were identified during the April 3, 2008, site visit that would be expected to impact the effectiveness or protectiveness of remedies implemented at IMM. Issues and observations related to implementation and scope of the operation and maintenance (O&M) procedures were identified and are detailed in this technical memorandum. These were discussed with IMO and AIG Consultants, Inc. (AIG) during a meeting at the IMM Site on April 25, 2008. Significant recommendations and follow-up actions from the site inspections are summarized in the *IMM Fourth Five-Year Review Report*.

The *Site Inspection Checklist, Iron Mountain Mine Five-Year Review* (Site Inspection Checklist) is included as Attachment 5 of the *IMM Fourth Five-Year Review Report*. Photographs are attached to this technical memorandum to illustrate the conditions described below. Table 2 summarizes annual IMO O&M costs. Table 3 summarizes the schedule of IMO primary operation, maintenance, and inspections performed in 2007 (IMO, 2008d).

1.0 General

1.1 Iron Mountain Operations Staff

Wes Franks/IMO discussed that he will be retiring relatively soon. IMO's subcontracted site workers with Churn Creek Construction are knowledgeable regarding site maintenance. However, there is concern that, without a transition plan, knowledge necessary to effectively maintain the IMM remedies may be lost.

As one method of decreasing the Minnesota Flats Treatment Plant (MFTP) facility's vulnerability to the loss of one or more personnel, the IMM Third Five-Year Review (EPA, 2003) recommended that a computerized maintenance system be installed that interfaces with the operations computer. The system could track run hours as well as maintenance completed on each piece of equipment and maintain a spare parts inventory. During discussions with Sandra Shearer on March 27, 2008, Rudy Carver said that IMO is using Excel spreadsheets to track MFTP maintenance and is evaluating other maintenance software that generates lists and schedules of maintenance items to complete.

1.1.1 Recommendation

CH2M HILL recommends that IMO and AIG continue to develop strategies to decrease the vulnerability to the loss of IMO personnel. During the April 25, 2008 meeting, Dave Sadoff/AIG described that a high priority for AIG is updating the secession plan for IMO staff.

1.2 Spring Creek Arm Sediment Remedial Action

IMO suggested that the MFTP equipment could be used to generate a lime slurry for treatment of dredge discharge as part of the IMM Record of Decision 5 (ROD 5) (EPA, 2004) sediment removal remedial action. IMO would sell the lime slurry to EPA. The sediment remedial action is preliminarily scheduled to occur between mid-October and mid-December, which is generally a period of low acid mine drainage (AMD) generation and low treatment plant influent flows.

1.3 Onsite Documents and Records

Onsite documents and records were verified and found to be readily available, as documented in the Site Inspection Checklist. Onsite documents and records verified include O&M manuals (IMO, 2001; EPA, 2000), as-built drawings, maintenance logs, site-specific health and safety plan (SHN Consulting Engineers, 2007a and 2007b), emergency response plan (IMO, 2008e), training records, air discharge permits, and monitoring records.

Section 6.3 of the SOW (EPA, 2000) requires the following:

> By May 1 of each year, or other agreed-upon date, the Site Operator shall submit for Oversight Agency review and approval a draft Annual Operations Work Plan. This plan will provide a detailed plan for the operation, maintenance, and inspection activities planned for the twelve (12)-month period beginning on June 1 of that year ("next year"). The draft Annual Operations Work Plan shall address all activities related to O&M, Remedial Designs, Remedial Actions, modifications to the Site implemented during the previous plan year, modifications to the Site planned for the next year, and all other information necessary to enable the Oversight Agency to effectively evaluate whether the Performance Standards have been and will be met.

IMO has reduced the scope of the Annual Operations Work Plan during recent years, when no large remedial actions were being undertaken. In 2007, the Annual Operations Work Plan consisted of a letter report to EPA that provided a schedule for inspections and maintenance activities to be performed.

1.3.1 Recommendation

IMO should ensure that future Annual Operations Work Plans meet the requirements of Section 6.3 of the SOW (EPA, 2000). The Annual Operations Work Plan should make reference to the SOW when describing O&M requirements.

1.4 AMD Pipelines

On December 18, 2007, a leak of the AMD pipeline occurred near Road Marker 16.5 near the intersection of the AMD pipeline and the filtrate pipeline that extends from the Mine Waste Disposal Cell. The pipeline was immediately shut down, and temporary repairs were made with rubber couplings so that the pipeline could be returned to service to handle the high flows from SCRR caused by heavy rains (IMO, 2008d). On January 4, 2008, during heavy rainfall, the temporary rubber coupling repair failed where the Mine Waste Disposal Cell filtrate pipeline enters the AMD pipeline. Due to the 4 inches of rainfall that occurred on that date, the leak could not be stopped until January 5, 2008. Permanent repairs were competed on the pipeline on January 8, 2008, when stainless steel band clamps arrived (IMO, 2008b).

IMO staff performs inspections of the site throughout the day and night to quickly identify leaks when they occur. Notifications of the leaks were made to EPA, Central Valley Regional Water Quality Control Board, and the Bureau of Reclamation. A photograph of the repaired pipeline is included in the photo log.

Scale from the AMD pipelines was removed before SCRR went into service. Since the completion of scale removal, IMO has inspected the AMD conveyance pipelines by removing the lids on the service saddles. A portion of the AMD conveyance pipelines is inspected annually, and a more thorough inspection of the entire AMD conveyance pipeline system is performed on a less frequent basis. IMO performed a thorough inspection of the entire AMD conveyance pipeline system using all service saddles in April 2008, and the inspection will be documented in the Field Activity Daily Logs in the April 2008 IMO Monthly Progress Report.

1.4.1 Recommendation

The pipeline route continues to erode. Erosion protection should be placed on top of the pipeline to prevent further erosion of the pipeline trench near Road Marker 16.5.

The SOW (EPA, 2000) states the following: "The Site Operator shall maintain a minimum 90 percent flow capacity in all conveyance piping. The Site Operator shall conduct annual inspections of the AMD piping and shall certify the pipe capacity." IMO should perform AMD pipeline inspections and have an engineer calculate capacity estimates annually. These should be certified in an annual letter to EPA.

1.5 Adjacent Property Residents

John Lyons of EPA facilitated a meeting in the Iron Mountain conference room in November 2007 with downgradient property owners, Bob and Annette Rardin, and representatives from Stauffer, AIG, and BLM to address access agreement concerns related to long term maintenance of the Flat Creek Drainage Area (IMO, 2007b). During the April 3, 2008, site inspection, IMO stated that they have maintained a good relationship with the Rardins through close communication and response to requests.

Sandra Shearer/CH2M HILL talked with Annette Rardin on April 22, 2008, regarding maintenance of erosion controls on her property, downgradient from IMM. Mrs. Rardin stated that her property is being adequately maintained, and that she feels confident that Wes Franks/IMO is performing thorough inspections. The Flat Creek channel does continue to shift and deepen due to ongoing erosion. Mrs. Rardin does not think further maintenance is required now, but further maintenance of the Flat Creek channel might be required in the future.

1.5.1 Recommendation

Mrs. Rardin stated that she was very happy with the November 2007 meeting facilitation and felt that a lot was accomplished during the meeting. However, she commented that there were action items identified during the meeting that have not been completed. Mrs. Rardin stated that Stauffer agreed to pay the Rardins' attorney fees, and late fees have accumulated on the outstanding balance. The Rardins had also identified changes required to the draft easement, and the easement has not been resubmitted for their review or their attorney's review.

2.0 Upper Spring Creek Diversion

2.1 Current Pipeline Condition

The Upper Spring Creek Diversion pipeline lining continues to deteriorate with use, and as the lining is removed, the underlying concrete erodes (IMO, 2008a). The 2007 inspection report for the Upper Spring Creek Clean Water Diversion concluded that the extent and depth of erosion is not a structural concern at this time, however, the eroded concrete and liner should be monitored on an annual basis (IMO, 2008a).

CH2M HILL participated in the 2007 annual site inspection and concluded that 22 percent of the pipe sections were in somewhat worse condition than the previous year. Worsening condition was characterized by continuing deterioration of the polyurethane lining, with a corresponding increase in the amount of erosion on exposed concrete surfaces (CH2M HILL, 2007a).

Deterioration of the lining is occurring through two mechanisms: erosion or wear of the lining by solids in the flowing water; and disbondment or peeling of the lining in some areas as it is pulled from the concrete pipe by the flowing water. In areas where the protective lining has been removed, the exposed concrete progressively deteriorates from minor surface erosion, resulting in exposed aggregate, followed by aggregate removal and loss of section in the concrete (CH2M HILL, 2007a).

Deterioration continues to occur mainly on the pipeline invert and especially at the joints. The number of affected areas and the progress of damage are generally increasing over time. However, repairs that were made in 2004 at eroded locations in the joints of pipeline have generally performed well (CH2M HILL, 2007a).

2.2 Statement of Work Requirements

Section 9.10.2.3 (Non-routine O&M Requirements for the Upper Spring Creek Diversion) of the SOW requires the following:

“Over the next 3 years, the Site Operator shall perform necessary studies and implement a satisfactory repair program to restore the RCCP lining system or, as necessary, replace the RCCP lining system by December 2003.”

Studies and evaluations performed by the Site Operator indicated that it would be costly to restore or replace the pipeline liner system. Achieving adequate and long-term bonding of a pipeline lining to concrete pipeline material is technically challenging. For these reasons, the comprehensive liner repair program, as described in the SOW, has not been conducted. As discussed in the following section, IMO’s current approach is an annual pipeline inspection and pipeline repair process to maintain the structural integrity of the pipeline.

2.3 Pipeline Monitoring and Repair Approach

The Site Operator performed upstream improvements (moving gravel out of the channel above the Iron Mountain Road Spring Creek crossing and deepening the sediment basin upstream of the diversion) that has minimized the gravel carried into the Upper Spring Creek diversion pipeline.

An Abrasion Test Program was performed in 1999, which evaluated 6 concrete coatings to determine the abrasion resistant effectiveness (Schwein / Christensen Laboratories, Inc. 1999). The Site Operator also performed an in-place suitability study of different repair products.

In the Proposed Scope of Work and Contract Award for *Spring Creek Diversion RCCP Pipe Inspection and Repair Project* (IMO, 2003a, 2003b), IMO proposed and has implemented a pipeline inspection and repair program. The program includes annual inspection of the pipeline, preparation of a pipeline inspection report for EPA review, evaluating and selecting the appropriate pipeline repair methods and materials, and implementing the repairs with appropriate quality assurance and quality control inspection and documentation (IMO, 2003b).

Two concrete repair materials are currently being used, which have been tested and shown to be effective: Rezi-Weld epoxy with sand and the Emaco S88 repair mortar. Both materials require surface preparation, removal of standing water, and a temporary dam to prevent the area to be repaired from becoming wet. Rezi-Weld contains solvents and tends to sag when placed, so ample ventilation, respirators, and forms for placement are essential. Emaco requires sawing or chipping out concrete to allow placement in a thick section and avoid feathering the product over the surface. As noted during the 2007 pipeline inspection, repairs that were made in 2004 at eroded locations in the joints of the pipeline have generally performed well.

2.4 Other Components of the Spring Creek Diversion Structure

No issues with the Upper Spring Creek Diversion impact structure were noticed during the April 3, 2008, inspection. The impact structure was covered with stainless steel during the 2004 maintenance inspection (IMO, 2008a). Stainless steel plates that were recently installed on the impact structure appear to be in good condition.

Sediment and gravel have accumulated in the sedimentation basin at the Upper Spring Creek Diversion inlet.

2.5 Recommendations

Sediment and gravel that has accumulated in the sedimentation basin at the Upper Spring Creek Diversion inlet needs to be removed during the 2008 dry season. This was identified on the 2008 Maintenance List provided by Wes Franks.

During the April 25, 2008, meeting, IMO stated that the annual Upper Spring Creek and Slickrock Creek Diversion inspections are scheduled for July 28, 2008. IMO, in consultation with their materials expert, should develop a work plan for review by EPA that details the long-term inspection and repair approach to mitigate future deterioration and maintain the pipeline to meet the requirements of the SOW. The following are considerations for improvements to the existing inspection and repair program:

- The pipeline condition rating system used by IMO is subjective and ranges from Very Good' to Very Poor'. The subjective rating system is not fully documenting changes in pipeline condition from year to year. For example, although approximately 20 percent of the pipeline section appeared to be in worse condition in 2007 compared to 2006, the overall condition rating of the pipeline did not change from 2007 to 2006 (CH2M HILL, 2007a). More detailed pipeline inspection documentation would provide the information needed to quantify the rate of deterioration and help determine the point in time when rehabilitation or complete replacement of the lining is warranted. Following the 2007 Upper Spring Creek Diversion Inspection, CH2M HILL recommended that IMO consider adding video recording of the pipeline to the inspection regime, and a comparison of video records over a period of years, as one method of documenting pipeline deterioration (CH2M HILL, 2007a).
- The level of deterioration that triggers a pipeline repair has not been defined. Conditions that will result in a pipeline repair should be well defined to allow consistent action over the years and ensure adequate maintenance of the pipeline.

- The existing liner should be preserved to the extent feasible to prevent further erosion of the concrete pipeline. IMO should evaluate the feasibility of removing and repairing loose liner sections, to prevent the disbondment or peeling of the lining in adjacent areas.
- AIG and IMO could consider the feasibility of a partial-relining / repair alternative to preserve as much of the existing intact lining as possible while repairing the various types of damage that the pipeline exhibits. That approach might reduce construction costs and be a more practical solution to maintaining the pipeline in good condition.

3.0 Minnesota Flats Treatment Plant

An inspection of the MFTP was performed to satisfy requirements of the five-year review and to provide information for the Site Inspection Checklist.

The MFTP programmable logic controller (PLC) system was updated to use Modicon Quantum controllers. The plant was returned to full operation on September 17 using the upgraded plant control system (IMO, 2007c). IMO is also proposing additional upgrades, including ethernet connections and additional telemetry.

IMO plans to repair significant areas of corrosion on the coating for the thickener rake arms, center well, and center column during the 2008 inspection and maintenance for TK-11.

3.1 Recommendations

1. The Site Inspection Checklist includes an assessment of whether sampling ports are properly marked and functional. Sampling ports, including the treatment plant influent, thickener overflow, and sludge sampling stations, are not marked. During the April 25, 2008, meeting, IMO stated that labels would be added to these locations.
2. Attachment 3 of the *IMM Fourth Five-Year Review* includes an assessment of the MFTP effluent discharge. The recommendation is made that EPA should formally revise the SOW to modify BAT effluent limits based on metal removal level currently achieved at the MFTP.
3. Attachment 3 of the *IMM Fourth Five-Year Review* includes a statistical analysis of paired CH2M HILL and IMO datasets. Both datasets result in similar conclusions of MFTP performance and compliance with CWA standards and BAT limits. However, the correlation between the CH2M HILL and IMO datasets could be improved. The following recommendations are presented to help reconcile differences between the datasets, and to provide data for further comparison:
   - The effluent composite sample should be well mixed by IMO and by CH2M HILL prior to collecting sample. This will help to ensure that solids are distributed uniformly throughout the composite sample and possibly reduce the differences in total metals concentrations. Section 6.1.1 of the IMO O&M manual (IMO, 2001) should be modified to specify that the composite sample is well mixed.
   - As sample volume allows, split sample analyses could be performed during the 2008-2009 wet seasons to help identify potential differences in laboratory

methodology. CH2M HILL recommends that split samples be collected by IMO and analyzed at the EPA Region 9 laboratory.

– As sample volume allows, additional duplicate effluent samples could be collected during the 2008-2009 wet season to provide additional data for statistical analysis and to quantify variability resulting from sampling or analytical methodology. CH2M HILL will plan to collect duplicate effluent samples for analysis at the EPA Region 9 laboratory.

– IMO should be provided a copy of CH2M HILL's annual IMM Surface Water Sampling Summary Report.

4. The 2000 SOW (EPA, 2000), IMO's O&M Plan (IMO, 2001), and IMO's Emergency Response Plan and Contingency Procedures (IMO, 2008e) specify procedures for emergency response and routine and non-routine O&M. IMO should look for opportunities to improve their emergency preparedness, including annual updates to the Emergency Response Plan and Contingency Procedures, posting emergency contact numbers in a prominent location, and ensuring that IMO staff are familiar with emergency procedures. During the April 25, 2008, meeting, AIG stated that the Emergency Response Plan and Contingency Procedures would be reviewed annually.

5. IMO submits sitewide data monthly to CH2M HILL and EPA in a Microsoft Access database that was initiated by IT Corporation, the previous site operator, and finalized in 2002 by Shaw Environmental Corporation. While this database has sufficient functionality for reporting requirements, over the longer term, IMO may want to consider a new database for running extended queries and data evaluation by the site operator. During the April 25, 2008, meeting, IMO stated they are currently considering upgrades to the database.

4.0 Sludge Drying Beds

No sludge was hauled from the sludge drying beds to Brick Flat Pit during the 2007 dry season because of the low volume of sludge generated during the 2007 water year. IMO has recommended to AIG that a sludge haul be performed during the 2008 dry season.

MFTP sludge drying bed Number 4 is almost full, and is projected to be full at the end of the 2008 Water Year, for a total sludge volume of 18,000 cubic yards. Sludge drying bed Number 3 is one third full, with a sludge volume of approximately 4,000 cubic yards. MFTP sludge drying beds 1 and 2 are empty, and IMO estimates that approximately 50,000 cubic yards of sludge storage capacity would be available during the 2009 water year if sludge is not transported to Brick Flat Pit.

Gullying continues to occur on the sludge drying bed bank below Drying Bed Number 4. Most of the gullying appears to be minor, but some gullies are deeper. Wes Franks/IMO said that he continues to monitor this area, and the gullying has not increased over the last 5 to 6 years.

4.1 Recommendation

During the April 25, 2008, meeting, AIG indicated that a sludge haul will be performed during the 2008 dry season to ensure adequate sludge storage capacity is available for the 2009 wet season.

Gullying on the sludge drying bed bank below sludge drying bed Number 4 should continue to be monitored, and if gullying worsens, drainage should be redirected or the area should be vegetated.

5.0 Boulder Creek Mouth

Sediment that accumulated behind the weir at Boulder Creek Mouth (BCMO) sampling location was dredged in mid-March, and additional cleanout is scheduled for the fall.

An ISCO sampler collects BCMO 24-hour composite water samples. IMO staff collects the composite samples daily.

5.1 Observations

The area surrounding the IMO BCMO sampling point and transducer contained leaves and vegetative debris during the site inspection. During the April 25, 2008, meeting, IMO stated that leaves and debris are frequently removed from the sampling location. The ISCO sampling bottles appeared to have a residue on the side of the bottles during the site inspection. During the April 25, 2008, meeting, IMO stated that the sample bottles are rinsed daily with deionized water, and weekly rinseate samples are analyzed and have no detectable concentrations of metals.

6.0 Boulder Creek Tailings Dam

Approximately 25,000 cubic yards of tailings are located in this area. Improvements to the Boulder Creek tailings dam were completed in 2004, as documented in the *Final Construction Report for Spillway Improvements at the Boulder Creek Tailings Area* (TRC, 2005). Improvements included raising the dam, building a spillway, adding gabions, and improving Boulder Creek upstream of the tailings dam. The improvements were in good condition, and no issues were identified during the April 3, 2008, site inspection.

7.0 Iron Mountain Mines, Inc., Tanks

Three 6,500-gallon poly tanks are located adjacent to the east-side of the metal shed that is across the road from the cementation plant. An additional poly tank of similar volume is located within the metal shed, along with equipment. Many 55-gallon plastic drums are stored on the north side of the metal shed, and most appeared to be empty. One 55-gallon plastic drum was labeled “Kwik N Kleen”. The label stated that the product contained potassium hydroxide (caustic potash), was listed as corrosive, and had a health hazard ranking of 2 or “Hazardous”. The tanks, equipment, and drums in this area are property of Mr. T. W. Arman, Iron Mountain Mines, Inc.

Rudy Carver/IMO discussed the contents of the tanks with Mr. Arman. The tanks contain raw AMD, sodium silicate, and Mr. Arman's Ag-Gel fertilizer product. The tanks are not labeled, and it is unknown which tank contains which contents. The three tanks located outside of the metal shed contained a total volume of approximately 8,600 gallons of fluid during the April 3, 2008, inspection. The tank located closest to the road contained 1,200 gallons of fluid. The middle tank contained 4,400 gallons of fluid. The tank located furthest from the road contained 3,000 gallons of fluid. There is no secondary containment for any of the tanks or drums. Precipitates had formed on the pipe connection for the middle poly tank, indicating a leak. Sand between the poly tanks and the shed was wet, but fluid was not visibly leaking from the tanks during the inspection.

7.1 Recommendation

The IMM Third Five-Year Review (EPA, 2003) recommended the contents of the fluid in these chemical storage tanks be determined and proper containment should be provided, if required, or the contents should be properly disposed. This recommendation should be addressed by Mr. Arman.

8.0 Boulder Creek Landslide Area

8.1 Boulder Creek Landslide

Minimal movement of the Boulder Creek Landslide has occurred over the 2007 or 2008 wet seasons. Precipitation during the 2007 and 2008 water years was below average. The *2007 Boulder Creek Landslide Annual Inspection and Evaluation Report* (The Mines Group, 2007c) plotted observed displacement during each water year from 1998 to the present against the observed precipitation for that water year. The results show a moderately strong correlation between precipitation and displacement magnitude.

The 2007 Boulder Creek Landslide inspection report states "clearly water is a major factor in the observed displacements within the slope failure complex, and the control of water would help control future displacements" (The Mines Group, 2007c). Various measures have been implemented to address the continued displacement of the Boulder Creek Landslide, and the landslide effects on the Lawson Mine (IMO, 2008f). These measures include:

1. Grading of the slopes above the Lawson Mine and at the top of the landslide to maintain effective drainage.
2. Installation of an 18-inch drain pipe to divert surface drainage to areas outside of the landslide.
3. Installation of 4 "fan drains" into the Lawson Mine.
4. Installation of 4 additional horizontal drains on the slope immediately above the Lawson Mine.
5. Mechanical cleaning of all horizontal and fan drains in the area to maintain efficient function.
6. Annual maintenance of the pipelines and surface water drainage to minimize infiltration.

The IMM Third Five-Year Review (EPA, 2003) recommended that the exposed PVC pipe at the ends of the horizontal drains be replaced with non-UV sensitive pipe. This has not yet been performed.

8.2 Boulder Creek Channel

The Boulder Creek channel was originally designed to convey peak flow during the 100-year storm. Around 1997, a culvert was constructed to convey Boulder Creek under a temporary access road to the horizontal drains. Gravel and rocks have accumulated on the upstream end of the culvert. The culvert will not convey peak flow from the 100-year storm. CH2M HILL expressed concern that the culvert will back up flow, and that the access road will be washed out, or structures between the access road and the portal might be damaged.

8.3 Lawson Access Road

The Lawson Road from Iron Mountain Road to the Lawson portal is defined by the SOW as an all-weather, critical access road. The roadway and culverts are in relatively poor condition, particularly between the Lawson Gate and the Lawson Laydown Area. This condition was identified on the 2008 Maintenance List provided by Wes Franks.

8.4 Recommendations

The Lawson Road from Iron Mountain Road to the Lawson portal requires additional maintenance. IMO should consider replacement and improvement of the culverts and improvement of the drainage ditch. During the April 25, 2008, meeting, IMO stated that the Lawson Road culverts will be repaired this year, and IMO is considering widening the road by up to 2 or 3 feet.

The effectiveness of recent drainage improvements at the Boulder Creek landslide area should be monitored, and further control measures should be considered and implemented, as necessary, to help to control future displacement of the landslide. During the April 25, 2008, meeting, IMO stated that the annual Richmond Mine, Lawson Portal, and Boulder Creek Landslide inspections are scheduled for May 14 and 15, 2008.

IMO should have an engineer determine the capacity of the culvert under the temporary access road and determine the risks associated with leaving the culvert in place. If the engineering evaluation indicates there is a significant risk to upstream or downstream structures during the 100-year peak flow event, IMO should remove the temporary access road and culvert during the wet seasons, or IMO should prepare a design for a culvert with the capacity to convey the peak flow in Boulder Creek from the 100-year storm.

Exposed PVC portions of the horizontal drains on top of and surrounding the Boulder Creek Landslide should be replaced with UV-resistant piping or covered with a UV-resistant coating. One option would be to paint the PVC pipe with a light (e.g., white or tan) water-based acrylic latex paint. The pipe would need to be repainted at an appropriate frequency to maintain the coating. Another option would be to replace exposed PVC pipe with Yelomine, a UV-resistant PVC pipe material.

9.0 Richmond Mine

The Richmond Adit was inspected on June 11, 2007, by The Mines Group, Inc (2007a). This was a visual inspection and no testing or measurements were conducted. The inspection included the Richmond Adit, Bypass, and A, B, C, and D drifts to the last muck dam in each drift. In addition to this inspection, extensometer and multiple-point borehole extensometer (MPB) readings were performed by IMO. The results of these readings are presented separately (IMO, 2008f).

Conditions at the Richmond portal and adit showed no significant deterioration. Routine inspections need to be continued to identify conditions if they change. The Bypass had additional rock bolts installed at the muck bay nose and these appeared to be working adequately.

No failed shotcrete was observed at the five-way intersection. Routine inspections in this area are needed to determine if the structural integrity of the shotcrete and other support (rock bolts) are maintained.

The inspection report (The Mines Group, Inc., 2007a) states that there was no failed shot-crete in the B drift; however, during five-year inspection on April 3, 2008, sections of deteriorated and fallen shotcrete were observed in the B and C drifts. During follow up discussion with IMO staff, it was clarified that the inspection report should state that no failed structural shotcrete was observed. The shotcrete that had failed in the B and C drifts was installed as temporary support. However, the areas with failed shotcrete need to be monitored over the long term to determine if these drifts will require additional support to remain functional. In the short term, fallen and deteriorated shotcrete needs to be removed from drifts to maintain access and to assist in monitoring additional changes in shotcrete conditions. The inspection report states that failed shotcrete will be replaced. However, it is understood that this should refer to only failed structural shotcrete.

The 2007 Richmond Adit Inspection Report in the tabulated component summary (Serial No. 47; The Mines Group, Inc., 2007a) states that the rock bolts in the five way could not be inspected visually and should be tested. IMO should specify how and when the rock bolts will be tested.

For several locations (e.g., Mattie, five way, bypass drift) the 2007 inspection report (The Mines Group, Inc., 2007a) states that "no failed sections of shotcrete were observed", but no other description of the shotcrete was provided. A more detailed description of the observed condition of all areas of structural shotcrete inspected should be provided in future inspection reports so that changing conditions can be determined.

Regular (annual) removal of muck that accumulates behind the muck dams and the AMD dams is critical to continue operation of the AMD collection and conveyance system. This is a routine maintenance item that is being conducted and it is specified in the SOW. The SOW Section 9.9.2.1 (EPA, 2000) states that, at a minimum, muck shall be removed annually from the designated maintenance areas if more than 30 cubic yards accumulate.

The concrete plugs in the ore chutes continue to deteriorate. This is a long-term issue that should be addressed with routine chute plug inspection. The conditions of each chute that was plugged (those between the furthest muck dam and the five way) should be inspected and recorded. Currently, not all chutes are inspected each year. In the 2007 Richmond Inspection Report (The Mines Group, Inc., 2007a), it appears that none of the chute plugs in the B and C drifts were inspected.

The concern with the chute plugs is that a plug could fail and release large quantities of muck and AMD. Depending on the size and location of the plug failure, the muck and AMD management system behind the five way may or may not be able to handle the release. There are three observed problems with the chutes. First, the drainage pipes installed in many of the chutes have become plugged and it is not known if the head above these chutes is rising to an unacceptable level. Second, there are several plugs that have developed leakage between the concrete plug and the chute wall. With low pH AMD flowing around the plug, the concrete will deteriorate relatively quickly compared to the condition of AMD pooled on top of the plug. Third, the potential for falling shotcrete or concrete from the chutes should continue to be recognized and addressed as a health and safety concern. It is uncertain when these leaking plugs will fail. IMO should begin to develop a strategy to address the failing chute plugs.

9.1 Recommendations

Routine inspections of the Richmond Mine need to be continued to identify changes in conditions, including the following:

- Routine inspections in the five way to determine if the structural integrity of the shotcrete and other support (rock bolts) are maintained. IMO should specify how and when the rock bolts in the five way will be tested.
- Monitoring of the areas with failed shotcrete in the B and C drifts to determine if these drifts will require additional support to remain functional.
- A more detailed description of the observed condition of all areas of structural shotcrete inspected should be provided in future inspection reports so that changing conditions can be determined.
- Routine chute plug inspection to document the conditions of each chute plugged between the furthest muck dam and the five way. During the April 25, 2008, meeting, IMO stated that a standardized checklist for chute inspection would be developed to track changing conditions.

During the April 25, 2008, meeting, IMO stated that the annual Richmond Mine, Lawson Portal, and Boulder Creek Landslide inspections are scheduled for May 14 and 15, 2008. IMO said they would provide The Mines Group, Inc. the recommendations for incorporation in the annual inspection.

The following maintenance items were identified:

- Ponded water was observed at several locations in the Richmond Adit. Gravel in the adit should be graded after annual maintenance activities to minimize ponding.
- Fallen and deteriorated shotcrete needs to be removed from drifts to maintain access and to assist in monitoring additional changes in shotcrete conditions. At the April 25, 2008, meeting, IMO stated this work had been completed for the 2008 dry season.

- Failed structural shotcrete should be replaced, when identified. During the April 25, 2008, meeting, IMO stated that no structural concrete has failed.
- Regular (annual) removal of muck that accumulates behind the muck dams and the AMD dams should continue in accordance with the SOW.
- The concrete plugs in the ore chutes continue to deteriorate. IMO needs to develop a strategy to address the failing chute plugs and the associated risks to worker safety, mine access, and the AMD conveyance and treatment system.
- During the April 25, 2008, meeting, IMO stated that the AMD dams would be improved during the 2008 dry season. CH2M HILL requested the opportunity to review the plans for the AMD dam modifications, and stated that IMO should confirm the volume of muck behind the C Drift AMD dam during the construction. The muck behind this AMD dam is currently submerged.
- During the April 25, 2008, meeting, IMO also stated that the five way inlet is deteriorating, and should be replaced with a stainless steel insert. A schedule for this action should be developed by IMO.

10.0 Lawson Mine

The Lawson Adit was inspected on June 11, 2007, by The Mines Group, Inc. (2007b). This was a visual inspection and no testing or measurements were conducted. The inspection included the Lawson Adit from the portal to station 5 80.

The primary issue with the Lawson is that the portal is located within the Boulder Creek landslide. This has caused movement of the portal over time. The movement of the portal is being tracked with routine surveying of specified locations. Mine supports were realigned in May 2007 to maintain their integrity. The steel supports from the portal to station 0 65 were straightened prior to the inspection. There is the potential that a significant landslide movement could result in a large displacement of the portal supports. A key issue with a collapse or partial collapse of the portal would be potential damage to the AMD conveyance system.

Two actions were taken to reduce the potential for failure of the AMD conveyance system.

- The AMD conveyance pipeline was encased in concrete from the portal to the AMD collection dam.
- A well was drilled from the ground surface into the Lawson behind the AMD collection dam to allow for pumping AMD if the collection pipeline were damaged. Mark Suden Mine Construction raised the elevation of the AMD dam at station 600 in August 2007 (IMO, 2007d). Diamond Core Drilling drilled and constructed the well in September 2007 (IMO, 2007c), and installed the pump and associated stainless steel well pipe in October 2007 (IMO, 2007a).

These actions improve the reliability of the AMD collection and conveyance system for the Lawson. CH2M HILL's understanding is that during non-emergency conditions, AMD will be conveyed through the auxiliary AMD collection pipeline, and the auxiliary pipeline is located only 4 to 6 inches higher than the original AMD collection pipeline.

In the Lawson component summary table (Serial No. 5; The Mines Group, Inc., 2007b), it is stated that the displacements in the portal area were modest in 2006-2007. CH2M HILL commented that it was not clear in the 2007 annual inspection report how this conclusion was reached. The only survey data for 2007 presented in the 2007 Lawson Adit Survey Data were for 10/16/2007. For sets 12 and 22, substantial displacements were noted between the 11/02/06 and 10/16/07 surveys. During the April 25, 2008, meeting, IMO stated that the survey was performed after the sets were straightened in May 2007. IMO stated the conclusion that modest displacement occurred between 2006 and 2007 was based on survey data collected at the Boulder Creek Landslide. The Boulder Creek Landslide monitoring point 6 exhibited no elevation change and 0.05 feet of horizontal displacement between 2006 and 2007. IMO also used a level and inspected the sets prior to straightening to support the conclusion that additional displacement was observed since 2006.

10.1 Recommendations

CH2M HILL recommends that IMO submit an as-built drawing of the Lawson backup pumping system and a brief description of its intended operation for a final review by CH2M HILL and EPA.

CH2M HILL recommends that future annual inspection reports include adequate detail to understand conclusions made using the data presented.

If the sets are straightened in the future, survey data should be obtained before and after the straightening to allow comparison with previous and future survey data.

11.0 Brick Flat Pit

The amount of filtrate has decreased significantly at Brick Flat Pit. Throughout 2005, IMO noted in the Monthly Progress Reports that minimal flow was occurring at Filtrate Monitoring Sump 8R and low to minimal flow was observed from the Brick Flat Pit Spillway System. Minimal filtrate flow rates have continued to occur. During the October 26, 2005, meeting with AIG, EPA, IMO, and CH2M HILL (CH2M HILL, 2005), two possible reasons for reduced filtrate flow were discussed: (1) the filtrate piping has malfunctioned, or (2) the amount of filtrate has decreased as a result of the thickness of the overlying sludge, and the water is exiting the pit through the unlined sidewalls of the pit. The Brick Flat Pit liner extends 10 feet from the bottom of the pit. The sludge is currently about 80-feet thick.

IMO has conducted monitoring, but has not identified seeps around Brick Flat Pit. IMO has performed phosfluorescent dye studies on the drainage system in an attempt to trace the pathway of seepage from Brick Flat Pit. The phosfluorescent dye was a dye that is typically used in sewer tracer studies. The dye has not been detected at potential exit points, including AMD collected from the Richmond Mine. The dye might be diluted to below detectable limits by other flows in the Richmond Mine or degraded during contact with low-pH waters. IMO has monitored the water level in the filtrate riser pipe, and no standing water has been detected. IMO has poured water into the filtrate riser pipes, and the water has been observed to flow over the weir, indicating that the filtrate pipelines are not broken. IMO thinks, but has not been able to verify, that drainage from Brick Flat Pit is entering stopes of the Richmond Mine, through the highly fractured north slope of Brick Flat Pit (Carver, 2008).

Brick Flat Pit is considered a dry landfill (EPA, 2000). The location of Brick Flat Pit was determined to be an effective sludge disposal location because drainage, if not captured, would reenter the ore body and be captured by the AMD treatment system (EPA, 1986), or would be discharged to the Slickrock Creek drainage, which is currently captured for treatment by SCRR.

Section 6.4 (Landfill Management Report and Plan) of the SOW (EPA, 2000) requires that "by November 30 of each year, the Site Operator shall provide to the Oversight Agency, for Oversight Agency review and approval, the Landfill Management Report and Plan". As described in the SOW, The Landfill Management Report and Plan is an annual report that enables the Oversight Agency to effectively evaluate whether the Brick Flat Pit landfill was properly managed, consistent with the concept design for a dry landfill, over the preceding twelve (12)-month period, and that the landfill will be properly managed as a dry landfill over the upcoming twelve (12)-month period. The Operations and Maintenance Submittal Register of the *IMO February 200 Monthly Progress Report* (Table 10 of IMO, 2008g) indicates that the most recent Landfill Management Report and Plan was submitted in January 2004 (IMO, 2004).

11.1 Recommendations

IMO should submit an annual Landfill Management Report and Plan that addresses the requirements in the SOW (EPA, 2000).

Reasons for the reduced filtrate at Brick Flat Pit should continue to be evaluated. During the April 25, 2008, meeting, CH2M HILL and IMO discussed that other types of dye, such as lithium or a radioactive tracer, be considered for additional studies.

Groundwater elevation data collected at Brick Flat Pit are included in the road operator monthly data sheets in the IMO Monthly Progress Reports and are reviewed by IMO staff. CH2M HILL recommends that IMO also include Brick Flat Pit groundwater elevation data in the Microsoft Access database for potential future use in evaluation of filtrate pathways.

The 2008 Maintenance List includes a 10-foot extension of 4 filtrate riser pipes at Brick Flat Pit.

12.0 Old/No. 8 Mine Seep

12.1 CH2M HILL April 2008 Assessment

IMO described that operation of the Old / No. 8 Mine Seep was modified in 2005 to curtail pumping during the wet season and allow water levels in the Old / No. 8 Mine Seep to rise to between 50 and 30 feet below ground surface. When a seep was observed at the ground surface, IMO initiated pumping of PW3 to bring the water level within Old / No. 8 Mine back down, and PW3 was operated during the dry season (Carver, 2008).

On January 4, 2008, the power line crossing Boulder Creek Canyon and supplying power to SCRR and Old / No. 8 Mine Seep was disabled by high winds and inaccessible for repairs due to heavy snows in January and early February. The power line was repaired and restored to service on February 20, 2008 (IMO, 2008g). The emergency generators were used to operate SCRR, but no emergency power was available to PW3 at the Old / No. 8 Mine Seep. IMO described that during this period, the water level within Old / No. 8 Mine rose and encountered a fracture system, and a substantial seep was observed at the ground surface. IMO used this opportunity to construct a gravity drain system for the Old / No. 8 Mine Seep in February and March 2008. The gravity drain system provides a backup collection system if PW3 is inoperable and provides an alternative to the current pumping system during wet weather conditions (Carver, 2008).

Wes Franks / IMO stated that construction of the gravity drainage system was completed the week of March 24, 2008. CH2M HILL's understanding of the system is that an HDPE pipeline was installed as a gravity drain and collects AMD at a depth of 33 feet below ground surface. For comparison, Pump PW3 is located approximately 134 feet below the ground surface (EPA, 2000), and pumping is used to maintain the water level in the Old / No. 8 seep between 50 and 70 feet below ground surface (Carver, 2008). The gravity drain discharges into a small grit chamber (Tank TK9). The discharge from the gravity drain grit chamber is conveyed by a separate pipeline that is witched into the 18-inch HDPE pipeline near the bottom of the Slickrock Creek sedimentation basin. The discharge from the gravity drain grit chamber is then conveyed to the MFTP for treatment. The gravity drainage system can accept 125 gpm before the grit chamber / tank is overtopped, after which AMD from the Old / No. 8 Mine Seep would discharge into SCRR.

Pump PW3 was not operating during the April 3, 2008, site inspection. IMO began pumping PW3 in April after the site inspection, to bring the water level back down in Old / No. 8 Mine. This will provide storage for the planned 6 to 8 week period during the 2008 dry season when IMO plans to take the thickener offline and perform maintenance. The 1 million gallon emergency storage tank (TK14), and if necessary, the simple mix treatment process will be used to address AMD from the Richmond and Lawson Mines during the 6- to 8-week maintenance period (Carver, 2008).

CH2M HILL has the following concerns regarding the use the Old / No. 8 gravity drainage system:

1. Use of the gravity drainage system depletes the emergency storage reservoir within the Old / No. 8 Mine.
2. The AMD collection system is put at risk by not continuously or regularly operating PW3. There is a concern that the pump may not be operational when needed in an emergency situation.
3. The SCRR grout curtain and outlet works encasement contain cement hydration products that are susceptible to acid attack. They were not designed to resist the more highly acidic water from the Old / No. 8 Mine Seep.
4. IMO did not submit a design for the gravity drainage system to EPA or CH2M HILL for approval prior to construction and operation.

Table 4 presents monthly average pH and flow data for the Old / No. 8 Mine Seep and SCRR. Tables 5, 6, and 7 present a monthly summary of operational data for PW3.

12.2 October 26, 2005. Meeting: Old/No. 8 Mine/PW3

AIG, EPA, IMO, and CH2M HILL met on Wednesday, October 26, 2005, to discuss the SOW, proposed clarifications and modifications to the SOW, and other miscellaneous items. CH2M HILL prepared a meeting summary to document the issues discussed at the meeting and their proposed resolution (CH2M HILL, 2005). EPA requested that IMO review this memorandum and provide any comments to EPA to ensure that the meeting agreements are reflected accurately. The following is the documented resolution regarding the Old / No. 8 Mine / PW3:

a. IMO requested consideration of modifying the collection of Old / No. 8 Mine Seep by stopping pumping from PW3 and either allowing the seep to flow into the SCRR or by collecting it in a pipe at the surface seep location.

b. EPA noted that there will be no change in the requirement to ensure the capability to operate PW3 for selective treatment using PW3. The option to allow seepage to directly enter the SCRR for collection is not acceptable because of the low pH of the Old / No. 8 Mine water. EPA will consider allowing collection at the ground surface.

c. Because of the potential for significant low-pH underflow, it will be necessary to determine the effectiveness of collection at the ground surface and the impact on the pH of the SCRR dead pool.

12.3 GEI Consultants 2007 Annual Dam Safety Inspection Report

GEI Consultants (GEI) performed the 2007 Annual Dam Safety Inspection (GEI, 2008). The GEI inspection report discussed that IMO changed operation of Old / No. 8 Mine Seep in 2005, and GEI expressed concerns regarding potential impacts to the SCRR facility. The following is an excerpt of the GEI inspection report regarding the Old / No. 8 Mine Seep (GEI, 2008).

> In 2005, IMO modified operation of the Old / No. 8 Mine Seep. The original design of SCRR assumed that the Old / No. 8 Mine Seep would continue to be pumped and conveyed separately from the SCRR (i.e., not discharged into the reservoir), since the water quality data indicated that the Old / No. 8 Mine Seep water was significantly more acidic than the reservoir water. Data collected by IMO indicated that there may not be as significant of a difference between these two water sources as was assumed during the design. IMO therefore proposed to shut off the Old / No. 8 Mine Seep pumps allowing the Old / No. 8 Mine Seep water to build up in the buried mine workings and seep into the reservoir. IMO discussed the issue with EPA and received preliminary approval to shut off the pumps in the winter, when the presumably higher-acidity water from the mine workings would be diluted by Slickrock Creek's higher winter flows, but will maintain pumping in the summer months when the creek flow shuts down.

GEI's review of IMO's pH data for Slickrock Creek and Old / No.8 Mine Seep waters suggests that on average the latter remains more acidic (by about 0.5 pH units) than the former. The grout curtain and outlet works encasement contain cement hydration products and therefore are susceptible to acid attack. They were not designed to resist the more highly acidic water from the Old / No. 8 Mine Seep water. Reservoir water with high acidity could eventually dissolve the grout curtain and / or attack the outlet works concrete. Such detrimental effects likely would be indicated by a trend of gradually decreasing pH of the seepage water at the dam's down-stream toe and potentially a trend of increasing seepage flows. Such trends could lead to the need to regrout the dam foundation and / or repair the outlet works.

The cost of such repair measures would most certainly negate and overwhelm any savings derived from reductions in pumping of Old / No. 8 Mine Seep water. Therefore, recommends extreme caution in the use of gravity discharge of Old / No. 8 Mine Seep water to SCRR. This should only be allowed when the acidity of the two waters is similar, and the Slickrock Creek flow is high enough to effectively dilute the Old / No. 8 Mine Seep water. When the acidity of the Old / No. 8 Mine Seep is higher (i.e., of a lower pH) and the Slickrock Creek flow rate is relatively low, GEI recommends that the Old / No. 8 Mine Seep water be pumped and discharged to its dedicated pipeline.

12.4 Recommendation

CH2M HILL recommends that IMO submit an as-built drawing of the Old / No. 8 gravity discharge system and a description of the intended operation for a formal review by CH2M HILL and EPA.

CH2M HILL recommends that IMO actively pump the Old / No. 8 Mine Seep for AMD collection, and IMO should use the gravity discharge system only as an emergency backup system.

During the April 25, 2008, meeting, IMO stated that Old / No. 8 is currently being pumped but would not be pumped during the 6 to 8 week period of treatment plant maintenance. IMO plans to review the variation in pH during periods of no pumping.

13.0 Slickrock Creek Retention Reservoir

13.1 Sedimentation Basin and Rock Check Dams

In 2007, IMO constructed several new rock check dams upstream of the sedimentation basin to supplement the existing upstream check dams constructed by IMO over the last four years (GEI, 2008). Sediment that accumulates behind the rock check dams is dredged each year. These upstream rock check dams are effectively reducing the amount of sediment accumulation in the main sediment basin. GEI (2008) reported that storage space for sediment removed from the rock check dams is running out, and IMO will need to develop a new disposal plan following cleaning in 2008.

Approximately 8,500 cy of material was removed from the sedimentation basin in November 2006 (GEI, 2008). Approximately 20 feet of material has accumulated in the sedimentation basin since the removal in 2006.

13.2 Clean Water Diversion

Sand and gravel have accumulated upstream of the SCRR clean water diversion intake and needs to be removed during the 2008 dry season. This basin is cleaned out every 5 years, and cleanout was identified on the 2008 Maintenance List provided by Wes Franks.

Rocks have accumulated in the concrete-lined ditch that conveys storm water along the south side of SCRR. The storm water is discharged into the energy dissipater at the upstream end of the dam spillway. Rocks have been transported under the bars of the metal grate and into the spillway. CH2M HILL expressed concern that the capacity of the concrete-lined ditch is reduced by the rocks, and the ditch may not be able to convey the peak runoff from a 100-year, 24-hour storm.

13.3 Right Abutment and Stabilized Slide Area

No significant cracks were identified in the shotcrete above the anchors in the stabilized slide area.

Dirt has accumulated around the piezometer casings. This dirt should be cleaned out and a small amount of concrete placed around the casing to prevent dirt from entering the casing.

13.4 27 Road and 28 Road Drop Inlet Structures

The inlet of the 27 Road and 28 Road drop inlet structures has been propped up with 4 x 4 pieces of wood. This is not an acceptable long-term solution because of the potential for plugging these structures.

13.5 Recommendations

GEI (2008) reported that storage space for sediment removed from the rock check dams is running out, and IMO will need to develop a new disposal plan. During the April 25, 2008, meeting, IMO stated that approximately 10,000 cubic yards of sediment disposal volume remains. IMO will submit a design for additional sediment disposal areas for EPA review; however, the additional disposal area will not be required for several years.

Sand and gravel has accumulated upstream of the SCRR clean water diversion intake and should be removed routinely to maintain capacity at all times of the diversion structures and clean water diversion. This is required under SOW Section 9.10.4.2. This was included on the 2008 Maintenance List provided by Wes Franks/IMO.

The concrete-lined ditch that conveys storm water along the south side of SCRR needs to be cleaned out more frequently to remove rocks. Cleanout of the ditch was included on the 2008 Maintenance List provided by Wes Franks/IMO. The metal bars should be extended downward on the grate over the discharge to the energy dissipater. The accumulated debris in the spillway catch basin should be cleared at an opportune time.

Dirt has accumulated around the piezometer casings. This dirt should be cleaned out and a small amount of concrete placed around the casing to allow easier clean out and prevent dirt from entering the casing.

IMO should work with design engineers for the 27 Road and 28 Road drop inlet structures to provide a more reliable long-term solution. During the April 25, 2008, meeting, IMO and CH2M HILL discussed that catch basins should be constructed to capture upgradient flows and prevent material from entering the structures.

14.0 Consolidated Hematite Pile Toe Berm

No issues were identified for the toe berm for the hematite pile.

A white precipitate (potentially aluminum hydroxide) was observed in the filtrate from the eastern hematite drain.

15.0 Jeep Road

Four of the down comers from the culverts along the Jeep Road were broken or were missing sections of pipeline. The pipelines that were observed during the April 3, 2008, inspection were located on the east and west side of Road Marker 2 along the Jeep Road.

15.1 Recommendation

The damaged down comers along the Jeep Road should be repaired. The reason for failure of the storm water pipelines should be determined and conditions corrected, if possible. CH2M HILL suggests inspecting other downdrain piping at the site to determine if similar deterioration has occurred.

During the April 25, 2008, meeting, IMO stated that the damaged down comers along the Jeep Road were repaired, and the pipelines are inspected monthly.

16.0 Matheson Disposal Cell

Monthly visual inspections of the Matheson disposal cell are performed by Wes Franks/IMO, and no issues have been identified.

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TABLE 1
Summary of Iron Mountain Mine Recent Site Inspections
Site Inspection Summary, IMM Five-Year Review

Inspection Area	Most Recent Inspection Start Date	Most Recent Inspection Finish Date	Document Source[a]	Persons Conducting or Attending Inspection	Inspection Activities Conducted	Inspection Observations and Issues
2007 Richmond Mine Annual Inspection	06/11/07	06/12/07	The Mines Group, Inc., 2007a	Robert Spengler, The Mines Group, Inc. Kenneth Myers, PE, The Mines Group, Inc. IMO – Richmond Mine Extensometer and MPBX readings	Annual visual inspection of rehabilitated portions of the Richmond Mine and associated components (portal, mine support, ventilation, AMD collection system).	Inspection issues and observations are documented in this memorandum.
2007 Lawson Mine Annual Inspection	06/11/07	06/12/07	The Mines Group, Inc., 2007b	Robert Spengler, The Mines Group, Inc. Kenneth Myers, PE, The Mines Group, Inc. Pace Civil, Inc. – Surveys	Annual visual inspection of the Lawson adit and associated components (portal, mine support, pipelines, water check dams). The most recent survey was performed on October 27, 2007.	Inspection issues and observations are documented in this memorandum.
Upper Spring Creek Clean Water Diversion Including Impact Structure Inspection	07/24/07	07/26/07	IMO, 2008a CH2M HILL, 2007a	Joe Benoit, Extech, LLC Rod Jackson, CH2M HILL Rudolph Carver, IMO	Inspected the Spring Creek clean water diversion structure to identify and document any change in the condition of the internal lining and concrete condition in the pipeline.	Pipeline lining continues to deteriorate with use, and as the lining is removed, the underlying concrete erodes. Extent and depth of erosion is not a concern at this time. The eroded concrete and liner should be monitored on an annual basis. The impact structure is in good condition. Repair of some coating failure noted on the inlet structure gate will be scheduled for 2008. Either Rezi-Weld epoxy with sand or Emaco S88 repair mortar should be used for future concrete pipeline repairs.
Thickener TK-11 Coating Inspection	07/23/07	08/08/07	IMO, 2008a CH2M HILL, 2007b	Joe Benoit, Extech, LLC Rod Jackson, CH2M HILL Rudolph Carver, IMO	1. Quality assurance inspection of IMO's recoating of the thickener tank launder. 2. Scheduled maintenance inspection of the coal tar epoxy internal lining (thickener shell). 3. Scheduled maintenance inspection of the coal tar epoxy coating on the thickener mechanism (i.e., rake arms, center well, and center column).	1. The present condition of the tank launder should allow many years of service without major repairs required. 2. Areas identified with pinpoint corrosion and mechanical damage for Thickener Tank TK-11 tank shell were repaired by IMO. The thickener coating is in very good condition and performing well. 3. Areas of corrosion on the coating for the rake arms, center well, and center column will be scheduled for 2008 maintenance of TK-11. None of the identified areas will affect the structural integrity of the mechanism.
Slickrock Creek Clean Water Diversion Including Impact Structure and Spillway Inspection	07/26/07	07/27/07	IMO, 2008a CH2M HILL, 2007c	Joe Benoit, Extech, LLC Rod Jackson, CH2M HILL Rudolph Carver, IMO Wes Franks, IMO	Inspected the Slickrock Creek diversion pipeline, impact structure, and spillway to identify and document abnormalities in condition of reinforced concrete pipeline and concrete structure due to normal wear, or failures of previously repaired portions of the pipeline.	No repair recommendations were identified for Slickrock Creek diversion and impact structure or the Slickrock Creek spillway. There were areas of the pipeline that should be watched for further deterioration during future inspection.
Sludge Conditioning Tank TK-13 Cleaning and Inspection	08/07/07	08/09/07	IMO, 2008a	Joe Benoit, Extech, LLC	Quality assurance inspection of IMO's recoating of the Tank TK-13.	The present condition of Tank TK-13 should allow many years of service without major repairs required.
Minnesota Flats Treatment Plant (MFTP) Effluent Discharge Compliance Oversight and Review	08/01/03	01/31/08	CH2M HILL, 2008 CH2M HILL, 2007d	CH2M HILL	1. Weekly wet season surface water sampling. 2. Fourth IMM Five-Year Review evaluation of the operational performance of MFTP in meeting the performance standards for treatment plant effluent discharge.	The SOW should be modified to modify BAT effluent limits based on metal removal level currently achieved at the MFTP. This was previously discussed in October 25, 2005, meeting with AIG, EPA, IMO, and CH2M HILL (CH2M HILL, 2005).

TABLE 1
Summary of Iron Mountain Mine Recent Site Inspections
Site Inspection Summary, IMM Five-Year Review

Inspection Area	Most Recent Inspection Start Date	Most Recent Inspection Finish Date	Document Source[a]	Persons Conducting or Attending Inspection	Inspection Activities Conducted	Inspection Observations and Issues
Slickrock Creek Retention Reservoir, Semi-Annual Geotechnical Data Evaluation	December 2006	08/01/07	GEI, 2007	Dan Wanket, GEI Project Manager Alberto Pujol, P.E., GEI Dam Engineer Pace Civil, Inc. – Surveys	Evaluation of specific geotechnical data for SCRR for December 2006 through June 2007 Brief site reconnaissance on 08/01/07.	Recommended that EPA/CH2M HILL provide action levels and response actions for data from the load cells on the slope anchors on the right abutment of the dam. This was completed by CH2M HILL (2007e).
2007 Boulder Creek Landslide Annual Inspection	9/27/07	9/27/07	The Mines Group, Inc., 2007c	Kenneth Myers, PE, The Mines Group, Inc. Pace Civil, Inc. – Surveys	Settlement monuments (21 total) are surveyed to determine surface movements within the slope failure complex. Report evaluates data through May 17, 2007.	Minimal movement of the Boulder Creek Landslide occurred over the 2007 or 2008 wet seasons. Data show a moderately strong correlation between precipitation and displacement magnitude. The report concludes that water is a major factor in the observed displacements within the slope failure complex, and the control of water would help control future displacements.
Subsidence Areas and Clay Caps Survey	10/16/07	10/16/07	IMO, 2007a	Pace Civil, Inc. – Surveys	Annual survey of subsidence areas	Comparing the 2007 versus 2006 surveys indicates minimal continuing vertical movement of the monitored areas. The differences measured between 2007 and 2006 are similar to the measured displacements over previous years. For the period between November 14, 2006 and October 16, 2007, the vertical changes ranged from +0.00 to -0.06 feet. The total movement since survey markers were set on June 26, 1995, shows vertical change ranging from -0.01 feet to -1.54 feet.
Slickrock Creek Dam, 2007 Annual Dam Safety Inspection	12/20/07	12/20/07	GEI, 2008	Dan Wanket, GEI Project Manager Alberto Pujol, P.E., GEI Dam Engineer Pace Civil, Inc. – Surveys	1. Reviewed geotechnical data collected by IMO from the previous year (through December 2007) 2. Annual dam inspection on December 20, 2007, including the dam and appurtenances.	Slickrock Creek Dam is performing well, is well maintained, and is in satisfactory condition. Dam performance and operation appear consistent with design expectations. The slide over the right abutment does not appear to have undergone significant movement since it was stabilized during construction. No safety deficiencies or significant issues requiring immediate actions were identified. Maintenance-level actions were identified, and significant observations are documented in this memorandum.
Iron Mountain Operations Monthly Progress Reports	Monthly	N/A	IMO, 2008b	Iron Mountain Operations	Monthly reports include a summary of operation and maintenance activities, tables with analyses and operational data, cost reports, project schedule, health and safety, inspection reports, and an electronic database.	Varies by month. Significant current issues are summarized in this memorandum.
Iron Mountain Operations SCRR Monthly Reports	Monthly	N/A	IMO, 2008c	Iron Mountain Operations	Monthly reports include a summary of activities, summary of inspections, work planned for the next reporting period, issues of concern, and monitoring data.	Varies by month. Significant current issues are summarized in this memorandum.
Fourth IMM Five-Year Review Site Inspection	04/03/08	04/03/08	Inspection issues and observations are documented in this memorandum.	John Spitzley/CH2M HILL Sandra Shearer/CH2M HILL Dave Bunte/CH2M HILL Eric Halpenny/CH2M HILL	Inspection included onsite documents and records; AMD pipelines; the Upper Spring Creek diversion; Minnesota Flats Treatment Plant and sludge drying beds; Boulder Creek mouth, tailings dam, landslide, and channel; Richmond Mine; Lawson Portal; Brick Flat Pit; Old/No. 8 Mine Seep; SCRR; Matheson Disposal Cell; and site roads, slopes, and tanks.	Inspection issues and observations are documented in this memorandum.

[a]Full citations for each document are provided in the Works Cited.

Note:
P.E. = Professional Engineer

TABLE 2
Iron Mountain Project Costs
Site Inspection Summary, IMM Five-Year Review

Line	Costcode	Description	AIG 2003 ($)	AIG 2004 ($)	AIG 2005 ($)	AIG 2006 ($)	AIG 2007 ($)
1	06-00-00	Miscellaneous Work Plans					
2	06-04-00	Landfill Management Report and Plan					
3	06-05-00	SCRR Startup/Shakedown Work Plan		7,737			
4	06-06-00	Site Health and Safety Plans		985	2,901	7,283	17,897
5	06-08-00	Quality Assurance Project Plan					
6	07-00-00	Site Staff Including Payroll and Benefits	1,015,355	1,126,657	1,239,922	1,266,736	1,299,779
7	09-00-00	Treatment Plant – Routine	383,449	291,406	212,994	290,633	296,343
8	09-00-01	Insurance (e.g., property, liability, auto)	n/a	206,981	184,854	318,949	262,642
9	09-01-00	Lime	1,018,019	862,403	919,163	1,376,078	514,628
10	09-02-00	Electricity	594,887	520,625	424,621	453,326	397,348
11	09-03-00	Sludge Haul	649,214	679,384	410,727	1,141,559	45,260
12	09-03-03	Treatment Plant – Nonroutine	240,521	205,950	516,553	129,461	385,966
13	09-04-02	Ancillary Facilities – Routine	5,341	6,404	9,630	18,207	5,705
14	09-04-03	Ancillary Facilities – Nonroutine		70,085	12,417	2,448	109,765
15	09-05-03	Roads – Routine	40,000	56,602	31,651	80,419	54,905
16	09-05-04	Roads – Nonroutine	213,706	117,392	48,970	109,021	18,422
17	09-05-10	Electrical Support (e.g., power poles)		13,831	5,547		
18	09-06-02	AMD Conveyance Systems – Routine		5,428		1,588	
19	09-06-03	AMD Conveyance Systems – Nonroutine	140,776	30,505	1,925	7,699	5,635
20	09-07-02	Brick Flat Pit – Routine	13,000	28,993	28,945	34,854	11,454
21	09-07-03	Brick Flat Pit – Nonroutine	41,000	31,053	4,792		
22	09-08-02	Subsidence Areas – Routine	3,000	3,385	6,335	3,506	11,139
23	09-08-03	Subsidence Areas – Nonroutine					
24	09-09-21	Richmond Adit – Routine		7,944	38,116	66,626	11,784
25	09-09-22	Richmond Adit – Nonroutine	1,635,069	273,020	64,185	4,172	8,844
26	09-09-23	Lawson Adit – Routine	3,000	1,755	10,430	28,733	10,380
27	09-09-24	Lawson Adit – Nonroutine			2,425	33,061	181,484
28	09-09-25	Mine Workings/Old/No. 8 – Routine	8,488	4,064	765		
29	09-09-26	Mine Workings/Old/No. 8 – Nonroutine			1,315		
30	09-10-22	Upper Spring Creek Diversion – Routine	43,406	8,271	2,250	7,187	370

TABLE 2
Iron Mountain Project Costs
Site Inspection Summary, IMM Five-Year Review

Line	Costcode	Description	AIG 2003 ($)	AIG 2004 ($)	AIG 2005 ($)	AIG 2006 ($)	AIG 2007 ($)
31	09-10-23	Upper Spring Creek Diversion – Nonroutine	15,583	35,483			
32	09-10-42	Upper Slickrock Creek Diversion-Routine		4,181	3,065	2,125	
33	09-10-43	Upper Slickrock Creek Diversion – Nonroutine					
34	09-10-52	Left-Side Clean Diversions – Routine					
35	09-10-53	Left-Side Clean Diversions – Nonroutine					
36	09-11-02	Boulder Creek Tailings Dam – Routine		1,100			
37	09-11-03	Boulder Creek Tailings Dam – Nonroutine	24,156	90,477	47,505		
38	09-12-02	Slickrock Creek Basin – Routine		24,469	45,284	166,834	53,081
39	09-12-03	Slickrock Creek Basin – Nonroutine		15,048	77,363		56,613
40	09-13-02	Boulder Creek Landslide Area – Routine	3,000	4,168	11,489	8,033	1,473
41	09-13-03	Boulder Creek Landslide Area – Nonroutine			27,772	3,126	10,351
42	09-14-00	Sampling Program – Laboratory Analysis	104,269	80,281	68,332	61,415	59,264
43	09-14-01	Sampling Program – Laboratory Supplies	5,000	10,114	12,292	10,275	7,724
44	09-14-02	BCMO Weir Maintenance/Sediment	10,000	2,537	6,462	3,081	
45	09-15-00	Boulder Creek Cementation Plant					
46	09-16-00	Security Systems		1,838			10,196
47	09-17-00	Downgradient Property		11,084	2,494	4,275	
48	09-18-00	Waste Disposal Facilities	27,554	33,873	11,534		
49	10-00-00	Emergency Response					
50	11-00-00	Response to Extreme Events					
Totals			**6,237,793**	**4,875,511**	**4,495,024**	**5,640,711**	**3,848,451**

Notes:

Fiscal years extend from December 1st through November 31st.

Source: Iron Mountain Operations (IMO). December 2007 Monthly Progress Report. January 18, 2008.

TABLE 3
Iron Mountain Operations, Primary Operation, Maintenance, and Inspections Performed in 2007
Site Inspection Summary, IMM Five-Year Review

Start	Finish	Activity	Duration (days)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
02/05/07	02/23/07	Lawson & Richmond Mine Maintenance	15		--										
06/11/07	06/12/07	Inspect Richmond & Lawson Mines	3						--						
05/07/07	05/25/07	Maintenance at Lawson Mine	20					-----							
08/06/07	12/30/07	Back-Up AMD collection system for Lawson	30								---				
04/01/07	12/30/07	2007 Plant Maintenance Program	180				---								
06/01/07	08/31/07	Shop-Test Modicon Quantum Boards @ ArcSine	90						-----------------------------						
09/06/07	09/30/07	ArcSine to install Quantum Boards at IMO	21									-----			
07/30/07	07/31/07	Clean & Inspect TK13	2							-					
08/03/07	08/10/07	TK13 Recoating by Redwood Painting	0								--				
07/18/07	08/17/07	Thickener TK11 Outage	30							---------------					
07/23/07	08/10/07	Thickener Overflow Trough Recoating by Redwood	21							-------------					
07/24/07	07/24/07	Inspect Spring Creek Diversion RCCP	1							-					
07/25/07	07/25/07	Inspect Thickener TK11 Coating	1							-					
07/26/07	07/26/07	Inspect SCRR Diversion Pipeline	1							-					
07/27/07	07/27/07	Inspect SCRR Spillway Pipe	1							-					
07/23/07	08/10/07	Extech Inspection Services	21							------					

TABLE 3
Iron Mountain Operations, Primary Operation, Maintenance, and Inspections Performed in 2007
Site Inspection Summary, IMM Five-Year Review

Start	Finish	Activity	Duration (days)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12/10/07	12/10/07	SCRR Slide Gate Maintenance	1												-
		Sludge Haul - Not Necessary For 2007													
		Extend Brick Flat Pit Vents - Not Necessary For 2007													
06/18/07	07/18/07	Expand Rock Creek Dam at SCRR	10						------						
04/09/07	05/25/07	Rebuild French Drains at SDB-4 and SDB-2	15				--	--							
09/01/07	09/14/07	Close-in Old Treatment Plant for additional storage	10									---			
11/01/07	11/30/07	New gate at property line	15											Deferred to 2008	

Source: Iron Mountain Operations (IMO). *December 2007 Monthly Progress Report*. January 18, 2008.

TABLE 4
Iron Mountain Operations Monthly Average Data for the Period Between August 27, 2004, and March 19, 2008
Site Inspection Summary, IMM Five-Year Review

Month	Old/No. 8 PW3 Flow (gpm)	SCRR Flow (gpm)	Old/No. 8 PW3 pH	SCRR pH
January	78	1,034	2.19	2.50
February	97	854	2.17	2.48
March	101	1,308	2.15	2.47
April	185	1,402	2.02	2.51
May	163	746	2.11	2.46
June	109	246	2.10	2.41
July	40	110	2.04	2.27
August	48	191	2.18	2.33
September	34	101	2.14	2.50
October	43	82	2.20	2.38
November	47	126	2.28	2.43
December	41	584	2.25	2.48

Note:

Flow data is an average of parameters “Flow (GPM)-PMCS” and “Flow (GPM)-Local” in the IMO database.

TABLE 5

Old/No. 8 PW3 Operational Data - Average Water Level Measurements Using a Tape

Site Inspection Summary, IMM Five-Year Review

Year	Units	Annual Average	January	February	March	April	May	June	July	August	September	October	November	December
2001	ft	86	87	84	83	88	89		90	85	81	87	89	86
2002	ft	87	82	90	91	90	91	90	83	71				90
2003	ft	89	90	90	90	89	89		89		82			
2004	ft	89												89
2005	ft	70	90	91	84	91	89	92	89	58	36	34	36	29
2006	ft	53	29	52	63	43	44	49	26	43	51	56	75	93
2007	ft	54	82	75	38	27	52	82	83	60	44	34	28	32
2008	ft	25	22	24	31	--	--	--	--	--	--	--	--	--

TABLE 6

Old/No. 8 PW3 IMO Operational Data – Number of Days with Zero Total Flow

Site Inspection Summary, IMM Five-Year Review

Year	Units	Total Number of Days	January	February	March	April	May	June	July	August	September	October	November	December
2001	Days	44	8	1					16	9	8	2		
2002	Days	38	3					18	17					
2003	Days	31					1	13	4	2		8	3	
2004	Days	20						15	5					
2005	Days	121			2			9	24	30	10	22	24	6
2006	Days	29					8	19		2				
2007	Days	222	10	16	27	14		14	19	30	31	30	31	31
2008	Days	50	31	19		--	--	--	--	--	--	--	--	--

TABLE 7

Old/No. 8 PW3 IMO Operational Data - Total Annual and Monthly Flow (Million Gallons)

Site Inspection Summary, IMM Five-Year Review

Year	Units	Total Annual Flow	January	February	March	April	May	June	July	August	September	October	November	December
2001	MG	48	1.8	4.2	10.4	5.2	3.8	3.1	3.0	1.5	2.5	2.5	3.1	6.7
2002	MG	47	9.4	5.6	5.0	3.9	3.4	3.2	1.7	1.4	2.5	3.6	2.4	4.6
2003	MG	61	11.2	6.4	5.2	5.5	8.7	4.8	2.4	3.4	3.9	2.4	2.1	4.9
2004	MG	58	9.0	8.0	11.3	5.9	4.3	3.3	1.4	3.6	3.1	2.5	2.4	2.8
2005	MG	43	5.7	4.9	5.5	8.7	6.4	5.8	3.1	0	0	2.4	0.37	0.34
2006	MG	64	6.1	8.0	8.5	9.7	9.7	3.5	0.67	5.0	2.5	2.8	4.5	3.4
2007	MG	16	1.9	0.95	0.01	1.6	5.1	4.5	1.4	0.49	0	0	0	0
2008	MG	--	0	1.2	2.8	--	--	--	--	--	--	--	--	--

Iron Mountain Mine Sitewide Inspection, April 3, 2008

Upper Spring Creek Diversion Impact Structure. Stainless steel plates were installed during the 2004 annual maintenance event.

Upper Spring Creek Diversion Inlet Structure. Sand and gravel in sedimentation basin needs to be removed.

Upper Spring Creek Diversion Inlet Structure. Sand and gravel in sedimentation basin needs to be removed.

Minnesota Flats Treatment Plant (MFTP) Control Center.

MFTP Control Center. Programmable logic controller (PLC) system updated in September 2007.

MFTP lime slurry pumps. All pumps and tanks, except the thickener, have redundancy.

MFTP acid mine drainage (AMD) influent sample location. Sample ports should be labeled.

MFTP manual 3-way valve for AMD influent.

MFTP lime slurry tanks. The treatment plant has two lime slurry tanks for redundancy.

MFTP thickener. The thickener tank launder was recoated in 2007.

MFTP sludge drying beds. Pond # 4 was almost full and Pond # 3 was one third full, for a total sludge volume of about 20,000 yd^3.

Boulder Creek Mouth (BCMO) weir and sampling location.

IMO's sampling and monitoring equipment at BCMO. Sticks and leaves were located adjacent to the sampler upon arrival.

Boulder Creek Tailings Dam. Improvements were completed in 2005 to raise the dam, build the spillway, and improve Boulder Creek upstream.

Boulder Creek adjacent to Tailings Dam.

Boulder Creek upstream of Tailings Dam.

Ted Arman maintains tanks within the metal shed and on the east side of the shed.

Three 6,500-gallon poly tanks are on the east side of the shed. Per IMO discussion with Ted Arman, the tanks contain raw Acid Mine Drainage, Sodium Silicate, and Ag-Gel fertilizer product.

Precipitates on the pipe connection for the middle poly tank, located east of the shed, indicates a leak. There is no secondary containment.

Sand between the poly tanks and the shed was wet, but fluid was not visibly leaking from the tanks during the inspection.

55-gallon drums stored on north side of warehouse. Many of the drums were empty.

Label on one 55-gallon drum. Contains potassium hydroxide (caustic potash), which is listed as a corrosive health hazard.

Tanks maintained by Ted Arman and located within the metal shed. Photo was taken from window on north side of shed.

Boulder Creek Landslide Area. The culvert was constructed to convey Boulder Creek under a temporary access road to horizontal drains.

Boulder Creek landslide area. Downstream end of culvert under temporary access road.

PVC horizontal drains in Boulder Creek landslide area. The exposed PVC piping should be coated or replaced with UV-resistant piping.

Lawson Portal. AMD pipeline was encased in concrete to protect the pipeline from falling rocks.

Lawson Portal. AMD pipeline was encased in concrete to protect the pipeline from falling rocks.

On 12/18/07, a leak of the AMD pipeline occurred near Road Marker 16.5 near the intersection of the AMD pipeline and the filtrate pipeline that extends from the Mine Waste Disposal Cell. Pipeline was repaired.

Richmond Mine. Wes Franks commented this was a pile of the shotcrete form that had fallen from the wall (the "back").

Richmond Mine. Shotcrete form has fallen off a portion of the plug. The pipe drain shown in the photo is blocked, and seepage is occurring around the edge of the chute plug.

Richmond Mine. Seepage is occurring around the edge of the chute plug.

Brick Flat Pit, looking NE. IMO will raise 4 filtrate riser pipes by 10 feet in 2008. Filtrate has decreased significantly and needs to be investigated.

Old No. 8 gravity drain pipeline installed in March 2008. PW-3 was not being pumped at the time of the inspection.

Old No. 8 PW-3 Grit Chamber shown in background. New gravity drain pipeline alignment evident in foreground, adjacent to orange cone.

SCRR, looking south.

 SCRR sedimentation basin, looking southwest.	 SCRR sedimentation basin and rock check dams, looking east. The rock check dams are performing well.
 Upstream of SCRR clean water diversion intake. Sand and gravel need to be removed from basin.	 SCRR storm water channel. Rocks have accumulated in channel and need to be removed more frequently.

 SCRR storm water channel. Rocks have accumulated in channel and need to be removed more frequently.	 SCRR storm water channel. Gap between channel bottom and metal grate has allowed some rocks to enter spillway. Bars should be extended.
 SCRR Spillway. Rocks and gravel have entered the spillway from the storm water channel.	 SCRR intake structure and dam. The water level this wet season came up to the second gate.

 Toe berm for upper consolidated hematite pile. No issues were identified. A white precipitate (potentially aluminum hydroxide) was observed in the filtrate from the eastern hematite drain.	 Matheson disposal cell. No issues were identified.
 Four down comers from culverts along the Jeep Road have broken and need to be replaced. This pipeline is near mile marker 2 ½.	 Four down comers from culverts along the Jeep Road have broken and need to be replaced. This pipeline is near mile marker 2 ½.

ttac ment 7
Institutional Control Assessment

TECHNICAL MEMORANDUM CH2MHILL

Institutiona ontro ssessment Iron Mountain Mine Five-Year Review

TO: Rick Sugarek / U.S. Environmental Protection Agency

FROM: Sandra Shearer / CH2M HILL
Caroline iegler / CH2M HILL

DATE: July 8, 2008

PROJECT NUMBER: 367266.SR.04

This memorandum provides an institutional control (IC) assessment in accordance with June 2001 OSWER Directive 9355.7-03B-P, "Comprehensive Five-Year Review Guidance." The U.S. Environmental Projection Agency (EPA) has not yet implemented ICs at the Iron Mountain Mine (IMM) Superfund Site in the five signed Records of Decision (EPA, 1986 [ROD 1]; EPA, 1992 [ROD, 2]; EPA, 1993 [ROD 3]; EPA, 1997 [ROD 4]; EPA, 2004 [ROD 5]). However, EPA has outlined IMM access controls in the October 2000 *Statement of Work Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (EPA, 2000a), and several interim actions, including fencing and security gates, have been taken at IMM. ICs will be implemented in a final remedy for IMM. This memorandum discusses the interim access controls and procedures that have been implemented.

Interim Access Controls and Procedures

The SOW (EPA, 2000a) includes the principal steps necessary to operate and maintain the CERCLA remedies selected under RODs 1 through 4 at IMM (EPA, 2000a). The Site Operator, Iron Mountain Operations (IMO), is responsible for implementing the SOW and controlling access to the Site. The SOW was included in the December 2000 settlement of cost recovery litigation between the United States and the State of California with Aventis CropScience USA. The settlement provides funding that ensures proper operation and maintenance of the remedies implemented pursuant to RODs 1 though 4.

This section reproduces details from the SOW pertaining to IMM site access and security measures. This section also summarizes a conversation with the IMM Site Operator regarding the effectiveness of current access controls. Finally, this section summarizes Bureau of Reclamation (Reclamation) security measures for Spring Creek Debris Dam (SCDD).

Iron Mountain Mine Site Access Requirements

The SOW (EPA, 2000a) details requirements for site access, summarized as follows:

1. The Site Operator shall provide the Oversight Agency, the Support Agency, and their representatives with access at all reasonable times to the Site, or such other property, to conduct any activity related to the SOW

2. The Site Operator shall refrain from using the Site, or such other property, in any manner that would interfere with or adversely affect the integrity or protectiveness of the remedial measures to be implemented pursuant to the Consent Decree and SOW.

3. If the Site Operator acquires any ownership or other property interest in the Site, or any other property where access and / or land / water use restrictions are needed to implement the Consent Decree, the Site Operator shall:

    a. Upon acquiring such interest, provide the Oversight Agency, the Support Agency and their authorized representatives with access at all reasonable times to the Site, or such other property, for the purpose of conducting any activity related to the SOW and the Consent Decree; and

    b. In coordination with the Oversight Agency and the Support Agency, take appropriate steps to ensure the long-term enforceability of access and ICs with respect to such property, including, but not limited to, appropriate deed notices and other actions.

4. The Oversight Agency will secure permission for the Site Operator to enter and perform Work at the property owned by Iron Mountain Mines, Inc., T.W. Arman, the United States, or the State (if any), including the facilities, plant and equipment located thereon (and necessary to carry out the actions of the SOW and Consent Decree) for the sole purpose of permitting the Site Operator to carry out the Work under the SOW and Consent Decree.

5. To the extent that access and / or land / water use restrictions at property not owned by the Site Operator and not at the property referenced in Number 4 above are needed to implement the Consent Decree or the SOW, the Site Operator shall use its best efforts to secure from persons who own such property, to the extent determined by the Oversight Agency to be necessary, as applicable:

    a. An agreement to provide access thereto for the Site Operator, as well as for the United States and the State, and their representatives (including contractors), for the purpose of conducting any activity related to the Consent Decree;

    b. An agreement, enforceable by the Site Operator, the United States, and the State to abide by the obligations and restrictions established by Number 3(b) above, or that are otherwise necessary to implement, ensure non-interference with, or ensure the protectiveness of the activities to be performed pursuant to the Consent Decree;

    c. The execution and recordation in the Recorder’s Office of Shasta County, California, of an easement, running with the land, that (i) grants a right of access for the purpose of conducting any activity related to the SOW and the Consent Decree, and (ii) grants the right to enforce the land / water use restrictions that the Oversight Agency and the Support Agency, as appropriate, determine are necessary to implement, ensure non-interference with, or ensure the protectiveness of the activities to be performed pursuant to the Consent Decree or the SOW;

    d. The access rights and / or rights to enforce land / water use restrictions shall be granted to (i) the United States, on behalf of its representatives, (ii) the State and its representatives, and (iii) other appropriate grantees, as determined by the Oversight Agency; and

e. If the Oversight Agency so requests, within sixty (60) days of notice from the Oversight Agency that access is required, the Site Operator shall submit to the Oversight Agency and the Support Agency, as appropriate, for review and approval with respect to such property:

   i. A draft easement that is enforceable under the laws of the State of California, free and clear of all prior liens and encumbrances (except as approved by the Oversight Agency), and acceptable under the Attorney General's Title Regulations promulgated pursuant to 40 U.S.C. Section 255; and

   ii. A current title commitment or report prepared in accordance with the U.S. Department of Justice Standards for the Preparation of Title Evidence in Land Acquisitions by the United States (1970) (the "Standards"). Within fifteen (15) days of approval by the Oversight Agency and the Support Agency, as appropriate, and acceptance of the easement, the Site Operator shall update the title search and, if it is determined that nothing has occurred since the effective date of the commitment or report to affect the title adversely, the easement shall be recorded with the Recorder's Office of Shasta County. Within thirty (30) days of the recording of the easement, the Site Operator shall provide the Oversight Agency and the Support Agency, as appropriate, with final title evidence acceptable under the Standards and a certified copy of the original recorded easement showing the clerk's recording stamps.

6. Notwithstanding any provision of the SOW, the United States and the State retain all of their access authorities and rights, as well as all of their rights to require land / water use restrictions, including enforcement authorities related thereto, under CERCLA, RCRA, and any other applicable federal or State law, statutes, or regulations.

Iron Mountain Mine Property Security Measures

The October 2000 SOW (EPA, 2000a) details the existing IMM security measures and associated operation and maintenance requirements. Text included in the SOW relating to the security measures is reproduced below (EPA, 2000a).

In addition to the security measures described below, the property owner has posted the property to discourage trespassers. The Site Operator performs monthly inspections of potential points of entry to the site to look for evidence of and deter trespassers. Also, the *ROD 4 Remedial Action Report, Slickrock Creek Retention Reservoir* (CH2M HILL, 2004) describes the interim access control that was implemented as part of the ROD 4 remedial action, which was completed in 2004. This is included as Number 5 in the Security Systems Unit Description below.

Security Systems Unit Description

1. The security systems include, but are not limited to, two electronic, locally and remotely controlled gates on Iron Mountain Road. The Site entry gate provides primary access to

the Site, sludge drying beds, and Minnesota Flats Treatment Plant (MFTP), and is located on Iron Mountain Road near the Flat Creek crossing. The entry gate system includes overhead lighting, a keypad entry control panel, an intercom that allows communication with the MFTP operation room, remote operations capability, a pressure pad embedded in the roadway that triggers the gate motor, a gate motor, and a gate.

2. The secondary Site electronic gate, located just above the MFTP, controls access on Iron Mountain Road above the MFTP and includes a magnetic key entry pad, remote operations capability, a pressure pad embedded in the roadway that triggers the gate motor, and a gate.
3. The security systems include, but are not limited to, seven locked gates consisting of posts, chain link, angle iron, and other materials positioned across roadways that lead offsite in the Upper Slickrock Creek Basin, Upper Boulder Creek (north of Brick Flat Pit), and Spring Creek watersheds.
4. The security systems include locked gates at the Richmond and Lawson portals and locked fence.
5. A locked electrical control room was constructed at the Slickrock Creek Retention Reservoir project site.

O&M Requirements for the Security Systems

1. The Site Operator shall control access to the Site and shall prevent unauthorized individuals from entering the Site. The Site entry gate shall remain closed, except during emergencies and during those periods that the Site Operator or the Oversight Agency retains direct control of the entry.
2. The Site Operator shall maintain a list of individuals and companies that possess the keypad entry codes to the primary gate, magnetic keys that allow entry to the secondary Site gate, and keys to all gates and facilities.
3. The Site Operator shall operate and maintain the electronically operated and heavy-duty steel gates, including all parts, components, and directional signs.

Effectiveness of Iron Mountain Mine Access Controls

CH2M HILL met with the Site Operator to discuss the effectiveness of Iron Mountain Mine access requirements and security measures. Sandra Shearer / CH2M HILL met with Rudolph Carver, IMO Project Manager, on March 27, 2008, at the IMM Site. CH2M HILL staff (Sandra Shearer, John Spitzley, Dave Bunte, and Eric Halpenny) met with IMO staff (Rudolph Carver and Wes Franks) during the IMM Five-Year Review sitewide inspection. Details of the meeting and inspection are provided in Attachments 5 and 6 of the *IMM Fourth Five-Year Review* (CH2M HILL, 2008a and 2008b).

No vandalism has recently occurred on the site. The property is located between two heavily used national forests. The Site Operator performs monthly inspections of potential points of entry to the site to look for evidence of and deter trespassers. There is evidence that dirt bikes or motorcycles have accessed the site from adjacent federal lands. In response, IMO has placed additional signage, barriers (e.g., boulders or trees), or trenches across these points of entry to discourage future access.

IMO identified that copper electrical cables (replacement value   14,000) stored at the Richmond Mill Buildings were missing on March 21, 2007. IMO notified the Shasta County Sheriff, and the missing cable was identified at Northstate Recycling. The cable was delivered to Northstate Recycling by individuals working for Mr. T.W. Arman, current owner of the Iron Mountain property (IMO, 2007).

Spring Creek Debris Dam Security Measures

Acid mine drainage discharged from IMM is transported via Spring Creek through the Spring Creek Reservoir (the impoundment created by SCDD), into the Spring Creek Arm. SCDD was constructed in 1963 to regulate the discharge flow rate of metal-rich contaminated water in Spring Creek into the Sacramento River and to reduce or prevent sediment in the Spring Creek Basin from entering the Spring Creek Arm.

Access to Spring Debris Dam, and subsequently Spring Creek Reservoir, is restricted by Bureau of Reclamation. A pad-locked gate and fence restricts vehicular access to SCDD. The area is regularly patrolled by Bureau of Reclamation Northern California Area Office security guards as part of the overall Shasta and Keswick area security measures. As described below, the Iron Mountain Mine Site, including Spring Creek Reservoir, is located between two heavily used national forests, so direct exposure is possible for trespassers.

EPA's remedial actions implemented under RODs 1 through 4 have resulted in more than 97 percent reduction in metal loading discharges from the IMM Site. Because of remedies implemented under RODs 1 through 4, EPA anticipates that discharges from SCDD will not result in exceedances of State and Federal drinking water standards at the point of withdrawal for the Redding Municipal and Bella Vista Water Districts (EPA, 1997; EPA, 2003).

Bureau of Reclamation initiated a Spring Creek Debris Dam Emergency Exercise on August 15, 2007. The purpose of the exercise was to test the emergency preparedness in the event that metal-laden sediment was released from the Spring Creek Arm in amounts that could adversely impact downstream drinking water sources. As part of the Emergency Exercise, the SCDD Emergency Action Plan was successfully used to make downstream notifications in a timely manner to prevent impacted water from entering domestic water supplies (U.S. Bureau of Reclamation, 2008). The Regional Water Quality Control Board also coordinates with the City of Redding during SCDD spill and emergency release periods so that groundwater can be used if appropriate, thereby providing additional protection to human health.

Conclusions

EPA has not yet implemented ICs at the IMM Superfund Site in the five signed RODs (EPA, 1986; EPA, 1992; EPA, 1993; EPA, 1997; EPA, 2004). However, EPA has outlined IMM access controls in the SOW (EPA, 2000a) and several interim actions, including fencing and security gates, have been taken at IMM. The IMM interim access controls and SCDD security measures are controlling potential human exposures and preventing adverse impacts to the integrity or protectiveness of the remedial measures. A layered IC strategy will be implemented in the final IMM ROD.

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Applicable or Relevant and Appropriate
Requirement Analysis

pp ica e or Re evant and ppropriate Re uirement na sis Iron Mountain Mine Five-Year Review

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PROJECT NUMBER: 367266.SR.01

This technical memorandum provides an analysis of updates to the applicable or relevant and appropriate requirements (ARAR) and guidance to be considered since the fifth Iron Mountain Mine Record of Decision (ROD 5) (U.S. Environmental Protection Agency [EPA], 2004). The following changes in ARARs and TBCs have occurred since ROD 5 was issued in September 2004:

- EPA promulgated acute and chronic copper criteria under the EPA National Recommended Ambient Water Quality Criteria (AWQC) for Freshwater Aquatic Life Protection that are calculated using a bioavailability model, the Biotic Ligand Model (EPA, 2007).
- The California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA), revised the Public Health Goal (PHG) for copper in drinking water.
- Revisions are recommended to the best available technology (BAT) economically achievable effluent controls for the high density sludge (HDS) acid mine drainage (AMD) neutralization facility at Iron Mountain Mine (IMM).

This memorandum evaluates the effects of newly promulgated or modified federal, state, and local regulations regarding the protectiveness of human health or the environment for the remedies originally selected in the RODs for IMM.

Biotic Ligand Model

EPA promulgated continuous (4-day average) and maximum (1-hour average) copper criteria under the EPA National Recommended AWQC for Freshwater Aquatic Life Protection. The revised criteria are calculated using a bioavailability model, the Biotic Ligand Model (EPA, 2007). The Biotic Ligand Model is a metal bioavailability model that uses equilibrium reactions of copper and other cations with a single, simple type of surface ligand to estimate the effects of physicochemical exposure conditions on toxicity. The Biotic Ligand Model takes into account several parameters, including dissolved organic carbon (DOC), cations (sodium, potassium, calcium, and magnesium), anions (sulfate and chloride), pH, alkalinity, and temperature.

The Biotic Ligand Model criteria are customized to the particular water body under consideration. The model's dissolved copper criteria are highly dependent on pH and DOC. In water bodies with relatively low DOC levels, the model's dissolved copper water quality criteria can be equal to or more stringent than the current hardness-based copper criteria. In other cases, the current hardness-based copper criteria might be overly stringent for particular water bodies.

EPA's document *Aquatic Life Ambient Freshwater Quality Criteria – Copper* (EPA, 2007) provides updated guidance to states and authorized tribes to establish water quality standards under the Clean Water Act (CWA) to protect aquatic life from elevated copper exposure. The state of California has not taken any action to implement the revised EPA National Recommended AWQC criteria for copper using the Biotic Ligand Model. The applicable numeric chemical-specific standards identified in ROD 5 are presented in Table 1 (EPA, 2004). These standards should be reevaluated if the state of California implements the revised EPA National Recommended AWQC or during the next IMM Five-Year Review.

TABLE 1
Basin Plan and California Toxics Rule Water Quality Criteria for the Sacramento River below Keswick Dam
Applicable or Relevant and Appropriate Requirement Analysis, Iron Mountain Mine Five-Year Review

Parameter	Basin Plan Maximum Concentration[a] (µg/L)	California Toxics Rule Continuous Concentration[a] (4-day Average) (µg/L)
Arsenic	10	150
Cadmium	0.22[b]	1.1[b]
Copper	5.6[b]	4.1[b]
Iron	300	No standard
Zinc	16[b]	54[b]

[a]Expressed as dissolved concentrations.
[b]Concentration is dependent on hardness. Objectives presented assume a hardness of 40 mg/L.

Notes:

µg/L = micrograms per liter

Basin Plan = *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin*

Source: EPA, 2004

Public Health Goal

A revised PHG of 300 g/L was developed for copper in drinking water, based on a review of the scientific literature since the original PHG, in 1997 (OEHHA, 2008). Copper is an essential nutrient in humans, and has not been shown to be carcinogenic in animals or humans. However, young children, and infants in particular, appear to be especially susceptible to the effects of excess copper.

The revised PHG of 300 g/L is two orders of magnitude greater than the applicable numeric chemical-specific standards identified in ROD 5 for the protection of freshwater aquatic life (see Table 1). Therefore, the revised PHG for copper will have no impact on the protectiveness of the remedies originally selected in the RODs for IMM.

Best Available Technology Economically Achievable Effluent Controls

Attachment 3 in the *Fourth Iron Mountain Mine Five-Year Review, Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Five-Year Review*, provides an evaluation of the performance of the Minnesota Flats Treatment Plant (MFTP) at IMM in meeting the standards for treatment plant effluent discharge. The evaluation focuses on the discharge limits in the IMM scope of work, dated October 2, 2000 (EPA, 2000). The memorandum also reviews and provides recommendations for modifications to the technology-based effluent controls.

The Clean Water Act system of technology-based effluent controls requires that discharges achieve the best practicable technology and BAT. The HDS AMD neutralization control technology currently employed at the MFTP constitutes BAT. The BAT effluent limits are provided in Table 2 and were set in October 2000 from the limited MFTP data available at that time. However, operation of the MFTP over the last 5 years demonstrates that HDS metal removal can not achieve the initial BAT effluent limits for dissolved zinc or the BAT 30-day average limit for dissolved cadmium.

TABLE 2
Best Available Control Technology Limits
Applicable or Relevant and Appropriate Requirement Analysis, Iron Mountain Mine Five-Year Review

Parameter	30-day Average[a] (µg/L)	7-day Average[b] (µg/L)	Daily Maximum[c] (µg/L)
Copper (dissolved)	5	10	15
Cadmium (dissolved)	1	2	3
Zinc (dissolved)	10	20	30

[a]Running average of daily values for 30 consecutive days.
[b]Running average of daily values for 7 consecutive days (2 x 30 day average).
[c]Maximum allowable for any one day (3 x 30-day average).

Source: EPA, 2000, Table 14-2.

BAT effluent limits should be modified based upon metal removal level currently achieved at the MFTP. The following revisions to BAT limits are recommended (CH2M HILL, 2008; CH2M HILL, 2005):

- Change daily dissolved zinc BAT limit from 30 to 300 g/L
- Change 7-day average dissolved zinc BAT limit from 20 to 150 g/L
- Change 30-day average dissolved zinc BAT limit from 10 to 100 g/L
- Change 30-day average dissolved cadmium BAT limit from 1 to 2 g/L

Metal discharges during the past 5 years from the MFTP are substantially below the Clean Water Act Effluent Guidelines and Standards for Ore Mining and Dressing in 40 Code of Federal Regulations 440.102(a) and 440.103(a) (CH2M HILL, 2008). Revision of the dissolved zinc and 30-day dissolved cadmium BAT effluent limits to more accurately reflect metal removal by the HDS AMD neutralization process will not impact the protectiveness of the remedies originally selected in the RODs for IMM. Changes to the technology-based performance standards should not change treatment plant operations by the Site Operator, particularly with respect to pH controls.

Conclusions and Recommendations

Changes to newly promulgated or modified federal, state, and local regulations and guidance do not impact the protectiveness of human health or the environment for the remedies originally selected in the RODs for IMM.

The state of California has not taken any action to implement the revised EPA National Recommended AWQC for copper using the Biotic Ligand Model. IMM numeric surface-water standards should be reevaluated if the state of California implements the revised EPA National Recommended AWQC or during the next IMM Five-Year Review.

The dissolved zinc and 30-day dissolved cadmium BAT effluent limits should be revised to more accurately reflect metal removal by the HDS AMD neutralization process. Metal discharges during the past 5 years from the MFTP are substantially below the Clean Water Act Effluent Guidelines, and revision of the BAT limits will not impact the protectiveness of the remedies originally selected in the RODs for IMM.

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