# FIFTH FIVE-YEAR REVIEW REPORT FOR

# IRON MOUNTAIN MINE SUPERFUND SITE

# REDDING, CALIFORNIA

PREPARED FOR:

AES Contract No. 68-S7-04-01/ Task Order 064-RI-CO-0917
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Approved by: Date: 9/26/13

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# Executive Summary

This is the Fifth Five-Year Review (FYR) for the Iron Mountain Mine (IMM) Superfund Site (Site), which is near Redding, California. The purpose of this FYR is to review information to determine if the interim remedies are and will continue to be protective of human health and the environment. The trigger for the First FYR was the start of construction of the partial cap in September 1988. The First FYR was completed September 30, 1993; the Second FYR was completed October 8, 1998; the Third FYR was completed September 30, 2003; and the Fourth FYR was completed July 14, 2008.

The interim remedies for the Site 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 (SCDD) into dilution flows from Shasta Dam. The remedial action objective for the Site has been defined as eliminating the IMM discharges that are harmful to the environment (U.S. Environmental Protection Agency [EPA], 1993 and 1997), and more specifically, protecting the Sacramento River ecosystem from releases of heavy metals and preventing adverse impacts on water quality and beneficial uses of the Sacramento River below Keswick Dam (EPA, 2004a). Figure 1 is a location map for the Site and Figure 2 shows the Site features in the Main Mine Area. The remedies selected in the Records of Decision (ROD) 1 through 5 have been implemented; the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action, selected in ROD 5, was completed during this FYR period.

This FYR assessment found that the remedies implemented under RODs 1 through 5 are operating as intended and the operation and maintenance (O&M) at the Site has been satisfactory over the past 5 years. The interim remedial actions completed under RODs 1 through 4 have afforded substantial protection for the valuable Sacramento River ecosystem by eliminating 97 percent of the historical metals discharges from the Site. The interim remedial actions were designed to meet protective water quality criteria in the Sacramento River downstream of Keswick Dam, to the extent practicable. The results of water quality sampling performed between January 2008 and December 2012 indicate copper, cadmium, and zinc concentrations in the Sacramento River below Keswick Dam complied with the *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin* (Basin Plan) standards. The interim action completed under ROD 5, dredging metal-contaminated sediment from Spring Creek Arm that was susceptible to erosion, also resulted in significant environmental benefits for the Sacramento River ecosystem and beneficial uses.

The remedial actions selected in RODs 1 through 5 are interim actions and leave some releases of hazardous substances unabated. EPA invoked an ARARs waiver for the “interim measures”. The IMM interim remedy relies on the Bureau of 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 less than 5 percent of the overall historical IMM discharges of copper and zinc. The Bureau of Reclamation water management actions are necessary to reduce the likelihood of uncontrolled spills and meet Basin Plan standards in the Sacramento River below Keswick Dam. Exceedances of water quality standards are expected downstream of Keswick Dam on the rare

occasions when large early winter storms follow very dry summers. The IMM interim remedies were not intended to meet water quality objectives in the immediate receiving waters. IMM interim access controls, security measures, governmental agreements, and governmental controls are effectively controlling potential human exposures and preventing adverse impacts on the integrity or protectiveness of the interim remedial measures implemented under RODs 1 through 5. EPA is evaluating the need for additional remedial actions as part of the sitewide remedial investigation report and the forthcoming feasibility study report.

The interim remedial actions implemented at IMM selected in RODs 1 through 4 for Operable Units 1 through 4 are protective of human health and the environment. The interim remedial actions implemented at IMM selected in ROD 5 for Operable Unit (OU) 5 is protective of human health and the environment in the short term. To remain protective of the environment over the long term, operational controls selected in ROD 5, including limited restrictions on the Keswick Reservoir water elevation to prevent mobilization of sediment remaining in Spring Creek Arm, need to be officially recorded.

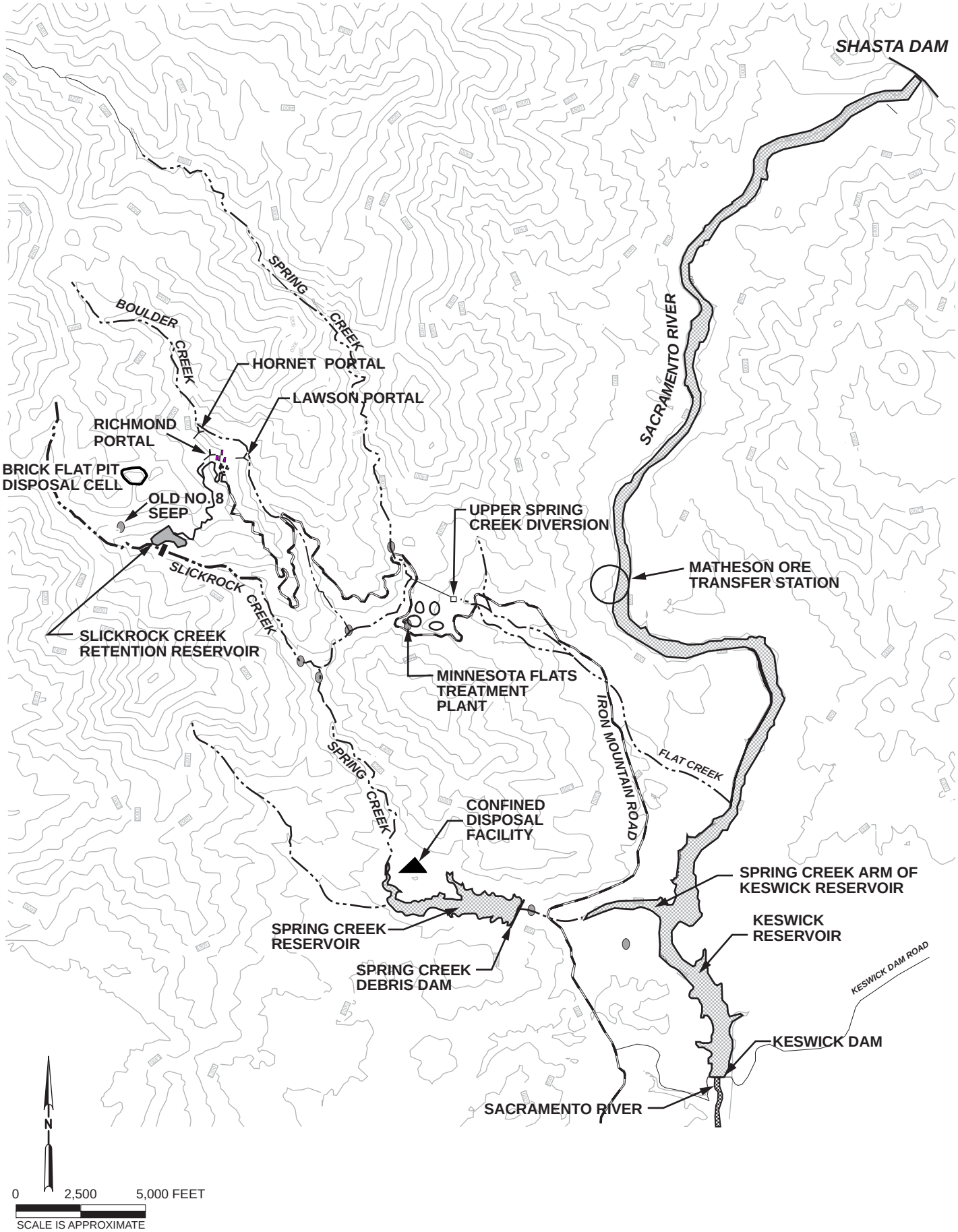


**FIGURE 1**
**LOCATION MAP**
2013 FIVE-YEAR REVIEW
IRON MOUNTAIN MINE

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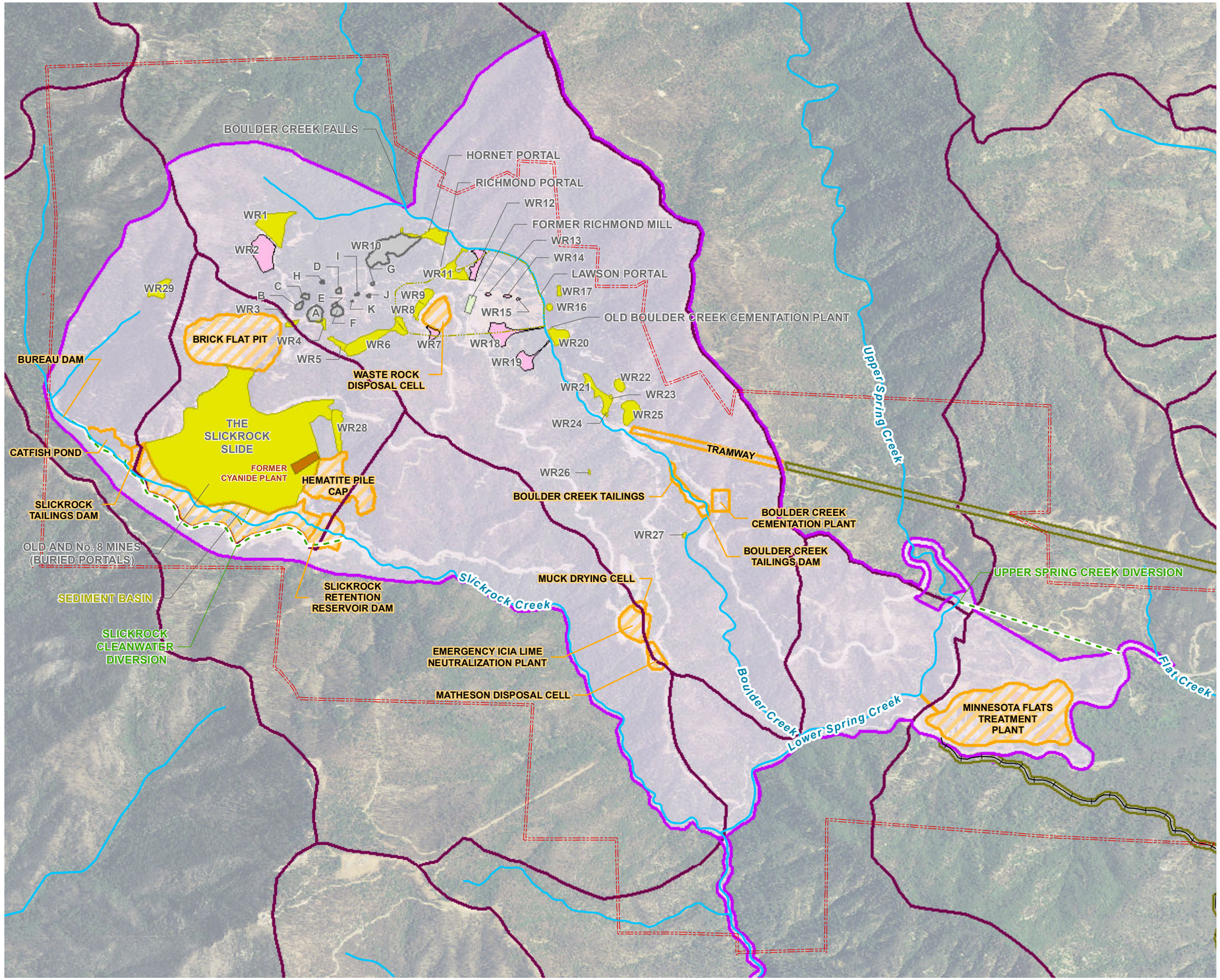
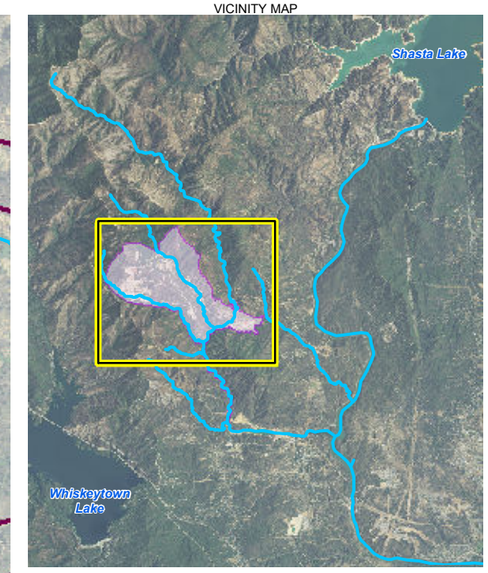



VICINITY MAP




**LEGEND**

- IMM PROPERTY BOUNDARY
- RIVER/STREAM
- RAILROAD TO KESWICK SMELTER
- DIVERSION
- FORMER CYANIDE PLANT
- RI/FS GROUP SITE
- PART OF IMM ONGOING OPERATIONS
- CAPPED SINKHOLE
- WASTE ROCK PILE EXPOSED
- WASTE ROCK PILE REMOVED OR CAPPED
- MAIN MINE AREA
- RAILROAD AND TRAMWAY AREAS
- DRAINAGE BASIN

N

0 1,500
Feet

**FIGURE 2**
**LOCATION MAP OF FEATURES IN THE MAIN MINE AREA**
IRON MOUNTAIN MINE

RDD V:\IMM_380897\MAPFILES\5YRREV\FIG2_IMM_MAINMINE_FEATURES.MXD ECLARK1 3/14/2013 8:26:40 AM

# 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 | |
| **Multiple OUs?**<br>Yes | **Has the site achieved construction completion?**<br>No |

| REVIEW STATUS |
|---|
| **Lead agency:** EPA<br>**If "Other Federal Agency" was selected above, enter Agency name:** |
| **Author name (Federal or State Project Manager):** James Sickles |
| **Author affiliation:** EPA Region 9 |
| **Review period:** 01/08/2013 – 09/30/2013 |
| **Dates of site inspection:** 02/19/2013, 02/27/2013, and 02/28/2013 |
| **Type of review:** Statutory |
| **Review number:** 5 |
| **Triggering action date:** 07/14/2008 |
| **Due date *(five years after triggering action date)*:** 07/14/2013 |

# Five-Year Review Summary Form (continued)

| Issues/Recommendations | | | | |
|---|---|---|---|---|
| **OU(s) without Issues/Recommendations Identified in the Five-Year Review:** | | | | |
| OU-1 through OU-4 | | | | |
| **Issues and Recommendations Identified in the Five-Year Review:** | | | | |
| **OU(s):** OU-5 | **Issue Category: Institutional Controls** | | | |
| | **Issue:** Operational controls selected in ROD 5 are being followed by the Bureau of Reclamation, but controls specifying limited restrictions on Keswick Reservoir water elevations have not been officially recorded. | | | |
| | **Recommendation:** Implement operational controls selected in ROD 5 through an update to the 1980 Memorandum of Understanding. | | | |
| **Affect Current Protectiveness** | **Affect Future Protectiveness** | **Implementing Party** | **Oversight Party** | **Milestone Date** |
| No | Yes | EPA, in coordination with Bureau of Reclamation | EPA, along with DTSC and RWCB, as support agencies. | 2017 |

| Protectiveness Statement | | |
|---|---|---|
| ***Operable Unit:*** OU-1 through 4 | ***Protectiveness Determination:*** Protective | ***Addendum Due Date (if applicable):*** |
| *Protectiveness Statement:* The interim remedial actions implemented at IMM selected in RODs 1 through 4 for Operable Units 1 through 4 are protective of human health and the environment. | | |
| ***Operable Unit:*** OU-5 | ***Protectiveness Determination:*** Short-term Protective | ***Addendum Due Date (if applicable):*** |
| *Protectiveness Statement:* The interim remedial actions implemented at IMM selected in ROD 5 for OU-5 is protective of human health and the environment in the short term. To remain protective of the environment over the long term, operational controls selected in ROD 5, including limited restrictions on the Keswick Reservoir water elevation to prevent mobilization of sediment remaining in Spring Creek Arm, need to be officially recorded. | | |

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# List of Abbreviations

| | |
|---|---|
| 1980 MOU | *Memorandum of Understanding (MOU) to Implement Actions to Protect the Sacramento River System from Heavy Metal Pollution from Spring Creek and Adjacent Watersheds* |
| 2000 Settlement | December 18, 2000, litigation settlement |
| µg/L | micrograms per liter |
| AIG | American International Group, Inc. |
| AMD | acid mine drainage |
| ARAR | applicable or relevant and appropriate requirement |
| Basin Plan | *The Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and San Joaquin River Basin* |
| BLM | Bureau of Land Management |
| CDF | confined disposal facility |
| CDFW | California Department of Fish and Wildlife (formerly California Department of Fish and Game) |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CERCLIS | Comprehensive Environmental Response, Compensation, and Liability Information System |
| CFR | Code of Federal Regulations |
| Consent Decree | December 2000 Consent Decree |
| CTR | California Toxics Rule |
| CVP | Central Valley Project |
| DTSC | Department of Toxic Substances Control |
| EPA | U.S. Environmental Protection Agency |
| $ft^3$/sec | cubic feet per second |
| FYR | Five-Year Review |
| FS | feasibility study |
| GLP | Global Loss Prevention, Inc. (formerly American International Group Consultants, Inc.) |
| HDS | high-density sludge |
| IMM | Iron Mountain Mine |
| IMMI | Iron Mountain Mines, Inc. |
| IMO | Iron Mountain Operations |
| mg/L | milligrams per liter |

| | |
|---|---|
| msl | mean sea level |
| NOAA Fisheries | National Oceanic and Atmospheric Administration Marine Fisheries Service |
| OHV | off-highway vehicle |
| O&M | operation and maintenance |
| OU | Operable Unit |
| ppb | parts per billion |
| PRC | PRC Environmental Management, Inc. |
| Reclamation | Bureau of Reclamation |
| RI Report | *Remedial Investigation Report, Iron Mountain Mine Superfund Site, Redding, California* |
| ROD | Record of Decision |
| SCDD | Spring Creek Debris Dam |
| SCPP | Spring Creek Power Plant |
| SCRR | Slickrock Creek Retention Reservoir |
| Site | Iron Mountain Mine Superfund Site |
| SOW | October 2000 *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 |
| treatment plant | Minnesota Flats Treatment Plant |
| Water Board | Central Valley Regional Water Quality Control Board |

# List of Involved Parties at Iron Mountain Mine

| | |
|---|---|
| U.S. Environmental Protection Agency | The lead governmental agency for the cleanup at Iron Mountain Mine. |
| CH2M HILL | EPA's technical contractor. |
| State of California | The State of California, through Department of Toxic Substances Control (DTSC) and Central Valley Regional Water Quality Control Board, acts as the supporting governmental agency at Iron Mountain Mine. DTSC is also responsible for operation and maintenance of the Operable Unit 5 confined disposal facility. |
| Bureau of Reclamation | EPA technical advisor at the Iron Mountain Mine Superfund Site (Site) and the federal land manager responsible for operating the Central Valley Project, which includes Shasta, Keswick, and Spring Creek Debris dams (part of the remedy for the Site). |
| California Department of Fish and Wildlife | Served on the Technical Advisory Committee as trustee for the fishery resources (formerly California Department of Fish and Game). |
| National Oceanic and Atmospheric Administration | Served on the Technical Advisory Committee as the federal trustee for the anadromous fishery resources (i.e. salmon and steelhead) in the Sacramento River 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. Aventis CropScience USA, Inc., formerly known as Stauffer Chemical Company, Rhône-Poulenc Basic Chemicals Company, and Rhône-Poulenc, Inc. |
| Stauffer Chemical Co. | Former owner/operator of Iron Mountain Mine. Acquired Mountain Copper Co., Ltd., the original developer of the property, in 1968 and thereby acquired beneficial ownership of Iron Mountain Mine. |
| Global Loss Prevention, Inc. | The entity responsible for performing the Statement of Work under the Consent Decree (formerly American International Group Consultants, Inc.). |
| Iron Mountain Operations | The Site Operator, under Global Loss Prevention, Inc. |
| Iron Mountain Mines, Inc. | Current owner of the inactive mine property. |

# Fifth Five-Year Review Report

# for

# Iron Mountain Mine Superfund Site

## 1. Introduction

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

The U.S. Environmental Protection Agency (EPA) prepared this Fifth FYR 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 Sections [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 Code of Federal Regulations (CFR) 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 actions no less often than every five years after the initiation of the selected remedial action*."

EPA Region 9 conducted this FYR of the interim remedial actions implemented at the Site from January 2013 through September 2013. This report documents the results of the review.

This is the Fifth FYR for the Site. The triggering action for the First FYR was the date of the start of construction of the partial cap in September 1988. Response is ongoing, and all hazardous materials, pollutants, and contaminants have not been removed. The First FYR was completed September 30,

1993; the Second FYR was completed October 8, 1998; the Third FYR was completed September 30, 2003; and the Fourth FYR was completed July 14, 2008.

The Site consists of six Operable Units (OU). This FYR addresses interim remedial actions completed for OU-1 through OU-5. OU-6 is defined as the Boulder Creek watershed. EPA is currently preparing a remedial investigation report (RI Report) to describe the nature and extent of remaining contaminants at the Site and determine the risk posed by those contaminants to human health and the environment.

# 2. Site Chronology

Table 1 lists the dates of important events for the Site.

**TABLE 1**
Site Chronology
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Event | Date |
|---|---|
| IMM Listed on the National Priority List (Superfund List) | 1983 |
| OU-1 – "Sitewide": 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 |
| Interim ROD 1 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 |
| Interim ROD 2 Signed | 1992 |
| Aerated Simple Mix Component of Treatment Plant Completed | 1994 |
| HDS Component of Treatment Plant Completed | 1997 |
| Emergency Storage Facility for Treatment Plant Completed (final required component of interim remedy) | 2000 |
| First FYR | 1993 |
| OU-3 – "Old /No. 8 Mine Seep OU": Seep Discharge Treatment | |
| Remedial Investigation and Feasibility Study of Options Completed | 1993 |
| Interim ROD 3 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 |
| Interim ROD 4 Signed | 1997 |
| Slickrock Creek Retention Reservoir (SCRR) Completion | 2004 |
| Second FYR | 1998 |
| Third FYR | 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 | 2004 |

**TABLE 1**
Site Chronology
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Event | Date |
|---|---|
| Interim ROD 5 Signed | 2004 |
| Remedial Design Completed | 2007 |
| Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action | |
| Implementation of remedy including hydraulic dredging and construction and closure of the Confided Disposal Facility. | 2008 - 2011 |
| "Operational and Functional" determination; EPA turned over the CDF to DTSC on October 26, 2012 | 2012 |
| Fourth FYR | 2008 |
| Sitewide Remedial Investigation and Feasibility Study, including OU-6 – "Boulder Creek Area Sources" | Ongoing |
| Fifth FYR | 2013 |

Notes:

CDF = Confined Disposal Facility

DTSC = Department of Toxic Substances Control

HDS = High-density Sludge

OU = Operable Unit

ROD = Record of Decision

Spring Creek Arm = Spring Creek Arm of Keswick Reservoir

# 3. Background

## 3.1. Physical Characteristics

The Site is located in Shasta County, California, approximately 9 miles northwest of Redding, California. The Iron Mountain Mines are the southernmost mines in the West Shasta Mining District, which encompasses more than a dozen sulfide mines that have been mined for copper, gold, pyrite, silver, and zinc. The Site includes former surface and underground mine workings, waste rock piles, tailings piles, abandoned mining facilities, and former smelting areas.

The Site comprises approximately 4,400 acres 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. The National Marine Fisheries Service (NOAA Fisheries) considers the Upper Sacramento River to be the most important natural salmon spawning area in California. The Sacramento-San Joaquin River system is the principal producer of Chinook salmon caught in California's ocean fisheries (California Department of Fish and Wildlife [CDFW], 2013).

## 3.2. Hydrology

The Site is located in a mountainous region that contains numerous, deeply incised creeks. The Main Mine Area is located on a ridge that drains to Boulder Creek on the north and Slickrock Creek on the south (see Figure 1). Boulder Creek and Slickrock Creek are tributaries to Lower Spring Creek, which flows into the Spring Creek Reservoir and then into Keswick Reservoir. The Upper Spring Creek diversion diverts up to 850 cubic feet per second ($ft^3$/sec) of clean water into Flat Creek, effectively providing additional storage of contaminated water in Spring Creek Reservoir. The Upper Spring Creek diversion marks the divide between Upper Spring Creek and Lower Spring Creek. The Minnesota Flats Treatment Plant (treatment plant) discharges treated water to Lower Spring Creek.

The mines (including the Richmond Mine, Hornet Mine, and Old/No. 8 Mine Seep), waste rock piles, and tailings piles discharge acidic waters that typically have high concentrations of heavy metals. These discharges are referred to collectively as acid mine drainage (AMD). AMD from the Site has affected the downstream reaches of Boulder Creek, Slickrock Creek, Lower Spring Creek, Spring Creek Reservoir, Keswick Reservoir (including Spring Creek Arm and the main body of Keswick Reservoir), and the Sacramento River.

## 3.3. Land and Resource Use

This section describes demographics and land uses for the different areas of the Site.

### 3.3.1. Main Mine Area

The Shasta County Planning Division has zoned the Main Mine Area as Mineral Resource. Most of the land in the Main Mine Area is owned by Iron Mountain Mines, Inc. [IMMI]); the remainder is owned by the federal government and managed by Bureau of Land Management (BLM). Access is limited because IMM is a designated Superfund site under CERCLA. There are no full-time residents at IMM. Iron Mountain Operations (IMO) personnel work in shifts to operate and maintain the remedial infrastructure at IMM. Historically, the land uses in the Main Mine Area have generally been limited to mining-related activities.

The Main Mine Area is remote from populated areas because of the rugged terrain. The nearest community is Keswick, four miles from the IMM gate. Keswick has approximately 450 residents. The nearest city is Redding, approximately nine miles away. Redding has a population of approximately 90,000 people.

The adjacent land is largely undeveloped, with a rugged topography and a few former forestry roads. Off-highway vehicles (OHV) visit these areas, and BLM has notified EPA about the potential acquisition of adjacent land for preservation as an undeveloped area and for potential enhancements for recreational use.

### 3.3.2. Residents of Iron Mountain Road

Public roads in the area include the asphalt-covered Iron Mountain Road and gravel roads in the Chappie-Shasta OHV Area, northeast of Iron Mountain Road. There are three private residences along Iron Mountain Road between the community of Keswick and IMM. There is an operational, public, outdoor, firing range operated by BLM along the west side of Iron Mountain Road.

### 3.3.3. Spring Creek Debris Dam Area

The Spring Creek Debris Dam (SCDD) area is owned by the federal government and managed by the Bureau of Reclamation (Reclamation). Reclamation will operate SCDD to manage water discharged from the Site in perpetuity; therefore, the land use and ownership are not expected to change. This land is not expected to be used for recreation or construction. All access roads to the Confined Disposal Facility (CDF) located in the SCDD area are owned by the federal government and managed by Reclamation.

### 3.3.4. Lower Keswick Reservoir Area

Spring Creek Arm and Lower Keswick Reservoir are classified as Public Lands; the general plan map (Shasta County Department of Resource Management, 2004) indicates that most of the land surrounding these areas is public land that will not be developed for residential, commercial, or industrial use. The area is used for recreational boating and fishing, and a former railroad track along the west bank of Keswick Reservoir has been converted to a multiuse trail for the public.

## 3.4. History of Contamination

Mining operations started at the Site in the 1860s and continued until 1963. The operations included open pit mining, adits and stoping inside Iron Mountain, milling, ore transportation via railroad and tramway, a cyanide leaching plant, cementation plants, ore roasting areas, and a smelter. Lasting environmental effects have come from AMD and acid rock drainage discharging to surface water, exposed waste rock piles eroding into creeks and rivers, the remains of open ore roasting activities, and smelter fall out. Numerous historical fish kills in the Sacramento River were attributed to the AMD from the Main Mine Area. The Site was added to the National Priorities List in September 1983.

## 3.5. Initial Response

Multiple field investigations and remedial actions have been completed at the Site since its listing on the National Priorities List in 1983. EPA has issued five feasibility studies (FS) and two FS addenda to support five interim records of decision (ROD) for the Site. The focus of EPA to date has been on mitigating the cadmium, copper, and zinc contamination in Site surface water that has historically affected the Sacramento River downstream from Keswick Dam.

EPA and the State of California (State) settled cost recovery litigation with the potentially responsible party (PRP) in December 2000 (2000 Settlement). The 2000 Settlement assures that the interim remedial actions selected in RODs 1 through 4 will be operated and maintained. Pursuant to the 2000 Settlement, Global Loss Prevention, Inc. (GLP) (formerly American International Group [AIG] Consultants, Inc.), on behalf of the PRP, will perform the operation and maintenance (O&M) of the interim remedial actions implemented pursuant to the RODs 1 through 4 for 30 years. O&M is being performed in accordance with the *Statement of Work Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (EPA, 2000). IMO is the Site Operator, under GLP. The PRP also entered into a guaranteed investment contract with GLP to pay $514 million to the federal or state agency performing oversight of O&M activities at the Site at Year 30 to fund O&M activities beyond the initial 30-year period.

## 3.6. 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, open pit mine workings, and area sources in the Slickrock Creek and Boulder Creek watersheds. The exceedances of water quality standards and the accumulation of toxic sediments downstream from IMM historically caused severe ecological impacts and posed a potential threat to human health.

The Sacramento River is a source of drinking water for Redding and other municipal water users. The Central Valley Project (CVP) facilities in Northern California are important components of California's water supply system. CVP operates under a complex operational plan to supply agricultural and drinking water, produce power, and 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 from uncontrolled heavy metal discharges from IMM. NOAA considers the Upper Sacramento River to be the most important salmon spawning area in California. The Sacramento River downstream from Keswick Dam contains four races of anadromous Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*). Chinook salmon (fall-, late fall-, spring-, and winter-run) migrate into, spawn, incubate, and rear immediately downstream from Keswick Dam. Sacramento River winter-run Chinook salmon are listed as endangered by the federal Endangered Species Act and the California Endangered Species Act (NOAA Fisheries, 2013a). Central Valley spring-run Chinook salmon is a federal- and state-listed threatened species (NOAA Fisheries, 2013a). Fall-run and late fall-run Chinook salmon are federally listed species of concern (NOAA Fisheries, 2013a). The Central Valley distinct population segment of steelhead and the southern distinct population segment of North American green sturgeon are federally listed as threatened (NOAA Fisheries, 2013b and 2013c). Green sturgeon are believed to use Sacramento River habitats as far upstream as Shasta County.

# 4. Remedial Actions

This section discusses the remedy selection, remedy implementation, and O&M for each of the interim actions completed at the Site. Table 2 provides a summary of the IMM RODs, including implemented remedy components, operational controls, remedial action objectives, chemical-specific ARARs or performance criteria, and ARARs waivers. A more detailed version of this table, including ROD text excerpts and section and page numbers, is provided in Appendix F.

## 4.1. 1986 Record of Decision (ROD 1): Sitewide

### 4.1.1. ROD 1 Remedy Selection

The 1986 ROD (ROD 1) (EPA, 1986) selected an interim remedy that identified specific projects, including the following:

- 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 for Upper Slickrock Creek, around the waste rock and slide debris, to avoid contamination of clean water and reduce the flow from the "big seep"
- Construction of a diversion for Upper Spring Creek to avoid contamination of the clean water and filling Spring Creek Reservoir
- Installation of perimeter controls as necessary to minimize any direct contact threats
- A study of the feasibility of filling mine passages with low-density cellular concrete
- Construction of a diversion for the South Fork of Spring Creek (formally eliminated in ROD 4 in preference for a "dam and treat" remedial approach)
- Enlargement of SCDD, the exact size of which would be determined after an evaluation of the effectiveness of the other remedies (formally eliminated in ROD 4 in preference for a "dam and treat" remedial approach)

The interim remedies selected under ROD 1 and all subsequent RODs rely on water management components of the *Memorandum of Understanding (MOU) to Implement Actions to Protect the Sacramento River System from Heavy Metal Pollution from Spring Creek and Adjacent Watersheds* (1980 MOU) (State Water Resources Control Board et al., 1980). The 1980 MOU is an agreement among the State Water Resources Control Board, the Water and Power Resources Service (predecessor of Reclamation), and the California Department of Fish and Game (currently CDFW) that establishes the short- and long-term actions and responsibilities of the agencies in minimizing toxicity problems near Spring Creek. As part of the 1980 MOU, Reclamation agreed to operate the Spring Creek Debris Dam and the Shasta Dam water management system in a manner that would dilute the discharges from IMM to meet water quality criteria in the Sacramento River downstream of Keswick Dam, to the extent practicable.

ROD 1 stated that the IMM remedy would be implemented in a phased approach and include a balance of source control, treatment, and water management controls. The following key general objectives for the Site were defined:

- To minimize off-site contaminant migration via surface water runoff and seepage, and
- To mitigate impacts and minimize the migration of contaminants that have already moved from the site through receiving waters

ROD 1 recommended the overall IMM cleanup program be designed to meet the State of California *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin* [Basin Plan] criteria in the Sacramento River below Keswick Dam except during the worst case year. The water quality objectives are provided in Table 2.

ROD 1 invoked a fund-balancing waiver to select a remedy which most closely approaches the level of protection provided by applicable or relevant and appropriate requirements (ARARs) considering the specific fund-balanced sum of money available for the Site. ROD 1 stated that federal water quality standards would be met in the Sacramento River below Keswick Dam for protection of the salmon population, but State and Federal water quality standards would not be met in the immediate receiving waters, including portions of Spring Creek, Slickrock Creek, Boulder Creek, and Keswick Reservoir. The ROD 1 fund-balancing waiver was revoked in 1991 under an "explanation of significant difference"; subsequent RODs invoked an ARARs waiver for "interim measures" as discussed below.

### 4.1.2. ROD 1 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 and capped the lower portion of Brick Flat Pit. As part of the Brick Flat Pit cap construction, EPA used tailings from the Minnesota Flat area (and several other tailings piles) that contained relatively high concentrations of cadmium, copper, 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 Reclamation, began construction of the Slickrock Creek diversion in July 1989 and completed construction in January 1990. The diversion consists of a small stilling pool and diversion dam, a 36-inch-diameter, urethane-lined, concrete pipeline approximately 1 mile in length, and an energy-dissipation structure.

Construction of the Upper Spring Creek diversion began 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 discharge to Flat Creek.

**TABLE 2**
Iron Mountain Mine Record of Decision (ROD) Summary
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| ROD Title; Date | *Record of Decision*, *Iron Mountain Mine, Redding, California*; October 3, 1986 | *Record of Decision, Boulder Creek Operable Unit*, *Iron Mountain Mine, Shasta County, California*; September 30, 1992 | *Record of Decision, Old/No. 8 Seep, Iron Mountain Mine, Shasta County, California*; September 24, 1993 | *Record of Decision*, *Iron Mountain Mine, Shasta County, California*; September 30, 1997 | *Record of Decision*, *Iron Mountain Mine, Shasta County, California*; September 30, 2004 |
| Implemented Remedy Components | • Construction of a partial cap over the Richmond mineralized zone, including Brick Flat Pit and several subsidence areas<br>• Construction of a diversion for Upper Slickrock Creek, around the waste rock and slide debris<br>• Construction of a diversion for Upper Spring Creek<br>• Installation of perimeter controls as necessary to minimize any direct contact threats | • Treatment of the AMD discharges from the Richmond and Lawson adits in a lime neutralization treatment plant<br>• Consolidation and capping of seven waste piles<br>• Disposal of the IMM treatment plant sludges in a landfill constructed in Brick Flat Pit | Treatment of the AMD discharges from the Old/No. 8 Mine Seep at the treatment plant, as appropriately modified | Treatment of AMD from the Slickrock Creek area sources, including:<br>• Design and construction of a retention reservoir to collect AMD discharges in the Slickrock Creek Basin for treatment<br>• Surface-water diversion facilities<br>• Hematite-erosion-control structure<br>• Upgrades to the treatment plant and pipeline | • Dredging sediment that was most susceptible to erosion in Spring Creek Arm<br>• Disposing of the sediment in a CDF adjacent to Spring Creek Reservoir<br>• Institutional controls, including operational controls and CDF access and use restrictions |
| Operational Controls | ROD 1 stated that under the 1980 MOU, "the Bureau of Reclamation agreed to operate SCDD and the Shasta Dam water management system in such a manner that, to the extent possible, sufficient dilution water would be available to ensure that State water quality criteria below Keswick Dam would be met." | Same as ROD 1 | Same as ROD 1 | Same as ROD 1 | The following operational controls were selected in ROD 5:<br>1. Current operational controls that require Reclamation to restrict Keswick Reservoir elevations during release events from SCPP and SCDD to minimize the potential for erosion of sediment in the Spring Creek Arm will be revised. Operational restrictions would be removed except for periods during rare storm events where continued operational restrictions are necessary to assure that remaining sediments do not erode into the environment.<br>2. Current operational controls will be continued that require Reclamation to operate SCDD releases to comply with water quality ARARs in the Sacramento River below Keswick Dam, and to continue low-flow releases from SCPP as necessary to flush Spring Creek Reservoir water through the Spring Creek Arm. |
| Remedial Action Objectives | The following key general objectives were defined:<br>• To minimize off-site contaminant migration via surface water runoff and seepage, and<br>• To mitigate impacts and minimize the migration of contaminants that have already moved from the site through receiving waters | The overall remedial action objective was defined as eliminating the IMM discharges that are harmful to the environment.<br>ROD 2 stated that "results from implementation of remedial actions for sources in the Boulder Creek Operable Unit will be important considerations in setting remedial action objectives for an overall final site remedy." | Same as ROD 2 | As with ROD 2, the overall remedial action objective was defined as eliminating the IMM discharges that are harmful to the environment.<br>EPA also identified three primary goals for the IMM Superfund remedial action in ROD 4:<br>1. Comply with the water quality criteria established under the Clean Water Act.<br>2. Reduce the mass discharge of toxic heavy metals through application of appropriate control technologies. | The overall objective of EPA's IMM Superfund cleanup program was defined as eliminating IMM AMD discharges that are harmful to human health and the environment.<br>Remedial action objectives for contaminated sediment in Spring Creek Arm included the following:<br>• Protect the Sacramento River ecosystem from releases of heavy metals from Spring Creek Arm by preventing the mobilization and redeposition of contaminated sediment into important fishery spawning habitats in the Sacramento River below Keswick Dam. |

**TABLE 2**
Iron Mountain Mine Record of Decision (ROD) Summary
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| | | | | 3. Minimize the need to rely on special releases of California's valuable water resources to ensure compliance with water quality standards in the Sacramento River through special releases of waters to dilute toxic spills of IMM contaminants. | • 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 discharges from Spring Creek Arm to the Sacramento River.<br>Achievement of RAOs was expected to result in additional ancillary benefits listed in ROD 5. |
| Chemical-specific ARARs or Performance Criteria | ROD 1 recommended the overall cleanup program be designed to meet the State of California Basin Plan criteria except during the worst case year, at which time the EPA water quality criteria for protection of aquatic life would be met. The EPA water quality criteria for protection of aquatic life listed in ROD 1 were not carried forward in subsequent RODs. | ROD 2 identified the chemical-specific ARARs for the treatment plant as the Clean Water Act effluent limitations for discharges of mine drainage from copper mines, exercise of best professional judgment under the Clean Water Act, Safe Drinking Water Act MCLs and nonzero MCL goals at the water intake to the City of Redding, and the Basin Plan water quality objectives.<br>MCLs included the following; other criteria are provided in subsequent rows of this table.<br>Copper: N/A<br>Cadmium: 5 ppb<br>Zinc (Secondary MCL): 5,000 ppb<br>ROD 2 stated that EPA is relying upon the ARAR waiver for "interim measures" (40 C.F.R. § 300.430 (f)(l)(ii)(C)(i) for remedy selection with respect to the Boulder Creek OU and therefore is waiving the Basin Plan water quality objectives and the Fish and Game § 5650 standards which would necessitate elimination of all releases as ARARs for this operable unit. EPA's overall goal at the site remains achieving these water quality objectives and Fish and Game standards. | Same as ROD 2 | Same as ROD 2<br>ROD 4 also evaluated the proposed CTR as "To Be Considered Standards" rather than potential ARARs criteria, as the proposed CTR were not yet finalized at the time of ROD 4. The proposed CTR were included in the ARARs waived (see below). | The following performance criteria were defined in ROD 5 for the dredging operations during implementation of the interim remedial action. These performance criteria are no longer applicable now that interim remedial action has been completed.<br>• Discharges of sediment from Spring Creek Arm shall not cause exceedances of the chemical-specific ARARs at the compliance point. The applicable numeric standards were defined as the Basin Plan maximum concentration and CTR continuous concentration criteria for the Sacramento River below Keswick Dam.<br>• Basin Plan turbidity standards shall be achieved at the compliance point during dredging operations.<br>• Return water discharged from the CDF shall not exceed the relevant and appropriate effluent limitation guidelines established for existing point sources at copper and zinc mines in 40 Code of Federal Regulations 440.102(a) and 440.103(a)<br>• Sediment that is susceptible to erosion shall be removed (or contained through residual management) to 560 feet above mean sea level (msl) or to an elevation determined by further analysis to prevent erosion under the following operational condition:<br>- Combined release from SCDD and SCPP up to 6,600 ft3/sec and Keswick Reservoir elevation of 574 feet msl or greater. |

**TABLE 2**
Iron Mountain Mine Record of Decision (ROD) Summary
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| Treatment Plant Effluent Limitations | | | | | |
| ARAR | Effluent limitations for mine drainage at 40 CFR Part 400, Subpart J, which are achievable by using lime treatment and precipitation | Effluent limitations for existing point sources at copper and zinc mines in 40 C.F.R. §§440.102(a) and 440.103(a) were deemed relevant and appropriate for the treatment plant effluent. | Same as ROD 2 | Same as ROD 2 | Same as ROD 2; effluent limitation guidelines were deemed relevant and appropriate for CDF effluent. |
| Cadmium (ppb) | Not specified | Daily maximum: 100<br>30-day average: 50 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| Copper(ppb) | Not specified | Daily maximum: 300<br>30-day average: 150 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| Lead (ppb) | Not specified | Daily maximum: 600<br>30-day average: 300 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| Zinc (ppb) | Not specified | Daily maximum: 1,500<br>30-day average: 750 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| pH | Not specified | 6.0 to 9.0<br>Applies only to discharges to Flat Creek | Same as ROD 2 | Same as ROD 2 | Not retained as performance criteria for CDF effluent |
| TSS (mg/L) | Not specified | Daily maximum: 30<br>30-day average: 20<br>Applies only to discharges to Flat Creek | Same as ROD 2 | Same as ROD 2 | Not retained as performance criteria for CDF effluent |
| ARARs Waived (Numerical, see also Narrative below) | | | | | |
| Cadmium (ppb) [a] | Basin Plan: 0.22; EPA: 0.55 | Basin Plan: 0.22 | Same as ROD 2 | Same as ROD 2; Proposed CTR | Basin Plan: 0.22; CTR: 1.1; National Toxics Rule |
| Copper(ppb) [a] | Basin Plan: 5.6; EPA: 5.4 | Basin Plan: 5.6 | Same as ROD 2 | Same as ROD 2; Proposed CTR | Basin Plan: 5.6; CTR: 4.1; National Toxics Rule |
| Zinc (ppb) [a] | Basin Plan: 16; EPA: 47 | Basin Plan: 16 | Same as ROD 2 | Same as ROD 2; Proposed CTR | Basin Plan: 16; CTR: 54; National Toxics Rule |
| Narrative Standards | N/A | Fish and Game Code Section 5650 which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life." | Same as ROD 2 | Same as ROD 2 | Fish and Game Code Section 5650<br>SWRCB Resolution 92-49 |
| Target Compliance Point (see also “ARARs Waiver”) | Sacramento River below Keswick Dam: ROD 1 stated that federal water quality standards would be met in the Sacramento River below Keswick Dam but not in the immediate receiving waters as required by the Clean Water Act. | Sacramento River below Keswick Dam (same as ROD 1)<br>MCLs and MCLGs would only apply to the area of the Sacramento River near Redding's Jewel Creek Intake. | Sacramento River below Keswick Dam (similar to ROD 2) | Sacramento River below Keswick Dam (similar to ROD 2) | Sacramento River below Keswick Dam: ROD 5 stated that the RAOs focus on the protection of the Sacramento River ecosystem, and do not require the removal of all contaminated sediment to eliminate ecological risks in the Spring Creek Arm or Keswick Reservoir due to the ongoing IMM metal discharges. |

**TABLE 2**

Iron Mountain Mine Record of Decision (ROD) Summary

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

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| ARARs Waiver (Narrative) | Fund-balancing waiver, 40 CFR 300.68(i)(5)(ii):<br>ROD 1 stated that State and Federal standards would probably not be met in portions of Spring Creek, Slickrock Creek, Boulder Creek, and Keswick Reservoir at any time. ROD 1 stated that the selected alternative would achieve water quality at a point below Keswick Dam. The cost of meeting water quality objectives in the stream near the source was determined to be extremely large, and fund balancing was used to select a less costly remedy.<br>ROD 4 stated that through a formal action in 1991 known as an “explanation of significant difference”, EPA revoked the fund balancing waiver upon which EPA relied for ROD1. | Waiver for interim measures:<br>ROD 2 stated that the selected remedy does not address all sources of contaminant discharges at the site and cannot provide for compliance with the chemical-specific ARARs of the Basin Plan and for compliance with Fish and Game Code Section 5650 which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life." EPA invoked the CERCLA Section 121(d)(4)(A) waiver for "interim measures."<br>ROD 2 also stated that Boulder Creek and Slickrock Creek do not comply with ambient water quality criteria, and remediation of sources in the ROD 2 interim action would not allow for compliance with these standards without further actions. Therefore, EPA relied upon a waiver for "interim measures" and was not requiring that the discharge meet ambient water quality criteria in surface waters receiving the discharge. | Waiver for interim measures:<br>Similar to ROD 2.<br>ROD 3 also stated that EPA was not requiring that the discharge from the treatment plant meet the ambient water quality criteria in lower Spring Creek for this interim action. | Waiver for interim measures:<br>Similar to ROD 2.<br>ROD 4 also stated the following:<br>• State Basin Plan standards would be met below Keswick Dam except during IMM AMD spills from SCDD, which were projected to occur on a frequency of once every 8 to 10 years.<br>• Regular exceedances of the State Basin Plan standards (and the proposed CTR) are likely to continue in areas of Keswick Reservoir and in the Spring Creek watershed without further response action at the Site.<br>• Continuous exceedances of the State Basin Plan standards and proposed CTR were expected to remain in water bodies above SCDD, even after implementation of the interim remedy. | Waiver for interim measures:<br>ROD 5 stated that EPA was relying on the ARARs waiver for "interim measures" (CERCLA § 121(d)(4)(A); 40 CFR § 300.430(f)(1)(ii)(C)(1)) for this remedial action. EPA does not anticipate that the ROD 5 interim remedy, in conjunction with the other remedies implemented to date, would be sufficient to ensure compliance with (1) the numeric, chemical-specific water quality standards contained in the National Toxics Rule, CTR, and the Basin Plan for copper, cadmium, or zinc, (2) California Fish and Game Code § 5650, and (3) applicable requirements of SWRCB Resolution 92-49.<br>ROD 5 also stated that the National Toxics Rule, Basin Plan or CTR criteria would not be achieved in Spring Creek, its tributaries, or in portions of Keswick Reservoir under all circumstances following completion of the interim action, as these water bodies are impacted by remaining discharges of AMD from the IMM Site. |

Notes:

[a] The Basin Plan and CTR criteria for copper, cadmium, and zinc concentrations are for dissolved constituents and are hardness dependent. Objectives presented in this table assume a hardness of 40 mg/L .

N/A: Not applicable

AMD: acid mine drainage

Basin Plan: *The Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and San Joaquin River Basin*

CDF: Confined Disposal Facility

CTR: California Toxics Rule

MCL: Maximum Contaminant Level

MOU: State Water Resources Control Board, U.S. Water and Power Resources Service, and California Department of Fish and Game. 1980. *Memorandum of Understanding (MOU) to Implement Actions to Protect the Sacramento River System from Heavy Metal Pollution from Spring Creek and Adjacent Watersheds*. January.

OCAP: Bureau of Reclamation. 2004. *Long-term Central Valley Project Operations Criteria and Plan, CVP-OCAP.* June 30.

OU: Operable Unit

ROD: Record of Decision

SCDD: Spring Creek Debris Dam

SCPP: Spring Creek Power Plant

Spring Creek Arm: Spring Creek Arm of Keswick Reservoir

### 4.1.3. ROD 1 Operation and Maintenance

No significant unanticipated O&M efforts were required after removal of the Minnesota Flats tailings pile; construction of the Brick Flat Pit cap, the subsidence area partial caps, and related surface water controls; and construction of the Slickrock Creek clean water diversion.

The Upper Spring Creek diversion has functioned as designed. However, the urethane pipeline lining system has deteriorated since it was constructed and is an ongoing O&M issue. In 2002, a stilling basin was excavated in Spring Creek upstream from the inlet trash rack to settle out small rocks and gravel to reduce erosion of the lining system. This stilling basin has been very effective. Annual inspections of the piping system are currently performed and locations with significant deterioration are repaired with mortar or grout. The deteriorating liner does not jeopardize the effectiveness of the interim remedy. Provisions have been made in the SOW for the Site Operator to restore or replace the lining system, as necessary (EPA, 2000). EPA has requested that the Site Operator develop a plan for evaluating the refurbishment and long-term maintenance of the liner system for submittal by December 2013 (see Section 6.5 and Appendix J).

## *4.2. 1992 Record of Decision (ROD 2): Boulder Creek*

### 4.2.1. ROD 2 Remedy Selection

The 1992 ROD (ROD 2) (EPA, 1992a) selected treatment of the AMD discharges from the Richmond and Lawson adits in a lime neutralization treatment plant. ROD 2 also selected the consolidation and capping of seven waste piles in a landfill to be located at the Site. ROD 2 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.

The overall remedial action objective for the Site was defined as eliminating the IMM discharges that are harmful to the environment. ROD 2 stated that results from implementation of the interim remedial actions would be important considerations in setting remedial action objectives for an overall final Site remedy.

ROD 2 identified the chemical-specific ARARs for the treatment plant as the effluent limitations for existing point sources at copper and zinc mines in 40 C.F.R. §§440.102(a) and 440.103(a), exercise of best professional judgment under the Clean Water Act, Safe Drinking Water Act Maximum Contaminant Levels and nonzero Maximum Contaminant Level Goals at the water intake to the City of Redding, and the Basin Plan water quality objectives. These criteria are provided in Table 2.

In ROD 2, EPA invoked an ARARs waiver for "interim measures" (40 C.F.R. § 300.430 (f)(l)(ii)(C)(i)) for remedy selection with respect to the Boulder Creek operable unit. EPA waived the Basin Plan water quality objectives and the Fish and Game § 5650 standards which would necessitate elimination of all releases as ARARs for this operable unit. ROD 2 stated that the goal of the overall remedy, including the activities in ROD 1, ROD 2, and subsequent operable units, is to achieve compliance with the Basin Plan water quality objectives and Fish and Game standards in the

Sacramento River downstream of Keswick Dam. As with ROD 1, ROD 2 stated that the selected remedy would not achieve water quality objectives in the immediate receiving waters, including Boulder Creek and Slickrock Creek.

### 4.2.2. ROD 2 Remedy Implementation

The PRP began construction of the aerated simple-mix components of the treatment plant in late summer 1993 and completed construction in September 1994. The PRP 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. The PRP did not complete the construction of required emergency storage facilities (the final required component of the interim remedy) until September 2000. EPA designed the HDS modifications to the treatment plant and constructed them from spring 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.

The PRP excavated, consolidated, and capped seven largely pyritic waste piles in a disposal cell at the Site.

### 4.2.3. ROD 2 Operation and Maintenance

The Site Operator has properly operated the treatment plant, and there have been no significant, unanticipated O&M requirements during the FYR period. The treatment plant has been very effective in reducing heavy metal discharges from the Site, removing, on average, 99.7 percent of dissolved metals from the AMD inflow. Total metal concentrations in the treatment plant effluent substantially complied with the Clean Water Act effluent limits for copper and zinc mining operations (40 CFR 440.102(a) and 440.103(a)) specified in ROD 2, and in most cases, were well below these limits during the FYR period.

In 2010, the Site Operator made an operational change to optimize metals removal. In accordance with the SOW (EPA, 2000), the Site Operator was maintaining Reactor Tank 1 at pH 8.4 or higher. When both reactors were in operation during high AMD inflow, the pH in Reactor Tank 2 was not specifically controlled and was dropping as iron continued to oxidize. The Site Operator now monitors the pH in the Reactor Tank 2 and controls lime addition to the sludge recycle tank to keep the pH in Reactor Tank 2 above 8.4. This change has further reduced dissolved cadmium and zinc concentrations in the treatment plant effluent. Additional information on the treatment plant operational performance is provided in Section 6.4.

## *4.3. 1993 Record of Decision (ROD 3): Old /No. 8 Mine Seep*

### 4.3.1. ROD 3 Remedy Selection

The 1993 ROD (ROD 3) (EPA, 1993) selected treatment of the AMD discharges from the Old/No. 8 Mine Seep at the treatment plant, as appropriately modified. Remedial action objectives, chemical-

specific ARARs, and the ARARs waiver identified in ROD 3 are the same as discussed in Section 4.2 for ROD 2.

### 4.3.2. ROD 3 Remedy Implementation

The PRP designed and constructed the facilities to collect and convey AMD from Old /No. 8 Mine to the treatment plant. The PRP constructed the necessary aerated simple-mix components of the treatment plant by September 1994. EPA constructed the HDS modifications to the treatment plant, which became effective in January 1997. The PRP completed the construction of required emergency storage facilities (the final required component of the interim remedy) in September 2000.

### 4.3.3. ROD 3 Operation and Maintenance

The Old/No. 8 Mine Seep 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 of AMD is extracted from the Old/No. 8 Mine Seep wells, passes through one of the grit chambers, and is routed to the treatment plant through the 18-inch-diameter Old/No. 8 Mine Seep pipeline. AMD from the Old/No. 8 Mine Seep pipeline and discharge from SCRR flow via the same pipeline to the treatment plant, so the discharge from both sources must be considered for proper operation of the Slickrock Creek AMD control systems (CH2M HILL, 2004a).

## *4.4. 1997 Record of Decision (ROD 4): Water Management*

### 4.4.1. ROD 4 Remedy Selection

The 1997 ROD (ROD 4) (EPA, 1997) focused on the Slickrock Creek watershed. Among other items, ROD 4 provided for design and construction of a 220-acre-foot retention reservoir to collect 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 treats essentially all of the 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 cadmium and zinc loads associated with the previously uncontrolled IMM discharges.

As discussed for ROD 2, the overall remedial action objective was defined as eliminating the IMM discharges that are harmful to the environment. EPA also identified three primary goals for the IMM Superfund remedial action in ROD 4:

- Comply with water quality criteria established under the Clean Water Act (see also discussion of ARARs waiver below).
- Reduce the mass discharge of toxic heavy metals through application of appropriate control technologies.

- Minimize the need to rely on special releases of California's valuable water resources to ensure compliance with water quality standards in the Sacramento River through special releases of waters to dilute toxic spills of IMM contaminants.

The chemical-specific ARARs identified in ROD 4 are the same as discussed in Section 4.2 for ROD 2 and are presented in Table 2. In addition, ROD 4 evaluated the proposed California Toxics Rule (CTR) as "To Be Considered Standards" rather than potential ARARs criteria, as the proposed CTR were not finalized at the time of ROD 4. The ROD 4 interim remedy was expected to result in better water quality in the Sacramento River by limiting discharges of copper, cadmium, zinc, and acidity from the Site, thereby reducing the number of days and/or the degree of exceedances of the State Basin Plan standards (and the proposed CTR) in the Sacramento River and Keswick Reservoir.

As discussed for ROD 2, since the interim actions leave some releases of hazardous substances unabated, EPA invoked an ARARs waiver for “interim measures” (CERCLA 121(d)(4)(A) and 40 CFR 300.430(f)(1)(ii)(C)(1)) for this remedial action. EPA did not anticipate that the ROD 4 interim remedy, in conjunction with the other remedies implemented to date, would be sufficient to ensure compliance with Basin Plan water quality objectives and California Fish and Game Code Section 5650. ROD 4 provided additional details on the expected compliance with water quality ARARs, including the following:

- State Basin Plan standards were expected to be met below Keswick Dam except during IMM AMD spills from SCDD, which were projected to occur on a frequency of once every 8 to 10 years.

- Regular exceedances of the State Basin Plan standards (and the proposed CTR) were likely to continue in areas of Keswick Reservoir and in the Spring Creek watershed without further response action at the Site.

- Continuous exceedances of the State Basin Plan standards and proposed CTR were expected to remain in water bodies above SCDD, including Spring Creek, Slickrock Creek, and Boulder Creek, even after implementation of the interim remedy.

### 4.4.2. ROD 4 Remedy Implementation

The hydraulic upgrades to the treatment plant, AMD conveyance pipelines from SCRR, roadway and culvert upgrades, and the discharge tunnel from the treatment plant to Spring Creek were completed by the PRP by September 2000.

EPA started construction of the dam 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 approximately 5 acres, up to 120 feet deep, above the spillway excavation. The slope was stabilized by 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 the Department of Water Resources,

Division of Safety of Dams. Slope stabilization and associated design modifications delayed the 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).

### 4.4.3. ROD 4 Operation and Maintenance

The *Operations and Maintenance Manual, Slickrock Creek Retention Reservoir Project* (CH2M HILL, 2004a) outlines the O&M requirements for SCRR. The O&M manual provides operation, inspection, maintenance, monitoring, and security requirements for SCRR and appurtenances, clean water diversions, AMD diversions, spillway, outlet works, sedimentation basin, and upstream hematite pile.

Significant O&M items have included: erosion on the downstream face of the SCRR dam; difficulties addressing clean water runoff from the right abutment, immediately upstream from the spillway; and an increased rate of scaling in sections of the AMD pipeline where the relatively higher pH water from SCRR is conveyed (see Section 6.5 for more information). No other significant, unanticipated O&M efforts were required after completion of SCRR.

Completion of SCRR 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 SCDD to 5 percent of the pre-1994 discharge. For Water Years 2005 through 2012, the actual copper and zinc discharged from SCDD was less than 3 percent of the pre-1994 discharge.

### 4.4.4. ROD 1 through 4 Operation and Maintenance Cost

Table 3 summarizes annual costs incurred by the Site Operator for O&M of the completed remedial action components under RODs 1 through 4 and O&M of the overall Site. Detailed costs are provided as an attachment to the Site inspection checklists (see Appendix D). The costs incurred over this FYR period were not unusually high or unanticipated. For comparison, annual costs for the Fourth FYR period (fiscal years 2003 through 2007) ranged from $3.8 million to $6.2 million (EPA, 2008). The Fourth FYR costs have not been adjusted for inflation, and a portion of the costs occurred prior to completion of SCRR. Costs are highly dependent on the precipitation received during each water year and the subsequent amount of AMD generated that requires treatment; sludge that requires dewatering, handling and disposal; and muck formation in the mine workings.

**TABLE 3**
Iron Mountain Mine (IMM) Operation and Maintenance (O&M) Costs
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Period | Cost ($) |
|---|---|
| GLP 2008 fiscal year | 5.0 million |
| GLP 2009 fiscal year | 5.9 million |
| GLP 2010 fiscal year | 8.2 million |
| GLP 2011 fiscal year | 7.2 million |
| GLP 2012 fiscal year | 5.0 million |
| **Total for Fifth FYR Period** | **31.3 million** |

Notes:
Fiscal years extend from December 1 through November 31.
The table presents costs incurred by the Site Operator, IMO. CDF O&M costs are excluded.
Source: IMO, 2013.

## 4.5. Site Improvements under the 2000 Settlement

The 2000 Settlement provided funding for several Site improvements, including rehabilitation of a portion 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 to provide safe access for maintenance and collection of AMD. This work started in September 2001 and was completed in September 2003. This project addressed the largest identified risk for an uncontrolled spill at the Site by improving the reliability of the AMD collection system at the Richmond Mine. However, the harsh environment of the Richmond Mine, including the extremely low pH of AMD (less than 1) and high production of "muck," continues to result in challenges with AMD collection and the deterioration of the mine workings.

The Phase II Brick Flat Pit 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 provide spillway capacity to pass the peak 100-year storm flow. The spillway capacity was increased by raising the height of the dam and adding a gabion wall that is anchored to the spillway and covered with shotcrete (gunite). Improvements were also made to the Boulder Creek channel upstream from the dam. Improvements to the Boulder Creek Tailings Dam were completed between December 2003 and October 2004 (TRC, 2005).

## 4.6. 2004 Record of Decision (ROD 5): Sediment

### 4.6.1. ROD 5 Remedy Selection

ROD 5 selected an interim remedial action to dredge contaminated sediment that was most susceptible to erosion in Spring Creek Arm and dispose of the sediment in a CDF adjacent to Spring Creek Reservoir. The remedial action was a fund lead action.

Remedial action objectives developed in ROD 5 for contaminated sediment in Spring Creek Arm include the following. The RAOs focus on the protection of the Sacramento River ecosystem, and did not require the removal of all contaminated sediment to eliminate ecological risks in the Spring Creek Arm or Keswick Reservoir due to the ongoing IMM metal discharges.

- Protect the Sacramento River ecosystem from releases of heavy metals from Spring Creek Arm by preventing the mobilization and redeposition of contaminated sediment into important fishery spawning habitats in the Sacramento River downstream from 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 discharges from Spring Creek Arm to the Sacramento River.

The following performance criteria were defined in ROD 5 for the dredging operations during implementation of the interim remedial action. By meeting these performance criteria, the remedy also achieved remedial action objectives. These performance criteria are no longer applicable now that interim remedial action has been completed.

- Discharges of sediment from Spring Creek Arm shall not cause exceedances of the chemical-specific ARARs at the compliance point. The applicable numeric standards are presented in Table 2.
- Basin Plan turbidity standards shall be achieved at the compliance point during dredging operations.
- Return water discharged from the CDF shall not exceed the effluent limitation guidelines established for existing point sources at copper and zinc mines in 40 Code of Federal Regulations 440.102(a) and 440.103(a) (see Table 2).
- Sediment that is susceptible to erosion shall be removed (or contained through residual management) to 560 feet above mean sea level (msl) or to an elevation determined by further analysis to prevent erosion under the following operational condition:
  - Combined release from SCDD and Spring Creek Power Plant (SCPP) up to 6,600 $ft^3$/sec and Keswick Reservoir elevation of 574 feet msl or greater.

The selected interim remedy requires institutional controls, including CDF access and use restrictions and continued operational controls. Operational controls include restrictions on Keswick Reservoir water elevations during rare storm or flood events to prevent erosion of sediment that remains at deeper depths in Spring Creek Arm. As with RODs 1 through 4, the interim remedy in ROD 5 relies

on Reclamation to operate SCDD releases to comply with water quality ARARs in the Sacramento River below Keswick Dam, to the extent practicable.

Similar to RODs 2, 3, and 4, ROD 5 invoked the ARARs waiver for "interim measures" for this remedial action. EPA does not anticipate that the ROD 5 interim remedy, in conjunction with the other remedies implemented to date, would be sufficient to ensure compliance with (1) the numeric, chemical-specific water quality standards contained in the National Toxics Rule, CTR, and the Basin Plan for copper, cadmium, or zinc, (2) California Fish and Game Code § 5650, and (3) applicable requirements of SWRCB Resolution 92-49. ROD 5 also stated that the National Toxics Rule, Basin Plan or CTR criteria would not be achieved in Spring Creek, its tributaries, or in portions of Keswick Reservoir under all circumstances following completion of the interim action, as these water bodies are impacted by remaining discharges of AMD from the IMM Site.

### 4.6.2. ROD 5 Remedy Implementation

The remedial design for the ROD 5 interim remedy, the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action, was completed in September 2007. Construction activities began in fall 2008 and were completed in October 2011.

Construction of the first phase of the remedy was completed in December 2008. Phase 1 included access road construction and clearing the borrow pit area and the CDF footprint.

Construction of the second phase of the remedy was completed in summer 2009. Activities included construction of the CDF, construction of three lift stations to convey sediment from Spring Creek Arm to the CDF, construction of the conveyance pipeline, installation of the lime slaking system, and installation of the polymer treatment system.

Implementation of the second phase of the remedy involved sediment removal, which was performed from October 13, 2009, to December 12, 2009, and from March 31, 2010, to June 8, 2010. This portion of the work included hydraulic dredging of the sediment in Spring Creek Arm; treatment of the sediment with lime, polymer, and coagulant; water quality monitoring in Keswick Reservoir and the Sacramento River throughout dredging; CDF effluent monitoring during sediment dredging and dewatering; and demobilization of the Phase 2 equipment and facilities.

Phase 3 of the remedy included CDF closure, removal of sediment from the SCDD outlet works and spillway stilling pool, and implementation of the O&M program. Approximately 3,500 $yd^3$ of sediment was removed from the SCDD outlet works, spillway, and lower Spring Creek channel and transported to the secondary cell of the CDF. Closure of the CDF included grading the dredged sediments and constructing a multilayer capping system over the primary and secondary cells. Closure of the CDF, the last phase of the ROD 5 interim action, was substantially complete on October 25, 2011.

Implementation of the sediment interim action achieved performance criteria outlined in ROD 5. Contaminated sediment that was susceptible to erosion was removed to Elevation 560 feet. Laboratory and field water quality data demonstrate that dredging activities had no effect on water quality in Lower Keswick Reservoir or the Sacramento River below Keswick Dam. All compliance standards

were met. Elevated turbidity and copper and zinc concentrations were detected in Keswick Reservoir in October 2009 and April 2010 but were a result of large storm events and related releases from SCDD. Effluent limits for the CDF were also achieved. Metals concentrations in effluent samples were well below the compliance standards during dredging and dewatering activities (EPA, 2012).

The ROD 5 remedial action was expected to have an ancillary benefit of reduced operational restrictions. Prior to the remedial action, Reclamation restricted Keswick Reservoir elevations during SCPP operations to prevent scouring of metals-laden sediment from Spring Creek Arm. Reclamation water quality and operational data collected since the completion of dredging demonstrate that removal of the sediment from Spring Creek Arm has enabled full use of the Keswick Reservoir operating range without affecting water quality (see Appendices H and I).

### 4.6.3. ROD 5 Operation and Maintenance

The *Final Closure and Post-closure Maintenance Plan, Spring Creek Sediment Removal Remedial Action, Iron Mountain Mine, Redding, California* (CH2M HILL, 2012) outlines the CDF inspection, maintenance, monitoring, and security requirements, and an emergency response plan.

EPA performed the 1-year shakedown period and post-closure O&M on the CDF beginning on October 26, 2011. EPA completed necessary CDF repairs and maintenance in August 2012, after the first wet season. This included filling and grading areas within the CDF that had settled, construction of and improvements to drainage ditches, repair of erosional gulleys, and additional hydroseeding. EPA turned over O&M of the CDF to DTSC on October 26, 2012, the day after the project was jointly determined operational and functional by EPA and DTSC.

# 5. Progress Since the Last Five-Year Review

## 5.1. Previous Five-Year Review Protectiveness Statement and Issues

The following is the protectiveness statement from the 2008 FYR (EPA, 2008):

> *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 Site.*
>
> *During this FYR 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.*

During the 2008 FYR (EPA, 2008), the treatment plant and Site were determined to be properly operated and maintained. No issue was identified during the 2008 FYR that was expected to affect the protectiveness of remedies implemented under RODs 1 through 4. The status and resolution of 2008 FYR O&M recommendations is provided in Appendix J.

## 5.2. Work Completed at the Site during the Review Period

### 5.2.1. Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action

During this FYR period, EPA completed construction of the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action. This interim remedial action was selected in ROD 5 to prevent the migration and deposition of contaminated sediment from Spring Creek Arm into the Sacramento River and to reduce metal loads and suspended solids associated with the contaminated sediment. As discussed in Section 4.6, the remedy was implemented in three phases between 2008 and 2011. ROD 5 performance criteria were achieved. Contaminated sediment that was susceptible to erosion was removed to Elevation 560 feet. Water quality data demonstrate that dredging activities had no effect on water quality in Lower Keswick Reservoir or the Sacramento River below Keswick Dam, and CDF effluent limits were met during dredging and dewatering (EPA, 2012). EPA turned over O&M of the CDF to DTSC on October 26, 2012, the day after the project was jointly determined operational and functional by EPA and the State.

### 5.2.2. 1980 Memorandum of Understanding Update

The 1980 MOU (State Water Resources Control Board et al., 1980) is currently being updated and has not been signed by participating parties. The 1980 MOU is an agreement among the State Water Resources Control Board, the Water and Power Resources Service (predecessor of Reclamation), and the California Department of Fish and Game (currently CDFW) that establishes the short- and long-term actions and responsibilities of the agencies in minimizing toxicity problems near Spring Creek. The 1980 MOU establishes the release schedule and criteria for the discharge of water from SCDD to Spring Creek Arm and includes a monitoring program.

The IMM interim remedial actions have eliminated 97 percent of the historical metals discharges from the Site (see Section 6.4 and Appendix H). The reduction in IMM metals discharges provides greater operational flexibility than historical conditions, allowing additional releases from SCDD and lower dilution requirements from Shasta Dam and SCPP. However, the 1980 MOU requires updates to (1) update water quality criteria and (2) officially document operational controls selected in ROD 5.

The 1980 MOU includes total copper and total zinc criteria that approximate the State Basin Plan standards by assuming that 50 percent of the dissolved metals will form precipitates in Keswick Reservoir (EPA, 2004a). Under the *Long-term Central Valley Project Operations Criteria and Plan* (OCAP) (Bureau of Reclamation, 2004), Reclamation now operates SCDD targeting the actual Basin Plan criteria of 5.6 ppb dissolved copper and 16 ppb dissolved zinc in addition to the MOU goals.

The updated MOU is the intended mechanism to implement the operational controls selected in ROD 5. Currently, the OCAP includes the requirement to coordinate releases from SCDD with releases from SCPP to minimize the buildup of metal concentrations in the Spring Creek Arm; this operational control is not included in the 1980 MOU. Operational restrictions on Keswick Reservoir elevations are not documented in the 1980 MOU or the OCAP. Although the operational restrictions on Keswick Reservoir elevations were reduced after completion of the ROD 5 interim action, restrictions are still required during rare storm or flood events to prevent erosion of sediment that remains at deeper depths in Spring Creek Arm.

### 5.2.3. Sitewide Remedial Investigation

EPA is currently preparing a sitewide RI Report to describe the nature and extent of remaining contaminants at the Site and determine the risk posed by those contaminants to human health and the environment. The RI Report incorporates results from a bioassessment in 2008 (CH2M HILL, 2009a), updates to the surface water quality model in 2009 (CH2M HILL, 2009b), and additional data gaps investigations in 2010 and 2011. In addition, EPA has collected IMM surface water quality data since completion of the SCRR and Spring Creek Arm interim remedies. EPA has also collected surface water quality data to monitor the progress of remediation of other mines within the West Shasta Mining District.

### 5.2.4. Ongoing Operation and Maintenance

GLP is responsible for O&M of the completed remedial action components under RODs 1 through 4 and the Site. IMO, the Site Operator for GLP, performs routine inspections and maintenance activities specified in the SOW (EPA, 2000).

The following are significant nonroutine activities that have been conducted between 2008 and 2012:

- Restoration after a historic rainfall event: On October 13 and 14, 2009, approximately 23 inches of rain fell in the Slickrock Creek basin. This volume far exceeded the 24-hour, 100-year storm volume at IMM (IMO, 2009 and EPA, 2012). Extensive road repairs, sediment removal, and limited SCRR dam repairs on the right upstream abutment were necessary.
- Large forest fire at the Site in June and July 2008: Culverts and portions of pipelines at the Site required replacement (IMO, 2008). Burned out trees that had a high probability of falling on roads were also cleared.
- Boulder Creek improvements: Riprap and shotcrete were installed in summer 2012 along a portion of the Boulder Creek bed and banks to minimize erosion (IMO, 2012).

# 6. Five-Year Review Process

This section summarizes the FYR process, including administration, community involvement, document review, data review, Site inspections, interviews, and institutional controls. The following appendices provide supporting information:

- Appendix A: List of Documents Reviewed
- Appendix B: Press Notices
- Appendix C: Interview Forms
- Appendix D: Site Inspection Checklists
- Appendix E: Photographs from Site Inspections
- Appendix F: Applicable or Relevant and Appropriate Requirement Review
- Appendix G: Minnesota Flats Treatment Plant Effluent Discharge
- Appendix H: Site Evaluation and Compliance at Keswick Dam
- Appendix I: Institutional Control Assessment
- Appendix J: Resolution of 2008 FYR O&M Recommendations

## 6.1. Administrative Components

EPA Region 9 initiated the Fifth FYR in January 2013. The review team was led by James Sickles/EPA, Remedial Project Manager for the Site, and included Cynthia Wetmore/EPA and the EPA attorney and EPA community involvement coordinator. Contractor support was provided by CH2M HILL. This FYR effort included community notifications; document reviews; interviews with the Site Operator, an adjacent resident, and agency representatives; Site inspections; ARAR analysis; review of treatment plant operational, influent, and effluent data; Sacramento River water quality analysis; an update on the status of previous FYR recommendations and issues; and development and review of this FYR report.

## 6.2. Community Involvement

On February 27, 2013, a public notice in the *Record Searchlight* announced the commencement of the FYR process for the Site. The notice provided James Sickles' contact information, and invited community participation. The notice is available in Appendix B. EPA did not receive any inquiries from the public regarding the advertisement.

This FYR report will be available to the public after it is finalized. Copies of the report, the IMM Administrative Record, and other Site documents and reports will be available at the Redding Library and the EPA Superfund Records Center. After completion of the FYR report, a public notice will be placed in the *Record Searchlight* to announce the availability of the report.

## 6.3. Document Review

This FYR includes a review of relevant Site-related documents, including the RODs, remedial action reports, O&M plans and reports, IMO inspection and operations reports, and recent monitoring data. A complete list of the documents reviewed is provided in Appendix A.

### 6.3.1. Applicable or Relevant and Appropriate Requirements Review

Section 121 (d)(2)(A) of CERCLA specifies that Superfund remedial actions must meet federal standards, requirements, criteria, or limitations that are determined to be ARARs. ARARs are standards, criteria, or limitations promulgated under federal or state laws that specifically address hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at CERCLA sites.

Appendix F provides a detailed review of the chemical-, location-, and action-specific ARARs identified in RODs 1 through 5 to identify federal and state laws and regulations that have been promulgated or changed over the past 5 years. There have been no revisions of laws or regulations that affect the protectiveness of the interim remedial actions identified in RODs 1 through 5.

The remedial actions selected in RODs 1 through 5 are interim actions and leave some releases of hazardous substances unabated. As discussed in Section 4, EPA invoked an ARARs waiver for "interim measures" for these interim remedial actions. Water quality in the Sacramento River below Keswick Dam has improved since EPA completed the interim remedial actions. However, EPA does not anticipate that the interim actions will be sufficient to ensure compliance with (1) the numeric, chemical-specific water quality standards in the National Toxics Rule, CTR, and the Basin Plan for cadmium, copper, or zinc, (2) California Fish and Game Code Section 5650, which prohibits the discharge of contaminants deleterious to fish, plant life, or bird life, and (3) applicable requirements of State Water Resources Control Board Resolution 92-49. EPA, therefore, waived compliance with those standards for the interim remedial actions to the extent those standards cannot be achieved by the remedies selected in RODs 1 through 5.

The RODs describe EPA's goal at the site as complying with water quality ARARs in the Sacramento River downstream of Keswick Dam. 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 historical IMM discharges of copper and zinc. The Reclamation water management actions are necessary to reduce the likelihood of uncontrolled spills and meet State Basin Plan standards in the Sacramento River below Keswick Dam, to the extent practicable. ROD 4 estimated that State Basin Plan standards would be met below Keswick Dam, except during IMM AMD spills from SCDD, which were projected to occur on a frequency of once every 8 to 10 years. Similarly, water modeling conducted in 2009 estimated there would be three uncontrolled SCDD spills during the 50-year prediction period caused by heavy, early, winter storms after very dry summers (CH2M HILL, 2009b).

The RODs stated that the selected remedies would not meet water quality objectives in the immediate receiving waters. ROD 1 stated that State and Federal standards would probably not be met in portions of Spring Creek, Slickrock Creek, Boulder Creek, and Keswick Reservoir at any time. ROD 2 stated that the selected remedy would not meet ambient water quality criteria in Boulder Creek or Slickrock Creek, and ROD 3 added lower Spring Creek. ROD 4 stated that regular exceedances of the State Basin Plan standards and the CTR were likely to continue in areas of Keswick Reservoir and in the Spring Creek watershed, and continuous exceedances were expected to remain in water bodies above SCDD. ROD 5 stated that the interim remedy would not achieve National Toxics Rule, Basin Plan, or CTR criteria in Spring Creek, its tributaries, or in portions of Keswick Reservoir under all circumstances.

### 6.3.2. Risk Assessment Review

PRC Environmental Management, Inc. (PRC) conducted a baseline human health risk assessment (PRC, 1991), and EPA conducted the Environmental Endangerment Assessment (EPA, 1992b). These assessments reflect conditions prior to construction of the IMM treatment plant and other interim remedial action components. The PRC risk assessment evaluated the human health risks from AMD transporting cadmium, copper, iron, and zinc downstream from the Site. Risks to adult and child residents living downstream from the Site, and potentially exposed to these contaminants through ingestion of drinking water, were evaluated. Risk estimates for adult and child recreational users were also evaluated, which included the potential ingestion of contaminated sediment, fish, and surface water, as well as absorption through dermal contact. The risk characterization results from the PRC risk assessment are summarized below (PRC, 1991):

- Individuals entering the IMM site are at risk if they directly contact or ingest the AMD; however, PRC believes the probability of such exposure is small. The risk of such exposure is currently limited by controlled access to the mine site (see Section 6.7).

- Children are at greater risk than adults, when considering noncancer toxicity resulting from incidental ingestion of creek water downstream from IMM. Risks from carcinogens (e.g., cadmium), were well below risk management limits.

- Individuals who come in direct contact with or ingest water or sediments from the main body of Keswick Reservoir or Sacramento River are not at risk.

- Individuals who consume fish from the main body of Keswick Reservoir or Sacramento River may be at some risk; the uncertainties associated with this scenario are great and likely overestimate the risk.

ROD 4 further discussed the human health risks. ROD 4 stated that although continuing IMM AMD discharges are transported to the Sacramento River, which is a source of drinking water, the nearest point of withdrawal from the Sacramento River for domestic or municipal water use is downstream from Keswick Dam. EPA anticipates that the Safe Drinking Water Standards will be met at that point. Further, the Water Board 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. The interim remedies that reduce metal loads to state waters would be expected to reduce human health risks associated with consumption of fish contaminated with high levels of heavy metals from IMM, although the risks associated with such consumption has not been quantified (EPA, 1997).

The primary conclusions resulting from the Environmental Endangerment Assessment, conducted prior to implementation of the IMM interim remedies, included the following (EPA, 1992b):

- Those portions of the Spring Creek drainage, Spring Creek Reservoir, and Spring Creek Arm of Keswick Reservoir were devoid of most forms of aquatic life as a result of AMD from IMM.
- A majority of the copper, zinc, and cadmium loadings into the upper Sacramento River originated from the AMD from IMM.
- Water quality objectives for copper, cadmium, and zinc, adopted for the Sacramento Basin by the Central Valley Regional Water Quality Control Board, for the protection of aquatic life were frequently not met for acute and chronic toxicity limits.
- The primary species of concern, as a result of the discharge of IMM AMD, are four runs of Chinook salmon. Other species of concern are the migratory populations of steelhead trout and the resident populations of rainbow trout.
- Implemented remedial actions at IMM [prior to publication of the Environmental Endangerment Assessment in May 1992] were expected to alter historical patterns of risk to Sacramento River fishery resources, with fewer occurrences of uncontrolled spills occurring from SCDD in the future. However, the assessment noted that potentially acute and chronic toxicity to the species of concern might continue in the future as a result of unavoidable releases of AMD from SCDD.

An update of the potential risk posed by the sediment in Spring Creek Arm was completed in 2004 (EPA, 2004b). The 2004 update evaluated an exposure scenario for a youth exposed to Spring Creek Arm sediment for 12 days per year for 9 years. The Hazard Index for this exposure scenario was below the value of 1.0. Therefore, this exposure does not pose an appreciable risk of harmful health effects, even for sensitive subgroups such as children. The cumulative excess lifetime cancer risk from all carcinogenic contaminants of potential concern was within the risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$.

EPA is in the process of performing human health and ecological risk assessments as part of the sitewide RI Report (EPA, In preparation). The risk assessments use data that reflect conditions after completion of the interim remedial actions. The majority of data were collected during the IMM data gaps sampling in 2010. The media sampled included soil, sediment, surface water, and groundwater. The risk assessments incorporate new or revised analytical procedures, exposure and risk models, and toxicity values available since the original risk calculations were performed for the Site.

## 6.4. Data Review

This FYR includes reviews of the operational performance of the treatment plant and water quality in the Sacramento River. The reviews are presented in Appendices G and H, respectively. Conclusions from the data review are presented in the following sections.

### 6.4.1. Treatment Plant Operational Performance

The treatment plant has been very effective in reducing heavy metal discharges from the Site, removing, on average, 99.7 percent of dissolved metals from the AMD inflow. For Water Years 2008 through 2012, IMM interim remedial actions prevented the discharge of approximately 870,000 pounds of copper and 3 million pounds of zinc by treating approximately 2 billion gallons of concentrated AMD. This section compares the treatment plant effluent concentrations with (1) Clean Water Act effluent limitations selected in the RODs and (2) technology-based performance standards established in the O&M SOW.

#### 6.4.1.1 Clean Water Act Effluent Limitations Selected in the RODs

ROD 2 discussed that there are no technology-based effluent limitations specifically identified for inactive copper or pyrite mines. There are technology-based limitations for active coal, iron, copper and zinc mines. Because the problems of acid mine drainage from the underground mining at IMM are similar to the problems of active open pit and underground copper mines, EPA selected the Clean Water Act effluent limitations for existing point sources at copper and zinc mines (40 CFR 440.102(a) and 440.103(a)) as relevant and appropriate for the treatment plant in RODs 2, 3, and 4.These include maximum daily and 30-day average effluent limits for total metals. During this FYR period, metal discharges from the treatment plant substantially complied with the effluent limits, and in most cases, were well below the limits.

#### 6.4.1.2 Technology-based Performance Standards

Pursuant to the December 2000 Consent Decree, EPA established technology-based performance standards for dissolved cadmium, copper, and zinc in the O&M SOW (EPA, 2000), based upon metal removal levels achieved by the IMM treatment plant. These standards are more stringent than the Clean Water Act effluent limitations selected in the RODs and were established to maximize the metals removal by the HDS treatment process through implementation of best management practices.

Only limited performance data were available at the time the standards were established in 2000, and SCRR had not yet been constructed. Completion of SCRR changed the composition of the AMD treatment plant influent. EPA indicated in the SOW that the treatment plant performance should be monitored and the technology-based performance standards should be revised after completion of SCRR, if warranted. The SOW also specified that every 5 years thereafter, the standards should be evaluated and modified, if appropriate.

EPA's review of treatment plant performance data indicates that the Site Operator has properly operated the treatment plant. However, operational data collected since the completion of SCRR demonstrate that when the treatment plant is operating normally, dissolved cadmium and dissolved zinc concentrations in the effluent frequently exceed the technology-based performance standards specified in the SOW. As recommended in the Fourth FYR, EPA is working with GLP to formally modify the SOW, including revisions to the technology-based performance standards to more accurately reflect metals removal by the HDS AMD neutralization process. Changes to these standards should not change treatment plant operations by the Site Operator, particularly with respect to pH controls, and will not affect the protectiveness of the remedies at the point of compliance (Sacramento River and Keswick Dam).

### 6.4.2. Water Quality in the Sacramento River below Keswick Dam

The RODs describe EPA's goal at the site as complying with water quality ARARs in the Sacramento River downstream of Keswick Dam, as discussed in Section 6.3. The interim remedies continue to rely on Reclamation's operations of SCDD to achieve this goal, to the extent practicable. Reclamation controls discharges from Central Valley Project facilities in accordance with the 1980 MOU and OCAP to comply with the Basin Plan standards. As discussed in Section 6.3, EPA waived compliance with the Basin Plan and CTR standards for copper, cadmium, and zinc (among other water quality ARARs) using the "interim actions" waiver. Exceedances of these standards are expected downstream of Keswick Dam during uncontrolled spills from SCDD, and compliance with water quality objectives is not expected in the immediate receiving waters. For analysis of the progress of the IMM interim remedies, this section compares metal concentrations in the Sacramento River below Keswick Dam with the Basin Plan and CTR standards in samples collected by Reclamation as part of the routine monitoring program.

During the past 5 years, the results of Reclamation's water quality monitoring program indicate that the dissolved copper concentrations in the Sacramento River below Keswick Dam did not exceed the 5.6 ppb Basin Plan instantaneous maximum limit. Between January 2008 and December 2012, the dissolved copper concentrations of water sampled from the Sacramento River below Keswick Dam exceeded the CTR 4-day average chronic exposure limit of 4.1 ppb one time (less than 0.4 percent of the samples collected by Reclamation), which is less than the CTR allowable exceedance of 4 consecutive days once every 3 years. For comparison, exceedances of the CTR 4-day average chronic exposure limit occurred 29 percent of the sampling days during the Third FYR period (EPA, 2003), before completion of the SCRR.

During the past 5 years, the results of Reclamation's water quality monitoring program indicate that dissolved zinc concentrations in the Sacramento River below Keswick Dam did not exceed either the Basin Plan instantaneous maximum limit or CTR chronic exposure limit. Reclamation performed only limited analysis of cadmium as part of the routine program; however, cadmium is analyzed as part of EPA's weekly wet season monitoring (see Appendix H). During the past five years, the maximum detection of dissolved cadmium in samples collected by EPA in the Sacramento River below Keswick

Dam was 0.11 ppb, well below the Basin Plan instantaneous maximum limit of 0.22 ppb and the CTR chronic exposure limit of 1.1 ppb.

During the past five years, dissolved copper concentrations ranged from 0.5 to 4.4 µg/L in samples collected by Reclamation of water discharged from Shasta Dam. The upper Sacramento River total maximum daily load (TMDL) report (Water Board, 2002) states that the Water Board will develop additional mine remediation and other activities needed to address dissolved copper concentrations that exceed 1.3 ppb in Shasta Dam releases. The TMDL goal was exceeded in the Shasta Dam releases more than 40 percent of the days sampled by Reclamation between 2008 through 2012.

## 6.5. Site Inspections

CH2M HILL performed the following FYR Site inspections:

- James Sickles (EPA); Tom Wallis, Dave Bunte, and Josh Bale (CH2M HILL); Rudy Carver and John Nash (IMO); and Dave Sadoff and Henry Gold (GLP) performed an inspection of the Main Mine Area on February 27, 2013.
- Josh Bale, Rudy Carver, and Don Odean (IMO) participated in a follow-up Site visit and detailed treatment plant inspection on February 28, 2013.
- Josh Bale and Tom Wallis performed a detailed CDF site inspection on February 19, 2013.
- James Sickles, Tom Wallis, Dave Bunte, and Josh Bale performed a follow-up CDF site inspection on February 27, 2013.

The Site is generally well-maintained. No issues were identified during the February 2013 Site inspections that are expected to affect the protectiveness of interim remedies implemented under RODs 1 through 5. The following are recommendations and follow-up actions resulting from the FYR Site inspection and interviews, which relate to implementation and scope of the O&M procedures:

- The Site Operator should continue to prepare and submit management plans and reports to meet requirements of the SOW, including annual operations work plans (Section 6.3 of the SOW) and the landfill management report and plan (Section 6.4 of the SOW). Although communications are generally good between EPA, GLP, and IMO, the Site Operator should use these submittals as a tool to notify EPA 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 issue. Annual inspections of the piping system are currently performed and locations with significant deterioration are repaired with mortar or grout. Provisions have been made for the Site Operator to restore or replace the reinforced concrete pipe lining system, as necessary (EPA, 2000). The Site Operator should develop a plan for evaluating the refurbishment and long-term maintenance of the liner system for submittal to EPA by December 2013.

- The previous two FYRs (EPA, 2003 and 2008) recommended that the contents of the Essential Solutions, Inc., chemical storage tanks across the road from the cementation plant be determined and proper containment provided, if required, or the contents disposed of properly. This work has not yet been completed. Essential Solutions, Inc., and IMMI are developing a work plan for closure of the Ag-Gel pilot project.
- In summer 2012, IMO placed riprap and shotcrete in Boulder Creek to minimize erosion and cleaned the horizontal drains at the toe of the landslide. The Site Operator should extend these improvements to minimize further bank and channel erosion. The Site Operator should continue to monitor displacement of the landslide and drainage improvement effectiveness.
- The concrete plugs in the ore chutes of the Richmond Adit continue to deteriorate. The Site Operator should develop a plan for submittal to EPA by December 2013 to address the failing chute plugs and the associated risks to worker safety, mine access, and the AMD conveyance and treatment system.
- As discussed in the Fourth FYR (EPA, 2008), the amount of filtrate has decreased significantly at Brick Flat Pit, and potential filtrate discharge pathways have not been confirmed. The Site Operator should continue to evaluate reasons for the reduced filtrate at Brick Flat Pit.
- Clean water runoff from above the right abutment of SCRR is flowing subsurface, discharging behind the dam, and being collected for treatment. The Site Operator should design and implement a long-term plan for routing drainage above the right abutment of SCRR to the clean water diversion.
- Settlement along the south SCRR perimeter road required repairs in 2010. Backfill materials were excavated, recompacted, and the surface restored to minimize additional longitudinal cracking in Slickrock Creek Clean Water Diversion pipeline. The Site Operator should closely monitor this area to verify that no additional settlement or longitudinal cracking of the pipeline occurs.
- The Site Operator should closely monitor the AMD pipeline in sections where the relatively higher pH water from SCRR is conveyed. The rate of scaling has increased in recent years. The AMD pipeline should be acid-washed, as necessary, or a more effective strategy should be developed to prevent excessive scaling inside the pipeline from causing a potential discharge of AMD.
- The Site Operator should scan all as-built drawings that do not have electronic backups into a high-resolution electronic format for redundancy. Some of the as-built drawings in the IMO office are the only known copies, and the information could be lost in the case of significant water damage, fire, or other unanticipated event.

## 6.6. Interviews

During the FYR process, interviews were conducted with parties affected by the Site, including the Site Operator, an adjacent resident, and agency representatives. The interviews document the

perceived status of the Site and perceived problems or successes with the interim remedies implemented to date.

Onsite interviews were conducted on February 27 and 28, 2013, with the following IMO staff: Rudy Carver, Site Manager; John Nash, Site Construction Manager; and Don Odean, Treatment Plant Operator. Issues and observations during the IMO interviews are included with the Site inspection checklist in Appendix D and discussed in Section 6.5. In addition, interviews were conducted with the following people in February, March, and April: an adjacent resident, McKinley Lewis/DTSC, Phil Woodward/Water Board, and Don Reck/Reclamation. Interview forms are included in Appendix C.

Generally, the interviews were positive about the work at the Site and the communication. No significant problems regarding the Site were identified during the interviews. The adjacent resident discussed long-term maintenance of Flat Creek and the status of access agreements.

McKinley Lewis/DTSC discussed O&M of the CDF after the operational and functional determination in October 2012. Mr. Lewis stated that the level and quality of communications received from EPA have been very positive. Mr. Lewis confirmed that Reclamation was performing monthly security inspections, and he was not aware of any evidence of trespassing or vandalism. At the time of the interview in February 2013, DTSC was in the process of procuring a contractor to perform maintenance tasks and was scheduled to inspect the CDF in March. Results of the CH2M HILL inspection of the CDF are presented in Appendix D and discussed in Section 6.5.

Phil Woodward/Water Board stated that remedial activities at the mine have significantly reduced the discharge of metals from the Site into Keswick Reservoir and the Sacramento River, reducing the impacts on the beneficial uses of each water body. Mr. Woodward described that the success of the remedies is the result of the close cooperation and expertise of the agencies involved for over more than 30 years, including EPA, the Water Board, DTSC, Reclamation, and CDFW (formerly the California Department of Fish and Game). Over the past few years, several of the key agency representatives with accumulated institutional and historical knowledge of the Site have retired. Mr. Woodward commented that it is imperative that communication and coordination continue, and he recommended periodic (i.e., semiannual or annual) meetings or monthly e-mail notifications coordinated by EPA with all involved agencies. This would allow agency staff with experience at the Site to pass this institutional knowledge on to the new staff.

Mr. Woodward also noted that the current compliance standards for heavy metals (cadmium, copper, and zinc) are the Basin Plan standards, and the compliance point is below Keswick Dam. He commented that the standards should be re-evaluated in light of new CTR standards and that the compliance point should be moved to Spring Creek Arm to assure protection of the beneficial uses assigned to Keswick Reservoir by the Basin Plan. The 1980 MOU is currently being renegotiated to define how CVP facilities will be operated to meet water quality standards.

Don Reck/Reclamation stated that the water quality conditions within Spring Creek Reservoir have dramatically improved over the past five years. Mr. Reck stated that communications between EPA and IMO are working well. Mr. Reck also stated that as a result of the dredging in the Spring Creek

Arm of the Keswick Reservoir, Reclamation has been able to operate Keswick Reservoir within the full design elevation range with extremely favorable operation and scheduling results. Mr. Reck's final comment was that the "remediation actions have had very good results that have worked out well for Reclamation".

## 6.7. Institutional Controls

EPA selected installation of perimeter controls in ROD 1 to minimize direct contact threats. Access restrictions and security measures have been implemented at the Main Mine Area, as detailed in the SOW (EPA, 2000) (see Appendix I). These include electronic, locally and remotely controlled gates and security cameras along Iron Mountain Road; blocked access points elsewhere on site, including earthen berms and locked gates; and detailed access requirements and restrictions. The FYR site inspection and interviews with the Site Operator indicate that access restrictions and security measures are being effectively implemented, monitored, and maintained.

EPA selected institutional controls in ROD 5, including operational controls and an institutional control to protect the CDF. Operational controls included limited restrictions on Keswick Reservoir water elevations to prevent mobilization of sediment remaining in Spring Creek Arm. Hydraulic evaluations indicate that maintaining the Keswick Reservoir water elevation above 578 feet when the combined discharge from SCPP and SCDD approaches or exceeds 6,600 $ft^3$/sec would prevent erosion of contaminated sediment remaining in Spring Creek Arm after dredging. These flows would likely only occur during abnormal storm events. ROD 5 also selected controls for operation of SCDD releases to comply with water quality ARARs in the Sacramento River downstream from Keswick Dam and to continue low-flow releases from SCPP to flush Spring Creek Reservoir water through Spring Creek Arm. Although Reclamation followed the ROD 5 operational controls during the FYR period (see Appendix H), operational restrictions on the Keswick Reservoir water elevation need to be officially recorded. As discussed in Section 5.2, the 1980 MOU is being renegotiated by the stakeholders and is the intended mechanism to implement the operational controls.

Existing governmental agreements, security measures, and governmental controls are being used to restrict access to, and future use of, the portion of federal lands used for the CDF. The *Agreement between the United States of America (By and Through the Bureau of Reclamation and the Bureau of Land Management) and Shasta County for the Cooperative Management of the Interlakes Special Recreation Management Area* (Reclamation, 1994) documents the responsible parties for managing the Spring Creek Reservoir area, which includes the CDF. Entry roads to the CDF include Reclamation roads from Rock Creek Road and Benson Road; both roads have locked gates. Monthly security inspections are performed by Reclamation. The CDF is located on land managed by Reclamation. The *Shasta County General Plan* (Shasta County Department of Resource Management, 2004) map indicates that Reclamation land is public. Future land ownership and uses of the CDF and adjacent areas are not expected to change. A proposed change to Shasta County's adopted land use policies or maps contained in the general plan would require advertised public hearings because of potential environmental and land use impacts.

IMM interim access controls, security measures, governmental agreements, and governmental controls are effectively controlling potential human exposures and preventing adverse impacts on the integrity or protectiveness of the interim remedial measures implemented under RODs 1 through 5. Although Reclamation followed operational controls selected in ROD 5 over the FYR period, controls specifying limited restrictions on Keswick Reservoir water elevations need to be officially recorded to remain protective of the environment over the long term.

# 7. Technical Assessment

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

The review of Site documents, water quality data, and Site inspection results indicates that the IMM interim remedies are functioning as intended by the decision documents. The treatment plant and Site are being properly operated and maintained by the Site Operator. Operation and maintenance costs incurred over the Fifth FYR period were not unusually high or unanticipated. No issues or observations were identified during the February 2013 inspections that are expected to affect the protectiveness of interim remedial actions implemented under RODs 1 through 5.

RODs 1 through 4 use a combination of source control, treatment, and water management. The collection and treatment of AMD from the Richmond Mine, Lawson Mine, and Old No. 8 Mine adits, and the area sources of AMD from the Slickrock Creek watershed have eliminated 97 percent of the historical metals discharges from the Site. The treatment plant substantially complies with Clean Water Act effluent limits specified in RODs 2, 3, and 4, and in most cases, effluent concentrations are well below these limits. EPA's review of performance data indicates that the treatment plant has been operated properly. 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 Spring Creek Reservoir, thereby increasing the effectiveness of Reclamation water management operations.

EPA's interim remedial action selected in ROD 5 (EPA, 2004) addressed 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, and disposal of dredged sediment in the CDF adjacent to Spring Creek Reservoir, mitigated the risk for release events of contaminated sediment. The ROD 5 interim action also provided an ancillary benefit of reducing restrictions on SCPP and Keswick Reservoir operations.

The interim remedial actions selected in RODs 1 through 5 were designed to protect the fishery resources and ecosystem of the Sacramento River below Keswick Dam from cadmium, copper, and zinc discharges from IMM to meet protective water quality criteria, to the extent practicable. The interim remedies continue to rely on Reclamation's 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 less than 5 percent of the overall historical IMM discharges of copper and zinc. Reclamation controls discharges from Central Valley Project facilities in accordance with the 1980 MOU and OCAP to comply with the Basin Plan standards in the Sacramento River below Keswick Dam.

For analysis of the progress of the IMM interim remedies, metal concentrations in the Sacramento River below Keswick Dam were compared with the Basin Plan and CTR standards in samples

collected by Reclamation as part of the routine monitoring program. However, EPA waived compliance with the Basin Plan and CTR standards for copper, cadmium, and zinc (among other water quality ARARs) using the ”interim actions” waiver. Exceedances of these standards are expected downstream of Keswick Dam during the rare occasion of heavy, early, winter storms following a very dry summer (estimated to once every 8 to 10 years in ROD 4, or 3 storm events in the 50-year 2009 water quality model scenario), and compliance with water quality objectives is not expected in the immediate receiving waters. The results of water quality sampling performed over the past 5 years (January 2008 through December 2012) indicate that copper, cadmium, and zinc concentrations in the Sacramento River below Keswick Dam complied with Basin Plan standards, and dissolved cadmium and dissolved zinc concentrations complied with CTR chronic exposure limits. The dissolved copper concentrations of water sampled from the Sacramento River below Keswick Dam exceeded the CTR 4-day average chronic exposure limit of 4.1 ppb one time (less than 0.4 percent of the samples collected by Reclamation), which is less than the CTR allowable exceedance of 4 consecutive days once every 3 years. For comparison, exceedances occurred 29 percent of the days sampled during the Third FYR period, before completion of the SCRR.

IMM interim access controls, security measures, governmental agreements, and governmental controls are effectively controlling potential human exposures and preventing adverse impacts on the integrity or protectiveness of the interim remedial measures implemented under RODs 1 through 5. Although Reclamation followed operational controls selected in ROD 5 over the FYR period, controls specifying limited restrictions on Keswick Reservoir water elevations need to be officially recorded to remain protective of the environment over the long term.

## 7.2. Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

### 7.2.1. Changes in Standards and To Be Considered Criteria

There have been no revisions to laws or regulations that affect the protectiveness of the interim remedial actions identified in RODs 1 through 5. Appendix F contains an analysis of ARARs.

### 7.2.2. Risk Evaluations

EPA is in the process of performing human health and ecological risk assessments as part of the sitewide RI Report (EPA, in preparation). The risk assessments use recent data that reflect conditions after completion of the interim remedial actions and incorporate new or revised analytical procedures, exposure and risk models, and toxicity values available since the original risk calculations were performed.

### 7.2.3. Expected Progress Toward Meeting Remedial Action Objectives

The interim remedial actions have minimized the potential exposure and resultant threats to human health and the environment outside of the Site caused by acid mine drainage discharges from contaminant sources addressed by the actions. Performance of the interim remedial actions relative to the three primary goals identified in ROD 4 is summarized below:

- Compliance with water quality criteria is discussed under Question A.
- During this FYR period, the interim remedial action reduced the mass discharge of toxic heavy metals by 97 percent from the historical discharges.
- During this FYR period, no special releases of valuable water resources were needed to dilute contaminant discharges and attain protective water quality criteria.

The following summarize the performance of the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action relative to the criteria in ROD 5:

- Contaminated sediment that was susceptible to erosion was removed to Elevation 560 feet.
- Laboratory and field water quality data demonstrate that dredging activities had no effect on water quality in Lower Keswick Reservoir or the Sacramento River below Keswick Dam.
- Effluent limits for the CDF were achieved. Metals concentrations in effluent samples were well below the compliance standards during dredging and dewatering activities.
- The ancillary benefit of reduced restrictions on Keswick Reservoir operating levels was achieved. Since the completion of dredging in June 2010, Reclamation has routinely operated Keswick Reservoir over the full range of reservoir water elevations.

## *7.3. Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?*

No other information was identified during the FYR that calls into question the protectiveness of the remedy. Site restoration was required after wide-spread wildfires in summer 2008 and a historic rainfall event in October 2009, which far exceeded the 24-hour, 100-year storm volume. However, no issues arose during these events that affected the protectiveness of the remedial actions.

## *7.4. Technical Assessment Summary*

This FYR assessment found that the remedies implemented under RODs 1 through 5 are operating as intended, and the O&M at the Site has been satisfactory over the past 5 years. The interim remedial actions completed under RODs 1 through 4 have afforded substantial protection for the valuable Sacramento River ecosystem by eliminating 97 percent of the historical metals discharges from the Site. The interim remedial actions were designed to meet protective water quality criteria in the Sacramento River downstream of Keswick Dam, to the extent practicable. The results of water quality sampling performed between January 2008 and December 2012 indicate copper, cadmium, and zinc

concentrations in the Sacramento River below Keswick Dam complied with Basin Plan standards. The interim action completed under ROD 5, dredging metal-contaminated sediment from Spring Creek Arm that was susceptible to erosion, also resulted in significant environmental benefits for the Sacramento River ecosystem and beneficial uses.

The remedial actions selected in RODs 1 through 5 are interim actions and leave some releases of hazardous substances unabated. EPA invoked an ARARs waiver for the "interim measures". The IMM interim remedy relies on the Bureau of 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 less than 5 percent of the overall historical IMM discharges of copper and zinc. The Bureau of Reclamation water management actions are necessary to reduce the likelihood of uncontrolled spills and meet Basin Plan standards in the Sacramento River below Keswick Dam, to the extent practicable. Exceedances of water quality standards are expected downstream of Keswick Dam on the rare occasions when large early winter storms follow very dry summers, and the IMM interim remedies were not intended to meet water quality objectives in the immediate receiving waters.

IMM interim access controls, security measures, governmental agreements, and governmental controls are effectively controlling potential human exposures and preventing adverse impacts on the integrity or protectiveness of the interim remedial measures implemented under RODs 1 through 5. EPA is evaluating the need for additional remedial actions as part of the sitewide remedial investigation report and the forthcoming feasibility study report.

# 8. Issues

No issues were identified that affect the current protectiveness of the interim remedial actions completed under RODs 1 through 5. Table 4 summarizes the one issue identified, which if not addressed, has the potential to affect the future protectiveness of the ROD 5 interim remedial action.

**TABLE 4**
Current Issues at the Site
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Issue | Affects Current Protectiveness (Yes or No) | Affects Future Protectiveness (Yes or No) |
|---|---|---|
| Operational controls selected in ROD 5 are being followed by Reclamation, but controls specifying limited restrictions on Keswick Reservoir water elevations have not been officially recorded. | No | Yes |

# 9. Recommendations and Follow-up Actions

Table 5 provides recommendations to address the current issues at the Site. No recommendations were identified during the FYR that affect the current protectiveness of the interim remedial actions.

**TABLE 5**
Recommendations to Address Current Issues at the Site
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Issue | Recommendations/ Follow-Up Actions | Party Responsible | Oversight Agency | Milestone Date | Affects Protectiveness? (Yes or No) | |
|---|---|---|---|---|---|---|
| | | | | | Current | Future |
| Operational controls selected in ROD 5 are being followed by Reclamation, but controls specifying limited restrictions on Keswick Reservoir water elevations have not been officially recorded. | Implement operational controls selected in ROD 5 through the 1980 MOU update. | EPA, in coordination with Reclamation | EPA, along with DTSC and RWCB, as support agencies. | 2017 | No | Yes |

In addition, the following are recommendations identified during the FYR that may improve management of O&M but do not affect the protectiveness of the interim remedial actions:

- EPA should update the technology-based performance standards specified in the O&M SOW based on the metal removal currently achieved at the treatment plant (see Section 6.4).
- Several key agency representatives have recently retired, and the Water Board emphasized the importance of continued close coordination and communication between EPA and the IMM Technical Advisory Committee. The Water Board recommended that EPA conduct periodic (i.e., semi-annual or annual) meetings, monthly e-mail notifications, or both, for all involved agencies as possible approaches for addressing this issue.
- CH2M HILL identified issues and observations related to implementation and scope of O&M procedures (see Section 6.5). In general, the treatment plant and the Site are properly operated and maintained. The February 2013 Site inspections identified no issues that would affect the protectiveness of remedies implemented under RODs 1 through 5.

# 10. Protectiveness Statements

The interim remedial actions implemented at IMM selected in RODs 1 through 4 for OUs 1 through 4 are protective of human health and the environment.

The interim remedial actions implemented at IMM selected in ROD 5 for OU-5 is protective of human health and the environment in the short term. To remain protective of the environment over the long term, operational controls selected in ROD 5, including limited restrictions on the Keswick Reservoir water elevation to prevent mobilization of sediment remaining in Spring Creek Arm, need to be officially recorded.

# 11. Next Review

IMM Superfund Site is a statutory site that requires ongoing FYRs as long as waste is onsite that does not allow for unrestricted use and unlimited exposure. The next FYR for the Site is required in 2018, within 5 years of the signature date of this FYR report.

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# Appendix A: List of Documents Reviewed

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# List of Documents Reviewed
# Iron Mountain Mine Five-Year Review

**PREPARED FOR:** James Sickles/U.S. Environmental Protection Agency

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**DATE:** July 26, 2013

**PROJECT NUMBER:** 406751.FR.01

The following documents were reviewed as part of the Iron Mountain Mine Fifth Five-Year Review:

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# Appendix B: Press Notices

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**U.S. EPA BEGINS FIFTH FIVE-YEAR REVIEW OF CLEANUP**
**AT IRON MOUNTAIN MINE SUPERFUND SITE**
***Published in the Record Searchlight on February 27, 2013***

The U.S. Environmental Protection Agency (EPA) is conducting a review of cleanup actions at the Iron Mountain Mine Superfund site near Redding, California to ensure they remain protective or human health and the environmental. This review will cover source control, acid mine drainage collection and treatment, and water management components including water diversions and coordinated releases or contaminated surface water from Spring Creek Debris Dam into releases or dilution flows from Shasta Dam. This review will also look at past recommendations and whether or not they have been implemented.

This is the fifth Five-Year Review at the Iron Mountain Mine site. The last one, conducted in 2008, found that cleanup continued to be protective of human health and the environment.

During this upcoming review process, EPA will study additional information about the site gathered during the period between 2008 and 23013 and conduct a site inspection and site personnel interviews. The methods, findings and conclusions from the review will be documented in the Fifth Five-Year Review Report. Upon completion, a copy of the final report will be posted on EPA's website and placed in the information repositories listed below. A notice summarizing the conclusions and recommendations will also be placed in a local paper.

EPA invites the community to learn more about this review process and provide input to the Agency. You may contact James Sickles, Remedial Project Manager, with any questions or observations regarding cleanup at the Iron Mountain Mine site: (415) 972-3265 or sickles.james@epa.gov. You can obtain more information about the site at: http://www.epa.gov/region9/ironmoutainmine

Information Repositories: The Administrative Record and other site documents and reports can be found at the Redding Library, 1100 Parkview Ave., Redding, CA 96001, (530) 245-7252 and EPA's Superfund Records Center, 95 Hawthorne St., 4th floor, San Francisco, CA 94105, (415) 820-4700.

**CNS#2440575**

# Appendix C: Interview Forms

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## INTERVIEW DOCUMENTATION FORM

The following is a list of individual interviewed for this five-year review. See the attached contact record(s) for a detailed summary of the interviews.

| Name | Title/Position | Organization | Date |
|---|---|---|---|
| N/A | Adjacent Resident | N/A | February 22, 2013 |
| Rudy Carver | Site Manager | Iron Mountain Operations | February 27 and 28, 2013 |
| McKinley Lewis | Project Manager | Department of Toxic Substances Control (DTSC) | February 25, 2013 |
| Phil Woodward | Senior Engineering Geologist | Central Valley Regional Water Quality Control Board | March 7, 2013 |
| Don Reck | Northern California Environmental Division Manager | Bureau of Reclamation, Northern California Area Office | April 25, 2013 |

| **Five-Year Review Interview Record** | | | **Interviewee:** Adjacent Resident<br>email: | | |
|---|---|---|---|---|---|
| **Site Name** | | **EPA ID No.** | | **Date of Interview** | **Interview Method** |
| Iron Mountain Mine (IMM) Superfund Site | | EPA ID# CAD980498612 | | 2/22/13 | Phone ☒<br>Fax/email ☐<br>In person ☐ |
| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** | |
| Jim Sickles | EPA Region 9 | 415-972-3265 | Sickles.James@EPA.gov | 75 Hawthorne Street, , SFD-7-2<br>San Francisco, CA 94105 | |
| Tom Wallis | CH2M HILL, EPA contractor | 530-229-3236 | Tom.Wallis@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 | |

**Purpose of the Five-Year Review**

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions performed. This interview is being conducted as a part of the fifth five-year review for the Iron Mountain Mine (IMM) Superfund Site. The period covered by this five-year review is from completion of the fourth five-year review in July 2008 to present.

**Interview Questions**

**1.** Do you have comments, suggestions, or recommendations regarding the site's operation and maintenance?

**Response:** I would like to see the reports that contain the data collected at Flat Creek Bridge.

**2.** During the fourth IMM five-year review in 2008, you described that the Flat Creek channel continues to shift and deepen due to ongoing erosion. How would you describe the current status of Flat Creek erosion and maintenance?

**Response:** I think it is pretty stable.

**3.** Do you have any concerns regarding the site or its operation and administration?

**Response:** No

**4.** During the fourth IMM five-year review in 2008, you discussed the access agreement for long term maintenance of the Flat Creek drainage area. Have related action items been addressed?

**Response:** No, the terms of a new agreement between BLM and IMM PRP were presented to us, but were unacceptable. Since then, nothing has happened.

| | |
|---|---|
| **5.** | During the fifth five-year review period, EPA removed contaminated sediment from the Spring Creek Arm of Keswick Reservoir. What effects, if any, did that project have on you or the surrounding community? |
| **Response:** | None that I am aware of. No personal effects. |
| **6.** | Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? |
| **Response:** | No. During the fires of 2008 emergency response vehicles had access. |

| **Five-Year Review Interview Record** | | | | **Interviewee:** Rudy Carver, Iron Mountain Operations<br>email: rcarver@starband.net | |
|---|---|---|---|---|---|
| **Site Name** | | **EPA ID No.** | | **Date of Interview** | **Interview Method** |
| Iron Mountain Mine (IMM) Superfund Site | | EPA ID# CAD980498612 | | February 27 and 28, 2013 | Phone ☐<br>Fax/email ☐<br>In person ☒ |
| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** | |
| Jim Sickles | EPA Region 9 | 415-972-3265 | Sickles.James@EPA.gov | 75 Hawthorne Street, , SFD-7-2<br>San Francisco, CA 94105 | |
| Tom Wallis | CH2M HILL, EPA contractor | 530-229-3236 | Tom.Wallis@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 | |
| Dave Bunte | CH2M HILL, EPA contractor | 530-229-3223 | David.Bunte@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 | |
| Josh Bale | CH2M HILL, EPA contractor | 530-229-3451 | Josh.Bale@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 | |

**Purpose of the Five-Year Review**

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions performed. This interview is being conducted as a part of the fifth five-year review for the Iron Mountain Mine (IMM) Superfund Site. The period covered by this five-year review is from completion of the fourth five-year review in July 2008 to present.

**Summary of Conversation**

EPA and CH2M HILL met with Iron Mountain Operations on February 27 and 28, 2013, to perform a site inspection and onsite interviews. The inspection and onsite interviews provided information on the performance of the remedies implemented to date and the status of operations and maintenance (O&M). Inspection and discussion items are summarized in the February 27 and 28, 2013 site visit agenda. Information gained during the inspection and onsite interviews is documented in the site inspection checklist (Appendix D), photo log (Appendix E), status of recommendations from the 2008 five-year review (Section 5), and identification of current issues at the site (Section 8).

| **Five-Year Review Interview Record** | | | | **Interviewee:** McKinley Lewis, Department of Toxic Substances Control<br>email: mckinley.lewis@dtsc.ca.gov | |
|---|---|---|---|---|---|
| **Site Name** | | **EPA ID No.** | | **Date of Interview** | **Interview Method** |
| Iron Mountain Mine (IMM) Superfund Site | | EPA ID# CAD980498612 | | 2/25/13 | Phone ☒<br>Fax/email ☐<br>In person ☐ |
| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** | |
| Jim Sickles | EPA Region 9 | 415-972-3265 | Sickles.James@EPA.gov | 75 Hawthorne Street, , SFD-7-2<br>San Francisco, CA 94105 | |
| Tom Wallis | CH2M HILL, EPA contractor | 530-229-3236 | Tom.Wallis@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 | |

**Purpose of the Five-Year Review**

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions performed. This interview is being conducted as a part of the fifth five-year review for the Iron Mountain Mine (IMM) Superfund Site. The period covered by this five-year review is from completion of the fourth five-year review in July 2008 to present.

**Interview Questions**

**1.** What is your overall impression of EPA's IMM cleanup project?

**Response:** Overall, positive.

**2.** Do you feel well informed about the site's activities and progress?

**Response:** Yes, EPA project manager has been very responsive.

**3.** EPA turned over the Confined Disposal Facility (CDF) to the State of California, Department of Toxics Substances Control on October 26, 2012, one year after closure. Do you have any comments or concerns regarding maintenance of the CDF?

**Response:** Our engineer visited the CDF in early 2012 and noted that the vegetation had not taken hold as well as anticipated.

**4.** Were you provided a copy of the CDF maintenance manual (*Final Closure and Post-closure Maintenance Plan, Spring Creek Sediment Removal Remedial Action, Iron Mountain Mine, Redding, California,* CH2M HILL, January 2012) and has it been effective?

**Response:** Yes, DTSC has received the manual, and yes, thus far, it has been effective.

**5.** Please describe the frequency and staff for CDF security inspections. Are you aware of any events, incidents, or activities at the CDF, such as vandalism, trespassing, or emergency responses from local authorities?

**Response:** Security inspections are being completed once a month by Bureau of Reclamation. No, I have not been notified of such evidence.

**6.** Please describe the frequency and staff for other inspections the CDF, such as storm and erosion control and CDF cap and vegetation systems. What are the results of inspections performed since October 2012?

**Response:** DTSC and/or contractor will be conducting these inspections. DTSC is currently under negotiations with the contractor and they should be at the CDF in the next month.

**7.** Have there been unexpected maintenance difficulties or costs at the CDF since the State took ownership in October 2012? If so, please give details.

**Response:** No.

**8.** Have there been other routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? If so, please give purpose and results.

**Response:** No.

**9.** Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

**Response:** No.

**10.** Have there been any changes in State laws and regulations that may impact protectiveness of the IMM cleanup actions implemented to date?

**Response:** No.

**11.** Do you have any other comments, suggestions, or recommendations regarding the site's management or operation?

**Response:** The level and quality of communications I have received from EPA on this matter has been very positive and I look forward to continuing to work well with the EPA.

| **Five-Year Review Interview Record** | **Interviewee:** Phil Woodward, Central Valley Regional Water Quality Control Board<br>email: pwoodward@waterboards.ca.gov |
|---|---|

| **Site Name** | **EPA ID No.** | **Date of Interview** | **Interview Method** |
|---|---|---|---|
| Iron Mountain Mine (IMM) Superfund Site | EPA ID# CAD980498612 | 3/7/2013 | Phone ☐<br>Fax/email ☒<br>In person ☐ |

| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** |
|---|---|---|---|---|
| Jim Sickles | EPA Region 9 | 415-972-3265 | Sickles.James@EPA.gov | 75 Hawthorne Street, , SFD-7-2<br>San Francisco, CA 94105 |
| Tom Wallis | CH2M HILL, EPA contractor | 530-229-3236 | Tom.Wallis@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 |

**Purpose of the Five-Year Review**

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions performed. This interview is being conducted as a part of the fifth five-year review for the Iron Mountain Mine (IMM) Superfund Site. The period covered by this five-year review is from completion of the fourth five-year review in July 2008 to present.

**Interview Questions**

**1.** What is your overall impression of EPA's IMM cleanup project?

**Response:** The remedial activities at the mine, concluding with the construction and operation of the Slickrock Creek Retention Reservoir, have significantly reduced the discharge of metals from the site into Keswick Reservoir and the Sacramento River, reducing the impacts to the beneficial uses of each water body. The success of the chosen remedies are the result of the close cooperation and expertise of all the agencies involved over the past 30+ years, including EPA, RWQCB, DTSC, BOR, and CDFG. It is imperative the communication and coordination continue into the far future.

IMM is a unique cleanup site as, under the current scenario, active treatment will need to continue for at least 1,500+ years. However, over the past few years we have lost major players and their accumulated institutional and historical knowledge of the site including Rick Sugarek (EPA), Jim Pedri (RWQCB), Dennis Heiman (RWQCB), Harry Rectenwald (CDFG), Larry Ball (BOR), Don Mandell (DTSC) etc. With the long term commitment required to maintain the site and control pollution, it is imperative that agency staff with experience on the site pass this knowledge on to the younger staff and provisions be made to assure this continues

**2.** Have there been routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? If so, please give purpose and results.

**Response:** The major impact of discharges from the site is on water quality in Keswick Reservoir and the Sacramento River. Since protection of water quality and the established beneficial uses assigned to a water body are the primary responsibility of the Regional Water Quality Control Board, we have been heavily involved in the site for many years, well before the site was listed on the NPL. Staff periodically inspects the site to assure the chosen remedies are effective and if additional efforts are required. To date, the remedies applied appear effective in reducing impacts to the beneficial uses assigned to the Sacramento River below Keswick Dam, however we believe it is time to evaluate the impacts to beneficial uses in Keswick Reservoir, including the Spring Creek Arm.

**3.** Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

**Response:** During maintenance operations at the tailrace of the Spring Creek Debris Dam (SCDD) in July 2011, the Bureau of Reclamation (BOR) discharged a significant amount of sediment into the Spring Creek Arm of Keswick Reservoir. The BOR did not notify the Regional Board such work was underway, nor did they notify the Regional Board that such a discharge had taken place. The event was brought to the attention of the Regional Board by a private citizen who observed the event over the weekend. Upon investigation, the BOR acknowledged the event stating that a lack of internal communication in the operation of the discharge gates at the SCDD was responsible for the event.

It is imperative that all interested/responsible agencies be kept abreast of activities at and near the site. Periodic (six month or annual) meetings with all involved agencies would be appropriate and/or monthly notifications via e-mail coordinated by EPA. Any activities planned by EPA, their contractors, or the BOR should be clearly communicated to all the responsible agencies to allow for a knowledgeable response in the event of contact from the general public regarding a observed or perceived concern.

**4.** Do you feel well informed about the site's activities and progress?

**Response:** Our office has received little contact with EPA staff over the past few years and have not been kept up to date on site activities and issues. This appears to be a problem with staff turnover not only with EPA but with but DTSC, and the BOR. The recommendation stated in Item 3 above regarding periodic meetings and/or monthly progress reports via e-mail will help resolve this issue.

An annual meeting would also help bring younger staff up to speed as the current, more experienced staff in each agency retires and passes the work to staff that may have less knowledge and experience. Passing on this "institutional" knowledge is imperative for each agency.

It may also be beneficial for EPA to put together a "living" document on what activities have been performed, the reasoning behind the major decisions, and the effectiveness of each activity. Such a document should be concise, but provide adequate information for the next generations of staff to utilize to gain knowledge of the site. If such a document and/or effort were to begin in the near future, the knowledge of major players in past decisions is still available and can be collected from personal interviews (i.e. Sugarick, Pedri, Heiman, Ball, Rectenwald, etc.)

**5.** During the fifth five year review period, EPA completed the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action ("Spring Creek"). Do monitoring data you've reviewed or collected indicate that the cleanup action is performing as expected in meeting Remedial Action Objectives (RAOs)? The project's RAOs include:
--Protect the Sacramento River ecosystem from releases of heavy metals originating from Spring Creek Arm by preventing the mobilization and re-deposition of contaminated sediment in important fishery spawning habitat in the Sacramento River downstream from Keswick Dam.
--Prevent adverse impacts on water quality and the beneficial uses of the Sacramento River below Keswick Dam by reducing the metal loads and suspended solids associated with contaminated metals containing sediment discharged from Spring Creek Arm to the Sacramento River.

**Response:** We are unaware of any evidence the dredging efforts significantly or directly improved water quality, however it appears the sediment removal did allow for more efficient operation of Keswick Reservoir for power production by allowing a lowering of the reservoir surface without the potential for sediment erosion and downstream transport.

**6.** Have there been any changes in State laws and regulations that may impact protectiveness of the IMM cleanup actions implemented to date?

**Response:** The current compliance standards for heavy metals (copper, zinc, cadmium) are the Central Valley Basin Plan standards and the compliance point is a point below Keswick Dam. The standards should be reevaluated in light of new standards for some metals contained within the California Toxics Rule. Further, the compliance point should be moved to the Spring Creek Arm of Keswick Reservoir to assure protection of the beneficial uses assigned to Keswick Reservoir contained within the Basin Plan.

The controls currently implemented by the BOR to coordinate releases from the SCDD, Spring Creek Power Plant, Shasta Dam, and Keswick Reservoir are required to protect water quality during high precipitation storm events and the resulting runoff from IMM. These controls are outlined in a 1980 MOU between the concerned agencies. A revised and updated MOU between the BOR, SWRCB, EPA and CDFG was circulated and signed by the SWRCB in April 2011, however we have yet to receive a copy of the revised MOU with the signatures of all parties involved.

**7.** Are you aware of any recent data, studies, or actions within Keswick Reservoir, Shasta Lake, the Sacramento River, or adjacent areas that could impact the IMM project, or that EPA should otherwise be aware of?

**Response:** Efforts by the owners of abandoned mines located on tributaries of Shasta Lake continue to reduce metals loading to Shasta Lake and thus the Sacramento River drainage. Most residual sources of AMD present after remedial activities such as portal plugging and surface water diversions are collected and treated in biological treatment systems. For example such activities have reduced copper loading to West Squaw Creek approximately 95 percent. These efforts will continue under direction of the Regional Water Board.

**8.** Do you have comments, suggestions, or recommendations regarding the site's management or operation?

**Response:** The site manager, Iron Mountain Mine Operations, has consistently kept Regional Water Board staff informed of major site activities under their responsibility.

Regional Water Board staff believes the current remedy, while effective, is resource intensive in cost, materials and maintenance. Under the current conditions, it is estimated treatment will be required for 1,500+ years. The current treatment system is over 20 years old. This is an appropriate time to reevaluate the current remedy (collection of AMD and treatment with lime neutralization), look at what other technologies may have been developed in the last 20 years, and see if other options/remedies are available which may be more cost effective or efficient.

| **Five-Year Review Interview Record** | | | | **Interviewee:** Don Reck, Bureau of Reclamation<br>email: dreck@usbr.gov | |
|---|---|---|---|---|---|
| **Site Name** | | **EPA ID No.** | | **Date of Interview** | **Interview Method** |
| Iron Mountain Mine (IMM) Superfund Site | | EPA ID# CAD980498612 | | April 25, 2013 | Phone ☐<br>Fax/email ☒<br>In person ☐ |
| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** | |
| Jim Sickles | EPA Region 9 | 415-972-3265 | Sickles.James@EPA.gov | 75 Hawthorne Street, , SFD-7-2<br>San Francisco, CA 94105 | |
| Tom Wallis | CH2M HILL, EPA contractor | 530-229-3236 | Tom.Wallis@CH2M.com | 2525 Airpark Drive<br>Redding, CA 96001 | |

**Purpose of the Five-Year Review**

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions performed. This interview is being conducted as a part of the fifth five-year review for the Iron Mountain Mine (IMM) Superfund Site. The period covered by this five-year review is from completion of the fourth five-year review in July 2008 to present.

**Interview Questions**

**1.** What is your overall impression of EPA's IMM cleanup project?

**Response:** The water quality conditions within Spring Creek Reservoir have dramatically improved over the past 5 years. Currently the overall metals concentrations are half of what they were in 2008. In addition, the pH values in Spring Creek Reservoir have risen from 3.0 in 2008, to a neutral 7.0 pH in 2013.

**2.** Do you feel well informed about the site's activities and progress?

**Response:** Yes, especially during the dredging of the contaminated sediments in the Spring Creek arm of Keswick Reservoir. Also, Rudy Carver at the water treatment plant alerts Reclamation prior to the two week maintenance period in the mid- to late-summer.

**3.** During the fifth five year review period, EPA dredged contaminated sediment from Spring Creek Arm of Keswick Reservoir that was most susceptible to erosion. This remedial action was expected to have an ancillary benefit of reducing restrictions on the operation of Spring Creek Debris Dam (SCDD), Spring Creek Power Plant (SCPP), and Keswick Reservoir operating levels. Prior to removal of sediment in Spring Creek Arm, the operating range of Keswick Reservoir was limited to 578 to 587 feet. Has Central Valley Operations been able to operate within the full design elevation range of 574 to 587 feet since completion of the Spring Creek Project, and if so, what has been the impact?

**Response:** Reclamation's Central Valley Operations Office has been operating Keswick Reservoir within the full design elevation range (574' – 587') with extremely favorable operation/scheduling results. The additional 4' of operating elevation allows for less generation off peak, more peaking on super peaks, as well as additional reserves space provides a great monetary benefit to power customers.

**4.** Limited operational controls are still required to restrict Keswick Reservoir operating levels during releases from SCPP and SCDD that could scour sediment remaining at greater depths in the Spring Creek Arm (Pile C). Hydraulic evaluations indicate that Keswick Reservoir pool elevation should be maintained above 578 feet when the combined discharge from SCPP and SCDD approaches or exceeds 6,600 ft3/sec. This release corresponds to the upper end of SCPP capacity (4,900 ft3/sec) plus the historical maximum discharge from SCDD (1,700 ft3/sec). Do you have any concerns or comments about these ongoing restrictions?

**Response:** These restrictions have had minimal impact on operations/scheduling. Normally there is a weather event when the SCPP and SCDD discharges are high.

**5.** Operating controls are still required for SCDD releases to comply with water quality objectives in the Sacramento River downstream from Keswick Dam, and for low-flow releases from SCPP to flush Spring Creek Reservoir water through Spring Creek Arm, as described in the pending MOU revision. What is the relative difficulty of operating SCDD to comply with water quality objectives since implemention of the IMM cleanup actions? Do you have any concerns or comments about these ongoing operational controls?

**Response:** In general, no. Since the water quality in Spring Creek Reservoir is greatly improved, the reservoir can be drawn down more quickly when desired and is easier to schedule around other operations.

**6.** Over the past five years, has water needed to be released from Shasta or Whiskeytown in order to compensate for IMM discharges? If so, how often and what were the circumstances?

**Response:** There have been no additional releases from Whiskeytown or Shasta Reservoirs.

**7.** Have there been any changes to the current or planned operations of SCPP, SCDD, Keswick Reservoir and Dam, Shasta Lake and Dam, or other facilities that could impact the IMM project, or that EPA should otherwise be aware of?

**Response:** None.

**8.** Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

**Response:** Only that the remediation actions have had very good results that have worked out well for Reclamation.

# Appendix D: Site Inspection Checklists

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# Site Inspection Checklist
# Iron Mountain Mine Five-Year Review
# Main Mine Site

| I. SITE INFORMATION | |
|---|---|
| **Site name:** Iron Mountain Mine (IMM) | **Date of inspections:** Five-year review inspection on February 27, 2013; inspection follow-up on February 28, 2013; 2012 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:** Mostly sunny and calm to light winds (approximately 60 degrees Fahrenheit) |

**Remedy includes**: (Check all that apply)
☑ Landfill cover/containment
☑ Access controls
☑ Institutional controls
☐ Groundwater pump and treatment
☑ Surface water collection and treatment
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls
☑ Other: See Section 4 of the IMM Fifth Five-Year Review Report for specifics of remedial actions implemented under Records of Decision (ROD) 1 through 4.

**Attachments:** ☐ Inspection team roster attached ☑ Site map attached

**II. INTERVIEWS** (Check all that apply)

1. **Operations and Management (O&M) site manager**

Rudolph Carver/Iron Mountain Operation (IMO)/Site Manager — 02/27/13, 02/28/13
Name/Title — Date

Interviewed: ☑ at site ☐ at office ☐ by phone: 530/245-4477 (see agenda attached to this appendix)
Problems, suggestions; ☑ See the IMM Fifth Five-Year Review Report, Section 6.

Rudolph Carver provided a status update on site maintenance and treatment plant audit recommendations from the IMM Fourth Five-Year Review (see Appendix I of the IMM Fifth Five-Year Review Report) and on recommendations from recent inspections (see Table 1 attached to this checklist). He also participated in the IMM Fifth Five-Year Review site inspection (see Section 6 of the IMM Fifth Five-Year Review Report).

2. **O&M staff**

John Nash (IMO)/Site Construction Manager — 530/241-4599 — 02/27/13
Name/Title — Phone number — Date

Don Odean (IMO)/Minnesota Flats Treatment Plant (MFTP) Operator — 530/245-4478 — 02/28/13
Name/Title — Phone number — Date

Interviewed: ☑ at site ☐ at office ☐ by phone
Problems, suggestions; ☑ See the IMM Fifth Five-Year Review Report, Section 6.

John Nash/IMO participated in the February 27, 2013, site inspection. Don Odean/IMO participated in the detailed MFTP inspection on February 28, 2013. Observations and recommendations from the inspections are summarized in Section 6 of the IMM Fifth Five-Year Review.

3. **Local regulatory authorities and response agencies** (e.g., 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) Fill in all that apply.
Agency: Central Valley Regional Water Quality Control Board (Water Board)
Contact: Phil Woodward, Senior Engineering Geologist
Problems, suggestions: ☑ Report attached (see Appendix C of the IMM Fifth Five-Year Review)

4. **Other interviews** (optional) ☑ Report attached (see Appendix C of the IMM Fifth Five-Year Review).

An adjacent resident was interviewed by phone in February 2013, and her comments are provided in Appendix C. Discussion items included long-term maintenance of the Flat Creek drainage area.

Phil Woodward/Central Valley Regional Water Quality Control Board provided written responses to interview questions in March 2013, as documented in Appendix C.

An interview was conducted with McKinley Lewis/California Department of Toxic Substances Control (DTSC) on February 25, 2013. This is documented in the confined disposal facility (CDF) inspection checklist as the interview was focused on DTSC's O&M of the CDF.

Don Reck/Bureau of Reclamation provided written responses to interview questions in April 2013, as documented in Appendix C. Discussion items included improved water quality in Spring Creek Reservoir and reduced operating restrictions on Keswick Reservoir elevations following removal of sediments from the Spring Creek Arm of Keswick Reservoir.

## 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:

O&M Manuals:
IMO. 2001. *Operation and Maintenance Plan, Redding, Shasta County, California*. April.
EPA. 2000. *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California (SOW)*. October. Modifications and clarifications to the SOW were recommended during the October 26, 2005, meeting between AIG Consultants, Inc. (AIG) (now Global Loss Prevention, Inc. [GLP]); EPA; IMO; and CH2M HILL. The IMM Fourth Five-Year Review Report recommends that EPA formally modify the SOW to incorporate appropriate changes. Negotiations are ongoing to formalize the changes and issue an updated SOW. The most recent meeting to discuss changes was conducted on October 26, 2012, between EPA, CH2M HILL, GLP, and IMO.

IMO. 2012. *Annual Operations Work Plan*. July.

As-built Drawings: IMO has the as-built drawings in the plant office. The as-built drawings for the most recent plant upgrade, *Safety Anchors and Lifelines,* were reviewed as an example. Older as-built drawings do not have electronic backups and may be the only copies of the drawings. It was recommended that electronic copies of all drawings be maintained.

Maintenance Logs: IMO describes maintenance in monthly reports submitted to AIG, DTSC, the Water Board, EPA, and CH2M HILL. The periodic maintenance tracking is now electronic and maintenance schedules are generated out of the maintenance computer system. The system is tied to the overall plant operating computer system. If a periodic maintenance item has not been completed (or cleared in the computer system) and the date is approaching, an alert will be generated on the plant computer system.

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: All plans related to health and safety appear to be up to date and appropriately reflect potential site hazards.

| | | |
|---|---|---|
| 3. | **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ☐ N/A<br>Remarks: OSHA training records were reviewed for one employee as an example. Plant employees receive hands-on O&M training but there is no documentation of the specific O&M training performed. It is recommended to come up with a checklist and/or sign-off sheet for major plant O&M to track O&M training. | |
| 4. | **Permits and Service Agreements**<br>☑ Air discharge permit ☑ Readily available ☑ Up to date ☐ N/A<br>☑ Effluent discharge ☑ Readily available ☐ Up to date ☐ N/A<br>☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☑ N/A<br>☑ Other permits: California Department of Water Resources, Division of Safety of Dams for SCRR and Brick Flat Pit<br>☑ Readily available ☑ Up to date<br>Remarks: IMO renews air discharge permits for the 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, RODs 2, 3, and 4 specified Clean Water Act effluent limitations and the October 2000 O&M SOW specifies technology-based performance standards for the MFTP (see SOW, Sections 8 and 14). Modifications and clarifications to the SOW are currently in negotiations. | |
| 5. | **Gas Generation Records** ☐ Readily available ☐ Up to date ☑ N/A<br>Remarks_____ | |
| 6. | **Settlement Monument Records** ☑ Readily available ☑ Up to date ☐ N/A<br>Remarks:<br>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.*<br>Boulder Creek Landslide: Settlement monuments (21 total) are surveyed by PACE Engineering, Inc. (PACE), 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*.<br>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*.<br>Lawson Mine: Survey data are obtained by PACE, and reported annually in the *Lawson Adit Survey Data.* The Mines Group, Inc., evaluates the data annually in the *Lawson Mine Annual Inspection Report*.<br>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<br>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 but are dry most of the year. Groundwater quality data are not currently collected. | |
| 8. | **Leachate Extraction Records** ☑ Readily available ☑ Up to date ☐ N/A<br>Remarks: Filtrate water quality analytical data are collected for Brick Flat Pit at the Left Abutment Concentrated Energy Dissipater (LACED) at SCRR if filtrate begins to flow again from 8R. Filtrate water quality analytical data are also collected for 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, and CH2M HILL monthly. An evaluation of MFTP effluent is provided in Appendix G of the IMM Fifth Five-Year Review Report.

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 12/01/11 to | 11/30/12 | $4,981,271 | ☑ Breakdown attached (see Table 2 attached to this checklist) |
| From 12/01/10 to | 11/30/11 | $7,197,787 | ☑ Breakdown attached (see Table 2 attached to this checklist) |
| From 12/01/09 to | 11/30/10 | $8,238,737 | ☑ Breakdown attached (see Table 2 attached to this checklist) |
| From 12/01/08 to | 11/30/09 | $5,898,941 | ☑ Breakdown attached (see Table 2 attached to this checklist) |
| From 12/01/07 to | 11/30/08 | $5,014,506 | ☑ Breakdown attached (see Table 2 attached to this checklist) |

3. **Unanticipated or Unusually High O&M Costs during Review Period**
Describe costs and reasons: The costs incurred over the IMM Fifth 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 Appendix I of the IMM Fifth Five-Year Review Report.

**C. Institutional Controls (ICs)**

1. **Implementation and enforcement**

| | | | |
|---|---|---|---|
| Site conditions imply ICs not properly implemented | ☐ Yes | ☑ No | ☐ N/A |
| Site conditions imply ICs not being fully enforced | ☐ Yes | ☑ No | ☐ N/A |

Type of monitoring (e.g., self-reporting, drive by): Drive-by inspections.
Frequency: Five days a week during the dry season, minimally daily during the wet season.
Responsible party/agency: IMO contact:

| Name | Title | Phone number |
|---|---|---|
| John Nash | Construction Manager | (530) 241-4599 |

| | | | |
|---|---|---|---|
| Reporting is up-to-date | ☑ Yes | ☐ No | ☐ N/A |
| Reports are verified by the lead agency | ☑ Yes | ☐ No | ☐ N/A |
| Specific requirements in deed or decision documents have been met | ☐ Yes | ☐ No | ☑ N/A |
| Violations have been reported | ☑ Yes | ☐ No | ☐ N/A |

Other problems or suggestions: ☑ Report attached (see Appendix I of the IMM Fifth Five-Year Review Report)

If significant trespassing or vandalism occurs, IMO notifies Jim Sickles/EPA and Dave Bunte/ CH2M HILL.

2. **Adequacy** ☑ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: An IC assessment is included as Appendix I of the IMM Fifth Five-Year Review Report. EPA selected installation of perimeter controls in ROD 1 to minimize direct contact threats. EPA 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** ☐ Location shown on site map ☑ No vandalism evident
Remarks: No known vandalism, but have had limited issues in the past 5 years with trespassing. Most significantly, there was a drug bust of a marijuana farm in 2009 hidden in one of the canyons onsite. Also, an unauthorized car followed an authorized vehicle through the gate once in the last 5 years but that incident has not been repeated since. Verbal threats were made by an associate of the property owner, who was asked to leave the site with no incident. To discourage illegal entry from trails that access the back sides of IMM, large boulders and "tank tracks" have been installed at potential entry points. Since the installation of these features, no off-road vehicle entry has been noted.

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

3. **Land use changes off site** ☑ N/A
Remarks_____

## VI. GENERAL SITE CONDITIONS

**A. Roads** ☑ Applicable ☐ N/A

1. **Roads damaged** ☑ Location shown on site map ☑ Roads adequate ☐ N/A
Remarks: Road maintenance requirements are detailed in the October 2000 SOW. Due to the relatively dry winter (with the exception of storms in November and December), with the exception of Road 28, the roads were in excellent condition during the Five-year Review inspection on February 27, 2013. During major storms in November, a large slide occurred on the Slickrock slide face that covered a portion of Road 28. Road 28 is not a critical access road, and Road 27 or the Jeep Road can be used to reach the base of SCRR. The road will be repaired in summer 2013.

**B. Other Site Conditions**

Remarks: Recommendations from the February 27, 2013, sitewide inspection and recent annual inspections are summarized in Section 6 of the IMM Fifth Five-Year Review Report.

## VII. LANDFILL COVERS ☑ Applicable ☐ N/A

**A. Landfill Surface**

1. **Settlement** (Low spots) ☐ Location shown on site map ☑ Settlement not evident
Areal extent_____ Depth_____
Remarks: No significant settlement areas were identified at Brick Flat Pit or 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. Comparison of the 2011 and 2012 surveys indicated minimal continuing vertical movement of the monitored areas.

2. **Cracks** ☐ Location shown on site map ☑ Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☑ Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. **Holes** ☐ Location shown on site map ☑ Holes not evident
Areal extent_____ Depth_____
Remarks_____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks: Not applicable.

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
Remarks: The rock cover over the Matheson disposal cell is intact and no issues were identified.

7. **Bulges** ☐ Location shown on site map ☑ Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☑ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks: Wet areas and water damage were not observed at Brick Flat Pit or the Matheson disposal cell during the February 27, 2013, 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 has been collected from Brick Flat Pit filtrate in the last 5 years. The suspected reasons are still being investigated and evaluated.

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☑ No evidence of slope instability
Areal extent_____
Remarks_____

**B. Benches** ☐ 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** ☐ 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** ☐ Location shown on site map ☑ N/A or okay
Remarks_____

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

**C. Letdown Channels** ☑ Applicable ☐ 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** ☐ Location shown on site map ☑ No evidence of settlement
Areal extent_____ Depth_____
Remarks: Letdown channels were not visually inspected by CH2M HILL during the February 27, 2013, site inspection; John Nash/IMO has not identified any issues in routine inspections.

2. **Material Degradation** ☐ Location shown on site map ☑ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☑ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map ☑ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☐ Location shown on site map ☑ No obstructions
Size_____
Remarks: IMO removes obstructions when they occur.

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

**D. Cover Penetrations** ☑ Applicable ☐ N/A

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

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

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

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☑ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☑ Needs Maintenance ☐ 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. No water was collected from Brick Flat Pit filtrate during the previous 5 water years. IMO is continuing to evaluate the causes for the loss of filtrate.

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

Brick Flat Pit: 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 most recent landfill management report plan submitted was the *2012 Landfill Management Report and Plan*.

Subsidence Areas and Clay Caps: 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 10, 2012.

Boulder Creek Landslide: 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 June 14, 2012.

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 June 28, 2012.

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 June and October 2012.

| | | | |
|---|---|---|---|
| **E. Gas Collection and Treatment** | ☐ Applicable | ☑ N/A | |
| 1. | **Gas Treatment Facilities**<br>☐ Flaring ☐ Thermal destruction ☐ Collection for reuse<br>☐ Good condition ☐ Needs Maintenance<br>Remarks_____ | | |
| 2. | **Gas Collection Wells, Manifolds and Piping**<br>☐ Good condition ☐ Needs Maintenance<br>Remarks_____ | | |
| 3. | **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)<br>☐ Good condition ☐ Needs Maintenance ☐ N/A<br>Remarks_____ | | |
| **F. Cover Drainage Layer** | ☐ Applicable | ☑ N/A | |
| 1. | **Outlet Pipes Inspected** ☐ Functioning ☐ N/A<br>Remarks_____ | | |
| 2. | **Outlet Rock Inspected** ☐ Functioning ☐ N/A<br>Remarks_____ | | |
| **G. Detention/Sedimentation Ponds** | ☑ Applicable | ☐ N/A | |
| 1. | **Siltation** Areal extent_____ Depth_____ ☐ N/A<br>☐ Siltation not evident.<br>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. All sedimentation basins were cleaned during the summer of 2012. Only limited sediment has accumulated behind a couple of the SCRR check dams that IMO constructed to reduce the amount of sediment accumulating in the main sediment basin. Limited sediment remains in the inlet structure of the Upper Spring Creek Diversion and will be removed during the summer of 2013. | | |
| 2. | **Erosion** Areal extent_____ Depth_____<br>☑ Erosion not evident<br>Remarks_____ | | |
| 3. | **Outlet Works** ☑ Functioning ☐ N/A<br>Remarks_____ | | |
| 4. | **Dam** ☑ Functioning ☐ N/A<br>Remarks_____ | | |
| **H. Retaining Walls** | ☐ Applicable | ☑ N/A | |
| 1. | **Deformations** ☐ Location shown on site map ☐ Deformation not evident<br>Horizontal displacement_____ Vertical displacement_____<br>Rotational displacement_____<br>Remarks_____ | | |
| 2. | **Degradation** ☐ Location shown on site map ☐ Degradation not evident<br>Remarks_____ | | |
| **I. Perimeter Ditches/Off-Site Discharge** | ☑ Applicable | ☐ N/A | |
| 1. | **Siltation** ☐ Location shown on site map ☑ Siltation not evident<br>Areal extent_____ Depth_____<br>Remarks: IMO performs routine monitoring and maintenance on perimeter ditches across the site in accordance with the SOW. No significant accumulation was noted in any perimeter ditches during the February 27, 2013, site inspection. | | |

| | |
|---|---|
| 2. | **Vegetative Growth** ☐ Location shown on site map ☐ N/A<br>☐ Vegetation does not impede flow<br>Areal extent_____ Type_____<br>Remarks: All vegetation was removed from site perimeter ditches during the summer of 2012. No evidence of new vegetation noted during the February 27, 2013, site inspection. |
| 3. | **Erosion** ☐ Location shown on site map ☑ Erosion not evident<br>Areal extent_____ Depth_____<br>Remarks: IMO performs routine monitoring and maintenance on perimeter ditches across the site in accordance with the SOW. No significant erosion was noted in any perimeter ditches during the February 27, 2013, site inspection. |
| 4. | **Discharge Structure** ☑ Functioning ☐ N/A<br>Remarks_____ |
| | **VIII. VERTICAL BARRIER WALLS** ☐ Applicable ☑ N/A |
| 1. | **Settlement** ☐ Location shown on site map ☐ Settlement not evident<br>Areal extent_____ Depth_____<br>Remarks_____ |
| 2. | **Performance Monitoring** Type of monitoring_____<br>☐ Performance not monitored<br>Frequency_____ ☐ Evidence of breaching<br>Head differential_____<br>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**<br>☑ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A<br>Remarks: IMO is regularly pumping Old/No. 8 pumping well PW3 now and using the Old/No. 8 gravity discharge only as an emergency backup system, in accordance with the recommendations from the IMM Fourth Five-year Review. |
| 2. | **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☑ Good condition ☐ Needs Maintenance<br>Remarks: See discussion in Section IX-A-1 (Pumps, Wellhead Pumping, and Electrical) |
| 3. | **Spare Parts and Equipment**<br>☑ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks_____ |
| | **B. Surface Water Collection Structures, Pumps, and Pipelines** ☑ Applicable ☐ N/A |
| 1. | **Collection Structures, Pumps, and Electrical**<br>☑ Good condition ☐ Needs Maintenance<br>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. Significant scaling buildup had occurred on the AMD pipeline in 2012 and required acid rinsing of the pipeline to remove the scale. Evaluation is ongoing to determine if there are methods to minimize scale formation.

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 ☐ 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: High-density sludge treatment technology
☑ Good condition ☐ Needs Maintenance
☑ Sampling ports properly marked and functional
☑ Sampling/maintenance log displayed and up to date: Now computerized
☑ Equipment properly identified
☐ Quantity of groundwater treated annually: MFTP flow rates totaled under surface water.
☑ Quantity of surface water treated annually: During the 2008 to 2012 water years, the annual treatment plant inflow ranged from 241 to 660 million gallons.

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☑ Good condition ☐ Needs Maintenance
Remarks: The lime feed vales are on logic control now and the plant computer system was updated in 2011.

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☑ Good condition ☑ Proper secondary containment ☐ Needs Maintenance
Remarks: See Table 1 attached to this checklist regarding recent tank inspection and maintenance.

4. **Discharge Structure and Appurtenances**
☐ N/A ☑ Good condition ☐ Needs Maintenance
Remarks_____

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

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

| | |
|---|---|
| **D. Monitoring Data** | |
| 1. | Monitoring Data<br>☑ Is routinely submitted on time ☑ Is of acceptable quality (an evaluation of MFTP effluent data are provided in Appendix G of the IMM Fifth Five-Year Review) |
| 2. | Monitoring data suggests:<br>☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining |
| **E. Monitored Natural Attenuation** | |
| 1. | **Monitoring Wells** (natural attenuation remedy)<br>☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition<br>☐ All required wells located ☐ Needs Maintenance ☑ N/A<br>Remarks_____ |
| **X. OTHER REMEDIES** ☑ Applicable ☐ N/A | |
| 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.<br>A site inspection of the CDF constructed under ROD 5 was also completed and documented in a separate site inspection checklist included in this appendix. | |
| **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).<br>The interim remedies for the site consist of a combination of source control, acid mine drainage collection and treatment, and water management components, including water diversions. Issues and observations identified during the February 27, 2013, site visit are detailed in Section 6.5. No issues were identified that would be expected to affect the protectiveness 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.<br>Issues and observations related to implementation and scope of the O&M procedures were identified during the February 27, 2013, site visit and are detailed in Section 6.5. In general, the treatment plant and the site are properly operated and maintained. |
| **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.<br>No issues or observations were identified during the February 27, 2013, 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.<br>No significant opportunities for optimization were identified during the February 27, 2013, site visit. |

# Site Inspection Checklist
# Iron Mountain Mine Five-Year Review
# Confined Disposal Facility

| I. SITE INFORMATION | |
|---|---|
| **Site name:** Iron Mountain Mine (IMM) | **Date of inspections:** Five-year review inspections on February 19 and 27, 2013, and 2012 scheduled annual, semi-annual, and quarterly 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:**<br>February 19: Overcast and light showers<br>February 27: Mostly sunny and calm winds (approximately 60 degrees Fahrenheit) |

**Remedy includes**: (Check all that apply)

☑ Landfill cover/containment
☑ Access controls
☐ Institutional controls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls
☑ Other: See Section 4 of the IMM Fifth Five-Year Review Report for specifics of remedial actions implemented under Record of Decision (ROD) 5.

**Attachments:** ☐ Inspection team roster attached ☑ Site map attached

**II. INTERVIEWS** (Check all that apply)

**1. O&M site manager**

McKinley Lewis/Department of Toxic Substances Control (DTSC), Project Manager — 02/25/2013
Name/Title — Date

Interviewed: ☐ at site ☐ at office ☑ by phone: 916/255-3625
Problems, suggestions: ☑ Report attached: Appendix C

Mr. Lewis provided a status update on confined disposal facility (CDF) operations and maintenance since the October 2012 handoff from EPA. A DTSC engineer was onsite to evaluate the conditions of the CDF in January 2013. At the time of the interview, DTSC was in the process of procuring a contractor to perform maintenance activities. Mr. Lewis stated that the level and quality of communications received from EPA have been very positive. Additionally, Mr. Lewis reported that Bureau of Reclamation (Reclamation) has been performing monthly security inspections of the CDF. See Appendix C of the IMM Fifth Five-Year Review Report for detailed interview responses.

2. **O&M staff**

Name/Title — Phone number — Date

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

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) ☑
Reclamation is a stakeholder in the IMM project and was involved in the ROD 5 decision processes and remedial action. Don Reck/Bureau of Reclamation provided written responses to interview questions in April 2013, as documented in Appendix C of the IMM Fifth Five-Year Review Report. Discussion items included improved water quality in Spring Creek Reservoir and reduced operating restrictions on Keswick Reservoir elevations following removal of sediments from the Spring Creek Arm.

## 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:

O&M Manuals:
CH2M HILL. 2012. *2012 Spring Creek Confined Disposal Facility Operation and Maintenance Report, Iron Mountain Mine Superfund Site, Redding, California*. October.
CH2M HILL. 2012. *Closure and Post-closure Maintenance Plan, Spring Creek Sediment Removal Remedial Action, Iron Mountain Mine, Redding, California*. January.

As-built Drawings:
CH2M HILL. 2012. *After Action Report, Spring Creek Arm of Keswick Reservoir, Sediment Removal Remedial Action, Phase 3, Iron Mountain Mine Superfund Site, Redding, California*. March.
CH2M HILL. 2012. *2012 Spring Creek Confined Disposal Facility Operation and Maintenance Report, Iron Mountain Mine Superfund Site, Redding, California*. October.

Maintenance Logs: CDF operations and maintenance checklist templates are provided in the *Closure and Post-closure Maintenance Plan,* and completed checklists are provided in the *2012 Spring Creek Confined Disposal Facility Operation and Maintenance Report.*

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: DTSC will be responsible for developing site health and safety plans and contingency/ emergency response plans.

3. **O&M and OSHA Training Records** ☑ Readily available ☑ Up to date ☐ N/A
Remarks: OSHA training records were reviewed for one CH2M HILL employee as an example of training for the October 2011 to October 2012 maintenance period. The employee also received hands-on O&M training. As discussed above, DTSC was in the process of procuring a maintenance contractor at the time of the interview and site inspection; therefore, training records were not available for current O&M staff.

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: | ☐ Readily available | ☐ Up to date | ☑ N/A |

Remarks: CDF effluent compliance standards are specified in the *Closure and Post-closure Maintenance Plan*. Onsite CERCLA actions do not require a permit.

| | |
|---|---|
| 5. | **Gas Generation Records** ☐ Readily available ☐ Up to date ☑ N/A<br>Remarks_____ |
| 6. | **Settlement Monument Records** ☑ Readily available ☐ Up to date ☐ N/A<br>Remarks: Five primary settlement monitors were installed in the primary cell and one was installed in the secondary cell. |
| 7. | **Groundwater Monitoring Records** ☑ Readily available ☐ Up to date ☐ N/A<br>Remarks: A groundwater underdrain system was constructed under the CDF to keep dewatered sediment a minimum of 5 feet above the highest anticipated elevation of underlying groundwater. Groundwater is monitored east of the CDF effluent pipe. Data were regularly collected during the Spring Creek dredging and closure operations. No indications of elevated metals concentrations were reported. The *Closure and Post-closure Maintenance Plan* allows for discontinuing monitoring of groundwater after 1 year if elevated metals concentrations are not detected. Continuation of monitoring is, therefore, not required and at the discretion of DTSC. |
| 8. | **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☑ N/A<br>Remarks_____ |
| 9. | **Discharge Compliance Records**<br>☐ Air ☐ Readily available ☐ Up to date ☑ N/A<br>☑ Water (effluent) ☑ Readily available ☐ Up to date ☐ N/A<br>Remarks: Metals concentrations in CDF effluent samples were well below the compliance standards during dredging and dewatering activities, as documented in the *Final Remedial Action Report, Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action* (EPA, June 2012) The flow rate from the CDF decreased to approximately 1.3 gallons per minute by July 2012. Because of the consistently low metal concentrations and the low flow rate, effluent sampling was discontinued. DTSC, at its discretion, may continue monitoring the effluent sampling location. At the time of this inspection, the groundwater underdrain flow was approximately 1 liter per minute and the CDF effluent flow was approximately 2 liter per minute. |
| 10. | **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☑ N/A<br>Remarks: With the exceptions of inspections and repairs, access is restricted by locked gates. Reclamation security officers patrol the property during normal security sweeps of Reclamation facilities. |
| | **IV. O&M COSTS** |
| 1. | **O&M Organization**<br>☑ State in-house ☐ Contractor for State<br>☐ PRP in-house ☐ Contractor for PRP<br>☐ Federal Facility in-house ☐ Contractor for Federal Facility<br>☐ Other |
| 2. | **O&M Cost Records**<br>☐ Readily available ☐ Up to date<br>☐ Funding mechanism/agreement in place ☐ Breakdown attached<br>Remarks: DTSC just took over management of the CDF in October 2012 and had not completed the first wet season annual inspection at the time of the site inspection. O&M costs are unavailable, if they have been developed. |
| 3. | **Unanticipated or Unusually High O&M Costs during Review Period:** N/A |
| | **V. ACCESS AND INSTITUTIONAL CONTROLS** ☑ Applicable ☐ N/A |
| **A. Fencing** | |
| 1. | **Fencing damaged** ☐ Location shown on site map ☑ Gates secured ☐ N/A<br>Remarks:_____ |

**B. Other Access Restrictions**

1. **Signs and other security measures** ☑ Location shown on site map ☐ N/A
Remarks: All access to roads to the CDF are locked and controlled by Reclamation access gates. Signs are posted indicated access is limited to authorized personnel only.

**C. Institutional Controls (ICs)**

1. **Implementation and enforcement**

| | | | |
|---|---|---|---|
| Site conditions imply ICs not properly implemented | ☐ Yes | ☐ No | ☑ N/A |
| Site conditions imply ICs not being fully enforced | ☐ Yes | ☐ No | ☑ N/A |

Type of monitoring (e.g., self-reporting, drive by): Drive-by inspections.
Frequency ____Monthly _____
Responsible party/agency: DTSC is the responsible agency; Reclamation performs the security inspections.

| McKinley Lewis | Site Manager | 02/25/13 | (916) 255-3625 |
|---|---|---|---|
| Name | Title | Date | Phone number |

| | | | |
|---|---|---|---|
| Reporting is up-to-date | ☐ Yes | ☐ No | ☑ N/A |
| Reports are verified by the lead agency | ☐ Yes | ☐ No | ☑ N/A |
| Specific requirements in deed or decision documents have been met | ☐ Yes | ☐ No | ☑ N/A |
| Violations have been reported | ☐ Yes | ☐ No | ☑ N/A |

Other problems or suggestions:

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☑ N/A
Remarks_____

**D. General**

1. **Vandalism/trespassing** ☐ Location shown on site map ☑ No vandalism evident
Remarks_____

2. **Land use changes on site** ☐ Yes ☑ No ☐ N/A
Remarks_____

3. **Land use changes off site** ☐ Yes ☑ No ☐ N/A
Remarks: The CDF is contained behind the Spring Creek Debris Dam (SCDD) and within the SCDD reservoir area. Access to the dam (which is required to access the CDF) is controlled by Reclamation security. Future land uses adjacent to the CDF are not expected to change, as discussed in Appendix I of the IMM Fifth Five-Year Review Report.

## VI. GENERAL SITE CONDITIONS

**A. Roads** ☑ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☑ Roads adequate ☐ N/A
Remarks: Minor erosional rills have begun to form on the shoulders of the road to the CDF alongside the paved portion before entering the gate to the CDF. There appears to be no undercutting of the paved road subgrade but conditions should continue to be monitored at least annually.

**B. Other Site Conditions**

Remarks: Very limited sluffing/sliding of hillside soil onto access roadway was observed, which likely occurred during large December 2012 storms. The location is near the former CDF effluent discharge point into the SCDD reservoir. The access road should be inspected annually to determine if further hill slope instability continues that could compromise access to the CDF.

| **VII. LANDFILL COVERS** ☑ Applicable ☐ N/A | |
|---|---|
| **A. Landfill Surface** | |
| 1. | **Settlement** (Low spots) ☑ Settlement evident ☐ Settlement not evident<br>Areal extent: There are multiple areas of differential settlement across the primary cell. The areal extent of the settlement areas vary.<br>Depth: Up to approximately 1 foot of settlement<br>Remarks: Several settlement areas were identified in the primary cell cover surface (see photo log in Appendix E of the IMM Fifth Five-Year Review Report). At this time, settlement does not appear significant enough to pond excessive water. DTSC will perform an annual inspection at the end of the wet season to evaluate repairs necessary due to settlement. |
| 2. | **Cracks** ☑ Cracking evident ☐ Cracking not evident<br>Lengths: 10 to 25 feet Widths: Approximately 3 to 4 inches Depths: Less than 6 inches<br>Remarks: Minor cracking is beginning on the surface in the southwest end of the primary cell (see photo log in Appendix E of the IMM Fifth Five-Year Review Report). Cracks should be monitored annually to make sure separation of capping materials is not occurring due to differential settlement or sliding. |
| 3. | **Erosion** ☑ Erosion evident ☐ Erosion not evident<br>Areal extent: Approximately 10 feet by 4 feet Depth: Approximately 1 foot<br>Remarks: The only significant erosional rill noted was just south of the east-west riprap channel installed in August 2012 along the transition between the primary and secondary cells (see photo log in Appendix E of the IMM Fifth Five-Year Review Report). The rill is near the east end of the channel. |
| 4. | **Holes** ☐ Location shown on site map ☑ Holes not evident<br>Areal extent_____ Depth_____<br>Remarks_____ |
| 5. | **Vegetative Cover** ☑ Grass ☑ Cover properly established ☐ No signs of stress<br>☐ Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: With the exception of areas repaired during the August 2012 O&M effort, the grass cover is well established. In the recently repaired areas, grass is just starting to sprout and will likely completely fill in over the course of the spring. |
| 6. | **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A<br>Remarks: |
| 7. | **Bulges** ☐ Location shown on site map ☑ Bulges not evident<br>Areal extent_____ Height_____<br>Remarks_____ |
| 8. | **Wet Areas/Water Damage** ☑ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent_____<br>☐ Ponding ☐ Location shown on site map Areal extent_____<br>☐ Seeps ☐ Location shown on site map Areal extent_____<br>☐ Soft subgrade ☐ Location shown on site map Areal extent_____<br>Remarks: Limited rainfall has occurred since December 2012, and primary cell settlement low spots may retain ponded water but no significant ponding was noted during the five-year inspection. |
| 9. | **Slope Instability** ☐ Slides ☐ Location shown on site map ☑ No evidence of slope instability<br>Areal extent_____<br>Remarks_____ |

**B. Benches** ☐ 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** ☐ Location shown on site map ☑ N/A or okay
Remarks_____

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

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

**C. Letdown Channels** ☑ Applicable ☐ N/A
(Channels lined with riprap, grout bags, or gabions that descend the perimeter of the cover and will allow the runoff water collected move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☑ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐ Location shown on site map ☑ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☑ No evidence of erosion
Material type_____ Areal extent_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map ☑ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☑ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
☑ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____

**D. Cover Penetrations** ☑ Applicable ☐ N/A

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

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

| | |
|---|---|
| 3. | **Monitoring Wells** (within surface area of landfill)<br>☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition<br>☐ Evidence of leakage at penetration ☐ Needs Maintenance ☑ N/A<br>Remarks_____ |
| 4. | **Leachate Extraction Wells**<br>☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition<br>☐ Evidence of leakage at penetration ☐ Needs Maintenance ☑ N/A<br>Remarks_____ |
| 5. | **Settlement Monuments** ☐ Located ☑ Routinely surveyed ☐ N/A<br>Remarks: The *Closure and Post-closure Maintenance Plan* requires that the settlement monuments be monitored every 5 years. The most recent survey was August 2012, as documented in the *Spring Creek Confined Disposal Facility Operation and Maintenance Report*. |
| **E. Gas Collection and Treatment** | ☐ Applicable ☑ N/A |
| 1. | **Gas Treatment Facilities**<br>☐ Flaring ☐ Thermal destruction ☐ Collection for reuse<br>☐ Good condition ☐ Needs Maintenance<br>Remarks_____ |
| 2. | **Gas Collection Wells, Manifolds and Piping**<br>☐ Good condition ☐ Needs Maintenance<br>Remarks_____ |
| 3. | **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)<br>☐ Good condition ☐ Needs Maintenance ☐ N/A<br>Remarks_____ |
| **F. Cover Drainage Layer** | ☑ Applicable ☐ N/A |
| 1. | **Outlet Pipes Inspected** ☑ Functioning ☐ N/A<br>Remarks_____ |
| 2. | **Outlet Rock Inspected** ☑ Functioning ☐ N/A<br>Remarks_____ |
| **G. Detention/Sedimentation Ponds** | ☐ Applicable ☑ N/A |
| 1. | **Siltation** Areal extent_____ Depth_____ ☐ N/A<br>☐ Siltation not evident.<br>Remarks_____ |
| 2. | **Erosion** Areal extent_____ Depth_____<br>☐ Erosion not evident<br>Remarks_____ |
| 3. | **Outlet Works** ☐ Functioning ☐ N/A<br>Remarks_____ |
| 4. | **Dam** ☐ Functioning ☐ N/A<br>Remarks_____ |

**H. Retaining Walls** ☐ Applicable ☑ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
Horizontal displacement_____ Vertical displacement_____
Rotational displacement_____
Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
Remarks_____

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

1. **Siltation** ☑ Siltation evident ☐ Siltation not evident
Areal extent: Limited Depth: Minimal
Remarks: Minor siltation noted at the northeast secondary CDF discharge point for surface drainage (see photo log in Appendix E of the IMM Fifth Five-Year Review Report).

2. **Vegetative Growth** ☐ Location shown on site map ☑ N/A
☐ Vegetation does not impede flow
Areal extent_____ Type_____
Remarks_____

3. **Erosion** ☑ Erosion evident ☐ Erosion not evident
Areal extent: Approximately 10 feet in length Depth: Approximately 2 feet into sidewall
Remarks: West cut slope at northwest drop channel, which drains the west side of the access road, has erosion forming around the top of the channel (see photo log in Appendix E of the IMM Fifth Five-Year Review Report).

4. **Discharge Structure** ☐ Functioning ☑ N/A
Remarks_____

**VIII. VERTICAL BARRIER WALLS** ☐ Applicable ☑ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent_____ Depth_____
Remarks_____

2. **Performance Monitoring** Type of monitoring_____
☐ Performance not monitored
Frequency_____ ☐ 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_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☑ Good condition ☐ Needs Maintenance ☐ N/A
Remarks: The only system is the CDF groundwater underdrain system, with a pipe discharge located east of the CDF effluent pipeline.

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided ☑ N/A
Remarks_____

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

1. **Collection Structures, Pumps, and Electrical**
☑ Good condition ☐ Needs Maintenance
Remarks_____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☑ Good condition ☐ Needs Maintenance
Remarks_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided ☑ N/A
Remarks_____

**C. Treatment System** ☐ Applicable ☑ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☐ Carbon adsorbers
☐ Filters:
☐ Additive (*e.g.*, chelation agent, flocculent):
☐ Others_____
☐ Good condition ☐ Needs Maintenance
☐ Sampling ports properly marked and functional
☐ Sampling/maintenance log displayed and up to date
☐ Equipment properly identified
☐ Quantity of groundwater treated annually
☐ Quantity of surface water treated annually

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks_____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks_____

4. **Discharge Structure and Appurtenances**
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks_____

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

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

| | |
|---|---|
| **D. Monitoring Data** | |
| 1. | Monitoring Data<br>☐ Is routinely submitted on time ☑ Is of acceptable quality (see Attachment 3)<br>Remarks: Groundwater underdrain monitoring data have not shown elevated concentrations of metals during operation, closure, or post-closure. The *Closure and Post-closure Maintenance Plan* allows for discontinuing monitoring of groundwater after 1 year if elevated metals concentrations are not detected. Continuation of monitoring is, therefore, not required and at the discretion of DTSC. |
| 2. | Monitoring data suggests:<br>☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining ☑ N/A |
| **E. Monitored Natural Attenuation** | |
| 1. | **Monitoring Wells** (natural attenuation remedy)<br>☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition<br>☐ All required wells located ☐ Needs Maintenance ☑ N/A<br>Remarks_____ |
| **X. OTHER REMEDIES** ☑ Applicable ☐ N/A | |
| | A site inspection summary of the main mine area, including the RODs 1 through 4 interim remedial action components, was also completed and is documented in a separate site inspection checklist included in this appendix. |
| **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).<br>No issues or observations were identified during the February 2013 CDF site inspections that would be expected to affect the effectiveness of remedy implemented under ROD 5. There are minor O&M issues, which if not eventually addressed and continue to worsen over time, may lead to exposing the top liner cover in the primary cell. |
| **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.<br>The CDF was just handed over to the State of California in October 2012, and at the time of the interview, the State had not had sufficient time to procure a contractor. There were no significant issues that required immediate attention, and DTSC was in the process of finalizing a contract to allow O&M oversight and repairs to be performed in the future. At this time, following two wet seasons since closure of the CDF, long-term O&M protectiveness of remedy appears to be effective as long as O&M continues to adhere to the *Closure and Post-closure Maintenance Plan*. |
| **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.<br>No issues or observations were identified during the February 2013 CDF site inspections indicating that the protectiveness of the ROD 5 interim remedy may be compromised. |
| **D.** | **Opportunities for Optimization** |
| | Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.<br>No significant opportunities for optimization were identified during the February 2013 site inspections. |

# Tables

**TABLE 1**
Summary of Iron Mountain Mine Recent Site Inspections
*Appendix D – Site Inspection Checklists*

| 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 |
|---|---|---|---|---|---|---|
| 2012 Richmond Mine Annual Inspection | 06/18/12 | 06/18/12 | The Mines Group, Inc., 2012 | Robert Spengler, Matt Dusenbury, and Kenneth Myers – The Mines Group, Inc.<br>Dave Bunte and Eric Halpenny – CH2M HILL<br>Rudy Carver – IMO<br>James Sickles – EPA<br>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). | Chutes and plugs continue to deteriorate slowly.<br>Shotcrete is deteriorating in various areas and has fallen off shaft walls in the A drift. The haulage drifts are in the worst condition.<br>New gravel fill placed around C drift timber muck dam.<br>All timer muck and AMD dams were in proper positions and generally good condition. The B drift stainless steel dam near Chute 8C was repoured and fitted with a slot for slide gate to minimize seepage.<br>Many of the drain pipes continue to have constricted flow as a result of scaling. Inadequate draining could lead to potential failure in the plug areas.<br>The extensiometer and MPBX measurements do not show any significant cause for concern at this time. In general, there appears to be some limited convergence at the 5-way intersection and Mattie area based on the extensiometer measurements. |
| 2012 Lawson Mine Annual Inspection | 06/18/12 | 06/18/12 | The Mines Group, Inc., 2012 | Robert Spengler, Matt Dusenbury, and Kenneth Myers – The Mines Group, Inc.<br>Dave Bunte and Eric Halpenny – CH2M HILL<br>Rudy Carver – IMO<br>James Sickles – EPA<br>PACE – Surveys | Annual visual inspection of the Lawson adit and associated components (portal, mine support, pipelines, water check dams).<br>The most recent survey was performed on June 28, 2012. | The reinforced concrete AMD pipeline shows no signs of displacement or deterioration other than minor surface blemishes.<br>Timber caps at 5+20 and 4+75 are in need of replacement.<br>Steel sets appear to be acceptably stable since they were straightened from the portal to 0+65.<br>Survey of steel sets indicated gradual outward (easterly) movement. |
| Upper Spring Creek Clean Water Diversion, Including Impact Structure Inspection | 08/02/12 | 08/02/12 | PACE, 2012<br>CH2M HILL, 2012 | John Brunemeier – PACE<br>Rod Jackson – CH2M HILL | 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. Approximately 50 percent of the pipeline sections were missing aggregate from the surface of the concrete, where the concrete was exposed by missing or damaged lining. The erosion depth was approximately ½-inch at the bottom of the pipeline. Where deeper gouging had occurred over the years, repairs were performed using Rezi-Weld, Emaco S88, or Emery Top. Emery Top appears to perform the best of the three. At the time of inspection, PACE reported that the extent of erosion did not appear to be a structural concern. The pipeline should be inspected, monitored, and repaired on an annual basis. The impact structure had 13 cracked welds, which IMO reported were repaired in September 2012. |
| Thickener TK-11 Coating Inspection | 07/31/12 | 07/31/12 | PACE, 2012<br>Corrpro, 2012<br>CH2M HILL, 2012 | John Brunemeier – PACE<br>Rod Jackson and Dave Bunte – CH2M HILL<br>James Sickles – EPA<br>Rudy Carver – IMO<br>Dave Sadoff – GLP<br>Corrpro – Cathodic Protection Survey | A limited inspection was conducted because of other site work occurring during the time of inspection that would not allow for complete emptying of the thickener tank. The tank exterior, effluent launder, and cathodic protection rectifier were inspected. Because of entanglement of the cathodic protection anode system with the rake arm, portions of that system were replaced in April 2012.<br>Cathodic Protection Survey was performed on November 20, 2012. | The overall exterior tank coating is in fair condition. The few small areas where the coating has been damaged were repaired. The repairs are noticeable and they did not use original materials, but the repairs appear to be performing acceptably.<br>The effluent launder was completely emptied and the interior coating is in good condition. Three spots were located where the coating was damaged and the steel was exposed. Locations were marked for repairs.<br>The cathodic protection rectifier panel showed zero current output and a potential that appeared to be outside the optimal range.<br>Corrpro tested the cathodic protection system and concluded that the system appears to be operating properly. CH2M HILL reviewed the survey report and provided comments in December 2012 regarding the cathodic protection system operations, adjustments, and optimization. The primary issue identified by CH2M HILL was interpretation of the “tank-to-water potential” measurements relative to the criteria for protection in the reference standard. |

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|---|---|---|---|---|---|---|
| Slickrock Creek Clean Water Diversion, Including Impact Structure and Spillway Inspection | 08/01/12 | 08/01/12 | PACE, 2012<br>CH2M HILL, 2012 | John Brunemeier – PACE<br>Rod Jackson – CH2M HILL | 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. | Pipeline joint filler is deteriorating with use and some surface cracking and exposed reinforced steel is appearing. Overall the condition of the pipeline is good but the eroded joint filler should be refilled with Emaco S88. Twenty-six sections have exposed steel reinforcement. In all occasions, it appears that the steel was very shallowly impeded in those locations. Five sections had longitudinal cracking but have not appeared to expand significantly since originally observed in 2010. The eroded concrete and exposed reinforced steel should be monitored on an annual basis. |
| Sludge Conditioning Tank TK-13 Cleaning and Inspection | 08/27/12 | 08/30/12 | IMO, 2008 | Rudy Carver and Don Odean – IMO | Quality assurance inspection of Tank TK-13. | Tank had no indications of spot corrosion that required repairs. Mixer MX-13 was replaced. |
| Minnesota Flats Treatment Plant (MFTP) Effluent Discharge Compliance Review | 2008 | 2012 | Bunte, 2012<br>Sadoff, 2012<br>CH2M HILL, 2010 | Jim Stefanoff and Dave Bunte – CH2M HILL<br>James Sickles – EPA<br>Dave Sadoff – Chartis<br>Tom Higgs – AMEC<br>Rudy Carver and Don Odean – IMO | A series of meetings and conference calls have been conducted between EPA, Global Loss Prevention, Inc., and IMO to discuss modifications to the October 2000 *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW). In the November 17, 2010, technical memorandum prepared for EPA, CH2M HILL evaluated MFTP effluent metals concentrations and provided recommendations for opportunities to optimize dissolved metals removal. | The SOW is being modified, including revisions to the technology-based performance standards based on the metals removal level currently achieved at the MFTP. Following the 2010 evaluation, IMO made an operational change to monitor the pH in the Reactor Tank 2 and control lime addition to the sludge recycle tank to keep the pH in Reactor Tank 2 above 8.4. |
| Slickrock Creek Retention Reservoir (SCRR), Semi-Annual Geotechnical Data Evaluation | 07/05/12 | 07/05/12 | GEI, 2012 | Dan Wanket – GEI Project Manager<br>Alberto Pujol – GEI Dam Engineer<br>Mark Twede – CH2M HILL<br>PACE – Surveys<br>Geometron – Inclinometer | Evaluation of specific geotechnical data for SCRR for December 2011 through June 2012. | No major issues were identified from the data evaluation. Piezometers VW PZ-2A and PZ-3A showed slight rises in water level and should continue to be monitored closely to determine if a rising trend is occurring. Continue monitoring the seepage weir pH and the pH data rise. |
| 2012 Boulder Creek Landslide Annual Inspection | 06/14/12 | 06/14/12 | The Mines Group, Inc., 2012 | Kenneth Myers – The Mines Group, Inc.<br>PACE. – Surveys | Settlement monuments (21 total) were surveyed to determine surface movements within the slope failure complex. Report evaluates data through June 14, 2012. | Minimal movement of the Boulder Creek landslide occurred over the 2008-2012 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 control of water would help control future displacement. There may be some component of basal shear but this would require the use of downhole monitoring systems to verify. |
| Subsidence Areas and Clay Caps Survey | 10/10/12 | 10/10/12 | IMO, 2012 | PACE. – Surveys | Annual survey of subsidence areas. | Comparison of the 2011 and 2012 surveys indicated minimal continuing vertical movement of the monitored areas. For the period between October 26, 2011, and October 11, 2012, the vertical changes ranged from +0.08 to -0.04 foot. The total movement since survey markers were set on June 26, 1995, shows vertical change ranging from +0.03 foot to -1.91 feet. |
| Slickrock Creek Dam, 2011 Annual Dam Safety Inspection | 12/20/11 | 12/20/11 | GEI, 2012 | Dan Wanket – GEI Project Manager<br>Alberto Pujol – GEI Dam Engineer<br>PACE – Surveys | Reviewed geotechnical data collected by IMO from the previous year (through December 2011).<br>Annual dam inspection on December 20, 2011, 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. No significant safety deficiencies requiring immediate action by IMO were identified. The 2009 storm repairs continue to perform well. The right abutment slide does not appear to have undergone significant movement since it was stabilized during construction. No significant additional cracks or spalling were observed in the shotcrete on the excavated benches on the right abutment slope, and the cracks and spalls that were sealed and patched last year to reduce infiltration have held up well. |

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*Appendix D – Site Inspection Checklists*

| 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 |
|---|---|---|---|---|---|---|
| IMO Monthly Progress Reports | Monthly | N/A | IMO, 2013 | IMO | 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 include the following:<br>Significant scaling buildup had occurred on the AMD pipeline in 2012 and required acid rinsing of the pipeline to remove the scale.<br>Additional rip rap placed on Boulder Creek landslide slope and stream bed to minimize potential for failure after storm-related slope damages occurred.<br>Reactor Tank TK-1 and TK-2 were separately removed from service and cleaned. The sludge recycle chutes for both were replaced.<br>Sludge from Drying Bed #1 was hauled to Brick Flat Pit.<br>One of the two plant air compressor heads failed and required replacement. |
| CDF Semi-Annual Inspection | 09/13/12 | 09/13/12 | CH2M HILL, 2012 | Travis Howard and Scott Washington – CH2M HILL | Final Semi-Annual Inspection prior to handing over operation and maintenance of the CDF to DTSC. This inspection was conducted after the completion of final O&M activities performed by EPA in August 2012.<br>Final as-built survey conducted in August 2012. | No significant issues. Due to time of year, all vegetation was dormant. Newly repaired areas did not have any established vegetation but were well hydroseeded. Vegetation was present at discharge of groundwater pipeline. |
| IMO SCRR Monthly Reports | Monthly | N/A | IMO, 2013 | IMO | 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 include the following:<br>Erosion rills on SCRR dam face were repaired<br>Erosion rill at the top of the hematite disposal area were repaired<br>The main sedimentation basin and the LACED were cleaned of sediment and surveyed.<br>SCRR Diversion pipeline repairs conducted at various joints.<br>SCRR Dam was discharging at the maximum rate of 3,200 gpm in December 2012 and exceeded the 40 acre-foot volume starting on December 3, 2012. By the end of the month the volume was restored to normal levels. |
| IMM Fifth Five-Year Review Site Inspection | 02/27/13 | 02/28/13 | Inspection issues and observations are documented in the Fifth Five-Year Review Report, Section 6. | Tom Wallis, Dave Bunte, and Josh Bale – CH2M HILL<br>James Sickles – EPA<br>Rudy Carver and John Nash – IMO<br>Dave Sadoff and Henry Gold – Global Loss Prevention, Inc. | Inspection included onsite documents and records; CDF; AMD pipelines; the Upper Spring Creek diversion; MFTP 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 and Slickrock Creek diversion; Matheson Disposal Cell; and site roads, slopes, and tanks. | Inspection issues and observations are documented in the IMM Fifth Five-Year Review Report, Section 6. |

[a]Full references for each document are provided in Appendix A of the IMM Fifth Five-Year Review Report.

**TABLE 2**
IMO O&M Costs
*Appendix D – Site Inspection Checklists*

| Line | Costcode | Description | GLP 2008 ($) | GLP 2009 ($) | GLP 2010 ($) | GLP 2011 ($) | GLP 2012 ($) |
|---|---|---|---|---|---|---|---|
| 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 | | | | | |
| 4 | 06-06-00 | Site Health and Safety Plans | 5,324 | 61,655 | 12,015 | 3,435 | 337 |
| 5 | 06-08-00 | Quality Assurance Project Plan | | | | | |
| 6 | 07-00-00 | Site Staff Including Payroll and Benefits | 1,284,665 | 1,350,556 | 1,426,653 | 1,388,058 | 1,414,078 |
| 7 | 09-00-00 | Treatment Plant – Routine | 285,342 | 344,437 | 257,552 | 291,927 | 242,930 |
| 8 | 09-00-01 | Insurance (e.g., property, liability, auto) | 233,628 | 270,129 | 182,093 | 266,254 | 266,456 |
| 9 | 09-01-00 | Lime | 785,928 | 1,515,454 | 2,503,154 | 1,865,816 | 1,130,178 |
| 10 | 09-02-00 | Electricity | 410,503 | 462,756 | 511,743 | 468,537 | 432,938 |
| 11 | 09-03-00 | Sludge Haul | 746,070 | 648,935 | 1,555,321 | 1,058,258 | 290,250 |
| 12 | 09-03-03 | Treatment Plant – Nonroutine | 162,270 | 148,397 | 171,633 | 524,065 | 266,228 |
| 13 | 09-04-02 | Ancillary Facilities – Routine | 18,238 | 17,037 | 29,617 | 28,555 | 15,832 |
| 14 | 09-04-03 | Ancillary Facilities – Nonroutine | 11,030 | 381,807 | 103,932 | 435,175 | 35,326 |
| 15 | 09-05-03 | Roads – Routine | 56,949 | 95,042 | 136,155 | 101,565 | 86,268 |
| 16 | 09-05-04 | Roads – Nonroutine | 118,699 | 101,687 | 18,029 | 226,689 | 37,121 |
| 17 | 09-05-10 | Electrical Support (e.g., power poles) | 16,242 | | | 1,359 | 7,553 |
| 18 | 09-06-02 | AMD Conveyance Systems – Routine | 104,288 | 14,542 | 5,818 | 8,487 | 161,678 |
| 19 | 09-06-03 | AMD Conveyance Systems – Nonroutine | 17,919 | 20,368 | 1,024 | 14,930 | 220,746 |
| 20 | 09-07-02 | Brick Flat Pit – Routine | 35,685 | 17,646 | 53,542 | 54,953 | 15,205 |
| 21 | 09-07-03 | Brick Flat Pit – Nonroutine | | 1,634 | 818 | 60,168 | 1,847 |
| 22 | 09-08-02 | Subsidence Areas – Routine | 4,089 | 8,334 | 1,201 | 7,582 | 4,204 |
| 23 | 09-08-03 | Subsidence Areas – Nonroutine | | | 3,823 | | |
| 24 | 09-09-21 | Richmond Adit – Routine | 39,910 | 7,391 | 65,383 | 35,092 | 38,612 |
| 25 | 09-09-22 | Richmond Adit – Nonroutine | 17,501 | 7,225 | 101,041 | 632 | 1,400 |
| 26 | 09-09-23 | Lawson Adit – Routine | 9,882 | 3,710 | 25,242 | 17,946 | 16,465 |
| 27 | 09-09-24 | Lawson Adit – Nonroutine | 13,094 | | 2,350 | 1,593 | 2,420 |
| 28 | 09-09-25 | Mine Workings/Old/ No. 8 – Routine | 1,179 | 7,487 | | | |
| 29 | 09-09-26 | Mine Workings/Old/ No. 8 – Nonroutine | 41,901 | | 5,610 | 3,109 | 1,456 |

**TABLE 2**
IMO O&M Costs
*Appendix D – Site Inspection Checklists*

| Line | Costcode | Description | GLP 2008 ($) | GLP 2009 ($) | GLP 2010 ($) | GLP 2011 ($) | GLP 2012 ($) |
|---|---|---|---|---|---|---|---|
| 30 | 09-10-22 | Upper Spring Creek Diversion – Routine | 7,675 | 20,233 | 48,260 | 8,315 | 6,689 |
| 31 | 09-10-23 | Upper Spring Creek Diversion – Nonroutine | | 90,815 | | | |
| 32 | 09-10-42 | Upper Slickrock Creek Diversion-Routine | 28,310 | 6,554 | 6,230 | 20,350 | 8,777 |
| 33 | 09-10-43 | Upper Slickrock Creek Diversion – Nonroutine | | | 17,208 | | |
| 34 | 09-10-52 | Left-Side Clean Diversions – Routine | | | | 2,605 | |
| 35 | 09-10-53 | Left-Side Clean Diversions – Nonroutine | | | | | |
| 36 | 09-11-02 | Boulder Creek Tailings Dam – Routine | | | 3,231 | | |
| 37 | 09-11-03 | Boulder Creek Tailings Dam– Nonroutine | | 20,666 | | | |
| 38 | 09-12-02 | Slickrock Creek Basin – Routine | 77,915 | 63,312 | 94,058 | 74,834 | 82,985 |
| 39 | 09-12-03 | Slickrock Creek Basin – Nonroutine | 6,384 | | 14,714 | 82,055 | 33,888 |
| 40 | 09-13-02 | Boulder Creek Landslide Area – Routine | 8,985 | 3,153 | 29,589 | 28,297 | 4,940 |
| 41 | 09-13-03 | Boulder Creek Landslide Area – Nonroutine | | | 2,808 | | 59,871 |
| 42 | 09-14-00 | Sampling Program – Laboratory Analysis | 62,807 | 62,787 | 62,857 | 58,653 | 56,867 |
| 43 | 09-14-01 | Sampling Program – Laboratory Supplies | 10,120 | 9,877 | 8,995 | 13,191 | 7,347 |
| 44 | 09-14-02 | BCMO Weir Maintenance/Sediment | 1,228 | 4,669 | 6,723 | 12,691 | 17,287 |
| 45 | 09-15-00 | Boulder Creek Cementation Plant | | | | | |
| 46 | 09-16-00 | Security Systems | 19,575 | 7,184 | 24,457 | 32,613 | 13,093 |
| 47 | 09-17-00 | Downgradient Property | | | | | |
| 48 | 09-18-00 | Waste Disposal Facilities | | | | | |
| 49 | 10-00-00 | Emergency Response | | | | | |
| 50 | 11-00-00 | Response to Extreme Events | 371,172 | 123,431 | 745,860 | | |
| **Totals** | | | **5,014,506** | **5,898,941** | **8,238,737** | **7,197,787** | **4,981,271** |

Notes:

Fiscal years extend from December 1 through November 31.

CDF O&M costs are excluded.

Source: IMO. 2013a. *December 2012 Monthly Progress Report*. January 18.

**TABLE 3**

Primary Operation, Maintenance, and Inspections Performed in 2012

*Appendix D – Site Inspection Checklists*

| Start | Finish | Activity | Duration (days) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/16/12 | 01/18/12 | CDF Stormwater-related Repairs | 3 | -- | | | | | | | | | | | |
| 01/20/12 | 01/20/12 | CDF Semi-annual Inspection | 1 | - | | | | | | | | | | | |
| 03/19/12 | 12/30/12 | AMD Pipeline Mechanical Cleaning | 20 | | | | --------- | | | ---------- | | ---------- | | | |
| 04/01/12 | 12/30/12 | 2011 Plant Maintenance Program | 180 | | | | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- |
| 04/23/12 | 10/03/12 | Boulder Creek Streambed Maintenance at Lawson | | | | | -------- | | ---- | | | | -- | | |
| 04/23/12 | 04/23/12 | CDF Annual Inspection | 1 | | | | - | | | | | | | | |
| 06/18/12 | 06/18/12 | Inspect Richmond and Lawson Mines | 1 | | | | | | - | | | | | | |
| 06/18/12 | 06/18/12 | Inspect Boulder Creek Landslide Area | 1 | | | | | | - | | | | | | |
| 06/27/12 | 10/10/12 | SCRR Survey, Inclinometer Evaluation | 2 | | | | | | -- | | | | - | | |
| 06/28/12 | 06/29/12 | Survey Boulder Creek Landslide, Lawson Portal | 1 | | | | | | -- | | | | | | |
| 07/05/12 | 07/05/12 | SCRR Geotechnical Inspection/Evaluation by GEI | 1 | | | | | | | - | | | | | |
| 07/31/12 | 07/31/12 | Inspect Thickener TK11 Coating by PACE | 1 | | | | | | | | - | | | | |
| 08/01/12 | 08/01/12 | Inspect SCRR Diversion Pipeline by PACE | 1 | | | | | | | | - | | | | |
| 08/02/12 | 08/02/12 | Inspect Spring Creek Diversion Pipeline by PACE | 1 | | | | | | | | - | | | | |

**TABLE 3**

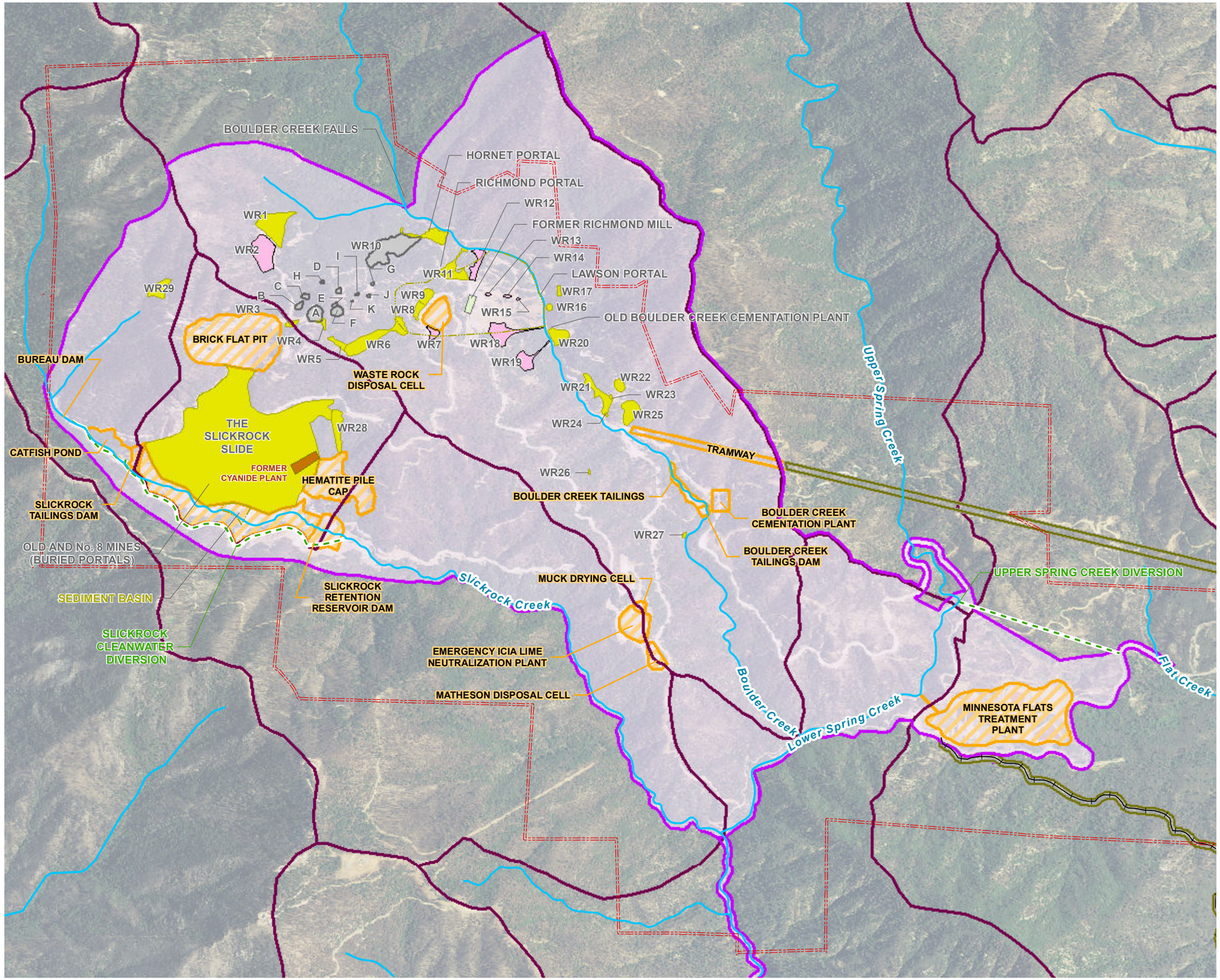
Primary Operation, Maintenance, and Inspections Performed in 2012

*Appendix D – Site Inspection Checklists*

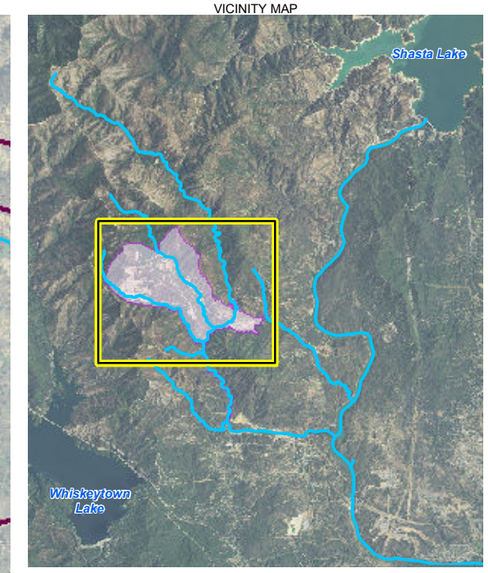
| Start | Finish | Activity | Duration (days) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/06/12 | 08/16/12 | CDF Stormwater-related Repairs and Repairing Primary Cell Settlement Areas | 8 | | | | | | | | --- | | | | |
| 08/13/12 | 08/15/12 | AMD Pipeline: Install Three 24-inch Service Tees | 3 | | | | | | | | -- | | | | |
| 09/10/12 | 09/21/12 | Sludge Haul SDB #1 | 20 | | | | | | | | | ----- | | | |
| 09/14/12 | 09/14/12 | CDF Semi-annual Inspection | 1 | | | | | | | | | - | | | |
| 10/10/12 | 10/10/12 | Survey Brick Flat Pit monuments, subsidence areas | 1 | | | | | | | | | | - | | |
| 10/25/12 | 10/26/12 | EPA final Inspection of CDF and turnover to DTSC | 1 | | | | | | | | | | - | | |
| 10/29/12 | 11/02/12 | TK-14 Sediment Removal | 5 | | | | | | | | | | | -- | |
| 11/06/12 | 11/06/12 | SCRR Slide Gate and Valve Vault Maintenance | 1 | | | | | | | | | | | - | |
| 11/16/12 | 12/01/12 | Lawson and Richmond Mine Maintenance | 15 | | | | | | | | | | | | ---- |
| 12/19/12 | 12/19/12 | SCRR Annual Inspection by GEI | 1 | | | | | | | | | | | | - |
| | | Thickener TK11 Outage for 2012 | | | | | | Cancelled for AMD Pipe Cleaning | | | | | | | |
| | | Raise BFP Vents | | | | | | Cancelled – not necessary for 2012 | | | | | | | |

Source: IMO. 2013. *December 2012 Monthly Progress Report*. January 18.

# Figures




VICINITY MAP




**LEGEND**

- IMM PROPERTY BOUNDARY
- RIVER/STREAM
- RAILROAD TO KESWICK SMELTER
- DIVERSION
- FORMER CYANIDE PLANT
- RI/FS GROUP SITE
- PART OF IMM ONGOING OPERATIONS
- CAPPED SINKHOLE
- WASTE ROCK PILE EXPOSED
- WASTE ROCK PILE REMOVED OR CAPPED
- MAIN MINE AREA
- RAILROAD AND TRAMWAY AREAS
- DRAINAGE BASIN

N

0 1,500
Feet

**FIGURE 1**
**LOCATION MAP OF FEATURES IN THE MAIN MINE AREA**
IRON MOUNTAIN MINE

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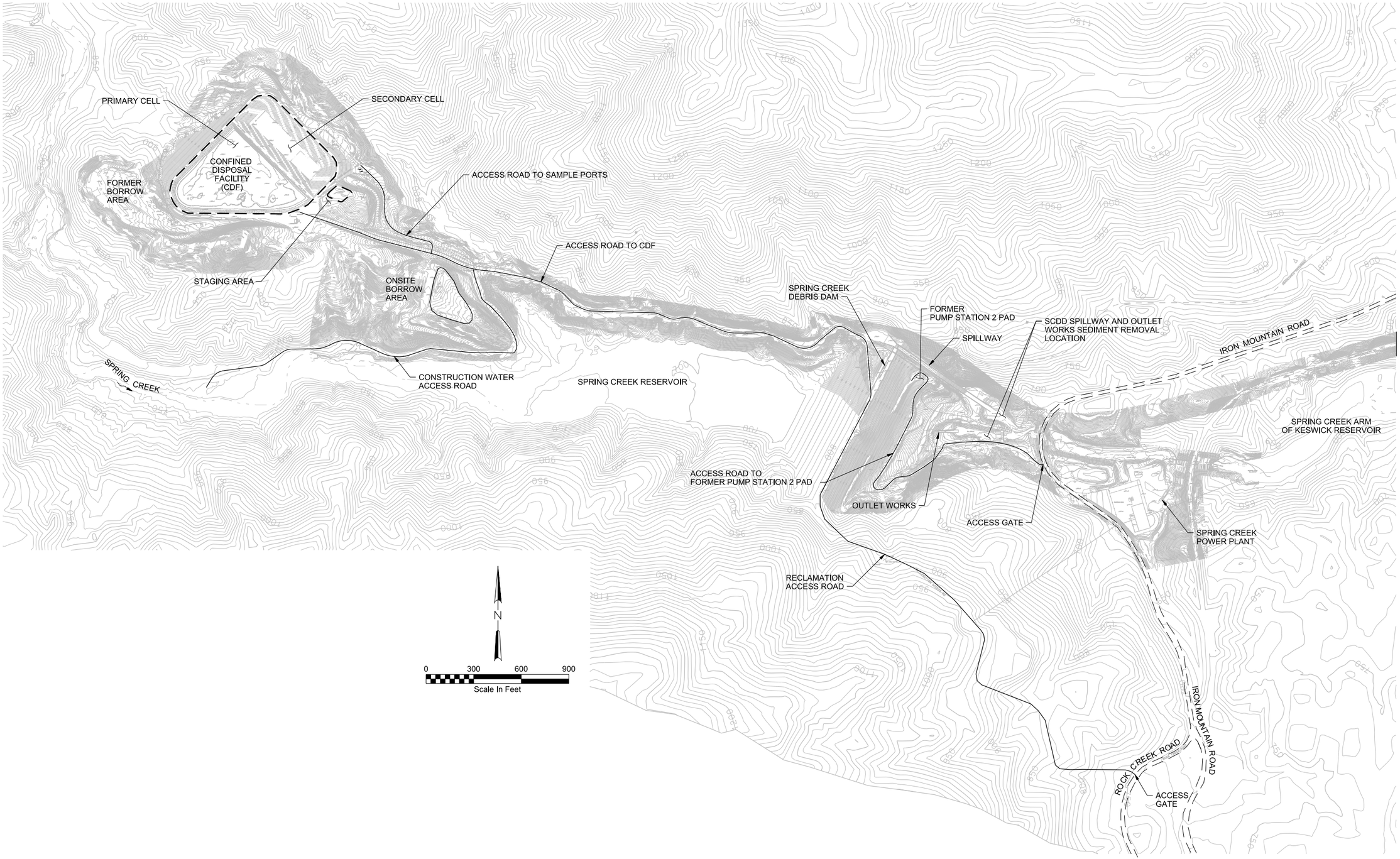


411032-FIGURE2.DGN

# FIGURE 2
# CONFINED DISPOSAL FACILITY
IRON MOUNTAIN MINE

# Attachment 1
# Iron Mountain Mine 2013 Five-Year Review
# Site Visit Meeting Agenda

# Iron Mountain Mine 2013 Five-Year Review Site Visit

| | | |
|---|---|---|
| ATTENDEES: | Jim Sickles/EPA<br>Rudy Carver/IMO<br>John Nash/IMO<br>Dave Sadoff/Global Loss Prevention, Inc. | Henry Gold/Global Loss Prevention, Inc.<br>Tom Wallis/CH2M HILL<br>Dave Bunte/CH2M HILL<br>Josh Bale/CH2M HILL |
| PREPARED BY: | Tom Wallis/CH2MHILL | |
| PROJECT NUMBER: | 406751.FR.04 | |
| MEETING DATE: | February 27 and 28, 2013 | |
| MEETING START TIME: | 8:00 am at CH2M HILL office, 9 am at IMO Office | |
| VENUE: | Iron Mountain Mine Superfund Site | |

This site visit is being performed to fulfill requirements of the CERCLA five-year review (FYR) process.

## February 27, 2013 EPA, IMO, and CH2M HILL Site Visit

1. 8 a.m. EPA and CH2M HILL personnel meet at CH2M HILL Office
2. EPA and CH2M HILL visit CDF
3. 9 a.m. EPA and CH2M HILL meet with Iron Mountain Operations (IMO) and Chartis at IMO office
4. <u>Meeting in the IMO Office:</u>
    a. Introductions
    b. Discuss FYR requirements and process
        - Site inspection checklist
        - Site inspection photo log
        - Interviews with site operators, nearby residents, and agency representatives
        - Status update on 2008 FYR recommendations
        - Discuss significant work items completed over review period (2008 to 2013)
        - Identify any significant issues and recommendations or follow-up actions for the 2013 FYR
5. <u>Site Visit:</u>
    a. Minnesota Flats Treatment Plant
        - 2008 FYR recommendation: Modify Statement of Work (SOW) to update best-available-technology performance standards based on the metal removal level currently achieved.
    b. Sludge Drying Beds
    c. Upper Spring Creek Diversion
        - Pipeline Condition (discussion of annual inspection findings and work to be performed)
            - 2008 FYR recommendation: Discuss plans to ensure that the deteriorating liner does not jeopardize the effectiveness of the Upper Spring Creek diversion.

        - Impact Structure
        - Sedimentation Basin

d. Boulder Creek Mouth

e. Acid Mine Drainage (AMD) Pipelines (external inspection at ground surface)

f. Boulder Creek Tailings Dam

g. Iron Mountain Mines, Inc., Tanks

    - 2008 FYR recommendation: Contents of the fluid in Essential Solutions, Inc., chemical storage tanks should be determined and proper containment be provided, if required, or the contents should be properly disposed of (to be addressed by Iron Mountain Mines, Inc. (IMMI).

h. Boulder Creek Landslide Area

    - Lawson Access Road
    - Boulder Creek Landslide
        - 2008 FYR recommendation: 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.
    - Boulder Creek Channel
    - Lawson Portal (visit will not enter the portal)

i. Matheson Disposal Cell

j. Richmond Mine (visit will not enter the portal)

    - 2008 FYR recommendation: 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.
    - Waste Rock Disposal Cell (near the Richmond Mill Area)

k. Brick Flat Pit

    - 2008 FYR recommendation: Evaluate reasons for the reduced filtrate at Brick Flat Pit.

l. Drop Inlet Structures

m. Consolidated Hematite Pile Toe Berm

n. Old/No. 8 Mine Seep

    - 2008 FYR recommendation: Actively pump the Old/No. 8 Mine Seep for AMD collection and use the gravity discharge system only as an emergency backup system.

o. Slickrock Creek Retention Reservoir

    - Clean Water Diversion
    - Sedimentation Basin and Rock Check Dams
    - Right Abutment and Stabilized Slide Area

p. Jeep Road

6. <u>Meeting in the IMO Office:</u> Regroup and discuss observations as needed.

## February 28, 2013, IMO and CH2M HILL Follow-Up Items

Due to time constraints with the overall site visit, CH2M HILL will meet separately with IMO to discuss more detailed elements of the site inspection checklist and 2008 FYR recommendations.

1. Onsite Documents and Records review (checklist Section III)
   - Operation and maintenance (O&M) manuals, including:
     - IMO O&M Plan
     - Annual Operations Work Plan (Section 6.3 of the SOW) and the Landfill Management Report and Plan (Section 6.4 of the SOW) (2008 FYR recommendation)
     - SOW
     - As-built Drawings: Review one set (e.g., Slickrock Creek Retention Reservoir) as an example
   - Site-specific health and safety plan
   - Procedures for emergency response (see SOW, Section 10) and response to extreme events (see SOW, Section 11)
   - O&M and OSHA Training Records
   - Permits and Service Agreements
     - Air discharge permit
     - Water usage permits
   - Confirm that 2008 site inspection checklist is still accurate regarding Settlement Monument Records, Groundwater Monitoring Records, and Leachate Extraction Records.
2. O&M costs (Checklist Section IV)
   - Discuss unanticipated or unusually high O&M costs during FYR review period (2008 to present). Total O&M costs from the December 2012 Monthly Progress Report follow.

| 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| $5,014,506 | $5,898,941 | $8,238,737 | $7,197,787 | $4,981,271 |

3. Monitoring, observations, and follow-up actions regarding trespassing and vandalism (Checklist Section V)
4. Strategies to decrease vulnerability to the loss of IMO personnel (2008 FYR recommendation)
5. Impacts of natural disasters on the remedies, including cleanup actions, restoration, and potential remedy impacts of the 2008 fires
6. More detailed inspection of Minnesota Flats Treatment Plant (as needed to complete Checklist Section IX); for example, confirm that sampling ports are properly marked and functional

## February and March 2013 Interviews

CH2M HILL will perform up to five additional interviews with in February and March 2013. Interviewees may include:

- Adjacent resident
- Central Valley Regional Water Quality Control Board (Water Board): Phil Woodward or delegate
- Department of Toxic Substances Control (DTSC): McKinley Lewis or delegate
- Bureau of Reclamation: Paul Fujitani or delegate

# Appendix E: Photographs from Site Inspections

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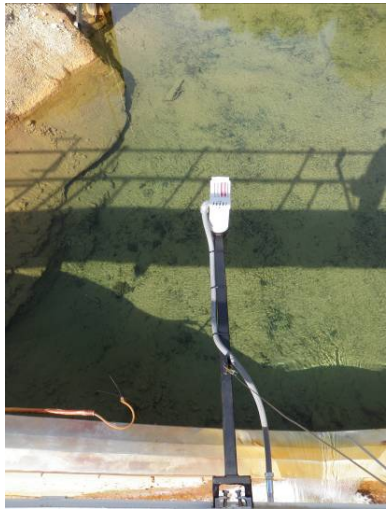
# Iron Mountain Mine Sitewide Inspection, February 27, 2013

Minnesota Flats Treatment Plant looking toward TK-1 and TK-2 reactor tanks and lime silos.

Upper Spring Creek Diversion Inlet Structure. Impact plate appears in good condition, with no significant sediment accumulation.

Upper Spring Creek Diversion discharge point. Eroding pipe lining can be seen in photograph.



Boulder Creek discharge weir with new sonic level indicator being tested at Boulder Creek.

Upper Spring Creek Diversion inlet structure.

Ted Arman's IMMI tank and drum storage area. Fourth Five-Year Review recommended removal of contents of tanks and drums. The area is beginning to become silted in from storm water discharges from adjacent drainage.

Boulder Creek tailings dam.

Lawson Portal entrance.

Lawson Portal grit chamber.

Lawson Portal emergency bypass system piping is the black piping on left; on the right are the standard portal AMD pipelines.

Boulder Creek riprap and shotcrete repairs due to landslide area and storm washout. Additional riprap and shotcrete are still necessary to remove falls generated by erosion.

Matheson Disposal Cell landfill cap.

Corroding drums and unmarked chemicals in building next to Matheson Disposal Cell.

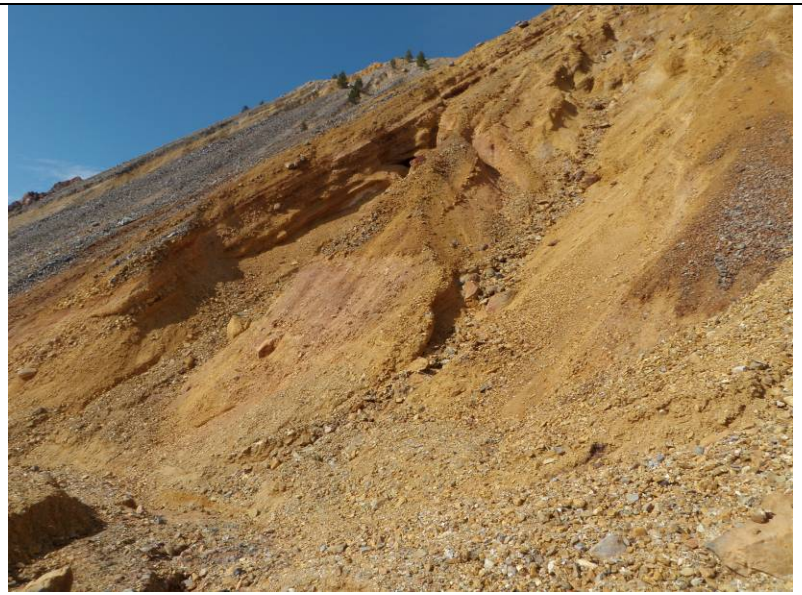
Muck cell area. PPE debris was placed in muck cell and, if not distributed, may create poorly compactable area in future.

Richmond Portal entrance.

Brick Flat Pit.

Confidence Portal entrance.

Drainage at east end of Slickrock slide zone along 28 Road, which captures a significant portion of hillside drainage from Slickrock slide.



Landslide that blocked the 28 Road during November and December 2012 storms. The road will be reopened in summer 2013.

Old/No. 8 Mine grit chamber with algae blooms on surface. The algae is being investigated to determine if it is enhancing scale buildup on AMD pipeline.

Old/No. 8 gravity tank in foreground and Slickrock Creek Retention Reservoir (SCRR) sedimentation basin in background.

Slickrock Creek Clean Water Diversion inlet.

View of Slickrock Creek drainage basin and dam from west end.

Settlement in south SCRR perimeter road required repair in 2010. Backfill materials were excavated and recompacted, and surface was restored to minimize additional longitudinal cracking in Slickrock Creek CWD pipeline.

Temporary gabion installed to minimize clean water flowing subsurface near right abutment of SCRR.

SCRR spillway and clean water diversion outlet structure.

SCRR dam and reservoir.

Hematite pile cap with vegetative cover materials developing.

# Confined Disposal Facility Inspection, February 19, 2013

Primary cell of CDF.

Borrow area.

West cut slope of CDF.

Secondary cell of CDF.

Erosional area on primary cell of CDF at transition to secondary cell.

Primary cell perimeter drain discharge location and surface drainage channel around secondary cell.

Small wet area on primary cell surface.

Minor surface cracks forming on primary cell.

South cut slope of CDF.

East cut slope of secondary cell.

North and northwest cut slope of CDF.

Erosion of top of drainage channel along west cut slope draining maintenance roadway.

CDF effluent discharging.

Groundwater underdrain discharge pipeline.

Minor hill slope sluffing/sliding of soil.

Former Pump Station No. 2 pad restoration and SCDD discharge channel.

# Appendix F: Applicable or Relevant and Appropriate Requirement Review

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APPENDIX F

# Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review

Section 121 (d)(2)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) specifies that Superfund remedial actions must meet federal standards, requirements, criteria, or limitations that are determined to be applicable or relevant and appropriate requirements (ARAR). ARARs are those standards, criteria, or limitations promulgated under federal or state laws that specifically address hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at CERCLA sites.

This appendix provides a detailed review of the chemical-, location-, and action-specific ARARs identified in the five Iron Mountain Mine (IMM) Records of Decision (ROD) (U.S. Environmental Protection Agency [EPA], 1986a [ROD 1]; EPA, 1992a [ROD, 2]; EPA, 1993 [ROD 3]; EPA, 1997 [ROD 4]; EPA, 2004 [ROD 5]). The objective of the review is to identify changes in these ARARs or promulgation of new standards that might be ARARs that have occurred over the past five years and could potentially affect the protectiveness of the remedy.

A discussion of numerical standards and the ARARs interim measures waiver is presented first, followed by a review of all chemical-, location-, and action-specific ARARs. There have been no revisions to laws or regulations that affect the protectiveness of the interim remedial actions identified under RODs 1 through 5.

## Clean Water Act Effluent Guidelines and Standards

ROD 2 discussed that there are no technology-based effluent limitations specifically identified for inactive copper or pyrite mines. There are technology-based limitations for active coal, iron, copper and zinc mines. Because the problems of acid mine drainage from the underground mining at IMM are similar to the problems of active open pit and underground copper mines, EPA selected the Clean Water Act effluent limitations for existing point sources at copper and zinc mines (40 CFR 440.102(a) and 440.103(a)) as relevant and appropriate for the treatment plant in RODs 2, 3, and 4. There has been no change to this ARAR and no impact on the protectiveness of the interim remedial actions.

The Clean Water Act effluent limitations established for existing point sources at copper and zinc mines in 40 CFR 440.102(a) and 440.103(a) were also included as performance criteria in ROD 5 for return water discharged from the CDF. However, the pH and total suspended solids effluent limitations were subsequently waived for the CDF. The target pH for treatment of dredge discharge was greater than 9.0 to meet long-term, residual lime demand. The pH of the overflow and filtrate from the CDF at times exceeded the effluent

discharge limits of 6.0 to 9.0. Elevated pH values did not have a detrimental effect on the aquatic environment of Spring Creek Reservoir or Spring Creek Arm (CH2M HILL, 2012).

**TABLE 1**
Clean Water Act Effluent Limitations
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, 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,d] | 20 | 30 |
| pH [d] | 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] TSS = Total Suspended Solids.
[d] Applicable for discharge to Flat Creek.
Note:
Effluent limitations are from 40 CFR 440.102(a) and 440.103(a).

# Sacramento River Water Quality Criteria

ROD 5 specified that discharges of sediment from Spring Creek Arm shall not cause exceedances of the chemical-specific ARARs at the compliance point. The applicable numeric standards from ROD 5 are presented in Table 2. There have been no changes to these ARARs and no impact on the protectiveness of the interim remedial actions.

**TABLE 2**
Basin Plan and CTR Water Quality Criteria for the Sacramento River below Keswick Dam
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Parameter | Basin Plan Maximum Concentration (µg/L) [a] | California Toxics Rule Continuous Concentration (4-day Average) (µg/L) [a] |
|---|---|---|
| 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] Dissolved concentrations.
[b] Concentration is dependent on hardness; objectives presented assume a hardness of 40 mg/L.
Note:
Basin Plan = *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin* (Central Valley Water Quality Control Board [Water Board], 1998)
Source: ROD 5 (EPA, 2004)

Chemical-specific ARARs identified in RODs 1, 2, 3, and 4, were equal to or less stringent than the standards in Table 2, or the standards were vacated. Most recently, after ROD 4 was signed, the State's Inland Surface Water Plan was vacated by the court and 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 promulgated new criteria for chronic exposures for this reach of the Sacramento River.

The Bureau of Reclamation (Reclamation) controls the discharges from Central Valley Project facilities in accordance with the 1980 Memorandum of Understanding (1980 MOU) (State Water Resources Control Board et al., 1980) and the *Long-term Central Valley Project Operations Criteria and Plan* (OCAP) (Bureau of Reclamation, 2004) to comply with Basin Plan requirements, to the extent practicable. As discussed in the following section, EPA waived compliance with the Basin Plan and California Toxics Rule, among other standards, to the extent those standards cannot be achieved by the interim remedies selected in RODs 1 through 5. For analysis of the progress of the IMM interim remedies, a comparison of copper and zinc concentrations in the Sacramento River with the Basin Plan requirements and CTR criteria is provided in *Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*, Appendix H "Site Evaluation and Compliance at Keswick Dam" (CH2M HILL, 2013).

## ARARs Interim Measures Waiver

The remedial actions selected in RODs 1 through 5 are interim actions that leave some releases of hazardous substances unabated. EPA invoked an ARARs waiver for "interim measures" (CERCLA 121(d)(4)(A); 40 CFR 300.430(f)(1)(ii)(C)(1)) for these interim remedial actions.

Water quality in the Sacramento River below Keswick Dam has improved since EPA completed the interim remedial actions. However, EPA does not anticipate that the remedies implemented under RODs 1 through 5 will be sufficient to ensure compliance with (1) the numeric, chemical-specific water quality standards contained in the National Toxics Rule, California Toxics Rule, or the Basin Plan for cadmium, copper, or zinc, (2) California Fish and Game Code Section 5650, which prohibits discharge of contaminants deleterious to fish, plant life, or bird life, and (3) applicable requirements of State Water Resources Control Board Resolution 92-49. EPA, therefore, waived compliance with those standards for the interim remedial action to the extent those standards cannot be achieved by the remedies selected in RODs 1 through 5.

The RODs describe EPA's goal at the site as complying with water quality ARARs in the Sacramento River downstream of Keswick Dam, to the extent practicable. ROD 4 estimated that State Basin Plan standards would be met below Keswick Dam, except during IMM AMD spills from SCDD, which were projected to occur on a frequency of once every 8 to 10 years (EPA, 1997). Water modeling conducted in 2009 estimated there would be three uncontrolled SCDD spills during the 50-year prediction period (CH2M HILL, 2009). The RODs also stated that the selected remedies would not meet water quality objectives in the immediate receiving waters, including portions of Spring Creek, Slickrock Creek, Boulder Creek, and Keswick Reservoir. A sitewide remedial investigation report (EPA, In

preparation) and a forthcoming feasibility study report will evaluate the feasibility of implementing additional controls on the remaining IMM discharges.

# ARARs Additional Review

The following tables summarize the chemical-specific ARARs (see Table 3), location-specific ARARs (see Table 4), and action-specific ARARs (see Table 5) from the IMM RODs. ROD 1 was included where applicable; however, the ARARs in the 1986 ROD were more limited than subsequent documents. EPA identified the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the National Environmental Policy Act (NEPA), and the Endangered Species Act as the environmental laws to be addressed by interim remedy selected in ROD 1 (EPA, 1986a). ROD 1 also invoked a fund-balancing waiver for the interim remedy. The fund-balancing waiver was revoked in 1991 under an explanation of significant difference; subsequent RODs used an ARARs waiver for "interim measures" as discussed above.

In some cases, the ARARs were classified differently in the RODs. As an example, the Clean Water Act Effluent Limitations were considered chemical-specific ARARs in ROD2 and action-specific ARARs in ROD 5. In these cases, the classification from the most recent ROD, generally ROD 5, was used.

The following ARARs and to-be-considered guidance, criteria, and advisories were not included, as they were specific to construction and are no longer applicable to the operation and maintenance phase of the interim remedies:

- National Historic Preservation Act (16 USC 470 et seq.; 36 CFR Part 800; 40 CFR 6.301(b); and Executive Order 11593)
- National Historic Landmarks Program (36 CFR Part 65); National Register of Historic Places (36 CFR Part 60)
- Archaeological and Historical Preservation Act (16 USC 469 et seq., 40 CFR 6.301(c))
- Archaeological Resources Protection Act of 1979 (16 USC 470aa-ii, and 43 CFR 7)
- Protection of Floodplains (Executive Order 11988; 40 CFR 6.302(b)); 40 CFR Part 6)
- Protection of Wetlands (Executive Order 11990; 40 CFR 6.302(a); and 40 CFR Part 6)

There have been no new ARARs identified or revisions to laws or regulations that affect the protectiveness of the interim remedial actions identified in RODs 1 through 5.

# Summary of IMM RODs

Table 6 provides a summary of the IMM RODs for further clarification of the items discussed above. Table 6 includes the implemented remedy components, operational controls, remedial action objectives, chemical-specific ARARs or performance criteria, and ARARs waivers. Where appropriate, the table includes excerpts of text from each ROD and section and page numbers for reference. Additional discussion is provided in Section 4.0 of the *Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California.*

**TABLE 3**
Chemical-specific ARARs
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision; Remedy Component | Standard, Requirement, Criterion, or Limitation | ARAR Status | Description | Comment | Affect on Protectiveness/ Amendment Date |
|---|---|---|---|---|---|
| RODs 2, 3, 4, and 5; performance criteria for Sacramento River near city of Redding's intake | National Primary Drinking Water Standards (MCLs)<br>40 CFR 141.61 and 141.62<br>Safe Drinking Water Act | Relevant and appropriate | Establishes national primary drinking water standards to protect the quality of water in public water systems. MCLs represent the maximum concentrations of contaminants permissible in a water system delivered to the public. MCLs are generally relevant and appropriate when determining acceptable exposure limits for current or potential sources of drinking water. | National primary drinking water standards are health-based standards (MCLs) for public water systems. The National Oil and Hazardous Substances Pollution Contingency Plan defines MCLs as relevant and appropriate for water determined to be a current or a potential source of drinking water in cases where maximum contaminant level goals are not ARARs. MCLs are enforced at the point where water is delivered to the public. For the IMM site, the only location where MCLs are currently relevant and appropriate is the Sacramento River near the city of Redding's Jewel Creek intake. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5; performance criteria for Sacramento River near city of Redding's intake | California Safe Drinking Water Standards (MCLs)<br>State MCLs in 22 CCR 64435 and 64444.5 | Relevant and appropriate | Establishes primary MCLs for contaminants that can not be exceeded in public water systems. In some cases, the California drinking water standards are more stringent than the federal MCLs. | Like federal MCLs, state MCLs are applicable as cleanup goals for waters determined to be a current or a potential source of drinking water. State MCLs are referenced in the Basin Plan as the minimum standards for waters with a beneficial use of municipal or domestic supply. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5; performance criteria for surface water at IMM site | National Toxics Rule and California Toxics Rule<br>40 CFR Part 131 | Applicable, but waived | Establishes numeric aquatic life criteria and human health criteria for priority toxic pollutants. This regulation is applicable to inland surface waters, bays, and estuaries in California. | This standard establishes criteria for surface water quality. Standards for site-related contaminants are applicable to surface waters at the IMM site. Condition has a waiver for interim measures in accordance with 42 USC 9621(d)(4)(A) and 40 CFR 300.430(f)(1)(ii)(C)(1). | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5; discharge from confined disposal facility (CDF) | State Water Resources Control Board Resolution 68-16 | Applicable | This resolution requires the continued maintenance of high-quality water of the state of California. Water quality may not be degraded below what is necessary to protect the beneficial uses of the water source. | Remedial actions that involve discharges to surface water or surface water drainage courses must take into account the protection of beneficial uses and the maintenance of high-quality waters in the area. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5; sediment removal and treatment of dredged materials | State Water Resources Control Board Resolution 92-49 | Applicable, but waived | Section III.G of the resolution states in part that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of background water quality or the best water quality that is reasonable if background levels cannot be restored. | Remedial alternatives evaluated must consider attainment of the highest water quality that is economically and technically achievable, and protects beneficial uses. Condition has a waiver for interim measures in accordance with 42 USC 9621(d)(4)(A) and 40 CFR 300.430(f)(1)(ii)(C)(1). | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 1, 2, 3, 4, and 5; performance criteria for protection of water quality | Basin Plan | Applicable, but waived | The Basin Plan establishes beneficial uses for groundwater and surface water, water quality objectives designed to protect those beneficial uses, and implementation plans to achieve water quality objectives. | The narrative water quality objectives and numerical standards for the Sacramento River described in the Basin Plan for site-related contaminants are considered ARARs. Condition has a waiver for interim measures in accordance with 42 USC 9621(d)(4)(A) and 40 CFR 300.430(f)(1)(ii)(C)(1). | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |

Notes:
CCR = Code of California Regulations
MCL = maximum contaminant level
USC = United States Code

**TABLE 4**
Location-specific ARARs
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision; Location | Standard, Requirement, Criterion, or Limitation | ARAR Status | Description | Comment | Affect on Protectiveness/ Amendment Date |
|---|---|---|---|---|---|
| ROD 5; State waters that support nongame fish and wildlife (Keswick Reservoir and Sacramento River) | Fish and Wildlife Conservation Act (16 USC 2901 et seq., and 50 CFR 83) | Applicable | Federal departments and agencies are required to use their statutory and administrative authority to conserve and promote conservation of nongame fish and wildlife and their habitats. Nongame fish and wildlife are defined as fish and wildlife that are not taken for food or sport, are not endangered or threatened, and are not domesticated. | Federal departments and agencies are required to use their authority to conserve and promote nongame fish and their habitats. | The regulations implementing the Fish and Wildlife Conservation Act were removed effective September 20, 2010. This change has no impact on the protectiveness of the interim remedial actions. |
| RODs 2, 3, 4, and 5; stream or water body that will be modified | Fish and Wildlife Coordination Act (16 USC 661 et seq. and 40 CFR 6.302(g)) | Applicable | Requires adequate provisions for protection of fish and wildlife resources. Certain remedies resulting in the temporary or permanent modification of naturally occurring water bodies and might require the construction of mitigated wetlands in other areas. | Remedial actions resulting in modifications of a naturally occurring water body required compliance with substantive provisions for protection of fish and wildlife resources. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, 4, and 5; designated waters (Sacramento River) | Fish and Game Code Section 1505 | Applicable | Requirements for the management, control, and protection of spawning areas on state lands to protect fish life in these areas. | Designates the state lands of the Sacramento River from Keswick to Squaw Hill Bridge (near Vina) as prime salmon and steelhead-spawning areas that are used by salmon species listed as threatened and endangered. Substantive requirements for the management, control, and protection of spawning areas are applicable. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5 | Fish and Game Code Sections 1600 and 1603 | Applicable | Requirements for construction by, or on behalf of, any state or local agency or public utility that will change the natural flow, use material from the spawning beds, or result in disposal into designated waters. | Substantive requirements are applicable. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, and 4 | Fish and Game Code Sections 3005 | Applicable | Prohibits the taking of any animal or bird with poison. | Substantive requirements are applicable. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, 4, and 5 | Fish and Game Code Sections 5650 | Applicable, but waived | Provides, among other prohibitions, that "It is unlawful to deposit in, permit into, or place into the waters of this state …substance or material deleterious to fish, plant life, or bird life." The actions taken at the IMM site are intended to prevent the continuing discharge so that it is no longer deleterious to fish. | Substantive requirements are applicable. Condition has a waiver for interim measures in accordance with 42 USC 9621(d)(4)(A) and 40 CFR 300.430(f)(1)(ii)(C)(1). | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, and 4 | Fish and Game Code Sections 5651 | Applicable | Requires CDFG to cooperate with the Water Board to correct "chronic water problems." | The interim remedial actions at the site are consistent with the intent of this section. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 1, 2, 3, 4, and 5; critical habitat upon which endangered species or threatened species depend (Sacramento River) | Fish and Game Code Section 2081 | Relevant and appropriate | Permits the California Department of Fish and Game to authorize taking of endangered, threatened, or candidate species under specific circumstances, including when the authorized take is for scientific, educational, or management purposes, or when the impacts of the authorized take shall be minimized and fully mitigated. | Substantive requirements related to taking of endangered, threatened, or candidate species are applicable to Chinook salmon in the Sacramento River. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| | Endangered Species Act (16 USC 1531 et seq., and 50 CFR Part 402) and 40 CFR 6.302(h) | Applicable | Protects endangered or threatened species and their habitat. If endangered or threatened species are in the vicinity of remediation work, the U.S. Fish and Wildlife Service must be consulted. Remediation activities must be designed to conserve endangered or threatened species and habitats. | Winter-run Chinook salmon (listed as endangered) rely on spawning areas in the Sacramento River. Remedial actions must be sensitive to the regulations that protect listed species. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |

**TABLE 4**
Location-specific ARARs
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision; Location | Standard, Requirement, Criterion, or Limitation | ARAR Status | Description | Comment | Affect on Protectiveness/ Amendment Date |
|---|---|---|---|---|---|
| RODs 2, 3, and 4; critical habitat upon which endangered species or threatened species depend (Sacramento River) | Fish and Game Code Sections 2070 and 2080 | Applicable | Prohibits taking of endangered species, among other provisions. | Substantive requirements are applicable. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, 4, and 5; Waters of the United States | Clean Water Act (Section 404) – Dredge or Fill Requirements (33 USC 1251-1376 and 40 CFR Part 230) | Applicable | Establishes requirements that limit the discharge of dredged or fill material into Waters of the United States. EPA guidelines for discharge of dredged or fill materials in 40 CFR 230 specifies the consideration of alternatives that have fewer adverse impacts and prohibits discharges that would exceed surface water quality standards, exceed toxic effluent standards, or jeopardize threatened or endangered species. Special consideration is required for special aquatic sites, including wetlands. | Substantive requirements are applicable to remedial actions involving discharge of dredged or fill material into Waters of the United States. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |

**TABLE 5**
Action-specific ARARs
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision; Remedy Components | Standard, Requirement, Criterion, or Limitation | ARAR Status | Description | Comment | Affect on Protectiveness/ Amendment Date |
|---|---|---|---|---|---|
| ROD 2, 3, and 4; mining wastes<br>ROD 5; contaminated sediment | Resource Conservation and Recovery Act Bevill Exclusion – Resource Conservation and Recovery Act 3001(b)(3)(A)(ii);<br>42 USC 6921(a)(3)(A)(ii); and<br>40 CFR 261.4(b)(7) | | The Bevill Exclusion, codified in 40 CFR 261.4(b)(7), provides that "solid waste from the extraction, beneficiation and processing of ores and minerals (including coal), including phosphate rock and overburden from the mining of uranium ore" are not hazardous wastes. | All of the wastes generated at the IMM Site relate in some manner to the historic and current mining and mineral processing operations at the Site. Similarly, sediment in Spring Creek Arm, and waste associated with removal of such sediment, is the result of historical mineral extraction or beneficiation at the Site. Therefore, these wastes may be excluded from hazardous waste designation. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5; remedy components that could generate air contaminants | Shasta County Air Quality Management District Rules 3-2 and 3-16. | Applicable | Rule 3-2: Prohibits discharges of air contaminants above specific concentrations for any single source.<br>Rule 3-16: Substantive requirements are those of Health and Safety Code Sections 41700 and 41701: "No person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property." | Requirements are applicable to remedial activities that could generate air contaminants. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 5; access and land use restrictions for the onsite CDF | Land Use Covenants Regulations | Relevant and appropriate | | Regulations are relevant and appropriate for access and land use restrictions at the onsite CDF. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| | 22 CCR 67391.1(a) | | Requires imposition of appropriate limitations on land use by recorded land use covenant when hazardous substances remain on the property at levels that are not suitable for unrestricted use of the land.. | | |
| | 22 CCR 67391.1(b) | | Requires that the cleanup decision document contains an implementation and enforcement plan for land use limitations | | |
| | 22CCR 67391.1(d) | | Requires that land use covenant be recorded in the county where the land is located. | | |
| | 22 CCR 67391.1(i) | | Definitions. | | |
| | California Civil Code, Section 1471(a) and (b) | | Specifies requirements for land use covenants to apply to successors in title to the land. | | |
| | California Health and Safety Code, Section 25222.1 | | | | |
| RODs 2, 3, and 4; treatment sludge and waste piles<br>ROD 5; CDF | Water Code 13172 and regulations promulgated thereunder (27 CCR 22480(b)) | Relevant and appropriate | Establishes three groups of mining wastes:<br>Group A – Mining wastes that must be managed as hazardous waste pursuant to Title 22, provided the Water Board finds that the mining wastes pose a significant threat to water quality.<br>Group B – Mining wastes that consist of or contain hazardous wastes, that qualify for a variance under Title 22, provided that the Water Board finds that the mining wastes pose a low risk to water quality; and mining wastes that consist of or contain non-hazardous soluble pollutants of concentrations which exceed water quality objectives for, or could cause, degradation of Waters of the State.<br>Group C – Mining wastes from which any discharge would be in compliance with the applicable water quality control, including water quality objectives other than turbidity. | In ROD 3, treatment residues from the HDS plant were categorized as Group B wastes. In ROD 5, EPA determined that sediment disposed in the CDF be managed as Group B mining wastes. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |

**TABLE 5**
Action-specific ARARs
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision; Remedy Components | Standard, Requirement, Criterion, or Limitation | ARAR Status | Description | Comment | Affect on Protectiveness/ Amendment Date |
|---|---|---|---|---|---|
| RODs 2, 3 and 4; Treatment sludge and waste piles<br><br>ROD 5; CDF | Mining closure requirements under Water Code 13172 | Applicable | Group A and B waste piles – close in accordance with 27 CCR 21090(a), (b), and (c).<br><br>Group A and B surface impoundments – close in accordance with 23 CCR 21400(a) and (b)(1); some surface impoundments with clay liners may be closed in place.<br><br>Group A and B tailings ponds – close in a accordance with 21090(a), (b), and (c) and 21400(a).<br><br>Group C units – close "in a manner that will minimize erosion and the threat of water quality degradation from sedimentation." | Regulations for closure of Group B waste piles are applicable to the disposal of treatment residues from HDS treatment plant, waste piles, and the upland CDF. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, and 4; Minnesota Flats Treatment Plant effluent<br><br>ROD 5; discharges to surface water from CDF | NPDES (40 CFR 122) | Applicable | The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into Waters of the United States. | Substantive requirements are applicable to the Minnesota Flats Treatment Plant effluent and discharge from the CDF. Onsite CERCLA actions do not require a permit. Substantive discharge requirements that are relevant and appropriate to discharges resulting from the management of mining wastes are the National Effluent Limitations Guidelines for copper and zinc mining operations in 40 CFR 440.102(a) and 440.103(a). | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| RODs 2, 3, 4; treatment sludge | TPCA, California Health and Safety Code 25208, et seq. | Applicable | TPCA prohibits the discharge of liquid hazardous waste or hazardous wastes containing free liquid into a surface impoundment. | If the HDS treatment sludge contains free liquids the disposal facility shall comply with TPCA requirements, unless the facility is eligible for a variance. Health and Safety Code 25208.13, provides an exemption for a surface impoundment into which mining waste is discharged if the discharge is otherwise in compliance with the requirements for mining waste, and the surface impoundment does not pollute or threaten to pollute the Waters of the State. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| ROD 4; SCRR Dam<br><br>ROD 5; CDF embankment | The National Dam Safety Act | Relevant and appropriate | Substantive provisions of the act encourage acceptable engineering policies and procedures to be used for dam site investigation, design, construction, operation and maintenance, and emergency preparedness. | Substantive requirements were ARARs for construction of the SCRR dam and the CDF embankment. | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |
| | Water Code 6000 through 6501 and regulations promulgated thereunder (23 CCR 301-333) | Relevant and appropriate | Establishes authority of the State of California to require that a dam shall be designed, constructed, operated, and maintained so that it does not constitute a danger to life or property. | | There have been no changes to this ARAR that affect the protectiveness of the interim remedial actions. |

Notes:

NPDES = National Pollutant Discharge Elimination System

SCRR = Slickrock Creek Retention Reservoir

TPCA = Toxic Pits Control Act

**TABLE 6**
Iron Mountain Mine Record of Decision (ROD) Summary
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| ROD Title; Date | *Record of Decision*, *Iron Mountain Mine, Redding, California*; October 3, 1986 | *Record of Decision, Boulder Creek Operable Unit*, *Iron Mountain Mine, Shasta County, California*; September 30, 1992 | *Record of Decision, Old/No. 8 Seep, Iron Mountain Mine, Shasta County, California*; September 24, 1993 | *Record of Decision*, *Iron Mountain Mine, Shasta County, California*; September 30, 1997 | *Record of Decision*, *Iron Mountain Mine, Shasta County, California*; September 30, 2004 |
| Implemented Remedy Components | • Construction of a partial cap over the Richmond mineralized zone, including Brick Flat Pit and several subsidence areas<br>• Construction of a diversion for Upper Slickrock Creek, around the waste rock and slide debris<br>• Construction of a diversion for Upper Spring Creek<br>• Installation of perimeter controls as necessary to minimize any direct contact threats (page 59) | • Treatment of the AMD discharges from the Richmond and Lawson adits in a lime neutralization treatment plant<br>• Consolidation and capping of seven waste piles<br>• Disposal of the IMM treatment plant sludges in a landfill constructed in Brick Flat Pit | Treatment of the AMD discharges from the Old/No. 8 Mine Seep at the treatment plant, as appropriately modified | Treatment of AMD from the Slickrock Creek area sources, including:<br>• Design and construction of a retention reservoir to collect AMD discharges in the Slickrock Creek Basin for treatment<br>• Surface-water diversion facilities<br>• Hematite-erosion-control structure<br>• Upgrades to the treatment plant and pipeline | • Dredging sediment that was most susceptible to erosion in Spring Creek Arm<br>• Disposing of the sediment in a CDF adjacent to Spring Creek Reservoir<br>• Institutional controls, including operational controls and CDF access and use restrictions |
| Operational Controls | "As part of [the 1980] MOU, Bureau of Reclamation agreed to operate SCDD and the Shasta Dam water management system in such a manner that, to the extent possible, sufficient dilution water would be available to ensure that State water quality criteria below Keswick Dam would be met." ("Previous Remedial Actions", page 7) | "At present, a MOU commits the U.S. Bureau of Reclamation to operate SCDD in a manner that (when considering releases of dilution water from Shasta Dam) will protect aquatic life in the Sacramento River downstream of Keswick Dam." (Section VI "Summary of Site Risks", page 34) | Same as ROD 2 (see Section VI "Summary of Site Risks", page 24) | "Since this interim remedy is not intended to address all remaining uncontrolled AMD releases, the interim remedy continues to rely on continuing operations of the SCDD to provide for the safe release of the continuing IMM contaminant discharges from the Spring Creek Reservoir (to the extent technically feasible in light of the current state of the response action at IMM)." (Section IV "Scope and Role of the Operable Unit within Site Strategy", page 38) (See also page 48)<br>"Operational parameters of the 1980 MOU approximate the State Basin Plan standards below Keswick Dam but do not assure compliance at that location under all circumstances." (Section VI "Summary of Site Risks", page 49) | The following operational controls were selected in ROD 5 (Section 2.12 "Description of Selected Remedy, page 2-91):<br>1. Current operational controls pursuant to the Operations Criteria and Plan (OCAP) that require Reclamation to restrict Keswick Reservoir elevations during release events from SCPP and SCDD to minimize the potential for erosion of sediment in the Spring Creek Arm will be revised. Operational restrictions would be removed except for periods during rare storm events where continued operational restrictions are necessary to assure that remaining sediments do not erode into the environment.<br>2. Current OCAP operational controls will be continued that require Reclamation to operate SCDD releases to comply with water quality ARARs in the Sacramento River downstream of Keswick Dam, and to continue low-flow releases from SCPP as necessary to flush Spring Creek Reservoir water through the Spring Creek Arm. |
| Remedial Action Objectives | The following key general objectives for the Site were defined in the Feasibility Study (EPA, 1985 and 1986b) and summarized in ROD 1 (Section VI "Alternatives Evaluation", page 28):<br>• To minimize off-site contaminant migration via surface water runoff and seepage, and<br>• To mitigate impacts and minimize | The overall remedial action objective for the Site was defined in the *Public Comment Feasibility Study, Boulder Creek Operable Unit, Iron Mountain Mine, Redding*, *California* (EPA, 1992b) as eliminating the IMM discharges that are harmful to the environment.<br>ROD 2 stated that "results from implementation of remedial actions for sources in the Boulder Creek Operable Unit | Similar to ROD 2:<br>"The remedial action objective at the site is to eliminate IMM site discharges that are harmful to the environment. The contaminants of concern identified in ROD 1 are acidity and toxic metals, which include copper, cadmium, and zinc. All of these are present in AMD from Old/No. 8 Mine Seep." (Section VII "Description of Alternatives", page 25) | "The overall remedial action objective at the Site is to eliminate IMM Site discharges that are harmful to the environment.<br>The EPA has also identified three primary goals for the IMM Superfund remedial action:<br>1. Comply with the water quality criteria established under the Clean Water Act.<br>2. Reduce the mass discharge of toxic | The overall objective of EPA's IMM Superfund cleanup program was defined as eliminating IMM AMD discharges that are harmful to human health and the environment.<br>Remedial action objectives for contaminated sediment in Spring Creek Arm included the following:<br>• Protect the Sacramento River |

**TABLE 6**
Iron Mountain Mine Record of Decision (ROD) Summary
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| | the migration of contaminants that have already moved from the site through receiving waters | will be important considerations in setting remedial action objectives for an overall final site remedy." (Section IV "Scope and Role of the Operable Unit within the Site Strategy", page 26) | "Results from implementation of remedial actions for sources in the Old/No. 8 Mine Seep Operable Unit will be important considerations in setting remedial action objectives for an overall final site remedy." (Section IV "Scope and Role of the Operable Unit within the Site Strategy", page 19) | heavy metals through application of appropriate control technologies.<br><br>3. Minimize the need to rely on special releases of California's valuable water resources to ensure compliance with water quality standards in the Sacramento River through special releases of waters to dilute toxic spills of IMM contaminants.<br><br>The contaminants of concern identified in the 1986 ROD are acidity and toxic metals, which include-copper, cadmium, and zinc. All of these are present in AMD from Slickrock Creek area sources. Arsenic is an additional contaminant of concern that has been identified with respect to the large hematite pile that is actively eroding into Slickrock Creek and downstream areas." (Section VII "Description of Alternatives", page 51) | ecosystem from releases of heavy metals from Spring Creek Arm by preventing the mobilization and redeposition of contaminated sediment into important fishery spawning habitats in the Sacramento River downstream from Keswick Dam.<br><br>• 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 discharges from Spring Creek Arm to the Sacramento River.<br><br>Achievement of RAOs was expected to result in additional ancillary benefits (listed in Section 2.8 "Remedial Action Objectives", page 2-58). |
| Chemical-specific ARARs or Performance Criteria | ROD 1 recommended the cleanup program be designed to meet the State of California Basin Plan criteria for every year except the worst case year (defined as the 1978 water year), at which time the EPA water quality criteria for protection of aquatic life would be met. ROD 1 stated that under these conditions, meeting federal standards should prevent fish kills from occurring in the Sacramento River. (Section XII "Recommended Cleanup Objectives and Design Year", page 59) (see also pages 29 and 52) | "Chemical-specific ARARs for the treatment plant include the Clean Water Act effluent limitations for discharges of mine drainage from copper mines, exercise of best professional judgment under the Clean Water Act, Safe Drinking Water Act MCLs and nonzero MCL goals at the water intake to the City of Redding, and the Basin Plan water quality objectives." (Section X "Statutory Determinations", page 70)<br><br>MCLs included the following; other criteria are provided in subsequent rows of this table.<br><br>Copper: N/A<br><br>Cadmium: 5 ppb<br><br>Zinc (Secondary MCL): 5,000 ppb<br><br>"EPA is relying upon the ARAR waiver for 'Interim Measures' (40 C.F.R. § 300.430 (f)(1)(ii)(C)(i) for remedy selection with respect to the Boulder Creek OU and therefore is waiving the Regional Board Basin Plan water quality objectives and the Fish and Game § 5650 standards which would necessitate elimination of all releases as ARARs for this operable unit. EPA's overall goal at the site remains achieving these water quality objectives and Fish and Game standards." (Section VIII "Summary of Comparative Analysis of Alternatives, page 48) | Same as ROD 2 (see Section X "Statutory Determinations", page 49) | Same as ROD 2 (see Section X "Statutory Determinations", page 95)<br><br>ROD 4 also evaluated the proposed CTR as "To Be Considered Standards" rather than potential ARARs criteria, as the proposed CTR were not yet finalized at the time of ROD 4 (Section III.3 "Public Participation for the 1996 Proposed Plan", page 32). The proposed CTR were included in the ARARs waived (see below). | The following performance criteria were defined in ROD 5 for the dredging operations during implementation of the interim remedial action (Section 2.12.4 "Performance Criteria and Water Quality ARARs", page 2-97). These performance criteria are no longer applicable now that interim remedial action has been completed.<br><br>• Discharges of sediment from Spring Creek Arm shall not cause exceedances of the chemical-specific ARARs at the compliance point. The applicable numeric standards were defined in Table 17 (page 2-98) as the Basin Plan maximum concentration and CTR continuous concentration criteria for the Sacramento River below Keswick Dam.<br><br>• Basin Plan turbidity standards shall be achieved at the compliance point during dredging operations.<br><br>• Return water discharged from the CDF shall not exceed the relevant and appropriate effluent limitation guidelines established for existing point sources at copper and zinc mines in 40 Code of Federal Regulations 440.102(a) and 440.103(a)<br><br>• Sediment that is susceptible to erosion shall be removed (or contained through residual management) to 560 feet above mean sea level (msl) or to an elevation determined by further analysis to prevent erosion under the following operational condition: |

**TABLE 6**
Iron Mountain Mine Record of Decision (ROD) Summary
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| | | | | | - Combined release from SCDD and SCPP up to 6,600 ft3/sec and Keswick Reservoir elevation of 574 feet msl or greater. Combined release of 6,600 ft3/sec is equivalent to the upper end of SCPP capacity (4,900 ft3/sec) plus the historical maximum discharge from SCDD (1,700 ft3/sec). |
| Treatment Plant Effluent Limitations | | | | | |
| ARAR | Effluent limitations for mine drainage at 40 CFR Part 400, Subpart J, which are achievable by using lime treatment and precipitation | Effluent limitations for existing point sources at copper and zinc mines in 40 C.F.R. §§440.102(a) and 440.103(a) were deemed relevant and appropriate for the treatment plant effluent. | Same as ROD 2 | Same as ROD 2 | Same as ROD 2; effluent limitation guidelines were deemed relevant and appropriate for CDF effluent. |
| Cadmium, Total (ppb) | Not specified | Daily maximum: 100<br>30-day average: 50 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| Copper, Total (ppb) | Not specified | Daily maximum: 300<br>30-day average: 150 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| Lead , Total (ppb) | Not specified | Daily maximum: 600<br>30-day average: 300 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| Zinc , Total (ppb) | Not specified | Daily maximum: 1,500<br>30-day average: 750 | Same as ROD 2 | Same as ROD 2 | Same as ROD 2 |
| pH | Not specified | 6.0 to 9.0<br>Applies only to discharges to Flat Creek | Same as ROD 2 | Same as ROD 2 | Not retained as performance criteria for CDF effluent |
| TSS (mg/L) | Not specified | Daily maximum: 30<br>30-day average: 20<br>Applies only to discharges to Flat Creek | Same as ROD 2 | Same as ROD 2 | Not retained as performance criteria for CDF effluent |
| ARARs Waived (Numerical, see also Narrative below) | | | | | |
| Cadmium (ppb) [a] | Basin Plan: 0.22; EPA: 0.55 | Basin Plan: 0.22 | Same as ROD 2 | Same as ROD 2; Proposed CTR | Basin Plan: 0.22; CTR: 1.1; National Toxics Rule |
| Copper(ppb) [a] | Basin Plan: 5.6; EPA: 5.4 | Basin Plan: 5.6 | Same as ROD 2 | Same as ROD 2; Proposed CTR | Basin Plan: 5.6; CTR: 4.1; National Toxics Rule |
| Zinc (ppb) [a] | Basin Plan: 16; EPA: 47 | Basin Plan: 16 | Same as ROD 2 | Same as ROD 2; Proposed CTR | Basin Plan: 16; CTR: 54; National Toxics Rule |
| Narrative Standards | N/A | Fish and Game Code Section 5650 which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life." | Same as ROD 2 | Same as ROD 2 | Fish and Game Code Section 5650<br>SWRCB Resolution 92-49 |

**TABLE 6**
Iron Mountain Mine Record of Decision (ROD) Summary
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| Target Compliance Point (see also "ARARs Waiver") | Sacramento River below Keswick Dam:<br><br>"Federal water quality standards will be met in the Sacramento River below Keswick Dam but not in the immediate receiving waters as required by the Clean Water Act." (Declarations, Page 2) | Sacramento River below Keswick Dam:<br><br>"The overall remedy, including the activities in the 1986 Record of Decision, this Operable Unit and subsequent operable units are expected to achieve compliance with these ARARs (at least in those portions of the Site immediately below Keswick Dam)… The selected remedy will not provide for meeting water quality objectives in Boulder Creek. (Section X.2.3 "ARAR Waivers for this Operable Unit", pages 86 and 87)<br><br>MCLs and MCLGs would only apply to the area of the Sacramento River near Redding's Jewel Creek Intake. (Section X "Statutory Determinations", page 74) | Sacramento River below Keswick Dam:<br><br>"The remedy will result in better water quality in the Sacramento River and reduce the number of days each year that the Sacramento River exceeds State Basin Plan standards due to discharges of copper, cadmium and zinc from IMM" (Section X "Statutory Determinations", page 49)<br><br>The overall remedy, including the activities in the 1986 Record of Decision, the 1992 Boulder Creek Record of Decision, this Operable Unit, and subsequent operable units are expected to achieve compliance with these ARARs (at least in those portions of the site immediately below Keswick Dam)… The selected remedy will not provide for meeting water quality objectives in Slickrock Creek. (Section X.2.2 "ARAR Waivers for this Operable Unit", page 52)<br><br>"The selected treatment remedy will comply with ... MCLs and non-zero MCLGs established under the Safe Drinking Water Act for the Sacramento River near Redding's Jewel Creek intake" (Section X "Statutory Determinations", page 50) | Sacramento River below Keswick Dam:<br><br>"The remedy will result in better water quality in the Sacramento River by limiting discharges of copper, cadmium, zinc, and acidity from the Site, thereby reducing the number of days and/or the degree of exceedances of the State Basin Plan standards (and the proposed CTR) in the Sacramento River and Keswick Reservoir." (Section X "Statutory Determinations", page 95)<br><br>"EPA anticipates that the operational targets of the SCDD can be revised to reflect the reduced metal loads from IMM once this remedial action has been implemented. Based upon the current operational procedures used by USBR, these changed operational targets would likely be able to attain the State Basin Plan standards (and potentially the proposed CTR) below Keswick Dam under most circumstances, although regular exceedances in areas of Keswick Reservoir and in the Spring Creek watershed are likely to continue without further response action at the Site." (Section IV "Scope and Role of the Operable Unit within Site Strategy", page 39) | Sacramento River below Keswick Dam:<br><br>"The RAOs for this ROD focus on the protection of the Sacramento River ecosystem, and do not require the removal of all contaminated sediment to eliminate ecological risks in the Spring Creek Arm or Keswick Reservoir due to the ongoing IMM metal discharges." (Declaration, page 1-8) (see also Performance Criteria and Water Quality ARARs", page 2-97 and Table 17, page 2-98) |
| ARARs Waiver (Narrative) | Fund-balancing waiver, 40 CFR 300.68(i)(5)(ii):<br><br>"The selected remedy does not: address all waste rock dumps or tailings piles along Boulder Creek and Slickrock Creek; collect and treat all seeps or subsurface drainage along Boulder Creek and Slickrock Creek; address metal-bearing sediments in receiving waters; or fully achieve aquatic water quality standards in Boulder Creek, Slickrock Creek, portions of Spring Creek, and Keswick Reservoir. In essence, the selected remedy will achieve aquatic water quality standards below Keswick Dam, but not in the tributary streams; however, water quality in those receiving waters is expected to improve substantially to the point where certain beneficial uses may return on a seasonal basis." (Section XIII "Consistency with Other Environmental Laws", page 60)<br><br>"State and Federal standards will probably not be met in portions of Spring Creek, Slickrock Creek, Boulder Creek, and Keswick Reservoir at any time. [The selected alternative] achieves water quality at a point below Keswick Dam. As described under Fund Balancing, the cost of meeting | Waiver for interim measures:<br><br>"The selected remedy does not address all sources of contaminant discharges at the site and cannot provide for compliance with the chemical-specific ARARs of the Basin Plan and for compliance with Fish and Game Code Section 5650 which prohibits discharge of contaminants 'deleterious to fish, plant life, or bird life.' EPA is invoking the CERCLA Section 121(d)(4)(A) waiver for 'interim measures'." (Declaration, Section V "Statutory Determinations", Page 4)<br><br>"Because Boulder Creek and Slickrock Creek do not currently comply with ambient water quality criteria, and remediation of sources in the interim action pursuant to the Boulder Creek OU will not allow for compliance with these standards without further actions, EPA is relying upon a waiver for "interim measures" and is not requiring that the discharge meet ambient water quality criteria in surface waters receiving the discharge." (Section IX "Selected Remedy", page 67) (see also Section VIII, Summary of Comparative Analysis of Alternatives, page 49) | Waiver for interim measures:<br><br>Same as ROD 2 (see Declaration, Section V "Statutory Determinations", Page 4; Section IX "Selected Remedy", page 46)<br><br>ROD 3 also states "EPA is not requiring that the discharge from the treatment plant meet the ambient water quality criteria in lower Spring Creek for this interim action." (Section IX "Selected Remedy", page 46) | Waiver for interim measures:<br><br>"Since the action selected in this ROD is an interim action that leaves some releases of hazardous substances unabated, EPA is relying on the ARARs waiver for "interim measures" (CERCLA Section 121(d)(4)(A); 40 CFR Section 300.430(f)(1)(ii)(C)(1)) for this remedial action. In particular, EPA anticipates that the remedy will improve water quality in Spring Creek, Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River, but EPA does not anticipate that this remedy, in conjunction the other remedies implemented to date, will be sufficient to ensure compliance with (1) the numeric, chemical-specific standards contained in the State Basin Plan standards for copper, cadmium, or zinc, and (2) California Fish and Game Code Section 5650 (which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life"). The EPA is therefore waiving compliance with those standards for the interim action to the extent those standards cannot be achieved by the remedy selected in this ROD in conjunction with the remedies implemented under prior RODs." (Declaration, Section VII "Statutory | Waiver for interim measures:<br><br>"Since the actions selected in this ROD are interim actions that leave some releases of hazardous substances unabated, EPA is relying on the ARARs waiver for "interim measures" (CERCLA § 121(d)(4)(A); 40 CFR § 300.430(f)(1)(ii)(C)(1)) for this remedial action. In particular, the EPA anticipates that once the remedial actions selected in this ROD have been implemented, water quality in Keswick Reservoir and the Sacramento River will improve as the result of reducing metal loads and suspended solids associated with contaminated sediment. EPA does not anticipate that this remedy, in conjunction with the other remedies implemented to date, will be sufficient to ensure compliance with (1) the numeric, chemical-specific water quality standards contained in the National Toxics Rule, California Toxics Rule (CTR) and the Basin Plan for copper, cadmium, or zinc, and (2) California Fish and Game Code § 5650 (which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life"). The EPA is therefore waiving compliance with those standards for the interim action selected in this ROD to the |

**TABLE 6**
Iron Mountain Mine Record of Decision (ROD) Summary
*Appendix F – Applicable or Relevant and Appropriate Requirement Review, Iron Mountain Mine Five-Year Review*

| Record of Decision (ROD) | ROD 1 | ROD 2 | ROD 3 | ROD 4 | ROD 5 |
|---|---|---|---|---|---|
| | water quality objectives in the stream near the source is extremely large and fund balancing is used to back off to a less costly remedy" (Section XIII "Consistency with Other Environmental Laws, CWA", page 62).<br><br>"Through a formal action in 1991 known as an explanation of significant difference (ESD), EPA revoked the fund balancing waiver upon which EPA relied for ROD1." (ROD 4 Declaration, Section II.4 "History of Federal and State Site Investigations", page 21) | | | Determinations", Page 6) (se also page 97)<br><br>"None of the alternatives fully complies with ARARs because none of the alternatives would achieve State Basin Plan standards or the proposed CTR in Spring Creek, Slickrock Creek, or Boulder Creek…. [The selected remedy] would meet the State Basin Plan standards below Keswick Dam except during IMM AMD spills from SCDD, which are projected to occur on a frequency of once every 8 to 10 years (when the SCDD is operated to target compliance with the State Basin Plan standards below Keswick Dam)." (Section VIII "Alternative Comparisons", page 70) (see also Section X "Statutory Determinations", page 93)<br><br>"The selected remedy would improve water quality in Keswick Reservoir but would not assure compliance with the State Basin Plan standards under all circumstances….The selected remedy does not ensure compliance with the State Basin Plan standards or proposed CTR above the SCDD, and continuous exceedances in those bodies are expected to remain even after implementation of [the interim remedy]." (Section X "Statutory Determinations", page 95) | extent those standards cannot be achieved by the remedy selected in this ROD. EPA is also employing the interim action waiver to waive the applicable requirements of SWRCB Resolution 92-49." (Declaration, Section 1.6.2 "Compliance with ARARs", page 1-6) (see also page 2-99)<br><br>"None of the remedial alternatives fully complies with chemical-specific water quality ARARs because none of the alternatives would alone achieve National Toxics Rule, Basin Plan or CTR criteria in Spring Creek, its tributaries, or in portions of Keswick Reservoir under all circumstances following completion of the construction of the respective remedial alternative. These water bodies are impacted by remaining discharges of AMD from the IMM Site….Therefore, it would be appropriate to invoke an interim remedy ARARs waiver." (Section 2.10 "Comparative Analysis of Alternatives", page 2-71) |

Notes:

ROD section numbers and page numbers for each reference are indicated in parentheses.

[a] The Basin Plan and CTR criteria for copper, cadmium, and zinc concentrations are for dissolved constituents and are hardness dependent. Objectives presented in this table assume a hardness of 40 mg/L .

N/A: Not applicable

AMD: acid mine drainage

Basin Plan: *The Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and San Joaquin River Basin*

CDF: Confined Disposal Facility

CTR: California Toxics Rule

MCL: Maximum Contaminant Level

MOU: State Water Resources Control Board, U.S. Water and Power Resources Service, and California Department of Fish and Game. 1980. *Memorandum of Understanding (MOU) to Implement Actions to Protect the Sacramento River System from Heavy Metal Pollution from Spring Creek and Adjacent Watersheds*. January.

OCAP: Bureau of Reclamation. 2004. *Long-term Central Valley Project Operations Criteria and Plan, CVP-OCAP*. June 30.

OU: Operable Unit

ROD: Record of Decision

SCDD: Spring Creek Debris Dam

SCPP: Spring Creek Power Plant

Spring Creek Arm: Spring Creek Arm of Keswick Reservoir

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# Appendix G: Minnesota Flats Treatment Plant Effluent Discharge

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# Minnesota Flats Treatment Plant Effluent Discharge Iron Mountain Mine Five-Year Review

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DATE: April 5, 2013

PROJECT NUMBERS: 406751.FR.02

## 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 limitations contained in the IMM Scope of Work (SOW), dated October 2, 2000 (U.S. Environmental Protection Agency [EPA], 2000).

The SOW includes the requirements necessary to operate and maintain the IMM interim remedies selected under the first four Records of Decision (EPA, 1986 [ROD 1]; EPA, 1992 [ROD, 2]; EPA, 1993 [ROD 3]; EPA, 1997 [ROD 4]). The IMM interim remedies under RODs 1 through 4 include 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 interim remedies include treatment of AMD by a high-density sludge (HDS) treatment process at MFTP and long-term onsite storage of sludge generated from the treatment process. The data reviewed were collected during the fifth five-year review (FYR) period, from January 1, 2008, through December 31, 2012.

Figure 1 presents a plot of the monthly AMD flow treated at the MFTP from January 2008 through December 2012 (figures appear at the end of this technical memorandum). For this period, approximately 2 billion gallons of AMD were treated at the MFTP. Figure 2 presents the approximate monthly copper and zinc loads removed at the MFTP from January 2008 through December 2012. For Water Years 2008 through 2012 (October 2007 through September 2012), approximately 870,000 pounds of copper and 3,000,000 pounds of zinc were removed from the site contaminant discharges.

# Effluent Discharge Requirements

Sections 8 and 14 of the SOW state the performance standards required for operation of the MFTP. These sections include the following requirements:

- The applicable or relevant and appropriate requirements (ARAR) specify that the AMD neutralization facility will 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
Clean Water Act Effluent Guidelines and Standards
*Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review*

| Parameter | Units | 30-day Average [a] | Daily Maximum [b] |
|---|---|---|---|
| Copper (Total) | µg/L | 150 | 300 |
| Cadmium Total) | µg/L | 50 | 100 |
| Zinc (Total) | µg/L | 750 | 1,500 |
| Lead (Total) | µg/L | 300 | 600 |
| TSS [c,d] | mg/L | 20 | 30 |
| pH [d] | pH units | 6.0 to 9.0 | 6.0 to 9.0 |

Source: Table 14-1 of the SOW (EPA, 2000)

[a] Average of daily concentration values for 30 consecutive days.

[b] Maximum allowable concentration measured for any one day.

[c] TSS = Total Suspended Solids.

[d] Applicable for discharge to Flat Creek.

Notes:

Effluent limitations are from 40 CFR 440.102(a) and 440.103(a).

µg/L = micrograms per liter

The CWA system of technology-based effluent controls requires discharges to achieve the best practicable control technology and the best available technology (BAT) economically achievable. The treatment plant effluent metal concentrations substantially comply with, and in most cases are well below, the 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 the 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
Best Available Technology 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 |

Source: Table 14-2 of the SOW (EPA, 2000)

[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).

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

- The SOW required effluent discharged to lower Spring Creek to comply with the effluent limitations specified in Tables 1 and 2, except for pH and TSS levels. As stated in RODs 2 and 3, 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 this creek. Treatment to TSS levels proscribed 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).
- The 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). As recommended in the IMM Fourth Five-Year Review Report (EPA, 2008), EPA is working with Global Loss Prevention, Inc. (formerly American International Group Consultants, Inc.) to modify the SOW, including revisions to the BAT effluent limits to more accurately reflect metals removal by the HDS AMD neutralization process.

# Compliance Monitoring Data

The data used to conduct this review are maintained by CH2M HILL in an electronic data warehouse. Most of the data used to assess compliance with the SOW requirements were supplied directly by the Site Operator, Iron Mountain Operations (IMO), and reported in the IMO monthly reports submitted to Global Loss Prevention, Inc.; the California Department of Toxic Substances Control; the Central Valley Regional Water Quality Control Board; EPA; and CH2M HILL. Additional data used for this review were collected by CH2M HILL for

EPA during annual wet season sampling. Although the data warehouse 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, but are described in the IMO monthly reports.

IMO data were used for the review except where noted otherwise. Table 3 summarizes the compliance data reported by IMO between January 1, 2008, and December 31, 2012. For the purposes of this evaluation, calculations used the method detection limit for non-detect values.

TABLE 3
Summary of Iron Mountain Operations Effluent Monitoring Data, January 2008 through December 2012
*Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review*

| Parameter | No. of Results | No. of NDs | Percent NDs | Median ND Value (µg/L) |
|---|---|---|---|---|
| Cadmium, Dissolved | 1,632 | 22 | 1 | 0.2 |
| Cadmium, Total | 1,638 | 676 | 41 | 2.0 |
| Copper, Dissolved | 1,634 | 42 | 3 | 0.6 |
| Copper, Total | 1,638 | 1 | 0.1 | 2 |
| Zinc, Dissolved | 1,634 | 0 | 0 | N/A |
| Zinc, Total | 1,640 | 0 | 0 | N/A |
| Daily pH | 1,665 | N/A | N/A | N/A |
| Daily Flow | 1,765 | N/A | N/A | N/A |

Note:
ND = non-detect

## 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

Figure 3 provides a plot of MFTP effluent pH from January 2008 through December 2012. No exceedances of the daily or monthly CWA limits for pH were observed for the MFTP effluent during the period.

### Total Cadmium

No exceedances of the daily or monthly CWA limits for total cadmium occurred during the review period. The average of IMO data equaled 2.56 µg/L, with a maximum of 13.1 µg/L. The maximum result of 13.1 µg/L occurred on December 17, 2010. The January 2010 monthly average of 4.8 µg/L was the highest monthly average during the FYR period, but

far below the CWA monthly average limit of 50 µg/L. Figure 4 shows the daily concentrations and Figure 5 shows the 30-day rolling average concentrations for total cadmium during the review period.

### Total Copper

The MFTP achieved the CWA requirements for total copper for more than 99 percent of the days reported for the FYR period. Fourteen days (less than 1 percent) exceeded the daily CWA limit for total copper from January 2008 through December 2012. Table 4 provides an explanation of contributing factors, as reported in IMO monthly progress reports. Figure 6 shows the daily concentrations and Figure 7 shows the 30-day rolling average concentrations for total copper during the review period. The monthly average exceeded the CWA limit for total copper (150 µg/L) on two occasions: March 2008 and February 2010 (152.3 and 160.7 µg/L, respectively). 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 exceeded.

TABLE 4
Factors Influencing Total Copper and Total Zinc Concentrations Exceeding the Clean Water Act 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) |
|---|---|---|---|---|
| 3/25/2008 | Total copper | 305 | Windy conditions affected TSS and total copper. | 25.3 |
| 7/13/2009 | Total copper | 479 | No assignable cause identified. | 12.9 |
| 9/28/2009 | Total copper | 461 | Windy conditions affected TSS and total copper. | 21.0 |
| 1/21/2010 | Total copper | 307 | High TSS was measured but no assignable cause identified for high total copper. | 11.0 |
| 1/24/2010 | Total copper | 337 | High TSS was measured but no assignable cause identified for high total copper. | 7.0 |
| 1/25/2010 | Total copper | 532 | High TSS was measured but no assignable cause identified for high total copper. | 7.8 |
| 2/2/2010 | Total copper | 653 | No assignable cause identified. | 9.6 |
| 2/2/2010 | Total zinc | 1,570 | No assignable cause identified. | 9.6 |
| 2/6/2010 | Total copper | 310 | High TSS was measured but no assignable cause identified for high total copper. | 9.2 |
| 4/14/2010 | Total copper | 404 | High TSS was measured but no assignable cause identified for high total copper. | 10.5 |
| 4/15/2010 | Total copper | 315 | High TSS was measured but no assignable cause identified for high total copper. | 10.5 |
| 12/17/2010 | Total copper | 468 | Thickener overflow trough cleaning. | 5.8 |
| 12/17/2010 | Total zinc | 1,980 | Thickener overflow trough cleaning. | 5.8 |
| 1/17/2012 | Total copper | 530 | During exceptionally low flow, ice formed on the discharge trough during the night and melted in the morning, mobilizing solids that accumulated. | 10.0 |

TABLE 4
Factors Influencing Total Copper and Total Zinc Concentrations Exceeding the Clean Water Act 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) |
|---|---|---|---|---|
| 1/17/2012 | Total zinc | 1,600 | During exceptionally low flow, ice formed on the discharge trough during the night and melted in the morning, mobilizing solids that accumulated. | 10.0 |
| 4/3/2012 | Total copper | 348 | Windy conditions affected TSS and total copper. | 51.0 |
| 12/4/2012 | Total copper | 304 | No assignable cause identified. | 11.0 |

[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.

Note:

Wind speeds greater than 20 mph are considered high winds that could affect total metals concentrations (Carver, 2008).

### Total Zinc

The MFTP achieved the CWA requirements for total zinc (1,500 µg/L) for more than 99 percent of the days reported. Three days (0.2 percent) exceeded the daily CWA limit for total zinc during the FYR period. See Table 4 below for an explanation of contributing factors. Figure 8 shows the daily concentrations and Figure 9 shows the 30-day rolling average concentrations for total zinc during the review period. The monthly average did not exceed the CWA limit for total zinc.

### Total Lead

The SOW does not require IMO to collect samples to demonstrate compliance with the CWA limits for lead. However, CH2M HILL (for EPA) periodically analyzes effluent grab samples for lead as part of its oversight monitoring program. The CH2M HILL dataset was used to provide the information for this section. During the past 5 years, CH2M HILL collected 186 effluent samples for lead analysis. Most of these samples were collected weekly during the winter months. The average for all the samples equaled 1.6 µg/L, and the maximum result equaled 7.6 µg/L. The maximum lead result of 7.6 µg/L occurred on April 4, 2012, which coincides with a high result for total zinc on that day. The next highest result for total lead equaled 6.3 µg/L. None of the test results exceeded the CWA daily or monthly limits for total lead.

## Best Available Technology Limit Compliance

This section summarizes IMO compliance with BAT requirements. 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 98 percent of the days reported. In the 1,629 treatment plant effluent samples collected at the MFTP, 22 (1.4 percent) of the reported concentrations were greater than 3 µg/L. Figure 10 shows the daily concentrations, Figure 11 shows the 7-day rolling average concentrations, and Figure 12 shows the 30-day rolling average concentrations for dissolved cadmium during the review period.

Figure 10 shows that the majority of the dissolved cadmium exceedances during the review period occurred from December 2008 through March 2009 and in January 2010. In 2010, CH2M HILL evaluated possible reasons for elevated dissolved cadmium and zinc concentrations in the treatment plant effluent (CH2M HILL, 2010). A key finding of this evaluation was that when both reactors were in operation during high AMD inflow, the pH in Reactor Tank 2 was not specifically controlled. In accordance with the SOW, IMO was maintaining Reactor Tank 1 at pH 8.4 or higher. However, the pH was dropping in Reactor Tank 2 as iron continued to oxidize. IMO made an operational change following the 2010 evaluation to monitor the pH in the Reactor Tank 2 and control lime addition to the sludge recycle tank to keep the pH in Reactor Tank 2 above 8.4. Figure 10 shows that the effluent dissolved cadmium concentrations were generally below 3 µg/L following this operational change.

### Dissolved Copper

CH2M HILL data demonstrate substantial compliance with the BAT requirements for maximum daily dissolved copper (15 µg/L) from January 2008 through December 2012. In the 1,629 samples of the treatment plant effluent collected by CH2M HILL at the MFTP, the reported concentrations were less than 15 µg/L for all but 9 (0.55 percent) of the samples. Figure 13 shows the daily concentrations, Figure 14 shows the 7-day rolling average concentrations, and Figure 15 shows the 30-day rolling average concentrations for dissolved copper during the review period. The majority of the dissolved copper exceedances occurred in July 2012; these exceedances were attributed to Tank 11 (TK11) overflow trough cleaning operations (IMO, 2012).

### 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 1,529 days (94 percent of IMO data). The average of all concentrations equaled 76 µg/L, with a minimum of 3.9 µg/L and a maximum of 882 µg/L. Figure 16 shows the daily concentrations, Figure 17 shows the 7-day rolling concentrations, and Figure 18 shows the 30-day rolling average concentrations for dissolved zinc during the review period.

The highest zinc detections occurred in 2009 and 2010, including the maximum result of 882 µg/L on January 10, 2010. As discussed for dissolved cadmium, CH2M HILL evaluated possible reasons for elevated dissolved zinc concentrations in the MFTP effluent (CH2M HILL, 2010). Following this 2010 evaluation, IMO made an operational change to monitor the pH in the Reactor Tank 2 and control lime addition to the sludge recycle tank to keep the pH in Reactor Tank 2 above 8.4. Figure 16 shows that the effluent dissolved zinc concentrations were below 300 µg/L following this operational change.

### Best Available Technology Limit Evaluation

The 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 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 ROD 4 was determined operational and functional by EPA and the State of California on August 26, 2004 (CH2M HILL, 2004).

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 MFTP. Specifically, when the MFTP is operating normally, the effluent frequently exceeds BAT limits for dissolved zinc and dissolved cadmium. Global Loss Prevention, Inc., EPA, and IMO are working together to finalize clarifications and modifications to the SOW, including re-evaluation of BAT performance standards.

## Conclusions and Five-Year Review Recommendations

The following are conclusions and recommendations resulting from the review of the MFTP effluent data collected over the past 5 years.

### Clean Water Act Effluent Limitations

#### Conclusion

The MFTP 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 when CWA daily or 30-day average limits were exceeded were rare and frequently could be attributed to operational conditions or other known factors.

#### Recommendation

No change in the CWA effluent limitations is recommended. The HDS technology is being properly implemented by the Site Operator.

### Best Available Technology Effluent Limitations

#### Conclusion

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

#### Recommendation

EPA should formally revise the SOW to modify BAT effluent limits based on the metals removal level currently achieved at the MFTP.

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# Figures

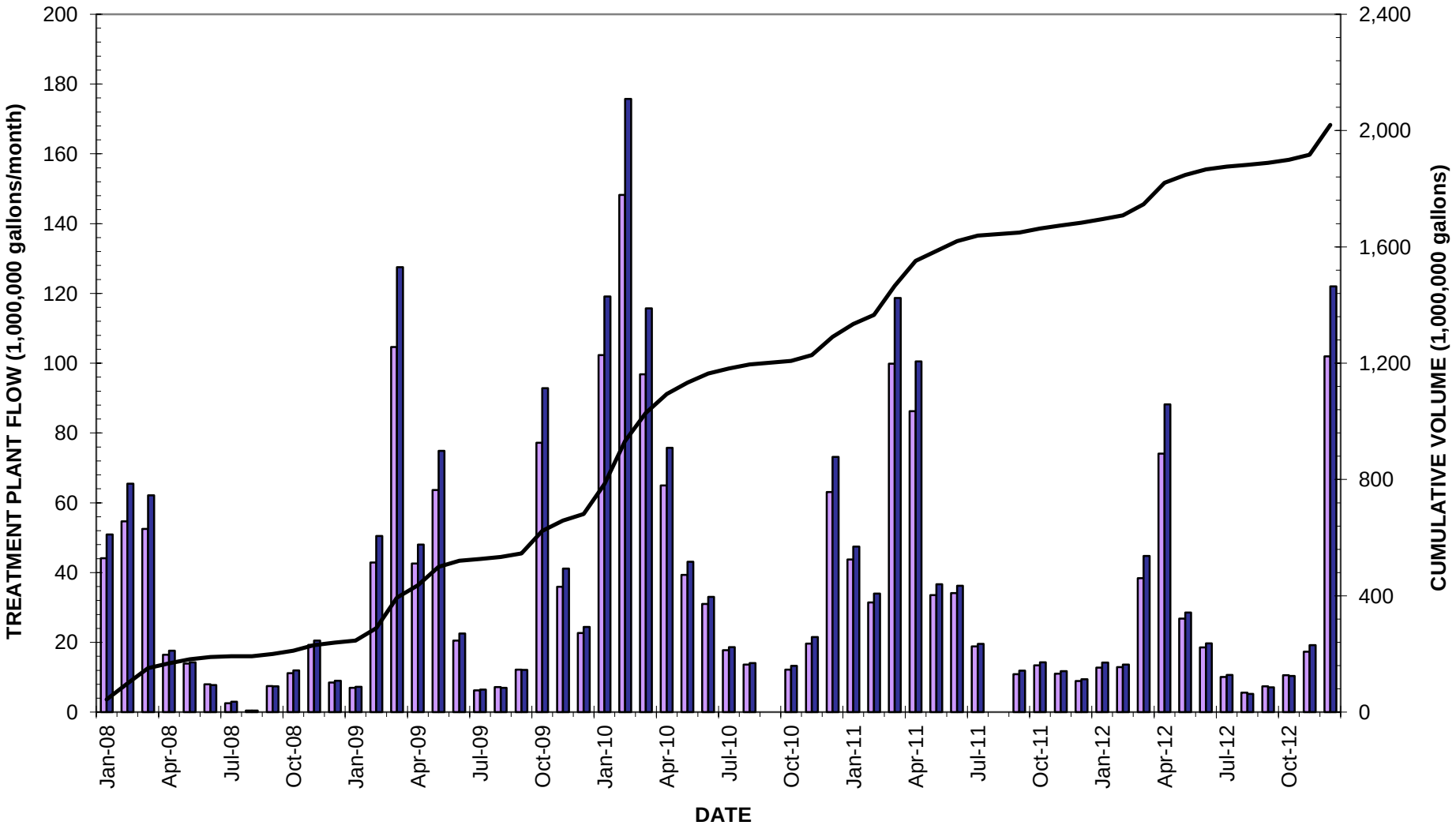
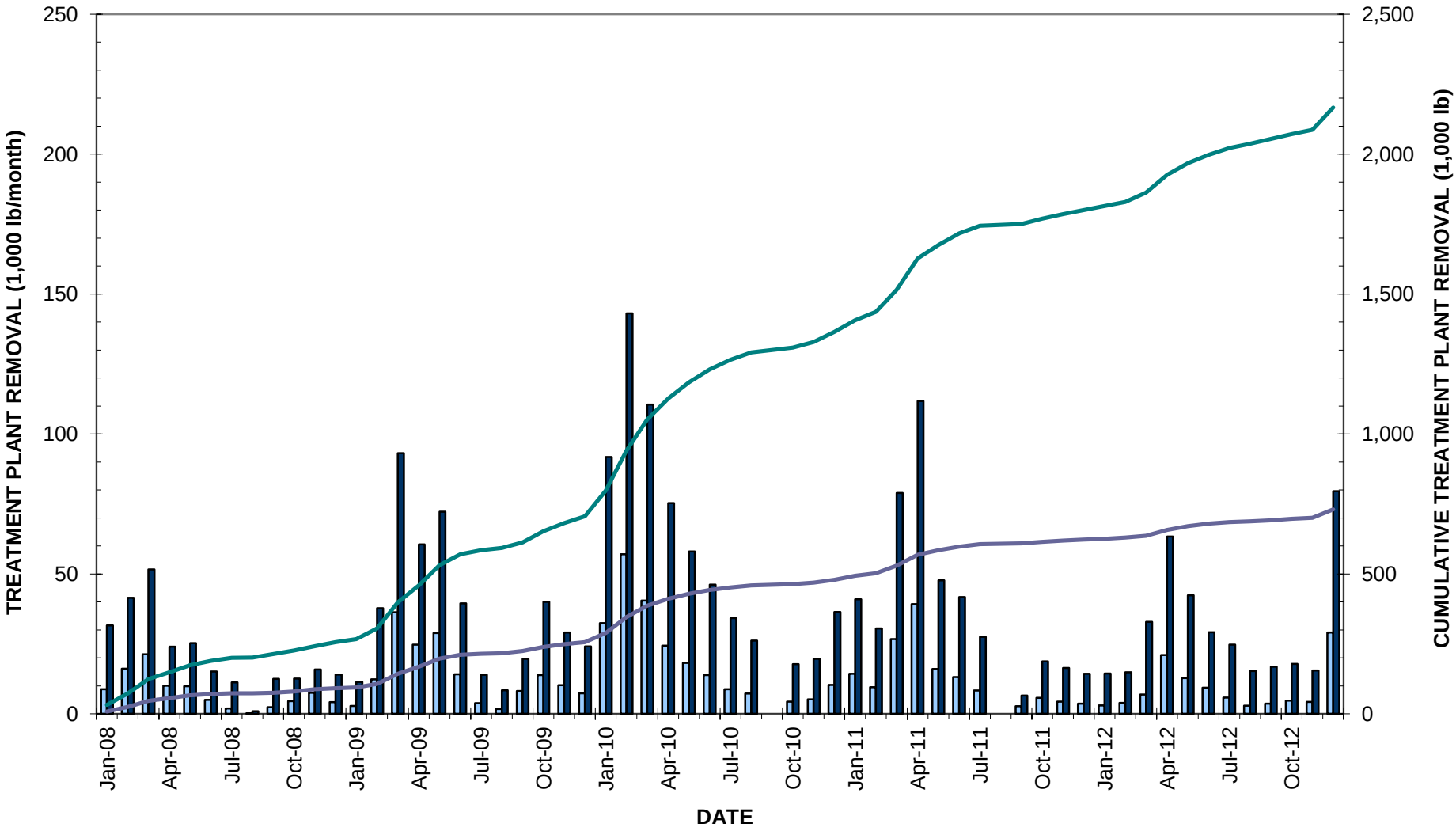



**FIGURE 1**
**MFTP MONTHLY FLOW SUMMARY,**
**JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

2008-2013_MFTP_Effluent_Compliance_figures.xlsm: F1-flow




COPPER LOAD REMOVED

ZINC LOAD REMOVED

CUMULATIVE COPPER LOAD REMOVED

CUMULATIVE ZINC LOAD REMOVED

**FIGURE 2**
**MFTP MONTHLY COPPER AND ZINC LOAD REMOVAL SUMMARY, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

2008-2013_MFTP_Effluent_Compliance_figures.xlsm: F2-load

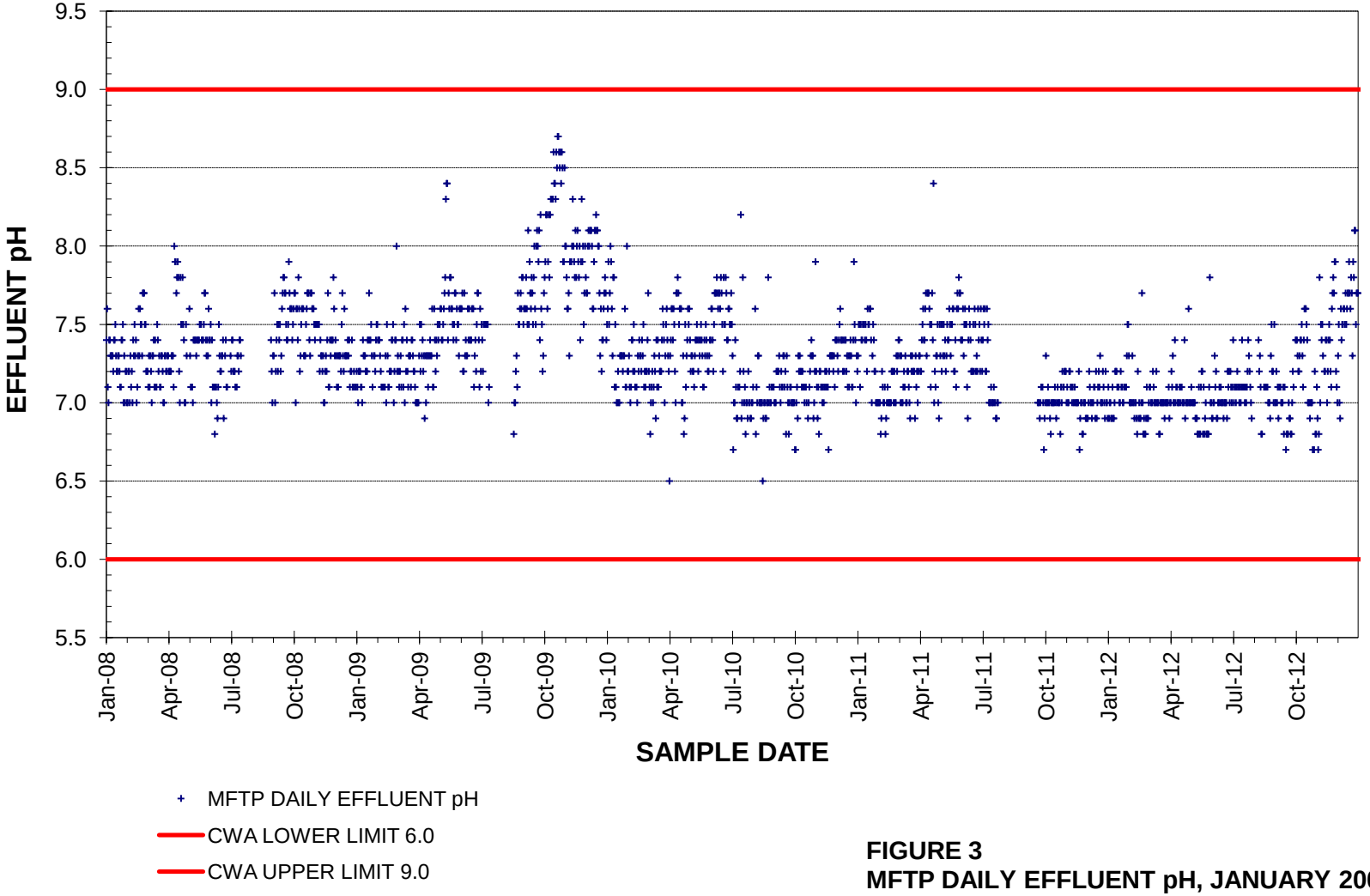
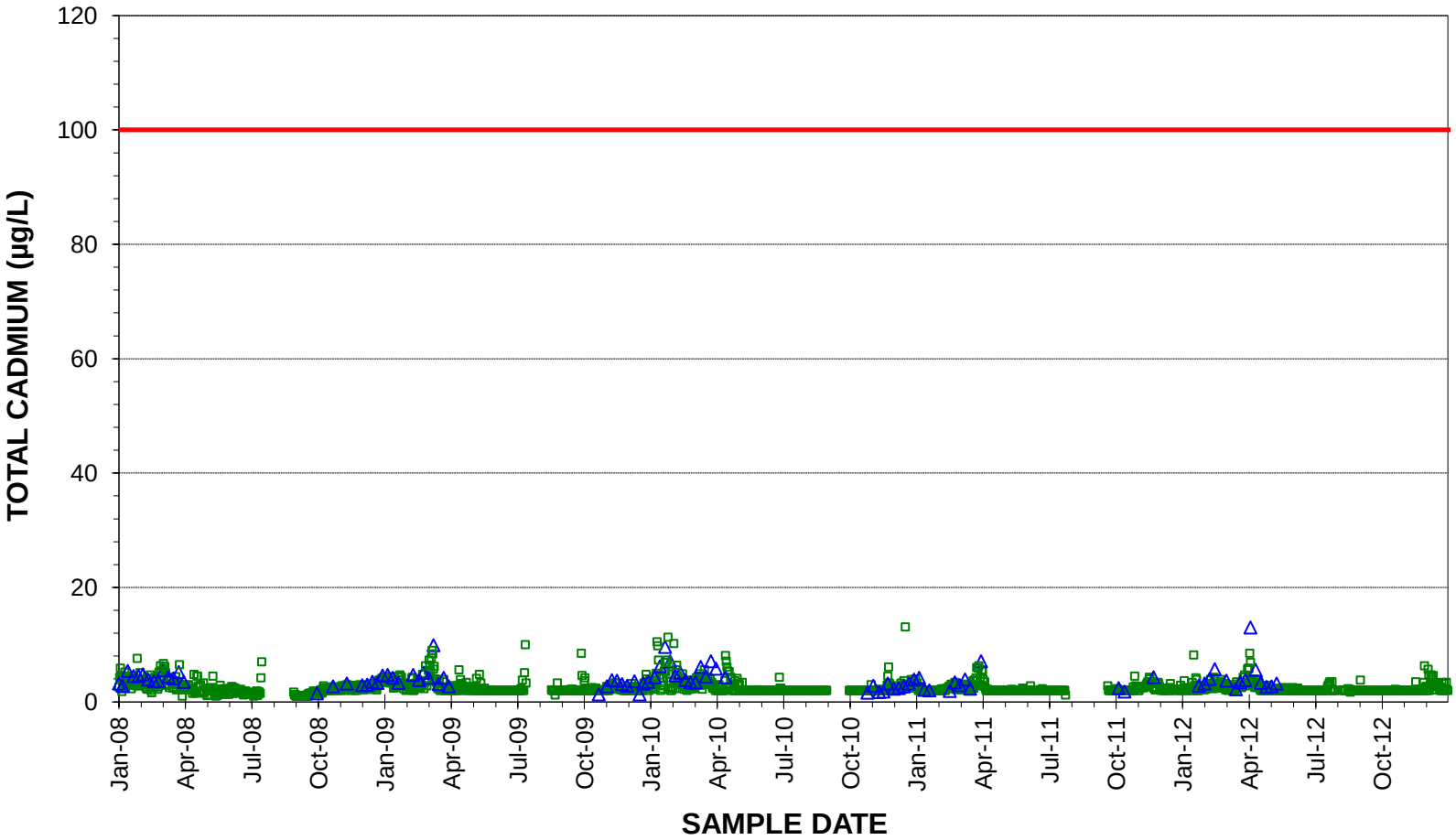



**FIGURE 3**
**MFTP DAILY EFFLUENT pH, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

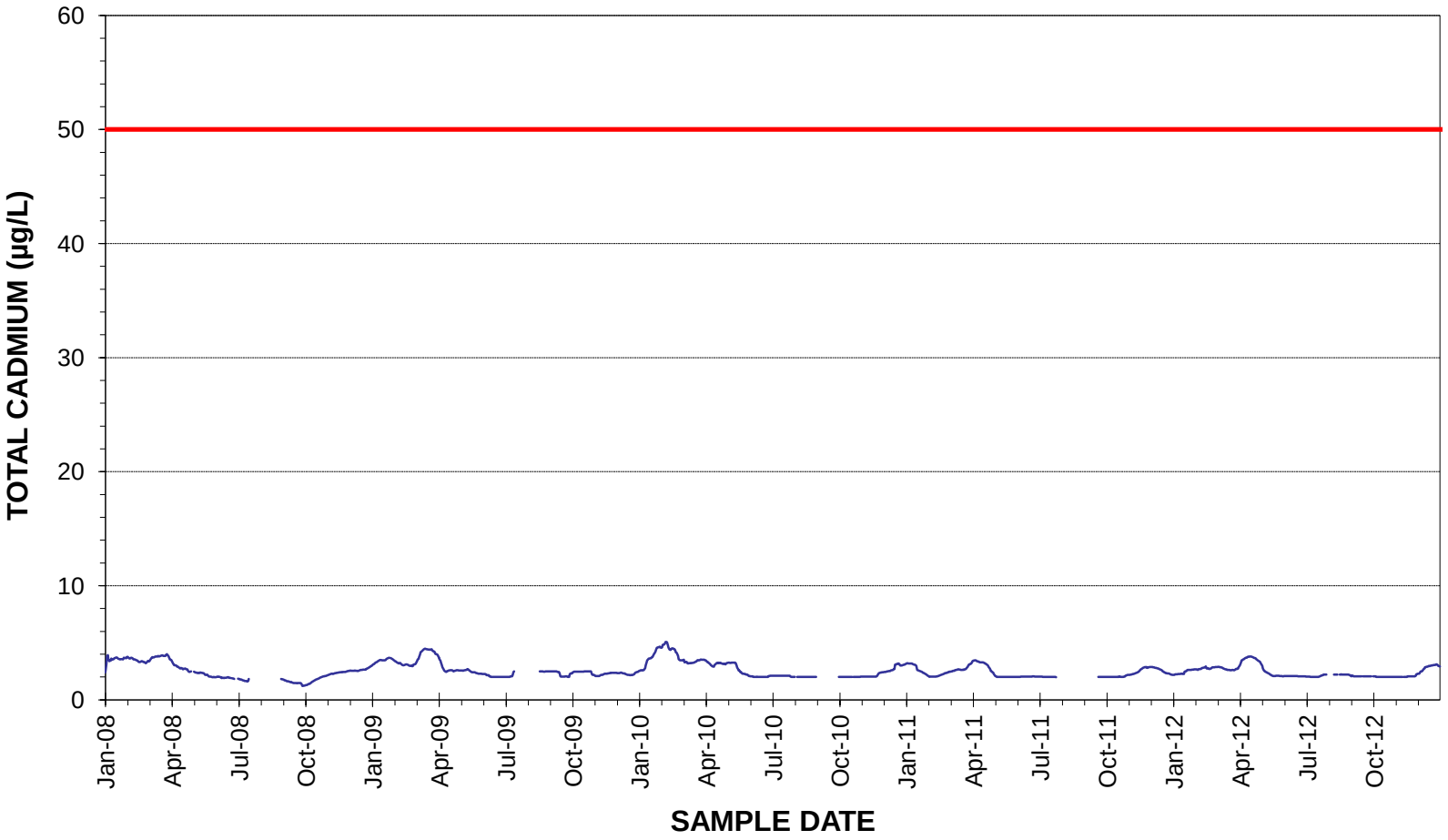



MFTP TOTAL CADMIUM DAILY

CH2M HILL TOTAL CADMIUM

CWA DAILY MAXIMUM 100 µg/L

**FIGURE 4**
**MFTP DAILY EFFLUENT TOTAL CADMIUM, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE




TOTAL CADMIUM 30-DAY AVERAGE

CWA 30-DAY MAXIMUM 50 µg/L

**FIGURE 5**
**MFTP 30-DAY AVERAGE EFFLUENT TOTAL CADMIUM, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

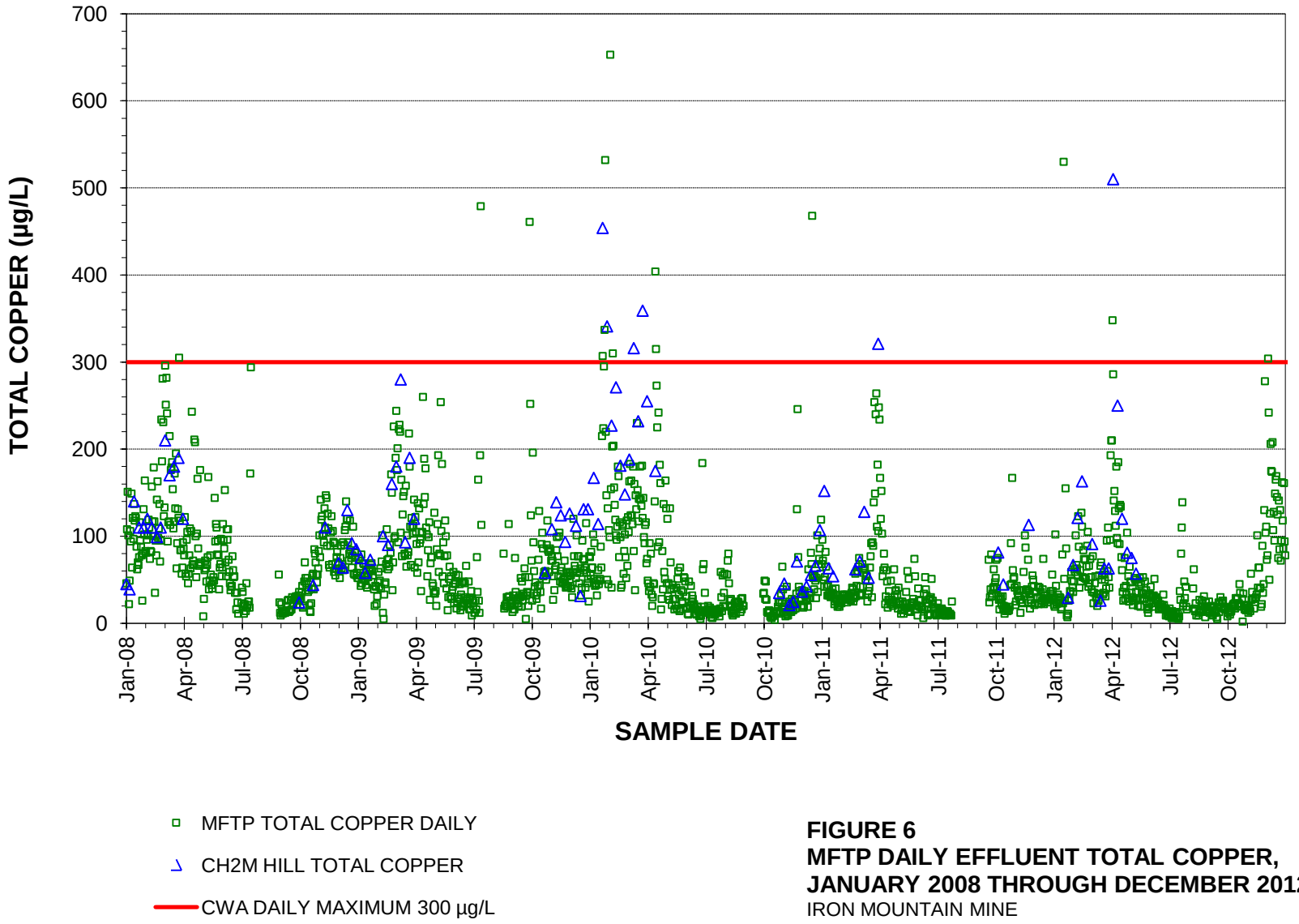
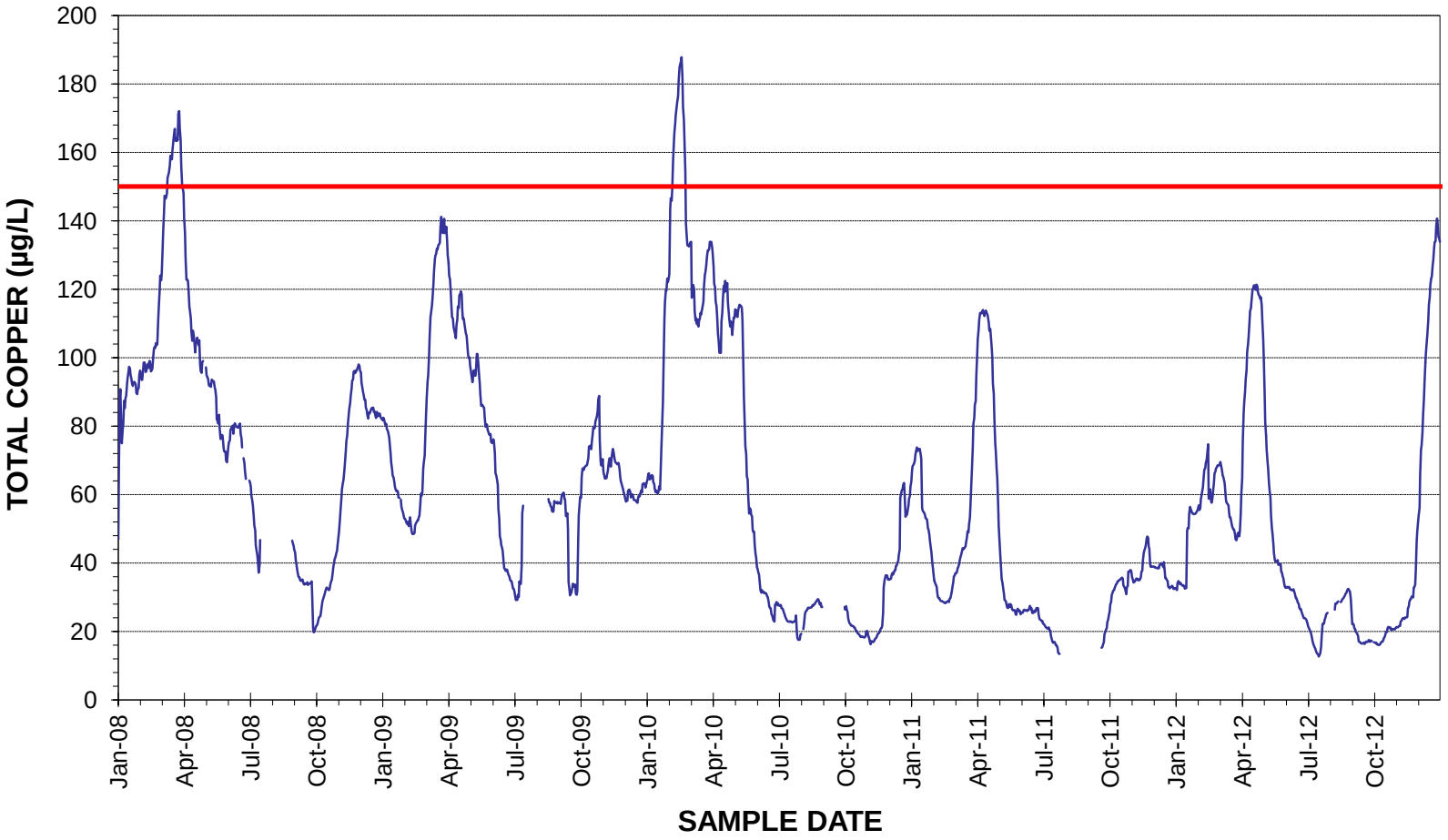


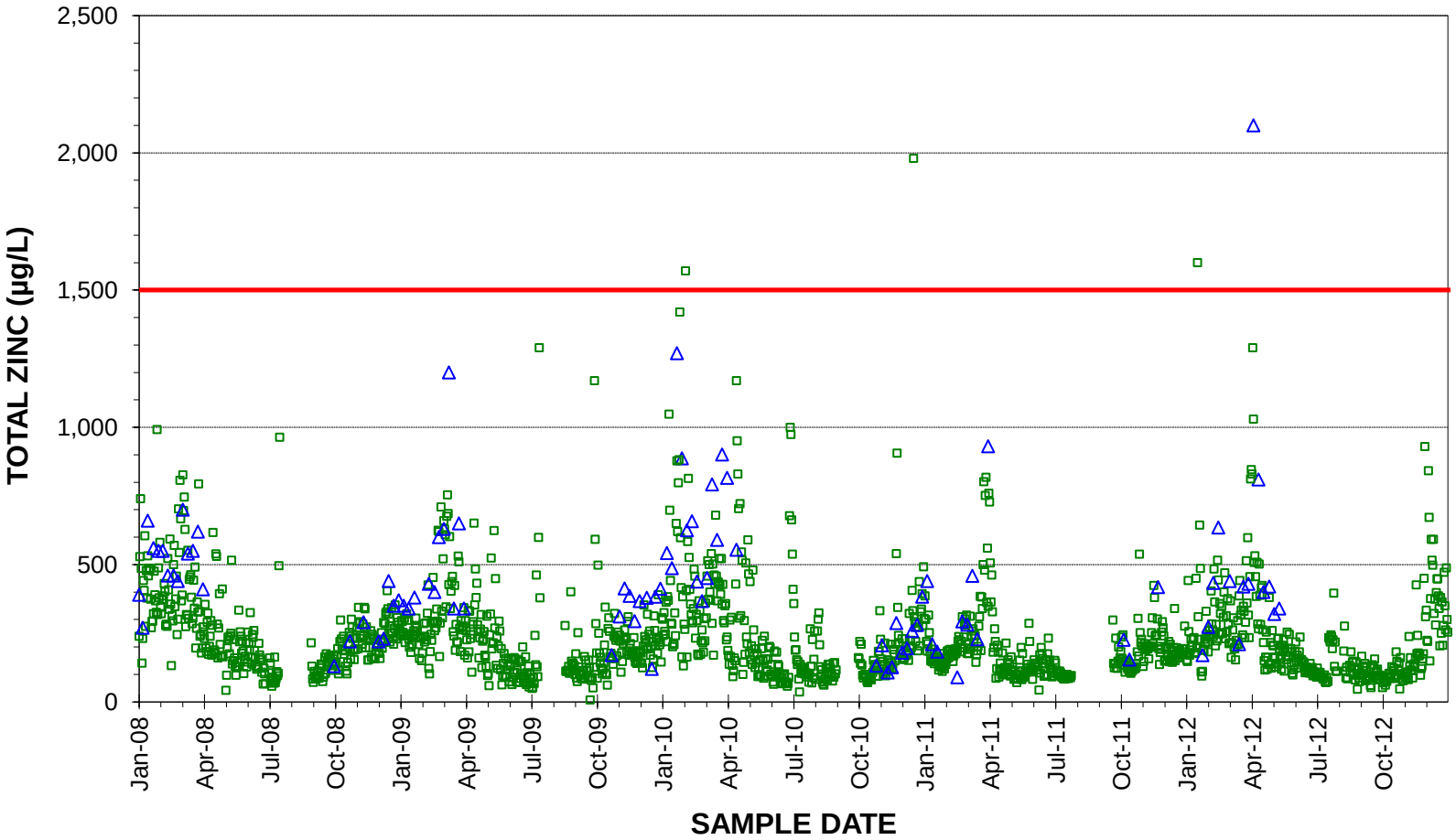

**FIGURE 6**
**MFTP DAILY EFFLUENT TOTAL COPPER, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE




TOTAL COPPER 30-DAY AVERAGE

CWA 30-DAY MAXIMUM 150 µg/L

**FIGURE 7**
**MFTP 30-DAY AVERAGE EFFLUENT TOTAL COPPER, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

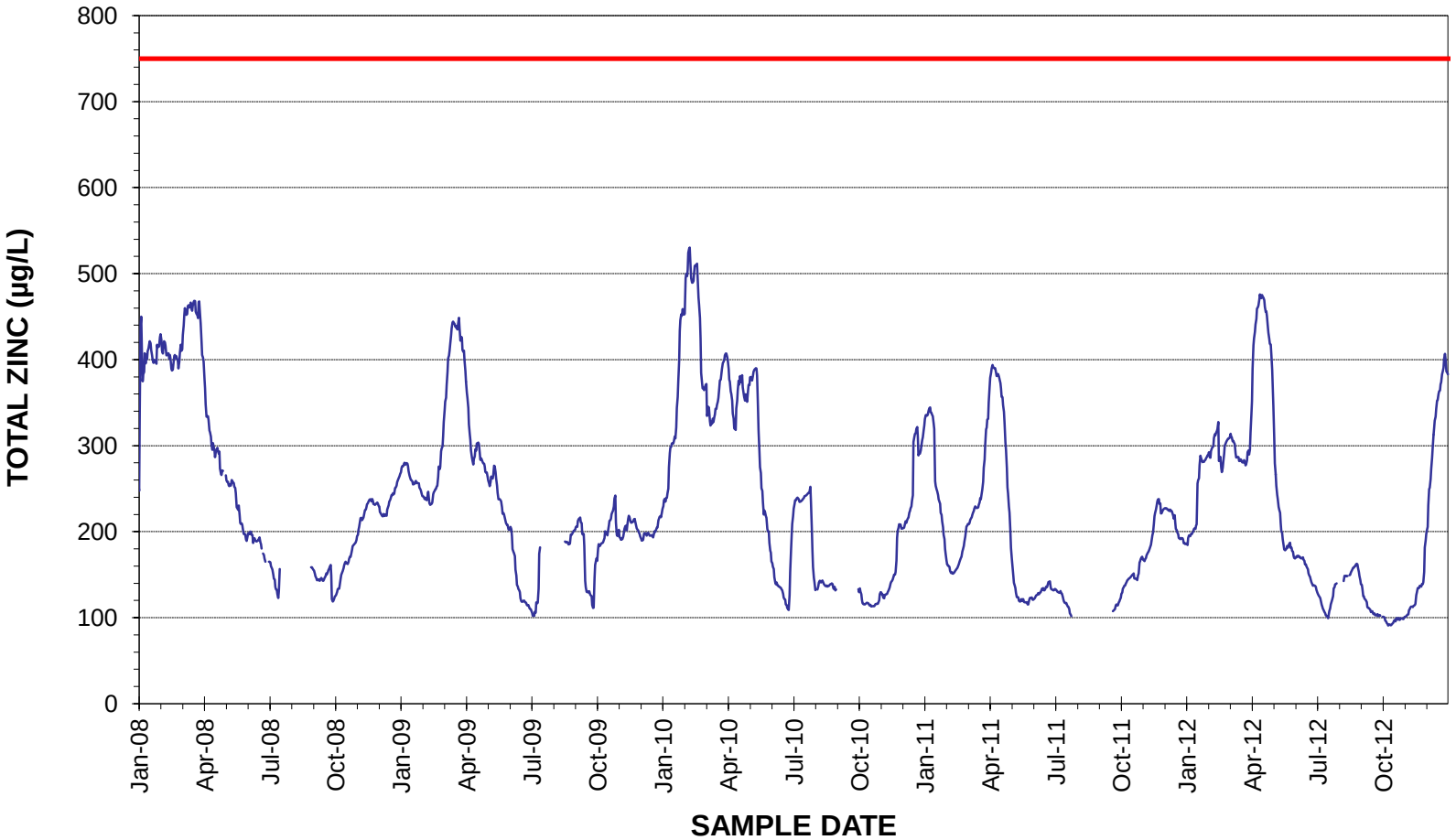



MFTP TOTAL ZINC DAILY

CH2M HILL TOTAL ZINC

CWA DAILY MAXIMUM 1500 µg/L

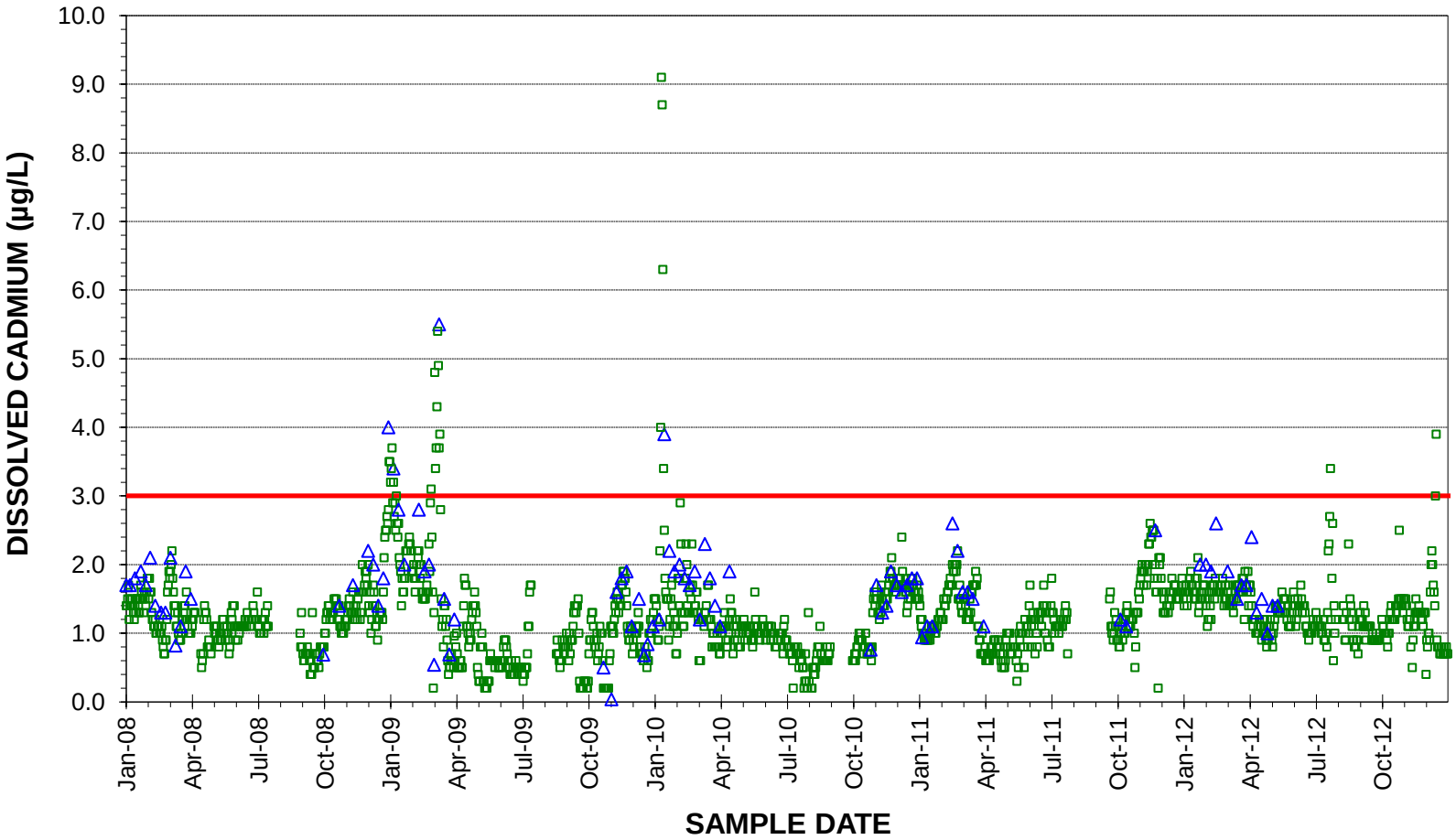
**FIGURE 8**
**MFTP DAILY EFFLUENT TOTAL ZINC, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE




TOTAL ZINC 30-DAY AVERAGE

CWA 30-DAY MAXIMUM 750 µg/L

**FIGURE 9**
**MFTP 30-DAY AVERAGE EFFLUENT TOTAL ZINC, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

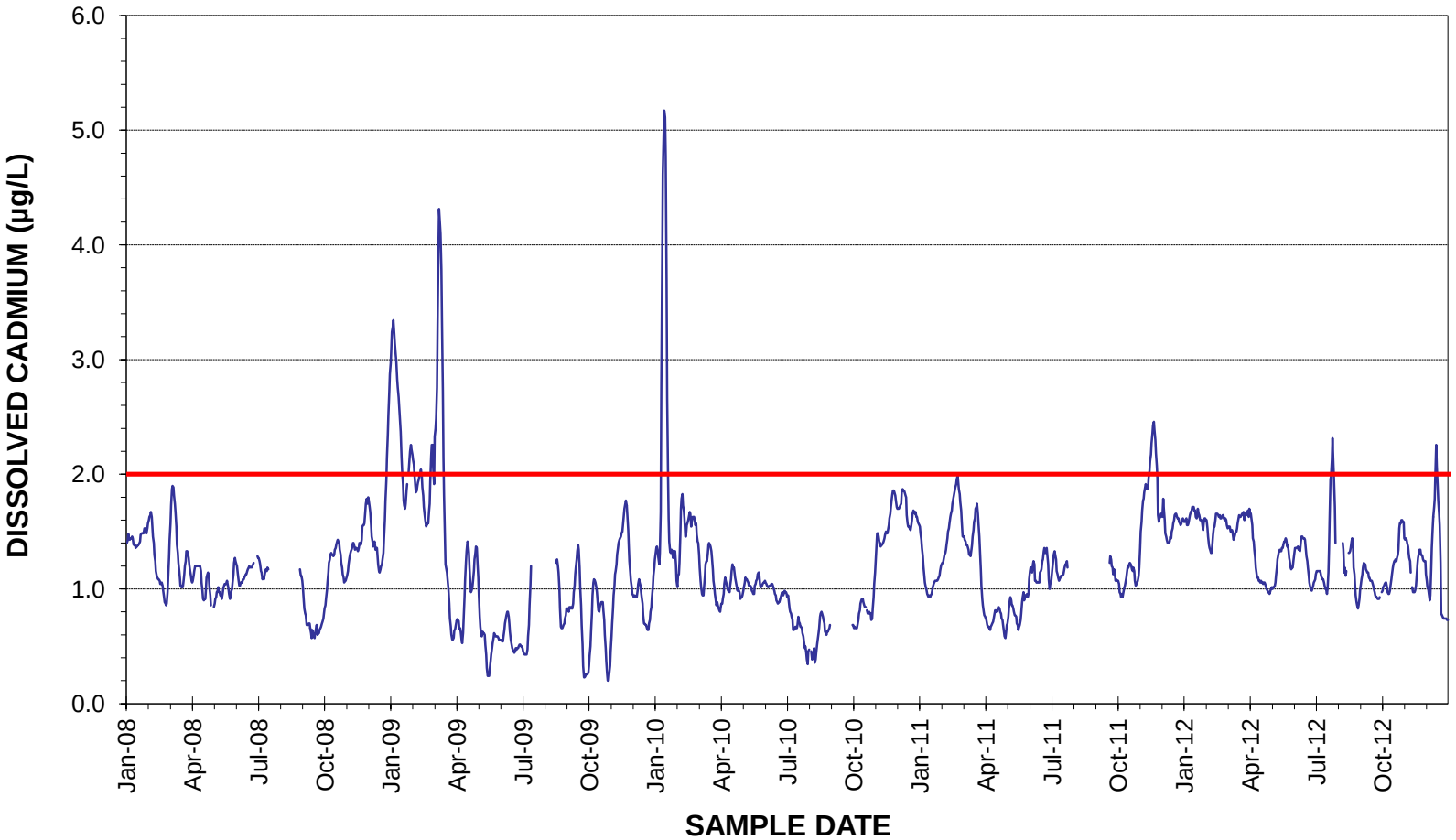



MFTP DISSOLVED CADMIUM DAILY

CH2M HILL DISSOLVED CADMIUM

BAT DAILY MAXIMUM 3 µg/L

**FIGURE 10**
**MFTP DAILY EFFLUENT DISSOLVED CADMIUM, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE




DISSOLVED CADMIUM 7-DAY AVERAGE

BAT 7-DAY MAXIMUM 2 µg/L

**FIGURE 11**
**MFTP 7-DAY AVERAGE EFFLUENT DISSOLVED CADMIUM, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

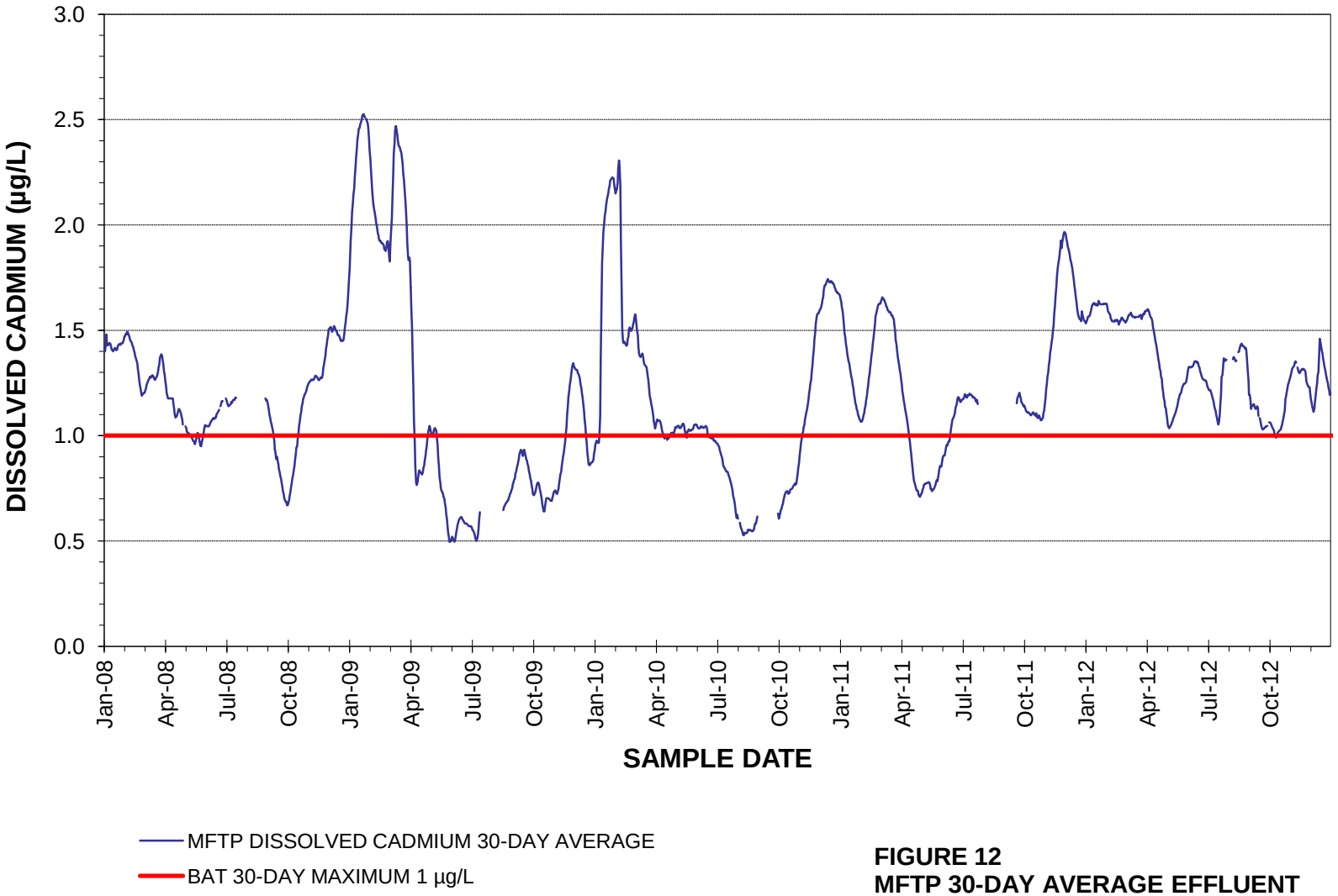
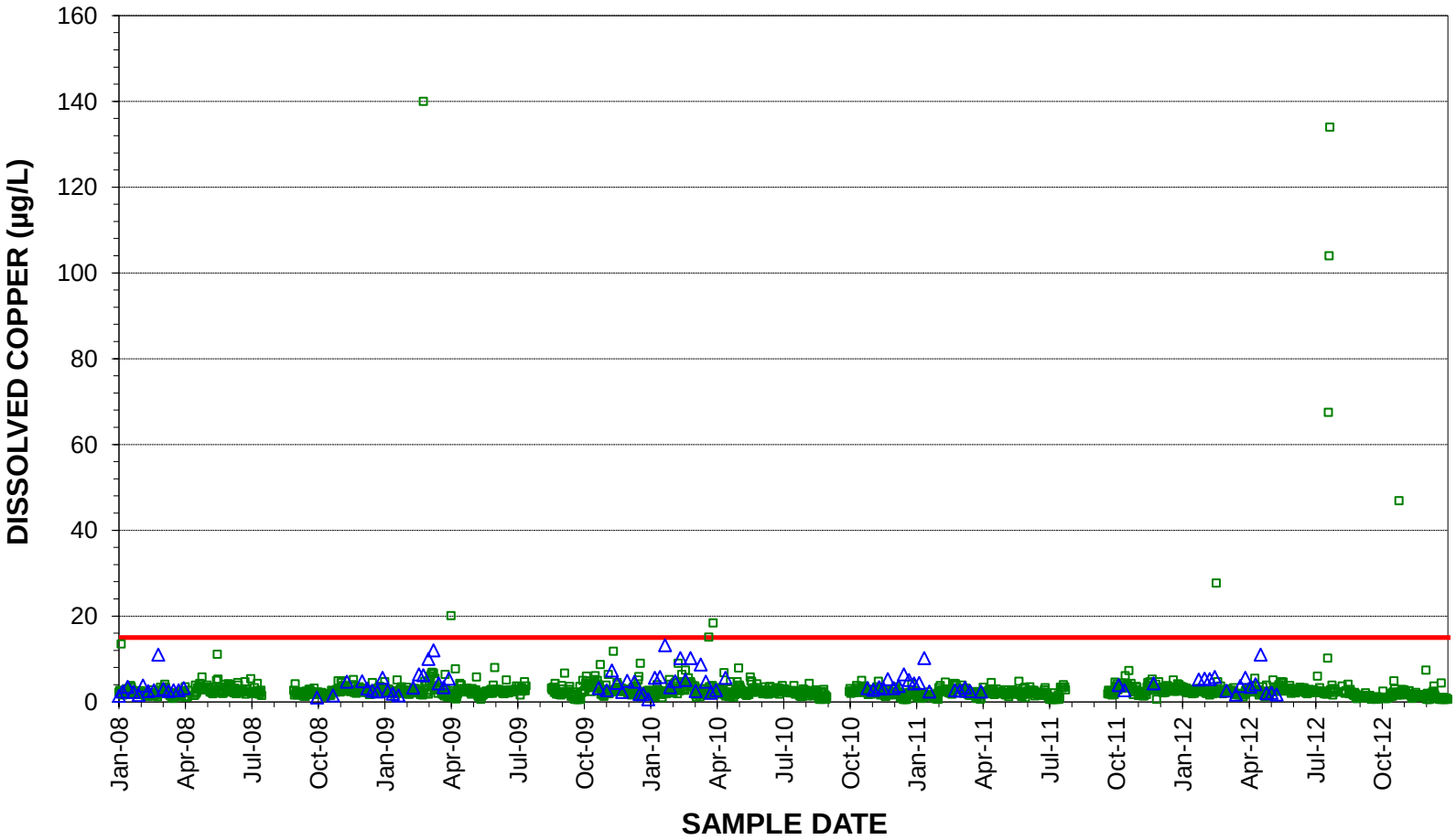



**FIGURE 12**
**MFTP 30-DAY AVERAGE EFFLUENT DISSOLVED CADMIUM, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE




MFTP DISSOLVED COPPER DAILY

CH2M HILL DISSOLVED COPPER

BAT DAILY MAXIMUM 15 µg/L

**FIGURE 13**
**MFTP DAILY EFFLUENT DISSOLVED COPPER, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

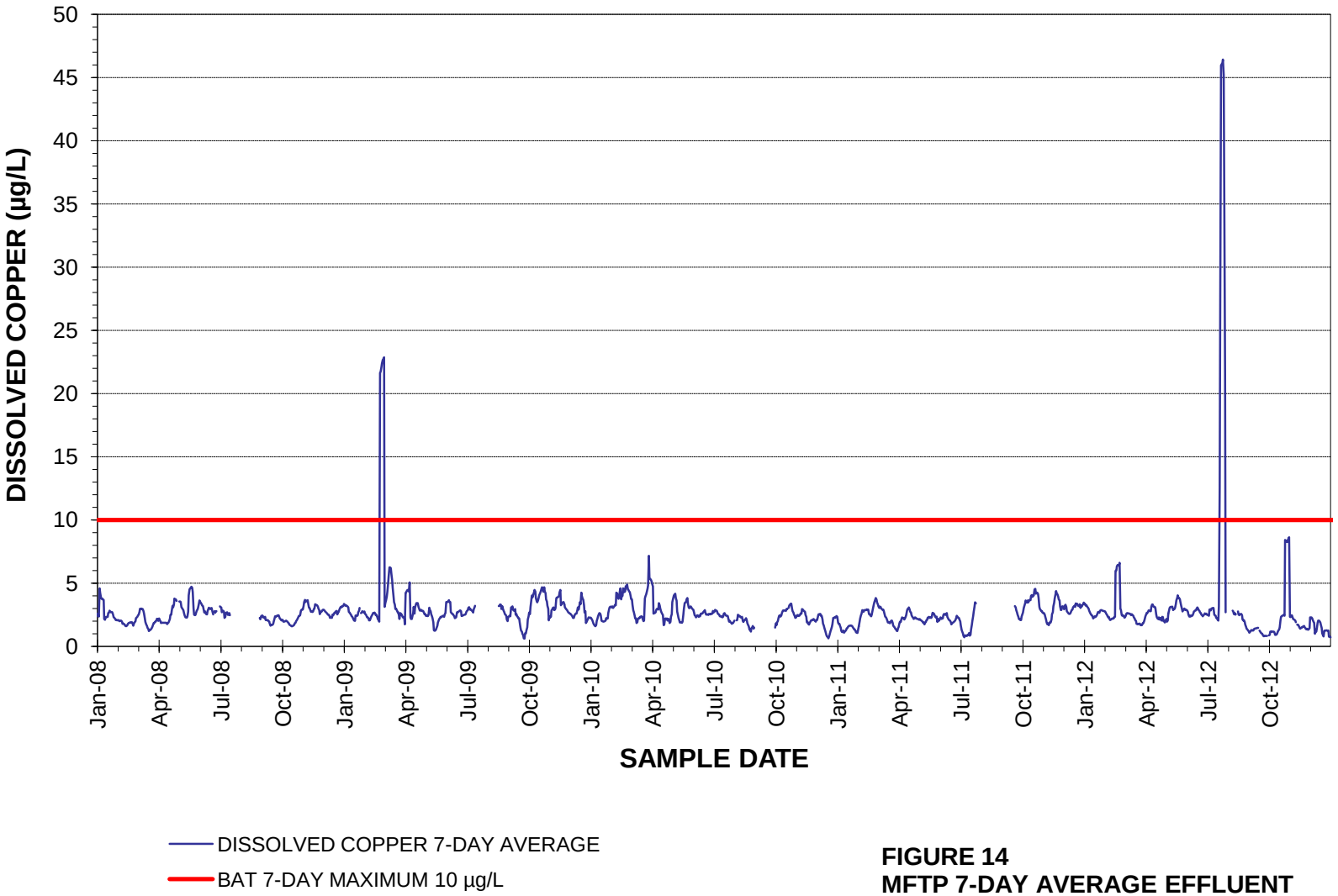
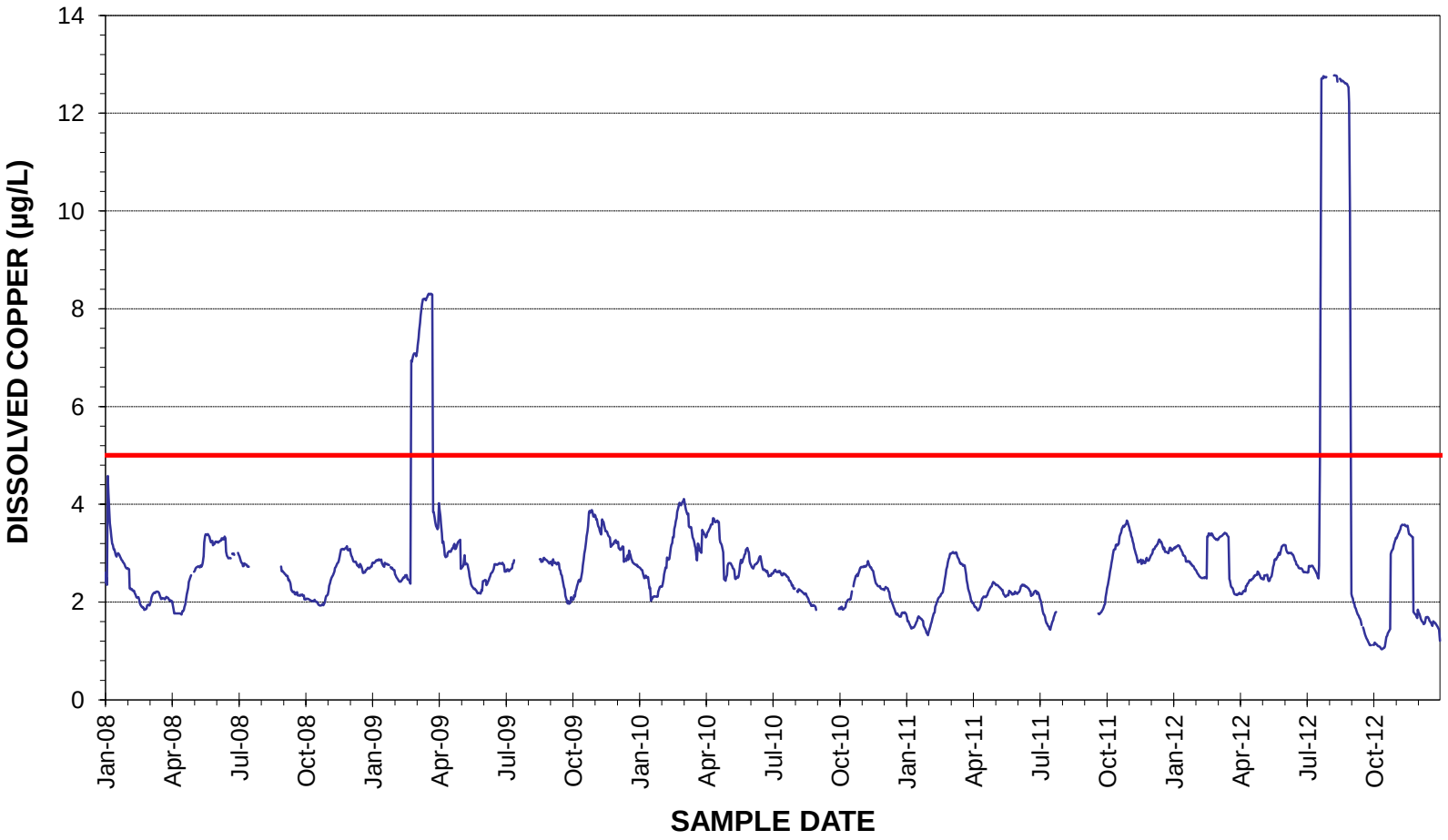



**FIGURE 14**
**MFTP 7-DAY AVERAGE EFFLUENT DISSOLVED COPPER, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE




MFTP DISSOLVED COPPER 30-DAY AVERAGE

BAT 30-DAY MAXIMUM 5 µg/L

**FIGURE 15**
**MFTP 30-DAY AVERAGE EFFLUENT DISSOLVED COPPER, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

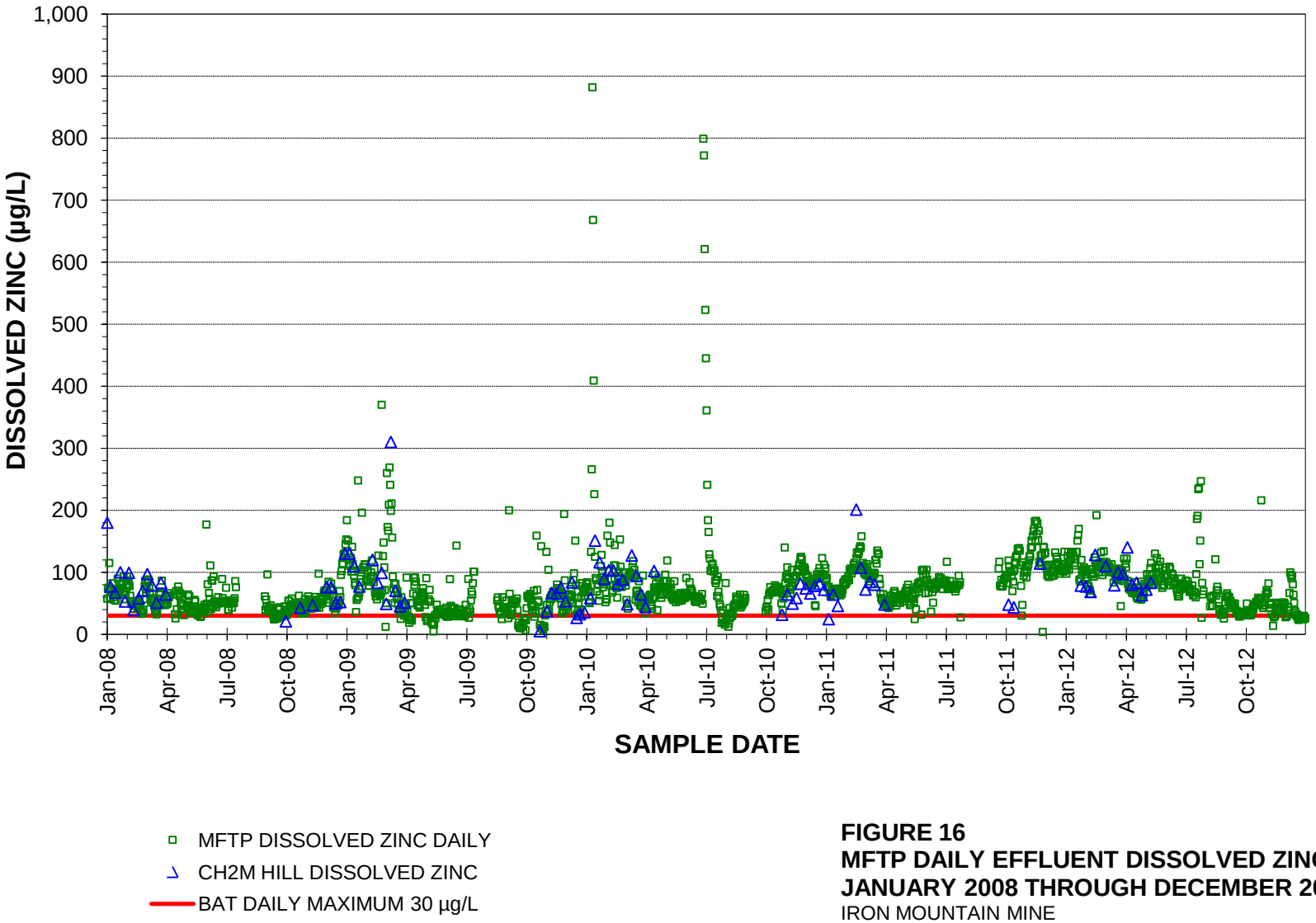



**FIGURE 16**
**MFTP DAILY EFFLUENT DISSOLVED ZINC, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

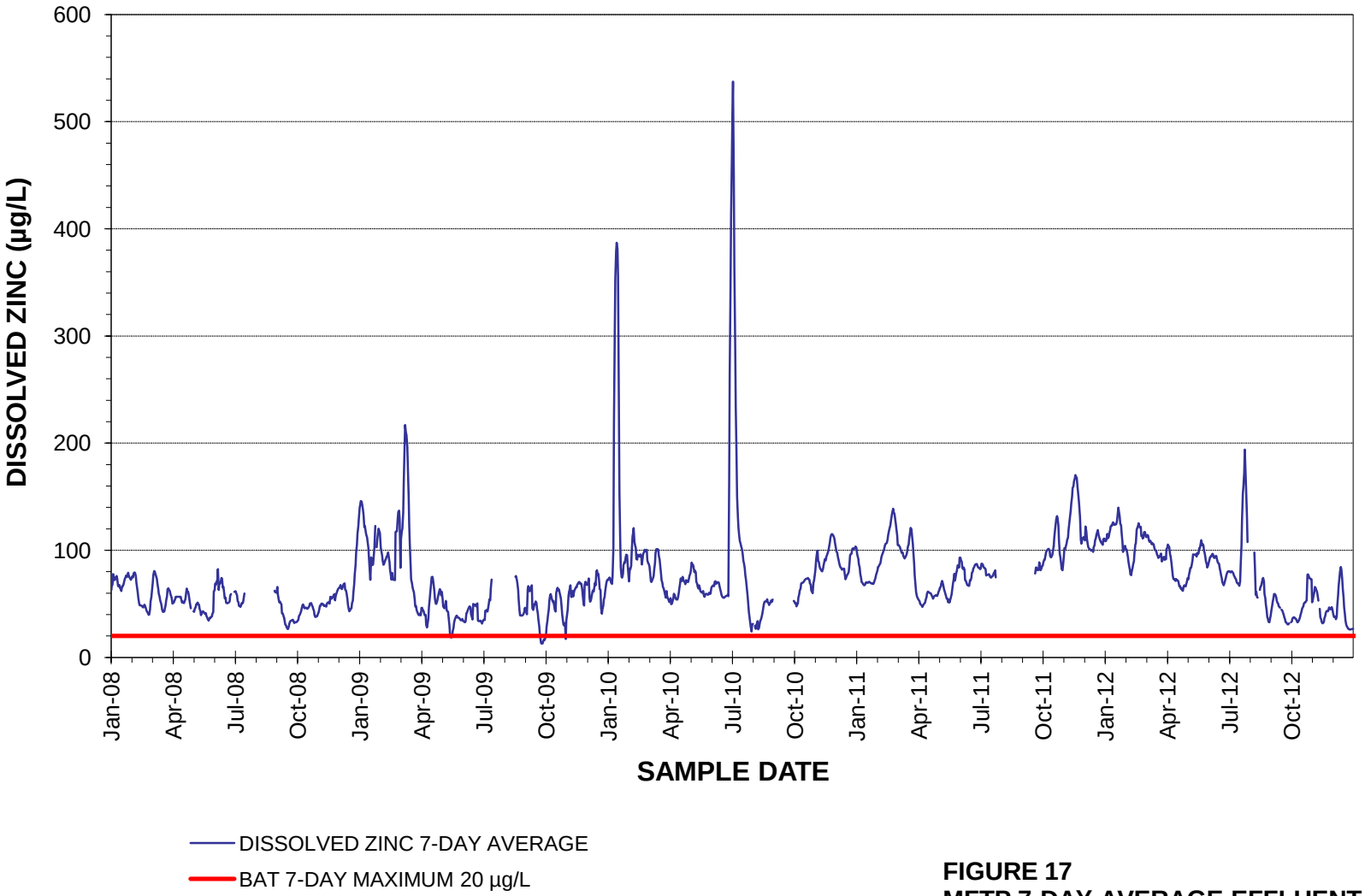



**FIGURE 17**
**MFTP 7-DAY AVERAGE EFFLUENT DISSOLVED ZINC, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

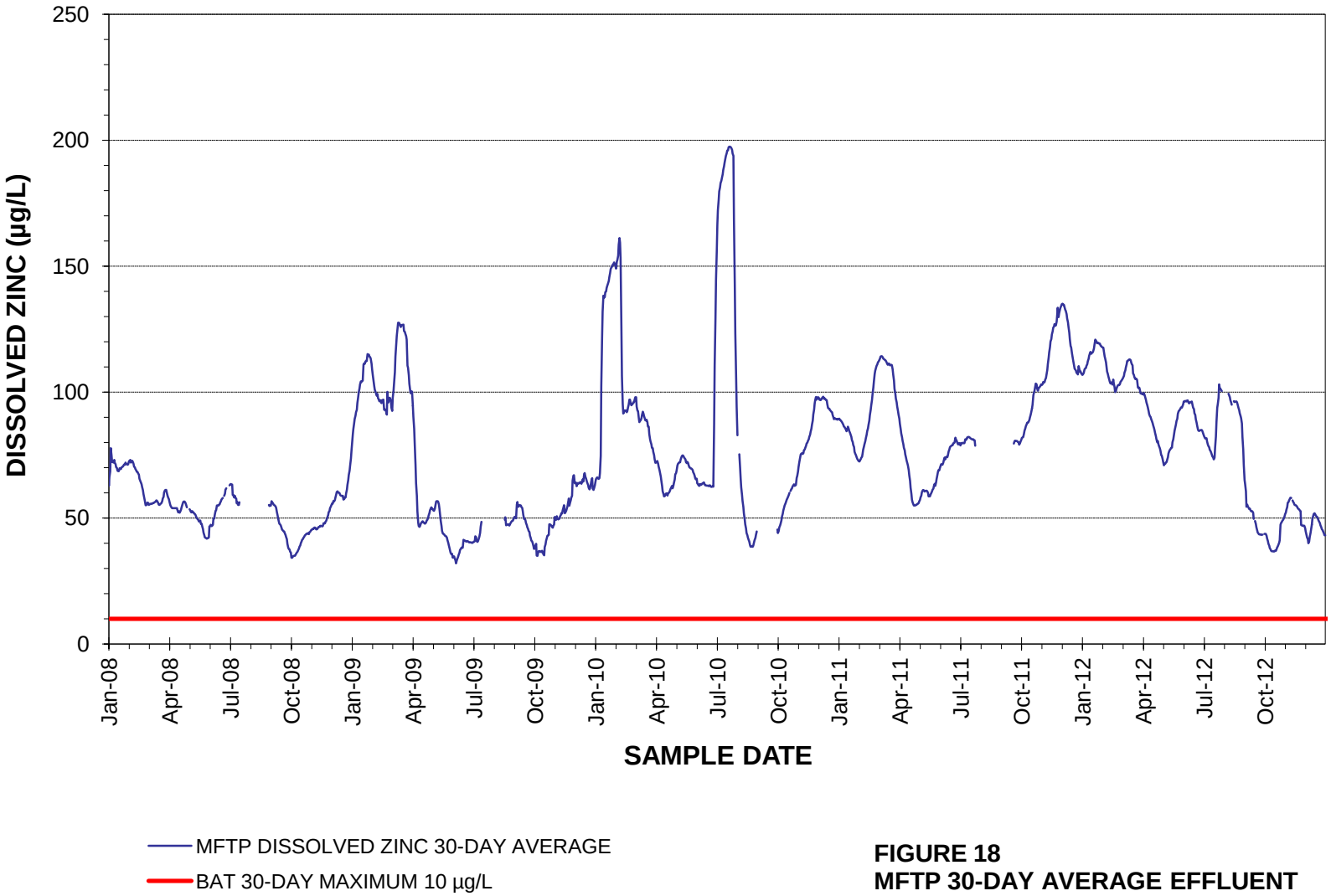



**FIGURE 18**
**MFTP 30-DAY AVERAGE EFFLUENT DISSOLVED ZINC, JANUARY 2008 THROUGH DECEMBER 2012**
IRON MOUNTAIN MINE

# Appendix H: Site Evaluation and Compliance at Keswick Dam

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

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PREPARED BY: Tom Wallis/CH2M HILL
Ed McCarthy/CH2M HILL
Sandra Shearer/CH2M HILL

DATE: April 5, 2013

PROJECT NUMBERS: 406751.FR.02

## 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 January 2008 through December 2012. 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.

## 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 (figures appear at the end of this technical memorandum). Acid mine drainage (AMD) from abandoned mine workings, waste piles, and other area sources discharges has affected the downstream reaches of Boulder Creek, Slickrock Creek, Lower Spring Creek, Spring Creek Reservoir, Keswick Reservoir (including the Spring Creek Arm of Keswick Reservoir [Spring Creek Arm] and the main body of Keswick Reservoir), and the 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.

## Iron Mountain Mine Remedy Effectiveness

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.

## 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 the interim remedial actions authorized under these RODs 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, 2004a) provided for a remedy that prevents the migration and deposition of contaminated sediment from Spring Creek Arm to the Sacramento River and reduces metal loads and suspended solids associated with the contaminated sediment. The Spring Creek Arm Sediment Removal Remedial Action was completed during this five-year review period. Sediment that was most susceptible to erosion was dredged from the Spring Creek Arm from October to December 2009 and March to June 2010. Sediment was dewatered and disposed of in the Confined Disposal Facility (CDF) located adjacent to Spring Creek Reservoir. Closure of the CDF, the last phase of the ROD 5 interim action, was substantially complete on October 25, 2011 (EPA, 2012).

## Treatment Plant Operations

In response to RODs 2 and 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 HDS portion of Minnesota Flats Treatment Plant (MFTP), with startup in January 1997. Since operations began in September 1994, MFTP has continued round-the-clock operations. Except for short downtime periods during heavy storm events, a 2008 forest fire, and periods of planned maintenance during the dry season, the plant has run continuously 24 hours per day, 7 days per week, during the fifth five-year review period. During downtime, AMD is stored in the 1-million-gallon emergency storage tank (TK14).

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 2008 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 from AMD collected and treated at MFTP for Water Years 2008 through 2012. During this period, EPA's remedial action at the IMM site prevented the discharge of approximately 870,000 lb of copper and 3.0 million lb of zinc by treating approximately 2 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) |
|---|---|---|---|
| 2008 | 229,250,000 | 82,000 | 257,000 |
| 2009 | 451,940,000 | 310,000 | 1,240,000 |
| 2010 | 660,270,000 | 234,000 | 680,000 |
| 2011 | 468,800,000 | 159,000 | 500,000 |
| 2012 | 241,450,000 | 84,000 | 311,000 |
| **Total** | **2,051,710,000** | **869,000** | **2,988,000** |

Note:
lb = pound

## 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 third and fourth five-year review memoranda, *Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review* (CH2M HILL, 2003 and 2008a), the Central Valley Regional Water Quality Control Board (Water Board), EPA, and Reclamation have routinely collected samples of surface water discharging from SCDD at sampling location LSC to monitor pH, total copper, total zinc, and total cadmium in the reservoir discharge. Figures 2a and 3a present the total copper and total zinc concentrations, respectively, measured at LSC for the period of record from 1970 through the end of 2012. These figures show the reduction in total copper and total zinc concentrations at LSC as a result of the 1994 start up of the aerated, simple-mix treatment component at Minnesota Flats Treatment Plant. Figures 2b and 3b show total copper and total zinc concentrations, respectively, for the shorter time, from 1994 to the end of 2012. These figures show the reduction in total copper and total zinc concentrations at LSC as a result of the 2004 start up of the Slickrock Creek Retention Reservoir. Figures 2c and 3c present the same total copper and total zinc concentrations, respectively, measured at LSC from 2003 to the end of 2012.

Table 2 provides the pH range in discharges from the Spring Creek Reservoir over specific periods. A plot of the SCDD discharge pH from October 1998 through December 2012 is

provided on Figure 4. The pH of the SCDD discharge noticeably increased in response to IMM interim remedial actions completed under RODs 1 through 4. From 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. The aerated, simple-mix component of the treatment plant was completed in 1994, and the HDS component of the treatment plant was completed in 1997. From November 1996 through May 1998, the pH of the water averaged 4.5; from September 1999 through July 2003, the pH of SCDD discharge averaged 4.2 (CH2M HILL, 2003). SCRR was completed in 2004. From August 2003 through January 2008 (the fourth five-year review period), the pH of SCDD discharge ranged from 2.97 to 7.07, with an average of 4.7 (CH2M HILL, 2008a). From February 2008 through December 2012 (the fifth five-year review period), the pH averaged 5.9. During dredging and dewatering operations in 2009 and 2010, CDF effluent with basic pH was discharged to Spring Creek Reservoir and may have contributed, in part, to higher pH measurements in the SCDD discharges.

TABLE 2
pH Range for Spring Creek Reservoir Discharge Water over Specific Periods of Time
*Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review*

| Period | pH Range | Average pH | Number of pH Measurements Used in Average Calculation |
|---|---|---|---|
| 1983 through 1994 | 2 to 3 | 2.8 | 264 |
| Nov 1996 through May 1998 | 3.75 to 5.20 | 4.5 | 46 |
| Sep 1999 through Jul 2003 | 3.00 to 5.45 | 4.2 | 356 |
| Aug 2003 through Jan 2008 | 2.97 to 7.07 | 4.7 | 321 |
| Feb 2008 through Dec 2012 | 3.0 to 7.7 | 5.9 | 371 |

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 at LSC, 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 technical 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 Years 1970 through 2012. The annual and cumulative copper and zinc discharges for the period are presented on Figures 5 and 6, respectively. Since 1970, approximately 4.6 million lb of copper and 19.7 million lb of zinc have been discharged from SCDD into Keswick Reservoir and the Sacramento River.

Table 3 lists the copper and zinc loads (in lb) discharged from SCDD for Water Years 2008 through 2012. For this period, approximately 24,800 lb of copper and 79,900 lb of zinc were discharged from SCDD into Keswick Reservoir and the Sacramento River.

TABLE 3
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) |
|---|---|---|---|
| 2008 | 9,100 | 2,800 | 8,200 |
| 2009 | 16,600 | 2,700 | 11,300 |
| 2010 | 55,800 | 12,600 | 36,600 |
| 2011 | 22,700 | 4,300 | 14,400 |
| 2012 | 3,800 | 2,400 | 9,400 |
| **Total** | **108,000** | **24,800** | **79,900** |

Note:
acre-ft = acre-feet

## Total Copper and Zinc Load Percent Reduction

Table 4 lists the combined copper and zinc loads for the IMM site for Water Years 2008 through 2012. The combined loads include IMM contaminant flows, collected and treated at MFTP (see Table 1), and SCDD (see Table 3) discharge loads. For the fifth, five-year review period, the combined loads for IMM were approximately 900,000 lb of copper and 3 million lb of zinc.

TABLE 4
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 (%) |
|---|---|---|---|---|---|
| 2008 | 9,100 | 85,100 | 264,900 | 97 | 97 |
| 2009 | 16,600 | 313,200 | 1,237,000 | 99 | 99 |
| 2010 | 55,800 | 246,400 | 716,700 | 95 | 95 |
| 2011 | 22,700 | 162,900 | 514,600 | 97 | 97 |
| 2012 | 3,800 | 86,900 | 320,200 | 97 | 97 |
| **Total** | **108,000** | **894,500** | **3,053,400** | **97** | **97** |

For the fifth five-year review period, collection and treatment of portal discharges have resulted in an average reduction in copper and zinc discharges of 97 percent. The total values in Table 3 are 3 percent of those in Table 4; therefore, 97 percent of the load has been removed by the treatment plant. For the complete water years (2005 through 2012) since

SCRR came online, reductions in copper and zinc discharges were also 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.

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.

## 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 2012, the actual copper and zinc discharged from SCDD was less than 3 percent of pre-1994 discharge. The annual average copper and zinc loads for Water Years 2005 through 2012 were divided by the average loads for Water Years 1970 through 1994.

## Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action

Implementation of the Spring Creek Arm Sediment Removal Remedial Action achieved performance criteria outlined in ROD 5. Contaminated sediment that was susceptible to erosion was removed to Elevation 560 feet mean sea level (msl). This included removal of sediment Piles A and B and partial removal of Pile C. Laboratory and field water quality data demonstrated that dredging activities had no effect on water quality in Lower Keswick Reservoir or the Sacramento River below Keswick Dam. All compliance standards were met. Elevated turbidity and copper and zinc concentrations were detected in Keswick Reservoir in October 2009 and April 2010, but were a result of large storm events and related releases from SCDD. Effluent limits for the CDF were also achieved. Metals concentrations in effluent samples were well below the compliance standards during dredging and dewatering activities (EPA, 2012).

The ROD 5 remedial action was also expected to have an ancillary benefit of reduced restrictions on Keswick Reservoir operating levels. The hydroelectric generators in Keswick Power Plant are designed to operate within a normal reservoir water elevation range of 574 to 587 feet msl. Prior to the remedial action, Reclamation maintained Keswick Reservoir at 578 feet msl or above during all operations of SCPP, to prevent scouring of metals-laden sediment from the Spring Creek Arm. Since the completion of dredging in June 2010, Reclamation has routinely operated Keswick Reservoir over the full reservoir elevation operating range (see Figure 7). Between June 8, 2010, and February 28, 2013 (the most recent available data), Keswick Reservoir hourly elevations were below 578 feet msl 21 percent of the time.

Although the normal reservoir water elevation range has been restored to between 574 and 587 feet msl, evaluations conducted by EPA as part of the Sediment Feasibility Study (EPA, 2004b) indicated that when the combined discharge from Spring Creek Power Plant (SCPP) and SCDD approaches 6,600 cubic feet per second (cfs), the water elevation in Keswick

Reservoir should be maintained above 578 feet msl to prevent erosion of the contaminated sediment that remained after dredging. A combined release of 6,600 cfs is equivalent to the upper end of SCPP capacity (4,900 cfs) plus the historical maximum discharge from SCDD (1,700 cfs). Such flows would likely only occur during abnormal storm events and would naturally raise the elevation of Keswick Reservoir because of accretion flows. Between the completion of dredging in June 2010 and December 31, 2012 (the most recent data available), the average combined discharge from SCDD and SCPP was 900 cfs and the maximum combined discharge was 2,450 cfs, well below the 6,600-cfs threshold (see Figure 8).

# Water Quality Compliance at Keswick Reservoir

During the fifth five-year review period, Reclamation conducted routine discharge sampling at locations downstream of Shasta Dam (SRS) and Keswick Dam (SRK2). The sampling locations are shown on Figure 1. Sampling and testing were 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.

## Water Quality Objectives in Sacramento River Below Keswick Dam

Metals concentrations in the Sacramento River were compared against criteria in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Basin Plan) (Water Board, 1998 with updates through October 2011) and the California Toxics Rule (CTR) (provided in Water Board, 2011). The Basin Plan establishes maximum concentration criteria and the CTR establishes 4-day continuous concentration criteria.

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

- The Basin Plan establishes the maximum dissolved copper concentration for the upper Sacramento River as 5.6 micrograms per liter (µg/L). The Basin Plan establishes the maximum dissolved zinc concentration for the upper Sacramento River as 16 µg/L.
- The CTR sets objectives for dissolved copper and zinc concentrations by using an assumed water hardness (as calcium carbonate) of 40 milligrams per liter (mg/L). The CTR establishes a 4-day average continuous concentration of 4.1 µg/L for dissolved copper and 54 µg/L for dissolved zinc.

Table 5 shows the water quality objectives for dissolved copper and zinc and the number of samples with detected results that exceeded the limits of the 275 samples for dissolved copper and 264 samples for dissolved zinc collected by Reclamation from January 2008 to December 2012.

TABLE 5
Dissolved Copper and Zinc 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 Continuous (4-day average) Concentration for Chronic Exposure (µg/L) [a] | Number of Exceedances (Percent Exceedance) |
|---|---|---|---|---|
| Copper | 5.6 [b,c] | 0 | 4.1 [d,e] | 1 (0.4%) |
| Zinc | 16 [b,c] | 0 | 54 [d,e] | 0 (0%) |

[a] The CTR continuous chronic exposure is the continuous concentration (4-day average concentration).

[b] Based upon surface water with a hardness of 40 mg/L. Where deviations in water hardness from 40 mg/L occur, the criteria, in µg/L, shall be determined by using the following formulas:

Dissolved Copper = $(e^{[0.905 \times \ln(\text{hardness}) - 1.612]})$
Dissolved Zinc = $(e^{[0.830 \times \ln(\text{hardness}) - 0.289]})$

[c] Based upon Basin Plan (Water Board, 1998 with updates through October 2011).

[d] Based upon surface water with a hardness of 40 mg/L. Where deviations in water hardness from 40 mg/L occur, the criteria, in µg/L, shall be determined by using the following formulas:

Dissolved Copper = $0.96 \times (e^{[0.8545 \times \ln(\text{hardness}) - 1.702]})$
Dissolved Zinc = $0.986 \times (e^{[0.8473 \times \ln(\text{hardness}) + 0.884]})$

[e] Based upon the CTR (provided in Water Board, 2011).

## Copper and Zinc Concentrations at Keswick Dam

During the period from January 2008 through December 2012, Reclamation conducted sampling and testing for copper on 275 days at SRK2 (location shown on Figure 1). The reported dissolved and total copper concentrations measured at SRK2 and at SRS are shown on Figures 9 and 10, respectively. The dissolved copper concentration did not exceed the Basin Plan limit of 5.6 µg/L on any of the 275 days during which samples were collected. The dissolved copper concentrations at SRK2 exceeded the CTR of 4.1 µg/L on only 1 of the 275 reported days (only 0.4 percent). Sampling frequency was not increased to determine the number of exceedances, if any, on a 96-hour basis. For comparison, dissolved copper concentrations ranged from 0.5 µg/L to 4.4 µg/L in water discharges from Shasta Dam during the five-year-review period.

During the period from January 2008 through December 2012, Reclamation conducted sampling and testing for dissolved zinc on 264 days at SRK2. The reported dissolved and total zinc concentrations measured at SRK2 and at SRS are shown on Figures 11 and 12, respectively. Prior to April 2010, Reclamation reported the majority of the dissolved and total zinc concentrations at the reporting limit of 15 µg/L. The dissolved zinc concentrations did not exceed the Basin Plan limit of 16 µg/L or the CTR of 54 µg/L.

Additional surface water samples were collected by CH2M HILL at SRK2. The results for Water Years 2011 and 2012 are presented in Table 6 (located at the end of this technical memorandum). The results presented in Table 6 confirm the Reclamation results, that Basin Plan and CTR dissolved copper and zinc water quality criteria were not exceeded in the Sacramento River below Keswick Dam.

# CH2M HILL Routine Surface Water Sampling

CH2M HILL conducted routine surface water sampling for Water Years 2008 through 2012 at the IMM Superfund Site and at locations downgradient. Samples were collected in the following areas:

- Boulder Creek and Slickrock Creek drainages, within the IMM site
- Spring Creek and Flat Creek drainages, downgradient from IMM
- Influent and effluent from the HDS treatment plant located at the IMM site

Samples were analyzed by the EPA Region 9 Laboratory or a lab from EPA's contract laboratory program). The samples collected by CH2M HILL augment the routine sampling performed by Reclamation. Results of CH2M HILL surface water sample analyses from Water Years 2011 and 2012 are presented herein while results from Water Years 2008, 2009, and 2010 were previously published (CH2M HILL, 2008b, 2010, 2011).

Startup and shakedown testing of SCRR began in March 2004. SCRR was completed in May 2004. After SCRR began operating, the total copper concentrations at Lower Spring Creek (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. The average concentration of total copper decreased to 96 µg/L between January 2008 and December 2012. The results of surface water sampling completed by CH2M HILL at LSC are presented in Table 7 (located at the end of this technical memorandum) and on Figures 13, 14, 15, and 16.

Figure 17 shows the total copper load discharged from SCDD from October 1998 through December 2012. From Water Year 1999 through Water Year 2003, copper loads averaged 72 pounds per day (lb/day) annually and 113 lb/day during winter months (December through March). Startup of SCRR occurred in May 2004. Copper loads averaged 18 lb/day annually and 25 lb/day during winter months of Water Years 2005 and 2006. Loads from Water Year 2007 were anomalous because that Water Year had below-average precipitation. For Water Years 2008 through 2012, copper loads continued to average 14 lb/day annually and the loads during winter months decreased to 17 lb/day.

The *Statement of Work for Site Operations and Maintenance* (SOW) (EPA, 2000) provides maximum metal concentration guidelines for the Mouth of Boulder Creek (BCMO), which are provided in Table 8. Table 9 (located at the end of this technical memorandum) summarizes the analytical results for BCMO. Because of the low pH (average pH is less than 5) of the Boulder Creek water, the total copper and total zinc concentrations were essentially equal to the dissolved copper and dissolved zinc concentrations, respectively. All samples collected by CH2M HILL at BCMO had total copper and total zinc concentrations less than the SOW guidelines presented in Table 8. The annual average concentrations of total copper were 261 µg/L in 2011 and 321 µg/L in 2012. The annual average concentrations of total zinc were 625 µg/L in 2011 and 885 µg/L in 2012. The annual average copper and zinc concentrations at BCMO are shown on Figures 13, 14, 15, and 16.

TABLE 8
Maximum Metal Concentration Guidelines for Sampling Location BCMO
*Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review*

| Flow Range [a] (cfs) | Total Copper [b] (µg/L) | Total Zinc [b] (µg/L) |
|---|---|---|
| Less than 25 | 1,600 | 4,000 |
| 25 to 100 | 600 | 1,000 |
| Greater than 100 | 400 | 500 |

[a] Flow rates for Boulder Creek were obtained from a database provided by IMO.

[b] Maximum concentration taken from Table 14-4 of the SOW (EPA, 2000).

Table 10 (located at the end of this technical memorandum) summarizes the CH2M HILL analytical results for Minnesota Flats Treatment Plant effluent (TPEFF). The annual average copper and zinc concentrations at TPEFF are shown on Figures 13, 14, 15, and 16. The copper and zinc concentrations in the treatment plant acid mine drainage (TPAMD) influent are also presented on Figures 13, 14, 15, and 16. The *Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*, Appendix G, *Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Review* (CH2M HILL, 2013), evaluates the treatment plant effluent concentrations against requirements in the SOW**.**

Table 11 (located at the end of this technical memorandum) summarizes the analytical results from the Mouth of Slickrock Creek (SRMO) sampling location. Table 12 (located at the end of this technical memorandum) summarizes the analytical results from the Spring Creek Weir (SCWIR) sampling location, which is approximately 100 feet downstream from the confluence of Spring Creek and Slickrock Creek. The annual average copper and zinc concentrations at SRMO are shown on Figures 13, 14, 15, and 16. Copper and zinc concentrations at SRMO decreased substantially in Water Year 2005 as a result of the completion of SCRR and these decreases were maintained through Water Year 2012.

Flow from Spring Creek, upstream from Iron Mountain, was diverted into Flat Creek. Surface water samples were collected from Flat Creek, downstream from the diversion, at Flat Creek Bridge (FCB). Table 13 (located at the end of this technical memorandum) summarizes the analytical results for sampling location FCB. The annual average copper and zinc concentrations at FCB are shown on Figures 13, 14, 15, and 16. Copper and zinc concentrations at FCB were stable during Water Years 2008 through 2012.

# Summary

During the entire period between January 2008 and December 2012, Sacramento River below Keswick Dam met the Basin Plan maximum dissolved copper concentration for the upper Sacramento River of 5.6 µg/L. The dissolved copper concentrations exceeded the CTR chronic exposure limit of 4.1 µg/L on only 1 day (only 0.4 percent of the days sampled), compared to exceedances on 29 percent of the days sampled during the third five-year review period (EPA, 2003). Sampling frequency was not increased to determine the number of exceedances, if any, on a 96-hour basis. Over this period, dissolved zinc concentrations

met both the Basin Plan maximum concentration for the upper Sacramento River of 16 µg/L and the CTR chronic exposure limit of 54 µg/L.

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 historical IMM discharges of copper and zinc. Table 14 presents the copper and zinc discharged from SCDD between Water Years 1999 and 2012. The Reclamation water management actions are necessary to reduce the likelihood of uncontrolled spills and meet the water quality objectives in the Sacramento River below Keswick Dam.

TABLE 14
Comparison of SCDD Load Discharges from 1999 to 2012
*Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review*

| Water Years | SCDD Discharge (acre-ft) | Copper Load Discharge (lb) | Zinc Load Discharge (lb) |
|---|---|---|---|
| 1999 – 2003 | 81,500 | 90,000 | 140,000 |
| 2004 – 2007 | 68,200 | 27,400 | 73,000 |
| 2008 – 2012 | 125,000 | 24,800 | 79,900 |

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**TABLE 6**

Sacramento River Below Keswick Dam (SRK2)

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

| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 0.02 U | 0.02 U | 1.0 J | 1.2 J | 0.02 U | 0.02 U | 0.01 UJ | | 0.01 U | 0.01 U | 2 J | 2 J | | | 6.5 |
| 11/3/2010 | 0.02 U | 0.02 U | 1.0 J | 1.3 J | 0.02 U | 1.50 | 0.05 J | | 0.01 U | 0.01 U | 0 U | 3 | | | 6.5 |
| 11/11/2010 | 0.02 J | 0.02 J | 1.1 J | 1.2 J | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 0 U | 3 J | | | 6.6 |
| 11/17/2010 | 0.02 U | 0.02 U | 1.0 J | 1.3 J | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 3 J | 0 U | | | 6.6 |
| 11/23/2010 | 0.02 UJ | 0.02 UJ | 1.1 J | 1.3 J | 0.02 UJ | 0.02 UJ | 0.01 U | | 0.02 J | 0.01 U | 3 J | 3 J | | | 6.5 |
| 12/1/2010 | 0.02 U | 0.02 U | 0.8 J | 0.9 J | 0.02 U | 0.02 U | 0.01 J | | 0.01 U | 0.01 U | 3 | 3 | | | 6.0 |
| 12/8/2010 | 0.02 U | 0.02 U | 1.0 J | 1.2 J | 0.02 U | 0.02 U | 0.05 J | | 0.01 J | 0.01 UJ | 3 | 3 | | | 6.6 |
| 12/15/2010 | 0.03 J | 0.03 J | 1.9 J | 2.5 | 0.02 J | 0.06 J | 0.04 J | | 0.01 U | 0.01 U | 4 J | 4 J | | | 6.9 |
| 12/22/2010 | 0.03 J | 0.03 J | 1.8 J | 2.7 | 0.02 U | 0.02 U | 0.09 J | | 0.01 U | 0.01 U | 3 | 4 | | | 6.8 |
| 12/29/2010 | 0.02 U | 0.02 U | 2.4 | 4.4 | 0.02 U | 0.02 U | 0.23 | | 0.01 U | 0.01 U | 5 | 8 | 6 | 7.5 | 6.9 |
| 1/5/2011 | 0.03 J | 0.04 J | 2.0 J | 2.7 | 0.02 U | 0.02 U | 0.01 U | | 0.01 J | 0.01 U | 5 J | 0 U | | | 6.8 |
| 1/12/2011 | 0.02 UJ | 0.02 UJ | 2.5 J | 2.0 J | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 4 J | 4 J | | | 6.9 |
| 1/19/2011 | 0.03 J | 0.03 J | 2.3 J | 2.9 J | 0.01 U | 0.01 U | 0.00 U | | 0.01 U | 0.01 U | 0 U | 4 | | | 6.9 |
| 2/16/2011 | 0.07 U | 0.07 U | 2.4 | 2.8 | 0.20 U | 0.20 U | 0.06 J | | 0.02 U | 0.02 U | 5 | 7 | 7 | 7.9 | 6.6 |
| 2/23/2011 | 0.07 U | 0.07 U | 2.3 | 2.5 | 0.20 U | 0.20 U | 0.05 J | | 0.01 U | 0.01 U | 3 | 4 | 4 | 7.8 | 7.3 |
| 3/2/2011 | 0.07 U | 0.07 U | 2.4 | 3.0 | 0.20 U | 0.20 U | 0.06 J | | 0.01 U | 0.01 U | 5 | 6 | 6 | 7.9 | 7.5 |
| 3/9/2011 | 0.07 U | 0.07 U | 2.8 | 3.3 | 0.20 U | 0.20 U | 0.06 J | | 0.01 U | 0.01 U | 6 J | 8 J | 6 | 8.0 | |
| 3/16/2011 | 0.07 U | 0.07 U | 2.4 | 3.7 | 0.20 U | 0.20 U | 0.08 J | | 0.01 U | 0.01 U | 1 U | 7 | 4 | 8.0 | 6.6 |
| 3/31/2011 | 0.07 U | 0.07 U | 1.9 J | 3.0 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 3 J | 32 J | 4 | 8.0 | 7.5 |
| WY 2011 Average | 0.04 | 0.04 | 1.8 | 2.3 | 0.07 | 0.15 | 0.04 | | 0.01 | 0.01 | 3 | 5 | 5 | 7.9 | 6.8 |
| WY 2011 Maximum | 0.07 | 0.07 | 2.8 | 4.4 | 0.20 | 1.50 | 0.23 | | 0.02 | 0.02 | 6 | 32 | 7 | 8.0 | 7.5 |
| WY 2011 Minimum | 0.02 | 0.02 | 0.8 | 0.9 | 0.01 | 0.01 | 0.00 | | 0.01 | 0.01 | 0 | 0 | 4 | 7.5 | 6.0 |
| 10/6/2011 | 0.07 U | 0.07 U | 0.9 U | 2.7 | 0.20 U | 0.22 J | 0.03 U | | 0.01 U | 0.01 U | 2 | 7 | | | |
| 10/14/2011 | 0.07 U | 0.07 U | 0.9 U | 0.9 U | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 2 J | 2 J | | | 6.7 |
| 11/23/2011 | 0.07 U | 0.07 U | 0.9 U | 0.9 U | 0.20 U | 0.20 U | 0.06 J | | 0.01 U | 0.01 U | 2 J | 2 J | | | 7.2 |
| 1/24/2012 | 0.11 J | 0.07 U | 1.9 J | 2.4 | 0.20 U | 0.20 U | 0.06 J | | 0.01 U | 0.01 U | 5 | 6 | | | 7.3 |
| 2/1/2012 | 0.07 U | 0.07 U | 1.6 J | 1.8 J | 0.20 U | 0.20 U | 0.03 U | | 0.02 UJ | 0.02 UJ | 3 | 4 | | | 7.5 |
| 2/8/2012 | 0.07 UJ | 0.07 U | 2.0 J | 1.8 J | 0.20 U | 0.20 U | 0.03 U | | 0.02 U | 0.02 U | 3 J | 3 | | | 7.1 |
| 2/15/2012 | 0.07 U | 0.07 U | 1.4 J | 1.9 J | 0.20 U | 0.20 U | 0.05 J | | 0.02 U | 0.02 U | 4 | 4 | | | 6.5 |
| 3/2/2012 | 0.20 U | 0.20 U | 1.4 J | 1.8 J | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 5 U | 5 J | | | 7.2 |
| 3/15/2012 | 0.20 U | 0.20 U | 1.6 J | 2.7 | 0.50 U | 0.50 U | 0.05 J | | 0.02 U | 0.02 U | 5 U | 5 U | | | 6.1 |
| 3/21/2012 | 0.20 U | 0.20 U | 1.5 J | 1.7 J | 0.50 U | 0.50 U | 0.11 | | 0.02 U | 0.02 U | 5 U | 5 U | | | 6.4 |
| 3/28/2012 | 0.20 U | 0.20 U | 2.9 | 4.5 | 0.50 U | 0.50 U | 0.20 | | 0.02 U | 0.02 U | 8 J | 11 | | | 6.4 |
| 4/4/2012 | 0.20 U | 0.20 U | 2.4 | 3.4 | 0.50 U | 0.50 U | 0.07 J | | 0.02 U | 0.02 U | 7 J | 8 J | | | 7.5 |
| 4/11/2012 | 0.20 U | 0.20 U | 3.1 | 3.9 | 0.50 U | 0.50 U | 0.05 J | | 0.02 U | 0.02 U | 6 J | 7 J | | | 7.4 |
| 4/18/2012 | 0.20 U | 0.20 U | 2.8 | 3.5 | 0.50 U | 0.50 U | 0.06 J | | 0.02 U | 0.02 U | 5 U | 5 J | | | 7.8 |
| 4/26/2012 | 0.20 U | 0.20 U | 1.0 U | 4.1 | 0.50 U | 0.50 U | 0.05 J | | 0.02 U | 0.02 U | 5 U | 5 U | | | 7.6 |
| 5/3/2012 | 0.20 U | 0.20 U | 2.8 | 3.4 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 5 J | 6 J | | | 7.8 |
| 5/10/2012 | 0.20 U | 0.20 U | 2.3 | 3.2 | 0.50 U | 0.50 U | 0.05 J | | 0.02 U | 0.02 U | 5 U | 6 J | | | 7.4 |
| WY 2012 Average | 0.15 | 0.15 | 1.8 | 2.6 | 0.38 | 0.38 | 0.06 | | 0.01 | 0.01 | 5 | 5 | | | 7.1 |
| WY 2012 Maximum | 0.20 | 0.20 | 3.1 | 4.5 | 0.50 | 0.50 | 0.20 | | 0.02 | 0.02 | 8 | 11 | | | 7.8 |
| WY2012 Minimum | 0.07 | 0.07 | 0.9 | 0.9 | 0.20 | 0.20 | 0.03 | | 0.01 | 0.01 | 2 | 2 | | | 6.1 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

TABLE 7

Lower Spring Creek (LSC)

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

| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 1.10 | 1.20 | 21 | 59 | 0.02 U | 2.60 | 3.57 J | | 0.01 U | 0.01 U | 164 J | 199 J | | | 5.7 |
| 11/3/2010 | 1.60 | 1.70 | 31 | 49 | 0.02 U | 0.72 | 0.87 | | 0.01 U | 0.01 U | 234 | 243 | | | 5.9 |
| 11/11/2010 | 1.10 | 1.20 | 9 | 34 | 0.02 U | 2.30 | 2.67 | | 0.01 U | 0.01 U | 142 J | 166 J | | | 6.3 |
| 11/17/2010 | 1.50 | 1.30 | 16 | 33 | 0.02 U | 0.93 | 0.90 | | 0.01 U | 0.01 U | 198 | 205 | | | 6.3 |
| 11/23/2010 | 1.40 | 1.40 | 16 | 38 | 0.02 UJ | 1.10 | 1.02 | | 0.01 U | 0.02 J | 196 J | 208 J | | | 6.2 |
| 12/1/2010 | 1.60 | 1.60 | 45 | 59 | 0.02 U | 0.55 | 0.26 | | 0.01 U | 0.01 U | 256 | 258 | | | 6.0 |
| 12/8/2010 | 1.70 | 1.70 | 65 | 75 | 0.02 U | 0.79 | 0.41 | | 0.03 J | 0.03 J | 408 | 393 | | | 5.7 |
| 12/15/2010 | 1.40 | 1.40 | 44 | 52 | 0.33 J | 0.81 | 1.05 | | 0.01 U | 0.01 U | 277 J | 281 J | | | 5.9 |
| 12/22/2010 | 0.83 | 0.86 | 16 | 43 | 0.02 U | 1.10 | 1.37 | | 0.01 U | 0.01 U | 140 | 150 | | | 6.2 |
| 12/29/2010 | 0.45 | 0.57 | 8 | 50 | 0.02 U | 3.80 | 4.85 | 5 U | 0.01 U | 0.05 J | 62 J | 98 J | 76 | 6.6 | 6.3 |
| 1/5/2011 | 1.30 | 1.30 | 44 | 52 | 0.02 U | 0.65 | 0.99 | | 0.02 J | 0.03 J | 235 | 235 | | | 6.0 |
| 1/12/2011 | 1.00 J | 0.97 J | 37 J | 43 J | 0.02 U | 0.02 U | 0.29 | | 0.01 U | 0.01 U | 167 J | 161 J | | | 6.4 |
| 1/19/2011 | 1.40 | 1.40 | 45 J | 52 J | 0.01 U | 0.01 U | 0.20 | | 0.01 U | 0.01 U | 242 | 240 | | | 6.2 |
| 2/16/2011 | 1.10 | 1.10 | 13 | 44 | 0.20 U | 1.00 | 0.67 | 5 U | 0.02 U | 0.03 | 178 | 196 | 170 | 7.2 | 6.3 |
| 2/23/2011 | 0.65 | 0.71 | 18 | 43 | 0.20 U | 0.85 | 0.39 | 5 U | 0.01 U | 0.01 U | 117 | 130 | 110 | 6.8 | 6.8 |
| 3/2/2011 | 0.93 | 0.93 | 23 | 43 | 0.20 U | 0.50 | 0.19 | 5 U | 0.01 U | 0.01 U | 189 | 207 | 130 | 7.0 | 6.9 |
| 3/9/2011 | 0.73 | 0.72 | 23 | 38 | 0.20 U | 0.50 | 0.26 | 5 U | 0.01 U | 0.01 U | 172 J | 174 J | 150 | 6.8 | |
| 3/16/2011 | 0.72 | 0.74 | 14 | 46 | 0.20 U | 0.67 | 0.50 | 5 U | 0.01 U | 0.01 U | 158 | 177 | 130 | 6.9 | 6.4 |
| 3/31/2011 | 0.79 | 0.81 | 28 | 50 | 0.20 U | 0.72 | 0.62 | 5 U | 0.01 U | 0.01 U | 153 J | 162 J | 160 | 6.5 | 6.8 |
| WY 2011 Average | 1.12 | 1.14 | 27 | 47 | 0.09 | 1.03 | 1.11 | | 0.01 | 0.02 | 194 | 204 | 132 | 6.8 | 6.2 |
| WY 2011 Maximum | 1.70 | 1.70 | 65 | 75 | 0.33 | 3.80 | 4.85 | | 0.03 | 0.05 | 408 | 393 | 170 | 7.2 | 6.9 |
| WY 2011 Minimum | 0.45 | 0.57 | 8 | 33 | 0.01 | 0.01 | 0.19 | | 0.01 | 0.01 | 62 | 98 | 76 | 6.5 | 5.7 |
| 10/6/2011 | 2.10 | 1.90 | 19 | 33 | 0.20 U | 0.35 J | 0.03 U | | 0.01 U | 0.01 U | 248 | 236 | | | |
| 10/14/2011 | 2.00 | 2.10 | 23 | 35 | 0.20 U | 0.30 J | 0.03 U | | 0.01 U | 0.01 U | 271 | 268 | | | 6.1 |
| 11/23/2011 | 2.00 | 2.60 | 28 | 47 | 0.20 U | 0.51 | 0.08 J | | 0.01 U | 0.01 U | 296 J | 371 J | | | 6.9 |
| 1/24/2012 | 1.90 | 2.00 | 25 | 60 | 0.20 U | 0.74 | 0.51 | | 0.01 U | 0.01 U | 280 | 307 | | | 6.8 |
| 2/1/2012 | 1.90 | 2.10 | 34 | 56 | 0.20 U | 0.55 | 0.31 | | 0.02 UJ | 0.02 UJ | 316 | 327 | | | 6.0 |
| 2/8/2012 | 2.30 J | 2.30 | 69 | 77 | 0.20 U | 0.35 J | 0.16 | | 0.02 U | 0.02 U | 367 J | 360 | | | 6.4 |
| 2/15/2012 | 2.00 | 1.90 | 58 | 65 | 0.20 U | 0.28 J | 0.14 | | 0.02 U | 0.02 U | 341 | 334 | | | 5.9 |
| 3/2/2012 | 1.80 | 1.90 | 38 | 47 | 0.50 U | 0.50 U | 0.06 J | | 0.02 U | 0.02 U | 350 | 330 | | | 6.8 |
| 3/15/2012 | 1.50 | 1.60 | 26 | 49 | 0.50 U | 0.82 J | 0.39 | | 0.02 U | 0.02 J | 320 | 340 | | | 5.8 |
| 3/21/2012 | 0.97 | 0.97 | 20 | 35 | 0.50 U | 0.56 J | 0.43 | | 0.02 U | 0.03 | 210 | 210 | | | 5.6 |
| 3/28/2012 | 0.51 | 0.61 | 7 | 38 | 0.50 U | 3.40 | 4.20 | | 0.02 U | 0.05 | 69 | 110 | | | 6.0 |
| 4/4/2012 | 0.88 | 0.97 | 15 | 36 | 0.50 U | 0.58 J | 0.52 | | 0.02 U | 0.02 J | 150 | 180 | | | 7.8 |
| 4/11/2012 | 1.70 | 1.70 | 51 | 62 | 0.50 U | 0.63 J | 0.26 | | 0.02 U | 0.02 U | 330 | 350 | | | 6.5 |
| 4/18/2012 | 0.92 | 0.93 | 21 | 35 | 0.50 U | 0.50 U | 0.28 | | 0.02 U | 0.02 U | 150 | 160 | | | 6.9 |
| 4/26/2012 | 1.10 | 1.10 | 1 U | 31 | 0.50 U | 0.50 U | 0.13 | | 0.02 U | 0.02 U | 200 | 200 | | | 6.7 |
| 5/3/2012 | 1.50 | 1.50 | 29 J | 33 | 0.50 U | 0.50 U | 0.09 J | | 0.02 U | 0.02 U | 270 | 270 | | | 7.5 |
| 5/10/2012 | 1.60 | 1.60 | 28 | 36 | 0.50 U | 0.50 U | 0.07 J | | 0.02 U | 0.02 U | 300 | 290 | | | 6.8 |
| WY 2012 Average | 1.57 | 1.63 | 29 | 45 | 0.38 | 0.68 | 0.45 | | 0.01 | 0.02 | 263 | 273 | | | 6.5 |
| WY 2012 Maximum | 2.30 | 2.60 | 69 | 77 | 0.50 | 3.40 | 4.20 | | 0.02 | 0.05 | 367 | 371 | | | 7.8 |
| WY2012 Minimum | 0.51 | 0.61 | 1 | 31 | 0.20 | 0.28 | 0.03 | | 0.01 | 0.01 | 69 | 110 | | | 5.6 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

**TABLE 9**

Boulder Creek at Mouth (BCMO)

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

| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 9.50 | 9.10 | 545 | 531 | 13.70 | 13.30 | 0.97 J | | 0.01 U | 0.01 U | 1,490 J | 1,470 J | | | 3.5 |
| 11/3/2010 | 7.70 | 7.80 | 456 | 465 | 13.00 | 13.20 | 0.92 | | 0.01 U | 0.01 U | 1,160 | 1,200 | | | 3.2 |
| 11/11/2010 | 5.70 | 5.70 | 408 | 410 | 10.10 | 10.10 | 0.88 | | 0.01 U | 0.01 U | 982 J | 970 J | | | 3.7 |
| 11/17/2010 | 3.30 | 3.20 | 403 | 402 | 10.80 | 11.00 | 0.38 | | 0.01 U | 0.01 U | 1,120 | 1,120 | | | 3.6 |
| 11/23/2010 | 4.10 | 4.00 | 308 | 311 | 6.40 | 6.70 | 1.81 | | 0.02 J | 0.01 U | 762 J | 768 J | | | 3.3 |
| 12/1/2010 | 4.90 | 5.00 | 374 | 389 | 8.50 | 9.00 | 0.96 | | 0.01 U | 0.01 U | 864 | 882 | | | |
| 12/8/2010 | 2.30 | 2.40 | 211 | 216 | 3.20 | 3.60 | 2.18 | | 0.01 UJ | 0.01 UJ | 520 | 532 | | | 3.9 |
| 12/15/2010 | 2.70 | 2.60 | 227 | 231 | 3.80 | 4.00 | 1.14 | | 0.01 U | 0.01 U | 471 J | 478 J | | | 4.1 |
| 12/22/2010 | 1.30 | 1.30 | 146 | 143 | 4.20 J | 1.30 J | 4.29 | | 0.01 U | 0.01 U | 220 | 222 | | | 3.7 |
| 12/29/2010 | 1.60 | 1.60 | 174 | 178 | 1.60 | 3.40 | 3.12 | | 0.01 U | 0.01 U | 266 J | 264 J | 48 | 4.6 | 3.8 |
| 1/5/2011 | 3.30 | 3.30 | 269 | 266 | 4.00 | 4.00 | 0.77 | | 0.01 U | 0.01 U | 612 | 603 | | | 4.0 |
| 1/12/2011 | 2.10 J | 2.10 J | 209 J | 201 J | 4.50 | 4.40 | 0.56 | | 0.01 U | 0.01 U | 521 J | 516 J | | | 4.1 |
| 1/19/2011 | 3.50 | 3.60 | 272 J | 272 J | 4.70 | 4.80 | 0.44 | | 0.01 U | 0.01 U | 683 | 681 | | | 4.1 |
| 2/16/2011 | 1.50 | 1.40 | 126 | 128 | 1.20 | 1.90 | 1.19 | | 0.02 U | 0.02 J | 276 | 281 | 37 | 5.1 | 4.6 |
| 2/23/2011 | 2.50 | 2.50 | 215 | 207 | 2.90 | 3.00 | 0.86 | | 0.01 U | 0.01 U | 480 | 498 | 61 | 4.7 | 4.7 |
| 3/2/2011 | 1.30 | 1.30 | 120 | 119 | 1.10 | 2.00 | 1.46 | | 0.01 U | 0.01 U | 277 | 268 | 34 | 4.8 | 4.8 |
| 3/9/2011 | 2.20 | 2.10 | 188 | 186 | 2.40 | 2.70 | 0.69 | | 0.01 U | 0.01 U | 491 J | 482 J | 53 | 5.0 | 4.0 |
| 3/16/2011 | 1.60 | 1.60 | 151 | 165 | 1.50 | 1.80 | 1.13 | | 0.01 U | 0.01 U | 348 | 374 | 43 | 4.9 | 5.7 |
| 3/31/2011 | 1.20 | 1.20 | 141 | 142 | 1.40 | 1.70 | 1.06 | | 0.01 U | 0.01 U | 257 J | 262 J | 35 | 4.9 | 5.3 |
| WY 2011 Average | 3.28 | 3.25 | 260 | 261 | 5.21 | 5.36 | 1.31 | | 0.01 | 0.01 | 621 | 625 | 44 | 4.9 | 4.1 |
| WY 2011 Maximum | 9.50 | 9.10 | 545 | 531 | 13.70 | 13.30 | 4.29 | | 0.02 | 0.02 | 1,490 | 1,470 | 61 | 5.1 | 5.7 |
| WY 2011 Minimum | 1.20 | 1.20 | 120 | 119 | 1.10 | 1.30 | 0.38 | | 0.01 | 0.01 | 220 | 222 | 34 | 4.6 | 3.2 |
| 10/6/2011 | 7.90 | 8.10 | 456 | 482 | 9.60 | 11.40 | 6.45 | | 0.01 U | 0.01 U | 2,170 | 2,290 | | | |
| 10/14/2011 | 8.90 | 8.90 | 535 | 528 | 12.00 | 11.90 | 0.43 | | 0.01 U | 0.01 U | 1,470 | 1,470 | | | 3.8 |
| 11/23/2011 | 5.90 | 7.60 | 369 | 467 | 5.60 | 7.40 | 0.43 | | 0.01 U | 0.01 U | 1,240 J | 1,560 J | | | 3.6 |
| 1/24/2012 | 6.90 | 6.60 | 553 | 565 | 9.10 | 8.90 | 6.14 | | 0.01 U | 0.01 U | 1,170 | 1,190 | | | 3.1 |
| 2/1/2012 | 4.60 | 4.50 | 387 | 388 | 5.10 | 5.10 | 1.88 | | 0.02 UJ | 0.02 UJ | 929 | 900 | | | 3.9 |
| 2/8/2012 | 3.60 J | 3.60 | 274 | 258 | 2.80 | 2.80 | 1.06 | | 0.03 U | 0.02 U | 656 J | 627 | | | 3.8 |
| 2/15/2012 | 5.30 | 5.20 | 417 | 418 | 6.70 | 6.50 | 0.99 | | 0.02 U | 0.02 U | 967 | 934 | | | 3.3 |
| 3/2/2012 | 5.80 | 5.80 | 350 | 350 | 5.50 | 5.80 | 0.84 | | 0.02 U | 0.02 U | 1,300 | 1,200 | | | 3.7 |
| 3/15/2012 | 1.60 | 1.60 | 170 | 170 | 1.50 | 4.00 | 3.60 | | 0.02 U | 0.04 | 300 | 310 | | | 3.8 |
| 3/21/2012 | 3.00 | 2.90 | 230 | 220 | 3.20 | 3.30 | 1.10 | | 0.02 U | 0.02 U | 600 | 580 | | | 3.2 |
| 3/28/2012 | 1.40 | 1.40 | 150 | 160 | 1.50 | 4.00 | 1.90 | | 0.02 U | 0.03 | 260 | 260 | | | 3.7 |
| 4/4/2012 | 2.60 | 2.40 | 200 | 190 | 2.40 | 2.70 | 0.66 | | 0.02 U | 0.02 U | 510 | 490 | | | 5.0 |
| 4/11/2012 | 2.90 | 3.00 | 240 | 260 | 2.80 | 3.30 | 0.87 | | 0.02 U | 0.04 | 620 | 600 | | | 4.4 |
| 4/18/2012 | 2.80 | 2.80 | 230 | 230 | 2.90 | 3.00 | 0.56 | | 0.02 U | 0.02 U | 590 | 570 | | | 4.8 |
| 4/26/2012 | 1.70 | 1.70 | 140 | 140 | 1.40 | 1.70 | 0.66 | | 0.02 U | 0.02 J | 380 | 380 | | | 4.8 |
| 5/3/2012 | 3.50 | 3.60 | 280 | 290 | 4.20 | 4.50 | 0.49 | | 0.02 U | 0.02 J | 750 | 770 | | | |
| 5/10/2012 | 4.20 | 4.20 | 350 | 340 | 5.40 | 5.60 | 0.50 | | 0.02 U | 0.02 U | 940 | 920 | | | 4.2 |
| WY 2012 Average | 4.27 | 4.35 | 314 | 321 | 4.81 | 5.41 | 1.68 | | 0.01 | 0.02 | 874 | 885 | | | 3.9 |
| WY 2012 Maximum | 8.90 | 8.90 | 553 | 565 | 12.00 | 11.90 | 6.45 | | 0.03 | 0.04 | 2,170 | 2,290 | | | 5.0 |
| WY2012 Minimum | 1.40 | 1.40 | 140 | 140 | 1.40 | 1.70 | 0.43 | | 0.01 | 0.01 | 260 | 260 | | | 3.1 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

**TABLE 10**

Minnesota Flats Treatment Plant Effluent (TPEFF)

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

| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | IMO Field pH | CH2M HILL Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 0.76 | 1.60 | 3.2 | 35 | 0.02 U | 0.02 U | 2.53 J | | 0.01 U | 0.01 U | 32 J | 132 J | | | 7.4 | |
| 11/3/2010 | 1.70 | 2.80 | 2.8 | 46 | 0.02 U | 0.60 | 4.20 | | 0.01 U | 0.01 U | 64 | 206 | | | 7.1 | |
| 11/11/2010 | 1.30 | 1.70 | 3.4 | 21 | 0.02 U | 0.02 U | 1.69 | | 0.01 U | 0.01 U | 49 J | 107 J | | | 7.0 | |
| 11/17/2010 | 1.40 | 1.80 | 3.1 | 25 | 0.02 U | 0.02 U | 2.01 | | 0.01 U | 0.01 U | 59 | 126 | | | 7.2 | |
| 11/23/2010 | 1.90 | 3.20 | 5.3 | 71 | 0.02 UJ | 1.10 | 5.05 | | 0.01 J | 0.02 J | 81 J | 287 J | | | 7.3 | |
| 12/1/2010 | 1.70 | 2.30 | 3.2 | 36 | 0.02 U | 0.54 | 3.01 | | 0.01 U | 0.01 U | 74 | 179 | | | 7.4 | |
| 12/8/2010 | 1.60 | 2.40 | 3.7 | 42 | 0.02 U | 0.61 | 2.92 | | 0.02 J | 0.01 UJ | 66 | 195 | | | 7.4 | |
| 12/15/2010 | 1.70 | 2.70 | 6.4 | 56 | 0.07 J | 0.91 | 4.21 | | 0.01 U | 0.01 U | 78 J | 258 J | | | 7.4 | |
| 12/22/2010 | 1.80 | 3.20 | 5.1 | 66 | 0.02 U | 1.40 | 4.96 | | 0.01 U | 0.01 U | 81 | 280 | | | 7.4 | |
| 12/29/2010 | 1.80 | 3.90 | 4.3 | 107 | 0.02 U | 1.90 | 8.41 | 5 U | 0.01 U | 0.01 U | 72 | 383 | 1,900 | 6.3 | 7.4 | |
| 1/5/2011 | 0.94 | 4.20 | 4.4 | 152 | 0.02 U | 2.80 | 0.01 U | | 0.03 J | 0.02 J | 24 | 440 | | | 7.1 | |
| 1/12/2011 | 1.10 J | 2.10 J | 10 J | 63 J | 0.02 U | 0.03 U | 4.05 | | 0.01 U | 0.01 U | 64 J | 210 J | | | 7.4 | |
| 1/19/2011 | 1.10 | 2.00 | 2.4 J | 54 J | 0.01 U | 0.77 | 3.80 | | 0.01 U | 0.01 U | 46 | 183 | | | 7.6 | |
| 2/16/2011 | 2.60 J | 1.90 J | | | 0.56 | 0.20 U | 0.03 U | 5 U | 0.02 U | 0.02 U | 201 J | 89 J | 1,800 | 6.7 | 7.0 | |
| 2/23/2011 | 2.20 | 3.40 | 2.7 | 62 | 0.20 U | 0.87 | 4.17 | 5 U | 0.01 U | 0.01 U | 107 | 293 | 1,900 | 6.3 | 7.0 | |
| 3/2/2011 | 1.60 | 2.90 | 2.6 | 71 | 0.20 U | 1.00 | 4.79 | 5 U | 0.01 U | 0.01 U | 72 | 281 | 1,800 | 6.4 | 7.4 | |
| 3/9/2011 | 1.60 | 3.90 | 3.3 | 128 | 0.20 U | 1.90 | 7.60 | 5 U | 0.01 U | 0.01 U | 84 J | 459 J | 1,900 | 6.6 | 7.1 | |
| 3/16/2011 | 1.50 | 2.30 | 2.5 | 52 | 0.20 U | 0.60 | 2.77 | 5 U | 0.01 U | 0.01 U | 80 | 228 | 2,000 | 6.5 | 7.2 | |
| 3/31/2011 | 1.10 | 7.10 | 2.4 | 321 | 0.20 U | 5.10 | 19.50 | 5 U | 0.01 U | 0.01 U | 48 J | 931 J | 1,800 | 6.5 | 7.2 | |
| WY 2011 Average | 1.55 | 2.92 | 3.9 | 78 | 0.10 | 1.07 | 4.51 | | 0.01 | 0.01 | 73 | 277 | 1,871 | 6.5 | 7.3 | |
| WY 2011 Maximum | 2.60 | 7.10 | 10 | 321 | 0.56 | 5.10 | 19.50 | | 0.03 | 0.02 | 201 | 931 | 2,000 | 6.7 | 7.6 | |
| WY 2011 Minimum | 0.76 | 1.60 | 2.4 | 21 | 0.01 | 0.02 | 0.01 | | 0.01 | 0.01 | 24 | 89 | 1,800 | 6.3 | 7.0 | |
| 10/6/2011 | 1.20 | 2.40 | 3.9 | 81 | 0.20 U | 0.70 | 3.86 | | 0.01 U | 0.01 U | 48 | 226 | | | 7.1 | 7.7 |
| 10/14/2011 | 1.10 | 1.80 | 2.7 | 45 | 0.20 U | 0.36 J | 2.62 | | 0.01 U | 0.01 U | 43 | 154 | | | 7.0 | 7.6 |
| 11/23/2011 | 2.50 | 4.30 | 4.3 | 113 | 0.20 U | 1.10 | 6.03 | | 0.01 U | 0.01 U | 114 J | 418 J | | | 7.0 | |
| 1/24/2012 | 2.00 | 2.80 | 5.2 | 29 | 0.20 U | 0.35 J | 2.52 | | 0.01 U | 0.01 U | 78 | 170 | | | 7.0 | 7.5 |
| 2/1/2012 | 2.00 | 3.20 | 5.4 | 67 | 0.20 U | 0.74 | 4.21 | | 0.02 UJ | 0.02 UJ | 77 | 273 | | | 7.3 | 7.7 |
| 2/8/2012 | 1.90 J | 4.00 | 5.3 | 121 | 0.20 U | 1.10 | 6.03 | | 0.02 U | 0.02 U | 68 J | 433 | | | 7.0 | 8.3 |
| 2/15/2012 | 2.60 | 5.70 | 5.8 | 163 | 0.20 U | 1.80 | 8.47 | | 0.02 U | 0.02 U | 128 | 635 | | | 6.9 | 7.3 |
| 3/2/2012 | 1.90 | 3.70 | 2.6 | 91 | 0.50 U | 1.10 | 4.80 | | 0.02 U | 0.02 U | 110 | 440 | | | 7.1 | |
| 3/15/2012 | 1.50 | 2.20 | 1.7 J | 26 | 0.50 U | 0.50 U | 2.30 | | 0.02 U | 0.02 U | 79 | 210 | | | 7.0 | 7.9 |
| 3/21/2012 | 1.70 | 3.40 | 3.7 | 63 | 0.50 U | 1.10 | 4.50 | | 0.02 U | 0.02 U | 100 | 420 | | | 7.0 | 7.5 |
| 3/28/2012 | 1.70 | 3.80 | 1.7 J | 63 | 0.50 U | 1.10 | 4.30 | | 0.02 U | 0.02 U | 97 | 430 | | | 7.0 | 7.8 |
| 4/4/2012 | 2.40 | 13.00 | 3.5 | 510 | 0.50 U | 7.60 | 24.00 | | 0.02 U | 0.02 U | 140 | 2,100 | | | 7.1 | 7.8 |
| 4/11/2012 | 1.30 | 5.60 | 4.1 | 250 | 0.50 J | 3.20 | 11.00 | | 0.02 U | 0.02 U | 80 | 810 | | | 7.1 | 7.9 |
| 4/18/2012 | 1.50 | 3.30 | 11 | 120 | 0.50 U | 1.60 | 5.60 | | 0.02 U | 0.02 U | 83 | 400 | | | 7.1 | 7.5 |
| 4/26/2012 | 1.00 | 2.60 | 1.0 U | 81 | 0.50 U | 1.10 | 4.50 | | 0.02 U | 0.02 U | 63 | 420 | | | 7.0 | 6.8 |
| 5/3/2012 | 1.40 | 2.70 | 2.1 | 75 | 0.50 U | 0.91 J | 4.30 | | 0.02 U | 0.02 U | 72 | 320 | | | 7.0 | 7.6 |
| 5/10/2012 | 1.40 | 3.20 | 1.7 J | 57 | 0.50 U | 0.80 J | 3.00 | | 0.02 U | 0.02 U | 83 | 340 | | | 6.9 | 7.6 |
| WY 2012 Average | 1.71 | 3.98 | 3.9 | 115 | 0.38 | 1.48 | 6.00 | | 0.01 | 0.01 | 86 | 482 | | | 7.0 | 7.6 |
| WY 2012 Maximum | 2.60 | 13.00 | 11 | 510 | 0.50 | 7.60 | 24.00 | | 0.02 | 0.02 | 140 | 2,100 | | | 7.3 | 8.3 |
| WY2012 Minimum | 1.00 | 1.80 | 1.0 | 26 | 0.20 | 0.35 | 2.30 | | 0.01 | 0.01 | 43 | 154 | | | 6.9 | 6.8 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

**TABLE 11**

Slickrock Creek at Mouth (SRMO)

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

| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 0.02 U | 0.02 U | 4 | 6 | 0.02 U | 0.02 U | 0.01 UJ | | 0.01 U | 0.01 U | 5 J | 6 J | | | 6.5 |
| 11/3/2010 | 0.02 U | 0.02 U | 3 | 6 | 0.02 U | 0.02 U | 0.08 J | | 0.01 U | 0.01 U | 9 | 8 | | | 6.6 |
| 11/11/2010 | 0.33 | 0.36 | 7 | 16 | 0.02 U | 0.73 | 0.11 | | 0.01 U | 0.01 U | 50 J | 55 J | | | 7.0 |
| 11/17/2010 | 0.02 U | 0.02 U | 3 | 4 | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 7 | 8 | | | 7.1 |
| 11/23/2010 | 0.02 UJ | 0.02 UJ | 6 | 20 | 0.02 UJ | 0.02 UJ | 0.20 | | 0.01 U | 0.04 J | 17 J | 21 J | | | 6.3 |
| 12/1/2010 | 0.02 U | 0.02 U | 3 | 4 | 0.02 U | 0.02 U | 0.03 J | | 0.01 U | 0.01 U | 7 | 7 | | | 6.7 |
| 12/8/2010 | 0.02 U | 0.02 U | 7 | 23 | 0.02 U | 0.02 U | 0.37 | | 0.01 UJ | 0.03 J | 14 | 19 | | | 6.6 |
| 12/15/2010 | 0.07 J | 0.07 J | 6 | 8 | 0.03 J | 0.07 J | 0.08 J | | 0.01 U | 0.01 U | 8 J | 9 J | | | 6.9 |
| 12/22/2010 | 0.14 J | 0.20 | 14 | 40 | 0.02 U | 0.77 | 1.50 | | 0.01 U | 0.01 U | 19 | 29 | | | 6.4 |
| 12/29/2010 | 0.02 U | 0.02 U | 9 | 20 | 0.02 U | 0.02 U | 1.18 | | 0.01 U | 0.02 J | 8 | 12 | 9 | 7.6 | 6.4 |
| 1/5/2011 | 0.05 J | 0.04 J | 4 | 6 | 0.02 U | 0.02 U | 0.01 U | | 0.02 J | 0.03 J | 7 | 8 | | | 6.6 |
| 1/12/2011 | 0.02 UJ | 0.02 UJ | 5 J | 3 J | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 6 J | 6 J | | | 6.8 |
| 1/19/2011 | 0.04 J | 0.06 J | 3 J | 4 J | 0.01 U | 0.01 U | 0.00 U | | 0.01 U | 0.14 | 6 | 7 | | | 6.8 |
| 2/16/2011 | 0.07 U | 0.07 U | 9 | 15 | 0.20 U | 0.20 U | 0.13 | | 0.02 U | 0.02 J | 11 | 15 | 9 | 7.7 | 6.8 |
| 2/23/2011 | 0.07 U | 0.07 U | 10 | 14 | 0.20 U | 0.20 U | 0.06 J | | 0.01 U | 0.01 U | 13 | 14 | 13 | 7.6 | 7.2 |
| 3/2/2011 | 0.07 U | 0.07 U | 11 | 23 | 0.20 U | 0.31 J | 0.27 | | 0.01 U | 0.01 U | 12 | 19 | 9 | | 6.3 |
| 3/9/2011 | 0.07 U | 0.07 U | 5 | 8 | 0.20 U | 0.20 U | 0.03 J | | 0.01 U | 0.01 U | 9 J | 10 J | 11 | 7.8 | |
| 3/16/2011 | 0.07 U | 0.07 U | 11 | 18 | 0.20 U | 0.20 U | 0.11 | | 0.01 U | 0.01 U | 58 J | 16 J | 10 | | 6.9 |
| 3/31/2011 | 0.07 U | 0.07 U | 9 | 22 | 0.36 J | 0.94 | 0.20 | | 0.01 U | 0.01 U | 34 J | 26 J | 10 | 7.8 | 7.1 |
| WY 2011 Average | 0.06 | 0.07 | 7 | 14 | 0.08 | 0.20 | 0.23 | | 0.01 | 0.02 | 16 | 16 | 10 | 7.7 | 6.7 |
| WY 2011 Maximum | 0.33 | 0.36 | 14 | 40 | 0.36 | 0.94 | 1.50 | | 0.02 | 0.14 | 58 | 55 | 13 | 7.8 | 7.2 |
| WY 2011 Minimum | 0.02 | 0.02 | 3 | 3 | 0.01 | 0.01 | 0.00 | | 0.01 | 0.01 | 5 | 6 | 9 | 7.6 | 6.3 |
| 10/6/2011 | 0.07 U | 0.07 U | 6 | 14 | 0.20 U | 0.27 J | 0.77 | | 0.01 U | 0.01 U | 3 | 17 | | | |
| 10/14/2011 | 0.07 U | 0.07 U | 2 | 3 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 3 | 4 | | | 7.2 |
| 11/23/2011 | 0.07 U | 0.07 U | 3 | 5 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 6 J | 7 J | | | 7.2 |
| 1/24/2012 | 0.07 J | 0.21 | 20 | 28 | 0.20 U | 0.20 U | 0.09 J | | 0.01 U | 0.01 U | 19 | 20 | | | 6.9 |
| 2/1/2012 | 0.07 U | 0.07 U | 4 | 6 | 0.20 U | 0.20 U | 0.03 U | | 0.02 UJ | 0.02 UJ | 6 | 6 | | | 7.0 |
| 2/8/2012 | 0.07 UJ | 0.10 J | 7 | 11 | 0.20 U | 0.20 U | 0.06 J | | 0.02 U | 0.02 U | 9 J | 11 | | | 7.3 |
| 2/15/2012 | 0.07 U | 0.07 U | 3 | 4 | 0.20 U | 0.20 U | 0.03 U | | 0.02 U | 0.02 U | 7 | 7 | | | 7.6 |
| 3/2/2012 | 0.20 U | 0.20 U | 3 | 4 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 6 J | 6 J | | | 7.5 |
| 3/15/2012 | 0.20 U | 0.20 U | 20 | 39 | 0.50 U | 64.00 | 0.32 | | 0.02 U | 0.03 | 14 | 21 | | | 6.8 |
| 3/21/2012 | 0.20 U | 0.20 U | 6 | 5 | 0.50 U | 0.50 U | 0.08 J | | 0.02 U | 0.02 U | 18 | 5 U | | | 6.3 |
| 3/28/2012 | 0.20 U | 0.20 U | 9 | 21 | 0.50 U | 0.50 U | 0.95 | | 0.02 U | 0.02 J | 8 J | 13 | | | 7.1 |
| 4/4/2012 | 0.20 U | 0.20 U | 6 | 9 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 10 J | 9 J | | | 7.5 |
| 4/11/2012 | 0.20 U | 0.20 U | 11 | 16 | 0.50 U | 0.50 U | 0.08 J | | 0.02 U | 0.02 U | 13 | 14 | | | 7.4 |
| 4/18/2012 | 0.20 U | 0.20 U | 6 | 7 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 8 J | 8 J | | | 7.8 |
| 4/26/2012 | 0.20 U | 0.20 U | 1 U | 7 | 0.50 U | 0.50 U | 0.46 | | 0.02 J | 0.02 J | 6 J | 9 J | | | 7.2 |
| 5/3/2012 | 0.20 U | 0.20 U | 3 | 4 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 7 J | 7 J | | | 7.9 |
| 5/10/2012 | 0.20 U | 0.20 U | 2 J | 4 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 5 J | 7 J | | | 7.7 |
| WY 2012 Average | 0.15 | 0.16 | 7 | 11 | 0.38 | 4.12 | 0.19 | | 0.01 | 0.01 | 9 | 10 | | | 7.3 |
| WY 2012 Maximum | 0.20 | 0.21 | 20 | 39 | 0.50 | 64.00 | 0.95 | | 0.02 | 0.03 | 19 | 21 | | | 7.9 |
| WY2012 Minimum | 0.07 | 0.07 | 1 | 3 | 0.20 | 0.20 | 0.03 | | 0.01 | 0.01 | 3 | 4 | | | 6.3 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

**TABLE 12**

Spring Creek at Weir (SCWIR)

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

| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 1.90 | 2.00 | 95 | 112 | 1.40 | 2.30 | 0.36 J | | 0.01 U | 0.01 U | 297 J | 308 J | | | 5.4 |
| 11/3/2010 | 4.10 | 4.30 | 215 | 221 | 5.60 | 6.00 | 0.54 | | 0.01 U | 0.01 U | 570 | 589 | | | 4.6 |
| 11/11/2010 | 3.50 | 3.70 | 213 | 219 | 4.70 | 5.20 | 0.80 | | 0.01 U | 0.01 U | 527 J | 553 J | | | 4.9 |
| 11/17/2010 | 2.40 | 2.40 | 225 | 227 | 5.70 | 6.00 | 0.42 | | 0.01 U | 0.01 U | 632 | 640 | | | 4.8 |
| 11/23/2010 | 3.20 | 3.30 | 213 | 221 | 3.90 | 4.60 | 1.80 | | 0.02 J | 0.02 J | 555 J | 570 J | | | 4.5 |
| 12/1/2010 | 3.30 | 3.40 | 215 | 217 | 4.20 | 4.50 | 0.92 | | 0.01 U | 0.01 U | 503 | 511 | | | 5.0 |
| 12/8/2010 | 1.50 | 1.50 | 118 | 112 | 1.30 | 1.90 | 1.90 | | 0.01 UJ | 0.02 J | 286 | 262 | | | 6.1 |
| 12/15/2010 | 1.70 | 2.30 | 128 | 154 | 1.40 | 2.50 | 1.77 | | 0.01 U | 0.01 U | 289 J | 361 J | | | 5.6 |
| 12/22/2010 | 0.96 | 1.10 | 83 | 106 | 0.59 | 3.20 | 3.61 | | 0.01 U | 0.01 U | 140 | 167 | | | 6.1 |
| 12/29/2010 | 0.94 | 1.00 | 75 | 96 | 0.02 U | 2.00 | 2.54 | | 0.01 U | 0.01 U | 136 J | 155 | 150 | 6.1 | 5.3 |
| 1/5/2011 | 1.70 | 2.20 | 107 | 134 | 1.10 | 2.20 | 1.90 | | 0.02 J | 0.02 J | 264 | 334 | | | 5.6 |
| 1/12/2011 | 1.60 J | 1.40 J | 127 J | 113 J | 2.60 J | 2.00 J | 0.16 J | | 0.01 U | 0.01 U | 323 J | 288 J | | | 5.3 |
| 1/19/2011 | 1.90 | 2.10 | 127 J | 137 J | 1.90 | 2.30 | 0.69 | | 0.01 U | 0.01 U | 339 | 354 | | | 5.4 |
| 2/16/2011 | 0.34 | 0.32 | 14 | 35 | 0.20 U | 0.53 | 0.38 | | 0.02 U | 0.02 J | 57 | 63 | 41 | 7.4 | 6.8 |
| 2/23/2011 | 0.85 | 0.92 | 36 | 64 | 0.20 U | 0.85 | 0.60 | | 0.01 U | 0.01 U | 137 | 158 | 140 | 6.8 | 5.8 |
| 3/2/2011 | 0.25 | 0.26 | 13 | 38 | 0.20 U | 0.64 | 0.60 | | 0.01 U | 0.01 U | 52 | 63 | 42 | 6.9 | 6.9 |
| 3/9/2011 | 1.10 | 1.20 | 76 | 94 | 0.46 J | 1.30 | 0.77 | | 0.01 U | 0.01 U | 241 J | 255 J | 230 | 6.5 | |
| 3/16/2011 | 0.38 | 0.35 | 17 | 48 | 0.20 U | 0.42 J | 0.37 | | 0.01 U | 0.01 U | 76 | 95 | 69 | 7.4 | 7.4 |
| 3/31/2011 | 0.22 | 0.26 | 13 | 36 | 0.20 U | 0.98 | 0.44 | | 0.01 U | 0.01 U | 58 J | 68 J | 66 | 6.9 | 7.1 |
| WY 2011 Average | 1.68 | 1.79 | 111 | 126 | 1.89 | 2.60 | 1.08 | | 0.01 | 0.01 | 289 | 305 | 105 | 6.9 | 5.7 |
| WY 2011 Maximum | 4.10 | 4.30 | 225 | 227 | 5.70 | 6.00 | 3.61 | | 0.02 | 0.02 | 632 | 640 | 230 | 7.4 | 7.4 |
| WY 2011 Minimum | 0.22 | 0.26 | 13 | 35 | 0.02 | 0.42 | 0.16 | | 0.01 | 0.01 | 52 | 63 | 41 | 6.1 | 4.5 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

**TABLE 13**

Flat Creek at Flat Creek Bridge (FCB)

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

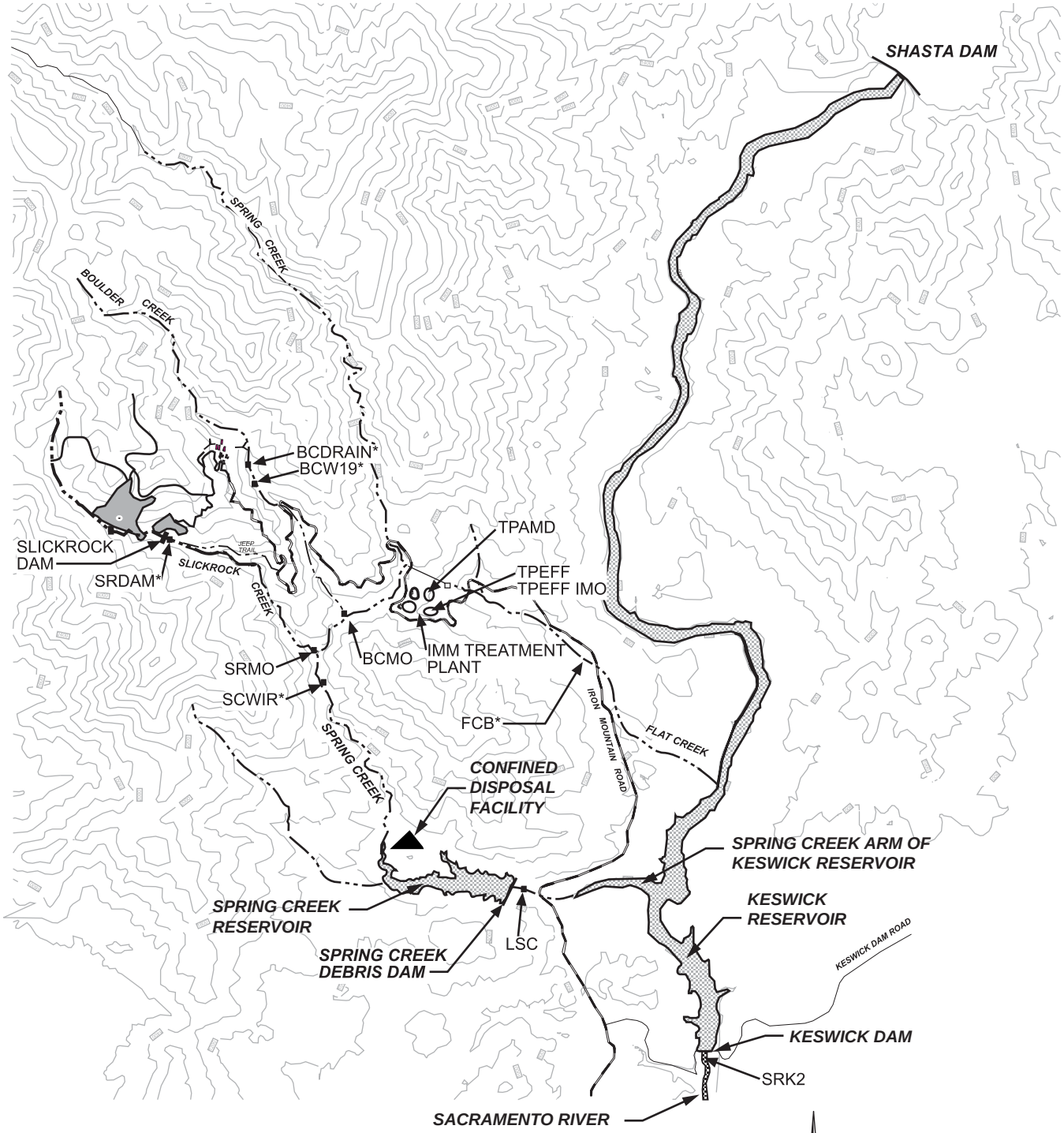
| Sampling Date | Dissolved Cadmium (µg/L) | Total Cadmium (µg/L) | Dissolved Copper (µg/L) | Total Copper (µg/L) | Dissolved Lead (µg/L) | Total Lead (µg/L) | Total Iron (µg/L) | Ferrous Iron (µg/L) | Dissolved Mercury (µg/L) | Total Mercury (µg/L) | Dissolved Zinc (µg/L) | Total Zinc (µg/L) | Sulfate (µg/L) | Laboratory pH | Field pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/26/2010 | 0.02 U | 0.02 U | 4 | 5 | 0.02 U | 0.02 U | 0.01 UJ | | 0.01 U | 0.01 U | 9 J | 10 J | | | 6.3 |
| 11/3/2010 | 0.02 U | 0.02 U | 3 | 6 | 0.02 U | 0.02 U | 0.03 J | | 0.01 U | 0.01 U | 14 | 15 | | | 6.3 |
| 11/11/2010 | 0.14 J | 0.14 J | 4 | 7 | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 15 J | 16 J | | | 6.7 |
| 11/17/2010 | 0.02 U | 0.02 U | 3 | 5 | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 18 | 18 | | | 6.6 |
| 11/23/2010 | 0.02 UJ | 0.02 UJ | 7 | 19 | 0.02 UJ | 0.02 UJ | 0.01 U | | 0.01 U | 0.01 U | 27 J | 30 J | | | 6.5 |
| 12/1/2010 | 0.02 U | 0.02 U | 4 | 9 | 0.02 U | 0.02 U | 0.01 J | | 0.01 U | 0.01 U | 27 | 28 | | | 6.1 |
| 12/8/2010 | 0.02 U | 0.02 U | 6 | 10 | 0.02 U | 0.02 U | 0.10 J | | 0.01 UJ | 0.01 UJ | 17 | 21 | | | 5.6 |
| 12/15/2010 | 0.15 J | 0.18 J | 5 | 10 | 0.02 U | 0.04 J | 0.02 J | | 0.01 U | 0.01 U | 22 J | 24 J | | | 6.7 |
| 12/22/2010 | 0.10 J | 0.13 J | 5 | 14 | 0.02 U | 0.02 U | 0.47 | | 0.01 U | 0.01 U | 13 | 21 | | | 6.3 |
| 12/29/2010 | 0.02 U | 0.02 U | 5 | 10 | 0.02 U | 0.02 U | 0.41 | | 0.01 U | 0.01 U | 16 J | 19 J | 6 | 7.1 | 6.2 |
| 1/5/2011 | 0.23 | 0.20 J | 5 | 11 | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 29 | 30 | | | 6.0 |
| 1/12/2011 | 0.02 UJ | 0.02 UJ | 5 J | 12 J | 0.02 U | 0.02 U | 0.01 U | | 0.01 U | 0.01 U | 29 J | 30 J | | | 6.5 |
| 1/19/2011 | 0.17 J | 0.16 J | 5 J | 10 J | 0.01 U | 0.01 U | 0.00 U | | 0.01 U | 0.01 U | 24 | 26 | | | 6.4 |
| 2/16/2011 | 0.07 U | 0.07 J | 4 | 8 | 0.20 U | 0.20 U | 0.09 J | | 0.02 U | 0.02 U | 14 | 17 | 6 | 7.5 | 6.8 |
| 2/23/2011 | 0.08 J | 0.10 J | 5 | 8 | 0.20 U | 0.20 U | 0.04 J | | 0.01 U | 0.01 U | 24 | 26 | 11 | 7.4 | 6.9 |
| 3/2/2011 | 0.10 J | 0.07 U | 14 J | 8 J | 0.20 U | 0.20 U | 0.04 J | | 0.01 U | 0.01 U | 21 J | 17 J | 6 | 7.5 | 6.9 |
| 3/9/2011 | 0.07 U | 0.07 U | 4 | 9 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 25 J | 25 J | 9 | 7.5 | 6.0 |
| 3/16/2011 | 0.07 U | 0.07 U | 6 | 9 | 0.20 U | 0.20 U | 0.08 J | | 0.01 U | 0.01 U | 18 | 21 | 8 | 7.6 | 6.6 |
| 3/31/2011 | 0.07 U | 0.07 U | 6 | 9 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 21 J | 21 J | 7 | 7.6 | 7.1 |
| WY 2011 Average | 0.07 | 0.07 | 5 | 9 | 0.07 | 0.07 | 0.07 | | 0.01 | 0.01 | 20 | 22 | 7 | 7.5 | 6.4 |
| WY 2011 Maximum | 0.23 | 0.20 | 14 | 19 | 0.20 | 0.20 | 0.47 | | 0.02 | 0.02 | 29 | 30 | 11 | 7.6 | 7.1 |
| WY 2011 Minimum | 0.02 | 0.02 | 3 | 5 | 0.01 | 0.01 | 0.00 | | 0.01 | 0.01 | 9 | 10 | 6 | 7.1 | 5.6 |
| 10/6/2011 | 0.14 J | 0.07 U | 11 | 19 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 21 | 24 | | | |
| 10/14/2011 | 0.11 J | 0.07 U | 2 | 4 | 0.20 U | 0.20 U | 0.03 U | | 0.01 U | 0.01 U | 16 | 16 | | | 6.6 |
| 11/23/2011 | 0.07 U | 0.24 | 9 | 24 | 0.20 U | 0.20 U | 0.04 J | | 0.01 U | 0.01 U | 32 J | 45 J | | | 7.1 |
| 1/24/2012 | 0.27 | 0.27 | 8 | 13 | 0.20 U | 0.20 U | 0.05 J | | 0.01 U | 0.01 U | 36 | 34 | | | 6.8 |
| 2/1/2012 | 0.22 | 0.26 | 7 | 14 | 0.20 U | 0.20 U | 0.03 U | | 0.02 UJ | 0.02 UJ | 32 | 35 | | | 7.3 |
| 2/8/2012 | 0.19 J | 0.23 | 14 | 19 | 0.20 U | 0.20 U | 0.03 U | | 0.02 U | 0.02 U | 32 J | 34 | | | 6.8 |
| 2/15/2012 | 0.15 J | 0.14 J | 6 | 12 | 0.20 U | 0.20 U | 0.03 U | | 0.02 U | 0.02 U | 34 | 33 | | | 7.0 |
| 3/2/2012 | 0.24 J | 0.23 J | 5 | 12 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 39 | 37 | | | 7.3 |
| 3/15/2012 | 0.20 U | 0.20 U | 9 | 31 | 0.50 U | 0.50 U | 0.25 | | 0.02 U | 0.02 J | 14 | 28 | | | 6.2 |
| 3/21/2012 | 0.20 U | 0.20 U | 4 | 8 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 22 | 25 | | | 5.9 |
| 3/28/2012 | 0.20 U | 0.20 U | 4 | 15 | 0.50 U | 0.50 U | 0.21 | | 0.02 U | 0.02 U | 13 | 24 | | | 5.9 |
| 4/4/2012 | 0.20 U | 0.20 U | 6 | 9 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 26 | 26 | | | 7.8 |
| 4/11/2012 | 0.20 U | 0.20 U | 7 | 12 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 23 | 24 | | | 6.9 |
| 4/18/2012 | 0.20 U | 0.20 U | 4 | 8 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 20 | 23 | | | 7.7 |
| 4/26/2012 | 0.20 U | 0.20 U | 1 U | 12 | 0.50 U | 0.50 U | 0.10 J | | 0.02 U | 0.02 U | 16 | 20 | | | 7.0 |
| 5/3/2012 | 0.20 U | 0.20 U | 4 | 8 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 24 | 26 | | | 7.4 |
| 5/10/2012 | 0.20 U | 0.20 U | 4 | 10 | 0.50 U | 0.50 U | 0.05 U | | 0.02 U | 0.02 U | 25 | 27 | | | 7.4 |
| WY 2012 Average | 0.19 | 0.19 | 6 | 13 | 0.38 | 0.38 | 0.07 | | 0.01 | 0.01 | 25 | 28 | | | 6.9 |
| WY 2012 Maximum | 0.27 | 0.27 | 14 | 31 | 0.50 | 0.50 | 0.25 | | 0.02 | 0.02 | 39 | 45 | | | 7.8 |
| WY2012 Minimum | 0.07 | 0.07 | 1 | 4 | 0.20 | 0.20 | 0.03 | | 0.01 | 0.01 | 13 | 16 | | | 5.9 |

Notes:

J = the analyte was positively identified, but the reported value is an estimate.

U = the analyte was not detected above the value shown.

# Figures




| ID | LOCATION |
|---|---|
| **ROUTINE** | |
| SRK2 | SACRAMENTO RIVER BELOW KESWICK DAM |
| LSC | SCDD DISCHARGE ABOVE WEIR |
| TPEFF | TREATMENT PLANT EFFLUENT |
| TPEFF IMO | TREATMENT PLANT EFFLUENT COLLECTED BY IMO |
| BCMO | MOUTH OF BOULDER CREEK |
| SRMO | MOUTH OF SLICKROCK CREEK |
| TPAMD | TREATMENT PLANT INFLUENT |

**ADDITIONAL** (INDICATED BY AN ASTERISK)

| | |
|---|---|
| FCB | FLAT CREEK BRIDGE |
| SCWIR | SPRING CREEK WEIR |
| SRDAM | DISCHARGE BELOW SLICKROCK DAM |
| BCW19 | BOULDER CREEK AT WASTE PILE 19 |
| BCDRAIN | HORIZONTAL DRAINS BC LANDSLIDE |

N

0 3,000 6,000 FEET

SCALE IS APPROXIMATE

**FIGURE 1**
**LOCATION MAP AND WEEKLY ROUTINE SAMPLING LOCATIONS**
IRON MOUNTAIN MINE

ES031113163701RDD Figure_1 (03-14-13)

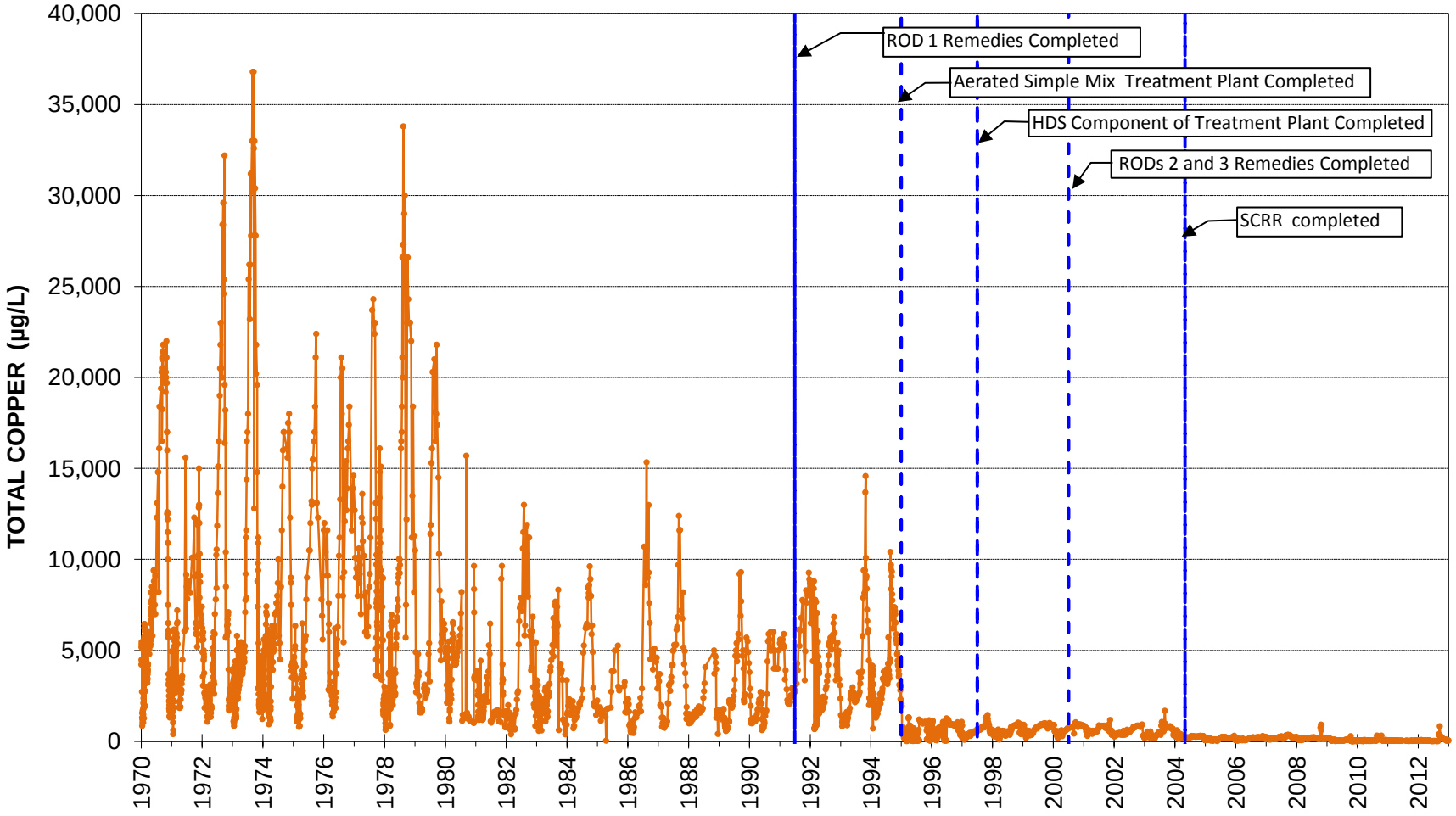



**FIGURE 2a**
**TOTAL COPPER CONCENTRATIONS FROM 1970 TO PRESENT IN LOWER SPRING CREEK**
IRON MOUNTAIN MINE

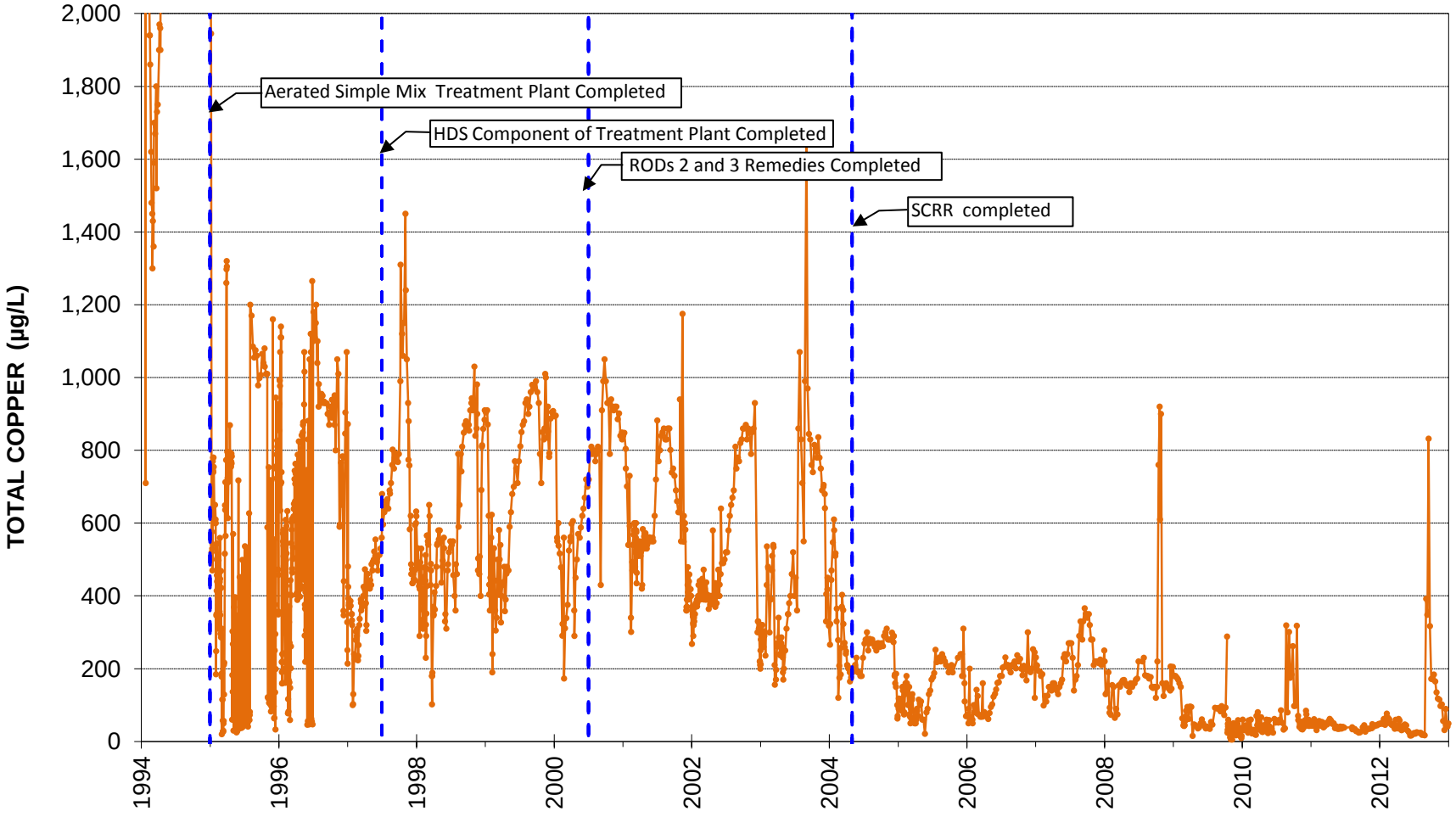



**FIGURE 2b**
**TOTAL COPPER CONCENTRATIONS FROM 1994 TO PRESENT IN LOWER SPRING CREEK**
IRON MOUNTAIN MINE

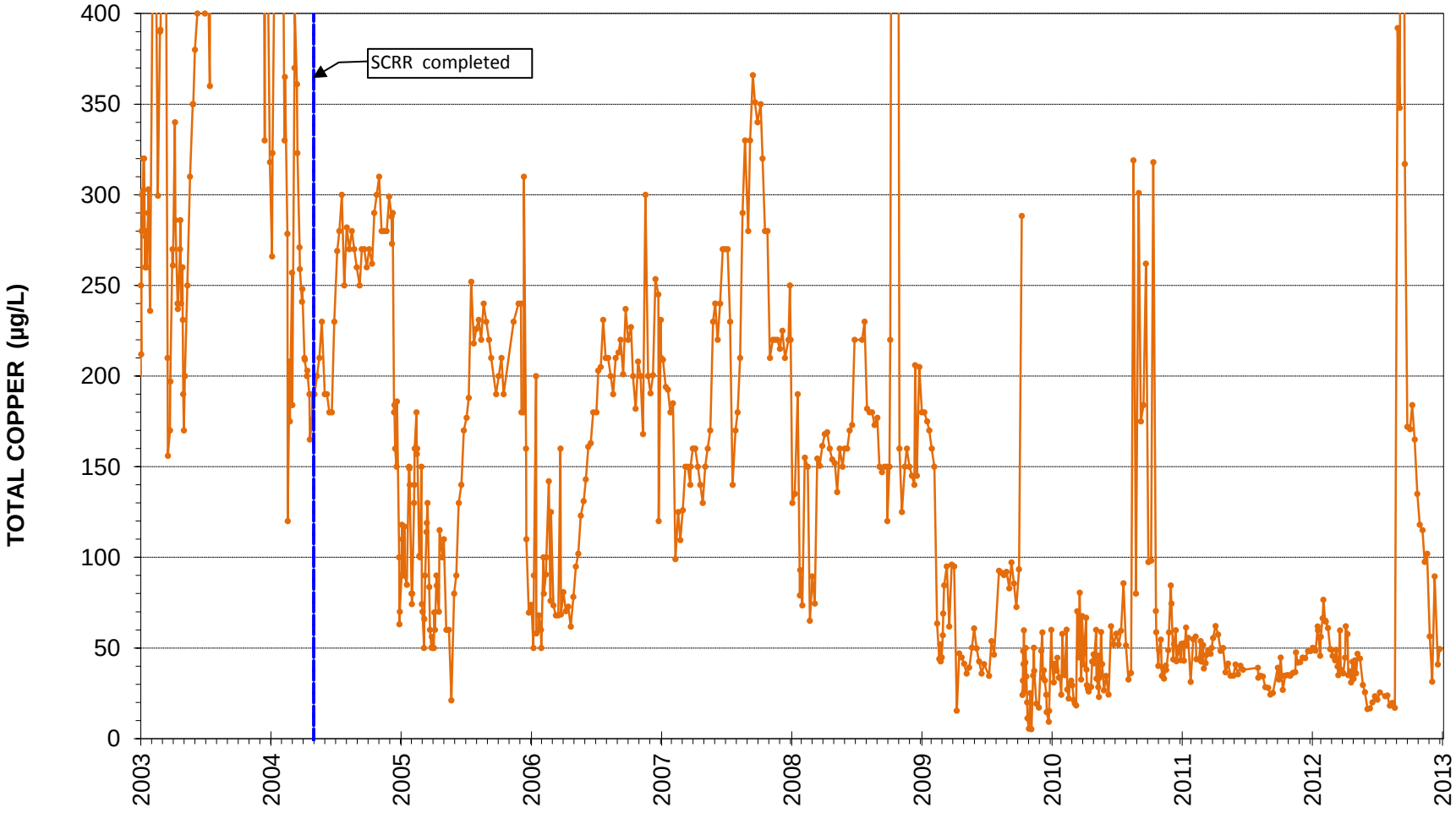



**FIGURE 2c**
**TOTAL COPPER CONCENTRATIONS FROM 2003 TO PRESENT IN LOWER SPRING CREEK**
IRON MOUNTAIN MINE

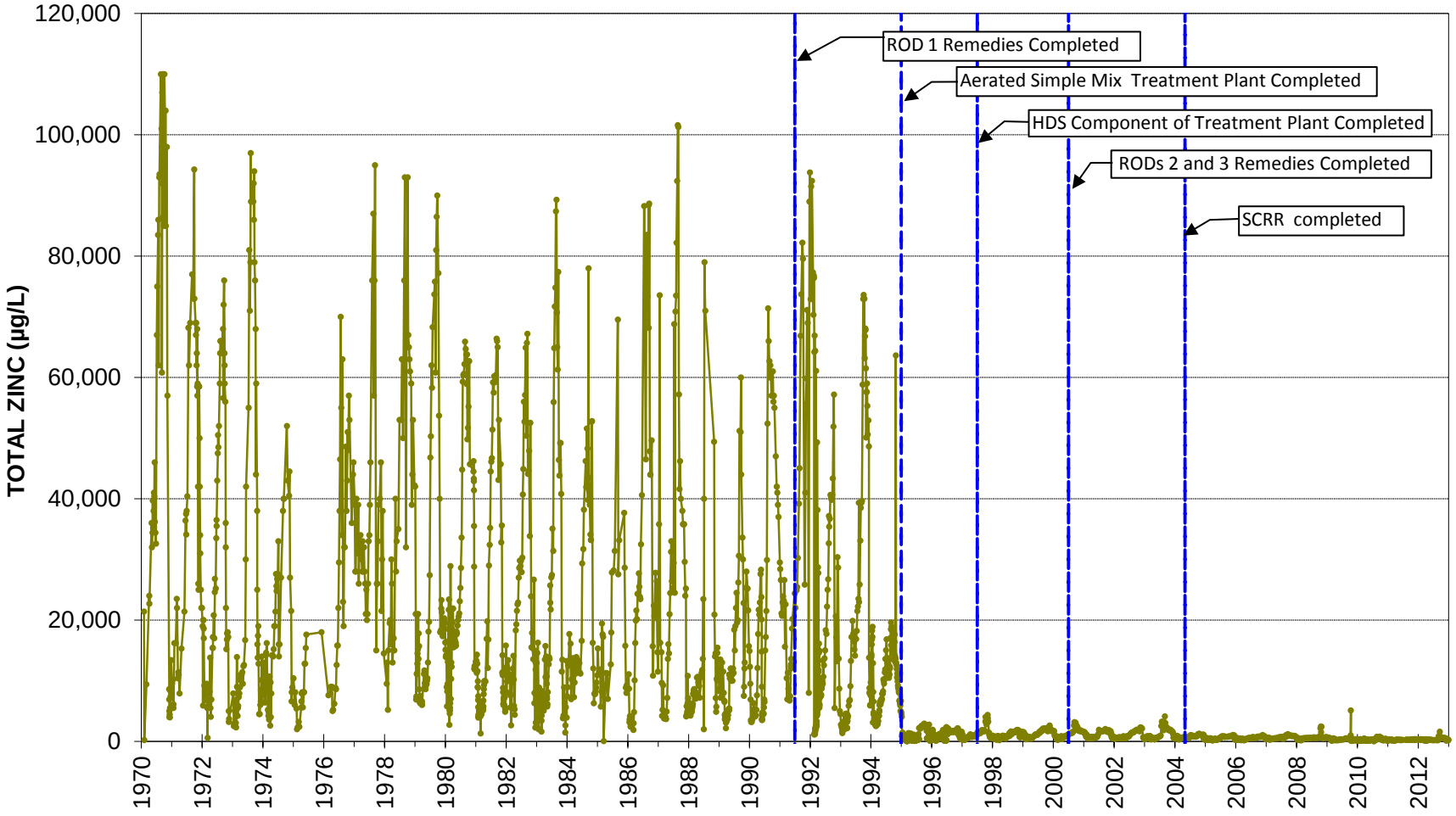



**FIGURE 3a**
**TOTAL ZINC CONCENTRATIONS FROM 1970 TO PRESENT IN LOWER SPRING CREEK**
IRON MOUNTAIN MINE

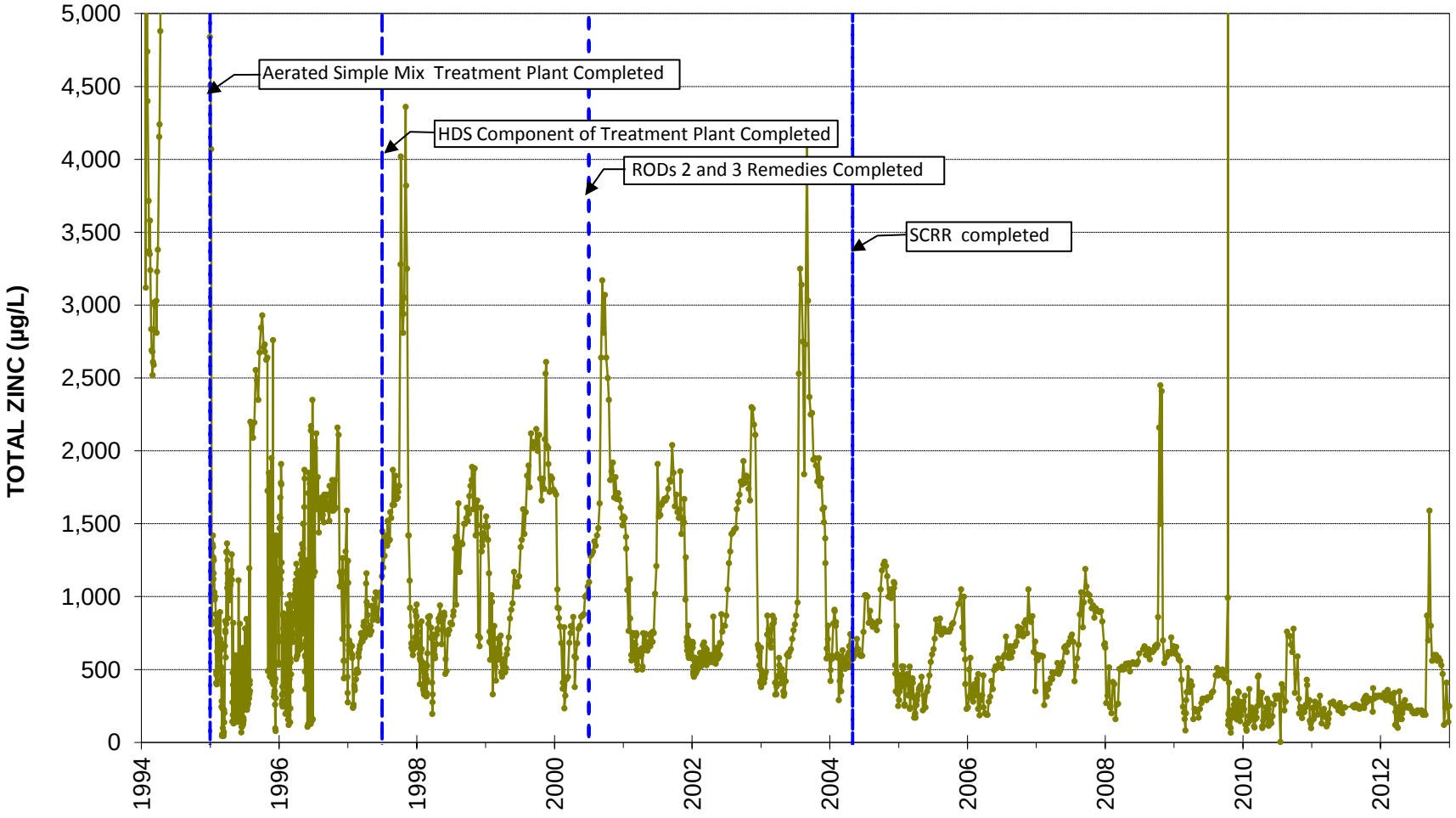



**FIGURE 3b**
**TOTAL ZINC CONCENTRATIONS FROM 1994 TO PRESENT IN LOWER SPRING CREEK**
IRON MOUNTAIN MINE

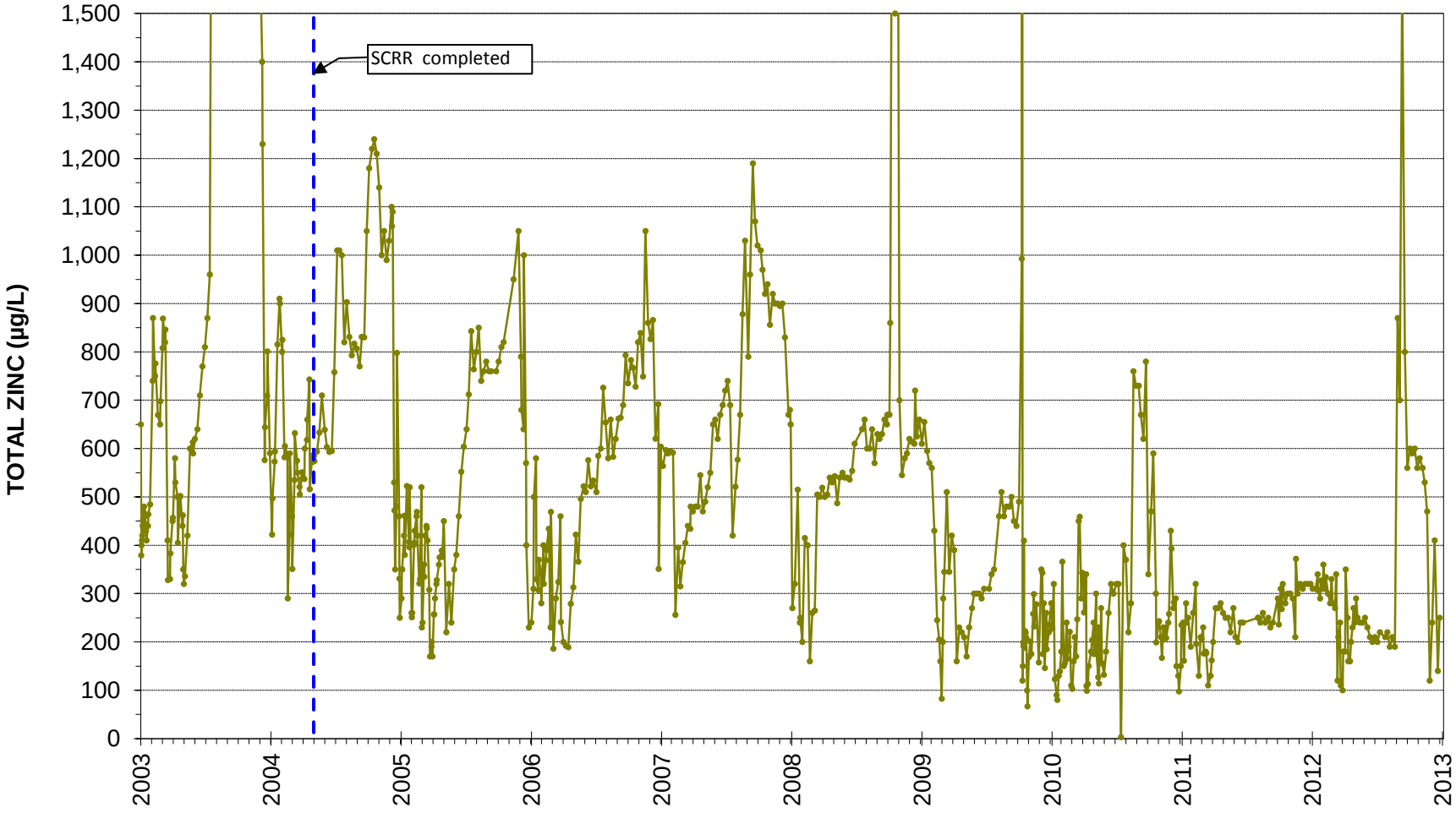



**FIGURE 3c**
**TOTAL ZINC CONCENTRATIONS FROM 2003 TO PRESENT IN LOWER SPRING CREEK**
IRON MOUNTAIN MINE

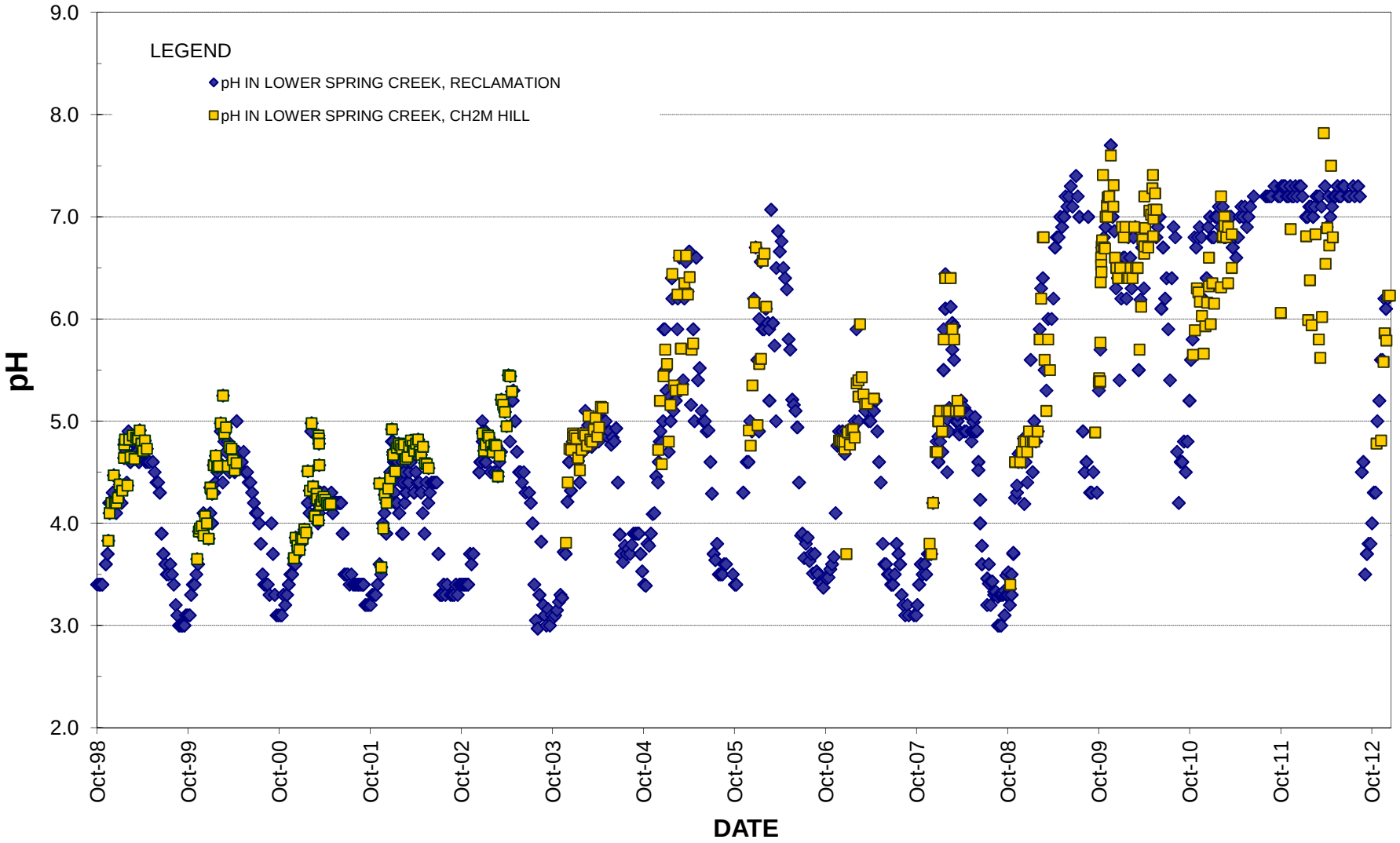



**FIGURE 4**
**SPRING CREEK DEBRIS DAM DISCHARGE**
**pH MEASUREMENTS**
IRON MOUNTAIN MINE

SCDD-pH-Figure.xls: FIG-pH

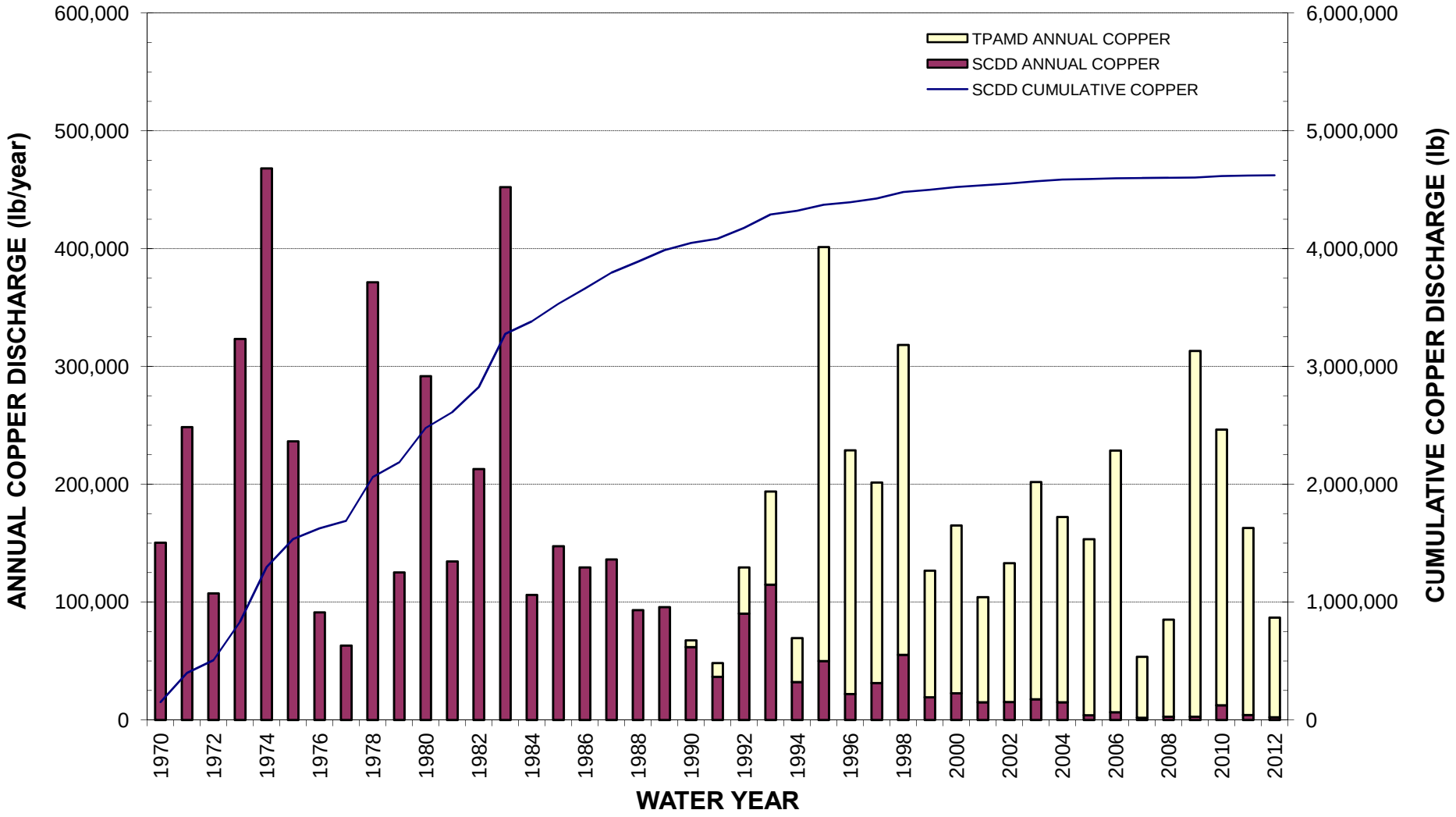



**FIGURE 5**
**COPPER LOAD DISCHARGE FROM IRON MOUNTAIN MINE WATER YEARS 1970 THROUGH 2012**

IRON MOUNTAIN MINE

**1994-2012: COPPER REMOVED BY TREATMENT PLANT = 3,120,207 lbs**

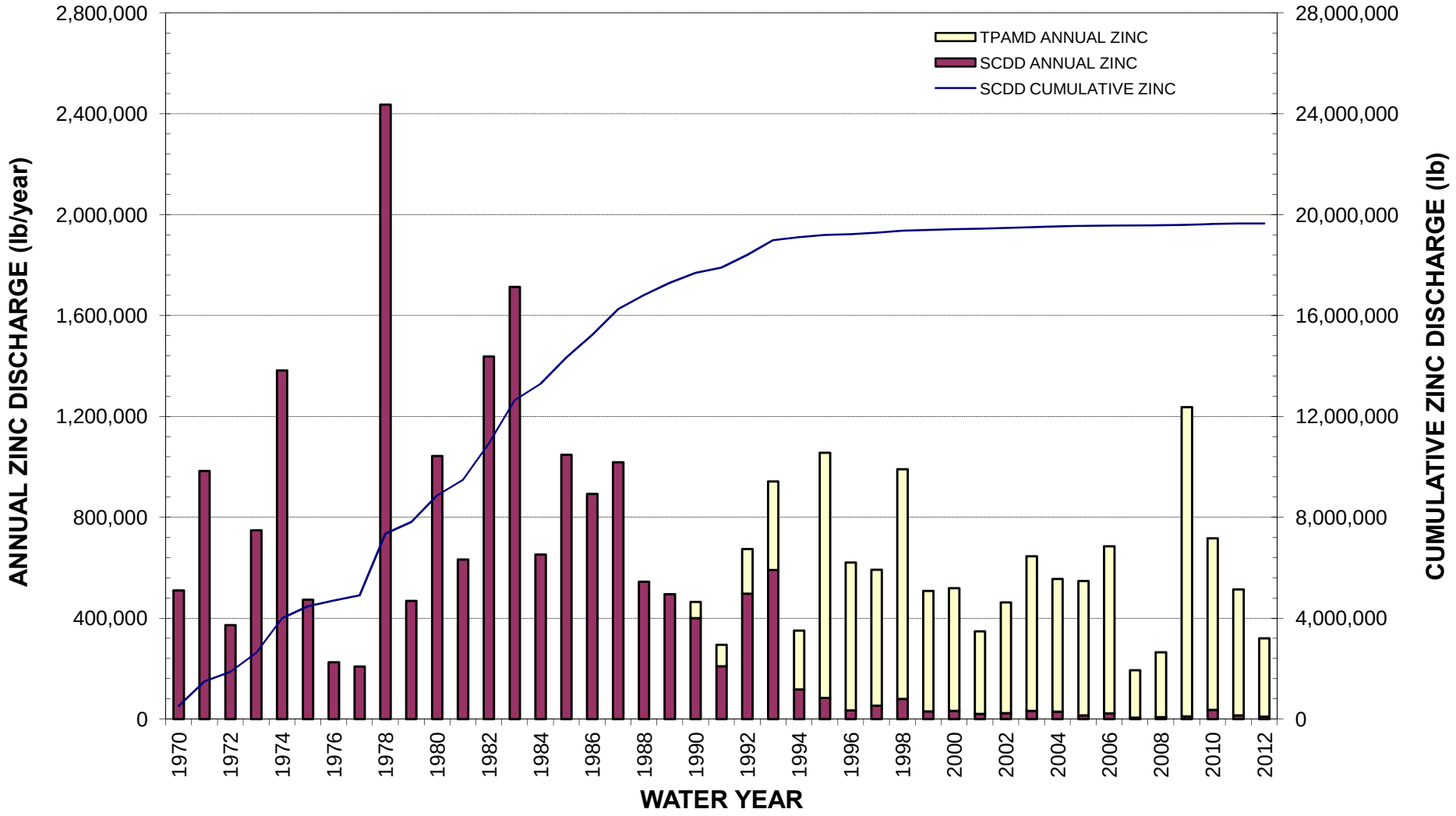
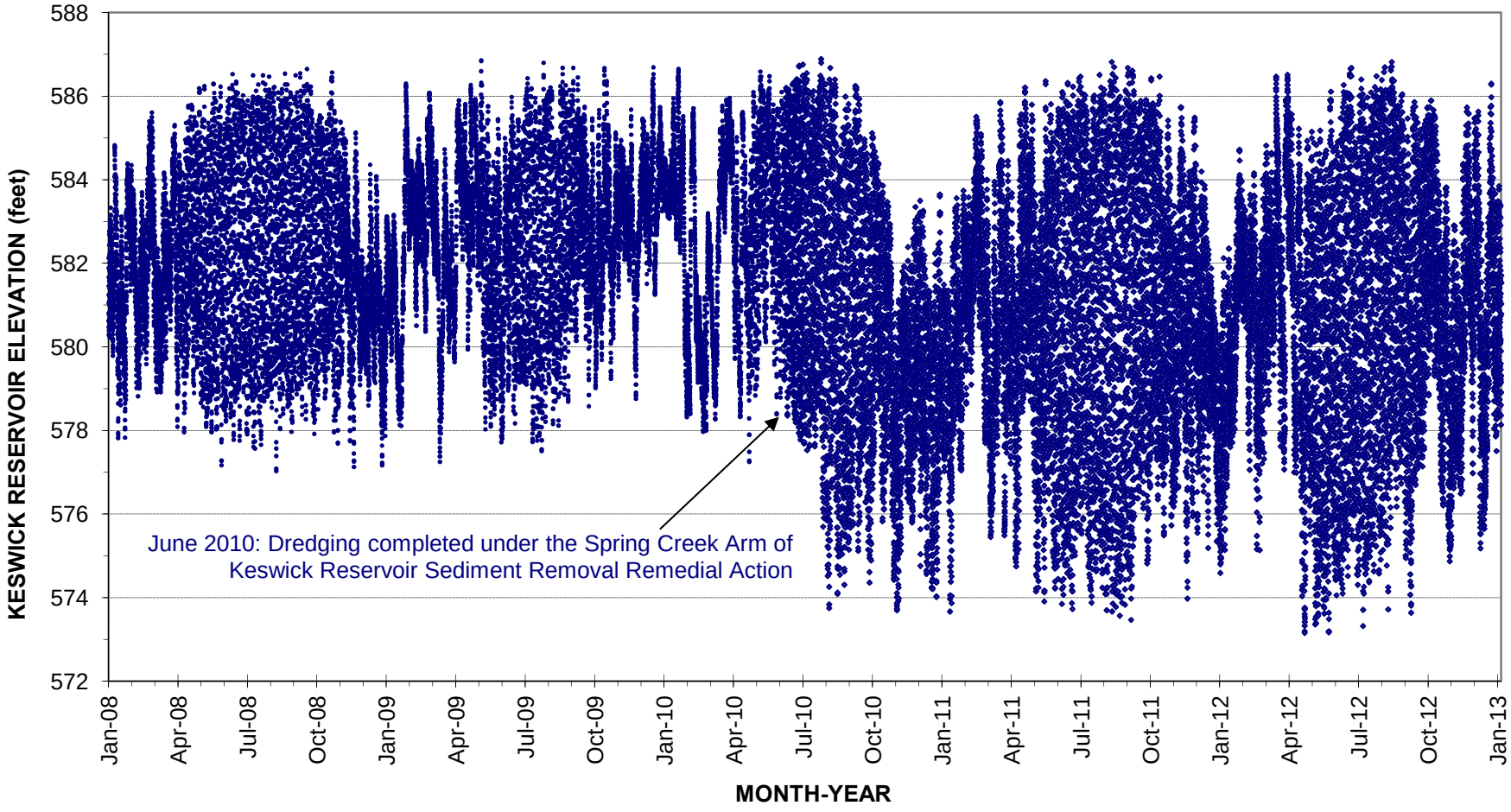



**FIGURE 6**
**ZINC LOAD DISCHARGE FROM IRON MOUNTAIN MINE WATER YEARS 1970 THROUGH 2012**

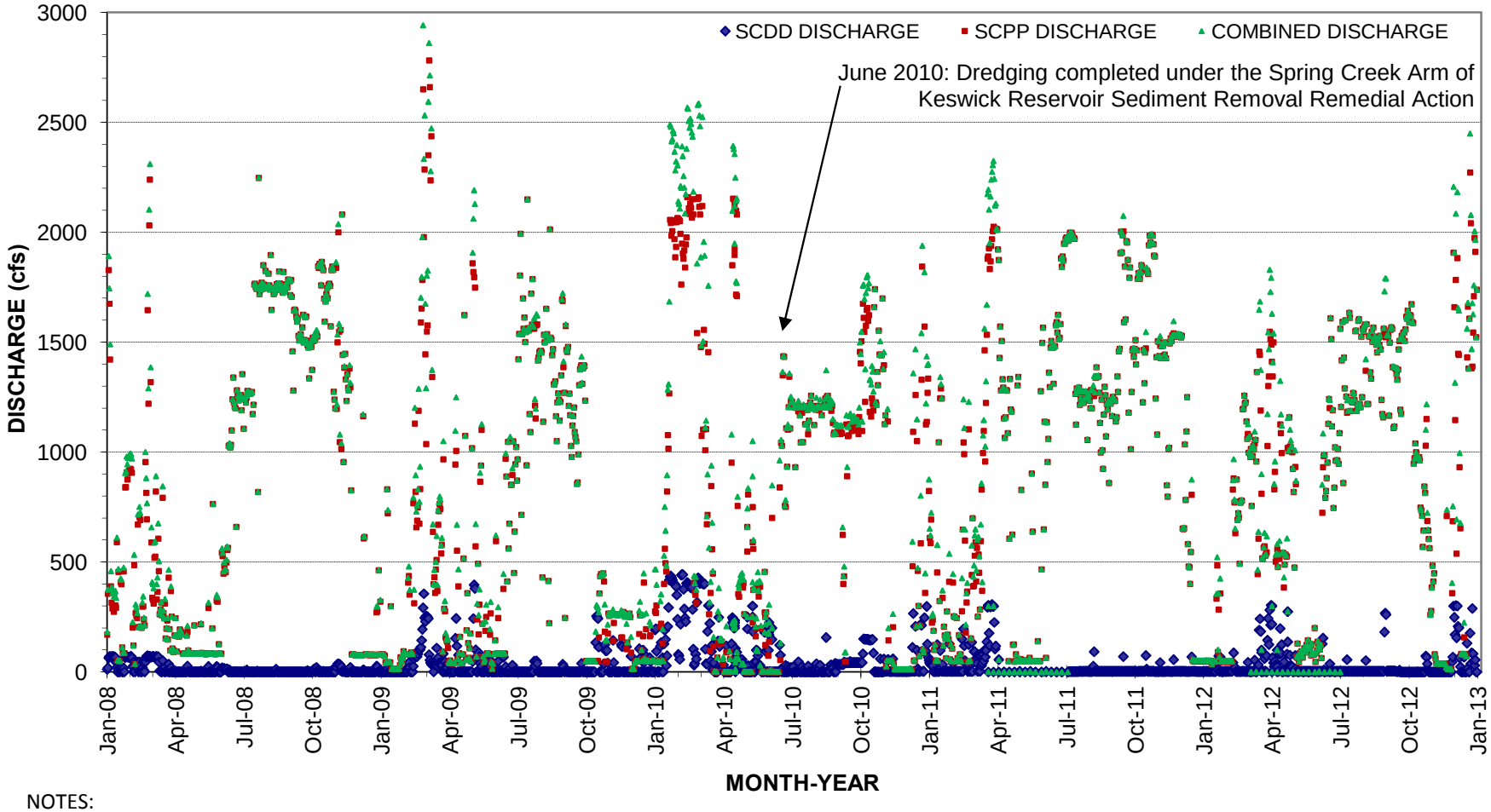
IRON MOUNTAIN MINE

**1994-2012: ZINC REMOVED BY TREATMENT PLANT = 10,468,638 lbs**



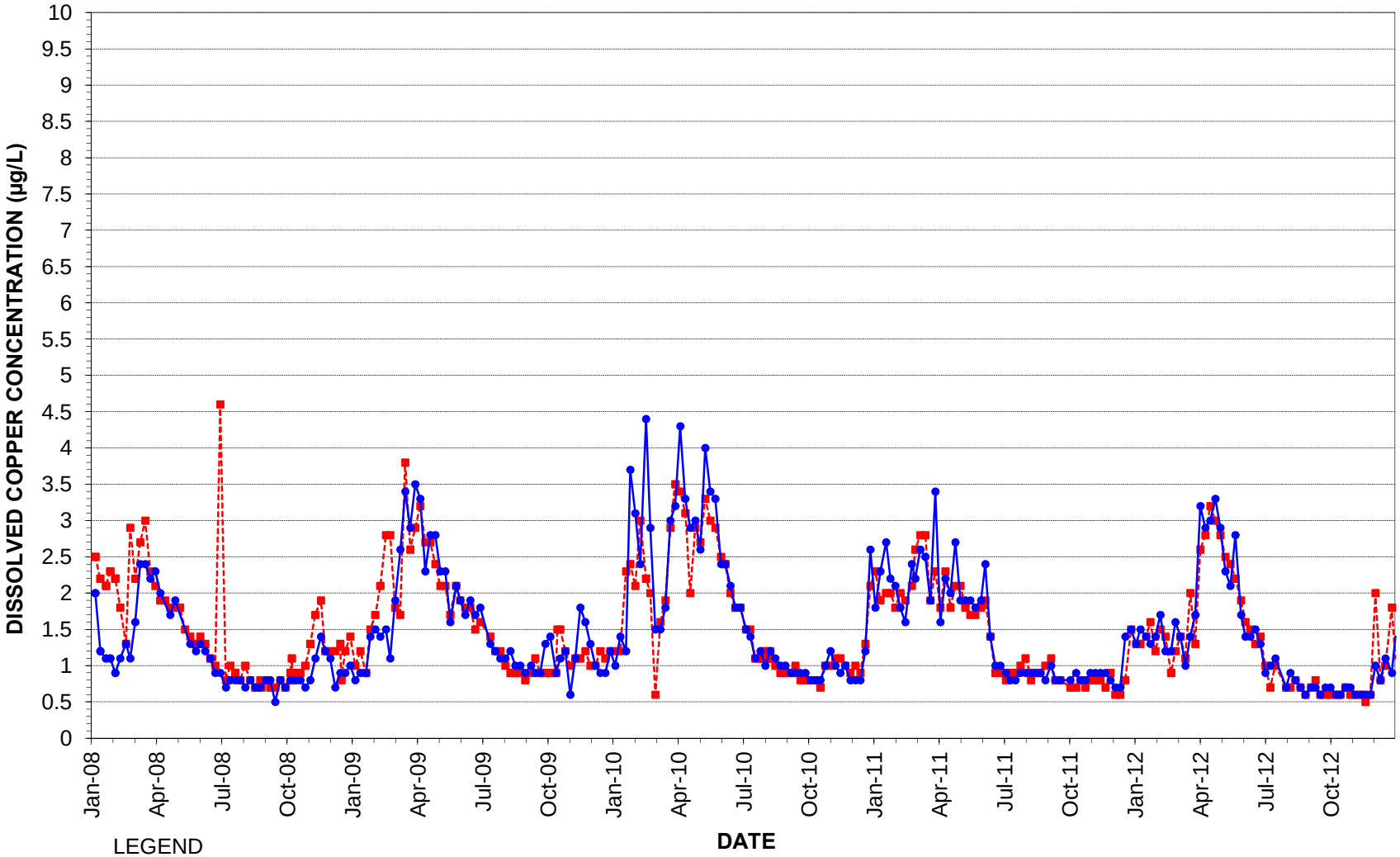

DATA SOURCE:
DEPARTMENT OF WATER RESOURCES, CALIFORNIA DATA EXCHANGE CENTER,
http://cdec.water.ca.gov/, FEBRUARY 2013, STATION "KES".

**FIGURE 7**
**KESWICK RESERVOIR ELEVATION**
IRON MOUNTAIN MINE




NOTES:
1. cfs = CUBIC FEET PER SECOND
2. SCDD = SPRING CREEK DEBRIS DAM
3. SCPP = SPRING CREEK POWER PLANT
4. SCDD DATA SOURCE: DEPARTMENT OF WATER RESOURCES, CALIFORNIA DATA EXCHANGE CENTER, http://cdec.water.ca.gov/, FEBRUARY 2013, STATION "SPC".
5. SCPP DATA SOURCE: BUREAU OF RECLAMATION.

**FIGURE 8**
**SPRING CREEK DEBRIS DAM AND SPRING CREEK POWER PLANT DISCHARGE**
IRON MOUNTAIN MINE



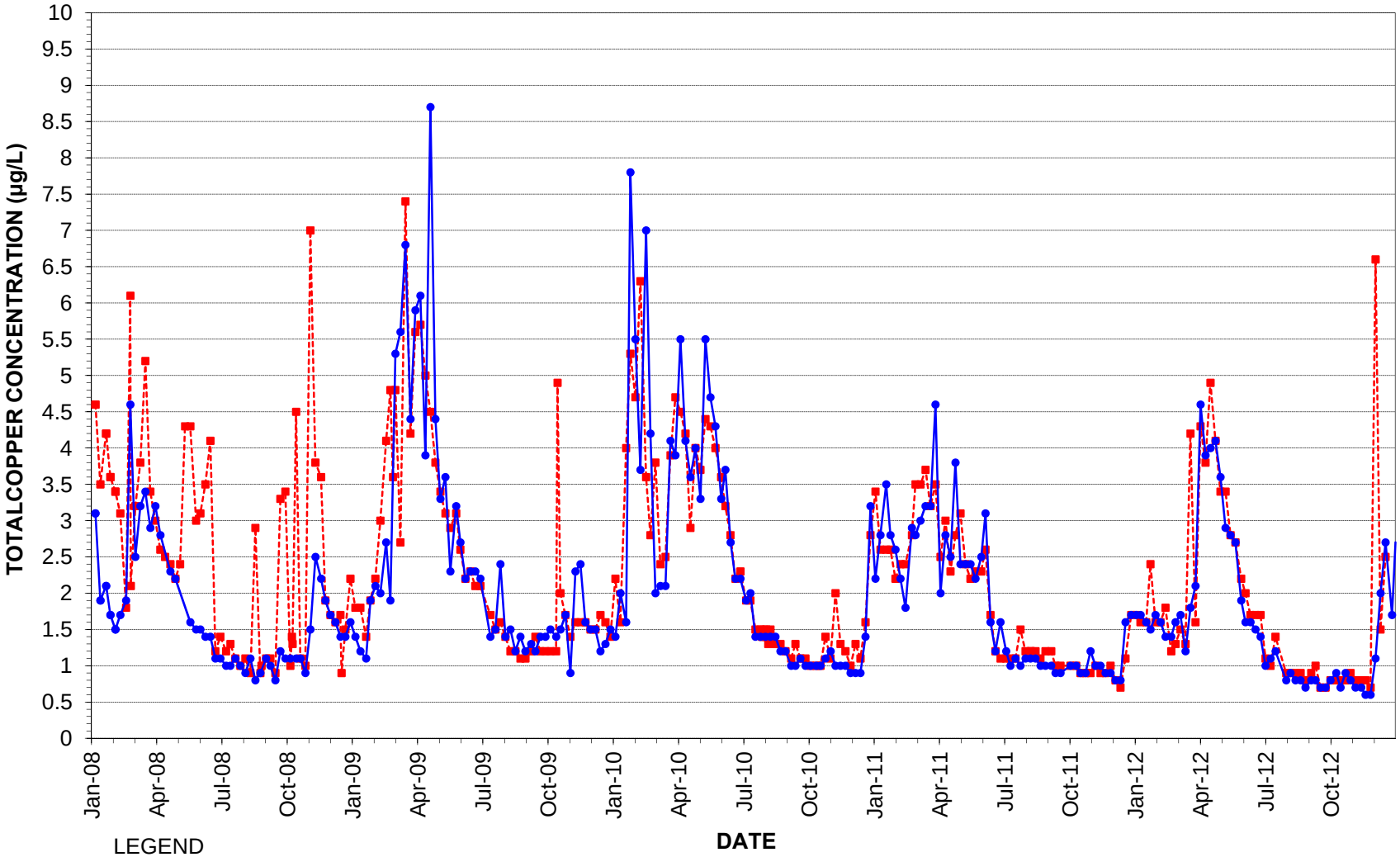

LEGEND

SACRAMENTO RIVER BELOW SHASTA DAM (SRS)

SACRAMENTO RIVER BELOW KESWICK DAM (SRK2)

NOTES:
DATA SOURCE: BUREAU OF RECLAMATION

**FIGURE 9**
**DISSOLVED COPPER CONCENTRATIONS IN SACRAMENTO RIVER BELOW SHASTA AND KESWICK DAMS**
IRON MOUNTAIN MINE



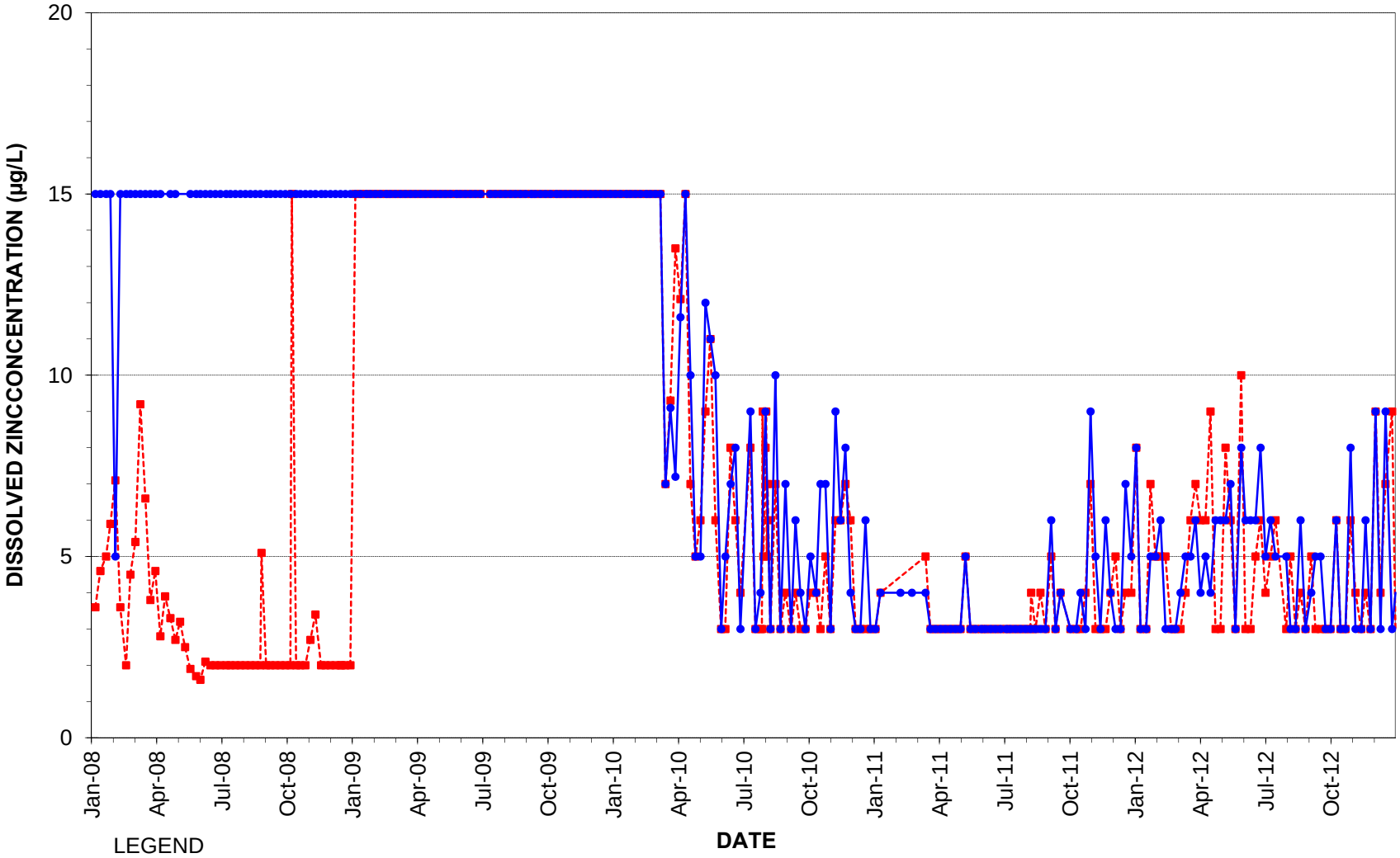

LEGEND

SACRAMENTO RIVER BELOW SHASTA DAM (SRS)

SACRAMENTO RIVER BELOW KESWICK DAM (SRK2)

NOTES:
DATA SOURCE: BUREAU OF RECLAMATION

**FIGURE 10**
**TOTAL COPPER CONCENTRATIONS IN SACRAMENTO RIVER BELOW SHASTA AND KESWICK DAMS**
IRON MOUNTAIN MINE



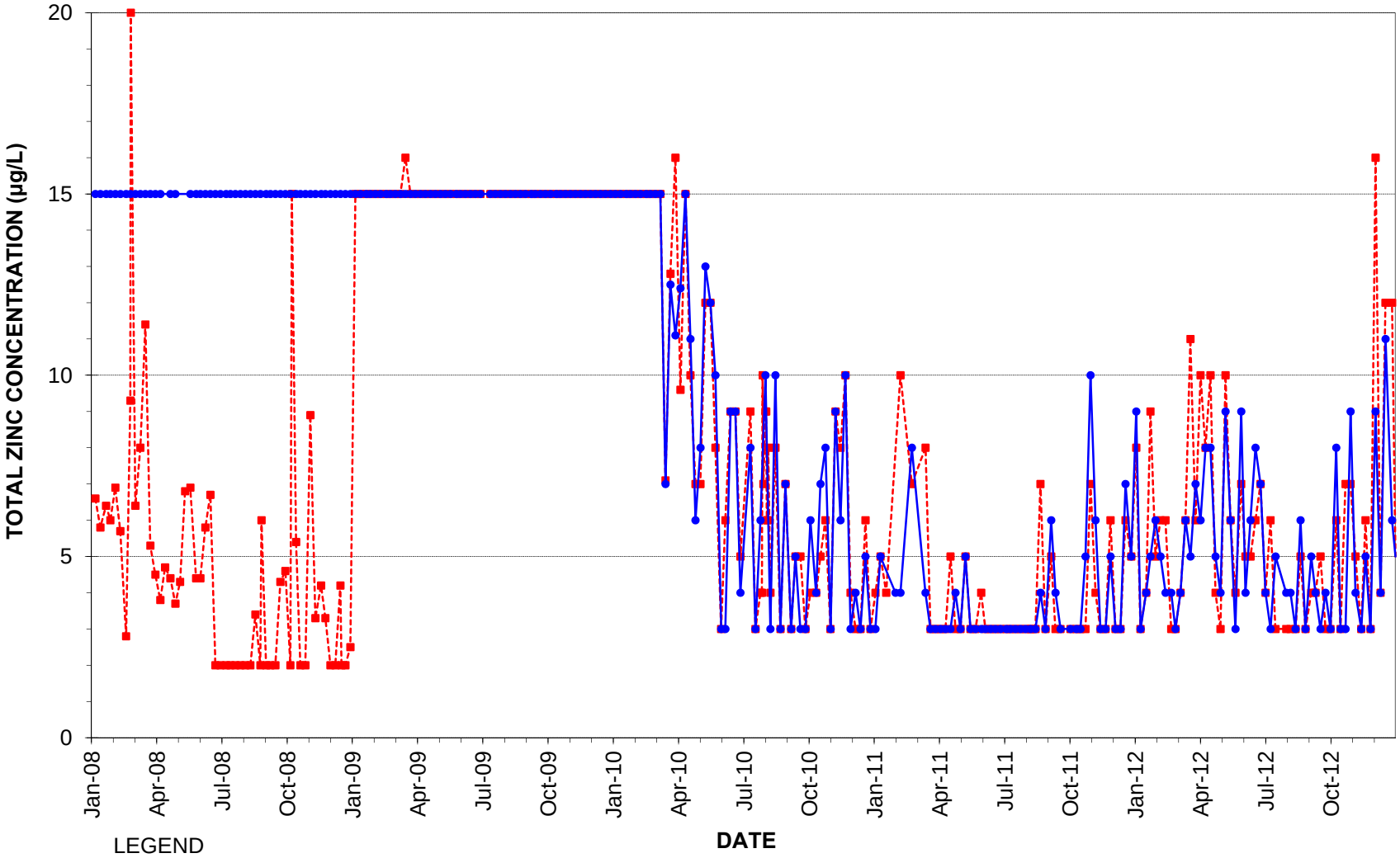

LEGEND

SACRAMENTO RIVER BELOW SHASTA DAM (SRS)

SACRAMENTO RIVER BELOW KESWICK DAM (SRK2)

NOTES:
DATA SOURCE: BUREAU OF RECLAMATION

**FIGURE 11**
**DISSOLVED ZINC CONCENTRATIONS IN SACRAMENTO RIVER BELOW SHASTA AND KESWICK DAMS**
IRON MOUNTAIN MINE



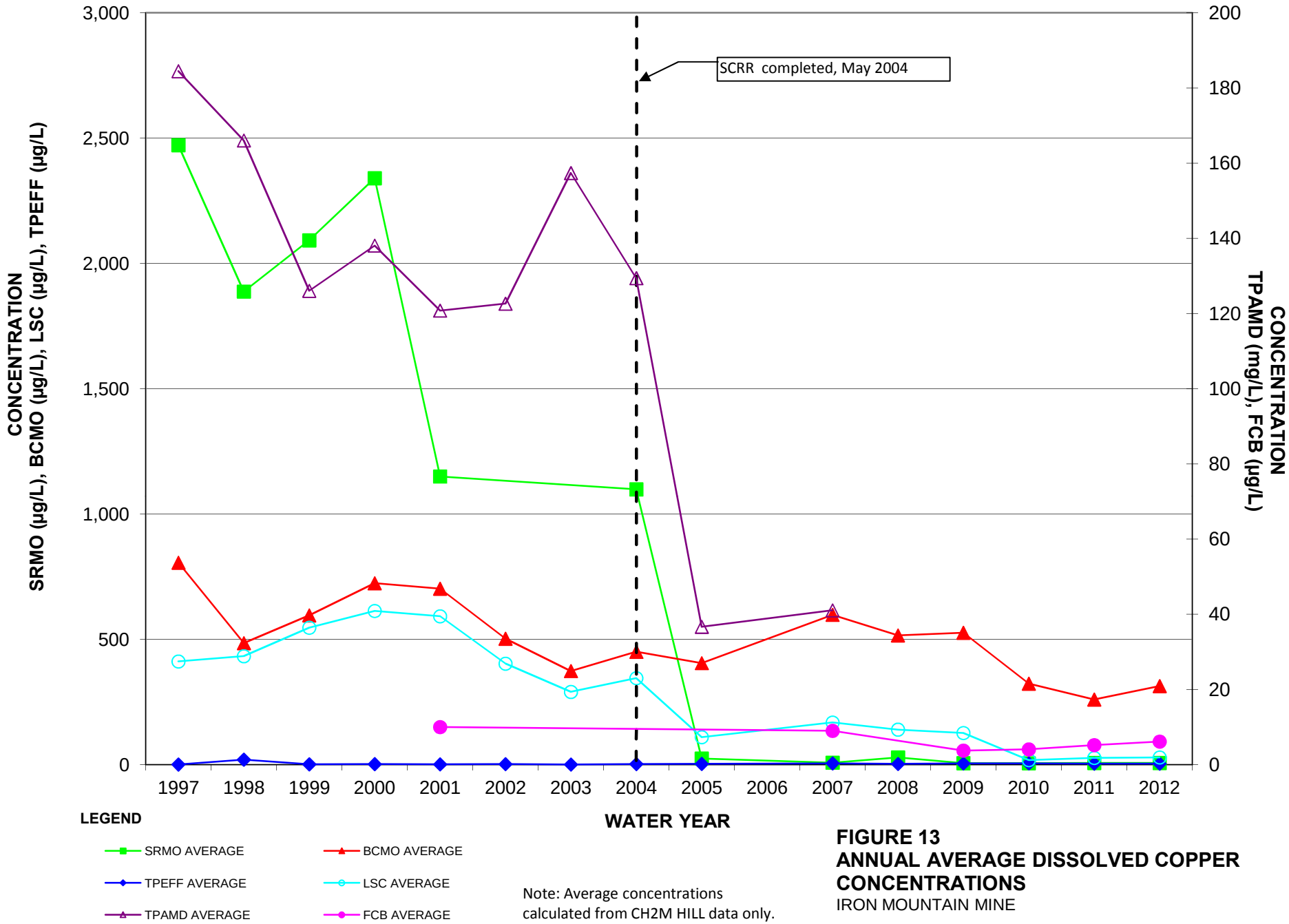

LEGEND

SACRAMENTO RIVER BELOW SHASTA DAM (SRS)

SACRAMENTO RIVER BELOW KESWICK DAM (SRK2)

NOTES:
DATA SOURCE: BUREAU OF RECLAMATION

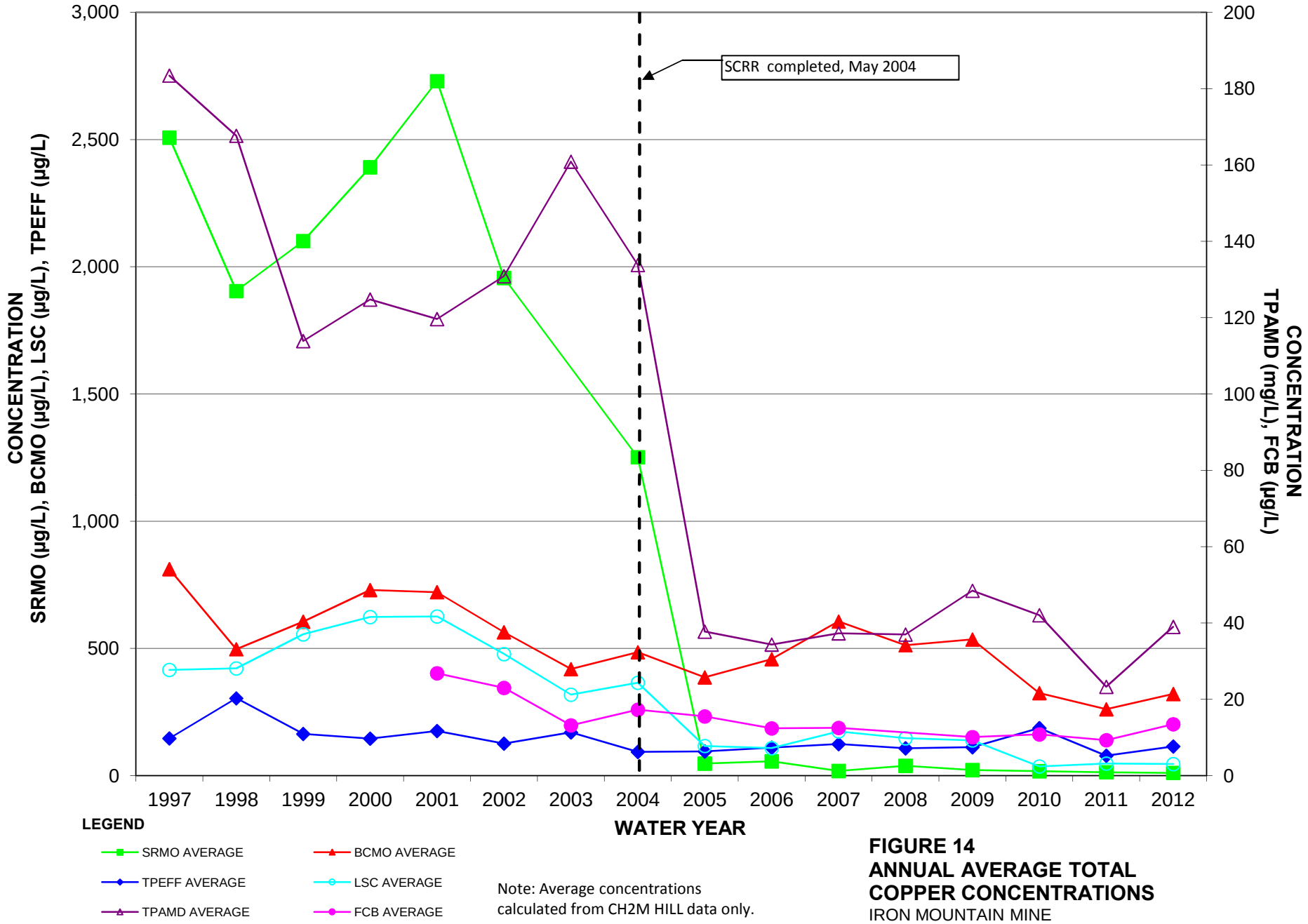
**FIGURE 12**
**TOTAL ZINC CONCENTRATIONS IN SACRAMENTO RIVER BELOW SHASTA AND KESWICK DAMS**
IRON MOUNTAIN MINE




Note: Average concentrations calculated from CH2M HILL data only.

**FIGURE 13**
**ANNUAL AVERAGE DISSOLVED COPPER CONCENTRATIONS**
IRON MOUNTAIN MINE

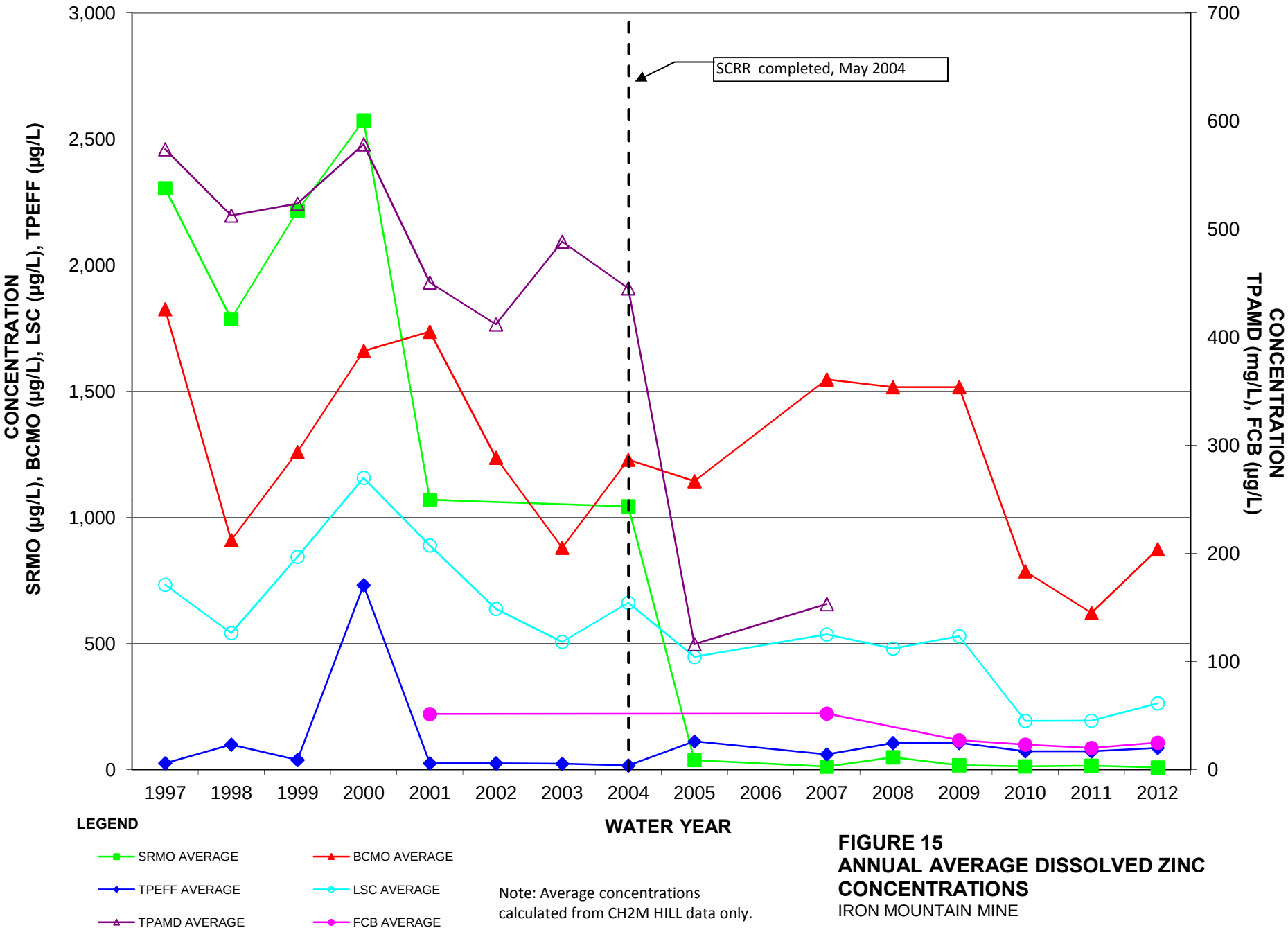
BCMO Plots.xlsx




Note: Average concentrations calculated from CH2M HILL data only.

**FIGURE 14**
**ANNUAL AVERAGE TOTAL COPPER CONCENTRATIONS**
IRON MOUNTAIN MINE

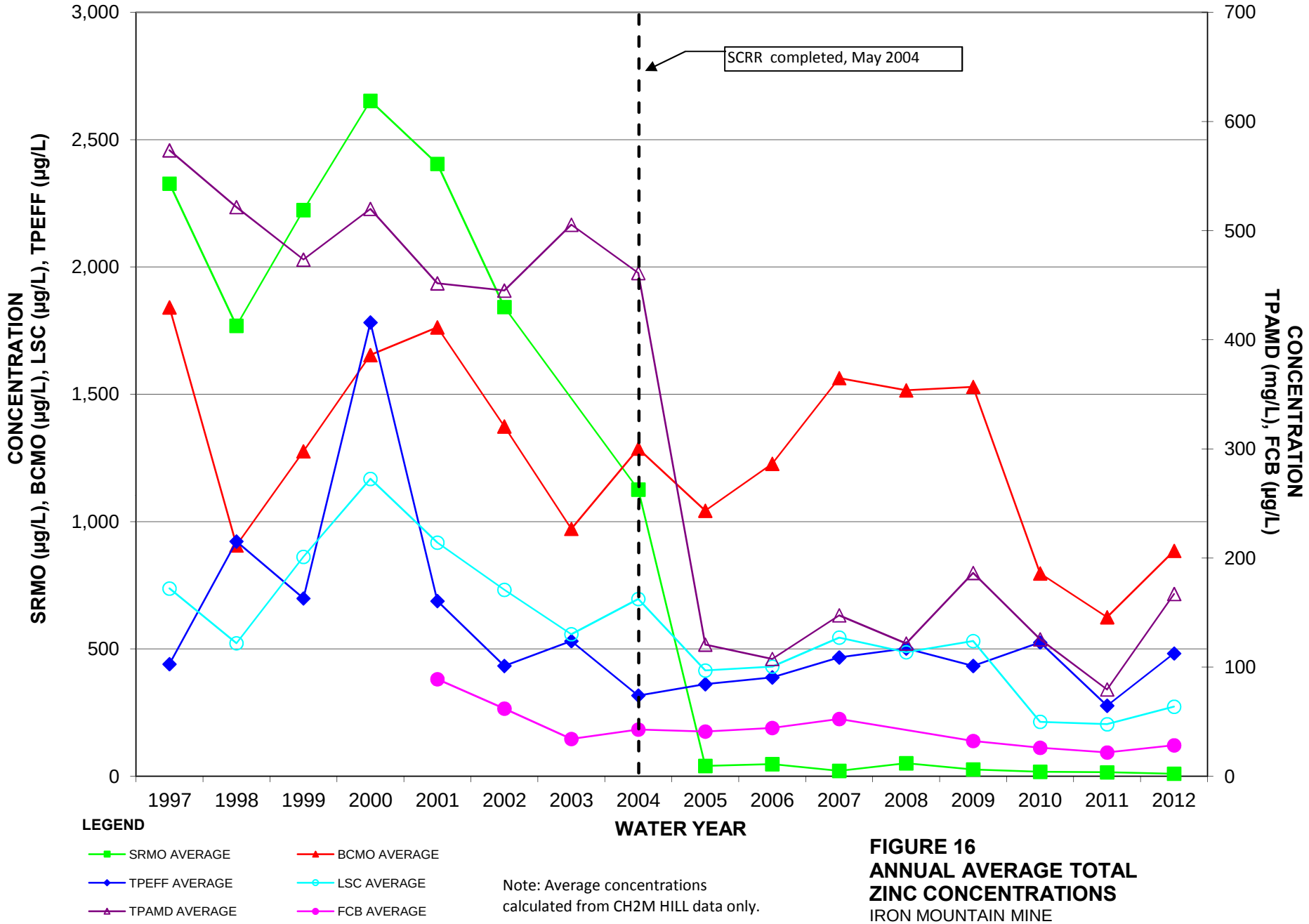
BCMO Plots.xlsx




Note: Average concentrations calculated from CH2M HILL data only.

**FIGURE 15**
**ANNUAL AVERAGE DISSOLVED ZINC CONCENTRATIONS**
IRON MOUNTAIN MINE

BCMO Plots.xlsx




Note: Average concentrations calculated from CH2M HILL data only.

**FIGURE 16**
**ANNUAL AVERAGE TOTAL ZINC CONCENTRATIONS**
IRON MOUNTAIN MINE

BCMO Plots.xlsx

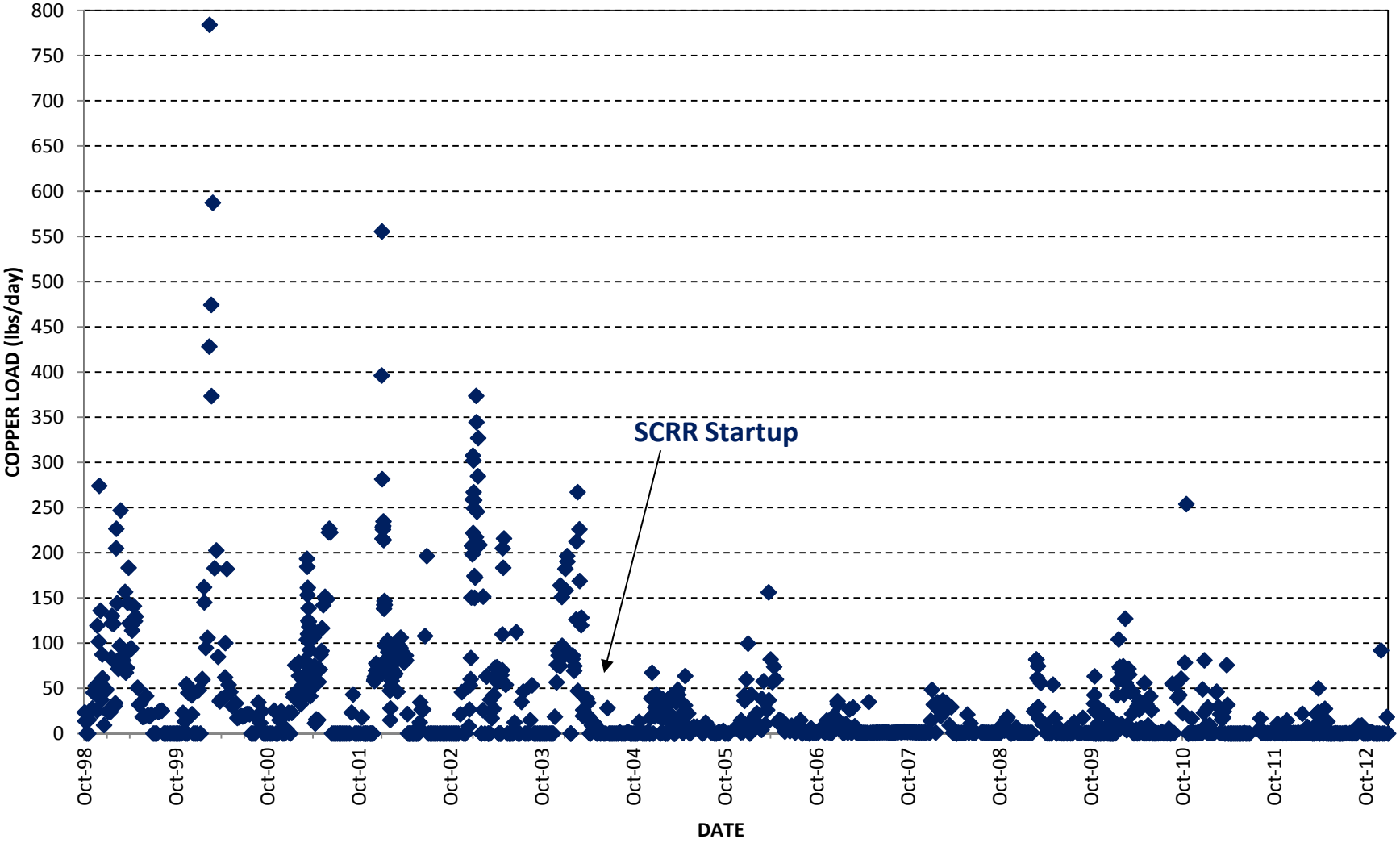



**FIGURE 17**
**SPRING CREEK DEBRIS DAM COPPER LOADS**
**WATER YEARS 1998 THROUGH 2012**
IRON MOUNTAIN MINE

# Appendix I: Institutional Control Assessment

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# Institutional Control Assessment
# Iron Mountain Mine Five-Year Review

**TO:** James Sickles/U.S. Environmental Protection Agency

**FROM:** Tom Wallis/CH2M HILL
Sandra Shearer/CH2M HILL

**DATE:** July 26, 2013

**PROJECT NUMBER:** 406751.FR.02

This technical memorandum provides an institutional control (IC) assessment in accordance with June 2001 OSWER Directive 9355.7-03B-P, *Comprehensive Five-Year Review Guidance* (U.S. Environmental Protection Agency [EPA], 2001) and September 2011 OSWER Directive 9355.7-12, *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"* (EPA, 2011). EPA selected installation of perimeter controls in the first Record of Decision (ROD 1; EPA, 1986) to minimize direct contact threats. Access controls have been implemented at the main mine area, including fencing and security gates, as detailed in the October 2000 *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (EPA, 2000). EPA also selected institutional controls in the fifth Record of Decision (EPA, 2004a [ROD 5]) to prevent mobilization of sediment remaining in Spring Creek Arm of Keswick Reservoir (Spring Creek Arm) and to protect the confined disposal facility (CDF).

This technical memorandum discusses the interim access controls and procedures that have been implemented for the main mine area. This technical memorandum also discusses governmental agreements, security measures, and governmental controls used to implement controls for the ROD 5 interim remedy, the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action. These actions are summarized in Table 1.

**TABLE 1**
Iron Mountain Mine Interim Access Controls, Security Measures, and Governmental Agreements
*Institutional Control Assessment Iron Mountain Mine Five-Year Review*

| Decision Document | ICs Called for in the Decision Documents | Affected Area | Control Objective | Instrument in Place | Notes |
|---|---|---|---|---|---|
| RODs 1, 2, 3, and 4 | Yes (perimeter controls selected in ROD 1) | IMM Property | Restrict access to IMM site | October 2000 SOW (EPA, 2000) | The SOW details requirements for site access. The Site Operator, IMO, is responsible for implementing the SOW. |

**TABLE 1**
Iron Mountain Mine Interim Access Controls, Security Measures, and Governmental Agreements
*Institutional Control Assessment Iron Mountain Mine Five-Year Review*

| Decision Document | ICs Called for in the Decision Documents | Affected Area | Control Objective | Instrument in Place | Notes |
|---|---|---|---|---|---|
| RODs 1, 2, 3, and 4 | Yes (perimeter controls selected in ROD 1) | IMM Property | Implement security measures | October 2000 SOW (EPA, 2000) | The SOW details the security systems, including fencing and security gates, and operation and maintenance requirements. |
| ROD 5 | Yes | Spring Creek Arm of Keswick Reservoir | Spring Creek Debris Dam and Spring Creek Power Plant operational controls to comply with water quality ARARs in the Sacramento River downstream from Keswick Dam and to flush Spring Creek Arm | *Memorandum of Understanding (MOU) to Implement Actions to Protect the Sacramento River System from Heavy Metal Pollution from Spring Creek and Adjacent Watersheds* (State Water Resources Control Board, U.S. Water and Power Resources Service, and California Department of Fish and Game, 1980) and *Long-term Central Valley Project Operations Criteria and Plan* (OCAP) (Bureau of Reclamation, 2004) | The 1980 MOU is being renegotiated by the stakeholders and is the intended mechanism to implement the ROD 5 operational controls. |
| ROD 5 | Yes | Spring Creek Arm | Keswick Reservoir operational controls to prevent mobilization of sediment remaining in the Spring Creek Arm of Keswick Reservoir | No instrument is currently in place. | The 1980 MOU is being renegotiated by the stakeholders and is the intended mechanism to implement ROD 5 operational controls. |

**TABLE 1**
Iron Mountain Mine Interim Access Controls, Security Measures, and Governmental Agreements
*Institutional Control Assessment Iron Mountain Mine Five-Year Review*

| Decision Document | ICs Called for in the Decision Documents | Affected Area | Control Objective | Instrument in Place | Notes |
|---|---|---|---|---|---|
| ROD 5 | Yes | CDF | Restrict access to, and future use of, the CDF | *Agreement between the United States of America (By and Through the Bureau of Reclamation and the Bureau of Land Management) and Shasta County for the Cooperative Management of the Interlakes Special Recreation Management Area* (Bureau of Reclamation, 1994) | This agreement documents the responsible parties for managing the Spring Creek Reservoir area. |
| ROD 5 | Yes | CDF | Restrict access to the CDF | Bureau of Reclamation Shasta and Keswick area security measures<br>Inspection requirements outlined in the *Final Closure and Post-closure Maintenance Plan, Spring Creek Sediment Removal Remedial Action* (CH2M HILL, 2012) | Security measures include locked gates and monthly security inspections by Bureau of Reclamation |
| ROD 5 | Yes | CDF | Restrict future use of the CDF | *Shasta County General Plan* (Shasta County Department of Resource Management, 2004) | Zoning classifications and other development policies must be consistent with the *Shasta County General Plan*. A proposed change to Shasta County's adopted land use policies or maps contained in the general plan would require advertised public hearings because of potential environmental and land use impacts. |

Notes:
ARAR = applicable or relevant and appropriate requirements
IMO = Iron Mountain Operations

# Interim Access Controls and Procedures

The SOW (EPA, 2000) includes the principal steps necessary to operate and maintain the CERCLA remedies selected under RODs 1 through 4 and the IMM site (EPA, 2000). The Site Operator, 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 discussion with the IMM Site Operator regarding the effectiveness of current access controls.

## Iron Mountain Mine Site Access Requirements

The SOW (EPA, 2000) details requirements for site access; a summary follows:

1. The Site Operator shall provide the Oversight Agency [EPA], 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, 2000) details the existing IMM security measures and associated operation and maintenance requirements. Text included in the SOW that relates to the security measures is reproduced below (EPA, 2000). EPA is working with Global Loss Prevention, Inc. (formerly American International Group Consultants, Inc.) to formally modify the October 2000 SOW. Minor updates are being made to this section as part of the SOW modification and are included below for consistency with current procedures.

In addition to the security measures described below, the property owner has posted the property to discourage trespassers. The Site Operator performs routine 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 MFTP [Minnesota Flats Treatment Plant], and is located on Iron Mountain Road downstream of 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, blocked access points consisting of earth berms and locked gates (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 at the SCRR valve house and electrical room.

5. A locked electrical control room was constructed at the Slickrock Creek Retention Reservoir project site.

### Operation and Maintenance 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 and 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 IMM access requirements and security measures. EPA staff (James Sickles and Lily Tavassoli) and CH2M HILL staff (Tom Wallis, Dave Bunte, and Josh Bale) met with IMO staff (Rudolph Carver and John Nash) during the IMM Five-Year Review sitewide inspection on February 27, 2013. Josh Bale/CH2M HILL followed up on specific items with Rudolph Carver, IMO Site Manager, on February 28, 2013, at the IMM site. Details of the meeting and inspection are provided in the *Site Inspection Checklist, Iron Mountain Mine Five-Year Review, Main Mine Site* (CH2M HILL, 2013a).

The only road to the main mine area, Iron Mountain Road, has a locked gate at the boundary, with security cameras and an intercom connection to IMO personnel 24 hours per day. The property is located between two heavily used national forests. The perimeter of the site in the rugged backwoods is not fenced, but former forestry dirt roads leading into the main mine area have been blocked. The Site Operator performs routine inspections of potential points of entry to the site to look for evidence of and deter trespassers. Because the remedial systems at IMM will operate in perpetuity, these security systems and access controls will remain in place for the foreseeable future.

No vandalism has recently occurred on the site. There have been limited issues over the past 5 years with trespassing. Most significantly, a marijuana farm that had been hidden in one of the canyons onsite was eradicated by drug enforcement authorities in 2009. Also, an unauthorized car followed an authorized vehicle through the gate once in the last 5 years, but that incident has not been repeated since. Finally, verbal threats were made by an associate of the property owner, who was asked to leave the site with no incident. To discourage illegal entry from trails that access the back sides of IMM, large boulders and "tank tracks" have been installed at potential entry points. Since the installation of these features, no off-road vehicle entry has been noted (CH2M HILL, 2013a).

## Record of Decision 5 Interim Remedy Controls

During the five-year review period, EPA completed construction of the Spring Creek Arm of Keswick Reservoir Sediment Removal Remedial Action. This interim remedial action was selected under ROD 5 to prevent the migration and deposition of contaminated sediment from Spring Creek Arm to the Sacramento River and to reduce metal loads and suspended solids associated with the contaminated sediment. This section discusses the controls required to prevent mobilization of sediment remaining in the Spring Creek Arm and for protection of the CDF. EPA turned over operation and maintenance of the CDF to the

California Department of Toxics Substances Control on October 26, 2012, the day after the project was determined operational and functional by EPA and the State.

## Operational Controls

ROD 5 states that continued use of existing operational controls or ICs and implementation of new operational controls or ICs would meet performance goals. Proposed operational controls included the following (EPA, 2004a):

- Current operational controls that require Bureau of Reclamation to restrict Keswick Reservoir elevations during release events from Spring Creek Power Plant and Spring Creek Debris Dam to minimize the potential for erosion of sediment in Spring Creek Arm would be revised. Operational restrictions would be removed, except for periods during rare storm events where continued operational restrictions would be necessary to ensure that remaining sediments do not erode into the environment.
- Current operational controls would be continued that require the Bureau of Reclamation to operate Spring Creek Debris Dam releases to comply with water quality applicable or relevant and appropriate requirements in the Sacramento River downstream from Keswick Dam, and to continue low-flow releases from Spring Creek Power Plant necessary to flush Spring Creek Reservoir water through Spring Creek Arm.

Evaluations conducted as part of the *Iron Mountain Mine Sediment Feasibility Study, Iron Mountain Mine, Redding, California* (EPA, 2004b) and during remedial design (CH2M HILL, 2006) indicate that limited restrictions to maintain Keswick Reservoir pool elevation above 578 feet when the combined discharge from Spring Creek Power Plant and Spring Creek Debris Dam approaches or exceeds 6,600 cubic feet per second (cfs) would prevent erosion of contaminated sediment remaining after dredging.

Although the Bureau of Reclamation followed the ROD 5 operational controls over the FYR period (see the IMM Fifth Five-Year Review Report, Appendix H of *Site Evaluation and Compliance at Keswick Dam* [CH2M HILL, 2013c]), operational restrictions on the Keswick Reservoir pool elevation need to be officially implemented. The *Memorandum of Understanding (MOU) to Implement Actions to Protect the Sacramento River System from Heavy Metal Pollution from Spring Creek and Adjacent Watersheds* was signed in 1980 (State Water Resources Control Board, U.S. Water and Power Resources Service, and California Department of Fish and Game, 1980). The MOU established discharge requirements for Spring Creek Power Plant, Shasta Reservoir, and Spring Creek Debris Dam to minimize the impact of releases from IMM during storm events. The MOU is being renegotiated by the stakeholders and is the intended mechanism to implement the operational controls selected in ROD 5. The 1980 MOU is discussed further in Section 5 of the *Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*.

## Confined Disposal Facility

ROD 5 selected an IC for protection of the CDF, located adjacent to Spring Creek Reservoir, as follows (EPA, 2004a):

- A new IC will be required to restrict access to, and future use of, the portion of federal lands that is used for the CDF to prevent potential human exposure to contaminants. The IC will restrict land use at and near the CDF by prohibiting residential use (and

related uses) and by prohibiting intrusive activities that could damage the integrity of the CDF.

The Bureau of Reclamation is the federal land manager for the Spring Creek Reservoir area, including the CDF. The *Agreement between the United States of America (By and Through the Bureau of Reclamation and the Bureau of Land Management) and Shasta County for the Cooperative Management of the Interlakes Special Recreation Management Area* (Bureau of Reclamation, 1994) documents the responsible parties for managing the Spring Creek Reservoir area, which includes the CDF. Residential construction and related uses, and intrusive activities that could damage the integrity of the CDF will be restricted by the Bureau of Reclamation.

The CDF is located on land managed by the Bureau of Reclamation. Therefore, the land use and the land ownership for the area where the CDF is located are not expected to change. This land is not expected to be used for recreation or construction. Entry roads to the project site include the Bureau of Reclamation roads from Rock Creek Road and Benson Road. Both of these roads have locked gates. Monthly security inspections are performed by Bureau of Reclamation Northern California Area Office security guards, in accordance with the *Final Closure and Post-closure Maintenance Plan, Spring Creek Sediment Removal Remedial Action* (CH2M HILL, 2012).

Future land uses adjacent to the CDF are not expected to change. The *Shasta County General Plan* (Shasta County Department of Resource Management, 2004) is the official land use policy document for Shasta County. The *Shasta County General Plan* map indicates that Bureau of Reclamation land is public. Zoning classifications and other development policies must be consistent with the *Shasta County General Plan*. A proposed change to Shasta County's adopted land use policies or maps contained in the general plan would require advertised public hearings because of potential environmental and land use impacts.

EPA has determined that these controls are protective and no additional ICs are required (EPA, 2012).

## Effectiveness of ROD 5 Interim Remedy Controls

Josh Bale and Tom Wallis with CH2M HILL performed an inspection of the CDF on February 19, 2013. James Sickles/EPA and Tom Wallis, Josh Bale, and Dave Bunte/ CH2M HILL performed an inspection of the CDF on February 27, 2013. No evidence of trespassing or vandalism was apparent in these inspections.

CH2M HILL performed interviews that included discussions of the effectiveness of the operational controls and CDF access restrictions and security measures. These interviews are documented in the IMM Five-Year Review Interview Forms (CH2M HILL, 2013b). Tom Wallis/CH2M HILL performed a telephone interview with McKinley Lewis, Jr./ California Department of Toxic Substances Control on February 25, 2013. Mr. Lewis confirmed that Bureau of Reclamation has been performing monthly security inspections of the CDF.

Don Reck/Bureau of Reclamation provided written responses to interview questions on April 25, 2013. Mr. Reck stated that as a result of the dredging in the Spring Creek Arm, Reclamation has been able to operate Keswick Reservoir within the full design elevation range with extremely favorable operation and scheduling results. Mr. Reck confirmed that the limited operational controls that are still required during high release events from

Spring Creek Debris Dam and Spring Creek Power Plant have had minimal impact on operations and scheduling. Finally, Mr. Reck stated that the water quality in Spring Creek Reservoir is greatly improved, and thus the reservoir can be drawn down more quickly when desired and is easier to schedule around other operations.

Bureau of Reclamation operations and water quality data were reviewed to confirm that operational controls were being implemented (California Data Exchange Center, 2013). Between the completion of dredging in June 2010 and December 31, 2012, the average combined discharge from Spring Creek Debris Dam and Spring Creek Power Plant was 900 cfs and the maximum combined discharge was 2,450 cfs. The combined discharge was well below the 6,600-cfs threshold for all Keswick Reservoir operating levels (CH2M HILL, 2013c). Operational data also confirmed that Bureau of Reclamation continued low-flow releases from Spring Creek Power Plant to flush Spring Creek Reservoir water through Spring Creek Arm, except during ROD 5 dredging operations. EPA and CH2M HILL made specific operational requests during dredging to minimize flow through Spring Creek Arm as part of the resuspension management practices.

The Bureau of Reclamation operated Spring Creek Debris Dam releases over the FYR period to comply with water quality ARARs in the Sacramento River downstream from Keswick Dam. During the past 5 years (from January 2008 to December 2012), the results of Reclamation's water quality monitoring program indicate that dissolved copper and zinc concentrations in the Sacramento River below Keswick Dam did not exceed the *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin* instantaneous maximum limits. The dissolved copper exceeded the CTR 4-day average chronic exposure limit of 4.1 ppb one time (less than 0.4 percent of the samples collected by Reclamation), which is less than the CTR allowable exceedance of 4 consecutive days once every 3 years. Dissolved zinc concentrations in the Sacramento River below Keswick Dam did not exceed the CTR chronic exposure limit. EPA waived compliance with the Basin Plan and CTR, among other standards, to the extent those standards cannot be achieved by the interim remedies selected in RODs 1 through 5 (EPA, 2004a).

# Conclusions

IMM interim access controls, security measures, governmental agreements, and governmental controls are effectively controlling potential human exposures and preventing adverse impacts on the integrity or protectiveness of the interim remedial measures implemented under RODs 1 through 5. Although Reclamation followed operational controls selected in ROD 5 over the FYR period, these controls need to be officially implemented to remain protective over the long term.

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# Appendix J: Resolution of 2008 Five-Year Review Operation and Maintenance Recommendations

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# Resolution of 2008 Five-Year Review Operation and Maintenance Recommendations

**TO:** James Sickles/U.S. Environmental Protection Agency

**FROM:** Tom Wallis/CH2M HILL
Sandra Shearer/CH2M HILL

**DATE:** July 26, 2013

**PROJECT NUMBER:** 406751.FR.05

The Fourth Five-Year Review (FYR) for the Iron Mountain Mine (IMM) Superfund Site (Site) was completed July 14, 2008 (EPA, 2008). During the 2008 FYR, the treatment plant and Site were determined to be properly operated and maintained. No issue was identified during the 2008 FYR that was expected to affect the protectiveness of remedies implemented under Record of Decision (ROD) 1 through 4. Recommendations were made regarding operation and maintenance (O&M) of the remedies and the Site. The status of the 2008 FYR recommendations are summarized in Table 1 and described in this appendix.

**TABLE 1**
Resolution of 2008 Five-Year Review Operation and Maintenance Recommendations
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Issues from previous FYR | Recommendations | Party Responsible | Milestone Date | Action Taken and Outcome | Date of Action |
|---|---|---|---|---|---|
| 1 | Develop strategies to decrease vulnerability to the loss of personnel. | GLP/IMO | 12/2009 | A succession plan was developed and the senior construction manager and senior plant operator were replaced. There are currently backups identified for both positions. Retirements will be an ongoing issue, but IMO feels adequately prepared to address these when they arise. | NA |

**TABLE 1**
Resolution of 2008 Five-Year Review Operation and Maintenance Recommendations
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Issues from previous FYR | Recommendations | Party Responsible | Milestone Date | Action Taken and Outcome | Date of Action |
|---|---|---|---|---|---|
| 2 | Submit management plans and reports to meet requirements of the SOW. | GLP/IMO | 12/2009 | IMO submitted an annual operations work plan every year over the FYR period, with the exception of 2009. IMO submitted landfill management report and plans for 2009 and 2012 (IMO, 2010 and 2013, respectively). IMO should consistently produce and distribute these documents annually, in accordance with the SOW. | Ongoing |
| 3 | Discuss plans to ensure that the deteriorating liner does not jeopardize the effectiveness of the Upper Spring Creek diversion. | GLP/ IMO | 12/2009 | Annual inspections are performed and locations with significant deterioration are repaired. GLP and IMO should develop a plan for evaluating the refurbishment and long-term maintenance of the liner system for submittal to EPA by December 2013. | 12/2013 |
| 4 | Modify the SOW to update BAT performance standards based on the metal removal currently achieved at the treatment plant. | EPA | NA | The proposed modifications are currently being negotiated. | Ongoing |
| 5 | Determine the contents of the fluid in Essential Solutions, Inc., chemical storage tanks and provide proper containment or disposal of the contents. | IMMI | 12/2009 | This work has not yet been completed. IMMI is preparing a work plan for removal of the tanks and contents. | Ongoing |

**TABLE 1**
Resolution of 2008 Five-Year Review Operation and Maintenance Recommendations
*Fifth Five-Year Review Report for Iron Mountain Mine Superfund Site, Redding, California*

| Issues from previous FYR | Recommendations | Party Responsible | Milestone Date | Action Taken and Outcome | Date of Action |
|---|---|---|---|---|---|
| 6 | 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. | GLP/IMO | 12/2009 | IMO placed riprap and shotcrete in Boulder Creek to minimize erosion and cleaned the horizontal drains at the toe of the landslide. An additional length of riprap will be required in 2013. | 10/2013 |
| 7 | Develop a strategy to address the failing chute plugs in the Richmond Adit and the associated risks to worker safety, mine access, and the AMD conveyance and treatment system. | GLP/ IMO | 12/2009 | Routine inspections and maintenance of the Richmond Adit are performed. GLP and IMO should develop a plan to address the chute plugs for submittal to EPA by December 2013. | 12/2013 |
| 8 | Evaluate reasons for the reduced filtrate at Brick Flat Pit. | GLP/ IMO | 12/2009 | Evaluations are ongoing to identify the filtrate discharge pathway. | 10/2013 |
| 9 | 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. | IMO | 12/2009 | Old/No. 8 Mine is being actively pumped. | 10/2008 |

Notes:
NA = not applicable
BAT = best available technology
GLP = Global Loss Prevention, Inc.
IMMI = Iron Mountain Mines, Inc.
IMO = Iron Mountain Operations (Site Operator under GLP)
SOW = October 2000 *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California*

***Recommendation 1:* Develop strategies to decrease vulnerability to the loss of personnel.**

Global Loss Prevention, Inc. (GLP) and Iron Mountain Operations (IMO), the Site Operator under GLP, have developed a more uniform strategy for personnel management over the last 5 years. John Nash has replaced Wes Franks as senior construction manager. Don Odean has replaced Bob Lindskog as senior plant operator. Backup personnel have been identified

for both positions in the event of job departures, medical leave, or relocation. In addition, Bill Hanson has replaced the previous maintenance manger. There are currently a few Site workers, the Site Manager, Rudy Carver, included, who are nearing retirement age, but they have no specific plans to retire in the next 5 years. GLP has a tentative plan in place for promoting current staff or procuring a replacement for Mr. Carver when he retires.

This issue has been adequately addressed at this time. Staff attrition due to retirement or other issues is a continuous issue, but IMO feels adequately prepared to address this when it arises.

***Recommendation 2:* Submit management plans and reports to meet requirements of the SOW.**

Section 6.3 of the *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (EPA, 2000) states that "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." The SOW also details the requirements for this plan. The most recent annual operations work plan was submitted by IMO in July 2013. Annual operations work plans were also submitted in 2008, 2010, 2011, and 2012.

Section 6.4 of the SOW states "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." IMO submitted the *2009 Landfill Management Report and Plan* (IMO, 2010) and *2012 Landfill Management Report and Plan* (IMO, 2013) during the FYR period. This remains an issue because the SOW requires annual submittals.

***Recommendation 3:* Discuss plans to ensure that the deteriorating liner does not jeopardize the effectiveness of the Upper Spring Creek Diversion.**

The Upper Spring Creek diversion has functioned as designed to effectively divert up to 850 $ft^3$/sec of clean water into Flat Creek, providing additional storage of contaminated water in Spring Creek Reservoir. However, the urethane pipeline lining system has deteriorated since it was constructed and is an ongoing O&M item. Currently, annual inspections of the piping system are performed and locations with significant deterioration are repaired with mortar or grout.

This will remain an issue until a long-term strategy for the diversion can be implemented. Provisions have been made for the Site Operator to restore or replace the reinforced concrete pipe lining system, as necessary (EPA, 2000). GLP and IMO should develop a plan for evaluating the refurbishment and long-term maintenance of the liner system for submittal to EPA by December 2013.

***Recommendation 4:* Modify the SOW to update best-available-technology performance standards based on the metal removal currently achieved at the treatment plant.**

During this FYR period, metal discharges from the treatment plant substantially complied with the Clean Water Act effluent limits for copper and zinc mining operations (40 CFR 440.102(a) and 440.103(a)) specified in RODs 2, 3, and 4, and in most cases were well below these limits. EPA's review of treatment plant performance data indicates that the Site Operator has properly operated the treatment plant. However, operation of the treatment plant since 2000 demonstrates that high density sludge (HDS) metal removal cannot achieve

the best available technology (BAT) economically achievable performance standards for dissolved cadmium and dissolved zinc set in the O&M SOW (EPA, 2000). These performance standards are more stringent than the Clean Water Act effluent limits selected in the RODs and were established to maximize the metals removal by the HDS treatment process through implementation of best management practices. The standards were set using limited performance data available at the time, and Slickrock Creek Retention Reservoir (SCRR) had not yet been constructed. EPA indicated in the SOW that the treatment plant performance should be monitored and the BAT effluent limits should be revised after completion of SCRR, if warranted.

As recommended in the Fourth FYR, EPA is working with GLP to formally modify the SOW (EPA, 2000), including revisions to the BAT effluent limits to more accurately reflect metal removal by the HDS acid mine drainage (AMD) neutralization process. EPA, GLP, and IMO attended a series of meetings and conference calls during this FYR period to discuss the final wording and BAT effluent limits for the updated SOW. This will remain an issue until the SOW modifications are finalized.

***Recommendation 5:* Determine the contents of the fluid in Essential Solutions, Inc., chemical storage tanks and provide proper containment or disposal of the contents.**

The 2008 and 2003 FYRs (EPA, 2008 and 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 provided, if required, or the contents should be properly disposed of. Essential Solutions, Inc., and Iron Mountain Mines, Inc. (IMMI) are developing a work plan for closure of the Ag-Gel pilot project. The large tanks reportedly contain a sodium silicate solution, the Ag-Gel product, and AMD.

This work has not yet been completed. No secondary containment has been built around the tanks. In addition to the three large tanks, there are numerous plastic 55-gallon drums stored outside the building adjacent to the tanks. Although many of the drums appear to be empty, the drums are not labeled and the contents are unknown. The contents of the tanks and the drums should be removed as soon as possible. The adjacent drainage channel appears to be silting in the building, the lower row of drums, and the base of the tanks. Significant additional silt accumulation may make it difficult to remove drums and turn tank valves to drain tanks.

This will remain an issue until the contents of the tanks are removed or secondary containment is constructed and all drums are properly contained, labeled, or shown to be empty.

***Recommendation 6:* 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.**

In summer 2012, IMO placed riprap and shotcrete in Boulder Creek to minimize erosion along the creek and cleaned the horizontal drains at the toe of the landslide. Repetitive heavy rainstorms occurred the last week of November 2012, culminating with a 5-inch rain storm on December 1, 2012. Locations where riprap and shotcrete were placed show no additional bank erosion. However, undercutting of the channel has occurred at the end of the shotcrete. Approximately 200 feet of additional channel length will require

improvements during the 2013 dry season. Also, IMO plans to install inclinometers during 2013 to provide additional measurements of slide movement.

This remains an issue, but the 2013 improvements to Boulder Creek will significantly decrease further bank and channel erosion. The inclinometers will provide additional data to monitor displacement of the landslide and drainage improvement effectiveness.

***Recommendation 7:* Develop a strategy to address the failing chute plugs in the Richmond Adit and the associated risks to worker safety, mine access, and the AMD conveyance and treatment system.**

Routine inspections and maintenance of the Richmond Adit are currently performed. IMO's contractors, including The Mines Group, perform mine maintenance work and inspect the mine prior to the annual inspection. The concrete plugs in the ore chutes continue to deteriorate, but no significant chute plug failures have occurred to date. GLP and IMO should develop a plan to address the chute plugs for submittal to EPA by December 2013, and the resolution agreed upon in the plan should be implemented.

This will remain an issue until a long-term strategy for the failing chute plugs is implemented.

***Recommendation 8:* Evaluate reasons for the reduced filtrate at Brick Flat Pit.**

As discussed in the Fourth FYR (EPA, 2008), the amount of filtrate has decreased significantly at Brick Flat Pit. Regular inspections of Brick Flat Pit are currently performed and monitoring of the filtrate pipeline is conducted by IMO. IMO performed a dye study evaluation, but the study was unsuccessful in locating the discharge point of filtrate. IMO presented two possible discharge pathways for filtrate from Brick Flat Pit. Drainage from Brick Flat Pit may be entering the stopes of the Richmond Mine through the highly fractured north slope of Brick Flat Pit, or the filtrate could be seeping through fractured bedrock into SCRR, through the Old/No. 8 Mine or various seep points.

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 it would be discharged to the Slickrock Creek drainage, which is currently captured by SCRR for treatment.

GLP has contracted GEI Consultants, Inc., to further evaluate the likely pathways of filtrate from Brick Flat Pit. A report is expected by October 2013. This will remain an issue until the pathway for filtrate is identified.

***Recommendation 9:* 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.**

Based on recommendations in the Fourth FYR (EPA, 2008), IMO pumped down the gravity discharge system and began actively pumping the Old/No. 8 Mine Seep for AMD collection. This issue appears to have been adequately addressed and is considered closed.

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