2010 Annual Completion Report:
Channel Underdrain, Delta Seep, and Aspen Seep
Water Treatment Activities

Leviathan Mine Site
Alpine County, California

Prepared for:
Atlantic Richfield, La Palma, California

Prepared by:
AMEC Geomatrix, Inc., Rancho Cordova, California

April 2011

Project 0130911112

Atlantic Richfield Company

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April 8, 2011

Mr. Gary Riley
Mr. Kevin Mayer
US EPA Region 9
75 Hawthorne Street; SFD-7-2
San Francisco, CA 94105

RE: 2010 Annual Completion Report
Channel Underdrain, Delta Seep, & Aspen Seep Water Treatment Activities
Leviathan Mine
Alpine County, California

Dear Messrs. Riley and Mayer:

On behalf of Atlantic Richfield, please find enclosed the 2010 Annual Completion Report – Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities (Annual Report) prepared for the Leviathan Mine Site. This Annual Report meets the commitments made to the United States Environmental Protection Agency (US EPA) in the 2010 Removal Action Work Plan (Atlantic Richfield; April 2010) and the Annual Report meets the requirements of the Administrative Settlement Agreement and Order on Consent for Removal Action (AOC) issued by US EPA on January 21, 2010.

CERTIFICATION

As required in the draft AOC, we certify this report as follows:

"Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparations of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

If there is anyone else that should receive a copy of this report please let us know. In addition, if you have any questions or comments, please feel free to contact me at (714) 228-6770 or via e-mail at Anthony.Brown@bp.com.

Sincerely,

Tony Brown
Project Manager Mining

Enclosures: *2010 Annual Completion Report – Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities – three hardcopies and one electronic copy on compact disc*

cc: Chuck Curtis, Lahontan Regional Water Quality Control Board
Adam Cohen, Esq. Davis Graham & Stubbs LLP
Nathan Block, BP America, Inc. – via electronic
Joe Niland, AMEC Geomatrix, Inc. – via electronic
Marc Lombardi, AMEC Geomatrix, Inc.
Dave McCarthy, Copper Environmental
Sandy Riese, EnSci

CERTIFICATION

Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparations of this report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Marc R. Lombardi, CEM, PG
Principal Geologist

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LIST OF ABBREVIATIONS AND ACRONYMS

AF	acre feet
AOC	Administrative Order on Consent
AD	acid drainage
ANSI	American National Standards Institute
ARWS	Atlantic Richfield Work Season
AS	Aspen Seep
ASB	Aspen Seep Bioreactor
CCR	California Code of Regulations
C.F.R.	Code of Federal Regulations
COC	chain-of-custody
CUD	Channel Underdrain
cy	cubic yard
DO	dissolved oxygen
DOC	dissolved organic carbon
DQO	data quality objectives
DS	Delta Seep
ELAP	California Environmental Laboratory Accreditation Program
ft	feet
gpd	gallons per day
gpm	gallons per minute
HDPE	high-density polyethylene
HDS	high density sludge
HMI	human-machine interface
HSSE	Health and Safety, Security, and Environment
H_2S	hydrogen sulfide
LAS	Limited Access Season
LCP	local control panel
LRWQCB	Lahontan Regional Water Quality Control Board
LTF	lagoon treatment facility
LTS	lime treatment system
mg	milligrams
mL	milliliters

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

mL/L	milliliters per liter
mg/L	milligrams per liter
MRAM	Modification to the Removal Action Memorandum
MRR	mass recycle ratio
MS/MSD	matrix spike/matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
NTU	Nephelometric turbidity unit
O&M	operations and maintenance
ORP	oxidation reduction potential
PLC	programmable logic controller
PPE	personal protective equipment
ppm	parts per million
PUD	Pit Underdrain
PWTF	pond water treatment facility
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAWP	Removal Action Work Plan
RCRA	Resource Conservation and Recovery Act
RCTS	rotating cylinder treatment system
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCBA	self contained breathing apparatus
SDA	specially denatured alcohol
SDB	sludge drying bed
SOP	standard operating procedure
SPLP	synthetic precipitation leaching procedure
STLC	soluble threshold limit concentration
s.u.	standard units
TAC	Technical Advisory Committee
TCLP	toxicity characteristic leaching procedure

LIST OF ABBREVIATIONS AND ACRONYMS
(Continued)

TKN	total kjeldahl nitrogen
TTLC	total threshold limit concentration
U.S. EPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UPS	uninterruptible power supply

2010 ANNUAL COMPLETION REPORT: CHANNEL UNDERDRAIN, DELTA SEEP, AND ASPEN SEEP WATER TREATMENT ACTIVITIES

Leviathan Mine
Alpine County, California

EXECUTIVE SUMMARY

This 2010 Annual Completion Report: Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities (Annual Report) has been prepared by AMEC Geomatrix, Inc. (AMEC), on behalf of Atlantic Richfield Company (Atlantic Richfield) to describe the activities conducted at the Leviathan Mine Site (site) in 2010. Specifically, this Annual Report serves as a summary to document the completion of 2010 water treatment activities and other work relating to discharges from the Channel Underdrain (CUD), Delta Seep (DS), and Aspen Seep (AS) at the site.

The Annual Report has been prepared to meet the requirements of the Administrative Settlement Agreement and Administrative Order on Consent (AOC) for Removal Action, CERCLA Docket No. 2008-29 (U.S. EPA, 2009).

The following is a list of Removal Action water treatment activities completed at the site in 2010:

- Operation of the CUD and DS collection-and-conveyance equipment;
- Commissioning and operation of the High Density Sludge (HDS) Treatment System including discharge of treated CUD and DS water to Leviathan Creek;
- Removal of HDS Treatment System generated solids (sludge);
- Operation of the Aspen Seep Bioreactor (ASB) Treatment System, including discharge of treated AS water to Aspen Creek; and
- Removal of ASB Treatment System sludge.

Approximately 7.4 million gallons of CUD water, approximately 3.2 million gallons of DS water, approximately 431,000 gallons of existing Pond 4 water, and approximately 3.8 million gallons of AS water were treated and discharged during 2010 to Leviathan and Aspen creeks. Approximately 53 tons of sludge produced from the HDS Treatment Plant operations and dewatered via lined filter bins, were removed from the site. Approximately 95 tons of non-hazardous sludge produced by the ASB Treatment System and dewatered via a pilot scale

sludge drying bed (SDB) test and a centrifuge were removed from the site. Sludge generated from the HDS Treatment Plant was classified as a non-Resource Conservation and Recovery Act (RCRA) California Hazardous waste solid. Sludge generated from the ASB Treatment System was classified as non-hazardous by RCRA and California regulations. All sludge was characterized, profiled, and transported under manifest to US Ecology, Inc., in Beatty, Nevada, for disposal.

The HDS Treatment System was commissioned on April 28 and operated from May 1 through November 11. CUD and DS flows were collected from May 6 to November 1. Collection of CUD flows resumed on November 5 and ceased on November 9. The HDS Treatment Plant continued to operate until November 11 to lower the water level in Pond 4 to the lowest extent possible. Improvements in 2010 to the Pond 4 intake pumps, data management, and site office trailer power system increased the operational reliability of the HDS Treatment System.

The ASB Treatment System operated each day in 2010 with minor upsets occurring several times throughout the year. Improvements and systems optimization from 2007 through 2009 continued to be tested and modified for efficiency and reliability. Continued improvements to the remote monitoring system, chemical feed systems, and power system, along with continued sludge removal, have increased the operational reliability of the ASB Treatment System, although maintenance and sludge management requirements continue to be significant. Two sludge removal and dewatering efforts were used in 2010: the SDB pilot test and a mobile centrifuge. A historical evaluation of the treatment performance with respect to the site discharge criteria was also carried out to assist in comparing current and past performance of the ASB.

In addition to the above-mentioned water treatment activities, the following related activities were completed at the site in 2010:

- Community relations activities, including participating in Technical Advisory Committee (TAC) meetings, stakeholder review and comments on documents prepared for the site, and maintaining project information repositories and public information sites.
- Performance monitoring of the treatment systems, including sampling and analysis of water and sludge.
- Removal and disposal of miscellaneous materials no longer in use at the site.
- Other activities completed at the HDS Treatment System included: Pond 4 access improvements, Pond 4 intake pump modifications, Pond 4 liner repairs, HDS data historian installation, site office trailer power modifications, conveyance line piping

modifications, DS transfer tank access platform improvements, and DS wall maintenance.

- Other activities completed at the ASB included: battery condition assessment and reconditioning, Programmable Logic Controller (PLC) replacement, sludge/filtrate handling pipeline extension, structural improvements to the ASB Pond 3 recirculation manifold access platform, ethanol and sodium hydroxide pump replacement, installation of tank level sensors in the sodium hydroxide and ethanol tanks, installation of a year-round safety shower, and aeration channel access walkway improvements.
- Road maintenance on both the California and Nevada access portions of Leviathan Mine Road, including, road crown and drainage maintenance, dust suppression, and installation of slope monitoring monuments on the Nevada access route.

In addition to descriptions of water treatment-related response actions and performance monitoring results, this report also includes summary information on costs incurred by Atlantic Richfield during 2010 in complying with the AOC.

2010 ANNUAL COMPLETION REPORT: CHANNEL UNDERDRAIN, DELTA SEEP, AND ASPEN SEEP WATER TREATMENT ACTIVITIES

Leviathan Mine
Alpine County, California

1.0 INTRODUCTION

This 2010 Annual Completion Report: Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities (Annual Report), has been prepared by AMEC Geomatrix, Inc. (AMEC), on behalf of Atlantic Richfield Company (Atlantic Richfield) to describe the activities conducted at the Leviathan Mine Site (site; see Figure 1, Site Location Map) in 2010. Specifically, this Annual Report serves as a summary to document the completion of 2010 water treatment activities and other work relating to discharges from the Channel Underdrain (CUD), Delta Seep (DS), and Aspen Seep (AS) at the site.

This Annual Report has been prepared to meet the requirements of the Administrative Settlement Agreement and Order on Consent (AOC) for Removal Action, CERCLA Docket No. 2008-29 (U.S. EPA, 2009a), paragraph 63.

Additionally, the Annual Report meets the commitments made by Atlantic Richfield in Section 7.1 of Revision 1.0 of the *2010 Removal Action Work Plan* [RAWP] (Work Plan) submitted to the U.S. Environmental Protection Agency (U.S. EPA) in May 2010 (Atlantic Richfield, 2010d).

The Annual Report also meets the commitments made by Atlantic Richfield in the following documents:

- Request for Authorization to Perform Water Treatment During the 2010 winter/Spring Portion of the Limited Access Season (LAS), High Density Sludge (HDS) Treatment System, Leviathan Mine, Alpine County, California; dated March 18, 2010 (Atlantic Richfield; 2010a). This letter requested U.S. EPA authorization for Atlantic Richfield to begin water treatment activities at the site during the LAS in May 2010.

- Response to April 12, 2010 Comments, 2010 Removal Action Work Plan, Leviathan Mine, Alpine County, California; dated May 11, 2010 (Atlantic Richfield; 2010e). This letter was prepared to address U.S. EPA questions regarding the 2010 RAWP.

- Amendment #1 – Aspen Seep Bioreactor Sludge Management, 2010 RAWP, Leviathan Mine, Alpine County, California; dated August 18, 2010 (Atlantic Richfield; 2010h). This RAWP amendment notified U.S. EPA of Atlantic Richfield's modified plans for dewatering treatment generated solids (sludge) from the Aspen Seep Bioreactor (ASB) Treatment System using a mobile centrifuge.

- Request for Approval of Fall 2010 LAS Operations, and 2010 Year-End Decommissioning and Winterization Plan, Leviathan Mine, Alpine County, California; dated September 20, 2010 (Atlantic Richfield; 2010i). This letter addressed Atlantic Richfield's plans for decommissioning and winterization of the HDS Treatment System. It also requested U.S. EPA authorization for Atlantic Richfield to operate the HDS Treatment System beyond the Atlantic Richfield Work Season (ARWS).

Note: The AOC defines the ARWS as the period from June 1 through September 30, and the LAS as the period from October 1 through May 31, during each year the AOC remains in effect, unless modified in writing by the US EPA and Atlantic Richfield.

1.1 Report Objectives and Scope

As indicated, this Annual Report meets the following objectives and scope:

- A summary of the treatment activities conducted in 2010;
- A tabulation of the validated data collected as part of the treatment activities, and accompanying laboratory data sheets;
- A summary of health and safety performance;
- An interpretation of the data and treatment system performance;
- A listing of materials moved off-site or handled on-site, a discussion of removal and disposal options considered for these materials, a listing of the ultimate destination(s) of those materials, a presentation of the analytical results of all sampling and analysis performed, and accompanying appendices containing all relevant documentation generated during the Removal Action;
- A summary of support/system improvements activities; and
- A summary of costs incurred.

Additionally, this report includes site background information, including descriptions of the CUD, DS, and AS, and Removal Action activities previously performed at these locations.

1.2 Purpose of the Removal Action

The purpose of the Removal Action at the site is to satisfy the requirements of the AOC, including treatment of collected flows from the CUD, DS, and AS. The water treatment activities also provide important operational information that may be used in formulating a final, long-term remedy for the site consistent with the Remedial Investigation/Feasibility Study (RI/FS) process. As such, water treatment activities implemented by Atlantic Richfield in 2010 were intended to investigate the cost, effectiveness, and implementability of the treatment technologies and solids management measures employed at the site. The 2010 treatment activities water quality goals were consistent with the discharge criteria presented in the *Non-Time Critical Removal Action Memorandum* in connection with the site, as modified by the U.S. EPA in the *Modification to the Removal Action Memorandum dated September 25, 2008* (MRAM*;* U.S. EPA, 2008), which restated the discharge criteria. The MRAM discharge criteria are listed with a summary of the analytical data for the HDS Treatment System and ASB Treatment System in Tables 1, 2, and 3 of this Annual Report.

The 2010 treatment activities included the following general activities:

- Operation of the CUD collection and conveyance equipment;
- Operation of the DS collection and conveyance equipment;
- Operation of the HDS Treatment System including discharge of treated CUD and DS water to Leviathan Creek;
- Removal of HDS Treatment System sludge;
- Operation of the ASB Treatment System, including discharge of treated AS water to Aspen Creek; and
- Removal of ASB Treatment System sludge.

1.3 HEALTH, SAFETY SECURITY, AND ENVIRONMENT EXPECTATIONS

Atlantic Richfield is fully committed to health, safety, security, and environment (HSSE) goals, which are *no* accidents, no harm to people, and no damage to the environment. Atlantic Richfield values the HSSE goals because it is committed to the health, safety, and security of people; the safety of the communities in which it operates; and the protection of the natural environment. Accordingly, Atlantic Richfield has an expectation that everyone who works for them has a responsibility for *getting HSSE right*. In order to reach and promote these expectations, AMEC created the Leviathan Mine Site HSSE Program Document (AMEC, 2010c) which is the site-wide occupational health and safety guidance document for Atlantic Richfield and their contractors, subcontractors, and visitor personnel, working at or visiting the site.

The Leviathan Mine Site HSSE Program document is updated annually and intermittently as needed. Each person who works on the Leviathan site as a contractor, subcontractor, or visitor is expected to read the most recent version of the "Leviathan Mine Site HSSE Program

Document" (AMEC, 2010c) as the HSSE Program Document is the site-wide occupational health and safety guidance document for the Atlantic Richfield project team, which includes Atlantic Richfield Company personnel, primary contractors, subcontractors, and visitors working at or visiting the site. The HSSE Program Document describes the Atlantic Richfield Control of Work procedures, identifies the general potential physical and chemical hazards that may be encountered, outlines emergency response procedures, and specifies the requirements for contractor health and safety at the site. In addition, in 2010 all contractors working at the site were responsible for preparing their own company task-specific HSSE plans, specific to the hazard of the tasks being performed in their individual work areas of responsibility.

Each person who works on the site as an Atlantic Richfield employee, subcontractor, or visitor is expected to: (1) read the current HSSE Program Document and applicable task-specific HSSE plan(s); (2) become familiar and comply with Remediation Management's HSSE expectations; and (3) participate in a process of continuous health and safety improvement.

1.4 REPORT ORGANIZATION

The remainder of this report is organized into the following sections:

- Section 2 - Site Background Information: summarizes the site's physical setting and the history of Atlantic Richfield's Removal Action activities.
- Section 3 - Health and Safety Performance and Community Relations: summarizes the health and safety performance and community relations activities conducted for the site in 2010.
- Section 4 - 2010 Removal Action Activities: describes the objectives and details of the water treatment activities, related response actions completed, and summarizes the materials removed from the site in 2010.
- Section 5 - 2010 Performance Monitoring Activities: describes the performance monitoring activities conducted at the site in 2010, including data quality objectives (DQOs) and sampling and analysis activities.
- Section 6 - 2010 Performance Monitoring Results: presents an evaluation of 2010 influent water quality compared to post-treatment water quality relative to treatment goals.
- Section 7 - 2010 System Improvements and Construction Activities: provides a summary of the construction activities conducted at the site in 2010 to improve site safety and to support more efficient and reliable water treatment activities.
- Section 8 - Statement of Costs Incurred: provides a summary of costs incurred during 2010.
- Section 9 - References: provides a listing of references cited.

2.0 SITE BACKGROUND INFORMATION

This section presents relevant site background information, including a description of the site location and physical setting and a history of past treatment activities.

2.1 SITE LOCATION, PHYSICAL SETTING, AND WATERSHED DESCRIPTIONS

The site is a former copper and sulfur mine in an unpopulated area of Alpine County, California, that is surrounded by Toiyabe National Forest. The site is located approximately 20 miles south of Gardnerville, Nevada, approximately 4 miles west of the California/Nevada border, and approximately 7 miles east of Markleeville, California. The site is accessible via a gravel road, known as both Leviathan Mine Road and Forest Service Road 10052. Leviathan Mine Road/Forest Service Road 10052 intersects U.S. Highway 395 (US 395) approximately 10 miles south of Gardnerville, Nevada and trends southwest approximately 14 miles where it connects with California State Route 89 (SR 89), approximately 3 miles west of Monitor Pass. The site is located on Leviathan Mine Road, approximately 11 miles from US 395 and 3 miles from SR 89, as shown on the site location map (Figure 1).

The site is located on the eastern flank of the Sierra Nevada, which is situated near the western margin of the Basin and Range geologic province. The topography is mountainous, ranging from 6,900 to 7,400 feet (ft) above mean sea level. The region is seismically active and classified as a seismic zone 4.

The site lies within the Bryant Creek watershed of the Carson River Basin. Surface water at the site flows into Nevada and the internal Great Basin watershed via tributaries of the East Fork of the Carson River. Specifically, Leviathan Creek flows through the site. Aspen Creek discharges into Leviathan Creek approximately ¼ mile downstream from the site. Leviathan Creek converges with Mountaineer Creek approximately 2 miles downstream of the site to form the headwaters of Bryant Creek. From here, Bryant Creek flows approximately 7½ miles before connecting with the East Fork of the Carson River.

2.2 OVERVIEW OF PAST TREATMENT ACTIVITIES

According to the U.S. EPA, and based on available data, five flows or discharge areas contribute the majority of acid drainage (AD) loading to surface water at the site, as follows:

1. The Adit,
2. Pit Underdrain (PUD),
3. CUD,

4. DS, and
5. AS.

The locations of these sources are shown on the site map presented as Figure 2. Water treatment activities related to discharges from the CUD, DS, and AS are summarized in this report. Discharges from the Adit and PUD are being addressed separately by the Lahontan Regional Water Quality Control Board (LRWQCB) under a U.S. EPA Administrative Abatement Action, CERCLA Docket No. 2005-15. A chronology and summary of prior response actions conducted by Atlantic Richfield are presented below. This information comes from the *2009 Annual Completion Report: Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities* (Atlantic Richfield, 2010c).

2.2.1 Pond 4 Treatment Area, Channel Underdrain and Delta Seep

The Pond 4 treatment area has historically been used to treat CUD and DS flows during the summer months. The following features are important to treatment activities at the Pond 4 area:

- **CUD** - The CUD collects subsurface water year-round at a flow rate ranging from approximately 18 to 45 gallons per minute (gpm) from beneath the concrete Leviathan Creek diversion channel and underground pipelines.
- **DS** - The DS produces a flow year-round ranging in rate between approximately 6 and 25 gpm from the lowest topographic portion of the mine waste rock in the Leviathan Canyon, located approximately 600 ft downstream from the end of the Leviathan Creek concrete diversion channel and the CUD. The DS is visible as both an upper and lower seep.
- **Pond 4 Treatment Area** - During the summer months, the Pond 4 treatment area is where collected CUD and DS are treated and discharged into the Leviathan Creek diversion channel. The Pond 4 treatment area has generally consisted of the pond, and varying types of treatment systems, and a source of power.

The following activities have been conducted during previous years to address flows from the CUD and DS at the Pond 4 area:

2001 – In 2001, a short-term, continuous lime addition treatment system designed for metal hydroxide and metal oxy-hydroxide precipitation was implemented. The treatment system, constructed in 2001, was referred to as the lagoon treatment facility (LTF), which treated CUD waters between August 2 and October 1 at Pond 4. The LTF demonstrated the effectiveness of lime treatment with metal concentrations of treated discharge water below the site discharge criteria.

2002 – The LTF was reestablished to treat the CUD water as it did at the end of 2001. The LTF operated successfully between June and November. A total of approximately 3.2 million gallons of CUD water were treated during 2002. Changes made to the lime delivery system resulted in better process control and fewer difficulties with clogging of the lime pumps. Water quality monitoring in Leviathan Creek showed higher pH readings and reduced metals concentrations downstream of the CUD discharge location during the time CUD water was being collected and treated by the LTF.

At the end of November 2002, a four-day study was conducted to determine the feasibility of treating combined flows from the CUD, DS, Adit, and PUD sources. System additions to accomplish this study included a capture-and-pump system for transportation of the DS water to the location of the CUD collection tank; a pumping system to transport the combined CUD and DS waters to the LRWQCB pond water treatment facility (PWTF) located near Pond 1 (Figure 2); and plumbing modifications to the PWTF. The PWTF effectively treated the combined flow prior to discharge into Pond 4; however, it was reported that extended operation would be required to accurately determine the reliability of the process.

2003 – The 2003 treatability activities focused on evaluating and optimizing the use of the PWTF for combined flow treatment. Two phases of combined flow treatment using the PWTF were conducted. The first phase was conducted from June 18 through July 29. The second phase was conducted from August 18 through September 29. From July 18 through August 18, the PWTF was only used for treatment of evaporation Pond water (collected Adit and PUD flows). At this time, flows from the CUD and DS were diverted from Leviathan Creek and the LTF was reassembled and used to treat the CUD and DS discharges. Between July 21 and August 20 approximately 1.5 million gallons of CUD and DS waters were treated and discharged to Leviathan Creek. Results of the PWTF for combined flow treatment and the LTF treatability study showed that both systems were effective in reducing the concentrations of dissolved metals below site discharge criteria.

2004 – In 2004, the LTF was reassembled and initially used to treat the CUD and DS waters. Subsequently, the LTF was taken offline and a rotating cylinder treatment system (RCTS) was implemented and evaluated for treating the combined CUD and DS waters. The design concept of the RCTS differs from the deep tank designs of conventional lime treatment systems (LTS) such that it uses shallow trough-like cells for mixing the impacted waters and lime by rotating cylinders for improved aeration and agitation during treatment of the water. During the 2004 treatment period, approximately 4.9 million gallons of CUD and DS waters were treated and discharged to Leviathan Creek. The 2004 laboratory analytical results indicated that the majority of the treated discharge concentrations of dissolved metals were below effluent discharge criteria.

2005 – In 2005, a pilot program to evaluate HDS treatment technology was conducted for treatment of CUD water. The DS water was not collected and treated due to logistical and safety concerns related to Delta Slope stabilization activities performed by the LRWQCB between June and October,[1] including installation of a drain intended to collect surface water runoff from the slope.

The HDS technology is based on the traditional lime neutralization method, but additionally involves recycling a portion of the sludge from a clarifier to further increase the sludge density and draining properties, and to reduce sludge volume. From July 27 through September 30, approximately 2.9 million gallons of CUD waters were treated and discharged to Leviathan Creek. The 2005 laboratory analytical results indicated that the majority of the treated discharge concentrations of dissolved metals were below effluent discharge criteria.

2006 – In 2006, the CUD was collected and treated using the same HDS technology as in the 2005 pilot program. Treatment of the CUD began on July 19 and was temporarily discontinued on August 25 in preparation for the transition to another treatment system, then under construction. During this time, approximately 1.9 million gallons were treated and discharged to Leviathan Creek. From September 2 through October 20, the CUD was collected and treated using an interim lime-neutralization treatment system or LTF system. The LTF system was similar to the 2004 LTF. During this period approximately 2.0 million gallons were treated and discharged to Leviathan Creek. The DS was not collected in 2006 for the reasons described above for 2005.

2007 – In 2007, approximately 2.9 million gallons of CUD water were collected from June 15 to October 10 using a modified version of the 2006 collection system. Approximately 660,000 gallons of DS water were collected continuously from June 29 to October 10, with a suspension (approved by the U.S. EPA) from September 14 through September 25. From June 19 to October 10, a newly constructed Pond 4 LTS using RCTS technology was used to treat collected CUD and DS flows as well as approximately 400,000 gallons of water existing in Pond 4 at the beginning of the treatment season. Approximately 56.7 tons of non-hazardous sludge generated from the 2006 LTF and approximately 45.2 tons of non-hazardous sludge

[1] Surface water runoff from a thunderstorm on August 12, 2004, triggered a landslide that buried the DS collection system. Atlantic Richfield issued a no-entry into the DS area until slope stabilization and a geotechnical evaluation of the slope were completed.

generated from the 2007 LTS were disposed of during the summer and fall 2007 at US Ecology Beatty, Nevada.

Additionally, while the temporary LTS was being used to treat CUD and DS flows, the HDS Treatment System was being designed and planned for construction in 2008. In 2007, a process building for the planned HDS Treatment Plant was designed, constructed, and erected. Semi-permanent collection and conveyance equipment for CUD and DS were also designed, constructed, and completed in 2007.

2008 – In 2008, approximately 4.4 million gallons of CUD water and 1.3 million gallons of DS water were collected from May 28 to October 9. Both the CUD and DS were collected using the semi-permanent collection and conveyance equipment that was constructed in the fall of 2007. From May 30 to October 9, the Pond 4 LTS using the RCTS (constructed in 2007) was used to treat collected CUD and DS flows as well as approximately 300,000 gallons of water existing in Pond 4 at the beginning of the treatment season. In the fall of 2008, approximately 56 tons of non-hazardous sludge generated from the 2008 LTS was disposed of at US Ecology Beatty, Nevada.

While flows from the CUD and DS were treated with the Pond 4 LTS, construction of the HDS Treatment System (including the CUD and DS collection and conveyance equipment; power generation system; and electrical controls, and instrumentation systems) was initiated on May 12 and continued through September 2008. Once the HDS Treatment System was constructed, testing and pre-commissioning activities commenced. These activities included the inspection and initial testing of instrumentation, input/output controls, pumps, the generator system, the fuel supply system, the lime system, the flocculent mixing/addition system, the aeration blower system, and the clarifier. In October, the HDS Treatment System was winterized as it was planned to be commissioned in 2009.

2009 – In 2009, approximately 5.1 million gallons of CUD water and 1.9 million gallons of DS water were collected from May 1 to October 30. Both the CUD and DS were collected using the semi-permanent collection and conveyance equipment that was constructed in the fall of 2007. From May 1 to July 15, the Pond 4 LTS using the RCTS (constructed in 2007) was used to treat CUD and DS flows as well as approximately 286,000 gallons of water existing in Pond 4 at the beginning of the treatment season. The volume of stored water in Pond 4 was reduced to the greatest extent possible using the Pond 4 LTS.

While flows from the CUD and DS were treated with the Pond 4 LTS, pre-commissioning activities were initiated at the HDS Treatment System. On July 20 the HDS Treatment System was commissioned and Pond 4 was converted from a clarifying pond to an untreated equalization pond. From July 20 to November 1, the HDS Treatment System including the CUD and DS collection and conveyance equipment was used to treat approximately 3.3 million gallons of CUD and DS flows. Approximately 75 tons of non-hazardous sludge produced from 2009 Pond 4 LTS operations and dewatered via filter bags and 11 tons of non-RCRA California hazardous waste solid (sludge) produced from the HDS Treatment Plant operations, were disposed of at US Ecology in Beatty, Nevada. The HDS Treatment Plant was effective at treating impacted CUS and DS water to below the site discharge criteria and used less hydrated dry lime and produced a lower volume of sludge per the same volume of water than the Pond 4 LTS. The Pond 4 LTS was decommissioned on July 16, 2009.

2.2.2 Aspen Seep

The AS (also referred to as the Overburden Seep) produces influent flows year-round at a rate ranging typically between 3 and 28 gpm from low points below overburden in the Aspen Creek drainage. Flows at the AS are treated with the ASB Treatment System. The ASB Treatment System consists of the following features that initially (1996 through 2003) operated during the summer and early fall months. In 2004, the ASB Treatment System began year-round operations.

- **ASB Treatment System –** The ASB Treatment System treats flows from the AS prior to discharge to Aspen Creek. The ASB Treatment System utilizes sulfate-reducing bacteria, supported by ethanol as an organic carbon food source, to produce sulfide for removal of dissolved metals by metal sulfide precipitation. Sodium hydroxide is added for pH adjustment to produce a suitable pH environment for the sulfate-reducing bacteria and to encourage metal sulfide precipitation which occurs at neutral to slightly alkaline conditions. The ASB Treatment System generally consists of a series of ponds, chemical feed pumps, recirculation pumps, remote telemetry system, and a power source.

The following is a brief overview of past activities conducted to address discharges at the AS:

1996-2000 – The original ASB Treatment System was designed, constructed, and pilot tested by the LRWQCB in collaboration with the University of Nevada, Reno. The history and performance of the bioreactors through 2000 is presented in detail in the *Operation and Monitoring of Bioreactors at the Leviathan Mine* report (Atlantic Richfield, 2001).

2001 – In 2001, efforts at the ASB Treatment System included the installation of solar panels to drive peristaltic pumps that dosed sodium hydroxide to the system for pH adjustment to enhance the removal of iron as iron sulfide.

2002-2003 – AS water was treated using the previous year's bioreactor system from January to August of 2002. After August 2002, construction began on the infrastructure of the current bioreactor system, which was designed to be larger, gravity-operated, and have improved flow distribution, flushing, and sludge retention. Construction was completed in the spring of 2003. The newly constructed bioreactor treatment system consisted of a collection trench, five ponds (a pretreatment pond, two biocell ponds, and two settling ponds, denoted ASB Treatment System Pond 3 and Pond 4), and an aeration channel. At this time evaluation and testing of four alternative alkaline additives to potentially replace sodium hydroxide were carried out. The evaluation concluded that sodium hydroxide was the most effective option for the application and was used from this point forward.

2004 – Starting January 1, 2004, the entire AS was captured and the newly constructed ASB Treatment System was operated as designed. A total of approximately 1.7 million gallons were treated and discharged to Aspen Creek between January 1 and May 11. On May 12, the "recirculation" mode of operation was initiated by directing influent AS water into the first settling pond and adding a submersible pump (powered by a diesel generator) in the first settling pond to pump water to the pretreatment pond. The purpose of these changes was to reduce the amount of sludge that was produced and collected in the biocells by encouraging mixing of the metal-laden influent water with the sulfide-rich biocell effluent, and subsequent metal sulfide sludge formation, in the first settling pond rather than in the biocells. The recirculation pump provides water with low metals and high sulfate concentration to the biocells for sulfide production. For the remainder of 2004, the system was operated in the recirculation mode, treating approximately 2.8 million gallons prior to discharge to Aspen Creek.

2005 – The ASB Treatment System was operated for the entire year. Approximately 6.8 million gallons (an approximate 240 percent increase over the 2004 volume) from the AS was collected and treated using the recirculation mode of operation. Due to a relative increase in annual precipitation (mainly as snow), flows and metal concentrations were elevated, thereby necessitating increased reagent dosing rates compared to previous years. A minimal amount of sludge was removed from Pond 3, Biocell 1, and Biocell 2 by pumping via trash pump into filter bags. The filter bags were stored on site through the winter and were removed in 2006.

2006 – The ASB Treatment System collected and treated approximately 7.9 million gallons. During this year, several engineering upgrades were accomplished, including the installation of two flow meters (one for the primary recirculation pipeline and one for the effluent pipeline). From July through early October, a treatability test was conducted to use a biodiesel by-product consisting mainly of glycerol and methanol as a carbon source for the system. The test concluded that ethanol was the most effective option and ethanol use was resumed after the experiment. Larger, more permanent storage tanks were purchased to allow greater on-site storage capacity for sodium hydroxide and ethanol.

Prior to the spring of 2006, the ASB Treatment System had operated since construction (approximately three years) with minimal sludge removal. During spring 2006, the volume of sludge accumulation in Pond 3 reached a level requiring removal. Consequently, Pond 3 sludge was pumped either into filter bags for dewatering, pumped into Pond 4 to await future removal, or pumped into containers or a vacuum truck for off-site disposal. In 2006, non-hazardous waste solids and liquids by RCRA and California regulations were disposed of at US Ecology in Beatty, Nevada during September and October including: approximately 27 cubic yards (cy) collected in filter bags from the 2005 and 2006 seasons; approximately 77.7 cy of non-dewatered sludge from the pretreatment pond; and approximately 228.1 cy of non-hazardous non-dewatered sludge from Pond 3.

2007 – During 2007, approximately 4.0 million gallons of water from the AS were treated and discharged. Activities completed at the ASB Treatment System during 2007 included operating and monitoring the bioreactor, sampling influent and discharged water, and performing various modifications, including replacement of the diesel generator with propane generators and completing improvements to optimize the existing system components.

Two methods of sludge removal including the filter bag method and mobile belt filter press method were pilot tested to evaluate the feasibility of sludge dewatering at the ASB Treatment System. As a result of these pilot tests, it was determined that investigation of alternative sludge handling and dewatering methods should continue. Approximately 5.6 tons of non-hazardous sludge dewatered in the filter bags and approximately 59.3 tons of non-hazardous sludge dewatered in the belt filter press were removed from the ASB Treatment System and disposed of in October 2007 at US Ecology in Beatty, Nevada.

2008 – Approximately 3.2 million gallons of water from the AS were treated and discharged in 2008. Activities completed during 2008 at the ASB Treatment System included bioreactor operations and maintenance (O&M)[2], monitoring of system performance, sampling influent and treated water, and performing improvements and upgrades to optimize the existing system components. In June, Atlantic Richfield began additional sample collection and analysis at the ASB Treatment System to aid in the assessment of bioreactor performance. The performance evaluation was carried out to better examine the biogeochemical processes that occur within the bioreactor and the results of the evaluation were presented to the U.S. EPA in October 2008.

A belt filter press (similar to the 2007 mobile belt filter press pilot test) was mobilized to the site in July 2008 to dewater sludge from the ASB Treatment System. The 2008 sludge removal activities included: multiple events of biocell flushing and biocell pipe flushing, sludge removal from the ASB Treatment System Pond 3 and Pond 4 and the installation of a permanent conveyance line to the belt filter press operations. Approximately 57.7 tons of non-hazardous sludge were removed from the ASB Treatment System and disposed of in September 2008 at US Ecology in Beatty, Nevada.

2009 – During 2009, approximately 3.2 million gallons of water from the AS were treated and discharged. Activities completed during 2009 at the ASB Treatment System included bioreactor O&M, monitoring of system performance, sampling influent and treated water, replacing the ethanol and sodium hydroxide bulk chemical storage tanks, and performing improvements and upgrades to optimize the existing system components. In July, Atlantic Richfield began additional sample collection and analysis at the ASB Treatment System to aid in the assessment of bioreactor performance. The performance evaluation was carried out to better examine the biogeochemical processes that occur within the bioreactor and the results of the evaluation were presented to the U.S. EPA in December 2009.

Two sludge dewatering and removal efforts were tested in 2009: a mobile centrifuge (similar to the 2008 and 2009 belt filter press), and a SDB pilot test. Prior to the centrifuge dewatering effort, a separate conveyance line was added to allow for simultaneous pumping of sludge from the ASB Treatment System to the centrifuge, and discharge of filtrate water from the centrifuge to the ASB Treatment System Pond 4. Additionally, flushing of sludge from the biocells into Pond 3 was completed before pumping of sludge to the centrifuge commenced. Approximately 42 tons of non-hazardous sludge were removed from the ASB Treatment System and disposed of at US Ecology in Beatty, Nevada. The SDB pilot test consisted of two filter bins; one was configured for testing dewatering by evaporation and the other was configured for testing

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[2] As used throughout this report, the term "operations and maintenance" or "O&M" is meant to refer to the ongoing operation and maintenance of removal action equipment and treatment system components implemented in accordance with the requirements of the AOC. Use of this term is not meant to imply that response actions at the Site have reached a point where "operation and maintenance (O&M) measures" need to be initiated under 40 C.F.R. § 300.435(f).

dewatering by filtration, decanting and evaporation. The SDB pilot test was finished in 2010 and the results are presented in Section 4.3.5.1 and the complete letter report is provided in Appendix G.

3.0 HEALTH AND SAFETY PERFORMANCE AND COMMUNITY RELATIONS

The following sections discuss the 2010 health and safety performance and community relations for the site.

3.1 2010 HEALTH AND SAFETY PERFORMANCE

During 2010 operations, morning safety meetings were conducted with all on-site workers and visitors so that each person was aware of the day-to-day health, safety, and security concerns such as site conditions, including weather, deliveries, and the daily scope of work; this was also a time to discuss learning opportunities from the previous day's work.

An orientation to the site was provided to every Atlantic Richfield-related person who conducted work or visited the site in 2010. The Health and Safety Coordinator presented the orientation, which provided information on specific procedures including the permit system and a briefing on work practices and policies, expectations, codes, and standards set forth in the Site HSSE Program Document.

In accordance with the site HSSE Program Document, incidents, near misses, and stop-work scenarios at the site were reported to the on-site Health and Safety Coordinator. Of the approximate 51,286 hours worked on- and off- the site during 2010, there were no first-aid cases or OSHA recordable injuries. Site personnel identified 2 near misses and 32 stop-work scenarios, none of which involved injuries. These were considered health and safety learning opportunities and discussed during the daily safety meeting on the mornings after they occurred. In addition, the standard practices and procedures for the site were modified as appropriate to reflect these learning opportunities.

3.2 2010 COMMUNITY RELATIONS

Community relations activities conducted in 2010 were as follows:

Leviathan Mine Road Public Participation Teleconference – On September 25, 2010, a teleconference was hosted by Atlantic Richfield with representatives from the U.S. Forest Service (USFS), U.S. EPA and members of the public in attendance. The purpose of the teleconference was to give the public an opportunity to ask questions, provide input or express concerns regarding Atlantic Richfield's 2010 Dust Suppression Evaluation Report and selection of the preferred alternative for dust suppression on Leviathan Mine Road in 2010.

Technical Advisory Committee (TAC) Meeting – On December 2, 2010, a meeting was conducted with the TAC and stakeholders to inform them of the progress being made on the

Removal Action and RI/FS activities. During this meeting, which the U.S. EPA hosted, Atlantic Richfield and the LRWQCB made presentations to describe the work completed, and the U.S. EPA was available to respond to questions the public and stakeholders had regarding the work being conducted.

Stakeholder Review and Comments on Site Documents – The U.S. EPA is the lead agency for compiling comments from the stakeholders on site documents. The U.S. EPA provided certain documents submitted by Atlantic Richfield in 2010 to the stakeholders for comment.

Project Information Repositories – Certain project documents and other site communications are posted to a Web site, as well as two separate repositories as they become available. The stakeholders and public have access to the Web site to review this information.

Public Information Sites – Both the U.S. EPA and the LRWQCB post project reports and other information to each agency's Web pages for the site. The U.S. EPA maintains the Superfund Site Web page and the LRWQCB maintains a Web site where the proceedings of the Regional Board are posted.

4.0 2010 REMOVAL ACTION ACTIVITIES

The following section summarizes the Removal Action activities implemented by Atlantic Richfield during 2010, including systems testing and commissioning of the HDS Treatment System, operation of the ASB Treatment System and other Removal Action activities. All activities were completed in accordance with Revision 1.0 of the 2010 RAWP, (Atlantic Richfield, 2010d), RAWP Amendment (Atlantic Richfield, 2010h), and the treatment objectives listed in Section 4.1.

4.1 OBJECTIVES

The overall site objectives as cited in the 2010 RAWP were as follows:

1. Collect information that will be used to identify effective, reliable, and suitable treatment methods that may be incorporated into the long-term remedy for the site;
2. Treat the previously identified flows of CUD, DS, and AS, to discharge criteria previously established for the site to the extent practicable for a treatability study;
3. Optimize treatment systems;
4. Implement HSSE-related improvements at all treatment areas; and
5. Reduce the potential for environmental impacts due to spills or treatment disruptions.

The activities conducted to achieve the above five objectives are divided into two categories:

- Water treatment activities to satisfy objectives 1 and 2; and
- Construction activities and other work to satisfy objectives 3 through 5.

Water treatment and performance monitoring activities and results are described in the remainder of Section 4.0, Section 5.0 and Section 6.0, respectively. Construction activities and other work are described in Section 7.0.

4.1.1 Channel Underdrain and Delta Seep

During 2010, waters from the CUD and the DS were collected and treated using the HDS Treatment System. The primary activities related to CUD and DS water treatment undertaken during 2010 were as follows:

- Maintained the DS collection area to optimize flow collection;

- Maintained the CUD collection area to optimize flow collection and facilitate year-round U.S. Geological Survey (USGS) flow measurements;
- Commissioned and operated the HDS Treatment System to treat collected CUD and DS flows;
- Evaluated possible optimization of HDS Treatment System operations to produce treatment generated sludge that meets numeric limits for a non-hazardous waste;
- Evaluated sludge for disposal;
- Winterized the HDS Treatment System; and,
- Based on the objectives in the MRAM, Atlantic Richfield made efforts to extend the length of the water treatment season for the CUD and DS flows to the extent practicable while gathering information on the operational and performance reliability of the HDS Treatment System (including the CUD and DS collection and conveyance equipment) during "shoulder-season" or LAS cold weather conditions.

4.1.2 Aspen Seep

In 2010, flows from the AS continued to be treated year-round with the existing bioreactor system. In addition during 2010, the following activities were conducted:

- Continued to optimize system performance;
- Removed sludge and evaluated future sludge management practices; and
- Continued engineering evaluation and optimization of the power supply, telemetry, and chemical feed and storage system, as necessary, to promote safe and reliable operations.

4.2 CHANNEL UNDERDRAIN AND DELTA SEEP TREATMENT RELATED ACTIVITIES

This section summarizes the activities implemented in 2010 to treat the flows from the CUD and DS.

4.2.1 Site Access, LAS Mobilization, and General Pond 4 Area Activities

The U.S. EPA was notified of the commencement of mobilization activities on April 1, 2010. Starting on April 7, 2010, Atlantic Richfield began removing snow from the Nevada access route of Leviathan Mine Road starting approximately 8.5 miles from U.S. 395 (Figure 1) and proceeding into the site. Once snow was removed, delivery and set-up of Pond 4 infrastructure began on April 12, 2010. Infrastructure set-up activities included: delivery of office trailers, power supply and satellite communications equipment connections, and delivery of tools and general supplies to support treatment activities. Delivery of fresh water occurred on April 16, 2010. Site snow removal and infrastructure set up were delayed several times due to inclement weather and HSSE concerns. HDS Treatment System commissioning activities began shortly thereafter which are described in Section 4.2.3.1.

4.2.2 Channel Underdrain and Delta Seep

Approximately 10.6 million gallons of water from the CUD and DS, were collected, treated, and discharged during 2010. CUD and DS flows were collected by utilizing the HDS Treatment System collection and conveyance equipment constructed in 2008 and treated using the HDS Treatment Plant. Table 4 presents a monthly summary of influent flow and treated volume from the CUD and DS in 2010. The following subsections describe the collection of the CUD and DS flows during 2010.

4.2.2.1 Channel Underdrain

The flow from the CUD was collected continuously during the 2010 treatment season, from collection equipment startup on May 6 through system shutdown on November 1, except during a short term interruption in collection occurring on May 28, which is discussed further in Section 6.1.3. The U.S. EPA was notified of this interruption via email and additional documentation was presented in the monthly reports submitted to the U.S. EPA by Atlantic Richfield. Flow from the CUD was also collected from November 5 through November 9, 2010 for end of treatment season lime utilization purposes prior to HDS Treatment Plant shutdown. Copies of the 2010 monthly reports are provided in Appendix A. Overall, approximately 7.4 million gallons of water from the CUD were collected and treated in 2010 (Table 4).

4.2.2.2 Delta Seep

The flow from the DS was collected continuously during the 2010 treatment season, from startup on May 6 through system shutdown on November 1. The DS did not experience any interruption in collection during the 2010 treatment season. Approximately 3.2 million gallons of water from the DS were collected and treated in 2010 (Table 4).

4.2.3 High-Density Sludge Treatment System

The HDS Treatment System is composed of the CUD and DS capture and conveyance equipment, Pond 4, the HDS Treatment Plant (which includes the process equipment), and the HDS Power Generation System. Approximately 10.6 million gallons of water from the CUD and DS along with 431,000 gallons of water collected over the previous winter in Pond 4 were treated by the HDS Treatment Plant and subsequently discharged to Leviathan Creek in 2010. Overall, approximately 11.0 million gallons of water was treated in 2010 by the HDS Treatment System. The following sections present a description of the HDS Treatment System activities implemented in 2010, including:

- Commissioning and operation,
- Maintenance,
- Optimization,
- Sludge management,
- Pond 4 sludge evaluation, and
- Winterization.

The Pond 4 HDS Treatment Plant equipment layout is provided in Figure 3, and the HDS Treatment System process flow diagram is provided in Figure 4.

4.2.3.1 Commissioning and Operation

The HDS Treatment System must be commissioned every year following winter decommissioning. Spring commissioning of the HDS Treatment System began on April 12, 2010 and was completed on April 28, 2010. Commissioning of the HDS Treatment System involved the installation of conveyance pumps, drive belts, various motors, replacement of required lubricants and fluids, conveyance line installation and hydro-testing, and tightening and adjusting equipment and the testing of each piece of equipment to verify the proper operation. Beginning on April 28, 2010, the HDS Treatment System commenced pumping water from Pond 4 that had collected over the previous winter into the HDS Treatment Plant. Once all of the process tanks and the clarifier were filled with water the HDS Treatment Plant was operated in recycle mode through May 2, 2010, to verify proper treatment operation. The HDS Treatment Plant began discharging treated Pond 4 water on May 3, 2010. Collection of the water from CUD and DS was initiated on May 6, 2010. The CUD and DS were pumped directly to Pond 4 for storage before treatment by the HDS Treatment Plant. From May 6 through November 11, 2010, approximately 10.6 million gallons of water from the CUD and DS were treated by the HDS Treatment System and subsequently discharged at a rate between 40 to 80 gpm to Leviathan Creek (Table 4). HDS Treatment System operations were conducted in accordance with the U.S. EPA approved 2010 RAWP (Atlantic Richfield, 2010d).

In accordance with the Work Plan, discharge suitability was determined by at least once daily field monitoring of pH and twice daily field monitoring of dissolved iron concentrations in the effluent tank. The discharge was considered suitable when the pH was measured between 7.2 and 9 pH standard units (s.u.) and less than 1.0 milligram per liter (mg/L) dissolved ferrous plus ferric iron. In the event that pH or the measured iron concentrations had been outside this range the discharge was immediately stopped and the water was recycled back to Pond 4 for further treatment until discharge criteria were achieved. Treated water discharged from the

HDS Treatment Plant was sampled and sent to a laboratory for compliance analytical parameters on a weekly basis for the first four weeks of spring operation and then once a month thereafter for the remainder of the treatment season. Details on sampling and analysis are provided in Section 5.2.

The HDS Treatment Plant operated continuously except during short-term shutdowns in July, August, September, and October 2010, which are discussed further in Section 6.1.3. None of the HDS Treatment System interruptions resulted in discharge of untreated water to Leviathan Creek. The U.S. EPA was notified via email of system interruptions. These system interruptions were further documented in the monthly reports submitted to the U.S. EPA by Atlantic Richfield (Appendix A).

On September 20, 2010, Atlantic Richfield provided written notification to EPA of a change in the mode of operation of the HDS Treatment Plant due to difficulties experienced in attempting to operate the plant at low flow rates from the CUD and DS. Beginning October 1, 2010, HDS Treatment System operations were completed in accordance with the Request for Approval of Fall 2010 LAS Operations, and 2010 Year-End Decommissioning and Winterization Plan, (Atlantic Richfield, 2010i). The CUD and DS collection and conveyance equipment continued to operate under normal operations; however, the HDS Treatment Plant was operated on an intermittent basis each week to allow for adequate water accumulation in Pond 4 and to optimize the treatment process.

4.2.3.2 Maintenance

Maintenance activities conducted for the HDS Treatment System included the following:

- Sludge management and removal, described further in Section 4.2.4.4;
- Moving the 6-inch rip rap at the DS, as necessary, to reestablish a preferential flow pathway from the upper seep to the fanned culvert inlet;
- Routine periodic cleaning of the CUD and DS conveyance lines, including using a high pressure low volume cleaner to remove scale built up inside the CUD conveyance lines; and cleaning of the collection pumps, collection tanks, and tank level controls;
- Routine inspection of collection pumps for wear to determine if seals should be replaced;
- Periodic inspections, cleaning, and lubrication of the HDS Treatment Plant and power generation equipment; and
- Replacing the lime feed screw and hopper in the HDS Treatment Plant.

An additional maintenance activity included reinforcing the existing DS cutoff wall. The DS cutoff wall was designed and installed in 2007 to be a semi-permanent structure for the collection of surficial flows at the DS as part of the Removal Action. Since 2007, spalling has been observed on the upper portion of the wall. In order to address the spalling, Atlantic Richfield performed maintenance on the wall in July, August, and September 2010 which consisted of reinforcing the existing concrete wall with a new layer of concrete poured immediately adjacent to the existing wall on the seep side. The below grade portion of the DS cutoff wall was sound and was left in-place to maintain collection and ease installation by utilizing the existing wall as one of the concrete forms. The bottom and the sides of the new layer of concrete were installed at roughly the same dimensions as the existing wall.

4.2.3.3 Optimization

Prior to September 2010, the turbidity of the water discharged from the HDS Treatment Plant effluent ranged between 20 and 90 Nephelometric turbidity units (NTU), which was greater than anticipated. During September and October 2010, optimization activities were completed at the HDS Treatment System to reduce the turbidity of the effluent water while continuing to achieve water quality within the MRAM discharge criteria. These optimization activities included making adjustments to:

- The flocculant type and dosing rate; and
- The sludge recycle flow rate and wasting frequency.

During the last three weeks of HDS Treatment Plant operations, these adjustments resulted in a higher quality sludge, improved solids settling, and effluent turbidity between 0-10 NTU. The following subsections describe optimization efforts in 2010.

Flocculant Type and Dosing Rate — In the HDS Treatment Plant, reacted water is dosed with flocculant prior to entering the clarifier to promote sludge settling. When the plant was initially designed, the initial flocculant product purchased was Magnafloc 10 (a commonly used weak anionic water treatment flocculant). In September 2010, a flocculant manufacturer was consulted and jar testing was conducted with the goal of identifying a more effective flocculant product. A total of 12 different flocculants were tested, and the following flocculants were recommended: Magnafloc 10, 155, 5250, and Nalco 8173. After further and more detailed jar testing at various concentrations, Nalco 8173 was selected for use and implemented on September 24, 2010. After some adjustments, the optimum dosage rate for the Nalco 8173 was determined to be 4-5 parts per million (ppm).

Sludge Recycle Flow Rate and Wasting Frequency — Sludge at the bottom of the clarifier is either recycled to the lime sludge mix tank or wasted to the sludge bins. The recycled sludge is mixed with dry lime, forcing contact between the sludge particles and lime particles which promotes coagulation of particles into denser precipitates. This sludge recycling process improves the quality of the sludge (more crystalline and free draining) and the efficiency of the lime reaction, reducing the amount of lime used to treat the AD.

In 2010, the quality of the sludge produced by the HDS Treatment Plant was evaluated based on the solids generation rate, sludge slurry specific gravity, percent solids measured in the clarifier, and sludge particle size. Based on this evaluation, it was determined that the mass recycle ratio (MRR), which is the ratio of the mass of solids being recycled in the sludge recycle stream (by the sludge recycle pumps) relative to the mass of solids being generated by treatment of the influent AD with lime, was higher than optimal. Additionally, it was concluded that the sludge particles were possibly breaking down due to being over-recycled.

In October 2010, Atlantic Richfield reduced the sludge recycle flow rate from approximately 20 gpm down to 5-10 gpm and increased the frequency of sludge wasting from once per week to three times per week in order to achieve the desired MMR and reduce the mechanical breakdown of sludge particles. At the conclusion of these changes, it was observed that the volume of sludge wasted per event was reduced, though the overall volume of sludge wasted from the HDS Treatment Plant was relatively unchanged.

4.2.3.4 Sludge Management

On June 10, 2010, HDS Treatment Plant operators initiated use of the sludge waste pumps to remove sludge from the HDS Treatment Plant. Sludge was pumped from the clarifier into filter bins lined with non-woven fabric filter bin liners for sludge dewatering. The filtered liquid drained from the filter bins into the trench drain and sump. The filtered liquid was then pumped back to the HDS Treatment Plant for further clarification.

Sludge was wasted from the HDS Treatment Plant, filling up approximately 5 filter bins, through November 11, 2010. The roll-off-style filter bins held the filter bags and provided a means to easily transport the dewatered sludge off-site. Following the complete filling of a filter bin, the sludge in the filter bins was characterized, profiled and transported off-site for disposal under manifest. Sludge disposal is discussed further in Section 4.2.4.4.

4.2.3.5 Pond 4 Sludge Evaluation

In early 2010, Atlantic Richfield evaluated the effects of the sludge in Pond 4 on the operations of the HDS Treatment Plant and began evaluating alternatives later in 2010 for sludge removal for increased capacity during the LAS.

Between 2002 and 2009, the LTF, and later the Pond 4 LTS were both used to treat AD from the CUD and DS. Both the LTF and LTS used filtration systems prior to discharging reacted water into Pond 4; however, Pond 4 served as a final settling pond. These operations resulted in the gradual accumulation of sludge in Pond 4. Beginning in July 2009, untreated AD from the CUD and DS was pumped directly into Pond 4 for temporary storage prior to treatment by the HDS Treatment Plant and the pond was no longer used as a final settling pond. According to field observations, perimeter and central sludge depth measurements, and water level observations relative to the USGS Pond 4 gauge, it was estimated that approximately 1,900 cy of sludge had accumulated in Pond 4 by the end of July 2009 when the HDS Treatment Plant operation commenced.

The estimated sludge accumulation of 1,900 cy leaves approximately 1.4 acre feet (AF) (456,000 gallons) or approximately 54 percent of the total 2.6 AF (847,000 gallons) storage capacity of Pond 4 (Brown and Caldwell, 2002). Pond 4 volume was estimated based on the Leviathan Mine Early Response Action CUD Treatment System Figure 2, February 2002 (prepared by Brown and Caldwell) and an estimate based on site photos and observations made by field personnel, that indicate approximately 2.0 ft of pond freeboard exists between the maximum operating pond stage (at 7.0 ft on the USGS gauge station) and the crest of the pond overflow pipe.

Under high priority conditions, AMEC assumed that typical failures or maintenance requirements of the HDS could be mitigated and completed in one week (i.e., 5 days). To maintain 5 days of available storage capacity at the assumed maximum monthly inflows to Pond 4, the pond and treatment flow rate should be managed to maintain approximately 1.1 AF (358,400 gallons or 42 percent) of available Pond 4 capacity under normal operating conditions to accommodate possible downtime of the HDS. This level corresponds to a USGS gauge height of approximately 5.2 ft.

Based on this evaluation, it was determined that sludge removal from Pond 4 is not required at this time for the operation of the HDS Treatment System; however, the lost pond capacity may be needed for LAS storage in high precipitation years.

Atlantic Richfield is in the process of completing an evaluation of the various methods for sludge removal and is in the process of preparing an Addendum to the 2011 Removal Action Work Plan (RAWP) which describes this evaluation and the proposed approach for initiating Pond 4 sludge removal.

4.2.3.6 Winterization

Winterization of the HDS Treatment System began on November 11, 2010 and was completed on November 18, 2010. Winterization activities included:

- Draining all tanks and piping;
- Weatherproofing all electrical components including control panels, motors, and valves;
- Checking and refilling (if necessary) the antifreeze, motor oil, and diesel fuel day tank in the generators, removal of the generator batteries, and spraying rust protection on all exposed generator surfaces;
- Emptying and cleaning polymer and lime systems;
- Removing and placing all protection system device batteries in storage; and
- Removing and placing all pH and turbidity probes and pressure relief valves in storage.

Unused bagged dry lime from 2010 operations was wrapped and stored inside the HDS Treatment System building for the winter. The above ground diesel storage tank was filled and a winterization fuel conditioner added in order to facilitate commencement of collection and treatment operations as early in 2011 as practicable. Winterization activities were performed as outlined in the 2010 RAWP (Atlantic Richfield, 2010d) and the Request for Approval of Fall 2010 LAS Operations, and 2010 Year-End Decommissioning and Winterization Plan (Atlantic Richfield; 2010i).

4.3 ASPEN SEEP TREATMENT RELATED ACTIVITIES

Approximately 3.8 million gallons of water from the AS were treated and discharged to Aspen Creek in 2010.[3] Table 5 presents the 2010 monthly summary of the AS influent flow and treated volume. The following sections present a description of the ASB Treatment System activities implemented in 2010, including:

[3] This volume was calculated using flow rates from the USGS influent weir, and differs from the 3.6 million gallons calculated by the Atlantic Richfield effluent flow meter which was reported in the 2010 ASB Treatment System Performance Review (Appendix F) and 2010 TAC Meeting.

- Operation,
- Maintenance,
- Optimization,
- Performance evaluation, and
- Sludge Removal.

The ASB Treatment System layout is presented on Figure 5, and the ASB Treatment System process flow diagram is presented on Figure 6.

4.3.1 Operation

The ASB Treatment System operated continuously in recirculation mode except during brief disruptions and associated system recovery observed during January, February, and November 2010, which are discussed in Section 6.2.3. The U.S. EPA was notified via email of each of the system interruptions. These instances were further documented in the monthly reports (Appendix A) submitted to the U.S. EPA by Atlantic Richfield.

4.3.2 Maintenance

Periodic maintenance conducted for the ASB Treatment System included the following activities:

- Inspection and as-needed replacement of influent and recirculation pipelines;
- Annual inspection, debris removal, and precipitate and sediment removal of the AS collection area;
- Sludge management and removal, described further in Section 4.3.4;
- Periodic inspections, operational data collection, and testing of equipment; and
- Periodic cleaning, lubrication, and fluid replacement for equipment.

4.3.3 Optimization

During 2010, the ASB Treatment System continued the use of specially denatured alcohol (SDA) 3A as the system organic carbon supply, as well as continuing monthly addition of sodium mono-phosphate and urea to provide both a nitrogen source and a phosphorous source for bacterial growth. Four enhanced sampling events for water quality parameters and analytes, including nutrients dissolved organic carbon (DOC), ethanol and acetate, occurred during the 2010 ARWS to evaluate nutrient addition, ethanol blend and ethanol dose rate, and to provide additional information regarding microbial activity for future optimization. The ASB Treatment System enhanced sampling and analysis plan (SAP) is discussed further in Section 5.2.1.2.

4.3.4 Performance Evaluation

In 2010, data from the ASB Treatment System was compiled for comparison to historic data. A conference call and presentation was conducted on February 14, 2011 between Atlantic Richfield's contractors, the U.S. EPA and stakeholder representatives to discuss the ongoing performance evaluation and optimization of system inputs. The performance evaluation is discussed further in Section 6.2.4.

4.3.5 Sludge Removal

The ASB Treatment System consists of a series of ponds with a capacity of approximately 328,500 gallons. The capacities of the various ponds in the ASB Treatment System as described in the *Aspen Seep Biocell Construction Report* (Atlantic Richfield, 2004) include:

- Pretreatment pond – approximately 7,500 gallons;
- Biocell 1 – approximately 40,000 gallons;
- Biocell 2 – approximately 23,000 gallons;
- Pond 3 (mixing and settling) – approximately 123,000 gallons; and
- Pond 4 (settling) – approximately 135,000 gallons.

Sludge is produced in all parts of the bioreactor system. The most significant precipitate production occurs in Pond 3, where the metal-rich influent water mixes with the sulfide-rich effluent from the biocells and sodium hydroxide for pH adjustment. These two water streams (the AS and the flow from Biocell 2) and sodium hydroxide are combined in Manhole 6, where some mixing occurs. Pond 3 provides additional mixing by way of the recirculation flow, as well as providing retention time for metal sulfide precipitate formation (sludge). Sludge settles out in both Ponds 3 and 4. Excess biomaterial and some metal sulfide precipitates are produced in Biocells 1 and 2, and these settle or attach to the biocell rock surfaces and piping. Some of the biomaterial and associated metal precipitates dislodge from the rock matrix and piping and flow into Ponds 3 and 4. Eventually, the sludge can cause clogging of the rock matrix and, potentially, the biocell influent and effluent piping. In order to maintain sufficient residence time and flow through the biocells, regular sludge management and removal is required. Reversing the flow direction within each biocell can prevent sludge deposits and prevent formation of preferential flow paths within the biocells. Also, biocell and pipeline flushing removes excess solids, allowing greater hydraulic capacity and residence time.

The following sludge removal and dewatering efforts took place in 2010:

- The removal and disposal of the sludge dewatered during the 2009 SDB Pilot Test as described in Section 2.2.2 and Summary of Phase I SDB Pilot Test Results (Atlantic Richfield 2010l); and
- Centrifuge operations which included biocell flushing and piping cleanout, sludge removal and dewatering, discharge and monitoring of filtrate water, disposal of sludge solids and mobilization of a trailer mounted centrifuge.

The above two efforts are described in the following subsections.

4.3.5.1 SDB Pilot Test

The SDB pilot test, initiated in October 2009, was completed and decommissioned on July 20, 2010. The objective of the SDB pilot test was to evaluate the effectiveness and potential cost savings of passive drying bed technology. The test was installed in roll-off style filtration bins and was composed of two different SDB configurations (Trial 1 and Trial 2). Trial 1 was constructed to allow dewatering by passive filtration, decanting, and evaporation. Trial 2 was constructed as a simplified system to allow dewatering only by evaporation. The SDB pilot test layout is shown on Figure 7.

An additional component of this SDB Pilot Test was characterization of the mineralogical and chemical composition of the sludge and tests to provide indications of the stability of the sludge if stored onsite under oxidizing conditions. Results of the SDB pilot test were presented to the U.S. EPA in the letter *Summary of the Phase I SDB Pilot Test*, submitted on October 19, 2010 (Atlantic Richfield, 2010l) and included herein as Appendix G.

4.3.5.2 Centrifuge Operation

From September 9, 2010, until September 14, 2010, normal ASB Treatment System recirculation was interrupted as the level in Pond 3 was lowered to facilitate sludge removal activities. Components of the 2010 sludge removal included the following:

- Biocell flushing and piping cleanout;
- Sludge removal and dewatering;
- Discharge and monitoring of filtrate water; and,
- Disposal of sludge solids.

A summary of the 2010 centrifuge operation including sludge removal from the ASB Treatment System is described in the following paragraphs.

Biocell Flushing and Piping Cleanout – Flushing of the biocells is necessary to help reduce accumulated sludge and preferential flow through the biocells. Each flushing event involved draining (or flushing) by opening two flush loops at a time. After the biocell was drained, it was refilled using a trash pump to pump water from ASB Treatment System Pond 3 or 4 into the biocells. The discharge hose connected to the trash pump was fitted with an injection spout and the flow directed downward into the biocell in an attempt to dislodge sludge accumulated on the rock media. The process was repeated so that all six flush loops of each biocell were flushed at least once. The system was allowed to stabilize for one or two days between each biocell flushing event. Biocells 1 and 2 were flushed during June and July, 2010.

Sludge accumulation in the biocell influent and effluent lines was flushed by injecting water from ASB Treatment System Pond 3 or Pond 4 through each line. A pressure gauge was installed on the flushing assembly to prevent over-pressurizing the influent line piping. Sludge generated from biocell and line flushing was collected in Pond 4.

Sludge Removal and Dewatering – During 2010, centrifuge technology was selected for sludge dewatering based on the effectiveness and relative cost savings of the centrifuge results from 2009 compared to the filter belt press technology implemented in 2007 and 2008. Sludge was pumped from Pond 3 to the storage tanks via the sludge pipeline installed in 2008 and 2009, and extended in 2010. As described in Amendment #1-2010 ASB Sludge Management, 2010 RAWP (Atlantic Richfield, 2010h) the pipeline was extended to allow sludge delivery to the sludge processing area which was relocated due to geotechnical concerns for the previous location. Sludge storage tanks were utilized to allow controlled delivery of sludge from the storage tanks to the centrifuge. The centrifuge sludge removal layout is shown on Figure 8. The layout includes:

- Two 18,000-gallon storage tanks, each equipped with mixing devices, to store sludge prior to processing it through the centrifuge;
- A 20,000-gallon storage tank used to provide polymer make-up water prior to centrifugation;
- A 20,000-gallon weir tank to collect processed filtrate water from the centrifuge, settle solids, and provide water to the polymer make-up tank; and
- The mobile centrifuge.

The mobile centrifuge was provided and operated by Clearwater Compliance, Inc. of Loomis, California. The storage tanks and the centrifuge were mobilized to the site during the week of August 30, 2010. Each of the tanks, the centrifuge, and the inter-tank conveyance pipelines were placed inside spill guards and were connected via valve manifolds. To ensure the equipment was clean and free of leaks, the conveyance, storage, and centrifuge systems were inspected and tested prior to pumping any sludge.

Sludge dewatering activities began on September 9, 2010 by pumping sludge from Pond 3 to the two 20,000-gallons storage tanks. The centrifuge began dewatering sludge on September 10, 2010. The centrifuge operation continued through September 30 at an average flow rate of 12,500 gallons per day (gpd) and a maximum flow rate of 26,700 gpd. A total of approximately 138,000 gallons of sludge were removed and dewatered from the ASB Treatment System in 2010.

Discharge and Monitoring of Filtrate Water – During centrifuge operation, filtrate water was discharged from the settling tank either directly to Aspen Creek, or to Pond 3 or Pond 4 of the ASB Treatment System depending on filtrate water quality. Filtrate water quality was evaluated on a daily basis to determine the appropriate discharge location, as presented in Amendment #1 – 2010 ASB Sludge Management, RAWP (Atlantic Richfield, 2010h). Filtrate meeting discharge criteria was discharged directly to Aspen Creek. Filtrate not meeting discharge requirements was returned to the ASB Treatment System for further treatment. In order to ensure compliance with the ASB Treatment System discharge criteria, the pH of the discharge water was maintained between 7.2 and 9.0. This operational goal was set based on a review of historical data that shows a very good correlation between pH and dissolved metals concentrations as described in the *Technical Memorandum – Aspen Seep Bioreactor Sludge Removal*, September 6, 2007 (Atlantic Richfield, 2007). An effluent with a pH above 7.2 has been demonstrated to typically correlate to primary metals (iron, copper, nickel, and zinc) concentrations below the ASB Treatment System discharge criteria. Additionally, field determination of iron concentration (by colorimetric HACH iron test kit) provides a direct measurement of iron concentration. Prior to discharge of water directly to Aspen Creek, dissolved iron concentrations were confirmed to be less than 1.0 mg/L.

After sludge dewatering and filtrate water discharge was completed, the storage tanks were cleaned with water. The rinsate water generated during cleaning was collected in the settling tank and discharged to Pond 4 in accordance with the protocol for the filtrate water discharge. Cleaning and demobilization of equipment was completed on October 13, 2010.

Disposal of Sludge Solids – During the dewatering process, sludge filter cake was placed in roll-off type bins for subsequent characterization, profiling and off-site disposal under manifest. Details on sludge disposal are presented in Section 4.4.2.2.

4.4 MATERIALS DISPOSED OF OFF-SITE

This section documents the materials disposed of off-site during 2010. A summary of 2010 waste manifests is presented in Table 6. Copies of the 2010 Waste Disposal Notification letters[4], waste profiles, and waste manifests are provided in Appendix B.

4.4.1 HDS Treatment System Sludge Treatment Generated Solids

As discussed in Section 4.2.3.4, the HDS Treatment System generates sludge as part of the treatment process. Sludge was pumped into roll-off dewatering bins lined with non-woven fabric filter bin liners. The roll-off dewatering bins were provided by Environmental International Inc. (ENV) of Richmond, California. Only five of six, 25-cy roll-off bins delivered by ENV were used for containerizing sludge from the 2010 HDS Treatment System operations. Each bin contained approximately 9 to 12 tons of sludge. Five bins totaling 53 tons of sludge were collected. Dewatered HDS Treatment System solids had an average of 55 percent moisture content by weight. This equated to approximately 24 tons of dry solids.

Waste characterizations samples of the sludge were collected on July 13 and October 19, 2010 (the analytical testing results are presented in Section 6.1.5). The waste was profiled by ENV and transported by ENV to US Ecology in Beatty, Nevada, for disposal.

4.4.2 Aspen Seep Bioreactor Treatment Generated Solids

As discussed in Section 4.3.5.1 and 4.3.5.2, the ASB Treatment System generates sludge as part of the treatment process. Two methods (SDB Pilot Test and Mobile Centrifuge) were used to dewater and remove sludge in 2010. The following two subsections describe the process for disposing of the sludge off-Site.

4.4.2.1 SDB Pilot Test

The two 25-cy roll-off bins used for the SDB Pilot Test were sampled for waste characterization on April 26, 2010 and the waste was profiled by ENV. A minimal amount of sludge resulting from the SDB pilot test was disposed of along with the non-woven geotextile, High-Density Polyethylene (HDPE) liners, gravel, and sand used for filtering and decanting water. On July 28, 2010, the two bins were transported under a non-hazardous waste manifest to US Ecology in Beatty, Nevada, for disposal. More details regarding the SDB pilot test are described in the October 19, 2010, letter *Summary of the Phase I SDB Pilot Test* (Atlantic Richfield, 2010l), presented in Appendix G.

[4] Waste Disposal Notification: “Miscellaneous Waste” (July 16, 2010); “ASB Treatment Solids” (July 23, 2010); “Lime Treatment Solids: (August 5, 2010) “Miscellaneous Waste” (August 27, 2010); “ASB Treatment Solids” (October 1, 2010); “Lime Treatment Solids” (October 26, 2010); “Miscellaneous Waste” (November 8, 2010); “Lime Treatment Solids” (November 16, 2010).

4.4.2.2 Centrifuge Operation

Approximately 138,000 gallons of sludge were dewatered during 2010 by the mobile centrifuge operation. Ten, 18-cy roll-off style bins were used to contain dewatered sludge. The ASB Treatment System and centrifuge processes have not been significantly modified since samples of the sludge waste material were collected in August 2009. Therefore, Atlantic Richfield's waste management contractor, ENV, and the U.S. Ecology disposal facility classified the 2010 ASB Treatment System sludge to have the same characteristics as the ASB Treatment System sludge evaluated in 2009 as presented in the October 1 2010, Waste Material Off-site Shipment Notification Letter (Appendix B). A total of 95 tons of sludge was transported off site. Dewatered ASB Treatment System solids had an average of 83 percent moisture content by weight; consequently, the mass of dry solids was approximately 16 tons. The bins were removed from the site by ENV on July 29, October 11, and October 13, 2010 and transported to US Ecology in Beatty, Nevada, for disposal.

4.4.3 Miscellaneous Material from 2010 and Previous Field Seasons

As part of the site HSSE goals and commitments discussed in Section 1.3, one of Atlantic Richfield's priorities is to maintain proper disposal of waste materials generated during site operations as well as to remove and dispose of miscellaneous material used during previous field seasons and that are no longer in use at the HDS or ASB Treatment Systems. This required sampling, profiling, and containerizing waste materials that was either generated in 2010 or had been stored on site prior to the 2010 field season, including:

- Used oil;
- Sampling wastes (spent pH buffer solution iron reagent waste);
- Personal protective equipment (PPE), rags, and debris;
- Lead batteries used at the ASB Treatment System;
- Maintenance wastes (aerosols, flammables, spent florescent light bulbs etc.);
- Lime, iron precipitate, and sediment from cleaning the Pond 4 LTS tanks and CUD conveyance;
- Rinse water containing oil from cleaning the clarifier in the HDS Treatment Plant; and,
- Rinse water from cleaning the tanks used during the centrifuge operations.

Used oil was sent for recycling by Syblon Reid Contractors (SRC) of Folsom, California (Atlantic Richfield's construction contractor). Profiling of all other waste was performed by ENV and with the exception of the rinse water from cleaning the tanks used during the centrifuge operation, (which were disposed of at Instrat, Inc. in Rio Vista, California) all other miscellaneous material was transported and removed from the site by ENV to US Ecology in Beatty, Nevada, for disposal. Details on waste descriptions, classifications, quantities, and dates removed from the Site for the miscellaneous materials are listed in Table 6.

5.0 2010 PERFORMANCE MONITORING ACTIVITIES

Treatment performance was monitored throughout the 2010 operation of the HDS and ASB Treatment Systems. The DQOs and sampling activities are described in the following sections.

5.1 DATA QUALITY OBJECTIVES

Determination of treatment effectiveness requires that sufficient data of appropriate quality is gathered and evaluated. DQOs for the 2010 treatment activities were established to ensure that the data collected was of sufficient quantity and quality for the intended use of the data. The specific DQO’s are presented in Appendix C to the 2010 RAWP (Atlantic Richfield, 2010d). In summary, data collected during 2010 to support water treatment activities for the HDS and ASB Treatment Systems were used to:

- Evaluate the effectiveness, reliability and costs of certain collection and treatment techniques for interim water treatment while RI/FS investigations and final remedy selection proceeds;
- Evaluate the safety and reliability of the treatment systems for treating CUD, DS, and AS flows;
- Evaluate the effectiveness of the HDS Treatment System for removing constituents of concern from waters collected at the CUD and DS;
- Assess the contingencies that must be considered during system upsets;
- Assess system enhancements that are necessary to consistently and continuously discharge treated waters to Leviathan Creek and Aspen Creek;
- Verify that treatment systems’ effluent meets established discharge criteria;
- Evaluate the chemical and physical characteristics and quantity of ASB Treatment System generated sludge as appropriate for assessing disposal options; and
- Evaluate the chemical and physical characteristics and quantity of solids generated by water treatment of CUD and DS flows.

5.2 SAMPLING AND ANALYSIS

The monitoring program implemented for the 2010 water treatment activities was designed to meet the objectives listed in Section 5.1 and was described in the Sampling and Analysis Plan (SAP) included in the 2010 RAWP and the 2010 RAWP Quality Assurance Project Plan (QAPP) (Atlantic Richfield, 2010d) and designed to provide sufficient data to meet these DQOs.

The following sections detail the sampling and analysis program employed at the site for 2010.

5.2.1 Sampling Location, Schedule, and Parameters

As detailed in the 2010 RAWP, water samples were collected for laboratory analysis at sample stations relevant to determining treatment technology effectiveness and reliability, as well as discharge compliance. In addition, field monitoring data was collected at additional treatment process locations to evaluate the treatment system performance and make system adjustments as necessary.

Treatment-generated sludge samples were collected for laboratory analysis to determine waste characterization and profiling for disposal on an as-needed basis from the various solids collection areas. Additionally, ASB Treatment System sludge samples were collected and analyzed to determine physical and chemical properties as part of the SDB pilot test.

The 2010 HDS Treatment System and ASB Treatment System sampling and analysis schedule is presented in Table 7. This table includes sample locations, frequencies, and analytical parameters for samples collected in 2010. The 2010 HDS and ASB Treatment System summary of laboratory analytical methods for aqueous- and solid-phase parameters is presented in Table 8. Station locations and frequency of sampling and parameters are described in Sections 5.2.1.1 through 5.2.1.2.

5.2.1.1 HDS Treatment System Monitoring Locations and Frequency

During operation of the HDS Treatment System, laboratory samples and field parameter measurements were collected at the pre-designated sampling locations illustrated on Figures 3 and 4. The existing influent sampling location is at the Pond 4 intake pump sampling port prior to entering the HDS Treatment Plant. The effluent samples are collected from an in-line sample port on the effluent tank recirculation line prior to treated water discharge to Leviathan Creek.

During system startup, monitoring of field parameters including iron and pH measurements was performed daily. In addition to field parameters, analytical compliance samples were collected on the following schedule:

- For the first four weeks (May 17 through June 11), analytical compliance sampling was conducted once per week for HDS effluent and sampled once in May and once in June for CUD, DS, and HDS influent.
- Thereafter, analytical compliance sampling was conducted one time per month as described in Table 7.

As detailed in the 2010 RAWP, surrogate field parameters coupled with periodic confirmation sampling for laboratory analysis were used to assess that the HDS Treatment System effluent met the discharge criteria. Surrogate field parameters consist of pH and field measured iron concentration. Based on accumulated site data related to treatment of CUD and DS waters with lime, treated water with a pH above 7.2 results in effluent that meets discharge criteria with respect to metals concentrations. Additionally, the field measurement dissolved iron (measured as the total of Fe^{2+} plus Fe^{3+} species) with a HACH Company field sampling kit provides a direct measurement of discharge compliance with respect to iron. Field measured dissolved iron of 1.0 mg/L or less, and an effluent pH operating range of 7.5 to 8.5 was selected to provide a conservative surrogate parameter range for discharge compliance.

The suitability of water quality for discharge from the HDS Treatment Plant was electronically monitored and controlled by in-line pH probes in the reactor and effluent tanks. These measurements were confirmed as part of daily operations by the manual collection and measurement of pH and iron concentration. Information gathered from in-line monitoring also served as indicators of changes in treated water quality between field measurements and laboratory sample collection. Field and system monitoring provided sufficient safeguards against discharging treated water that was outside of the discharge criteria listed in the MRAM (Table 1 and Table 2).

5.2.1.2 ASB Treatment System Monitoring Locations and Frequency

During operation of the ASB Treatment System laboratory sampled and field parameter measurements were collected at the pre-designated sampling locations illustrated on Figures 5 and 6. ASB Treatment System influent samples for laboratory analysis were collected at the USGS weir box prior to the treatment system. Effluent samples for laboratory analysis were collected at the end of the aeration channel when possible. During periods when snow inhibited access to the end of the aeration channel, ASB Treatment System effluent samples were collected either at the northern edge of the ASB Treatment System Pond 4, just prior to the outfall, or at the Pond 4 discharge to the aeration channel at the head of the aeration channel. Sample collection for laboratory analysis was conducted once a month during the LAS and twice a month during the ARWS.

Field monitoring of water quality parameters was conducted at the influent and effluent stations, as well as at the manholes located throughout the ASB Treatment System. Water-quality field parameters were collected at manhole locations to assess the process conditions of the system (Figure 5). During the LAS, monitoring of field parameters was conducted at the same time as sample collection for laboratory analysis. During the ARWS, monitoring of field parameters was conducted with additional frequency (once a week) during normal ASB Treatment System operations.

In addition to the routine monitoring locations, supplemental monitoring of field parameters (pH, conductivity, temperature, dissolved oxygen (DO), and colorimetric field measurements for dissolved iron) was conducted during discharge of filtrate water from the centrifuge dewatering operations. Sludge filtrate field parameters were collected once daily, at a minimum. Field parameters were collected daily at the centrifuge settling tank and at the ASB Treatment System discharge point on days when filtrate water was discharged to Pond 3. The filtrate discharge location was determined daily based on the filtrate water quality, as described in Amendment #1 - 2010 ASB Sludge Management, 2010 RAWP (Atlantic Richfield, 2010h).

During sludge dewatering operations when filtrate water was being discharged to Aspen Creek or ASB Treatment System Pond 4, sampling for laboratory analysis was conducted weekly at the appropriate discharge location. At the completion of sludge dewatering operations, the sampling frequency was returned to twice monthly for the remainder of the ARWS.

Four enhanced sampling events were conducted at the ASB Treatment System. Samples were collected from the various manholes and analyzed for nitrate, nitrite, nitrate/nitrate-N, total kjeldahl nitrogen (TKN), ammonia, phosphorous, DOC, sulfide, ethanol, and acetate. General parameters (Table 8) were collected concurrently with collection of enhanced samples.

5.2.2 Sampling Procedures

Sampling procedures for the HDS and ASB Treatment Systems are described in Standard Operating Procedures (SOPs) contained in the respective system O&M manuals (AMEC, 2010a; AMEC, 2010b), and the 2010 RAWP QAPP (Atlantic Richfield, 2010d). These documents were followed as guidance when obtaining field measurements and collecting samples for laboratory analysis. A brief description of the sample and data collection procedures follows.

5.2.2.1 Flow Data

CUD and AS influent flow are measured and recorded on a continual year round basis by the USGS-operated V-notch weir box and data collection system installed at each location. The level in Pond 4 is also measured and recorded by a USGS-operated stage gauge. The USGS monitors these locations under contract to the LRWQCB and is responsible for all monitoring procedures and quality assurance/quality control (QA/QC) of data generated from these flow measuring systems. Both provisional and final data from each location is provided to Atlantic Richfield periodically throughout the year. Flow data provided by the USGS as final is uploaded to the project database.

Throughout 2010, during operation of the CUD and DS collection and conveyance equipment, magnetic flow totalizers were used to monitor total volume and instantaneous pump flow rates for the collected CUD and DS flows.

During operation of the HDS Treatment System, the volume of untreated water pumped from Pond 4 into the HDS Treatment Plant was measured by a magnetic flow totalizer. Three additional magnetic flow totalizers are installed underneath the clarifier tank; two for measurement of flow from the sludge recycle pumps and one for measurement of flow from the sludge waste pumps to provide operational process monitoring.

At the ASB Treatment System, magnetic flow totalizers were used to measure bioreactor effluent flow and recirculation flow. Data from the magnetic flow totalizers is logged and stored by the systems PLC and transmitted daily to an offsite FTP site via a telemetry system. In addition, system flow rates are manually recorded during field monitoring events. Influent flow at the weir box was measured using a graduated bucket and timer at least once per month to obtain real time flow data for use in adjusting chemical feed dose rates. The USGS data provides a more complete set of daily flow readings and are the data relied upon for this report.[5]

5.2.2.2 Water Quality Measurements and Sampling Procedures

Where possible, water quality field measurements were conducted in-situ using a field probe and meter capable of measuring pH, DO, temperature, conductivity, and oxidation reduction potential (ORP). These parameters were recorded on field measurement data sheets which are provided in Appendix C. The field meter was calibrated at least once per sampling event, and the probe was decontaminated between each sample location. At locations where in-situ measurement was not possible due to inaccessibility or health and safety hazards, a HDPE container was used to collect grab samples from which field measurements were measured and recorded. The HDPE container was triple-rinsed with sample water prior to the collection of each grab sample.

Field measurements for iron speciation/concentration were made using a Hach™ colorimetric test kit and Hach™ spectrophotometer. Hach™ vials for measurement of field iron were reused; however, each vial was decontaminated prior to each use.

Sample containers with appropriate preservatives for each analysis were provided by the contract laboratory. Samples for laboratory analysis were collected directly into the laboratory-provided containers if no preservative was required. For samples requiring preservation,

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[5] At the time of this Annual Report, USGS has only provided provisional CUD and AS flow data for 2010.

samples were collected in either disposable HDPE containers or disposable bailers and transferred to the preserved bottles.

Sample aliquots requiring field filtering were collected in clean HDPE containers and filtered through disposable 0.45-micron filters directly into the laboratory-provided containers. A peristaltic pump was used to pump the samples through the filters. New filters and pump tubing were used for each sample.

HDS Treatment System treated water discharge samples were collected as composite samples, each composed of three time-separate grab samples collected within one day. Each grab sample was preserved and filtered as appropriate immediately after collection. All other water samples were collected as discrete grab samples.

5.2.2.3 Sludge Sampling Procedures

Sludge samples associated with the HDS and ASB Treatment System operations were collected from the roll-off containers that were used to collect solids for off-site disposal. Sludge grab samples were collected using a decontaminated stainless steel trowel, and placed directly into unpreserved laboratory supplied 8-ounce glass jars. Three sludge samples were collected from each roll-off bin and composited by the analytical laboratory prior to analysis. Sample jar lids were tightened to ensure that no change occurred to sample moisture content during shipping.

Direct collection of sludge from the ASB Treatment System ponds was done with HDPE containers attached to poles for extended access to the ponds, or via a sludge collection tool, and then transferred into the laboratory-provided glass jars.

For disposal purposes, sludge samples were analyzed for the solid-phase parameters outlined in Title 26 of the California Code of Regulations (CCR) and Code of Federal Regulations (C.F.R.) including:

- Total threshold limit concentration (TTLC);
- Soluble threshold limit concentration (STLC);
- Toxicity characteristic leaching procedure (TCLP); and
- Synthetic precipitation leaching procedure (SPLP).

These parameters are also listed in Table 8.

5.2.3 Sample Identification

Collected samples were immediately labeled with all required information using self-adhesive labels and waterproof ink. Sample labels included the following information:

- Project name;
- Site location;
- Sample identification code (see following explanation);
- Date and time of sample collection, with sampler's initials;
- Analysis required;
- Method of preservation, if used; and
- Sample matrix.

Each sample was assigned a unique identification code according to the sample location and sampling sequence. The three parts of the sample identification code are (1) the sampling event sequence number, (2) the station designation, and (3) the sample sequence number (continuous for all stations within a treatment area) as outlined in the QAPP and treatment system specific SOP's. The sequence numbers are continued from year to year to eliminate the possibility of duplicate sample identifications. The sample identification code is recorded without space or symbols separating the three components.

The sample station designations generally follow the convention historically used at the site, with minor modifications to increase clarity. The following station designations were used:

- CUD – untreated water from the CUD;
- DS – untreated water from the DS;
- HDSINF – untreated water from Pond 4 (influent equalization basin), as it flows into the HDS Treatment Plant;
- HDSEFF – water from the HDS Treatment Plant, as it flows through the recirculation line on the effluent tank;
- ASPINF – untreated water from the AS, as it flows into the ASB;
- ASPEFF – effluent from the ASB Treatment System;
- HDSSLUDGE – sludge generated in the Pond 4 HDS Treatment Plant;

- ASPSLG – sludge generated in the ASB;
- ASPMH# – manhole locations where process samples are collected within the ASB (# symbol is replaced by the actual manhole number); and
- ASPP3 or ASPP4 — samples collected in Ponds 3 or 4 of the ASB.

Additional sludge sample station designations were used to indicate samples collected from specific treatment process locations or a specific roll-off container. The designations aid in sample source identification and waste characterization profiling.

5.2.4 Laboratory Analytical Program

During 2010, treatment-related samples, including sludge, were sent to TestAmerica Laboratories, Inc. in Irvine, California (TestAmerica), for laboratory analysis. The only exceptions were:

- Sludge samples from the pilot scale SDB test collected for specialty analysis; and
- Sludge samples from the HDS Treatment System collected for density analysis.

These samples were either delivered by field personnel to Sierra Environmental monitoring, Inc. (SEM) in Reno, Nevada or shipped to ACZ Laboratories, Inc. (ACZ), in Steamboat Springs, Colorado.

5.2.5 Sample Collection & Quality Assurance/Quality Control

Upon collection, samples were labeled, logged on the chain-of-custody form (COC), and kept in ice-chilled coolers until they were delivered to the analytical laboratory. Sample labeling and COC procedures were adhered to during sampling events to ensure the credibility and acceptability of analytical results. Samples remained in the custody of the field personnel until they were either transferred following COC protocol to a certified carrier for transport to TestAmerica, ACZ laboratories or directly transferred to SEM. COCs were signed by each sample custodian. Samples were typically shipped within 48 hours of sample collection. All samples were analyzed within the acceptable hold times for analytes related to site discharge criteria.

AMEC performed data verification on all laboratory analytical data. In addition, 20 percent of the data was validated by a third party, Environmental Standards, Inc. (ESI), of Valley Forge, Pennsylvania[6]. Level 4 data packages were prepared by the contract laboratory, upon request. All laboratory data from TestAmerica with appropriate qualifiers was entered into the site

[6] Samples analyzed by SEM and ACZ were not externally validated by ESI.

database. In addition, field monitoring parameters for the treatment process stations have been added to the database to allow greater utility in evaluating process optimization and reliability.

Procedures for QA and QC are specified in the 2010 RAWP QAPP (Atlantic Richfield, 2010d). The QAPP was prepared in general accordance with the guidance provided in U.S. EPA QA/G-5, *U.S. EPA Guidance for Quality Assurance Project Plans* (U.S. EPA, 1998, 2002) and U.S. EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans* (U.S. EPA, 2001).

The QA/QC program consists of field and laboratory QA measures, testing of QC samples for both the field and laboratory, and data validation. A summary of the QA/QC measures for 2010 is provided below for each element of the QA/QC program. The results of the QA/QC samples are presented in Section 6.3.

5.2.5.1 Quality Assurance Measures

Field QA/QC consisted of using skilled personnel for monitoring and sampling, operating and maintaining field devices in accordance with specifications provided by the manufacturer, using standard field forms, and adhering to protocols required by the SAP and the QAPP. The need for decontamination in the field was eliminated for water sample collection for laboratory analysis by sampling directly into the sampling container, or by using disposable equipment.

TestAmerica, SEM, and ACZ are certified by the California Environmental Laboratory Accreditation Program (ELAP). TestAmerica and ACZ are also certified by the National Environmental Laboratory Accreditation Program (NELAP). All three laboratories have extensive SOPs, QA guidelines, and periodic laboratory-wide quality testing.

5.2.5.2 Quality Control Testing

Field QC samples consisted of the collection of field duplicates and field method blanks. As mentioned above, equipment rinse blank samples were not required, as disposable sampling equipment was used. The purpose of field duplicate samples was to test the precision of field sampling procedures. The purpose of field method blanks was to test whether field sampling procedures added any target analytes to the samples. In conformance with the SAP, the numbers of both types of field QC samples were at least 10 percent of the number of specified samples. Field QC samples were labeled with sample station IDs (i.e., CUD, DS, HDSEFF, and ASPEFF) within the normal sampling event sequence in order to mask the identity of QC samples for the laboratory.

Laboratory QC samples were used primarily to determine if adjustments were needed to analytical equipment or procedures during analysis to obtain usable results, and secondarily, to test the quality of the final data set produced through standard QA practices and adjustments. The following laboratory QC samples were analyzed for this study:

- Method blank;
- Laboratory control sample;
- Matrix spike and matrix spike duplicate (MS/MSD); and
- Laboratory duplicate.

TestAmerica provided the results for all of the above QC samples with their laboratory reports.

6.0 2010 PERFORMANCE MONITORING RESULTS

Results from treatment system sampling and analysis were used in conjunction with operations monitoring to evaluate the HDS and ASB Treatment Systems for their effectiveness and reliability. The following sections describe the volume of treated water, compliance monitoring results, system performance, and waste stream characterization for the HDS and ASB Treatment Systems. Treatment system data tables are presented in Appendix D. Laboratory data reports and COC forms are included in Appendix E.

6.1 HDS TREATMENT SYSTEM

6.1.1 Treated Volume and Flow Rates

During the 2010 treatment season, approximately 11.0 million gallons of water were treated and discharged by the HDS Treatment Plant including: approximately 7.43 million gallons of CUD water, approximately 3.17 million gallons of DS water, and approximately 431,000 gallons of existing Pond 4 water. Table 4 presents the monthly volume of water collected at the CUD and DS which is based on totalizing flow meters on each of the respective conveyance lines that only operate during the time water is being collected for treatment. Table 4 also presents the average flow rates of the CUD (17.2 to 34.8 gpm) and DS (9.6 to 14.5 gpm) which were calculated from totalizing flow meter data. For comparison purposes, the CUD flow data as measured by the USGS weir box is also included in Table 4.

A summary of 2010 HDS Treatment System discharge events is summarized in Table 9. Treated water was discharged directly to the channelized portion of Leviathan Creek. The discrepancy between the total volume collected/treated (Table 4) and the total volume discharged (Table 9) is likely due to evaporation in Pond 4.

6.1.2 Compliance Monitoring

In 2010, effluent compliance samples and field surrogate parameters indicate that discharges of treated water from the HDS Treatment Plant did not exceed the MRAM discharge criteria. Direct discharge from the HDS Treatment System occurred only if the pH was between 7.5 and 9.0 and dissolved iron concentration was below 1.0 mg/L. During discharge, field surrogate parameters were collected daily for field monitoring of pH and dissolved iron. When treated water did not meet pH or dissolved iron discharge criteria, discharge to Leviathan Creek ceased, and effluent water was diverted to Pond 4. Influent from Pond 4 would continue to be pumped into the HDS Treatment Plant, treated, and discharged back to Pond 4 until the surrogate field parameters were measured to be within the discharge criteria. System upsets requiring the diversion of HDS Treatment Plant effluent to Pond 4 are described below in Section 6.1.3.

HDS Treatment Plant effluent, influent, CUD, and DS samples for laboratory analysis were collected per the schedule described in Section 5.2.1.1. Results from samples were included in the monthly progress reports to the U.S. EPA (Appendix A) and are also included in Appendices D and E. A summary of 2010 minimum, maximum, and average constituent concentrations for CUD and DS influent and HDS Treatment System influent and effluent compared to MRAM discharge criteria is presented in Tables 1 and 2 respectively.

6.1.3 System Performance

During 2010, the HDS Treatment System was effective at treating impacted CUD and DS water to below discharge criteria. The following list summarizes the system mechanical conditions that affected HDS Treatment System operations during 2010:

- On May 28, 2010, a brief (approximate 2 minute) collection interruption at the CUD was observed. Upon inspection by operators, the pump was removed and electrical tests were conducted after which water intrusion was observed inside the pump motor. Normal operations resumed using the lead pump while the secondary pump was replaced.
- On July 6, and July 10, 2010, a mechanical breakdown of lime feed equipment occurred causing temporary interruptions of treated water discharge from the HDS Treatment Plant to Leviathan Creek and a temporary change in the operations. A contingency plan was enacted to allow operation of the HDS Treatment Plant during the time when operators were present on site. Intermittent plant operations continued from July 13 to July 22, 2010 after which a normal 24-hour plant operation resumed.
- On July 30, 2010, the Uninterruptible Power Supply (UPS) located in the Local Control Panel (LCP) in the HDS building began malfunctioning causing a temporary interruption of treated water discharge. The UPS was replaced, and normal plant operations resumed on August 3, 2010.
- On August 7, 10, and 12, 2010, a sudden increase in effluent turbidity was observed. The increase in turbidity caused an interruption of treated water discharge which was related to a clogged sludge recycle pipeline. During these events, the HDS Treatment Plant was placed in Standby Mode while the system was flushed. Once the condition was corrected the HDS Treatment Plant was restarted.
- On September 22, 2010, the HDS Treatment Plant was placed in recycle mode due to a high pH condition in the effluent tank. Once the system water quality parameters stabilized, an effluent sample was collected, compliance with discharge criteria was confirmed, and the system was returned to normal operation, and discharge resumed.

- Between October 12 and 13, 2010, a malfunctioning pH probe caused a temporary interruption in treated water discharge. The pH probe was replaced and the system was returned to normal operations.

With the exception of the May 28, 2010 interruption, the collection of the CUD and DS was maintained and no discharge of untreated water to Leviathan Creek occurred during any of the above HDS Treatment System interruptions.

6.1.4 Lime Utilization

The HDS Treatment Plant utilized approximately 27 tons of hydrated dry lime to treat an estimated 11.0 million gallons of water in 2010. This equates to an estimated lime utilization rate of 588 milligrams (mg) of lime per liter of water treated.

6.1.5 Treatment Generated Solids

Solids generated in the HDS Treatment Plant were sampled and analyzed for regulated metals for disposal purposes. Disposal of the sludge is discussed in Section 4.4.1. Results of the sludge analysis from the HDS Treatment System are presented in Appendix B.

The analytical results for HDS Treatment Plant sludge for the regulated metal constituents were below published CFR criteria for the TCLP and below CCR criteria for the TTLC, but were above the CCR for nickel in the STLC. Therefore, the waste was classified as a non-RCRA California Hazardous waste solid. Sludge was also tested using the SPLP to assess the leaching potential of the metals from the solids if stored on site in the future. In addition to extraction and analysis of metals, the pH and moisture content of the solids were also measured. The pH of the solids was within the appropriate range for a non-hazardous waste by RCRA[7] and California[8] regulations. As shown in Appendix B, sample measurement indicated 41 and 61 percent soil moisture (59 and 39 percent solids) by weight.

6.2 ASPEN SEEP BIOREACTOR

6.2.1 Treated Volume and Flow Rates

Approximately 3.8 million gallons of AS flow were collected and treated by the ASB Treatment System during 2010. Flow from the AS to the ASB Treatment System is measured on a continuous basis by a USGS-operated V-notch weir box and data collection system. Influent flow rates ranged from 4.8 to 9.8 gpm during 2010. The highest average monthly flows occurred in May and June, while the lowest average flows occurred in January, February, and

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[7] C.F.R., Title 40, Parts 239–282.
[8] CCR, Title 22, §66261.22.

December. A monthly summary of ASB Treatment System influent flow and treated volume is presented in Table 5.

6.2.2 Compliance Monitoring

The ASB Treatment System effluent constituent concentrations exceeded the MRAM discharge criteria for the site in 6 of the 18 sampling events. The 2010 sampling events with exceedances are listed below.

- Dissolved iron exceeded the maximum daily criteria value of 2.0 mg/L in 5 of the sampling events (January 14, April 26, September 16 and 30, and December 7).
- On the February 2 sampling event, dissolved iron exceeded the average criteria value but not the maximum daily criteria value.
- Dissolved nickel was reported above the average criteria value during the January 14 and the December 7 sampling events.
- Dissolved aluminum equaled and copper exceeded the maximum discharge criteria during the September 30 sampling event.
- Dissolved zinc exceeded the maximum and average discharge criteria during the April 26 sampling event[9];

The U.S. EPA was notified of the above exceedances within the monthly progress reports (Appendix A). A summary of 2010 minimum, maximum, and average constituent concentrations for AS influent and ASB Treatment System is presented in Table 3.

6.2.3 Mechanical Performance

The following is a summary of system mechanical issues that limited the performance of the ASB Treatment System in 2010:

- On December 17, 2009, AMEC personnel determined that there was a failed gear drive on one of the sodium hydroxide feed pumps causing a low effluent pH. A backup pump was immediately placed into operation to restore proper sodium hydroxide dosing to the ASB Treatment System. System recovery continued through February, 2010.
- On November 29, 2010, one of the two power inverters and one of the PLC cards failed, causing an immediate loss of power and the shutdown of sodium hydroxide, ethanol, and recirculation pumps. As soon as the inclement weather cleared, AMEC personnel were able to troubleshoot and replace the PLC card and the

[9] The metals analytical data from the April 26, 2010 sampling event was rejected during AMEC's data verification process due to evidence that the influent and effluent samples were switched by the laboratory during analysis.

power inverter on December 7 and 11, 2010, at which time the system was returned to normal operation. During these troubleshooting events, low system pH was observed.

6.2.4 Bioreactor Historical Performance Evaluation and Enhanced Sampling Results

Various enhancements to the chemical feed systems, power supply, and remote monitoring system have been carried out in 2007 through 2010 in order to improve system reliability and performance. The 2010 ASB Treatment System performance activities and indicators are discussed in the following sections.

6.2.4.1 Performance Evaluation

During 2010, Atlantic Richfield reviewed the current performance of the ASB Treatment System with respect to discharge criteria and historic water quality results as part of the continuing ASB Treatment System performance evaluations. Summary water quality data charts and historic sludge removal volumes were compiled and prepared for evaluation. This compilation of the historic data proved useful in evaluating current performance with respect to water quality, sludge generation, and opportunities for future system optimization to continue to enhance performance and reliable operation of the ASB Treatment System. The 2010 Performance Evaluation was reviewed and discussed with the U.S. EPA in a conference call on February 14, 2011. Copies of the 2010 ASB Treatment System performance review slide presentation (including enhanced sample results) presented during the conference call are provided in Appendix F.

A review of metals data with respect to discharge criteria indicates that performance reliability is highly dependent on system mechanical reliability, especially the reliability of the sodium hydroxide dosing pumps. Reported concentrations of dissolved iron in effluent waters have fluctuated significantly in the historical data record. Many of the higher reported iron values in effluent waters correlate with system upsets, including disruption in chemical feeds, and during high influent flow periods indicating that iron removal is sensitive to system perturbations.

During 2010, mechanical reliability was good with the exception of the December 2009 and November 2010 events described in Section 6.2.3. However, mechanical failures were observed to have significant system performance repercussions when they occurred during the LAS. During this time, the rate of failure resolution is highly dependent on opportunities for site access, which are limited. This was demonstrated by the December 2009 sodium hydroxide pump failure that contributed to elevated effluent iron and nickel concentrations continuing through February 2010. In addition to maintaining system mechanical operations, implementing appropriate system setpoints for varying influent conditions is difficult with low frequency site visits (site visits are typically performed on a monthly basis during the LAS).

Sulfate removal is used to estimate concentrations of sulfide available to precipitate influent dissolved metals in the ASB Treatment System. 2010 Sulfate removal in 2010 was similar to that observed from 2003 to 2005 and in 2008, as presented in the ASB Treatment System 2010 Performance Review (Appendix F). During 2010, the amount of sulfate removed typically exceeded the approximate 190 mg/L of sulfate conversion required to produce sufficient sulfide for precipitation of influent dissolved metals as metal sulfides.

The ORP values reported for biocell effluents ranged between -19 and -403 millivolts (mV) indicating slightly reducing to strongly reducing conditions. The 2010 average ORP value was 278 mV, which is an appropriate environment for biological sulfate reduction. The biological reduction of sulfate is confirmed via ORP measurements and sulfate removal data.

6.2.4.2 Calculated Sludge Generation

The annual generation of dry sludge solids by mass was estimated by assuming total iron, nickel, copper, and zinc removed by treatment were precipitated as metal sulfides, total aluminum was precipitated as an aluminum hydroxide, and total calcium was removed as calcite. These assumptions are for ideal ASB Treatment System performance; in reality, there may be multiple other minerals which are produced and incorporated into sludge solids. Further evaluation is required to determine the relative amounts of various minerals present in the sludge.

During 2010, sludge accumulation due to biomass was also estimated based on total organic carbon data from the ASB Treatment System sludge. Prior to 2007, it is estimated that annual sludge generation outpaced annual sludge removal. Lower influent AS flows and therefore lower metals loading and sludge generation were experienced in 2007 through 2010 compared to 2004 through 2006, allowing more recent sludge removal efforts to reduce the total volume of sludge that had accumulated in past years.

6.2.4.3 Nitrogen and Phosphorus Concentrations

During 2010, the addition of urea and sodium mono-phosphate nutrients was continued on a monthly basis. Urea provided a nitrogen source and sodium mono-phosphate provided a phosphorus source for bacterial growth. Samples collected during 2010 to evaluate the effects of nutrient addition on bioreactor performance showed that the concentrations of phosphorus remained low throughout the system as compared to target levels. Based on a carbon to nitrogen to phosphorus (C:N:P) ratio of 100:0.5:0.01 recommended for anaerobic bioreactors, (Huss, 1997), and a target ethanol dose rate of 0.5 milliliters per liter (mL/L), the target phosphorus concentration is 0.3 mg/L. In contrast, the maximum concentration of phosphorus was consistently non-detectable at less than 0.04 mg/L. This data suggests that further increases in the dose rate of phosphorus could increase system performance without increasing the mass loading of this nutrient in the bioreactor effluent.

6.2.4.4 Ethanol Dosing Optimization

Optimization of ethanol addition began in 2008 with the goal of reducing the organic carbon load in system effluent while maintaining sufficient excess organic carbon within the system to ensure reliability. Ethanol addition optimization was performed in two steps:

1. A change in the ethanol blend to SDA formula 3a 190 proof (October 2008); and
2. A 50 percent ethanol feed rate reduction (April 2009).

In April 2009, the ethanol dose rate was reduced from 1 milliliter (mL) of ethanol blend per one liter of influent seep to 0.5 mL/L. The current dose rate of 0.5 mL/L (approximately 1.9 mL per gallon of influent AD), provides an average initial DOC concentration of approximately 154 mg/L. A requirement of 0.3 mL ethanol per liter of AS influent was calculated by assuming complete ethanol oxidation and targeted reduction of 500 mg/L sulfate and 10 mg/L DO removal; a safety factor was added for a final target dose rate of 0.5 mL ethanol per liter of influent. Evaluation of the ethanol addition optimizations began in 2008 with the sampling for DOC throughout the system. Continued sampling for DOC during the 2008, 2009, and 2010 seasons has indicated that the spring 2009 reduction in ethanol dose rate has resulted in a reduced effluent DOC concentration.

During the 2010 ARWS, acetate and ethanol analyses were added to the ASB Treatment System SAP to evaluate the respective concentrations that contribute to DOC in the ASB Treatment System and effluent samples. Acetate is an end-product of the incomplete oxidation of ethanol during sulfate reduction. Laboratory results indicate that ethanol introduced to the ASB Treatment System is partially oxidized to form acetate, and acetate may be oxidized to some extent during transport through Ponds 3 and 4. The evidence that ethanol oxidation is incomplete in the biocells (conversion to acetate but no further) indicates that the current ethanol dose rate is providing less excess carbon substrate than previously calculated, and has efficiency limitations as a substrate in this application. However, there has been no indication that the spring 2009 reduction of ethanol dose rate has impacted the system performance negatively, and the system currently demonstrates acceptable overall performance, including sufficient sulfate to sulfide conversion for precipitation of influent dissolved metals.

6.2.4.5 Biocell Reversal

Biocell flow reversal is a method for potentially reducing preferential flow pathways through the biocells, which may enhance biocell performance. The flow direction through Biocell 2 and

Biocell 1 was reversed on May 17 and June 14, 2010, respectively to evaluate the impact on treatment performance. Following the flow reversal of each biocell, water quality parameters were monitored with increased frequency in order to track potential changes in the ASB Treatment System performance.

Following the flow reversals, an overall reduction of the ORP and DO was observed in the influent and effluent of Biocell 1 and Biocell 2, indicating improved conditions for sulfate reduction through both biocells. Additionally, during 2010, key indicators of microbial respiration, sulfide production and ethanol consumption in Biocells 1 and 2 increased following flow reversal, indicating enhanced microbial activity and system performance. These data suggest that flow reversal as a routine O&M activity may help in optimizing treatment system performance.

6.2.5 Treatment Generated Solids

Ten 18-cubic-yard roll-off style bins were used to contain the approximate 95 tons of sludge generated by the centrifuge operations during 2010. Solids dewatered by the mobile centrifuge were sampled for density and percent moisture. Waste characterization and profiling for disposal is only required every two years, thus the 2010 sludge was disposed of using the waste profile results submitted in 2009. Disposal of the sludge and sludge solids content are discussed in Section 4.4.2. The concentrations of regulated metal constituents established for ASB Treatment System sludge in 2009 were below published limits for the TCLP, TTLC, and STLC criteria (AMEC, 2009a).

6.3 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

Per the RAWP 2010, validation of 20 percent of the laboratory data was performed by ESI, and all data was verified by AMEC. The validation was performed in accordance with Section 5.2.5. Data was examined to determine compliance with the requirements specified in the published analytical methods, *National Functional Guidelines for Inorganic Data Review* (U.S. EPA, 1994).

The data quality issues noted by ESI are described in detail in the data QA/QC reports. Appropriate data qualifiers were added to the data in the site database and included in the tabulated data reporting in Appendix D. Any unverified data that was used in progress reporting was accompanied by an indication that the data was provisional. In summary, data was qualified when necessary due to occurrences of the following data quality issues noted for some analytes in some samples by ESI:

- Target analytes detected in field or laboratory blanks;

- Dissolved metals results exceeding total metals results;
- Low or high internal calibration standard recovery;
- Low or high reporting limit standard recovery;
- Low or high laboratory or field duplicate recovery; and,
- Low or high MS/MSD recoveries.

Some metals data were qualified as estimated or rejected where dissolved metals concentrations exceeded total metals concentrations by an unacceptable percentage; this occurrence was more frequent in the impacted seep water samples than in the treated water samples. Target analytes found occasionally in field blanks are suspected to be from the purchased purified water source. This source water is not used in sample preparation and is not expected to negatively impact the concentration of metals in the samples. In cases where analytes were detected in laboratory blanks above the detection limit or reporting limit, the detection or reporting limits were adjusted and sample analyte concentrations were qualified as estimated in some samples. Each QA/QC report describes the number of samples qualified due to applicable data quality concerns. The QA/QC assessment reports produced by ESI are attached as Appendix H and are organized by laboratory work order number.

7.0 2010 SYSTEM IMPROVEMENTS AND CONSTRUCTION ACTIVITIES

This section summarizes the system improvements and construction activities completed in 2010 at the HDS and ASB Treatment Systems and site access roads.

7.1 HDS TREATMENT SYSTEM, CHANNEL UNDERDRAIN, AND DELTA SEEP

During the 2010 LAS and ARWS, Atlantic Richfield performed the following system improvements and construction activities to promote safe reliable operations. Activities completed at the HDS Treatment System and Pond 4 Area included:

- Installation of a data historian for the HDS Treatment System;
- Site trailer power modifications;
- Pond 4 intake pump modifications;
- Access improvements to the DS transfer tank platform;
- Pond 4 LTS cleaning; and
- Pond 4 liner repair.

Each activity is described in further detail in the following subsections.

7.1.1 HDS Treatment System Data Management

On May 6, 2010 Atlantic Richfield installed a historical data acquisition server for the HDS Treatment System. Software and hardware were installed that download data from the existing Human-Machine Interface (HMI), and store the data on an on-site server. The on-site server is mirrored at an off-site server in the AMEC office located in Rancho Cordova, California. This facilitates engineering support and QA personnel reviewing HDS Treatment operations data without requiring remote access to the on-site HMI. The historical data server stores several years of operational data rather than the 60-day data storage that was available through the on-site HMI.

7.1.2 Site Trailer Power Modifications

During the 2009 treatment season, several generator system alarm conditions occurred which impacted the operation of the HDS Treatment System. Based on a review of the 2009 HDS power generation system operations and alarm conditions observed, the critical problem affecting the HDS power generation system appeared to be the large single-phase loads resulting in a voltage imbalance.

To address this issue, in May 2010 Atlantic Richfield reduced the single-phase loads from the site office trailers by replacing the existing 480 V/240–120 V transformer used to power the site office trailers with a 208V three-phase transformer, and replaced the trailer heating/AC units with true three-phase units. In this way, the large heating and AC loads were all three-phase loads and the single-phase trailer loads were limited to wall receptacles and lighting. These changes reduced the alarm conditions significantly during the 2010 LAS and ARWS.

7.1.3 Pond 4 Intake Pump Modifications

During the 2009 ARWS, the Pond 4 intake pumps were evaluated by a manufacturer's representative. To prevent pump damage, it was recommended that the minimum operating flow rate for the pumps was 40 gpm. The pump speed and related flow rate for the Pond 4 intake pumps can be varied, with the pump flow rate typically set to match the combined influent flow rate from the CUD and DS. However, beginning in the late summer, the combined flow rate from the CUD and DS drops below 40 gpm, while the Pond 4 intake pump flow rate is maintained at 40 gpm. Due to the low flow conditions experienced in the late summer the volume of water stored in Pond 4 is slowly reduced until there is not a sufficient amount of water available to operate the HDS Treatment Plant. Therefore, on June 10, 2010, a recirculation line was installed to allow the Pond 4 intake pumps to operate at higher flow rates while maintaining a sufficient amount of water in Pond 4. This is achieved by directing a portion of the Pond 4 intake pump discharge back to Pond 4. Therefore, the amount of water entering the HDS Treatment Plant could be reduced to match the combined CUD and DS flow rates, while the Pond 4 intake pumps could maintain pumping at a minimum of 40 gpm.

Air relief valves were also installed on the pump cavities. These valves allow air to be rapidly purged from the pump discharge during pump priming, increasing the speed and effectiveness of pump priming. An additional air relief valve was installed on the high point of the discharge loop to prevent a potential air lock from forming in the Pond 4 intake pump discharge line. Heat trace and pipe insulation were extended to include the new Pond 4 intake pump piping to help protect it from potential freeze damage.

7.1.4 Delta Seep Transfer Tank Access Platform

During the 2009 ARWS, an access catwalk and work platform was installed at the DS Transfer Tank to facilitate access for inspecting and maintain the DS Transfer Tank, pumps, and level controls. In July 2010, minor work to complete the catwalk installation was performed including the installation of safety chains and painting the catwalk stairs.

7.1.5 Pond 4 LTS and CUD Conveyance Cleaning

The Pond 4 LTS tanks and RCTS units were decommissioned in 2009 but were never cleaned. In June 2010, the tanks and RCTS units were cleaned using a pressure washer to loosen the residual lime, iron precipitate and sediment and a vacuum tuck to remove the material from the tanks. Additionally, the iron precipitate built up in the CUD conveyance line was also loosened by a pressure washer and removed using a vacuum truck. This work was completed by ENV with support from SRC. The material was disposed of as discussed in Section 4.4.3.

7.1.6 Pond 4 Liner Repair

Repairs to visible holes and tears in the Pond 4 HDPE liner above the water line were completed in September 2010 by Comanco, of Reno, Nevada.

7.2 ASPEN SEEP BIOREACTOR TREATMENT SYSTEM

During the 2010 ARWS, Atlantic Richfield performed the following system improvements and construction activities to promote safe, reliable operations at the ASB Treatment System:

- Sludge/filtrate pipeline extension;
- Power generation system improvements;
- Treatment system improvements;
- Aeration channel walkway improvements;
- Manhole engineering controls; and
- Installation of a year-round safety shower.

Each of these activities is described in further detail in the following subsections.

7.2.1 Sludge Filtrate Pipeline Extension

During the week of August 30, 2010, one of the two existing HDPE sludge/filtrate pipelines was extended from the former sludge dewatering location to the new sludge dewatering location near the AS access gate as described in the Notice of Sludge/ filtrate Handling Pipeline Extension, Sludge Removal and Dewatering, 2009 RAWP (Atlantic Richfield, 2010e). The sludge filtrate pipeline is shown on Figure 8. This pipeline extension allowed for pumping of sludge from the settling ponds to the new sludge dewatering area. Discharge of filtrate water from the dewatering area back to the ASB Treatment System was conducted through the same pipeline when necessary, on an alternate schedule from the sludge pumping. The pipeline was secured to control/minimize lateral movement caused by expansion and contraction and sludge pumping pressure, and is terminated by a blind flange at the top and gate valves at the mid-point and bottom of the line, when not in use.

7.2.2 Power Generation System Improvements

During 2010, HSSE concerns regarding the existing battery bank and proposed improvements (described in Section 7.2.3) and additions to the ASB Treatment System that might impact the power requirements prompted an evaluation. Two power generation system improvements (battery and PLC evaluation) were conducted to improve system reliability, accommodate treatment system improvements, and extend the service life of existing equipment. These improvements are described in the following subsections.

7.2.2.1 Battery Evaluation and Reconditioning

An evaluation of the ASB Treatment System Power Generation System battery bank was conducted in August and September 2010 to assess the current performance and remaining service life of the existing battery bank for ensuring continued system reliability. Battery evaluation consisted of performing load testing, measurement of specific gravity readings and measurement of individual battery cell voltages. The initial results of the battery evaluation indicated that the batteries were at 50-55 percent of their rated capacity (note: battery replacement is typically recommended when battery capacity drops to 80 percent or below). The battery manufacturer suggested that the reduced battery capacity was most likely due to sulfation[10]. ASB Treatment System engineers worked with the battery manufacturer to develop a battery rehabilitation plan, which consisted of performing equalization charging as the primary method for removing sulfation, and deep cycling. Following equalization, additional load testing indicated that battery equalization had returned the battery bank to approximately 75 percent of capacity; however, the results were depressed by three bad cells identified within the battery bank. On October 17, 2010, the three bad battery cells were replaced and the system returned to normal operation.

7.2.2.2 PLC Evaluation and Replacement

An evaluation of the ASB Treatment System PLC was conducted in 2010 to assess the potential for the existing PLC to accommodate additional input/output (I/O) modules needed for treatment system improvements (Section 7.2.2). As a result of the evaluation, it was determined that the PLC did not have sufficient I/O modules to accept the planned equipment controls. Consequently, a new PLC with expanded I/O capability was installed and commissioned by

[10] Sulfation is the formation of lead sulfate on battery plates. If not broken down on a regular basis through controlled battery overcharging (equalization), lead sulfate can harden and reduce battery capacity.

TESCO Controls, Inc. (TESCO), between October 20 and 27, 2010. TESCO also implemented associated controls programming for the new equipment I/O.

7.2.3 Treatment System Improvements

During 2010, ASB Treatment System improvements were conducted in order to improve HSSE considerations and increase system reliability. Treatment system improvements are discussed in the following sections.

7.2.3.1 Improvements to the Recirculation Pump System

Recirculation pump system improvements in 2010 included the installation of quick-disconnect cable plugs on the recirculation pump power cords, installation of mechanical interlock switched safety sockets and enclosures for each recirculation pump, and expansion of the recirculation pump access platform.

During 2010, two ASB Treatment System recirculation pumps failed and were replaced due to normal wear. Prior to the recirculation pump improvements, both recirculation pumps were hardwired into a single electrical junction box, thus requiring an electrician to land the electrical connections and the shutdown of both pumps during a single pump replacement for proper energy isolation. The improvements included the installation of quick-disconnect cable plugs on the power cords of the recirculation pumps and the installation of individual mechanical interlock switched safety sockets and enclosures for each pump. The elimination of the hardwired power connections enables system operators to change out pumps without an electrician on site. Additionally, installation of the separate mechanical interlock switched safety sockets and enclosures allow for the operation of one pump during lock-out / tag-out and maintenance of the other pump. The recirculation pump plugs and safety enclosures were installed on October 25, 2010.

During October 2010, the recirculation pump access platform was expanded in order to provide system operators with improved equipment access and a larger work area for performing pump O&M. The recirculation pump valve manifold was relocated from the side of Pond 3 to the platform to improve HSSE for operators during valve access, and the recirculation pump mechanical interlock switched safety enclosures and pump plug receivers were installed on the access platform. The enlarged work area provides an improved area for operators to conduct equipment inspections.

7.2.3.2 Ethanol and Sodium Hydroxide Pump Replacement

Ethanol pump replacement was conducted in order to achieve compliance with the ethanol enclosure electrical classification. Between October 20 and 21, 2010, the previous primary and backup peristaltic pumps were replaced by pumps that are rated for use in class I, division 2 electrical areas where explosive vapors could be present under abnormal conditions. The new pumps satisfy all operational and maintenance requirements for use at the ASB Treatment System, and have reduced maintenance compared to the previous ethanol pumps.

Sodium hydroxide pump replacement was conducted in order to improve pump controls, increase NaOH pump dosing reliability, and increase HSSE associated with performing O&M. On October 19, 2010, the previous primary and backup Stenner peristaltic pumps were replaced by Masterflex peristaltic pumps, similar to those previously used for dosing ethanol. The new pumps allow control of dose rate from the HMI, improved dose rate precision, improved pump reliability and reduced maintenance compared to the previous pumps, and improved HSSE due the ability to adjust dose rate from the HMI and reduced pump maintenance which reduces operator contact with NaOH equipment.

7.2.3.3 Installation of Chemical Tank Level Sensors

The existing float-style chemical tank level sensors consist of a clock gauge level indicator that is intermittently visible via the site remote surveillance camera for the sodium hydroxide tanks, but is not visible for the ethanol tank. During 2010, additional tank level sensors and transmitters were installed in the two sodium hydroxide tanks, and the ethanol tank. The new tank level sensors have inputs to the system PLC thereby enabling remote monitoring of all chemical volumes, and, via differential tank volume calculations, enabling chemical dose rate confirmation. Currently, this is the only method of remote confirmation of chemical dose rate. The new tank level indicators are compatible with both sodium hydroxide and ethanol.

7.2.4 ASB Treatment System Aeration Channel Walkway

Previously, the walkway to the effluent sampling location consisted of steep and uneven terrain. Walkway improvements were addressed to meet HSSE concerns associated with slip/trip/fall hazards, especially during the LAS when snow is present. During October 2010, the aeration channel walkway was improved by adding compacted base rock and delineating side-boards on the upper part of the walkway, and by construction of a board-walk and stairs with handrails on the lower part of the walkway extending from Pond 3 to the ASB Treatment System effluent sampling location and edge of the infiltration lagoon (as shown in Figure 5).

7.2.5 Manhole Engineering Controls

Access inside of the ASB Treatment System manholes is required for field parameter monitoring and sample collection and has the potential to expose personnel to hydrogen sulfide (H2S) gas. Therefore, workers accessing the manholes are currently required to wear self contained breathing apparatus (SCBA) for respiratory protection.

On September 3 through 5, 2010, an H2S monitoring investigation was conducted to collect the necessary data to more accurately evaluate and assess levels of ambient H2S concentrations in the work zones of the manholes at the ASB Treatment System. This data will be utilized in continuing efforts to better implement appropriate engineering controls to minimize personnel occupational exposure to H2S and reduce, or eliminate, the respiratory protection requirement.

The results of the evaluation indicated that the ASB SOPs for O&M activities at eight of the ten manholes (1, 2, 3 [inactive], 5 [inactive], 6, 8, 9 [inactive] and 10) may be revised to allow routine tasks to be performed without the use of SCBA's. All other PPE requirements should remain in place, as well as the real time air monitoring procedures for manhole entry and the use of personnel H2S monitor badges. Supplied air escape respirators should also be available in the event of changing conditions or H2S badge alarm. All personnel air samples and real time monitoring in the personnel breathing zone indicated no H2S concentrations; however, Manhole 4 and 7 consistently produce hazardous concentrations of the gas at the level of the manhole opening. Continuous readings over a forty minute time period of Manhole 4 indicated that passive ventilation did not diminish the concentrations significantly; and it was recommended that current PPE requirements including SCBA's remain in place when accessing Manhole 4 and 7 until satisfactory engineering controls such as a closed manhole piping system can be implemented. This recommendation would also include Manhole 3, 5 and 9 during times of activation of these manholes. This evaluation will be finalized and engineering controls will be implemented as necessary in 2011.

7.2.6 Installation of a Year-Round Safety Shower

Previously, an American National Standards Institute (ANSI)-compliant shower has not been available on-site during the LAS, due to considerations with freezing water. During November 2010, a custom built year-round, safety shower and eyewash was installed, tested, and commissioned at the ASB Treatment System. The shower water temperature is maintained by a propane heater and insulation in the enclosure walls, and water pressure is maintained by redundant air supply tanks and pressure regulators. The shower water temperature and delivery pressure may be monitored remotely via satellite communication to confirm shower function prior to accessing the site during the LAS. The location of the safety shower is shown on Figure 5.

7.3 ROAD ACTIVITIES

In March 2010, Atlantic Richfield prepared the *2010 Annual Operating Plan* issued to the USFS (Atlantic Richfield, 2010b) in accordance with a U.S. Forest Service Road Use Permit (USFS, 2008). The permit allows Atlantic Richfield to conduct road maintenance (with certain provisions) on Leviathan Mine Road; also known as Forest Service Roads 10052 and 10348, which consists of approximately 16 miles of mostly unpaved roads connecting the site to State Route 89 (SR 89) and U.S. 395. These roads are commonly referred to as the California access road, the Nevada access road, and the Aspen access road. The major road activities completed in 2010 included routine surface grading and compacting, installing additional mirrors and signs, and road crowning, drainage improvements, and dust suppression. All road-related work was conducted to maintain safe and reliable access to the site, which is necessary for performing water treatment activities and related work in accordance with AOC requirements. During road work activities, traffic control and/or pilot cars were used to ensure the safety of the public, the road maintenance crews, and site workers while traveling the roads.

7.3.1 Grading and Compacting

The road maintenance completed in 2010 included grading and compacting the surface of the roadway from approximately 2 miles west of Highway 395 in Nevada, through the site to Highway 89 in California, including the portion of Leviathan Mine Road that stretches from the Nevada access gate to the AS access gate, at the beginning of the season; repairing select sections of the road damaged by erosion from stormwater runoff; grading select portions of the road throughout the year as necessary to reduce “wash boarding”; addition of certified “weed free” baserock to select portions of the road surface as necessary to cover exposed bedrock; and removal of rocks and debris from ditches and culverts.

7.3.2 Installation of Additional Mirrors and Signs

In July, 2010, additional mirrors and signs were installed as well as relocated to more optimal locations along the California and Nevada access roads. On the Nevada access road, three mirrors and 25 signs were added, and two signs were relocated. On the California access road, two signs were added and one sign was relocated.

7.3.3 Nevada Access Road Dust Suppression

In August 2010, Atlantic Richfield prepared the *Revised 2010 Dust Suppression Evaluation* issued to the USFS (Atlantic Richfield, 2010g) to support the selection of a dust suppression remedy on the Nevada access road along an approximate 1.6 mile stretch of roadway commencing from approximately 0.2 miles from its intersection with Highway 395. The evaluation was completed in response to the need for mitigating dust generation on Leviathan Mine Road related to use of the road by the public, residents living along the road, and contractors working on behalf of the LRWQCB and Atlantic Richfield at the site. The details of the evaluation and all dust suppressant alternatives are provided in the *Revised 2010 Dust Suppression Evaluation Report*. As a result of the evaluation, the completed activities along the approximate 1.6 mile stretch of roadway included: cleaning out drainage ditches, unclogging existing culverts, improving one existing drivable dip and installing two new drivable dips, crowning the road to improve surface drainage off of the road surface, and application of the dust palliative Envirotac II®. These activities are described in the following sections.

7.3.3.1 Road Drainage Maintenance Activities

Road crown and drainage maintenance activities began on September 14, 2010 and were completed on October 1, 2010. Maintenance activities included:

- Ditch and Culvert Clearing
  - Clearing out sloughed road base and vegetation from existing ditches on the north and south sides of the road.
  - Clearing out and un-plugging five existing culverts by removing accumulated rock, sediment, and weeds from around the upstream and downstream openings.
- Road Crown
  - Specifications outlined in the Gravel Roads Maintenance and Design Manual (U.S. Department of Transportation, 2000) were followed for constructing the road base crown. Prior to building the crown, the surface of the existing road base was tilled to a depth of approximately 3 to 4 inches using the rippers on the road grader. The purpose of tilling the existing road base was to provide a better bonding surface between the existing road base and the imported aggregate base material.
  - Approximately 3,100 tons of certified weed-free Class II aggregate road base was imported and was placed on the prepared road surface. The crown depth at the centerline of the road was built up to approximately 6 inches compared to the previous surface.
- Drivable Drainage Dips
  - Drivable drainage dips were either installed or modified so their construction was in accordance with the Handbook for Forest and Ranch Roads, A Guide for Planning, Designing, Constructing, Reconstructing, Maintenance and Closing Wildland Roads (U.S.D.A. SCS, 1994).
  - One existing dip was modified and two new dips were installed to drain surface water away from the road.
  - Measured from the intersection of Highway 395 and Leviathan Mine Road, the three completed dips were located at mileposts 0.5 miles (improved existing dip), 0.75 miles (new dip), and 0.86 miles (new dip). A second existing dip was filled when building the road crown.

7.3.3.2 Dust Suppression

Starting in September 2010, thirty-six, 275-gallon plastic totes of Envirotac II® solution were delivered to a staging area on the Nevada access road. Per manufacturer instructions, the Envirotac II® solution was mixed with water and applied to the road base using a 2,000-gallon capacity water truck in approximate 800-foot segments. A total of three application treatment coats (foundation coat, base coat, and final coat) were made to the road base, each at a different application ratio. The foundation coat was designed to lock in the fine-grain particles of the existing road base and to help provide an optimal bonding surface between the existing road base and imported aggregate base. The base coat was designed to lock in the aggregate base rock and fine-grained particles, thus providing for improved dust suppression and the final coat was designed to seal the road surface and provide maximum dust suppression. The total volume of Envirotac II® solution applied to the road yielded an approximate application rate of 20.5 square ft per gallon. The manufacturer suggested time frame for reapplication of the final coat for dust control is every 12 to 36 months, at 20 percent of the original application amount.

7.3.4 California Access Road Maintenance

In September 2010, Atlantic Richfield prepared the *Supplemental 2010 California Access Route Maintenance Plan* issued to the USFS (Atlantic Richfield, 2010j) pertaining to maintenance on the approximate three mile-long stretch of the California access road. The Plan provided the details for improving water management controls and enhancing 2-way traffic safety on an approximate 0.7 mile stretch of roadway, measured approximately 1.84 miles from the intersection with SR 89 to approximately 2.54 miles from the intersection with SR 89.

Maintenance on the road began October 13. Work on the road was delayed several times due to inclement weather. Approximately 0.6 miles of the planned 0.7 miles of improvements were completed before the onset of inclement weather. The drainage improvement activities included removing debris from the in-slope drainage ditches, filling the in-slope drainage ditches with imported base rock, out-sloping the road, enhancing already present drainage swales across the roadway, and placing rip-rap along the edges of existing drainage swales where swales intersect the roadway. Approximately 2,310 tons of weed-free aggregate base rock was imported. On average, approximately 7 ft of road width was added to the road width along the 0.6-mile stretch by filling the in-slope drainage ditch.

7.3.5 Road Stability Monitoring

Atlantic Richfield submitted the Leviathan Mine Road Stability Monitoring Plan to the USFS (Atlantic Richfield, 2010k) outlining the planned activities to evaluate the stability of an approximately 400-foot stretch of Leviathan Mine Road located just above the hair pin turn on the Nevada access road approximately 9 miles from Highway 395. The Road Stability Monitoring Plan was prepared in response to cracks observed in the road surface by Atlantic Richfield contractors in early August 2010. Observed cracks were ¼- to ¾-inches wide, with measured depths of up to 2 inches, the cracks trend parallel to the length of the road, with two to three lines of cracks across the width of the road.

The road stability monitoring plan included the installation of three monument pairs installed along an approximately 400-foot stretch of road. Any horizontal displacement that occurs between established monument pairs will be measured and recorded using a tape extensometer. Baseline readings were collected after installation of the monitoring stations and subsequent readings will be collected and compared to the baseline readings. Vertical changes between paired monuments will be collected using a manometer. The resulting data will be reviewed and plotted against time. If significant vertical or horizontal movement occurs between monument pairs, Atlantic Richfield will notify the USFS.

8.0 STATEMENT OF COSTS INCURRED

The costs associated with the activities conducted in 2010 are presented under the general cost categories described below. The total approximate cost for the 2010 work completed was $8,615,000. A summary of the approximate costs incurred (rounded to $1,000 increments) is presented in Table 10.

8.1 PROJECT COMPLIANCE, REPORTING, PROJECT MANAGEMENT, AND HSSE OVERSIGHT

Project compliance, regulatory reporting, project management, and HSSE oversight activities were performed in support of ongoing work conducted for the site. These activities include:

- Updates to health and safety plans;
- Project management, scheduling, and cost projections;
- Updating and managing the database;
- HSSE support, oversight, audits, training, and planning;
- Regulatory reporting and document preparation such as the Spill Prevention, Control and Countermeasure Plans, Hazardous Materials Business Plans, Monthly Progress Reports, Work Plans, and the Annual Completion Report;
- Stakeholder meetings; and
- Agency communications and costs, public relations support, and procurement support.

The total cost for the above project compliance, reporting, project management, and HSSE oversight activities in 2010 was $3,227,000.

8.2 POND 4 ACTIVITIES

As described in Section 7.1.5, the decommissioned Pond 4 LTS Tanks and RCTS units were cleaned. Additionally, as described in Sections 7.1.6 and 4.2.4.5, the Pond 4 liner was repaired and a sludge evaluation was completed for Pond 4. The total 2010 cost for these Pond 4 activities was $36,000.

8.3 CHANNEL UNDERDRAIN AND DELTA SEEP TREATMENT RELATED ACTIVITIES

The total 2010 costs for CUD and DS treatment related activities were $2,173,000. The costs are broken down in the following subsections.

8.3.1 Spring Commissioning

Spring-commissioning of the HDS Treatment System occurred in April and May of 2010. Spring-commissioning activities are described in the RAWP (Atlantic Richfield. 2010d), but generally included the removal of snow from the Nevada access road, installation and wiring of conveyance and transfer pumps, replacing required lubricants and fluids, tightening and adjusting equipment, and installing belt drives. The proper operation of each piece of equipment including process controls were tested, calibrated, and verified. The total cost for spring-commissioning activities at the HDS Treatment System was $211,000.

8.3.2 Operations and Maintenance

The O&M activities for the HDS Treatment System included:

- Engineering support, geochemistry support, agency reporting, O&M assurance;
- Field logistics and daily routine O&M of the HDS Treatment System, including the CUD and DS collection and conveyance equipment;
- O&M manual preparation;
- HDS Treatment Plant reagents including dry lime and polymer;
- DS cut off wall maintenance;
- Generator troubleshooting/optimization;
- Performance monitoring and data evaluation; and
- Laboratory analysis and data validation of samples.

The total cost of O&M for the treatment of CUD and DS in 2010 was $1,538,000.

8.3.3 Sludge Management and Disposal

As discussed in Section 4.2.4.4, treatment-generated solids in 2010 were characterized, removed from the site, and transported to a disposal facility. The total cost for loading, characterization, transportation, and disposal of the HDS Treatment System treatment-generated solids in 2010 was $63,000.

8.3.4 System Winterization

As discussed in Section 4.2.4.6, the HDS Treatment System was winterized. These activities included weatherproofing all electrical components including control panels and motors, draining tanks and piping, and emptying the polymer and lime systems. The total cost for winterization of the HDS Treatment System in 2010 was $125,000.

8.3.5 Engineering Support and System Improvements

As discussed in Section 7.1, engineering support and system improvements were completed at the HDS Treatment Plant. Improvements included the installation of a data historian for the HDS Treatment System, site trailer power modifications, Pond 4 intake pump modifications, and DS Transfer tank access platform. The total cost for the 2010 engineering support and system improvements, including material, labor, and construction oversight was $236,000.

8.4 ASPEN SEEP TREATMENT RELATED ACTIVITIES

The total costs for AS treatment related activities were $1,886,000. The costs are broken down in the following subsections.

8.4.1 Operations and Maintenance

The O&M activities at the ASB included daily, weekly, or monthly (including the snowmobile trips during the winter) mobilization of personnel to perform routine O&M activities such as:

- Influent and effluent sampling;
- Propane generator maintenance and propane fuel supply;
- Deliveries of ethanol and sodium hydroxide;
- Updates to the O&M manual;
- Geochemistry support, training, hazard revision and assurance;
- Performance monitoring and data evaluation activities; and
- Laboratory analysis and data validation of samples.

The total cost of O&M for the treatment of AS in 2010 was $999,000.

8.4.2 Sludge Management and Disposal

Costs associated with ASB Treatment System sludge management and disposal included the installation of a sludge/filtrate handling pipeline (discussed in Section 7.2.1) and the temporary rental and operation costs of the trailer-mounted centrifuge (discussed in Section 4.3.5.2). As described in Section 4.4.2, sludge generated from the ASB Treatment System was removed from the site. The total cost for ASB Treatment System sludge management and disposal in 2010 was $585,000.

8.4.3 Engineering Support and System Improvements

As described in Section 7.2, ASB Treatment System improvements included: the power generation system evaluation, treatment system improvements, installation of a year-round safety shower, improvements to the ASB Treatment System aeration channel walkway, and a sludge filtrate pipeline extension. The total cost for the 2010 engineering support and system improvements, including material, labor, and construction oversight was $302,000.

8.5 SITE ACCESS

The total costs for site access related activities in 2010 were $1,293,000. The costs are broken down in the following subsections.

8.5.1 Site Setup and Maintenance

The total cost for site setup and maintenance in 2010 was $519,000. Included in this cost is the following:

- Rental of office trailers, furniture, portable restrooms, and trash receptacles through the field season;
- Potable drinking water brought to the site;
- Site communications such as satellite service, and portable satellite phone service;
- Site management and coordination;
- Purchase of safety and first-aid items such as H2S badges, atmospheric testing meters, oxygen, fire extinguishers, and first-aid kits;
- Earthwork and grading; and
- Pond 4 signage.

8.5.2 Leviathan Mine Road Activities

Road maintenance was conducted along the length of Leviathan Mine Road. Road maintenance is discussed in Section 7.3. The total cost for road maintenance in 2010 was $774,000.

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