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April 10, 2012

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

RE: 2011 Annual Completion Report
Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities
Leviathan Mine
Alpine County, California

Dear Messrs. Riley and Mayer:

On behalf of Atlantic Richfield, please find enclosed the *2011 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 (U.S. EPA) in the *2011 Removal Action Work Plan* (Atlantic Richfield; April 2011) and the requirements of the Administrative Settlement Agreement and Order on Consent for Removal Action (AOC) issued by U.S. EPA on January 21, 2009.

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: *2011 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, Esq., BP America, Inc. – via electronic
Marc Lombardi, AMEC Environment & Infrastructure, Inc.
Dave McCarthy, Copper Environmental
Sandy Riese, EnSci

2011 ANNUAL COMPLETION REPORT:
CHANNEL UNDERDRAIN, DELTA SEEP, AND ASPEN SEEP WATER TREATMENT ACTIVITIES

Leviathan Mine Site
Alpine County, California

Prepared for:
Atlantic Richfield Company
La Palma, California

Prepared by:
AMEC Environment & Infrastructure, Inc.
Rancho Cordova, California

April 2012

Project 0013091122

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

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 1
- 1.1 REPORT OBJECTIVES AND SCOPE 2
- 1.2 PURPOSE OF THE REMOVAL ACTION 3
- 1.3 HEALTH, SAFETY, SECURITY, AND ENVIRONMENT EXPECTATIONS 4
- 1.4 REPORT ORGANIZATION 4

2.0 SITE BACKGROUND INFORMATION 6
- 2.1 SITE LOCATION, PHYSICAL SETTING, AND WATERSHED DESCRIPTIONS 6
- 2.2 OVERVIEW OF PAST TREATMENT ACTIVITIES 6
  - 2.2.1 Pond 4 Treatment Area, CUD, and DS 7
  - 2.2.2 Aspen Seep 11

3.0 HEALTH AND SAFETY PERFORMANCE AND COMMUNITY RELATIONS 16
- 3.1 2011 HEALTH AND SAFETY PERFORMANCE 16
- 3.2 2011 COMMUNITY RELATIONS 16

4.0 2011 REMOVAL ACTION ACTIVITIES 18
- 4.1 OBJECTIVES 18
- 4.2 CUD AND DS TREATMENT-RELATED ACTIVITIES 18
  - 4.2.1 Site Access, LAS Mobilization, and General Pond 4 Activities 19
  - 4.2.2 HDS Treatment System 19
    - 4.2.2.1 Spring Commissioning and Startup 20
    - 4.2.2.2 Operations and Consumable Usage 21
    - 4.2.2.3 Maintenance Activities 22
    - 4.2.2.4 Sludge Management 23
    - 4.2.2.5 Shutdown and Storage 23
  - 4.2.3 HDS Treatment System Evaluations and Improvements 24
    - 4.2.3.1 Clarifier Inlet Launder Modifications 25
    - 4.2.3.2 Lime Sludge Mix Tank Modifications 25
    - 4.2.3.3 Flocculant Auto-Batch Capabilities 26
    - 4.2.3.4 Turbidity Meter Relocation 26
    - 4.2.3.5 Pond 4 Pump Modifications 27
    - 4.2.3.6 Conveyance Line Piping Modifications 27
    - 4.2.3.7 Conveyance Line LCP GFCI Upgrades 28
    - 4.2.3.8 Generator Curtain Replacement 28
    - 4.2.3.9 Safety Shower Piping Modifications 29
  - 4.2.4 Pond 4 Activities 29
    - 4.2.4.1 Pond 4 Bypass 30
    - 4.2.4.2 Sludge Removal Operations 31
    - 4.2.4.3 Pond 4 Liner Repair 32
- 4.3 ASPEN SEEP TREATMENT-RELATED ACTIVITIES 32
  - 4.3.1 ASB Treatment System 33
    - 4.3.1.1 Operations and Consumable Usage 34
    - 4.3.1.2 Maintenance 35
    - 4.3.1.3 Sludge Management 35

TABLE OF CONTENTS
(Continued)

4.3.2 ASB Treatment System Evaluations and Improvements 38
4.3.2.1 Nutrient Addition Adjustments 39
4.3.2.2 Sodium Hydroxide Tubing Modifications 39
4.3.2.3 Power Generation System Improvements 40
4.3.2.4 Satellite Accumulation Area Improvements 42
4.3.2.5 Infiltration/Overflow Pond Evaluation 42
4.3.2.6 H_2S Incident and Evaluation 43
4.4 WASTE MATERIALS DISPOSED OF OFF SITE 44
4.4.1 HDS Treatment System Sludge 44
4.4.2 Pond 4 Sludge 44
4.4.3 ASB Treatment System Sludge 45
4.4.4 ASB Treatment System Batteries 45
4.4.5 Miscellaneous Waste 45

5.0 2011 MONITORING ACTIVITIES 47
5.1 DATA QUALITY OBJECTIVES 47
5.2 SAMPLING AND ANALYSIS 47
5.2.1 Performance Monitoring Locations, Schedules, and Parameters 48
5.2.1.1 HDS Treatment System Monitoring Locations and Frequency 49
5.2.1.2 ASB Treatment System Monitoring Locations and Frequency 50
5.2.2 Additional Monitoring Locations, Schedules, and Parameters 51
5.2.2.1 Pond 4 Sludge 51
5.2.2.2 Pond 4 Inflow 51
5.2.2.3 Infiltration/Overflow Pond 52
5.2.2.4 H_2S Monitoring 52
5.2.3 Sampling Procedures 52
5.2.3.1 Flow Data 53
5.2.3.2 Water Quality Measurements and Sampling Procedures 53
5.2.3.3 Sludge Sampling Procedures 54
5.2.3.4 Air Sampling Procedures 55
5.2.4 Sample Identification 55
5.2.5 Laboratory Analytical Program 56
5.2.6 Sample Collection and Quality Assurance/Quality Control 57
5.2.6.1 Quality Assurance Measures 57
5.2.6.2 Quality Control Testing 58

6.0 2011 MONITORING RESULTS 59
6.1 CUD AND DS TREATMENT-RELATED MONITORING RESULTS 59
6.1.1 HDS Treatment System Performance 59
6.1.1.1 Treated Volume and Flow Rates 59
6.1.1.2 Performance Monitoring 59
6.1.1.3 Mechanical Performance 60
6.1.1.4 Consumable Utilization 62
6.1.1.5 Sludge Generation 63
6.1.2 Pond 4 Sludge Results 63

TABLE OF CONTENTS
(Continued)

6.2 ASPEN SEEP TREATMENT-RELATED MONITORING RESULTS 64
6.2.1 ASB Treatment System Performance....64
6.2.1.1 Treated Volume and Flow Rates....64
6.2.1.2 Performance Monitoring 65
6.2.1.3 Mechanical Performance....66
6.2.1.4 Consumable Utilization....68
6.2.1.5 Sludge Generation and Results....68
6.2.2 Infiltration/Overflow Pond Results....69
6.2.3 H_2S Monitoring Results....69
6.3 QUALITY ASSURANCE/QUALITY CONTROL RESULTS 70

7.0 2011 SITE MAINTENANCE ACTIVITIES....72
7.1 GENERAL POND 4 ACTIVITIES 72
7.1.1 Satellite System Upgrades 72
7.1.2 Pond 4 Area Dust Suppression 72
7.1.3 Temporary Storm Water Controls....72
7.2 ROAD MAINTENANCE....73
7.2.1 Grading and Compacting....73
7.2.2 Cleaning Ditches and Culverts 74
7.2.3 Tree Removal and Clearing for Line of Sight....74
7.2.4 Monitoring of Access Road Ground Deformation 74
7.2.5 Nevada Access Road Residential Area....76

8.0 STATEMENT OF COSTS INCURRED 77
8.1 PROJECT COMPLIANCE, REPORTING, MANAGEMENT, AND HSSE OVERSIGHT 77
8.2 SITE ACCESS 77
8.2.1 Site Setup and Maintenance....78
8.2.2 Leviathan Mine Road Activities....78
8.3 HDS TREATMENT SYSTEM ACTIVITIES 78
8.3.1 Spring Commissioning....78
8.3.2 Operations and Maintenance....79
8.3.3 Sludge Management and Disposal....79
8.3.4 System Winterization....79
8.3.5 Engineering Support and System Improvements 79
8.3.6 Pond 4 Sludge Removal....80
8.4 ASB TREATMENT SYSTEM ACTIVITIES 80
8.4.1 Operations and Maintenance....80
8.4.2 Sludge Management and Disposal....80
8.4.3 Engineering Support and System Improvements 81
8.4.4 H_2S Monitoring....81

9.0 REFERENCES....82

TABLE OF CONTENTS
(Continued)

TABLES

Table 1	Summary of 2011 Analytical Data for Samples Collected from the CUD and DS
Table 2	Summary of 2011 Analytical Data for Samples Collected from the HDS Treatment System
Table 3	Summary of 2011 Analytical Data for Samples Collected from the ASB Treatment System
Table 4	Summary of 2011 Analytical Data for Samples Collected from the Pond 4 Inflow Pipe
Table 5	2011 Monthly Summary of Influent Flow and Treated Volume from the CUD and DS
Table 6	2011 Monthly Summary of Influent Flow and Captured Volume from Aspen Seep
Table 7	Summary of 2011 Waste Manifests
Table 8	2011 HDS Treatment System Sampling and Analysis Schedule
Table 9	2011 ASB Treatment System Sampling and Analysis Schedule
Table 10	2011 HDS and ASB Treatment Systems Laboratory Analytical Methods for Aqueous and Solid-Phase Parameters
Table 11	Summary of 2011 HDS Treatment System Discharge Events
Table 12	Summary of 2011 HDS Treatment System Sludge Analytical Data
Table 13	Summary of 2011 ASB Treatment System Sludge Analytical Data
Table 14	Summary of 2011 Pond 4 Sludge Analytical Data
Table 15	Summary of 2011 ASB Treatment System Infiltration/Overflow Pond Sediment Data
Table 16	Summary of 2011 Field Duplicates
Table 17	Summary of 2011 Field Method Blanks
Table 18	Summary of 2011 Costs Incurred

FIGURES

Figure 1	Site Location Map
Figure 2	Site Layout
Figure 3	HDS Treatment System Layout and Sampling Locations
Figure 4	HDS Treatment Plant Equipment Layout
Figure 5	HDS Treatment System Process Flow Diagram
Figure 6	ASB Treatment System Layout and Sampling Locations
Figure 7	ASB Treatment System Process Flow Diagram
Figure 8	ASB Treatment System Sludge Dewatering Operations Layout
Figure 9	Pond 4 Sludge Removal Layout
Figure 10	Pond 4 Sludge Removal Dredge Setup

TABLE OF CONTENTS
(Continued)

APPENDICES

Appendix A	2011 Monthly Reports
Appendix B	2011 Waste Disposal Notification Letters, Waste Profiles, Waste Manifests, and Confirmation of Material Reclamation
Appendix C	2011 Field Measurement Data Sheets
Appendix D	2011 Treatment System Data Tables
Appendix E	2011 Laboratory Data Reports and Chain-of-Custody Forms
Appendix F	2011 Aspen Seep Bioreactor Performance Review Presentation Slides
Appendix G	Hydrogen Sulfide Monitoring Completion Report
Appendix H	Pond 4 Sludge Liner Repairs Technical Memorandum
Appendix I	2011 Road Stability Monument Inspection Data
Appendix J	2011 Quality Assurance/Quality Control Assessment Reports
Appendix K	Temporary Storm Water Control Measures Memorandum

LIST OF ABBREVIATIONS AND ACRONYMS

ABA	acid-base accounting
AOC	Administrative Order on Consent
AD	acid drainage
AGM	absorbed glass mat
AMEC	AMEC Environment & Infrastructure, Inc
ARWS	Atlantic Richfield Work Season
AS	Aspen Seep
ASB	Aspen Seep Bioreactor
Atlantic Richfield	Atlantic Richfield Company
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain-of-custody
CUD	Channel Underdrain
cy	cubic yard
DI-WET	Waste Extraction Test modified to use deionized water as the extraction fluid
DO	dissolved oxygen
DOC	dissolved organic carbon
DQO	data quality objective
DS	Delta Seep
DST	Delta Seep Transfer
ELAP	Environmental Laboratory Accreditation Program
EPT	Electrical Power Trailer
FLA	flooded lead acid
ft	feet
FTP	file transfer protocol
GB	gigabyte
GFCI	ground fault circuit interrupter
gpd	gallons per day
gpm	gallons per minute
H_2S	hydrogen sulfide
HDPE	high-density polyethylene
HDS	High Density Sludge
HMI	Human Machine Interface
HSSE	Health, Safety, Security, and Environment
IDLH	Immediately Dangerous to Life and Health
IOP	Infiltration/Overflow Pond
kbps	kilobytes per second
LAS	Limited Access Season
LCP	local control panel
LRWQCB	Lahontan Regional Water Quality Control Board
LTF	lagoon treatment facility
LTS	lime treatment system
MB	megabyte
mg/L	milligrams per liter
MH	manhole
mL/L	milliliters per liter

LIST OF ABBREVIATIONS AND ACRONYMS
(Continued)

MRAM	Modification to the Removal Action Memorandum
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts
NaOH	sodium hydroxide
NNP	net neutralization potential
NTU	Nephelometric Turbidity Unit
O&M	operations and maintenance
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
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
SDB	sludge drying bed
SOP	Standard Operating Procedure
SPLP	synthetic precipitation leaching procedure
SRB	sulfate-reducing bacteria
STLC	soluble threshold limit concentration
s.u.	standard units
TAC	Technical Advisory Committee
TCLP	toxicity characteristic leaching procedure
TSP	trisodium phosphate
TTLC	total threshold limit concentration
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UPS	uninterruptible power supply
VFD	variable frequency drive

2011 ANNUAL COMPLETION REPORT: CHANNEL UNDERDRAIN, DELTA SEEP, AND ASPEN SEEP WATER TREATMENT ACTIVITIES

Leviathan Mine
Alpine County, California

EXECUTIVE SUMMARY

This *2011 Annual Completion Report: Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities* (Annual Report) has been prepared by AMEC Environment & Infrastructure, Inc. (AMEC), on behalf of Atlantic Richfield Company (Atlantic Richfield) to describe the CERCLA response actions conducted at the Leviathan Mine Site (site) in 2011. Specifically, this Annual Report serves as a summary to document the completed 2011 water treatment-related 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). Additionally, the Annual Report meets the commitments made by Atlantic Richfield in Section 6.1 of the *2011 Removal Action Work Plan* (RAWP) submitted to the U.S. Environmental Protection Agency (U.S. EPA) in March 2011 (Atlantic Richfield, 2011d).

The following is a list of Removal Action water treatment-related activities completed at the site in 2011:

- Spring commissioning, operation, maintenance and winterization of the High Density Sludge (HDS) Treatment System utilized to capture and treat flows from the CUD and DS for discharge to Leviathan Creek;
- Removal of HDS Treatment System treatment-generated solids (sludge);
- Operation and maintenance of the Aspen Seep Bioreactor (ASB) Treatment System to treat flows from the AS for discharge to Aspen Creek;
- Removal of ASB Treatment System sludge; and
- Removal of accumulated lime treatment sludge from Pond 4.

During 2011, approximately 10.2 million gallons of water from the CUD, 3.6 million gallons of water from the DS were captured and treated by the HDS Treatment System, and

approximately 7.2 million gallons of water from the AS were treated by the ASB Treatment System. An additional 0.6 million gallons of water were captured in Pond 4 for treatment at the HDS Treatment System. Approximately 138 tons of sludge produced from HDS Treatment Plant operations and 707 tons of sludge removed from Pond 4 was dewatered in lined filter bins and removed from the site. Approximately 86 tons of sludge produced by the ASB Treatment System was dewatered by a belt filter press and removed from the site. Sludge generated by the HDS and ASB Treatment Systems, and removed from Pond 4 was classified as non-hazardous according to Resource Conservation and Recovery Act (RCRA) and California regulations. All sludge was characterized, profiled, and transported under manifest to US Ecology, Inc., in Beatty, Nevada, for disposal.

Spring commissioning of the HDS Treatment System was initiated on April 18, 2011. HDS Treatment System operations commenced on May 5, 2011 and continued through November 4, 2011. CUD and DS flows were collected from May 13, 2011 through November 2, 2011. Pond 4 sludge removal activities were also performed in 2011.

The ASB Treatment System operated year-round in 2011 with minor disruptions occurring occasionally throughout the year. ASB Treatment System sludge dewatering was also performed using a belt filter press.

In addition to the above-mentioned water treatment activities, the following activities were completed at the site in 2011:

- Community relations, 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 HDS and ASB Treatment Systems, including sampling and analysis of water and sludge.
- Additional HDS Treatment System evaluations and improvements including: clarifier inlet modifications, lime sludge mix tank modifications, flocculant auto-batch modifications, turbidity meter relocation, Pond 4 pump modifications, conveyance line piping modifications, outdoor electrical panel ground fault circuit interrupter (GFCI) upgrades, safety shower piping modifications, and generator curtain replacement.
- Additional ASB Treatment System improvements and evaluations included: nutrient addition optimization, chemical feed system improvements, battery enclosure improvements, battery bank replacement, uninterruptible power supply (UPS) and grounding upgrades, and hydrogen sulfide (H2S) monitoring.

- Road maintenance on both the California and Nevada access portions of Leviathan Mine Road, including grading and subsurface maintenance, road stability monitoring, drainage maintenance, dust suppression, maintenance of drivable dips, signs, and mirrors, removal of trees that presented an imminent hazard to traffic accessing the site, and trimming trees and brush for line of sight.

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 2011 in complying with the AOC.

2011 ANNUAL COMPLETION REPORT: CHANNEL UNDERDRAIN, DELTA SEEP, AND ASPEN SEEP WATER TREATMENT ACTIVITIES

Leviathan Mine
Alpine County, California

1.0 INTRODUCTION

This *2011 Annual Completion Report: Channel Underdrain, Delta Seep, and Aspen Seep Water Treatment Activities* (Annual Report), has been prepared by AMEC Environment & Infrastructure, Inc. (AMEC), on behalf of Atlantic Richfield Company (Atlantic Richfield) to describe the CERCLA response actions conducted at the Leviathan Mine Site (site) in 2011. Specifically, this Annual Report serves as a summary to document the completion of 2011 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, 2009), paragraph 63. Additionally, the Annual Report meets the commitments made by Atlantic Richfield in Section 6.1 of the *2011 Removal Action Work Plan* (RAWP) submitted to the U.S. Environmental Protection Agency (U.S. EPA) in March 2011 (Atlantic Richfield, 2011d).

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

- *Request for Authorization to Perform Water Treatment During the 2011 Winter/Spring Portion of the Limited Access Season, High Density Sludge Treatment System, Leviathan Mine, Alpine County, California*; dated March 23, 2011 (Atlantic Richfield; 2011a). This letter requested U.S. EPA authorization for Atlantic Richfield to perform activities related to access, High Density Sludge (HDS) Treatment System spring commissioning, and the collection and treatment of CUD and DS flows during the spring 2011 Limited Access Season (LAS) and was approved by U.S. EPA on March 30, 2011.

- *Response to March 30, 2011 Comments, 2011 Removal Action Work Plan, Leviathan Mine, Alpine County, California*; dated May 11, 2011 (Atlantic Richfield; 2011e). This letter was prepared to address U.S. EPA comments to the 2011 RAWP.

- *Amendment #1 – 2011 Pond 4 Sludge Removal, 2011 RAWP, Leviathan Mine, Alpine County, California*; dated June 21, 2011 (Atlantic Richfield; 2011g). This amendment notified U.S. EPA of Atlantic Richfield's plans for removing, dewatering, and disposing of treatment-generated solids (sludge) from Pond 4 and was approved by U.S. EPA on June 22, 2011.

- *Revision #1, Amendment #1 – 2011 Pond 4 Sludge Removal, 2011 RAWP, Leviathan Mine, Alpine County, California*; dated July 13, 2011 (Atlantic Richfield; 2011h). This amendment notified U.S. EPA of Atlantic Richfield's plan for bypassing Pond 4 during the Pond 4 sludge removal and dewatering operations and was approved by U.S. EPA on July 14, 2011.

- *Request for Approval of Fall 2011 LAS Operations, and 2011 Year-End Decommissioning and Winterization Plan, Leviathan Mine, Alpine County, California*; dated September 26, 2011 (Atlantic Richfield; 2011i). This letter requested U.S. EPA authorization for Atlantic Richfield to operate the HDS Treatment System beyond the 2011 Atlantic Richfield Work Season (ARWS) and presented plans for decommissioning and winter preparation of the HDS Treatment System and was approved by U.S. EPA on September 30, 2011.

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 U.S. EPA and Atlantic Richfield.

1.1 REPORT OBJECTIVES AND SCOPE

This Annual Report was prepared to meet the following objectives and scope:

- Provide a summary of the treatment-related activities conducted in 2011;

- Provide a tabulation of the validated data collected in 2011 as part of the treatment activities, and accompanying laboratory data sheets;

- Summarize health and safety performance during 2011;

- Provide an interpretation of the data and treatment system performance during 2011;

- Provide a listing of Waste Materials (as defined in the AOC) moved off-site or handled on-site, a discussion of removal and disposal options considered for these materials, a listing of the final destination(s) of these 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;

- Provide a summary of support/system improvements activities conducted in 2011; and

- Summarize the costs incurred in 2011.

Additionally, this report includes site background information, including descriptions of the CUD, DS, 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 2011 were intended to investigate the cost, effectiveness, and implementability of the treatment technologies and solids management measures employed at the site. The 2011 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* (MRAM*;* U.S. EPA, 2008), dated September 25, 2008 which restated the discharge criteria. The MRAM discharge criteria are listed with a summary of the analytical data for the HDS and the Aspen Seep Bioreactor (ASB) Treatment Systems in Tables 1, 2, and 3.

The 2011 treatment activities included the following general activities:

- Spring commissioning, operation and maintenance, and winterization of the HDS Treatment System to capture and treat flows from the CUD and DS for discharge to Leviathan Creek;
- Removal of HDS Treatment System treatment-generated solids (sludge);
- Operation of the Aspen Seep Bioreactor (ASB) Treatment System to treat flows from the AS for discharge to Aspen Creek;
- Removal of ASB Treatment System treatment-generated sludge; and
- Removal of accumulated sludge from Pond 4.

All response actions performed by Atlantic Richfield at or in connection with the site were conducted pursuant to U.S. EPA orders and in accordance with work plans, work plan amendments, or other authorization requests submitted to and approved by the U.S. EPA. All response actions described in this report related, either directly or indirectly, to the collection and treatment of AD at the CUD, DS, and AS.

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 these 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 Health, Safety, Security, and Environment Program Document* (HSSE Program Document; AMEC, 2011c) which is the site-wide occupational health and safety guidance document for Atlantic Richfield and their 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. The HSSE Program Document is updated annually and as conditions change or new information becomes available.

Additionally, in 2011 all contractors working at the site were responsible for preparing a Task Specific Health and Safety Plan (TSHASP) specific to their company's HSSE Management Program and site specific scope of work, authorities, and responsibilities. The TSHASPs contain information necessary for the more specific day-to-day HSSE management and are used in conjunction with the HSSE Program Document.

Each person who performs work at the site as an Atlantic Richfield employee, contractor, subcontractor, or visitor is expected to read and acknowledge understanding of the current HSSE Program Document and applicable TSHASPs, Atlantic Richfield Remediation Management's (RM's) Control of Work (CoW) Defined Practices and HSSE expectations, and 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, descriptions of the treatment systems, 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 2011.

- Section 4 - 2011 Removal Action Activities: describes the objectives and details of the water treatment activities, related response actions completed to improve site safety and to support more efficient and reliable water treatment activities, and summarizes the materials removed from the site in 2011.

- Section 5 - 2011 Monitoring Activities: describes the monitoring activities conducted at the site in 2011, including data quality objectives (DQOs), sampling and analysis activities, and quality assurance (QA)/quality control (QC) measures.

- Section 6 - 2011 Monitoring Results: describes the results of the monitoring activities described at the site in 2011, including treated volume and flow rates, sampling and analysis results, and system performance.

- Section 7 - 2011 Site Maintenance Activities: provides a summary of the site maintenance activities conducted at the site in 2011, including general Pond 4 activities and road maintenance.

- Section 8 - Statement of Costs Incurred: provides a summary of costs incurred during 2011.

- 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 four miles west of the California/Nevada border, and approximately seven 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 three miles west of Monitor Pass. The site is located on Leviathan Mine Road, approximately 11 miles from US 395 and three 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; elevations within the fenced portions of the site range from approximately 6,900 to 7,400 feet (ft) above mean sea level. Elevations within the surrounding watershed exceed 8,000 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 a quarter mile downstream from the site. Leviathan Creek converges with Mountaineer Creek approximately two miles downstream of the site to form the headwaters of Bryant Creek. Bryant Creek flows approximately 7.5 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.

2.2.1 Pond 4 Treatment Area, CUD, and DS

The Pond 4 treatment area has historically been used to treat flows from the CUD and DS 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 outlet. 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, varying types of treatment systems, and power generation systems.

The following summarizes activities conducted during previous years to address flows from the CUD and DS:

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. A detailed description of the HDS Treatment System is provided in Section 4.2.2. 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. 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 re-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.

2010 – In 2010, approximately 7.4 million gallons of CUD water and 3.2 million gallons of DS water were collected. Flows from the CUD and DS were captured from May 6 to November 1. Capture of CUD flows was resumed on November 5, and ceased on November 9 to utilize residual lime in the lime storage hopper prior to winterization activities. The HDS Treatment Plant treated and discharged approximately 11 million gallons to Leviathan Creek.

Spring commissioning activities were initiated at the HDS Treatment System on April 12. The HDS Treatment System was commissioned on April 28 and operated from May 1 through November 11 to treat flows from the CUD and DS, as well as approximately 431,000 gallons of water existing in Pond 4 at the beginning of the treatment season that had collected during the previous winter. The volume of stored water in Pond 4 was reduced to the lowest extent possible using the HDS Treatment System prior to winter shutdown.

Approximately 53 tons of non-RCRA California hazardous waste solid (sludge) produced from the HDS Treatment Plant was disposed of at US Ecology in Beatty, Nevada. The HDS Treatment Plant was effective at treating impacted CUD and DS water to below the site discharge criteria.

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 initially operated (1996 through 2003) during the summer and early fall months. In 2004, the ASB Treatment System began year-round operations. A generalized description of the ASB Treatment System is provided below as background information, a detailed description of the ASB Treatment System is provided in Section 4.3.1.

- **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 NaOH 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 NaOH were carried out. The evaluation concluded that NaOH 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% 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 NaOH 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 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.

[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 CFR § 300.435(f).

Two sludge dewatering and removal efforts were tested in 2009: a mobile centrifuge, and a sludge drying bed (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 dewatering by filtration, decanting and evaporation. The SDB pilot test was completed in 2010.

2010 – During 2010, approximately 3.7 million gallons of water from the AS were treated and discharged. Activities completed during 2010 at the ASB Treatment System included bioreactor O&M, monitoring of system performance, sampling influent and treated water, and performing improvements and upgrades to optimize the existing system components. Upgrades completed during 2010 include the installation of year-round safety shower, installation of new chemical pumps and tank monitoring sensors, installation of a new PLC, extension of the existing sludge conveyance pipeline, installation of backup recirculation and influent pipelines, and aeration channel access improvements. Similar to 2009 activities, in June 2010, Atlantic Richfield began additional sample collection and analysis at the ASB Treatment System to continue the assessment and optimization of bioreactor performance. The performance evaluation results were presented to the U.S. EPA in February 2011 in a teleconference.

A mobile centrifuge was used to dewater sludge in 2010. Approximately 95 tons of non-hazardous sludge was removed from the ASB Treatment System and disposed of at US Ecology in Beatty, Nevada.

3.0 HEALTH AND SAFETY PERFORMANCE AND COMMUNITY RELATIONS

The following sections discuss the 2011 health and safety performance and community relations for the site.

3.1 2011 HEALTH AND SAFETY PERFORMANCE

During 2011 operations, morning safety meetings were conducted with all on-site workers and visitors so that each person was aware of the day-to-day HSSE concerns such as site conditions, including weather, deliveries, and the daily scope of work. Learning opportunities from the previous day's work were also discussed during the morning safety meetings.

An orientation to the site was provided to every Atlantic Richfield-related person who conducted work or visited the site in 2011. 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 HSSE Program Document.

In accordance with the HSSE Program Document, incidents, near misses, and Stop Work scenarios at the site were reported to the Health and Safety Coordinator. Of the approximate 85,446 hours worked on- and off- the site during 2011, there were five first-aid cases and zero Occupational Safety and Health Administration (OSHA) recordable injuries. Site personnel identified 16 near misses and 105 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 2011 COMMUNITY RELATIONS

Community relations activities conducted in 2011 included the following:

Leviathan Mine Road Notice of Road Work – On May 26, 2011, a Notice of Road Work was distributed to the residents along Leviathan Mine Road to notify them of scheduled road maintenance and dust suppression activities.

Technical Advisory Committee (TAC) Meeting – On October 26, 2011, 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 2011 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 and repositories for review of 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 2011 REMOVAL ACTION ACTIVITIES

The following section summarizes the Removal Action activities implemented by Atlantic Richfield during 2011, including operation of the HDS and ASB Treatment Systems, and other Removal Action activities. All activities were completed in accordance with the 2011 RAWP, (Atlantic Richfield, 2011d), RAWP Amendment #1 (Atlantic Richfield, 2011f), RAWP Revision #1 to Amendment #1 (Atlantic Richfield, 2011g), and the treatment objectives listed below in Section 4.1.

4.1 OBJECTIVES

The overall site objectives for activities conducted under the AOC and as cited in the 2011 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 (CUD, DS, and AS) to discharge criteria previously established for the site to the extent practicable for a removal action;
3. Optimize the HDS and ASB 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
- Evaluation and system improvement activities to satisfy objectives 3 through 5.

Removal action activities, including evaluation and system improvements are described in the remainder of Section 4.0. Monitoring activities and monitoring results are presented in Section 5.0 and Section 6.0, respectively.

4.2 CUD AND DS TREATMENT-RELATED ACTIVITIES

In 2011, various treatment-related activities were conducted in order to treat flows from the CUD and DS. Section 4.2.1 describes activities associated with site access, LAS mobilization and general Pond 4 activities necessary to support work at the site. Section 4.2.2 describes the HDS Treatment System and routine system O&M activities, and Section 4.2.3 describes HDS Treatment System evaluations and improvements implemented in 2011. Section 4.2.4 describes Pond 4 activities including sludge removal and liner repairs performed in 2011.

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

The U.S. EPA was notified of the commencement of mobilization activities on March 23, 2011. On April 14, 2011, Atlantic Richfield began snow removal and road maintenance activities on the Nevada access route of Leviathan Mine Road starting approximately nine miles from US 395 (Figure 1) and proceeding into the site. Following snow removal and initial road maintenance, Pond 4 setup activities began on April 18, 2011, which included delivery of office trailers, satellite communications equipment setup, and delivery of tools and general supplies to support treatment activities. Site snow removal and setup were periodically delayed due to inclement weather and HSSE concerns. HDS Treatment Systems activities began shortly thereafter, and are described in the following sections.

4.2.2 HDS Treatment System

The HDS Treatment System is comprised of the CUD and DS collection and conveyance equipment, Pond 4, the HDS Treatment Plant (including the process equipment), and the HDS Power Generation System. A layout of the HDS Treatment System, including sampling locations, is presented in Figure 3. The layout of the HDS Treatment Plant equipment, including the HDS Power Generation System is presented in Figure 4. The HDS Treatment System process flow diagram is presented in Figure 5.

The HDS Treatment System is designed to treat combined flows from the CUD and DS up to 100 gallons per minute (gpm). Flows from the CUD and DS are captured and pumped to Pond 4 for temporary storage. Untreated water (influent) is pumped from Pond 4 to the HDS Treatment Plant, reacted with hydrated lime to increase pH and precipitate dissolved metals, and dosed with flocculant to enhance solids removal from the reacted water. The solids generated settle in the clarifier as sludge. Clarified water (effluent) flows from the clarifier to the effluent tank and may be discharged directly to Leviathan Creek or recycled back to Pond 4. A portion of the sludge in the bottom of the clarifier is recycled through the process to increase the density of the sludge and decrease water content. Sludge is wasted (or removed) periodically by pumping sludge from the bottom of the clarifier to sludge dewatering bins.

Routine HDS Treatment System O&M activities conducted in 2011 are broken down into the following categories:

- Spring commissioning and startup;
- Operations and consumable usage;
- Maintenance activities;

- Sludge management; and
- Winter shutdown and storage.

These activities are discussed in further details in the following sections.

4.2.2.1 Spring Commissioning and Startup

The HDS Treatment System must be commissioned every year following winter shutdown. Spring commissioning of the HDS Treatment System began on April 18, 2011 and was completed on May 5, 2011. Following site access and snow removal activities, consumables including diesel, flocculant, and hydrated lime, which were left on-site over the winter to facilitate early startup, were inspected and determined to be suitable for use. The HDS Power Generation System was commissioned to restore power to the site. The first delivery of freshwater occurred on April 26, 2011, to allow HSSE equipment including the HDS Treatment Plant safety shower to be commissioned. Various system improvements were implemented during spring commissioning activities and are discussed further in Section 4.2.3. Following completion of these system improvements, the HDS Treatment Plant was commissioned, which included the following activities:

- The HDS Treatment Plant piping was reconnected and visually checked for leaks;
- All electrical terminations were inspected and torqued;
- Equipment including blowers, pumps, screw conveyors, vibrators, and agitators were serviced in accordance with the manufacturer's recommendations and were returned to service;
- The lime and flocculant systems were serviced, tested, commissioned and returned to service;
- Sensitive electrical equipment including pH probes and the turbidity meter which had been stored off-site during winter shutdown were reinstalled and calibrated; and
- The Human Machine Interface (HMI) and data historian computers were reinstalled in the Operator Trailer.

On May 5, 2011 the HDS Treatment Plant started treating water from Pond 4 that had collected over the winter. The HDS Treatment Plant was initially started in the Recycle Mode, discharging effluent back to Pond 4 with no water discharging to Leviathan Creek. Once the HDS Treatment Plant water quality parameters stabilized, an effluent sample was collected and the HDS Treatment Plant effluent surrogate field parameters (field measured pH and dissolved iron concentrations, as described in Section 5.2.1) were confirmed to meet discharge criteria.

The HDS Treatment Plant was placed in the Normal Mode of operation and began discharging to the channelized portion of Leviathan Creek at 80 gpm. Water in Pond 4 was treated and discharged until the pond level (relative to the USGS gauge height) was lowered from 7.2 feet to approximately 4.3 feet in order to provide approximately five days of holding capacity in the event of an unanticipated HDS Treatment Plant shutdown during operations.

Following commissioning of the HDS Treatment Plant, commissioning of the CUD and DS collection and conveyance equipment commenced and included the following activities:

- Health and safety equipment, including the portable eyewash stations, first aid kit, and fire extinguisher, were reinstalled;
- Electrical equipment installed on the conveyance lines, including level controls, motor control valves, flow meters, and electrical panels were tested and the desiccant/moisture absorbent and shrink-wrap were removed;
- The heat trace was tested and returned to service;
- The piping connecting the USGS weir to the CUD Collection Tank was inspected, cleaned, and re-connected;
- The CUD and DS conveyance lines were pressure tested; and
- The conveyance pumps were reinstalled and tested.

In conjunction with the commissioning activities presented above, conveyance line piping modifications were also performed as described in Section 4.2.3.6.

Once appropriate capacity was achieved in Pond 4, capture of flows from the CUD and DS was initiated on May 13, 2011.

4.2.2.2 Operations and Consumable Usage

The HDS Treatment System is designed to operate 24 hours a day during the ARWS and portions of the LAS. System operators were on-site during daily shifts (weather and access permitting) to maintain system operations and perform routine system checks.

Similar to previous years and in accordance with the 2011 RAWP, the suitability of water quality for discharge from the HDS Treatment Plant was assessed by surrogate field parameter monitoring. Additionally, the HDS Treatment Plant utilized continuous pH and turbidity monitoring for operational control, which indicated if effluent quality had changed significantly between surrogate field monitoring events. Based on operational data from previous years, the HDS Treatment Plant was operated to achieve an effluent pH operating range of 7.5 to

8.5 standard units (s.u.). Operators also collected confirmation compliance samples for laboratory analysis in accordance with the sampling and analysis procedures specified in the 2011 RAWP and summarized in Section 5.2.

The HDS Treatment Plant operated continuously, discharging directly to Leviathan Creek, except during planned and unplanned short-term disruptions, which are discussed in Section 6.1.1.3. 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 these system interruptions. These interruptions were also documented in the monthly reports submitted to the U.S. EPA by Atlantic Richfield (Appendix A).

In order to treat flows from the CUD and DS, the HDS Treatment System requires various consumables including diesel to operate the generators as part of the power generation system, flocculant to enhance solids removal from the reacted water, hydrated lime to raise the influent pH and precipitate dissolved metals, and freshwater for flocculant make-up and various plant wash down activities. The quantities consumed and utilization rates for these chemicals are presented in Section 6.1.1.4.

4.2.2.3 Maintenance Activities

Periodic equipment maintenance requirements of the HDS Treatment System were scheduled and performed by site personnel, specialized maintenance contractors, and off-site maintenance specialists, as appropriate. Typical maintenance activities for the HDS Treatment System included the following:

- Maintaining a preferential flow pathway through the 6-inch minus rip-rap from the DS to the fanned culvert inlet by moving and cleaning the riprap;
- Periodically cleaning or replacing as necessary the CUD and DS conveyance lines and collection tank level controls;
- Inspecting the conveyance pumps for wear and repairing or replacing them as required; and
- Periodically inspecting, cleaning, lubricating, calibrating, adjusting, or replacing HDS Treatment Plant and HDS Power Generation System equipment as necessary.

Non-routine maintenance activities or equipment failures resulting in short-term HDS Treatment Plant disruptions are detailed in Section 6.1.1.3.

4.2.2.4 Sludge Management

The HDS Treatment System process produces a sludge comprised primarily of water, reacted lime, and metal precipitates. Accumulated sludge in the clarifier was wasted (removed from the clarifier) periodically to the sludge dewatering bins. A total of 58,290 gallons of sludge was wasted from the clarifier to the dewatering bins in 2011. The dewatering bins were staged to the east of the process building on a concrete pad and were lined with a nonwoven filter fabric for sludge dewatering. The filtered liquid (supernatant) drained from the dewatering bins into the sump and was pumped either back to the HDS Treatment Plant for subsequent treatment or to Pond 4. When a dewatering bin was ready for removal, the sludge was profiled and transported under manifest by ENV Environmental, Inc. (ENV) to US Ecology in Beatty, Nevada, for disposal. All HDS sludge generated in 2011 was profiled as a non-hazardous waste. A total of 14 sludge filter bins were filled and 138 tons of dewatered sludge was disposed off-site during 2011.

4.2.2.5 Shutdown and Storage

To protect the equipment from damage and in consideration for worker safety due to inclement weather and freezing temperatures experienced during the LAS, the CUD and DS collection and conveyance equipment was shutdown on November 2, 2011. The HDS Treatment Plant continued to operate in order to treat the remaining AD in Pond 4 to the lowest practicable water level (approximately 1.1 feet) before ceasing discharge on November 4, 2011 (note: 1.1 feet of water in Pond 4 equates to a USGS Pond 4 gauge height of approximately 3.2 feet).

Winterization activities then commenced for the HDS Treatment System and Pond 4 work area, and included the following:

- The conveyance pumps in the CUD, DS, and DS transfer collection tanks were removed, cleaned, inspected, and stored off-site.
- The conveyance lines were drained and blown free of water using an air compressor to minimize potential damage due to freezing conditions.
- The piping connecting the USGS weir to the CUD collection tank was disconnected, diverting the flow to Leviathan Creek.
- Electrical equipment installed on the conveyance lines, including level controls, motor control valves, flow meters, and electrical panels, were winterized and shrink-wrapped;
- The lime system was emptied and cleaned. Approximately 1.5 tons of excess lime in the system was mixed with process water and discharged to Pond 4. Operators

minimized the amount of lime transferred to Pond 4 during this cleaning process by anticipating the lime usage required prior to shutdown;

- Equipment including blowers, pumps, and agitators were winterized, and the motors were shrink-wrapped with desiccant/moisture absorbent containers;
- Sludge from the clarifier was pumped into the sludge filter bins to minimize the amount of sludge transferred to Pond 4;
- The HDS Treatment Plant piping was flushed with freshwater, drained of remaining water, and blown-out with air to reduce the potential for freeze damage;
- Sensitive HDS Treatment Plant equipment, such as pH probes and the turbidity meter, were removed and stored off-site;
- HDS Treatment Plant tanks and sumps were drained and cleaned;
- The 5,000 gallon diesel above ground storage tank (AST) was filled to a volume of 4,170 gallons and a winter fuel conditioner was added to mitigate condensation and thus facilitate early commencement of spring commissioning activities in 2012;
- Unused hydrated lime bags were wrapped for moisture protection and stored inside the HDS Treatment Plant for the winter;
- The temporary field office trailers were removed; and
- The power generation system was shutdown, the generators were winterized, and the batteries were removed for winter storage.

Upon completion of all winterization activities on November 17, 2011, the HDS Treatment Building, HDS Power Generation Building, and Pond 4 access gates were locked and secured as personnel departed from the site.

4.2.3 HDS Treatment System Evaluations and Improvements

In 2011 numerous optimization activities and engineering evaluations were conducted to improve discharge water quality and promote safe, reliable and efficient operations. During the 2011 LAS and ARWS, Atlantic Richfield completed the following improvements:

- Clarifier inlet launder modifications;
- Lime sludge mix tank modifications;
- Flocculant auto-batch modifications;
- Turbidity meter relocation;
- Pond 4 pumps modifications;

- Conveyance line piping modifications;
- Conveyance line local control panel (LCP) ground fault circuit interrupter (GFCI) upgrades;
- Generator curtain replacement; and
- Safety shower piping modifications.

The improvements are described in detail in the following sections.

4.2.3.1 Clarifier Inlet Launder Modifications

The clarifier inlet launder is an open top rectangular trough which carries reacted water from the reactor tank to the clarifier. Reacted water flows down the inlet launder at a fairly high velocity, approximately 2.5 feet per second. Prior to the modification the reacted water splashed and periodically overtopped the lower end of the inlet launder at all operational flow rates, thus short-circuiting the clarifier and partially fouling the otherwise clear supernatant (treated water). On September 3, 2010 a temporary cover was installed over the end of the clarifier inlet launder to prevent reacted water from overtopping the launder. The temporary cover was successful in mitigating the overtopping that occurred at the end of the inlet launder; therefore, a permanent cover was installed in April 2011 prior to HDS Treatment Plant startup. The permanent cover was successful in 2011 at preventing reacted water from overtopping the launder and fouling the clarifier supernatant.

4.2.3.2 Lime Sludge Mix Tank Modifications

Bulk dry lime is stored in a storage hopper and conveyed via a screw feeder to the lime metering hopper. From the lime metering hopper, dry lime is metered into the lime sludge mix tank by a screw feeder through the lime dosing port. During the 2010 treatment season, as the dry lime was metered into the lime sludge mix tank, it gradually built up on the walls of the lime dosing port and required frequent cleaning by operators to maintain effective lime dosing. A combination of splashing from the recycled sludge slurry entering the lime sludge mix tank, humidity within the tank, and the proximity of one of the tank baffles contributed to the buildup of lime on the walls of the lime dosing port. To alleviate these issues, modifications to the lime sludge mix tank were evaluated and implemented in April 2011, prior to the HDS Treatment Plant startup. These improvements included:

- Increasing the lime discharge port diameter from 4 inches to 8 inches to reduce lime buildup on the sides of the port;

- Extending the two sludge recycle pipelines to 3 inches below the normal liquid level in the lime sludge Mix Tank to prevent splashing. Anti-siphon holes were also installed on each line;

- Shortening the baffle below the lime discharge port to 6 inches below the normal liquid level in the lime sludge mix tank to reduce lime/sludge buildup. An additional baffle support was also installed; and

- Installing an additional inspection and cleaning access port adjacent to the lime discharge port.

These improvements resulted in reduced lime buildup in the lime dosing port, which extended the maintenance interval required for cleaning, and improved the reliability of the lime dosing system.

4.2.3.3 Flocculant Auto-Batch Capabilities

As part of the HDS Treatment Plant process, flocculant is used to aid in the settling of suspended solids from the treated water in the clarifier. A batch of flocculant solution is prepared in the flocculant mix tank by mixing dry flocculant, metered from the flocculant hopper, and freshwater, pumped from the fresh water tank. During the 2010 treatment season, operators were required to manually engage the freshwater pumps and initiate the batch sequence at the flocculant system control panel. The flocculant system can be set to automatically make new batches as necessary; however, limitations of the freshwater feed system prevented auto-batch capabilities. To facilitate automatic batch make-up, the fresh water piping was modified in April 2011 by installing a flow recirculation loop back to the fresh water tank, prior to HDS Treatment Plant startup. This modification allowed for constant operation of the fresh water pumps, thereby continuously providing a fresh water source to the flocculant system. Following the freshwater piping modifications, flocculant auto-batch mode was engaged and used throughout 2011 reducing system operations and maintenance requirements.

4.2.3.4 Turbidity Meter Relocation

After system optimization activities were completed in October 2010, effluent turbidity decreased from greater than 20 Nephelometric Turbidity Units (NTUs) to less than 10 NTUs. Although a lower turbidity effluent was produced, operators observed that the in-line turbidity meter became unreliable and required excessive (twice daily) calibration. After an evaluation of the turbidity meter was completed, it was determined that reflective interference from the back wall of the recirculation loop pipe was causing the unreliable measurements. In April 2011, prior to HDS Treatment Plant startup, the turbidity meter was removed from the recirculation loop and installed directly into the effluent tank to provide the necessary clearance to eliminate wall

reflective interference. Following the turbidity meter relocation, the turbidity meter accurately measured effluent turbidity and required only occasional calibration; thus extending the maintenance interval on the turbidity meter and reducing the system operation and maintenance requirements.

4.2.3.5 Pond 4 Pump Modifications

The HDS Treatment Plant used two Pond 4 influent pumps (a primary and backup) to convey influent from Pond 4 to the reactor tank for subsequent treatment. The HDS Treatment Plant was designed to treat flow rates of up to 100 gpm; however, during the 2009 and 2010 treatment seasons, the maximum flow rate achieved during field testing of the pumps was 89 gpm.

Prior to 2011 each of the Pond 4 influent pumps was driven by a 5 horsepower (HP) motor. In order to increase the pumping capacity, several modifications were evaluated and implemented in April 2011, prior to HDS Treatment Plant startup. On both Pond 4 influent pumps, the 5 HP motor was replaced with a 7.5 HP motor, and the maximum pump speed was increased from 2,350 revolutions per minute (rpm) to 2,650 rpm. Field testing with the upgraded Pond 4 influent pumps was conducted during HDS Treatment Plant startup in May 2011, and a flow rate of 100 gpm was achieved.

4.2.3.6 Conveyance Line Piping Modifications

Flows from the CUD and DS are captured and pumped to Pond 4 by the CUD and DS collection and conveyance equipment. Prior to 2011, the CUD and DS conveyance lines each consisted of an insulated line (typically used during the LAS) and an un-insulated line (typically used during the ARWS) with ball valves installed along the lines to route the flows as necessary. The CUD and DS insulated and un-insulated conveyance lines each converged at a pipe junction (referred to as the “Y”) to a single insulated line, upstream of the flow meters that measure the flow of AD from the CUD and DS, prior to discharge to Pond 4. During 2010, several modifications to the conveyance lines were evaluated to improve system reliability and facilitate inspection and maintenance of the lines. In conjunction with spring commissioning of the CUD and DS collection and conveyance equipment in April 2011, the following modifications were implemented:

- The ball valves (which can hold water internally in the valve when closed) were replaced with gate valves (except for the six bleed-back ball valves) to reduce potential damage due to freezing;
- The 90 degree turns at the “Y” were replaced with gradual sweeps to facilitate line maintenance;

- The insulated and un-insulated conveyance lines at the ”Y” were separated, and continued independently in parallel to Pond 4 to reduce areas of stagnant flow and additional freeze hazards;

- Two additional flow meters, one on the CUD un-insulated line and one on the DS uninsulated line, were installed to allow for flow measurements on both the insulated and un-insulated conveyance lines;

- The existing connections and associated conveyance piping to the Pond 4 LTS Equalization Tank, which were no longer in use, were removed to reduce areas of stagnant flow and additional freeze hazards;

- The pig launchers, receivers, and associated ball valves on the CUD and DS conveyance lines were removed to reduce areas of stagnant water and additional freeze hazards; and

- Removable 4-foot pipe sections were installed at 100 foot intervals along the CUD insulated and un-insulated conveyance lines to facilitate inspection and maintenance of the lines.

Following implementation of these improvements, the conveyance lines experienced no significant damage due to freezing, the newly installed flow meters operated successfully, and a reduced level of effort was required when inspecting and maintaining lines.

4.2.3.7 Conveyance Line LCP GFCI Upgrades

Local control panels (LCPs) which contain the associated electrical equipment are located at the CUD, DS, and DST. Each LCP has an electrical outlet, situated on the side of the panel, which allows operators to plug in a laptop while working in any of these areas. The 2011 National Electrical Code (NEC) Section 210.8 B(4) provides a requirement for outdoor outlets to have ground fault circuit interrupters (GFCIs) for non-dwelling units. GFCIs prevent injuries due to electric shock by monitoring the amount of electricity flowing from the ‘hot’ to the neutral line (i.e., electrical short). If an imbalance is detected between the two lines, the GFCI trips the circuit, stopping the flow of electricity. In October 2011 the electrical outlets at the CUD, DS, and DST LCPs were upgraded with faceless GFCIs.

4.2.3.8 Generator Curtain Replacement

The HDS Treatment Plant and power generation system are housed in a building with a sloped roof designed to shed snow. Access to the generator enclosure is provided by a man-door on the west side of the building. Falling snow and ice has been identified as a hazard to site personnel beneath the eaves on the west side of the generator enclosure.

Prior to November 2011, the curtain used to close and secure the generator enclosure provided limited security. The curtain, constructed of poly-coated canvas, could easily be cut, allowing intruders into the generator enclosure which contains the Electrical Power Trailer (EPT), the three HDS generators and the diesel AST. Additionally, raising and lowering of the generator enclosure curtain required the use of heavy equipment and working at heights at the beginning and end of each treatment season, thus presenting hazards to personnel.

In November 2011 the generator curtain was removed and two new metal roll-up doors were installed to improve the security of the generator enclosure during the winter when personnel are not on-site, and to reduce health and safety risks associated with annually lowering and raising the roll-up curtain. A new man-door was installed within the opening of one of the metal-roll up doors. The new man-door allows site personnel to enter the generator enclosure without walking below the western roof eave where falling snow and ice hazards exist.

4.2.3.9 Safety Shower Piping Modifications

Two safety shower and eye wash stations are installed in the HDS Treatment Plant. Safety Shower and Eyewash Station 01 (SS-01) is installed on the lower level of the HDS Treatment Plant and Safety Shower and Eyewash Station 02 (SS-02) is installed on the upper level. Both SS-01 and SS-02 are supplied with water by a pressurized 325 gallon potable water tank located behind SS-01. During function testing of SS-01 and SS-02, site personnel observed significant particulate (i.e., rust) in the potable water flushed through the eyewash and shower stations due to corrosion in the black iron piping which feeds SS-01 and SS-02. To prevent rust build up and improve the water quality within the eyewash and shower stations, the black iron pipe was replaced with high-density polyethylene (HDPE) pipe which is resistant to corrosion and has a longer life span. The three carbon steel ball valves were also replaced with similar type brass ball valves. After the safety shower piping modifications were completed a function test to ensure SS-01 and SS-02 was preformed to confirm proper operation.

4.2.4 Pond 4 Activities

Between 2002 and 2009, the LTF and later the Pond 4 LTS were used to treat AD flows from the CUD and DS. During LTF and Pond 4 LTS operations, Pond 4 was used as a final settling pond, resulting in the gradual accumulation of sludge. 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 HDS Treatment Plant operations commenced. Currently Pond 4 is used as an equalization or surge basin to provide a short-term contingency storage capacity for AD collected from the CUD and DS and to prevent a loss of capture should the HDS Treatment plant have an unplanned shutdown. Additional sludge accumulation due to

water treatment by the HDS Treatment Plant is minimal; however, minor additional sludge deposition in the pond may be caused by oxidation of AD stored in the pond prior to treatment due to the generation of ferric iron oxy-hydroxide precipitates. In early 2011, the total sludge volume was estimated at approximately 2,200 cy. The estimated sludge accumulation of 2,200 cy decreased the storage capacity of Pond 4 by approximately 400,000 gallons or close to 50% of the total 847,000 gallons working capacity of Pond 4.

Partial sludge removal and dewatering operations were proposed to increase the working capacity of Pond 4 so that it can continue to serve as an effective flow equalization and surge basin for the HDS Treatment Plant. Atlantic Richfield completed an evaluation of the various methods for sludge removal and prepared an Amendment to the 2011 RAWP (Atlantic Richfield, 2011f) which notified the EPA of Atlantic Richfield's plans for removal, dewatering, and disposing of sludge from Pond 4. Pond 4 sludge removal operations are discussed further in Section 4.2.4.2.

Based on the evaluation, a small remotely-piloted floating dredge was selected as the safest and most cost effective method for Pond 4 sludge removal. This method was also selected because it would not damage the HDPE Liner, it was relatively easy to implement, and it had been successfully implemented in similar ponds on other projects.

4.2.4.1 Pond 4 Bypass

To reduce site hazards and prevent corrosion to dredging equipment, Pond 4 was isolated from CUD and DS flows during Pond 4 sludge removal operations and the pH of the water in Pond 4 was adjusted from a pH of approximately to 3 s.u. to 5.5 s.u. or greater. Revision *#1, Amendment #1 - 2011 Pond 4 Sludge Removal* (Atlantic Richfield, 2011g) notified the EPA of Atlantic Richfield's plan for bypassing Pond 4 during Pond 4 sludge removal operations.

Pond 4 was bypassed on July 15, 2011 by diverting CUD and DS flows into two 21,000-gallon liquid storage tanks connected in series rather than directly into Pond 4, thus allowing the pH Pond 4 to be more easily adjusted and controlled. One of the existing Pond 4 pump intakes was removed from Pond 4 and connected to the storage tanks to provide influent for the HDS Treatment Plant. The HDS Treatment Plant was then periodically placed in the Recycle Mode (i.e., effluent diverted back to Pond 4) as necessary to raise the pH and maintain a sufficient water level for dredging operations. When the HDS Treatment Plant was not in Recycle Mode, water was treated and discharged to Leviathan Creek. To provide a contingency in the event of a planned or unplanned HDS Treatment Plant shutdown, the Pond 4 pumps were operated to maintain a constant water level in the storage tanks, such that at least 12 hours of storage capacity was available. Additionally, the storage tanks were plumbed to overflow into Pond 4 in

the event of a long term HDS Treatment Plant shutdown, and the water level in Pond 4 was managed to maintain at least five days of storage capacity during dredging operations.

4.2.4.2 Sludge Removal Operations

In accordance with *Amendment #1 – 2011 Pond 4 Sludge Removal* (Atlantic Richfield, 2011f), Pond 4 sludge removal operations were conducted from July 19, 2011 through September 29, 2011.

Sludge in Pond 4 was removed using a remotely controlled floating dredge operated from a 460 volt (V) control panel, located on the Pond 4 berm as shown in Figure 9. The control panel and the dredge were powered using a 150 kilowatt (KW) portable generator. Diesel fuel for the generator was stored nearby in a 1,000-gallon AST located within secondary containment. A three anchor manual traverse system was installed around Pond 4 to support and anchor the dredge as shown in Figure 10. The dredge traversed Pond 4 in a series of overlapping rows, from multiple directions, by rotating the three anchor points around Pond 4. A 54-inch wide caged cutter head, equipped with rubber tires to prevent damage to the Pond 4 liner, was used to collect sludge from the bottom of Pond 4. Sludge collected by the cutter head was pumped, at an average rate of approximately 600 gpm, through a floating 6-inch hose which connected to an onshore 6-inch PVC pipe. A distribution manifold was used to direct the sludge from the 6-inch PVC pipe into four dewatering bins simultaneously. The dewatering bins were similar to those used to manage the HDS Treatment System sludge.

As many as 12 dewatering bins were connected to the manifold at one time, to maximize the amount of sludge pumped per day. Typically the dewatering bins were filled in the morning, and allowed to dewater for approximately six hours before being filled again to dewater overnight. This process was continued until the dewater bin was sufficiently filled with sludge, which would take approximately three days.

To promote solids settling and facilitate the dewatering process, a 3% liquid polymer solution was dosed directly into the 6-inch PVC pipe. Prior to the commencement of Pond 4 sludge removal operations, bulk sludge samples were collected for testing of settling and dewatering characteristics. This testing included the use of selected polymers at various doses to enhance coagulation, settling and sludge draining. Based on the sludge testing, the NALCO Core Shell® 71305 polymer was recommended to enhance sludge settling and dewatering. Based on sludge drainage tests through three different geotextile fabrics (fine, medium, and coarse mesh), a fine fabric (Mirafi 135N) was selected as the most effective for use in the Pond 4 sludge dewatering bins. This is the same bin liner fabric used in the dewatering bins at the

HDS Treatment Plant. During dredging operations, the polymer dosing flow was adjusted by operators based on settling tests and visual observations to maintain optimal polymer dosing.

Following disposal of the sludge at US Ecology in Beatty, Nevada, the dewatering bins were decontaminated and refit with new filter liners for reuse at the site.

Upon completion of Pond 4 operations, a total of 108 dewatering bins containing 707 tons of sludge were removed from the site. The results of Pond 4 sludge removal operations are discussed further in Section 6.1.2.

4.2.4.3 Pond 4 Liner Repair

As part of the site RI/FS activities, on June 23 and 24, 2011, Leak Location Services, Inc. (LLSI) of San Antonio, Texas performed a leak location survey of Pond 4 using electrical leak location methods. During the survey, LLSI identified electrical signals for eight potential leak locations in the Pond 4 liner. The location of each leak signal was recorded using Global Positioning System (GPS) coordinates. After Pond 4 sludge removal activities were completed in October 2011, Pond 4 was completely drained.

During the time period when Pond 4 was empty and isolated, manual liner inspections and repairs were conducted. On October 10 and 11, 2011, the eight areas identified as leak signal locations in the Pond 4 liner were inspected using the GPS coordinates recorded during the leak location survey. Small holes or liner abnormalities were identified at five of the eight locations and repaired by patching the liner or cleaning and re-sealing the liner seams. Following each repair, the location was vacuum tested and confirmed that no leaks were present. At the other three locations, no holes or liner abnormalities were observed in a 4-foot by 4-foot area around the recorded signal location. It is suspected that the anomalies recorded at these three locations may have been due to electrical conduction paths caused by metallic materials on top of the liner which may have been moved or sucked up by the dredge during sludge removal operations. Additional details on the Pond 4 liner repairs are included in the memorandum *Pond 4 Liner Repairs, Leviathan Mine Site, Alpine County, California* dated March 6, 2012 (Appendix H).

4.3 ASPEN SEEP TREATMENT-RELATED ACTIVITIES

In 2011, various treatment-related activities were conducted in order to treat flows from the AS. Section 4.3.1 describes the ASB Treatment System and the routine O&M activities, and Section 4.3.2 describes ASB Treatment System evaluations and improvements implemented in 2011.

4.3.1 ASB Treatment System

A layout of the ASB Treatment System, including sampling locations, is presented in Figure 6. The ASB Treatment System process flow diagram is presented in Figure 7. The ASB Treatment System generally consists of a collection area, followed by a series of five ponds, one of which was initially designed as a pre-treatment pond, two of which are filled with a rock matrix (denoted Biocells 1 and 2) to provide surface area for the growth of attached sulfate-reducing bacteria (SRB), and two of which are the initial and final settling ponds (denoted Ponds 3 and 4, respectively). Influent to the ASB Treatment System flows from the seep collection area through a United States Geological Survey (USGS) weir for flow measurement prior to treatment. The flow data collection system is solar powered and USGS is the sole operator. The pH of the influent water is adjusted with sodium hydroxide (NaOH) and mixed with sulfide-rich biocell effluent prior to entering Pond 3, where the water is recycled by a recirculation pump to the pre-treatment pond at the head of the biocells. Flow from the pre-treatment pond provides influent water to the biocells. This recirculation flow configuration, which has been exclusively used during normal operations since 2004, promotes solids settling within Pond 3 instead of in the biocells, improving water conditions for the SRB and reducing sludge accumulation in the biocells.

The ASB Treatment System requires two chemical feeds, an ethanol blend as an organic carbon food source for the SRB, and NaOH to increase the pH. Increasing system pH promotes formation and precipitation of metal sulfides, and creates more favorable conditions for the SRB. The ethanol and NaOH are dosed into the ASB Treatment System by peristaltic pumps. Additionally, urea and trisodium phosphate (TSP) are manually added to the biocells to provide the macro-nutrients nitrogen and phosphorus to promote SRB growth.

A propane generator-based battery-integrated power generation system was installed and modified in 2007 and 2008, respectively. The generators are used to charge the batteries from which inverted power is used to operate the various system components. The integrated battery bank powers all system equipment and allows the propane generators to cycle operation; thus, reducing generator run-time and fuel consumption, extending the interval required for generator maintenance and facilitating less frequent site visits during the LAS.

The ASB Treatment System is monitored and controlled (both locally and remotely) by a Supervisory Control and Data Acquisition (SCADA) system. The primary components of the SCADA system are the Human Machine Interface (HMI) and the programmable logic controller (PLC), which facilitate control and monitoring of the chemical feed and recirculation pumps, flow meters, generators, and battery bank. A network camera facilitates remote inspections of site conditions, such as current snow levels or ASB Treatment System process water color as it

enters Pond 3. The power inverters are equipped with a Sunny WebBox, which facilitates remote power quality data access and inverter control. Off-site access to the network camera, Sunny WebBox, and SCADA system is available through web based applications via satellite internet communication. The SCADA system, network camera and Sunny WebBox improve overall reliability of the ASB Treatment System by enabling remote inspections of site conditions and providing limited troubleshooting capabilities.

Routine ASB Treatment System O&M activities conducted in 2011 are separated into the following categories:

- Operations and consumable usage;
- Maintenance; and
- Sludge management.

These activities are discussed in further detail in the following sections.

4.3.1.1 Operations and Consumable Usage

During 2011, Atlantic Richfield operated the ASB Treatment System to continuously treat flows from the AS. During the LAS, the ASB Treatment System was visited approximately once monthly as required for operations. Remote inspections via the SCADA system and network camera were performed to monitor onsite operations between site visits during the LAS. During the ARWS, the ASB was visited approximately twice weekly to maintain system operations.

During ASB Treatment System operations, operating parameters, including ethanol and NaOH dosing rates, and recirculation flow rates, were verified and adjusted as necessary. NaOH dose rates were adjusted as described in the ASB O&M Manual to achieve an effluent pH between 7.2 and 8.0 s.u. Based on historic operations, this pH operating range typically results in effluent with dissolved metals concentrations below discharge criteria.

The ASB Treatment System operated continuously in the recirculation flow configuration except during brief disruptions, which are discussed in Section 6.2.1.3. None of the operational disruptions resulted in discharge of untreated water to Aspen Creek; however, premature wearing of the NaOH peristaltic pump tubing in January and February, 2011 and increasing influent flow rates during April and May, 2011 caused discharge of water exceeding some of the discharge criteria as described in Section 6.1.1.2.

During the 2011 ARWS, Atlantic Richfield used various consumables to treat flows from the AS. Ethanol was added as the organic carbon and energy substrate for SRB to promote the

bacterial conversion of sulfate to sulfide. NaOH was added to adjust the pH of the influent, promote precipitation of metal sulfides and create an appropriate environment for the SRB. TSP and urea were added as nutrients for the SRB. Propane was utilized as fuel for the power generation system. Chemical deliveries were coordinated on an as-needed basis during the ARWS, and to ensure sufficient inventory prior to the LAS. Deliveries conducted during 2011 included one ethanol delivery, six NaOH deliveries, and two propane deliveries. Numerous NaOH deliveries were required since the narrow site roads limit the permitted length of delivery trucks and the associated size of chemical deliveries. TSP and urea were obtained and transported to the site by system operators as needed. The quantities consumed and utilization rates for these chemicals are presented in Section 6.2.1.4.

4.3.1.2 Maintenance

Equipment maintenance activities were scheduled and performed by site personnel, specialized maintenance contractors, and off-site maintenance specialists, as appropriate. Routine maintenance requirements are detailed in the *ASB Operation and Maintenance Manual* (Atlantic Richfield, 2011) and include:

- Periodic inspection, replacement, and/or cleaning of influent and recirculation pipelines to mitigate accumulation of scale and flow restrictions;
- Manual removal of debris and sediment deposits from the AS collection area geo-textile cover to maintain proper flow through the rock matrix and prevent surface ponding;
- Periodic inspection, testing, cleaning, fluid replacement, and/or lubrication of ASB Treatment System, power generation system, protective system devices (i.e., smoke detectors, tank level alarms, etc.), and SCADA/Telemetry and Communications System components to ensure optimal equipment operation; and
- Sludge management (Section 4.3.1.2).

Non-routine maintenance activities performed during 2011 included battery bank replacement as described in Section 4.3.2.3.

4.3.1.3 Sludge Management

The ASB Treatment System produces biomass from the SRB and precipitates insoluble metal sulfides from the influent AD to form sludge. By design, the majority of the sludge is precipitated in Pond 3 where the metal-rich influent is mixed with the sulfide-rich effluent from the biocells; however, sludge is also deposited within the biocells, manholes, pipes and other ponds. Annual management or removal of sludge from the ASB Treatment System is necessary to maintain optimal flow through the biocells, prevent pipe clogging, maintain residence time in the biocells

and ponds, and promote reliable system performance. Sludge management activities implemented in 2011 include:

- Biocell flushing;
- Biocell flow reversal; and
- Sludge removal and dewatering.

Sludge disposal is described in Section 4.4.3, and system monitoring and sampling activities and results are described in Sections 5.2.1.2 and 6.2.1.5, respectively.

Biocell and Pipe Flushing

Flushing of the biocells is necessary to reduce accumulated sludge and preferential flow through the biocells. A flushing event involves draining (or flushing) sludge and water from a biocell by opening three of six available flush loops located at the bottom of the biocell. After a biocell is drained, it is refilled with clarified water from Pond 3. During biocell refilling, the stream of clarified water is directed over various regions of the biocell rock matrix in an attempt to dislodge accumulated sludge. To ensure flushing of the entire biocell matrix, the flushing process is repeated via the remaining three flush loops. Biocells 1 and 2 were flushed during June 2011 and Biocell 2 was flushed a second time during September 2011. A second round of Biocell 1 flushing was scheduled; however, it was not completed due to a Stop Work event caused by an elevated H_2S incident, H_2S evaluation activities (Section 4.3.2.6), and the onset of winter conditions in mid-November, 2011. Sludge removed from the biocells during flushing activities was transferred to Pond 4 for temporary storage prior to sludge removal activities.

Biocell Flow Reversal

Reversing the flow direction within each biocell can prevent long-term sludge deposits, minimize formation of preferential flow paths within the biocells, and was previously considered as a method for improving biocell performance. Biocell flow reversal was performed by adjusting the height of various manhole standpipes in order to change the direction of flow. When flow was reversed, biocell influent piping became effluent piping, and vice versa. Following each biocell flow reversal, the treatment system was observed intermittently for several hours to confirm that appropriate equilibrium flow conditions were re-established. The flow direction through Biocell 1 and Biocell 2 was reversed on September 14 and 16, 2011, respectively, to manage sludge deposits and evaluate the impact of this maintenance activity on system performance. Results of the biocell flow reversals during 2011 are presented in Section 6.2.1.2.

Maintenance and Resurfacing of the Sludge Dewatering Area

To provide a level staging area for the sludge dewatering equipment and tanks, the sludge dewatering area was re-graded on June 4, 2011. A front-end loader and a roller were used to place and compact approximately 25 tons of supplemental certified weed free base rock in the staging area.

Sludge Removal and Dewatering

Sludge removal and dewatering activities were required in 2011 due to the large volume of accumulated sludge resulting from the high influent flow rates and metals loading. During June 2011, in preparation for sludge dewatering, the water levels in Ponds 3 and 4 were lowered and sludge was transferred from Pond 3 to Pond 4 in order to minimize unavoidable system downtime during sludge removal from Pond 3. Mobilization of sludge removal and dewatering equipment, including a mobile centrifuge, one storage tank, one mix tank, and two weir tanks, two portable generators, and a high-head diesel pump, began on June 6, 2011. Clear Water Compliance, Inc. (CWC) of Loomis, California provided all equipment and two full-time operations personnel for sludge dewatering activities. Equipment and associated piping and manifolds were staged inside spill guards at the sludge dewatering area. To ensure that equipment was operable and free of leaks, the conveyance, storage, and dewatering systems were inspected and tested onsite prior to operations with sludge. Following equipment testing, ASB Treatment System clarified process water was pumped to one weir tank and sludge was pumped to the mix and storage tanks through a 4-inch diameter HDPE sludge conveyance pipeline. The layout of the dewatering equipment and associated tanks and sludge/filtrate water conveyance lines is shown on Figure 8.

On June 22, 2011 following onsite troubleshooting by the centrifuge manufacturer representative, it was determined that the existing centrifuge could not achieve the required solids content for the dewatered sludge and it was necessary to obtain alternate dewatering equipment. A more appropriate centrifuge was not available; therefore, a belt filter press was mobilized to the site on July 7, 2011 by CWC. A similar belt filter press was used for sludge dewatering in 2008.

Sludge dewatering using the belt filter press was conducted between July 12 and August 25, 2011. Approximately 7,100 gallons of sludge were processed daily during typical belt filter press operations and a total of 185,000 gallons (86 wet tons, 15 dry tons) of sludge was dewatered during 2011. The belt filter press dewatered sludge by applying pressure and physically squeezing water (denoted filtrate water) out of the sludge. Prior to dewatering, a polymer was added to the sludge to flocculate sludge particles and enhance the dewatering process. The material entering the belt filter press was compressed between two tensioned,

porous belts running over rollers of increasingly smaller diameter which continuously increased the pressure applied to the sludge. Occasional cleaning of the belt filter was required as part of normal operations.

During belt filter press operation, sludge was transferred from the storage tanks to the mix tanks, continuously mixed to maintain an appropriate consistency, and pumped to the belt filter press. Sludge storage and mix tanks were utilized to allow controlled delivery of sludge to the belt filter press that could not be achieved if sludge was pumped directly from the ponds. Flow totalizers were used to quantify the volume of sludge pumped to the belt filter press. Sludge was pumped from the ponds to the sludge storage tanks through the sludge conveyance pipeline every two to four days, dependent on operations. Sludge pumping was conducted using a high-head diesel pump equipped with two 4-inch intake hoses with stingers. Operators achieved an appropriate sludge consistency by mixing process water with sludge or by moving the pump intake stingers to locations with lower or higher sludge density.

Dewatered sludge was collected in a one cubic yard transfer bin prior to containerization in 20-cy closed-top sludge storage bins. Belt filter press filtrate water was cycled through one or two weir tanks for clarification, pumped through a polishing bag filter, and typically discharged daily through a flow meter to Aspen Creek. Prior to discharging filtrate, water quality monitoring was completed as described in Section 5.2.1.2, and evaluated as described in Section 6.2.1.5.

Following sludge dewatering activities, the belt filter press and the storage, mix, and weir tanks were cleaned by ENV with non-chlorinated water from Gardnerville, Nevada. The rinsate generated during cleaning was collected in one of the weir tanks and discharged to Pond 4 in accordance with the protocol for the filtrate water discharge. Onsite cleaning and demobilization of equipment was completed on September 10, 2011. Additional offsite cleaning of storage, mix, and weir tanks was completed by ENV and the generated rinsate was disposed of at U.S. Ecology in Beatty, Nevada.

During 2011, sludge was removed from the system to the fullest possible extent, and the sludge volumes in Ponds 3 and 4 were reduced to approximately ten percent of total pond operational capacities which exceeds the extent of historic sludge removal efforts.

4.3.2 ASB Treatment System Evaluations and Improvements

During the 2011 ARWS, Atlantic Richfield performed the following system evaluations and improvements to promote safe, reliable operations at the ASB Treatment System:

- Nutrient addition adjustments;

- Sodium hydroxide tubing modifications;
- Power Generation System improvements;
- Satellite accumulation area improvements;
- Infiltration/Overflow Pond evaluation; and
- H2S monitoring and evaluation.

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

4.3.2.1 Nutrient Addition Adjustments

The results of enhanced ASB Treatment System sampling conducted in 2010 indicate that water in the ASB Treatment System continues to have low to very low levels of the nutrients nitrogen and phosphorous compared to the concentration of dissolved organic carbon (DOC). While the ASB Treatment System previously performed adequately with respect to water quality compliance, optimizing system nutrient addition was continued in 2011 with the objective of providing better conditions for the SRB which could minimize chemical usage and sludge generation due to biomass accumulation, thus reducing operational costs. Additionally, alternative nutrient additives were implemented on the basis of effectiveness, availability, and cost.

In January 2011, Atlantic Richfield changed the formulation of the phosphorus additive from monosodium phosphate to TSP, which has greater availability with reduced costs. TSP is a common nutrient additive in bioreactor treatment systems. During November 2011, nutrient additions of urea and TSP were increased by approximately 50 percent (%). Continued monitoring through *Regular Field Monitoring*, *Analytical Compliance Sampling* and the *Enhanced Sampling for Optimization* events, as described in Section 5.1.1, were used to evaluate the effects of urea and TSP addition on system performance and effluent quality. System performance was typically satisfactory during 2011. There were no significant performance changes which could be attributed to either the change in type or quantity of nutrients.

4.3.2.2 Sodium Hydroxide Tubing Modifications

As part of the ASB Treatment System process (Section 2.2.2), NaOH is added to influent AD for pH adjustment. Reliable dosing rates are required in order to maintain effluent quality which meets discharge criteria. A new type of pump and associated new pump tubing were installed prior to the 2010/2011 LAS to improve system reliability.

During January and February 2011, it was observed that NaOH dose rates were declining significantly between the monthly LAS site visits. The dosing decline was attributed to poor performance of the NaOH peristaltic pump tubing. Therefore, during the 2011 ARWS, various pump heads and pump tubing formulations were evaluated for use with the existing pumps. A new tubing formulation with greater durability (Masterflex Gore® High-Resilience tubing) was selected and implemented in September, 2011. The performance of the new tubing has resulted in more reliable NaOH dose rates.

4.3.2.3 Power Generation System Improvements

The ASB Treatment System requires electrical power to operate process pumps, instrumentation, and controls. Power is provided by an off-grid power generation system composed of a 48-volt (V) battery bank, two power inverters, and two propane generators which intermittently operate to charge the battery bank. The original flooded lead-acid (FLA) batteries were installed in the operator control room (Electrical Conex) in 2007. These batteries had the potential to expose operators to hydrogen off-gassing during charging and to the liquid acid electrolyte contained within the batteries during maintenance. Additionally, electrical systems and controls were housed with the batteries in the Electrical Conex.

During 2010, HSSE concerns regarding the existing battery bank and suspected deviations in power quality prompted evaluation of the power generation system. The resulting recommendations included battery enclosure upgrades based on industry recommendations for electrical systems, battery bank replacement since the existing batteries were reaching the end of their recommended useful life, and uninterruptable power supply (UPS) and grounding upgrades to improve system power quality. These activities are described in the following subsections.

Battery Enclosure Upgrades

During September and October 2011, a 1-hour fire-rated partition wall was constructed across the rear portion of the Electrical Conex to create a dedicated battery room separate from the controls area. Instrumentation and control modifications for the battery room were completed during battery room construction, including updates and improvements to the power generation system control strategy and the installation of an additional hydrogen gas sensor, a solar heater, rigid insulation, and an additional ventilation fan in order to increase safety and system reliability. These activities achieved the following system benefits:

- HSSE improvements through isolation of batteries from potential ignition sources located in the Electrical Conex;

- HSSE improvements by limiting personnel access to the batteries, resulting in reduced personnel exposure to battery-related hazards;
- Improved ventilation management to vent hydrogen gas by installing the additional hydrogen gas detector and implementing detector-controlled ventilation fan operation; and
- Improved battery temperature control through insulation, improved ventilation management, and solar heater installation, resulting in improved battery longevity.

Additionally during construction activities, the floor of the new battery room was reinforced with a steel plate and additional conex cross-beams to accommodate the weight of the new battery bank described in the following section.

Battery Bank Replacement

During construction of the battery room, the FLA batteries were replaced with more compact AGM batteries. Replacement of the previous batteries with AGM batteries provided the following benefits:

- Significantly lower hydrogen gas production during charge cycles relative to FLA batteries, decreasing explosion risk;
- Elimination of operator exposure to acid electrolyte during battery maintenance, due to the sealed design of the AGM batteries;
- Reduced risk of battery acid release because the AGM batteries are sealed and the battery acid is stored in a non-liquid (gel-like) form; and
- Improved operator and equipment safety due to the seismically-rated battery racking system.

The AGM batteries were installed with oversight by battery manufacturer representatives and commissioned on October 26, 2011. The FLA batteries were recycled offsite as described in Section 4.4.4.

UPS and Grounding Upgrades

Minimizing nuisance alarms and electrical faults is critical to reliable operation of the ASB Treatment System, especially during the winter months when the site is unmanned. Therefore, during August 2011, H2E, Inc. (H2E), an electrical engineering contractor, spent three days recording power quality data and reviewing system wiring at the ASB Treatment System in an effort to identify the source of the reported alarms and nuisance electrical faults.

During H2E's monitoring, it was discovered that when the inverters transfer between alternate power sources (i.e., the battery bank or the generators) there is a short interruption in power that results in voltage excursions. A UPS was installed on November 17, 2011 between the power inverters and the system controls to provide more reliable power to system controls when the inverters transfer between alternate power sources. The system controls include the components which are most susceptible to poor quality power. The UPS was installed in the insulated battery room, which is equipped with a solar powered heater, to optimize the operating conditions of the UPS.

System wiring reviews included inspection of the neutral wiring, ground wiring, and the associated termination points. During review, parallel grounding, bonding, and neutral paths were identified which can cause electrical noise in a circuit and potentially interfere with the proper operation of system devices. Wiring and bonding upgrades were performed during October 2011 to eliminate these paths, reduce the current return paths to a single conductor, and minimize potential electrical interference in the system.

Since the installation of the UPS and completion of the grounding and bonding upgrades, nuisance alarms and electrical faults have not been observed.

4.3.2.4 Satellite Accumulation Area Improvements

The satellite accumulation area is used for the temporary storage of miscellaneous waste generated at the ASB Treatment System. This area was previously constructed with wooden fence posts, fencing, and an access gate which were in disrepair. On October 24 2011, the perimeter fence of the ASB Treatment System satellite accumulation area was replaced with new aluminum fence posts, new wire fencing, and a new entry gate in order to improve security and personnel safety.

4.3.2.5 Infiltration/Overflow Pond Evaluation

The Infiltration/Overflow Pond (IOP) is situated in a low lying area between the end of the aeration channel and Aspen Creek. This area is created between the concave shaped hillside to the south and an earthen berm of unknown construction origin to the north. Because of the topography, water flowing from the aeration channel collects in this area prior to overflowing to Aspen Creek. Although this area has been indicated on some system drawings and site layout maps, Atlantic Richfield did not design or construct the IOP, and it is not a component of the ASB Treatment System.

Atlantic Richfield began an evaluation of the IOP during 2011, including collection of sediment samples to characterize this area; however, the evaluation was not completed because work activities during the end of the 2011 field season shifted to investigate the cause of the elevated H_2S concentrations. Prior to 2011, there had been no known sampling of the IOP. A description of the sampling event and summary of analytical results are provided in Sections 5.2.2.3 and 6.2.2, respectively.

4.3.2.6 H_2S Incident and Evaluation

H_2S gas has been a known hazard at the ASB Treatment System since current system construction in 2003. Exposure to H_2S in high concentrations can range from minor to severe symptoms, including pulmonary paralysis, sudden collapse, or death. The source of H_2S at the ASB Treatment System is the reduction of sulfate to sulfide in the aqueous phase which is a key process in the treatment of AD. Prior to 2011, H_2S had been detected infrequently around system manholes at low concentrations. Most detections occurred when the manhole covers were removed, which allowed venting of air that had been in contact with process water. Consequently, the areas near system manholes were designated as exclusion zones. Due to the H_2S hazard and proximity of the exclusion zones to other work areas, site protocol for all work areas included site-specific H_2S training for hazard awareness and evacuation procedures, use of personal alarming H_2S monitors (monitors), and use of multi-gas alarming meters (meters). For workers entering exclusion zones, protocol also included the use of self-contained breathing apparatus (SCBA).

On October 7, 2011 two operators were performing routine access of an exclusion zone in accordance with site protocol. Upon opening the cover to manhole 6 (MH-6), a peak concentration of 252 ppm H_2S was measured with the operator's meter. The monitor worn by the operator opening the manhole recorded a peak measurement of 72.1 ppm. The monitor worn by the operator located approximately five feet away from the manhole recorded a peak measurement of 1.5 ppm. The meter and monitor worn by the lead operator both sounded audible alarms, and the operators and other site workers evacuated the area immediately, in accordance with the site protocol. A Stop Work was implemented between October 7 and October 19, 2011 during which time a review of the current H_2S monitoring and worker protection protocol was completed and the events on and around October 7 were evaluated.

The H2S concentration measured on October 7, 2011 was significantly higher than previous H2S measurements recorded at MH-6, or any site manholes, and was above the Immediately Dangerous to Life and Health (IDLH) concentration for workers without respiratory protection (IDLH for H2S is 100 ppm without SCBA and 100,000 ppm with SCBA). In response to the apparent increase in hazard level, an evaluation involving intensive air and water monitoring

and sampling was immediately initiated to determine whether this was an anomalous site occurrence and to quantify H2S concentrations. The evaluation was also designed to test the hypotheses for the cause of the event, and improve the understanding of ASB Treatment System sulfide generation and H2S hazard. In conjunction with the intensive H2S evaluation, required site access training and HSSE protocols were increased for workers returning to the ASB Treatment System on October 20, 2011. The monitoring and sampling activities associated with the evaluation are described in Section 5.2.2.2. Evaluation monitoring and sampling results are discussed in Section 6.2.3, and the complete H2S evaluation report is presented in Appendix G.

4.4 WASTE MATERIALS DISPOSED OF OFF SITE

This section documents the Waste Materials disposed of off-site during 2011. A summary of 2011 waste manifests is presented in Table 7. Copies of the 2011 Waste Disposal Notification letters, waste profiles, waste manifests, and material reclamation documents are provided in Appendix B.

4.4.1 HDS Treatment System Sludge

As discussed in Section 4.2.2.4, the HDS Treatment System process produces a sludge which is dewatered in 20-cy roll-off style bins lined with non-woven filter fabric, and disposed off-site. In 2011, the HDS Treatment System filled 14 dewatering bins with sludge during the treatment season. A total of 138 tons of sludge was disposed of, with an approximate percent solids of 46%, for a total of 63.5 tons of dry solids removed. A waste characterization sample of the sludge was collected on June 2, 2011. The sample procedures and analytical results are presented in Sections 5.2.3.3 and 6.1.1.5, respectively. The sludge, profiled as non-hazardous waste, was transported under manifest by Environmental International Inc. (ENV) of Richmond, California to US Ecology in Beatty, Nevada, for disposal.

4.4.2 Pond 4 Sludge

As discussed in Section 4.2.4.2, Pond 4 sludge was removed in 2011. Dredged sludge was pumped into roll-off style dewatering bins, similar to those used at the HDS Treatment System, and disposed of off-site. In 2011, 106 dewatering bins were filled between July and September. A total of 707 tons of sludge was disposed with an approximate percent solids of 19%, for a total of 136 tons of solids removed. Waste characterization samples of the sludge were collected on May 27, July 28, and August 11, 2011 (the sample procedures and analytical results are presented in Sections 5.2.2.1 and 6.1.2, respectively). The sludge was profiled as non-hazardous waste and transported under manifest by ENV to US Ecology in Beatty, Nevada for disposal.

4.4.3 ASB Treatment System Sludge

As discussed in Section 4.3.1.2, the ASB Treatment System generates sludge as part of the treatment process. During 2011, sludge was removed from the ASB Treatment System, dewatered, characterized for waste profiling purposes, and transported for disposal. Sampling activities and sludge analytical results are described in Sections 5.2.1.2 and 6.2.1.5, respectively.

Ten 20-cy closed-top sludge storage bins were provided by ENV and used to containerize approximately 86 wet tons (15 dry tons) of dewatered sludge. The dewatered sludge was profiled, removed from the site, and transported to US Ecology in Beatty, Nevada, for disposal by ENV on September 1 and September 15, 2011.

4.4.4 ASB Treatment System Batteries

During the ASB Treatment System power generation system upgrades described in Section 4.3.2.3, the previous FLA batteries were replaced with new AGM batteries. The FLA batteries were removed from operation on October 26, 2011 and transported on six pallets via flatbed truck to Gardnerville, Nevada for temporary storage. FLA battery recycling for lead reclamation was coordinated by GNB Industrial Power of Aurora, Illinois, and completed by Kinsbursky Brothers of Anaheim, California. Kinsbursky Brothers received the batteries for recycling on December 6, 2011.

4.4.5 Miscellaneous Waste

Miscellaneous waste generated during operations of the HDS and ASB Treatment Systems are containerized and stored in the satellite accumulation areas prior to transportation and disposal. Miscellaneous waste generated during the 2011 field season includes:

- Used oil;
- Sampling wastes (spent pH buffer solution and iron reagent waste);
- Personal protective equipment (PPE), rags, and debris;
- Empty lime bags, Nalco Core Shell Polymer, and Magnafloc 10 polymer from previous HDS Treatment Plant operations;
- A small amount of soil containing hydraulic oil located at the HDS satellite accumulation area; and
- A small amount of soil containing antifreeze located at the HDS satellite accumulation area.

Waste sampling for characterization is described in Sections 5.2.1.1 and 5.2.1.2. Profiling, transportation, and disposal tasks for all miscellaneous waste at US Ecology in Beatty, Nevada, were performed by ENV, including recycling of used oil. The one exception was handling of the rinse water generated from cleaning tanks used during the belt filter press operation at the ASB Treatment System. The rinse water was disposed of at Instrat, Inc. in Rio Vista, California by ENV. Details on waste descriptions, classifications, quantities, and dates removed from the Site for the miscellaneous waste are listed in Table 7.

5.0 2011 MONITORING ACTIVITIES

Treatment performance was monitored throughout the 2011 operation of the HDS and ASB Treatment Systems. The Data Quality Objectives (DQOs) and sampling activities are described in the following sections.

5.1 DATA QUALITY OBJECTIVES

Determination of treatment effectiveness and sludge disposal options requires that sufficient data of appropriate quality is gathered and evaluated. The DQOs for the 2011 treatment related activities were established to ensure that the data collected was of sufficient quantity and quality for the intended use of the data. The specific DQOs are presented in Appendix C of the 2011 RAWP (Atlantic Richfield, 2011d). Similar to previous years, data collected during 2011 to support water treatment activities for the HDS and ASB Treatment Systems were used to meet the following objectives:

- 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;
- Verify that effluent from the treatment systems meets established discharge criteria;
- Evaluate the safety and reliability of the treatment systems for treating flows from the CUD, DS and AS;
- Evaluate treatment system modifications necessary to improve operations;
- Assess the contingencies that must be considered during treatment system disruptions;
- Assess system enhancements that are necessary to consistently and continuously discharge treated waters to Leviathan Creek and Aspen Creek; and
- Evaluate the chemical and physical characteristics and quantity of sludge from the treatment of the flows from the CUD, DS and AS for assessing disposal options.

5.2 SAMPLING AND ANALYSIS

The monitoring program implemented for the 2011 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 2011 RAWP and the 2011 RAWP Quality Assurance Project Plan (QAPP) (Atlantic Richfield, 2011d).

The following sections detail the sampling and analysis program used at the site during 2011.

5.2.1 Performance Monitoring Locations, Schedules, and Parameters

As described in the 2011 RAWP, water samples were collected for laboratory analysis at sample locations relevant to determining treatment technology effectiveness and reliability, as well as discharge compliance. Field monitoring data was collected at additional treatment process locations to evaluate the treatment system performance and make system adjustments as necessary. The performance monitoring and sampling groups are described below:

- *Regular Field Monitoring* includes field measurement of pH, dissolved oxygen (DO), oxidation/reduction potential (ORP), specific conductance, temperature, field measured iron speciation/concentration, and flow (where applicable).
- *Analytical Compliance Sampling* includes analytes, evaluated by laboratory methods, which are required for comparison with the discharge criteria listed in the MRAM and other analytes that are important in assessing treatment system performance and understanding of water quality.
- *Enhanced Sampling for Optimization* includes analytes, evaluated by field or laboratory methods, which are important for further optimization and process control of the ASB Treatment System, and are monitored only for ASB Treatment System waters.
- *Surrogate Field Parameter Monitoring* includes field measured pH and dissolved iron concentration and is used to evaluate HDS Treatment Plant effluent water quality for discharge suitability.

Treatment-generated sludge samples were also collected for laboratory analysis to determine waste characterization and profiling for disposal on an as-needed basis from the various solids collection areas. 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 (CFR) 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 10. Additionally, sludge samples were analyzed for percent moisture and paste pH for use in future evaluations.

The 2011 HDS and ASB Treatment Systems sampling and analysis schedule are presented in Tables 8 and 9, respectively. These tables include sample locations, frequencies, and

analytical parameters for samples collected in 2011. The 2011 summary of laboratory analytical methods for aqueous- and solid-phase parameters is presented in Table 10.

The sampling locations, schedules, and parameters for samples collected from the HDS and ASB Treatment Systems are described in Sections 5.2.1.1 and 5.2.1.2, respectively.

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 four pre-designated sampling locations as illustrated on Figure 3. The influent sampling location is the in-line sample port on the discharge side of the Pond 4 influent pump. The effluent sample location is the in-line sample port on the effluent tank recirculation line. The CUD and DS sample locations are at the discharge of each conveyance line prior to Pond 4.

During operation of the HDS Treatment System, *Surrogate Field Parameter Monitoring* was typically performed daily (twice weekly at a minimum), and *Regular Field Monitoring* was performed weekly in accordance with the 2011 RAWP. *Analytical Compliance Samples* were collected on the following schedule:

- For the first four weeks of operation, abbreviated Analytical Compliance Sampling for HDS Treatment Plant effluent was conducted once per week; and
- During each month of operation, *Analytical Compliance Sampling* was conducted for HDS Treatment Plant influent, effluent, CUD, and DS.

As detailed in the 2011 RAWP, *Surrogate Field Parameter Monitoring* coupled with periodic confirmation sampling for laboratory analysis were used to confirm that the HDS Treatment System effluent met the discharge criteria. Surrogate field parameters were chosen because the field measurement of 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 dissolved iron. Additionally, HDS Treatment System historical data related to treatment of flows from the CUD and DS indicated that treated water with a pH above 7.2 s.u. results in effluent that consistently meets discharge criteria with respect to dissolved metals concentrations. Therefore, an effluent pH operating range of 7.5 to 8.5 s.u. with field measured dissolved iron of 1.0 milligram/liter (mg/L) or less was selected to provide a conservative surrogate parameter range for discharge compliance. The field monitoring and automated system monitoring has been shown to provide sufficient safeguards against discharging water that is outside of the discharge criteria listed in the MRAM (U.S. EPA, 2008).

In addition to discharging treated water from the HDS Treatment Plant, treated water from the HDS Treatment Plant that was stored in Pond 4 to facilitate sludge removal operations was also discharged directly from Pond 4 to Leviathan Creek after sludge operations were completed. Prior to discharge, regular field monitoring at four locations around Pond 4 was performed, and a confirmation analytical compliance sample, composited from the four locations, was collected.

Sludge waste characterization samples (described in Section 5.2.1) were collected directly from the dewatering bins prior to off-site disposal.

5.2.1.2 ASB Treatment System Monitoring Locations and Frequency

During operation of the ASB Treatment System, laboratory samples and field parameter measurements were collected at the pre-designated sampling locations presented in Figure 6. *Analytical Compliance Sampling* performed at influent and effluent sample locations was conducted once a month during the LAS and twice a month during the ARWS. ASB Treatment System influent samples were collected at the USGS weir prior to entering the ASB treatment system. Effluent samples were collected at the end of the aeration channel when possible. During periods when snow or ice inhibited access to the end of the aeration channel, effluent samples were collected either at the northern edge of the ASB Treatment System Pond 4, just prior to the outfall, or at the effluent flow meter, located at the head of the aeration channel.

Regular Field Monitoring was conducted at the influent and effluent stations, and at the active manholes, defined as manholes with process water flow, located throughout the ASB Treatment System. Water quality field parameters at manhole locations were used to assess the process conditions of the system. 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 weekly during normal ASB Treatment System operations and concurrently with *Analytical Compliance Sampling.*

During 2011, four *Enhanced Sampling for Optimization* events were conducted at the ASB Treatment System. During these events *Regular Field Monitoring* was performed and samples were concurrently collected from active manholes. *Enhanced Sampling for Optimization* was always conducted at the same time as *Analytical Compliance Sampling* to maximize the data set from these events.

During sludge dewatering operations, described in section 4.3.1.2, treated filtrate water was discharged from the belt filter press directly to Aspen Creek in accordance with 2011 RAWP (Atlantic Richfield, 2011d). Discharge typically occurred daily and was only conducted during working hours. *Analytical Compliance Sampling* was conducted weekly at the belt filter press

discharge location as confirmation for field measurements. *Regular Field Monitoring* activities were conducted at least once daily at the belt filter press weir tank, including a measurement prior to the start of daily filtrate water discharge. Since water quality at the weir tank was consistently within discharge standards, all filtrate water was discharged directly to Aspen Creek. *Regular Field Monitoring* was also performed at the belt filter press discharge point to Aspen Creek during discharge confirmation sampling.

During the sludge dewatering activities, dewatered solids generated in the ASB Treatment System were sampled from three sludge bins for laboratory analysis as described in Section 5.2.1. The sludge samples were collected on July 19, 2011. Disposal of the sludge is discussed in Section 4.4.3 and sludge sample results are presented in Section 6.2.1.5.

5.2.2 Additional Monitoring Locations, Schedules, and Parameters

In addition to the performance monitoring performed at the HDS and ASB Treatment Systems, task specific monitoring was also performed. The task specific monitoring included waste characterization of the Pond 4 sludge, water sampling of the Pond 4 inflow, sediment sampling of the Infiltration/Overflow Pond (IOP), and additional water and air monitoring at the ASB Treatment System as part of the H_2S evaluation. The sampling locations, schedules, and parameters for these tasks are described in the following sections.

5.2.2.1 Pond 4 Sludge

Prior to sludge removal operations, waste characterization samples (described in Section 5.2.1) of the Pond 4 sludge were collected from four locations around Pond 4 for laboratory analyses to characterize the sludge for landfill disposal. During Pond 4 sludge removal operations, additional confirmation sludge samples were collected from full dewatering bins to confirm the waste characterization.

5.2.2.2 Pond 4 Inflow

In additional to captured flows from the CUD and DS, flows from the Pond 4 inflow pipe, located in the south-eastern portion of Pond 4 were sampled in 2011. The Pond 4 inflow pipe reportedly receives un-controlled flow sourced from numerous subsurface drains installed to collect various seeps that were encountered during construction of the ponds and can also receive overflow water from Pond 3. The pipeline extending from the Pond 3 overflow to the Pond 4 inflow pipe is controlled via a flow control valve and can be directed to either Pond 4, through the inflow pipe, or to the channelized portion of the Leviathan Creek. The various seeps appear to have been the sources of water entering Pond 4 from the Pond 4 inflow pipe during 2011, as the LRWQCB reports to only have discharged water from Pond 3 to the concrete channel.
Two grab samples of the Pond 4 inflow were collected from inside the inflow pipe prior to

discharge into Pond 4 for laboratory analysis. Results from these samples are discussed in Section 6.1.1.2.

5.2.2.3 Infiltration/Overflow Pond

On July 14, 2011, sediment samples were collected from the bottom of the IOP for laboratory analysis for characterization. Samples were collected from the head and tail of the pond, as close as possible to the primary water flow path. Laboratory analysis included soluble metals, total metals, paste pH, total organic carbon, and acid-base accounting in accordance with the 2011 RAWP. Results from this sampling event are presented in Section 6.2.2.

5.2.2.4 H_2S Monitoring

In response to the H_2S incident (Section 4.3.2.5) intensive monitoring and sampling activities were conducted continuously between October 19 and November 16, 2011. Monitoring and sampling were performed to further understand the conditions and events that likely led up to the H_2S incident so that this information can be used to evaluate alternatives to increase worker safety at the ASB Treatment System. Monitoring included continuous data-logging of H_2S gas concentrations and water quality parameters at several manholes. Additionally, continuous data-logging of H_2S gas concentrations was performed in a treatment system vault, at five fence-line locations, and at two work area locations. Air and water samples were collected for laboratory analysis of manhole headspace air and process water for correlation with and confirmation of logged data. Meteorological parameters were continuously logged, and peak H_2S exposure was recorded for each personnel entering the work areas. Additional details regarding the monitoring and sampling activities are provided Appendix G, *Aspen Seep Bioreactor - H_2S Monitoring Completion Report*. A summary of sample results is presented in Section 6.2.3.

5.2.3 Sampling Procedures

Sampling procedures for the HDS and ASB Treatment Systems, except for air sampling, are described in Standard Operating Procedures (SOPs) contained in the respective system O&M manuals (AMEC, 2011a; AMEC, 2011b), and the 2011 QAPP (Atlantic Richfield, 2011d). These documents were followed as guidance when obtaining field measurements and collecting samples for laboratory analysis. Air sampling is not typically conducted as part of the Removal Action activities but was conducted in 2011 in accordance with standard industry sampling procedures. The sample and data collection procedures are described in the following sections.

5.2.3.1 Flow Data

The flows from the CUD and AS are directed through weirs operated and maintained by the USGS for flow rate measurements on a continual year-round basis. 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 are provided to Atlantic Richfield periodically throughout the year. Flow data provided by the USGS as final is uploaded to the project database.[3]

During operation of the CUD and DS collection and conveyance equipment in 2011, magnetic flow totalizers were used to monitor total volume and instantaneous flow rates for the captured flows from the CUD and DS.

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 control.

At the ASB Treatment System, magnetic flow totalizers are used to measure the effluent and recirculation flows. Data from the magnetic flow totalizers is logged and stored by the SCADA system. This data is transmitted to an offsite file transfer protocol (FTP) site daily. System flow rates are manually recorded during field monitoring events. Influent flow at the weir was measured weekly using a graduated bucket and timer during the ARWS and once per month during the LAS to obtain real time flow data for use in adjusting chemical feed dose rates. The USGS data provides a more complete set of daily influent flow readings and is used for reporting AS flow in this report.

5.2.3.2 Water Quality Measurements and Sampling Procedures

When practicable, water quality field measurements were conducted in-situ using a field probe and meter capable of measuring pH, DO, temperature, conductivity, and 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 or during times where in-situ

[3] At the time of this Annual Report, USGS has only provided provisional flow data for the CUD and AS for 2011.

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. If no preservative was required, samples for laboratory analysis were collected directly into the containers provided by the laboratory. For samples requiring preservation, samples were collected in clean HDPE containers 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 effluent samples were collected as composite samples, each composed of three equal volume, time-separated 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.

5.2.3.3 Sludge Sampling Procedures

Sludge samples associated with operation of the HDS and ASB Treatment Systems were collected directly from the roll-off containers that were used to store solids prior to off-site disposal. Sludge grab samples were collected using a decontaminated stainless steel trowel or HDPE sampling pole, and placed directly into unpreserved laboratory supplied 8-ounce glass jars. Three or four 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 and Pond 4 was performed using a clean HDPE container attached to a sampling pole, or via a sludge collection tool, and then transferred into the glass jars provided by the laboratory.

5.2.3.4 Air Sampling Procedures

Grab and 24-hour air samples collected at the ASB Treatment System during the H_2S monitoring were collected using 6-liter summa canisters provided by the laboratory, equipped with dedicated sample intake tubing. The initial and final summa canister vacuum pressures were recorded on the sample chain-of-custody (COC) for confirmation of appropriate sample collection. Following sample collection, summa canisters were packaged appropriately and shipped to the laboratory for analysis.

5.2.4 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 SOPs. 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 used in 2011 were:

- CUD – untreated water from the CUD;
- DS – untreated water from the DS;

- HDSINF – influent from Pond 4 (influent equalization basin), as it flows into the HDS Treatment Plant;
- HDSEFF – effluent from the HDS Treatment Plant, as it flows through the recirculation line on the effluent tank;
- ASPINF – influent water from the AS, as it flows into the ASB;
- ASPEFF – effluent from the ASB Treatment System;
- HDSSLUDGE **–** sludge generated by the HDS Treatment Plant;
- PND4SLDG **–** sludge generated during Pond 4 sludge removal operations;
- ASPSLG **–** sludge generated by the ASB Treatment System;
- ASPMH# – manhole locations where process samples are collected within the ASB Treatment System (# symbol is replaced by the actual manhole number);
- ASPP3 or ASPP4 **–** samples collected in Ponds 3 or 4 of the ASB Treatment System;
- POND3OVERFLOW **–** untreated water from the Pond 4 inflow;
- IOPINF **–** sludge collected from the head of the IOP; and
- IOPEFF **–** sludge sampled from the tail end of the IOP.

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

5.2.5 Laboratory Analytical Program

During 2011, treatment-related samples, including sludge, were sent to TestAmerica Laboratories, Inc. in Irvine, California (TestAmerica), for laboratory analysis. The only exceptions were:

- Air samples collected for the H_2S monitoring program at the ASB Treatment System; and
- Sludge samples from the Infiltration/Overflow Pond (IOP) at the ASB Treatment System submitted for specialty analysis.

The air samples were shipped to ALS Environmental Laboratories (ALS) in Salt Lake City, Utah and Cincinnati, Ohio. The IOP samples were delivered by field personnel to Sierra Environmental Monitoring, Inc. (SEM) in Reno, Nevada.

5.2.6 Sample Collection and Quality Assurance/Quality Control

Upon collection, samples were labeled, logged on the COC, and kept in ice-chilled coolers (except for air samples which were stored in ambient conditions) 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 or ALS Environmental Laboratories or directly transferred to SEM. COCs were signed by each sample custodian. Samples were typically shipped within 24 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. Approximately 26% of the data was validated by a third party, Environmental Standards, Inc. (ESI), of Valley Forge, Pennsylvania meeting the minimum QAPP requirement (20%) for data validation.[4] Upon request, level 4 data packages were prepared by the contract laboratory for data validation. All laboratory data has been added to the site database. In addition, data qualifiers representing any bias in the final data set have been appended to the respective data and are presented in the data tables in Appendix D. 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/QC are specified in the QAPP (Atlantic Richfield, 2011d). 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, 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 2011 is provided below for each element of the QA/QC program.

5.2.6.1 Quality Assurance Measures

Field QA/QC consisted of using skilled personnel for monitoring and sampling, operating and maintaining field devices in accordance with the manufacturer specifications, using standard field forms, and adhering to protocols required by the SAP and QAPP. The need for

[4] Samples analyzed by SEM and ALS were not externally validated by ESI since these samples are not associated with the compliance monitoring program described in the QAPP.

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, and SEM are certified by the California Environmental Laboratory Accreditation Program (ELAP). ALS is certified for industrial hygiene methods by the AIHA Laboratory Accreditation Programs, LLC. All three laboratories have extensive SOPs, QA guidelines, and periodic laboratory-wide quality testing.

5.2.6.2 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% 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. A total of nine field duplicates and nine field method blanks were collected in conjunction with the compliance monitoring and sampling in 2011. Results for field duplicates are presented in Table 16. Results for field method blanks are presented in Table 17.

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 and SEM provided the results for all of the above QC samples with their laboratory reports included in Appendix E.

6.0 2011 MONITORING RESULTS

The following sections summarize the results of the Removal Action activities implemented by Atlantic Richfield during 2011, including CUD, DS, and AS treatment-related monitoring results and sample data QA/QC results. Treatment system data tables are presented in Appendix D. Laboratory data reports and COC forms are included in Appendix E.

6.1 CUD AND DS TREATMENT-RELATED MONITORING RESULTS

The CUD and DS treatment-related monitoring results, including HDS Treatment System performance and Pond 4 sludge removal operations results are summarized in the following sections.

6.1.1 HDS Treatment System Performance

Several different aspects of the HDS Treatment System are evaluated when determining the overall performance. These include the treated volume and flow rates, compliance monitoring results, mechanical performance, consumable utilization, and sludge generation rates. Each of these aspects is described in detail below.

6.1.1.1 Treated Volume and Flow Rates

During the 2011 treatment season, approximately 13.8 million gallons of water were treated and discharged by the HDS Treatment Plant. Approximately 10.2 million gallons of water from the CUD and 3.6 million gallons of water from the DS were captured. Additionally, approximately 0.6 million gallons of water accumulated in Pond 4 during the previous winter season. A total of approximately 14.5 million gallons of water was collected in Pond 4 during 2011. Table 5 presents the monthly volume of water captured from the CUD and DS, which is based on the totalizer flow meters installed on the insulated and un-insulated CUD and DS conveyance lines. Table 5 also presents the monthly average flow rates of the CUD and DS which were calculated from the totalizer flow meter data. For comparison purposes, the CUD flow data as measured by the USGS weir is also included in Table 5.

The discrepancy between the total volume captured and collected in Pond 4 (14.5 million gallons) and the total volume discharged (13.8 million gallons) is likely due to evaporation from Pond 4 and water content that was present in the sludge removed from Pond 4.

6.1.1.2 Performance Monitoring

In 2011, effluent compliance samples and field surrogate parameters indicate that discharges of treated water from the HDS Treatment Plant did not exceed MRAM discharge criteria with the exception of the May 10 and May 17, 2011, effluent compliance samples which exceeded the

MRAM discharge criteria for total selenium. The water entering Pond 4 from the Pond 4 inflow may have contributed to the source of total selenium present in the process water. During the spring portion of the LAS, the flow from the Pond 4 inflow pipe was measured by the volumetric flow method and was determined to be approximately 0.5 gpm. The water from the Pond 4 inflow was sampled on June 22, 2011 and November 8, 2011 and was found to have higher concentrations of total selenium than the concentrations measured in flows from the CUD and DS (Table 4).

During 2011, direct discharge from the HDS Treatment System to Leviathan Creek occurred while effluent pH was between 7.5 and 9.0 and the total dissolved iron concentration was below 1.0 mg/L. During discharge, field surrogate parameters were collected at least twice weekly, typically daily, for field monitoring of pH and total dissolved iron. If treated water did not meet pH or total dissolved iron discharge criteria (i.e., during upset conditions, or after restarting the HDS Treatment Plant following a short-term or long-term shutdown), the effluent was diverted back to Pond 4. System disruptions requiring the diversion of HDS Treatment Plant effluent to Pond 4 are described below in Section 6.1.1.3.

Samples of the CUD and DS, and the HDS Treatment Plant influent and effluent were collected for laboratory analysis in accordance with the schedule presented in the 2011 RAWP and summarized in Section 5.2.1.1. Results from the 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 the minimum, maximum, and average constituent concentrations from the CUD and DS samples, and the HDS Treatment Plant influent and effluent samples compared to MRAM discharge criteria for 2011 is presented in Tables 1 and 2, respectively.

6.1.1.3 Mechanical Performance

During 2011, several mechanical disruptions occurred that affected the operation of the HDS Treatment System, all of which were reported to U.S. EPA at or very soon after the time of occurrence. A summary of each disruption is provided below.

- On May 9, 2011, there were approximately 10.5 hours of system downtime due to lime bridging in the K-Tron feeder hopper preventing lime from dosing to the lime/sludge mix tank. Lime was manually dislodged in the K-Tron feeder hopper and normal operations were resumed on May 10, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.
- On May 10, 2011, there were approximately 10.5 hours of system downtime due to a variable frequency drive (VFD) fault “P033 - Overload Current” at the Pond 4 pumps. The VFD set point was increased to match the service factor on the motor

(1.15) and normal operations were resumed on May 11, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.

- On May 13, 2011, there were approximately 20.1 hours of system downtime due to a low effluent pH condition in the reactor tank caused by a low lime dosing speed set point. The lime screw feeder output was increased from 35% to 50% and normal operations were resumed on May 14, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.

- On May 15, 2011, there were approximately 20 hours of system downtime due to a low effluent pH condition in the reactor tank caused by bridging in the lime storage hopper. Bin activator BA-001 runtime was increased from 4 seconds to 6 seconds, and lime storage hopper inspections were added to the HDS Treatment Plant daily checklist. Normal operations were resumed on May 16, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.

- On May 15, 2011, there was a partial loss of capture of flows from the CUD. For approximately 8 hours, a total of approximately 1,700 gallons of flow from the CUD was not captured when the lead pump faulted and the backup pump could not maintain capture due to scaling in the CUD conveyance line which reduced pumping capacity. The cross-over valve for the CUD conveyance line was opened to allow AD to flow through both the lead and backup conveyance lines, creating sufficient capacity and restoring complete capture of flows from the CUD. On May 21, 2011, the CUD conveyance lines were replaced due to the significant scale buildup.

- On May 27, 2011, there was a loss of capture of flows from the DS. For approximately 18 minutes, a total of approximately 380 gallons of flow from the DS was not captured when the lead pump malfunctioned and did not register a fault. Because the fault was not registered by the PLC, the lead pump did not shutdown and close the associated motor control valve automatically. The backup pump automatically started; however, the backup pump could not maintain capture because it was re-circulating water back through the malfunctioning lead pump. Operators restored capture by remotely shutting down the lead pump which also closed the associated motor control valve.

- On May 30, 2011, there were approximately 19.5 hours of system downtime due to a high effluent pH condition caused by pH probe drift. The pH probe was removed from service and recalibrated, and normal operations were resumed on May 31, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.

- On May 31, 2011, there were approximately 25 minutes of system downtime for a planned shutdown of the HDS Power Generation System. This shutdown was required to facilitate electrical work within the generator control panel. Approximately 700 gallons of flows from the CUD and DS could not be captured during this planned system downtime.

- On June 1, 2011, operators observed a fault at agitator AG-004 associated with the lime feeder hopper. Upon further inspection, it was observed that screw conveyor CV-001 which transferred lime from the lime feeder hopper to the K-Tron feeder hopper was broken and required replacement. On June 1, 2011, screw conveyor CV-001 was replaced and normal operations were resumed. This repair did not require a system shutdown or affect capture of flows from the CUD or DS.

- On July 30, 2011, there were approximately 15.6 hours of system downtime due to an extreme rain event that resulted in a high level alarm in the sludge bin sump. Both sludge bin sump pumps operated as normal; however, they could not keep up with the rain event. Normal operations were resumed on July 31, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.

- On August 3, 2011, there were approximately 12 hours of system downtime due to lime bridging in the lime storage hopper because bin activator BA-001 failed to operate. The bin activator BA-001 motor was reset and operators cleared the lime bridge. Normal operations resumed on August 4, 2011. There was no loss of capture of flows from the CUD or DS during this downtime.

- On November 11, 2011, a small electrical fire was observed on the Generator 1 motor alternator when a sealed bearing failed, causing the armature to short against the windings. The Generator 1 motor alternator was replaced on November 15, 2011. No system downtime or loss of capture resulted from this repair because the HDS Treatment System had been previously shutdown for winterization.

With the exception of the interruptions on May 15, May 27, and May 31, 2011, the capture of the flows from the CUD and DS was maintained throughout the treatment season.

6.1.1.4 Consumable Utilization

The HDS Treatment System uses several consumables both directly and indirectly throughout the treatment process, including diesel fuel, dry flocculant, freshwater, and lime.

- Approximately 15,350 gallons of diesel was used by the HDS Power Generation System to supply power to the HDS Treatment System and site office trailers. The Pond 4 generator also used an additional 600 gallons of diesel during Pond 4 dredging operations. At the end of the 2010 treatment season approximately 2,700 gallons were left on-site and used during spring commissioning in 2011; at the end of the 2011 treatment season approximately 4,170 gallons of diesel was left on-site to facilitate spring commissioning in 2012. Diesel was used at an average rate of 72 gallons per day (gpd) during the ARWS and 78 gpd during the shoulder portions of the LAS.

- Flocculant was dosed at an average concentration of 6.4 ppm to promote solids settling in the HDS Treatment Plant clarifier. Approximately 700 pounds (lbs) of dry flocculant was used and 368 batches of flocculant solution were prepared.

- Approximately 54,400 gallons of Freshwater was used for both HDS Treatment Plant operations and RI/FS drilling support. Freshwater was used in the HDS Treatment Plant for cleaning lab ware, preparing flocculant solution, flushing pipelines, and pressure washing. Freshwater was also used for preparing the flocculant solution used during Pond 4 sludge removal activities.

- Lime was dosed at an average rate of 0.74 grams per liter (g/L) for treatment of HDS Treatment Plant influent. Approximately 42.5 tons of dry hydrated lime were used in 2011.

6.1.1.5 Sludge Generation

The HDS Treatment Plant generated a total of approximately 138 tons of sludge at an average rate of 10 tons of sludge per million gallons of treated water discharged. Dewatered sludge generated by the HDS Treatment Plant was sampled on June 2, 2011, for waste characterization, and the results of the sludge analysis are presented in Table 12. The June 2, 2011 sludge sample did not exceed the Federal or California TCLP, TTLC, STLC, or pH thresholds, and was classified as non-hazardous waste. Disposal of the sludge is discussed in Section 4.4.1. The samples were also analyzed for soil moisture by weight. The soil moisture of the sample was 54% moisture (46% solids), equating to a total of approximately 64 tons of solids generated.

6.1.2 Pond 4 Sludge Results

A total of 707 tons of sludge was removed from Pond 4 during sludge removal operations. Prior to the commencement of Pond 4 sludge removal operations, samples of Pond 4 sludge were collected on May 27, 2011, from four locations around Pond 4 for waste characterization. Additional waste characterization confirmation samples were collected on July 28 and August 11, 2011. Results of the sludge analysis from the Pond 4 sludge removal operations are presented in Table 14. The May 27, 2011 Pond 4 sludge samples did not exceed the Federal TCLP, TTLC, or pH thresholds and was not considered RCRA hazardous waste. One of four May 27, 2011 sludge samples exceeded the California STLC threshold of 20 mg/L for nickel (it was measured at 33 mg/L); however, the average STLC nickel concentration for the four collected samples was 12.7 mg/L, which is below the California STLC threshold value. The remaining parameter concentrations were below California STLC threshold values for all four of the collected samples. Therefore, the Pond 4 sludge was characterized as non-hazardous waste. The July 28 and August 11, 2011 dewatered sludge samples did not exceed Federal or California TCLP, TTLC, STLC, or pH thresholds, confirming the non-hazardous classification. Disposal of the sludge is discussed in Section 4.4.2. These dewatered sludge samples were also analyzed for soil moisture by weight, with results of 84% and 86% moisture (16% and 14% solids). Field measurements of dewatered sludge were also performed, and an

average soil moisture by weight of 81% (19% solids) was measured, equating to a total of approximately 134 tons of solids removed.

6.2 ASPEN SEEP TREATMENT-RELATED MONITORING RESULTS

The following sections present results of Aspen Seep treatment-related monitoring, including:

- ASB Treatment System performance monitoring;
- IOP sampling; and
- H2S monitoring and sampling.

6.2.1 ASB Treatment System Performance

Understanding the overall performance of the ASB Treatment System enables improvements in treatment efficiency and operations. To help understand the overall performance, operational parameters were used to compare 2011 with historical performances. An ASB Treatment System 2011 Performance Review presentation was reviewed and discussed with the U.S. EPA in a conference call on February 15, 2012. The ASB Treatment System 2011 Performance Review presentation slides are provided in Appendix F.

The following subsections summarize the ASB Treatment System 2011 Performance Review results and include:

- Treated volume and flow rates;
- Performance monitoring;
- Mechanical performance;
- Consumables utilization; and
- Sludge generation.

6.2.1.1 Treated Volume and Flow Rates

Approximately 7.2 million gallons of flow from the AS was treated by the ASB Treatment System during 2011 based on data from the USGS-operated V-notch weir and data collection system. Influent flow rates ranged from 6.7 to 40.9 gpm during 2011. The highest average monthly flows occurred in April and May, while the lowest average flows occurred in January, February, and December. A monthly summary of ASB Treatment System influent flow and treated volume is presented in Table 6.

6.2.1.2 Performance Monitoring

The ASB Treatment System effluent dissolved metals concentrations exceeded the MRAM discharge criteria for the site during four of 17 sampling events during 2011. The specific metals and sample events when discharge criteria were exceeded are listed below.

- Total dissolved iron exceeded the maximum discharge criteria during four sampling events (January 7, February 1, April 26, and May 11, 2011); and
- Dissolved nickel exceeded the four-day average criteria but not the maximum daily criteria during two sampling events (January 7, and May 11, 2011).

Exceedances were likely due to the NaOH peristaltic pump tubing performance in January and February, 2011 (discussed in Section 6.2.1.3) and increasing or high system flow rates during April and May, 2011. During periods of varying influent flow rates, such as those encountered in April and May, 2011, timely adjustments of system set points are necessary for successful water treatment, but can be difficult to achieve during the LAS when access to the site may be restricted by snow or inclement weather. The U.S. EPA was notified of the above exceedances in monthly progress reports (Appendix A). A summary of 2011 minimum, maximum, and average constituent concentrations for the ASB Treatment System influent and effluent is presented in Table 3.

In addition to performance monitoring for discharge compliance, treatment system performance was evaluated based on indicator parameters, nutrient concentrations, and ethanol monitoring as presented below.

Indicator Parameters

In 2011, ORP measurements and sulfate removal data collected during *Regular Field Monitoring* and *Analytical Compliance Sampling* measurements confirmed satisfactory biological reduction of sulfate to sulfide. During 2011, the ORP values reported for the biocell influent and effluent ranged between -200 and -582 millivolts (mV) indicating reducing to strongly reducing conditions generally appropriate for sulfate reduction. The 2011 average biocell ORP value was -367 mV which was slightly lower than prior annual averages indicating an improvement in system conditions for sulfate reduction. Target ORP values for biological sulfate reduction, and the ASB Treatment System biocells, are between -350 and -400 mVs.

Sulfate removal was used as a measure of SRB activity and to estimate concentrations of sulfide available to precipitate dissolved metals from influent AD. Sulfate removal in 2011 was high (18-19% of influent concentrations), indicating good SRB activity. Similar sulfate removal was observed in 2003, 2004, 2005, 2008, and 2010, as presented in the ASB Treatment

System 2011 Performance Review (Appendix F). During 2011, the amount of sulfate removed typically exceeded the approximate 245 mg/L of sulfate conversion required to produce sufficient sulfide for precipitation of influent dissolved metals.

The decrease in ORP over several annual monitoring periods and the current high sulfate removal both indicate that reliable system operations and maintenance activities, including regular sludge removal, system optimization, and power generation system upgrades, have been successful in improving performance of the ASB Treatment System. However, based on indicator data from 2010 and 2011, biocell flow reversal has been shown to have little or no effect on treatment system performance. Neither ORP measurements nor sulfate removal rates showed significant improvements following biocell flow reversals.

Nutrient Concentrations

Samples collected during 2011 to evaluate the effects of nutrient addition on bioreactor performance (Section 4.3.2.1) showed that the concentrations of phosphorus remained low throughout the system as compared to target levels, including after the nutrient addition increase in November, 2011. 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. Nitrogen levels are similarly lower than recommended. This data suggests that further increases in the nutrient dose rates could improve system performance without increasing the mass loading of these nutrients in the bioreactor effluent. The change from monosodium phosphate to TSP appeared to have negligible effects on system performance.

Ethanol Monitoring Results

Laboratory results from 2011 indicated that ethanol introduced to the ASB Treatment System is consumed during transport through Biocells 1 and 2. These results provide verification, similar to results in 2009 and 2010, that the current ethanol dose rate is providing minimal excess carbon substrate to the biocells and is not likely a limiting factor in treatment system performance. Therefore, 2011 data supports the conclusion that ethanol dosing has been successfully optimized.

6.2.1.3 Mechanical Performance

The following is a summary of mechanical disruptions that affected the performance of the ASB Treatment System in 2011:

- On January 3, 2011, there were approximately 0.2 hours of partial system downtime due to an ethanol pump fault.
- On January 11, 2011, there were approximately 0.9 hours of partial system downtime due to an ethanol pump fault.
- On February 22, 2011, there were approximately 3.5 hours of partial system downtime of due to a NaOH pump fault.
- On June 12, 2011, there were approximately 0.1 hours of partial system downtime of due to a PLC reset.
- On June 28, 2011, there were approximately 8.2 hours of total system downtime due to a loss of power alarm following a generator fault.
- On July 2, 2011, there were approximately 2 hours of total system downtime due to a loss of power alarm that occurred when the lead generator faulted and the generator auto cycle malfunctioned.
- On October 5, 2011, there were approximately 21.5 hours of total system downtime due to a inverter fault that caused a loss of power and shutdown the NaOH, ethanol, and recirculation pumps.
- On December 22, 2011, there were approximately 105 hours of partial system downtime due to frozen pipes which prevented recirculation flow. During this time, NaOH pumps were operational.
- On December 31, 2011, there were approximately 15 hours of partial system downtime when operators shutdown the ethanol and recirculation pumps due to observed ice-related flow restrictions between Biocell 1 and Biocell 2. During this time, NaOH pumps were operational. This partial system downtime continued into 2012.

As noted, during many of these disruptions, the ASB Treatment System was partially operational. These issues were resolved at the soonest practicable time in order to maximize treatment of flows from the AS.

In addition to the quantified disruptions listed above, the ASB Treatment System experienced mechanical reliability issues with the NaOH pump tubing during January and February 2011. During these months, NaOH dose rate decline resulted in effluent metals concentrations above discharge criteria. Dose rate decline was due to premature wearing and performance decline of the NaOH peristaltic pump tubing and infrequent site access imposed by LAS conditions which restricts the pump tubing replacement interval. At no point did the tubing completely fail. A more durable formulation of tubing was implemented in response to this issue as described in Section 4.3.2.2.

The issues experienced in January and February, 2011 provide evidence consistent with historic data that system reliability is highly dependent on system mechanical reliability, especially the reliability of the NaOH dosing pumps, and that system reliability issues have the most significant performance repercussions when they occurred during the LAS since site access opportunities for troubleshooting are limited. Many of the historic high dissolved iron values in effluent correlate with system disruptions during the LAS, including disruption or decline in chemical feeds, especially NaOH.

6.2.1.4 Consumable Utilization

The ASB Treatment System uses several consumables both directly and indirectly throughout the treatment process, including NaOH, ethanol, TSP, urea, and propane. During 2011, chemical consumption was generally higher than previous years due higher influent flow rates.

- NaOH was dosed at an average rate of 1.3 mL/L. Approximately 9,100 gallons NaOH was used in 2011.
- Ethanol was dosed at an average rate of 0.4 mL/L. Approximately 3,100 gallons ethanol was used in 2011.
- TSP was dosed at an average rate of 1.4 mg/L. Approximately 100 cups of TSP was used in 2011.
- Urea was dosed at an average rate of 0.3 mg/L. Approximately 25 cups of urea was used in 2011.
- Propane was used at an average rate of 9 gpd during the ARWS and 12 gpd during the LAS. Approximately 4,300 gallons of propane was used in 2011. Increased propane consumption compared to previous years was likely due to cold weather conditions and operation of the safety shower which was installed in November, 2010.

6.2.1.5 Sludge Generation and Results

The ASB Treatment System generated a total of approximately 86 tons of sludge at an average rate of 12 tons of sludge per million gallons of treated water discharged. Sludge generated by the ASB Treatment System was sampled on July 19, 2011, for waste characterization, and the results of the sludge analysis are presented in Table 13. The July 19, 2011 sludge sample did not exceed the Federal or California TCLP, TTLC, STLC, or pH thresholds, and was classified as non-hazardous waste. Disposal of the sludge is discussed in Section 4.4.3. The samples were also analyzed for soil moisture by weight. The average soil moisture of the sample was 83% moisture (17% solids), equating to a total of approximately 15 tons of solids removed. Visual observations and historic sludge production estimates compared with sludge removal

measurements indicate that sludge removal efforts since 2007 have been successful in maintaining a low operational volume of sludge in the ASB Treatment System.

During 2011 sludge dewatering activities, all filtrate water *Regular Field Monitoring* measurements were within the standards referenced in the 2011 RAWP (pH between 7.2 and 9.0 and dissolved iron less than 1.0 mg/L). Therefore, all filtrate water was discharged directly to Aspen Creek. Filtrate sample results indicate that filtrate water was within discharge criteria for all 2011 weekly sampling events.

6.2.2 Infiltration/Overflow Pond Results

The IOP sediment samples collected at the head and tail of the pond on July 28, 2011, were black in color and reportedly had an odor similar to that of the bioreactor sludge. The sediments were both near neutral with a paste pH of 7.3 and 7.4 s.u. for the head and tail samples, respectively. Waste characterization laboratory results show that the regulated metal constituents in sediments collected from both locations were below Federal and California TCLP, TTLC, STLC, or pH thresholds. Therefore, the IOP sludge would be classified as a non-hazardous waste. Acid-base accounting (ABA) test results indicate that the samples may have the potential to be net acid generating, although there is some ambiguity in the results. Based on the sulfide-sulfur data, net neutralization potential (NNP) for the head and tail samples is 18 and -3, respectively, which falls within the range (-20 to 20) where prediction of acid potential is more difficult, often referred to as the 'zone of uncertainty' (EPA, 1994). If total sulfur is used for the calculations then the NNP of the influent and effluent samples are -204 and -70, respectively, indicating a potential for acid generation. On average, sulfate-sulfur accounted for 43% of the total sulfur and iron sulfate and/or iron hydroxysulfate mineral phases are a common secondary source of acidity. It therefore appears likely that this material will be net acid producing. The IOP sediment sample analytical results are presented in Table 15.

6.2.3 H_2S Monitoring Results

During the H_2S evaluation monitoring period between October 19 and November 16, 2011, high H_2S concentrations were routinely measured in several manholes via the continuous data-logging meters. The highest and lowest four-week average headspace air H_2S concentrations were measured in MH-6 and MH-2, with approximate values of 54 and 0 ppm, respectively. Peak headspace air H_2S values exceeding 500 ppm were measured in MH-4 and MH-6.

Laboratory analytical results verified the elevated H_2S concentrations detected by the meters. H_2S concentrations in instantaneous (grab) samples from the manhole headspaces ranged from 10 ppm to 830 ppm, with an average concentration of 172 ppm. Samples collected from the manhole headspaces to provide 24 hour average H_2S concentrations ranged from 12 to 380

ppm, with an average concentration of 129 ppm. Samples collected from process water in the manholes for aqueous sulfide concentrations varied over a range from less than 0.10 mg/L to 84 mg/L.

Comprehensive H_2S monitoring and sampling data, including water quality parameters, data summary tables, and modeling results, as well as results discussion and conclusions, are presented in the *Hydrogen Sulfide Monitoring Completion Report* (Appendix G).

6.3 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

In accordance with the 2011 RAWP, validation of approximately 26% 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, and the QAPP, according to the procedures described in *National Functional Guidelines for Inorganic Superfund Data Review* (U.S. EPA, 2010).

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 laboratory blanks;
- Low reporting limit standard recovery;
- Missed holding times for pH and acidity method samples; and
- Low MS/MSD recoveries.

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 did not result in the qualification of sample results. 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 anomalous (i.e., “not detected”) in some samples. Results from analysis where holding times were not met were not used for compliance monitoring. 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 J and are organized by laboratory work order number.

In addition, AMEC implemented the corrective action process described in the QAPP as a result of suspected lab error in the reported concentrations for aluminum, calcium, iron, magnesium and hardness of sample 143ASPINF454 collected on May 20, 2011 and the respective results were deemed unreliable and subsequently qualified as rejected in the project database. Rejected data are not included in the data tables presented in Appendix D due to poor data quality.

7.0 2011 SITE MAINTENANCE ACTIVITIES

This section summarizes 2011 site maintenance activities conducted at the site, including general Pond 4 activities and road maintenance activities.

7.1 GENERAL POND 4 ACTIVITIES

The following sections summarize the site system improvements and construction activities completed in 2011 in the Pond 4 area, including satellite system upgrades, Pond 4 area dust suppression, and construction of temporary storm water controls.

7.1.1 Satellite System Upgrades

The Pond 4 satellite systems were upgraded in August and September 2011 to provide increased service speed and total data package size. These upgrades were necessary to accommodate increased operations and personnel on-site. The following upgrades were made:

- Pond 4 Satellite System 1 service speed was increased from 256/1544 (upload/download) kilobytes per second (kbps) to 1000/3000 kbps and the total data package size was increased from 2 gigabytes (GB) to 3 GB; and
- Pond 4 Satellite System 2 (used to remotely monitor the HDS Treatment System) service speed was increased from 512/1544 kbps to 1000/3000 kbps and the total data package size was increased from 3 GB to 9 GB.

7.1.2 Pond 4 Area Dust Suppression

On June 25, 2011 Envirotac II® was applied to the Pond 4 parking area and partially up the California and Nevada Access Routes to control and reduce onsite personnel exposure to dust. Additional Envirotac II® was applied along the Nevada Access Route residential area as described in Section 7.2.5.

7.1.3 Temporary Storm Water Controls

In the summer of 2011, as part of the LRWQCB's road improvement project, a new culvert was installed beneath the road that branches off the California Access Road and goes around Pond 3. As constructed, water from this culvert would build-up in a pool fashion on the outfall side and eventually flow down the north edge of the access road and sheet flow across and down the access road, eventually into either Pond 4 or the drainage ditch on the east side of Pond 4. On November 1, 2011 and October 27, 2011 temporary storm water control measures were installed on and along the California Access Road to reduce storm water from potentially impacting Atlantic Richfield's operations at the site, including Pond 4, the Pond 4 support area (i.e., parking and temporary office trailers), and ultimately the CUD and DS collection systems. These controls included:

- Installations of two drivable diversion berms to divert sheet flow from the road surface to the existing drainage ditch on the southwest side of the road which directs flow into the channelized portion of Leviathan Creek;

- Removal of windrow material (i.e., 3-inch rock and fines) that existed along the southwest side of the road between the drivable berms to promote drainage to the existing drainage ditch on the southwest side of the road and eventually into the channelized portion of Leviathan Creek; and

- Extension of the existing drainage channel located east of Pond 4 and the access road to prevent water flowing down the eastern hillside from entering the access road between the two diversion berms.

The memorandum *Leviathan Mine - Temporary Storm Water Control Measures*, dated December 31, 2011 (Appendix K) includes additional details and photos of the temporary storm water control measures. The performance of these temporary storm water control measures will be evaluated in the spring of 2012, and repairs and/or alternative control measures will be evaluated at that time.

7.2 ROAD MAINTENANCE

In March 2011, Atlantic Richfield submitted the *2011 Annual Operating Plan* (Atlantic Richfield, 2011b) to the United States Department of Agriculture (USDA) Forest Service in accordance with the USDA Forest Service Road Use Permit (USDA Forest Service, 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 US 395. These roads are commonly referred to as the California Access Route, the Nevada Access Route, and the Aspen Access Route. The major road activities completed in 2011 included routine surface grading and compacting, installing additional mirrors and signs, road crowning, drainage improvements, dust suppression, tree removal and constructing drivable dips. 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.

7.2.1 Grading and Compacting

The road maintenance completed in 2011 included grading and compacting the surface of the roadway from approximately two miles west of US 395 in Nevada (past the area where dust suppressant was applied), through the site to SR 89 in California, including the portion of Leviathan Mine Road that stretches from the Nevada access gate to the AS access gate (Aspen Access Route); repairing sections of road damaged by erosion from storm water runoff;

grading select portions of the road throughout the year as necessary to reduce “wash boarding”; and addition of approximately 2,900 tons of certified weed-free aggregate base rock to select portions of the road surface as necessary to cover exposed bedrock.

7.2.2 Cleaning Ditches and Culverts

The road maintenance included cleaning roadside ditches and culverts, and clearing out and un-plugging culverts by removing accumulated rock, sediment, and weeds from around the upstream and downstream openings.

7.2.3 Tree Removal and Clearing for Line of Sight

On June 7, 2011, AMEC staff drove the Nevada, California, and AS Access Routes with a representative of the USDA Forest service to identify trees that posed an imminent hazard to traffic accessing the site and to obtain approval for removing trees located greater than three feet off the travel way in accordance with the Road Use Permit. The primary criteria for determining the risk of a tree falling onto the access roads were:

- What was the strength of the root system and surrounding soil (i.e., roots undermined by erosion);
- Was the tree living or dead; and
- Does the tree have visible bug infestation or disease?

Based on the location and size of the tree, the criteria above were used to determine if the tree presented a potential hazard for vehicle access to the site. During this assessment, 35 trees were identified as potential hazards. The 35 trees were removed between June 13 and June 17, 2011. Tree removal and disposal was performed in accordance with the USDA Forest Service guidelines.

Additional road maintenance activities in 2011 included trimming tree branches and removal of brush that impeded visibility along the road.

7.2.4 Monitoring of Access Road Ground Deformation

During 2010, Atlantic Richfield submitted the Leviathan Mine Road Stability Monitoring Plan to the USDA Forest Service (Atlantic Richfield, 2010) 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 Route approximately nine miles from US 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 0.25 to 0.75 inches

wide, with measured depths of up to 2 inches, the cracks trended parallel to the length of the road, with two to three lines of cracks across the width of the road.

During November 2010, three pairs of road monuments were installed along the approximate 400 foot stretch of road; the monument pairs were designated as 1A-1B, 2A-2B, and 3A-3B. In May 2011, the reference distance between each pair of monuments was established by connecting a tape extensometer to the eye bolts and tensioning the tape to a standard tension. The vertical reference height between the tops of each monument pair was determined using a manometer. Subsequent readings were completed at least monthly and compared to initial base line values. The horizontal and vertical differentials were plotted as a function of time, and are included with the monument inspection data in Appendix I.

The vertical monitoring data for all three of the monument pairs shows considerable variation that is primarily attributed to measurement errors. Evaluation of the data for monument pairs 1A-1B and 2A-2B indicates that little if any vertical movement is occurring. For monument pair 3A-3B, approximately 0.2 inches of vertical-downward movement was observed during June 2011. The movements measured in June correspond to an average rate of approximately 2.9 inches per year. Prior and subsequent readings indicate that little or no movement occurred during other time periods. Additional movement of the monument pair 3A-3B was observed in the January 2012 reading; however, the result should be verified with additional measurements.

Measurement of horizontal displacements for all of the monument pairs appears to be less variable and susceptible to error than the vertical displacements. The data compiled to date indicates that little or no horizontal movement occurred for all of the monument pairs from May to August, 2011. Between August and November, 2011, all three of the monument pairs showed monthly extension (increased horizontal distance between monument pairs) that varied from approximately 0.2 inches between 1A-1B to 0.75 inches between both 2A-2B and 3A-3B. During this time period, the rate of movement calculated using the measured extensions varied from approximately 0.75 inches per year for 1A-1B to as much as 2.8 inches per year for 2A-2B and 3A-3B. The data from November through December suggests that there was no additional movement.

The recognized road distress was initially thought to be related to movement of the relatively shallow wedge of road fill positioned on an inclined layer of clayey residual soil that was not removed during construction of the road. Movements were thought to have initiated as surface runoff from the spring thaw infiltrated the road fill and supporting soils. Based on this assumption the greatest magnitude and rate of movement should occur shortly after the spring thaw. The current data does not support this argument. None of the monument pairs showed

movements during the periods of greatest run-off which typically occur during April and May. Detected movements occurred during June and between August and November. Based on the data, it does not appear that the slope is in a state of incipient failure. However, the data does suggest that the locus of the movement may be much deeper and more laterally extensive than anticipated and monitoring should be continued. If the current pattern of ground deformation continues, it may be necessary to install inclinometers to more accurately characterize the observed movements. If additional monitoring is recommended, Atlantic Richfield will notify the USDA Forest Service prior to implementation.

7.2.5 Nevada Access Road Residential Area

In 2011, Nevada Access Route maintenance activities in the residential area included minor surface grading, drainage maintenance, and a re-application of Envirotac II® for dust suppression.

Prior to re-application of the dust suppressant, surface grading and drainage maintenance activities were performed on June 20 and June 21, 2011. Drainage maintenance included cleaning out roadside drainage ditches and culverts, drivable dip maintenance, and construction of a fourth drivable dip in general accordance with the Handbook for Forest and Ranch Roads, A Guide for Planning, Designing, Constructing, Reconstructing, Maintenance and Closing Wildland Roads (USDA SCS, 1994). As measured from the intersection of US 395 and Leviathan Mine Road, the four drivable dips are located at milepost 0.5, 0.6, 0.75 and 0.86 miles.

On June 22, 2011, the re-application of the dust palliative Envirotac II® was placed on the 1.6 mile stretch of the Nevada Access Route to prevent excessive dust generation in front of the residences. This application was prepared by and applied in accordance with the manufacturer's recommendations to the same section of road as the original application that was applied in 2010.

8.0 STATEMENT OF COSTS INCURRED

The costs associated with the Removal Action activities conducted in 2011 are presented under the general cost categories described below5. All reported costs were incurred in performing response actions related, either directly or indirectly, to the collection and treatment of AD as required under the UAO. The total approximate cost for the 2011 work completed was $8,485,000. A summary of the approximate costs incurred (rounded to $1,000 increments) is presented in Table 18.

8.1 PROJECT COMPLIANCE, REPORTING, 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 the HSSE Program Document and TSHASPs;
- Project management, scheduling, subcontractor cost tracking, and spend projections;
- Updating and managing the database;
- HSSE support, on-site oversight, audits, training, and planning;
- Regulatory reporting and document preparation such as the 2011 RAWP, Spill Prevention, Control and Countermeasure Plan, Hazardous Materials Business Plans, Annual Road Operating Plan, Monthly Progress Reports, and the 2010 Annual Completion Report;
- Non-regulatory reporting and documentation preparation such as the Site Operations Plan;
- TAC meeting presentation; and
- Agency communications and public relations support.

The total cost for the above project compliance, reporting, project management, and HSSE oversight activities in 2011 was $2,589,000.

8.2 SITE ACCESS

The total costs for site access related activities in 2011 were $850,000. The costs are broken down in the following subsections.

[5] The costs presented herein are based on Atlantic Richfield annual spend which is tracked from December 2010 to December 2011.

8.2.1 Site Setup and Maintenance

The total cost for site setup and maintenance in 2011 was $439,000. Included in this cost are the following activities:

- Rental of office trailers, furniture, portable restrooms, and trash receptacles during the field season;
- Potable drinking water brought to the site;
- Site communications such as satellite internet service, satellite phone service, and site radio equipment;
- Site management and coordination;
- Purchase of safety related equipment such as H2S monitoring badges, multi-gas meters, air-escape packs, fire extinguishers, and first-aid kits; and
- Tree trimming and removal.

8.2.2 Leviathan Mine Road Activities

The total cost for road maintenance in 2011 was $411,000. Included in this cost are the following activities:

- Grading and compacting of the Nevada and California Access Routes;
- Cleaning ditches and culverts along the Nevada and California Access Routes;
- Implementing temporary storm water controls along the California Access Routes;
- Performing road stability monument inspections at the hair-pin turn; and
- Applying dust suppressant on the Nevada Access Routes at the residential area and at the Pond 4 area.

8.3 HDS TREATMENT SYSTEM ACTIVITIES

The total 2011 costs for HDS Treatment System operations and directly associated activities (including spring commissioning, operations and maintenance, sludge management and disposal, system winterization, engineering support, system improvements and Pond 4 sludge removal) were $3,370,000. 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, 2011. The cost of spring commissioning was $210,000, and included the following activities:

- Removal of snow from the Nevada Access Road and Pond 4 area; and
- Spring commissioning and startup activities as described in Section 4.2.2.1.

8.3.2 Operations and Maintenance

The total cost of O&M for the treatment of flows from the CUD and DS in 2011 was $1,228,000. The O&M activities associated with this cost included:

- Engineering oversight, geochemistry support, agency reporting, O&M assurance;
- Field logistics and daily routine O&M (including weekends) of the HDS Treatment System;
- HDS O&M manual updates;
- HDS Treatment System consumables, including lime, polymer, and diesel;
- Mechanical and electrical maintenance, including major equipment repairs;
- Spare parts procurement;
- Performance monitoring and data evaluation; and
- Laboratory sample analysis and data validation.

8.3.3 Sludge Management and Disposal

As discussed in Section 4.4.1, the HDS Treatment System generated 138 tons of dewatered sludge which was disposed of off-site. The total cost for dewatering, characterization, transportation, and disposal of the HDS Treatment System sludge in 2011 was $95,000.

8.3.4 System Winterization

Winterization of the HDS Treatment System occurred in November, 2011. The cost of winterization was $183,000, and included the activities described in Section 4.2.2.5.

8.3.5 Engineering Support and System Improvements

During 2011, HDS Treatment System engineering support and troubleshooting was conducted and various HDS Treatment System improvements were implemented. The cost associated with engineering support and system improvements was $244,000, and included the following activities:

- HDS Treatment System improvements as discussed in Section 4.2.3;
- HDS Treatment System troubleshooting; and

- Root cause analysis reports following system or equipment disruptions.

8.3.6 Pond 4 Sludge Removal

As described in Section 4.2.4, a floating dredge was used to remove the sludge from Pond 4. Costs associated with Pond 4 sludge removal included setup, operation, and decommissioning, routing the conveyance piping to bypass Pond 4, equipment rental (floating dredge, polymer skid, filter bins, storage tanks, forklift), labor, materials, Pond 4 liner repair, and disposal of 707 tons of sludge as described in Section 4.4.2. The total cost for Pond 4 Sludge Removal activities in 2011 was $1,410,000.

8.4 ASB TREATMENT SYSTEM ACTIVITIES

The total costs for ASB Treatment System operations and directly associated activities (including operations and maintenance, sludge management and disposal, engineering support, system improvements and H_2S monitoring) was $1,676,000. The cost is broken down in the following subsections.

8.4.1 Operations and Maintenance

The total cost of O&M for the treatment of flows from the AS in 2011 was $710,000. The O&M activities associated with this cost included:

- Engineering oversight, geochemistry support, agency reporting, O&M assurance;
- Weekly routine O&M during the ARWS;
- Monthly routine O&M during the LAS, including winter site visits;
- ASB O&M manual updates;
- ASB Treatment System consumables, including sodium hydroxide, ethanol, and propane;
- Mechanical and electrical maintenance, including major equipment repairs;
- Spare parts procurement;
- Performance monitoring and data evaluation; and
- Laboratory sample analysis and data validation.

8.4.2 Sludge Management and Disposal

Sludge removal activities were conducted during June through August, 2011. The cost of sludge removal activities was $541,000, and included the following activities:

- Maintenance and resurfacing of the sludge dewatering area; and
- Sludge removal and dewatering activities as described in Section 4.3.1.3.

8.4.3 Engineering Support and System Improvements

During 2011, ASB Treatment System engineering support and troubleshooting was conducted and various ASB Treatment System improvements were implemented. The cost associated with engineering support and system improvements was $295,000, and included the following activities:

- ASB Treatment System improvements as discussed in Section 4.3.2;
- ASB Treatment System troubleshooting; and
- Root cause analysis reports following system or equipment disruptions.

8.4.4 H_2S Monitoring

H_2S monitoring was performed at the ASB Treatment System in October and November, 2011. The cost of H_2S monitoring was $130,000, and included the activities described in Section 5.2.2.4.

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TABLES

TABLE 1
SUMMARY OF 2011 ANALYTICAL DATA FOR SAMPLES COLLECTED FROM THE CUD AND DS
Leviathan Mine Site
Alpine County, California

Parameter (mg/L)[a]	CUD[b,c]			DS[b,c]			Discharge Criteria[g]	
	Minimum[d]	Maximum[e]	Average[f]	Minimum[d]	Maximum[e]	Average[f]	Maximum	Average
pH (field)	3.2	4.6	3.7	3.2	5.4	4.3	NA	6.0-9.0
Dissolved Aluminum	26	93	57	4.2	32	16	4.0	2.0
Dissolved Arsenic	0.43	1.5	0.8	0.019	0.037	0.029	0.34	0.15
Dissolved Calcium	70	330	270	274	350	310	NA	NA
Dissolved Cadmium	<0.0005	0.012	0.004	0.001	0.004	0.002	0.009	0.004
Dissolved Chromium	0.007	0.14	0.05	<0.0009	0.011	0.004	0.97	0.31
Dissolved Copper	0.005	0.067	0.026	0.045	0.32	0.14	0.026	0.016
Dissolved Iron	150	567	427	15.4	26	18	2.0	1.0
Dissolved Magnesium	18	86	71	78	97	89	NA	NA
Dissolved Nickel	1.4	3.1	2.2	0.4	0.72	0.5	0.84	0.094
Dissolved Lead	<0.0004	<0.001	0.002	<0.0002	<0.0002	0.0005	0.136	0.005
Total Selenium	0.0017	0.005	0.005	0.0013	0.0053	0.0027	NA	0.005
Dissolved Zinc	0.29	0.61	0.40	0.12	0.38	0.24	0.21	0.21
Hardness (dissolved)	250	1,200	990	1,000	1,300	1,100	NA	NA
Acidity	920	2,000	1,260	10	380	170	NA	NA
Alkalinity (Bicarbonate)	<2.4	<2.4	1.2	<2.4	9.75	2.4	NA	NA
Alkalinity (Carbonate)	<1.2	<1.2	0.6	<1.2	<1.2	0.6	NA	NA
Alkalinity (Hydroxide)	<0.7	<0.7	0.4	<0.7	<0.7	0.4	NA	NA
Total Chloride	2.1	7.1	5.2	2.2	3.7	3.2	NA	NA
Total Alkalinity	<2	<2	1	<2	8	2	NA	NA
Sulfate	1,960	3,200	2,460	684	1,400	1,170	NA	NA
TDS	3,240	5,200	3,900	1,750	2,200	1,980	NA	NA
TSS	14	84	44	21	79	42	NA	NA

Notes

[a] Concentrations in milligrams per liter except pH which is in standard units.

[b] Data from the CUD and DS was collected between May 2011 and November 2011. Grab samples were collected for laboratory analysis.

[c] Constituents that were not detected are listed as "<" the detection limit value.

[d] Minimum values represent the lowest detected concentration or the method detection limit if the analyte was not detected at least once during the sampling period.

[e] Maximum values represent the highest detected concentration during the period of sample collection.

[f] Average values represent the calculated mean of concentrations during the sampling period. If the analyte was not detected, half of the reporting limit was used to calculate the average.

[g] Discharge criteria and basis for maximum and average values are listed in the *Request for Approval of Modification to the Removal Action at the Leviathan Mine Memorandum* (U.S. EPA, 2008).

Abbreviations

CUD = Channel Underdrain
DS = Delta Seep
mg/L = milligrams per liter
NA = not applicable
TDS = total dissolved solids
TSS = total suspended solids

TABLE 2
SUMMARY OF 2011 ANALYTICAL DATA FOR SAMPLES COLLECTED FROM THE HDS TREATMENT SYSTEM

Leviathan Mine Site

Alpine County, California

Parameter (mg/L)[a]	HDS Treatment Plant Influent[b,c]			HDS Treatment Plant Effluent[b,c,g]			Discharge Criteria[h]	
	Minimum[d]	Maximum[e]	Average[f]	Minimum[d]	Maximum[e]	Average[f]	Maximum	Average
pH (field)	2.9	4.5	3.5	7.7	8.6	8.4	NA	6.0-9.0
Dissolved Aluminum	28	87	54	0.12	0.81	0.53	4.0	2.0
Dissolved Arsenic	0.15	0.52	0.34	<0.0009	0.0015	0.0008	0.34	0.15
Dissolved Calcium	292	363	326	270	898	709	NA	NA
Dissolved Cadmium	0.00025	0.0092	0.0028	<0.0001	0.00047	0.0005	0.009	0.004
Dissolved Chromium	0.0031	0.076	0.027	<0.0009	<0.0009	0.001	0.97	0.31
Dissolved Copper	0.011	0.19	0.07	0.0016	0.01	0.01	0.026	0.016
Dissolved Iron	259	400	340	0.027	0.537	0.242	2.0	1.0
Dissolved Magnesium	78	94	86	59	100	85	NA	NA
Dissolved Nickel	0.88	2.1	1.5	0.025	0.078	0.045	0.84	0.094
Dissolved Lead	<0.0002	<0.001	0.001	<0.0002	<0.0002	0.0005	0.136	0.005
Total Selenium	0.0014	0.0045	0.0031	0.00086	0.0096	0.0039	NA	0.005
Dissolved Zinc	0.15	0.5	0.3	<0.004	0.013	0.009	0.21	0.21
Hardness	1,100	1,300	1,200	930	2,600	2,130	NA	NA
Acidity	670	1,200	950	<2	6	2	NA	NA
Alkalinity (Bicarbonate)	<2.4	<2.4	1.2	18	48.8	29	NA	NA
Alkalinity (Carbonate)	<1.2	<1.2	0.6	<1.2	<1.2	0.7	NA	NA
Alkalinity (Hydroxide)	<0.7	<0.7	0.4	<0.7	<0.7	0.4	NA	NA
Total Alkalinity	<2	<2	1	15	40	24	NA	NA
Sulfate	1,790	2,500	2,120	1,100	2,460	2,010	NA	NA
TDS	2,840	3,800	3,300	1,300	3,700	3,000	NA	NA
TSS	16	130	57	<1	22	13	NA	NA

Notes

[a] Concentrations in milligrams per liter except pH which is in standard units.

[b] Data collected between May 2011 and November 2011. Grab samples were collected for laboratory analysis except in the case of effluent samples (see note g).

[c] Constituents that were not detected are listed as "<" the detection limit value.

[d] Minimum values represent the lowest detected concentration or the method detection limit if the analyte was not detected at least once during the sampling period.

[e] Maximum values represent the highest detected concentration during the period of sample collection.

[f] Average values represent the calculated mean of concentrations during the sampling period. If the analyte was not detected, half of the reporting limit was used to calculate the average.

[g] Effluent samples for laboratory analysis were collected as composite of three temporally segregated grab samples during one day, each sample was field filtered and acid fixed as required promptly after colleciton.

[h] Discharge criteria and basis for maximum and average values are listed in the *Request for Approval of Modification to the Removal Action at the Leviathan Mine Memorandum* (U.S. EPA, 2008).

Abbreviations

HDS = High density sludge

mg/L = milligrams per liter

NA = not applicable

TDS = total dissolved solids

TSS = total suspended solids

TABLE 3
SUMMARY OF 2011 ANALYTICAL DATA FOR SAMPLES COLLECTED FROM THE ASB TREATMENT SYSTEM

Leviathan Mine Site

Alpine County, California

Parameter (mg/L)[a]	ASB Treatment System Influent[b,c]			ASB Treatment System Effluent[b,c]			Discharge Criteria[g]	
	Minimum[d]	Maximum[e]	Average[f]	Minimum[d]	Maximum[e]	Average[f]	Maximum	Average
pH (field)	2.8	7.5	3.4	6.9	8.1	7.5	NA	6.0-9.0
Dissolved Aluminum	38	55	48	0.04	0.47	0.09	4.0	2.0
Dissolved Arsenic	<0.0009	0.0029	0.0010	<0.0009	0.0022	0.0009	0.34	0.15
Dissolved Calcium	304	406	361	256	401	343	NA	NA
Dissolved Cadmium	0.0012	0.0028	0.0020	<0.0001	0.00016	0.0005	0.009	0.004
Dissolved Chromium	0.0022	0.0089	0.0045	<0.0009	0.0011	0.0010	0.97	0.31
Dissolved Copper	0.47	1.2	1.0	<0.0005	0.0055	0.0029	0.026	0.016
Dissolved Iron	112	168	141	<0.015	21	2	2.0	1.0
Hardness	1,100	1,400	1,300	880	1,600	1,180	NA	NA
Dissolved Magnesium	73	96	87	59	150	77	NA	NA
Dissolved Nickel	0.33	0.6	0.5	0.0023	0.12	0.04	0.84	0.094
Dissolved Lead	<0.0002	0.00026	0.0005	<0.0002	0.0003	0.0005	0.136	0.005
Total Selenium	0.00083	0.0055	0.0027	0.00051	0.0041	0.0017	NA	0.005
Dissolved Zinc	0.43	0.76	0.58	<0.004	0.021	0.010	0.21	0.21
Acidity	530	710	632	<2	96	7	NA	NA
Alkalinity (Bicarbonate)	<2.4	<2.4	1.2	74.4	419	249	NA	NA
Alkalinity (Carbonate)	<1.2	<1.2	0.6	<1.2	<1.2	0.6	NA	NA
Alkalinity (Hydroxide)	<0.7	<0.7	0.4	<0.7	<0.7	0.4	NA	NA
Total Alkalinity	<2	<2	1.0	61	344	204	NA	NA
Total Chloride	2.0	5.5	3.5	<1.5	19	5	NA	NA
Sulfate	1,540	2,200	1,910	1,160	2,430	1,590	NA	NA
TDS	2,340	3,120	2,800	1,990	3,290	2,630	NA	NA
TSS	6.0	40	26	<1	38	10	NA	NA

Notes

[a] Concentrations in milligrams per liter except pH which is in standard units.

[b] Constituents that were not detected are listed as "<" the detection limit value.

[c] Data collected from January 2011 through December 2011. Grab samples were collected for laboratory analysis.

[d] Minimum values represent the lowest detected concentration or the method detection limit if the analyte was not detected at least once during the sampling period.

[e] Maximum values represent the highest detected concentration during the period of sample collection.

[f] Average values represent the calculated mean of concentrations during the sampling period. If the analyte was not detected, half of the reporting limit was used to calculate the average.

[g] Discharge criteria and basis for maximum and average values are listed in the *Request for Approval of Modification to the Removal Action at the Leviathan Mine Memorandum* (U.S. EPA, 2008).

Abbreviations

ASB = Aspen Seep Bioreactor

mg/L = milligrams per liter

NA = not applicable

TDS = total dissolved solids

TSS = total suspended solids

TABLE 4
SUMMARY OF 2011 ANALYTICAL DATA FOR SAMPLES COLLECTED FROM THE POND 4 INFLOW

Leviathan Mine Site
Alpine County, California

Parameter (mg/L)[a]	Pond 4 Inflow[b,c]			Discharge Criteria[g]	
	Minimum[d]	Maximum[e]	Average[f]	Maximum	Average
pH (field)	2.5	2.5	2.5	NA	6.0-9.0
Dissolved Aluminum	63	160	112	4.0	2.0
Dissolved Arsenic	0.002	0.0039	0.003	0.34	0.15
Dissolved Calcium	442	508	475	NA	NA
Dissolved Cadmium	0.0061	0.0081	0.0071	0.009	0.004
Dissolved Chromium	0.036	0.14	0.09	0.97	0.31
Dissolved Copper	0.76	0.99	0.88	0.026	0.016
Dissolved Iron	18.9	99.6	59.3	2.0	1.0
Hardness	1,700	1,700	1,700	NA	NA
Dissolved Magnesium	150	350	250	NA	NA
Dissolved Nickel	0.84	2.2	1.5	0.84	0.094
Dissolved Lead	<0.0002	<0.0002	0.0005	0.136	0.005
Total Selenium	0.031	0.05	0.04	NA	0.005
Dissolved Zinc	0.53	1.1	0.82	0.21	0.21
Acidity	550	550	550	NA	NA
Alkalinity (Bicarbonate)	<2.4	<2.4	1.2	NA	NA
Alkalinity (Carbonate)	<1.2	<1.2	0.6	NA	NA
Alkalinity (Hydroxide)	<0.7	<0.7	0.4	NA	NA
Total Alkalinity	<2	<2	1	NA	NA
Total Chloride	5.4	13	9	NA	NA
Sulfate	2,240	3,840	3,040	NA	NA
TDS	3,460	3,460	3,460	NA	NA
TSS	11	11	11	NA	NA

Notes

[a] Concentrations in milligrams per liter except pH which is in standard units.

[b] Constituents that were not detected are listed as "<" the detection limit value.

[c] Pond 4 inflow samples collected on 6/22/2011 and 11/8/2011. Grab samples were collected for laboratory analysis.

[d] Minimum values represent the lowest detected concentration or the method detection limit if the analyte was not detected at least once during the sampling period.

[e] Maximum values represent the highest detected concentration during the period of sample collection.

[f] Average values represent the calculated mean of concentrations during the sampling period. If the analyte was not detected, half of the reporting limit was used to calculate the average.

[g] Discharge criteria and basis for maximum and average values are listed in the *Request for Approval of Modification to the Removal Action at the Leviathan Mine Memorandum* (U.S. EPA, 2008).

Abbreviations

mg/L = milligrams per liter
NA = Not applicable
TDS = total dissolved solids
TSS = total suspended solids

TABLE 5
2011 MONTHLY SUMMARY OF INFLUENT FLOW AND TREATED VOLUME FROM THE CUD AND DS

Leviathan Mine Site

Alpine County, California

Month in 2011	CUD: Average Monthly Flow (Weir) (gpm)[a]	CUD: Estimated Volume per Month (Weir) (gallons)[a]	CUD: Estimated Average Monthly Flow (Totalizer) (gpm)[b,c]	CUD: Estimated Volume Captured (Totalizer) (gallons)[b,c]	DS: Estimated Average Monthly Flow (Totalizer) (gpm)[b,c]	DS: Estimated Volume Captured (Totalizer) (gallons)[b,c]
January	25.3	1,128,973	--	--	--	--
February	25.4	1,025,117	--	--	--	--
March	30.7	1,372,035	--	--	--	--
April	37.1	1,603,142	--	--	--	--
May	40.7	1,816,541	42.3	1,158,663	23.0	628,615
June	46.4	2,005,705	44.9	1,940,178	18.3	791,253
July	42.9	1,916,067	45.4	2,028,055	15.0	668,831
August	36.0	1,605,210	43.4	1,937,519	13.2	589,234
September	32.7	1,414,237	39.4	1,703,584	11.5	497,935
October	30.3	1,351,225	31.7	1,413,088	10.2	453,948
November	27.1	1,170,657	31.7	61,973	9.2	19,594
December	27.0	1,205,814	--	--	--	--
Total Estimated Volume	**--**	**17,614,725**	**--**	**10,243,060**	--	**3,649,408**
			Total CUD and DS Volume Captured	**13,892,468**		
			Total Volume Discharged Directly from Pond 4[d]	**682,081**		
			Total Volume Discharged from the HDS Treatment Plant[e]	**13,100,977**		
			Total Volume Discharged[f]	**13,783,058**		

Notes

[a] Data Source: U.S. Geological Survey (USGS). Data for 2011 is provisional and subject to correction.

[b] Data Source: Field recording of volume totalizer reading on influent flow meter from the CUD and DS collection and conveyance, average monthly flow calculated from daily volume recording. Total estimated volume per month calculated from volume totalizer readings.

[c] Flows from the CUD and DS were collected from May 13 through November 2, 2011.

[d] Data Source: Field recording of volume totalizer reading on effluent flow meter from on the temporary Pond 4 discharge pump.

[e] Discharged volume includes initial approximate Pond 4 volume of 0.6 million gallons and captured flows from the CUD and DS.

[f] All discharged water was treated. Discrepency between water captured and discharged is assumed to be due to minor losses (i.e. evaporation) and flow meter accuracy.

Abbreviations

-- = not applicable or not collected

DS = Delta Seep

CUD = Channel Underdrain

gpm = gallons per minute

TABLE 6
2011 MONTHLY SUMMARY OF INFLUENT FLOW AND TREATED VOLUME FROM THE ASPEN SEEP
Leviathan Mine Site
Alpine County, California

Month	Minimum Daily Flow[a] (gpm)	Maximum Daily Flow[a] (gpm)	Average Monthly Flow (gpm)	Total Estimated Volume Treated per Month (gallons)[b]
January	7.6	8.8	8.1	359,352
February	6.7	10.2	8.4	337,478
March	10.0	40.9	14.6	652,637
April	17.8	28.0[c]	22.2[c]	958,608
May	18.2	24.6	20.7	925,834
June	16.4	18.9	17.3	746,064
July	13.8	16.3[d]	14.8[d]	660,672
August	14.0	14.4	14.1	629,870
September	11.9	14.4	13.0	559,440
October	10.6	11.8	11.1	494,611
November	9.8	11.1	10.3	444,960
December	9.4	9.7	9.6	427,651
Total Estimated Treated Volume (gallons)			**7,197,178**	

Notes

[a] Data Source: U.S. Geologic Survey (USGS), ASB influent weir. Data for 2011 is provisional and subject to correction.

[b] Total estimated treated volume per month is calculated from the average monthly flow multiplied by the number of operating minutes in each month.

[c] USGS reported a maximum daily flow of 46.3 gpm on April 21, 2011, no storm events or abnormal operations were recorded on this day; therefore, this data point is not used in the maximum daily flow and average monthly flow for the month of April 2011.

[d] USGS reported two maximum daily flows of 61.0 gpm and 50.6 gpm on July 29, 2011 and July 30, 2011; no storm events or abnormal operations were recorded on these days; therefore, the two data points were not used in the maximum daily flows and average monthly flows for the month of July 2011.

Abbreviations

ASB = Aspen Seep Bioreactor
gpm = gallons per minute

TABLE 7
SUMMARY OF 2011 WASTE MANIFESTS
Leviathan Mine Site
Alpine County, California

Date Removed From Site	Profile Number	Manifest Number	Source	Waste Description	Classification	California Hazardous Waste Code	Container Size	Weight [a] (tons unless noted P for pounds)
6/28/2011	070179888-0	AMEC1101	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.00
6/28/2011	070179898-0	AMEC1101	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	9.93
6/28/2011	070179898-0	AMEC1101	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.57
7/15/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.98
7/15/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.65
7/22/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.79
7/22/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	8.45
7/26/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	6.77
7/26/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	6.36
7/26/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	6.30
7/27/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	5.54
7/27/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.31
7/28/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.23
8/2/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.54
8/2/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.79
8/3/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.22
8/7/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.60

TABLE 7
SUMMARY OF 2011 WASTE MANIFESTS
Leviathan Mine Site
Alpine County, California

Date Removed From Site	Profile Number	Manifest Number	Source	Waste Description	Classification	California Hazardous Waste Code	Container Size	Weight [a] (tons unless noted P for pounds)
8/7/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.36
8/11/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.53
8/11/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.42
8/11/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.52
8/16/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.06
8/16/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.66
8/17/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	16.36
8/17/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.69
8/18/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.19
8/18/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.10
8/22/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.70
8/22/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.84
8/23/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.53
8/23/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.02
8/24/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.06
8/24/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.30

TABLE 7
SUMMARY OF 2011 WASTE MANIFESTS
Leviathan Mine Site
Alpine County, California

Date Removed From Site	Profile Number	Manifest Number	Source	Waste Description	Classification	California Hazardous Waste Code	Container Size	Weight [a] (tons unless noted P for pounds)
8/29/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.71
8/29/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.31
8/30/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.59
8/30/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.37
8/31/2011	070181762-0	AMEC1102	Aspen Seep Belt Filter Press	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	18.06
8/31/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.17
8/31/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.29
9/1/2011	070181762-0	AMEC1102	Aspen Seep Belt Filter Press	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.17
9/1/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.94
9/6/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.97
9/6/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.03
9/7/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	15.24
9/7/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.73
9/8/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.92
9/8/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.60
9/12/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.39
9/12/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	11.69

TABLE 7
SUMMARY OF 2011 WASTE MANIFESTS
Leviathan Mine Site
Alpine County, California

Date Removed From Site	Profile Number	Manifest Number	Source	Waste Description	Classification	California Hazardous Waste Code	Container Size	Weight [a] (tons unless noted P for pounds)
9/13/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.08
9/13/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.42
9/14/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.01
9/14/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	9.22
9/14/2011	0-701377471695	AMEC1102	Aspen Seep Rinse Water	Rinse Water from mix tanks	Non-Hazardous Waste, Liquid	--	275 gal	11,700 P
9/15/2011	070181762-0	AMEC1102	Aspen Seep Belt Filter Press	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	18.19
9/15/2011	070181762-0	AMEC1102	Aspen Seep Belt Filter Press	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	17.34
9/15/2011	070181762-0	AMEC1102	Aspen Seep Belt Filter Press	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	18.65
9/19/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.95
9/19/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.93
9/20/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.87
9/20/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.30
9/21/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.49
9/21/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.84
9/22/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.31
10/3/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	8.58
10/3/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	14.18

TABLE 7
SUMMARY OF 2011 WASTE MANIFESTS
Leviathan Mine Site
Alpine County, California

Date Removed From Site	Profile Number	Manifest Number	Source	Waste Description	Classification	California Hazardous Waste Code	Container Size	Weight [a] (tons unless noted P for pounds)
10/3/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	10.65
10/3/2011	070180275-0	AMEC 1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	9.37
10/3/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	13.89
10/4/2011	070180275-0	AMEC1102	Pond 4 Sludge	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	7.45
10/13/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	9.73
10/13/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	5.97
10/13/2011	070131570-4840	3531654	HDS Plant	Spent pH buffer solution / iron reagent waste	Non-RCRA Hazardous Waste, Solid	135	5 gal and 38 gal	180 P
10/13/2011	070131570-4232	3531654	Pond 4	Used oil filters and rags	Non-RCRA Hazardous Waste, Solid	221	55 gal	100 P
10/13/2011	070131570-4232	3531654	Pond 4	Used oil filters and rags	Non-RCRA Hazardous Waste, Solid	221	55 gal	200 P
10/13/2011	070128300-4024	3531654	Pond 4	Soil contaminated with anti-freeze (Dexcool)	Non-RCRA Hazardous Waste, Solid	181	5 gal	30 P
10/13/2011	070128300-3932	3531650	Pond 4	Soil contaminated with hydraulic oil	Non-RCRA Hazardous Waste, Solid	352	55 gal	400 P
10/13/2011	070128043-1983	AMEC1105	Aspen Seep	Personal Protective Equipment	Non-Hazardous Waste, Solid	--	55 gal	30 P
10/13/2011	070128043-1983	AMEC1105	HDS Plant	Personal Protective Equipment	Non-Hazardous Waste, Solid	--	55 gal	120 P
10/13/2011	070128043-1982	AMEC1105	HDS Plant	Empty Lime Bags	Non-Hazardous Waste, Solid	--	55 gal	100 P
11/2/2011	0-701377471695	AMEC1103	Pond 4	Rinsate water from tank cleaning	Non-Hazardous Waste, Liquid	--	275 gal	6255 P
11/15/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	12.29
11/15/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	6.80

TABLE 7
SUMMARY OF 2011 WASTE MANIFESTS
Leviathan Mine Site
Alpine County, California

Date Removed From Site	Profile Number	Manifest Number	Source	Waste Description	Classification	California Hazardous Waste Code	Container Size	Weight [a] (tons unless noted P for pounds)
11/15/2011	070179898-0	SYB1104	HDS Plant	Treatment Solids (Sludge)	Non-Hazardous Waste, Solid	--	20 cy	5.64
11/15/2011	070128043-1982	AMEC1105	HDS Plant	Empty Lime Bags	Non-Hazardous Waste, Solid	--	55 gal	40 P
11/15/2011	070128043-1983	AMEC1105	HDS Plant	Personal Protective Equipment	Non-Hazardous Waste, Solid	--	55 gal	40 P
11/15/2011	070131570-4231	3531668	HDS Plant	Used oil	Non-RCRA Hazardous Waste, Liquid	221	55 gal	550 P
11/15/2011	070131570-4232	3531668	HDS Plant	Used oil filter and rags	Non-RCRA Hazardous Waste, Liquid	221	55 gal	40 P
11/15/2011	070131570-4840	3531668	HDS Plant	Spent pH buffer solution / iron reagent waste	Non-RCRA Hazardous Waste, Solid	135	5 gal and 38 gal	100 P
11/15/2011	070128300-4159	3531668	HDS Plant	Magnafloc 10 Polymer	Non-RCRA Hazardous Waste, Solid	352	5 gal	60 P
11/15/2011	070128300-4160	3531668	HDS Plant	Empty Nalco Core Shell Polymer	Non-RCRA Hazardous Waste, Solid	513	55 gal	30 P

Notes
[a] Weight for treatment-generated solids recorded at disposal facility: US Ecology in Beatty, Nevada.

Abbreviations
-- = not applicable
ASB = Aspen Seep Bioreactor
cy = cubic yards
gal = gallons
HDS = High Denisty Sludge
P = pounds
RCRA = Resource Conservation and Recovery Act

TABLE 8
2011 HDS TREATMENT SYSTEM SAMPLING AND ANALYSIS SCHEDULE
Leviathan Mine Site
Alpine County, California

Sample ID Designation	Sample Location	Field Parameters	Field Parameter Frequency	Sample Analytes	Sample Frequency
CUD	CUD flow collected at the discharge of the conveyance line prior to Pond 4	pH, Temp, Conductivity, DO, ORP, Flow rate	1 x per month minimum	Acidity, alkalinity, hardness, Cl, sulfate, TDS, TSS, and target metals[a]	1 x per month
DS	DS flow collected at the discharge of the conveyance line prior to Pond 4				
HDSINF	Pond 4 water at Pond 4 influent pump sampling port prior to entering the HDS Treatment Plant		1 x per month minimum; pH weekly		
HDSEFF	Discharge of treated water from HDS Treatment Plant at effluent tank recirculation line sampling port	pH, Temp, Conductivity, DO, ORP, Flow rate, Dissolved Total Iron	1 x per week for the first four weeks of operation; 1 x per month minimum thereafter; Dissolved Total Iron and pH twice weekly		1 x per week for the first four weeks of operation; 1 x per month thereafter
HDSSLDG	Collected from sludge dewatering bins	NA	NA	TCLP, STLC, TTLC, SPLP, DI-WET, moisture content, paste pH	Prior to initial sludge disposal
PND4SLDG	Collected at four locations around Pond 4				
	Collected from sludge dewatering bins				Two samples varied throughout the year

Notes
[a] Target metals measured as dissolved: aluminum, arsenic, calcium, cadmium, chromium, copper, iron, lead, magnesium, nickel, and zinc. Selenium measured as total selenium.

Abbreviations
Cl = chloride
CUD = Channel Underdrain
DI = deionized water
DO = dissolved oxygen
DS = Delta Seep
HDS = High Density Sludge
NA = not applicable
ORP = oxidation reduction potential
SPLP = Synthetic Precipitation Leaching Procedure
STLC = Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TDS = total dissolved solids
Temp = temperature
TSS = total suspended solids
TTLC = Total threshold Limit Concentration
USGS = U.S. Geological Survey
WET = Waste ExtractionTest

TABLE 9
2011 ASB TREATMENT SYSTEM
SAMPLING AND ANALYSIS SCHEDULE
Leviathan Mine Site
Alpine County, California

Sample ID Designation	Sample Location	Field Parameters	Field Parameter Frequency	Sample Analytes	Sample Frequency
ASPINF	Bioreactor Influent (USGS Weir)	pH, Temp, Conductivity, DO, ORP, Flow rate	ARWS: 1 x per week LAS: 1 x per month	Acidity, alkalinity, hardness, Cl, sulfate, TDS, TSS, and target metals[a]	ARWS: 2 x per month LAS: 1 x per month
ASPEFF	Bioreactor Effluent	pH, Temp, Conductivity, DO, ORP, Flow rate, Dissolved Total Iron, Iron Speciation			
MH-1, MH-2, MH-3, MH-4, MH-5, MH-6, MH-7, and/or MH-9	Process Locations[b]	pH, Temp, Conductivity, DO, ORP, Dissolved Total Iron, Iron Speciation		Ammonia, dissolved target metals[a], dissolved organic carbon, ethanol, nitrate/nitrite, sulfate, sulfide, phosphorus	ARWS: 4 x per year LAS: up to 4 events
ASPSLG	Collected from bins containing dewatered sludge	NA	NA	TCLP, STLC, TTLC, SPLP, DI-WET, moisture content, paste pH	Prior to initial sludge disposal

Notes

[a] Target metals measured as dissolved: aluminum, arsenic, calcium, cadmium, chromium, copper, iron, lead, magnesium, nickel, and zinc. Selenium measured as total selenium.

[b] Process monitoring locations vary with system configuration, data collected from process locations was used to optimize system performance.

Abbreviations

ARWS = Atlantic Richfield Work Season
ASB = Aspen Seep Bioreactor
Cl = chloride
DI = deionized water
DO = dissolved oxygen
LAS = Limited Access Season
NA = not applicable
ORP = oxidation reduction potential
SPLP = Synthetic Precipitation Leaching Procedure
STLC = Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TDS = total dissolved solids
Temp = temperature
TSS = total suspended solids
TTLC = Total threshold Limit Concentration
USGS = U.S. Geological Survey
WET = Waste ExtractionTest

TABLE 10
2011 LABORATORY ANALYTICAL METHODS
FOR AQUEOUS AND SOLID-PHASE PARAMETERS
Leviathan Mine Site
Alpine County, California

Parameter	Sample Preparation or Type	Method	Minimum Method Detection Limit	Units
AQUEOUS-PHASE SAMPLES				
Anions and General Parameters				
Acidity	Unfiltered	SM 2310B	10.0	mg/L (as $CaCO_3$)
Alkalinity	Unfiltered	SM 2320B	5.0	mg/L (as $CaCO_3$)
Chloride	Unfiltered	EPA 300.0	5.0	mg/L
Sulfate	Unfiltered	EPA 300.0	10.0	mg/L
Hardness	Unfiltered	SM 2340B	1.0	mg/L (as $CaCO_3$)
Total Dissolved Solids	Unfiltered	SM 2540C	10.0	mg/L
Total Suspended Solids	Unfiltered	SM 2540D	10.0	mg/L
Major Cations and Trace Metals				
Aluminum	Filtered	EPA 6010B/6020/200.7	0.08	mg/L
Arsenic	Filtered	EPA 6010B/6020/200.7	0.005	mg/L
Calcium	Filtered	EPA 6010B/6020/200.7	0.5	mg/L
Cadmium	Filtered	EPA 6010B/6020/200.7	0.001	mg/L
Chromium	Filtered	EPA 6010B/6020/200.7	0.005	mg/L
Copper	Filtered	EPA 6010B/6020/200.7	0.005	mg/L
Iron	Filtered	EPA 6010B/6020/200.7	0.1	mg/L
Lead	Filtered	EPA 6010B/6020/200.7	0.001	mg/L
Magnesium	Filtered	EPA 6010B/6020/200.7	0.5	mg/L
Nickel	Filtered	EPA 6010B/6020/200.7	0.005	mg/L
Selenium	Unfiltered	EPA 6010B/6020/200.7	0.02	mg/L
Zinc	Filtered	EPA 6010B/6020/200.7	0.005	mg/L
ASB Treatment System Enhanced Sampling				
Phosphorous	Filtered	EPA 6010B/6020/200.7	0.02	mg/L
Ammonia-N	Filtered	SM-4500-NH3	0.10	mg/L
Ethanol	Filtered	EPA 8260B	5	ug/L
Nitrate-N	Filtered	EPA 300.0	0.10	mg/L
Nitrite-N	Filtered	EPA 300.0	0.10	mg/L
Nitrate/Nitrate-N	Unfiltered	EPA 300.0 - Calculation	0.10	mg/L
Dissolved Organic Carbon	Filtered	SM5310B	0.5	mg/L
Sulfide	Unfiltered	SM4500-S	1.0	mg/L
SOLID-PHASE SAMPLES				
TCLP Metals	Sludge	EPA 1311/6010B/7470A	Varies	mg/L
SPLP Metals	Sludge	EPA 1312/6010B/7470A	Varies	mg/L
TTLC Metals	Sludge	EPA 6010B/7471A	Varies	mg/kg
STLC Metals	Sludge	DIWET/WET/EPA 6010B/7470A	Varies	mg/L
Paste pH	Sludge	SW-845 9045A	NA	standard units
Density	Sludge	ASTM E1109 (ASTM D2937)	0.1	g/cc
Percent Solids	Sludge	EPA 160.2	0.1	%
Moisture Content	Sludge	ASTM 2450B	0.1	%

Abbreviations

ASTM = American Society for Testing and Materials
$CaCO_3$ = calcium carbonate
DI = deionized water
EPA = U.S. Environmental Protection Agency
g/cc = grams per cubic centimeter
mg/kg = milligrams per kilograms
mg/L = milligrams per liter
NA = not applicable
N = Nitrogen
SM = standard methods
SPLP = Synthetic Precipitation Leaching Procedure
STLC = Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TTLC = Total threshold Limit Concentration
WET = Waste ExtractionTest

TABLE 11
SUMMARY OF 2011 HDS TREATMENT SYSTEM
DISCHARGE EVENTS
Leviathan Mine Site
Alpine County, California

Month	Dates of Discharge	Estimated Volume of Discharge (gallons)[a]
May	5/5 to 5/31	2,146,472
June	6/1 to 6/30	2,918,988
July	7/1 to 7/15	1,263,900
	7/19 to 7/31	901,970
August	8/1 to 8/15	1,142,416
	8/17 to 8/31	930,964
September	9/1 to 9/30	1,918,306
October	10/1 to 10/20	1,217,584
	10/26 to 10/31	419,405
	Pond 4 Discharge 9/29 - 10/8	682,081
November	11/1 to 11/4	240,972
Total 2011 Volume Discharged		13,783,058

Notes
[a] Discharge volume is calculated from the influent flow totalizer while the HDS Treatment Plant discharge valve is open.

Abbreviations
CUD = Channel Underdrain
DS = Delta Seep
HDS = High Density Sludge

TABLE 12
SUMMARY OF 2011 HDS TREATMENT SYSTEM
SLUDGE ANALYTICAL DATA
Leviathan Mine Site
Alpine County, California

Parameter	Analytical Results[a,b]					Maximum Regulatory Threshold[c]		
	Total Metals (mg/kg)	STLC (mg/L)	TCLP (mg/L)	SPLP (mg/L)	DI-WET (mg/L)	TTLC (Regulatory Limits for Total Metals) (mg/kg)	STLC (Regulatory Limits) (mg/L)	TCLP (Regulatory Limits) (mg/L)
	Sample Date: 2 June 2011 Sample ID: 159HDSSLUDGE417							
Aluminum	30,000	930	0.97 J	5.8	0.80	NA	NA	NA
Antimony	<4.4	<0.14	<0.070	<0.070	<0.00030	500	15	NA
Arsenic	180	0.39	<0.070	<0.070	<0.00090	500	5.0	5.0
Barium	7	<0.12	<0.060	<0.060	0.0041	10,000	100	100
Beryllium	4	0.053 J	<0.010	<0.010	<0.00010	75	0.75	NA
Cadmium	<1.0	0.050 J	<0.020	<0.020	0.00014 J	100	1.0	1.0
Chromium	28	0.30	0.028 J	<0.020	<0.00090	500[d]	5 (560)[e]	5.0
Cobalt	270	8.60	<0.020	<0.020	0.0016	8,000	80	NA
Copper	110	2.1	0.067 J	<0.030	0.0029	2,500	25	NA
Iron	120,000	860	<0.15	<0.15	0.020 J	NA	NA	NA
Lead	<2.5	<0.080	<0.040	<0.040	<0.00020	1,000	5.0	5.0
Mercury	0.26	0.012	<0.0010	<0.0010	<0.00010	20	0.2	0.2
Molybdenum	<1.0	<0.040	0.024 J	<0.020	0.00069 J	3,500	350	NA
Nickel	660	18	0.037 J	<0.020	0.0038	2,000	20	NA
Selenium	7.4 J	0.24	0.11	<0.080	0.0010 J	100	1.0	1.0
Silver	<4.0	<0.12	<0.060	<0.060	<0.00010	500	5.0	5.0
Thallium	20 J	<0.14	0.073 J	<0.070	0.042	700	7.0	NA
Vanadium	29	<0.060	<0.030	<0.030	<0.00080	2,400	24	NA
Zinc	170	0.92	<0.060	<0.060	0.020	5,000	250	NA
pH (standard units)	8.5					Corrosivity criteria for pH = ≤ 2.0 or ≥ 12.5		
Soil Moisture (% by weight)	54							

Notes

[a] Constituents that were not detected are listed as "<" the detection limit value.

[b] Results noted with "J" are an approximate value and were less than the reporting limit but greater than or equal to the method detection limit.

[c] Title 22 California Code of Regulations, Section 66261.24 (a)(2): Samples were tested for waste extraction test, solubility, and total concentrations. If the results of the STLC or TTLC equal or exceed their respective regulatory thresholds, the waste is a hazardous waste.

[d] Concentration limit for total chromium and/or chromium (III) is 2,500 mg/L and limit for chromium (VI) is 500 mg/L.

[e] The federal hazardous waste level for soluble chromium is 5mg/L. California has a Waste Extraction Test (WET) soluble level for chromium (III) (560 mg/L) and chromium (VI) (5 mg/L). To use the 560 mg/L regulatory threshold, it must be demonstrated first that the waste is not a RCRA waste.

Abbreviations

DI = deionized water
HDS = High Density Sludge
mg/kg = milligrams per kilograms
mg/L = milligrams per liter
NA = not applicable
RCRA = Resource Conservation Recovery Act
SPLP = Synthetic Precipitation Leaching Procedure
STLC = Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TTLC = Total threshold Limit Concentration
WET = Waste ExtractionTest

TABLE 13
SUMMARY OF 2011 ASB TREATMENT SYSTEM
SLUDGE ANALYTICAL DATA
Leviathan Mine Site
Alpine County, California

Parameter	Analytical Results[a,b]					Maximum Regulatory Threshold[c]		
	Total Metals (mg/kg)	STLC (mg/L)	TCLP (mg/L)	SPLP (mg/L)	DI-WET (mg/L)	TTLC (Regulatory Limits for Total Metals) (mg/kg)	STLC (Regulatory Limits) (mg/L)	TCLP (Regulatory Limits) (mg/L)
	Sample Date: 19 July 2011 Sample ID:151ASPSLG478							
Aluminum	12,000	1200	0.66 J	<0.40	0.1	NA	NA	NA
Antimony	<1.7	<0.14	<0.070	<0.070	<0.00030	500	15	NA
Arsenic	2.0 J	<0.13	<0.070	<0.070	<0.00090	500	5.0	5.0
Barium	9.1	0.47	0.15 J	<0.060	0.012	10,000	100	100
Beryllium	2.7	0.21	<0.010	<0.010	<0.00010	75	0.75	NA
Cadmium	0.71 J	<0.040	<0.020	<0.020	<0.00010	100	1.0	1.0
Chromium	1.4 J	0.11	<0.020	<0.020	<0.00090	500[d]	5 (560)[e]	5.0
Cobalt	63	1.2	0.27	<0.020	0.00029 J	8,000	80	NA
Copper	290	<0.060	<0.030	<0.030	0.0025	2,500	25	NA
Iron	30,000	1,900	420	<0.15	0.24	NA	NA	NA
Lead	1.1 J	<0.080	<0.040	<0.040	<0.00020	1,000	5.0	5.0
Mercury	<0.012	<0.0010	<0.0010	<0.0010	<0.00010	20	0.2	0.2
Molybdenum	<0.39	<0.040	<0.020	<0.020	0.0024	3,500	350	NA
Nickel	95	3.1	0.91	<0.020	0.0012 J	2,000	20	NA
Selenium	<2.0	<0.16	<0.080	<0.080	<0.00050	100	1.0	1.0
Silver	<1.6	<0.12	<0.060	<0.060	0.00040 J	500	5.0	5.0
Thallium	<1.6	<0.14	<0.070	<0.070	<0.00020	700	7.0	NA
Vanadium	<0.59	<0.060	<0.030	<0.030	<0.00080	2,400	24	NA
Zinc	180	4.3	0.35 J	<0.060	<0.0040	5,000	250	NA
pH (standard units)	7.9					Corrosivity criteria for pH = ≤ 2.0 or ≥ 12.5		
Soil Moisture[f] (% by weight)	151ASPSLG478 A - 83%							
	151ASPSLG478 B - 81%							
	151ASPSLG478 C - 84%							

Notes

[a] Constituents that were not detected are listed as "<" the detection limit value.

[b] Results noted with "J" are an approximate value and were less than the reporting limit but greater than or equal to the method detection limit.

[c] Title 22 California Code of Regulations, Section 66261.24 (a)(2): Samples were tested for waste extraction test, solubility, and total concentrations. If the results of the STLC or TTLC equal or exceed their respective regulatory thresholds, the waste is a hazardous waste.

[d] Concentration limit for total chromium and/or chromium (III) is 2,500 mg/L and limit for chromium (VI) is 500 mg/L.

[e] The federal hazardous waste level for soluble chromium is 5mg/L. California has a Waste Extraction Test (WET) soluble level for chromium (III) (560 mg/L) and chromium (VI) (5 mg/L). To use the 560 mg/L regulatory threshold, it must be demonstrated first that the waste is not a RCRA waste.

[f] Each individual sludge sample (A, B, C) of the 3-part composite was analyzed for soil moisture (% by weight).

Abbreviations

DI = deionized water
HDS = High Density Sludge
mg/kg = milligrams per kilograms
mg/L = milligrams per liter
NA = not applicable
RCRA = Resource Conservation Recovery Act
SPLP = Synthetic Precipitation Leaching Procedure
STLC = Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TTLC = Total threshold Limit Concentration
WET = Waste ExtractionTest

TABLE 14
SUMMARY OF 2011 POND 4 SLUDGE ANALYTICAL DATA
Leviathan Mine Site
Alpine County, California

Parameter	Analytical Results[a,b]															Maximum Regulatory Threshold[f]		
	Total Metals (mg/kg)			STLC (mg/L)			TCLP (mg/L)			SPLP (mg/L)			DI-WET (mg/L)			TTLC (Regulatory Limits for Total Metals) (mg/kg)	STLC (Regulatory Limits) (mg/L)	TCLP (Regulatory Limits) (mg/L)
	Minimum[c]	Maximum[d]	Average[e]	Minimum[c]	Maximum[d]	Average[e]	Minimum[c]	Maximum[d]	Average[e]	Minimum[c]	Maximum[d]	Average[e]	Minimum[c]	Maximum[d]	Average[e]			
Aluminum	2,800	20,000	8,600	53	820	334	<0.4	56	10	0.41	3.8	1.1	<0.04	0.15	0.07	NA	NA	NA
Antimony	<1.7	<4.4	18	<0.14	<0.14	0.1	<0.07	<0.07	0.10	<0.07	0.094	0.10	<0.0003	0.00031	0.0009	500	15	NA
Arsenic	48	530	209	0.4	1.2	0.7	<0.07	<0.07	0.10	<0.07	<0.07	0.05	<0.0009	0.0016	0.0010	500	5.0	5.0
Barium	3.5	240	53	<0.12	1.1	0.3	<0.06	0.13	0.11	<0.06	<0.06	0.10	0.0014	0.21	0.04	10,000	100	100
Beryllium	0.44	3.2	1.2	0.018	0.18	0.07	<0.01	<0.01	0.04	<0.01	<0.01	0.04	<0.0001	<0.0001	0.0002	75	0.75	NA
Cadmium	0.39	1.6	1.0	<0.04	<0.04	0.05	<0.02	<0.02	0.05	<0.02	<0.02	0.05	<0.0001	0.0011	0.0006	100	1.0	1.0
Chromium	2.5	31	13	0.083	0.56	0.29	<0.02	<0.02	0.05	<0.02	0.021	0.05	<0.0009	<0.0009	0.0010	500[g]	5 (560)[h]	5.0
Cobalt	24	300	85	0.39	16	6	<0.02	2.3	0.6	<0.02	0.19	0.11	0.0004	0.11	0.03	8,000	80	NA
Copper	9.9	93	43	0.17	5.2	1.7	<0.03	0.039	0.09	<0.03	<0.03	0.10	0.0010	0.0043	0.0018	2,500	25	NA
Iron	25,000	99,000	63,000	740	2,800	1,570	<0.15	79	13	<0.15	<0.15	0.40	<0.015	0.1	0.04	NA	NA	NA
Lead	<0.99	14	6	<0.08	<0.08	0.05	<0.04	0.066	0.05	<0.04	<0.04	0.05	<0.0002	0.0003	0.0005	1,000	5.0	5.0
Mercury	0.019	5.4	1.2	<0.001	0.0016	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.0001	<0.0001	0.0001	20	0.2	0.2
Molybdenum	<0.39	<1	3	<0.04	<0.04	0.20	<0.02	<0.02	0.20	<0.02	0.021	0.17	<0.0002	0.018	0.004	3,500	350	NA
Nickel	53	1,200	330	0.98	33	12	0.054	4.8	1.5	<0.02	0.37	0.17	0.0025	0.3	0.10	2,000	20	NA
Selenium	<2	13	6	<0.16	0.75	0.26	<0.08	0.22	0.13	<0.08	<0.08	0.05	<0.0005	0.0014	0.0012	100	1.0	1.0
Silver	<1.6	<4	1.8	<0.12	<0.12	0.10	<0.06	<0.06	0.10	<0.06	<0.06	0.10	<0.0001	0.0009	0.0006	500	5.0	5.0
Thallium	<1.6	5.6	17	<0.14	0.42	0.17	<0.07	0.16	0.07	<0.07	<0.07	0.05	0.0046	0.016	0.010	700	7.0	NA
Vanadium	6.4	38	19	<0.06	0.53	0.21	<0.03	<0.03	0.10	<0.03	<0.03	0.10	<0.0008	0.0042	0.0014	2,400	24	NA
Zinc	27	380	106	0.29	5.4	2.4	0.063	0.75	0.28	<0.06	0.11	0.19	<0.004	0.023	0.013	5,000	250	NA
Average[e] pH (standard units)	6.7															Corrosivity criteria for pH = ≤ 2.0 or ≥ 12.5		
Average[e] Soil Moisture (% by weight)	73																	

Notes

[a] Pond 4 sludge samples collected on 5/27/2011, 7/28/2011, and 8/11/2011.

[b] Constituents that were not detected are listed as "<" the detection limit value.

[c] Minimum values represent the lowest detected concentration or the method detection limit if analyte was not detected at least once during the sampling period.

[d] Maximum values represent the highest detected concentration during the period of sample collection.

[e] Average values represent the calculated mean of concentrations during the sampling period. If the analyte was not detected, half of the reporting limit was used to calculate the average.

[f] Title 22 California Code of Regulations, Section 66261.24 (a)(2): Samples were tested for waste extraction test, solubility, and total concentrations. If the results of the STLC or TTLC equal or exceed their respective regulatory thresholds, the waste is a hazardous waste.

[g] The federal hazardous waste level for soluble chromium is 5mg/L. California has a Waste Extraction Test (WET) soluble level for chromium (III) (560 mg/L) and chromium (VI) (5 mg/L). To use the 560 mg/L regulatory threshold, it must be demonstrated first that the waste is not a RCRA waste.

[h] Concentration limit for total chromium and/or chromium (III) is 2,500 mg/L and limit for chromium (VI) is 500 mg/L.

Abbreviations

DI = deionized water
HDS = High Density Sludge
mg/kg = milligrams per kilograms
mg/L = milligrams per liter
NA = not applicable
SPLP = Synthetic Precipitation Leaching Procedure
STLC = Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TTLC = Total threshold Limit Concentration
WET = Waste ExtractionTest

TABLE 15
SUMMARY OF 2011 ASB TREATMENT SYSTEM INFILTRATION/OVERFLOW POND SEDIMENT DATA
Leviathan Mine Site
Alpine County, California

Parameter	July 14 2011 149IOPINF475 Infiltration/Overflow Pond Sediment (pond head)					July 14 2011 149IOPEFF476 Infiltration/Overflow Pond Sediment (pond tail)					TTLC Regulatory Limits for Total Metals (mg/kg)	STLC Regulatory Limits (mg/L)	TCLP Regulatory Limits (mg/L)
	DI-WET (mg/L)	SPLP (mg/L)	STLC (mg/L)	TCLP (mg/L)	Total (mg/kg)	DI-WET (mg/L)	SPLP (mg/L)	STLC (mg/L)	TCLP (mg/L)	Total (mg/kg)			
Aluminum	0.053	<0.4	450	3.1	5,800	1.8	4.4	95	1.3	6,100	NA	NA	NA
Antimony	0.00084 J	<0.07	<0.14	<0.07	<1.8	0.0056	<0.07	<0.14	<0.07	<1.8	500	15	NA
Arsenic	0.0059	<0.07	<0.13	<0.07	31	0.29	<0.07	<0.13	0.15 J	81	500	5.0	5.0
Barium	0.082	<0.06	4.4	0.43	110	0.1	0.1 J	15	1.1	320	10,000	100	100
Beryllium	<0.0001	<0.01	0.11	<0.01	1.3	<0.0001	<0.01	<0.018	<0.01	0.46 J	75	0.75	NA
Cadmium	<0.0001	<0.02	<0.04	<0.02	0.69 J	<0.0001	<0.02	<0.04	<0.02	<0.4	100	1.0	1.0
Chromium	<0.0009	<0.02	0.4	<0.02	9.2	0.00099 J	<0.02	1.1	0.024 J	22	500[a]	5 (560)[b]	5.0
Cobalt	0.00058 J	<0.02	<0.04	<0.02	98	0.0013	<0.02	0.15 J	0.027 J	12	8,000	80	NA
Copper	<0.0005	<0.03	<0.06	<0.03	120	0.0033	<0.03	<0.06	<0.03	50	2,500	25	NA
Iron	<0.015	<0.15	960	270	30,000	1.5	2.7	1,200	220	28,000	NA	NA	NA
Lead	<0.0002	<0.04	<0.08	<0.04	8.2	0.0017	<0.04	<0.08	<0.04	25	1,000	5.0	5.0
Mercury	<0.0001	<0.001	<0.001	<0.001	1.3	0.00016 J	<0.001	<0.001	<0.001	2.8	20	0.2	0.2
Molybdenum	0.0024	<0.02	<0.04	<0.02	<0.4	0.032	<0.02	<0.04	<0.02	<0.4	3,500	350	NA
Nickel	0.0032	<0.02	1.7	<0.02	150	0.0082	<0.02	0.74	<0.02	20	2,000	20	NA
Selenium	<0.0005	0.18	<0.16	<0.08	4.1	0.00071 J	<0.08	<0.16	0.11	5.2	100	1.0	1.0
Silver	0.00022 J	<0.06	<0.12	<0.06	<1.6	<0.0001	<0.06	<0.12	<0.06	<1.6	500	5.0	5.0
Thallium	<0.0002	<0.07	<0.14	<0.07	4.2 J	0.00034 J	<0.07	<0.14	<0.07	5.4 J	700	7.0	NA
Vanadium	<0.0008	<0.03	1	<0.03	17	0.015	<0.03	2.9	<0.03	41	2,400	24	NA
Zinc	<0.004	<0.06	<0.12	0.06 J	180	<0.004	<0.06	0.19 J	0.6	33	5,000	250	NA
pH (s.u.)	-	-	-	-	8.3	-	-	-	-	8.7	Corrosivity criteria for pH = ≤ 2.0 or ≥ 12.5[c]		
AGP - Sulfide Acid Leach (tons $CaCO_3$ / 1,000 tons)	-	-	-	-	38	-	-	-	-	21	-	-	-
AGP - Total Sulfur (tons $CaCO_3$ / 1,000 tons)	-	-	-	-	260	-	-	-	-	88	-	-	-
Neutralization Potential (tons $CaCO_3$ / 1,000 tons)	-	-	-	-	56	-	-	-	-	18	-	-	-
pH - Saturated Paste (s.u.)	-	-	-	-	7.33	-	-	-	-	7.36	-	-	-
Sulfur Residual - LECO Furnace (%)	-	-	-	-	2.4	-	-	-	-	1.3	-	-	-
Sulfur Sulfate - LECO Furnace (%)	-	-	-	-	4.6	-	-	-	-	0.83	-	-	-
Sulfur Sulfide - LECO Furnace (%)	-	-	-	-	1.2	-	-	-	-	0.66	-	-	-
Sulfur, Total - LECO Furnace (%)	-	-	-	-	8.2	-	-	-	-	2.8	-	-	-
Total Organic Carbon	-	-	-	-	7,600	-	-	-	-	7,800	-	-	-
Percent Moisture (%)	-	-	-	-	60	-	-	-	-	38	-	-	-
Percent Solids (%)	-	-	-	-	40	-	-	-	-	62	-	-	-

Notes

[a] Concentration limit for total chromium and/or chromium (III) is 2,500 mg/L and limit for chromium (VI) is 500 mg/L.

[b] The federal hazardous waste level for soluble chromium is 5mg/L. California has a Waste Extraction Test (DI-WET) soluble level for chromium (III) (560 mg/L) and chromium (VI) (5 mg/L). To use the 560 mg/L regulatory threshold, it must be demonstrated first that the waste is not a Resource Conservation Recovery Act (RCRA) waste.

[c] Title 22 California Code of Regulations, Section 66261.24 (a)(2): Samples were tested for waste extraction test, solubility, and total concentrations. If the results of the STLC or TTLC equal or exceed their respective regulatory thresholds, the waste is a hazardous waste.

Abbreviations

"<" = Constituent not detected at or above the method detection limit.
% = percent
- = Not measured or available
AGP = Acid generation potential
$CaCO_3$ = calcium carbonate
DI = deionized water
J = The associated value is an estimated quantity
mg/L = milligrams per liter
mg/kg = milligrams per kilograms
NA = Not applicable
RCRA = Resource Conservation Recovery Act
SPLP = Synthetic precipitation leaching procedure
STLC = Soluble threshold limit concentration
s.u. = standard units
TCLP = Toxicity Characteristic Leaching Procedure
TTLC = California Total Threshold Limit Concentration; based on wet weight concentration
WET = Waste ExtractionTest

TABLE 16
SUMMARY OF 2011 FIELD DUPLICATES
Leviathan Mine Site
Alpine County, California

Parameter (mg/L)	Basis[a]	ASB Treatment System Effluent Duplicates[b,c]					ASB Treatment System Influent Duplicates[b,c]	Delta Seep Duplicates[b,c]	HDS Treatment Plant Effluent Duplicates[b,c]	
		26 April 2011 141ASPEFF488	1 June 2011 145ASPEFF466	28 July 2011 152ASPEFF483	28 September 2011 160ASPEFF507	15 November 2011 165ASPEFF588	30 August 2011 158ASPINF498	4 October 2011 167DS440	2 June 2011 158HDSEFF412	3 August 2011 163HDSEFF428
Aluminum	Dissolved	<0.04	0.16	0.14	<0.04	0.051	49	8	0.52	0.56
Arsenic	Dissolved	<0.0009	<0.0009	<0.0009	0.0035	<0.0009	<0.0009	0.04	<0.0009	0.0017
Cadmium	Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0022	0.0013	<0.0001	<0.0001
Calcium	Dissolved	324	367	346	352	334	380	284	788	739
Chromium	Dissolved	<0.0009	<0.0009	<0.0009	0.0011 J	<0.0009	0.004	0.0014 J	<0.0009	<0.0009
Copper	Dissolved	0.0025	0.0022	0.0011 J	0.0093	0.0038	1.1	0.061	0.0015 J	0.0044
DOC	Dissolved	--	210	--	--	--	--	--	--	--
Hardness	Dissolved	1100	1200	1200	1200	1100	1300	1100	2400	2200
Iron	Dissolved	4.51	<0.015	0.0337 J	0.0397 J	0.464	140	20.5	0.106	0.565
Lead	Dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002 J	<0.0002	<0.0002
Magnesium	Dissolved	66	61	76	77	69	93	83	96	82
Nickel	Dissolved	0.08	0.018	0.0023	0.023	0.04	0.52	0.4	0.078	0.046
Phosphorous	Dissolved	--	<0.02	--	--	--	--	--	--	--
Zinc	Dissolved	0.015 J	0.004 UJ	<0.004	0.013 J	0.0061 J	0.58	0.15	<0.004	<0.004
Acidity	Total	<2	<2	<2	<2	<2	630	110	<2	<2
Alkalinity (Bicarbonate)	Total	74.9	210	361	332	249	<2.4	<2.4	23.2	36.6
Alkalinity (Carbonate)	Total	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Alkalinity (Hydroxide)	Total	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Alkalinity (Total)	Total	61.4	172	296	272	204	<2	<2	19	30
Ammonia	Total	--	0.19 J	--	--	--	--	--	--	--
Chloride	Total	2.7	2.9	<1.5	4.2	4.6	2.2 J	2.2 J	<3	3
Ethanol	Total	--	140	--	--	--	--	--	--	--
Nitrate	Total	--	<0.06	--	--	--	--	--	--	--
Nitrite	Total	--	<0.09	--	--	--	--	--	--	--
Nitrite+Nitrate	Total	--	<0.09	--	--	--	--	--	--	--
Selenium	Total	0.0034	0.0027	<0.0005	0.0013 J	0.00062 J	0.0025	0.0018 J	0.002	0.00095 J
Sulfate	Total	1610	1690	1590	1580	1550	2200	1250	2340	1980
TDS	Total	2220	2760	2900	2670	2650	3000	1770	3550	3050
TSS	Total	9 J	3 J	6 J	2 J	2 J	27	67	16	20

Notes
[a] Dissolved fraction concentrations reported for field filtered samples.
[b] Constituents that were not detected are listed as "<" the detection limit value.
[c] Results noted with "J" are an approximate value and were less than the reporting limit but greater than or equal to the method detection limit.

Abbreviations
-- = not applicable or not collected
ASB = Aspen Seep Bioreactor
DOC = dissolved organic carbon
HDS = High Density Sludge
mg/L = milligrams per liter
TDS = total dissolved solids
TSS = total suspended solids

Table 17
SUMMARY OF 2011 FIELD METHOD BLANKS
Leviathan Mine Site
Alpine County, California

Parameter (mg/L)	Basis[a]	Field Method Blanks[b,c]								
		26 April 2011 141ASPINF450	1 June 2011 145ASPINF468	2 June 2011 158HDSEFF413	28 July 2011 152ASPINF484	3 August 2011 163DS429	30 August 2011 158ASPEFF497	28 September 2011 160ASPINF508	15 November 2011 165ASPINF589	4 October 2011 167CUD441
Aluminum	Dissolved	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Arsenic	Dissolved	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009
Cadmium	Dissolved	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	Dissolved	<0.05	0.0583 J	0.267	0.0574 J	0.107	0.051 J	0.0637 J	<0.05	0.086 J
Chromium	Dissolved	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009
Copper	Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.001 J	0.00086 J	<0.0005	<0.0005
DOC	Dissolved	--	<0.5	--	--	--	--	--	--	--
Hardness	Dissolved	<0.33	<0.33	0.67	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Iron	Dissolved	<0.015	<0.015	<0.015	<0.015	<0.015	0.018 J	<0.015	<0.015	<0.015
Lead	Dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Magnesium	Dissolved	0.028	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012
Nickel	Dissolved	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Phosphorous	Dissolved	--	<0.02	--	--	--	--	--	--	--
Zinc	Dissolved	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Acidity	Total	3	5 J	8	--	9	3	2	2	4
Alkalinity (Bicarbonate)	Total	<2.4	<2.4	2.44	2.44	<2.4	4.9	7.32	7.32	7.32
Alkalinity (Carbonate)	Total	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Alkalinity (Hydroxide)	Total	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Alkalinity (Total)	Total	<2	<2	2	2	<2	4	6	6	6
Ammonia	Total	--	<0.1	--	--	--	--	--	--	--
Chloride	Total	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Ethanol	Total	--	<0.1	--	--	--	--	--	--	--
Nitrate	Total	--	<0.06	--	--	--	--	--	--	--
Nitrite	Total	--	<0.09	--	--	--	--	--	--	--
Nitrite+Nitrate	Total	--	<0.09	--	--	--	--	--	--	--
Selenium	Total	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00068 J	<0.0005	<0.001
Sulfate	Total	<0.3	0.302 J	1.02	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Sulfide	Total	--	0.047 J	--	--	--	--	--	--	--
TDS	Total	<1	<1	<1	<1	<1	2 J	1 J	1 J	<1
TSS	Total	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes
[a] Dissolved fraction concentrations reported for field filtered samples.
[b] Constituents that were not detected are listed as "<" the detection limit value.
[c] Results noted with "J" are an approximate value and were less than the reporting limit but greater than or equal to the method detection limit.

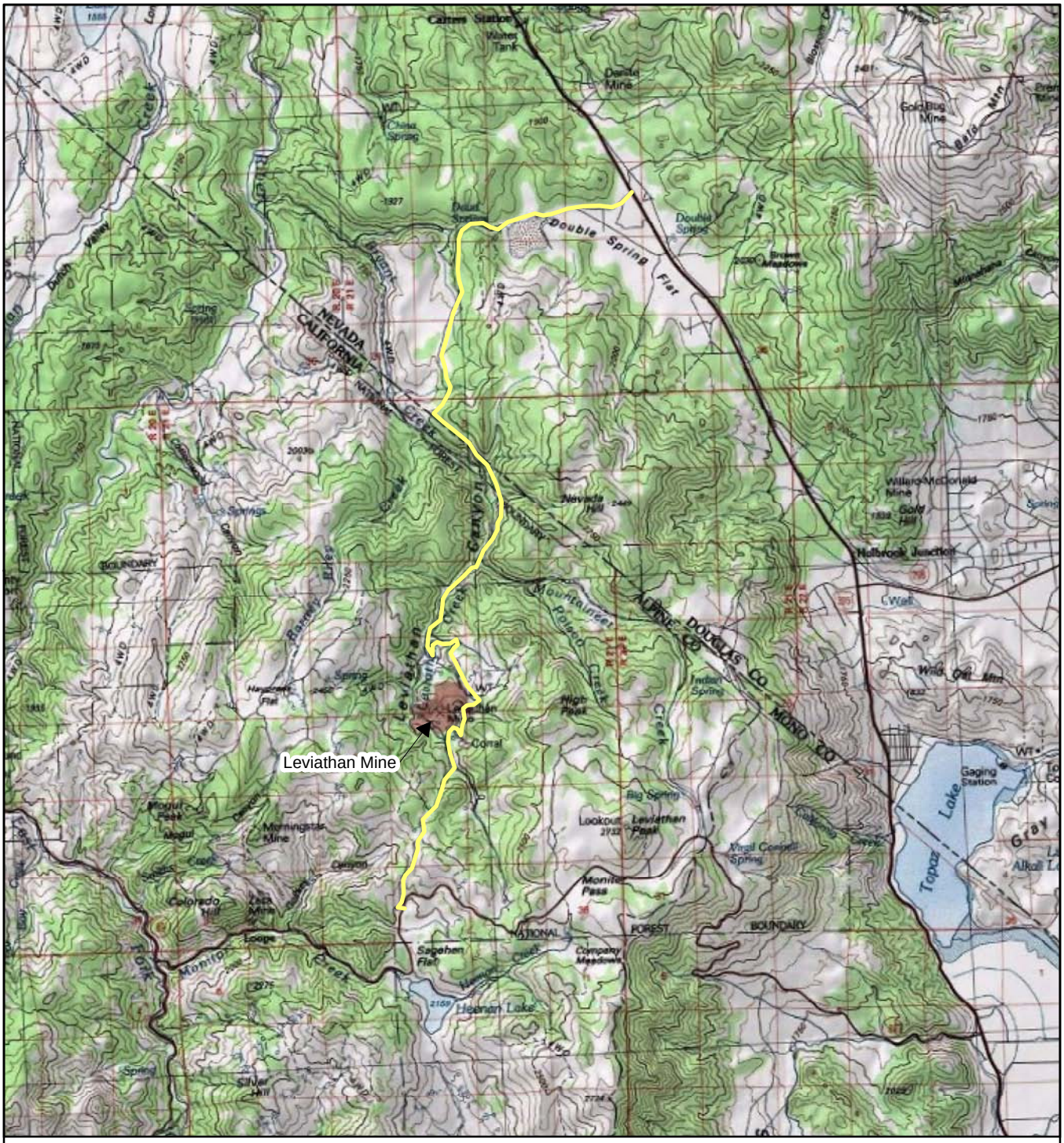
Abbreviations
-- = not applicable
DOC = dissolved organic carbon
mg/L = milligrams per liter
TDS = total dissolved solids
TSS = total suspended solids

TABLE 18
SUMMARY OF 2011 COSTS INCURRED
Leviathan Mine Site
Alpine County, California

Task Description	
Project Management and Health, Safety, Security, and Environment (HSSE) Oversight	
Project Compliance, Reporting, Project Management and HSSE Oversight	**$2,589,000**
Site Access	
Site Setup and Maintenance	$439,000
Leviathan Mine Road Maintenance	$411,000
Site Access Total =	**$850,000**
HDS Treatment System Activities	
Spring Commissioning	$210,000
Operation and Maintenance	$1,228,000
Sludge Management and Disposal	$95,000
System Winterization	$183,000
Engineering Support and System Improvements	$244,000
Pond 4 Sludge Removal	$1,410,000
HDS Treatment System Activities Total =	**$3,370,000**
ASB Treatment System Activities	
Operations and Maintenance	$710,000
Sludge Management and Disposal	$541,000
Engineering Support and System Improvements	$295,000
Hydrogen Sulfide Monitoring	$130,000
ASB Treatment System Activities Total =	**$1,676,000**
Grand Total =	**$8,485,000**

Note
Expenditures were rounded to $1,000 increments.

FIGURES

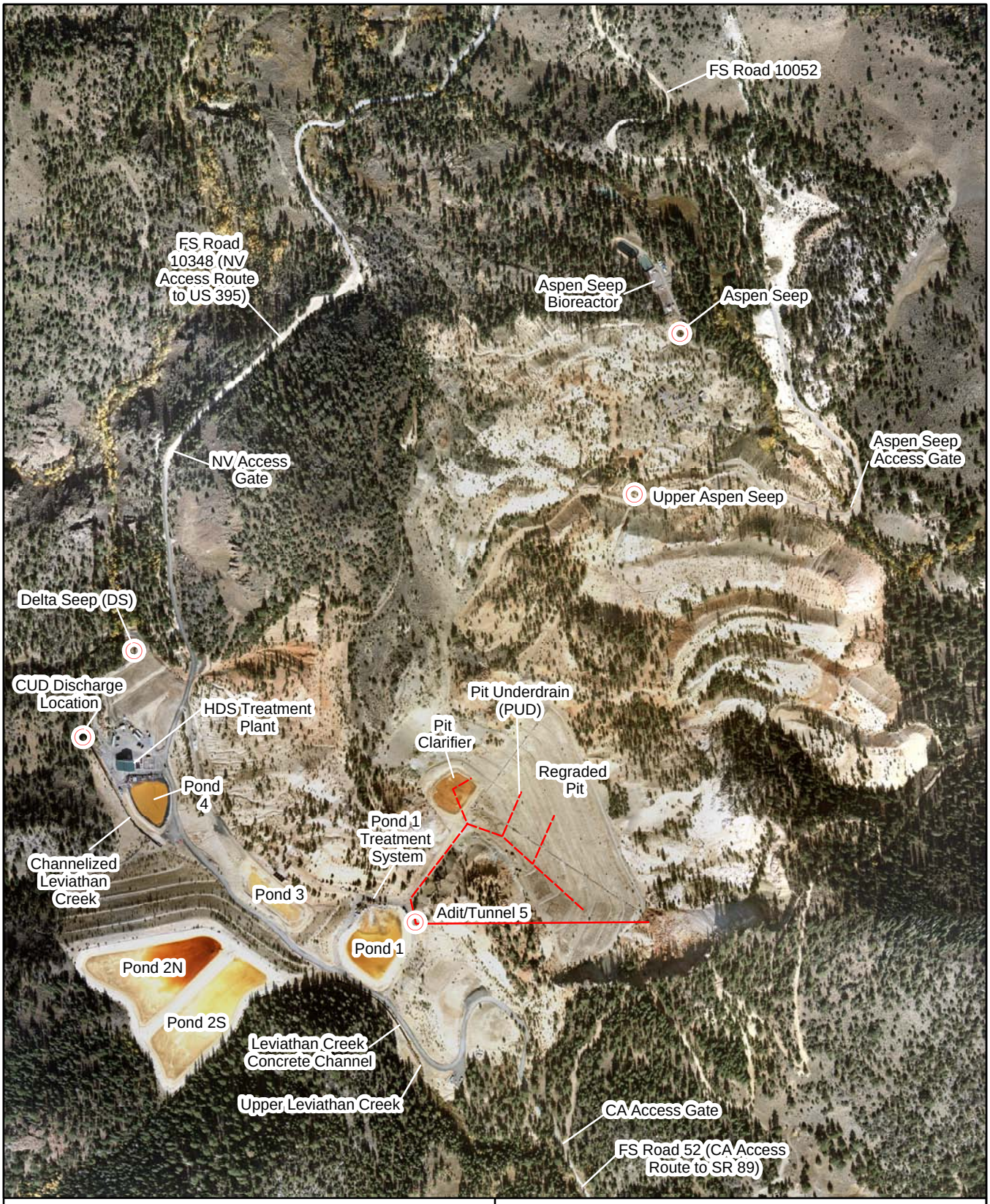


N

0 2 4 Miles

SITE LOCATION MAP
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 2/01/2012	Project No. 001309112
amec		Figure 1



Explanation

Discharge Points

CA	California
CUD	Channel Underdrain
FS	Forest Service
NV	Nevada
SR	State Route
US	United States Highway

N

0 500 1,000 Feet

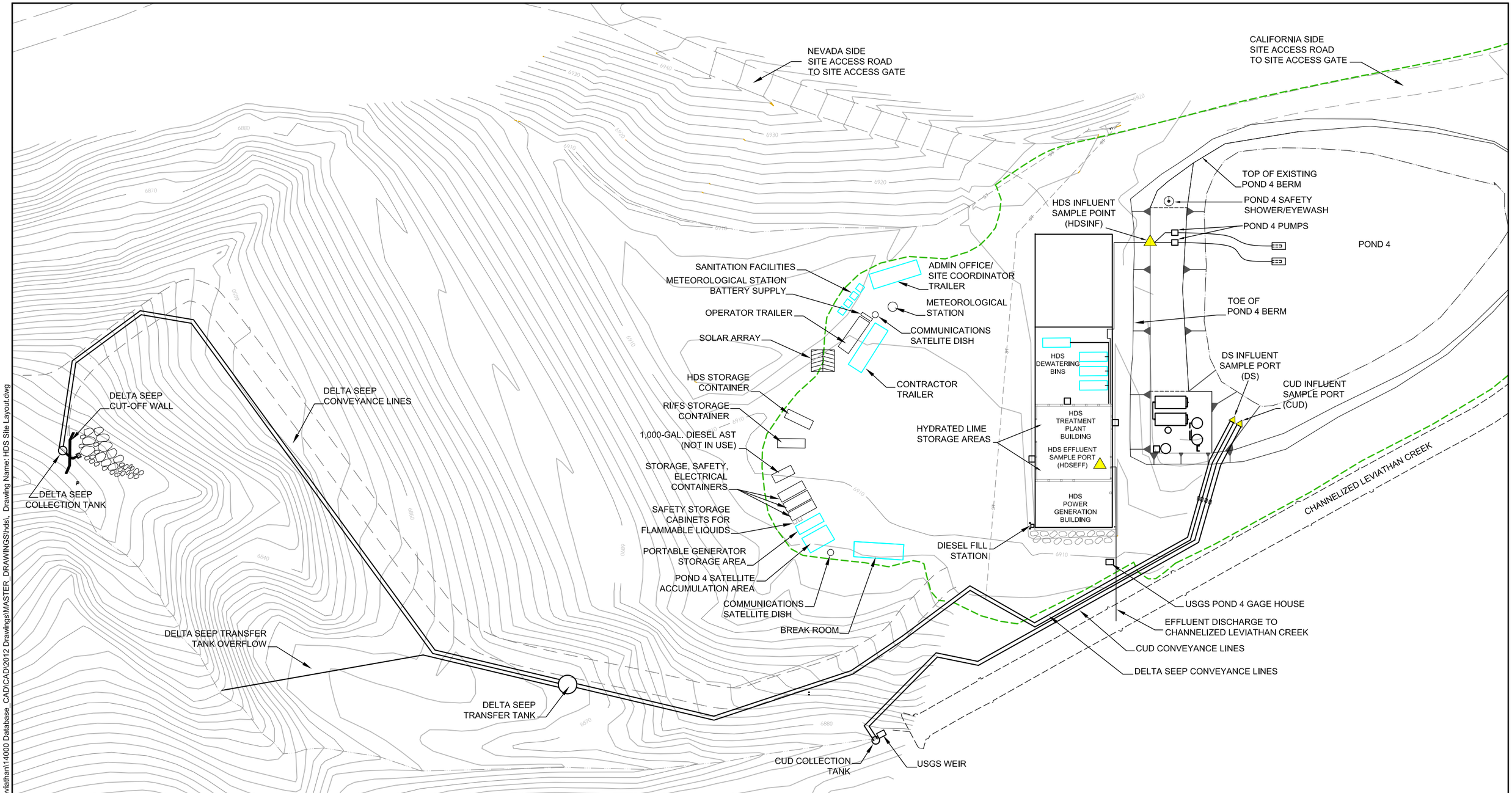
SITE LAYOUT
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 02/17/2012	Project No. 0013091112

amec

Figure 2

P:\Project\13000s\13091 Leviathan\14000 Database_CAD\CAD\2012 Drawings\MASTER_DRAWINGS\site\sitelayout.mxd



EXPLANATION:

- POND 4 SITE WORK AREA
- ITEMS IN BLUE ARE FOR TEMPORARY USE DURING THE TREATMENT SEASON
- POND 4 LTS EQUIPMENT TO BE REMOVED
- SAMPLE LOCATION

AST	ABOVE-GROUND STORAGE TANK
CUD	CHANNEL UNDERDRAIN
GAL	GALLON
HDS	HIGH DENSITY SLUDGE
LTS	LIME TREATMENT SYSTEM
RI/FS	REMEDIAL INVESTIGATION/FEASIBILITY STUDY
USGS	UNITED STATES GEOLOGICAL SURVEY

APPROXIMATE SCALE IN FEET
0 60

HDS TREATMENT SYSTEM LAYOUT
AND SAMPLING LOCATIONS
Leviathan Mine Site
Alpine County, California

By: dpv | Date: 02/15/12 | Project No. 001309112

amec

Figure 3

Plot Date: 02/15/12 - 4:54pm, Plotted by: donna.valasek
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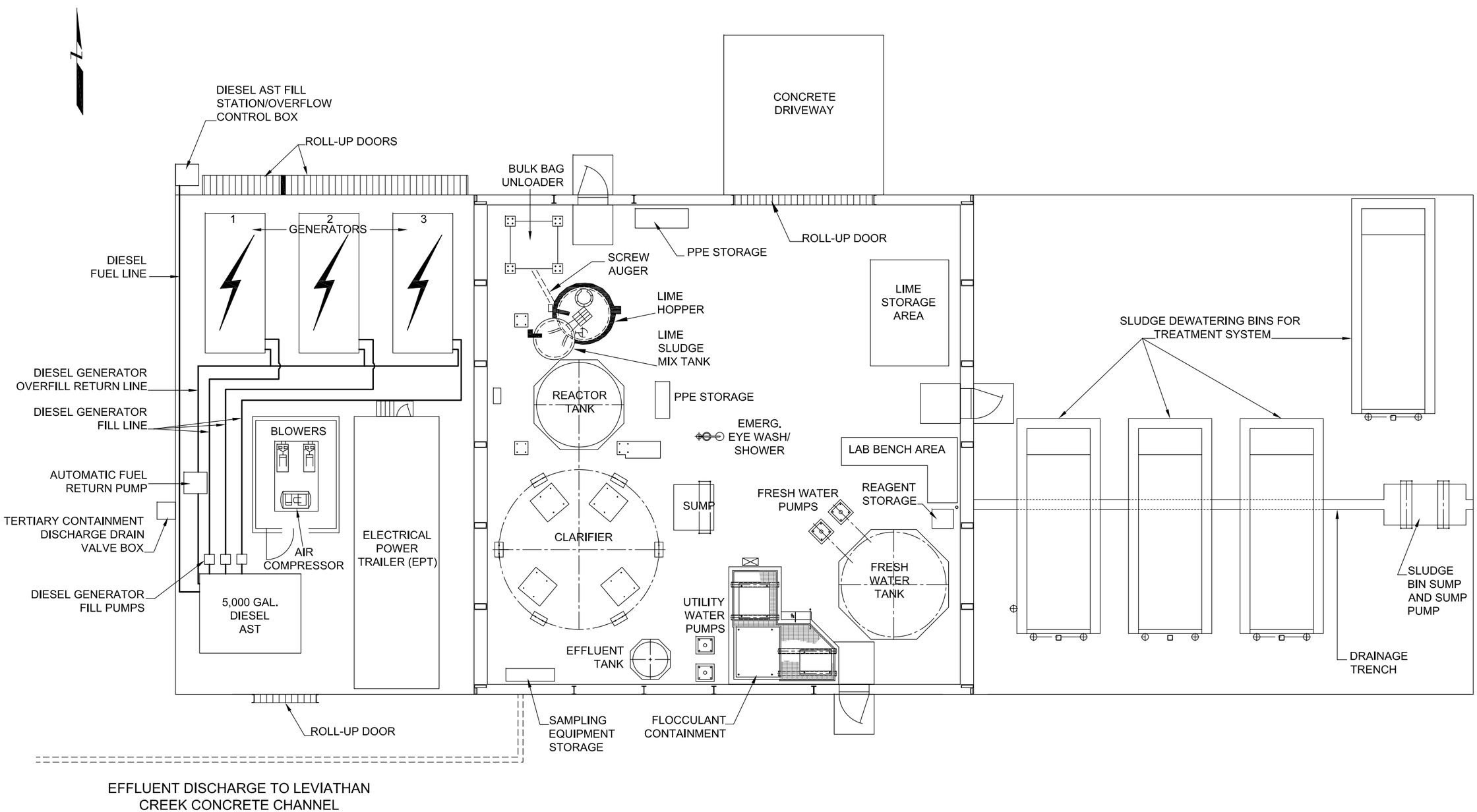

Abbreviations

HDS	High Density Sludge
AST	Above-Ground Storage Tank
PPE	Personal Protective Equipment

APPROXIMATE SCALE IN FEET
0 10

HDS TREATMENT PLANT EQUIPMENT LAYOUT
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 02/15/12	Project No. 001309112
amec		Figure 4

Plot Date: 02/15/12 - 4:56pm, Plotted by: donna.valasek
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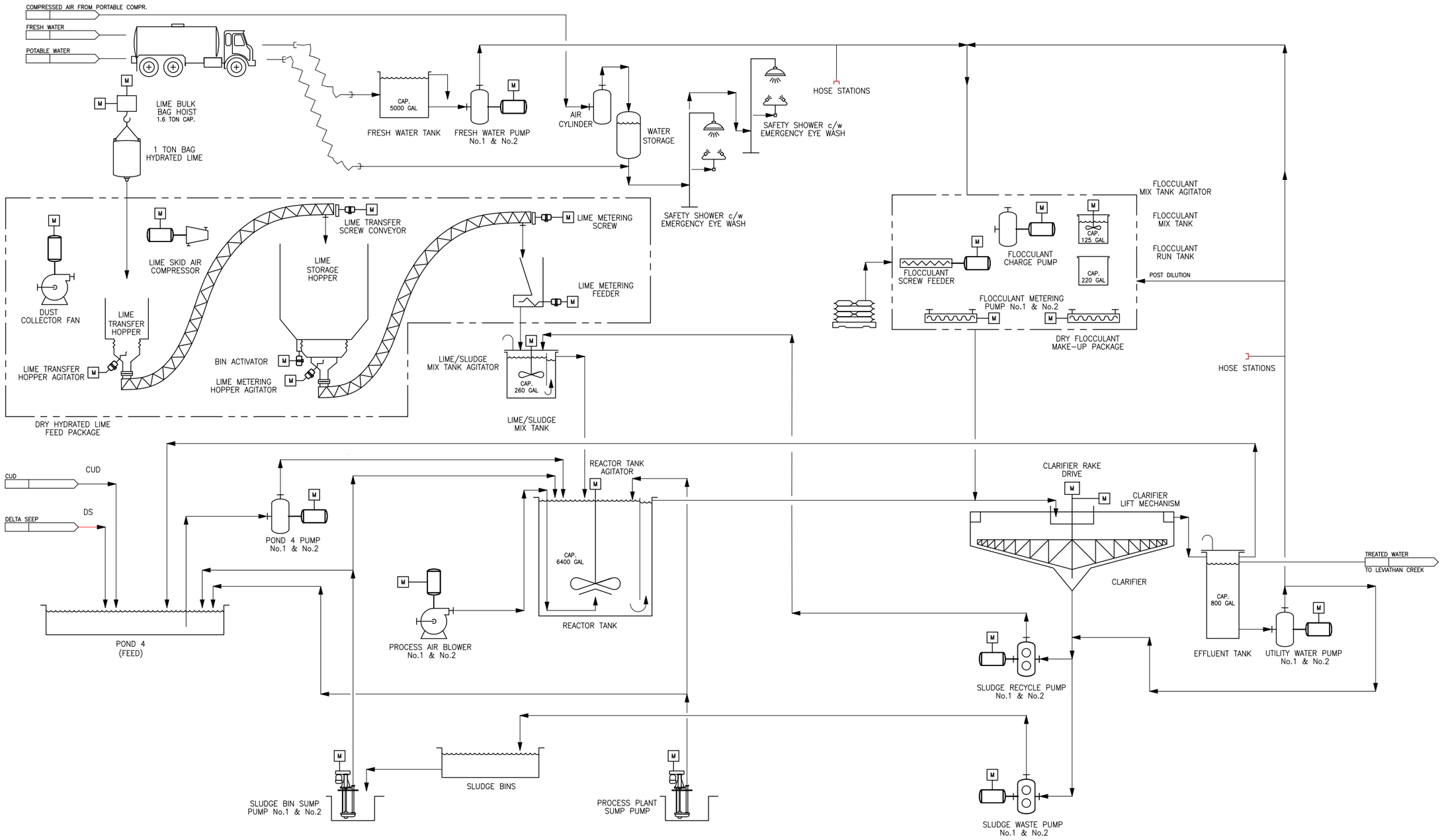

Abbreviations

HDS High Density Sludge

HDS TREATMENT SYSTEM PROCESS FLOW DIAGRAM
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 02/15/12	Project No. 001309112
amec		Figure 5

Plot Date: 02/15/12 - 4:57pm, Plotted by: donna.valasek
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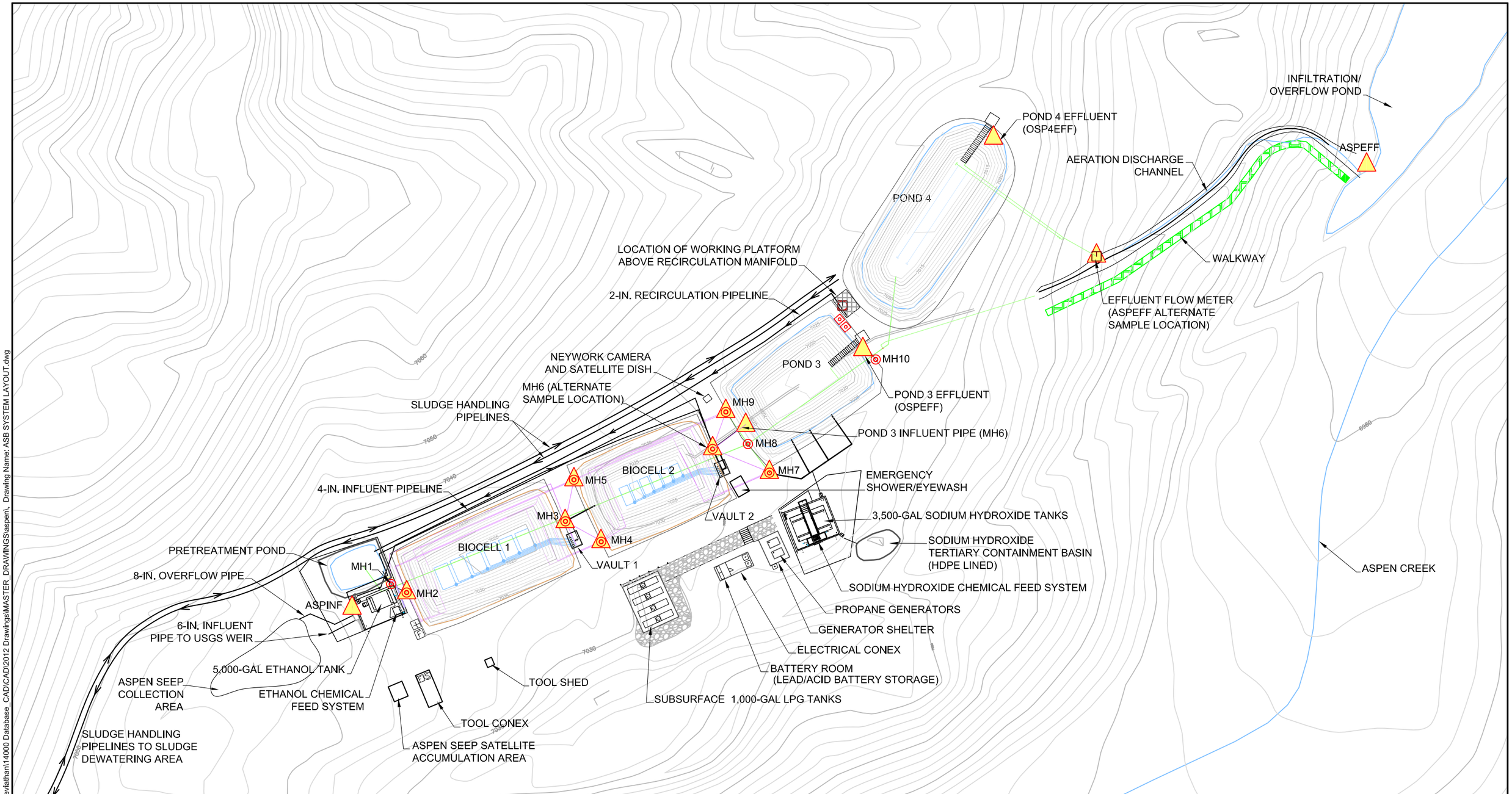

Explanation

- Sample point
- Manhole
- Rock slope
- Submersible pump
- Flowmeter/totalizer
- First aid
- Spill kit
- Fire extinguisher
- Walkway
- ASB — Aspen Seep Bioreactor

N

APPROXIMATE SCALE IN FEET
0 50

ASB TREATMENT SYSTEM LAYOUT AND
SAMPLING LOCATIONS
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 02/15/12	Project No. 001309112
amec		Figure 6

Plot Date: 02/15/12 - 5:00pm. Plotted by: donna.valasek
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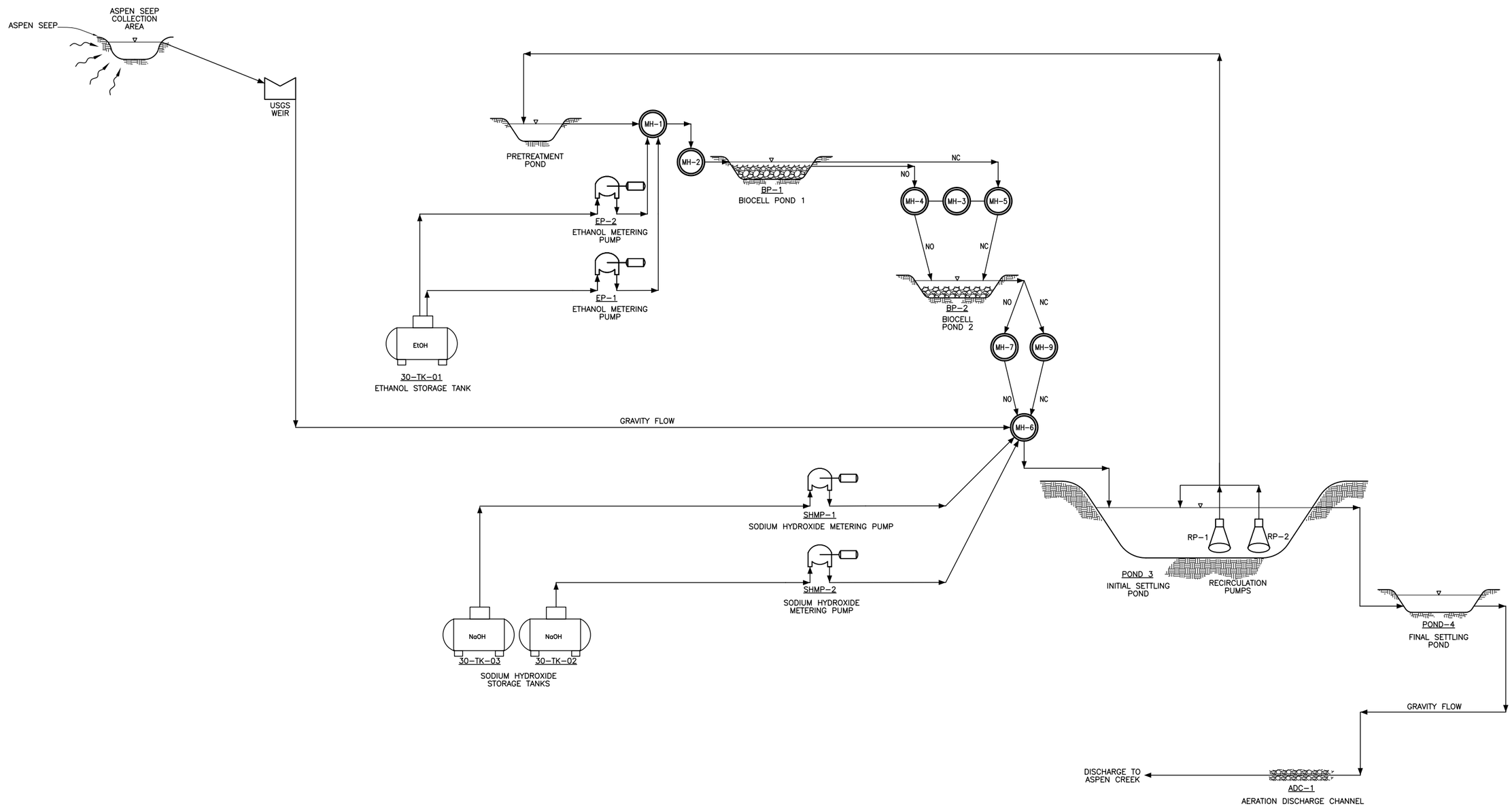


NOTES:

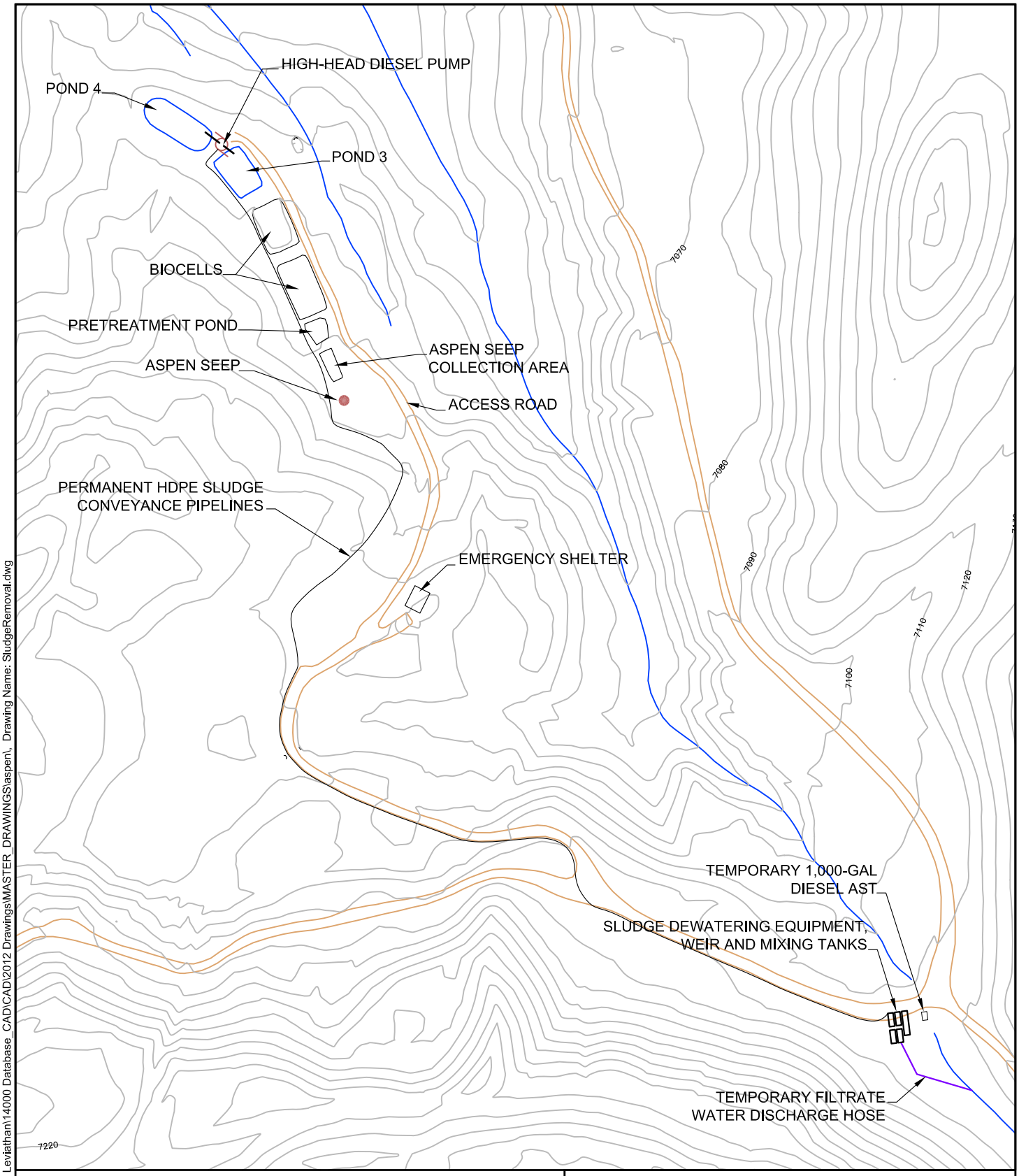
1. CONFIGURATION SHOWN AS FRONT TO BACK FLOW THROUGH BP-1 AND BP-2.

NC NORMALLY CLOSED
NO NORMALLY OPEN
NaOH SODIUM HYDROXIDE
EtOH ETHANOL

ASB TREATMENT SYSTEM
PROCESS FLOW DIAGRAM
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 02/17/12	Project No. 001309112
amec		Figure 7

Plot Date: 02/17/12 - 11:55am, Plotted by: donna.valasek
Drawing Path: P:\Project\13000s\13091 Leviathan\14000 Database_CAD\CAD\2012 Drawings\MASTER_DRAWINGS\aspen\, Drawing Name: Process Flow Diagram.dwg



Explanation

	Roads
	Streams
AST	Above-ground storage tank
HDPE	High-Density Polyethylene
ASB	Aspen Seep Bioreactor

N

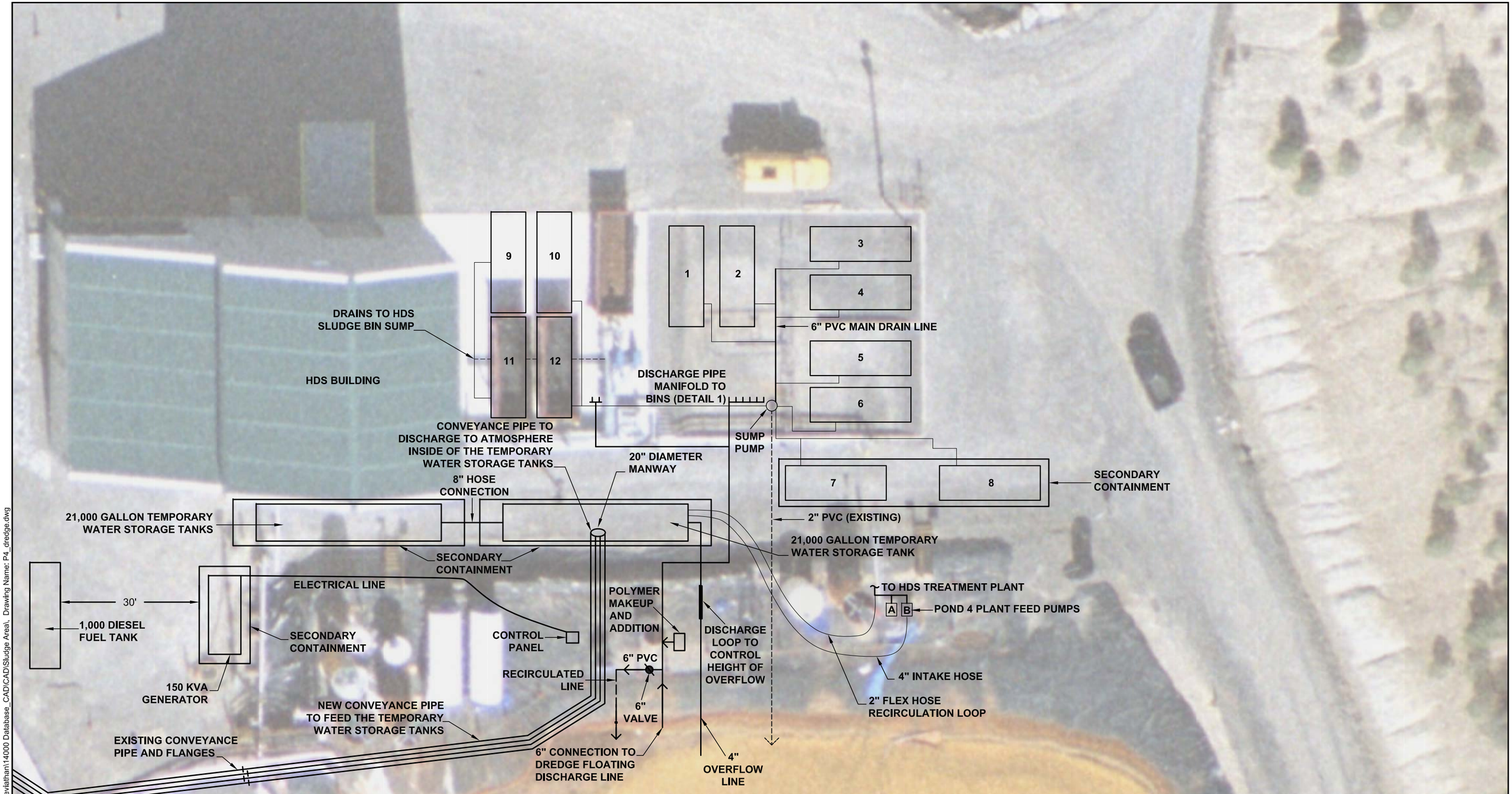
APPROXIMATE SCALE IN FEET

0 200

ASB TREATMENT SYSTEM SLUDGE DEWATERING OPERATIONS LAYOUT
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 3/28/2012	Project No. 0130911112
amec		Figure 8

Plot Date: 03/27/12 - 2:26pm, Plotted by: donna.valasek
Drawing Path: P:\Project\13000s\13091 Leviathan\14000 Database_CAD\CAD\2012 Drawings\MASTER_DRAWINGS\aspen\, Drawing Name: SludgeRemoval.dwg



Abbreviations

HDS High Density Sludge

PVC Polyvinyl chloride

N

APPROXIMATE SCALE IN FEET

0 20

POND 4
SLUDGE REMOVAL LAYOUT
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 02/07/12	Project No. 13091111
amec		Figure 9

Plot Date: 02/07/12 - 2:06pm, Plotted by: donna.valasek
Drawing Path: P:\Project\13000s\13091 Leviathan\14000 Database_CAD\CAD\Sludge Area\, Drawing Name: P4_dredge.dwg

APPROXIMATE SCALE IN FEET
0 30

Reference: Summit Engineering, 2009.

POND 4
DREDGE SETUP
Leviathan Mine Site
Alpine County, California

By: dpv	Date: 03/27/12	Project No. 0130911115
amec		Figure 10

Plot Date: 03/27/12 - 2:24pm, Plotted by: donna.valasek
Drawing Path: P:\Project\13000s\13091 Leviathan\14000 Database_CAD\CAD\Sludge Area\, Drawing Name: P4_dredge.dwg