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March 31, 2017

Lynda Deschambault
Remedial Project Manager, Superfund Division
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street, 10th Floor (SFD 7-1)
San Francisco, California 94105

Subject: Draft Amendment No. 2 – Full Scale Field Demonstration Interim Combined Acid Drainage Treatability Investigation Work Plan
Leviathan Mine Site
Alpine County, California

Dear Ms. Deschambault:

This letter presents Draft Amendment No. 2 (Amendment 2) to Atlantic Richfield Company's (Atlantic Richfield) Interim Combined Acid Drainage Treatability Investigation Work Plan (Work Plan, 2014) dated March 28, 2014, prepared to evaluate use of the High Density Sludge (HDS) Treatment Plant and existing pond storage for interim combined treatment of acid drainage (AD) from the managed AD discharges at the Leviathan Mine Site (site) in Alpine County, California. This Amendment 2 requests U.S. Environmental Protection Agency (U.S. EPA) approval of Atlantic Richfield's plan to initiate a full-scale interim combined treatment (ICT) field demonstration and optimization (ICT Demonstration) as presented in the Interim Combined Acid Drainage Treatability Investigation Report (ICT Report) dated December 18, 2015, and provides additional implementation details. The ICT Demonstration is planned for the 2017 treatment season to evaluate the feasibility and effectiveness of combined treatment using the HDS Treatment System under reasonably anticipated flow scenarios as defined in the ICT Report.

The results of the ICT Demonstration will be used in the Feasibility Study (FS) for assessing and selecting a final, long-term remedy for the site, as required under the Administrative Order for Remedial Investigation and Feasibility Study (RI/FS; Unilateral Administrative Order), CERCLA Docket No. 2008-18, and as a goal of obtaining critical information for selecting a long-term remedy, as stated in the Request for Approval of Modification to the Removal Action at the Leviathan Mine (referred to herein as the Modification to the Removal Action Memorandum [MRAM]) dated September 25, 2008[1]. Subject to obtaining prior U.S. EPA approval and modification of the administrative orders, the results may also be used to support seasonal use of the HDS Treatment System for treating combined flows from four of the five primary AD discharges (Channel Underdrain [CUD], Delta Seep [DS], Pit Underdrain [PUD], and Adit) during the remainder of the NTCRA. Such operation would likely occur in conjunction with the periodic use of a contingency (or emergency) system by the Lahontan Regional Water Quality

[1] The MRAM states that the Non-Time Critical Removal Action (NTCRA) shall include, among other tasks, "performance of additional treatability studies which may be required to test the effectiveness and reliability of treatment of combined Adit, PUD, CUD, and Delta Seeps, particularly to assess sludge characteristics."

Control Board (LRWQCB) at times when higher-than-normal precipitation requires early spring treatment of AD retained in Ponds 1, 2N/2S, and 3 to prevent overflows.

This Amendment 2 was reviewed by the LRWQCB and reflects their input

BACKGROUND

The primary objectives of the treatability study, as presented in the Work Plan, were to:

- evaluate the effectiveness and efficiency of HDS treatment technology to treat the primary AD discharges (CUD, DS, AS, PUD, and Adit) at the site;
- evaluate the adequacy and sizing of the HDS Treatment System to handle flows from the combined AD discharges under reasonably anticipated discharge rate scenarios;
- evaluate the chemistry and stability of sludge resulting from HDS treatment of the AD discharges at the site;
- evaluate HDS Treatment System operations and maintenance costs associated with combined treatment of the AD discharges at the site; and
- evaluate the technology needed for collecting and conveying AD from the various discharge points to the HDS Treatment system.

To accomplish these objectives, bench-scale testing, pilot-scale testing, and full-scale capacity testing were performed, as documented in the ICT Report which recommended performing a full-scale ICT Demonstration of the PUD, Adit, CUD, and DS AD discharges.

Although details for ICT Demonstration are provided in Section 7.4 of the Work Plan, modifications for the testing to be performed in 2017 are required based on the results of the previous testing and evaluations, as documented in the ICT Report, and discussed below.

ICT REPORT EVALUATION

The ICT Report presented an evaluation of the existing HDS Treatment System to perform as a component of full-scale ICT under different ICT scenarios representing low, average, and high water years. The different scenarios represented the range of reasonably anticipated influent flow rates and water chemistry anticipated during ICT. Conservative assumptions and results from bench-, pilot-, and full-scale testing were used to evaluate the HDS Treatment System against the ICT scenarios.

For consistency with the MRAM and current practices, water balance calculations used in assessing the effectiveness of the HDS Treatment System under ICT conditions were based on the same limited collection and treatment season for the CUD and DS that Atlantic Richfield has accomplished for the past several years – that is, early May through late October. An additional collection scenario was evaluated for the 85th percentile year, which assumed that extreme weather conditions at the site (including heavy snow accumulations, difficult late spring access, and early onset of winter) would shorten the treatment season and limit collection of CUD and

DS flows in Pond 4 to the period specified in the Administrative Settlement Agreement and Order on Consent for Removal Action (AOC) – that is, June 1 through September 30.

Bench-scale testing demonstrated that simple lime neutralization can treat individual and combined AD discharges. Pilot-scale testing demonstrated that the HDS process can effectively and efficiently treat a range of combined AD discharge blends to meet the MRAM discharge criteria. Pilot-scale testing also established the anticipated HDS Treatment Plant system operational settings for ICT. The full-scale Pond 4 capacity testing demonstrated that the HDS Treatment Plant can handle CUD/DS flows at influent flow rates that exceed the flow rates reasonably anticipated during ICT.

The evaluation presented in the ICT Report indicated that one modification would be required in order for the HDS Treatment Plant to treat the range of reasonably anticipated ICT influent flow rates and water chemistry: increasing the Lime Metering Feeder capacity, which was completed in 2016.

The ICT Report also requested U.S. EPA's approval to construct an Upper Pond Conveyance System (UPCS) to convey water from the Upper Ponds to Pond 4, which was approved by U.S. EPA on March 14, 2016. The UPCS was largely constructed in 2016, and will be completed and commissioned in early 2017 prior to initiation of the ICT Demonstration, described herein.

The ICT Report also identified additional modifications (e.g., improving access to various process tanks and piping to facilitate scale removal, modifications to reduce the potential of short-circuiting or preferential flow pathways in the clarifier, modifying the sludge dewatering bin pad to provide additional bin storage capacity, etc.) that may be necessary for ICT; however, additional data from the ICT Demonstration is required in order to fully evaluate whether these modifications should in fact be implemented. In addition, the ICT Report identified optional modifications that may improve and/or optimize O&M activities during ICT.

The ICT Demonstration planned for 2017 will provide additional information about the feasibility and effectiveness of using the HDS Treatment System to effectuate combined treatment of the PUD, Adit, CUD, and DS AD discharges by testing the system under full-scale operating conditions. The most conservative of the various ICT scenarios is the shortened-season 85th percentile (high water year) treatment scenario as presented in Table 7 of the ICT Report and included as Attachment 1. Therefore, the influent water chemistry and flow rates from that scenario will be the target influent parameters for the ICT Demonstration: (1) average influent acidity between 2,600 mg/L and 2,900 mg/L, at (2) an average flow rate of 143 gallons per minute (gpm). Whether these influent target parameters can be consistently achieved throughout the entire duration of the ICT Demonstration will be dependent on the volume and chemistry of the water contained in the Ponds 1 and 2N/2S (Upper Ponds) and to a lesser extent the flow rates for the CUD and DS at the time of testing. Atlantic Richfield plans to run the ICT Demonstration for a duration of 30 consecutive days or until the total volume of water contained in Ponds 1, 2N, and 2S at the time of testing has been treated (i.e., until the Upper Ponds are emptied), whichever is less.

The water chemistry and flow data collected as part of the 2017 ICT Demonstration will also support future evaluation of ICT treatment scenarios.

An updated ICT Demonstration plan is presented below.

ICT DEMONSTRATION PLAN

During the ICT Demonstration, Upper Pond water will be pumped from Ponds 1 and/or 2N/2S using the UPCS to Pond 4. CUD/DS water will also be collected and pumped to Pond 4. The combined water in Pond 4 (Upper Pond water and CUD/DS) will be continuously pumped to the HDS Treatment Plant for treatment.

In order to operate the HDS Treatment Plant continuously at an average flow rate of 143 gpm during the ICT Demonstration, the combined flow from the Upper Ponds pumped via the UPCS and CUD/DS must equate to approximately 143 gpm. The flow rate from CUD/DS, which cannot be adjusted by personnel, varies naturally between approximately 10 to 60 gpm, depending on the water year (e.g., wet, average, dry) and time of season (e.g. spring, summer, fall). Therefore; the flow of Upper Pond water will be regulated to maintain the combined flow of approximately 143 gpm into Pond 4. The holding capacity in Pond 4 will provide some flexibility for operators to vary the flow rate into Pond 4 from the Upper Ponds; however, there will be limitations for personnel to operate at the target influent parameters because they will not have the ability to significantly adjust the blending ratio between CUD/DS and Upper Pond water. Therefore, it is critical that the Upper Pond water contain the appropriate acidity in order to achieve the target influent parameters for the ICT Demonstration.

Although not anticipated, it may become necessary during the ICT Demonstration to temporarily reduce or discontinue collection and conveyance of CUD/DS flows while water is being received into Pond 4 from the Upper Ponds. In accordance with Paragraph 104(c) of the AOC, Atlantic Richfield will notify and request written approval from U.S. EPA in advance if such measures are required to avoid exceeding the holding capacity and causing an overflow of Pond 4.

Water chemistry in the Upper Ponds and Pond 4 varies throughout the year; therefore, personnel will monitor the water chemistry in the Upper Ponds, Pond 4, and the flow rates of CUD/DS. Atlantic Richfield will attempt to initiate the ICT Demonstration when the available pond water chemistry and volumes are favorable for performing the test with the target influent parameters. In the event sufficient pond water chemistry or volumes are not available to achieve the target influent parameters, the HDS Treatment Plant may operate at a lower flow rate with a higher influent acidity, or at a higher flow rate with a lower influent acidity. Any necessary change to the influent parameters, will be evaluated at the time of the test.

The ICT Demonstration is composed of three primary phases, 1) Pond water monitoring, 2) ICT Demonstration Start-Up, and 3) ICT Demonstration Testing, which are described in detail below.

Pond Water Monitoring

Water quality samples of Upper Ponds and Pond 4 will be collected in early spring (April or May, depending on site access constraints) to initially characterize the ponds. Pond water samples will be analyzed in accordance with the sampling and analysis summary presented in Table 1 and sampling matrix presented in Table 2.

The results of the pond water characterization will inform operators as to the timing for the start of the ICT Demonstration. Table 3 presents a calculation method to estimate the required Upper Pond flow rate and acidity necessary to achieve the target influent parameters. Based on the actual CUD/DS flow rates and Pond 4 acidity results, the required flow rate and acidity range from the Upper Ponds will be calculated using the method presented in Table 3. The calculated Upper Pond water acidity range will be compared to the actual Upper Pond water sample results to determine when the ICT Demonstration will be initiated. Testing will not be initiated until the pond water chemistry and volumes are favorable for meeting the target influent parameters, to the extent practicable. If the ICT Demonstration is delayed, pond water monitoring will continue approximately once every two weeks.

Table 4 presents an example calculation using the historical CUD and DS flow rates and acidities for the 85th percentile water year, and the resulting calculated required flow rates and acidity ranges from the Upper Ponds.

Pond Stratification Evaluation

During previous early season emergency treatment operations (2006 and 2011), pond stratification was observed in Pond 1, with dilute water resting on top, and more concentrated water sitting below. If pond stratification is present during the ICT Demonstration, significant changes in Upper Pond chemistry could occur, thus impacting Atlantic Richfield's ability to maintain consistent target influent parameters, which in turn could complicate the evaluation of the ICT Demonstration data.

To support evaluation of pond water stratification and consistent influent feed, water quality samples in the Upper Ponds may be collected at three depths prior to initiation of the ICT Demonstration. Following the initial Upper Pond water quality sampling, the Upper Ponds may be mixed via mechanical mixing techniques (e.g., circulating the ponds with a portable trash pump) and resampled to assess mixing effectiveness. The Upper Ponds may be resampled following the mixing activities. If stratification is not observed during the initial sampling event, mixing and resampling would provide supporting data regarding potential pond stratification, and minimize the potential of stratification not being observed due to limitations in sampling locations/techniques. Additionally, mixing and resampling would also provide additional information regarding ferrous iron oxidation in the Upper Ponds. Due to the relatively shallow depths of the Upper Ponds (approximately 5-6 feet) and spring atmospheric conditions (when pond turnover typically occurs), it is anticipated that the ponds will remain homogenous following the mechanical mixing. The continued pond water monitoring (approximately once every two weeks until ICT Demonstration is initiated) will further support evaluation of pond

stratification. Once the ICT Demonstration is initiated, UPCS sampling (discussed below) will also support evaluation of pond stratification.

The LRWQCB has begun conducting early season treatment in 2017 to prevent overflows from the Upper Ponds, and some form of sampling may be completed by the LRWQCB as part of their treatment operations. Therefore, Atlantic Richfield may not perform pond water monitoring or mixing, or may reduce the proposed pond water monitoring scope, depending on the activities conducted by the LRWQCB.

Atlantic Richfield and the LRWQCB have been in communication regarding the LRWQCB's current plan for early season water treatment and the potential implications on the ICT Demonstration. Atlantic Richfield and the LRWQCB will continue to coordinate in an effort to ensure that pond overflows are prevented while also enabling the ICT Demonstration to succeed. Once the LRWQCB sufficiently lowers the pond water levels, Atlantic Richfield and the LRWQCB will consider options to manage the flows into and out of one or more of the Upper Ponds to best ensure that the influent flow and acidity targets for the ICT Demonstration can be achieved.

ICT Demonstration Start-Up

The HDS Treatment Plant will undergo normal spring commissioning and start-up for CUD/DS collection and treatment. Once the available Upper Pond water volume and chemistry are favorable for performing the ICT Demonstration with the target influent parameters, Upper Pond water will be pumped to Pond 4 at the required flow rate (dependent on current CUD/DS collection flow rates) as discussed above. The HDS Treatment Plant will be placed into Recycle Mode (effluent discharging to Pond 4) at or less than the design flow rate of 100 gpm, and operational parameters/set-points will be monitored closely and adjusted as necessary. Once effluent surrogate field parameters (pH, in-line turbidity, and dissolved total iron) are stable (which should take approximately one to two days), the HDS Treatment Plant will be placed in Normal Mode and begin discharge to Leviathan Creek. Influent and effluent samples (Table 1) will also be collected to verify the target influent acidity and that the treated water meets MRAM discharge criteria. The flow rate will then be incrementally increased up to the target ICT Demonstration flow rate of 143 gpm over the course of one to five days, depending on operational results/performance and sludge quality. Once the target flow rate of 143 gpm is reached, influent and effluent sampling will be performed, and the ICT Demonstration test will commence.

ICT Demonstration Testing Details

Once the ICT Demonstration commences, it will run for a duration of 30 consecutive days (or if that volume is not available, until the total volume of AD in Ponds 1, 2N, and 2S has been treated). During the ICT Demonstration, normal operating procedures will be followed, including recording operational parameters, conducting sludge settling tests, etc. Any downtime will also be recorded, including the cause and length of the downtime. Observations of various treatment parameters including lime dosage, flocculant dosage, fresh water usage, sludge generated, etc. will be recorded to facilitate evaluating the cost of ICT operations. Equipment and pipelines will

be visually monitored for scale build up, and coupons will be installed in the Clarifier and Reactor Tank to evaluate scaling rates. Sampling of the influent and effluent will be performed twice a week (Table 1). During the twice a week sampling, one sample event will analyze for the standard suite of metals and general chemistry analysis (Table 2), and the other sample event will analyze for an extended suite of metals and general chemistry analysis (Table 5).

The standard suite of metals and general chemistry analysis are presented in the Work Plan and are based on the 2013 Removal Action Work Plan, dated March 1, 2013. The extended suite is based on the RI/FS metals and general chemistry analysis, and Strontium and Silica, which will be used to support future evaluation of potential treatment technologies (e.g., secondary treatment) during the FS. Target detections limits based on the MRAM discharge criteria and potential FS treatment technology evaluations, and estimated lab reporting limits, are presented in Table 6. Additional influent or effluent sampling may be performed as necessary.

Sludge wasted from the HDS Treatment Plant will be directed to an unused sludge bin, and waste characterization sampling will be performed prior to off-site disposal (Table 1 and 2). The waste characterization will assist with evaluating the chemistry and stability of sludge resulting from ICT operations.

Depending on the effectiveness of natural mixing in Pond 4, additional mechanical mixing (e.g., circulating the pond via pumping) may be necessary to maintain a consistent feed to the HDS Treatment Plant. Pond mixing will be assessed by monitoring for variations in the influent water chemistry to the HDS Treatment Plant. The primary parameter to be monitored as a surrogate for influent water chemistry will be the influent lime utilization rate, which is continuously monitored by the HDS Treatment Plant. If the average influent lime utilization rate changes by more than 0.5 grams per liter (g/L), which equates to approximately a 600 mg/L change in influent acidity, over a two-hour period, mechanical mixing may be implemented. A trash pump will be available for use if mechanical mixing is necessary.

During the ICT Demonstration, Upper Pond water will be regulated to maintain the combined flow with CUD/DS water of approximately 143 gpm into Pond 4, as possible. As discussed above, in the event sufficient pond water chemistry or volumes are not available to achieve the target influent parameters, the Upper Pond flow rate may be reduced or increased such that the flow rate into the HDS Treatment Plant is lower than 143 gpm with a higher influent acidity, or higher than 143 gpm with a lower influent acidity.

Effluent Quality

The HDS Treatment Plant has continuous effluent pH and turbidity monitoring for operational control, which will automatically shut down the system and cease discharge if an upset is detected. Field monitoring and automated system monitoring has been shown to provide sufficient safeguards against discharging water that is outside of the MRAM discharge criteria. The ICT Demonstration is considered to be an approved “optimization trial” for purposes of Paragraph 104(b) of the AOC. Never the less, the normal automated system monitoring will be in place, and Atlantic Richfield will perform frequent monitoring and sampling, as stated above,

to prevent or minimize discharging water outside the MRAM discharge criteria to Leviathan Creek. Because the HDS Treatment Plant will be operated outside the design criteria during this test, the possibility exists for short-term discharges of water outside the MRAM discharge criteria. If operational issues are observed necessitating terminating the test (based on field monitoring results indicating a potential to inadequately treat the water), the Pond 4 Pumps will be shut down, the influent flow rate will be reduced, or the HDS Treatment Plant will be placed in the Recycle Mode.

Testing Completion

After 30 consecutive days or until the total volume of water contained in Ponds 1, 2N, and 2S at the time of testing has been treated (i.e., until the Upper Ponds are emptied), the ICT Demonstration will be concluded. The UPCS will be shut down, and the HDS Treatment Plant will resume normal operations.

SCHEDULE AND REPORTING

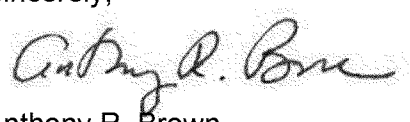
Pending approval of this Amendment 2, the anticipated schedule and reporting for the ICT Demonstration is summarized below:

- 2017 - Conduct full-scale ICT Demonstration. A Detailed schedule for testing in 2017 will be developed and adjusted as necessary in April/May 2017 depending on the severity of the winter and the volume and chemistry of water in the Upper Ponds.
- Fall/Winter 2017 - Prepare and submit to the U.S. EPA an ICT Demonstration Summary Memorandum documenting the ICT Demonstration activities, results, and proposed schedule for subsequent full-scale ICT activities. Also request approval from U.S. EPA to modify the AOC and the Administrative Abatement Action (AAA) to allow for full-scale implementation of ICT operations.

Atlantic Richfield requests U.S. EPA approval of this Amendment 2 pursuant to Paragraph 146 of the AOC. Additionally, Atlantic Richfield requests U.S. EPA approval to conduct this work as an “optimization trial” pursuant to Paragraph 104, Subparagraph (b) of the AOC.

If you have any questions or comments, please feel free to contact me at (657) 529-4537 or anthony.brown@bp.com.

Sincerely,



Anthony R. Brown
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Tables:

Table 1	ICT Demonstration Sampling and Analysis Summary
Table 2	ICT Demonstration Standard Sampling Matrix
Table 3	Upper Pond Flow Rate and Acidity Range Calculation Walkthrough
Table 4	Upper Pond Flow Rate and Acidity Range 85th Percentile Calculation Example
Table 5	ICT Demonstration Extended Sampling Matrix
Table 6	Analytical Limits for ICT Demonstration

Attachments:

Attachment 1	Table 7 - Interim Combined Treatability Investigation Evaluation Criteria and Operational Calculations

cc: Gary Riley, U.S. Environmental Protection Agency, Region 9 – via electronic copy
Brian Johnson, Atlantic Richfield – via electronic copy
John Hillenbrand, U.S. Environmental Protection Agency, Region 9 – via electronic copy
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Jeremy Boucher, Broadbent & Associates, Inc. – via electronic copy
Cory Koger, U.S. Army Corps of Engineers – via electronic copy
Greg Reller, Burleson Consulting – via electronic copy
Michelle Hochrein, Washoe Tribe of California and Nevada – via electronic copy
Fred Kirschner, AESE, Inc. – via electronic copy

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TABLES

TABLE 1
ICT DEMONSTRATION SAMPLING AND ANALYSIS SUMMARY
Leviathan Mine Site
Alpine County, California

Sample Program	Sampling Locations	Location Description	Sampling Depth (below water surface elevation)	Sampling Frequency	Sampling Method	Rationale	Sample Testing	
							Field Analysis	Laboratory Analysis[1]
Interim Combined Treatment Demonstration	Pond4-1	Northeast location around the Pond 4 perimeter	0-2 feet	One sampling event for initial pond water characterization, every two weeks thereafter as necessary	• All samples will be grab samples. • Samples will be collected using a peristaltic pump, dip sampler, or using the direct method in accordance with SOP 8.0 - Streamflow Measurement and Surface Water Sampling. • If necessary, the sample will be filtered using a 0.45 micron filter.	Compare general physical and chemical properties between monitoring locations. Support interim combined treatment evaluation.	• pH • temperature • SEC • DO • ORP • Fe^{2+} (field filtered)[2]	• Standard metals[3] • Standard general chemistry[4]
	Pond4-2	Southeast location around the Pond 4 perimeter	0-2 feet					
	Pond4-3	Southwest location around the Pond 4 perimeter	0-2 feet					
	Pond4-4	Northwest location around the Pond 4 perimeter	0-2 feet					
	Pond1-1	Northeast location around the Pond 1 perimeter	0-2, 2-4, 4-6 feet					
	Pond1-2	Southeast location around the Pond 1 perimeter	0-2, 2-4, 4-6 feet					
	Pond1-3	Southwest location around the Pond 1 perimeter	0-2, 2-4, 4-6 feet					
	Pond1-4	Northwest location around the Pond 1 perimeter	0-2, 2-4, 4-6 feet					
	Pond2N-1	Northeast location around the Pond 2N perimeter	0-2, 2-4, 4-6 feet					
	Pond2N-2	Southeast location around the Pond 2N perimeter	0-2, 2-4, 4-6 feet					
	Pond2N-3	Southwest location around the Pond 2N perimeter	0-2, 2-4, 4-6 feet					
	Pond2N-4	Northwest location around the Pond 2N perimeter	0-2, 2-4, 4-6 feet					
	Pond2S-1	Northeast location around the Pond 2S perimeter	0-2, 2-4, 4-6 feet					
	Pond2S-2	Southeast location around the Pond 2S perimeter	0-2, 2-4, 4-6 feet					
	Pond2S-3	Southwest location around the Pond 2S perimeter	0-2, 2-4, 4-6 feet					
	Pond2S-4	Northwest location around the Pond 2S perimeter	0-2, 2-4, 4-6 feet					

TABLE 1
ICT DEMONSTRATION SAMPLING AND ANALYSIS SUMMARY
Leviathan Mine Site
Alpine County, California

Sample Program	Sampling Locations	Location Description	Sampling Depth (below water surface elevation)	Sampling Frequency	Sampling Method	Rationale	Sample Testing	
							Field Analysis	Laboratory Analysis[1]
Interim Combined Treatment Demonstration	UPCS-1	Pond 1 water at the sample port on the discharge of the Pond 1 influent pump	Not Applicable	Upon initial effluent discharge, upon operating at target flow rate of 143 gpm, and twice weekly[5] thereafter for duration of the test	• All samples will be grab samples. • Samples will be collected using a peristaltic pump, dip sampler, or using the direct method in accordance with SOP 8.0 - Streamflow Measurement and Surface Water Sampling. • If necessary, the sample will be filtered using a 0.45 micron filter.	Compare general physical and chemical properties between monitoring locations. Support interim combined treatment evaluation.	• pH • temperature • SEC • DO • ORP • Fe^{2+} (field filtered)[2]	• Standard metals[3] and extended metals[6] • Standard general chemistry[4] and extended general chemistry[7]
	UPCS-2	Pond 2N/2S water at the sample port on the discharge of the Pond 2N/2S influent pump						
	HDSICT-1	Pond 4 water at the sample port on the discharge of the Pond 4 influent pump						
	HDSICT-2	Discharge of treated water from HDS Treatment Plant at effluent tank recirculation line sampling port	Not Applicable	Upon initial effluent discharge, upon operating at target flow rate of 143 gpm, and twice weekly[5] thereafter for duration of the test	• All samples will be a field composite consisting of three temporally-separated grab samples over the course of one work day for laboratory analysis; filtration and preservation, as appropriate, of each grab sample will occur immediately following collection prior to preparing the field composite sample. • Samples will be collected using a peristaltic pump, dip sampler, or using the direct method in accordance with SOP 8.0 - Streamflow Measurement and Surface Water Sampling. • If necessary, the sample will be filtered using a 0.45 micron filter.	Evaluate effluent against discharge criteria. Support interim combined treatment evaluation.	• pH • temperature • SEC • DO • ORP • Fe Total (field filtered)[2]	• Standard metals[3] and extended metals[6] • Standard general chemistry[4] and extended general chemistry[7]

TABLE 1
ICT DEMONSTRATION SAMPLING AND ANALYSIS SUMMARY
Leviathan Mine Site
Alpine County, California

Sample Program	Sampling Locations	Location Description	Sampling Depth (below water surface elevation)	Sampling Frequency	Sampling Method	Rationale	Sample Testing	
							Field Analysis	Laboratory Analysis[1]
Interim Combined Treatment Demonstration	HDSICT-SLDG	Collected from sludge dewatering bins	Not Applicable	Prior to initial sludge disposal	• All samples except Moisture Content[7] will be a field composite sample consisting of three grab samples from three different sludge bins, or from three different locations between one or two sludge bins if three sludge bins are not available. • Samples will be collected using a trowel or scoop in accordance with SOP 10.0 - Sediment Sampling.	Waste characterizatio n. Support interim combined treatment evaluation.	None	STLC, TCLP, TTLC, SPLP, DI-WET, Moisture Content[8], Dry Specific Gravity, Paste pH

Notes
[1] Analytical methods, sample volumes, preservation requirements, and filtration requirements are summarized on Table 2.
[2] Field iron will be measured in the field using Hach Colorimeter (or equivalent) in accordance with SOP 6.0.
[3] Standard metals include: (dissolved) aluminum, arsenic, calcium, cadmium, chromium, copper, iron, lead, magnesium, nickel, and zinc; (total) selenium.
[4] Standard general chemistry includes: acidity, alkalinity, chloride, hardness, sulfate, TDS, and TSS.
[5] During twice-weekly sampling, one sample event will analyze for the standard metals and standard general chemistry, and the other sample event will analyze for the extended metals and extended general chem
[6] Extended metals include: (dissolved and total) aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silica, silver, sodium, strontium, thallium, vanadium, and zinc.
[7] Extended general chemistry includes: acidity, alkalinity, ammonia, chloride, nitrate-N, ortho-phosphate-P, sulfate, Total Dissolved Solids (TDS), total hardness, and Total Suspended Solids (TSS).
[8] For moisture content, three additional grab samples will be collected for laboratory analysis from the sludge bin(s).

Abbreviations
Cl = chloride
DI = deionized water
DO = dissolved oxygen
GPM = gallons per minute
HDS = High Density Sludge
ICT = Interim Combined Treatment
ORP = oxidation reduction potential
SPLP = Synthetic Precipitation Leaching Procedure
STLC = California Soluble Threshold Limit Concentration
TCLP = Toxicity Characteristic Leaching Procedure
TDS = total dissolved solids
Temp = temperature
TSS = total suspended solids
TTLC = California Total Threshold Limit Concentration; based on wet weight concentration
UPCS = Upper Pond Conveyance System
WET = Waste Extraction Test

TABLE 2
ICT DEMONSTRATION STANDARD SAMPLING MATRIX
Leviathan Mine Site
Alpine County, California

Parameters		Field Iron[1]	Field Ferrous Iron[1]	Dissolved Metals[2]	Total Selenium	Hardness	Anions[3]	Alkalinity	Acidity	TDS	TSS	STLC	TCLP	TTLC	SPLP	DI-WET	Dry Specific Gravity	Paste pH	Moisture Content	QC Samples[4]		
Laboratory		NA		ALS								Test America								Same as Primary Sample		
Method		SOP 6.0		EPA 200.7/200.8	EPA 200.8	SM 2340B	EPA 300.0	SM 2320B	SM 2310B	SM 2540C	SM 2540D	CA WET Citrate/ EPA 6010B/ 7470A	EPA 1311/ 3010A/ 6010B/ 7470A	EPA 6010B/ 7471A	EPA 1312/ 3010A/ 6010B/ 7470A	CA DI-WET EPA 6010B/ 7470A	ASTM D854 Dry Specific Gravity	DI Leach/ SW846 9045C	EPA Moisture	Field Blanks	Field Duplicates	MS/MSD or LD[5]
Containers		1 x 250 mL HDPE		1 x 250 mL HDPE	1 x 250 mL HDPE		1 x 1L HDPE					3 x 8 oz WMC							1 x 8 oz WMC	Same as Primary Sample		Same as Primary Sample
Minimum Volume		25 mL	25 mL	250 mL	250 mL		100 mL	300 mL	200 mL	200 mL		100 g	200 g	5 g	200 g	100 g	125 g	25 g	10 g			
Field Filtered[6]		Yes		Yes	No		No					No							No			
Preservation[7]		None		HNO_3 pH<2	HNO_3 pH<2		None					None							None			
Maximum Holding		ASAP		28 d	180 d		28 d	14 d	7 d	7 d		28 d	28 d	28 d	28 d	28 d	NA	7 d	28 d			
Study Area	Location ID																					
LCSA	Pond4-1		X	X	X	X	X	X	X	X	X											
LCSA	Pond4-2		X	X	X	X	X	X	X	X	X											
LCSA	Pond4-3		X	X	X	X	X	X	X	X	X											
LCSA	Pond4-4		X	X	X	X	X	X	X	X	X											X
LCSA	Pond1-1		X	X	X	X	X	X	X	X	X									X		
LCSA	Pond1-2		X	X	X	X	X	X	X	X	X										X	
LCSA	Pond1-3		X	X	X	X	X	X	X	X	X											
LCSA	Pond1-4		X	X	X	X	X	X	X	X	X											
LCSA	Pond2N-1		X	X	X	X	X	X	X	X	X											
LCSA	Pond2N-2		X	X	X	X	X	X	X	X	X											
LCSA	Pond2N-3		X	X	X	X	X	X	X	X	X											
LCSA	Pond2N-4		X	X	X	X	X	X	X	X	X											
LCSA	Pond2S-1		X	X	X	X	X	X	X	X	X											
LCSA	Pond2S-2		X	X	X	X	X	X	X	X	X									X		
LCSA	Pond2S-3		X	X	X	X	X	X	X	X	X										X	
LCSA	Pond2S-4		X	X	X	X	X	X	X	X	X											
LCSA	UPCS-1		X	X	X	X	X	X	X	X	X											
LCSA	UPCS-2		X	X	X	X	X	X	X	X	X											
LCSA	HDSICT-1		X	X	X	X	X	X	X	X	X										X	X
LCSA	HDSICT-2	X		X	X	X	X	X	X	X	X									X		
LCSA	HDSICT-SLDG											X	X	X	X	X	X	X	X			
	Total Samples									21										3	3	2

Note(s)
1. Field iron will be measured in the field using Hach Colorimeter (or equivalent) in accordance with SOP 6.0.
2. Metals include: (dissolved) aluminum, arsenic, calcium, cadmium, chromium, copper, iron, lead, magnesium, nickel, and zinc; (total) selenium.
3. Anions include: chloride and sulfate
4. The number of QA/QC samples collected are dependent on actual number of primary samples collected and will be adjusted to meet the minimum requirements frequency of 10% for field duplicates, 10% for field blanks, and 5% for MS/MSD or LD.
5. Three times the original sample volume must be provided to the laboratories for MS/MSD or LD and designated on the COC.
6. Filter samples using a 0.45 micron high capacity filter.
7. Samples should be stored at a temperature ranging from 0°C - 6°C.

Sample ID(s)
SWLMMDDYYXX Use for all surface water samples collected in the LCSA, consecutively, for a given date.
WSLMMDDYYXX Use for all waste samples collected in the LCSA, consecutively, for a given date.

Sample Matrix
SW Use for all primary and duplicate surface water samples.
WS Use for all primary and duplicate waste samples.
W Use for all field blanks.

Abbreviation(s)
°C = degrees Celsius
ASAP = as soon as possible
d = days
EPA = Environmental Protection Agency
HDPE = high density polyethylene
HNO_3 = nitric acid
hr = hours
ID = identification
LD = laboratory duplicate
LCSA = Leviathan Creek Study Area
mL = milliliter
MS/MSD = matrix spike / matrix spike duplicate
NA = not applicable
QC = quality control
SM = Standard Methods for Water and Wastewater
SOP = standard operating procedure
TDS = total dissolved solids
TSS = total suspended solids
WMC = wide mouth container (glass or poly)

TABLE 3
UPPER POND FLOW RATE AND ACIDITY RANGE CALCULATION WALKTHROUGH
Leviathan Mine Site
Alpine County, California

Type	Input - CUD Flow Rate (gpm)	Input - DS Flow Rate (gpm)	Calculated - Upper Pond Required Flow Rate (gpm)[1]	Total Combined Flow into HDS Treatment Plant (gpm)	Input - Pond 4 Acidity (mg/L)	Calculated - Upper Pond Minimum Required Acidity (mg/L)	Calculated - Upper Pond Maximum Required Acidity (mg/L)	Required Combined Acidity Range into the HDS Treatment Plant (mg/L)
Calculation Formulas	Input Actual CUD Flow Rate	Input Actual DS Flow Rate	Formula = 143.0 - CUD Flow - DS Flow	143.0	Input Actual Pond 4 Acidity	Formula = [(143.0 * 2,600) - (CUD Flow * Pond 4 Acidity) - (DS Flow * Pond 4 Acidity)] / Upper Pond Flow	Formula = [(143.0 * 2,900) - (CUD Flow * Pond 4 Acidity) - (DS Flow * Pond 4 Acidity)] / Upper Pond Flow	2,600 - 2,900
Calculation Example	30.0	15.0	= 143.0 - 30.0 - 15.0 = 98.0	143.0	1,500	= [(143.0 * 2,600) - (30.0 * 1,500) - (15.0 * 1,500)] / 98.0 = 3,105	= [(143.0 * 2,900) - (30.0 * 1,500) - (15.0 * 1,500)] / 98.0 = 3,543	2,600 - 2,900

Notes
1) The flow of Upper Pond water will be regulated to maintain the combined flow of approximately 143 gpm into Pond 4. The holding capacity in Pond 4 will provide some flexibility for operators to vary the flow rate into Pond 4 from the Upper Ponds; however, there will be limitations for personnel to operate at the target influent parameters because they will not have the ability to significantly adjust the blending ratio between CUD/DS and Upper Pond water.

Abbreviations
CUD = Channel Underdrain
DS = Delta Seep
gpm = gallon per minute
HDS = high density sludge
mg/L = milligram per liter

TABLE 4

UPPER POND FLOW RATE AND ACIDITY RANGE 85TH PERCENTILE CALCULATION EXAMPLE[1]

Leviathan Mine Site

Alpine County, California

Month	85th Percentile CUD Flow Rate[2] (gpm)	85th Percentile DS Flow Rate[2] (gpm)	Calculated - Upper Pond Required Flow Rate (gpm)	Total Combined Flow into HDS Treatment Plant (gpm)	85th Percentile CUD Acidity[3] (mg/L)	85th Percentile DS Acidity[3] (mg/L)	Calculated - Upper Pond Minimum Required Acidity (mg/L)	Calculated - Upper Pond Maximum Required Acidity (mg/L)	Required Combined Acidity Range into the HDS Treatment Plant (mg/L)
April	26.8	20.8	95.5	143.0	1,990	115	3,311	3,760	2,600 - 2,900
May	34.5	23.2	85.4	143.0	2,440	115	3,340	3,842	2,600 - 2,900
June	32.8	18.3	91.8	143.0	1,900	115	3,346	3,813	2,600 - 2,900
July	37.6	15.0	90.4	143.0	1,750	115	3,366	3,840	2,600 - 2,900
August	33.4	13.2	96.5	143.0	1,530	115	3,310	3,755	2,600 - 2,900
September	31.0	11.5	100.5	143.0	1,310	115	3,283	3,710	2,600 - 2,900

Notes

1. Calculation example uses 85th percentile flow year monthly flow and acidity averages to provide a preliminary estimate of the potential flows from each of the source waters to be tested. Actual Upper Pond water required acidity ranges will be determined in the field based on the actual water chemistry and CUD and DS flow rates at the time of testing.
2. Flow data source is Attachment E-3 of the Interim Combined Acid Drainage Treatability Investigation Report, Atlantic Richfield, December 18, 2015.
3. Pond 4 acidity data is not available; therefore, CUD and DS acidities were used as surrogates for this calculation example. Acidity data source is Attachment E-7 of the Interim Combined Acid Drainage Treatability Investigation Report, Atlantic Richfield, December 18, 2015.

Abbreviations

CUD = Channel Underdrain
DS = Delta Seep
gpm = gallon per minute
HDS = high density sludge
mg/L = milligram per liter

TABLE 5
ICT DEMONSTRATION EXTENDED SAMPLING MATRIX
Leviathan Mine Site
Alpine County, California

Parameters		Field Iron[1]	Field Ferrous Iron[1]	Dissolved Metals[2]	Total Metals[2]	Total Hardness	Ammonia	Anions[3]	Alkalinity	Acidity	TDS	TSS	QC Samples[4]		
Laboratory		NA		ALS									Same as Primary		
Method		SOP 6.0		EPA 200.7/ 200.8/245.1	EPA 200.7/ 200.8/245.1	SM 2340B	SM 4500 NH3	EPA 300.0/ EPA 365.3	SM 2320B	SM 2310B	SM 2540C	SM 2540D	Field Blanks	Field Duplicates	MS/MSD or LD[5]
Containers		1 x 250 mL HDPE		1 x 250 mL HDPE	1 x 250 mL HDPE		1 x 125 mL HDPE	1 x 1L HDPE or 2 X 500mL					Same as Primary Sample		Same as Primary Sample
Minimum Volume		25 mL	25 mL	250 mL	250 mL		125 mL	250 mL	300 mL		40 mL	200 mL			
Field Filtered[6]		Yes		Yes	No		No	No							
Preservation[7]		None		HNO_3 pH<2	HNO_3 pH<2		H_2SO_4 to pH < 2	None							
Maximum Holding		ASAP		28d	28d		28 d	2 d	14 d		7 d	7 d			
Study Area	**Location ID**														
LCSA	UPCS-1		X	X	X	X	X	X	X	X	X	X			
LCSA	UPCS-2		X	X	X	X	X	X	X	X	X	X			
LCSA	HDSICT-1		X	X	X	X	X	X	X	X	X	X		X	X
LCSA	HDSICT-2	X		X	X	X	X	X	X	X	X	X	X		
	Total Samples	4											1	1	1

Notes:
1. Field iron will be measured in the field using Hach Colorimeter (or equivalent) in accordance with SOP 6.0.
2. Metals (dissolved and total) include: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silica, silver, sodium, strontium, thallium, vanadium, and zinc.
3. Anions include: chloride, nitrate-N, ortho-phosphate-P, and sulfate.
4. The number of QA/QC samples collected are dependent on actual number of primary samples collected and will be adjusted to meet the minimum requirements frequency of 10% for field duplicates, 10% for field blanks, and 5% for MS/MSD or LD.
5. Three times the original sample volume must be provided to the laboratories for MS/MSD or LD and designated on the COC.
6. Filter samples using a 0.45 micron high capacity filter.
7. Samples should be stored at a temperature ranging from 0°C - 6°C.

Sample ID(s)
SWLMMDDYYXX Use for all surface water samples collected in the LCSA, consecutively, for a given date.

Sample Matrix
SW Use for all primary and duplicate surface water samples.
W Use for all field blanks.

Abbreviation(s)
°C = degrees Celsius
ASAP = as soon as possible
d = days
EPA = Environmental Protection Agency
HDPE = high density polyethylene
HNO_3 = nitric acid
hr = hours
ID = identification
LD = laboratory duplicate
LCSA = Leviathan Creek Study Area
mL = milliliter
MS/MSD = matrix spike / matrix spike duplicate
NA = not applicable
QC = quality control
SM = Standard Methods for Water and Wastewater
SOP = standard operating procedure
TDS = total dissolved solids
TSS = total suspended solids
WMC = wide mouth container (glass or poly)

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TABLE 6
ANALYTICAL LIMITS FOR ICT DEMONSTRATION
Leviathan Mine Site
Alpine County, California

Parameter	Method Reference[1]	Estimated Reporting Limits	Target Detection Limits[2]
pH	Field SOP 6.0 (YSI or similar)	0.1 unit	6.0 - 9.0 units
Specific Electrical Conductivity	Field SOP 6.0 (YSI or similar)	1 uS/cm	NA
Temperature	Field SOP 6.0 (YSI or similar)	1°C	NA
Oxidation Reduction Potential	Field SOP 6.0 (YSI or similar)	0.1 mV	NA
Dissolved Oxygen	Field SOP 6.0 (YSI or similar)	0.2 mg/L	NA
Turbidity	Field SOP 6.0 (YSI or similar)	1 NTU	NA
Ferrous Iron	Field SOP 6.0 (HACH 8146)	0.03 mg/L	NA
Total Iron	Field SOP 6.0 (HACH 8008)	0.03 mg/L	NA
Metals			
Aluminum	EPA 200.7/200.8/245.1	0.05 mg/L	2.0 mg/L
Antimony		0.05 mg/L	NA
Arsenic		0.001 mg/L	0.15 mg/L
Barium		0.1 mg/L	NA
Beryllium		0.005 mg/L	NA
Cadmium		0.0001 mg/L	0.004 mg/L
Calcium		5 mg/L	NA
Chromium		0.005 mg/L	0.31 mg/L
Cobalt		0.005 mg/L	NA
Copper		0.001 mg/L	0.016 mg/L
Iron		0.1 mg/L	1.0 mg/L
Lead		0.001 mg/L	0.005 mg/L
Magnesium		5 mg/L	NA
Manganese		0.005 mg/L	NA
Mercury		0.0002 mg/L	NA
Nickel		0.02 mg/L	0.094 mg/L
Potassium		5 mg/L	NA
Selenium		0.002 mg/L	0.005 mg/L
Silica		0.5 mg/L	5 mg/L
Silver		0.001 mg/L	NA
Sodium		5 mg/L	NA
Strontium		0.02 mg/L	10 mg/L
Thallium		0.002 mg/L	NA
Vanadium		0.010 mg/L	NA
Zinc		0.020 mg/L	0.21 mg/L

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TABLE 6
ANALYTICAL LIMITS FOR ICT DEMONSTRATION
Leviathan Mine Site
Alpine County, California

Parameter	Method Reference[1]	Estimated Reporting Limits	Target Detection Limits[2]
General Chemistry			
Total Dissolved Solids	SM 2540C	10 mg/L	NA
Total Suspended Solids	SM 2540D	10 mg/L	NA
Acidity	SM 2310B(4a)	10 mg/L	NA
Alkalinity	SM 2320B	5 mg/L	NA
Hardness (as $CaCO_3$)	EPA 200.7/SM 2340B	1 mg/L	NA
Sulfate	EPA 300.0	5 mg/L	NA
Chloride		5 mg/L	NA
Orthophosphate (as P)		1 mg/L	NA
Nitrate (NO_3 as N)		1 mg/L	NA
Ammonia	SM 4500 NH3-G	5 mg/L	NA

Notes:
1. Where applicable, sample preparation procedures outlined in the referenced method will be performed prior to analysis.
2. Target detection limits are based on the MRAM discharge criteria and potential FS treatment technology evaluations.

Abbreviations:
CaCO3 = calcium carbonate
EPA = Environmental Protection Agency
FS = Feasibility Study
mg/L = milligrams per liter
uS/cm = microsiemens per centimeter
MRAM = Modification to the Removal Action Memorandum
mV = millivolt
N = nitrogen
NA = not applicable
NO3 = Nitrate
NTU = Nephelometric Turbidity Units
P = phosphorus
SM = Standard Method
SOP = Standard Operation Procedure