APPENDIX 1

Summary of Previous Investigations and Historical Data Tables

Blackjack and Bluebird Mines Report Summary

Environmental sampling at and around the Bluebird and Blackjack Mines was initiated in 1980. However, that information was not available for review. Most detailed environmental studies began around 2003 and have continued since then. The US Forest Service (USFS), Region 6 provided 27 reports and data files for review. The following reports provided by the USFS address history, sampling, and analyses and are summarized below. Eight reports exhibited data significant enough for summarizing in an Excel spreadsheet following this summary.

EA Engineering, Science, and Technology, Inc., 2003. Site Inspection – Bluebird and Blackjack Mines, Umatilla National Forest, Oregon. Prepared for USFS, Pendleton, Oregon. Conclusions/Recommendations are summarized as follows:

- Metals were detected in both adit discharges above screening levels; elements commonly exceeding criteria included Ba, Fe, Mn, Ni, an Zn; only Fe and Mn exceeded criteria significantly.
- Metals were detected above screening criteria (some above background) in soil and waste at both sites; only As and Fe exceed common criteria significantly.
- A spill occurred at Blackjack with some impact to the benthic community for a short distance downstream in Clear Creek; significant impact over much of the stream length was small.
- Redband or cutthroat trout occur in the area and could have been impacted by the spill.
- An EE/CA for human health and ecological risk is recommended.
- The number of samples was limited.

Umatilla National Forest, USFS, R6, March 2003. Abbreviated Preliminary Assessment, Blackjack Mine.

- The upper adit discharges under Clear Creek to the opposite side of the County Road.
- The lower adit discharges directly to clear Creek.
- No samples were obtained.

USFS, R6, April 2003, Blackjack Mine 2003 TCRA Action Memo.

- Recommended replacement of the Bluebird Mine portal plug and pipeline.
- Recommended replacement of the Blackjack mine pipeline.
- Pipeline plugging is a persistent problem.
- Both pipelines may have shifted.
- The recommendations are common-sense, and most have been addressed with subsequent work.
- The responses seem intuitive without a great deal of scientific thought and related planning.

EA Engineering, Science & Technology, 2004. Site Inspection, Granite Creek Mines, Wallowa-Whitman National Forest, Oregon.

- Did not address Blackjack and Bluebird Mines.
- Provides general background information only.

Science Application International Corp., 2005. Final Engineering Evaluation/Cost Analysis, Bluebird Mine Site, Granite, Oregon. Prepared for USFS, Vancouver, Washington. Conclusions/Recommendations are summarized as follows:

- Based on the results of the streamlined human health risk evaluation and ecological risk assessment, no adverse human health or terrestrial ecological risks from exposure to soils and waste rock are expected.
- Therefore, preliminary remediation goals for these sources were not developed.
- The USFS has recently installed a new adit discharge system into settling ponds west of the County road. The current configuration of the ponds with a plugged culvert indicates no current adverse risk to the creek. However, adverse risks to Clear Creek could be likely if the culvert becomes unplugged.
- Numerous data gaps have been identified that need to be filled prior to developing serious alternatives for the settling pond should the culvert be unplugged. Note this culvert does not appear to reach the ponds, but rather may have been intended for road dewatering. Chemistry of discharge does not match pond chemistry. Limited samples were obtained.
- A supplemental EE/CA or an addendum to this EE/CA should be prepared after the data gaps regarding the settling pond issue have been collected and analyzed.

Science Application International Corp., 2005. Final Engineering Evaluation/Cost Analysis, Blackjack Mine Site, Granite, Oregon. Prepared for USFS, Vancouver, Washington. Conclusions/Recommendations are summarized as follows:

- Based on the results of a streamlined human health and ecological risk assessments, unacceptable hazards and risks to human health are not expected based on the current site configuration, and terrestrial ecological receptors are not adversely affected. This seems to be based on the status quo being maintained and does not account for potential catastrophic release of sludge.
- Preliminary remedial goals were not developed. These would be needed if catastrophic release were incorporated into a risk model.
- In accordance with 40 CFR 300.410(e)(2)(f)(5), this EE/CA process is determined complete because the amount, quantity, or concentrations released do not warrant further response at this time.
- The existing USFS long-term monitoring and maintenance plan for the pipeline system will further assure that the ecological values of Clear Creek are protected.

Cascade Earth Sciences, 2007. Non-Time Critical Removal Action Report, Bluebird Mine Portal, Wallowa-Whitman National Forest, Baker County, Oregon.

- To close a data gap a logger was installed in the Bluebird portal discharge line for date, Eh, pH, and temperature from 12/04/04 through 08/18/05.
- Eh ranged from 214 to 336 mV with higher values generally in the April spring flush.
- pH ranged from 4.78 to 7.20 units with the more acidic values generally in the summer months.
- Temperature remained at a constant 10^{o}C.
- Discharge analyses during this period indicated that Al, As, Fe, and Mn in suspended form significantly exceeded criteria.
- As and Cd in sludge significantly exceeded criteria.
- Sulfate concentrations are low, indicating metals in discharge may not be derived from acid production.
- Given the prior bullet, an airlock dam would have little or no effect on metal discharge rates.
- The adit was rehabilitated to 50 feet from the portal, a 3-foot high dam was constructed and connected to the discharge line, and a BAT gate was installed.

Cascade Earth Sciences, 2008. Non-Time Critical Removal Action Report, Blackjack Mine Portal and Pipeline, Wallowa-Whitman National Forest.

- In November 2005, Cascade Earth Sciences (CES) was retained to perform a Removal Action (RA) at the Blackjack Mine.
- The initial RA objective consisted of plug installations in both adits and reclamation of the site.
- Initial work at the site uncovered several cave-ins and unstable geology preventing the installation of plugs.
- A dam and drainage system was designed and implemented in 2 phases, 1) October through December 2006 - adit stabilization and dam construction and 2) September through October 2007 - new pipeline construction and site reclamation.
- BAT gates were installed at all portals.

Cascade Earth Sciences, 2008. Bluebird Mine Plug Installation Closure Report, Wallowa-Whitman National Forest, Grant County, Oregon.

- On July 18, 2006, CES was retained to perform a RA at the Bluebird Mine.
- RA objectives consisted of plug installation in the adit, repair of pipeline, and reclamation of the site.
- The plug, pipeline repair, and reclamation were designed and implemented in 2 phases, 1) October through December 2006 – plug installation and 2) September 2007 – pipeline repair/replacement across Clear Creek and site reclamation.
- The plug was installed at a depth of 150 feet from the portal.

- A secured BAT gate was installed at the portal.

US Forest Service, Willow-Whitman & Umatilla National Forest, 2008. Watershed Action Plan (WAP) To Remove Barriers and Improve Stream Function on National Forest System Lands Within the Granite Creek Watershed (HUC 1707020202).

- The WAP summarizes all work to date and identifies critical restoration needs for the next 5-10 years.
- Granite Creek has an extensive mining history with significant impact.
- Restoration of the watershed is critical to successful fish recovery in the John Day Basin.
- Mines under CERCLA action are the Blackjack and Bluebird Mines.
- Prioritize abandoned placer mine site reclamation.
- Remove physical barriers to aquatic passage.
- Reconnect and improve natural floodplains and streams plus improve habitat.
- Identify funding partnerships.
- Multiple specific actions identified.
- Redboy, Bluebird, and Blackjack Mines cleanups are key.

Cascade Earth Sciences, 2009. Final Operations and Maintenance Plan: Bluebird Mine Portal Plug, Seepage Dam, and Pipeline, Umatilla National Forest, Grant County, Oregon. Maintenance items include:

- Annual above ground inspection.
- Annual underground inspection.
- Adit maintenance as needed.
- Annual pipeline cleaning.
- Discharge cleanout as needed.

Cascade Earth Sciences, 2009. Final Operations and Maintenance Plan: Blackjack Mine Portal and Pipeline. Umatilla National Forest, Grant County, Oregon. Maintenance items include:

- Quarterly above ground inspection.
- Annual above ground inspection.
- Annual underground inspection.
- Adit maintenance as needed.
- Annual pipeline cleaning.
- Discharge cleanout as needed.

Cascade Earth Sciences, 2011. Technical Memorandum: Bluebird Mine October 2010 Post Removal Action Sampling Report.

- Six sample locations were identified.
- Six samples were obtained at each location between October 2007 and July 2010.

- Many of the above measured parameters and analyses are suspect.
- Several recommendations were made including a suggestion to design a passive treatment system and evaluate sludge handling options.

Cascade Earth Sciences, 2013. Mine Seep Discharge and Settling Ponds Assessment – Blackjack Mine. Prepared for North Fork John Day Watershed Council and Umatilla National Forest.

- Clear Creek water quality is impacted by activities upstream of the mine.
- The existing roadside wetlands/settling pond system is functioning largely as intended, although much of the attenuation appears to be related to dilution of Clear Creek water flowing from Clear Creek to the treatment system under the road.
- The existing ponds are high-risk and high maintenance.
- Replacing the existing pipe with larger pipe is recommended.
- Consider relocating Clear Creek to allow construction of an engineered settling pond/wetlands treatment area in the Clear Creek Floodplain.
- Consider replacing the adit timber supports with a large diameter culvert.
- Remove underground cave-in dams to reduce water storage.
- Redesign the pipe intakes to reduce blockage potential.

Cascade Earth Sciences, 2013. Expanded Preliminary Assessment (PA)/Engineering Evaluation, Red Boy Mine – ECSI#2467. Prepared for North Fork John Day River Watershed Council and Umatilla National Forest. This Expanded PA/Engineering Evaluation consists of the following tasks:

- A preliminary engineering evaluation of the adit and pipeline to identify a preferred alternative for minimization of discharge of hazardous substances.
    a. The 6-inch PVC line plugs frequently and is too small.
    b. Cleanouts are broken.
- Sampling of surface water and sediment, and measurement of wet chemistry parameters to assess instream water quality and metals loading at the site.
    a. Little impact on Congo Gulch water except for arsenic. These are still lower than Clear Creek upstream.
    b. Concentrations increase with the spring flush.
    c. Metals in sediment in Congo Gulch and Clear creek are elevated.
    d. Pond sludge metals and sediment contain extremely elevated metals.
- Field measurements of pH from the Red Boy Mine adit to the lowest settling pond at the Umatilla NF boundary to assess areas with lowering pH values in the system.
    a. Adit pHs are circumneutral; pond pHs are acidic (<3) with elevated metals. The Red Boy ponds discharge to the Bluebird ponds.
- Collection of waste rock and tailings samples, and field screening of surficial soils near the Red Boy mill and cyanide plant, to identify the lateral extent of areas with elevated concentrations metals at the site.
    a. Waste rock and tailings generally contained metals above various criteria.

- Sampling for benthic macroinvertebrates near the site to evaluate instream biological integrity.
    a) Reductions in habitat quality and probable effects from former mining activities have resulted in deleterious impacts to the invertebrate community in Congo Gulch.
    b) The benthic macroinvertebrate community in Clear Creek generally consisted of higher overall abundance and richness than the lower sections of Congo Gulch, but less than upper Congo Gulch.
- In Clear Creek, sediment data revealed an increase in metals concentrations downstream from the confluence with Congo Gulch. All of the concentrations of total arsenic exceeded applicable state and federal comparison criteria.
- Total sediment concentrations of other metals varied in Clear Creek, with no clear trends in the data.
- Total metals concentration in sediment samples collected from the Red Boy Mine ponds were primarily elevated from the background and upstream samples collected from Congo Gulch and Clear Creek.
- Concentrations of total arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc were in excess of applicable state and federal compassion criteria. Specifically, total arsenic was identified at a high concentration of 2,430 milligrams per kilogram (mg/kg).
- An inverse relationship was observed with total iron, which was identified at concentrations of 358,000 mg/kg (fall) and 41,500 mg/kg (spring).
- Seasonal variation in total iron and arsenic concentrations may be related to several physio-chemical properties within the Red Boy Mine ponds, some of which may not have been assessed during this Expanded PA (e.g., total organic carbon, acid-based accounting, etc.).
- A marked decrease in benthic macroinvertebrate abundance, diversity, and richness was identified from background station CG-01 to CG-03, downstream from the Red Boy Mine waste rock piles.
- Reductions in Ephemeroptera, Plecoptera, and Trichoptera (EPT) numbers and richness.
- BIBI scores; Shannon-Weaver Index values; and percent intolerant taxa were identified from station CG-01 to CG-03. However, habitat scoring exhibited a slight increase from station CG-02 to CG-03.
- Based on these data, reductions in habitat quality and probable effects from former mining activities have resulted in deleterious impacts to the invertebrate community in Congo Gulch.
- The benthic macroinvertebrate community in Clear Creek generally consisted of higher overall abundance and richness than the lower sections of Congo Gulch.
- This may be attributable to the greater size and flow of Clear Creek related to Congo Gulch, and probable increased habitat availability. However, biological index scoring was lower in Clear Creek than the background station (CG-01), which may be indicative of mining and habitat impacts in Clear Creek upstream from the confluence with Congo Gulch.

Recommendations include:

- Replace the pipeline with a larger HDPE line.
- Select and test various passive treatment system for adit discharge water.
- Complete an EE/CA.
- Prevent the Red Boy and Bluebird ponds from comingling.

Cascade Earth Sciences, 2015. Technical Memorandum: Sludge Disposal Options – Blackjack and Bluebird Mines. Prepared for USFS.

- Sludge volumes in adits and ponds was determined as was projected fill times.
- The BlackJack Mine is expected to fill with sludge to dam level in eight years for the mine; the ponds contain a conservatively estimated 667 cy of sludge based on a depth of 4 feet (which seems excessive) with and eight-year maintenance cycle.
- The Bluebird Mine adit is expected to require maintenance every seven years; the ponds contain a conservatively estimated 1,307 cy in the settling pond. No estimate was made for the treatment pond. A 25-year maintenance schedule for the settling pond is recommended. However, this seems to assume that the treatment pond will receive all settlement after the settling ponds are full, which may not happen, resulting in excessive volumes in the settling pond and impact to flow from Red Boy.
- Sludge contains elevated metals; Al, As, Cd, Cu, Fe, Hg, Ni, and Zn exceed criteria to various degrees.
- Five locations for a local sludge repository were considered; the 1031 Rock Pit was selected. Off-site disposal was rejected.
- Four transport methods were evaluated; dredging with truck transport was selected with at-pit dewatering by Geotube.
- Sludge removal was evaluated in staged events at 8, 16, 25, 33, 41, and 50-year cycles in perpetuity w/25 year selected as the most probable event.

Cascade Earth Sciences, 2015. Technical Memorandum: Clear Creek Options Assessment: Hydraulic Modeling of Clear Creek and Treatment Ponds – Blackjack and Bluebird Mines, Umatilla National Forest, Oregon. The objectives of this phase of the Clear Creek Options Assessment are as follows:

- Update and complete an existing U.S. Forest Service topographic survey of the Clear Creek floodplain and banks between Forest Road (FR) 13/Grant County Road 24 Bridge and the approximate Blackjack pipeline crossing of the road. Hereinafter, this road will be called FR 13.
    a) Several independent surveys were consolidated to a common datum of NAD83 (horizontal) and NADD88 (vertical).
- Conduct a topographic survey for approximately 700 feet upstream of the terminus of the Umatilla National Forest 2008 survey extent, and new topographic survey for approximately 1,200 feet in the vicinity of the Bluebird pond system.

    a) This supplemental survey filled data gaps remaining from the above consolidated surveys.
- Identify the hydrology of peak flow events in Clear Creek between the Blackjack and Bluebird Mines and the Bluebird Mine treatment pond system.
    a) The 100-year floodplain margins were identified using published maps, flow frequency analysis from local stream gages, Campbell's Equation, drainage area calculations, and HEC-RAS.
    b) Based on calculated hydrographs a series of flow models were developed.
- Describe the 100-year floodplain elevations along the perimeter of the Bluebird ponds to assess potential overtopping or failure mode of this pond system during peak flow events.
    a) The peak flood elevation was calculated to be 4,601-4,602 feet AMSL.
    b) This elevation will not impact the Bluebird ponds or extend west of Grant County Road 24.
- Provide a concept for potential re-meandering of Clear Creek below the Blackjack Mine to create a footprint for possible construction of a treatment wetland adjacent to the west of Clear Creek.
- Classic stream morphology was evaluated using the techniques of Leopold, a commonly accepted method.
- If the existing pipeline is replaced, CES determined that Clear Creek could be safely realigned to create a new artificial wetland on the west side of the creek for discharge treatment that would be outside of the 100-year floodplain. Given the uncertainties common to this type of analyses, this approach has significant risk.

Tetra Tech, 2016. Blackjack Mine, Grant County, Oregon – Site Visit and Recommendations. The objectives of the study were to use current knowledge from all work and recommendation to:

- Reduce or eliminate annual pipeline and portal maintenance operational costs.
- Reduce or eliminate the combined point source adit pipeline discharge.
- Accommodate possible plans for Forest Service road realignment.
- Sustain and or improve fisheries habitat for bull trout, steelhead, and salmon.
- Eliminate the potential threat to Clear Creek of uncontrolled mine water discharge.
- Eliminate visual evidence of acid mine drainage such as the ferri-hydroxide (iron) precipitate. (Note: the Blackjack mine is not the only source of these visual impacts in the immediate area).

Observations:

- The Lower Blackjack Adit was accessible with timber, BAT gates, and pipelines intact and in good working condition.
- The north drift dam was leaking, and not drainage was impounded behind the dam.
- The south drift dam discharge pipe had no debris screen and was partially blocked by debris and appeared to be partially blocked by precipitate.
- Minor leakage occurred under and around the dam.

- The upper Blackjack Adit is in good condition.
- Staining indicates that ponded water has overflowed the dam (Pipeline plugging?).
- Significant water is stored behind a natural cave-in dam, which presents a flood potential if breached.
- This flood would top the dam and impact Clear Creek.
- There is no connection with the lower adit.
- The pipelines and valves seem functional.
- Precipitate induce water backup at the outfall.
- Discharge water is clear by the time it reaches Clear Creek.
- The equipment access for maintenance is not good.
- There was no iron staining leaking through the road base to Clear Creek.

Identified data gaps:

- No single compilation of existing water quality data.
- Inadequate discharge data to characterize quality temporally, water chemistry interaction, and total versus dissolved loads.
- Persistent lack of mine discharge data, geologic data, structure data, and detailed reports.
- No mine maps availability.
- No aquatic evaluations since 2006.

Tetra Tech reviewed Alternatives by Cascade Earth Sciences. Recommended additional alternatives:

- Improve ponds for better maintenance;
- Construct an anoxic limestone drain
- Construct floating wetlands treatment areas.
- Determine if infiltration and inflow to mines can be found and terminated.
- Determine if upper and lower adit flows should be treated separately.
- Evaluate use of full adit plugs.

Cascade Earth Sciences, 2017. Site Characterization and Removal - Action Design, Bluebird and Blackjack Mines, Clear Creek Options Assessment. Given that Pit 1031 was selected as the location for disposal of any sludge removed from the Bluebird and Blackjack ponds, a detailed design was required for construction and closure of the repository. Cascade conducted the following during the assessment:

- Reviewed volume requirements to be 2,102 cy total.
- Reviewed landfill design requirements, because the selected location could be considered off-site, and not comply with CERCLA exemptions.
- Reviewed all location restriction for applicability
    a) Airport safety;
    b) Floodplains;

c) Wetlands;
d) Faults;
e) Seismic activity;
f) Ground stability
g) Critical habitat;
h) Hydrogeology;

No issues were identified with the above possible restrictions.

- The site-specific parameters were characterized including:
    a) Impact on adjacent landowners.
    b) A survey with detailed topographic map was performed.
    c) Hydrogeology and hydrology were evaluated.
    d) Sludge dewatering tests were performed.
- A sludge removal and dewatering schedule was developed that would require 68 days for complete removal, dewatering, and disposal.
- A repository to hold six disposal events at 7-8 year intervals was designed, including reclamation and closure.

Ecology and Environment, 2017. Mining District Site Recon and Prioritization, Granite Creek Watershed, Oregon. For the U.S. Environmental Protection Agency. E&E assessed all mine contamination potential in the entire Granite Creek Watershed of which Clear Creek is a part to:

- Collect and analyze samples to characterize the potential sources.
- Determine potential for off-site migration of contaminants.
- Provide the EPA with adequate information to determine whether particular sites within the historic mining district may be eligible for inclusion in the Superfund Enterprise Management System and/or placement on the National Priorities List.
- Document a threat or potential threat to public health or the environment posed by the sites within the historic mining district.
- Identify high priority sites for potential further assessment in coordination with the USFS and ODEQ.
- The Bluebird, Red Boy, and Blackjack Mines on Clear Creek were identified as needing additional sampling and evaluation.
- Significant concentrations of metals were identified at all three sites. Five of eight surface water samples collected from Clear Creek near the Bluebird, Red Boy, and Blackjack Mines contained significant concentrations of manganese in both the total and dissolved metals fractions with respect to background concentrations. All surface water samples collected from the Bluebird/Red Boy and Blackjack Mines settling ponds contained significant concentrations of manganese, nickel, and zinc in both total and dissolved metals fractions; the sample from the Blackjack Mine settling pond also contained significant concentrations of cadmium and copper in both the total and dissolved metals fractions. Further, the surface water sample collected from the Clear Creek slough downstream of

the Blackjack Mine settling pond contained significant concentrations of manganese in both the total and dissolved metals fractions. With regard to sediment samples, the Blackjack and Red Boy/Bluebird Mines settling ponds contained significant concentrations of antimony, arsenic, beryllium, and cadmium. In addition, the sample collected from the Blackjack Mine settling pond contained significant concentrations of copper, lead, mercury, and zinc. No sediment samples collected from the main channel of Clear Creek had significant concentrations of metals, though the sample collected from the Clear Creek slough had significant concentrations of barium, cadmium, copper, manganese, mercury, and zinc. All the above listed metals exceeded various criteria at various locations.

- It appears these ponds are having some mitigating impact to waters flowing into Clear Creek and its slough given that no surface water samples collected from these water bodies had metals concentrations in excess of EPA WQC and only manganese was detected at significant concentrations with respect to background concentrations. However, sediment sample results do appear to indicate an impact to the streambed of the Clear Creek slough.

USFS, 2018. TCLP Analyses of Bluebird and Blackjack Ponds Sludge Analyses.

- The US Forest Service obtained six samples of sludge from the Bluebird and Blackjack sludge ponds for TCLP (or SPLP) and total TAL metals. No samples exceeded TCLP limits for hazardous waste.

Tetra Tech, 2018. Preliminary Sampling Results – Blackjack and Bluebird Mines, Oregon. Tetra Tech conducted water and sediment sampling in the Granite Creek area, near Granite, Oregon, to better define effects to the watershed related to past and present mining activity. The project area includes the abandoned Blackjack and Bluebird mines located along Clear Creek, a tributary to Granite Creek, and other sites within the Granite Creek watershed. Sampling occurred in May, July, and November 2018 with the intent to obtain results from Spring, Summer, and Fall conditions. However, due to the late onsite of fall precipitation, the fall sampling event was postponed and eventually winter conditions returned to the area for the November 2018 sampling event. Key elements include:

- Water samples and field parameter measurements were obtained at the Bluebird and Blackjack Mines discharge points and three locations on Clear Creek.
- Sediment samples were taken at three location in Clear Creek.
- The results will supplement the database and provide for a higher quality of site characterization.

Reference: Tetra Tech, December 2018. Preliminary Sampling Results – Blackjack and Bluebird Mines, Oregon.

Table 1. Sample Sites

Sample Type	Site	Site Description	Table
Mine Water	AD-BB	Bluebird Mine	See Table 2
Mine Water	AD-BJLR	Blackjack Mine Lower Adit, Right	See Table 3
Mine Water	AD-BJLL	Blackjack Mine Lower Adit, Left	See Table 4
Mine Water	AD-BJU	Blackjack Mine Upper Adit	See Table 5
Mine Water	AD-BO	Blackjack Mine outfall (not mapped) Located across Clear Creek and Road from mine.	See Table 5
Surface Water	SW108	Clear Creek downstream of	See Table 6
Surface Water	SW100	Clear Creek downstream of	See Table 7
Surface Water	SW09	Clear Creek upstream of	See Table 8
Sediment	SD108	Clear Creek downstream of	See Table 9
Sediment	SD100	Clear Creek downstream of	See Table 10
Sediment	SD09	Clear Creek upstream of	See Table 11

Tables 2 Through 8. Surface and Adit Discharge Water

	Blue Bird AD-BB		Blue Bird AD-BB		Blue Bird AD-BB		Blackjack Lower Adit-Right		Blackjack Lower Adit-Right AD-BJLR		Blackjack Lower Adit-Right		Blackjack Lower Adit-Left AD-BJLL		Blackjack Lower Adit-Left AD-BJLL		Blackjack Lower Adit-Left AD-BJLL		Blackjack Outfall AD-BJO		Blackjack Upper Adit AD-BJU		Blackjack Upper Adit AD-BJU		Blackjack Upper Adit AD-BJU		Clear Creek SW108		Clear Creek SW108		Clear Creek SW108		Clear Creek SW100		Clear Creek SW100		Clear Creek SW100		Clear Creek SW09		Clear Creek SW09		Clear Creek SW09	
	5-22-2018		7-25-2018		11-19-2019		5-22-2018		7-25-2018		11-19-2018		5-22-2018		7-25-2018		11-19-2018		7-25-2018		5-22-2018		7-25-2018		11-19-2018		5/24/2018		7/24/2018		11/17/2018		5/22/2018		7/24/2018		11/18/2018		5/22/2018		7/24/2018		11/18/2018	
Analyte (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	ND *	ND *	0.14 J	ND	ND	ND	ND *	ND *	0.15 J	0.19 J	0.45 J	0.45 J	0.11 J	ND	ND	ND	ND	ND	0.42 J	ND	0.37 J *	0.11 J	2.3	ND	0.45 J	ND	0.14 J	ND	ND	ND	ND	ND	ND *	ND	ND	ND	ND	ND	1.6	ND	ND	ND		
Antimony	ND	ND	ND	0.00082 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00058 J	0.00089 J	ND	0.0010 J	ND	ND	0.00068 J	0.0013 J	ND	ND	ND	0.00057 J	ND	0.00059 J	ND	ND	ND	ND	0.00065 J	ND	0.0011 J	ND		
Arsenic	0.0072	0.0064	0.027	0.0056	0.0094	0.0069	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0029 J	0.0017 J	0.0033 J	0.0020 J	0.015	0.0021 J	0.0026 J	0.0022 J	0.0016 J	0.0015 J	0.0017 J	0.0019 J	0.0015 J	0.0016 J	0.0020 J	0.0017 J	0.0024 J	0.0023 J	0.0020 J	0.0017 J	0.0018 J	0.0017 J	0.0050	0.0024 J	0.0019 J	0.0019 J		
Barium	0.011	0.011	0.0095	0.0094	0.011	0.010	0.032	0.032	0.030	0.028	0.026	0.023	0.027	0.023	0.025	0.026	0.030	0.026	0.031	0.031	0.033	0.027	0.10	0.029	0.033	0.032	0.0080	0.0079	0.015	0.013	0.013	0.012	0.0094	0.0088	0.014	0.015	0.013	0.012	0.0096	0.0072	0.028	0.014	0.013	0.013		
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00053 J	0.00039 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Cadmium	ND	ND	ND	ND	ND	ND	0.00075 J	0.00078 J	0.00072 J	0.00082 J	0.0014 J	0.0012 J	ND	ND	ND	ND	ND	ND	0.00099 J	0.0010 J	0.00094 J	0.00093 J	0.0036	0.0011 J	0.0011 J	0.0011 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Calcium	6.6	6.3	6.6	6.4	6.4	6.5	11	12	11	11	12	11	7.3	7.1	7.9	8.5	7.6	7.7	5.9	6.0	5.5	5.4	6.5	5.8	5.8	5.6	7.5	7.5	14	13	14	14	7.9	7.9	14	14	14	13	8.0	7.0	13	12	15	15		
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0025	ND	ND	ND	0.0010 J	ND	0.0011 J	ND	0.0010 J	ND	0.0011 J	ND	ND	0.0010 J	0.00090 J	0.00091 J	0.00099 J	ND	0.0065	ND	0.0010 J	ND		
Cobalt	0.036	0.036	0.036	0.034	0.035	0.036	0.066	0.067	0.060	0.064	0.079	0.074	0.013	0.011	0.012	0.013	0.012	0.012	0.029	0.030	0.029	0.026	0.090	0.030	0.031	0.029	0.00025 J	ND	0.00021 J	ND	ND	ND	0.00020 J	ND	ND	ND	ND	ND	0.0019 J	ND	ND	ND		
Copper	0.0042 J	0.0036 J	0.0065 J	ND	0.0030 J	ND	0.043	0.046	0.060	0.079	0.21	0.20	0.0047 J	ND	ND	ND	ND	ND	0.070	0.043	0.076	0.039	0.39	0.042	0.080	0.049	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Iron	21	20	55 F1	20	23	20	2.6	2.5	3.0	1.8	2.6	1.1	40	12	15	15	14	12	11	8.5	12	9.3	72	9.6	11	9.2	0.15 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	ND	0.14 J	ND		
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0012 J	0.0015 J	0.0010 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0015 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Magnesium	15	14	14	14	14	14	33	33	30	31	32	30	14	14	15	17	14	14	8.2	8.2	7.4	6.9	7.8	7.5	7.7	7.4	4.4	4.3	8.6	8.0	9.1	9.2	5.1	5.0	8.1	8.1	8.7	8.3	5.0	4.2	8.7	7.6	9.2	9.0		
Manganese	7.7	7.7	7.8	7.3	7.4	7.3	6.4	6.5	5.8	6.1	6.8	6.0	2.4	2.2	2.2	2.3	2.2	2.2	2.1	2.2	2.2 F1	2.0	6.0	2.1	2.2	2.1 F1	0.0096 J	0.0061 J	0.074	0.064	0.13	0.12	0.015	0.0066 J	0.0069 J	0.0086 J	0.016	0.0085 J	0.0063 J	ND	0.13	0.025	0.010	0.0039 J		
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00037	ND	ND	ND	0.00037	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Nickel	0.099	0.10	0.10	0.095	0.10	0.10	0.28	0.29	0.26	0.28	0.33	0.31	0.054	0.049	0.053	0.054	0.051	0.051	0.073	0.074	0.073	0.066	0.21	0.073	0.077	0.072	0.0023 J	0.0018 J	0.0036 J	0.0028 J	0.0038 J	0.0035 J	0.0029 J	0.0021 J	0.00093 J	0.0010 J	0.00070 J	ND	0.0025 J	0.0016 J	0.012 J	0.0010 J	0.0011 J	0.00066 J		
Potassium	1.6 J	1.6 J	1.6 J	1.6 J	1.6 J	1.6 J	1.9 J	1.8 J	1.9 J	2.0 J	1.9 J	1.8 J	1.1 J	1.1 J	1.3 J	1.4 J	1.3 J	1.2 J	1.2 J	1.2 J	1.2 J	1.0 J	1.2 J	1.2 J	1.3 J	1.1 J	0.48 J	0.54 J	1.2 J	1.1 J	0.83 J	0.77 J	0.72 J	0.69 J	1.0 J	1.0 J	0.79 J	0.67 J	0.76 J	0.52 J	1.1 J	0.85 J	0.88 J	0.79 J		
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Sodium	2.9	2.8	2.9	2.9	3.1	2.9	1.9 J	2.0	1.8 J	1.9 J	2.2	1.9 J	2.0	2.4	2.6	3.8	2.9	2.6	3.0	3.0	2.8	2.3	3.0	2.9	3.4	2.9	1.6 J	1.2 J	2.9	2.6	3.0	2.9	1.8 J	1.8 J	2.5	2.5	2.7	2.5	1.9 J	1.4 J	2.6	2.4	2.7	2.6		
Thallium	ND	ND	0.00052 J	0.00062 J	0.00042 J	ND	0.00035 J	0.00039 J	0.00067 J	0.00084 J	0.0010 J	0.00074 J	ND	ND	0.00033 J	ND	ND	ND	0.00053 J	0.00054 J	ND	ND	0.0019 J	0.00064 J	0.00050 J	0.00034 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0051 J	ND	ND	ND		
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.014 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Zinc	0.12	0.11	0.12	0.099	0.11	0.11	0.58	0.60	0.53	0.60	0.77	0.71	0.13	0.095	0.12	0.12	0.12	0.11	0.10	0.11	0.10	0.095	0.30	0.10	0.11	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Alkalinity	5.5	--	14	--	13	--	ND	--	ND	--	ND	--	24	--	26	--	25	--	12	--	9.4	--	14	--	12	--	39	--	60	--	57	--	38	--	67	--	64	--	38	--	65	--	76	--		
Hardness as CaCO3	110	--	75	--	73	--	150	--	150	--	160	--	110	--	82	--	75	--	49	--	55	--	49	--	46	--	36	36	70	65	72	73	36	36	67	68	70	67	36	36	67	60	75	73		
Total Suspended	14 H	--	25	--	28	--	4.2 H	--	2.6	--	6.2	--	120 H	--	11	--	14	--	13	--	20 H	--	70	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Field Parameters																																														
Temp (C)	12.2	--	13.3	--	8.2	--	8.0	--	8.0	--	2.6	--	8.7	--	10.8	--	6.5	--	9.9	--	10.1	--	10.8	--	8.9	--	6.1	--	14.4	--	3.4	--	9.9	--	14.4	--	0.2	--	9.5	--	16.6	--	0.9	--		
pH	5.1	--	5.6	--	5.1	--	3.5	--	3.6	--	3.7	--	6.3	--	7	--	6.9	--	6.2	--	5.7	--	5.6	--	6.3	--	7.3	--	7.1	--	8.1	--	7.1	--	7.1	--	7.2	--	7.7	--	7.8	--	7.6	--		
ORP (mV)	203	--	111	--	410	--	332	--	413	--	515	--	80	--	0	--	239	--	111	--	110	--	126	--	306	--	137	--	32	--	178	--	86	--	32	--	82	--	75	--	88	--	68	--		
Cond. (mS/cm)	0.195	--	0.21	--	0.23	--	--	--	0.3	--	0.8	--	0.2	--	0.2	--	0.2	--	0.125	--	0.135	--	0.12	--	0.14	--	0.070	--	.117	--	0.14	--	0.069	--	.117	--	0.13	--	0.068	--	0.11	--	0.13	--		
Turbidity (NTU)	687	--	111	--	264	--	7.2	--	25.7	--	0.35	--	244	--	2.3	--	1.1	--	6.0	--	0	--	3.6	--	2.3	--	0	--	0	--	0.2	--	0	--	0	--	0.2	--	0	--	0	--	0.2	--		
Diss. Oxygen (mg/L)	2.5	--	3.89	--	1.5	--	3.9	--	2	--	1	--	6.5	--	4.3	--	3.9	--	7.9	--	10.8	--	3.8	--	3.1	--	9.9	--	7.9	--	9.3	--	10.9	--	7.9	--	8.3	--	10.5	--	7.4	--	5.8	--		
Fe2+ (mg/L)	3.09	--	--	--	--	--	1.66	--	--	--	0.26	--	1.97	--	--	--	--	--	--	--	2.64	--	--	--	2.85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		

* = LCS or LCSD is outside acceptance limits. Data not affected; H = Sample was prepped or analyzed beyond the specified holding time; J = Result is less than the reporting limit but greater than or equal to the method detection limit; concentration is an approximate value; ND = Not Detected at the method detection limit; F1 = MS and/or MSD Recovery is outside acceptance limits.

Tables 9 and 10. Stream Sediment Samples

		Clear Creek SD108			Clear Creek SD100			Clear Creek SD09		
Analyte	**Unit**	**05-24-28**	**07-24-18**	**11-17-18**	**5-22-18**	**7-24-18**	**11-18-18**	**05-22-18**	**07-24-18**	**11-18-18**
Aluminum	mg/Kg	17000 B	8000	10000	8100 B	8200	12000	7600 B	11000	10000
Antimony	mg/Kg	3.1	1.1	1.6	2.0	1.5	1.7	3.3	1.1	1.0
Arsenic	mg/Kg	42	23	28	29	32	23	18	19	20 F1
Barium	mg/Kg	150	81	110	46	66	220	47	63	55
Beryllium	mg/Kg	0.47	0.23	0.32	0.28	0.23	0.29	0.21	0.22	0.28
Cadmium	mg/Kg	0.63	0.45	0.45	0.22 J	0.26 J	0.27 J	0.23 J	0.21 J	0.23 J
Calcium	mg/Kg	4100 B	2200 F1	2700	1800 B	1800	2400	1600 B	2300	1800 F1
Chromium	mg/Kg	120	56 F1 F2	92	93	120	140	110	110	130 F1 F2
Cobalt	mg/Kg	29	18	25	17	19	22	15	22	18
Copper	mg/Kg	44	40 F1 B	34	24	33 B	33	21	29 B	25 F1
Iron	mg/Kg	33000	20000	24000	22000	34000	33000	19000	32000	29000
Lead	mg/Kg	5.7	3.2	3.7	3.5	13	3.0	2.6	3.7	2.8
Magnesium	mg/Kg	11000 B	6300 F2	8900	11000 B	9400	16000	8400 B	12000	11000
Manganese	mg/Kg	1700	1300 B	2200	500	600 B	2300	490	570 B	660
Mercury	mg/Kg	0.10	0.036	0.049	0.016 J	0.043	ND	0.015 J	0.015 J	ND F1
Nickel	mg/Kg	170	99 F1	160	120	130	160	120	130	110 F1
Potassium	mg/Kg	820	490	620	390	350	570	390	350	380
Selenium	mg/Kg	1.5	2.0	2.8	0.45 J	2.3	2.4	0.60 J	1.9	2.1
Silver	mg/Kg	0.70	0.20	0.25	0.14 J	0.36	0.26	0.26	0.14 J	0.10 J
Sodium	mg/Kg	170	98	130	120	100	160	110	130	98
Thallium	mg/Kg	0.24 J	0.21 J	0.14 J	0.088 J	0.077 J	0.083 J	0.076 J	0.054 J	0.13 J
Vanadium	mg/Kg	61	32 F1	44	44	45	51	37	66	44 F1 F2
Zinc	mg/Kg	110	69	100	42	67	65	36	43	46 F1
Physical Parameters										
Percent Moisture	%	48.5	27.6	30.6	18.1	22.5	27.2	20.6	19.4	17.5
Percent Solids	%	51.5	72.4	69.4	81.9	77.5	72.8	79.4	80.6	82.5
Clay	%	5.1	--	--	0.5	--	--	0.6	--	--
Silt	%	20.9	--	--	0.9	--	--	3.4	--	--
Sand	%	63.4	--	--	55.6	--	--	61.4	--	--
Gravel	%	10.6	--	--	43.0	--	--	34.6	--	--

B Compound was found in the blank and sample.

F1 MS and/or MSD Recovery is outside acceptance limits.

F2 MS/MSD RPD exceeds control limits

J Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Reference: Ecology and Environment, June 2017. Mining District Site Recon and Prioritization, Granite Creek Watershed, Oregon.

Table 2-1. Historical Water Quality Sample Results in Clear Creek*

Parameter	Date Collected	Historical Station Numbers: Beaver Creek above Olive Creek (background/ reference location)	2 Blackjack Mine Adit	3 Adit Water from Base of Blackjack Mine Spoils	4 Clear Creek 800 feet Downstream of Blackjack Mine Spoils	5 Mouth of Congo Gulch (downstream of Red Boy Mine)	6 Bluebird Mine Adit	7 Clear Creek Downstream of All Mines	Historical Water Quality Standards
pH	4/8/1980	7.50	3.90	4.00	7.20	6.80	6.50	--	6.5-8.5[1]
	9/5/1980	7.30	3.00	3.00	7.00	6.10	3.90	7.40	
Total Copper (mg/L)	4/8/1980	0.02	0.79	0.80	0.03	0.02	0.02	--	0.012 mg/L[2]
	9/5/1980	0.01	0.70	0.67	0.04	0.02	0.02	0.02	
Zinc (mg/L)	4/8/1980	0.04	0.57	0.54	0.04	0.06	0.31	--	0.110 mg/L[2,3]
	9/5/1980	0.04	0.66	0.68	0.04	0.12	0.30	0.07	
Total Iron (mg/L)	4/8/1980	0.36	19.00	28.00	0.55	5.40	10.00	--	1.0 mg/L[2]
	9/5/1980	0.36	23.00	24.00	0.55	19.00	12.00	1.00	
Manganese (mg/L)	4/8/1980	0.01	2.90	3.30	0.04	2.20	4.30	--	NS
	9/5/1980	0.11	3.20	3.40	0.12	5.00	4.70	0.12	
Arsenic (mg/L)	4/8/1980	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	NS
	9/5/1980	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Hexavalent Chromium (mg/L)	4/8/1980	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	0.011 mg/L[2]
	9/5/1980	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Lead (mg/L)	4/8/1980	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	0.0032 mg/L[2,3]
	9/5/1980	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Mercury (mg/L)	4/8/1980	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	0.000012 mg/L[2]
	9/5/1980	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Specific Conductance (Micro Mho/cm)	4/8/1980	88	300	310	85	190	150	--	NS
	9/5/1980	130	470	470	130	390	200	145	

Source: Weston 1996.

[1] State of Oregon water quality standards (ORS 340, Division 41).

[2] Freshwater chronic criteria for the protection of aquatic life (ORS 340, Division 41).

[3] Hardness dependent criteria (100 mg/L used).

* Data were taken from *Analysis of Water Discharge from Inactive Mines into Clear Creek,* Felix Ernesto. Prepared for the USDA Forest Service, Region 6, 1980.

mg/L = milligrams per liter

NS = No standards exist

Table 3-1. Sample Collection and Analysis Summary

EPA Number	CLP Number	Station Location	Sample Date	Sample Time	Sampler	Matrix	Depth (inches bgs)	TAL Metals	Hardness	Grain Size	SPLP	Location
Bluebird, Red Boy, and Blackjack Mines												
16434260	MJHSB0	SW01-T	10/25/2016	10:39	G. Aitken	SW-T	-	X	X	-	-	Clear Creek downstream of Red Boy/Bluebird Mines settling ponds.
16434313	MJHSG3	SW01-D	10/25/2016	10:39	G. Aitken	SW-D	-	X	X	-	-	Clear Creek downstream of Red Boy/Bluebird Mines settling ponds.
16434200	MJHR50	SD01	10/25/2016	10:45	G. Aitken	SD	0-6	X	-	-	-	Clear Creek downstream of Red Boy/Bluebird Mines settling ponds.
16434261	MJHSB1	SW02-T	10/25/2016	12:00	G. Aitken	SW-T	-	X	X	-	-	Clear Creek near the most downstream Red Boy/Bluebird Mine settling pond.
16434314	MJHSG4	SW02-D	10/25/2016	12:00	J. Fetters	SW-D	-	X	X	-	-	Clear Creek near the most downstream Red Boy/Bluebird Mine settling pond.
16434201	MJHR51	SD02	10/25/2016	12:10	G. Aitken	SD	0-6	X	-	-	-	Clear Creek near the most downstream Red Boy/Bluebird Mine settling pond.
16434262	MJHSB2	SW03-T	10/25/2016	12:30	G. Aitken	SW-T	-	X	X	-	-	Clear Creek.
16434315	MJHSG5	SW03-D	10/25/2016	12:30	J. Fetters	SW-D	-	X	X	-	-	Clear Creek.
16434202	MJHR52	SD03	10/25/2016	12:40	G. Aitken	SD	0-6	X	-	-	-	Clear Creek.
16434263	MJHSB3	SW04-T	10/25/2016	12:52	G. Aitken	SW-T	-	X	X	-	-	Clear Creek.
16434316	MJHSG6	SW04-D	10/25/2016	12:52	J. Fetters	SW-D	-	X	X	-	-	Clear Creek.
16434203	MJHR53	SD04	10/25/2016	13:00	G. Aitken	SD	0-6	X	-	-	-	Clear Creek.
16434264	MJHSB4	SW05-T	10/25/2016	14:06	J. Fetters	SW-T	-	X	X	-	-	Clear Creek.
16434317	MJHSG7	SW05-D	10/25/2016	14:06	J. Fetters	SW-D	-	X	X	-	-	Clear Creek.
16434204	MJHR54	SD05	10/25/2016	14:12	G. Aitken	SD	0-6	X	-	-	-	Clear Creek.
16434265	MJHSB5	SW06-T	10/25/2016	14:36	G. Aitken	SW-T	-	X	X	-	-	Clear Creek.
16434318	MJHSG8	SW06-D	10/25/2016	14:36	G. Aitken	SW-D	-	X	X	-	-	Clear Creek.
16434205	MJHR55	SD06	10/25/2016	14:40	G. Aitken	SD	0-6	X	-	-	-	Clear Creek.
16434266	MJHSB6	SW07-T	10/25/2016	15:11	J. Fetters	SW-T	-	X	X	-	-	Clear Creek.
16434319	MJHSG9	SW07-D	10/25/2016	15:11	J. Fetters	SW-D	-	X	X	-	-	Clear Creek.
16434206	MJHR56	SD07	10/25/2016	15:19	G. Aitken	SD	0-6	X	-	-	-	Clear Creek.
16434267	MJHSB7	SW08-T	10/25/2016	15:35	G. Aitken	SW-T	-	X	X	-	-	Clear Creek.
16434320	MJHSH0	SW08-D	10/25/2016	15:35	G. Aitken	SW-D	-	X	X	-	-	Clear Creek.
16434207	MJHR57	SD08	10/25/2016	15:40	G. Aitken	SD	0-6	X	-	-	-	Clear Creek.
16434268	MJHSB8	SW09-T	10/25/2016	15:10	J. Heyl	SW-T	-	X	X	-	-	Background/reference sample upstream of Blackjack, Red Boy, and Bluebird Mines on Clear Creek.
16434321	MJHSH1	SW09-D	10/25/2016	15:10	J. Heyl	SW-D	-	X	X	-	-	Bluebird Mines on Clear Creek.
16434208	MJHR58	SD09	10/25/2016	15:18	J. Heyl	SD	0-6	X	-	-	-	Background/reference sample upstream of Blackjack, Red Boy, and Bluebird Mines on Clear Creek.
16434269	MJHSB9	SW10-T	10/25/2016	11:33	J. Heyl	SW-T	-	X	X	-	-	Red Boy/Bluebird Mines settling pond.
16434322	MJHSH2	SW10-D	10/25/2016	11:33	J. Heyl	SW-D	-	X	X	-	-	Red Boy/Bluebird Mines settling pond.
16434209	MJHR59	SD10	10/25/2016	11:54	J. Heyl	SD	0-6	X	-	-	-	Red Boy/Bluebird Mines settling pond.
16434270	MJHSC0	SW11-T	10/25/2016	12:16	J. Heyl	SW-T	-	X	X	-	-	Red Boy/Bluebird Mines settling pond.
16434323	MJHSH3	SW11-D	10/25/2016	12:16	J. Heyl	SW-D	-	X	X	-	-	Red Boy/Bluebird Mines settling pond.
16434210	MJHR60	SD11	10/25/2016	12:24	J. Heyl	SD	0-6	X	-	-	-	Red Boy/Bluebird Mines settling pond.
16434271	MJHSC1	SW12-T	10/25/2016	12:42	J. Heyl	SW-T	-	X	X	-	-	Red Boy/Bluebird Mines settling pond.
16434324	MJHSH4	SW12-D	10/25/2016	12:42	J. Heyl	SW-D	-	X	X	-	-	Red Boy/Bluebird Mines settling pond.
16434211	MJHR61	SD12	10/25/2016	12:48	J. Heyl	SD	0-6	X	-	-	-	Red Boy/Bluebird Mines settling pond.
16434272	MJHSC2	SW13-T	10/25/2016	13:57	J. Heyl	SW-T	-	X	X	-	-	Clear Creek slough.
16434325	MJHSH5	SW13-D	10/25/2016	13:57	J. Heyl	SW-D	-	X	X	-	-	Clear Creek slough.
16434212	MJHR62	SD13	10/25/2016	14:15	J. Heyl	SD	0-6	X	-	-	-	Clear Creek slough.
16434273	MJHSC3	SW14-T	10/25/2016	14:44	J. Heyl	SW-T	-	X	X	-	-	Blackjack Mine settling pond. MS/Dup.
16434326	MJHSH6	SW14-D	10/25/2016	14:44	J. Heyl	SW-D	-	X	X	-	-	Blackjack Mine settling pond. MS/Dup.
16434213	MJHR63	SD14	10/25/2016	14:53	J. Heyl	SD	0-6	X	-	-	-	Blackjack Mine settling pond. MS/Dup.
16434274	MJHSC4	SW15-T	10/25/2016	16:04	J. Heyl	SW-T	-	X	X	-	-	Background/reference sample upstream of Red Boy Mine on Congo Gulch.
16434327	MJHSH7	SW15-D	10/25/2016	16:04	J. Heyl	SW-D	-	X	X	-	-	Background/reference sample upstream of Red Boy Mine on Congo Gulch.
16434214	MJHR64	SD15	10/25/2016	16:13	J. Heyl	SD	0-6	X	-	-	-	Background/reference sample upstream of Red Boy Mine on Congo Gulch.

Table 3-2. Sample Coding

SAMPLE NUMBER [1]		
Digits	**Description**	**Code (Example)**
1,2,3,4	Year and Month Code	1610 (YYMM)
5,6,7,8	Consecutive Sample Number	0001 (First sample of month)
SAMPLE NAME / LOCATION ID [2]		
Digits	**Description**	**Code (Example)**
1.2	Sampling Area	SD – Sediment SW – Surface Water TP – Tailings Pile
3.4	Consecutive Sample Number	01 – First Sample of Sampling Area
5.6	Analysis Code	D – Dissolved Metals T – Total Metals

1 = The Sample Number is a unique, 8-digit number assigned to each sample by the EPA Regional Sample Control Coordinator.
2 = The Sample Name or Location ID is used to further describe each sample or sample location.
EPA = United States Environmental Protection Agency.
ID = Identification.

Table 3-3. Water Quality Results

Location	Odor	Color	Temperature (Co)	pH	Dissolved Oxygen (mg/L)	Conductivity (S/m)	Turbidity (NTU)	Oxidation Reduction Potential
Bluebird, Red Boy, and Blackjack Mines								
SW01	None	Clear	NR	5.68	NR	0.224	NR	NR
SW02	None	Clear	8.29	7.73	42.36	0.144	2.4	198
SW03	None	Clear	8.59	7.92	10.4	0.142	5.7	172
SW04	None	Clear	8.89	8.02	36.06	0.142	4.7	145
SW05	None	Clear	8.23	8.21	11.18	0.137	24.7	146
SW06	None	Clear	8.2	8.17	12.79	0.137	2.1	149
SW07	None	Clear	8.16	8.25	10.29	0.136	3.6	143
SW08	None	Clear	8.1	8.21	0.86	0.135	5.2	140
SW09	None	Clear	8.25	7.75	12.84	0.138	1.2	55
SW10	None	Clear	9.56	3.32	11.07	0.417	6.9	395
SW11	None	Clear	10.4	4.24	8.3	0.397	10.2	262
SW12	Metallic	Clear	11.03	5.55	12.24	0.282	40.2	73
SW13	Biogenic	Clear	10.31	6.59	8.6	0.142	24.9	-11
SW14	None	Clear	10.3	5.77	9.9	0.157	18.5	120
SW15	None	Clear	8.3	8	12.4	0.179	73	89

Co = Degrees Celsius.
mg/L = milligrams per liter.
NR = Not recorded.
NTU = Nephelometric turbidity unit.
S/m = Siemens per meter.

Table 5-1. Criteria Values

TAL Metals	CAS Number	EPA WQC Fresh Water CCC (Chronic) (µg/L)	EPA WQC Fresh Water CMC (Acute) (µg/L)	NOAA Fresh Water Sediment TEL (mg/kg)	NOAA Fresh Water Sediment PEL (mg/kg)	ODEQ 90th Percentile Background Soil Concentrations for Blue Mountains Area (mg/kg)
Aluminum [a]	7429-90-5	87	750	N/A	N/A	N/A
Antimony	7440-36-0	N/A	N/A	N/A	N/A	N/A
Arsenic	7440-38-2	150	340	5.9	17	11.69
Barium	7440-39-3	N/A	N/A	N/A	N/A	864.5
Beryllium	7440-41-7	N/A	N/A	N/A	N/A	2.321
Cadmium	7440-43-9	0.72	1.8	0.596	3.53	0.563
Chromium, Total	7440-47-3	11 [b]	16 [b]	37.3	90	140
Cobalt	7440-48-4	N/A	N/A	N/A	N/A	N/A
Copper	7440-50-8	N/A	N/A	35.7	197	88.2
Iron	7439-89-6	1,000	N/A	N/A	N/A	N/A
Lead	7439-92-1	2.5	65	35	91.3	15.76
Manganese	7439-96-5	N/A	N/A	N/A	N/A	1510
Mercury, Total	7487-94-7	0.77 [c]	1.4 [c]	0.174	0.486	1.13
Nickel	7440-02-0	52	470	18	36	64.75
Selenium	7782-49-2	N/A	N/A	N/A	N/A	0.765
Silver	7440-22-4	N/A	3.2	N/A	N/A	0.657
Thallium	7440-28-0	N/A	N/A	N/A	N/A	2.299
Vanadium	7440-62-2	N/A	N/A	N/A	N/A	358
Zinc	7440-66-6	120	120	123	315	146.3

a - pH between 6.5 and 9.0.
b - Value provided is for chromium VI.
c - Value provided is for methylmercury.
µg/L = micrograms per liter.
CCC = Criterion Continuous Concentration.
CLP = Contract Laboratory Program.
CMC = Criterion Maximum Concentration.
CRQL = Contract Required Quantitation Limit.
EPA = United States Environmental Protection Agency.
mg/kg = Milligrams per kilogram.
N/A = None Available.
NOAA = National Oceanic and Atmospheric Administration.
ODEQ = Oregon Department of Environmental Quality.
PEL = Probable Effects Level.
SQuiRT = Screening Quick Reference Tables.
TAL = Target Analyte List.
TEL = Threshold Effects Level.
WQC = Water Quality Criteria.

Table 7-1. Contaminated Mines Surface Water Sample Results

EPA Sample ID	16434262	16434315	16434263	16434316	16434264	16434317	16434265	16434318	16434266	16434319	16434267	16434320	16434272	16434325	16434273	16434326	16434274	16434327	16434269	16434322	16434270	16434323	16434271	16434324
Station Location ID	SW03-T	SW03-D	SW04-T	SW04-D	SW05-T	SW05-D	SW06-T	SW06-D	SW07-T	SW07-D	SW08-T	SW08-D	SW13-T	SW13-D	SW14-T	SW14-D	SW15-T	SW15-D	SW10-T	SW10-D	SW11-T	SW11-D	SW12-T	SW12-D
Matrix	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Mine Name	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, Blackjack Mine, Cougar, and Buffalo Mines	Bluebird, Red Boy, Blackjack Mine, Cougar, and Buffalo Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines	Bluebird, Red Boy, and Blackjack Mines
Location Description	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek	Clear Creek Slough	Clear Creek Slough	Blackjack Mine Settling Pond	Blackjack Mine Settling Pond	Background/Ref erence (Congo Gulch)	Background/Ref erence (Congo Gulch)	Red Boy/Bluebird Settling Pond	Red Boy/Bluebird Settling Pond	Red Boy/Bluebird Settling Pond	Red Boy/Bluebird Settling Pond	Red Boy/Bluebird Settling Pond	Red Boy/Bluebird Settling Pond
TAL Metals (µg/L)																								
Aluminum	30.5 JQ	200 U	29.6 JQ	8.3 JQ	131 JQ	200 U	25 JQ	200 U	44.6 JQ	200 U	23.8 JQ	200 U	21.8 JQ	200 U	420	18 JQ	111 JQ	200 U	466	471	521	441	38.3 JQ	13.4 JQ
Antimony	60 U	60 U	60 U	60 U	60 U	60 U	3 JQ	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U
Arsenic	10 U	10 UJL	10 U	10 UJL	10 U	10 UJL	10 U	10 UJL	10 U	10 UJL	10 U	10 UJL	10 U	10 U	9.5 JQ	10 U	10 U	10 U	10 U	10 UJL	10 U	10 UJL	10 U	10 UJL
Barium	13.6 JQ	12.6 JQ	13.3 JQ	12.5 JQ	15.6 JQ	12.7 JQ	13.1 JQ	13.1 JQ	13.7 JQ	13.3 JQ	12.8 JQ	12.9 JQ	10.2 JQ	11.5 JQ	31.7 JQ	32.1 JQ	27.8 JQ (200 ACRQL)	25 JQ (200 ACRQL)	13.9 JQ	14.6 JQ	14.1 JQ	14.5 JQ	10.6 JQ	10.2 JQ
Beryllium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.21 JQ	0.21 JQ	5 U	0.21 JQ	0.27 JQ (5 ACRQL)	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Cadmium	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.86 (CCC = 0.37, CMC = 0.78)	0.77 (CCC = 0.37 CMC = 0.78)	0.5 U	0.5 U	0.16 JQ	0.12 JQ	0.2 JQ	0.17 JQ	0.5 U	0.5 U
Calcium	12700	12900	12800	12900	12400	12500	12400	12500	12400	12600	12100	12400	11800	11800	5220	5240	18000	18800	13900	14800	16500	15800	6620	6250
Chromium	0.67 JQ	10 U	10 U	10 U	1.4 JQ	10 U	10 U	10 U	0.82 JQ	10 U	0.97 JQ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.4 JQ	10 U	10 U	10 U	10 U	10 U
Cobalt	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	26.8 JQ	26.9 JQ	50 U	50 U	42.4 JQ	43.5 JQ	45.8 JQ	45.9 JQ	33.9 JQ	32.5 JQ
Copper	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	80 (CCC = 4.2 CMC = 5.8)	48.8 (CCC = 4.2 CMC = 5.8)	25 U	25 U	4.3 JQ	5.5 JQ	4.3 JQ	5.3 JQ	25 U	25 U
Iron	52.7 JQ	100 U	28.9 JQ	100 U	242	100 U	35.5 JQ	100 U	70.4 JQ	100 U	40.8 JQ	100 U	152	191	10600	8030	297	100 U	6130	6080	12100	11000	22700	19100
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.18 JQ (3 ACRQL)	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Magnesium	7700	7780	7800	7810	7380	7480	7330	7430	7320	7430	7180	7410	6980	7000	6810	6770	6060	6360	19100	20600	21900	21400	13900	13200
Manganese	113	108	118	123	67.8	21.9	6.7 JQ	4.6 JQ	10.5 JQ	2.2 JQ	4.9 JQ	4.3 JQ	393	587	2180	2180	62.6	4.5 JQ (15 ACRQL)	8100	9150	9180	9020	8580	8170
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	4.1 JQ	2.9 JQ	4.1 JQ	3.6 JQ	2.8 JQ	1.7 JQ	1.6 JQ	40 U	2 JQ	40 U	1.6 JQ	40 U	40 U	40 U	70.3 (CCC = 25 CMC = 221)	70.2 (CCC = 24 CMC = 220)	40 U	40 U	128 (CCC = 58 CMC = 519)	133 (CCC = 62 CMC = 554)	140 (CCC = 65 CMC = 588)	141 (CCC = 64 CMC = 577)	100 (CCC = 40 CMC = 362)	98.1 (CCC = 38 CMC = 346)
Potassium	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U
Selenium	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U
Silver	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Sodium	2380 JQ	2420 JQ	2490 JQ	2500 JQ	2350 JQ	2380 JQ	2390 JQ	2340 JQ	2340 JQ	2300 JQ	2150 JQ	2120 JQ	2500 JQ	2390 JQ	2590 JQ	2540 JQ	4830 JQ	5230	3660 JQ	3780 JQ	3980 JQ	3800 JQ	2740 JQ	2660 JQ
Thallium	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	4 JQ	25 U	3.5 JQ(10 ACRQL)	25 U	25 U	25 U	25 U	25 U	25 U
Vanadium	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Zinc	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	100 (CCC = 56 CMC = 55)	102 (CCC = 56 CMC = 55)	60 U	60 U	168 (CCC = 131 CMC = 130)	160 (CCC = 140 CMC = 139)	179 (CCC = 149 CMC = 147)	168 (CCC = 146 CMC = 144)	107 (CCC = 91 CMC = 91)	106 (CCC = 87 CMC = 87)
Hardness (mg/L)																								
Hardness (total)	63.4	64.2	64.1	64.4	61.4	62	61.1	61.8	61.1	62.1	59.8	61.5	58.2	58.3	41.1	41		73.1	113	122	131	128	73.8	70

Bold type indicates the sample result is above the contract required quantitation limit.
Underline type indicates the sample result is elevated as defined in Section 5.
Shaded type indicates the sample result exceeds the EPA Water Quality Criteria Fresh Water hardness-dependent CCC value (Chronic).
Red type indicates the sample result exceeds the EPA Water Quality Criteria Fresh Water hardness-dependent CMC value (Acute).
ACRQL = Adjusted Contract Required Quantitation Limit.
CCC = Criterion Continuous Concentration (Chronic).
CMC = Criterion Maximum Concentration (Acute).
EPA = United States Environmental Protection Agency.
ID = Identification.
J = The associated value is an estimated quantity.
L = The sample result is biased low.
mg/L = Milligrams per liter.
PPE = Probable Point of Entry.
Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
R = The data are rejected and unusable. The analyte may or may not be present in the sample.
TAL = Target Analyte List.
U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
ug/L = Micrograms per liter.

Table 7-2. Contaminated Mines Sediment Sample Results

EPA Sample ID			16434208	16434200	16434201	16434202	16434203	16434204	16434205	16434206	16434207	16434212	16434213	16434214	16434209	16434210	16434211
Station Location ID			SD09	SD01	SD02	SD03	SD04	SD05	SD06	SD07	SD08	SD13	SD14	SD15	SD10	SD11	SD12
Depth			0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches	0 to 6 inches
Location Description	NOAA Fresh Water SQuiRT Sediment TEL	NOAA Fresh Water SQuiRT Sediment PEL	Bluebird, Red Boy, and Blackjack Mines Background/ Reference Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek Downstream of Red Boy and Bluebird Settling Ponds	Bluebird, Red Boy, and Blackjack Mines Clear Creek Near the Most Downstream Red Boy/Bluebird Mines Settling Pond	Bluebird, Red Boy, and Blackjack Mines Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek	Bluebird, Red Boy, and Blackjack Mines Clear Creek Slough	Bluebird, Red Boy, and Blackjack Mines Settling Pond	Boy, Blackjack Mine, Cougar, and Buffalo Mines Background/ Reference (Congo Gulch)	Bluebird, Red Boy, and Blackjack Mines Settling Pond	Bluebird, Red Boy, and Blackjack Mines Settling Pond	Bluebird, Red Boy, and Blackjack Mines Red Boy/Bluebird Settling Pond
TAL Metals (mg/kg)																	
Aluminum	N/A	N/A	8880 JL	5330 JL	7960 JL	8330 JL	15900 JL	7300 JL	8920 JL	8610 JL	8600 JL	19800 JL	8800 JL	5310 JL	1580 JL	1200 JL	1210 JL
Antimony	N/A	N/A	0.86 JQ (5.4 ACRQL)	0.83 JQ	0.73 JQ	0.93 JQ	1.5 JQ	0.87 JQ	0.88 JQ	0.99 JQ	0.6 JQ	1.6 JQ	7.8	0.38 JQ (5.3 ACRQL)	14.8	11.1	11.9
Arsenic	5.9	17	24.7	14.7	12.7	30.5	24.7	8.3	21.7	23.8	32.9	58	88.8	4.2	69.7	112	249
Barium	N/A	N/A	51.6	79.1	74.1	80.4	152	47	68.6	58.8	54.7	301	19.5	114	5.2 JQ	4.2 JQ	7.9 JQ
Beryllium	N/A	N/A	0.49 JL	0.33 JQ	0.41 JQ	0.5 JL	0.82 JQ	0.42 JQ	0.51 JL	0.47 JL	0.51 JL	0.81 JL	4.4 JL	0.63 JL	6.6 JL	5.4 JL	5.5 JL
Cadmium	0.596	3.53	0.45 JL	0.44 JQ	0.55 JL	0.69 JL	1.2 JL	0.33 JQ	0.48 JL	0.43 JL	0.48 JL	3.7 JL	40.6 JL	0.7 JL	12.3 JL	18.5 JL	20.3 JL
Calcium	N/A	N/A	1830	1230	1840	1910	5560	1390	1810	1830	1600	3680	7610 U	1870	9150 U	3840 U	3840 U
Chromium	37.3	90	135 JL	45.9 JL	35.9 JL	143 JL	118 JL	44 JL	89.2 JL	73.8 JL	212 JL	84.1 JL	R	8.7 JL	R	R	R
Cobalt	N/A	N/A	19.4 JH	14 JH	17.7 JH	25.1 JH	36.8 JH	17 JH	24 JH	17.1 JH	19.1 JH	57.6 JH	21.6 JH	11.2 JH	11.1 JH	10.5 JH	12.2 JH
Copper	35.7	197	32	27.7	34.2	31.7	58.2	24.8	28.8	28.4	29.1	156	2050	37.1	102	18.4	40.9
Iron	N/A	N/A	26100 JH	18100 JH	22000 JH	27100 JH	27500 JH	21000 JH	25600 JH	23200 JH	25900 JH	43400 JH	783000 JH	17500 JH	743000 JH	565000 JH	595000 JH
Lead	35	91.3	2.7 JH	2.2 JH	2.5 JH	3 JH	6.9 JH	2.8 JH	2.8 JH	2.7 JH	2.4 JH	7.8 JH	42.7 JH	9.2 JH	6 JH	15.9 JH	18.1 JH
Magnesium	N/A	N/A	12900	5200	5050	14800	9670	5510	9430	8850	13400	8120	381 U	1340	63.5 JQ	57.2 JQ	182 JQ
Manganese	N/A	N/A	569 JL	1560 JL	1480 JL	1520 JL	1590 JL	638 JL	786 JL	659 JL	649 JL	4970 JL	96.3 JL	1390 JL	580 JL	276 JL	294 JL
Mercury	0.174	0.486	.018 JQ (0.11 ACRQL)	0.026 JQ	0.042 JQ	0.039 JQ	0.14 JQ	0.021 JQ	0.025 JQ	0.015 JQ	0.12 U	0.26	0.59	0.13	0.098 JQ	0.034 JQ	0.015 JQ
Nickel	18	36	131 JH	93.2 JH	106 JH	187 JH	246 JH	80.4 JH	122 JH	113 JH	169 JH	309 JH	19.2 JH	52.6 JH	7.8 JH	3 JQ	6.4 JH
Potassium	N/A	N/A	279 JQ	289 JQ	340 JQ	359 JQ	526 JQ	432	389 JQ	267 JQ	232 JQ	1290	381 U	438 JQ	915 U	11 JQ	24.7 JQ
Selenium	N/A	N/A	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Silver	N/A	N/A	1.1 JL	0.73 JQ	0.83 JQ	1.2 JL	1.6 JQ	0.92 JL	1.1 JL	0.97 JL	1 JL	R	R	R	14.1 JL	R	R
Sodium	N/A	N/A	198 JQ	132 JQ	213 JQ	205 JQ	284 JQ	131 JQ	226 JQ	193 JQ	188 JQ	390	2040	136 JQ	2650	2450	2520
Thallium	N/A	N/A	0.97 JQ (2.3 ACRQL)	0.61 JQ	0.69 JQ	0.74 JQ	1.7 JQ	0.98 JQ	0.95 JQ	1.1 JQ	1.2 JQ	1.9 U	1.9 U	2.2 U	1.6 JQ	1.9 U	1.9 U
Vanadium	N/A	N/A	48.5	27	39.3	41.2	54.6	35	42.6	39.6	43.1	63	5	21.2	8.6 JQ	6	9.8
Zinc	123	315	38.7	65.1	62.3	88.6	179	43.7	47.3	45.4	45	289	141	117	125	115	147
Grain Size (percent)																	
Clay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gravel, Fine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gravel, Medium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sand, Coarse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sand, Fine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sand, Medium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sand, Very Coarse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sand, Very Fine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silt	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Solids, Total	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Bold type indicates the sample result is above the contract required quantitation limit.
Underline type indicates the sample result is elevated as defined in Section 5.
Shaded type indicates the sample result exceeds the NOAA Fresh Water SQuiRT Sediment TEL value.
Red type indicates the sample result exceeds the NOAA Fresh Water SQuiRT Sediment PEL value.
-- = no value.
ACRQL = Adjusted Contract Required Quantitation Limit.
EPA = United States Environmental Protection Agency.
H = The sample result is biased high.
ID = Identification.
Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.
R = The data are rejected and unusable. The analyte may or may not be present in the sample.
SQuiRT = Screening Quick Reference Tables.
TAL = Target Analyte List.
TEL = Threshold Effects Level.
U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

Reference: USFS, 2018. TCLP Analyses of Bluebird and Blackjack Ponds Sludge Analyses.

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Laboratory Analysis Report

Sample Number: 1758299

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO1CP3MRNT

Time of Collection: 10:00
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Barium TCLP		0.29	mg/L	0.20	SW 846 6020	12/26/2017	JH
Cadmium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Chromium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Lead TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Mercury TCLP		<0.02	mg/L	0.02	SW 846 7470	12/28/2017	JD
Selenium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Silver TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
TCLP Extraction		*			SW 846 1311	12/22/2017	JD

Email: mrwilcox@fs.fed.us

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

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Laboratory Analysis Report

Sample Number: 1758301

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO1CP3MRNS

Time of Collection: 10:15
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Barium TCLP		0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Cadmium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Chromium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Lead TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Mercury TCLP		<0.02	mg/L	0.02	SW 846 7470	12/28/2017	JD
Selenium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Silver TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
TCLP Extraction		*			SW 846 1311	12/22/2017	JD

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758305

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO4CP3MRNT

Time of Collection: 11:40
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Barium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Cadmium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Chromium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Lead TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Mercury TCLP		<0.02	mg/L	0.02	SW 846 7470	12/28/2017	JD
Selenium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Silver TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
TCLP Extraction		*			SW 846 1311	12/22/2017	JD

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758308

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO5CP3MRWT

Time of Collection: 12:30
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Barium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Cadmium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Chromium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Lead TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Mercury TCLP		<0.02	mg/L	0.02	SW 846 7470	12/28/2017	JD
Selenium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Silver TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
TCLP Extraction		*			SW 846 1311	12/22/2017	JD

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758300

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO1CP3MRNT (CENTRIFUGE LIQUID)

Time of Collection: 10:00
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Aluminum, Al	UR	<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Antimony, Sb		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Arsenic, As		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Barium, Ba	2	<0.25	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Beryllium, Be		<0.025	mg/L	0.025	EPA 200.7	12/19/2017	JMS
Cadmium, Cd		<0.025	mg/L	0.025	EPA 200.7	12/19/2017	JMS
Calcium, Ca	UR	5.8	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Chromium, Cr		<0.25	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Cobalt, Co		<0.10	mg/L	0.10	EPA 200.7	12/19/2017	JMS
Copper, Cu	1.30	<0.05	mg/L	0.05	EPA 200.7	12/19/2017	JMS
Iron, Fe	UR	2.19	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Lead, Pb		<0.25	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Magnesium, Mg	UR	7.6	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Manganese, Mn	UR	0.94	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Mercury, Hg	0.002	<0.0002	mg/L	0.0002	EPA 245.1	12/28/2017	JD
Metals Digestion		*			EPA 200.2	12/18/2017	JH
Nickel, Ni	UR	<0.10	mg/L	0.10	EPA 200.7	12/19/2017	JMS
Potassium, K	UR	<2.5	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Selenium, Se		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Silver, Ag	UR	<0.25	mg/L	0.25	EPA 200.7	12/20/2017	JMS
Sodium, Na	UR	2.5	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Thallium, Tl		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758303

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO2CP3MRWT

Time of Collection: 10:30
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Barium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Cadmium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Chromium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Lead TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Mercury TCLP		<0.02	mg/L	0.02	SW 846 7470	12/28/2017	JD
Selenium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Silver TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
TCLP Extraction		*			SW 846 1311	12/22/2017	JD

Email: mrwilcox@fs.fed.us

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MDL = Method/Minimum Detection Limit
UR = Unregulated

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Laboratory Analysis Report

Sample Number: 1758307

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO4CP3MRNT (CENTRIFUGE LIQUIDS)

Time of Collection: 11:40
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Aluminum, Al	UR	1.35	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Antimony, Sb		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Arsenic, As		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Barium, Ba	2	<0.25	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Beryllium, Be		<0.025	mg/L	0.025	EPA 200.7	12/19/2017	JMS
Cadmium, Cd		<0.025	mg/L	0.025	EPA 200.7	12/19/2017	JMS
Calcium, Ca	UR	25.2	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Chromium, Cr		<0.25	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Cobalt, Co		<0.10	mg/L	0.10	EPA 200.7	12/19/2017	JMS
Copper, Cu	1.30	<0.05	mg/L	0.05	EPA 200.7	12/19/2017	JMS
Iron, Fe	UR	113	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Lead, Pb		<0.25	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Magnesium, Mg	UR	33.9	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Manganese, Mn	UR	11.7	mg/L	0.25	EPA 200.7	12/19/2017	JMS
Mercury, Hg	0.002	<0.0003	mg/L	0.0003	EPA 245.1	12/28/2017	JD
Metals Digestion		*			EPA 200.2	12/18/2017	JH
Nickel, Ni	UR	0.23	mg/L	0.10	EPA 200.7	12/19/2017	JMS
Potassium, K	UR	3.6	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Selenium, Se		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS
Silver, Ag	UR	<0.25	mg/L	0.25	EPA 200.7	12/20/2017	JMS
Sodium, Na	UR	5.5	mg/L	2.5	EPA 200.7	12/21/2017	JMS
Thallium, Tl		<0.50	mg/L	0.50	EPA 200.7	12/19/2017	JMS

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758302

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO1CP3MRNS (SPLP)

Time of Collection: 10:15
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 1/3/2018

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic, As SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Barium, Ba SPLP Extraction	2	<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Cadmium, Cd SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Chromium, Cr SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Lead, Pb SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Mercury, Hg SPLP Extraction	0.002	<0.02	mg/L	0.02	EPA 245.1	12/28/2017	JD
Selenium, Se SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Silver, Ag SPLP Extraction	UR	<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
SPLP Extraction		*			SW 846 1312	12/26/2017	JD

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758300

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO1CP3MRNT (CENTRIFUGE LIQUID)

Time of Collection: 10:00
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Zinc, Zn	UR	0.09	mg/L	0.05	EPA 200.7	12/19/2017	JMS
Cyanide, Total	0.20	<0.01	mg/L	0.01	EPA 335.4	12/22/2017	DS

Email: mrwilcox@fs.fed.us

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Laboratory Analysis Report

Sample Number: 1758304

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO3CP3MRNT

Time of Collection: 11:20
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Barium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Cadmium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Chromium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Lead TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Mercury TCLP		<0.02	mg/L	0.02	SW 846 7470	12/28/2017	JD
Selenium TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
Silver TCLP		<0.20	mg/L	0.20	SW 846 6020	12/26/2017	JH
TCLP Extraction		*			SW 846 1311	12/22/2017	JD

Email: mrwilcox@fs.fed.us

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

Thank you for choosing Analytical Laboratories for your testing needs.

If you have any questions about this report, or any future analytical needs, please contact your client manager:

James Hibbs

Analytical Laboratories, Inc.
1804 N. 33rd Street
Boise, Idaho 83703
Phone (208) 342-5515

Date Report Printed: 1/4/2018 2:27:15 PM
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These test results relate only to the items tested.

Laboratory Analysis Report

Sample Number: 1758307

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO4CP3MRNT (CENTRIFUGE LIQUIDS)

Time of Collection: 11:40
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 12/29/2017

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Zinc, Zn	UR	0.33	mg/L	0.05	EPA 200.7	12/19/2017	JMS
Cyanide, Total	0.20	<0.01	mg/L	0.01	EPA 335.4	12/22/2017	DS

Email: mrwilcox@fs.fed.us

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

Thank you for choosing Analytical Laboratories for your testing needs.

If you have any questions about this report, or any future analytical needs, please contact your client manager:

James Hibbs

Analytical Laboratories, Inc.
1804 N. 33rd Street
Boise, Idaho 83703
Phone (208) 342-5515

Date Report Printed: 1/8/2018 8:33:04 AM
http://www.analyticallaboratories.com
These test results relate only to the items tested.

Laboratory Analysis Report

Sample Number: 1758306

Attn: MICHAEL WILCOX
USDA FOREST SERVICE SALMON
STE# 329
516 E. MAIN ST.
SALMON, ID 83467

Collected By: M. WILCOX
Submitted By: M. WILCOX

Source of Sample:
BLACKJACK/BLUEBIRD SLUDGE ARD IRON HYDROX MINE SLO4CP3MRNT (SPLP)

Time of Collection: 11:40
Date of Collection: 12/14/2017
Date Received: 12/15/2017
Report Date: 1/3/2018

Field pH:
Field Temp:
Lab pH:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic, As SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Barium, Ba SPLP Extraction	2	<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Cadmium, Cd SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Chromium, Cr SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Lead, Pb SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Mercury, Hg SPLP Extraction	0.002	<0.02	mg/L	0.02	EPA 245.1	12/28/2017	JD
Selenium, Se SPLP Extraction		<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
Silver, Ag SPLP Extraction	UR	<0.20	mg/L	0.20	SW 846 6020	12/28/2017	JH
SPLP Extraction		*			SW 846 1312	12/26/2017	JD

Email: mrwilcox@fs.fed.us

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

Thank you for choosing Analytical Laboratories for your testing needs.

If you have any questions about this report, or any future analytical needs, please contact your client manager:

James Hibbs

Reference: Cascade Earth Sciences, January 2013. Expanded Preliminary Assessment/Engineering Evaluation, Red Boy Mine – ECSI#2467.

Summary of Forest Service 1980 Report

Sample Location	Arsenic	Chromium (Cr 6+)	Copper	Iron	Lead	Manganese	Mercury	Zinc
Surface Water (Total)	micrograms per liter (ug/L)							
Station 4 – Clear Creek Bridge (Spring)	<10	<10	30	550	<10	40	<1	40
Station 4 – Clear Creek Bridge (Fall)	<10	<20	40	550	<10	120	<1	40
Station 5 – Mouth of Congo Gulch (Spring)	<10	<10	20	5,400	<10	2,200	<1	60
Station 5 – Mouth of Congo Gulch (Fall)	<10	<20	20	19,000	<10	5,000	<1	120

NOTE: < = less than the listed detection limit

Summary of Weston Data Summary Report – Surface Water

Sample Location	Arsenic	Barium	Cadmium	Copper	Cyanide	Iron	Lead	Manganese	Mercury	Silver
Surface Water (TR)	ug/L									
Mine Portal	114	<9.7	1.1	26.9	--	96,400	1.9	13,500	<0.1	<0.9
Congo Gulch, Downstream from Waste	<1.6	15.7	<0.1	1.4	--	418	<0.7	413	<0.1	<0.9
Congo Gulch, Upstream from Waste Rock Pile	<1.6	<19.6	<0.1	<0.95	--	269	<1.3	54.1	<0.1	<0.9
First Settling Pond	<1.6	<13	<0.1	<0.1	<10	209	<1.3	30.4	<0.1	<0.9
Second Settling Pond (North of FR 13)	3.1	11	0.28	0.9	<10	2,140	<0.7	1,550	<0.1	<0.9
Confluence of Congo Gulch/ Clear Creek	<1.6	13.9	<0.1	1	--	375	<0.7	367	<0.1	<0.9
Clear Creek, Upstream from Congo Gulch	1.6	<10.6	<0.1	<0.75	--	62	<0.7	<6.4	<0.1	<0.9

Summary of Weston Data Summary Report – Sediment

Sample Location	Arsenic	Barium	Cadmium	Copper	Cyanide	Iron	Lead	Manganese	Mercury	Silver
Sediment (Total)	milligrams per kilogram (mg/kg)									
Mine Portal	35.9	223	1.4	35.5	--	35,000	5.8	3,130	0.21	1.4
Congo Gulch, Downstream from Waste	412	210	0.89	118	<0.47	169,000	11.2	8,420	0.62	<2.2
Congo Gulch, Upstream from Waste	997	47.5	<1	264	--	363,000	15	209	<0.43	2.5
First Settling Pond	715	178	<0.77	214	<0.4	277,000	13.1	1,800	<0.32	<1.9
Second Settling Pond (North of FR 13)	223	283	1.5	122	1.4	229,000	1.8	25,500	0.54	2.7
Confluence of Congo Gulch/Clear Creek	139	112	<0.4	38.6	--	43,400	5.6	3,380	<0.16	<0.97
Clear Creek, Upstream from Congo	34.9	69.7	<0.32	27.8	--	24,200	3.9	597	<0.13	<0.77

NOTE: < = less than the listed detection limit; -- not analyzed.

Summary of ODEQ 2006 Background Metals Concentrations in Soil and Sediment

Sample Media	Arsenic	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Zinc
Soil	mg/kg								
Mean	7.6	447	282	40	48,480	6.8	1,200	214	92
Median	5.9	411	107	21	32,545	6.3	926	26	85
90 UCL	9.4	581	403	40	60,807	8.3	1,482	357	104
Sediment	mg/kg								
Mean	25.9	114	20	26	45,411	3.8	--	189	49
90 UCL	39.5	186	26	32	76.875	5	--	316.4	59

NOTES:
"--" = Not calculated in report
90 UCL is the 90th percentile calculated on the mean and the recommended background concentration for soil/sediment in the Clear Creek Basin

Summary of EA, 2003 Site Inspection Sampling at Stations BLAC-04 and BLUE-05

Sample Location	Arsenic	Barium	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Surface Water (TR)	ug/L								
BLAC-04	<4.8	14.6	<0.6	<2.4	<33.3	<1.3	2.8	<0.1	1.8
BLUE-05	<2.4	14.6	<0.3	<1.4	<16.8	<1.5	11.8	<0.1	<5.7
Sediment (Total)	mg/kg								
BLAC-05	24.2	70.3	0.32	27.9	21,700	3.1	600	<0.019	50
BLUE-05	19.4	73.1	<0.059	28.8	28,100	3.6	665	0.38	56.2

NOTE: < = less than the listed detection limit

Table 1. Surface Water Analytical Results - Total

Sample I.D.	Sample Date	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total (Low-Level)	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total	Flow Rate	Temperature (Field)	pH (Field)*	pH (Lab)*	Conductivity (Field)	Dissolved Oxygen (Field)*	ORP (Field)	Hardness (CaCO3, Total)	Cyanide, Total	Acidity, Total	Sulfate[4]
		Results in µg/L																							cfs	°C	s.u.		mS/cm	mg/L	mV	mg/L			
Congo Gulch Backgound																																			
CG-SW-01	10/17/2011	172	< 0.5	*< 0.5*	26.9	< 0.2	< 0.08	20,700	0.81	< 0.5	0.92	167	0.13	7,080	17.5	NA	0.56	1,470	*< 0.5*	*< 0.5*	5,150	< 0.1	1.4	< 5	0.315	4.73	7.53	7.9 H	105	12	-173.1	80.2	NA	NA	2.3
CG-SW-01	4/24/2012	929	NA	*< 0.5*	13.1	NA	< 0.08	NA	1.2	NA	1.1	442	0.11	NA	5.6	NA	< 0.5	NA	NA	NA	NA	NA	NA	< 5	4.834	5.25	6.57	7.3 H	44	6.79	-213.1	23	NA	NA	< 1
Average background		550.5	0.25	0.25	20	0.1	0.04	20700	1.005	0.25	1.01	304.5	0.12	7080	11.55	NA	0.53	1,470	0.25	0.25	5,150	0.05	1.4	2.5											
Congo Gulch																																			
CG-SW-02	10/17/2011	11.2	< 0.5	0.82	17.3	< 0.2	< 0.08	17800	< 0.5	< 0.5	0.66	50.6	< 0.1	7300	37.1	NA	1.7	1400	< 0.5	< 0.5	4810	< 0.1	0.54	< 5	0.261	3.67	7.21	7.7 H	97	12.3	-194.7	76.2	NA	NA	5.9
CG-SW-02	4/24/2012	1160	NA	0.69	15.7	NA	< 0.08	NA	1.8	NA	2.2	665	0.23	NA	27.1	NA	1.6	NA	NA	NA	NA	NA	NA	5.6	10.913	5.7	6.12	7.2 H	62	7.12	-168.9	20.7	NA	NA	1.4
CG-SW-03	10/17/2011	108	< 0.5	0.66	13.6	< 0.2	< 0.08	18800	0.64	1.4	1.5	224	< 0.1	8330	217	0.0015	8.2	1430	< 0.5	< 0.5	4930	< 0.1	0.34	10.7	0.431	3.72	7	7.3 H	107	12.2	-206.6	79.5	< 0.01	NA	20.6
CG-SW-03	4/24/2012	761	NA	0.68	15	NA	0.12	NA	1.2	NA	4.3	532	1.9	NA	54	0.0199	2.5	NA	NA	NA	NA	NA	NA	13.2	14.75	5.21	6.54	7.2 H	41	6.97	-199.1	21.1	< 0.01 H	NA	2.6
Clear Creek																																			
BLAC-SW-04	10/17/2011	15.9	< 0.5	1.9	14.1	< 0.2	< 0.08	13100	1.5	< 0.5	0.8	< 50	< 0.1	7480	3.1	NA	1.2	880	< 0.5	< 0.5	2360	< 0.1	0.52	< 5	4.043	6.52	7.18	7.8 H	84	12.1	-185.6	63.5	NA	NA	5.5
BLAC-SW-04	4/24/2012	799	NA	1.9	15.7	NA	< 0.08	NA	3.2	NA	1.8	653	0.18	NA	21.8	NA	4.9	NA	NA	NA	NA	NA	NA	< 5	96.79	4.63	6.67	7.3 H	42	8.12	-190.8	25.1	NA	NA	1.4
CC-SW-11	10/17/2011	21.8	< 0.5	1.8	13.8	< 0.2	< 0.08	14000	1.1	< 0.5	0.65	< 50	< 0.1	7710	24.2	0.0011	1.7	965	< 0.5	< 0.5	2700	< 0.1	0.49	< 5	4.442	5.31	6.66	7.7 H	84	12.3	-199.7	64.1	< 0.01	NA	7.2
CC-SW-11	4/24/2012	1000	NA	2.2	18.5	NA	< 0.08	NA	4.1	NA	2.1	969	0.27	NA	32.4	0.0089	6.8	NA	NA	NA	NA	NA	NA	< 5	116.67	3.86	5.35	7.1 H	41	NM	-210.4	25.6	< 0.01 H	NA	1.4
Red Boy Ponds																																			
CC-SW-12	10/17/2011	845	< 0.5	22.5	13.2	0.3	1.2	47800	0.67	80.5	24.4	33400	0.22	49800	10700	0.001	266	< 0.5	< 0.5	< 0.5	7220	0.27	< 0.1	514	0.098	5.82	2.83	3.3 H	596	8.02	41	284	< 0.01	NA	437
CC-SW-12	4/24/2012	402	NA	7.4	21.5	NA	0.63	NA	1.6	NA	8.6	8690	0.28	NA	3050	0.0031	98.6	NA	NA	NA	NA	NA	NA	150	0.305	6.27	2.45	3.6 H	254	7.97	-81.6	110	< 0.01 H	30	142
Red Boy Mine - Blacksmith Tunnel Adit																																			
RBM-AS-01	10/17/2011	3830	< 0.5	56.4	10	1.2	2.6	75000	4.9	177	85	159000	0.94	89000	22900	NA	626	2930	0.79	< 0.5	12000	0.62	0.99	1200	NM	10.69	5.53	4.7 H	1033	6.94	-49.1	524	NA	NA	899
RBM-AS-01	4/24/2012	2760	NA	52.2	9.5	NA	2.6	NA	4.9	NA	74.6	130000	0.58	NA	17200	NA	485	NA	NA	NA	NA	NA	NA	860	NM	10.75	5.67	4 H	1076	5.06	-32.1	500	NA	306	711
Standards, corrected for hardness where applicable (used 73 mg/L background for surface water samples)																																			
Oregon - Aquatic Life [1]		87	NS	190	NS	NS	0.88	NS	NS	NS	9.009	1000	2.122	NS	NS	0.012	120.46	NS	5	0.12	NS	NS	NS	NS										*0.01*	NS	NS
Oregon - Ecological Screening Level Values [2]		87	1600	NS	4	5.3	2.2	NS	NS	*23*	*9*	1000	*2.5*	82000	120	0.77	52	53000	5	0.12	680000	40	20	120	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.005	NS	NS
Oregon - Human Health [3]		NS	5.1	2.1	1000	NS	NS	NS	NS	NS	1300	NS	NS	NS	NS	NS	140	NS	120	NS	NS	0.043	NS	2100	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.13	NS	NS
EPA - Aquatic Life (CCC) [4]		87	NS	*150*	NS	NS	*0.81*	NS	100	NS	*6.82*	1000	*1.777*	NS	NS	0.77	*120.1*	NS	5	NS	NS	NS	NS	*79.8*	NS	9-19	6.5-9	6.5-9	NS	9.5	NS	NS	NS	0.005	NS	NS
EPA - Human Health (Water+Organism) [5]		NS	5.6	0.018	1000	NS	NS	NS	NS	NS	1300	300	NS	NS	50	NS	610	NS	170	NS	NS	1.7	NS	7400	NS	NS	5-9	5-9	NS	NS	NS	NS	0.7	NS	NS
EPA - Region III BTAG, Freshwater Screening Benchmarks [6]		*87*	30	5	*4*	*0.66*	*0.25*	*116000*	*85*	*23*	9	300	*2.5*	*82000*	*120*	0.026	*52*	*53000*	1	*3.2*	*7E+05*	0.8	20	120	NS	NS	6.5-9	6.5-9	NS	NS	NS	NS	5	NS	NS
EPA - National Primary Drinking Water Regulations [7]		NS	6	10	2000	4	5	NS	100	NS	1300	NS	15	NS	NS	2	NS	NS	50	NS	NS	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ORNL - Surface Water PRGs [8]		87	30	NS	4	0.66	1.1	NS	NS	23	12	1000	3.2	NS	120	1.3	160	NS	0.39	0.36	NS	9	20	110	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.005	NS	NS

NOTES:

All analyses except Low-Level Mercury were conducted by Pace Analytical Services, Inc., Billings, MT per EPA Method 6020.

Low-Level Mercury analyses were conducted by Pace Analytical Services, Inc., Minneapolis, MN per EPA Method 1631.

Italic values indicate that the MDL exceeds the lowest standard.

Shaded values indicate that the value exceeds one or more standard; exceeded criteria also shaded.

Abbreviations: °C = degrees Celsius, < value = analyte not detected above Method Detection Limit (MDL, shown), cfs = cubic feet per second

H = storage and preservation times were not met, mg/L = milligrams per liter, µg/L = micrograms per liter,

mS/cm = microsiemens per centimeter, mV = millivolts, NA = not analyzed, NM = not measured, s.u. = standard units.

STANDARDS NOTES:

1 - State of Oregon Aquatic Life Water Quality Criteria (Chronic) (Table 20) (ODEQ, 2011), **underline** - corrected for hardness.

2 - State of Oregon Level II Ecological Screening Criteria (ODEQ, December 2001), italics - expressed as dissolved.

3 - State of Oregon Human Health Water Quality Criteria for Toxic Pollutants (Table 40), Water+Organism (ODEQ, 2011).

4 - EPA recommended chronic ambient water quality criteria for freshwater aquatic life used (EPA, 2009), **underline** - corrected for hardness, italics - expressed as dissolved.

5 - EPA recommended ambient water quality criteria for protection of human consumption of water and fish (EPA, 2009 NTR), ***italics*** - expressed as dissolved.

6 - EPA Region III Biological Technical Assistance Group (BTAG) Freshwater Screening Benchmarks (EPA, 2006). Hardness dependent criteria are normailzed to 100 mg/L.

7 -EPA National Primary Drinking Water Regulations (EPA, 2009).

8 - ORNL Preliminary Remediation Goals for Ecological Endpoints (ORNL, 1997). Hardness dependent criteria are normailzed to 100 mg/L.

NS = No Standard

Table 2. Surface Water Analytical Results - Dissolved

Sample I.D.	Sample Date	Aluminum, Dissolved	Antimony, Dissolved	Arsenic, Dissolved	Barium, Dissolved	Beryllium, Dissolved	Cadmium, Dissolved	Calcium, Dissolved	Chromium, Dissolved	Cobalt, Dissolved	Copper, Dissolved	Iron, Dissolved	Lead, Dissolved	Magnesium, Dissolved	Manganese, Dissolved	Nickel, Dissolved	Potassium, Dissolved	Selenium, Dissolved	Silver, Dissolved	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Dissolved
		Results in µg/L																					
Congo Gulch Background																							
CG-SW-01	10/17/2011	9.5	< 0.5	*< 0.5*	25.9	< 0.2	< 0.08	20,500	1.6	< 0.5	0.83	< 50	< 0.1	7,040	1.5	0.73	1,460	< 0.5	< 0.5	5,230	< 0.1	1.1	< 5
CG-SW-01	4/24/2012	196	NA	*< 0.5*	10.8	NA	< 0.08	NA	0.8	NA	0.82	107	< 0.1	NA	4.5	0.54	NA	NA	NA	NA	NA	NA	< 5
Average Background		102.8	< 0.25	0.25	18.35	0.1	0.04	20,500	1.2	< 0.25	0.825	78.5	0.05	7,040	3	0.635	1,460	0.25	0.25	5,230	0.05	1.1	2.5
Congo Gulch																							
CG-SW-02	10/17/2011	6.4	< 0.5	0.86	18.1	< 0.2	< 0.08	18,300	0.79	< 0.5	0.74	< 50	< 0.1	7,440	34.3	1.9	1,420	< 0.5	< 0.5	5,040	< 0.1	0.54	< 5
CG-SW-02	4/24/2012	2,210	NA	0.54	13.7	0.2	< 0.08	NA	2.5	NA	2.5	1,040	0.24	NA	6.4	2.5	NA	NA	NA	NA	NA	NA	5.9
CG-SW-03	10/17/2011	101	< 0.5	0.57	13.7	< 0.2	< 0.08	18,400	< 0.5	1.3	1.5	134	< 0.1	8,170	201	7.8	1,410	< 0.5	< 0.5	4,950	< 0.1	0.29	9.9
CG-SW-03	4/24/2012	388	NA	*< 0.5*	11.1	NA	< 0.08	NA	0.94	NA	1.5	216	0.14	NA	5.8	1.9	NA	NA	NA	NA	NA	NA	< 5
Clear Creek																							
BLAC-SW-04	10/17/2011	4.7	< 0.5	1.9	14.3	< 0.2	< 0.08	13,200	1	< 0.5	0.68	< 50	< 0.1	7,420	4.8	0.88	872	< 0.5	< 0.5	2,410	< 0.1	0.48	< 5
BLAC-SW-04	4/24/2012	153	NA	1.3	11.2	NA	< 0.08	NA	1.3	NA	1.1	107	< 0.1	NA	2.1	2.4	NA	NA	NA	NA	NA	NA	< 5
CC-SW-11	10/17/2011	24.2	< 0.5	1.7	13.8	< 0.2	< 0.08	13,400	1.2	< 0.5	0.85	< 50	< 0.1	7,420	21.1	1.6	912	< 0.5	< 0.5	2,650	< 0.1	0.46	< 5
CC-SW-11	4/24/2012	140	NA	1.3	11	NA	< 0.08	NA	1.4	NA	1.2	101	< 0.1	NA	1.8	2.4	NA	NA	NA	NA	NA	NA	< 5
Red Boy Ponds																							
CC-SW-12	10/17/2011	813	< 0.5	15.9	18.9	0.4	1.1	41,900	0.65	78	32.1	29,800	2.1	43,600	10,200	260	2,060	< 0.5	< 0.5	7,080	0.25	< 0.1	499
CC-SW-12	4/24/2012	249	NA	3	22.8	NA	0.56	NA	0.7	NA	8.8	2,340	1.5	NA	2,830	96.5	NA	NA	NA	NA	NA	NA	167
Red Boy Mine - Blacksmith Tunnel Adit																							
RBM-AS-01	10/17/2011	2,280	< 0.5	10.6	11.3	0.96	2.5	72,000	< 0.5	169	77.5	######	0.44	83,600	21,900	592	2,790	0.88	< 0.5	11,400	0.58	< 0.1	1,120
RBM-AS-01	4/24/2012	1,700	NA	6.6	9.7	NA	2.6	NA	0.86	NA	76.1	97,900	2.3	NA	18,900	494	NA	NA	NA	NA	NA	NA	811
Standards, corrected for hardness where applicable (used 73 mg/L background for surfa																							
Oregon - Aquatic Life [1]		87	NS	*150*	NS	NS	*0.815*	NS	NS	NS	*6.824*	1,000	*1.7769*	NS	NS	*120.1*	NS	5	0.12	NS	NS	NS	*80.95*
Oregon - Ecological Screening Level Values [2]		87	1,600	NS	4	5.3	2.2	NS	NS	23	9	1,000	2.5	82,000	120	52	NS	5	0.12	680,000	40	20	120
Oregon - Human Health [3]		NS	5.1	2.1	1,000	NS	NS	NS	NS	NS	1,300	NS	NS	NS	NS	140	NS	120	NS	NS	0.043	NS	2,100
EPA - Aquatic Life (CCC)[4]		87	NS	*150*	NS	NS	*0.815*	NS	100	NS	*6.824*	1,000	*1.7769*	NS	NS	*120.1*	NS	5	NS	NS	NS	NS	*80.95*
EPA - Region III BTAG, Freshwater Screening Benchmarks[6]		*87*	*30*	5	*4*	*0.66*	*0.25*	*116,000*	*85*	*23*	*9*	300	*2.5*	*82,000*	*120*	*52*	*53,000*	1	*3.2*	*680,000*	0.8	20	120
EPA - National Primary Drinking Water Regulations[7]		NS	6	10	2,000	4	5	NS	100	NS	1,300	NS	15	NS	NS	NS	NS	50	NS	NS	2	NS	NS
EPA - Human Health (Water+Organism)[8]		NS	5.6	0.018	1,000	NS	NS	NS	NS	NS	1,300	300	NS	NS	50	610	NS	170	NS	NS	1.7	NS	7,400

NOTES:

All analyses except Low-Level Mercury were conducted by Pace Analytical Services, Inc., Billings, MT per EPA Method 6020.

Italic values indicate that the MDL exceeds the lowest standard

Shaded values indicate that the value exceeds one or more standard; exceeded criteria also shaded

Abbreviations: < value = analyte not detected above Method Detection Limit (MDL, shown), µg/L = micrograms per liter, NA = not analyzed.

STANDARDS NOTES:

1 - State of Oregon Aquatic Life Water Quality Criteria (Chronic) (Table
underline - corrected for hardness, *italics* -

2 - State of Oregon Level II Ecological Screening criteria (ODEQ, December 2001), *italics* -

3 - State of Oregon Human Health Water Quality Criteria for Toxic Pollutants (Table 40),
underline - corrected for hardness, italics -

4 - EPA recommended chronic ambient water quality criteria for freshwater aquatic life
underline - corrected for hardness, italics -

5 - EPA recommended ambient water quality criteria for protection of human consumption of
(EPA, 2009 NTR), italics - expressed

6 - EPA Region III Biological Technical Assistance Group (BTAG) Freshwater Screening Benchmarks (EPA, 2006). Hardness dependent criteria are normailzed

Table 3. Sediment Analytical Results

Sample ID	Sample Date	Aluminum, Total	Antimony, Total	Arsenic - Total	Barium, Total	Beryllium, Total	Calcium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total	Cyanide, Total
		mg/kg																							
Congo Gulch Background																									
CG-SS-01	10/17/2011	10,500	< 0.65	1.5	76.1	0.34	2,740	< 0.1	10.2	4.6	8.1	15,800	2.8	3,070	304	0.027	10.4	825	< 0.65	< 0.65	188	< 0.13	24.2	39.1	NA
CG-SS-01	4/24/2012	8,210	NA	6.3	65.6	NA	NA	< 0.096	9.9	NA	10.1	16,000	3.2	NA	177	< 0.277	9.3	NA	NA	NA	NA	NA	NA	39.3	NA
Average Background		9,355	< 0.325	3.9	70.85	0.34	2740	0.049	10.05	4.6	9.1	15900	3	3070	240.5	< 0.277	9.85	825	< 0.65	< 0.65	188	< 0.13	24.2	39.2	NA
Congo Gulch																									
CG-SS-02	10/17/2011	8,480	1.2	86.4	143	0.54	2,040	1.4	21.6	29.9	45.7	44,900	5.6	2,000	2,610	0.19	76.4	583	1.1	< 0.69	120	0.65	33.6	179	NA
CG-SS-02	4/24/2012	6,240	NA	51.2	170	NA	NA	1.6	10.3	NA	26	27,800	3.4	NA	5,590	<	71.2	NA	NA	NA	NA	NA	NA	200	NA
CG-SS-03	10/17/2011	3,860	1.9	184	111	0.33	1,210	0.62	26	36.1	40.5	48,000	6.4	1,740	3,550	0.74	107	779	1.2	< 0.65	< 65.4	0.74	22.9	215	< 0.33
CG-SS-03	4/24/2012	5,270	NA	187	125	NA	NA	0.96	18.9	NA	57.3	42,500	9.3	NA	2,010	<	101	NA	NA	NA	NA	NA	NA	281	< 0.8
Clear Creek																									
BLAC-SS-04	10/17/2011	10,500	1.1	34.4	58.1	0.31	2,760	0.24	122	23.7	30.1	27,400	2.9	#####	726	0.035	143	521	< 0.62	< 0.62	209	0.34	53.8	53.1	NA
BLAC-SS-04	4/24/2012	14,100	NA	50	129	NA	NA	0.52	134	NA	41	24,100	5.3	NA	915	<	204	NA	NA	NA	NA	NA	NA	71.7	NA
CC-SS-11	10/17/2011	4,930	2.1	189	136	0.36	1,510	0.67	36.2	39.9	45.6	43,200	7.1	2,480	3,180	0.39	127	876	1.2	0.54	85.1	0.66	26.8	326	0.53
CC-SS-11	4/24/2012	9,970	NA	18.3	62.3	NA	NA	0.22	79.5	NA	27	20,300	2	NA	742	<	105	NA	NA	NA	NA	NA	NA	40.5	< 0.72
Red Boy Ponds																									
CC-SS-12	10/17/2011	7,830	4.3	368	35.9	< 0.9	527	0.4	22.5	65.2	156	358,000	4.1	992	2,810	1.3	68.1	326	*< 2.2*	< 2.2	< 224	1.7	9.9	291	< 2
CC-SS-12	4/24/2012	9,350	NA	2,430	87.4	NA	NA	0.93	53.4	NA	78.1	41,500	22.5	NA	1,410	11.2	74	NA	NA	NA	NA	NA	NA	192	2.3
Standards																									
OR - Freshwater [1]		NS	3	NS	NS	NS	NS	0.6	37	NS	36	NS	35	NS	1,100	0.2	18	NS	NS	4.5	NS	NS	NS	123	NS
EPA - Freshwater TEL [2]		NS	NS	5.9	NS	NS	NS	0.596	NS	NS	36	NS	35	NS	NS	0.174	18	NS	NS	NS	NS	NS	NS	123.1	NS
EPA - Freshwater PEL [3]		NS	NS	17	NS	NS	NS	3.53	NS	NS	197	NS	91.3	NS	NS	0.486	35.9	NS	NS	NS	NS	NS	NS	315	NS
OR - Backerground [4]		NS	NS	7	NS	NS	NS	1	NS	NS	NS	NS	17	NS	NS	0.07	NS	NS	2	NS	NS	NS	NS	NS	NS
OR - Clear Creek Basin Backerground [5]		29,956	0.82	39.5	128.3	NS	NS	NS	186	26	32	76,875	5	#####	NS	NS	316.4	NS	NS	NS	422	NS	65	59	NS
NOAA - SQuiRT SEL Vales [6]		NS	NS	33	NS	NS	NS	10	110	NS	110	40,000	250	NS	1,100	2	75	NS	NS	NS	NS	NS	NS	820	NS
ORNL - Freshwater [7]		NS	NS	42	NS	NS	NS	4.2	159	NS	77.7	NS	110	NS	NS	0.7	38.5	NS	NS	1.8	NS	NS	NS	270	NS

NOTES:
All analyses were conducted by Pace Analytical Services, Inc., Billings, MT per EPA Method 6020/7471.
Italic values indicate that the MDL exceeds the lowest standard
Shaded values indicate that the value exceeds one or more standard; exceeded criteria also shaded
Abbreviations: < value = analyte not detected above Method Detection Limit (MDL, shown), H = storage and preservation times were not met, mg/kg = milligrams per kilogram, NA = not analyzed.

STANDARDS NOTES:
1 - State of Oregon, Level II Screening Level Values for Freshwater Sediment (ODEQ, 2001)
2 - EPA Threshold Effects Level (NOAA, 1999)
3 - EPA Probable Effects Level (NOAA, 1999)
4 - State of Oregon, Regional Default Background Concentrations for Soil/Sediment (ODEQ, 2007)
5 - State of Oregon, Background Soil and Sediment in the Clear Creek Basin (ODEQ, 2006)
7 - National Oceanic and Atmospheric Administration (NOAA), Screening Quick Reference Table (SQuiRT) for Inorganics in Sediment (NOAA, 2008).
6 - ORNL ecological screening level values for freshwater, lowest chronic value used (ORNL, 1997)
NS = No Standard

Table 4. Soil and Waste Material Analytical Results

Sample ID	Sample Date	Sample Depth (feet)	Paste pH	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
			s.u.	mg/kg																					
Shaft Area - Waste Rock																									
RBM-WR-01	10/17/2011	0.5	NA	17,300	1.3	143	27	0.59	0.57	30,400	603	61.8	79	49,000	6.2	47,900	2,570	0.33	665	477	1.2	0.78	54.1	0.46	58.3	203
Blacksmith Tunnel - Waste Rock																									
RBM-WR-02	10/17/2011	0.5	NA	2,650	2.6	648	46.5	< 0.24	*< 0.096*	< 60	34.5	7.2	79.3	167,000	12.4	683	722	2.6	33.8	1,100	1	1.8	82	0.46	24.4	146
Mill Foundation - Tailings																									
RBM-T-01	10/17/2011	0.5	NA	1,420	14.7	542	85.1	< 0.23	*0.11*	122	23.7	2.3	43.5	31,200	582	282	40.1	3.1	23.3	958	3.5	24.8	126	0.82	10.7	45.2
Cyanide Plant - Tailings																									
RBM-T-02	10/19/2011	0.5	3.5 H	NA	37.8	479	NA	NA	*< 0.087*	NA	20.6	NA	81.1	27,800	211	NA	NA	10.7	NA	NA	NA	110	NA	NA	NA	31
Standards																									
OR - Ecological Receptors (p=plant, i=invertebrate, b =birds,				50 p	5 p	NS	85 b	10 p	4 p	NS	NS	20 p	50 i	NS	16 b	NS	100 i	0.1 i	30 p	NS	1 p	2 p	NS	1 p	2 p	50 p
OR - Risk-Based Concentrations for Occupational Receptors[2]				NS	NS	1.7	190,000	2,000	510	NS	5.5 (as Cr VI)	NS	41,000	NS	800	NS	23,000	310	20,000	NS	NS	5,100	NS	NS	NS	NS
EPA Regional Screening Levels for Industrial Soils[3]				100,000	410	1.6	67,000	2,000	800	NS	NS	1,900	41,000	720,000	800	NS	2,300	310	20,000	NS	5,100	5,100	NS	67	1,000	310,000
EPA - Ecological Receptors (m=mammal, b=bird, i = invertebrate, p=plant)[4]				NS	0.27 m	18 p	2,000 m	21 m	0.36 m	NS	26 (as Cr VI) a	13 p	28 a	NS	11 a	NS	220 p	NS	38 p	NS	0.52 p	4.2 a	NS	NS	7.8 a	46 a
EPA - Region 5 Ecological Screening Levels[5]				NS	0.142	5.7	1.04	1.06	0.0022	NS	0.4	0.14	5.4	NS	0.054	NS	NS	0.1	13.6		0.03	4.04	NS	0.057	1.59	6.62
OR - Clear Creek Basin Background [6]				NS	NS	9.4	NS	NS	n	NS	581	403	40	60,807	8.3	NS	1,482	NS	357	NS	NS	NS	NS	NS	NS	104
ORNL - Ecological Receptors[7]				NS	5	9.9	283	10	4	NS	0.4	20	60	NS	40.5	NS	NS	0.00051	30	NS	0.21	2	NS	1	2	8.5

NOTES:
All analyses were conducted by Pace Analytical Services, Inc., Billings, MT per EPA Method 6020.
Shaded values indicate that the value exceeds one or more standard; exceeded criteria also shaded
Abbreviations: < value = analyte not detected above Method Detection Limit (MDL, shown), H = Storage and preservation times were not met, mg/kg = milligrams per kilogram, NA = not analyzed, s.u. = standard units.

STANDARDS NOTES:
1 - State of Oregon, Level II Ecological Screening Level Values for Soil (ODEQ, 2001); dominantly based on soluble salts
2 - State of Oregon, Department of Environmental Quality (ODEQ) Occupational Risk-Based Concentrations for Soil Inhalation, Ingestion, and Demmal Contact (ODEQ, 2012).
3 - EPA Regional Screening Levels for Industrial Soils - (EPA, 2011).
4 - EPA Ecological Soil Screening Levels - Lowest Criteria Listed (EPA, 2005)
5 - EPA Region 5, RCRA Corrective Action Ecological Screening Levels (EPA, 2003)
6 - State of Oregon, Background Soil and Sediment in the Clear Creek Basin (ODEQ, 2006)
7 - ORNL = Oak Ridge National Laboratory Preliminary Remediation Goals for Ecological Endpoints (ORNL, 1997)
NS = Not standard

Table 5. Mill and Cyanide Plant XRF Readings

XRF Reading Location	Date	Silver	Arsenic	Gold	Barium	Cadmium	Cobalt	Chromium	Copper	Iron	Mercury	Manganes	Nickel	Lead	Antiomo	Selenium	Titanium	Uranium	Zinc	Area	Soil Description
		mg/kg																			
A-1	4/25/2012	<LOD	3,987	<LOD	<LOD	<LOD	82	280	84	45,292	<LOD	2,643	<LOD	58	<LOD	<LOD	4,516	<LOD	73	Red Boy Mill	tailings
A-2	4/25/2012	<LOD	367	<LOD	864	<LOD	39	<LOD	182	25,817	<LOD	1,025	<LOD	561	<LOD	<LOD	2,071	<LOD	80	Red Boy Mill	tailings
A-3	4/25/2012	<LOD	965	<LOD	<LOD	<LOD	52	<LOD	<LOD	32,043	<LOD	1,095	<LOD	237	<LOD	<LOD	4,035	<LOD	40	Red Boy Mill	tailings
A-3	4/25/2012	<LOD	723	<LOD	<LOD	<LOD	<LOD	<LOD	85	32,347	<LOD	1,235	<LOD	175	<LOD	<LOD	2,766	<LOD	33	Red Boy Mill	tailings
A-4	4/25/2012	167	2,210	55	<LOD	<LOD	114	<LOD	163	65,854	<LOD	3,644	<LOD	556	<LOD	<LOD	1,778	<LOD	99	Red Boy Mill	tailings
B-1	4/25/2012	<LOD	216	<LOD	<LOD	<LOD	<LOD	<LOD	54	11,271	<LOD	<LOD	<LOD	431	<LOD	<LOD	1,312	<LOD	22	Red Boy Mill	tailings
B-2	4/25/2012	<LOD	290	<LOD	<LOD	<LOD	38	<LOD	190	19,827	<LOD	1,558	<LOD	1,088	<LOD	<LOD	1,629	25	89	Red Boy Mill	tailings
B-3	4/25/2012	<LOD	273	<LOD	<LOD	<LOD	90	<LOD	110	46,876	<LOD	4,838	<LOD	264	<LOD	<LOD	4,511	<LOD	131	Red Boy Mill	tailings
C-21	4/25/2012	<LOD	238	<LOD	<LOD	<LOD	52	550	116	40,264	<LOD	2,841	115	129	<LOD	<LOD	3,824	<LOD	73	Red Boy Mill	tailings
C-21	4/25/2012	<LOD	275	<LOD	<LOD	<LOD	51	306	139	31,167	38	2,848	<LOD	99	<LOD	<LOD	3,977	<LOD	82	Red Boy Mill	tailings
C-3	4/25/2012	<LOD	23	<LOD	<LOD	<LOD	41	206	67	15,958	<LOD	2,640	<LOD	25	<LOD	<LOD	1,815	<LOD	62	Red Boy Mill	tailings
D-1	4/25/2012	<LOD	860	<LOD	<LOD	<LOD	106	314	89	51,470	115	1,681	<LOD	594	<LOD	<LOD	3,402	<LOD	32	Red Boy Mill	tailings
D-2	4/25/2012	<LOD	1,428	<LOD	<LOD	<LOD	215	<LOD	<LOD	151,706	222	3,126	<LOD	2,666	261	<LOD	<LOD	<LOD	297	Red Boy Mill	tailings
D-3	4/25/2012	<LOD	61	<LOD	816	<LOD	73	<LOD	74	29,016	<LOD	2,532	99	47	<LOD	<LOD	3,909	<LOD	102	Red Boy Mill	tailings
A-11	4/25/2012	<LOD	1,493	42	727	<LOD	56	<LOD	70	26,300	<LOD	1,075	<LOD	144	<LOD	<LOD	2,761	<LOD	38	Red Boy Mill	tailings
A-12	4/25/2012	<LOD	218	<LOD	<LOD	<LOD	<LOD	<LOD	63	24,013	<LOD	1,652	<LOD	41	<LOD	<LOD	2,401	<LOD	103	Red Boy Mill	tailings
B-11	4/25/2012	<LOD	77	<LOD	<LOD	<LOD	28	<LOD	59	10,503	<LOD	1,050	<LOD	16	<LOD	<LOD	1,783	<LOD	34	Red Boy Mill	tailings
B-11	4/25/2012	<LOD	165	<LOD	<LOD	<LOD	<LOD	<LOD	104	24,296	<LOD	1,479	<LOD	72	<LOD	<LOD	4,491	<LOD	61	Red Boy Mill	tailings
CP-1	4/25/2012	<LOD	366	<LOD	1013	<LOD	76	441	115	30,883	<LOD	1,243	<LOD	101	<LOD	<LOD	3,846	<LOD	<LOD	Cyanide Plant	tailings
N-1	4/25/2012	<LOD	452	<LOD	1025	<LOD	104	270	140	53,755	<LOD	2,385	100	53	<LOD	<LOD	3,117	<LOD	51	Cyanide Plant	tailings
N-2	4/25/2012	<LOD	288	<LOD	<LOD	<LOD	66	<LOD	117	26,980	<LOD	840	<LOD	441	<LOD	<LOD	2,051	<LOD	67	Cyanide Plant	tailings
N-3	4/25/2012	220	728	33	<LOD	<LOD	53	191	79	17,169	167	<LOD	<LOD	364	201	<LOD	3,326	<LOD	54	Cyanide Plant	tailings
NNE-1	4/25/2012	<LOD	462	<LOD	<LOD	<LOD	70	<LOD	103	29,611	<LOD	761	<LOD	326	<LOD	10	2,687	<LOD	72	Cyanide Plant	tailings
Plant Foundation	4/25/2012	<LOD	1,503	<LOD	<LOD	<LOD	696	<LOD	267	467,408	<LOD	7,250	<LOD	657	188	<LOD	6,429	<LOD	164	Cyanide Plant	tailings
Plant Foundation	4/25/2012	264	724	<LOD	<LOD	<LOD	98	656	<LOD	48,946	46	<LOD	<LOD	440	172	<LOD	5,356	<LOD	38	Cyanide Plant	tailings
S-1	4/25/2012	<LOD	112	<LOD	<LOD	<LOD	60	<LOD	<LOD	28,577	<LOD	2,848	<LOD	33	<LOD	<LOD	3,056	<LOD	45	Cyanide Plant	tailings
W-1	4/25/2012	231	226	<LOD	956	<LOD	25	<LOD	<LOD	14,449	136	594	<LOD	468	156	14	6,210	<LOD	22	Cyanide Plant	tailings
W-1	4/25/2012	<LOD	896	<LOD	<LOD	<LOD	66	<LOD	<LOD	51,280	<LOD	1,973	<LOD	38	<LOD	<LOD	5,105	<LOD	56	Cyanide Plant	tailings

NOTES:
Abbreviations: <LOD = below limit of detection, mg/kg = milligrams per kilogram, XRF = x-ray fluorescence.

Table 6. Benthic Macroinvertebrate Taxa Abundance and Community Composition - April 2012

Station	Date	Number of Taxa				EPT Taxa Richness	Total Taxa Richness	Percent EPT	Total Species Abundance
		Ephemeroptera	Plecoptera	Trichoptera	Others				
CG-01	4/24/2012	5	7	8	33	20	53	38%	413
CG-02	4/24/2012	3	4	2	20	9	29	31%	183
CG-03	4/24/2012	2	5	2	17	9	26	35%	122
BLAC-04	4/24/2012	6	6	5	23	17	40	43%	525
CC-12	4/24/2012	8	3	8	28	19	57	33%	628

NOTE:
Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) are generally considered to be pollution-intolerant taxa, which will typically decrease in abundance with decreased water quality.

Table 7. Boilogical Indices

Date	BIBI Index[1]				Percent Intolerant Taxa[2]	Shannon Weaver Index (log e)[3]
	Biological Condition Category					
	Low Biological Integrity	Medium Biological Integrity	High Biological Integrity	Total Score (Spring 2012)		
4/24/2012	0-25	26-40	40-50	40	27%	3.29
4/24/2012				34	14%	2.62
4/24/2012				30	8%	2.44
4/24/2012				32	9%	2.2
4/24/2012				34	11%	2.89

Calculated by Robert Wissman, Aquatic Biology Associates, Inc., Corvallis, Oregon.
IBI (Modified, 1999) is designed to evaluate riffle communities. This is for relative comparison at this site only.
ant species index is a measure of how many pollution sensitive species are present in each sample.
on-Weaver Species Diversity Index is a measure of the number of species (i.e., diversity) and the number of individuals within each species (i.e., evenness).

Table 8. Red Boy Ponds - Field Parameter Measurements

Description	Date	Pond	Temp	Dissolved Oxygen	pH	Conductivity	Oxygen Reduction Potential
			ºC	mg/L	s.u.	µS/cm	mV
Adit pipe discharge	4/24/2012	Pond #7	4.63	8.69	5.33	0.101	-180.4
		Pond #6	6.44	7.83	5.01	0.319	-165.3
		Pond #5	6.66	7.67	4.77	0.318	-156.4
		Pond #4	6.78	7.88	4.58	0.324	-152.6
Upper end	4/24/2012	Pond #3U	6.20	8.30	4.38	0.227	-157.9
Lower end	4/24/2012	Pond #3L	5.84	8.16	4.10	0.234	-150.1
		Pond #2	6.11	8.14	2.89	0.245	-42.9
UNF Boundary	4/24/2012	Pond #1	7.27	7.87	2.72	0.285	47.2

NOTE:
Abbreviations: oC = degrees Celsius, mg/L = milligrams per liter, mV = millivolts, s.u. = standard units, mS/cm = microsiemens per centimeter.

Table 9. QA/QC Analytical Results

Sample I.D.	Sample Date	Aluminum, Total	Antimony, Total	Arsenic Total,	Barium, Total	Berrylium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Low-Level	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
		µg/L																						
Congo Gulch																								
CG-SW-03	10/17/2011	108	< 0.5	0.66	13.6	< 0.2	< 0.08	18,800	0.64	1.4	1.5	224	< 0.1	8,330	217	0.0015	8.2	1,430	< 0.5	< 0.5	4,930	< 0.1	0.34	10.7
CC-SW-33	10/17/2011	110	< 0.5	0.64	14	< 0.2	< 0.08	19,300	0.89	1.4	1.4	229	< 0.1	8,580	223	0.0018	8.6	1,480	< 0.5	< 0.5	5,150	< 0.1	0.35	11
% Difference		**2%**	**0%**	**3%**	**3%**	**0%**	**0%**	**3%**	**33%**	**0%**	**7%**	**2%**	**0%**	**3%**	**3%**	**18%**	**5%**	**3%**	**0%**	**0%**	**4%**	**0%**	**3%**	**3%**
CG-SW-03	4/24/2012	761	NA	0.68	15	NA	0.12	NA	1.2	NA	4.3	532	1.9	NA	54.4	0.0199	2.5	NA	NA	NA	NA	NA	NA	13.2
CC-SW-33	4/24/2012	1,030	NA	0.9	15.5	NA	0.093	NA	2.2	NA	2.2	697	0.3	NA	51.2	0.0199	3.7	NA	NA	NA	NA	NA	NA	5.1
% Difference		**30%**	**NC**	**28%**	**3%**	**NA**	**25%**	**NC**	**59%**	**NC**	**65%**	**27%**	**145%**	**NC**	**6%**	**0%**	**39%**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**89%**
Rinsate Blanks																								
CC-SW-34	10/17/2011	9.6	< 0.5	< 0.5	< 0.3	< 0.2	< 0.08	896	0.67	< 0.5	0.88	< 50	0.1	476	< 0.5	NA	0.68	447	< 0.5	< 0.5	594	< 0.1	1	< 5
CC-SW-34	4/24/2012	43.2	< 0.5	< 0.5	2.1	< 0.2	< 0.08	508	1.5	< 0.5	0.97	< 50	0.12	33	1	NA	1.5	21.4	< 0.5	< 0.5	1,110	< 0.1	< 0.1	< 5
Air Blanks																								
CC-SW-35	10/17/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0005	NA	NA	NA	NA	NA	NA	NA	NA
CC-SW-35	4/24/2012	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 0.0005	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:
All analyses except low-level mercury were conducted by Pace Analytical Services, Inc., Billings, MT.
CC-SW-03 is a field duplicate of the surface water sample collected at station CG-03
CC-SW-04 is a rinsate blank collected from a stainless steel shovel
CC-SW-35 is an air blank collected at the Red Boy Mine, Blacksmith Tunnel Adit
Abbreviations: < value = analyte not detected above method detection limit (MDL), NA = not analyzed, NC = not calculated, µg/L = micrograms per liter.

Reference: Cascade Earth Sciences, February 2013. Mine Seep Discharge and Settling Ponds Assessment – Blackjack Mine.

Table 1. Surface Analytical Results - Total

Sample ID	Sample Date	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Beryllim, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total	Flow Rate	Temperature (field)	pH (field)*	pH (lab)	Conductivity (field)	Dissolved Oxygen (field)*	ORP (Field)	Hardness as CACO3	Sulfate
		µg/L																							cfs	°C	s.u.		µS/cm	mg/L	mV	mg/L	
Clear Creek Background																																	
BLAC-SW-01	10/18/2011	15.2	<0.5	2.2	13.2	<0.20	<0.08	13600	1.6	<0.5	1.5	<50	0.15	7750	5	<0.2	1.2	832	<0.5	<0.5	2380	<0.1	0.57	<5	4.52	5.1	6.57	7.3 H	83	11.9	-165.8	51	NA
BLAC-SW-01	4/25/2012	667	NA	1.8	13.9	NA	<0.08	NA	3.7	NA	1.6	552	0.14	NA	13.5	<0.2	5.2	NA	NA	NA	NA	NS	NA	<5	nm	3.19	6.03	5.3 H	41	9.74	-194	28.6	1.5
Blackjack Ponds																																	
BLAC-AD-01	10/18/2011	549	<0.5	3.3	31.4	<0.20	1.2	5760	0.94	33.1	102	12400	0.11	7340	2250	<0.2	85	1140	<0.5	<0.5	2780	0.58	0.12	120	0.31	9.64	5.75	5.6 H	111	7.33	-47	41.5	NA
BLAC-AD-01	4/25/2012	450	NA	2.5	31.1	NA	1.1	NA	1.8	NS	85.2	10600	<0.1	NA	1970	<0.2	80.5	NA	NA	NA	NA	NS	NA	116	0.22	9.32	5.83	5.4 H	120	5.72	-147.1	46.2	46.5
BJM-BP-SW-02	10/18/2011	544	<0.5	3.2	31	<0.20	1.2	5960	0.6	32.2	99.2	11700	0.14	7360	2170	<0.2	83.1	1130	<0.5	<0.5	2740	0.57	0.13	119	0	10.59	6	5.8 H	112	8.3	-108.5	43.3	NA
BJM-BP-SW-02	4/25/2012	411	NA	2.2	30.9	NA	1.1	NA	1.4	NS	78.9	9550	0.16	NA	1960	<0.2	79.7	NA	NA	NA	NA	NS	NA	115	0	9.35	6.27	6.2 H	118	7.13	-160.4	31.3	46.3
BLAC-SW-10	10/18/2011	65.7	<0.5	<0.5	29.7	<0.20	1	5840	<0.5	26.3	25.2	1970	<0.1	7300	2220	<0.2	80.2	1160	<0.5	<0.5	2720	0.41	<0.1	110	0	4.79	6.67	6.9 H	82	9.51	-166.9	42.7	NA
BLAC-SW-10	4/25/2012	405	NA	1.5	11.6	NA	<0.8	NA	2.6	NA	5.5	520	<0.1	NA	86.1	<0.2	7.5	NA	NA	NA	NA	NA	NA	8.6	0	5.03	6.76	7.2 H	50	8.62	-200.8	32.5	5.4
BLAC-SW-41	10/18/2011	24.3	<0.5	1.3	13.5	<0.20	<0.8	12220	1.1	<0.5	1.5	<50	<0.1	7180	10.4	<0.2	1.5	910	<0.5	<0.5	2470	<0.1	0.44	<5	2.75	7.95	6.95	7.2 H	86	9.75	-164.2	57.9	NA
BLAC-SW-41	4/25/2012	547	NA	2	11.8	NA	<0.8	NA	3.1	NA	4	490	0.12	NA	43.2	<0.2	5.5	NA	NA	NA	NA	NA	NA	<5	9.01	4.75	6.62	7.4 H	45	9.02	-190.6	30.2	2
BLAC-SW-42	10/18/2011	27.1	<0.5	1.4	14.2	<0.20	<0.8	12500	1.3	<0.5	1.2	53.5	0.12	7350	13	<0.2	1.3	943	<0.5	<0.5	2540	<0.1	0.43	<5	2.55	6.89	7.1	7.2 H	83	10.8	-155.5	61.6	NA
BLAC-SW-42	4/25/2012	522	NA	1.7	11.1	NA	<0.8	NA	3.2	NA	2.6	411	<0.1	NA	14.1	<0.2	5	NA	NA	NA	NA	NA	NA	<5	17.18	4.09	6.87	7.7 H	42	9.72	-142.8	27.3	2.1
BLAC-FS-1 - USFS Bo.	10/18/2011																								4.91	NM	NM	NA	NM	NM	NM	NA	NA
BLAC-FS-1 - USFS Bo.	4/25/2012																								13.32	NM	NM	NA	NM	NM	NM	NA	NA
BLAC-FS-2 - Flow Sta.	10/18/2011																								2.26	NM	NM	NA	NM	NM	NM	NA	NA
BLAC-FS-2 - Flow Sta.	4/25/2012																								8.74	NM	NM	NA	NM	NM	NM	NA	NA
Standards, corrected for hardness where applicable (used 41 mg/L background for surface water samples)																																	
Oregon - Acquatic Life [1]		87	NS	150	NS	NS	0.57	NS	NS	NS	5.5	1000	1.03	NS	NS	0.012	74.4	NS	5	0.12	NS	NS	NS	50	NS	NS	NS	NS	NS	NS	NS	NS	NS
Oregon - Ecological Screening level values [2]		87	1600	NS	4	5.3	2.2	NS	NS	23	9	1000	2.5	82000	120	0.77	52	53000	5	0.12	680000	40	20	12	NS	NS	BS	NS	NS	NS	NS	NS	NS
Oregon - Human Health [3]		NS	5.1	2.1	1000	NS	NS	NS	NS	NS	1300	NS	NS	NS	NS	NS	140	NS	120	NS	NS	0.043	NS	2100	NS	NS	BS	NS	NS	NS	NS	NS	NS
EPA - Acquatic Life [4]		87	NS	150	NS	NS	0.53	NS	100	NS	4.2	1000	0.95	NS	NS	0.77	74.2	NS	5	NS	NS	NS	NS	49.3	NS	9-19	6.5-9	6.5-9	NS	9.5	NS	NS	NS
EPA - Human Health [5]		NS	5.6	0.018	1000	NS	NS	NS	NS	NS	1300	300	NS	NS	50	NS	610	NS	170	NS	NS	1.7	NS	7400	NS	NS	5-9	5-9	NS	NS	NS	NS	NS
ORLN - Surface Water PRGs [6]		87	30	NS	4	0.66	1.1	NS	NS	23	12	1000	3.2	NS	120	1.3	160	NS	0.39	0.36	NS	9	20	110	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:

All Analyses except Low-Level Mercury were conducted by Pace Analytical Services, Inc. Billings, MT per EPA Method 600.

Italic values indicate that the MDL exceeds the lowest standard.

Shaded values indicate that the eceeds one or more standards; exceeded criteria also shaded.

Abbriviations: °C = degrees Celcius, < value = analyte not detected above Method Detection Limit (MDL shown), cfs = cubic feet per second.
H = storage and preservation times were not met, mg/L = milligrams per liter, mg/l - micrograms per liter,
mS /cm = micro siemens per centimeter, mV = millivolts, NA = Mot Analyzed, NM = Not Measued. S.u. = standard units.

STANDARDS NOTES:

1 - State of Oregon proposed Aquatic Life criteria (Toxic Compounds Crireria, May 2004),
underline - corrected for hardness; *italics* - expressed asdissolved

2 - State of Oregon Level II Ecological Screening citeria for Toxic Pollutants (ODEQ December 2001), *italics* - expressed as dissolved

3 - State of Oregon Human Health Aquatic Criteria for Toxic Pollutants (Table 40), Water+Organism (ODEQ 2011)
underline - corrected for hardness, *italics* - expressed as dissolved

4 - EPA recommend chronic ambient water quality criteria for for freshwater aquatic life used (EPA, 2002),
underline - corrected for hardness, *italics* - expressed as dissolved

5 - EPA recommended water quality criteria for consumption human of of water and fish
(EPA, 2002 NTR), *itlics* - expressed as dissolved

6 - ORNL Preiliminary Remediation Goals for Ecological Endpoints (ORNL, 1997)

NS- No Standard

Table 2. Surface Water Analytical Results - Dissolved

Sample ID	Sample Date	Aluminum, Dissolved	Antimony, Dissolved	Arsenic, Dissolved	Barium, Dissolved	Beryllin, Dissolved	Cadmium, Dissolved	Calcium, Dissolved	Chromium, Dissolved	Cobalt, Dissolved	Copper, Dissolved	Iron, Dossolved	Lead, Dissolved	Magnesium, Dissolved	Manganese, Dissoled	Nickel, Dissolved	Potassium, Dissolved	Selenium, Dossolved	Silver, Dissolved	Sodium, Dissolved	Thallium, Dissolved	Vanadium, Dissolved	Zinc, Dissovled
		µg/L																					
Clear Creek Background																							
BLAC-SW-01	10/18/2011	5.3	< 0.5	1.7	10	< 0.2	< 0.08	10,600	0.87	< 0.5	0.5	< 50	< 0.1	5,980	4.1	0.7	654	< 0.5	< ***0.5***	1,880	< ***0.1***	0.39	< 5
BLAC-SW-01	4/25/2012	336	NA	1.3	11.8	NA	< 0.08	NA	1.6	NA	1.1	230	0.11	NA	4.4	2.7	NA	NA	***NA***	NA	NA	NA	< 5
Blackjack Ponds																							
BLAC-AD-01	10/18/2011	64	< 0.5	< ***0.5***	28.8	< 0.2	1.1	5,280	< 0.5	41	42	3,000	< 0.1	6,890	2,050	78.4	1,060	< 0.5	< ***0.5***	2,610	0.52	< 0.1	111
BLAC-AD-01	4/25/2012	38	NA	***< 0.5***	30.3	NA	1	NA	1.3	NA	34.8	1,980	< 0.1	NA	2,160	76.1	NA	NA	NA	NA	NA	NA	114
BJM-BP-SW-02	10/18/2011	54	< 0.5	***< 0.5***	30	< 0.2	1.1	5,550	0.56	32	34.1	2,120	0.12	7,150	2,140	81.8	1,100	< 0.5	< 0.5	2,710	0.54	< 0.1	115
BJM-BP-SW-02	4/25/2012	262	NA	1.2	10.5	NA	< 0.08	NA	1.4	NA	4.2	253	< 0.1	NA	85	6.2	NA	NA	NA	NA	NA	NA	8.8
BLAC-SW-10	10/18/2011	11	< 0.5	< ***0.5***	28	< 0.2	0.97	5,520	0.55	25	7.3	< 50	< 0.1	7,020	1,820	75.6	1,100	< 0.5	< ***0.5***	2,630	0.38	< 0.1	102
BLAC-SW-10	4/25/2012	278	NA	1.2	10.6	NA	< 0.08	NA	1.5	NA	4.4	264	< 0.1	NA	85.6	6.5	NA	NA	NA	NA	NA	NA	8.8
BLAC-SW-41	10/18/2011	5.5	< 0.5	1.2	13	< 0.2	< 0.08	11,700	0.94	< 0.5	0.97	< 50	< 0.1	6,980	14	1.5	866	< 0.5	< 0.5	2,420	< ***0.1***	0.37	< 5
BLAC-SW-41	4/25/2012	282	NA	1.7	9.3	NA	< 0.08	NA	1.5	NA	2.5	182	0.19	NA	6.2	2.3	NA	NA	NA	NA	NA	NA	< 5
BLAC-SW-42	10/18/2011	5.2	< 0.5	1.3	13.9	< 0.2	< 0.08	12,500	1.2	< 0.5	0.89	< 50	< 0.1	7,410	10.1	1.2	944	< 0.5	< 0.5	2,600	*< 0.1*	0.4	< 5
BLAC-SW-42	4/25/2012	295	NA	1.4	9.7	NA	< 0.08	NA	1.6	NA	2	256	< 0.1	NA	4.2	2.7	NA	NA	NA	NA	NA	NA	< 5
Standards, corrected for hardness where applicable (used 41 mg/L background for surface water samples)																							
Oregon - Aquatic Life [1]		87	NS	***150***	NS	NS	*0.53*	NS	NS	NS	*4.20*	1,000	***0.95***	NS	NS	*74.20*	NS	5	0.12	NS	NS	NS	49.97
Oregon - Ecological Screening Level Values [2]		87	1,600	NS	4	5.3	2.2	NS	NS	23	9	1,000	***2.5***	82,000	120	*52*	NS	5	0.12	680,000	40	20	120
Oregon - Human Health[3]		NS	5.1	2.1	1,000	NS	NS	NS	NS	NS	1,300	NS	NS	NS	NS	140	NS	120	NS	NS	0.043	NS	2,100
EPA - Aquatic Life (CCC)[4]		87	NS	***150***	NS	NS	***0.53***	NS	100	NS	***4.20***	1,000	***0.95***	NS	NS	74.20	NS	5	NS	NS	NS	NS	49.97
EPA - Human Health (Water t Organism)[5]		NS	5.6	0.02	1,000	NS	NS	NS	NS	NS	1,300	300	NS	NS	50	610	NS	170	NS	NS	1.7	NS	7,400

NOTES:

All analyses except Low-Level Mercury were conducted by Pace Analytical Services, Inc., Billings, MT per EPA Method 6020,
Italic values indicate that the MDL exceeds the lowest standard.
Shaded values indicate that the value exceeds one at more standard; exceeded criteria also shaded.
Abbreviations: < value = analyte not detected above Method Detection Limit (MDL, shown), pg/L = micrograms per liter, NA = not analyzed.

STANDARDS NOTES:

1 - State of Oregon proposed Aquatic Life criteria (Toxic Compounds Criteria, May 2004),
underline - corrected for hardness, ***italics*** - expressed as dissolved
2 - State of Oregon Level n Ecological Screening criteria (ODEQ, December 2001), ***italics*** - expressed as dissolved
3 - State of Oregon Human Health Water Quality Criteria for Toxic Pollutants (Table 40), Water I Organism (ODEQ 2011).
underline - corrected for hardness, italics - expressed as dissolved
4 - EPA recommended chronic ambient water quality criteria far freshwater aquatic life used (EPA, 2002),
underline - corrected for hardness, italics - expressed as dissolved
5 - EPA recommended ambient water quality criteria for protection of human consumption of water and fish
(EPA, 2002 NTR), italics - expressed as dissolved
NS = No Standard

Table 3 . Sediment Analytical Results

Sample ID	Sample Date	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Berlyllin, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
		mg/kg																						
Clear Creek Background																								
BLAC-SS-01	10/18/2011	11,300	0.86	21.8	77.6	0.25	3,070	0.19	109	20.5	27.1	32,800	2.8	13,400	733	0.035	128	575	< 0.48	< 0.48	135	< 0.096	51	51.2
BLAC-SS-01	4/25/2012	7,720	NA	21.7	48.1	NA	NA	0.2	62.8	NA	32	16,900	3.6	NA	420	< ***0.1***	78.6	NA	NA	NA	NA	NA	NA	37
Blackjack Ponds																								
BJM-BP-SS-02	10/18/2011	2,500	< 0.5	13.4	11.4	< 0.2	70.1	0.24	4.1	4.3	297	58,400	1.9	59.6	62.1	0.13	7.8	153	< 0.5	< 0.5	< 49.5	0.11	3	46.1
BJM-BP-SS-02	4/25/2012	19,300	NA	124	21.5	NA	NA	1.7	12	NA	2,240	298,000	2.3	NA	297	0.61	22.1	NA	NA	NA	NA	NA	NA	156
BLAC-SS-10	10/18/2011	4,760	0.64	30.9	211	0.27	567	7	13.6	216	220	67,000	0.91	712	6,260	0.11	436	170	0.63	< 0.36	< 36.2	2.9	9.2	211
BLAC-SS-10	4/25/2012	9,610	NA	53.7	89.3	NA	NA	2.4	69.7	NA	557	118,000	3.5	NA	2,310	0.29	221	NA	NA	NA	NA	NA	NA	304
BLAC-SS-41	10/18/2011	13,200	0.54	10.5	47.6	0.22	4,090	0.74	95.8	22.8	63.3	25,700	3.1	10,200	429	0.02	130	472	< 0.49	< 0.49	175	< 0.098	66.5	119
BLAC-SS-41	4/25/2012	19,000	NA	31.3	182	NA	NA	15.1	94.6	NA	338	29,100	6.5	NA	1,450	< ***0.33***	414	NA	NA	NA	NA	NA	NA	589
BLAC-SS-42	10/18/2011	7,980	< 0.47	12.7	48.3	0.19	2,760	0.26	75	19.6	30	18,400	2.2	8,100	592	0.037	90.2	422	< 0.47	< 0.47	135	< 0.094	31.4	88.5
BLAC-SS-42	4/25/2012	9,340	NA	22.2	73.6	NA	NA	0.39	70.2	NA	38.3	20,700	2.7	NA	936	0.87	122	NA	NA	NA	NA	NA	NA	65.5
Standards																								
OR - Freshwater [1]		NS	3	NS	NS	NS	NS	0.6	37	NS	36	NS	35	NS	1,100	0.2	18	NS	NS	4.5	NS	NS	NS	123
EPA - Freshwater TEL [2]		NS	NS	5.9	NS	NS	NS	0.596	NS	NS	36	NS	35	NS	NS	0.174	18	NS	NS	NS	NS	NS	NS	123.1
EPA - Freshwater PEL [3]		NS	NS	17	NS	NS	NS	3.53	NS	NS	197	NS	91.3	NS	NS	0.486	35.9	NS	NS	NS	NS	NS	NS	315
OR - Clear Creek Basin Background [+]		29.96	0.82	39.5	128	NS	NS	NS	186	26	32	76,875	5	30,109	NS	NS	316	NS	NS	NS	422	NS	65	59
OR - Background [5]		NS	NS	7	NS	NS	NS	1	NS	NS	NS	NS	17	NS	NS	0.07	NS	NS	2	NS	NS	NS	NS	NS
ORNL - Freshwater[6]		NS	NS	42	NS	NS	NS	4.2	159	NS	77.7	NS	no	NS	NS	0.7	38.5	NS	NS	1.8	NS	NS	NS	270

NOTES:

All analyses were conducted by Pace Analytical Services, Inc., Billings, MT per BPA Method 6020/7471.
Italic values indicate that the MDL exceeds the lowest standard.
Shaded values indicate that the value exceeds one or more standard; exceeded criteria also shaded.
Abbreviations: < value = analyte not detected above Method Detection Limit (MDL, shown), mg/kg = milligrams per kilogram, NA = not analyzed.

STANDARDS NOTES:

1 - State of Oregon, Level C Screening Level Values for Freshwater Sediment (ODEQ, 2001)
2 - EPA Threshold Effects Level (NOAA, 1999)
3 - EPA Probable Effects Level (NOAA, 1999)
4 - State of Oregon, Background Soil and Sediment in the Clear Creek Basin (ODEQ, 2006)
5 - State of Oregon, Regional Default Background Concentrations for Soil/Sediment (ODEQ, 2007)
6 - ORNL ecological screening level values for freshwater, lowest chronic value used (ORNL, 1997)
NS = No Standard

Reference: Cascade Earth Sciences, March 2011. Technical Memorandum: Bluebird Mine October 2010 Post Removal Action Sampling Report.

Table 1. Sampling Location Identification

Sample Location ID	Latitude, North (degrees - minutes)	Longitude, West (degrees - minutes)	Description
BB1	44° 47.866	118° 28.391	Redboy Mine is upgradient of the Bluebird Mine. This sampling location is in the last pond in the Redboy settling system. The Red Boy system discharges to the Bluebird settling pond system, approximately 300 feet upgradient of Bluebird outfall.
BB2	44° 47.888	118° 28.400	Located approximately 150 feet upgradient of the Bluebird Mine effluent pipe.
BB3	44° 47.900	118° 28.392	Bluebird Mine drainage pipe.
BB4	44° 47.913	118° 28.382	Downgradient approximately 150 feet of the Bluebird Mine drainage pipe and in the second treatment pond.
BB5	44° 47.972	118° 28.352	Downgradient of outfall approximately 400 feet in the third treatment cell.
BB6	44° 47.989	118° 28.294	Discharge from the last settling cell through a culvert under Road 10. The discharge infiltrates to Clear Creek.

Table 2. Field Parameters

SAMPLE LOCATION ID	SAMPLE DATE	TEMP °C	EC µS/cm	DO mg/L	pH s.u.	ORP mV	FLOW [1] gpm
BB3 [2]	Dec-04 to May-05	10.3	203	4	6.3	253.1	80.8
BB1	10/26/2007	3.29	558	14.7	7	20.6	NM
	5/28/2008	9.21	168	11.8	6.26	84	NM
	10/14/2008	7.18	525	936	3.92	323.3	NM
	7/15/2009	16.11	0.59	6.35	3.2	425.63	NM
	9/30/2009	8.76	1252	9.81	2.85	408.8	NM
	7/9/2010	24.5	925	NM	3.19	NM	NM
BB2	10/26/2007	2.98	556	14.02	7.33	-60.1	NM
	5/28/2008	8.89	176	10.93	6	86.4	NM
	10/14/2008	7.63	535	9.71	3.69	357	NM
	7/15/2009	16.1	0.51	6.8	3.3	340	NM
	9/30/2009	8.97	1285	10.86	2.83	355	NM
	7/9/2010	22.8	965	NM	3.1	NM	NM
BB3	10/26/2007	9.75	730	9.75	5.72	98.5	42
	5/28/2008	9.99	918	687	5.41	117	31
	10/14/2008	9.92	516	6.21	5.54	171	50
	7/15/2009	9.18	806	7.72	5.6	180	95
	9/30/2009	9.95	757	9.19	5.28	196	60
	7/9/2010	11.7	540	NM	3.53	NM	66
BB4	10/26/2007	5.24	651	12.2	5.99	81.1	NM
	5/28/2008	9.54	245	10.66	5.81	101.3	NM
	10/14/2008	9.43	538	7.8	3.68	382	NM
	7/15/2009	10.1	0.67	6.6	3.9	245	NM
	9/30/2009	9.69	793	10.83	3.5	299	NM
	7/9/2010	20.8	637	NM	3.53	NM	NM
BB5	10/26/2007	5.67	646	10.5	4.31	247	NM
	5/28/2008	8.73	260	10.8	6.1	103	NM
	10/14/2008	7.52	581	9.78	3.34	424	NM
	7/15/2009	15.9	0.88	7.4	2.7	462	NM
	9/30/2009	9.63	958	10.2	3.07	300	NM
	7/9/2010	23.8	695	NM	3.3	NM	NM
BB6	10/26/2007	5.61	673	11.21	3.76	366	NM
	5/28/2008	9.45	259	10.79	5.76	112	NM
	10/14/2008	7.19	598	9.89	3.15	445	NM
	7/15/2009	16.1	0.89	7.1	3	402	NM
	9/30/2009	No Flow	No Flow	No Flow	No Flow	No Flow	NM
	7/9/2010	23.5	698	NM	3.29	NM	NM

NOTES

Abbreviations: oC = degrees Celsius, DO = dissolved oxygen, EC = electrical conductivity, gpm = gallons per minute, mg/L = milligrams per liter, mV = milliVolts, NM = not measured, ORP = oxidation reduction potential, s.u. standard units, Temp = temperature, µS/cm = microseimins per centimeter.

1 Flow estimated using a bucket and stopwatch.

2 Sample location BB3 is the pre-plug installation average.

Table 3. Analytical Results

Sample Location	Sample Date		Antimony, Diss.	Antimony, TR	Arsenic, Diss.	Arsenic, TR	Cadmium, Diss.	Cadmium, TR	Calcium, Diss.	Copper, Diss.	Copper, TR	Iron, Diss.	Iron, TR	Lead, Diss.	Lead, TR	Magnesium, Diss.	Manganese, Diss.	Manganese, TR	Mercury, Diss.	Mercury, total	Nickel, Diss.	Nickel, TR	Selenium, Diss.	Selenium, TR	Silver, Diss.	Silver, TR	Zinc, Diss.	Zinc, TR	Bicarbonte as $CaCO_3$	Carbonate as $CaCO_3$	Hardness as $CaCO_3$	Hydroxide as $CaCO_3$	pH @ 21°C (lab)	Sulfate	Total Alkalinity
			mg/L																														s.u.	mg/L	
BB3 [1]	Dec-04 to May-05		0.0003	0.0003	**0.0006**	**0.0013**	**0.0008**	**0.0007**	4.35	0.0025	0.0039	**2.5**	**12.33**	0.0001	0.0001	11.08	**4.91**	**4.88**	**0.0002**	**0.0002**	**0.1075**	**0.11**	0.001	0.001	NA	NA	**0.1988**	**0.1950**	NA	NA	NA	NA		67.50	NA
BB1	Oct-07		U	U	**0.0009**	**0.0101**	**0.0006**	**0.0005**	34.6	U	U	**17.8**	**24.4**	U	U	32.2	**6.08**	**5.83**	U	U	**0.15**	**0.14**	U	U	U	U	**0.27**	**0.23**	9	U	219	U	6.6	250	9
	May-08		U	U	**0.0012**	**0.005**	**0.0002**	**0.0003**	10.1	U	**0.01**	**0.7**	**8.74**	U	0.003	9.2	**1.44**	**1.47**	U	U	**0.06**	**0.05**	U	U	U	U	0.08	**0.13**	U	U	63	U	U	NA	U
	Oct-08		U	U	**0.0067**	**0.0132**	**0.0013**	**0.0012**	40.7	**0.02**	**0.02**	**36.4**	**39.1**	U	U	44.8	**9.77**	**9.71**	U	U	**0.3**	**0.28**	U	U	0.00006	U	**0.52**	**0.5**	U	U	286	U	**3.2**	390	U
	Jul-09		U	U	**0.00255**	**0.0104**	**0.00063**	**0.00062**	30.7	0.00855	0.00809	**10.1**	**11.1**	U	U	31.6	**7.1**	**6.97**	U	U	**0.16**	**0.148**	U	U	U	U	**0.308**	**0.305**	U	U	216		**3.4**	360	U
	Sep-09		U	U	**0.015**	**0.028**	**0.0013**	**0.0013**	48.7	**0.028**	**0.03**	**27.1**	**30**	0.00074	U	53.9	**12**	**13**	U	U	**0.28**	**0.3**	0.00042	0.00043	U	U	**0.609**	**0.617**	U	U	372		**3.4**	636	U
	Jul-10		U	U	**0.0053**	**0.015**	**0.001**	**0.00099**	45.2	**0.017**	**0.017**	**9.5**	**10.3**	**0.0034**	U	46.1	**9.1**	**8.2**	U	U	**0.2**	**0.2**	U	U	U	U	**0.338**	**0.379**	U	U	321	U	**3.32**	400	U
BB2	Oct-07		U	U	**0.0015**	**0.0097**	**0.0005**	**0.0005**	34.6	U	U	**17.1**	**23.3**	U	U	32	**6.05**	**5.74**	U	U	**0.16**	**0.14**	0.0002	U	U	U	**0.24**	**0.23**	7	U	218	U	6.7	250	7
	May-08		U	U	**0.0011**	**0.0047**	0.0002	0.0002	10.3	U	**0.01**	**0.7**	**8.07**	U	0.0002	9.4	**1.5**	**1.51**	U	U	**0.06**	**0.06**	U	U	U	U	0.09	**0.09**	U	U	64	U	U	NA	U
	Oct-08		U	U	**0.0067**	**0.0126**	**0.0013**	**0.012**	41.7	**0.02**	**0.02**	**36.3**	**39.1**	U	U	45.8	**10**	**10.1**	U	U	**0.3**	**0.29**	U	U	U	U	**0.52**	**0.52**	U	U	292	U	**3.3**	380	U
	Jul-09		U	U	**0.00352**	**0.00885**	**0.000666**	**0.00069**	31.8	**0.0144**	0.00829	**9.3**	**9.81**	U	U	32.8	**7.22**	**6.99**	U	U	**0.161**	**0.146**	U	U	U	U	**0.303**	**0.297**	U	U	242	U	**3.3**	427	U
	Sep-09		U	U	**0.009**	**0.025**	**0.0012**	**0.0013**	48.9	**0.027**	**0.029**	**23.5**	**26.5**	0.00023	U	54.1	**11**	**11**	U	U	**0.25**	**0.28**	0.00031	0.00055	U	U	**0.613**	**0.612**	U	U	376	U	**3.23**	788	U
	Jul-10		U	U	**0.0036**	**0.035**	**0.0013**	**0.001**	46	**0.015**	**0.014**	**4.7**	**4.48**	0.0013	U	46.6	**8.7**	**9.2**	U	U	**0.19**	**0.2**	U	U	U	U	**0.358**	**0.376**	U	U	318	U	**3.26**	404	U
BB3	Oct-07		U	U	**0.0019**	**0.0042**	**0.0005**	0.0004	18	U	U	**63.1**	**67.4**	U	U	52.3	**28.2**	**27.1**	U	U	**0.42**	**0.4**	U	U	U	U	**0.49**	**0.46**	U	U	260	U	**4.2**	420	U
	May-08		U	U	**0.0019**	**0.006**	0.0004	0.0004	21.6	U	U	**73.6**	**90.5**	0.0002	0.0001	63.2	**32.9**	**32.5**	U	U	**0.49**	**0.44**	U	U	U	U	**0.47**	**0.44**	U	U	314	U	U	NA	U
	Oct-08		U	U	**0.0017**	**0.0052**	0.0003	0.0002	18.5	U	U	**59.0**	**68.3**	U	U	49.6	**25.8**	**28.2**	U	U	**0.37**	**0.4**	U	U	0.00007	U	**0.38**	**0.41**	U	U	250	U	**3.2**	400	U
	Jul-09		U	U	**0.0018**	**0.0067**	U	U	16.8	U	U	**60.5**	**76.6**	U	U	45.6	**25.8**	**26.1**	U	U	**0.332**	**0.302**	U	U	U	U	**0.336**	**0.369**	U	U	266	U	**5.23**	578	12.5
	Sep-09		U	U	**0.00072**	**0.0052**	0.00021	0.00018	14.9	**0.021**	0.0036	**47.0**	**52.9**	U	U	40.2	**18**	**19**	U	U	**0.26**	**0.26**	U	0.00015	U	U	**0.328**	**0.325**	10	U	268	U	**4.86**	314	10
	Jul-10		U	U	**0.0015**	**0.0061**	0.00021	0.00019	13.1	0.0011	0.0026	**42.5**	**47.1**	U	U	33.8	**18**	**18**	U	U	**0.22**	**0.23**	U	U	U	U	**0.245**	**0.251**	10	U	170	U	**5.8**	274	10
BB4	Oct-07		U	U	**0.0017**	**0.0065**	**0.0005**	0.0005	27.2	U	U	**34.8**	**40.2**	U	U	40.6	**15.5**	**15.1**	U	U	**0.26**	**0.25**	U	U	U	U	**0.35**	**0.33**	U	U	235	U	**5.5**	340	U
	May-08		U	U	**0.0008**	**0.0048**	0.0003	0.0003	11.2	U	**0.01**	**3.8**	**15.1**	U	0.0003	13.7	**4.09**	**4.13**	U	U	**0.1**	**0.08**	U	U	U	U	**0.26**	**0.16**	U	U	84	U	U	NA	U
	Oct-08		U	U	**0.004**	**0.0074**	0.0008	0.0008	30.5	U	**0.01**	**37.1**	**44.6**	U	U	45.9	**16.4**	**17.7**	U	U	**0.32**	**0.33**	U	U	U	U	**0.44**	**0.47**	U	U	265	U	**3.1**	390	U
	Jul-09		U	U	**0.00219**	**0.00327**	U	U	17.9	0.00208	U	**49.7**	**52.7**	U	U	45.6	**24.9**	**24.9**	U	U	**0.316**	**0.28**	U	U	U	U	**0.345**	**0.358**	U	U	282	U	**3.77**	626	U
	Sep-09		U	U	**0.0013**	**0.003**	**0.00049**	0.00017	16.3	0.0033	0.0032	**34.0**	**40.2**	0.0001	U	40.1	**20**	**19**	U	U	**0.25**	**0.25**	0.0001	U	U	U	**0.314**	**0.329**	U	U	310	U	**3.67**	415	U
	Jul-10		U	U	**0.00077**	**0.0026**	0.00035	0.0003	19.2	0.0032	0.0032	**22.6**	**23.8**	U	U	36.1	**17**	**16**	U	U	**0.21**	**0.21**	U	U	U	U	**0.261**	**0.265**	U	U	200	U	**3.7**	293	U
BB5	Oct-07		U	U	**0.0024**	**0.0038**	**0.0005**	0.0004	26.4	U	U	**27.2**	**30.4**	U	U	38.5	**14.5**	**14.1**	U	U	**0.25**	**0.24**	U	U	U	U	**0.32**	**0.31**	U	U	224	U	**3.8**	320	U
	May-08		U	U	U	**0.0036**	0.0003	0.0003	11.9	U	U	**4.5**	**15.6**	U	0.0003	14.9	**4.5**	**4.54**	U	**0.0004**	**0.11**	**0.09**	U	U	U	U	**0.14**	**0.2**	U	U	0.91	U	U	NA	U
	Oct-08		U	U	**0.0013**	**0.0041**	**0.0009**	**0.0007**	31.4	U	U	**33.6**	**36.2**	U	U	47.6	**17.2**	**17.7**	U	U	**0.34**	**0.33**	U	U	U	U	**0.47**	**0.46**	U	U	274	U	**3.3**	390	U
	Jul-09		U	U	U	U	U	U	20.4	**0.0094**	0.00866	**26.5**	**28.8**	U	U	44.5	**22.8**	**22.5**	U	U	**0.305**	**0.272**	U	U	U	U	**0.406**	**0.369**	U	U	298	U	**3.15**	638	U
	Sep-09		U	U	U	**0.0012**	**0.00044**	0.00026	19	0.0033	0.0037	**26.1**	**27.1**	U	U	41.9	**18**	**17**	U	U	**0.25**	**0.24**	0.00012	0.00012	U	U	**0.338**	**0.343**	U	U	322	U	**3.36**	392	U
	Jul-10		U	U	U	**0.0008**	0.00035	0.00033	19.7	0.0053	0.0049	**14.5**	**14.8**	U	U	35.2	**16**	**15**	U	U	**0.22**	**0.21**	U	U	U	U	**0.253**	**0.259**	U	U	195	U	**3.4**	288	U
BB6	Oct-07		U	U	**0.002**	**0.0028**	**0.0005**	0.0004	27.3	U	U	**25.8**	**29.3**	U	U	39.6	**15**	**14.6**	U	U	**0.25**	**0.25**	0.0001	U	U	U	**0.33**	**0.33**	U	U	231	U	**3.7**	300	U
	May-08		U	U	**0.0006**	**0.0033**	0.0003	0.0003	12	U	U	**4.3**	**14.2**	U	U	15.3	**4.56**	**4.53**	U	U	**0.11**	**0.09**	U	U	U	U	**0.14**	**0.14**	U	U	0.93	U	U	U	U
	Oct-08		U	U	**0.0008**	**0.0036**	**0.0009**	**0.0008**	31.4	0.01	U	**31.2**	**33.1**	U	U	47.7	**17.2**	**17.6**	U	U	**0.34**	**0.32**	U	U	U	U	**0.45**	**0.44**	U	U	275	U	**3.3**	410	U
	Jul-09		U	U	U	U	U	U	21.4	**0.00974**	**0.00971**	**25.0**	**26.2**	U	U	44.5	**22.5**	**22.2**	U	U	**0.299**	**0.27**	U	U	U	U	**0.372**	**0.389**	U	U	260	U	**3.14**	594	U
	Sep-09		No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
	Jul-10		U	U	U	**0.00077**	0.00037	0.00037	19.6	0.0051	0.0053	**13.8**	**14.5**	U	U	34.9	**15**	**15**	U	U	**0.2**	**0.21**	U	U	U	U	**0.256**	**0.263**	U	U	192	U	**3.38**	292	U
MDL			0.0004	0.0004	0.0005	0.0005	0.0001	0.0001	0.2	0.01	0.01	0.02	0.02	0.0001	0.0001	0.2	0.005	0.005	0.0002	0.0002	0.01	0.01	0.0001	0.0001	0.00005	0.00005	0.01	0.01	2	2	1	2	0.1	10	2
Standards (Corrected where appropriate for an average hardness of 233 mg/L)																																		
Oregon - Ecological (Aquatic Life) [1]			NS	NS	0.19	0.19	0.00044	0.00051	NS	0.0185	0.0192	1	1	0.0062	0.0093	82	NS	NS	0.000012	0.000012	0.106	0.107	0.005	0.005	NS	NS	0.242	0.245	NS	NS	NS	NS	6.5-9	NS	NS
Oregon - Ecological SLVs [2]			1.6	1.6	0.15	0.15	0.0022	0.0022	116	0.009	0.009	1	1	0.0025	0.0025	82	0.12	0.12	0.00077	0.00077	0.052	0.052	0.005	0.005	0.00012	0.00012	0.12	0.12	NS	NS	NS	NS	NS	NS	NS
Oregon - Human Health [3]			0.146	0.146	0.0000022	0.0000022	NS	NS	NS	1.3	1.3	0.3	0.3	NS	NS	NS	0.05	0.05	NS	NS	0.0134	0.0134	0.01	0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES

Sample Locations:

BB1 - Upgradient of outfall ~500 feet.
BB2 - Upgradient of outfall ~250 feet.
BB3 - Adit Dam Pipe outfall.
BB4 - Downgradient of outfall ~150 feet "2nd" treatment cell.
BB5 - Downgradient of outfall ~400 feet "3rd" treatment cell.
BB6 - At discharge culvert for 3rd cell ~1,500 feet downgradient.

Abbreviations: CaCO3 = calcium carbonate, Diss. = dissolved, MDL = method detection limit, mg/L = milligrams per liter, NA = not analyzed, NS = no standard, s.u. = standard units, TR = total recoverable, U = analyte was not detected at the indicated MDL.

1 Sample location BB3 is the pre-plug installation average.

Bold indicates samples above standard**.**

STANDARD NOTES

1 ODEQ (2004) Water Quality Criteria Protection of Aquatic Life, Fresh Chronic Criteria (OAR 340-041-001), corrected for hardness
2 ODEQ (2001) Guidance for Ecological Risk Assessment, Level II Screening Values for surface water
3 ODEQ (2010) Water Quality Criteria, Protection of Human Health, Water and Fish Ingestion (OAR-340-041-001)

Reference: Cascade Earth Sciences, May 2007. Non-Time Critical Removal Action Report, Bluebird Mine Portal, Wallowa-Whitman National Forest, Baker County, Oregon.

Table 1. Bluebird Mine Average Weekly Logged (in-adit) Eh, pH, and Temperature Recordings
Bluebird Mine Portal Closure, Wallowa-Whitman National Forest, Baker County, Oregon

DATE	Eh (mV)	pH (su)	Temperature (°C)
12/4/2004	214	7.20	10.0
12/11/2004	215	7.10	9.9
12/18/2004	215	6.99	9.9
12/25/2004	214	6.94	9.9
1/1/2005	214	6.87	10.0
1/8/2005	214	6.85	10.0
1/15/2005	212	6.83	10.0
1/22/2005	211	6.82	10.0
1/29/2005	210	6.83	10.1
2/5/2005	209	6.86	10.1
2/12/2005	208	6.91	10.0
2/19/2005	219	6.84	10.1
2/26/2005	225	6.80	10.1
3/5/2005	226	6.82	10.1
3/12/2005	227	6.79	10.1
3/19/2005	225	6.76	10.1
3/26/2005	212	6.69	10.1
4/2/2005	230	6.53	10.1
4/9/2005	293	6.29	10.1
4/16/2005	334	6.07	10.1
4/23/2005	326	5.98	10.1
4/28/2005	314	6.10	10.1
5/21/2005	284	5.66	10.1
5/28/2005	266	5.56	10.1
6/4/2005	263	5.29	10.1
6/11/2005	271	5.11	10.2
6/18/2005	275	4.94	10.1
6/25/2005	274	4.91	10.1
7/2/2005	283	4.79	10.2
7/9/2005	269	4.79	10.1
7/16/2005	264	4.78	10.1
7/23/2005	260	4.84	10.1
7/30/2005	256	4.93	10.1
8/6/2005	265	4.96	10.1
8/13/2005	264	5.03	10.1
8/18/2005	272	5.07	10.1

NOTES:
Eh = Redox potential
mV = millivolts
su = standard units
°C = degrees Celcius

Table 2. Bluebird Mine Data Gap Investigation Analyses, Discharge Water Bluebird Mine Portal Closure, Wallowa-Whitman National Forest, Baker County, Oregon

| Sample I.D. | Sample Date | Aluminum, TR | Aluminum, Diss. | Antimony, TR | Antimony, Diss. | Arsenic,Total, TR | Arsenic Total, Diss. | Barium, TR* | Barium, Diss. | Beryllium, TR | Beryllium, Diss. | Cadmium, TR | Cadmium, Diss. | Calcium, TR | Calcium, Diss. | Chromium, TR | Chromium, Diss. | Cobalt, TR | Cobalt, Diss. | Copper, TR | Copper, Diss. | Iron, TR | Iron, Diss. | Lead, TR | Lead, Diss. | Magnesium, TR | Magnesium, Diss. | Manganese, TR | Manganese, Diss. | Mercury, TR | Mercury, Diss. | Nickel, TR | Nickel, Diss. | Potassium, TR | Potassium, Diss. | Selenium, TR | Selenium, Diss. | Silver, TR[1] | Silver, Diss. | Sodium, TR | Sodium, Diss. | Thallium, TR | Thallium, Diss. | Vanadium, TR | Vanadium, Diss. | Zinc, TR | Zinc, Diss. | Flow Rate | Temperature (Field) (Handheld Meter) | Temperature (Field) (Tempilon) | pH (Field) | pH (Field) | pH (Lab)* | Conductivity (Field) (Handheld Meter) | Conductivity @ 25°C (Lab) | Oxygen Reduction Potential | Dis. Oxygen (Field) | Residue, Filterable (TDS) | Residue, Non-Filterable | Sulfate |
|---|---|---|---

GENERAL INFORMATION FORM

GENERAL

Region/Station: 06 Forest Number: _____ District No.: _____
Congressional District: 02

Project Name: Bluebird and Blackjack Mines
Project Type: Site Inspection
Regional Priority: NA
5th Level HUC: NA 4th = 17070202 N.F. John Day

Single Site: ___ Multiple Site: x
List all site names in multiple sites: Bluebird and Blackjack Mines

ENVIRONMENT

Watershed Name: Granite Creek
Regional Watershed Priority: 02
Watershed size: ~120 mi.^{2}
Size of disturbed area (acres): ~4
Nearest surface water source: Clear Creek
Miles of stream impacted by site: ~1
303d listed impaired surface water Yes x No
If 303d listed impaired, what are the water quality limited contaminants? Temperature

Is the site affecting a Wild and Scenic river Yes ___ No x
Describe potential for a catastrophic failure if not addressed: _____

Beneficial uses downstream: Recreation, salmonid habitat and passage
Nearest critical sensitive area: Wetlands, anadromous fish migration route
Distance sensitive area is from site: On site
Sensitive species: redband trout, westslope cutthroat trout, sculpin, olive-sided flycatcher (identified in Grant County)
T&E species: bull trout, steelhead (identified in Grant County)
Is the soil environment conducive to contaminant movement Yes x No ___
Activities in the watershed that also contribute to environmental damage (logging, roads, dredging, grazing, etc.): Roads, mining, limited logging

Would a removal action have a noticeable positive impact on or reduce the potential future risk of damaged resources Yes x No ___
Other critical information relating to the environment: _____

HUMAN HEALTH AND SAFETY

	Within 200 ft of the Site	Within 4 mi of the Site	Within 15 mi of the Site
Year round population based on residences	0	~50	NA
Seasonal population based on residences	0	~50	NA
Water wells	0	0	NA
Surface water intakes	0	0	0

Recreational activities within 200 ft of the site: Swimming
Recreational activities that occur within 15 mi of the site: Hiking, camping, fishing, hunting
Established recreational sites within 200 ft of the site: Informal swimming hole on Clear Creek
Established recreational sites within 15 mi of the site: Campgrounds, trails
Depth to groundwater (ft): NA
Beneficial uses downstream: Habitat, recreation
Physical hazards: Settling ponds, debris, steep slopes

Hazard	
Dangerous Highwall	No
Subsidence	No
Vertical Opening/Shaft	No
Dangerous Impoundment	No
Dangerous Pile and Embankment	No
Dangerous Slide	No
Hazardous Equipment or Unstable Structures	No
Hazardous Explosive Gases	No
Hazardous Water Body/Ponds	Yes
Solid Waste	No
Horizontal Opening/Adit	Yes

Other critical information relating to health and safety: _____

MIXED OWNERSHIP INFORMATION

% of the site on NFS land (managed by NFS): 100
% of the watershed on NFS land (managed by NFS): ~85

POTENTIAL CONTAMINATION

	Yes	No
Surface Water Indicators		
High turbidity in surface water		X
Active erosion into surface water	X	
Staining or precipitate/sediments	X	
Aquatic kills	X	
Visible plume	X	
Discharges to surface water sources (i.e., adit drainage or leachate)	X	
Noticeable decline in aquatic population (compared to upstream of the site)		X
Surface water void of life in the area of the mine site		X
Site located in the floodplain/wetland	X	
Failing or Inadequate Design		
Oversteepened slopes	X	
Unlined ponds	X	
Inadequate landfill design or dumps		X
Unstable retainment structure		X
Past Practices		
Uncontrolled landfill/dump		X
Improper disposal	X	
Chemical/wastes were stored onsite in drums/tanks, etc.	X	
Past practices at site used hazardous materials	X	
Other Indicators		
Stressed vegetation	X	
Dead vegetation or lack of vegetation	X	
Animal kills		X
Visual contaminants	X	
Heavily stained soils/salts present	X	

Other critical potential contaminant information: _____

ANALYTICAL/DOCUMENTED CONTAMINATION

Media	Distance	Location	Rate of Discharge/Volume (gpm or cy)	Contaminant	Exceedance	Background
Water	On site	Blackjack Adit	NA	Ba, Fe, Pb, Mn, Hg, Ni, Zn, pH	Various	Various
	On site	Bluebird Adit	NA	Ba, Co, Fe, Ma, Hg, Ni, Zn, pH	Various	Various
	Variable	Blackjack Streams	NA	Ar, ArV, Ba, Pb, Hg, DO	Various	Various
	Variable	Bluebird Streams	NA	ArV, Ba, Hg, TDS	Various	Various
	On site	Blackjack Pond	NA	Al, Ba, Cd, Co, Cu, Fe, Pb, Ma, Hg, Ni, Se, Zn, pH, DO	Various	Various
	On site	Bluebird Pond	NA	Al, ArV, Ba, Co, Fe, Pb, Ma, Hg, Ni, Se, Zn, pH, DO	Various	Various
Sediment	On site	Blackjack Adit	NA	An, Ar, Cd, Cu, Hg, Ni, Zn	Various	Various
	Variable	Blackjack Streams	NA	An, Ar, Cd, Cr, Cu, Ma, Hg, Ni, Ag, Zn	Various	Various
	Variable	Bluebird Streams	NA	An, Ar, Cd, Cr, Cu, Hg, Ni	Various	Various
	On site	Blackjack Pond	NA	An, Ar, Cd, Cr, Cu, Ma, Hg, Ni, Zn	Various	Various
	On site	Bluebird Pond	NA	An, Ar, Cd, Cu, Ma, Ni, Zn	Various	Various
Soil/Waste	On site	On site Blackjack	NA	Al, An, Ar, Ba, Be, Cr, Co, Cu, Fe, Pb, Ma, Hg, Ni, Se, Tl, V, Zn	Various	Various
	On site	On site Bluebird	NA	Al, An, Ar, Ba, Be, Cr, Co, Cu, Fe, Pb, Ma, Hg, Ni, Se, Tl, V, Zn	Various	Various

ADDITIONAL STUDIES

Biological studies that show a decrease in the number and lower species diversity downstream of the site: Yes ___ No x
Increased mortality in nesting wildlife: Yes ___ No x
Other critical contaminant information: _____

Table F-1. Number and Relative Abundance of Taxa Collected from Riffle Habitat near Bluebird and Blackjack Mines, 21 and 23 July 2003

Table F-1. Number and Relative Abundance of Taxa Collected from Riffle Habitat near Bluebird and Blackjack Mines, 21 and 23 July 2003

	BLAC-ST-BMR-01		BLAC-ST-BMR-02		BLAC-ST-BMR-03		BLAC-ST-BMR-04		BLAC-ST-BMR-42		BLUE-ST-BMR-05		BLUE-ST-BMR-06		BLUE-ST-BMR-07		BLUE-ST-BMR-08	
Taxa	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Turbellaria	38	1.71	34	0.58	26	0.71	26	0.68	55	3.14	89	2.75	107	5.48	16	1.16	38	1.82
Lumbriculidae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	0.29	7	0.34
Tubificidae	69	3.10	171	2.90	51	1.40	13	0.34	6	0.34	167	5.16	13	0.67	12	0.87	97	4.65
Ostracoda	--	--	--	--	--	--	--	--	--	--	11	0.34	--	--	--	--	--	--
Pacifastacus	2	0.09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydracarina	31	1.39	69	1.17	--	--	--	--	6	0.34	11	0.34	--	--	4	0.29	15	0.72
Ameletus	46	2.07	--	--	16	0.44	1	0.03	6	0.34	1	0.03	13	0.67	18	1.30	7	0.34
Acentrella	--	--	--	--	--	--	297	7.79	12	0.68	44	1.36	7	0.36	--	--	--	--
Baetis tricaudatus	62	2.79	449	7.61	505	13.85	207	5.43	18	1.03	213	6.58	68	3.48	55	3.99	99	4.74
Diphetor hageni	8	0.36	68	1.15	26	0.71	27	0.71	223	12.72	23	0.71	20	1.02	12	0.87	--	--
Centroptilum	--	--	--	--	13	0.36	--	--	--	--	--	--	--	--	--	--	--	--
Heptageniidae	86	3.87	85	1.44	128	3.51	194	5.09	6	0.34	33	1.02	73	3.74	68	4.93	--	--
Epeorus (Iron)	62	2.79	258	4.37	168	4.61	68	1.78	51	2.91	114	3.52	67	3.43	20	1.45	61	2.92
Paraleptophlebia	8	0.36	17	0.29	66	1.81	--	--	37	2.11	33	1.02	46	2.36	8	0.58	--	--
Serratella teresa	--	--	19	0.32	--	--	--	--	--	--	--	--	--	--	13	0.94	49	2.35
Serratella tibialis	93	4.18	766	12.98	158	4.33	284	7.45	74	4.22	179	5.53	178	9.12	90	6.52	167	8.00
Drunella flavilinea	1	0.04	51	0.86	2	0.05	14	0.37	2	0.11	2	0.06	3	0.15	4	0.29	--	--
Drunella spinifera	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	52	2.49
Timpanoga hecuba	--	--	--	--	40	1.10	--	--	--	--	11	0.34	14	0.72	16	1.16	--	--
Attenella margarita	54	2.43	69	1.17	38	1.04	26	0.68	--	--	22	0.68	--	--	--	--	--	--
Zapada cinctipes	--	--	--	--	--	--	--	--	60	3.42	--	--	--	--	--	--	--	--
Pteronarcys californica	9	0.40	35	0.59	--	--	13	0.34	--	--	45	1.39	7	0.36	--	--	8	0.38
Calineuria californica	8	0.36	18	0.30	40	1.10	117	3.07	6	0.34	--	--	42	2.15	39	2.83	1	0.05
Claassenia sabulosa	--	--	1	0.02	1	0.03	13	0.34	1	0.06	--	--	3	0.15	2	0.14	24	1.15
Doroneuria baumanni	--	--	--	--	1	0.03	--	--	--	--	--	--	--	--	--	--	--	--
Hesperoperla pacifica	47	2.11	108	1.83	13	0.36	--	--	--	--	33	1.02	--	--	--	--	7	0.34
Sweltsa	46	2.07	17	0.29	13	0.36	26	0.68	36	2.05	22	0.68	33	1.69	28	2.03	46	2.20
Dolophilodes	--	--	1	0.02	--	--	--	--	139	7.93	23	0.71	8	0.41	5	0.36	30	1.44
Polycentropus	1	0.04	--	--	2	0.05	--	--	--	--	--	--	--	--	--	--	7	0.34
Hydropsyche	102	4.59	276	4.68	117	3.21	118	3.10	21	1.20	124	3.83	122	6.25	73	5.29	18	0.86
Hydropsyche occidentalis	--	--	17	0.29	1	0.03	--	--	--	--	--	--	--	--	--	--	119	5.70
Parapsyche almota	--	--	--	--	--	--	--	--	1	0.06	--	--	--	--	--	--	--	--
Rhyacophila	--	--	--	--	--	--	--	--	6	0.34	--	--	--	--	--	--	7	0.34
Rhyacophila alberta grp.	--	--	--	--	--	--	--	--	1	0.06	--	--	--	--	--	--	--	--
Rhyacophila brunnea grp.	8	0.36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rhyacophila coloradensis grp.	--	--	--	--	1	0.03	--	--	--	--	--	--	--	--	--	--	--	--
Glossosoma	--	--	--	--	--	--	--	--	--	--	--	--	8	0.41	11	0.80	7	0.34
Hydroptilidae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	0.38
Hydroptila	--	--	34	0.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stactobiella	15	0.67	137	2.32	27	0.74	13	0.34	--	--	11	0.34	13	0.67	8	0.58	--	--
Brachycentrus americanus	24	1.08	53	0.90	26	0.71	13	0.34	36	2.05	44	1.36	23	1.18	--	--	2	0.10
Micrasema	23	1.03	153	2.59	--	--	13	0.34	--	--	--	--	34	1.74	16	1.16	67	3.21
Neophylax	2	0.09	3	0.05	--	--	13	0.34	--	--	--	--	3	0.15	3	0.22	10	0.48
Onocosmoecus	--	--	--	--	--	--	--	--	1	0.06	--	--	--	--	--	--	--	--
Dicosmoecus gilvipes	18	0.81	1	0.02	2	0.05	4	0.10	1	0.06	15	0.46	--	--	--	--	--	--
Psychoglypha	--	--	--	--	13	0.36	--	--	--	--	--	--	7	0.36	--	--	--	--

Table F-1 (cont.)

	BLAC-RE-BMR-01		BLAC-ST-BMR-02		BLAC-ST-BMR-03		BLAC-ST-BMR-04		BLAC-ST-BMR-42		BLUE-ST-BMR-05		BLUE-ST-BMR-06		BLUE-ST-BMR-07		BLUE-ST-BMR-08	
Taxa	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Apatania	8	0.36	--	--	13	0.36	--	--	18	1.03	--	--	40	2.05	32	2.32	--	--
Lepidostoma	109	4.90	360	6.10	258	7.08	373	9.79	--	--	134	4.14	133	6.81	226	16.38	89	4.26
Oreodytes	2	0.09	1	0.02	--	--	--	--	--	--	23	0.71	--	--	--	--	1	0.05
Brychius	--	--	--	--	--	--	--	--	6	0.34	1	0.03	--	--	--	--	--	--
Cleptelmis ornata	--	--	20	0.34	13	0.36	1	0.03	--	--	--	--	34	1.74	1	0.07	135	6.47
Dubiraphia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.05
Heterlimnius koebelei	1	0.04	19	0.32	13	0.36	1	0.03	48	2.74	12	0.37	7	0.36	9	0.65	--	--
Microcylloepus pusillus	--	--	--	--	13	0.36	--	--	--	--	--	--	--	--	--	--	--	--
Narpus concolor	23	1.03	18	0.30	--	--	--	--	13	0.74	12	0.37	--	--	5	0.36	1	0.05
Optioservus quadrimaculatus	179	8.05	255	4.32	90	2.47	259	6.80	158	9.01	146	4.51	106	5.43	60	4.35	60	2.87
Optioservus divergens	--	--	1	0.02	26	0.71	1	0.03	--	--	22	0.68	--	--	9	0.65	--	--
Zaitzevia parvula	419	18.84	650	11.01	452	12.40	916	24.04	170	9.70	659	20.35	126	6.45	156	11.30	150	7.18
Blepharicera	2	0.09	--	--	--	--	--	--	--	--	23	0.71	--	--	--	--	1	0.05
Pentaneurini	15	0.67	--	--	38	1.04	13	0.34	6	0.34	33	1.02	33	1.69	8	0.58	7	0.34
Diamesinae	69	3.10	136	2.30	51	1.40	13	0.34	12	0.68	78	2.41	26	1.33	32	2.32	22	1.05
Orthocladiinae	170	7.64	918	15.55	283	7.76	232	6.09	252	14.38	447	13.80	224	11.48	124	8.99	215	10.30
Chironomini	38	1.71	34	0.58	77	2.11	64	1.68	6	0.34	78	2.41	79	4.05	44	3.19	67	3.21
Tanytarsini	54	2.43	17	0.29	154	4.22	51	1.34	12	0.68	89	2.75	13	0.67	24	1.74	7	0.34
Maruina	8	0.36	18	0.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Simulium	162	7.28	374	6.34	579	15.88	270	7.08	150	8.56	56	1.73	73	3.74	56	4.06	118	5.65
Antocha	54	2.43	52	0.88	26	0.71	52	1.36	72	4.11	100	3.09	73	3.74	36	2.61	179	8.57
Dicranota	--	--	--	--	--	--	--	--	6	0.34	--	--	--	--	--	--	--	--
Hexatoma	1	0.04	--	--	1	0.03	27	0.71	1	0.06	--	--	7	0.36	--	--	15	0.72
Atherix	47	2.11	102	1.73	64	1.76	38	1.00	--	--	33	1.02	66	3.38	32	2.32	67	3.21
Silvius	--	--	17	0.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pisidium	--	--	--	--	--	--	--	--	18	1.03	11	0.34	--	--	1	0.07	--	--
Margaritifera falcata	--	--	--	--	--	--	--	--	--	--	11	0.34	--	--	--	--	--	--
Total	2224	100.00	5902	100.00	3645	100.00	3811	100.00	1753	100.00	3238	100.00	1952	100.00	1380	100.00	2088	100.00

Table F-1A. Number and Relative Abundance of Taxa Collected from Riffle Habitat Near Bluebird and Blackjack Mines After the Blackjack Spill, 9 August 2003

	BLAC-ST-BMR-1A		BLAC-ST-BMR-2A		BLAC-ST-BMR-3A		BLUE-ST-BMR-5A	
Taxa	No.	%	No.	%	No.	%	No.	%
Turbellaria	14	0.68	14	1.21	--	--	17	1.27
Lumbriculidae	--	--	1	0.09	1	0.14	--	--
Tubificidae	54	2.64	41	3.55	4	0.55	63	4.69
Hydracarina	88	4.30	28	2.42	4	0.55	--	--
Ameletus	--	--	--	--	2	0.27	--	--
Acentrella	61	2.98	--	--	11	1.50	61	4.54
Baetis tricaudatus	231	11.28	45	3.89	39	5.33	34	2.53
Diphetor hageni	49	2.39	--	--	2	0.27	--	--
Heptageniidae	131	6.40	8	0.69	18	2.46	23	1.71
Epeorus (Iron)	32	1.56	1	0.09	3	0.41	8	0.60
Paraleptophlebia	14	0.68	4	0.35	16	2.19	4	0.30
Serratella tibialis	51	2.49	71	6.14	22	3.01	31	2.31
Drunella flavilinea	14	0.68	--	--	--	--	--	--
Drunella spinifera	20	0.98	50	4.33	14	1.91	9	0.67
Timpanoga hecuba	--	--	4	0.35	3	0.41	--	--
Attenella margarita	7	0.34	--	--	16	2.19	--	--
Zapada cinctipes	55	2.69	13	1.12	5	0.68	9	0.67
Pteronarcys californica	--	--	6	0.52	3	0.41	6	0.45
Pteronarcys dorsata	1	0.05	--	--	--	--	--	--
Calineuria californica	7	0.34	7	0.61	9	1.23	5	0.37
Claassenia sabulosa	14	0.68	5	0.43	--	--	2	0.15
Hesperoperla pacifica	31	1.51	19	1.64	2	0.27	26	1.94
Sweltsa	49	2.39	12	1.04	18	2.46	30	2.23
Dolophilodes	--	--	--	--	--	--	8	0.60
Cheumatopsyche	7	0.34	--	--	--	--	--	--
Hydropsyche	49	2.39	81	7.01	37	5.05	55	4.10
Rhyacophila	14	0.68	--	--	2	0.27	17	1.27
Glossosoma	--	--	4	0.35	--	--	--	--
Stactobiella	20	0.98	4	0.35	--	--	--	--
Brachycentrus americanus	36	1.76	7	0.61	3	0.41	4	0.30
Micrasema	29	1.42	70	6.06	--	--	4	0.30
Neophylax	--	--	1	0.09	--	--	1	0.07
Dicosmoecus gilvipes	1	0.05	1	0.09	--	--	2	0.15
Psychoglypha	--	--	1	0.09	2	0.27	1	0.07
Apatania	--	--	17	1.47	9	1.23	5	0.37
Lepidostoma	43	2.10	96	8.30	92	12.57	51	3.80
Oreodytes	--	--	4	0.35	1	0.14	4	0.30
Cleptelmis ornata	20	0.98	12	1.04	4	0.55	4	0.30
Heterlimnius koebelei	8	0.39	8	0.69	--	--	8	0.60
Microcylloepus pusillus	--	--	4	0.35	--	--	--	--
Narpus concolor	9	0.44	--	--	2	0.27	4	0.30
Optioservus quadrimaculatus	29	1.42	32	2.77	42	5.74	97	7.22
Optioservus divergens	--	--	--	--	--	--	8	0.60
Zaitzevia parvula	170	8.30	172	14.88	176	24.04	136	10.13
Blepharicera	--	--	--	--	--	--	8	0.60
Pentaneurini	14	0.68	16	1.38	4	0.55	8	0.60
Diamesinae	20	0.98	8	0.69	11	1.50	218	16.23
Orthocladiinae	232	11.33	132	11.42	40	5.46	185	13.78
Chironomini	14	0.68	29	2.51	27	3.69	--	--
Tanytarsini	101	4.93	32	2.77	32	4.37	29	2.16
Dixa	27	1.32	--	--	--	--	--	--
Simulium	213	10.41	53	4.58	30	4.10	55	4.10
Antocha	23	1.12	17	1.47	5	0.68	73	5.44
Hexatoma	1	0.05	4	0.35	--	--	4	0.30
Atherix	44	2.15	22	1.90	19	2.60	22	1.64
Silvius	--	--	--	--	2	0.27	--	--
Pisidium	--	--	--	--	--	--	4	0.30
Total	2047	100.00	1156	100.00	732	100.00	1343	100.00

Table F-2. Number and Relative Abundance of Taxa Collected from Pool Habitat near Bluebird and Blackjack Mines, 21 and 23 July 2003

Taxa	BLAC-ST-BMP-01		BLAC-ST-BMP-02		BLAC-ST-BMP-03		BLAC-ST-BMP-04		BLUE-ST-BMP-05		BLUE-ST-BMP-06		BLUE-ST-BMP-07		BLUE-ST-BMP-08	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Turbellaria	--	--	6	0.66	11	0.70	--	--	5	0.35	4	0.34	11	0.97	--	--
Lumbriculidae	--	--	--	--	--	--	--	--	--	--	8	0.68	11	0.97	3	0.31
Tubificidae	79	4.31	34	3.74	65	4.16	108	7.97	214	15.10	12	1.03	4	0.35	40	4.10
Helobdella stagnalis	--	--	--	--	--	--	--	--	1	0.07	--	--	--	--	--	--
Hydracarina	6	0.33	15	1.65	11	0.70	1	0.07	10	0.71	4	0.34	4	0.35	18	1.85
Ameletus	6	0.33	49	5.39	18	1.15	10	0.74	35	2.47	62	5.30	11	0.97	43	4.41
Acentrella	--	--	--	--	--	--	--	--	--	--	--	--	4	0.35	--	--
Baetis tricaudatus	--	--	9	0.99	5	0.32	10	0.74	5	0.35	8	0.68	--	--	--	--
Diphetor hageni	--	--	6	0.66	--	--	--	--	1	0.07	1	0.09	5	0.44	--	--
Centroptilum	120	6.55	9	0.99	79	5.06	88	6.49	29	2.05	12	1.03	22	1.95	--	--
Heptageniidae	24	1.31	25	2.75	16	1.02	20	1.48	34	2.40	32	2.74	23	2.03	46	4.72
Epeorus (Iron)	--	--	9	0.99	--	--	1	0.07	--	--	--	--	--	--	26	2.67
Paraleptophlebia	120	6.55	68	7.48	239	15.31	152	11.22	195	13.76	56	4.79	26	2.30	35	3.59
Serratella tibialis	6	0.33	6	0.66	--	--	13	0.96	1	0.07	12	1.03	9	0.80	7	0.72
Drunella flavilinea	--	--	--	--	--	--	--	--	--	--	--	--	11	0.97	--	--
Timpanoga hecuba	43	2.35	3	0.33	47	3.01	5	0.37	65	4.59	12	1.03	24	2.12	--	--
Attenella margarita	--	--	22	2.42	--	--	20	1.48	14	0.99	4	0.34	22	1.95	18	1.85
Cordulegaster dorsalis	--	--	--	--	--	--	--	--	2	0.14	--	--	--	--	--	--
Ophiogomphus	--	--	--	--	1	0.06	--	--	--	--	--	--	--	--	--	--
Pteronarcys californica	--	--	--	--	--	--	1	0.07	--	--	--	--	--	--	--	--
Perlidae	--	--	--	--	--	--	--	--	--	--	64	5.47	--	--	--	--
Calineuria californica	6	0.33	--	--	11	0.70	5	0.37	29	2.05	5	0.43	18	1.59	--	--
Claassenia sabulosa	--	--	--	--	--	--	5	0.37	--	--	--	--	--	--	--	--
Hesperoperla pacifica	--	--	3	0.33	--	--	--	--	--	--	--	--	--	--	8	0.82
Sweltsa	48	2.62	37	4.07	40	2.56	34	2.51	12	0.85	52	4.44	81	7.16	38	3.90
Corixidae	--	--	--	--	--	--	--	--	10	0.71	--	--	--	--	--	--
Sialis	2	0.11	--	--	5	0.32	1	0.07	--	--	--	--	--	--	--	--
Polycentropus	--	--	--	--	11	0.70	7	0.52	1	0.07	1	0.09	--	--	2	0.21
Glossosoma	--	--	--	--	--	--	--	--	1	0.07	--	--	--	--	--	--
Hydroptila	6	0.33	9	0.99	--	--	--	--	--	--	--	--	--	--	--	--
Stactobiella	12	0.66	12	1.32	5	0.32	--	--	1	0.07	--	--	--	--	7	0.72
Brachycentrus americanus	--	--	1	0.11	--	--	--	--	--	--	--	--	--	--	--	--
Amphicosmoecus canax	--	--	4	0.44	--	--	--	--	--	--	--	--	--	--	--	--
Neophylax	--	--	--	--	--	--	--	--	5	0.35	--	--	1	0.09	9	0.92
Dicosmoecus gilvipes	6	0.33	--	--	--	--	6	0.44	14	0.99	--	--	--	--	--	--
Psychoglypha	84	4.59	28	3.08	159	10.19	1	0.07	75	5.29	--	--	4	0.35	3	0.31
Apatania	48	2.62	15	1.65	--	--	44	3.25	19	1.34	108	9.23	33	2.92	31	3.18
Lepidostoma	236	12.88	80	8.80	135	8.65	194	14.32	55	3.88	140	11.97	231	20.42	164	16.82
Oecetis disjuncta	--	--	--	--	--	--	--	--	5	0.35	--	--	--	--	--	--
Hydrovatus	--	--	--	--	--	--	11	0.81	--	--	--	--	--	--	--	--
Oreodytes	30	1.64	75	8.25	53	3.40	26	1.92	22	1.55	1	0.09	7	0.62	3	0.31

Table F-2 (cont.)

Taxa	BLAC-ST-BMP-01		BLAC-ST-BMP-02		BLAC-ST-BMP-03		BLAC-ST-BMP-04		BLUE-ST-BMP-05		BLUE-ST-BMP-06		BLUE-ST-BMP-07		BLUE-ST-BMP-08	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Brychius	13	0.71	3	0.33	2	0.13	17	1.25	--	--	--	--	--	--	--	--
Cleptelmis ornata	--	--	3	0.33	--	--	30	2.21	--	--	--	--	--	--	--	--
Heterlimnius koebelei	--	--	--	--	--	--	--	--	10	0.71	--	--	7	0.62	--	--
Narpus concolor	--	--	3	0.33	39	2.50	5	0.37	6	0.42	--	--	1	0.09	7	0.72
Optioservus quadrimaculatus	217	11.84	58	6.38	54	3.46	83	6.13	125	8.82	158	13.50	66	5.84	64	6.56
Optioservus divergens	--	--	--	--	--	--	--	--	29	2.05	--	--	11	0.97	--	--
Zaitzevia parvula	282	15.39	117	12.87	259	16.59	236	17.42	92	6.49	234	20.00	197	17.42	168	17.23
Pentaneurini	54	2.95	46	5.06	81	5.19	56	4.13	112	7.90	20	1.71	22	1.95	28	2.87
Diamesinae	36	1.97	6	0.66	11	0.70	5	0.37	19	1.34	20	1.71	40	3.54	18	1.85
Orthocladiinae	60	3.28	49	5.39	43	2.75	30	2.21	44	3.11	16	1.37	70	6.19	65	6.67
Chironomini	--	--	22	2.42	16	1.02	29	2.14	--	--	8	0.68	15	1.33	18	1.85
Tanytarsini	240	13.10	52	5.72	135	8.65	78	5.76	34	2.40	72	6.15	88	7.78	46	4.72
Simulium	--	--	3	0.33	5	0.32	--	--	--	--	--	--	--	--	3	0.31
Tipulidae	--	--	--	--	--	--	--	--	--	--	40	3.42	--	--	--	--
Antocha	6	0.33	3	0.33	5	0.32	5	0.37	10	0.71	--	--	37	3.27	12	1.23
Hexatoma	6	0.33	--	--	--	--	6	0.44	--	--	--	--	11	0.97	33	3.38
Atherix	18	0.98	--	--	--	--	10	0.74	10	0.71	--	--	4	0.35	12	1.23
Silvius	--	--	1	0.11	--	--	1	0.07	24	1.69	--	--	--	--	--	--
Physella	--	--	1	0.11	--	--	--	--	5	0.35	--	--	--	--	--	--
Ferrissia	--	--	--	--	--	--	--	--	5	0.35	--	--	--	--	--	--
Pisidium	18	0.98	17	1.87	--	--	1	0.07	32	2.26	4	0.34	--	--	--	--
Total	1832	100.00	909	100.00	1561	100.00	1355	100.00	1417	100.00	1170	100.00	1131	100.00	975	100.00

Table F-2A. Number and Relative Abundance of Taxa Collected from Pool Habitat
Near Bluebird and Blackjack Mines After the Mine Breech, 9 August 2003

Taxa	BLAC-ST-BMP-1A No.	%	BLAC-ST-BMP-2A No.	%	BLAC-ST-BMP-3A No.	%	BLUE-ST-BMP-5A No.	%
Turbellaria	7	0.94	--	--	--	--	--	--
Lumbriculidae	--	--	3	0.41	--	--	--	--
Tubificidae	8	1.08	15	2.04	35	6.54	36	5.17
Ostracoda	3	0.40	--	--	--	--	--	--
Hydracarina	17	2.29	8	1.09	7	1.31	--	--
Ameletus	--	--	5	0.68	4	0.75	5	0.72
Baetis tricaudatus	2	0.27	--	--	2	0.37	2	0.29
Centroptilum	5	0.67	5	0.68	--	--	7	1.01
Heptageniidae	2	0.27	--	--	4	0.75	12	1.72
Paraleptophlebia	57	7.69	25	3.41	57	10.65	184	26.44
Serratella tibialis	--	--	--	--	--	--	2	0.29
Drunella spinifera	--	--	--	--	--	--	7	1.01
Timpanoga hecuba	6	0.81	8	1.09	1	0.19	--	--
Tricorythodes	--	--	--	--	2	0.37	--	--
Cordulegaster dorsalis	--	--	1	0.14	--	--	1	0.14
Zapada cinctipes	2	0.27	--	--	--	--	--	--
Calineuria californica	--	--	--	--	--	--	2	0.29
Hesperoperla pacifica	--	--	--	--	2	0.37	2	0.29
Sweltsa	15	2.02	12	1.63	15	2.80	12	1.72
Corixidae	--	--	--	--	--	--	24	3.45
Polycentropus	2	0.27	--	--	--	--	--	--
Hydropsyche	2	0.27	--	--	--	--	2	0.29
Rhyacophila	5	0.67	--	--	--	--	--	--
Hydroptila	2	0.27	--	--	--	--	--	--
Brachycentrus americanus	2	0.27	--	--	--	--	--	--
Micrasema	--	--	--	--	2	0.37	--	--
Onocosmoecus	--	--	--	--	--	--	1	0.14
Dicosmoecus gilvipes	--	--	--	--	2	0.37	--	--
Psychoglypha	4	0.54	2	0.27	46	8.60	29	4.17
Apatania	3	0.40	5	0.68	4	0.75	5	0.72
Lepidostoma	6	0.81	30	4.09	24	4.49	17	2.44
Oreodytes	22	2.97	50	6.81	15	2.80	13	1.87
Brychius	2	0.27	8	1.09	2	0.37	--	--
Cleptelmis ornata	2	0.27	--	--	--	--	--	--
Lara	--	--	--	--	2	0.37	--	--
Narpus concolor	5	0.67	2	0.27	4	0.75	--	--
Optioservus quadrimaculatus	10	1.35	15	2.04	18	3.36	7	1.01
Zaitzevia parvula	49	6.61	23	3.13	44	8.22	22	3.16
Tanypodinae	--	--	--	--	--	--	2	0.29
Pentaneurini	34	4.59	18	2.45	35	6.54	24	3.45
Diamesinae	7	0.94	--	--	--	--	10	1.44
Orthocladiinae	57	7.69	15	2.04	24	4.49	46	6.61
Chironomini	367	49.53	453	61.72	176	32.90	173	24.86
Tanytarsini	32	4.32	25	3.41	4	0.75	44	6.32
Simulium	2	0.27	--	--	--	--	--	--
Atherix	--	--	1	0.14	2	0.37	5	0.72
Pisidium	2	0.27	5	0.68	2	0.37	--	--
Total	741	100.00	734	100.00	535	100.00	696	100.00

Table F-3. Summary of Level 3 Metrics and Scores for Macroinvertebrate Sampling Locations
Near Bluebird and Blackjack Mines, 21 and 23 July 2003

Serial Number	Date	Sample Type	Sample Location	Taxa Richness	Score	Mayfly Richness	Score	Stonefly Richness	Score	Caddisfly Richness	Score	Sensitive Taxa	Score	Sediment Sensitive Taxa	Score	Modified HBI	Score	Percent Tolerant Taxa	Score	Percent Sediment Tolerant Taxa	Score	Percent Dominant (single taxa)	Score	**Total Score**
BLAC-ST-BMP-01	23-Jul-03	Pool	1	29	3	6	3	2	1	6	3	1	1	0	1	3.6	5	41.9	3	5.0	5	15.4	5	**30**
BLAC-ST-BMP-02	23-Jul-03	Pool	2	38	5	10	5	2	1	7	3	1	1	0	1	3.7	5	34.1	3	4.2	5	12.9	5	**34**
BLAC-ST-BMP-03	23-Jul-03	Pool	3	29	3	6	3	2	1	4	3	0	1	0	1	3.6	5	33.2	3	4.5	5	16.6	5	**30**
BLAC-ST-BMP-04	23-Jul-03	Pool	4	38	5	9	5	4	3	5	3	1	1	0	1	3.6	5	45.1	1	8.8	5	17.4	5	**34**
BLUE-ST-BMP-05	21-Jul-03	Pool	5	42	5	9	5	2	1	9	5	1	1	1	3	4.2	3	39.6	3	16.5	3	15.1	5	**34**
BLUE-ST-BMP-06	21-Jul-03	Pool	6	28	3	9	5	2	1	3	1	1	1	0	1	3.0	5	36.3	3	5.1	5	20.1	3	**28**
BLUE-ST-BMP-07	21-Jul-03	Pool	7	34	3	10	5	2	1	4	3	1	1	0	1	3.1	5	28.5	3	5.6	5	20.4	3	**30**
BLUE-ST-BMP-08	21-Jul-03	Pool	8	30	3	6	3	2	1	6	3	1	1	0	1	3.2	5	29.7	3	9.0	5	17.2	5	**30**
BLAC-ST-BMR-01	23-Jul-03	Riffle	1	43	5	9	5	4	3	10	5	2	3	0	1	3.7	5	36.8	3	5.6	5	18.8	5	**40**
BLAC-ST-BMR-02	23-Jul-03	Riffle	2	43	5	9	5	5	3	10	5	1	1	1	3	3.6	5	26.2	3	3.8	5	15.6	5	**40**
BLAC-ST-BMR-03	23-Jul-03	Riffle	3	43	5	11	5	5	3	10	5	2	3	0	1	4.2	3	23.0	3	2.1	5	15.9	5	**38**
BLAC-ST-BMR-04	23-Jul-03	Riffle	4	36	5	9	5	4	3	7	3	0	1	0	1	3.7	5	35.3	3	2.4	5	24.0	3	**34**
BLAC-ST-BMR-42	23-Jul-03	Riffle	42	40	5	9	5	4	3	9	5	3	3	1	3	3.9	5	20.6	3	4.8	5	14.4	5	**42**
BLUE-ST-BMR-05	21-Jul-03	Riffle	5	42	5	11	5	3	3	6	3	3	3	1	3	3.9	5	36.3	3	8.2	5	20.4	3	**38**
BLUE-ST-BMR-06	21-Jul-03	Riffle	6	39	5	10	5	4	3	10	5	2	3	2	3	3.5	5	23.9	3	4.8	5	11.5	5	**42**
BLUE-ST-BMR-07	21-Jul-03	Riffle	7	40	5	10	5	3	3	8	3	2	3	2	3	3.3	5	25.1	3	3.8	5	16.4	5	**40**
BLUE-ST-BMR-08	21-Jul-03	Riffle	8	42	5	6	3	5	3	11	5	3	3	2	3	3.6	5	31.4	3	14.3	3	10.3	5	**38**

Notes: While these Level 3 metrics and scores were calculated using ODEQ methods, they are used in this report to compare sites on Clear Creek rather than for comparison to a regional or statewide reference condition.

Table F-3A. Summary of Level 3 Metrics and Scores for Macroinvertebrate Sampling Locations
After the Blackjack Spill Near Bluebird and Blackjack Mines, 9 August 2003

Serial Number	Date	Sample Type	Sample Location	Taxa Richness	Score	Mayfly Richness	Score	Stonefly Richness	Score	Caddisfly Richness	Score	Sensitive Taxa	Score	Sediment Sensitive Taxa	Score	Modified HBI	Score	Percent Tolerant Taxa	Score	Percent Sediment Tolerant Taxa	Score	Percent Dominant (single taxa)	Score	**Total Score**
BLAC-ST-BMP-1A	9-Aug-03	Pool	1A	32	3	5	3	2	1	8	3	1	1	0	1	5.2	1	13.8	5	1.1	5	49.5	1	**24**
BLAC-ST-BMP-2A	9-Aug-03	Pool	2A	23	3	4	3	1	1	3	1	1	1	0	1	5.3	1	16.3	3	2.5	5	61.7	1	**20**
BLAC-ST-BMP-3A	9-Aug-03	Pool	3A	27	3	6	3	2	1	5	3	1	1	0	1	4.4	3	22.1	3	6.9	5	32.9	3	**26**
BLUE-ST-BMP-5A	9-Aug-03	Pool	5A	28	3	7	3	3	3	5	3	2	3	0	1	4.6	3	13.2	5	5.2	5	26.4	3	**32**
BLAC-ST-BMR-1A	9-Aug-03	Riffle	1A	42	5	10	5	6	5	8	3	1	1	0	1	4.2	3	18.2	3	3.8	5	11.3	5	**36**
BLAC-ST-BMR-2A	9-Aug-03	Riffle	2A	42	5	7	3	6	5	10	5	2	3	1	3	3.6	5	31.9	3	5.4	5	14.9	5	**42**
BLAC-ST-BMR-3A	9-Aug-03	Riffle	3A	39	5	11	5	5	3	6	3	2	3	0	1	3.6	5	39.1	3	1.4	5	24.0	3	**36**
BLUE-ST-BMR-5A	9-Aug-03	Riffle	5A	42	5	7	3	6	5	10	5	4	3	1	3	3.6	5	29.0	3	10.4	3	16.2	5	**40**

Notes: While these Level 3 metrics and scores were calculated using ODEQ methods, they are used in this report to compare sites on Clear Creek rather than for comparison to a regional or statewide reference condition.

TABLE F-4 SUMMARY OF HABITAT ASSESSMENT SCORES
FOR BLACKJACK AND BLUEBIRD MINES - JULY 2003

Habitat Parameter	Blackjack Mine Stations					Bluebird Mine Stations			
	01	02	03	04	42	05	06	07	08
Epifaunal substrate/available cover	19	19	19	20	12	17	17	20	20
Embeddedness	17	14	19	20	11	15	20	19	20
Velocity/depth regime	20	16	15	20	15	12	20	20	20
Sediment Deposition	18	13	20	20	6	16	19	17	20
Channel flow status	18	15	19	17	20	18	18	19	18
Channel alteration	20	20	20	20	20	20	20	20	20
Frequency of riffles (or bends)	19	20	20	19	16	20	20	20	20
Bank stability									
Left bank	9	9	7	9	9	5	6	8	8
Right bank	7	9	7	8	7	8	8	9	5
Vegetative protection									
Left bank	10	9	7	10	9	2	2	8	8
Right bank	8	9	7	8	8	8	8	9	5
Riparian vegetative zone width									
Left bank	10	10	9	10	4	0	0	1	8
Right bank	1	6	2	2	10	10	9	10	10
SCORE	176	169	171	183	147	151	167	180	182

Sample No.			TAL Metals, µg/L																			Laboratory General Chemistry										Field Parameters								
			ALUMINUM	ANTIMONY	ARSENIC	BARIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SODIUM	VANADIUM	ZINC	ALKALINITY, BICARBONATE MG/L	CONDUCTANCE UMHOS/CM	HARDNESS MG/L	PH PH UNITS	REDOX POTENTIAL MV	SULFATE MG/L	SUSPENDED SOLIDS, TOTAL MG/L	SUSPENDED SOLIDS, VOLATILE MG/L	TOTAL ALKALINITY MG/L	TOTAL DISSOLVED SOLIDS MG/L	CHROMIUM, HEXAVALENT MG/L	CURRENT VELOCITY FT/SEC	DEPTH FT	DISSOLVED OXYGEN MG/L	PH PH UNITS	REDOX POTENTIAL MV	SPECIFIC CONDUCTANCE MS/CM³	TEMPERATURE DEG C	TURBIDITY NTU
Adits	BLAC	AD-SFW-11	<23.6U	<4.7U	<4.8U	**27.6B**	<0.6U	7390	<1.4U	12B	<2.4U	**13100**	**1.8B**	12900	**2380**	**0.21**	**43.2**	1460B	<3.4U	2820B	<2U	89.3	35.4	179	128	6.6	232	67.4	21.7	<5U	35.4	209	0.01	0.39	0.25	6.62	**6.03**	153.3	0.237	7.89	62.5
	BLUE	AD-SFW-19	77.8B	<4.7U	<4.8U	**9.3B**	<0.6U	4400B	<1.4U	**34.8B**	<2.4U	**7340**	<1.3U	11100	**4790**	**0.23**	**106**	1340B	<3.4U	3090B	<2U	**198**	6.8	163	148	**5.2**	267	63.3	16.3	<5U	6.8		0.01	4.01	NM	6.09	**5.45**	216.5	0.192	10.4	37.3
Stream Samples	BLACK	ST-SFW-01	<23.6U	<4.7U	**4.9B**	**13.5B**	<0.6U	11400	<1.4U	<2U	<2.4U	<33.3U	<1.3U	6920	1.9B	<0.1U	<2.1U	991B	<3.4U	2290B	<2U	1.4B	60	463	108	7.8	163	6.9	1.5	<5U	60	90	0.02	2.58	0.40	8.05	8.23	239.0	0.121	20.39	0.4
		ST-SFW-01A	<23.6U	<4.7U	<4.8U	**14.7B**	<0.6U	12400	<1.4U	<2U	<2.4U	<33.3U	**1.6B**	7480	3.2B	<0.1U	<2.1U	1160B	<3.4U	2590B	<2U	3.8B	64	113	128	7.9	166	6.9	<0.5U	<5U	64	102	0.01	NM	NM	8.33	7.75	170.0	0.114	18.50	0.66
		ST-SFW-02	<23.6U	<4.7U	<4.8U	**15.1B**	<0.6U	12200	<1.4U	<2U	<2.4U	<33.3U	<1.3U	6930	3.2B	<0.1U	<2.1U	1190B	<3.4U	2400B	<2U	1.5B	61.6	112	108	7.7	180	6.9	1.3	<5U	61.6		0.01	1.40	0.17	9.00	7.41	217.4	0.116	19.45	0.5
		ST-SFW-02A	<23.6U	<4.7U	<4.8U	**16B**	<0.6U	13400	<1.4U	<2U	<2.4U	<33.3U	<1.3U	7710	4.2B	<0.1U	<2.1U	1220B	<3.4U	2720B	<2U	3.9B	64.5	115	148	8.2	148	6.8	0.6	<5U	64.5	108	0.00	NM	NM	9.21	8.07	165.0	0.118	19.60	0.62
		ST-SFW-03	42.6B	<4.7U	<4.8U	**14.9B**	<0.6U	12100	<1.4U	<2U	<2.4U	34.6B	<1.3U	6940	3.5B	<0.1U	<2.1U	1290B	<3.4U	2470B	<2U	1.9B	63.9	114	104	7.9	174	6.9	1.2	<5U	63.9		0.01	1.58	0.42	9.19	8.24	135.5	0.116	20.33	0.4
		ST-SFW-03A	<23.6U	<4.7U	<4.8U	**15.9B**	<0.6U	13600	<1.4U	<2U	<2.4U	<33.3U	**1.6B**	7830	3.9B	<0.1U	<2.1U	1250B	<3.4U	2780B	<2U	5B	65.1	115	172	8.2	140	6.8	0.5	<5U	65.1	106	0.00	NM	NM	7.79	8.12	176.0	0.119	20.20	6.25
		ST-SFW-04	24.9B	<4.7U	<4.8U	**14.6B**	<0.6U	11700	<1.4U	<2U	<2.4U	<33.3U	<1.3U	6780	2.8B	<0.1U	<2.1U	1200B	<3.4U	2600B	<2U	1.8B	59.5	113	104	8.4	147	6.8	1.7	<5U	59.5		0.01	1.33	0.17	9.13	8.4	236.1	0.148	19.21	0.5
		ST-SFW-42	40.2B	<4.7U	<4.8U	**15.8B**	<0.6U	12500	1.5B	<2U	<2.4U	58.9B	<1.3U	7190	17.3	<0.1U	<2.1U	1370B	<3.4U	2840B	<2U	3.2B	59.6	116	84	8.3	159	8.1	1.7	<5U	59.6		0.01	0.02	1.00	9.90	8.08	185.8	0.118	17.74	0.8
	BLUE	ST-SFW-05	20.9B	4.7B	<2.4U	**14.6B**	<0.3U	11500	<0.6U	<1.8U	<1.4U	<16.8U	<1.5U	6520	11.8B	<0.1U	<2U	1170B	<1.7U	2660B	<2.2U	<5.7U	59.2	112	96	7.7	158	7.8	1	<5U	59.2	**442**	0.00	2.31	0.50	9.47	8.19	167.3	0.12	18.93	0.6
		ST-SFW-05A	<23.6U	<4.7U	<4.8U	**17.4B**	<0.6U	13600	<1.4U	<2U	<2.4U	<33.3U	<1.3U	7860	14.7B	<0.1U	<2.1U	1310B	<3.4U	2960B	<2U	8.6B	62.7	119	92	7.8	138	8.3	0.6	<5U	62.7	101	0.01	NM	NM	7.60	7.61	170.0	0.124	15.50	0.65
		ST-SFW-06	40.3B	4B	<2.4U	**15B**	<0.3U	12000	<0.6U	<1.8U	<1.4U	17B	<1.5U	6840	9.7B	<0.1U	<2U	1290B	<1.7U	2740B	2.5B	<5.7U	59.5	115	96	8	168	<5U	2.4	<5U	59.5	77	0.00	2.07	0.33	9.33	8.24	184.4	0.12	20.32	0.5
		ST-SFW-07	47.7B	4B	<2.4U	**14.2B**	<0.3U	11700	<0.6U	<1.8U	<1.4U	<16.8U	<1.5U	6670	8.2B	<0.1U	<2U	1320B	<1.7U	2730B	<2.2U	<5.7U	59.9	116	144	8	172	8.3	1	<5U	59.9	74	0.01	2.56	0.21	9.41	8.42	165.3	0.12	21.34	0.5
		ST-SFW-08	56.9B	4.2B	<2.4U	**14.1B**	<0.3U	11800	<0.6U	<1.8U	<1.4U	<16.8U	<1.5U	6680	7.3B	<0.1U	<2U	1240B	<1.7U	2730B	2.4B	<5.7U	58.7	116	100	8.2	169	8.2	1.6	<5U	58.7	90	0.01	1.3	0.42	8.86	8.38	226.9	0.119	22.01	0.7
Ponds	BLAC	PD-SFW-10	**211**	<4.7U	<4.8U	**33.5B**	**2.4B**	6080	<1.4U	**53.7**	**102**	**7710**	<1.3U	8070	**2430**	<0.1U	**151**	1310B	<3.4U	3270B	<2U	**176**	2.8	156	100	**5.2**	375	95.4	26.2	<5U	2.8	146	0.00	NM	0.17	6.88	6.63	182.3	0.181	11.50	77.6
		PD-SFW-15	**173B**	<4.7U	<4.8U	**32.4B**	**2.3B**	5950	<1.4U	**53.2**	**114**	**10700**	<1.3U	7900	**2370**	<0.1U	**147**	1320B	**3.8B**	2760B	<2U	**171**	5.5	157	104	**5.5**	370	134	19	<5U	5.5	147	0.00	NM	0.50	**5.48**	**6.17**	201.1	0.183	10.1	32.2
		PD-SFW-41	<23.6U	<4.7U	<4.8U	**17B**	<0.6U	11900	<1.4U	<2U	<2.4U	<33.3U	<1.3U	6880	1B	<0.1U	<2.1U	1290B	<3.4U	2810B	<2U	4.2B	62.4	117	96	7.3	201	8.2	8.3	<5U	62.4		0.00	NM	1.00	7.61	**6.26**	158.0	0.12	15.74	0.8
		PD-SFW-43	<23.6U	<4.7U	<4.8U	<5.9U	<0.6U	7500	<1.4U	<2U	2.6B	53B	<1.3U	13900	**188**	**0.2**	<2.1U	1460B	<3.4U	2800B	<2U	4.9B	20.2	170	124	**6.1**	228	60.1	1.8	<5U	20.2	105	0.01	NM	0.67	6.46	**5.94**	143.6	0.192	13.34	0.6
	BLUE	PD-SFW-16	68.2B	<4.7U	<4.8U	**19.6B**	<0.6U	27300	<1.4U	**30.6B**	2.9B	**1310**	<1.3U	25500	**4930**	**0.27**	**126**	1860B	**3.4B**	5780	<2U	**192**	1.9	406	284	**4.8**	298	193	2.1	<5U	1.9		0.01	NM	1.00	**4.22**	**4.8**	196.0	0.414	24.14	3.6
		PD-SFW-17	<23.6U	<4.7U	<4.8U	**24.1B**	<0.6U	13600	<1.4U	4B	<2.4U	41.9B	<1.3U	9050	**1140**	<0.1U	**14.9B**	1420B	<3.4U	3500B	<2U	14.8B	49.7	140	124	6.7	233	35.3	59	7.5	49.7	98	0.00	NM	0.50	6.99	6.98	166.1	0.152	18.51	162.0
		PD-SFW-18	**87.2B**	<4.7U	<4.8U	**9B**	0.71B	4370B	<1.4U	**35B**	<2.4U	**6740**	**1.4B**	11100	**4860**	**0.24**	**108**	1310B	<3.4U	3270B	<2U	**204**	5.4	171	228	**5.2**	294	65.9	20.3	<5U	5.4		0.01	NM	NM	**5.53**	**5.71**	219.7	0.193	10.7	28.7
Comparison	Criteria	EPA-Ecological	87	30	150	4	1.1	NA	86.2	23	15.9	1000	1.0	NA	120	0.77	68.5	NA	5	NA	20	137.3			>20	6.5-9			NA						8	6.5-9				
		EPA-Human Health	NA	5.6	0.018	1000	NA	NA	NA	NA	1300	300	NA	NA	50	NA	610	NA	170	NA	NA	7400			NA	5-9			NA			250			NA	5-9				
		Oak Ridge PRG	87	30	NA	4	1.1	NA	11	23	12	1000	3.2	NA	120	1.3	160	NA	0.39	NA	20	110			NA	NA			NA			NA			NA	NA				
		OR-Ecological	87	1600	NA	4	1.2	116000	100.3	23	15.9	1000	1.4	82000	120	0.012	68.7	53000	5	680000	20	139.2			NA	6.5-9			NA			500			6-11	6.5-9				
		OR-Human Health	NA	146	0.022	1000	10	NA	50	NA	NA	300	50	NA	50	0.144	13.4	NA	10	NA	NA	NA			NA	NA			NA			NA			NA	NA				

Notes

- **Bold, shaded results indicate concentrations above the lowest applicable comparison criterion.**
- Cyanide (total) was analyzed for but not detected in any sample.
- All alkalinity was contributed by bicarbonate: carbonate and hydroxide were not detected in any samples.
- The following dissolved metals were analyzed for but not detected in any sample: beryllium, silver and thallium.
- There were no comparison criteria for total chromium (Cr); therefore, the most conservative criteria, for Cr 6, were used.

`Hardness-based criteria for cadmium, chromium III, copper, lead, nickel, silver, and zinc were calculated based on the mean hardness of 22 Bluebird and Blackjack samples (128 mg/L). These criteria may need to be adjusted for adit and pond samples.

U = Analyte was analyzed for but not detected.

B = Analyte was detected at a concentration between the method detection limit (MDL) and practical quantitation limit (PQL). NA = Not available.

NM = Not measured.

Empty cells in the table indicate no data.

Units:

DEG C = Degrees celcius MV = Millivolts

FT = Feet NTU = Nephelometric turbidity units FT/SEC = Feet per second UG/L = Micrograms per liter

MG/L = Milligrams per liter UMHOS/CM = Micro MHOS per centimeter' MS/CM³ = Millisiemens per cubic centimeter

Comparison Criteria

Oregon Ecological - Criteria are the lowest of:

- ODEQ (2003) Water Quality Criteria, Protection of Aquatic Life, Fresh Chronic Criteria (OAR 340-041-001), or
- ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values for surface water.

EPA Ecological - Criteria are the lowest of:

- USEPA (2002) recommended ambient water quality criteria for freshwater aquatic organisms, chronic; hardness dependent values are normalized to 128 mg/L, or
- USEPA (2002) recommended ambient water quality criteria for freshwater aquatic organisms, Tier II secondary chronic values calculated by Oak Ridge National Laboratory (Suter & Tsao 1996).

Oak Ridge PRGs - Oak Ridge National Laboratory Preliminary Remediation Goals (Efroymson et al 1997).

Oregon Human Health - ODEQ (2003) Water Quality Criteria, Protection of Human Health, Water and Fish Ingestion (OAR-340-041-001). EPA Human Health - USEPA (2002) recommended ambient water quality criteria for protection of human consumption of fish; hardness dependent values are normalized to 128 mg/L.

Sample No.			TAL Metals, µg/L															Lab	Field Parameters						
			ALUMINUM	ANTIMONY	BARIUM	CALCIUM	CHROMIUM, TOTAL	COPPER	IRON	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SODIUM	VANADIUM	ZINC	TOTAL DISSOLVED SOLIDS MG/L	CHROMIUM, HEXAVALENT MG/L	DISSOLVED OXYGEN MG/L	PH PH UNITS	REDOX POTENTIAL MV	SPECIFIC CONDUCTANCE MS/CM³	TEMPERATURE DEG C	TURBIDITY NTU
Stream Samples	BLAC	ST-PWP-01	36.3B	<4.7U	**23.3B**	13500	<1.4U	<2.4U	<33.3U	7540	2.9B	<0.1U	<2.1U	1560B	3420B	<2U	3B		0.01	7.20	8.15	211.0	0.122	21.50	23.1
		ST-PWP-01A	<23.6U	<4.7U	**15.7B**	12400	<1.4U	<2.4U	50B	7310	1.1B	<0.1U	<2.1U	1150B	2540B	<2U	4.1B	96	0.01	7.50	7.47	163.0	0.116	18.10	3.28
		ST-PWP-02	<23.6U	<4.7U	**15.2B**	11900	<1.4U	<2.4U	<33.3U	6760	6.1B	<0.1U	<2.1U	1220B	2810B	<2U	4.3B		0.00	8.86	7.98	149.2	0.117	19.96	143.0
		ST-PWP-02A	<23.6U	<4.7U	**16B**	13000	1.4B	<2.4U	<33.3U	7450	3.8B	<0.1U	2.7B	1200B	2850B	<2U	17.6B	100	0.00	7.60	7.67	187.0	0.119	20.50	4.14
		ST-PWP-03	<23.6U	<4.7U	**18.8B**	11800	<1.4U	<2.4U	<33.3U	7000	2.8B	<0.1U	<2.1U	1380B	2750B	<2U	2.9B		0.01	9.16	7.21	157.3	0.251	20.58	134.0
		ST-PWP-03A	<23.6U	<4.7U	**18.1B**	13000	<1.4U	<2.4U	<33.3U	7460	61.1	<0.1U	2.5B	1280B	2800B	<2U	4.4B	109	0.00	6.50	7.27	183.0	0.121	20.50	40.8
		ST-PWP-04	25.7B	<4.7U	**30.6B**	26700	<1.4U	<2.4U	<33.3U	14900	34.6	<0.1U	8.5B	2320B	6570	<2U	7B		0.01	7.93	8.32	196.2	0.148	21.20	35.9
		ST-PWR-02	<23.6U	<4.7U	**15.5B**	11400	<1.4U	<2.4U	<33.3U	6490	<0.7U	**0.12B**	<2.1U	1300B	2580B	<2U	1.9B								
		ST-PWR-03	<23.6U	<4.7U	**13.6B**	11300	<1.4U	<2.4U	<33.3U	6510	0.71B	<0.1U	<2.1U	1210B	2560B	<2U	1.4B								
		ST-PWR-42	**431**	<4.7U	**16.1B**	12100	2.4B	2.4B	399	7060	19.6	<0.1U	2.5B	1310B	2870B	<2U	5.5B		0.03	**5.41**	7.87	187.5	0.119	18.02	34.9
	BLUE	ST-PWP-05	58.9B	6.4B	**18.8B**	13000	<0.6U	<1.4U	37.3B	7350	7.7B	**0.17B**	<2U	1450B	2990B	<2.2U	<5.7U		0.01	9.52	7.72	200.7	0.125	20.22	34.9
		ST-PWP-05A	<23.6U	<4.7U	**18.1B**	13700	<1.4U	<2.4U	<33.3U	8000	12.1B	<0.1U	<2.1U	1360B	3000B	<2U	4.7B	111	0.00	7.90	7.48	180.0	0.125	17.10	5.2
		ST-PWP-06	41.9B	4.7B	**15.4B**	12200	<0.6U	<1.4U	<16.8U	6920	12.4B	<0.1U	<2U	1320B	2720B	3.1B	<5.7U		0.00	8.99	8.11	191.1	0.12	20.32	17.9
		ST-PWP-07	55.1B	<3.8U	**14B**	11800	<0.6U	<1.4U	<16.8U	6740	6B	<0.1U	<2U	1160B	2700B	2.2B	<5.7U		0.01	8.95	8.34	175.7	0.121	21.33	28.0
		ST-PWP-08	<23.6U	<4.7U	**14.2B**	11500	<1.4U	<2.4U	<33.3U	6550	9B	**0.15B**	<2.1U	1290B	2870B	<2U	1.2B		0.00	8.01	8.14	242.2	0.124	22.77	72.9
		ST-PWR-05	32.6B	4.5B	**14.6B**	12100	<0.6U	<1.4U	<16.8U	6830	8.9B	<0.1U	<2U	1120B	2730B	<2.2U	<5.7U								
		ST-PWR-06	52.5B	5.6B	**14.7B**	11800	<0.6U	<1.4U	<16.8U	6740	11.9B	<0.1U	<2U	1130B	2710B	<2.2U	<5.7U								
		ST-PWR-07	44.8B	<4.7U	**13B**	11600	<1.4U	<2.4U	49B	6680	1.9B	**0.12B**	<2.1U	1090B	2830B	<2U	<1U								
		ST-PWR-08	<23.6U	<4.7U	**14.7B**	11300	<1.4U	<2.4U	<33.3U	6510	3.4B	**0.16B**	<2.1U	1130B	2740B	<2U	6.2B								
Comparison	Criteria	EPA-Ecological	87	30	4	NA	88.3	16.3	1000	NA	120	0.77	70.2	NA	NA	20	140.6	NA		8	6.5-9				
		Oak Ridge PRG	87	30	4	NA	11	12	1000	NA	120	1.3	160	NA	NA	20	110	NA		NA	NA				
		OR-Ecological	87	1600	4	116000	102.6	16.3	1000	82000	120	0.012	70.4	53000	680000	20	142.6	500		6-11	6.5-9				

Notes

- **Bold, shaded results indicate concentrations above the lowest applicable comparison criterion.**
- Cyanide (total) was anaylzed for but not detected in any sample.
- The following dissolved metals were analyzed for but not detected in any sample: arsenic, berylium, cadmium, cobalt, lead, selenium, silver, and thallium.
- There were no comparison criteria for total chromium (Cr); therefore, the most conservative criteria, for Cr 6, were used.
- Hardness-based criteria for cadmium, chromium III, copper, lead, nickel, silver, and zinc were calculated based on the mean hardness of 22 Bluebird and Blackjack samples (128 mg/L). These criteria may need to be adjusted for adit and pond samples.

U = Analyte was analyzed for but not detected.

B = Analyte was detected at a concentration between the method detection limit (MDL) and practical quantitation limit (PQL). NA = Not available.

Empty cells in the table indicate no data.

Units:

DEG C = Degrees celcius MV = Millivolts

FT/SEC = Feet per second NTU = Nephelometric turbidity units

MG/L = Milligrams per liter UG/L = Micrograms per liter MS/CM³ = Millisiemens per cubic centimeter

Comparison Criteria

Oregon Ecological - Criteria are the lowest of:

- ODEQ (2003) Water Quality Criteria, Protection of Aquatic Life, Fresh Chronic Criteria (OAR 340-041-001), or
- ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values for surface water.

EPA Ecological - Criteria are the lowest of:

- USEPA (2002) recommended ambient water quality criteria for freshwater aquatic organisms, chronic; hardness dependent
- USEPA (2002) recommended ambient water quality criteria for freshwater aquatic organisms, Tier II secondary chronic Oak Ridge PRGs - Oak Ridge National Laboratory Preliminary Remediation Goals (Efroymson et al 1997).

Table G-3 Blackjack/Bluebird Sediment Analytical Results

Sample No.			TAL Metals, mg/kg																						
			CYANIDE	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
Adits	BLAC	AD-SSD-11	<0.5U	1720	**9.7B**	**34**	227	4.2B	**5.1B**	1250B	<1.6U	20.9B	**81.9**	729000	21.8	457B	982	**0.57**	**159**	<440U	<3.8U	<2.5U	690B	35.5	4.8B	**2230**
Stream Samples	BLAC	ST-PSD-01	<0.5U	12400	2.1B	**34.7**	67.5	0.33B	0.33B	3120	**102**	20	**30**	30000	3.3	10400	543	<0.019U	**131**	809	0.5B	<0.27U	277B	<0.71U	58.5	55.4
		ST-PSD-01A	<0.53U	8600	1.2B	**17.6**	60	0.34B	<0.064U	1600	**97.3**	15	**30.4**	25200	3.1	9610	676	0.018B	**101**	516B	0.32B	<0.23U	72.2B	1.4	52.5	36.9
		ST-PSD-02	<0.5U	17300	2.5B	**52.6**	102	0.4B	0.48B	4170	**193**	32.8	**37.2**	36600	4.9	21500	873	<0.023U	**224**	904	0.68	<0.3U	217B	<0.77U	71.9	66.8
		ST-PSD-02A	<0.61U	11500	1.9B	**48.6**	80.1	0.43B	<0.075U	2510	**111**	26.2	**32.8**	28200	3.8	17900	798	0.044	**193**	796	0.49B	<0.27U	123B	1.7	50.6	54.5
		ST-PSD-03	<0.5U	12000	1.4B	**19.2**	68.1	0.28B	0.27B	3170	**122**	21	**38.9**	25900	3.2	15200	638	0.026B	**138**	937	<0.4U	<0.26U	265B	<0.68U	49.4	50.7
		ST-PSD-03A	<0.55U	7970	1.2B	**26.7**	76.8	0.28B	<0.069U	2130	**52.2**	14.9	**20.9**	21700	2.4	8890	890	0.055	**98.4**	506B	0.64	<0.25U	124B	1B	32.2	35.6
		ST-PSD-04	<0.5U	7930	0.75B	**24.6**	112	0.25B	0.39B	2700	**65.7**	20.8	**23.8**	18800	3.2	6510	**1620**	<0.022U	**99.8**	710	0.88	<0.27U	308B	<0.7U	28.8	37.7
		ST-PSD-42	<0.5U	42700	**5.9B**	**55.7**	405	1.2B	**4.2**	6750	**191**	85.5	**323**	61100	11.6	18400	**3090**	**0.35**	**503**	2650	2.9	**2.6B**	516B	<2.5U	106	**556**
		ST-RSD-01A	<0.61U	6680	0.65B	**13.4**	58.9	0.3B	0.21B	1690	**66.1**	15.1	**27.8**	18500	3.1	5090	747	0.031B	**74.3**	669	0.52B	<0.26U	88B	1.1B	29	62.3
		ST-RSD-02	<0.5U	16700	2.1B	**54.4**	106	0.38B	0.59B	4280	**145**	34.4	**49.8**	41700	1.4	15100	1010	<0.019U	**172**	856	0.7	<0.26U	152B	0.86B	67.3	78.2
		ST-RSD-02A	<0.53U	8690	0.86B	**12.4**	40.5	0.27B	<0.071U	2730	**74**	15.1	17.7	18500	2.2	9750	409	<0.019U	**122**	294B	0.32B	<0.26U	398B	0.9B	37.4	30.1
		ST-RSD-03A	<0.54U	8700	1.2B	**18**	81.2	0.34B	0.11B	2590	**88.3**	15.1	**41.8**	23700	3.7	8750	620	<0.018U	**102**	719	<0.2U	<0.26U	262B	1.2B	45.7	42.3
		ST-RSD-04	<0.5U	10500	1.5B	**24.2**	70.3	0.26B	0.32B	2940	**87**	18.9	**27.9**	21700	3.1	10900	600	<0.019U	**124**	833	0.8	<0.27U	292B	<0.69U	36.7	50
		ST-RSD-42	<0.5U	14300	1.3B	**30.9**	89.8	0.32B	0.5B	4560	**105**	27.2	**42.6**	33300	3.1	20200	1090	<0.023U	**215**	888	<0.45U	<0.29U	532B	<0.76U	58.5	85.2
	BLUE	ST-PSD-05	<0.52U	14900	1.2B	**19.4**	73.1	0.36B	<0.059U	4180	**86.1**	20.7	**28.8**	28100	3.6	11500	665	**0.38**	**111**	808	0.52	<0.22U	226B	0.93B	52.2	56.2
		ST-PSD-05A	<0.6U	9110	1.8B	**34.3**	73.5	0.48B	<0.07U	2530	**98.5**	24.3	**31.3**	38900	3.7	13200	1080	0.097	**155**	646	0.58B	<0.26U	59.8B	2.4	49.6	68.6
		ST-PSD-06	<0.61U	7730	<0.52U	**7.4**	71.5	0.19B	0.077B	2980	20.4	14.9	**40.6**	10000	2	2690	786	0.075	**92**	350B	0.44B	<0.24U	337B	<0.63U	16.4	28.8
		ST-PSD-07	<0.69U	11800	1B	**31**	82.3	0.32B	0.12B	3350	**55.6**	14.6	**26.8**	20000	3.1	6500	571	0.1	**82.7**	1310	0.69	0.33B	364B	<0.62U	35.1	56.6
		ST-PSD-08	<0.56U	4750	0.96B	**15.3**	60.6	0.39B	<0.06U	1070	**78**	24.9	**51.3**	57900	5.4	11100	733	0.085	**160**	530	1	<0.22U	62.3B	2.2	57.1	56.6
		ST-RSD-08	<0.56U	12600	<0.47U	3.9	64.2	0.11B	<0.06U	5890	10.7	9.5	**54.1**	14000	1.3	4610	527	0.056	**51.9**	1110	<0.17U	<0.22U	1040	<0.58U	10.6	59.1
Ponds	BLAC	PD-SSD-10	<0.5U	15300	**7.4B**	**136**	9.1B	0.26B	**1.4B**	<108U	31.8	<1.2U	**1280**	531000	19.4	<106U	110	**1.4**	<1.2U	<233U	<2U	<1.3U	<280U	22.3	16.2B	75.4
		PD-SSD-41	<0.5U	40900	2.9B	**110**	837	1.6B	**21.2**	6880	**144**	283	**1080**	70000	11.8	15400	**32600**	**0.25**	**1810**	2400	9	<0.97U	463B	<2.5U	110	**1310**
		PD-SSD-43	<0.5U	1440	<0.64U	0.81B	12.4B	0.15B	0.27B	999	4.4	6B	**49.3**	4550	2.4	808	492	0.069	**72.9**	160B	<0.47U	<0.3U	155B	<0.78U	2.9B	60.9
	BLUE	PD-SSD-16	1.6	10600	**5.8B**	**279**	688	1.6B	**8.7**	1680B	24.8	1480	**100**	459000	22.1	830B	**178000**	<0.11U	**1300**	886B	50.3	<1.6U	494B	<4.2U	10.4B	**1470**
Comparison	Criteria	ER-L		NA	NA	8.2	NA	NA	1.2	NA	81	NA	34	NA	47	NA	NA	0.15	21	NA	NA	1	NA	NA	NA	150
		ER-M		NA	NA	70	NA	NA	9.6	NA	370	NA	270	NA	218	NA	NA	0.71	51.6	NA	NA	3.7	NA	NA	NA	410
		OR		NA	3	NA	NA	NA	0.6	NA	37	NA	36	NA	35	NA	1100	0.2	18	NA	NA	4.5	NA	NA	NA	123
		PEL		NA	NA	41.6	NA	NA	4.21	NA	160	NA	108	NA	112	NA	NA	0.696	42.8	NA	NA	1.77	NA	NA	NA	271
		TEL		NA	NA	7.24	NA	NA	0.676	NA	52.3	NA	18.7	NA	30.2	NA	NA	0.13	15.9	NA	NA	0.733	NA	NA	NA	124

Table G-3 Cont.

Sample No.			TAL Metals by SPLP, µg/L																			
			ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SODIUM	THALLIUM	VANADIUM	ZINC
Stream Samples	BLAC	ST-PSD-01A	1340	<4.7U	6.3B	68.8B	<0.2U	1320B	13	<2U	4.3B	2450	2.9B	1660B	76.5	<10U	17.3B	<393U	22600	<5.7U	6.2B	33.4
		ST-PSD-02A	3020	<4.7U	9.5B	168B	0.23B	2070B	24.9	3.7B	8.3B	4910	3.6	3310B	149	<10U	36.1B	<393U	12200	6B	9.7B	86.2
		ST-PSD-03A	910	<4.7U	<4.8U	36B	<0.2U	1100B	7.8B	<2U	4.8B	1660	1.5B	1100B	44.1	<10U	10.6B	<393U	6440	<5.7U	3.8B	10B
	BLUE	ST-PSD-05A	3010	5.1B	6.6B	136B	0.26B	1720B	12.5	<2U	7B	3530	2.9B	1490B	111	<10U	17.9B	547B	13000	6.2B	7.4B	60.4

Sample No.			Lab	Grain Size, percent						Clay Minerals. percent												
			TOC LLOYD KHAN MG/KG	GRAVEL %	SAND, COARSE %	SAND, FINE %	SAND, MEDIUM %	SILT %	CLAY %	<4µ WEIGHT% %	AMPHIBOLE %	ANTIGORITE %	CHLORITE %	ERIONITE %	GOETHITE %	ILLITE & MICA %	KAOLINITE %	K-FELDSPAR %	LAUMONTITE %	PLAGIOCLASE %	QUARTZ %	SMECTITE %
Adits	BLAC	AD-SSD-11	40700	0	0.2	1.3	0.5	64.8	33.1	14.58	0	0	0	0	70.75	29.25	0	0	0	0	0	0
Stream Samples	BLAC	ST-PSD-01	1490	19.4	25.9	6	46.2	1.5	1	0.26	9.17	13.64	9.85	0	0	18.94	3.25	1.08	13.15	6.55	6.57	17.81
		ST-PSD-01A	442	26.2	21.4	4.2	34.7	12.3	1.2	0.45	18.85	11.9	7.62	0	0	20.43	2.25	0	10.2	7.62	3.87	17.27
		ST-PSD-02	557	0	0	33.4	58.5	6.3	1.8	0.47	12.71	10.	5.49	0	0	13.8	1.73	0	4.41	11.	11.47	29.39
		ST-PSD-02A	<130U	11	2.5	11.2	67.3	6.2	1.7	0.56	10.71	15.42	4.36	0	0	9.69	2.67	0	6.85	13.45	6.5	30.36
		ST-PSD-03	1330	33.1	22	7.8	32.9	2	2.1	1.07	9.83	10.04	5.61	0	0	13.01	2.18	0.85	10.81	21.8	13.45	12.43
		ST-PSD-03A	578	55.2	14.1	7.3	18.6	4	0.7	1.2	10.36	15.01	7.71	0	0	12.82	3.1	0	6.86	14.72	7.63	21.8
		ST-PSD-04	697	26.4	20.3	10	38.8	3.2	1.3	1.09	10.57	11.78	6.76	0	0	10.08	2.12	0	9.69	18.13	15.49	15.38
		ST-PSD-42	111800	0	0	20	2.5	45.3	32.2	4.06	9.54	0	13.16	0	0	6.8	11.6	0	2.15	22.21	16.13	18.42
		ST-RSD-01A	<127U	42.7	21.5	4.4	28.2	2.3	0.9													
		ST-RSD-02	4610	36.3	10.1	21.4	24.4	5	2.8													
		ST-RSD-02A	<119U	9.2	2.1	6.2	24.9	56.5	1.1													
		ST-RSD-03A	<119U	47.8	29.8	1.2	17.9	2.9	0.4													
		ST-RSD-04	4090	24.4	24.8	11.7	35.8	2.1	1.3													
		ST-RSD-42	1310	21.8	24.4	6.8	43.3	2.7	1.1													
	BLUE	ST-PSD-05	3530	38.3	15.8	15.8	25.2	3.2	1.7	2.76	8.65	6.67	4.38	0	0	10.87	12.61	0	5.03	19.94	8.88	22.96
		ST-PSD-05A	<131U	25.8	17	13.5	36.5	6.3	0.9	2.78	10.98	13.45	6.74	0	0	9.85	3.74	0	6.64	10.98	6.48	31.14
		ST-PSD-06	<124U	30.6	27.3	6	33.4	2.1	0.5	1.99	9.13	4.35	8.31	0	0	9.07	4.06	0	5.47	32.48	10.04	17.08
		ST-PSD-07	22400	38.6	21.5	7.2	28.5	2.7	1.6	2.59	10.14	4.9	6.79	0	0	8.15	1.76	3.68	4.86	26.64	15.82	17.27
		ST-PSD-08	7820							1.33	12.79	9.68	8.54	0	0	8.97	2.7	2.92	4.79	15.59	12.43	21.59
		ST-RSD-08	26400	30	25.8	0.8	37.4	5.5	0.6													
Ponds	BLAC	PD-SSD-10	9960	0	0.2	13.4	8.4	30.3	47.8	12.49	0	0	0	0	90.01	9.99	0	0	0	0	0	0
		PD-SSD-41	3680	0	0	5.8	1.1	64.1	29	7.91	6.87	0	18.5	21.89	0	6.65	7.56	1.91	0	15.45	12.81	8.35
		PD-SSD-43	32700	0	0	20	15.8	44.4	19.8	10.17	15.47	0	3.74	0	0	35.74	17.65	0	0	0	24.34	3.06
	BLUE	PD-SSD-16	18100	0	0	15.6	8.1	41	35.3	36.51	0	0	0	0	0	100.	0	0	0	0	0	0

Notes

Bold, shaded results indicate concentrations above the lowest applicable comparison criterion.

U = Analyte was analyzed for but not detected.

B = Analyte was detected at a concentration between the method detection limit (MDL) and practical quantitation limit (PQL). NA = Not available.

Empty cells in the table indicate no data.

Units:

MG/KG = Milligrams per kilogram UG/L = Micrograms per liter

Comparison Criteria

- Threshold Effects Level (TEL) and Probable Effects Level (PEL) from USEPA National Sediment Quality Survey, Screening Values for Chemicals Evaluated, http://www.epa.gov/waterscience/cs/vol1/appdx_d.pdf.
- Effects Range-Low (ER-L) and Effects Range-Medium (ER-M), National Oceanic and Atmospheric Administration (NOAA), from USEPA (1997) National Sediment Quality Survey, Screening Values for Chemicals Evaluated.
- ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values for freshwater sediment (there was no criterion for total arsenic; therefore, the most conservative criterion, for arsenic 3, was used).

Oak Ridge National Laboratory values are not included; they are compiled from TEL and ER-L values, and USEPA Assessment and Remediation of Contaminated Sediment (ARCS) program values which exceed TELs.

Sediment samples analyzed for clay minerology were collected in pool habitat only. The grain size sample jar collected from BLUE-ST-PSD-08 was broken during shipment.

Table G-4 Blackjack/Bluebird Soil Analytical Results

			TAL Metals, mg/kg																						
Sample No.			ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, HEXAVALENT	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
Background	CLEA	BG-SSS-25(0.5)	**23100**	1.2B	**8.1**	**311**	**0.76**	0.16B	1520	<2.1U	**12.5**	7.3	**52.6**	30300	8.2	1910	**907**	**0.068**	21.9	1450	**1.9**	0.5B	299B	0.78B	**33.9**	**55.3**
		BG-SSS-26(0.5)	**27500**	<0.5U	**4.8**	**430**	**0.94**	0.16B	1880	<2.1U	**11.7**	12.9	35.3	35300	7.3	1780	**1520**	**0.045**	**39.5**	1110	**1.3**	0.53B	358B	**1.5**	**38.5**	**102**
On Site	BLAC	PD-SSS-44(0.4)	**1300**	**7.8B**	**21.2**	12.2B	<0.034U	1.1	<50.2U	<3.5U	**39.6**	18.3	**1440**	**459000**	**32**	<50U	72.9	**0.49**	23.9	214B	**29.7**	0.92B	<90.8U	**17.4**	**35.7**	**29.2**
		TA-SUS-14(1.5)	**3190**	3.4B	**20.5**	58	<0.019U	0.48	157B	<2.3U	**58.4**	9.6	**915**	**193000**	14.6	3940	81.8	**0.17**	**34.2**	471	**9.7**	0.44B	<49.4U	**6.3**	**36.4**	**27.4**
		TA-SUS-30(0.75)	**19300**	4.6B	**82.3**	53	**0.27B**	0.21B	2750	<2.8U	**147**	20	**126**	**106000**	10.3	13200	**330**	**0.75**	**146**	911	**4**	1.3B	453B	**3**	**64.8**	**46**
		TA-SUS-31(0.9)	**18400**	1.7B	**24.9**	61.5	**0.28B**	0.21B	5290	<2.0U	**53.3**	**30.5**	**216**	46800	13.9	6040	**720**	**0.096**	**77.8**	1080	**2.7**	0.5B	1150	**1.8**	**44.8**	**57.8**
		WP-SUS-12(1.0)	**12500**	0.96B	**7.9**	**131**	**0.45B**	0.2B	256B	<2.2U	**15.6**	**23**	**132**	47200	9.6	2350	**1020**	**0.19**	**33.6**	1230	**1.9**	0.31B	118B	**2.6**	**48.2**	**78.4**
		WP-SUS-13(1.5)	**3080**	1.3B	**8.9**	69.8	**0.26B**	<0.1U	<25.5U	0.59B	**3**	1.9B	20.9	21800	7.3	74.3B	15.8	**3.7**	16.8	867	**1.4**	0.11B	<46.2U	1	**19.1**	**29**
	BLUE	AD-SSS-19(0.5)	**7340**	**13.9**	**48.7**	39.2	**0.25B**	<0.035U	<26U	0.83B	**18.7**	**21.1**	**99.7**	**370000**	**21.7**	1470	**308**	**0.67**	28	1480	**17.1**	0.65B	151B	**20.6**	**15.4**	**82.4**
		TA-SSS-23(0.2)	**3030**	**20.2**	**44.3**	22.6B	**0.33B**	<0.043U	<32U	<3.5U	**14.6**	**29.2**	37	**557000**	**29.1**	238B	**260**	**0.25**	**46.9**	327B	**25.7**	0.84B	<31.4U	**30.9**	**3.8B**	**165**
		TA-SSS-27(0.5)	**16900**	1.1B	**7.3**	**271**	**0.54**	0.09B	1580	<2.2U	**10.1**	6.8	42.6	15300	12.9	1130	**499**	**0.062**	16.5	1070	**1.3**	0.19B	472	0.88B	**19.9**	**46**
		TA-SUS-24(1.0)	**15300**	0.82B	**36.8**	81.2	**0.52**	0.099B	2910	<2.3U	**96.5**	**23.1**	44.2	25300	6.4	9200	**1210**	**0.14**	**135**	820	**1.6**	0.78B	679	**1.6**	**45.6**	**93.8**
		TA-SUS-32(1.5)	**19100**	1.7B	**12.5**	**130**	**0.63**	3	4040	0.76B	**113**	**31.4**	**54.9**	49800	3.8	17500	**8270**	**0.035**	**221**	1340	**3.8**	0.85B	363B	**6.9**	**93.3**	**138**
		TA-SUS-33(2.0)	**13900**	1.8B	**10.5**	63.8	**0.51**	0.35B	3360	<2.1U	**147**	20	37.3	39100	4.1	14200	**856**	**0.052**	**135**	536	**2.3**	0.25B	275B	**1.1**	**63.1**	**69.8**
		WP-SUS-20(2.5)	**8260**	1.7B	**20.4**	78.1	**0.23B**	<0.026U	<19.4U	<2.1U	**17.9**	5.9	**58.2**	41200	11.3	5050	**230**	**1.2**	9.5	3370	**2.5**	0.34B	356B	**2.1**	**24.1**	**51.6**
		WP-SUS-21(1.5)	**3040**	2.8B	**86.8**	64.4	**0.19B**	<0.023U	70.7B	4.9	**8.6**	3.5B	**58.1**	34200	15.7	1050	72.5	**0.5**	7.2	1920	**4.1**	0.68B	147B	**2.1**	**17.5**	**49.6**
		WP-SUS-22(1.5)	**1970**	2B	**11.6**	38.3	**0.12B**	<0.024U	<18.1U	<1.9U	**8.7**	11.3	**53.5**	30200	8.3	573	**239**	**0.67**	21.7	1250	**1.6**	0.1B	141B	**2.3**	**12.3**	**79.1**
		WP-SUS-29(1.0)	**9460**	3.1B	**13**	64.5	**0.39B**	<0.028U	79.8B	<2.1U	**19.4**	6.1	**95.3**	36100	12.3	1260	96.5	**0.32**	22.5	939	**5.5**	0.2B	237B	**1.5**	**34.4**	**47.9**
Comparison	Criteria	EPA Industrial PRG	100000	410	1.6	67000	1900	450	NA	64	450	1900	41000	100000	750	NA	19000	310	20000	NA	5100	5100	NA	67	7200	100000
		EPA-Ecological	NA	21	37	NA	NA	29	NA	330	5	32	61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	120
		EPA-Human Health	NA	31	0.4	5500	0.1	78	NA	270	270	NA	NA	NA	400	NA	NA	NA	1600	NA	390	390	NA	NA	550	23000
		Oak Ridge	NA	5	9.9	283	10	4	NA	NA	0.4	20	60	NA	40.5	NA	NA	0.00051	30	NA	0.21	2	NA	1	2	8.5
		OR-Ecological	50	5	8	85	10	4	NA	410	NA	20	50	NA	16	NA	100	0.1	30	NA	1	2	NA	1	2	50

			TAL Metals by SPLP, µg/L																						
Sample No.			ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
Background	CLEA	BG-SSS-25(0.5)	1210	<3.8U	<2.4U	18.8B	<0.2U	<0.3U	1170B	1.2B	<1.8U	4.5B	654	<1.5U	271B	48.9	<10U	<2U	1160B	3.5B	<0.9U	7130	<2.8U	2.3B	<5.7U
		BG-SSS-26(0.5)	1980	<3.8U	<2.4U	49.2B	<0.2U	<0.3U	1070B	1.5B	<1.8U	4.8B	854	<1.5U	287B	31.4	<10U	<2U	1120B	2.1B	<0.9U	6460	<2.8U	2.6B	<5.7U
On Site	BLAC	PD-SSS-44(0.4)	58.2B	<3.8U	<2.4U	<7.3U	<0.2U	<0.3U	801B	<0.6U	<1.8U	2.2B	114	2.1B	342B	0.96B	<10U	<2U	<250U	<1.7U	<0.9U	1410B	<2.8U	<2.2U	<5.7U
		WP-SUS-12(1.0)	52.4B	<3.8U	<2.4U	43.5B	<0.2U	<0.3U	1060B	0.7B	<1.8U	3.3B	51.2B	<1.5U	612B	88.8	<10U	10B	732B	2.1B	<0.9U	6690	<2.8U	<2.2U	<5.7U
		WP-SUS-13(1.5)	84.8B	<3.8U	<2.4U	<7.3U	<0.2U	<0.3U	624B	0.63B	<1.8U	3.3B	66.7B	1.8B	<182U	<0.7U	<10U	<2U	890B	1.9B	<0.9U	5810	<2.8U	<2.2U	<5.7U
	BLUE	AD-SSS-19(0.5)	471	<3.8U	<2.4U	25.4B	0.37B	1.2B	1510B	<0.6U	8.5B	7.4B	<16.8U	6.2	1160B	677	14.8B	34.3B	1850B	1.8B	<0.9U	6580	<2.8U	<2.2U	50
		TA-SSS-27(0.5)	2010	5.1B	2.4B	30.6B	0.37B	<0.3U	1160B	1.5B	<1.8U	3.7B	1350	2.5B	227B	65.5	<10U	<2U	2280B	3.5B	<0.9U	6410	<2.8U	4.3B	7.6B
		TA-SUS-32(1.5)	1610	4.1B	8.1B	42.5B	<0.2U	0.62B	722B	14	<1.8U	4.9B	2430	1.5B	901B	1690	<10U	25B	600B	4.5B	<0.9U	7020	<2.8U	7B	27.2
		TA-SUS-33(2.0)	1080	<3.8U	<2.4U	14.2B	<0.2U	<0.3U	672B	11.8	1.8B	4.7B	5310	2.3B	824B	132	<10U	9B	<250U	2.3B	<0.9U	6670	<2.8U	5.8B	7B
		WP-SUS-20(2.5)	33.2B	<3.8U	<2.4U	16.2B	<0.2U	<0.3U	1030B	0.73B	<1.8U	1.4B	<16.8U	<1.5U	404B	39.9	<10U	2.6B	2270B	<1.7U	<0.9U	8380	<2.8U	<2.2U	15.2B
		WP-SUS-21(1.5)	115B	4.3B	<2.4U	36.7B	0.29B	<0.3U	1760B	0.79B	<1.8U	5.7B	<16.8U	<1.5U	404B	103	<10U	3.4B	2740B	<1.7U	<0.9U	11800	<2.8U	<2.2U	37.6
		WP-SUS-22(1.5)	261	<3.8U	5.4B	33.3B	0.62B	<0.3U	955B	0.83B	<1.8U	18.6B	296	11.8	321B	84.8	<10U	4B	1720B	2.8B	<0.9U	6840	<2.8U	<2.2U	48.4
		WP-SUS-29(1.0)	<18.3U	<3.8U	<2.4U	32.1B	<0.2U	<0.3U	970B	1.3B	<1.8U	<1.4U	<16.8U	<1.5U	<182U	63.1	<10U	5B	673B	1.8B	<0.9U	24900	<2.8U	<2.2U	25.9

Sample No.			Organic Compounds			Lab	Acid/Base Accounting										
			BIS(2-ETHYLHEXYL)PHTHALATE UG/KG	DICHLOROMETHANE UG/KG	MOTOR OIL MG/KG	PH PH UNITS	FIZZ RATING NO UNITS	MAXIMUM POTENTIAL ACIDITY KG CACO3/TON	NEUTRALIZATION POTENTIAL KG CACO3/TON	CORRECTED NP KG CACO3/TON	PASTE PH PH UNITS	SULFATE SULFUR WT.%	SULFIDE SULFUR WT.%	TOTAL SULFUR WT.%	NET NEUTRALIZATION POTENTIAL KG CACO3/TON	CORRECTED NNP KG CACO3/TON
Background	CLEA	BG-SSS-25(0.5)				6.5	none	<0.6	-2.8	2.8	5.8	<0.01	< .02	< .02	-2.8	2.5
		BG-SSS-26(0.5)				6.6	none	<0.6	-1.3	1.3	6.1	<0.01	< .02	< .02	-1.3	1.0
On Site	BLAC	PD-SSS-44(0.4)				5	none	29.7	-14.5	14.5	4.5	0.18	0.95	1.13	-44.2	-15.2
		TA-SUS-14(1.5)				3.9										
		TA-SUS-30(0.75)				5.3										
		TA-SUS-31(0.9)				4.7										
		WP-SUS-12(1.0)				4.6	none	0.0	-2.3	2.3	4.5	0.04	0.00	0.04	-2.3	2.3
		WP-SUS-13(1.5)				4	none	0.6	-0.8	0.8	4.9	0.01	0.02	0.03	-1.4	0.2
	BLUE	AD-SSS-19(0.5)				3.7	none	6.6	-15.8	15.8	3.8	0.49	0.21	0.7	-22.4	9.2
		TA-SSS-23(0.2)				5.4										
		TA-SSS-27(0.5)				6.6	none	<0.6	-2.5	2.5	6.2	<0.01	< .02	< .02	-2.5	2.2
		TA-SUS-24(1.0)				6										
		TA-SUS-32(1.5)	66JB1	1.68	35.8J	6.5	none	<0.6	4.3	4.3	6.4	<0.01	< .02	< .02	4.3	4.0
		TA-SUS-33(2.0)	104JB1	1.77	<51.7U	5.8	none	<0.6	3.3	3.3	6.4	<0.01	< .02	< .02	3.3	4.0
		WP-SUS-20(2.5)				3.8	none	2.5	-2.3	2.3	4.0	0.33	0.08	0.41	-4.8	-0.2
		WP-SUS-21(1.5)				3.6	none	2.5	-3.0	3.0	3.7	0.18	0.08	0.26	-5.5	0.5
		WP-SUS-22(1.5)				3.4	none	1.6	-3.3	3.3	3.4	0.21	0.05	0.26	-4.9	1.7
		WP-SUS-29(1.0)				4.4	none	0.6	-2.3	2.3	4.6	0.02	0.02	0.04	-2.9	1.7

= Negative NPs do not exist; something is wrong!

Notes

Bold, shaded results indicate concentrations above the lowest applicable comparison criterion.

Cyanide (total) was analyzed for but not detected in any sample.

U = Analyte was analyzed for but not detected.

B = Analyte was detected at a concentration between the method detection limit (MDL) and practical quantitation limit (PQL).

B1 = Analyte was detected in both the sample and the associated method blank. The sample concentration was not significantly higher (less than ten times) than the method blank concentration.

J = Estimated concentration NA = Not available.

Empty cells in the table indicate no data.

Units:

MG/KG = Milligrams per kilogram UG/KG = Micrograms per kilogram

UG/L = Micrograms per liter

Comparison Criteria

- OR Ecological - ODEQ (1998) Guidance for Ecological Risk Assessment, Level II Screening Values - lowest criteria for bird (b), plant (p), invertebrate (i), and mammal (m).
- EPA Ecological - EPA (2000b) Ecological Soil Screening Levels - Lowest Criteria Indicators for bird (b), plant (p), invertebrate (i), and mammal (m).
- Oak Ridge National Laboratory, US DOE (Efroymson et al 1997), Preliminary Remediation Goals (PRGs) for protection of plants (p), wildlife (w), or soil invertebrates (s).
- EPA Human Heath Criteria - Generic Soil Screening Levels (SSLs) for Protection of Human Health EPA (2000a). SSL is for ingestion unless indicated as inhalation of particulates by "ip".
- EPA Region 9 PRGS for industrial soil (http://www.epa.gov/region09/waste/sfund/prg/index.htm).

Table G-5 Blackjack/Bluebird Plant Tissue Analytical Results

Sample No.			TAL Metals and Cyanide, mg/kg																	
			CYANIDE	ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SODIUM	VANADIUM	ZINC
Background	CLEA	BG-PLT-25	<1.2U	189	406	0.1B	<0.15U	18200	0.79B	5.2B	241	0.82	4850	243	<0.04U	<0.51U	15600	1.7	364B	<0.49U	17.6
		BG-PLT-26	<1.2U	150	305	0.092B	<0.14U	15800	0.81B	5.2B	253	1.2	4390	200	<0.037U	<0.49U	17500	1.4	341B	0.51B	13.4
On Site	BLAC	AD-PLT-11	2.9	74.4B	12.7B	0.12B	<0.23U	9080	0.76B	5.6B	521	1.4	8860	179	<0.058U	4.3B	20200	2.3	507B	<0.78U	38.8
		WP-PLT-12	<1.4U	139	129	0.099B	<0.16U	11300	0.69B	4.6B	266	0.68B	3350	248	<0.047U	4.3B	18100	1.9	373B	<0.54U	16.8
	BLUE	WP-PLT-20	<1.2U	256	308	0.08B	0.14B	14300	<0.29U	4.5B	325	<0.31U	4320	195	0.083	<0.44U	14000	0.99B	235B	0.81B	17.3
		WP-PLT-24	<1.7U	273	72.3	0.13B	<0.18U	13000	1.8B	5.3B	431	0.99	5180	75.9	<0.056U	4.4B	15000	<1U	321B	1.2B	39.1

Notes

The following metals were analyzed for but not detected in any sample: antimony, arsenic, cobalt, silver, and thallium.

Units:

U = Analyte was analyzed for but not detected.

B = Analyte was detected at a concentration between the method detection limit (MDL) and practical quantitation limit (PQL).

MG/KG = Milligrams per kilogram

APPENDIX 2

Site Photographs



Bluebird Mine Portal and Pipeline Cleanout



Bluebird Mine Portal, BAT Gate and Pipeline



Bluebird Mine Adit and Pipeline



Bluebird Mine Waste Rock Area



Bluebird Mine Waste Rock Area



Bluebird Mine Waste Rock Area



Bluebird Mine Waste Rock Area



Bluebird Mine Historic Settling Pond



Upstream View of Clear Creek at Bluebird Mine (left)



View of Bluebird Treatment Pond



View of Settling Pond from Bluebird Mine (Note: Single Tree is Near Pipeline Discharge)



Measuring Bluebird Mine Treatment Pond Depth and Sludge Thickness



View of Upstream (South) End of Bluebird Treatment Pond



Sludge Measurement/Sampling in Bluebird Treatment Pond



Bluebird Settling Pond Sludge (Note: Animal Tracks)



Bluebird Settling Pond Sludge (Note: Animal Tracks)



Water Quality Measurements at Bluebird Mine Pipeline Discharge



Bluebird Settling Pond (Note: Extensive Wetland Vegetation)



View of Upper Blackjack Adit Waste Rock



View of Lower Blackjack Portal Area (Note: Pipeline Cleanouts)



View of Riparian Area Below Upper Blackjack Adit (Note: Mouse)



Upper Blackjack Waste Rock Pile (Note: Staining from Historic Adit Overflow Discharge)



View of Lower BlackJack Portal and Waste Rock Areasl



View of Lower Blackjack Adit (Note BAT Gate and Pipelines)



Upper Blackjack Portal (Note: BAT Gate and Pipeline Cleanout)



View From Upper Blackjack Portal Looking Down Towards Clear Creek



View of Upper Blackjack Adit



View of Upper Blackjack Waste Rock Looking Down Towards Clear Creek



View of Upper Blackjack Waste Rock Near Portal



View of Potential Wetland Treatment Area Downslope of Blackjack Mine



Measuring Blackjack Treatment Pond No. 1 Depth and Sludge Thickness



Blackjack Mine Pipeline Discharge



Blackjack Mine Upper Settling Pond Looking Downstream



Blackjack Mine Upper Settling Pond Looking Upstream



Blackjack Mine Treatment Pond No. 1 Looking Downstream



Blackjack Mine Treatment Pond No. 1 with Rock Dam



View of Blackjack Mine Treatment Pond No. 1



View of Blackjack Mine Treatment Pond No. 2



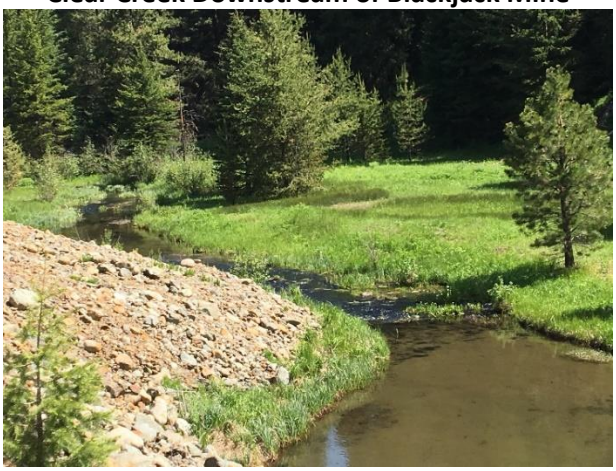
Clear Creek Downstream of Blackjack Mine



Clear Creek Downstream of Blackjack Mine



Blackjack Mine Discharge Stream Below Pipeline Discharge (Looking South)



Blackjack Mine Discharge Stream (Looking North)



View of Clear Creek From Bridge (Note: Confluence of Blackjack Mine Discharge Stream from the Right)



Upper Red Boy Pond (Note: Culvert on Far Side of Pond with Discharge from Red Boy Mine)



Middle Red Boy Ponds Looking South



Middle Red Boy Ponds Looking North



Lower Red Boy Pond at Boundary with USFS Land (Note: Culvert that Discharges to Bluebird Settling Pond)



View of County Road Embankment Along Clear Creek Adjacent to Red Boy Ponds (Note: Groundwater Seeps Along Base of Embankment)



Lower Red Boy Ponds Looking North



Pond on North Side of County Road (Note: No Surface Connection to Red Boy or Bluebird Ponds)(



Upper Portion of Bluebird Settling Pond (Note: Culvert Discharge from Lower Red Boy Pond)



View of Bluebird Pipeline Cleanout and Route Looking East Toward Bluebird Mine From Discharge



Measuring Bluebird Settling Pond Depth and Sludge Thickness



View of Isolated Pond on East Side of County Road Near Bluebird Treatment Pond and Downgradient of Red Boy Ponds (Note: Culvert has no exposed inlet)



View of Bluebird Mine Pipeline Discharge and Settling Pond



County Road Looking West with Red Boy Mine at Base of Slope



View of Red Boy Mine from County Road (Note: Mine Water Discharge

APPENDIX 3

Laboratory Reports

Pace Analytical®
National Center for Testing & Innovation

ANALYTICAL REPORT

September 26, 2019

Applied Intellect, LLC.- Boise, ID

Sample Delivery Group:	L1110283
Samples Received:	06/18/2019
Project Number:	EN19.003
Description:	Bluebird/Blackjack Mines

Report To: Chelsea Maxfield
345 Bobwhite Ct., Suite 230
Boise, ID 83706

Entire Report Reviewed By: Chris Ward

Chris Ward
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.



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BLK-WR-1 L1110283-01 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 13:50 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:44	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:35	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/23/19 23:59	LAT	Mt. Juliet, TN

BLK-WR-2 L1110283-02 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 13:55 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:46	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:48	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 00:26	LAT	Mt. Juliet, TN

BLK-WR-3 L1110283-03 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 14:05 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:48	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:51	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 00:31	LAT	Mt. Juliet, TN

BLK-WR-4 L1110283-04 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 14:10 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:51	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:00	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 00:47	LAT	Mt. Juliet, TN

BLK-WR-5 L1110283-05 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 14:40 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:57	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	10	06/20/19 17:55	06/24/19 00:07	EL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	20	06/20/19 17:55	06/24/19 03:38	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 00:53	LAT	Mt. Juliet, TN

BLK-WR-6 L1110283-06 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 14:45 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:59	ABL	Mt. Juliet, TN

BLK-WR-6 L1110283-06 Solid

Collected by: Paul Hunter | Collected date/time: 06/11/19 14:45 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:06	EL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	5	06/20/19 17:55	06/24/19 00:19	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 00:58	LAT	Mt. Juliet, TN

BLU-WR-1 L1110283-07 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 14:50 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:02	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	10	06/20/19 17:55	06/24/19 00:10	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:03	LAT	Mt. Juliet, TN

BLU-WR-2 L1110283-08 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 15:10 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:04	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:11	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:09	LAT	Mt. Juliet, TN

BLU-WR-3 L1110283-09 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 15:20 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 09:37	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:14	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:14	LAT	Mt. Juliet, TN

BLU-WR-4 L1110283-10 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 15:30 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299390	1	06/20/19 16:57	06/20/19 16:58	JD	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:06	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:17	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:19	LAT	Mt. Juliet, TN

BLU-BG-1 L1110283-11 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:00 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:08	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:20	EL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	5	06/20/19 17:55	06/24/19 00:22	EL	Mt. Juliet, TN

BLU-BG-1 L1110283-11 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:00 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:25	LAT	Mt. Juliet, TN

BLU-BG-2 L1110283-12 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:07 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:10	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:23	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:30	LAT	Mt. Juliet, TN

BLU-BG-3 L1110283-13 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:15 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:12	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 23:25	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:35	LAT	Mt. Juliet, TN

BLU-BG-4 L1110283-14 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:20 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:15	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:01	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:51	LAT	Mt. Juliet, TN

BLU-BG-5 L1110283-15 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:30 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:17	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:04	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 01:57	LAT	Mt. Juliet, TN

BLK-BG-1 L1110283-16 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 16:20 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:23	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:06	EL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	5	06/20/19 17:55	06/24/19 00:25	EL	Mt. Juliet, TN

BLK-BG-1 L1110283-16 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 16:20 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 02:02	LAT	Mt. Juliet, TN

BLK-BG-2 L1110283-17 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 16:30 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:26	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:09	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 02:07	LAT	Mt. Juliet, TN

BLK-BG-3 L1110283-18 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 16:40 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:28	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299310	1	06/20/19 18:23	06/23/19 21:02	EL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299310	5	06/20/19 18:23	06/24/19 00:16	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299305	5	06/20/19 18:39	06/23/19 22:03	LD	Mt. Juliet, TN

BLK-BG-4 L1110283-19 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 16:45 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:30	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	1	06/20/19 17:55	06/23/19 22:12	EL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	5	06/20/19 17:55	06/24/19 00:28	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 02:13	LAT	Mt. Juliet, TN

BLK-BG-5 L1110283-20 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 16:55 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299415	1	06/20/19 16:35	06/20/19 16:48	JD	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299392	1	06/20/19 15:28	06/21/19 10:32	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299306	5	06/20/19 17:55	06/24/19 00:31	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 02:18	LAT	Mt. Juliet, TN

BLK-BG-6 L1110283-21 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 17:00 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299420	1	06/21/19 10:19	06/21/19 10:28	KDW	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299441	5	06/20/19 15:56	06/20/19 23:03	TCT	Mt. Juliet, TN

BLK-BG-6 L1110283-21 Solid

Collected by: Paul Hunter | Collected date/time: 06/12/19 17:00 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Metals (ICP) by Method 6010D	WG1299306	10	06/20/19 17:55	06/24/19 00:13	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299302	5	06/20/19 18:13	06/24/19 02:23	LAT	Mt. Juliet, TN

BLU-WR-5 L1110283-22 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 15:40 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299420	1	06/21/19 10:19	06/21/19 10:28	KDW	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299441	1	06/20/19 15:56	06/20/19 22:52	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299310	1	06/20/19 18:23	06/23/19 21:15	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299305	5	06/20/19 18:39	06/23/19 22:40	LD	Mt. Juliet, TN

BLU-WR-6 L1110283-23 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 15:50 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299425	1	06/21/19 10:08	06/21/19 10:17	KDW	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299441	1	06/20/19 15:56	06/20/19 22:54	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299310	1	06/20/19 18:23	06/23/19 21:18	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299305	5	06/20/19 18:39	06/23/19 22:46	LD	Mt. Juliet, TN

BLU-WR-7 L1110283-24 Solid

Collected by: Paul Hunter | Collected date/time: 06/10/19 16:00 | Received date/time: 06/18/19 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Total Solids by Method 2540 G-2011	WG1299425	1	06/21/19 10:08	06/21/19 10:17	KDW	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1298437	1	06/19/19 16:00	06/19/19 17:00	JIC	Mt. Juliet, TN
Mercury by Method 7471B	WG1299441	1	06/20/19 15:56	06/20/19 22:56	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG1299310	1	06/20/19 18:23	06/23/19 21:27	EL	Mt. Juliet, TN
Metals (ICPMS) by Method 6020B	WG1299305	5	06/20/19 18:39	06/23/19 22:51	LD	Mt. Juliet, TN

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Chris Ward
Project Manager

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	93.6		1	06/20/2019 16:58	WG1299390

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	7.92	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-01 WG1298437: 7.92 at 23C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.265		0.00299	0.0214	1	06/21/2019 09:44	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3860	J5	3.74	10.7	1	06/23/2019 22:35	WG1299306
Antimony	1.93	J J6	0.802	2.14	1	06/23/2019 22:35	WG1299306
Arsenic	12.7		0.492	2.14	1	06/23/2019 22:35	WG1299306
Barium	162	J5	0.182	0.534	1	06/23/2019 22:35	WG1299306
Cadmium	0.608		0.0748	0.534	1	06/23/2019 22:35	WG1299306
Calcium	1340	J5	4.95	107	1	06/23/2019 22:35	WG1299306
Chromium	29.8		0.150	1.07	1	06/23/2019 22:35	WG1299306
Cobalt	19.6		0.246	1.07	1	06/23/2019 22:35	WG1299306
Copper	105		0.566	2.14	1	06/23/2019 22:35	WG1299306
Iron	33400	O1 V	1.51	10.7	1	06/23/2019 22:35	WG1299306
Lead	11.6		0.203	0.534	1	06/23/2019 22:35	WG1299306
Magnesium	2390	J3 J5 J6	1.19	107	1	06/23/2019 22:35	WG1299306
Manganese	860	O1 V	0.128	1.07	1	06/23/2019 22:35	WG1299306
Nickel	46.0		0.524	2.14	1	06/23/2019 22:35	WG1299306
Selenium	2.64		0.663	2.14	1	06/23/2019 22:35	WG1299306
Silver	U		0.128	1.07	1	06/23/2019 22:35	WG1299306
Tin	1.36	B J J6	0.470	5.34	1	06/23/2019 22:35	WG1299306
Vanadium	50.5		0.257	2.14	1	06/23/2019 22:35	WG1299306
Zinc	80.9	J6	0.631	5.34	1	06/23/2019 22:35	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.69	J	0.240	5.34	5	06/23/2019 23:59	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	95.5		1	06/20/2019 16:58	WG1299390

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0856		0.00293	0.0209	1	06/21/2019 09:46	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3290		3.67	10.5	1	06/23/2019 22:48	WG1299306
Antimony	1.30	J	0.785	2.09	1	06/23/2019 22:48	WG1299306
Arsenic	10.3		0.482	2.09	1	06/23/2019 22:48	WG1299306
Barium	109		0.178	0.524	1	06/23/2019 22:48	WG1299306
Cadmium	0.145	J	0.0733	0.524	1	06/23/2019 22:48	WG1299306
Calcium	220		4.85	105	1	06/23/2019 22:48	WG1299306
Chromium	10.1		0.147	1.05	1	06/23/2019 22:48	WG1299306
Cobalt	4.41		0.241	1.05	1	06/23/2019 22:48	WG1299306
Copper	64.7		0.555	2.09	1	06/23/2019 22:48	WG1299306
Iron	19000		1.48	10.5	1	06/23/2019 22:48	WG1299306
Lead	8.98		0.199	0.524	1	06/23/2019 22:48	WG1299306
Magnesium	522		1.16	105	1	06/23/2019 22:48	WG1299306
Manganese	251		0.126	1.05	1	06/23/2019 22:48	WG1299306
Nickel	20.0		0.513	2.09	1	06/23/2019 22:48	WG1299306
Selenium	1.07	J	0.649	2.09	1	06/23/2019 22:48	WG1299306
Silver	U		0.126	1.05	1	06/23/2019 22:48	WG1299306
Tin	1.34	B J	0.461	5.24	1	06/23/2019 22:48	WG1299306
Vanadium	16.9		0.251	2.09	1	06/23/2019 22:48	WG1299306
Zinc	46.6		0.618	5.24	1	06/23/2019 22:48	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.58	J	0.236	5.24	5	06/24/2019 00:26	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	94.8		1	06/20/2019 16:58	WG1299390

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.510		0.00295	0.0211	1	06/21/2019 09:48	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	2360		3.69	10.5	1	06/23/2019 22:51	WG1299306
Antimony	U		0.791	2.11	1	06/23/2019 22:51	WG1299306
Arsenic	0.493	J	0.485	2.11	1	06/23/2019 22:51	WG1299306
Barium	104		0.179	0.527	1	06/23/2019 22:51	WG1299306
Cadmium	U		0.0738	0.527	1	06/23/2019 22:51	WG1299306
Calcium	12.5	J	4.88	105	1	06/23/2019 22:51	WG1299306
Chromium	25.0		0.148	1.05	1	06/23/2019 22:51	WG1299306
Cobalt	0.245	J	0.243	1.05	1	06/23/2019 22:51	WG1299306
Copper	6.84		0.559	2.11	1	06/23/2019 22:51	WG1299306
Iron	2520		1.49	10.5	1	06/23/2019 22:51	WG1299306
Lead	16.8		0.200	0.527	1	06/23/2019 22:51	WG1299306
Magnesium	129		1.17	105	1	06/23/2019 22:51	WG1299306
Manganese	4.25		0.127	1.05	1	06/23/2019 22:51	WG1299306
Nickel	5.55		0.517	2.11	1	06/23/2019 22:51	WG1299306
Selenium	U		0.654	2.11	1	06/23/2019 22:51	WG1299306
Silver	U		0.127	1.05	1	06/23/2019 22:51	WG1299306
Tin	1.10	B J	0.464	5.27	1	06/23/2019 22:51	WG1299306
Vanadium	23.4		0.253	2.11	1	06/23/2019 22:51	WG1299306
Zinc	8.12		0.622	5.27	1	06/23/2019 22:51	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	4.73	J	0.237	5.27	5	06/24/2019 00:31	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	96.5		1	06/20/2019 16:58	WG1299390

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	5.65	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-04 WG1298437: 5.65 at 22.8C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0497	B	0.00290	0.0207	1	06/21/2019 09:51	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	1720		3.63	10.4	1	06/23/2019 23:00	WG1299306
Antimony	U		0.777	2.07	1	06/23/2019 23:00	WG1299306
Arsenic	5.28		0.477	2.07	1	06/23/2019 23:00	WG1299306
Barium	80.3		0.176	0.518	1	06/23/2019 23:00	WG1299306
Cadmium	U		0.0725	0.518	1	06/23/2019 23:00	WG1299306
Calcium	66.7	J	4.80	104	1	06/23/2019 23:00	WG1299306
Chromium	4.60		0.145	1.04	1	06/23/2019 23:00	WG1299306
Cobalt	0.586	J	0.238	1.04	1	06/23/2019 23:00	WG1299306
Copper	12.7		0.549	2.07	1	06/23/2019 23:00	WG1299306
Iron	6730		1.46	10.4	1	06/23/2019 23:00	WG1299306
Lead	5.81		0.197	0.518	1	06/23/2019 23:00	WG1299306
Magnesium	114		1.15	104	1	06/23/2019 23:00	WG1299306
Manganese	21.9		0.124	1.04	1	06/23/2019 23:00	WG1299306
Nickel	6.20		0.508	2.07	1	06/23/2019 23:00	WG1299306
Selenium	U		0.642	2.07	1	06/23/2019 23:00	WG1299306
Silver	U		0.124	1.04	1	06/23/2019 23:00	WG1299306
Tin	1.18	B J	0.456	5.18	1	06/23/2019 23:00	WG1299306
Vanadium	10.0		0.249	2.07	1	06/23/2019 23:00	WG1299306
Zinc	15.1		0.611	5.18	1	06/23/2019 23:00	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.57	J	0.233	5.18	5	06/24/2019 00:47	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	84.9		1	06/20/2019 16:58	WG1299390

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.136		0.00330	0.0236	1	06/21/2019 09:57	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	7700		41.2	118	10	06/24/2019 00:07	WG1299306
Antimony	U		8.84	23.6	10	06/24/2019 00:07	WG1299306
Arsenic	U		5.42	23.6	10	06/24/2019 00:07	WG1299306
Barium	223		2.00	5.89	10	06/24/2019 00:07	WG1299306
Cadmium	U		0.825	5.89	10	06/24/2019 00:07	WG1299306
Calcium	706	J	54.5	1180	10	06/24/2019 00:07	WG1299306
Chromium	28.4		1.65	11.8	10	06/24/2019 00:07	WG1299306
Cobalt	108		2.71	11.8	10	06/24/2019 00:07	WG1299306
Copper	124		6.24	23.6	10	06/24/2019 00:07	WG1299306
Iron	92900		16.6	118	10	06/24/2019 00:07	WG1299306
Lead	26.7		2.24	5.89	10	06/24/2019 00:07	WG1299306
Magnesium	3040		13.1	1180	10	06/24/2019 00:07	WG1299306
Manganese	12600		2.83	23.6	20	06/24/2019 03:38	WG1299306
Nickel	286		5.77	23.6	10	06/24/2019 00:07	WG1299306
Selenium	7.37	J	7.30	23.6	10	06/24/2019 00:07	WG1299306
Silver	U		1.41	11.8	10	06/24/2019 00:07	WG1299306
Tin	U		5.18	58.9	10	06/24/2019 00:07	WG1299306
Vanadium	28.1		2.83	23.6	10	06/24/2019 00:07	WG1299306
Zinc	491		6.95	58.9	10	06/24/2019 00:07	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.27	J	0.265	5.89	5	06/24/2019 00:53	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	94.5		1	06/20/2019 16:58	WG1299390

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	4.75	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-06 WG1298437: 4.75 at 23.4C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.119		0.00296	0.0212	1	06/21/2019 09:59	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3600		3.71	10.6	1	06/23/2019 23:06	WG1299306
Antimony	1.65	J	0.794	2.12	1	06/23/2019 23:06	WG1299306
Arsenic	2.32		0.487	2.12	1	06/23/2019 23:06	WG1299306
Barium	103		0.180	0.529	1	06/23/2019 23:06	WG1299306
Cadmium	0.252	J	0.0741	0.529	1	06/23/2019 23:06	WG1299306
Calcium	114		4.90	106	1	06/23/2019 23:06	WG1299306
Chromium	8.33		0.148	1.06	1	06/23/2019 23:06	WG1299306
Cobalt	28.8		0.244	1.06	1	06/23/2019 23:06	WG1299306
Copper	58.4		0.561	2.12	1	06/23/2019 23:06	WG1299306
Iron	31900		1.49	10.6	1	06/23/2019 23:06	WG1299306
Lead	6.33		0.201	0.529	1	06/23/2019 23:06	WG1299306
Magnesium	255		1.18	106	1	06/23/2019 23:06	WG1299306
Manganese	2770		0.635	5.29	5	06/24/2019 00:19	WG1299306
Nickel	62.7		0.519	2.12	1	06/23/2019 23:06	WG1299306
Selenium	1.84	J	0.656	2.12	1	06/23/2019 23:06	WG1299306
Silver	U		0.127	1.06	1	06/23/2019 23:06	WG1299306
Tin	1.40	B J	0.466	5.29	1	06/23/2019 23:06	WG1299306
Vanadium	13.6		0.254	2.12	1	06/23/2019 23:06	WG1299306
Zinc	98.4		0.625	5.29	1	06/23/2019 23:06	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.17	J	0.238	5.29	5	06/24/2019 00:58	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	63.5		1	06/20/2019 16:58	WG1299390

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	3.54	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-07 WG1298437: 3.54 at 22.6C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0788	B	0.00441	0.0315	1	06/21/2019 10:02	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3490		55.1	158	10	06/24/2019 00:10	WG1299306
Antimony	22.1	J	11.8	31.5	10	06/24/2019 00:10	WG1299306
Arsenic	25.7	J	7.25	31.5	10	06/24/2019 00:10	WG1299306
Barium	15.6		2.68	7.88	10	06/24/2019 00:10	WG1299306
Cadmium	1.40	J	1.10	7.88	10	06/24/2019 00:10	WG1299306
Calcium	U		72.9	1580	10	06/24/2019 00:10	WG1299306
Chromium	7.82	J	2.21	15.8	10	06/24/2019 00:10	WG1299306
Cobalt	U		3.62	15.8	10	06/24/2019 00:10	WG1299306
Copper	159		8.35	31.5	10	06/24/2019 00:10	WG1299306
Iron	381000		22.2	158	10	06/24/2019 00:10	WG1299306
Lead	10.6		2.99	7.88	10	06/24/2019 00:10	WG1299306
Magnesium	135	B J	17.5	1580	10	06/24/2019 00:10	WG1299306
Manganese	245		1.89	15.8	10	06/24/2019 00:10	WG1299306
Nickel	8.67	J	7.72	31.5	10	06/24/2019 00:10	WG1299306
Selenium	10.6	J	9.77	31.5	10	06/24/2019 00:10	WG1299306
Silver	U		1.89	15.8	10	06/24/2019 00:10	WG1299306
Tin	U		6.93	78.8	10	06/24/2019 00:10	WG1299306
Vanadium	U		3.78	31.5	10	06/24/2019 00:10	WG1299306
Zinc	186		9.29	78.8	10	06/24/2019 00:10	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	0.820	J	0.354	7.88	5	06/24/2019 01:03	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	94.8		1	06/20/2019 16:58	WG1299390

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	4.03	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-08 WG1298437: 4.03 at 23.3C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.678		0.00295	0.0211	1	06/21/2019 10:04	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	1700		3.69	10.6	1	06/23/2019 23:11	WG1299306
Antimony	2.18		0.791	2.11	1	06/23/2019 23:11	WG1299306
Arsenic	30.5		0.485	2.11	1	06/23/2019 23:11	WG1299306
Barium	48.2		0.179	0.528	1	06/23/2019 23:11	WG1299306
Cadmium	0.0827	J	0.0739	0.528	1	06/23/2019 23:11	WG1299306
Calcium	15.2	J	4.88	106	1	06/23/2019 23:11	WG1299306
Chromium	4.46		0.148	1.06	1	06/23/2019 23:11	WG1299306
Cobalt	3.78		0.243	1.06	1	06/23/2019 23:11	WG1299306
Copper	27.6		0.559	2.11	1	06/23/2019 23:11	WG1299306
Iron	16600		1.49	10.6	1	06/23/2019 23:11	WG1299306
Lead	7.72		0.200	0.528	1	06/23/2019 23:11	WG1299306
Magnesium	82.4	J	1.17	106	1	06/23/2019 23:11	WG1299306
Manganese	265		0.127	1.06	1	06/23/2019 23:11	WG1299306
Nickel	10.4		0.517	2.11	1	06/23/2019 23:11	WG1299306
Selenium	0.894	J	0.654	2.11	1	06/23/2019 23:11	WG1299306
Silver	U		0.127	1.06	1	06/23/2019 23:11	WG1299306
Tin	0.977	B J	0.464	5.28	1	06/23/2019 23:11	WG1299306
Vanadium	13.4		0.253	2.11	1	06/23/2019 23:11	WG1299306
Zinc	49.1		0.622	5.28	1	06/23/2019 23:11	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	1.31	J	0.237	5.28	5	06/24/2019 01:09	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	95.4		1	06/20/2019 16:58	WG1299390

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.599	J3 J5 J6	0.00293	0.0210	1	06/21/2019 09:37	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3980		3.67	10.5	1	06/23/2019 23:14	WG1299306
Antimony	2.51		0.786	2.10	1	06/23/2019 23:14	WG1299306
Arsenic	17.7		0.482	2.10	1	06/23/2019 23:14	WG1299306
Barium	69.3		0.178	0.524	1	06/23/2019 23:14	WG1299306
Cadmium	0.143	J	0.0734	0.524	1	06/23/2019 23:14	WG1299306
Calcium	28.1	J	4.85	105	1	06/23/2019 23:14	WG1299306
Chromium	13.2		0.147	1.05	1	06/23/2019 23:14	WG1299306
Cobalt	6.49		0.241	1.05	1	06/23/2019 23:14	WG1299306
Copper	54.3		0.555	2.10	1	06/23/2019 23:14	WG1299306
Iron	31200		1.48	10.5	1	06/23/2019 23:14	WG1299306
Lead	11.2		0.199	0.524	1	06/23/2019 23:14	WG1299306
Magnesium	954		1.16	105	1	06/23/2019 23:14	WG1299306
Manganese	180		0.126	1.05	1	06/23/2019 23:14	WG1299306
Nickel	19.8		0.513	2.10	1	06/23/2019 23:14	WG1299306
Selenium	1.45	J	0.650	2.10	1	06/23/2019 23:14	WG1299306
Silver	U		0.126	1.05	1	06/23/2019 23:14	WG1299306
Tin	1.53	B J	0.461	5.24	1	06/23/2019 23:14	WG1299306
Vanadium	19.5		0.251	2.10	1	06/23/2019 23:14	WG1299306
Zinc	65.0		0.618	5.24	1	06/23/2019 23:14	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.27	J	0.236	5.24	5	06/24/2019 01:14	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	94.4		1	06/20/2019 16:58	WG1299390

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.370		0.00297	0.0212	1	06/21/2019 10:06	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	8280		3.71	10.6	1	06/23/2019 23:17	WG1299306
Antimony	3.13		0.795	2.12	1	06/23/2019 23:17	WG1299306
Arsenic	41.3		0.487	2.12	1	06/23/2019 23:17	WG1299306
Barium	100		0.180	0.530	1	06/23/2019 23:17	WG1299306
Cadmium	0.243	J	0.0742	0.530	1	06/23/2019 23:17	WG1299306
Calcium	141		4.91	106	1	06/23/2019 23:17	WG1299306
Chromium	22.7		0.148	1.06	1	06/23/2019 23:17	WG1299306
Cobalt	6.89		0.244	1.06	1	06/23/2019 23:17	WG1299306
Copper	66.9		0.562	2.12	1	06/23/2019 23:17	WG1299306
Iron	36500		1.49	10.6	1	06/23/2019 23:17	WG1299306
Lead	13.9		0.201	0.530	1	06/23/2019 23:17	WG1299306
Magnesium	3200		1.18	106	1	06/23/2019 23:17	WG1299306
Manganese	266		0.127	1.06	1	06/23/2019 23:17	WG1299306
Nickel	22.0		0.519	2.12	1	06/23/2019 23:17	WG1299306
Selenium	2.28		0.657	2.12	1	06/23/2019 23:17	WG1299306
Silver	U		0.127	1.06	1	06/23/2019 23:17	WG1299306
Tin	2.08	B J	0.466	5.30	1	06/23/2019 23:17	WG1299306
Vanadium	32.2		0.254	2.12	1	06/23/2019 23:17	WG1299306
Zinc	67.0		0.625	5.30	1	06/23/2019 23:17	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	4.23	J	0.238	5.30	5	06/24/2019 01:19	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	81.3		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	5.54	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-11 WG1298437: 5.54 at 23.5C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0541	B	0.00344	0.0246	1	06/21/2019 10:08	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	27800		4.30	12.3	1	06/23/2019 23:20	WG1299306
Antimony	2.39	J	0.922	2.46	1	06/23/2019 23:20	WG1299306
Arsenic	16.5		0.566	2.46	1	06/23/2019 23:20	WG1299306
Barium	324		0.209	0.615	1	06/23/2019 23:20	WG1299306
Cadmium	0.568	J	0.0861	0.615	1	06/23/2019 23:20	WG1299306
Calcium	853		5.69	123	1	06/23/2019 23:20	WG1299306
Chromium	29.4		0.172	1.23	1	06/23/2019 23:20	WG1299306
Cobalt	9.19		0.283	1.23	1	06/23/2019 23:20	WG1299306
Copper	58.2		0.652	2.46	1	06/23/2019 23:20	WG1299306
Iron	55900		8.67	61.5	5	06/24/2019 00:22	WG1299306
Lead	10.1		0.234	0.615	1	06/23/2019 23:20	WG1299306
Magnesium	1490		1.36	123	1	06/23/2019 23:20	WG1299306
Manganese	522		0.148	1.23	1	06/23/2019 23:20	WG1299306
Nickel	28.5		0.602	2.46	1	06/23/2019 23:20	WG1299306
Selenium	1.92	J	0.762	2.46	1	06/23/2019 23:20	WG1299306
Silver	U		0.148	1.23	1	06/23/2019 23:20	WG1299306
Tin	2.15	B J	0.541	6.15	1	06/23/2019 23:20	WG1299306
Vanadium	49.4		0.295	2.46	1	06/23/2019 23:20	WG1299306
Zinc	89.6		0.725	6.15	1	06/23/2019 23:20	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.95	J	0.277	6.15	5	06/24/2019 01:25	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	82.3		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.67	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-12 WG1298437: 6.67 at 23.2C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0354	B	0.00340	0.0243	1	06/21/2019 10:10	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	12400		4.25	12.2	1	06/23/2019 23:23	WG1299306
Antimony	0.954	J	0.912	2.43	1	06/23/2019 23:23	WG1299306
Arsenic	5.21		0.559	2.43	1	06/23/2019 23:23	WG1299306
Barium	222		0.207	0.608	1	06/23/2019 23:23	WG1299306
Cadmium	0.181	J	0.0851	0.608	1	06/23/2019 23:23	WG1299306
Calcium	2160		5.63	122	1	06/23/2019 23:23	WG1299306
Chromium	10.1		0.170	1.22	1	06/23/2019 23:23	WG1299306
Cobalt	4.91		0.280	1.22	1	06/23/2019 23:23	WG1299306
Copper	20.3		0.644	2.43	1	06/23/2019 23:23	WG1299306
Iron	12100		1.71	12.2	1	06/23/2019 23:23	WG1299306
Lead	5.89		0.231	0.608	1	06/23/2019 23:23	WG1299306
Magnesium	977		1.35	122	1	06/23/2019 23:23	WG1299306
Manganese	495		0.146	1.22	1	06/23/2019 23:23	WG1299306
Nickel	16.8		0.596	2.43	1	06/23/2019 23:23	WG1299306
Selenium	0.832	J	0.754	2.43	1	06/23/2019 23:23	WG1299306
Silver	U		0.146	1.22	1	06/23/2019 23:23	WG1299306
Tin	1.69	B J	0.535	6.08	1	06/23/2019 23:23	WG1299306
Vanadium	19.4		0.292	2.43	1	06/23/2019 23:23	WG1299306
Zinc	37.0		0.717	6.08	1	06/23/2019 23:23	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.28	J	0.274	6.08	5	06/24/2019 01:30	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	89.3		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.70	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-13 WG1298437: 6.7 at 23C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0421	B	0.00313	0.0224	1	06/21/2019 10:12	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	20400		3.92	11.2	1	06/23/2019 23:25	WG1299306
Antimony	1.47	J	0.840	2.24	1	06/23/2019 23:25	WG1299306
Arsenic	22.6		0.515	2.24	1	06/23/2019 23:25	WG1299306
Barium	276		0.190	0.560	1	06/23/2019 23:25	WG1299306
Cadmium	0.567		0.0784	0.560	1	06/23/2019 23:25	WG1299306
Calcium	2580		5.18	112	1	06/23/2019 23:25	WG1299306
Chromium	38.5		0.157	1.12	1	06/23/2019 23:25	WG1299306
Cobalt	16.4		0.257	1.12	1	06/23/2019 23:25	WG1299306
Copper	120		0.593	2.24	1	06/23/2019 23:25	WG1299306
Iron	36000		1.58	11.2	1	06/23/2019 23:25	WG1299306
Lead	8.75		0.213	0.560	1	06/23/2019 23:25	WG1299306
Magnesium	5010		1.24	112	1	06/23/2019 23:25	WG1299306
Manganese	498		0.134	1.12	1	06/23/2019 23:25	WG1299306
Nickel	29.5		0.549	2.24	1	06/23/2019 23:25	WG1299306
Selenium	2.91		0.694	2.24	1	06/23/2019 23:25	WG1299306
Silver	U		0.134	1.12	1	06/23/2019 23:25	WG1299306
Tin	1.83	B J	0.493	5.60	1	06/23/2019 23:25	WG1299306
Vanadium	66.9		0.269	2.24	1	06/23/2019 23:25	WG1299306
Zinc	55.5		0.661	5.60	1	06/23/2019 23:25	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.04	J	0.252	5.60	5	06/24/2019 01:35	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	85.4		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.45	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-14 WG1298437: 6.45 at 22.9C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0130	B J	0.00328	0.0234	1	06/21/2019 10:15	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	17900		4.10	11.7	1	06/23/2019 22:01	WG1299306
Antimony	1.24	J	0.878	2.34	1	06/23/2019 22:01	WG1299306
Arsenic	14.7		0.539	2.34	1	06/23/2019 22:01	WG1299306
Barium	243		0.199	0.585	1	06/23/2019 22:01	WG1299306
Cadmium	0.318	J	0.0820	0.585	1	06/23/2019 22:01	WG1299306
Calcium	866		5.42	117	1	06/23/2019 22:01	WG1299306
Chromium	18.4		0.164	1.17	1	06/23/2019 22:01	WG1299306
Cobalt	10.2		0.269	1.17	1	06/23/2019 22:01	WG1299306
Copper	67.2		0.620	2.34	1	06/23/2019 22:01	WG1299306
Iron	23700		1.65	11.7	1	06/23/2019 22:01	WG1299306
Lead	10.9		0.222	0.585	1	06/23/2019 22:01	WG1299306
Magnesium	3220		1.30	117	1	06/23/2019 22:01	WG1299306
Manganese	520		0.140	1.17	1	06/23/2019 22:01	WG1299306
Nickel	33.9		0.574	2.34	1	06/23/2019 22:01	WG1299306
Selenium	1.10	J	0.726	2.34	1	06/23/2019 22:01	WG1299306
Silver	U		0.140	1.17	1	06/23/2019 22:01	WG1299306
Tin	2.02	B J	0.515	5.85	1	06/23/2019 22:01	WG1299306
Vanadium	32.1		0.281	2.34	1	06/23/2019 22:01	WG1299306
Zinc	73.8		0.691	5.85	1	06/23/2019 22:01	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	4.71	J	0.263	5.85	5	06/24/2019 01:51	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	81.8		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.42	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-15 WG1298437: 6.42 at 22.9C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0264	B	0.00342	0.0245	1	06/21/2019 10:17	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	16700		4.28	12.2	1	06/23/2019 22:04	WG1299306
Antimony	U		0.917	2.45	1	06/23/2019 22:04	WG1299306
Arsenic	9.29		0.562	2.45	1	06/23/2019 22:04	WG1299306
Barium	275		0.208	0.611	1	06/23/2019 22:04	WG1299306
Cadmium	0.600	J	0.0856	0.611	1	06/23/2019 22:04	WG1299306
Calcium	2250		5.66	122	1	06/23/2019 22:04	WG1299306
Chromium	21.5		0.171	1.22	1	06/23/2019 22:04	WG1299306
Cobalt	10.5		0.281	1.22	1	06/23/2019 22:04	WG1299306
Copper	45.1		0.648	2.45	1	06/23/2019 22:04	WG1299306
Iron	21400		1.72	12.2	1	06/23/2019 22:04	WG1299306
Lead	9.44		0.232	0.611	1	06/23/2019 22:04	WG1299306
Magnesium	2550		1.36	122	1	06/23/2019 22:04	WG1299306
Manganese	839		0.147	1.22	1	06/23/2019 22:04	WG1299306
Nickel	31.8		0.599	2.45	1	06/23/2019 22:04	WG1299306
Selenium	1.69	J	0.758	2.45	1	06/23/2019 22:04	WG1299306
Silver	U		0.147	1.22	1	06/23/2019 22:04	WG1299306
Tin	1.61	B J	0.538	6.11	1	06/23/2019 22:04	WG1299306
Vanadium	34.1		0.293	2.45	1	06/23/2019 22:04	WG1299306
Zinc	75.9		0.721	6.11	1	06/23/2019 22:04	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.77	J	0.275	6.11	5	06/24/2019 01:57	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	87.8		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.78	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-16 WG1298437: 6.78 at 23.4C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0366	B	0.00319	0.0228	1	06/21/2019 10:23	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	26800		3.99	11.4	1	06/23/2019 22:06	WG1299306
Antimony	U		0.854	2.28	1	06/23/2019 22:06	WG1299306
Arsenic	2.55		0.524	2.28	1	06/23/2019 22:06	WG1299306
Barium	418		0.194	0.569	1	06/23/2019 22:06	WG1299306
Cadmium	0.423	J	0.0797	0.569	1	06/23/2019 22:06	WG1299306
Calcium	2640		5.27	114	1	06/23/2019 22:06	WG1299306
Chromium	12.7		0.159	1.14	1	06/23/2019 22:06	WG1299306
Cobalt	9.99		0.262	1.14	1	06/23/2019 22:06	WG1299306
Copper	31.1		0.603	2.28	1	06/23/2019 22:06	WG1299306
Iron	16700		1.61	11.4	1	06/23/2019 22:06	WG1299306
Lead	5.81		0.216	0.569	1	06/23/2019 22:06	WG1299306
Magnesium	1920		1.26	114	1	06/23/2019 22:06	WG1299306
Manganese	2660		0.683	5.69	5	06/24/2019 00:25	WG1299306
Nickel	30.7		0.558	2.28	1	06/23/2019 22:06	WG1299306
Selenium	1.12	J	0.706	2.28	1	06/23/2019 22:06	WG1299306
Silver	U		0.137	1.14	1	06/23/2019 22:06	WG1299306
Tin	2.25	B J	0.501	5.69	1	06/23/2019 22:06	WG1299306
Vanadium	32.2		0.273	2.28	1	06/23/2019 22:06	WG1299306
Zinc	77.7		0.672	5.69	1	06/23/2019 22:06	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.34	J	0.256	5.69	5	06/24/2019 02:02	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	83.9		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.61	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-17 WG1298437: 6.61 at 23.4C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0299	B	0.00334	0.0238	1	06/21/2019 10:26	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	17900		4.17	11.9	1	06/23/2019 22:09	WG1299306
Antimony	U		0.894	2.38	1	06/23/2019 22:09	WG1299306
Arsenic	1.44	J	0.549	2.38	1	06/23/2019 22:09	WG1299306
Barium	258		0.203	0.596	1	06/23/2019 22:09	WG1299306
Cadmium	0.282	J	0.0835	0.596	1	06/23/2019 22:09	WG1299306
Calcium	1440		5.52	119	1	06/23/2019 22:09	WG1299306
Chromium	15.3		0.167	1.19	1	06/23/2019 22:09	WG1299306
Cobalt	6.73		0.274	1.19	1	06/23/2019 22:09	WG1299306
Copper	22.6		0.632	2.38	1	06/23/2019 22:09	WG1299306
Iron	20900		1.68	11.9	1	06/23/2019 22:09	WG1299306
Lead	8.50		0.227	0.596	1	06/23/2019 22:09	WG1299306
Magnesium	1300		1.32	119	1	06/23/2019 22:09	WG1299306
Manganese	900		0.143	1.19	1	06/23/2019 22:09	WG1299306
Nickel	35.4		0.584	2.38	1	06/23/2019 22:09	WG1299306
Selenium	1.19	J	0.739	2.38	1	06/23/2019 22:09	WG1299306
Silver	U		0.143	1.19	1	06/23/2019 22:09	WG1299306
Tin	1.83	B J	0.525	5.96	1	06/23/2019 22:09	WG1299306
Vanadium	32.5		0.286	2.38	1	06/23/2019 22:09	WG1299306
Zinc	49.0		0.704	5.96	1	06/23/2019 22:09	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.54	J	0.268	5.96	5	06/24/2019 02:07	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	84.5		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	7.10	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-18 WG1298437: 7.1 at 23C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0574	B	0.00331	0.0237	1	06/21/2019 10:28	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	20300	O1 V	4.14	11.8	1	06/23/2019 21:02	WG1299310
Antimony	0.999	J J6	0.888	2.37	1	06/23/2019 21:02	WG1299310
Arsenic	2.95		0.544	2.37	1	06/23/2019 21:02	WG1299310
Barium	606	V	0.201	0.592	1	06/23/2019 21:02	WG1299310
Cadmium	0.592	J	0.0828	0.592	1	06/23/2019 21:02	WG1299310
Calcium	5460	J3 V	5.48	118	1	06/23/2019 21:02	WG1299310
Chromium	16.5		0.166	1.18	1	06/23/2019 21:02	WG1299310
Cobalt	13.8		0.272	1.18	1	06/23/2019 21:02	WG1299310
Copper	49.0		0.627	2.37	1	06/23/2019 21:02	WG1299310
Iron	27800	O1 V	1.67	11.8	1	06/23/2019 21:02	WG1299310
Lead	8.05		0.225	0.592	1	06/23/2019 21:02	WG1299310
Magnesium	2180	J6	1.31	118	1	06/23/2019 21:02	WG1299310
Manganese	3650		0.710	5.92	5	06/24/2019 00:16	WG1299310
Nickel	41.9		0.580	2.37	1	06/23/2019 21:02	WG1299310
Selenium	1.69	J	0.734	2.37	1	06/23/2019 21:02	WG1299310
Silver	U		0.142	1.18	1	06/23/2019 21:02	WG1299310
Tin	2.10	B J	0.521	5.92	1	06/23/2019 21:02	WG1299310
Vanadium	37.9		0.284	2.37	1	06/23/2019 21:02	WG1299310
Zinc	88.3	J6 O1	0.698	5.92	1	06/23/2019 21:02	WG1299310

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.15	J	0.266	5.92	5	06/23/2019 22:03	WG1299305

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	84.2		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.99	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-19 WG1298437: 6.99 at 23C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.0655	B	0.00333	0.0238	1	06/21/2019 10:30	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	18800		4.16	11.9	1	06/23/2019 22:12	WG1299306
Antimony	U		0.891	2.38	1	06/23/2019 22:12	WG1299306
Arsenic	4.40		0.547	2.38	1	06/23/2019 22:12	WG1299306
Barium	848		0.202	0.594	1	06/23/2019 22:12	WG1299306
Cadmium	1.02		0.0832	0.594	1	06/23/2019 22:12	WG1299306
Calcium	7290		5.50	119	1	06/23/2019 22:12	WG1299306
Chromium	12.2		0.166	1.19	1	06/23/2019 22:12	WG1299306
Cobalt	13.1		0.273	1.19	1	06/23/2019 22:12	WG1299306
Copper	42.1		0.630	2.38	1	06/23/2019 22:12	WG1299306
Iron	19000		1.68	11.9	1	06/23/2019 22:12	WG1299306
Lead	7.32		0.226	0.594	1	06/23/2019 22:12	WG1299306
Magnesium	1680		1.32	119	1	06/23/2019 22:12	WG1299306
Manganese	4700		0.713	5.94	5	06/24/2019 00:28	WG1299306
Nickel	24.7		0.582	2.38	1	06/23/2019 22:12	WG1299306
Selenium	1.71	J	0.737	2.38	1	06/23/2019 22:12	WG1299306
Silver	U		0.143	1.19	1	06/23/2019 22:12	WG1299306
Tin	1.82	B J	0.523	5.94	1	06/23/2019 22:12	WG1299306
Vanadium	31.1		0.285	2.38	1	06/23/2019 22:12	WG1299306
Zinc	214		0.701	5.94	1	06/23/2019 22:12	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	1.78	J	0.267	5.94	5	06/24/2019 02:13	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	89.7		1	06/20/2019 16:48	WG1299415

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.60	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-20 WG1298437: 6.6 at 22.9C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.261		0.00312	0.0223	1	06/21/2019 10:32	WG1299392

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3270		19.5	55.7	5	06/24/2019 00:31	WG1299306
Antimony	6.65	J	4.18	11.1	5	06/24/2019 00:31	WG1299306
Arsenic	13.0		2.56	11.1	5	06/24/2019 00:31	WG1299306
Barium	91.9		0.947	2.79	5	06/24/2019 00:31	WG1299306
Cadmium	0.583	J	0.390	2.79	5	06/24/2019 00:31	WG1299306
Calcium	69.7	J	25.9	557	5	06/24/2019 00:31	WG1299306
Chromium	12.5		0.780	5.57	5	06/24/2019 00:31	WG1299306
Cobalt	20.5		1.28	5.57	5	06/24/2019 00:31	WG1299306
Copper	81.1		2.95	11.1	5	06/24/2019 00:31	WG1299306
Iron	136000		7.86	55.7	5	06/24/2019 00:31	WG1299306
Lead	10.1		1.06	2.79	5	06/24/2019 00:31	WG1299306
Magnesium	186	B J	6.19	557	5	06/24/2019 00:31	WG1299306
Manganese	347		0.669	5.57	5	06/24/2019 00:31	WG1299306
Nickel	112		2.73	11.1	5	06/24/2019 00:31	WG1299306
Selenium	U		3.46	11.1	5	06/24/2019 00:31	WG1299306
Silver	U		0.669	5.57	5	06/24/2019 00:31	WG1299306
Tin	U		2.45	27.9	5	06/24/2019 00:31	WG1299306
Vanadium	19.6		1.34	11.1	5	06/24/2019 00:31	WG1299306
Zinc	384		3.29	27.9	5	06/24/2019 00:31	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	2.01	J	0.251	5.57	5	06/24/2019 02:18	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	85.3		1	06/21/2019 10:28	WG1299420

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	6.52	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-21 WG1298437: 6.52 at 23.1C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	1.53		0.0164	0.117	5	06/20/2019 23:03	WG1299441

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	2580		41.0	117	10	06/24/2019 00:13	WG1299306
Antimony	9.98	J	8.79	23.4	10	06/24/2019 00:13	WG1299306
Arsenic	21.8	J	5.39	23.4	10	06/24/2019 00:13	WG1299306
Barium	78.8		1.99	5.86	10	06/24/2019 00:13	WG1299306
Cadmium	U		0.821	5.86	10	06/24/2019 00:13	WG1299306
Calcium	58.0	J	54.3	1170	10	06/24/2019 00:13	WG1299306
Chromium	11.1	J	1.64	11.7	10	06/24/2019 00:13	WG1299306
Cobalt	23.0		2.70	11.7	10	06/24/2019 00:13	WG1299306
Copper	73.7		6.21	23.4	10	06/24/2019 00:13	WG1299306
Iron	198000		16.5	117	10	06/24/2019 00:13	WG1299306
Lead	11.1		2.23	5.86	10	06/24/2019 00:13	WG1299306
Magnesium	96.7	B J	13.0	1170	10	06/24/2019 00:13	WG1299306
Manganese	307		1.41	11.7	10	06/24/2019 00:13	WG1299306
Nickel	129		5.74	23.4	10	06/24/2019 00:13	WG1299306
Selenium	U		7.27	23.4	10	06/24/2019 00:13	WG1299306
Silver	U		1.41	11.7	10	06/24/2019 00:13	WG1299306
Tin	U		5.16	58.6	10	06/24/2019 00:13	WG1299306
Vanadium	13.3	J	2.81	23.4	10	06/24/2019 00:13	WG1299306
Zinc	533		6.92	58.6	10	06/24/2019 00:13	WG1299306

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	1.44	J	0.264	5.86	5	06/24/2019 02:23	WG1299302

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	92.9		1	06/21/2019 10:28	WG1299420

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	5.63	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-22 WG1298437: 5.63 at 23.5C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.186		0.00301	0.0215	1	06/20/2019 22:52	WG1299441

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	12600		3.77	10.8	1	06/23/2019 21:15	WG1299310
Antimony	2.04	J	0.807	2.15	1	06/23/2019 21:15	WG1299310
Arsenic	21.1		0.495	2.15	1	06/23/2019 21:15	WG1299310
Barium	113		0.183	0.538	1	06/23/2019 21:15	WG1299310
Cadmium	0.428	J	0.0753	0.538	1	06/23/2019 21:15	WG1299310
Calcium	353		4.98	108	1	06/23/2019 21:15	WG1299310
Chromium	29.5		0.151	1.08	1	06/23/2019 21:15	WG1299310
Cobalt	12.7		0.248	1.08	1	06/23/2019 21:15	WG1299310
Copper	72.8		0.570	2.15	1	06/23/2019 21:15	WG1299310
Iron	34100		1.52	10.8	1	06/23/2019 21:15	WG1299310
Lead	11.9		0.204	0.538	1	06/23/2019 21:15	WG1299310
Magnesium	4230		1.19	108	1	06/23/2019 21:15	WG1299310
Manganese	321		0.129	1.08	1	06/23/2019 21:15	WG1299310
Nickel	30.4		0.527	2.15	1	06/23/2019 21:15	WG1299310
Selenium	1.45	J	0.667	2.15	1	06/23/2019 21:15	WG1299310
Silver	U		0.129	1.08	1	06/23/2019 21:15	WG1299310
Tin	1.59	B J	0.474	5.38	1	06/23/2019 21:15	WG1299310
Vanadium	44.2		0.258	2.15	1	06/23/2019 21:15	WG1299310
Zinc	59.4		0.635	5.38	1	06/23/2019 21:15	WG1299310

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	5.09	J	0.242	5.38	5	06/23/2019 22:40	WG1299305

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	95.0		1	06/21/2019 10:17	WG1299425

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	4.11	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-23 WG1298437: 4.11 at 22.8C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.235		0.00295	0.0210	1	06/20/2019 22:54	WG1299441

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3020		3.68	10.5	1	06/23/2019 21:18	WG1299310
Antimony	5.65		0.789	2.10	1	06/23/2019 21:18	WG1299310
Arsenic	99.8		0.484	2.10	1	06/23/2019 21:18	WG1299310
Barium	75.4		0.179	0.526	1	06/23/2019 21:18	WG1299310
Cadmium	U		0.0737	0.526	1	06/23/2019 21:18	WG1299310
Calcium	27.0	J	4.87	105	1	06/23/2019 21:18	WG1299310
Chromium	4.09		0.147	1.05	1	06/23/2019 21:18	WG1299310
Cobalt	1.47		0.242	1.05	1	06/23/2019 21:18	WG1299310
Copper	20.3		0.558	2.10	1	06/23/2019 21:18	WG1299310
Iron	13700		1.48	10.5	1	06/23/2019 21:18	WG1299310
Lead	15.8		0.200	0.526	1	06/23/2019 21:18	WG1299310
Magnesium	257		1.17	105	1	06/23/2019 21:18	WG1299310
Manganese	41.4		0.126	1.05	1	06/23/2019 21:18	WG1299310
Nickel	6.34		0.516	2.10	1	06/23/2019 21:18	WG1299310
Selenium	3.35		0.652	2.10	1	06/23/2019 21:18	WG1299310
Silver	0.554	J	0.126	1.05	1	06/23/2019 21:18	WG1299310
Tin	1.22	B J	0.463	5.26	1	06/23/2019 21:18	WG1299310
Vanadium	15.5		0.253	2.10	1	06/23/2019 21:18	WG1299310
Zinc	20.5		0.621	5.26	1	06/23/2019 21:18	WG1299310

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	3.39	J	0.237	5.26	5	06/23/2019 22:46	WG1299305

Total Solids by Method 2540 G-2011

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	%			date / time	
Total Solids	93.0		1	06/21/2019 10:17	WG1299425

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis	Batch
	su			date / time	
pH	4.06	T8	1	06/19/2019 17:00	WG1298437

Sample Narrative:

L1110283-24 WG1298437: 4.06 at 22.7C

Mercury by Method 7471B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.281		0.00301	0.0215	1	06/20/2019 22:56	WG1299441

Metals (ICP) by Method 6010D

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	3320		3.76	10.8	1	06/23/2019 21:27	WG1299310
Antimony	4.62		0.806	2.15	1	06/23/2019 21:27	WG1299310
Arsenic	128		0.495	2.15	1	06/23/2019 21:27	WG1299310
Barium	75.5		0.183	0.538	1	06/23/2019 21:27	WG1299310
Cadmium	U		0.0753	0.538	1	06/23/2019 21:27	WG1299310
Calcium	28.7	J	4.98	108	1	06/23/2019 21:27	WG1299310
Chromium	5.30		0.151	1.08	1	06/23/2019 21:27	WG1299310
Cobalt	1.55		0.247	1.08	1	06/23/2019 21:27	WG1299310
Copper	30.4		0.570	2.15	1	06/23/2019 21:27	WG1299310
Iron	18800		1.52	10.8	1	06/23/2019 21:27	WG1299310
Lead	15.6		0.204	0.538	1	06/23/2019 21:27	WG1299310
Magnesium	325		1.19	108	1	06/23/2019 21:27	WG1299310
Manganese	48.1		0.129	1.08	1	06/23/2019 21:27	WG1299310
Nickel	6.59		0.527	2.15	1	06/23/2019 21:27	WG1299310
Selenium	3.44		0.667	2.15	1	06/23/2019 21:27	WG1299310
Silver	0.439	J	0.129	1.08	1	06/23/2019 21:27	WG1299310
Tin	1.21	B J	0.473	5.38	1	06/23/2019 21:27	WG1299310
Vanadium	20.8		0.258	2.15	1	06/23/2019 21:27	WG1299310
Zinc	26.1		0.634	5.38	1	06/23/2019 21:27	WG1299310

Metals (ICPMS) by Method 6020B

Analyte	Result (dry)	Qualifier	MDL (dry)	RDL (dry)	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Thorium	4.02	J	0.242	5.38	5	06/23/2019 22:51	WG1299305

Method Blank (MB)

(MB) R3423306-1 06/20/19 16:58

Analyte	MB Result %	MB Qualifier	MB MDL %	MB RDL %
Total Solids	0.00100			

L1110283-07 Original Sample (OS) • Duplicate (DUP)

(OS) L1110283-07 06/20/19 16:58 • (DUP) R3423306-3 06/20/19 16:58

Analyte	Original Result %	DUP Result %	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Total Solids	63.5	67.0	1	5.34		10

Laboratory Control Sample (LCS)

(LCS) R3423306-2 06/20/19 16:58

Analyte	Spike Amount %	LCS Result %	LCS Rec. %	Rec. Limits %	LCS Qualifier
Total Solids	50.0	50.0	100	85.0-115	

Method Blank (MB)

(MB) R3423295-1 06/20/19 16:48

Analyte	MB Result %	MB Qualifier	MB MDL %	MB RDL %
Total Solids	0.00100			

L1110283-16 Original Sample (OS) • Duplicate (DUP)

(OS) L1110283-16 06/20/19 16:48 • (DUP) R3423295-3 06/20/19 16:48

Analyte	Original Result %	DUP Result %	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Total Solids	87.8	88.5	1	0.822		10

Laboratory Control Sample (LCS)

(LCS) R3423295-2 06/20/19 16:48

Analyte	Spike Amount %	LCS Result %	LCS Rec. %	Rec. Limits %	LCS Qualifier
Total Solids	50.0	50.0	100	85.0-115	

Method Blank (MB)

(MB) R3423633-1 06/21/19 10:28

Analyte	MB Result %	MB Qualifier	MB MDL %	MB RDL %
Total Solids	0.000			

L1110275-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1110275-01 06/21/19 10:28 • (DUP) R3423633-3 06/21/19 10:28

Analyte	Original Result %	DUP Result %	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Total Solids	83.2	83.3	1	0.122		10

Laboratory Control Sample (LCS)

(LCS) R3423633-2 06/21/19 10:28

Analyte	Spike Amount %	LCS Result %	LCS Rec. %	Rec. Limits %	LCS Qualifier
Total Solids	50.0	50.0	100	85.0-115	

Method Blank (MB)

(MB) R3423631-1 06/21/19 10:17

Analyte	MB Result %	MB Qualifier	MB MDL %	MB RDL %
Total Solids	0.000			

L1110566-03 Original Sample (OS) • Duplicate (DUP)

(OS) L1110566-03 06/21/19 10:17 • (DUP) R3423631-3 06/21/19 10:17

Analyte	Original Result %	DUP Result %	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Total Solids	95.2	95.6	1	0.329		10

Laboratory Control Sample (LCS)

(LCS) R3423631-2 06/21/19 10:17

Analyte	Spike Amount %	LCS Result %	LCS Rec. %	Rec. Limits %	LCS Qualifier
Total Solids	50.0	50.0	100	85.0-115	

L1110283-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1110283-01 06/19/19 17:00 • (DUP) R3422633-2 06/19/19 17:00

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
	su	su		%		%
pH	7.92	7.89	1	0.380		1

Sample Narrative:

OS: 7.92 at 23C

DUP: 7.89 at 22.8C

L1110283-24 Original Sample (OS) • Duplicate (DUP)

(OS) L1110283-24 06/19/19 17:00 • (DUP) R3422633-3 06/19/19 17:00

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
	su	su		%		%
pH	4.06	4.06	1	0.000		1

Sample Narrative:

OS: 4.06 at 22.7C

DUP: 4.06 at 23.1C

Laboratory Control Sample (LCS)

(LCS) R3422633-1 06/19/19 17:00

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
	su	su	%	%	
pH	10.0	9.96	99.6	99.0-101	

Sample Narrative:

LCS: 9.96 at 22.5C

Method Blank (MB)

(MB) R3423334-1 06/21/19 09:31

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Mercury	0.00715	J	0.00280	0.0200

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423334-2 06/21/19 09:33 • (LCSD) R3423334-3 06/21/19 09:35

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Mercury	0.300	0.240	0.257	80.1	85.6	80.0-120			6.64	20

L1110283-09 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1110283-09 06/21/19 09:37 • (MS) R3423334-4 06/21/19 09:40 • (MSD) R3423334-5 06/21/19 09:42

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	0.314	0.599	0.771	1.11	54.5	163	1	75.0-125	J6	E J3 J5	36.2	20

Method Blank (MB)

(MB) R3423202-1 06/20/19 22:06

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Mercury	U		0.00280	0.0200

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423202-2 06/20/19 22:09 • (LCSD) R3423202-3 06/20/19 22:11

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Mercury	0.300	0.298	0.324	99.3	108	80.0-120			8.26	20

L1110978-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1110978-03 06/20/19 22:13 • (MS) R3423202-4 06/20/19 22:15 • (MSD) R3423202-5 06/20/19 22:25

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury	0.300	0.0827	0.392	0.432	103	116	1	75.0-125			9.69	20

Method Blank (MB)

(MB) R3423870-1 06/23/19 22:27

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Aluminum	U		3.50	10.0
Antimony	U		0.750	2.00
Arsenic	U		0.460	2.00
Barium	U		0.170	0.500
Cadmium	U		0.0700	0.500
Calcium	U		4.63	100
Chromium	U		0.140	1.00
Cobalt	U		0.230	1.00
Copper	U		0.530	2.00
Iron	3.99	J	1.41	10.0
Lead	U		0.190	0.500
Magnesium	5.63	J	1.11	100
Manganese	0.136	J	0.120	1.00
Nickel	U		0.490	2.00
Selenium	U		0.620	2.00
Silver	U		0.120	1.00
Tin	0.962	J	0.440	5.00
Vanadium	U		0.240	2.00
Zinc	U		0.590	5.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423870-2 06/23/19 22:29 • (LCSD) R3423870-3 06/23/19 22:32

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Aluminum	1000	941	977	94.1	97.7	80.0-120			3.75	20
Antimony	100	96.7	99.3	96.7	99.3	80.0-120			2.62	20
Arsenic	100	93.4	96.0	93.4	96.0	80.0-120			2.69	20
Barium	100	103	107	103	107	80.0-120			3.31	20
Cadmium	100	97.1	100	97.1	100	80.0-120			3.14	20
Calcium	1000	965	1000	96.5	100	80.0-120			3.93	20
Chromium	100	94.5	98.7	94.5	98.7	80.0-120			4.35	20
Cobalt	100	101	104	101	104	80.0-120			3.30	20
Copper	100	95.7	99.8	95.7	99.8	80.0-120			4.17	20
Iron	1000	940	981	94.0	98.1	80.0-120			4.21	20
Lead	100	96.2	99.7	96.2	99.7	80.0-120			3.59	20
Magnesium	1000	956	997	95.6	99.7	80.0-120			4.16	20
Manganese	100	94.8	98.5	94.8	98.5	80.0-120			3.79	20
Nickel	100	99.3	102	99.3	102	80.0-120			3.16	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423870-2 06/23/19 22:29 • (LCSD) R3423870-3 06/23/19 22:32

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Selenium	100	92.5	95.3	92.5	95.3	80.0-120			2.98	20
Silver	20.0	17.8	18.4	88.8	92.1	80.0-120			3.63	20
Tin	100	96.9	100	96.9	100	80.0-120			3.08	20
Vanadium	100	98.5	102	98.5	102	80.0-120			3.72	20
Zinc	100	95.1	98.3	95.1	98.3	80.0-120			3.29	20

L1110283-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1110283-01 06/23/19 22:35 • (MS) R3423870-6 06/23/19 22:43 • (MSD) R3423870-7 06/23/19 22:46

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Aluminum	1070	3860	7140	7060	307	299	1	75.0-125	J5	J5	1.20	20
Antimony	107	1.93	69.3	66.9	63.0	60.8	1	75.0-125	J6	J6	3.52	20
Arsenic	107	12.7	100	98.9	82.0	80.6	1	75.0-125			1.47	20
Barium	107	162	354	347	180	173	1	75.0-125	J5	J5	2.04	20
Cadmium	107	0.608	96.4	93.8	89.7	87.1	1	75.0-125			2.83	20
Calcium	1070	1340	3160	2620	170	120	1	75.0-125	J5		18.6	20
Chromium	107	29.8	133	123	96.8	87.5	1	75.0-125			7.78	20
Cobalt	107	19.6	120	121	94.0	94.6	1	75.0-125			0.477	20
Copper	107	105	215	228	103	115	1	75.0-125			5.86	20
Iron	1070	33400	32300	38700	0.000	489	1	75.0-125	V	V	17.8	20
Lead	107	11.6	106	105	87.8	87.5	1	75.0-125			0.381	20
Magnesium	1070	2390	4050	2980	155	55.1	1	75.0-125	J5	J3 J6	30.3	20
Manganese	107	860	775	770	0.000	0.000	1	75.0-125	V	V	0.687	20
Nickel	107	46.0	144	158	91.8	104	1	75.0-125			8.91	20
Selenium	107	2.64	92.4	90.6	83.9	82.3	1	75.0-125			1.96	20
Silver	21.4	U	17.1	16.7	79.9	78.2	1	75.0-125			2.16	20
Tin	107	1.36	83.5	79.4	76.8	73.0	1	75.0-125		J6	5.02	20
Vanadium	107	50.5	155	144	97.6	87.7	1	75.0-125			7.04	20
Zinc	107	80.9	157	183	70.8	95.9	1	75.0-125	J6		15.8	20

Method Blank (MB)

(MB) R3423853-1 06/23/19 20:54

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Aluminum	U		3.50	10.0
Antimony	U		0.750	2.00
Arsenic	U		0.460	2.00
Barium	U		0.170	0.500
Cadmium	U		0.0700	0.500
Calcium	U		4.63	100
Chromium	U		0.140	1.00
Cobalt	U		0.230	1.00
Copper	U		0.530	2.00
Iron	1.57	J	1.41	10.0
Lead	U		0.190	0.500
Magnesium	U		1.11	100
Manganese	U		0.120	1.00
Nickel	U		0.490	2.00
Selenium	U		0.620	2.00
Silver	U		0.120	1.00
Tin	0.989	J	0.440	5.00
Vanadium	U		0.240	2.00
Zinc	U		0.590	5.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423853-2 06/23/19 20:56 • (LCSD) R3423853-3 06/23/19 20:59

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Aluminum	1000	886	920	88.6	92.0	80.0-120			3.83	20
Antimony	100	91.8	94.9	91.8	94.9	80.0-120			3.31	20
Arsenic	100	88.8	92.0	88.8	92.0	80.0-120			3.50	20
Barium	100	97.9	102	97.9	102	80.0-120			3.89	20
Cadmium	100	92.2	95.7	92.2	95.7	80.0-120			3.75	20
Calcium	1000	907	943	90.7	94.3	80.0-120			3.82	20
Chromium	100	90.6	96.2	90.6	96.2	80.0-120			6.03	20
Cobalt	100	95.6	99.2	95.6	99.2	80.0-120			3.69	20
Copper	100	92.1	97.2	92.1	97.2	80.0-120			5.38	20
Iron	1000	889	925	88.9	92.5	80.0-120			3.97	20
Lead	100	91.4	94.9	91.4	94.9	80.0-120			3.72	20
Magnesium	1000	904	944	90.4	94.4	80.0-120			4.25	20
Manganese	100	91.0	96.2	91.0	96.2	80.0-120			5.59	20
Nickel	100	94.4	97.9	94.4	97.9	80.0-120			3.58	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423853-2 06/23/19 20:56 • (LCSD) R3423853-3 06/23/19 20:59

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Selenium	100	87.7	90.7	87.7	90.7	80.0-120			3.37	20
Silver	20.0	17.2	18.1	86.0	90.6	80.0-120			5.28	20
Tin	100	91.7	95.2	91.7	95.2	80.0-120			3.70	20
Vanadium	100	93.7	96.9	93.7	96.9	80.0-120			3.39	20
Zinc	100	90.4	94.1	90.4	94.1	80.0-120			3.94	20

L1110283-18 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1110283-18 06/23/19 21:02 • (MS) R3423853-6 06/23/19 21:10 • (MSD) R3423853-7 06/23/19 21:13

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Aluminum	1180	20300	19700	22400	0.000	171	1	75.0-125	V	V	12.9	20
Antimony	118	0.999	74.7	69.3	62.3	57.7	1	75.0-125	J6	J6	7.63	20
Arsenic	118	2.95	114	116	93.7	95.5	1	75.0-125			1.86	20
Barium	118	606	532	566	0.000	0.000	1	75.0-125	V	V	6.19	20
Cadmium	118	0.592	118	120	98.9	101	1	75.0-125			1.76	20
Calcium	1180	5460	4210	5170	0.000	0.000	1	75.0-125	V	J3 V	20.3	20
Chromium	118	16.5	131	133	96.4	98.4	1	75.0-125			1.74	20
Cobalt	118	13.8	134	137	101	104	1	75.0-125			2.36	20
Copper	118	49.0	146	156	82.1	90.0	1	75.0-125			6.20	20
Iron	1180	27800	20700	21300	0.000	0.000	1	75.0-125	V	V	2.78	20
Lead	118	8.05	129	130	102	103	1	75.0-125			0.597	20
Magnesium	1180	2180	2710	2980	45.3	68.2	1	75.0-125	J6	J6	9.49	20
Manganese	118	3110	1910	1970	0.000	0.000	1	75.0-125	V	V	2.84	20
Nickel	118	41.9	149	156	90.7	96.1	1	75.0-125			4.14	20
Selenium	118	1.69	111	113	92.7	93.8	1	75.0-125			1.20	20
Silver	23.7	U	21.9	22.3	92.3	94.1	1	75.0-125			1.91	20
Tin	118	2.10	110	110	91.2	91.4	1	75.0-125			0.210	20
Vanadium	118	37.9	157	157	101	101	1	75.0-125			0.0958	20
Zinc	118	88.3	172	184	70.6	81.1	1	75.0-125	J6		7.01	20

Method Blank (MB)

(MB) R3423897-1 06/23/19 23:43

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Thorium	U		0.225	5.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423897-2 06/23/19 23:49 • (LCSD) R3423897-3 06/23/19 23:54

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Thorium	100	89.7	91.8	89.7	91.8	80.0-120			2.26	20

L1110283-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1110283-01 06/23/19 23:59 • (MS) R3423897-6 06/24/19 00:15 • (MSD) R3423897-7 06/24/19 00:21

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Thorium	21.4	3.69	90.7	87.6	81.4	78.5	5	75.0-125			3.48	20

Method Blank (MB)

(MB) R3423856-1 06/23/19 21:47

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Thorium	U		0.225	5.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3423856-2 06/23/19 21:52 • (LCSD) R3423856-3 06/23/19 21:57

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Thorium	100	85.9	86.2	85.9	86.2	80.0-120			0.266	20

L1110283-18 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1110283-18 06/23/19 22:03 • (MS) R3423856-6 06/23/19 22:19 • (MSD) R3423856-7 06/23/19 22:24

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Thorium	23.7	2.15	107	108	88.4	89.0	5	75.0-125			0.737	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

(dry)	Results are reported based on the dry weight of the sample. [this will only be present on a dry report basis for soils].
MDL	Method Detection Limit.
MDL (dry)	Method Detection Limit.
RDL	Reported Detection Limit.
RDL (dry)	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
T8	Sample(s) received past/too close to holding time expiration.
V	The sample concentration is too high to evaluate accurate spike recoveries.

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.
* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1 6]	90010	South Carolina	84004
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana [1]	LA180010	Texas	T104704245-18-15
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

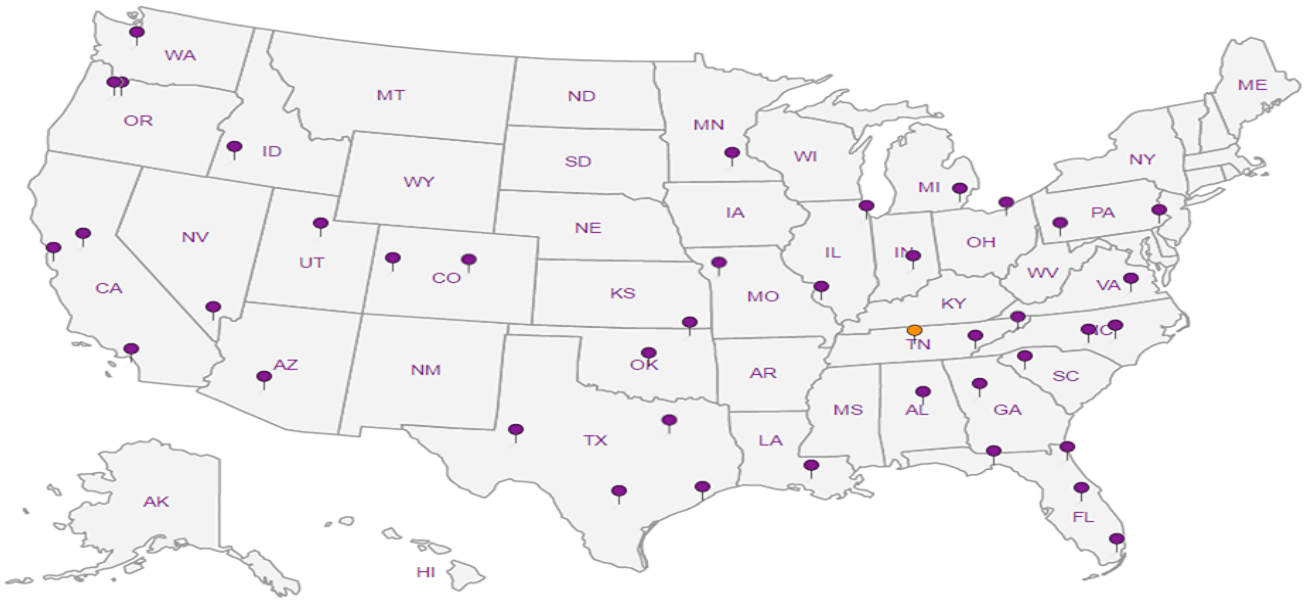
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Applied Intellect, LLC.- Boise,
345 Bobwhite Ct., Suite 230
Boise, ID 83706

Billing Information:
Accounts Payable- Ajit Louis
1827 Willow Oak Dr.
Wexford, PA 15090

Pres Chk

Report to: Chelsea Maxfield
Email To: chelsea.maxfield@ap-in.com

Project Description: Bluebird/Blackjack Mines
City/State Collected: Oregon

Phone: 208-953-7525
Fax:

Client Project # EM19.003
Lab Project # APPINTBID-BLUEJACK

Collected by (print): Paul Hunter
Site/Facility ID #
P.O. # EM19.003

Collected by (signature): Paul Hunter
Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day
Date Results Needed
Quote #

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	ALK,SULFATE 250mlHDPE-NoPres	Metals 250mlHDPE-HNO3	Metals 4ozClr-NoPres	PH 2ozClr-NoPres	Remarks	Sample # (lab only)
BLK-WR-1	G	SS	0.5'	6/11/19	1350	2			X	X		-01
BLK-WR-2	G	SS	0.5'	6/11/19	1353	1			X	X		02
BLK-WR-3	G	SS	0.5'	6/11/19	1405	1			X	X		03
BLK-WR-4	G	SS	0.5'	6/11/19	1410	2			X	X		04
BLK-WR-5	G	SS	0.5'	6/11/19	1440	1			X	X		05
BLK-WR-6	G	SS	0.5'	6/11/19	1445	2			X	X		06
BLU-WR-1	G	SS	0.5'	6/10/19	1450	2			X	X		07
BLU-WR-2	G	SS	0.5'	6/10/19	1510	2			X	X		08
BLU-WR-3	G	SS	0.5	6/10/19	1520	1			X	X		09
BLU-WR-4	G	SS	0.5	6/10/19	1530	1			X	X		10

Analysis / Container / Preservative

Chain of Custody Page 1 of 3

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L1116283
J211
Acctnum: APPINTBID
Template: T151271
Prelogin: P713658
TSR: 824 - Chris Ward
PB:
Shipped Via: FedEX Ground

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other

Remarks:Metals=AGICP,ALICP,ASICP,BAICP,CAICP,CDICP,COICP,CRICP,CUICP,FEICP,HG,MGICP,MNICP,NIICP,PBICP,SBICP,SEICP,SNICP,THG,VICP,ZNICP
BAD SOFTEN. 6/12/19

pH ____ Temp ____
Flow ____ Other ____

Samples returned via:
__ UPS X FedEx __ Courier __ ____
Tracking # 4794 8828 5167

Sample Receipt Checklist
COC Seal Present/Intact: __NP X Y __N
COC Signed/Accurate: X Y __N
Bottles arrive intact: X Y __N
Correct bottles used: X Y __N
Sufficient volume sent: X Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
Paul Hunter	6/17/19	1200	FedEx	0
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: °C Bottles Received:
				4.0-0.2=3.8 Fact 29
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: Time:
				6/18/19 0845

If preservation required by Login: Date/Time

Hold: Condition: NCF / OK

Applied Intellect, LLC.- Boise, ID

345 Bobwhite Ct., Suite 230
Boise, ID 83706

Billing Information:
Accounts Payable- Ajit Louis
1827 Willow Oak Dr.
Wexford, PA 15090

Pres Chk

Report to: Chelsea Maxfield

Email To: chelsea.maxfield@ap-in.com

Project Description: Bluebird/Blackjack Mines

City/State Collected: Oregon

Phone: 208-953-7525
Fax:

Client Project # EN19.003

Lab Project # APPINTBID-BLUEJACK

Collected by (print): Paul Hunter

Site/Facility ID #

P.O. # EN19.003

Collected by (signature): Paul Hunter
Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Analysis / Container / Preservative: ALK,SULFATE 250mlHDPE-NoPres	Metals 250mlHDPE-HNO3	Metals 4ozClr-NoPres	RH 20zGlass-NoPres	Remarks	Sample # (lab only)
BLU-BG-1	G	SS	0.5'	6/10/19	1600	2/1			X	X		-11
BLU-BG-2	G	SS	0.5'	6/10/19	1607	2/1			X	X		12
BLU-BG-3	G	SS	0.5'	6/10/19	1615	2/1			X	X		13
BLU-BG-4	G	SS	0.5'	6/10/19	1620	2/1			X	X		14
		GW				3	X	X				
		GW				3	X	X				
		GW				2	X	X				
BLU-BG-5	G	SS	0.5'	6/10/19	1630	1			X			15

Chain of Custody Page 2 of 3

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L1110283

Table #

Acctnum: APPINTBID
Template: T151271
Prelogin: P713658
TSR: 824 - Chris Ward
PB:

Shipped Via: FedEX Ground

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_____

Remarks: Metals=AGICP,ALICP,ASICP,BAICP,CAICP,CDICP,COICP,CRICP,CUICP,FEICP,HG,MGICP,MNICP,NIICP,PBICP,SBICP,SEICP,SNICP,THG,VICP,ZNICP

pH _____ Temp _____

Flow _____ Other _____

Samples returned via:
__ UPS X FedEx __ Courier __ _____

Tracking # Same

Sample Receipt Checklist
COC Seal Present/Intact: __NP __Y __N
COC Signed/Accurate: X Y __N
Bottles arrive intact: X Y __N
Correct bottles used: X Y __N
Sufficient volume sent: X Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	If preservation required by Login: Date/Time
Paul Hunter	6/17/19	1200	FedEx	Ø	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: °C Bottles Received: 29	
				4.0-0.2=3.8 FAM	
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 6/18/19 Time: 0845	Hold: Condition: NCF / OK

Applied Intellect, LLC.- Boise, ID

345 Bobwhite Ct., Suite 230
Boise, ID 83706

Billing Information:
Accounts Payable- Ajit Louis
1827 Willow Oak Dr.
Wexford, PA 15090

Pres Chk

Report to: Chelsea Maxfield

Email To: chelsea.maxfield@ap-in.com

Project Description: Bluebird/Blackjack Mines

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Phone: 208-953-7525
Fax:

Client Project # EN19.003

Lab Project # APPINTBID-BLUEJACK

Collected by (print): Paul Hunter

Site/Facility ID #

P.O. # EN19.003

Collected by (signature): Paul Hunter
Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	ALK,SULFATE 250mlHDPE-NoPres	Metals 250mlHDPE-HNO3	Metals 4ozClr-NoPres	PH 2ozClr-NoPres							Remarks	Sample # (lab only)
BLK-BG-1	G	SS	0.5'	6/12/19	1620	2			X	X								-16
BLK-BG-2	G	SS	0.5'	6/12/19	1630	2			X	X								17
BLK-BG-3	G	SS	0.5'	6/12/19	1640	2			X	X								18
BLK-BG-4	G	SS	0.5'	6/12/19	1645	2			X	X								19
BLK-BG-5	G	SS	0.5'	6/12/19	1655	2			X	X								20
BLK-BG-6	G	SS	0.5	6/12/19	1700	2			X	X								21
BLU-WR-5	G	SS	0.5	6/10/19	1540	2			X	X								22
BLU-WR-6	G	SS	0.5	6/10/19	1550	2			X	X								23
BLU-WR-7	G	SS	0.5	6/10/19	1600	2			X	X								24
		SS				2			X	X								

Analysis / Container / Preservative

Chain of Custody Page 3 of 3

Pace Analytical®
National Center for Testing & Innovation

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L# L1116283

Table #

Acctnum: APPINTBID
Template: T151271
Prelogin: P713658
TSR: 824 - Chris Ward
PB:

Shipped Via: FedEX Ground

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_____

Remarks: Metals=AGICP,ALICP,ASICP,BAICP,CAICP,CDICP,COICP,CRICP,CUICP,FEICP,HG,MGICP,MNICP,NIICP,PBICP,SBICP,SEICP,SNICP,THG,VICP,ZNICP
WIDSCREEN: <0.5 mR/hr

pH _____ Temp _____
Flow _____ Other _____

Samples returned via:
__ UPS X FedEx __ Courier _____

Tracking # Same

Sample Receipt Checklist
COC Seal Present/Intact: __NP X Y __N
COC Signed/Accurate: X Y __N
Bottles arrive intact: X Y __N
Correct bottles used: X Y __N
Sufficient volume sent: X Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
Paul Hunter	6/17/19	1200	FedEx
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)

Trip Blank Received: Yes / No
HCL / MeoH
TBR

Temp: °C Bottles Received: 29
4.0-0.2=3.8

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK

Date: 6/18/19 Time: 0845

One Government Gulch - PO Box 929
Kellogg, ID 83837-0929
(208) 784-1258
www.svl.net

Applied Intellect	**Project Name: Blackjack/Bluebird**
153321 N Columbus St	Work Order: **X9F0435**
Spokane, WA 99208	Reported: 03-Jul-19 13:58

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received	Notes
BLK-PD-1	X9F0435-01	Surface Water	12-Jun-19 15:00	RL	14-Jun-2019	
BB-PD-1	X9F0435-02	Surface Water	12-Jun-19 13:40	RL	14-Jun-2019	
BLK-ADIT-RES	X9F0435-03	Surface Water	12-Jun-19 15:05	RL	14-Jun-2019	

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.
Sample preparation is defined by the client as per their Data Quality Objectives.
This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.
Analyses were performed in accordance with SVL standard operating procedures and calibrations were performed and met SVL internal QC criteria.
The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative: X9F0435

SVL is not accredited for analysis in Oregon.

One Government Gulch - PO Box 929
Kellogg, ID 83837-0929
(208) 784-1258
www.svl.net

Applied Intellect
153321 N Columbus St
Spokane, WA 99208

Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Client Sample ID: **BLK-PD-1**
SVL Sample ID: **X9F0435-01 (Surface Water)**

Sampled: 12-Jun-19 15:00
Received: 14-Jun-19
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X926167	MWD	06/27/19 11:52	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	**Aluminum**	0.56	mg/L	0.08	0.03		X925113	AS	07/01/19 13:45	
EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X925113	AS	07/01/19 13:45	
EPA 200.7	Arsenic	< 0.025	mg/L	0.025	0.003		X925113	AS	07/01/19 13:45	
EPA 200.7	**Barium**	0.0345	mg/L	0.0020	0.0010		X925113	AS	07/01/19 13:45	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X925113	AS	07/01/19 13:45	
EPA 200.7	**Calcium**	5.54	mg/L	0.100	0.035		X925113	AS	07/01/19 13:45	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		X925113	AS	07/01/19 13:45	
EPA 200.7	**Cobalt**	0.0340	mg/L	0.0060	0.0008		X925113	AS	07/01/19 13:45	
EPA 200.7	**Copper**	0.0825	mg/L	0.0100	0.0014		X925113	AS	07/01/19 13:45	
EPA 200.7	**Iron**	11.8	mg/L	0.100	0.028		X925113	AS	07/01/19 13:45	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0025		X925113	AS	07/01/19 13:45	
EPA 200.7	**Magnesium**	8.22	mg/L	0.50	0.04		X925113	AS	07/01/19 13:45	
EPA 200.7	**Manganese**	2.24	mg/L	0.0080	0.0017		X925113	AS	07/01/19 13:45	
EPA 200.7	**Nickel**	0.0871	mg/L	0.0100	0.0012		X925113	AS	07/01/19 13:45	
EPA 200.7	**Potassium**	1.12	mg/L	0.50	0.09		X925113	AS	07/01/19 13:45	
EPA 200.7	Selenium	< 0.040	mg/L	0.040	0.006		X925113	AS	07/01/19 13:45	
EPA 200.7	**Silicon**	5.23	mg/L	0.08	0.03		X925113	DJS	07/02/19 10:01	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X925113	AS	07/01/19 13:45	
EPA 200.7	**Sodium**	2.83	mg/L	0.50	0.06		X925113	AS	07/01/19 13:45	
EPA 200.7	Thallium	< 0.015	mg/L	0.015	0.003		X925113	DJS	07/02/19 10:01	
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.003		X925113	AS	07/01/19 13:45	
EPA 200.7	Vanadium	< 0.0050	mg/L	0.0050	0.0010		X925113	AS	07/01/19 13:45	
EPA 200.7	**Zinc**	0.121	mg/L	0.010	0.003		X925113	AS	07/01/19 13:45	

One Government Gulch - PO Box 929
Kellogg, ID 83837-0929
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Applied Intellect
153321 N Columbus St
Spokane, WA 99208

Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Client Sample ID: **BLK-PD-1**
SVL Sample ID: **X9F0435-01 (Surface Water)**

Sampled: 12-Jun-19 15:00
Received: 14-Jun-19
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Dissolved)										
EPA 200.7	**Aluminum**	0.40	mg/L	0.08	0.05		X925315	AS	07/02/19 12:01	
EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.009		X925315	AS	07/02/19 12:01	
EPA 200.7	Arsenic	< 0.025	mg/L	0.025	0.006		X925315	AS	07/02/19 12:01	
EPA 200.7	**Barium**	0.0326	mg/L	0.0020	0.0019		X925315	AS	07/02/19 12:01	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0016		X925315	AS	07/02/19 12:01	
EPA 200.7	**Calcium**	5.40	mg/L	0.100	0.069		X925315	AS	07/02/19 12:01	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0020		X925315	AS	07/02/19 12:01	
EPA 200.7	**Cobalt**	0.0320	mg/L	0.0060	0.0016		X925315	AS	07/02/19 12:01	
EPA 200.7	**Copper**	0.0702	mg/L	0.0100	0.0027		X925315	AS	07/02/19 12:01	
EPA 200.7	**Iron**	10.9	mg/L	0.100	0.056		X925315	AS	07/02/19 12:01	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0049		X925315	DJS	07/02/19 14:05	
EPA 200.7	**Magnesium**	7.91	mg/L	0.50	0.08		X925315	AS	07/02/19 12:01	
EPA 200.7	**Manganese**	2.20	mg/L	0.0080	0.0034		X925315	AS	07/02/19 12:01	
EPA 200.7	**Nickel**	0.0844	mg/L	0.0100	0.0023		X925315	AS	07/02/19 12:01	
EPA 200.7	**Potassium**	1.08	mg/L	0.50	0.18		X925315	AS	07/02/19 12:01	
EPA 200.7	Selenium	< 0.040	mg/L	0.040	0.012		X925315	AS	07/02/19 12:01	
EPA 200.7	**Silicon**	5.00	mg/L	0.08	0.06		X925315	AS	07/02/19 12:01	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0019		X925315	AS	07/02/19 12:01	
EPA 200.7	**Sodium**	2.74	mg/L	0.50	0.12		X925315	AS	07/02/19 12:01	
EPA 200.7	Thallium	< 0.015	mg/L	0.015	0.005		X925315	AS	07/02/19 12:01	
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.007		X925315	AS	07/02/19 12:01	
EPA 200.7	Vanadium	< 0.0050	mg/L	0.0050	0.0019		X925315	AS	07/02/19 12:01	
EPA 200.7	**Zinc**	0.120	mg/L	0.010	0.005		X925315	AS	07/02/19 12:01	
Metals (Filtered)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X926166	MWD	06/27/19 10:59	
Classical Chemistry Parameters										
SM 2310 B	Acidity to pH 8.3	< 10.0	mg/L as CaCO3	10.0			X926147	KAG	06/26/19 15:30	
SM 2320 B	**Total Alkalinity**	7.3	mg/L as CaCO3	1.0			X926073	KAG	06/25/19 12:42	
SM 2540 C	**Total Diss. Solids**	103	mg/L	10			X925197	DKS	06/19/19 12:25	
Anions by Ion Chromatography										
EPA 300.0	**Chloride**	0.47	mg/L	0.20	0.14		X926191	DT	06/26/19 16:11	
EPA 300.0	**Fluoride**	0.109	mg/L	0.100	0.062		X926191	DT	06/26/19 16:11	
EPA 300.0	**Sulfate as SO4**	51.4	mg/L	3.00	1.80	10	X926191	DT	06/26/19 16:23	D2

Cation/Anion Balance and TDS Ratios

Cation Sum: 1.59 meq/L Anion Sum: 1.23 meq/L C/A Balance: 12.52 % Calculated TDS: 74 TDS/cTDS: 1.40

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager

One Government Gulch - PO Box 929
Kellogg, ID 83837-0929
(208) 784-1258
www.svl.net

Applied Intellect
153321 N Columbus St
Spokane, WA 99208

Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Client Sample ID: **BB-PD-1**
SVL Sample ID: **X9F0435-02 (Surface Water)**

Sampled: 12-Jun-19 13:40
Received: 14-Jun-19
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X926167	MWD	06/27/19 11:54	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	Aluminum	< 0.08	mg/L	0.08	0.03		X925113	AS	07/01/19 13:48	
EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X925113	AS	07/01/19 13:48	
EPA 200.7	Arsenic	< 0.025	mg/L	0.025	0.003		X925113	AS	07/01/19 13:48	
EPA 200.7	**Barium**	0.0116	mg/L	0.0020	0.0010		X925113	AS	07/01/19 13:48	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X925113	AS	07/01/19 13:48	
EPA 200.7	**Calcium**	5.92	mg/L	0.100	0.035		X925113	AS	07/01/19 13:48	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		X925113	AS	07/01/19 13:48	
EPA 200.7	**Cobalt**	0.0376	mg/L	0.0060	0.0008		X925113	AS	07/01/19 13:48	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0014		X925113	AS	07/01/19 13:48	
EPA 200.7	**Iron**	22.8	mg/L	0.100	0.028		X925113	AS	07/01/19 13:48	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0025		X925113	AS	07/01/19 13:48	
EPA 200.7	**Magnesium**	13.5	mg/L	0.50	0.04		X925113	AS	07/01/19 13:48	
EPA 200.7	**Manganese**	7.01	mg/L	0.0080	0.0017		X925113	AS	07/01/19 13:48	
EPA 200.7	**Nickel**	0.102	mg/L	0.0100	0.0012		X925113	AS	07/01/19 13:48	
EPA 200.7	**Potassium**	1.47	mg/L	0.50	0.09		X925113	AS	07/01/19 13:48	
EPA 200.7	Selenium	< 0.040	mg/L	0.040	0.006		X925113	AS	07/01/19 13:48	
EPA 200.7	**Silicon**	6.27	mg/L	0.08	0.03		X925113	DJS	07/02/19 10:04	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X925113	AS	07/01/19 13:48	
EPA 200.7	**Sodium**	2.78	mg/L	0.50	0.06		X925113	AS	07/01/19 13:48	
EPA 200.7	Thallium	< 0.015	mg/L	0.015	0.003		X925113	DJS	07/02/19 10:04	
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.003		X925113	AS	07/01/19 13:48	
EPA 200.7	Vanadium	< 0.0050	mg/L	0.0050	0.0010		X925113	AS	07/01/19 13:48	
EPA 200.7	**Zinc**	0.112	mg/L	0.010	0.003		X925113	AS	07/01/19 13:48	

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Spokane, WA 99208

Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Client Sample ID: **BB-PD-1**
SVL Sample ID: **X9F0435-02 (Surface Water)**

Sampled: 12-Jun-19 13:40
Received: 14-Jun-19
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Dissolved)										
EPA 200.7	Aluminum	< 0.08	mg/L	0.08	0.05		X925315	AS	07/02/19 12:10	
EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.009		X925315	AS	07/02/19 12:10	
EPA 200.7	Arsenic	< 0.025	mg/L	0.025	0.006		X925315	AS	07/02/19 12:10	
EPA 200.7	**Barium**	0.0110	mg/L	0.0020	0.0019		X925315	AS	07/02/19 12:10	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0016		X925315	AS	07/02/19 12:10	
EPA 200.7	**Calcium**	5.86	mg/L	0.100	0.069		X925315	AS	07/02/19 12:10	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0020		X925315	AS	07/02/19 12:10	
EPA 200.7	**Cobalt**	0.0343	mg/L	0.0060	0.0016		X925315	AS	07/02/19 12:10	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0027		X925315	AS	07/02/19 12:10	
EPA 200.7	**Iron**	19.7	mg/L	0.100	0.056		X925315	AS	07/02/19 12:10	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0049		X925315	DJS	07/02/19 14:14	
EPA 200.7	**Magnesium**	12.9	mg/L	0.50	0.08		X925315	AS	07/02/19 12:10	
EPA 200.7	**Manganese**	6.95	mg/L	0.0080	0.0034		X925315	AS	07/02/19 12:10	
EPA 200.7	**Nickel**	0.0989	mg/L	0.0100	0.0023		X925315	AS	07/02/19 12:10	
EPA 200.7	**Potassium**	1.42	mg/L	0.50	0.18		X925315	AS	07/02/19 12:10	
EPA 200.7	Selenium	< 0.040	mg/L	0.040	0.012		X925315	AS	07/02/19 12:10	
EPA 200.7	**Silicon**	5.82	mg/L	0.08	0.06		X925315	AS	07/02/19 12:10	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0019		X925315	AS	07/02/19 12:10	
EPA 200.7	**Sodium**	2.73	mg/L	0.50	0.12		X925315	AS	07/02/19 12:10	
EPA 200.7	Thallium	< 0.015	mg/L	0.015	0.005		X925315	AS	07/02/19 12:10	
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.007		X925315	AS	07/02/19 12:10	
EPA 200.7	Vanadium	< 0.0050	mg/L	0.0050	0.0019		X925315	AS	07/02/19 12:10	
EPA 200.7	**Zinc**	0.109	mg/L	0.010	0.005		X925315	AS	07/02/19 12:10	
Metals (Filtered)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X926166	MWD	06/27/19 11:05	
Classical Chemistry Parameters										
SM 2310 B	**Acidity to pH 8.3**	64.7	mg/L as CaCO3	10.0			X926147	KAG	06/26/19 15:30	
SM 2320 B	**Total Alkalinity**	12.1	mg/L as CaCO3	1.0			X926073	KAG	06/25/19 12:47	
SM 2540 C	**Total Diss. Solids**	177	mg/L	10			X925197	DKS	06/19/19 12:25	
Anions by Ion Chromatography										
EPA 300.0	**Chloride**	0.60	mg/L	0.20	0.14		X926191	DT	06/26/19 16:49	
EPA 300.0	**Fluoride**	0.185	mg/L	0.100	0.062		X926191	DT	06/26/19 16:49	
EPA 300.0	**Sulfate as SO4**	94.0	mg/L	3.00	1.80	10	X926191	DT	06/26/19 17:02	D2

Cation/Anion Balance and TDS Ratios

Cation Sum: 2.47 meq/L Anion Sum: 2.23 meq/L C/A Balance: 5.29 % Calculated TDS: 125 TDS/cTDS: 1.41

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager

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153321 N Columbus St
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Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Client Sample ID: **BLK-ADIT-RES**
SVL Sample ID: **X9F0435-03 (Surface Water)**

Sampled: 12-Jun-19 15:05
Received: 14-Jun-19
Sampled By: RL

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X926167	MWD	06/27/19 11:55	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	**Aluminum**	0.56	mg/L	0.08	0.03		X925113	AS	07/01/19 13:51	
EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X925113	AS	07/01/19 13:51	
EPA 200.7	Arsenic	< 0.025	mg/L	0.025	0.003		X925113	AS	07/01/19 13:51	
EPA 200.7	**Barium**	0.0344	mg/L	0.0020	0.0010		X925113	AS	07/01/19 13:51	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X925113	AS	07/01/19 13:51	
EPA 200.7	**Calcium**	5.44	mg/L	0.100	0.035		X925113	AS	07/01/19 13:51	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		X925113	AS	07/01/19 13:51	
EPA 200.7	**Cobalt**	0.0335	mg/L	0.0060	0.0008		X925113	AS	07/01/19 13:51	
EPA 200.7	**Copper**	0.0814	mg/L	0.0100	0.0014		X925113	AS	07/01/19 13:51	
EPA 200.7	**Iron**	11.8	mg/L	0.100	0.028		X925113	AS	07/01/19 13:51	
EPA 200.7	Lead	< 0.0075	mg/L	0.0075	0.0025		X925113	AS	07/01/19 13:51	
EPA 200.7	**Magnesium**	8.18	mg/L	0.50	0.04		X925113	AS	07/01/19 13:51	
EPA 200.7	**Manganese**	2.26	mg/L	0.0080	0.0017		X925113	AS	07/01/19 13:51	
EPA 200.7	**Nickel**	0.0864	mg/L	0.0100	0.0012		X925113	AS	07/01/19 13:51	
EPA 200.7	**Potassium**	1.11	mg/L	0.50	0.09		X925113	AS	07/01/19 13:51	
EPA 200.7	Selenium	< 0.040	mg/L	0.040	0.006		X925113	AS	07/01/19 13:51	
EPA 200.7	**Silicon**	5.24	mg/L	0.08	0.03		X925113	DJS	07/02/19 10:08	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X925113	AS	07/01/19 13:51	
EPA 200.7	**Sodium**	2.78	mg/L	0.50	0.06		X925113	AS	07/01/19 13:51	
EPA 200.7	Thallium	< 0.015	mg/L	0.015	0.003		X925113	DJS	07/02/19 10:08	
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.003		X925113	AS	07/01/19 13:51	
EPA 200.7	Vanadium	< 0.0050	mg/L	0.0050	0.0010		X925113	AS	07/01/19 13:51	
EPA 200.7	**Zinc**	0.121	mg/L	0.010	0.003		X925113	AS	07/01/19 13:51	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

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Applied Intellect
153321 N Columbus St
Spokane, WA 99208

Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Metals (Total)								
EPA 245.1	Mercury	mg/L	<0.00020	0.000093	0.00020	X926167	27-Jun-19	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)								
EPA 200.7	Aluminum	mg/L	<0.08	0.03	0.08	X925113	01-Jul-19	
EPA 200.7	Antimony	mg/L	<0.020	0.004	0.020	X925113	01-Jul-19	
EPA 200.7	Arsenic	mg/L	<0.025	0.003	0.025	X925113	01-Jul-19	
EPA 200.7	Barium	mg/L	<0.0020	0.0010	0.0020	X925113	01-Jul-19	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0008	0.0020	X925113	01-Jul-19	
EPA 200.7	Calcium	mg/L	<0.100	0.035	0.100	X925113	01-Jul-19	
EPA 200.7	Chromium	mg/L	<0.0060	0.0010	0.0060	X925113	01-Jul-19	
EPA 200.7	Cobalt	mg/L	<0.0060	0.0008	0.0060	X925113	01-Jul-19	
EPA 200.7	Copper	mg/L	<0.0100	0.0014	0.0100	X925113	01-Jul-19	
EPA 200.7	Iron	mg/L	<0.100	0.028	0.100	X925113	01-Jul-19	
EPA 200.7	Lead	mg/L	<0.0075	0.0025	0.0075	X925113	01-Jul-19	
EPA 200.7	Magnesium	mg/L	<0.50	0.04	0.50	X925113	01-Jul-19	
EPA 200.7	Manganese	mg/L	<0.0080	0.0017	0.0080	X925113	01-Jul-19	
EPA 200.7	Nickel	mg/L	<0.0100	0.0012	0.0100	X925113	01-Jul-19	
EPA 200.7	Potassium	mg/L	<0.50	0.09	0.50	X925113	01-Jul-19	
EPA 200.7	Selenium	mg/L	<0.040	0.006	0.040	X925113	01-Jul-19	
EPA 200.7	Silicon	mg/L	<0.08	0.03	0.08	X925113	02-Jul-19	
EPA 200.7	Silver	mg/L	<0.0050	0.0010	0.0050	X925113	01-Jul-19	
EPA 200.7	Sodium	mg/L	<0.50	0.06	0.50	X925113	01-Jul-19	
EPA 200.7	Thallium	mg/L	<0.015	0.003	0.015	X925113	02-Jul-19	
EPA 200.7	Tin	mg/L	<0.050	0.003	0.050	X925113	01-Jul-19	
EPA 200.7	Vanadium	mg/L	<0.0050	0.0010	0.0050	X925113	01-Jul-19	
EPA 200.7	Zinc	mg/L	<0.010	0.003	0.010	X925113	01-Jul-19	
Metals (Dissolved)								
EPA 200.7	Aluminum	mg/L	<0.08	0.05	0.08	X925315	02-Jul-19	
EPA 200.7	Antimony	mg/L	<0.020	0.009	0.020	X925315	02-Jul-19	
EPA 200.7	Arsenic	mg/L	<0.025	0.006	0.025	X925315	02-Jul-19	
EPA 200.7	Barium	mg/L	<0.0020	0.0019	0.0020	X925315	02-Jul-19	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0016	0.0020	X925315	02-Jul-19	
EPA 200.7	Calcium	mg/L	<0.100	0.069	0.100	X925315	02-Jul-19	
EPA 200.7	Chromium	mg/L	<0.0060	0.0020	0.0060	X925315	02-Jul-19	
EPA 200.7	Cobalt	mg/L	<0.0060	0.0016	0.0060	X925315	02-Jul-19	
EPA 200.7	Copper	mg/L	<0.0100	0.0027	0.0100	X925315	02-Jul-19	
EPA 200.7	Iron	mg/L	<0.100	0.056	0.100	X925315	02-Jul-19	
EPA 200.7	Lead	mg/L	<0.0075	0.0049	0.0075	X925315	02-Jul-19	
EPA 200.7	Magnesium	mg/L	<0.50	0.08	0.50	X925315	02-Jul-19	
EPA 200.7	Manganese	mg/L	<0.0080	0.0034	0.0080	X925315	02-Jul-19	
EPA 200.7	Nickel	mg/L	<0.0100	0.0023	0.0100	X925315	02-Jul-19	
EPA 200.7	Potassium	mg/L	<0.50	0.18	0.50	X925315	02-Jul-19	
EPA 200.7	Selenium	mg/L	<0.040	0.012	0.040	X925315	02-Jul-19	
EPA 200.7	Silicon	mg/L	<0.08	0.06	0.08	X925315	02-Jul-19	
EPA 200.7	Silver	mg/L	<0.0050	0.0019	0.0050	X925315	02-Jul-19	
EPA 200.7	Sodium	mg/L	<0.50	0.12	0.50	X925315	02-Jul-19	
EPA 200.7	Thallium	mg/L	<0.015	0.005	0.015	X925315	02-Jul-19	
EPA 200.7	Tin	mg/L	<0.050	0.007	0.050	X925315	02-Jul-19	
EPA 200.7	Vanadium	mg/L	<0.0050	0.0019	0.0050	X925315	02-Jul-19	
EPA 200.7	Zinc	mg/L	<0.010	0.005	0.010	X925315	02-Jul-19	
Metals (Filtered)								
EPA 245.1	Mercury	mg/L	<0.00020	0.000093	0.00020	X926166	27-Jun-19	
Classical Chemistry Parameters								
SM 2310 B	Acidity to pH 8.3	mg/L as CaCO3	<10.0		10.0	X926147	26-Jun-19	

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Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Quality Control - BLANK Data (Continued)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Classical Chemistry Parameters (Continued)								
SM 2320 B	Total Alkalinity	mg/L as CaCO3	<1.0		1.0	X926073	25-Jun-19	
SM 2540 C	Total Diss. Solids	mg/L	<10		10	X925197	19-Jun-19	
Anions by Ion Chromatography								
EPA 300.0	Chloride	mg/L	<0.20	0.14	0.20	X926191	26-Jun-19	
EPA 300.0	Fluoride	mg/L	<0.100	0.062	0.100	X926191	26-Jun-19	
EPA 300.0	Sulfate as SO4	mg/L	<0.30	0.18	0.30	X926191	26-Jun-19	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total)									
EPA 245.1	Mercury	mg/L	0.00531	0.00500	106	85 - 115	X926167	27-Jun-19	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.7	Aluminum	mg/L	1.02	1.00	102	85 - 115	X925113	01-Jul-19	
EPA 200.7	Antimony	mg/L	0.989	1.00	98.9	85 - 115	X925113	01-Jul-19	
EPA 200.7	Arsenic	mg/L	0.989	1.00	98.9	85 - 115	X925113	01-Jul-19	
EPA 200.7	Barium	mg/L	1.02	1.00	102	85 - 115	X925113	01-Jul-19	
EPA 200.7	Cadmium	mg/L	0.974	1.00	97.4	85 - 115	X925113	01-Jul-19	
EPA 200.7	Calcium	mg/L	19.1	20.0	95.5	85 - 115	X925113	01-Jul-19	
EPA 200.7	Chromium	mg/L	0.984	1.00	98.4	85 - 115	X925113	01-Jul-19	
EPA 200.7	Cobalt	mg/L	0.953	1.00	95.3	85 - 115	X925113	01-Jul-19	
EPA 200.7	Copper	mg/L	0.963	1.00	96.3	85 - 115	X925113	01-Jul-19	
EPA 200.7	Iron	mg/L	9.67	10.0	96.7	85 - 115	X925113	01-Jul-19	
EPA 200.7	Lead	mg/L	1.02	1.00	102	85 - 115	X925113	01-Jul-19	
EPA 200.7	Magnesium	mg/L	19.7	20.0	98.3	85 - 115	X925113	01-Jul-19	
EPA 200.7	Manganese	mg/L	0.974	1.00	97.4	85 - 115	X925113	01-Jul-19	
EPA 200.7	Nickel	mg/L	0.961	1.00	96.1	85 - 115	X925113	01-Jul-19	
EPA 200.7	Potassium	mg/L	19.6	20.0	97.8	85 - 115	X925113	01-Jul-19	
EPA 200.7	Selenium	mg/L	0.997	1.00	99.7	85 - 115	X925113	01-Jul-19	
EPA 200.7	Silicon	mg/L	5.01	5.00	100	85 - 115	X925113	02-Jul-19	
EPA 200.7	Silver	mg/L	0.0502	0.0500	100	85 - 115	X925113	01-Jul-19	
EPA 200.7	Sodium	mg/L	18.5	19.0	97.6	85 - 115	X925113	01-Jul-19	
EPA 200.7	Thallium	mg/L	0.971	1.00	97.1	85 - 115	X925113	02-Jul-19	
EPA 200.7	Tin	mg/L	0.995	1.00	99.5	85 - 115	X925113	01-Jul-19	
EPA 200.7	Vanadium	mg/L	0.996	1.00	99.6	85 - 115	X925113	01-Jul-19	
EPA 200.7	Zinc	mg/L	0.985	1.00	98.5	85 - 115	X925113	01-Jul-19	
Metals (Dissolved)									
EPA 200.7	Aluminum	mg/L	1.02	1.00	102	85 - 115	X925315	02-Jul-19	
EPA 200.7	Antimony	mg/L	0.971	1.00	97.1	85 - 115	X925315	02-Jul-19	
EPA 200.7	Arsenic	mg/L	0.979	1.00	97.9	85 - 115	X925315	02-Jul-19	
EPA 200.7	Barium	mg/L	1.00	1.00	100	85 - 115	X925315	02-Jul-19	
EPA 200.7	Cadmium	mg/L	0.985	1.00	98.5	85 - 115	X925315	02-Jul-19	
EPA 200.7	Calcium	mg/L	19.1	20.0	95.7	85 - 115	X925315	02-Jul-19	
EPA 200.7	Chromium	mg/L	0.971	1.00	97.1	85 - 115	X925315	02-Jul-19	
EPA 200.7	Cobalt	mg/L	0.954	1.00	95.4	85 - 115	X925315	02-Jul-19	
EPA 200.7	Copper	mg/L	0.927	1.00	92.7	85 - 115	X925315	02-Jul-19	
EPA 200.7	Iron	mg/L	9.60	10.0	96.0	85 - 115	X925315	02-Jul-19	
EPA 200.7	Lead	mg/L	1.03	1.00	103	85 - 115	X925315	02-Jul-19	
EPA 200.7	Magnesium	mg/L	19.8	20.0	98.9	85 - 115	X925315	02-Jul-19	
EPA 200.7	Manganese	mg/L	0.964	1.00	96.4	85 - 115	X925315	02-Jul-19	

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Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Quality Control - LABORATORY CONTROL SAMPLE Data (Continued)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Dissolved) (Continued)									
EPA 200.7	Nickel	mg/L	0.956	1.00	95.6	85 - 115	X925315	02-Jul-19	
EPA 200.7	Potassium	mg/L	19.4	20.0	97.0	85 - 115	X925315	02-Jul-19	
EPA 200.7	Selenium	mg/L	1.04	1.00	104	85 - 115	X925315	02-Jul-19	
EPA 200.7	Silicon	mg/L	4.81	5.00	96.1	85 - 115	X925315	02-Jul-19	
EPA 200.7	Silver	mg/L	0.0515	0.0500	103	85 - 115	X925315	02-Jul-19	
EPA 200.7	Sodium	mg/L	18.4	19.0	96.8	85 - 115	X925315	02-Jul-19	
EPA 200.7	Thallium	mg/L	0.977	1.00	97.7	85 - 115	X925315	02-Jul-19	
EPA 200.7	Tin	mg/L	0.995	1.00	99.5	85 - 115	X925315	02-Jul-19	
EPA 200.7	Vanadium	mg/L	0.971	1.00	97.1	85 - 115	X925315	02-Jul-19	
EPA 200.7	Zinc	mg/L	1.00	1.00	100	85 - 115	X925315	02-Jul-19	
Metals (Filtered)									
EPA 245.1	Mercury	mg/L	0.00530	0.00500	106	85 - 115	X926166	27-Jun-19	
Classical Chemistry Parameters									
SM 2310 B	Acidity to pH 8.3	mg/L as CaCO3	1150	1230	93.2	92.1 - 110	X926147	26-Jun-19	
SM 2320 B	Total Alkalinity	mg/L as CaCO3	97.0	99.3	97.7	94.3 - 106	X926073	25-Jun-19	
SM 2320 B	Total Alkalinity	mg/L as CaCO3	98.9	99.3	99.6	94.3 - 106	X926073	25-Jun-19	
Anions by Ion Chromatography									
EPA 300.0	Chloride	mg/L	3.03	3.00	101	90 - 110	X926191	26-Jun-19	
EPA 300.0	Fluoride	mg/L	2.00	2.00	100	90 - 110	X926191	26-Jun-19	
EPA 300.0	Sulfate as SO4	mg/L	10.2	10.0	102	90 - 110	X926191	26-Jun-19	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
Classical Chemistry Parameters									
SM 2310 B	Acidity to pH 8.3	mg/L as CaCO3	<10.0	<10.0	UDL	20	X926147	26-Jun-19	
SM 2320 B	Total Alkalinity	mg/L as CaCO3	<1.0	<1.0	UDL	20	X926073	25-Jun-19	
SM 2540 C	Total Diss. Solids	mg/L	612	625	2.1	10	X925197	19-Jun-19	
SM 2540 C	Total Diss. Solids	mg/L	617	601	2.6	10	X925197	19-Jun-19	

Quality Control - MATRIX SPIKE Data

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Recovery	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total)										
EPA 245.1	Mercury	mg/L	0.00109	<0.00020	0.00100	109	70 - 130	X926167	27-Jun-19	
EPA 245.1	Mercury	mg/L	0.00107	<0.00020	0.00100	107	70 - 130	X926167	27-Jun-19	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)										
EPA 200.7	Aluminum	mg/L	1.60	0.25	1.00	134	70 - 130	X925113	01-Jul-19	M1
EPA 200.7	Aluminum	mg/L	1.18	0.15	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Antimony	mg/L	1.02	<0.020	1.00	101	70 - 130	X925113	01-Jul-19	
EPA 200.7	Antimony	mg/L	1.09	0.060	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Arsenic	mg/L	1.01	<0.025	1.00	101	70 - 130	X925113	01-Jul-19	
EPA 200.7	Arsenic	mg/L	1.07	0.044	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Barium	mg/L	1.04	0.0116	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Barium	mg/L	1.06	0.0307	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Cadmium	mg/L	0.977	<0.0020	1.00	97.7	70 - 130	X925113	01-Jul-19	

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Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Quality Control - MATRIX SPIKE Data (Continued)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Recovery	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total Recoverable--reportable as Total per 40 CFR 136) (Continued)										
EPA 200.7	Cadmium	mg/L	0.947	0.0060	1.00	94.1	70 - 130	X925113	01-Jul-19	
EPA 200.7	Calcium	mg/L	45.7	25.3	20.0	102	70 - 130	X925113	01-Jul-19	
EPA 200.7	Calcium	mg/L	448	430	20.0	89.9	70 - 130	X925113	01-Jul-19	D2,M4
EPA 200.7	Chromium	mg/L	0.993	<0.0060	1.00	99.3	70 - 130	X925113	01-Jul-19	
EPA 200.7	Chromium	mg/L	0.973	<0.0060	1.00	97.2	70 - 130	X925113	01-Jul-19	
EPA 200.7	Cobalt	mg/L	1.02	0.0324	1.00	98.9	70 - 130	X925113	01-Jul-19	
EPA 200.7	Cobalt	mg/L	0.993	0.0336	1.00	95.9	70 - 130	X925113	01-Jul-19	
EPA 200.7	Copper	mg/L	1.04	<0.0100	1.00	104	70 - 130	X925113	01-Jul-19	
EPA 200.7	Copper	mg/L	1.07	<0.0100	1.00	106	70 - 130	X925113	01-Jul-19	
EPA 200.7	Iron	mg/L	10.1	0.241	10.0	98.5	70 - 130	X925113	01-Jul-19	
EPA 200.7	Iron	mg/L	10.0	0.421	10.0	96.2	70 - 130	X925113	01-Jul-19	
EPA 200.7	Lead	mg/L	1.03	<0.0075	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Lead	mg/L	1.00	<0.0075	1.00	100	70 - 130	X925113	01-Jul-19	
EPA 200.7	Magnesium	mg/L	20.3	0.67	20.0	98.4	70 - 130	X925113	01-Jul-19	
EPA 200.7	Magnesium	mg/L	91.4	71.1	20.0	101	70 - 130	X925113	01-Jul-19	
EPA 200.7	Manganese	mg/L	0.989	<0.0080	1.00	98.2	70 - 130	X925113	01-Jul-19	
EPA 200.7	Manganese	mg/L	2.71	1.72	1.00	98.6	70 - 130	X925113	01-Jul-19	
EPA 200.7	Nickel	mg/L	0.993	<0.0100	1.00	99.3	70 - 130	X925113	01-Jul-19	
EPA 200.7	Nickel	mg/L	1.19	0.224	1.00	97.1	70 - 130	X925113	01-Jul-19	
EPA 200.7	Potassium	mg/L	27.1	7.00	20.0	100	70 - 130	X925113	01-Jul-19	
EPA 200.7	Potassium	mg/L	53.2	32.7	20.0	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Selenium	mg/L	1.00	<0.040	1.00	99.2	70 - 130	X925113	01-Jul-19	
EPA 200.7	Selenium	mg/L	1.02	<0.040	1.00	100	70 - 130	X925113	01-Jul-19	
EPA 200.7	Silicon	mg/L	6.92	1.47	5.00	109	70 - 130	X925113	02-Jul-19	
EPA 200.7	Silicon	mg/L	17.8	12.9	5.00	98.4	70 - 130	X925113	02-Jul-19	
EPA 200.7	Silver	mg/L	0.0521	<0.0050	0.0500	104	70 - 130	X925113	01-Jul-19	
EPA 200.7	Silver	mg/L	0.0520	<0.0050	0.0500	104	70 - 130	X925113	01-Jul-19	
EPA 200.7	Sodium	mg/L	177	155	19.0	115	70 - 130	X925113	01-Jul-19	
EPA 200.7	Sodium	mg/L	240	221	19.0	95.7	70 - 130	X925113	01-Jul-19	
EPA 200.7	Thallium	mg/L	0.899	<0.015	1.00	89.9	70 - 130	X925113	02-Jul-19	
EPA 200.7	Thallium	mg/L	0.845	<0.015	1.00	84.2	70 - 130	X925113	02-Jul-19	
EPA 200.7	Tin	mg/L	1.03	<0.050	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Tin	mg/L	0.998	<0.050	1.00	99.8	70 - 130	X925113	01-Jul-19	
EPA 200.7	Vanadium	mg/L	1.03	<0.0050	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Vanadium	mg/L	1.02	<0.0050	1.00	102	70 - 130	X925113	01-Jul-19	
EPA 200.7	Zinc	mg/L	1.03	<0.010	1.00	103	70 - 130	X925113	01-Jul-19	
EPA 200.7	Zinc	mg/L	1.75	0.753	1.00	99.8	70 - 130	X925113	01-Jul-19	
Metals (Dissolved)										
EPA 200.7	Aluminum	mg/L	1.41	0.40	1.00	101	70 - 130	X925315	02-Jul-19	
EPA 200.7	Antimony	mg/L	0.962	<0.020	1.00	96.2	70 - 130	X925315	02-Jul-19	
EPA 200.7	Arsenic	mg/L	0.981	<0.025	1.00	98.1	70 - 130	X925315	02-Jul-19	
EPA 200.7	Barium	mg/L	1.04	0.0326	1.00	101	70 - 130	X925315	02-Jul-19	
EPA 200.7	Cadmium	mg/L	0.967	<0.0020	1.00	96.7	70 - 130	X925315	02-Jul-19	
EPA 200.7	Calcium	mg/L	24.9	5.40	20.0	97.4	70 - 130	X925315	02-Jul-19	
EPA 200.7	Chromium	mg/L	0.971	<0.0060	1.00	97.1	70 - 130	X925315	02-Jul-19	
EPA 200.7	Cobalt	mg/L	0.962	0.0320	1.00	93.0	70 - 130	X925315	02-Jul-19	
EPA 200.7	Copper	mg/L	0.994	0.0702	1.00	92.4	70 - 130	X925315	02-Jul-19	
EPA 200.7	Iron	mg/L	20.6	10.9	10.0	97.1	70 - 130	X925315	02-Jul-19	
EPA 200.7	Lead	mg/L	1.02	<0.0075	1.00	102	70 - 130	X925315	02-Jul-19	
EPA 200.7	Magnesium	mg/L	27.4	7.91	20.0	97.6	70 - 130	X925315	02-Jul-19	
EPA 200.7	Manganese	mg/L	3.08	2.20	1.00	88.1	70 - 130	X925315	02-Jul-19	
EPA 200.7	Nickel	mg/L	1.01	0.0844	1.00	93.0	70 - 130	X925315	02-Jul-19	
EPA 200.7	Potassium	mg/L	20.9	1.08	20.0	99.3	70 - 130	X925315	02-Jul-19	
EPA 200.7	Selenium	mg/L	0.982	<0.040	1.00	98.2	70 - 130	X925315	02-Jul-19	
EPA 200.7	Silicon	mg/L	9.73	5.00	5.00	94.6	70 - 130	X925315	02-Jul-19	
EPA 200.7	Silver	mg/L	0.0503	<0.0050	0.0500	101	70 - 130	X925315	02-Jul-19	

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Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Quality Control - MATRIX SPIKE Data (Continued)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Recovery	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Dissolved) (Continued)										
EPA 200.7	Sodium	mg/L	21.5	2.74	19.0	98.9	70 - 130	X925315	02-Jul-19	
EPA 200.7	Thallium	mg/L	0.958	<0.015	1.00	95.8	70 - 130	X925315	02-Jul-19	
EPA 200.7	Tin	mg/L	1.01	<0.050	1.00	101	70 - 130	X925315	02-Jul-19	
EPA 200.7	Vanadium	mg/L	0.976	<0.0050	1.00	97.6	70 - 130	X925315	02-Jul-19	
EPA 200.7	Zinc	mg/L	1.09	0.120	1.00	97.1	70 - 130	X925315	02-Jul-19	
Metals (Filtered)										
EPA 245.1	Mercury	mg/L	0.00107	<0.00020	0.00100	107	70 - 130	X926166	27-Jun-19	
EPA 245.1	Mercury	mg/L	0.00102	<0.00020	0.00100	102	70 - 130	X926166	27-Jun-19	
Anions by Ion Chromatography										
EPA 300.0	Chloride	mg/L	3.71	0.60	3.00	104	90 - 110	X926191	26-Jun-19	
EPA 300.0	Fluoride	mg/L	2.23	0.185	2.00	102	90 - 110	X926191	26-Jun-19	
EPA 300.0	Sulfate as SO4	mg/L	104	94.0	10.0	97.6	90 - 110	X926191	26-Jun-19	D2

Quality Control - MATRIX SPIKE DUPLICATE Data

Method	Analyte	Units	MSD Result	Spike Result	Spike Level	% Rec.	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Total)											
EPA 245.1	Mercury	mg/L	0.00110	0.00109	0.00100	110	0.9	20	X926167	27-Jun-19	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)											
EPA 200.7	Aluminum	mg/L	1.59	1.60	1.00	134	0.2	20	X925113	01-Jul-19	M1
EPA 200.7	Antimony	mg/L	1.01	1.02	1.00	100	0.9	20	X925113	01-Jul-19	
EPA 200.7	Arsenic	mg/L	1.00	1.01	1.00	99.6	1.4	20	X925113	01-Jul-19	
EPA 200.7	Barium	mg/L	1.03	1.04	1.00	101	1.2	20	X925113	01-Jul-19	
EPA 200.7	Cadmium	mg/L	0.964	0.977	1.00	96.4	1.4	20	X925113	01-Jul-19	
EPA 200.7	Calcium	mg/L	45.0	45.7	20.0	98.3	1.5	20	X925113	01-Jul-19	
EPA 200.7	Chromium	mg/L	0.976	0.993	1.00	97.6	1.7	20	X925113	01-Jul-19	
EPA 200.7	Cobalt	mg/L	1.01	1.02	1.00	97.6	1.2	20	X925113	01-Jul-19	
EPA 200.7	Copper	mg/L	1.03	1.04	1.00	102	1.5	20	X925113	01-Jul-19	
EPA 200.7	Iron	mg/L	10.0	10.1	10.0	97.9	0.6	20	X925113	01-Jul-19	
EPA 200.7	Lead	mg/L	1.02	1.03	1.00	102	1.3	20	X925113	01-Jul-19	
EPA 200.7	Magnesium	mg/L	20.2	20.3	20.0	97.5	0.9	20	X925113	01-Jul-19	
EPA 200.7	Manganese	mg/L	0.986	0.989	1.00	98.0	0.3	20	X925113	01-Jul-19	
EPA 200.7	Nickel	mg/L	0.983	0.993	1.00	98.3	1.0	20	X925113	01-Jul-19	
EPA 200.7	Potassium	mg/L	26.7	27.1	20.0	98.7	1.2	20	X925113	01-Jul-19	
EPA 200.7	Selenium	mg/L	0.989	1.00	1.00	98.1	1.1	20	X925113	01-Jul-19	
EPA 200.7	Silicon	mg/L	6.80	6.92	5.00	107	1.7	20	X925113	02-Jul-19	
EPA 200.7	Silver	mg/L	0.0513	0.0521	0.0500	103	1.5	20	X925113	01-Jul-19	
EPA 200.7	Sodium	mg/L	173	177	19.0	97.7	1.9	20	X925113	01-Jul-19	
EPA 200.7	Thallium	mg/L	0.887	0.899	1.00	88.7	1.4	20	X925113	02-Jul-19	
EPA 200.7	Tin	mg/L	1.02	1.03	1.00	102	1.0	20	X925113	01-Jul-19	
EPA 200.7	Vanadium	mg/L	1.01	1.03	1.00	101	1.8	20	X925113	01-Jul-19	
EPA 200.7	Zinc	mg/L	1.02	1.03	1.00	102	0.9	20	X925113	01-Jul-19	
Metals (Dissolved)											
EPA 200.7	Aluminum	mg/L	1.42	1.41	1.00	102	0.9	20	X925315	02-Jul-19	
EPA 200.7	Antimony	mg/L	1.01	0.962	1.00	101	4.6	20	X925315	02-Jul-19	
EPA 200.7	Arsenic	mg/L	1.03	0.981	1.00	103	4.5	20	X925315	02-Jul-19	
EPA 200.7	Barium	mg/L	1.05	1.04	1.00	102	0.9	20	X925315	02-Jul-19	
EPA 200.7	Cadmium	mg/L	1.00	0.967	1.00	100	3.7	20	X925315	02-Jul-19	
EPA 200.7	Calcium	mg/L	25.0	24.9	20.0	98.0	0.5	20	X925315	02-Jul-19	

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Project Name: Blackjack/Bluebird
Work Order: **X9F0435**
Reported: 03-Jul-19 13:58

Quality Control - MATRIX SPIKE DUPLICATE Data (Continued)

Method	Analyte	Units	MSD Result	Spike Result	Spike Level	% Rec.	RPD	RPD Limit	Batch ID	Analyzed	Notes
Metals (Dissolved) (Continued)											
EPA 200.7	Chromium	mg/L	1.01	0.971	1.00	101	3.9	20	X925315	02-Jul-19	
EPA 200.7	Cobalt	mg/L	0.996	0.962	1.00	96.4	3.4	20	X925315	02-Jul-19	
EPA 200.7	Copper	mg/L	1.03	0.994	1.00	96.0	3.5	20	X925315	02-Jul-19	
EPA 200.7	Iron	mg/L	20.7	20.6	10.0	98.4	0.6	20	X925315	02-Jul-19	
EPA 200.7	Lead	mg/L	1.07	1.02	1.00	107	4.7	20	X925315	02-Jul-19	
EPA 200.7	Magnesium	mg/L	27.8	27.4	20.0	99.3	1.2	20	X925315	02-Jul-19	
EPA 200.7	Manganese	mg/L	3.14	3.08	1.00	93.6	1.8	20	X925315	02-Jul-19	
EPA 200.7	Nickel	mg/L	1.05	1.01	1.00	96.2	3.1	20	X925315	02-Jul-19	
EPA 200.7	Potassium	mg/L	21.0	20.9	20.0	99.8	0.5	20	X925315	02-Jul-19	
EPA 200.7	Selenium	mg/L	1.02	0.982	1.00	102	3.9	20	X925315	02-Jul-19	
EPA 200.7	Silicon	mg/L	9.82	9.73	5.00	96.4	0.9	20	X925315	02-Jul-19	
EPA 200.7	Silver	mg/L	0.0505	0.0503	0.0500	101	0.5	20	X925315	02-Jul-19	
EPA 200.7	Sodium	mg/L	21.6	21.5	19.0	99.4	0.4	20	X925315	02-Jul-19	
EPA 200.7	Thallium	mg/L	1.00	0.958	1.00	100	4.6	20	X925315	02-Jul-19	
EPA 200.7	Tin	mg/L	1.00	1.01	1.00	100	0.6	20	X925315	02-Jul-19	
EPA 200.7	Vanadium	mg/L	1.02	0.976	1.00	102	4.1	20	X925315	02-Jul-19	
EPA 200.7	Zinc	mg/L	1.13	1.09	1.00	101	3.4	20	X925315	02-Jul-19	
Metals (Filtered)											
EPA 245.1	Mercury	mg/L	0.00106	0.00107	0.00100	106	0.9	20	X926166	27-Jun-19	
Anions by Ion Chromatography											
EPA 300.0	Chloride	mg/L	3.64	3.71	3.00	101	1.9	20	X926191	26-Jun-19	
EPA 300.0	Fluoride	mg/L	2.19	2.23	2.00	100	1.6	20	X926191	26-Jun-19	
EPA 300.0	Sulfate as SO4	mg/L	105	104	10.0	110	1.2	20	X926191	26-Jun-19	D2

Notes and Definitions

D2	Sample required dilution due to high concentration of target analyte.
M1	Matrix spike recovery was high, but the LCS recovery was acceptable.
M4	The analysis of the spiked sample required a dilution such that the spike recovery calculation does not provide useful information. The LCS recovery was acceptable.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
0.30R>S	% recovery not applicable; spike level is less than 30% of the sample concentration
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

Analytical Laboratories, Inc.

1804 N. 33rd Street
Boise, Idaho 83703
Phone (208) 342-5515

Date Report Printed: 6/27/2019 11:14:39 AM
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These test results relate only to the items tested.

Laboratory Analysis Report

Sample Number: 1928544

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLU-TP-1 (SLUDGE)

Time of Collection: 11:30
Date of Collection: 6/11/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		10.0	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

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If you have any questions about this report, or any future analytical needs, please contact your client manager:

James Hibbs

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Laboratory Analysis Report

Sample Number: 1928545

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLU-TP-3 (SLUDGE)

Time of Collection: 11:55
Date of Collection: 6/11/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		8.8	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

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Laboratory Analysis Report

Sample Number: 1928546

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLU-TP-5 (SLUDGE)

Time of Collection: 12:10
Date of Collection: 6/11/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		10.1	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

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Laboratory Analysis Report

Sample Number: 1928547

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLK-TP-1 (SLUDGE)

Time of Collection: 10:25
Date of Collection: 6/12/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		14.2	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

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MDL = Method/Minimum Detection Limit
UR = Unregulated

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Laboratory Analysis Report

Sample Number: 1928548

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLK-TP-2 (SLUDGE)

Time of Collection: 10:35
Date of Collection: 6/12/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		10.0	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

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MDL = Method/Minimum Detection Limit
UR = Unregulated

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Laboratory Analysis Report

Sample Number: 1928549

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLK-SP-1 (SLUDGE)

Time of Collection: 9:20
Date of Collection: 6/12/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		11.8	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

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Laboratory Analysis Report

Sample Number: 1928550

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLK-SP-2 (SLUDGE)

Time of Collection: 9:35
Date of Collection: 6/12/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		12.2	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

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These test results relate only to the items tested.

Laboratory Analysis Report

Sample Number: 1928551

Attn: PAUL HUNTER
APPLIED INTELLECT, LLC
STE 100
412 E PARKCENTER BLVD
BOISE, ID 83706

Collected By: PAUL HUNTER
Submitted By: PAUL HUNTER

Source of Sample:
USFS-BLUEBIRD BLACKJACK BLK-SP-3 (SLUDGE)

Time of Collection: 11:35
Date of Collection: 6/12/2019
Date Received: 6/14/2019
Report Date: 6/24/2019

Field pH:
Lab pH:
Field Temp:
Temp Rcvd in Lab:

PWS#:
PWS Name:

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Total Solids		17.5	%	0.200	SM 2540 G	6/18/2019	GM

Email: paul.hunter@ap-in.com

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

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James Hibbs

APPENDIX 5

Quality Assurance / Quality Control

QA/QC objectives were developed for the sites to provide guidelines for field and laboratory operations. The goal was to produce data of known and acceptable quality, allowing the site investigators to fully assess the degree and extent of Compounds of Potential Concern (COPCs) in the media present at the sites. During the course of environmental activities, the standard procedures outlined in the SAP were followed to maximize sample integrity to produce acceptable levels of accuracy, precision, completeness, representativeness, and comparability.

Data Precision and Accuracy

Precision is a measure of mutual agreement among individual measurements of the same property usually under prescribed conditions and calculated as the relative percent difference (RPD). Field duplicate samples were used to determine the precision of the sampling process. Acceptable RPDs were determined to range from 0% to 50%, as defined in the SAP. Precision for field duplicates was estimated on the basis of calculated RPD of parameters.

RPDs for waste rock samples ranged from 0.13 to 39.8% in the site sample and 1.22 to 141.7% in the background sample. RPD calculations are presented in Table 1 and 2 below.

Table 1. RPDs for detected Waste Rock Samples and Associated Duplicates

Analyte	BLU-WR-6 (mg/kg)	BLU-WR-7* (mg/kg)	RPD
Aluminum	3,020	3,320	9.46
Antimony	5.65	4.62	20.06
Arsenic	99.8	128	24.76
Barium	75.4	75.5	0.13
Calcium	27	28.7	6.10
Chromium	4.09	5.3	25.77
Cobalt	1.47	1.55	5.29
Copper	20.3	30.4	39.84
Iron	13,700	18,800	31.38
Lead	15.8	15.6	1.27
Magnesium	257	325	23.37
Manganese	41.4	48.1	14.97
Mercury	0.235	0.281	17.83
Nickel	6.34	6.59	3.86
Selenium	3.35	3.44	2.65
Silver	0.554	0.439	23.16
Thorium	3.39	4.02	17.00
Tin	1.22	1.21	0.82
Vanadium	15.5	20.8	29.20
Zinc	20.5	26.1	24.03

* Duplicate sample
mg/kg – milligrams per kilogram

RPD – relative percent difference

Table 2. RPDs for detected Background Soil Samples and Associated Duplicates

Analyte	BLK-BG-5 (mg/kg)	BLK-BG-6* (mg/kg)	RPD
Aluminum	3,270	2,580	23.58
Antimony	6.65	9.98	40.04
Arsenic	13	21.8	50.57
Barium	91.9	78.8	15.34
Calcium	69.7	58	18.32
Chromium	12.5	11.1	11.86
Cobalt	20.5	23	11.49
Copper	81.1	73.7	9.56
Iron	136,000	198,000	37.12
Lead	10.1	11.1	9.43
Magnesium	186	96.7	63.17
Manganese	347	307	12.23
Mercury	0.261	1.53	141.71
Nickel	112	129	14.11
Thorium	2.01	1.44	33.04
Vanadium	19.6	13.3	38.29
Zinc	384	533	32.49

* Duplicate sample
mg/kg – milligrams per kilogram
RPD – relative percent difference

RPDs for surface water samples ranged from 0 % to 1.8%. RPD calculations are presented in Table 3 below.

Table 3. RPDs for detected Water Samples and Associated Duplicates

Analyte	BLK-PD-1 (mg/l)	BLK-ADIT-RES* (mg/l)	RPD (%)
Aluminum	0.56	0.56	0.0
Barium	0.0345	0.0344	0.29
Calcium	5.54	5.44	1.82
Cobalt	0.034	0.0335	1.48
Copper	0.0825	0.0814	1.34
Iron	11.8	11.8	0.0
Magnesium	8.22	8.18	0.49
Manganese	2.24	2.26	0.89
Nickel	0.0871	0.0864	0.81
Potassium	1.12	1.11	0.90
Silicon	5.23	5.24	0.19

Analyte	BLK-PD-1 (mg/l)	BLK-ADIT-RES* (mg/l)	RPD (%)
Sodium	2.83	2.78	1.78
Zinc	0.121	0.121	0.0

* Duplicate sample
mg/l – milligrams per liter
RPD – relative percent difference

Accuracy was estimated on the basis of laboratory matrix spike/matrix spike duplicate (MS/MSD) recoveries. Accuracy is maximized by the use of standard sampling, shipping and analysis procedures, and the use of disposable sampling equipment to reduce the potential for sample contamination. Acceptable spike recovery ranges differ by analyte and were defined by Pace Analytical (solid samples) and SVL (water samples). Laboratory control samples were within control limits with the following exceptions:

- Seven soil MS/MSD analytes were outside the recovery range with a laboratory note indicating sample matrix interfered with the ability to make any accurate determination.
- Five soil MS/MSD analytes were outside the recovery range with a laboratory note indicating the sample concentration was too high to evaluate accurate spike recoveries.
- One water MS/MSD analyte (aluminum) was outside the recovery range with a laboratory note indicating the matrix spike recovery was high, but the LCS recovery was acceptable.

Data Representativeness, Comparability, and Completeness

Representativeness is defined as the degree to which the sample data accurately and precisely represents a characteristic of the environmental condition. Representativeness is evaluated by collecting sufficient samples, properly chosen with respect to location and time, and then comparing the results for field duplicate samples. The precision of a representative set of samples reflects the degree of variability of the sampled medium, as well as the effectiveness of the sampling techniques and laboratory analysis. Representativeness is considered acceptable for this evaluation on the basis of a sufficient number of samples being collected at locations that properly defined the extent of potential contamination.

Comparability is defined as the confidence with which one data set can be compared to another data set. Comparability was maximized by using standard sampling and analysis procedures, and is considered acceptable for this evaluation.

Completeness is defined as the percentage of valid data obtained in comparison to the amount that was planned. The data has been validated and all analytical samples are considered usable to determine compliance with applicable regulations.

Additional Field and Laboratory QC Checks

Laboratory Control Spike

A laboratory control spike (LCS) is a sample of an uncontaminated reference matrix (such as reagent water, clean sand, or other matrix material) that has had a known amount of the target analyte added to it in the laboratory before analysis. Laboratories commonly use LCS and LCS duplicate (LCSD) analyses to maintain quality control over the analytical process. All LCS and LCSD recoveries were found to be acceptable by Pace Analytical (solid samples) and SVL (water samples).

Holding Times

All samples were analyzed within the specified holding times.

Calibration

Instrument calibration verifications performed by the laboratories were all found to be within acceptable limits.

Field Records

Field documentation ensures sample integrity and provides sufficient technical information to recreate each field event. All field data was reviewed to ensure that:

- Proper field procedures were implemented;
- Appropriate documentation is available for each activity;
- Field instruments were calibrated as required;
- Required number and type of field QC samples were collected;
- Numerical value and units of each field measurement were documented; and
- Field equipment was decontaminated or disposable single-use materials were used as specified.

Review of field documentation shows documentation to be clear, comprehensive, and acceptable.

APPENDIX 6

Sludge Volume Calculations

SLUDGE VOLUME ESTIMATES

Blackjack and Bluebird Mines – Accumulated Adit Discharge Sludge Volume

The volume of accumulated sludge at the Blackjack and Bluebird Adit discharges was estimated on the basis of sludge thickness measurements. Sludge thickness was generally greater toward the center of the various settling pond areas, decreasing toward the edges. The maximum thickness measured was 3.5 feet at Bluebird and 2.5 feet at Blackjack (Table 1). Estimation of sludge volumes was complicated by variability in the sludge thickness from location to location, as well as the irregular shapes of the pond areas. The surface area of each pond was measured using aerial imagery (Table 2).

Volume estimates were developed by approximating each sludge pond as a simple section of a sphere with depth equal to the average sludge thickness and surface area equal to the actual pond area as measured by aerial imagery. This approximation reflects gradually increasing depth to the maximum measured and zero sludge thickness and the edges. The estimate of 128 cu yd sludge present inside the Bluebird Mine Adit was based on an inspection completed during 2014 (CES, 2015).

For the Bluebird Treatment Pond, where the sludge thickness was greater than zero at the edges, a more complex approximation was required. The sludge thickness measured at the edges of the Bluebird Treatment Pond was 0.6 to 0.8 foot, with an average of 0.68 foot. The volume of sludge in this area was approximated as a cylinder with vertical walls, 0.68 foot high, on top of a spherical section calculated as described above. Both shapes were based on the same surface area as measured using aerial imagery. The depth of the spherical portion was the measured average thickness of 0.77 feet minus the thickness included in the cylinder. These calculations are shown in Table 3 with examples provided below.

Sample Calculation 1: Blackjack Settling Pond SP-2 (Estimation as a section of a sphere)

Measured area = 3,566 sq ft (Table BBB)

Average sludge thickness = 1.8 ft (Table AAA)

For calculations, let R = radius, K = surface area, h = depth, and V = volume

Radius of equivalent circle $K = \pi R^2 \Rightarrow R = \sqrt[2]{K/\pi}$

$R = \sqrt[2]{3{,}566/\pi}$

R = 33.7 ft

$V = \frac{1}{6}\pi h(3R^2 + h^2)$ (CRC, 1984)

$V = \frac{1}{6}\pi * 1.8 * (3 * 33.7^2 + 1.8^2)$

$V = \frac{1}{6}\pi * 1.8 * (3405 + 3.4)$

V = 3,272 cu ft

Sample Calculation 2: Bluebird Treatment Pond (Estimation as a cylinder above a section of a sphere)

Measured area = 16,177 sq ft (Table BBB)

Average sludge thickness = 0.767 ft (Table AAA)

Shoreline sludge thickness = 0.683 ft

For calculations, let R = radius, K = surface area, h = depth, and V = volume

Radius of equivalent circle K = πR^2 => $R = \sqrt[2]{K/\pi}$

R = $\sqrt[2]{16{,}177/\pi}$

R = 71.8 ft

Part 1: consider a cylinder 0.683 ft deep representing the sludge volume held within relatively steep walls

$V_c = \pi R^2 h$

$V_c = \pi*(71.8)^2*0.683$

V_c = 11,054 cu ft

Part 2: consider a shallow section of a sphere representing a deeper area at center of pond

Depth = 0.767 ft – 0.683 ft = 0.083 ft

$V_s = \frac{1}{6}\pi h(3R^2 + h^2)$

$V_s = \frac{1}{6}\pi*0.083*(3*71.8^2 + 0.083^2)$

$V_s = \frac{1}{6}\pi*0.083*(15448 + 0.01)$

V_s = 674 cu ft

Total volume = cylinder + spherical section

$V = V_c + V_s$

V = 11,054 + 674

V = 11,728 cu ft

Table 1 – Sludge and Water Column Thickness

Sample	Water Column (ft)	Sludge Thickness (ft)	Shoreline Sludge Thickness (ft)
Bluebird Treatment Pond			
BLU-TP-1	6.0	1.0	0.6
BLU-TP-2	6.0	1.0	0.7
BLU-TP-3	7.0	0.7	0.8
BLU-TP-4	6.0	0.7	0.8
BLU-TP-5	5.0	0.7	0.6
BLU-TP-6	7.5	0.5	0.6
Average		0.77	0.68
Bluebird Settlement Pond			
BLU-SP-1	1.0	3.5	0.0
BLU-SP-2	1.0	2.5	0.0
BLU-SP-3	1.0	1.0	0.0
BLU-SP-4	1.2	1.0	0.0
BLU-SP-5	1.0	1.0	0.0
Average		1.80	0.0
Blackjack Settling Ponds			
BLK-SP1-1	2.0	2.5	0.0
BLK-SP1-1a	1.5	1.0	0.0
BLK-SP1-2	1.0	1.5	0.0
Average		1.67	0.0
BLK-SP2-2	NM	1.5	0.0
BLK-SP2-2a	NM	1.5	0.0
BLK-SP-2b	NM	2.5	0.0
Average		1.83	0.0
BLK-Ditch-1	NM	0.1	0.0
BLK-Ditch-2	NM	0.5	0.0
BLK-Ditch-3	NM	1.5	0.0
BLK-Ditch-4	NM	0.5	0.0
Average		0.65	0.0

Note: NM = Not measured

Table 2 – Impoundment Surface Areas

Impoundment	Sludge Surface Area (sq ft)
Bluebird Treatment Pond (BLU-TP)	16,177
Bluebird Settlement Pond (BLU-SP)	5,512
Blackjack Settling Pond BLK-SP1	598
Blackjack Settling Pond BLK-SP2	3,566
Blackjack Ditch (BLK-Ditch)	2,209

Table 3 – Volume Estimation Calculations

Impoundment	Equivalent Radius (ft)	Cylindrical Section Depth (ft)	Cylindrical Section V_c (cu ft)	Spherical Section Depth (ft)	Spherical Section V_s (cu ft)	Total Volume (cu ft)	Total Volume (cu yd)
Bluebird Treatment Pond (BLU-TP)	71.76	0.68	11,054	0.083	674	11,728	434
Bluebird Settlement Pond (BLU-SP)	41.89	0	0	1.80	4,964	4,964	184
Bluebird Adit (Dam to Plug)	N/A	N/A	N/A	N/A	N/A	3,443	128
Blackjack Settling Pond BLK-SP1	13.80	0	0	1.67	501	501	19
Blackjack Settling Pond BLK-SP2	33.69	0	0	1.83	3,272	3,272	121
Blackjack Ditch (BLK-Ditch)	26.52	0	0	0.65	718	718	27
					Total	24,626	913

SLUDGE GENERATION RATE ESTIMATES

Blackjack and Bluebird Mines - Adit Discharge Sludge Generation

The rates of sludge generation associated with the Blackjack and Bluebird Adit discharges was estimated using the USGS PHREEQC Modeling program. This model utilizes chemical equilibrium relationships together with site-specific data including flow rate, pH, and results of chemical analyses to estimate the rate of sludge generation on a mass per time basis. The bulk density of the sludge was then used to estimate the volumetric generation rate. All of the modeled sludge generation is assumed by the model to precipitate as ferric hydroxide ($Fe(OH)_3$).

The sludge generation rate can be affected by the amount of carbon dioxide (CO_2) degassing from the adit discharge as it approaches equilibrium with the atmosphere. Scenarios involving no CO_2 degassing were evaluated to provide minimum sludge generation rates; alternate scenarios involving complete degassing to equilibrate with atmospheric CO_2 levels were considered to determine maximum sludge generation rates.

Based on adit water sampling completed in June 2019, the calculated maximum and minimum sludge generation rates for each adit are summarized in Table 4. These model results are based on a flow rate of 75 gpm for Blackjack Mine and 60 gpm for Bluebird Mine.

Table 4 - Adit Discharge Sludge Generation Rates, Mass Basis

Location	Total Sludge Generation Rate (kg/day)	
	Min	Max
Blackjack Mine	6.61	9.22
Bluebird Mine	13.88	14.25

The PHREEQC Model provides mass generation rates, as above. Estimation of the volume of sludge generated over time is complicated by the tendency for ferric hydroxide, the primary component of the sludge, to form a loose, poorly-consolidated sludge mass that compacts slowly over time. Measurement of the solids content of sludge at each mine discharge yielded results summarized in Tables 5 and 6.

Table 5 – Bluebird Mine Sludge Solids Content

Sample ID	Result (% solids)	Sludge Thickness (ft)
BLU-TP-1	10.0	1
BLU-TP-3	8.8	0.7
BLU-TP-5	10.1	0.7
Mean	9.6	

Table 6 – Blackjack Mine Sludge Solids Content

Sample ID	Result (% solids)	Sludge Thickness (ft)
BLK-TP-1	14.2	1
BLK-TP-2	10.0	1.5
BLK-SP-1	11.8	0.88
BLK-SP-2	12.2	Not Measured
BLK-SP-3	17.5	1.5
Mean	13.1	

The bulk density of the sludge can be approximated by attributing the density of pure ferric hydroxide, 4.25 g/cm^3, to the solid fraction in each sample. The remainder of the samples is assumed to be primarily water with a density of 1.0 g/cm^3. This calculation approach will yield a value likely higher than the actual density due to the loose, poorly-consolidated structure typical of a ferric hydroxide precipitate. Therefore, actual sludge generation volumes are likely to be higher than estimated by this method.

For example, the maximum volumetric sludge generation rate for the Bluebird Mine adit discharge can be estimated as follows. For calculation, a basis of 100 g total sludge is used:

Total volume sludge per time = Volume ferric hydroxide + volume water

Mass ferric hydroxide = 9.6 g in 100 g sludge, see Table ZZZ.

Volume ferric hydroxide = 9.6 g / 4.25 g/cm^3= 2.27 cm^3 in 100 g sludge

Mass water = 100 – 9.6 = 90.4 g in 100 g sludge

Volume water = 90.4 cm^3

Total volume sludge = 2.27 cm^3 + 90.4 cm^3 = 92.6 cm^3

Time required for 100 g of sludge generation can be calculated using the generation rate in Table XXX. For this example, the maximum estimated generation rate of 14.25 kg/day is used. Dividing 100 g by 14.25 kg/day gives an estimated time to generate 100 g sludge of 10.1 minutes. Therefore, the calculated sludge volume of 92.6 cm^3 would require 10.1 minutes to produce, which is a rate of 9.2 cm^3/min. This is equivalent to 0.013 m^3/day or 0.017 cu yd per day = 6.3 cu yd/year.

The above calculation was regarding the Bluebird Mine discharge. A similar analysis for the Blackjack Mine discharge, using the 9.22 kg/day maximum estimated generation rate from Table 5 and the 13.1 % average solids content from Table 6, gives an estimated generation rate for Blackjack Mine of 0.0083 m^3/day or 0.011 cu yd per day = 4.0 cu yd/year. These results are summarized in Table 7.

Table 7 - Adit Discharge Sludge Generation Rates, Volumetric Basis

Location	Sludge Generation Rate (cubic yard/year)	
	Min	**Max**
Blackjack Mine	6.1	6.3
Bluebird Mine	2.8	4.0
Total	9.0	10.3

APPENDIX 7

Screening Level Human Health Risk Assessment

HUMAN HEALTH RISK ASSESSMENT

1.0 INTRODUCTION

Mining activities at the Sites have been impacting the land since the early 1900s. Human and ecological receptors near the Sites may be exposed to contaminants via mine waste sources (e.g., waste rock, mine water discharge). The area is used for recreation, fishing, and logging, and generated mine waste has contributed to metals in soils. Groundwater sampling was not conducted as part of this investigation. Groundwater is not used for drinking water at the Sites and future use as a drinking source is not anticipated because the USFS does not allow use of unpermitted wells. This section describes the screening level and baseline human health risk assessment for the Sites and establishes the potential magnitude of risk to human health receptors.

The results of this assessment are intended to help inform risk managers and the public about current and potential future health risks to humans that may occur as a result of exposure to site-related contaminants, and to help determine if there is a need for action to protect public health at the Site. The methods used to evaluate risks in this assessment are consistent with current guidelines for human health risk assessment provided by the United States Environmental Protection Agency (USEPA) for use at Superfund sites (USEPA 1989; 1991a; 1991b; 1992; 1997; 2002a; 2002b; 2004, 2009a) and the Oregon Department of Environmental Quality (ODEQ 2010).

2.0 EXPOSURE ASSESSMENT

Exposure is the process by which humans come into contact with chemicals in the environment. In general humans can be exposed to chemicals in a variety of environmental media (e.g., soil, sediment, water, air, or food) and these exposures can occur through several pathways (e.g., ingestion, inhalation, or dermal contact).

2.1 Site Conceptual Model

Figure 10 presents a Conceptual Site Model (CSM) that summarizes the current understanding of how chemical contaminants that have been released to the environment at the Site might result in the exposure of human receptors. The main features of the CSM are discussed below.

Primary Sources of Contamination

The two main sources of environmental contamination from former mining activities at the Site include:

- Deposits of various types of solid wastes (tailings and waste rock) that were placed onto soil near the mines or were discharged into nearby streams.
- Discharges of contaminated water from mine adits.

Transport in the Environment

Chemical contaminants in these two main sources of contamination may migrate in the environment by several processes:

- Fine-grained solid wastes may be released into air as a consequence either of wind erosion and/or or human disturbances.
- Solid wastes may be eroded into streams, resulting in contamination of both surface water and stream sediments.
- Contaminants in soils or sediments may be taken up into the tissues of plants or game animals.
- Contaminants in soils or sediments may be dissolved by water (rain or snowmelt) and enter surface water and may infiltrate into groundwater.

Populations of Chief Concern

Site Visitors

The Blackjack Mine and Bluebird Mines are abandoned mine sites located on public lands administered by the USFS Umatilla and Wallowa-Whitman National Forests. Land use in the area is limited to timber harvesting, firewood cutting and recreation (hiking, camping, hunting, etc.). Other than tribal ceremonial fishing, fishing is not allowed in Clear Creek due to the salmon restoration program. Since recreational visitors are expected to spend the most time at the site, their exposures and risks will be quantified in this risk assessment. Recreational visitors may consist of both adults and young children.

2.2 Exposure Pathways of Chief Concern

The following sections present a more detailed description of these pathways and an analysis of their relative importance for human exposure.

2.2.1 Exposures to Soil and Sediment

Incidental Ingestion of Soil/ Sediment

Even though few people intentionally ingest soil or sediment, anyone who has direct contact with contaminated media such as soil or sediment may incidentally ingest small amounts that adhere to their hands during outdoor activities or via contact with soil-derived dusts on interior surfaces. Ingestion of surface soil and sediment is a complete pathway and is evaluated quantitatively for visitors to the site. None of the receptors are expected to have regular contact with subsurface soil in their day to day routines. Therefore, the ingestion of subsurface soil is considered to be an incomplete pathway of exposure.

Inhalation of Airborne Soil Particulates

Whenever contaminated soil or waste materials are exposed at the surface, fine-grained particles of contaminated surface soil may become suspended in air by wind or mechanical disturbance, and humans in the area could inhale those particles. Inhalation of particulates is a complete pathway and is evaluated quantitatively for visitors to the site.

Dermal Contact with Soil/ Sediment

Humans who come into contact with contaminated soil or sediment may get some of the contaminated media on their skin. Most scientists consider that dermal absorption of metals from soil or sediment is likely to be minor in comparison to the amount of exposure that occurs by the oral route. This view is based on the recognition that most metals tend to bind to soils, reducing the likelihood that they would dissociate from the soil and cross the skin. In addition, ionic contaminants such as metals have a relatively low tendency to cross the skin even when contact does occur. For example, studies by Lowney (2005) have shown that dermal absorption of arsenic from Colorado and New York soils was negligible. Due to the lack of evidence supporting dermal absorption of lead from soil, neither EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA 1994) or Adult Lead Methodology (ALM) (USEPA 2003b) even include a dermal exposure pathway. Based on this, dermal contact with metals in soil or sediment is considered to be minor and is not evaluated quantitatively in this risk assessment.

2.2.2 Exposure to Surface Water

Visitors to the site may not intentionally ingest surface water but may incidentally ingest small amounts while recreating along area streams. Therefore, this exposure pathway is retained for quantitative evaluation. Recreational visitors along site creeks and streams may have occasional dermal contact with surface water while wading or playing along the streams. Similar to dermal contact with soils or sediments (discussed above), uptake

of metals across the skin from contact with water is usually considered to be a minor exposure pathway due to the relatively low tendency of metals to cross the skin even when contact does occur. For this reason, this pathway is not evaluated quantitatively in this assessment.

2.2.3 Summary of Exposure Pathways for Quantitative Assessment

The exposure pathways selected for quantitative evaluation in this risk assessment include:

- Incidental ingestion of surface soil and sediment;
- Inhalation of soil particulates; and
- Ingestion of surface water.

3.0 SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN

This section presents the rationale for the selection of the contaminants of potential concern (COPCs) for the Blackjack and Bluebird Mines. The selection of COPCs was conducted in accordance with the Oregon Department of Environmental Quality (ODEQ) Human Health Risk Assessment Guidance (ODEQ, 2010) and USEPA risk assessment guidance (USEPA, 1989).

3.1 Data Sets

The soil data collected by AI (USFS 2019) were used to select soil COPCs for the Blackjack and Bluebird Mine sites. The Sites were evaluated separately due to the geographical distance between the two sites. It should be noted that only waste rock samples were collected, not soil samples. For the purpose of this assessment the waste rock samples were evaluated as soil samples. However, human receptors may or may not be exposed to waste rock in the same manner that they are exposed to finer grained soil particles. The results from surface water and sediment samples collected by TetraTech (2018) for Clear Creek and the sediment samples collected by E&E (2017) for Clear Creek were used to select COPCs for those media. The surface water samples were analyzed for both total and dissolved metals, however, only total metals results were evaluated in the COPC screen because these are more representative of what human receptors would contact while swimming or wading. Adit water samples were not evaluated because humans would not be exposed to these media while swimming or wading. Background samples were collected and analyzed for each media in all of the data sets used.

3.2 COPC Selection Process

3.2.1 Comparison to Risk-Based Screening Levels

The waste rock/soil, surface water and sediment samples were analyzed for all Target Analyte List metals. In accordance with the ODEQ and EPA guidances, the screening process begins with a comparison to a risk-based screening level (RSL). An RSL is a concentration of a chemical in a medium that is believed to pose negligible health risk to a specified population of human receptors. For carcinogens, this is a concentration that corresponds to a cancer risk of 1E-06. For non-carcinogens, this is a concentration that corresponds to a Hazard Quotient of 1. For this assessment, RSLs used in the COPC selection protocol were taken from EPA's Regional Screening Table (EPA 2019), using values that are protective of occupational workers. The ODEQ guidance recommends that the maximum contaminant concentration be compared to the RSL. If the maximum detected concentration does not exceed the RSL, it may be concluded that the chemical does not pose a significant risk to humans. If the maximum detected concentration does exceed the RSL, the ODEQ recommends that the 90% Upper Confidence Limit on the Arithmetic Mean (UCLM) be calculated for the analyte and compared to the RSL. If the 90% UCLM exceeds the RSL, then the analyte is retained and further evaluated as a beneficial mineral and/or compared to background concentrations.

In addition to the potential risk posed by an individual analyte, any screening must take into consideration the risk posed by multiple analytes simultaneously within a given media. It is possible a few analytes that would be

screened out with concentrations just below an RSL of 1 could exceed a cumulative Hazard Index of 1. For this reason, an additional condition is used to screen non-carcinogens. A non-carcinogenic chemical is screened in if:

C/ RSL > 0.1 and SUM (C/RSL) > 1

For carcinogens, individual RSLs are based on an excess lifetime cancer risk of 1E-06. It is highly unlikely that chemicals would exceed the cumulative standard of 1E-05 with all concentrations below their RSLs. Therefore, ODEQ does not require a cumulative risk screen for carcinogens that are below RSLs.

3.2.2 Essential Nutrients

According to the USEPA, chemicals that are essential human nutrients, are present at low concentrations, and are toxic only at high doses may be screened out (USEPA 1989). Examples of essential nutrients that may qualify are calcium, iron, magnesium, potassium, and sodium.

3.2.3 Comparison to Background

Analytes which exceed their respective RSLs and are not essential nutrients are further evaluated by comparing the site concentrations to background levels. Each of the data sets evaluated for waste rock/soil, surface water and sediment included background or reference samples. Due to the small number of background samples collected, a Background Threshold Value (BTV) was calculated and compared to the maximum contaminant concentration or the 90% UCLM (when an adequate number of samples were available to estimate a 90% UCLM). The BTV value was calculated using ProUCL 5.1 (USEPA 2016) and using the 95% upper tolerance limit based on the appropriate distribution of the data.

3.3 Results of the Initial COPC Selection Process

The results of the COPC selection process are shown in Tables 1 and 2 (waste rock/soil), Table 3 (surface water) and Table 4 (sediment). The following COPCs were identified for the Blackjack and Bluebird Mine sites:

- Waste rock/soil for Blackjack Mine: manganese and cobalt;
- Waste rock/soil for Bluebird Mine: arsenic;
- Surface Water for Clear Creek: none; and
- Sediment for Clear Creek: none.

3.3.1 Secondary Screening – Comparison to BLM Site-Specific Screening Levels

An additional step suggested in the EE/CA workplan was to also screen the analytes against the BLM Screening Levels for recreational users provided in the BLM Technical Memorandum *Screening Assessment Approaches for Metals in Soils at BLM HazMat/AML Sites* (2017). Since these values are less conservative than the occupational values used above it is not necessary to re-screen all analytes. Only the analytes which were identified as COPCs from the occupational screen were evaluated against the BLM recreational screening levels. The BLM recreational screening levels assume that a person will visit the site 14 days/year for 26 years as both a child and an adult. When the COPCs identified in the occupational screen are compared to the BLM values, the contaminants in waste rock/ soils are above the BLM value divided by 10 (in accordance with Oregon DEQ risk assessment guidance) and remain as COPCs. The following COPCs were identified for the Blackjack and Bluebird Mine sites (Table 5) and should be evaluated further in a site-specific human health risk assessment.

- Waste rock/soil for Blackjack Mine: manganese and cobalt;
- Waste rock/soil for Bluebird Mine: arsenic;
- Surface Water for Clear Creek: none; and
- Sediment for Clear Creek: none.

4.0 EVALUATING EXPOSURE AND RISK FROM COPCS

4.1 Quantification of Exposure

4.1.1 Basic Equations

Ingestion Exposures

The amount of chemical which is ingested by receptors exposed to site media may be quantified using the following general equation:

$$DI = CS * CF * (IR_s/BW) * (EF * ED/AT) * RBA$$

where:

DI = Daily intake of chemical (mg per kg of body weight per day)
CS = Concentration of the chemical in the contaminated environmental medium to which the person is exposed. The units are mg/kg for soil.
CF = Conversion factor. The units are kg/mg.
IR = Intake rate of the contaminated environmental medium. The units are mg/day for soil.
BW = Body weight of the exposed person (kg)
EF = Exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.
ED = Exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.
AT = Averaging time (days). This term specifies the length of time over which the average dose is calculated. For a chemical which causes non-cancer effects, the averaging time is equal to the exposure duration. For a chemical that causes cancer effects, the averaging time is 70 years.
RBA = Relative bioavailability

For mathematical convenience, the general equation for calculating dose can be written as:

$$DI = CS * HIF * RBA$$

where:
HIF = Human Intake Factor. The term describes the average amount of an environmental medium contacted by the exposed person each day. The value of HIF is given by:

$$HIF = (IR/BW) * (EF*EF/AT) * CF$$

When the same individual may be exposed beginning as a child and extending into adulthood, exposure was calculated as the time-weighted average lifetime exposure for evaluating non-cancer and cancer risks as recommended in USEPA Guidance (1989).

Inhalation Exposures

Inhalation exposures are evaluated in accordance with the inhalation dosimetry methodology presented in EPA's *Risk Assessment Guidance for Superfund (RAGS) Part F: Inhalation Risk Assessment* (USEPA 2009a).

In accordance with USEPA (2009a), the human intake equation does not include an inhalation rate (m^3/day) or body weight because the amount of the chemical that reaches the target site is not a simple function of these factors. Therefore, the inhaled exposure concentration (EC) for chronic exposures is calculated as:

$$EC = CA * (ET * EF * ED)/AT)$$

where:

EC = Exposure Concentration (ug/m^3).
CA = Concentration of the chemical in air (ug/m^3) to which the person is exposed.
ET = Exposure time (hours/day). This describes how long a person is likely to be exposed to the contaminated medium over the course of a typical day.
EF = Exposure Frequency (days/year).
ED = Exposure Duration (years)
AT = Averaging time (hours)

If measured air data is not available, the concentration in air (CA) can be modeled from the concentration in soil (CS) by:

$$CA = CS/PEF$$

where:

PEF = Particulate Emission Factor

For mathematical convenience, the general equation for exposure concentration can be written as:

$$EC = CA * HIF_{inh}$$

where:

HIF_{inh} = Human Intake Factor for inhalation exposures
HIF_{inh} = (ET * EF * ED/AT)

As described above, when the same individual may be exposed beginning as a child and extending into adulthood, exposure was calculated as the time-weighted average lifetime exposure for evaluating non-cancer and cancer risks.

4.1.2 Human Exposure Parameters

For every exposure pathway of potential concern, it is expected that there will be differences between different individuals in the level of exposure at a specific location due to differences in intake rates, body weights, exposure frequencies, and exposure duration. Thus, there is normally a wide range of average daily intakes between different members of an exposed population. Because of this, all daily intake calculations must specify what part of the range of doses is being estimated. Typically, attention is focused on intakes that are "average" or are otherwise near the central portion of the range, and on intakes that are near the upper end of the range (e.g., the 95^{th} percentile). These two exposure estimates are referred to as Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME), respectively.

The Blackjack Mine and Bluebird Mines are abandoned mine sites located on public lands administered by the USFS Umatilla and Wallowa-Whitman National Forests. Land use in the area is limited to timber harvesting, firewood cutting and recreation (hiking, camping, hunting, etc.). Since recreational visitors are expected to spend the most time at the site, their exposures and risks will be quantified in this risk assessment. Recreational visitors may consist of both adults and young children. Table 6 lists the CTE and RME exposure parameters used in this assessment for the recreational visitor populations. The exposure assumptions for the recreational visitor are based on EPA's Standard Default Exposure Assumptions except for the exposure frequencies which are based on BLM's recommended screening exposure assumption of 14 days/year for recreational visitors Most BLM lands have no formal use or access restrictions, so this is a broad category that can cover a range of possible activities, including camping, hiking, hunting, biking, ATV riding, horseback riding, etc.

4.1.3 Exposure Areas

An exposure area (also referred to as an exposure unit) is the geographical area where a receptor may be exposed to one or more environmental media over a specified period of time. In general, receptors are assumed to move about at random within an exposure area and contact each portion of the exposure area equally.

The Blackjack Mine site is on the west side of Clear Creek and is located approximately 1 mile upstream of the Bluebird Mind Site. It covers approximately 2 acres and contains an upper and lower adit. The Bluebird Mine is on the east side of Clear Creek and encompasses about 2 acres of moderate to steep hillsides. It includes one adit located approximately 50 vertical feet above the elevation of nearby Clear Creek. Because of the small spatial area of these sites and the geographical distance between the two mine sites, each mine site is considered to be an exposure area for human receptor populations. That is, the Blackjack Mine site would be one exposure area (or decision unit) for human health, and the Bluebird Mine site would be a second exposure area (or decision unit) for human health. Exposures and risks will be calculated separately for each mine site.

4.1.4 Exposure Point Concentrations

Based on the assumption of random exposure over an exposure area, risk from a chemical within an exposure area is related to the arithmetic mean concentration of that chemical averaged over the entire exposure area. Since the true arithmetic mean concentration cannot be calculated with certainty from a limited number of measurements, the EPA recommends that the 95% upper confidence limit (95UCL) of the arithmetic mean at each exposure point be used as the exposure point concentration (EPC) when calculating exposure and risk at that location (USEPA 1992). However, the Oregon DEQ Human Health Risk Assessment Guidance (ODEQ 2010) specifies that the EPC term for the RME individual will be represented by the 90 percent upper confidence limit (90UCL) on the arithmetic mean. The mathematical approach that is most appropriate for computing the 90UCL of a data set depends on a number of factors, including the number of data points available, the shape of the distribution of the values, and the degree of censoring (USEPA 2002b). Because of the complexity of this process, the EPA Technical Support Center has developed a software application called ProUCL v 5.1.00 (EPA 2016) to assist in the estimation of the EPC values. ProUCL calculates EPC and upper confidence limits for a data set using several different strategies. The program typically recommends a preferred 95UCL based on the properties of the data set. However, a 90% Chebyshev UCL is calculated for data which is lognormal in distribution or nonparametric distribution free data if the data set is adequate. Typically, a minimum of 5 samples and 2 distinct detected values is required to calculate EPCs or upper confidence limits in ProUCL. If the minimum data requirements for ProUCL are not met, the EPC is set equal to the maximum detected value. For the CTE individual, the ODEQ guidance recommends that the arithmetic mean be used to represent the EPC.

In the 2019 EE/CA (USFS 2019), 7 waste rock samples were collected from the Bluebird Mine Site and 4 waste rock samples were collected from the Blackjack Mine Site. The COPC selection process used these waste rock samples to determine which COPCs should be carried forward in a baseline risk assessment for further evaluation. In the summer of 2020, Applied Intellect collected 5 additional soil samples from the Bluebird Site and 5 additional soil samples from the Blackjack site to resolve issues pertaining to data gaps. Each Site was divided into 5 sampling unit areas and 10-20 composite samples were collected in a grid pattern from each of the sampling unit areas. The soil samples were sieved to less than 250 microns and analyzed by ICP-AES (Method 6010) for Target Analyte List Metals. Because the 2019 samples were grab samples collected from waste rock and the 2020 samples were composite soil samples (which are more representative of human exposures) the two data sets will be evaluated separately. Separate EPCs, exposure and risk will be calculated for the waste rock samples and for the composite soil samples in this risk assessment.

The EPCs for each of the COPCs in each exposure area or DU are presented in Table 7.

4.1.5 Relative Bioavailability of Metals in Soil

An accurate assessment of human exposure to ingested chemicals requires knowledge of the amount of chemical absorbed from the gastrointestinal tract into the body from site media compared to the amount of absorption that occurred in the toxicity studies used to derive the toxicity factors. The ratio (amount absorbed from site media compared to the amount absorbed in toxicity tests) is referred to as relative bioavailability (RBA).

In general, metals in soil or sediment exist in the form of mineral particles that are not rapidly solubilized in gastrointestinal fluids when ingested, while toxicity studies often utilize readily soluble forms of the test chemical. Thus, oral RBA values for metals in soil or sediment may be less than 1.0.

The most reliable method for obtaining site-specific estimates of RBA in soil is to measure the gastrointestinal absorption in animals dosed with site soils compared to that for a fully soluble form of the metal. However, such tests are generally relatively costly and take considerable time to perform, and no such animal data are available for any soil samples for this site. In the absence of site-specific bioavailability data, the EPA recommends a default bioavailability of 60% for arsenic in soil (USEPA 2012). For all of the other COPCs a bioavailability of 100% will be used in this assessment.

4.2 Toxicity Assessment

4.2.1 Overview

The basic objective of a toxicity assessment is to identify what adverse health effects a chemical causes, and how the appearance of these adverse effects depends on exposure level. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure (subchronic, chronic, or lifetime). Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical may cause, and how the occurrence of these effects depends upon dose, route, and duration of exposure.

The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the non-cancer effects of the chemical, while the second addresses the cancer effects of the chemical. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and non-cancer effects.

Non-Cancer Effects

Essentially all chemicals can cause adverse health effects if given at a high enough dose. However, when the dose is sufficiently low, typically no adverse effect is observed. Thus, in characterizing the non-cancer effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be safe, while doses above the threshold are likely to cause an effect.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect, and the lowest dose which does produce an effect. These are referred to as the "No-observed-adverse-effect-level" (NOAEL) and the "Lowest-observed-adverse-effect-level" (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, in order to be conservative (health protective), non-cancer risk evaluations are not based directly on the threshold exposure level, but on a value referred to as the Reference Dose (RfD) for oral exposures or Reference Concentration (RfC) for inhalation exposures. The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The RfD and RfC values are derived from a NOAEL (or a LOAEL if a reliable NOAEL is not available) by dividing by an "uncertainty factor". If the data are from studies in humans, and if the observations are considered

to be very reliable, the uncertainty factor may be as small as 1.0. However, the uncertainty factor is normally at least 10, and can be much higher if the data are limited. The effect of dividing the NOAEL or the LOAEL by an uncertainty factor is to ensure that the RfD or RfC is not higher than the threshold level for adverse effects. Thus, there is always a "margin of safety" built into an RfD and RfC values, and doses equal to or less than the RfD or RfC are nearly certain to be without any risk of adverse effect. Doses higher than the RfD or RfC may carry some risk, but because of the margin of safety, a dose above the RfD or RfC does not mean that an effect will necessarily occur.

Cancer Effects

For cancer effects, the toxicity assessment process has two components. The first is a qualitative evaluation of the weight of evidence (WOE) that the chemical does or does not cause cancer in humans. Previously, this evaluation was performed by the EPA using the system summarized below:

WOE	Meaning	Description
A	Known human carcinogen	Sufficient evidence of cancer in humans.
B1	Probable human carcinogen	Suggestive evidence of cancer incidence in humans.
B2	Probable human carcinogen	Sufficient evidence of cancer in animals, but lack of data or insufficient data in humans.
C	Possible human carcinogen	Suggestive evidence of carcinogenicity in animals
D	Cannot be evaluated	No evidence or inadequate evidence of cancer in animals or humans
E	Not carcinogenic to humans	Strong evidence that it does not cause cancer in humans

More recently, EPA has developed a revised classification system for characterizing the weight of evidence for carcinogens (USEPA 2005). However, this system has not yet been implemented for a number of chemicals, so the older classification scheme is retained for use in this assessment.

For chemicals which are classified in Group A, B1, B2, or C, the second part of the toxicity assessment is to describe the carcinogenic potency of the chemical. This is done by quantifying how the number of cancers observed in exposed animals or humans increases as the dose increases. Typically, it is assumed that the dose response curve for cancer has no threshold, arising from the origin and increasing linearly until high doses are reached. Thus, the most convenient descriptor of cancer potency is the slope of the dose-response curve at low doses (where the slope is still linear). This is referred to as the Slope Factor (SF), which has dimensions of risk of cancer per unit dose.

Estimating the cancer SF is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses, frequently in the part of the dose-response curve that is no longer linear. Thus, it is necessary to use mathematical models to extrapolate from the observed high dose data to the desired (but un-measurable) slope at low dose. In order to account for the uncertainty in this extrapolation process, EPA typically chooses to employ the upper 95th upper confidence limit of the slope as the SF. That is, there is a 95 percent probability that the true cancer potency is lower than the value chosen for the SF. This approach ensures that there is a margin of safety in cancer as well as non-cancer risk estimates.

For inhalation exposures, cancer risk is characterized by an inhalation Unit Risk (UR) value. This value represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 ug/m^3 in air.

4.2.2 Toxicity Values

Health criteria used in this risk assessment are obtained from a variety of toxicological sources according to a hierarchy established in the Office of Environmental Health Hazard Assessment Directive 9285.7-53 (USEPA 2003c). The toxicity value hierarchy is as follows:

- Tier 1 – EPA's Integrated Risk Information System (IRIS) Database (USEPA 2019b).
- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs): The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program (EPA 2019c).
- Tier 3 – Other Toxicity Values: Tier 3 includes EPA and non-EPA sources of toxicity information, such as the California Environmental Protection Agency (Cal/EPA) and the Agency for Toxic Substances and Disease Registry (ATSDR). Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer-reviewed.

Table 8 summarizes the chronic RfD and RfCs used to estimate the noncancer effects and the cancer slope factors and Inhalation Unit Risks used to estimate cancer risks. Points to note regarding the data in this table are noted below:

- The RfD for manganese in soil and water (4.7E-02 mg/kg-day) is based on the oral RfD of 1.4E-01 mg/kg-day in the diet. In accord with recommendations in IRIS, for applications to exposures to soil and water, the RfD was adjusted by dividing by a modifying factor of 3.

4.3 Risk Characterization Approach

Non-Cancer Effects

The potential for non-cancer effects is evaluated by comparing the estimated exposure concentration for a receptor over a specified time period to a reference threshold that represents the exposure below which it is unlikely for even sensitive populations to experience adverse health effects (USEPA 1989). This ratio of exposure to toxicity is called a Hazard Quotient (HQ). When a receptor is exposed to a COPC by more than one route, or is exposed to more than one COPC, these values may be summed to yield a hazard Index (HI). If the HQ or HI value is equal to or less than one, it is believed that there is no appreciable risk that non-cancer health effects will occur. If an HQ or HI exceeds one, there is some possibility that non-cancer effects may occur, although an HQ or HI above one does not indicate an effect will definitely occur. This is because of the margin of safety inherent in the derivation of all toxicity values (see Section 4.2.1). However, the larger the HQ or HI value, the more likely it is that an adverse effect may occur. The ODEQ Human Health Risk Assessment Guidance (ODEQ 2010) recommends an acceptable non-cancer HQ and HI of 1.0.

Ingestion Exposures: For most chemicals, the potential for non-cancer effects is evaluated by comparing the estimated daily intake of the chemical over a specific time period with the RfD for that chemical derived for a similar exposure period, as follows (USEPA 1989):

$$HQ = DI / RfD$$

where:

DI = Daily Intake (mg/kg-day)
RfD = Reference Dose (mg/kg-day)

Inhalation Exposures: For inhalation exposures, the potential for non-cancer effects is evaluated by comparing the time-weighted exposure concentration (EC) over a specific time period to the appropriate inhalation reference concentration (RfC) for that chemical, as follows (USEPA 2009a):

$$HQ = EC / (RfC * 1000 ug/m^3)$$

Where:

EC = Exposure Concentration (ug/m^3)
RfC = Reference Concentration (mg/m^3)

Dermal Exposures: For dermal exposures, the potential for non-cancer effects is evaluated by comparing the time-weighted Dermal Absorbed Dose (DAD) to the appropriate Reference Dose adjusted for the fraction of contaminant absorbed in the GI tract (RfD_{ABS}) (USEPA 2004).

$$HQ = DAD/RfD_{ABS}$$

If an individual is exposed to more than one chemical, a screening-level estimate of the total non-cancer risk is derived simply by summing the HQ values for that individual. This total is referred to as the Hazard Index (HI). If the HI value is less than one, non-cancer risks are not expected from any chemical, alone or in combination with others.

Cancer Effects

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. Excess cancer risks are summed across all carcinogenic chemicals and all exposure pathways that contribute to exposure of an individual in a given population. The level of total cancer risk that is of concern is a matter of personal, community, and regulatory judgment. In general, the EPA considers excess cancer risks that are below 1E-06 to be so small as to be negligible, and risks above 1E-04 to be sufficiently large that some sort of remediation is desirable[1]. Excess cancer risks that range between 1E-04 and 1E-06 are generally considered to be acceptable (EPA 1991b), although this is evaluated on a case by case basis, and the stakeholders may determine that risks lower than 1E-04 are not sufficiently protective and warrant remedial action. The ODEQ Human Health Risk Assessment Guidance (ODEQ 2010) recommends that individual cancer risks below 1E-6 and cumulative cancer risks below 1E-05 are acceptable. Cancer risks for each chemical are calculated as described below.

Ingestion Exposures: The excess risk of cancer from ingestion exposure to a chemical is calculated as follows (USEPA 1989):

$$\text{Excess Cancer Risk} = DI_L \cdot SF$$

where:

DI_L = Daily Intake, averaged over a lifetime (mg/kg-day)
SF = Slope Factor $(mg/kg\text{-}day)^{-1}$

Inhalation Exposures: The excess risk of cancer from inhalation exposure is calculated based on inhalation unit risk (IUR) values, as follows (USEPA 2009a):

$$\text{Excess Cancer Risk} = EC \cdot IUR$$

where:

EC = Exposure Concentration (ug/m^3)
IUR = Inhalation Unit Risk $(ug/m^3)^{-1}$

Dermal Exposures: The excess risk of cancer from dermal exposure is calculated based on oral slope factors which have been adjusted to account for the fraction of contaminant absorbed in the GI tract (SF_{ABS}) as follows (USEPA 2004):

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[1]Note that excess cancer risk can be expressed in several formats. A cancer risk expressed in a scientific notation format as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. Similarly, a cancer risk of 1E-04 is equivalent to 1 in 10,000or 10^{-4}. For the purposes of this document, all cancer risks are presented in a scientific notation format (*i.e.*, 1E-06).

Excess Cancer Risk = DAD * SF_{ABS}
SF_{ABS} = SF/ABS_{GI}

where:

DAD = Dermal Absorbed Dose (mg/kg-day)
SF = Oral Cancer Slope Factor
ABS_{GI} = Fraction of contaminant absorbed in the GI tract (unitless)

4.4 RESULTS

A summary of the risk calculations is presented in Tables 9 and 10.

Recreational Visitor – Soil Data Set

Non-cancer risks for the recreational visitor from the ingestion of soil and inhalation of soil particulates were well below an HI of 1.0 for both the RME and CTE exposure scenarios for both the Bluebird and Blackjack Mine sites. The RME HI for the Bluebird Mine site was 1.8E-02. The CTE non-cancer HI was 2.6E-03. The non-cancer RME and CTE HI's for the Blackjack Mine site were 2.1E-02 and 4.8E-03, respectively. Per the ODEQ Human Health Risk Assessment Guidance (ODEQ 2010) the acceptable non-cancer HI for cumulative exposure is ≤ 1.0. If the HI value is less than one, non-cancer risks are not expected from any chemical, alone or in combination with others.

The RME and CTE cancer risks for all exposure pathways and COPCs at the Bluebird and Blackjack Mine sites were below or within EPA's acceptable risk range of 1E-06 to 1E-04. The cumulative cancer risks were also below ODEQ's acceptable risk management criteria of 1E-05. The RME cancer risk for the Bluebird site was 3E-06. The CTE cancer risk was 2E-07. Arsenic was the COPC driving the cancer risk. To put this result in perspective, the RME cancer risk associated with the background threshold value for arsenic (32.5 ppm) was 2E-06. The cumulative RME cancer risks for the Blackjack site was 2E-11. The CTE cancer risk was 4E-12 for the Blackjack Mine site.

Recreational Visitor – Waste Rock Data Set

Non-cancer risks to the recreational visitor from the ingestion of waste rock and inhalation of particulates for all COPCs were also well below an HI of 1 for both the RME and CTE exposure scenarios for both the Bluebird and Blackjack Mine sites. The RME HI for the Bluebird Mine site was 3.2E-02. The CTE non-cancer HI was 4.2E-03. The non-cancer RME and CTE HI's for the Blackjack Mine site were 8.1E-02 and 7.4E-03, respectively. Per the ODEQ Human Health Risk Assessment Guidance (ODEQ 2010) the acceptable non-cancer HI for cumulative exposure is ≤ 1.0. If the HI value is less than one, non-cancer risks are not expected from any chemical, alone or in combination with others.

The RME and CTE cancer risks for all exposure pathways and COPCs at the Bluebird and Blackjack Mine sites were within or well below EPA's acceptable risk range of 1E-06 to 1E-04. The cumulative cancer risks were also below ODEQ's acceptable risk management criteria of 1E-05. The RME cancer risk for the Bluebird site was 5E-06. The CTE cancer risk was 3E-07. Arsenic was the COPC driving the cancer risk. The cumulative RME cancer risks for the Blackjack site was 7E-11. The CTE cancer risk was 2E-11 for the Blackjack Mine site.

As noted earlier, the composite soil samples are more representative of what recreational visitors to the site would actually be exposed to. The soil samples were sieved to <250 microns which represents the soil fraction which readily adheres to people's hands and is available to be incidentally ingested. The waste rock samples are larger size samples which are not as easily ingested. The composite samples were collected over the entire sampling unit in a grid pattern which are more representative of the average area a visitor is expected to come into contact with over a chronic period of exposure. The waste rock samples were grab samples, which do not reflect human

behavior over a long period of time as well. Both of the results are presented here for completeness. It should be noted that the results are not that dissimilar.

4.5 UNCERTAINTIES IN THE RISK ASSESSMENT

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with contaminated media, and the true dose-response curves for non-cancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment. The following sections review the main sources of uncertainty in the risk calculations performed at the Site.

Uncertainties from Exposure Pathways Not Evaluated

As discussed above, humans may be exposed to site-related chemicals by a number of pathways, but not all of these pathways were evaluated quantitatively in this risk assessment. In most cases, this is because the contribution of the pathway omitted is believed to be minor compared to one or more other pathways that were evaluated. For example, dermal exposure to metals in soil was not quantified. Omission of these minor pathways will result in a small underestimation of exposure and risk, but the magnitude of this underestimation is not expected to be significant.

Uncertainties from Chemicals Not Evaluated

As discussed above, quantitative risk estimates are derived only for COPCs. Chemicals that were measured in site samples but excluded as COPC may contribute a small amount of added risk, but the contribution is expected to be so small that this is not a source of significant uncertainty.

Uncertainties in Exposure Point Concentrations

In all exposure calculations, the desired input parameter is the true mean concentration of a contaminant within a medium, averaged over the area where random exposure occurs. However, because the true mean cannot be calculated based on a limited set of measurements, the EPA (1989, 1992) recommends that the exposure estimate be based on the 95UCL. ODEQ recommends the use of a 90UCL. When data are plentiful and inter-sample variability is not large, the UCL may be only slightly higher than the mean of the data. However, when data are sparse or are highly variable, the 90 or 95UCL may be substantially greater than the mean of the available data.

Uncertainties in Human Exposure Parameters

Accurate calculation of risk values requires accurate estimates of the level of human exposure that is occurring. However, many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. Likewise, data are absent on the amount of actual amount of soil ingested by recreational visitors

and the values used in the calculations are based mainly on professional judgment. In general, when exposure data were limited or absent, the exposure parameters were chosen in a way that was intended to be conservative. Because of this, the values selected are thought to be more likely to overestimate than underestimate actual exposure and risk.

Uncertainties in Chemical Absorption (RBA)

The risk from an ingested chemical depends on how much of the ingested chemical is absorbed from the gastrointestinal tract into the body. This issue is especially important for metals in soil because some of the metals

may exist in poorly absorbable forms, and failure to account for this may result in a substantial overestimation of exposure and risk. In the absence of data, the default approach is to assume that the RBA is 100% for most metals. Use of this default assumption is likely to overestimate the true risk with the magnitude of the error depending on the true RBA value.

Uncertainties in Toxicity Values

Toxicity information for many chemicals is often limited. Consequently, there are varying degrees of uncertainty associated with toxicity values (i.e., oral SF, RfD, RfC, inhalation UR). For example, uncertainties can arise from the following sources:

- Extrapolation from animal studies to humans
- Extrapolation from high dose to low dose
- Extrapolation from continuous exposure to intermittent exposure
- Limited or inconsistent toxicity studies

In general, uncertainty in toxicity factors is one of the largest sources of uncertainty in risk estimates at a site. Because of the conservative methods EPA uses in dealing with the uncertainties, it is much more likely that the uncertainty will result in an overestimation rather than an underestimation of risk.

Uncertainties in Risk Estimates

Because risk estimates for a chemical are derived by combining uncertain estimates of exposure and toxicity (see above), the risk estimates for each chemical are more uncertain than either the exposure estimate, or the toxicity estimate alone. Additional uncertainty arises from the issue of how to combine risk estimates across different chemicals. In some cases, the effects caused by one chemical do not influence the effects caused by other chemicals. In other cases, the effects of one chemical may interact with effects of other chemicals, causing responses that are approximately additive, greater than additive (synergistic), or less than additive (antagonistic). In most cases, available toxicity data are not sufficient to define what type of interaction is expected, so EPA generally assumes effects are additive for non-carcinogens that act on the same target tissue and for carcinogens (all target tissues). Because documented cases of synergistic interactions between chemicals are relatively uncommon, this approach is likely to be reasonable for most chemicals.

For non-carcinogens, summing HQ values across different chemicals is properly applied only to compounds that induce the same effect by the same mechanism of action. Consequently, summation of HQ values for compounds that are not expected to include the same type of effects or that do not act by the same mechanisms could overestimate the potential for effects. Thus, all of the HI values in this report, which sum HQ values across multiple metals, are likely to overestimate the true level of human health non-cancer hazard.

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Table 1. Initial COPC Screening for Waste Rock/Soil at Blackjack Mine

Contaminant (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	RSL (nc)	RSL (ca)	Max/RSL (nc)	Max/RSL (ca)	Max/RSL>1 (nc, ca)	Max/RSL >0.1(nc)	BTV	Max>BTV	Essential Element?	COPC
Aluminum	1720	7700	1.10E+06	--	7.00E-03	--	No	No	--	--	--	No
Antimony	1.3	23.6	4.70E+02	--	5.02E-02	--	No	No	--	--	--	No
Arsenic	0.49	23.6	4.80E+02	3	4.92E-02	7.87E+00	Yes	No	32.5	No	--	No
Barium	80.3	223	2.20E+05	--	1.01E-03	--	No	No	--	--	--	No
Cadmium	0.15	5.89	9.80E+02	9.30E+03	6.01E-03	6.33E-04	No	No	--	--	--	No
Calcium	12.5	1340			--	--	No	--	--	--	Yes	--
Chromium(1)	4.6	29.8	3.50E+03	6.30E+00	8.51E-03	4.73E+00	Yes	No	53.9	No	--	No
cobalt	0.25	108	3.50E+02	1.90E+03	3.09E-01	5.68E-02	No	Yes	37.5	Yes	--	Yes*
Copper	6.8	124	4.70E+04	--	2.64E-03	--	No	No	--	--	--	No
Iron	2520	92900	8.20E+05	--	1.13E-01	--	No	Yes	198,000	No	--	No
Lead	5.81	26.7	800	--	3.34E-02	--	No	No	--	--	--	No
Magnesium	82.4	4230		---	--	--	--	--	--	--	Yes	--
Manganese	4.3	12600	2.60E+04	--	4.85E-01	--	No	Yes	4700	Yes	--	Yes*
Mercury	0.05	0.5	3.50E+02	--	1.43E-03	--	No	No	--	--	--	No
Nickel	5.6	286	2.20E+04	6.60E+04	1.30E-02	4.33E-03	No	No	--	--	--	No
Selenium	1.1	7.4	5.80E+03	--	1.28E-03	--	No	No	--	--	--	No
Silver	1	11.8	5.80E+03	--	2.03E-03	--	No	No	--	--	--	No
Thorium	2.2	4.7	--	--	--	--	--	--	--	--	--	--
Tin	1.1	58.9	7.00E+05	--	8.41E-05	--	No	No	--	--	--	No
Vanadium	10	50.5	5.80E+03	--	8.71E-03	--	No	No	--	--	--	No
Zinc	8.1	491	3.50E+05	--	1.40E-03	--	No	No	--	--	--	No
				Sum of HQs	1.09E+00							

(1) Conservatively assumes that all chromium present is Cr VI
BTV – Background Threshold Value
ca – Carcinogenic risk
mg/kg – milligrams per kilogram
nc – Noncarcinogenic risk
ND – The contaminant was not detected in any sample
RSL – USEPA Industrial Regional Screening Level (USEPA 2019)
Shading indicates the maximum concentration exceeds the RSL or 0.1*RSL. The comparison to 0.1* the RSL is done for non-carcinogens only.
* Manganese and cobalt are COPCs because the sum of Max/RSL > 1 and the individual Max/RSL (nc) > 0.1

Table 2. Initial COPC Screening for Waste Rock/Soil at Bluebird Mine

Contaminant (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	RSL (nc)	RSL (ca)	Max/RSLnc	Max/RSLca	Max/RSL>1 (nc, ca)	Max/RSL >0.1(nc)	BTV	Max>BTV	Essential element?	COPC
Aluminum	1700	12600	1.10E+06	--	1.15E-02	--	No	No	--	--	--	No
Antimony	2	22.1	4.70E+02	--	4.70E-02	--	No	No	--	--	--	No
Arsenic	17.7	128	4.80E+02	3	2.67E-01	4.27E+01	Yes	Yes	3.25E+01	Yes	--	Yes
Barium	15.6	113	2.20E+05	--	5.14E-04	--	No	No	--	--	--	No
Cadmium	0.08	1.4	9.80E+02	9.30E+03	1.43E-03	1.51E-04	No	No	--	--	--	No
Calcium	15.2	1580	--	--	--	--	--	--	--	--	Yes	No
Chromium (1)	4.1	29.5	3.50E+03	6.30E+00	8.43E-03	4.68E+00	Yes	No	5.30E+01	No	--	No
Cobalt	1.5	15.8	3.50E+02	1.90E+03	4.51E-02	8.32E-03	No	No	--	--	--	No
Copper	20.3	159	4.70E+04	--	3.38E-03	--	No	No	--	--	--	No
Iron	16600	3.81E+05	8.20E+05	--	4.65E-01	--	No	Yes	5.59E+04	Yes	--	No*
Lead	7.7	15.8	800	--	1.98E-02	--	No	No	--	--	--	No
Magnesium	114	3040	--	---	--	--	--	--	--	--	Yes	No
Manganese	41.4	321	2.60E+04	--	1.23E-02	--	No	No	--	--	--	No
Mercury	0.08	0.7	3.50E+02	--	2.00E-03	--	No	No	--	--	--	No
Nickel	6.6	30.4	2.20E+04	6.60E+04	1.38E-03	4.61E-04	No	No	--	--	--	No
Selenium	0.9	10.6	5.80E+03	--	1.83E-03	--	No	No	--	--	--	No
Silver	0.4	15.8	5.80E+03	--	2.72E-03	--	No	No	--	--	--	No
Thorium	0.8	5.1	--	--	--	--	--	--	--	--	--	No
Tin	0.98	78.8	7.00E+05	--	1.13E-04	--	No	No	--	--	--	No
Vanadium	13.4	44.2	5.80E+03	--	7.62E-03	--	No	No	--	--	--	No
Zinc	20.5	186	3.50E+05	--	5.31E-04	--	No	No	--	--	--	No
				Sum of HQs	8.97E-01							

(1) Conservatively assumes that all chromium present is Cr VI
BTV – Background Threshold Value
ca – Carcinogenic risk
mg/kg – milligrams per kilogram
nc – Noncarcinogenic risk
ND – The contaminant was not detected in any sample
RSL – USEPA Industrial Regional Screening Level (USEPA 2019)
Shading indicates the maximum concentration exceeds the RSL or 0.1*RSL. The comparison to 0.1* the RSL is done for non-carcinogens only.
* Iron is not a COPC because the sum of HQs noncancer is <1.

Table 3. Initial COPC Screening for Surface water at Clear Creek

Contaminant (mg/kg)	Minimum (mg/L)	Maximum (mg/L)	RSL (nc) (mg/L)	RSL (ca) (mg/L)	Max/RSLnc	Max/RSLca	Max/RSL>1 (nc, ca)	Max/RSL >0.1(nc)	Essential Element	BTV (mg/L)	Max>BTV	COPC
Aluminum	140	140.00	2.00E+04	--	7.00E-03	--	--	--	--	--	--	No
Antimony	0.68	0.68	7.8	--	8.72E-02	--	--	--	--	--	--	No
Arsenic	1.5	2.4	6	5.20E-02	4.00E-01	4.62E+01	Yes	Yes	No	16.8	No	No
Barium	8	14	3.80E+03	--	3.68E-03	--	--	--	--	--	--	No
Beryllium	ND	ND	2.50E+01	--	--	--	--	--	--	--	--	No
Cadmium	ND	ND	9.2	--	--	--	--	--	--	--	--	No
Chromium (1)	0.9	1	4.40E+01	3.50E-02	2.27E-02	2.86E+01	Yes	No	No	6.5	No	No
Cobalt	0.2	0.3	6	--	5.00E-02	--	--	--	--	--	--	No
Copper	ND	ND	8.00E+02	--	--	--	--	--	--	--	--	No
Iron	ND	ND	1.40E+04	--	--	--	--	--	--	--	--	No
Lead	ND	ND	15	--	--	--	--	--	--	--	--	No
Magnesium	4300	9200	--	--	--	--	--		Yes	--	--	No
Manganese	7	130	4.30E+02	--	3.02E-01	--	--	Yes	No	130	No	No
Mercury	ND	ND	5.7	--	0.00E+00	--	--	--	--	--	--	No
Nickel	0.7	4	3.90E+02	--	1.03E-02	--	--	--	--	--	--	No
Selenium	ND	ND	1.00E+02	--	--	--	--	--	--	--	--	No
Silver	ND	ND	9.40E+01	--	--	--	--	--	--	--	--	No
Thallium	ND	ND	2.00E-01	--	--	--	--	--	--	--	--	No
Vanadium	ND	ND	8.60E+01	--	--	--	--	--	--	--	--	No
Zinc	ND	ND	6.00E+03	--	--	--	--	--	--	--	--	No
				Sum of HQs	8.83E-01							

(1) Conservatively assumes that all chromium present is Cr VI
BTV – Background Threshold Value
ca – Carcinogenic risk
nc – Noncarcinogenic risk
mg/L – Milligrams per liter
ND – The contaminant was not detected in any sample
RSL – USEPA Industrial Regional Screening Level (USEPA 2019)
Shading indicates the maximum concentration exceeds the RSL or 0.1*RSL. The comparison to 0.1* the RSL is done for non-carcinogens only.

Table 4. Initial COPC Screening for Sediment at Clear Creek

Contaminant (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	RSL (nc)	RSL (ca)	Max/RSLnc	Max/RSLca	Max/RSL>1 (nc, ca)	Max/RSL >0.1(nc)	90% UCLM (mg/kg)	Essential Element?	BTV (mg/kg)	90% UCLM >BTV	COPC?
Aluminum	5330	17000	1.10E+06	--	1.55E-02	--	--	No	--	--	--	--	No
Antimony	0.6	3.1	4.70E+02	--	6.60E-03	--	--	No	--	--	--	--	No
Arsenic	8.3	42	4.80E+02	3	8.75E-02	1.40E+01	Yes	No	32.70	No	35.7	No	No
Barium	47	150	2.20E+05	--	6.82E-04	--	--	No	--	--	--	--	No
Beryllium	0.23	0.82	2.30E+03		0.00035652	--	--	No	--	--	--	--	No
Cadmium	0.22	1.2	9.80E+02	9.30E+03	1.22E-03	1.29E-04	No	No			--	--	No
Chromium (1)	35.9	212	3.50E+03	6.30E+00	6.06E-02	--	--	--	--	No	189	No	No
Cobalt	14	36.8	3.50E+02	1.90E+03	1.05E-01	1.94E-02	No	Yes	2.55E+01	--	33.6	No	No
Copper	24	58.2	4.70E+04	--	1.24E-03	--	--	No	--	--	--	--	No
Iron	18100	34000	8.20E+05	--	4.15E-02	--	--	No	--	--	--	--	No
Lead	2.4	13	800	--	1.63E-02	--	--	No	--	--	--	--	No
Manganese	6300	2300	2.60E+04	--	8.85E-02	--	--	--	--	--	--	--	No
Mercury	0.02	0.14	3.50E+02	--	1.12E-02	--	--	No	--	--	--	--	No
Nickel	80.4	246	2.20E+04	6.60E+04	1.12E-02	3.73E-03	No	No	--		--	--	No
Selenium	0.45	2.8	5.80E+03	--	4.83E-04	--	--	--	--	--	--	--	No
Silver	0.1	1.6	5.80E+03	--	2.76E-04	--		No	--	--	--	--	No
Thallium	0.08	1.7	1.20E+01	--	1.42E-01	--	--	--	1.56E+00	No	0.97	Yes	No*
Vanadium	32	61	5.80E+03	--	1.05E-02	--	--	No	--	--	--	--	No
Zinc	42	179	3.50E+05	--	5.11E-04	--	--	No	--	--	5.11E-03	--	No
				Sum (C/RSL)	6.01E-01								

(1) Chromium is conservatively assumed to be in the form of Cr VI
(2) BTV – Background Threshold Value
(3) A comparison to 0.1* the RSL is applied to non-carcinogens only
90% UCLM – 90 percent Upper Confidence Limit of the mean
RSL – Regional Screening level (nc) noncancer (ca) cancer
Shaded cells indicated a maximum concentration greater than the RSL or 0.1*RL
* Thallium is not a COPC because the sum of Max concentration/ RSL was < 1.

Table 5. Secondary COPC Screen Against BLM Recreational Risk Based Screening Levels

Media	Contaminant	EPC[1] (mg/kg)	BLM RBSL (mg/kg)	BLM RBSL/10 (mg/kg)	EPC exceeds RBSL or RBSL/10	COPC
Blackjack Mine Waste Rock/Soils	manganese	12,600	46,700	4,670	Yes	Yes
	cobalt	108	586	58.6	Yes	Yes
Bluebird Mine Waste Rock/Soils	arsenic	128	30.6	N/A	Yes	Yes

[1] A 90% UCLM was calculated as the exposure point concentration term when at least 10 samples were present in accordance with the Oregon DEQ guidance, otherwise the maximum concentration detected was used.

EPC – Exposure Point Concentration

BLM RBSL – US Bureau of Land Management Recreational risk-based screening level (BLM 2017)

mg/kg – milligrams per kilogram

Table 6. Exposure Factors – Reasonable Maximum (RME) and Central Tendency Exposures (CTE)

Parameter	Unit	Symbol	Recreational Visitor Reasonable Maximum Exposure (RME)			Recreational Visitor Central Tendency Exposure (CTE)		
			Value		Source	Value		Source
			Adult	Child		Adult	Child	
General								
Exposure Frequency	days/yr	EF	14(2)	14(2)	BLM 2017	7(2)	7(2)	BLM 2017
Exposure Duration	years	ED	20	6	BLM 2017	9	3	EPA 2011
Averaging Time (carcinogen)	days	AT_C	25550	25550	EPA2014	25550	25550	EPA 2014
Averaging Time (noncarcinogen)	days	AT_{NC}	7300	2190	EPA2014	3285	1095	EPA 2014
Body Weight	kg	BW	80	15	EPA2014	80	15	EPA 2014
Conversion factor	kg/mg	CF	$1x10^{-6}$	$1x10^{-6}$	EPA1991	$1x10^{-6}$	$1x10^{-6}$	EPA 1991
Soil								
Ingestion rate of soil	mg/day	IR-S	100	200	EPA 2014	50	100	EPA 1993
Bioavailability factor	unitless	BAF	0.6(1)	0.6(1)	EPA 2012	0.6(1)	0.6(1)	EPA 2012
Skin surface area	cm^2	SA	6032	2373	EPA 2014	6032	2373	EPA 2014
Adherence factor	mg/cm^2	AF	0.07	0.2	EPA 2014	0.01	0.04	EPA 2004
Dermal Absorption factor	unitless	ABS_d	0.14	0.14	EPA 2004	0.14	0.14	EPA 2004
Exposure Time-inhalation	hr/day	ET	8	8	EPA 2014	4(2)	4(2)	EPA 2014
Particulate Emission Factor	m^3/kg	PEF	$4.63x10^9$	$4.63x10^9$	EPA 1991	$4.63x10^9$	$4.63x10^9$	EPA 1991

Notes:

(1) The bioavailability factor of 0.6 will be used for arsenic in soil only. All other contaminants will be assumed to be 100% bioavailable from soil.

(2) Land use in the area is limited to timber harvesting, firewood cutting and recreation (hiking, camping, hunting, etc.). The BLM recommends an RME default exposure frequency of 14 days/yr for recreational visitors. The CTE value is assumed to be ½ of the RME value.

Sources:

EPA 1991. Risk Assessment Guidance for Superfund, Volume 1-Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) EPA/540/R-92/003.

EPA 2004. Risk Assessment Guidance for Superfund, Volume 1-Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R/99/005

EPA 2012. Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil. OSWER Directive 9200.1-113.

EPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120.

BLM 2017. BLM Technical Memorandum Screening Assessment Approaches for Metals in Soil at BLM HaxMat/AML Sites. **September 2017 Update.**

Table 7. Summary Statistics and Exposure Point Concentration Term Calculations

Arsenic							
Exposure Unit	#Detects	Minimum	Maximum	Average	S.D.	EPC	Basis
Units	count	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Bluebird Mine Soil	5 of 5	15.7	64.4	32.1	19.3	58	90% Chebyshev UCL
Bluebird Mine Waste Rock	7 of 7	17.7	128	52	43,7	102	90% Chebyshev UCL
Cobalt							
Exposure Unit	#Detects	Minimum	Maximum	Average	S.D.	EPC	Basis
Units	count	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Blackjack Mine Soil	5 of 5	27.4	29.9	28.8	1.1	30	90% Chebyshev UCL
Blackjack Mine Waste Rock	4 of 4	0.3	108	39.2	47.4	108	Maximum value
Manganese							
Exposure Unit	#Detects	Minimum	Maximum	Average	S.D.	EPC	Basis
Units	count	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Blackjack Mine Soil	5 of 5	843	3460	1742	1137	3268	90% Chebyshev UCL
Blackjack Mine Waste Rock	4 of 4	4.3	12600	4059	5810	12600	Maximum value

Table 8. Toxicity Factors

Analyte	Oral RfD mg/kg-day	Key	Inhalation RfC mg/m^3	Key	Oral Slope Factor (SF)	Cancer WOE	Key	Inhalation Unit Risk (IUR) $(ug/m^3)^{-1}$	Cancer WOE	Key	Target Organs/Health Effects
Arsenic	3.0E-04	I	1.5E-05	C	1.5	A	I	4.3E-03	A	I	Non-cancer: Cardiovascular, Dermal hyperpigmentation, keratosis, possible vascular complications
											Cancer: (Oral) Bladder, lung,liver, skin (Inhalation) Lung cancer
Cobalt	3E-04	P	6.0E-06	P				9E-03	-	P	Non-cancer: Respiratory, thyroid, decreased iodine uptake, irritation, and decreased lung function
											Cancer: Lung Cancer
Manganese (diet)	1.4E-01	I	5.0E-05	I		D					Non-cancer: Central nervous system effects, Impaired neurobehavioral function
Manganese (non-diet)	2.4 E-02	S	5.0E-05	I		D					Non-cancer: Central nervous system effects, Impaired neurobehavioral function

Key: I = IRIS; P = PPRTV; A = ATSDR; C = CalEPA; S=See user guide section 5 RSL Tables

Table 9. Summary of Estimated Risks for Soil COPCS

Exposure Unit	COPC	Exposed Population	Exposure Route	Non-cancer HQ		Cancer Risk	
				RME	CTE	RME	CTE
Bluebird Mine	Arsenic	Recreational	Ingestion of Soil	1.80E-02	2.60E-03	3.00E-06	2.00E-07
			Inhalation of particulates	4.60E-07	1.30E-07	1.10E-11	1.40E-12
			All	1.80E-02	2.60E-03	3.00E-06	2.00E-07
Blackjack Mine	Cobalt	Recreational	Ingestion of Soil	1.50E-02	3.90E-03		
			Inhalation of Particulates	9.90E-07	4.80E-07	2.00E-11	4.40E-12
			All	1.50E-02	3.90E-03	2.00E-11	4.40E-12
	Manganese	Recreational	Ingestion of Soil	6.40E-03	9.10E-04		
			Inhalation of Particulates	7.80E-06	2.10E-06		
			All	6.41E-03	0.0009121		
			All COPCs Blackjack	0.02140879	4.81E-03	2.00E-11	4.40E-12

Table 10. Summary of Estimated Risks for Waste Rock COPCS

Exposure Unit	COPC	Exposed Population	Exposure Route	Non-cancer HQ		Cancer Risk	
				RME	CTE	RME	CTE
Bluebird Mine	Arsenic	Recreational	Ingestion of Soil	3.20E-02	4.20E-03	5.30E-06	3.30E-07
			Inhalation of particulates	8.10E-07	2.10E-07	1.90E-11	2.30E-12
			All	3.20E-02	4.20E-03	5.30E-06	3.30E-07
Blackjack Mine	Cobalt	Recreational	Ingestion of Soil	5.60E-02	5.30E-03		
			Inhalation of Particulates	3.60E-06	6.40E-07	7.20E-11	1.50E-11
			All	5.60E-02	5.30E-03	7.20E-11	1.50E-11
	Manganese	Recreational	Ingestion of Soil	2.50E-02	2.10E-03		
			Inhalation of Particulates	3.00E-05	4.80E-06		
			All	2.50E-02	2.10E-03		
			All COPCs Blackjack	0.0810336	7.41E-03	7.20E-11	1.50E-11

APPENDIX 8

Streamlined Ecological Risk Assessment

1. INTRODUCTION

This Screening Level Ecological Risk Assessment (SLERA) was performed as part of the 2019 Engineering Evaluation/Cost Analysis (EE/CA) for the Bluebird and Blackjack Mines (the Sites). This assessment builds on and updates the information provided in the streamlined ecological risk assessments that were performed as part of the 2005 EE/CA reports (SAIC, 2005a and b), and on the information provided in the Site Inspection (SI) report (EA Engineering, 2003). The goal of the SLERA is to cohesively summarize the information available for the Sites from the earlier studies, and to evaluate whether exposures to Site-related contaminants in terrestrial and aquatic environments have the potential to result in adverse effects to plant and animal populations (i.e., ecological receptors) at the Sites.

This SLERA was conducted in accordance with:

- U.S. EPA's Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (U.S. EPA, 1993);
- U.S. EPA's Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (U.S. EPA, 1997); and
- Oregon Department of Environmental Quality's (DEQ) Guidance for Ecological Risk Assessment (DEQ, 2001).

According to U.S. EPA's *Guidance on Conducting Non-Time Critical Removal Actions* (U.S. EPA, 1993), a streamlined risk evaluation is intended to be intermediate in scope between a limited risk evaluation undertaken for emergency removal actions and a baseline risk assessment normally conducted for remedial actions. A streamlined risk evaluation can help justify undertaking a removal action and identify what current or potential exposures should be prevented. Therefore, the results of this SLERA can be used to determine whether cleanup actions are necessary to address ecological risk and what exposures need to be addressed by such actions.

U.S. EPA's *Ecological Risk Assessment Guidance for Superfund* (U.S. EPA, 1997) provides an eight-step process, with Step 1 being the Screening Level Problem Formulation and Ecological Effects Evaluation, and Step 2 being the Screening Level Exposure Estimate and Risk Calculation. The Scientific/Management Decision Point at the end of the Step 1 and Step 2 process is to determine if:

- There is adequate information to conclude that ecological risks are negligible and therefore no need for remediation based on ecological risk;
- The information is not adequate to decide at this point, and the ecological risk assessment process will continue to the next step; or
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted.

This SLERA is consistent with EPA's Step 1, the Screening Level Problem Formulation and Ecological Effects Evaluation, and Step 2, the Screening Level Exposure Estimate and Risk Calculation. To be consistent with guidance for ecological risk assessments in Oregon, the SLERA also includes elements of the Scoping (Level I) and Screening (Level II) steps of the Oregon DEQ (2001) guidance.

The SLERA consists of the following sections:

- Screening Level Problem Formulation, which includes the ecological description of the Sites, the habitat characterization, identification of ecological receptors, and the development of the preliminary ecological conceptual site model (CSM);
- Screening Level Ecological Effects Evaluation, which includes the selection of ecological Screening Level Values (SLVs) for surface water, sediment, and soil;
- Screening Level Exposure Estimate and Risk Calculation, which includes exposure estimates for ecological receptors, identification of the contaminants of potential ecological concern (COPECs), the uncertainty analysis, and the screening level risk calculations using a Hazard Quotient (HQ) approach; and
- The SLERA Summary and Scientific/Management Decision Point (SMDP).

2. SCREENING LEVEL PROBLEM FORMULATION

Step 1 of EPA's process is the screening level problem formulation. The problem formulation describes the environmental setting, what is known about contaminants at the Sites and their distribution, the ecological receptors that are likely to be affected, and what exposure pathways exist. Information on the environmental setting of the Bluebird and Blackjack Mine Sites was taken from the 2005 EE/CA reports (SAIC, 2005a and b) and the 2003 SI report (EA Engineering, 2003).

2.1 Environmental Setting

The Bluebird and Blackjack Mines are abandoned mining sites located on public lands administered by the USFS Umatilla and Wallowa-Whitman National Forests. The Sites are located within the Granite Mining District of Grant County, Oregon. The Sites are adjacent to Clear Creek, a tributary to Granite Creek, with the Blackjack Mine located approximately one mile upstream of the Bluebird Mine. Mining is the predominant land use on private lands within the Granite Creek watershed and there are numerous claims within the region surrounding the Sites. Another mine, the Red Boy Mine, is located on private property on the west side of Clear Creek, upstream of the Bluebird Mine. Prior studies have indicated that the Red Boy Mine has impacted water quality in the existing settling ponds as it comingles with mine water discharge from the Bluebird Mine.

The Blackjack Mine is located at an elevation of approximately 4,700-feet on the west side of Clear Creek and covers an area of approximately two acres. Mine features include two adits[1], a former settling pond, and waste rock piles. Water from the upper adit drains through a pipe running approximately 600-feet and underneath Clear Creek that discharges to a narrow roadside borrow ditch on the opposite (east) side of Clear Creek. This ditch serves as the current discharge settling pond. Drainage from the ditch continues downgradient for over 1,000 feet before discharging into Clear Creek. Drainage from the lower adit forms a marshy area directly adjacent to the mine, which then flows into Clear Creek. Waste rock from historic mining practices lies on top of the native soils and the site sits on steep slopes that have the potential for erosion. A spill occurred in July 2003 that deposited 70,000 gallons of Blackjack Mine discharge water into the creek (SAIC, 2005a). A plume of iron discharge was observed covering an area up to one mile downstream from where the spill entered Clear Creek (EA Engineering, 2003). A major concern at the Blackjack Mine is the clogging of the pipeline with iron precipitate, which leads to maintenance problems and possible releases when the pipe becomes clogged. Acid mine drainage is also a concern.

The Bluebird Mine is located at an elevation of approximately 4,600-feet on the east side of Clear Creek. The site covers an area of approximately two acres and has one adit located roughly 50 vertical feet above the elevation of Clear Creek. The adit formerly discharged mine drainage through a channel directly to Clear Creek (EA Engineering, 2003). Today, a pipeline, which goes under Clear Creek and a gravel road, diverts adit water from entering Clear Creek and into a settling pond channel. The site includes remnants of what is believed to be a former mill and a former settling pond. The site has coarse waste rock material scattered over moderately steep slopes (SAIC, 2005b).

Oregon DEQ Ecological Scoping Checklists were completed for the Sites as part of the streamlined ecological risk assessments conducted by SAIC (2005a and b).

2.1.1 Surface Water and Wetlands

The Sites are situated along Clear Creek, which flows into Granite Creek approximately one mile downstream of the Bluebird Mine and two miles below the Blackjack Mine (EA Engineering, 2003). Granite Creek is part of the North Fork John Day River watershed. Portion of the watershed is within the North Fork John Day Wilderness Area. The John Day River is a tributary to the Columbia River. A segment of the North Fork is included in the Oregon Scenic Waterways and National Wild and Scenic River systems. Most water yield in the area results from snowmelt. Clear Creek has slightly to moderately hard water (36 to 75 mg/L $CaCO_3$) with water that is slightly alkaline (pH 7.1 to 8.1), based on data for surface water sampled in 2018. Clear Creek is affected by other mining activity upstream of the Sites.

[1] An adit is the entrance to an underground mine which is horizontal or nearly horizontal, by which the mine can be entered, drained of water, ventilated, and minerals extracted.

Clear Creek contains protected species of anadromous salmonids and a salmon habitat restoration project was undertaken in 1999 in the reach adjacent to the Sites (EA Engineering, 2003). A fish kill of unknown cause was reported in Clear Creek in 2015. Also, in 2015, another fish kill was reported by Oregon Department of Fish and Wildlife (ODFW) in the Middle Fork John Day River due to low flows and high-water temperatures (ODFW, 2015). Therefore, one can surmise that the fish kill in Clear Creek may have been due to similar circumstances; however, the cause of the fish kill was not determined. Surface water and sediment samples collected upstream of the Blackjack and Bluebird mines suggests the creek is influenced from other upgradient mine-related sources (Cascade Earth Sciences [CES], 2013).

The National Wetland Inventory (NWI) Mapper[2] was consulted for information on wetlands within the vicinity of the Sites. The NWI characterizes Clear Creek in the vicinity as a riverine system that is upper perennial, unconsolidated bottom, and permanently flooded (R3UBH). There are several small ponds along Clear Creek in the vicinity of the Sites. These ponds receive mine drainage water and are classified by the NWI as excavated (man-made), palustrine, unconsolidated bottom, and permanently flooded wetlands (PUBHx).

2.1.2 Threatened, Endangered, and Sensitive Species and Environments

The SI report (EA Engineering, 2003) summarized the sensitive environments within 15 miles of the Sites as:

- North Fork John Day Wilderness Area;
- North Fork John Day Wild and Scenic River;
- Migratory pathways and spawning areas critical to the maintenance of protected anadromous fish species;
- Habitat potentially used by Federal-designated threatened species; and
- Wetlands as defined by 40 CFR 230.3.

One of the considerations in a SLERA is, "does the locality of the facility contain, or is it reasonably likely to contain, any individuals of a threatened or endangered species or their critical habitat?" (DEQ, 2001). To help answer this question, the U.S. Fish and Wildlife Service (USFWS) Information, Planning, and Consultation System (IPaC) was accessed to generate a Trust Resources Report for an area that is approximately one square mile around the Sites to identify species that are proposed, candidate, or listed as threatened and endangered and designated critical habitat areas that may be present. The Oregon Natural Heritage Information Center was queried regarding observations of rare, threatened, or endangered species within a two-mile radius as part of the SI[3].

[2] National Wetland Inventory Mapper. Accessed October 8, 2019 at https://www.fws.gov/wetlands/data/Mapper.html

[3] Field surveys for protected species and their habitats were not conducted as part of the current EE/CA, SI, or prior investigations at the Sites.

Clear Creek is considered a sensitive environment that provides migratory and spawning habitat that is critical to the maintenance of anadromous fish species (SAIC, 2005a and b; USFWS, 2019). Critical habitat for bull trout (*Salvelinus confluents*), a federally listed threatened species, is reported for Clear Creek (USFWS, 2019). The westslope cutthroat trout (*O. clarki lewisi*), reported within two miles of the Sites, is designated as a federal species of concern and a state-sensitive species. The interior redband trout (*O. mykiss gairdneri*), a state-sensitive species, also occurs in Clear Creek. The Columbia spotted frog (*Rana luteiventris*), a state-sensitive species, has been observed in a nearby side channel of Clear Creek (EA Engineering, 2003).

The Cassin's finch (*Carpodacus cassinii*), a migratory Bird of Conservation Concern, may occur during the summer breeding season within the vicinity of the mine sites, with the highest likelihood of occurrence in June (USFWS, 2019). No Cassin's finches were observed at the Sites during the SI observations in 2003 (EA Engineering, 2003).

The 2019 IPaC report also indicates there is critical habitat for the federally listed endangered gray wolf (*Canis lupus*) within the region. The gray wolf is listed as endangered in the western 2/3^{rds} of the State of Oregon but has been delisted in the eastern part of the state where the Sites are located (USFWS, 2015[4]).

The following plants are listed as protected in Grant County: South Fork John Day milkvetch (*Astragalus diaphanous*) and arrow-leaf thelypody (*Thelypodium eucosmum*) (Oregon Department of Agriculture (2019a). The threatened milkvetch occurs in habitats on dry, barren slopes in gravelly, shallow soils overlying basalt in openings in juniper woodland at elevations ranging from 2500 to 3600 feet and is restricted to the South Fork of the John Day River within the Blue Mountains ecoregion (Oregon Department of Agriculture, 2019b). Arrow-leaf thelypody, also listed as threatened, occurs in shaded areas under junipers on dry slopes and in dry to moist areas in stream beds and along seeps and streams within juniper-sagebrush plant communities at elevations ranging from 1640 to 5500 feet (Oregon Department of Agriculture, 2019c). While the Sites are located within the Blue Mountains ecoregion, the elevation and vegetative covertypes at the Sites do not support appropriate habitat for these protected plant species.

2.2 Habitat Characterization

It is important to understand the habitat characteristics at the Sites to identify the ecological receptors and exposure pathways that should be evaluated. Those areas of the Sites that do not support habitat (e.g., bare soil/tailings, waste rock, gravel, or otherwise disturbed areas) or that do not have complete exposure pathways to ecological receptors can be eliminated from further assessment (U.S. EPA, 2015). DEQ (2017) defines "acceptable habitat" as habitat that provides distinct food and cover benefits for ecological receptors.

[4] Wolf Management Zones in Oregon. Accessed October 24, 2019 at https://www.fws.gov/oregonfwo/Documents/maps/Wolf_Fed-StateListingZones23Jan2015.pdf. Also, Gray Wolf: https://www.fws.gov/oregonfwo/articles.cfm?id=149489434.

A habitat characterization was undertaken in 2003 as part of the SI (EA Engineering, 2003), the results of which are summarized here. The mines are located within a large valley ranging from 0.25- to one-mile wide and 1,000 feet deep, with very steep slopes in some areas. The two habitat types that were identified at the Sites are the coniferous forest on the hillsides and the Clear Creek riparian zone. The riparian floor is between 200- and 500-feet wide and is very flat in many areas due to past dredge mining practices and stream and riparian restoration efforts. Clear Creek ranges from 15- to 30-feet wide in the vicinity of the Sites and has undergone major stream engineering, including the installation of man-made riffles/runs and pools as part of the stream habitat restoration project.

The hillsides at the Sites contain scattered trees, including many large dead (apparently from bark beetle) ponderosa pine (*Pinus ponderosa*) and larch (*Larix occidentalis*). The hillsides on the drier southern facing slopes are dominated by ponderosa pine and lodgepole pine (*P. contorta*) and other slopes are dominated by Douglas-fir (*Pseudotsuga menziesii*). There is evidence of cattle grazing above Blackjack Mine. An absence of understory shrubs was noted on the hillsides with the primary understory being grasses, whortleberry (*Vaccinium* sp.), and scattered forbs. Wild strawberry (*Fragaria virginiana*), was reported as widespread. Sedges (*Carex* spp.) were observed along the Clear Creek riparian zone, as were cottonwood (*Populus* sp.), willow (*Salix* sp.) and alder (*Alnus incana*), fruiting shrubs were also observed including gooseberry (*Ribes* sp.) and elderberry (*Sambucus* sp.).

The settling ponds on the west side of Clear Creek were observed to have healthy vegetation dominated by cattails (*Typha* sp.), grasses and sedges, with little open water. The side channel located between the Bluebird and Blackjack Mines was observed to have the largest concentration of vegetation in the riparian zone. The settling ponds are man-made features and were not evaluated as aquatic habitat. This is consistent with DEQ guidance (2017), which states "anthropogenic aquatic features require periodic sediment management and do not represent a habitat quality similar to that of natural features, such as drainage/irrigation ditches, treatment ponds/lagoons, and stormwater diversion features."

Thousands of trees and shrubs were planted along Clear Creek as part of the habitat restoration program and a large amount of dredge tailings appeared to have been removed or regraded as part of that project. Open areas away from the creek were restored to grade and re-planted with ponderosa pine.

The habitat characterization also included observations of the following wildlife species or their sign:

- Mule Deer (*Odocoileus hemionus*)
- Pika (*Ochotona princeps*)
- Vole (*Microtus* sp.)
- Garter snake (*Thalanosa* sp.)
- Long-toed salamander (*Ambystoma macrodactylum*)
- Spotted frog (*Rana luteiventris*)
- Chinook salmon (*Oncorhynchus tshawytscha*)
- Redband trout (*O. mykiss*)
- Torrent sculpin (*Cottus rhotheus*)
- Speckled dace (*Rhinichthys osculus*)

- Pauite sculpin (*Cottus beldingi*)
- Crayfish (*Procambrus* sp.)
- Freshwater clam (unknown sp.)
- Great blue heron (Ardea herodias)
- Mallard (*Anas platyrhynchos*)
- Canada goose (*Branta canadensis*)
- Cooper's or sharp-shinned hawk (*Accipiter* sp.)
- Belted kingfisher (*Ceryle halcyon*)
- Spotted sandpiper (*Actitus macularia*)
- Vaux's swift (*Chaetura vauxi*)
- Common nighthawk (Chordeiles minor)
- Various songbirds (see Table 2 in 2003 SI report)

General information about a site, its physical characteristics, ecological habitats and receptors, can be used to identify areas with incomplete or insignificant exposure pathways, thus eliminating the need for further ecological evaluation within these parts of a site (U.S. EPA, 2015). Property "wholly contained within contiguous land characterized by pavement, buildings, landscaped area, functioning cap, roadways, equipment storage area, manufacturing or process area, or other surface cover or structure, or otherwise disturbed ground" meets the exclusion criteria. Areas that are bare soil, waste piles, or waste rock meet these criteria and are also "not attractive to wildlife or livestock, including threatened or endangered species; these areas do not serve as valuable habitat, foraging area, or refuge for ecological communities" (U.S. EPA, 2015). Any exposure experienced by wildlife on these highly disturbed areas would most likely be incidental and brief and would likely occur while animals are passing through to access other areas that provide more suitable habitat for foraging, breeding, or refuge.

2.3 Ecological Conceptual Site Model

A conceptual site model (CSM) is a planning tool used for identifying chemical sources, potentially affected environmental media, complete exposure pathways, and potential receptors on which to focus a risk assessment. The CSM examines the range of potential exposure pathways and identifies those that are present and may be important for ecological receptors and eliminates those pathways that are incomplete or insignificant from further consideration in the ecological risk assessment process. The CSM for ecological receptors (Figure 9) describes the relationships among chemicals potentially released from mine wastes at the Sites and the ecological receptors that may be exposed to them through pathways such as contact with contaminated media or ingestion of contaminated food or water. Specific receptors and exposure pathways at the Sites are discussed in Sections 2.4 and 2.5.

2.4 Potential Ecological Receptors

Ecological receptors that may be exposed to Site-related contaminants in soil, surface water, sediment, or impacted biota (plants and prey) include terrestrial invertebrates, plants, benthic invertebrates, fish, and avian and mammalian wildlife species. To focus on potential population-level effects, the SLERA relied on the evaluation of representative receptor groups as opposed to specific species. The representative receptor groups for this SLERA are terrestrial animals and plants, aquatic animals including fish and benthic invertebrates, and aquatic/wetland plants.

2.5 Exposure Pathways

For a site to present a potential for ecological risk, it must exhibit the following three criteria: 1) contain COPECs in abiotic media at detectable and biologically significant concentrations, 2) provide exposure pathways linking COPECs to ecological receptors, and 3) have these receptors either utilize the site, be present nearby, or be in the locality of COPECs migrating from the site (DEQ, 2001). For an exposure pathway to be complete, a contaminant must be able to travel from the source to ecological receptors and be taken up by the receptors via one or more exposure routes (U.S. EPA 1997). Oregon DEQ (2001) guidance states that only those pathways that are complete and are expected to contribute substantially to exposures by ecologically important receptors should be addressed in an ecological risk assessment. Potential exposure routes that were evaluated include:

- For terrestrial animals: ingestion of contaminated plants and prey, and incidental ingestion of contaminated soil[5].
- For terrestrial plants: uptake by root absorption of contaminants in soils and leaf absorption of contaminants deposited on the leaves.
- For aquatic animals including fish and aquatic invertebrates: direct contact with and uptake of contaminants in water and sediment, and ingestion of contaminated food and incidental ingestion of sediment.
- For aquatic and wetland plants: direct contact with and uptake of contaminants in water and sediments.
- For soil (terrestrial) invertebrates: direct contact with and ingestion of contaminated soil.

The air migration/inhalation pathway (wind erosion and inhalation of fugitive dust) is not a significant exposure pathway for ecological receptors, and the potential risk from this exposure was assessed via the soil pathway.

2.5.1 Surface Water Pathways

According to the 2005 EE/CAs, mine drainage from the Sites discharged directly into Clear Creek prior to the 1980s, affecting water quality and resulting in iron precipitate on the stream substrate. Presently, adit discharge water is piped into side channel settling ponds to reduce the flow entering the creek. Barium was identified as a Chemical of Interest (COI) in Clear Creek surface water in the 2005 streamlined ecological risk assessments. Fish and macroinvertebrate communities of Clear Creek may be exposed to Site-related contaminants from potential failures of the existing discharge pipe or failure of the side sediment pond that receives the mine drainage. Organisms in Clear Creek may also be exposed to potential discharge of contaminated groundwater from the side channel ponds and from adit seeps. Metals from the mine waste areas could be transported to groundwater via leaching and infiltration of dissolved metals, or migration via faults and fractures (SAIC, 2005a and b). Wildlife receptors could potentially be

[5] While inhalation and dermal pathways also exist, these are insignificant compared to the ingestion route for terrestrial receptors; therefore, these pathways are not quantitatively assessed.

exposed to contaminants in water contained within the settling ponds if using the ponds as a source of drinking water. Footprints of deer and raccoon were observed at the settling ponds during the 2019 site visit and sampling (refer to the photo log).

2.5.2 Sediment Pathways

Arsenic, chromium), cobalt, copper, iron, manganese, mercury, and nickel were identified as COIs in Clear Creek sediments in 2005 streamlined ecological risk assessments. Contaminants in sediments may be directly ingested by benthic invertebrates or fish or may become available by partitioning (based on adsorption characteristics and sediment organic carbon levels) into the water column (DEQ, 2001). Water-dependent ecological receptors, including aquatic plants, benthic invertebrates, fish, and piscivorous birds and mammals are the receptors most likely to be exposed to chemicals in sediment and water. Specifically, aquatic/wetland plants and benthic organisms may be exposed to chemicals through direct contact, uptake from sediment or water, incidental ingestion, and food chain pathways. Fish may be exposed to chemicals through direct contact with sediment and water, through incidental ingestion (e.g., during feeding), gill uptake, and through ingestion of contaminated food items.

2.5.3 Soil Pathways

Arsenic, chromium, cobalt, copper, iron, lead, mercury, nickel, selenium, thallium, and vanadium were identified as COIs for soil/waste rock in the 2005 EE/CAs. Abandoned mine sites that consist of tailings, waste piles, and waste rock provide little or no functional habitat for ecological receptors (BLM, 2016). Waste rock lacks the quality and nutrients of natural soils. Consequently, the material does not provide quality habitat for soil organisms or terrestrial vertebrates. While organisms could be exposed temporarily while passing though these areas, such exposure is not expected to be significant. While the Bluebird and Blackjack mine sites are not wholly comprised of areas of disturbed habitat, less highly disturbed and more desirable terrestrial habitat exists outside of the area influenced by the mines. Therefore, exposure by wildlife species is assumed to be limited at the Sites by these habitat constraints. In addition, leach testing of the waste piles conducted as part of the 2005 EE/CAs indicated that contaminant release potential from these sources is negligible, is not of regulatory concern and suggested minimal potential for bioavailability of metals to terrestrial receptors (refer to Section 3.4).

Mechanisms to transport site-related chemicals to soil include runoff during precipitation and/or flash flood events and possibly fugitive dusts transported by wind. While limited, exposure pathways to contaminated soil/waste rock (incidental ingestion, direct contact, food chain pathways, and root uptake) were assumed to be complete for terrestrial plants and invertebrates. Plants growing on contaminated soils or waste materials may uptake and bioaccumulate chemicals that could be directly toxic or could be transferred through the food web.

2.6 Assessment and Measurement Endpoints

U.S. EPA (1997) states that "assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site." Ecological risk management goals are defined as a general statement about the desired condition of ecological values of concern (U.S. EPA 1998). The selection of the assessment endpoints should reflect the ecological risk management goals for the site. The overall risk management goal for the Sites is to reduce ecological risks, if necessary, to levels that will result in the maintenance of healthy local populations and communities of biota. This is consistent with the first principle of ecological risk management outlined by U.S. EPA (1999). The assessment endpoints for the SLERA are:

- Survival, growth, and reproduction of aquatic life as represented by benthic invertebrate and fish populations in Clear Creek;
- Survival, growth, and propagation of terrestrial and wetland plant communities;
- Survival, growth, and reproduction of soil invertebrate populations; and
- Survival, growth, and reproduction of avian and mammalian wildlife populations.

Measures of effect, or measurement endpoints, are measurable characteristics that reflect the assessment endpoint (U.S. EPA 1997). These include measures of exposure, measures of effect, and measures of receptor and ecosystem characteristics. The measurement endpoints are:
Habitat characterization to verify exposure pathways, characterize use of the Sites by ecological receptors, and make observations regarding habitat quality and ecosystem and plant community health.

- Comparison of measured concentrations of contaminants in surface soil and sediment to risk-based screening values (SLVs), and measured concentrations in surface water compared to Oregon numeric water quality criteria for aquatic life.
- Evaluation of chemical and physical parameters that affect contaminant bioavailability, such as pH, total organic carbon (TOC), clay content (or cation exchange capacity), and grain size for soils and sediment; and surface-water pH, dissolved organic carbon, and major cations.
- Comparisons of measures of exposure from areas affected by Site-related constituents to background concentrations.

3. SCREENING LEVEL ECOLOGICAL EFFECTS EVALUATION

In the screening level ecological effects evaluation, conservative thresholds for adverse ecological effects are established (U.S. EPA, 1997); these screening ecotoxicity values are the SLVs (DEQ, 2001). SLVs were developed for each contaminant for each exposure pathway, route of exposure, and receptor class (e.g., terrestrial wildlife and plants, aquatic invertebrates and fish). For a SLERA, it is appropriate to use no-observed-adverse-effect-level (NOAEL) based SLVs so as not to underestimate risk (U.S. EPA, 1997).

3.1 Terrestrial Screening Level Values

Consistent with the risk evaluation framework outlined in DEQ guidance (DEQ, 2001), the ecological risk screening compares concentrations of chemicals in soil at the Sites with applicable ecological risk based SLVs. However, tailings and waste rock are not soil and have physical and chemical attributes that are different than soil (BLM, 2016). The ecological habitat value provided by tailings and waste rock is minimal and it is unlikely that wildlife receptors would spend a substantial amount of time in disturbed areas of waste material. Therefore, ecological SLVs for sessile terrestrial receptors, plants and soil invertebrates, were used to evaluate mine waste and waste rock. The selected soil SLVs for the SLERA are the lowest EPA soil screening levels (Eco-SSLs) for plants and soil invertebrates. The Eco-SSLs were developed to predict potential soil toxicity to terrestrial plants, soil invertebrates, and terrestrial mammals and birds during Step 2 of the ecological risk assessment process (U.S. EPA, 2005). For plants and soil invertebrates, the Eco-SSLs are the geometric mean of the concentrations that affect 20 percent of the test population (EC_{20}), the maximum acceptable toxicant concentrations (MATC), and the concentrations that affect 10 percent of the test population (EC_{10}) (U.S. EPA, 2005). EPA's Superfund program developed the Eco-SSLs for seventeen inorganic and four organic contaminants. The soil screening levels from DEQ (2001) were used in the absence of plant and soil invertebrate Eco-SSLs for chromium, mercury, and tin.

With regard to screening soil/waste rock for potential effects due to exposure to aluminum, EPA (2003b) states, “Because the measurement of total aluminum in soils is not considered suitable or reliable for the prediction of potential toxicity and bioaccumulation, an alternative procedure is recommended for screening aluminum in soils. The procedure is intended as a practical approach for determining if aluminum in site soils could pose a potential risk to ecological receptors. This alternative procedure replaces the derivation of numeric Eco-SSL values for aluminum. Potential ecological risks associated with aluminum are identified based on the measured soil pH. Aluminum is identified as a COPC only at sites where the soil pH is less than 5.5.”

3.2 Aquatic Screening Level Values

The DEQ Aquatic Life Water Quality Criteria for Toxic Pollutants and EPA Water Quality Criteria (WQC) Criterion Continuous Concentrations (CCC) are the SLVs for surface water. The CCC is the highest concentration of a contaminant in surface water to which the aquatic community can be exposed for an indefinite length of time without resulting in adverse effects. If maintained continuously, any concentration above the CCC is expected to cause an adverse effect. However, the concentration of a chemical can be above the CCC without causing an unacceptable effect if the magnitudes and durations of the excursions above the CCC are limited and there are compensating periods of time during which the concentration is below the CCC (USEPA, 2010). The surface water SLVs are based on dissolved metals, which more accurately represent the fraction of metals that would be bioavailable to aquatic receptors. The water quality criteria for cadmium, chromium, lead, nickel, silver, and zinc are dependent on water hardness and were calculated using the formulas provided in the DEQ Aquatic Life Water Quality Criteria for Toxic

Pollutants using the average hardness for Clear Creek surface water samples collected in 2018, 58 mg/L calcium carbonate ($CaCO_3$). Because surface water from adits and settling ponds could be used a source of drinking water for wildlife, the surface water data were also screened against the DEQ (2001) avian and mammalian drinking water values.

The sediment SLVs are the freshwater benthic toxicity screening levels from the Sediment Evaluation Framework for the Pacific Northwest (Northwest Regional Sediment Evaluation Team, RSET, 2018). These values were derived from regional paired sediment chemistry and benthic toxicity test data from sediment sites in Washington and Oregon. The SL1 corresponds to a concentration below which adverse effects to benthic communities would not be expected. In the State of Washington, the SL1 is equivalent to the sediment quality standard. The SL2 corresponds to a concentration above which adverse effects may be observed in benthic organisms. In the State of Washington, the SL2 is equivalent to the cleanup screening level. Sediment concentrations greater than SL1 but at or below the SL2 correspond to concentrations that may result in minor adverse effects to the benthic community (RSET, 2018).

3.3 Benthic Macroinvertebrate and Fish Data

As summarized in the prior EE/CA reports (SAIC, 2005a and b), EA Engineering conducted a benthic macroinvertebrate community study on Clear Creek in the vicinity of the Sites as part of the SI in 2003. The data indicated no significant differences between the upstream reference station and any of the downstream stations that are adjacent to the Sites. The station located in the side channel upstream from the Bluebird Mine had the highest macroinvertebrate community index score despite sediments with the highest concentrations of metals.

Fish population data were also collected by EA Engineering as part of the SI. Young-of-the-year (YOY) fish that were sampled from Clear Creek within the vicinity of the Sites included Chinook salmon (*Oncorhynchus tshawytscha*), either inland/interior redband trout (*O. mykiss gairdneri*) or westslope cutthroat trout (*O. clarki lewisi*), torrent sculpin (*Cottus rhotheus*), paiute sculpin (*C. beldingi*),and speckled dace (*Rhinichthys osculus*). The data indicated no apparent effects on fish populations or diversity in Clear Creek from the mines or the 2003 spill. Clear Creek aquatic habitat assessment scores also indicated that physical habitat conditions were not a limiting factor for supporting healthy macroinvertebrate and fish communities (EA Engineering, 2003; SAIC, 2005a and b).

3.4 Plant Tissue Data and Waste Rock Leach Tests

Plant tissue data (the target species was wild strawberry) that were collected as part of the SI showed most metals concentrations were within the range of background tissue concentrations, though plants on the disturbed areas of the Sites exhibited signs of stress (EA Engineering, 2003; SAIC, 2005a and b). Metals that were detected in plant tissues at concentrations exceeding background included aluminum, iron, magnesium, mercury, cyanide[6], and zinc (EA Engineering,

[6] Cyanide has not been detected in soil, waste, or sediment samples collected from the Sites (SAIC, 2005a).

2003). Leach test samples from the waste rock areas also indicated that the potential for contaminant release was low and that elevated metal concentrations in the waste rock material had low potential for bioavailability (SAIC 2005a and b).

4. SCREENING LEVEL EXPOSURE ESTIMATE AND RISK CALCULATION

Step 2 in the U.S. EPA (1997) process is the screening level exposure estimate and risk calculation. Risk estimates are developed by comparing exposure concentrations with the SLVs from Step 1. At the end of Step 2, a decision is made: either the SLERA is adequate to concluded ecological risks are negligible or the process should continue to a baseline ecological risk assessment (BERA).

4.1 Exposure Estimates

An exposure-point concentration (EPC) is used to estimate the magnitude of exposure for each receptor that may contact contaminants in environmental media and plants/prey. EPCs are estimates of the average concentration in a medium with which a receptor may be in contact over time (U.S. EPA 1989). To account for uncertainty in estimating a true average concentration, Oregon DEQ (2001) suggests that the EPC can be represented by either the 90^{th} percentile upper confidence limit of the uncertainty in the arithmetic mean (90UCLM), or the maximum detected concentration can also be used. If fewer than ten samples are available in each medium, it is inappropriate to calculate a 90UCLM (USEPA, 2003). In these cases, and if the 90UCLML exceeded the maximum detected concentration, the maximum detected concentrations were used. For plants, aquatic, and soil invertebrates that are immobile or nearly so, the maximum detected concentration in soil or sediment was used for the EPC (DEQ, 2001).

4.2 Chemicals of Potential Ecological Concern

COPECs were identified by comparing Site concentrations of contaminants in soil, sediment, and surface water to background concentrations (for naturally occurring constituents) and ecological SLVs. The most recent Site data for surface soil, sediment, and surface water were screened to identify the COPECs. Because receptors will not generally have contact with groundwater unless it discharges to the ground surface (e.g., seeps and springs) or surface water, potential effects from exposure to contaminants in groundwater were evaluated as surface water (DEQ, 2001). Chemicals with Site concentrations that exceed SLVs were retained as COPECs. The process used to screen for COPECs was:

- **Essentiality**. Data for chemicals that are essential macronutrients (calcium, magnesium, potassium, and sodium), and major anions measured to assess water/soil quality (e.g., alkalinity, total chloride, nitrate-nitrite, and sulfate) were eliminated from the screening process. Data for iron, which is an essential nutrient but may also be Site-related, were screened for potential toxicity.
- **Frequency of detection**. Constituents detected in less than five percent of the samples for a given media were eliminated (DEQ, 2001).

- **Background**. If the maximum detected concentration of a naturally occurring constituent was less than the maximum background concentration, that chemical was eliminated (DEQ, 2001, 2017). Where risk-based levels (SLVs) fall below background, the background concentration was defaulted to as the SLV.
- **PBT constituents**. Constituents that are persistent bioaccumulative and toxic (PBT) (i.e., PCBs, dioxins, certain organochlorine pesticides, lead, mercury, and selenium) were retained as COPECs regardless of whether their concentrations were below SLVs (DEQ, 2001 and 2007), unless Site concentrations were lower than background concentrations for these contaminants.
- **Constituents without SLVs**. Detected chemicals that could not be screened against background and without ecological screening values were retained as COPECs. These chemicals are addressed qualitatively due to a lack of toxicity data in the uncertainty analysis (Section 4.4).

The tables that present the COPEC screening assessments are:

- Table 1 presents the data screening for the 2019 Blackjack Mine soil/waste rock samples.
- Table 2 presents the screening of the 2019 Bluebird Mine soil/waste rock samples.
- Table 3 presents the COPEC screening for Clear Creek sediment samples.
- Table 4 presents the COPEC screening for Clear Creek surface water samples.
- Table 5 presents the COPEC screening for Clear Creek surface water and adit outfall samples as a potential source of drinking water for wildlife.

4.3 Screening Level Risk Calculation

For a SLERA, the Hazard Quotient (HQ) approach[7] is adequate to characterize risk (U.S. EPA 1997). Exposure concentrations are compared to the SLVs to estimate risk, using the following formula:

$$HQ = EPC/SLV$$

According to DEQ (2001) guidance, screening should consider risks posed by exposure to individual constituents, cumulative risk from multiple chemicals within a given medium, and aggregate exposure from individual or multiple chemicals within different media.

1. Individual HQs. For individual contaminants in a single medium, any constituent with an individual HQ greater than 1 for any listed threatened and endangered species or HQ greater than five[8] for non-listed species was retained as a COPEC.

[7] DEQ (2001) refers to Hazard Quotients at the Toxicity Ratio, or *T.*

[8] The HQ > 5 (or Q = 5) guidance applies only to soil; for surface water and sediment COPECs were identified based on HQ > 1 (DEQ, 2005).

2. Cumulative Risk. For multiple contaminants in a given media, a Hazard Index (HI)[9] was calculated as the sum of HQs for individual chemicals, and constituents were retained as COPECs if:

$$HQ/HI > (1/n) \times Q$$

Where n is the total number of chemicals in a given medium and Q is the receptor designator as follows: Q = 1 for listed threatened and endangered species and Q = 5 for non-listed species[7].

3. Aggregate Risk. DEQ (2001) guidance indicates aggregate risk should be calculated for individual constituents detected in multiple media, and, if the HI for a given contaminant in multiple media is greater than Q, the chemical should be retained as a COPEC. However, for this SLERA, no receptors were assessed that would be exposed to multiple media. For example, risks were evaluated for terrestrial plant and soil invertebrate exposure to constituents in soil/waste rock, but these receptors would not be exposed to surface water, sediment, or outfall water as drinking water. Similarly, aquatic receptors would not be exposed to soil/waste rock or outfall water. For this reason, aggregate risk was not calculated.

4.3.1 Risk Calculation for Soil/Waste Rock

There are no listed terrestrial species at the Sites. Therefore, for a constituent to be retained as a COPEC for soil/waste rock the HQ must be greater than 5. For the Blackjack Mine soil/waste rock samples, there were no HQs > 5 and no chemicals were retained as COPECs based on cumulative risk to terrestrial receptors (Table 1).

For the Bluebird Mine arsenic and mercury had HQs > 5 (HQs were 5.7 for arsenic and 12.5 for mercury); mercury was also identified for cumulative risk to terrestrial receptors (Table 2). Mercury was also retained as a bioaccumulative constituent. Iron was also identified as a COPEC based on samples with pH outside of the range from 5 to 8; four waste rock samples had pH ranging from 3.54 to 4.11 (BLU-WR-1, BLU-WR-2, BLU-WR-6, and BLU-WR-7).

4.3.2 Risk Calculation for Clear Creek Sediment

For a chemical to be retained as COPEC in sediment, the HQ must be greater than 1.0. Nine chemicals in sediment were retained as COPECs for risks to aquatic life: antimony, barium, beryllium, chromium, iron, manganese, nickel, thallium, and vanadium (Table 3). All of these constituents except for vanadium were also retained as COPECs for cumulative risk.

[9] DEQ (2001) refers to a Hazard Index as the sum of Toxicity Ratios for contaminants in a given medium.

4.3.3 Risk Calculation for Clear Creek Surface Water

For a chemical to be retained as COPEC in surface water, the HQ must be greater than 1.0. Only manganese was retained as a COPEC for cumulative risk to aquatic receptors; however, the upstream exposure concentration for manganese is identical to the Site concentration (Table 4).

4.3.4 Risk Calculation for Wildlife exposed to Surface Water as Drinking Water

There were no constituents with HQs greater than 1.0 for wildlife exposure to the Blackjack Outfall as a possible source of drinking water (Table 5). Aluminum was retained for cumulative risk. HQs were not calculated for Clear Creek surface water as drinking water because samples collected upstream of the Sites had concentrations that were greater than those collected from Clear Creek in areas adjacent to the Sites. There was no SLV to assess wildlife exposure to iron in drinking water and therefore iron was retained as a COPEC.

4.4 Uncertainty Analysis

Uncertainty analysis provides a better understanding of how the risk conclusions should be interpreted during the risk management decision-making process. The uncertainty analysis summarizes assumptions made and evaluates their validity and the strengths and weaknesses of the analyses (DEQ, 2001). Screening-level risk assessments such as this SLERA rely upon conservative risk assessment assumptions to prevent an underestimation of risk. This conservatism is acceptable in a screening-level ecological risk assessment because it ensures that COPECs and receptors that require further evaluation are not wrongly eliminated from further consideration in the risk assessment process. However, multiple conservative assumptions produce overly conservative estimates of risk. The primary sources of uncertainty for the SLERA include:

Inaccurate characterization of exposure. It was assumed that the samples that were used to characterize exposure adequately represent conditions typically encountered by ecological receptors at the Sites. However, targeted soil sample collection at waste rock piles, adits and other mine features maximizes the chances of finding high levels of metals in soil/waste rock, represents worst-case exposures, and overestimates risk. It is unlikely that the samples collected provide an accurate representation of the distribution of concentration values in surface soils across the Sites. In addition, this risk assessment is based on simplified estimates of exposure and effects that neglect toxicokinetics (the passage of a toxic agent or its metabolites through an organism) and toxicodynamics (the physiological mechanisms by which toxins are taken up, distributed, metabolized, and excreted) (Menzie et al. 2009). This also likely results in an overestimation of exposure and risk. Finally, relying on maximum concentrations, which, represent high-level exposures, does not represent realistic conditions experienced by ecological receptors and overestimates exposure. Nonetheless, this approach ensures that ecological risks are not overlooked.

Overestimation of metals bioavailability. Environmental factors, such as pH, dissolved oxygen, organic carbon, the presence of sulfides, and cation-exchange capacity, can influence the bioavailability of metals (Menzie et al. 2009). Most metals in natural soils and at waste sites are in poorly available, less soluble forms (Efroymson et al. 1997; and Drexler et al., 2003; as cited in Ford and Beyer, 2014). This concept is also important because the environmental form may differ from the forms used to in the experiments to derive the screening values (Menzie et al. 2009). The difference between the reported metal concentrations in soil, sediment, and surface water and the actual bioavailable fraction is not known, but assuming the measured concentrations are 100% bioavailable overestimates exposure and risk. In fact, leach testing performed on waste rock as part of the SI indicated that mobility of metals from waste rock was low.

No evaluation of dermal contact and inhalation pathways. Dermal contact and inhalation of contaminated soil and dust were not assessed. It has been estimated that dermal exposures contribute <1% of the total exposure, and the inhalation pathway contributes less 0.1% of the total exposure (U.S. EPA 2005). Therefore, not evaluating dermal and inhalation exposures would not be expected to substantially change the risk estimates derived from ingestion alone.

Food chain exposure pathways were not assessed. Site-specific food chain modeling was not undertaken to estimate exposures from incidental ingestion of soil and ingestion of contaminated plants and prey. Instead, the metal concentrations measured in mining-impacted soils/waste rock and in surface water and sediment were compared directly to published risk-based SLVs. Interpretation of the significance of exceeding a SLV depends on the magnitude of the exceedance as well as the species' ecology and other factors such as local reference concentrations (Ford and Beyer, 2014). Because mercury is considered a PBT chemical, food chain exposures may be important. Not evaluating such exposure may result in an underestimation of risk.

Use of conservative SLVs. The SLVs are based on lower-bound or no-effect toxicity thresholds and are typically derived from laboratory studies that use soluble metal species. The observed toxicity of metals in field-contaminated soils can be less than 10% of that found in laboratory-spiked soils (Vangheluwe et al., 2007). Using highly conservative SLVs can lead to overestimates of risk.

Overestimating use of the Sites by wildlife receptors. The disturbed nature of the habitat at the Blackjack and Bluebird Mines suggests that terrestrial habitat quality is diminished. However, the Sites are not wholly contained within areas of disturbed habitat and could not be completely excluded from ecological evaluation. It is likely that more suitable, better quality habitat exists outside of the area influenced by the mines, thereby limiting exposure by wildlife species at the Sites. Assuming frequent wildlife use of the Sites likely overestimates risk.

Calculating Hazard Incides (HI) as an indicator of cumulative risk. The DEQ (2001) guidance directs the risk assessor to calculate HIs (also referred to as Toxicity Ratios, T) as the sum of HQs for the individual contaminants. This assumes simple additivity of toxic responses, which is not likely accurate because different chemicals act on different target organs and elicit varied responses among receptors.

Not considering the physical limitations of mine wastes. Mining-related waste piles consist of chunks of overburden rocks and/or sterile, ground-up ore-bearing tailings; some of this material may also be compacted into a hard, crust-like layer. These waste materials do not provide the required physical properties needed to promote seed germination, plant growth, or the presence of invertebrates. The SLERA only assesses ecological risk from exposure to contaminants by comparing metal concentrations to SLVs and assumes that this approach accounts for all possible responses, even those not associated with metal toxicity. As such, this SLERA does not consider the potential impacts of the "physical" properties of the mine wastes (i.e., compaction, ability to retain soil moisture, lack of nutrients, lack of an organic matrix, and/or lack of a viable soil microbial community) on the local plants and invertebrates. This missing information represents a data gap that results in additional uncertainty.

4.5 SLERA Summary and Scientific/Management Decision Point (SMDP)

The purpose of this SLERA is to summarize the information available for the Sites from earlier studies, and to evaluate whether exposures to Site-related contaminants in terrestrial and aquatic environments have the potential to result in adverse effects to plant and animal populations (i.e., ecological receptors) at the Sites. Chemicals that were retained as COPECs for each exposure area are summarized in Table 6.

Mining-related metals that have the potential to adversely impact ecological receptors were identified for soil/waste rock, but only at the Bluebird Mine, where arsenic, mercury, and iron were identified as COPECs. Eight metals were identified as COPECs in Clear Creek sediment; however, for most constituents, upstream sediment concentrations were similar to those for samples collected adjacent to the Sites, most likely indicating upstream mining influences. Manganese in surface water was retained as a COPEC for cumulative risk to aquatic receptors; however, the upstream exposure concentration for manganese is identical to the Site concentration. Only one constituent, aluminum, was identified as a COPEC for wildlife exposure to the Blackjack outfall as a drinking water source, based on cumulative risk. Iron was retained as COPEC because there is no wildlife drinking water SLV for iron.

Protected species were identified for Clear Creek including bull trout, westslope cutthroat trout, interior redband trout, and the Columbia spotted frog. The Columbia spotted frog, westslope cutthroat trout, and possibly the redband trout have been observed in the vicinity of the Sites. Protection of these species and their habitats should be considered when developing remedial alternatives that might affect Clear Creek. Data collected on the benthic macroinvertebrate and fish communities in Clear Creek showed no Site influences on these populations.

Plant tissue data showed most metals concentrations were within the range of background concentrations and leach test samples from waste rock indicated low potential for contaminant release and low potential for bioavailability.

Data are adequate to support this screening-level risk assessment. The most significant exposure pathways are direct contact to/uptake of metals in soil by plants and terrestrial invertebrates, and benthic invertebrate exposure to Clear Creek sediment. Limited exposure due to habitat constraints reduces the likelihood of population-level effects from exposure to metals in soil at the Sites; risks are more probable for individual receptor organisms. Upstream sediment concentrations were similar to concentrations from samples collected adjacent to the Sites. Risks cannot be concluded to be negligible, but it is likely that risks to ecological receptors are low from exposure to metals at the Sites. Any remediation that might occur to mitigate human health risks will also reduce exposure and risk to ecological receptors, if care is taken to not further damage habitat while carrying out remedial actions. Therefore, it is our recommendation that no further investigation is required for the Bluebird and Blackjack Mines to draw conclusions regarding ecological risk.

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Table 1. Blackjack Mine Soil/Waste Rock COPEC Screening

Analyte (mg/kg)	Soil SLV	SLV Basis	BLK-WR-1		BLK-WR-2		BLK-WR-3		BLK-WR-4		BLK-WR-5		BLK-WR-6		BLK Max	BKGD Max	HQ	HQ/HI	(1/n)*5	HQ/HI >(1/n)*5
			2019	Q	2019	Q	2019	Q	2019	Q	2019	Q	2019	Q						
Antimony	78	Invert[a]	1.93	J	1.3	J	2.11	U	2.07	U	23.6	U	1.65	J	23.6	9.98	0.3	0.02	0.45	No
Arsenic	18	Plant[b]	12.7		10.3		0.493	J	5.28		**23.6**	U	2.32		23.6	21.8	1.1	0.06	0.45	No
Cadmium	32	Plant	0.608		0.145	J	0.527	U	0.518	U	5.89	U	0.252	J	5.89	5.86	0.2	0.01	0.45	No
Chromium	1	Plant[b,c]	**29.8**		10.1		**25**		4.6		**28.4**		8.33		29.8	16.5	1.8	0.10	0.45	No
Cobalt	13	Plant[b]	19.6		4.41		0.245	J	0.586	J	**108**		**28.8**		108	23	4.7	0.26	0.45	No
Copper	70	Plant[b]	**105**		64.7		6.84		12.7		**124**		58.4		124	81.1	1.5	0.09	0.45	No
Lead	120	Plant	11.6		8.98		16.8		5.81		26.7		6.33		26.7	11.1	0.2	0.01	0.45	No
Manganese	220	Plant[b]	860	OV	251		4.25		21.9		**12600**		2770		12600	4700	2.7	0.15	0.45	No
Nickel	38	Plant[b]	46		20		5.55		6.2		**286**		62.7		286	129	2.2	0.12	0.45	No
Thorium	---	---[b]	**3.69**	J	**3.58**	J	4.73	J	**2.57**	J	2.27	J	2.17	J	4.73	2.54	1.9	0.10	0.45	No
Vanadium	2	Plant[b]	**50.5**		16.9		23.4		10		28.1		13.6		50.5	37.9	1.3	0.07	0.45	No
pH			7.92	T	---		---		5.65	T	---		4.75	T		**HI =**	18			

[a]Soil invertebrate value (geometric mean of the EC_{20} values) was used because other values are below western U.S. backgound concentrations.

[b]Where the SLV < BKGD Max or there is no SLV, default to BKGD Max as SLV.

[c]Plant screening level from DEQ (2001) was used in the absence of plant and soil invertebrate values for chromium from the U.S. EPA Eco-SSLs.

Analytes that were not detected in any Site samples were eliminated from screening.

Al, Ba, Fe, Hg, Se, Sn, and Zn had Site concentrations < background; therefore, these constituents were eliminated in the first step of the screening process.

Values that are shaded exceed the SLV (or BKGD Max where SLV<BKGD Max).

J: The identification of the analyte is acceptable; the reported value is an estimate.

O: The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.

Q: Qualifier

T: Sample(s) received past/too close to holding time expiration.

U: Undetected.

V: The sample concentration is too high to evaluate accurate spike recoveries.

BLK Max: Maximum site concentration; the maximum concentration was used because there were an insufficient number of samples to calculate a 90UCLM.

BKGD Max: Maximum site-specific background concentration.

WR: Waste rock/soil sample.

SLV: Screening level value is the lowest of the U.S. EPA Eco-SSLs for plants and soil invertebrates.

HQ: Hazard Quotient.

HI: Hazard Index is the sum of Hazard Quotients.

n: Number of analytes

Table 2. Bluebird Mine Soil/Waste Rock COPEC Screening

Analyte (mg/kg)	Soil SLV	SLV Basis	BLU-WR-1		BLU-WR-2		BLU-WR-3		BLU-WR-4		BLU-WR-5		BLU-WR-6		BLU-WR-7		BLU Max	BKGD Max	HQ	HQ/HI	(1/n)*5	HQ/HI >(1/n)*5
			2019	Q	2019	Q	2019	Q	2019	Q	2019	Q	2019	Q	2019	Q						
Antimony	78	Invert[b]	22.1	J	2.18		2.51		3.13		2.04	J	5.65		4.62		22.1	2.45	0.3	0.01	0.42	No
Arsenic	18	Plant[c]	**25.7**	J	**30.5**		17.7		**41.3**		21.1		**99.8**		**128**		128	22.6	**5.7**	0.28	0.42	No
Cadmium	32	Plant	1.4	J	0.0827	J	0.143	J	0.243	J	0.428	J	0.526	U	0.538	U	1.4	0.6	0.04	0.00	0.42	No
Copper	70	Plant[c]	**159**		27.6		54.3		66.9		72.8		20.3		30.4		159	120	1.3	0.06	0.42	No
Iron	pH 5 to 8[a]	---	381000		16600		31200		36500		34100		13700		18800		381000	55900	---	---	---	---
Lead	120	Plant	10.6		7.72		11.2		13.9		11.9		15.8		15.6		15.8	10.9	0.1	0.01	0.42	No
Mercury	0.0002	Plant[c,d]	**0.0788**	B	**0.678**		**0.599**	J	**0.37**		**0.186**		**0.235**		**0.281**		0.678	0.0541	**12.5**	0.61	0.42	**Yes**
Selenium	0.52	Plant[c]	**10.6**	J	0.894	J	1.45	J	2.28		1.45	J	**3.35**		**3.44**		10.6	2.91	3.6	0.18	0.42	No
Silver	560	Plant	15.8	U	1.06	U	1.05	U	1.06	U	1.08	U	0.554	J	0.439	J	15.8	1.23	0.03	0.00	0.42	No
Thorium	---	---[c]	0.82	J	1.31	J	3.27	J	4.23	J	**5.09**	J	3.39	J	4.02	J	5.09	4.71	1.1	0.05	0.42	No
Tin	50	Plant[d]	**78.8**	U	0.977	BJ	1.53	BJ	2.08	BJ	1.59	BJ	1.22	BJ	1.21	BJ	78.8	2.15	1.6	0.08	0.42	No
Zinc	120	Invert	**186**		49.1		65		67		59.4		20.5		26.1		186	89.6	1.6	0.08	0.42	No
pH[a,e]			**3.54**	T	**4.03**	T					5.63	T	**4.11**	T	**4.06**	T		**HI=**	21			

[a]Where soil H is bewteen 5 and 8 iron is not expected to be toxic to plants.

[b]Soil invertebrate value (geometric mean of the EC_{20} values) was used because other values are below western U.S. backgound concentrations.

[c]Where the SLV < BKGD Max or there is no SLV, default to BKGD Max as SLV.

[d]Plant screening level from DEQ (2001) was used in the absence of plant and soil invertebrate values for mercury and tin from the U.S. EPA Eco-SSLs.

[e]Where pH values are highlighted iron may be a risk (i.e., pH is not between 5 and 8).

Analytes that were not detected in any Site samples were eliminated from screening.

Al, Ba, Cr, Co, Hg, Mn, Ni, and V had Site concentrations < background; therefore, these constituents were eliminated in the first step of the screening process.

Values that are shaded exceed the SLV (or BKGD Max where SLV<BKGD Max).

B: The same analyte is found in the associated blank.

J: The identification of the analyte is acceptable; the reported value is an estimate.

O: The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.

Q: Qualifier

T: Sample(s) received past/too close to holding time expiration.

U: Undetected.

V: The sample concentration is too high to evaluate accurate spike recoveries.

BLU Max: Maximum site concentration; the maximum concentration was used because there were an insufficient number of samples to calculate a 90UCLM.

BKGD Max: Maximum site-specific background concentration.

WR: Waste rock/soil sample.

SLV: Screening level value is the lowest of the U.S. EPA Eco-SSLs for plants and soil invertebrates.

HQ: Hazard Quotient.

HI: Hazard Index is the sum of Hazard Quotients.

n: Number of analytes.

Table 3. Blackjack and Bluebird Mines 2017 - 2018 Clear Creek Sediment Samples CoPEC Screening

Analyte	Sediment SLVs			SD108		SD100		SD03		SD04		SD05		SD06		SD07		SD08		Site	Upstream	HQ	HQ/HI	(1/n)*1	HQ/HI
(mg/kg)	SL1	SL2		11-17-18		11-18-18		2017		2017		2017		2017		2017		2017		Max	Max				>(1/n)*1
Aluminum	2.55%	---	[a]	10000		12000		8330	JL	15900	JL	7300	JL	8920	JL	8610	JL	8600	JL	15900	10000	0.6	0.03	0.05	No
Antimony	---	---	[b]	**1.6**		**1.7**		0.93	JQ	**1.5**	JQ	0.87	JQ	0.88	JQ	0.99	JQ	0.60	JQ	1.70	1.0	**1.7**	0.08	0.05	**Yes**
Arsenic	14	120		28		23		30.5		24.7		8.3		21.7		23.8		32.9		32.9	24.7	0.3	0.01	0.05	No
Barium	---	---	[b]	**110**		**220**		**80.4**		**152**		47		**68.6**		**58.8**		54.7		220	55	**4**	0.19	0.05	**Yes**
Beryllium	---	---	[b]	0.32		0.29		**0.5**	JL	**0.82**	JQ	0.42	JQ	**0.51**	JL	0.47	JL	**0.51**	JL	0.82	0.49	**1.7**	0.08	0.05	**Yes**
Cadmium	2.1	5.4		0.45		0.27	J	0.69	JL	1.2	JL	0.33	JQ	0.48	JL	0.43	JL	0.48	JL	1.2	0.45	0.2	0.01	0.05	No
Chromium	72	88	[b]	92		**140**		**143**	JL	118	JL	44	JL	89	JL	74	JL	**212**	JL	212	135	**1.6**	0.07	0.05	**Yes**
Cobalt	---	50	[c]	25		22		25.1	JH	36.8	JH	17.0	JH	24.0	JH	17.1	JH	19.1	JH	36.8	19	0.7	0.03	0.05	No
Copper	400	1200		34		33		32		58		25		29		28		29		58	32	0.05	0.002	0.05	No
Iron	2%	---	[a,b]	24000		**33000**		27100	JH	27500	JH	21000	JH	25600	JH	23200	JH	25900	JH	33000	29000	**1.1**	0.05	0.05	**Yes**
Lead	360	1300		3.7		3.0		3	JH	6.9	JH	2.8	JH	2.8	JH	2.7	JH	2.4	JH	6.9	2.8	0.01	0.0002	0.05	No
Manganese	---	460	[b,c]	**2200**		**2300**		**1520**	JL	**1590**	JL	638	JL	**786**	JL	659	JL	649	JL	2300	660	**3.5**	0.16	0.05	**Yes**
Mercury	0.66	0.8		0.049		ND		0.039	JQ	0.14	JQ	0.021	JQ	0.025	JQ	0.015	JQ	0.12	U	0.14	0.018	0.2	0.01	0.05	No
Nickel	26	110	[b]	**160**		**160**		**187**	JH	**246**	JH	80.4	JH	122	JH	113	JH	**169**	JH	246	131	**1.9**	0.09	0.05	**Yes**
Selenium	11	20		2.8		2.4		---	R	---	R	---	R	---	R	---	R	---	R	2.8	2.1	0.1	0.01	0.05	No
Silver	0.57	1.7		0.25		0.26		1.2	JL	1.6	JQ	0.92	JL	1.1	JL	0.97	JL	1	JL	1.6	1.1	0.9	0.04	0.05	No
Thallium	---	---	[b]	0.14	J	0.083	J	0.74	JQ	**1.7**	JQ	**0.98**	JQ	0.95	JQ	**1.1**	JQ	**1.2**	JQ	1.7	0.97	**1.8**	0.08	0.05	**Yes**
Vanadium	---	---	[b]	44		**51**		41.2		**54.6**		35.0		42.6		39.6		43.1		54.6	48.5	**1.1**	0.05	0.05	No
Zinc	3200	4200		100		65		88.6		179.0		43.7		47.3		45.4		45.0		179.0	46	0.04	0.002	0.05	No
																						HI=	22		

[a]Threshold Effect Level (TEL) from NOAA SQuiRT (Buchman, 2008)

[b]Where the SLV < BKGD Max or there is no SLV, default to BKGD Max as SLV.

[c]Low Effect Level (LEL) from NOAA SQuiRT (Buchman, 2008).

Analytes that were not detected in any Site samples were eliminated from screening.

Values that are shaded exceed the SLV (or BKGD Max where SLV<BKGD Max).

J: Result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value.

F1: Matrix spike (MS) and/or matrix spike duplicate (MSD) recovery is outside acceptance limits.

F2: MS/MSD RPD exceeds control limits.

H: The sample result is biased high.

J: The associated value is an estimated quantity.

L: The sample result is biased low.

Q: Detected concentration is below the method reporting limit/Contract Required Quantitation Limit, but is above the method quantitation limit.

R: The data are rejected and unusable. The analyte may or may not be present in the sample.

U: The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

SLV: Screening level value is the SL2.

SL1 corresponds to a concentration below which adverse effects to benthic communities would not be expected (RSET, 2018).

SL2 corresponds to a concentration above which more than minor adverse effects may be observed in benthic organisms (RSET, 2018); this value was used to calculate Hazard Quotients.

HQ: Hazard Quotient.

HI: Hazard Index is the sum of Hazard Quotients.

n: Number of analytes.

Table 4. Blackjack and Bluebird Mines 2018 Clear Creek Surface Water Samples COPEC Screening for Aquatic Life

	Surface Water SLVs				Avg.	SW108				SW108				SW108				SW100				SW100				SW100				Clear Creek Maximum		Upstream Maximum					
						5/24/2018				7/24/2018				11/17/2018				5/22/2018				7/24/2018				11/18/2018											
Analyte (mg/L)	Acute CMC		Chronic CCC		Hardness	Total		Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total	Dissolved	Total	Dissolved	HQ	HQ/HI	(1/n)* 1	HQ/HI >(1/n)* 1
Chromium	0.3750	[b,c]	0.0488	[b,c]		0.001	J	ND		0.0011	J	ND		0.001	J	ND		0.0011	J	ND		ND		0.001	J	0.0009	J	0.00091	J	0.0011	0.001	0.0065	ND	0.02	0.02	0.13	No
Manganese	---		0.12	[d]		0.0096	J	0.0061	J	0.074		0.064		0.13		0.12		0.015		0.0066	J	0.0069	J	0.0086	J	0.016		0.0085	J	0.13	0.12	0.13	0.03	1.0	0.9	0.13	**Yes**
Nickel	0.3039	[b,c]	0.0338	[b,c]		0.0023	J	0.0018	J	0.0036	J	0.0028	J	0.0038	J	0.0035	J	0.0029	J	0.0021	J	0.00093	J	0.001	J	0.0007	J	ND		0.0038	0.0035	0.012	0.0016	0.10	0.09	0.13	No
Alkalinity	---		20	[a]		39				60				57				38				67				64				67	ND	76					
CaCO3 (mg/L)					58	36		36		70		65		72		73		36		36		67		68		70		67				75	73				
Field Parameters																																	**HI=**	1.1			
Temp (C)						6.1				14.4				3.4				9.9				14.4				0.2						16.6					
pH						7.3				7.1				8.1				7.1				7.1				7.2						7.8					
ORP (mV)						137				32				178				86				32				82						88					
Cond. (mS/cm)						0.070				.117				0.14				0.069				.117				0.13						0.13					
Turbidity (NTU)						0				0				0.2				0				0				0.2						0					
DO (mg/L)						9.9				7.9				9.3				10.9				7.9				8.3						10.5					
Fe2+ (mg/L)						--				0.26				1.97				--				--				--						2.85					

[a]CCC is the minimum; concentrations should not be below this value.

[b]Criterion expressed in terms of dissolved concentrations.

[c]Criterion is a function of water hardness; CMC = (exp(m*[ln(hardness)] + b)), average Site hardness was used; formulas available in DEQ Aquatic Life Water Quality Criteria.

[d]Aquatic SLVs from DEQ (2001).

[e]Where the SLV < Upstream Max, default to Upstream Max as SLV.

* LCS or LCSD is outside acceptance limits; data not a ected.detection limit; F1 = MS and/or MSD Recovery is outside acceptance limits.

Analytes that were not detected in any Site samples were eliminated from screening.

Al, Sb, As, Co, and Fe had Site concentrations < background; therefore, these constituents were eliminated in the first step of the screening process.

Values that are shaded exceed the SLV.

H: Sample was prepped or analyzed beyond the specified holding time.

HQ: Hazard Quotient.

HI: Hazard Index is the sum of Hazard Quotients.

J: Result is less than the reporting limit but greater than or equal to the method detection limit; concentration is an approximate value.

n: Number of analytes.

ND: Not Detected at the method detection limit.

ORP: Oxidation reduction potential.

DO: Dissolved oxygen.

SLV: Screening level value.

Table 5. Blackjack and Bluebird Mines 2018 Clear Creek and Outfall Surface Water Samples COPEC Screening for Wildlife Drinking Water

	SLVs		Blackjack Outfall						Clear Creek													
	Avian Drinking Water	Mammal Drinking Water	AD-BJO 7-25-2018		Outfall HQ	HQ/HI	(1/n)*5	HQ/HI >(1/n)*5	SW108 5/24/2018		SW108 7/24/2018		SW108 11/17/2018		SW100 5/22/2018		SW100 7/24/2018		SW100 11/18/2018		Clear Creek Maximum	Upstream Max
Analyte (mg/L)			Total						Total		Total		Total		Total		Total		Total		Total	Total
Aluminum	797	8	0.42	J	0.05	0.72	0.33	Yes	0.14	J	ND		ND		ND*		ND		ND		0.14	1.6
Antimony	---	1	ND		---	---	---	---	ND		0.00068	J	ND		ND		ND		ND		0.00068	0.0011
Arsenic	18	6	0.0029	J	0.0005	0.01	0.33	No	0.0016	J	0.0017	J	0.0015	J	0.002	J	0.0024	J	0.002	J	0.0024	0.0050
Barium	150	39	0.031		0.0008	0.01	0.33	No	0.0080		0.015		0.013		0.0094		0.014		0.013		0.015	0.028
Cadmium	10	8	0.001	J	0.0001	0.00	0.33	No	ND		ND		ND		ND		ND		ND		ND	ND
Chromium	7.2	21000	ND		---	---	---	---	0.001	J	0.0011	J	0.001	J	0.0011	J	ND		0.0009	J	0.0011	0.0065
Cobalt	---	9	0.029		0.003	0.04	0.33	No	0.00025	J	0.00021	J	ND		0.0002	J	ND		ND		0.00025	0.0019
Copper	341	53	0.07		0.001	0.02	0.33	No	ND		ND		ND		ND		ND		ND		ND	ND
Iron	---	---	11		---	---	---	---	0.15	J	ND		ND		ND		ND		ND		0.15	2.1
Manganese	7242	676	2.1		0.003	0.04	0.33	No	0.0096	J	0.074		0.13		0.015		0.0069	J	0.016		0.13	0.13
Mercury	3.3	10	ND		---	---	---	No	ND		ND		ND		ND		ND		ND		ND	ND
Nickel	562	38	0.073		0.002	0.03	0.33	No	0.0023	J	0.0036	J	0.0038	J	0.0029	J	0.00093	J	0.0007	J	0.0038	0.012
Thallium	---	0.06	0.00053	J	0.009	0.12	0.33	No	ND		ND		ND		ND		ND		ND		ND	ND
Vanadium	82	1.6	ND		---	---	---	---	ND		ND		ND		ND		ND		ND		ND	0.0051
Zinc	105	1230	0.1		0.0010	0.01	0.33	No	ND		ND		ND		ND		ND		ND		ND	ND
Alkalinity			12	HI=	0.1				39		60		57		38		67		64		67	76

* LCS or LCSD is outside acceptance limits; data not affected.

H: Sample was prepped or analyzed beyond the specified holding time.

J: Result is less than the reporting limit but greater than or equal to the method detection limit; concentration is an approximate value.

ND: Not Detected at the method detection limit.

ORP: Oxidation reduction potential.

DO: Dissolved oxygen.

SLV: Screening level value is the lowest of the avian and mammalian freshwater values from DEQ (2001).

HQ: Hazard Quotient.

Total metals concentrations were used in the wildlife drinking water screening.

Analytes that were not detected in any Site samples were eliminated from screening.

Table 6. Summary of CoPECs

Analyte	Blackjack Soil/ Waste Rock	Bluebird Soil/ Waste Rock	Sediment	Surface Water	Outfall as Drinking Water
Aluminum					X
Antimony			X		
Arsenic		X			
Barium			X		
Beryllium			X		
Cadmium					
Chromium			X		
Cobalt					
Copper					
Iron		X	X		X[a]
Lead					
Manganese			X	X	
Mercury		X			
Nickel			X		
Selenium					
Silver					
Thallium			X		
Vanadium			X		
Zinc					

[a]Retained because there was no SLV.

APPENDIX 9

Potential Applicable or Relevant and Appropriate Requirements

CHEMICAL-SPECIFIC ARARS

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
National Primary & Secondary Drinking Water Regulations	42 USC § 300f et seq. 40 CFR Part 141 40 CFR Part 142 49 CFR Part 143	No	No	No	Establishes health-based and aesthetic standards (maximum contaminant levels [MCLs]) for public drinking water systems. Groundwater will not be addressed by this removal action or any proposed removal alternatives. No surface water intakes are known in the area.
National Ambient Water Quality Criteria (AWQC)	33 USC § 1314 40 CFR Part 131	Yes	Yes	No	Sets criteria for water quality based on toxicity to aquatic organisms and human health. The State of Oregon has been delegated this program. Applicable by reference in ORS 468B.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	42 USC § 7401 et seq. 40 CFR Part 50.6	No	No	No	Establishes air quality levels that protect public health. Sets standards on ambient concentrations of carbon monoxide, lead, nitrogen dioxide, PM|$_0$, ozone and sulfur oxides. Not an ARAR - only “major” sources are subject to requirements related to NAAQS. Emissions associated with proposed removal actions will be limited to fugitive dust emissions associated with earth moving activities on site. These activities will not constitute a major source. Defer to state regulation of fugitive dust emissions. Considered applicable by reference through OAR 340-202.
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Part 61	No	No	No	Regulates emissions of hazardous chemicals to the atmosphere from stationary sources. No stationary sources are anticipated for this removal action.
RCRA Subtitle C	42 USC §§ 6901-6992k 40 CFR Parts 260-270 RCRA Section 3001(b) (Bevill Amendment)	No	No	No	Defines solids wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262265 and Parts 124, 270, and 271. Exempts mining waste from RCRA Subtitle C, Bevill exempt. Even if TCLP testing confirmed a characteristic waste (Subpart C), it is still exempt. It should be noted that no samples collected from the site have exceed TCLP.
RCRA Subtitle D	42 USC §§ 6901 et seq. 40 CFR Parts 258, 261.2	No	Yes	No	Regulates the storage and handling of solid waste. Mining and processing wastes at this site are classified as exempt under the Bevill Amendment and therefore are considered a solid waste. Requirements for solid wastes under RCRA Subtitle D may be relevant and appropriate at this site.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Regional Screening Levels (RSL) for soil, water, and air	Regional Screening Level (RSL) Table June 2019	Yes	Yes	No	Regional Screening Levels (RSL) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist in initial screening-level evaluations of environmental risks. RSLs should be viewed as Agency guidelines, not legally enforceable standards. They are used for site "screening" and as initial cleanup goals if applicable.
BLM Risk Management Criteria (RMC)	Technical Note 390 rev.	No	Yes	Yes	Suggests acceptable multimedia risk-based criteria for heavy metals as they relate to recreational use and wildlife habitat on BLM lands.
STATE OF OREGON					
Hazardous Substance Remedial Action Rules	OAR 340-122-0084 & 1115	Yes	Yes	Yes	Establishes Oregon Department of Environmental Quality (ODEQ) guidelines for assessing human health and ecological risk assessments on potential adverse effects from contamination according to ODEQ risk guidelines and levels. Criteria may be relevant and appropriate for this site. however, USFS retains its CERCLA authority for work on this site.
Risk-based Decision Making for Remediation of Contaminated Sites	OAR 340-122-0100 through 340-122-0115 and 340-122-0205 through 340-122-0260	No	Yes	Yes	Oregon environmental cleanup law and regulations require a risk-based approach for assessing and managing environmental contamination. Applicable regulations: • Releases of hazardous substances including petroleum under the state's hazardous substance remedial action rules (OAR 340-122-0100 through 340-122-0115) • Cleanup of petroleum releases from regulated underground storage tanks under Oregon cleanup rules for Leaking Petroleum Underground Storage Tank Systems (Oregon Administrative Rules 340-122-0205 through 340-122-0260) Other models or approaches may be used to evaluate site risks. Alternative approaches must meet risk-based cleanup standards specified in Oregon Revised Statute 465.315. No USTs or petroleum contamination present at the site.
Oregon Water Quality Criteria for Protection of Human Health and Aquatic Life	OAR 340-041	Yes	Yes	No	State of Oregon is authorized by the EPA to implement the Clean Water Act in Oregon. Establishes acceptable contaminant levels for ingestion of aquatic organisms and for intake by aquatic organisms in surface water.
Oregon Primary Drinking Water Standards	OAR 340-041	No	No	No	Health-based standards (MCL) for public drinking water systems. Groundwater is not addressed by this removal action or any proposed removal alternatives. No surface water intakes are known to be in the area.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Oregon Water Pollution Control Statutes	ORS 468B.005 through ORS 468B.190	No	Yes	No	Addresses effluent standards, permit requirements for discharges to U.S. waters and minimum Federal water quality criteria. Covers the protection of surface water during removal activities. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Groundwater Quality Protection Program	OAR 340-040	No	No	No	Establishes the mandatory minimum groundwater quality protection requirements for federal and state agencies, cities, counties, industries, and citizens. Applicable to groundwater monitoring of a subsurface treatment system. No subsurface treatment systems are planned for this site.
Ambient Air Quality Standards and PSD Increments	OAR 340-202	No	No	No	Establish concentrations, exposure time, and frequency of occurrence of an air contaminant or multiple contaminants in the ambient air that must not be exceeded. Applicable to PM10 ambient air quality during removal activities.
Oregon Emission Standards for Hazardous Air Pollutants	OAR 340-244	No	No	No	Regulates emissions of hazardous chemicals to the atmosphere from stationary sources. No stationary sources are part of this removal action.
Oregon Air Pollution Laws	ORS 468A.005-085	No	Yes	No	Provides laws governing air pollution control, abatement and prevention. Relevant and appropriate to removal action construction activities. However, USFS may invoke CERCLA authority.
Identification and Listing of Hazardous Waste	OAR 340-101	Yes	No	No	Identifies those residues which are subject to regulation as hazardous wastes. Mine waste (e.g., tailings and waste rock) from the extraction, beneficiation, and processing of ores and minerals are exempt under 40 CFR Part 261.4(b)(7). However, treatment sludge and discharge are not exempt.
Oregon Standards for Mining Operations	ORS 517.952-989	No	No	No	Regulations governing design, construction, operation and closure of mining operations. Not applicable to abandoned mines.

LOCATION-SPECIFIC ARARS

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
Protection of Wetlands Executive Order 11990	33 USC § 131440 CFR Part 6.302(a) and Appendix A	No	No	Yes	Minimizes impacts to wetlands. Requires Federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.
Floodplain Management Executive Order 11988	33 USC § 1314 40 CFR Part, 6.302(b) and Appendix A	Yes	Yes	No	Regulates construction in floodplains. Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain to the extent possible. Relevant, if all or part of a treatment system or mine waste containment embankment is constructed in a floodplain.
Clean Water Act Section 404, Dredge and Fill Regulations	33 USC § 1314 33 CFR Parts 320-323 33 CFR Part 330 40 CFR Part 230	No	Yes	No	Regulates discharge of dredge or fill materials into waters of the U.S. Must take practicable steps to minimize and mitigate adverse impacts. Permits are not required for this action however the substantive portions of the regulation may be applicable. Permit requirements are not applicable to on-Site removal actions under CERCLA. The substantive requirements may be relevant and appropriate if excavation or dredging occurs.
Fish and Wildlife Coordination Act	16 USC §§ 661, et seq, 40 CFR 6.302(g)	Yes	No	No	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body to assure adequate protection of fish and wildlife resources.
Fish and Wildlife Conservation Act	16 USC §§ 2901-2912	No	No	No	Federal departments and agencies are encouraged to utilize their authority to conserve nongame fish and wildlife and their habitats and assist States in the development of their conservation plans, including during remedial activities.
Wild and Scenic Rivers Act	40 CFR Part, 6.302(e) 36 CFR Part 297 16 USC § 12,71-12,87	No	No	No	Establishes requirements to protect wild, scenic, or recreational rivers. The portion of Clear Creek at the site is not covered under the Wild and Scenic Rivers Act.
National Historic Preservation Act	16 USC § 470 et seq. 36 CFR Part 800 40 CFR Part 6.301(b) 36 CFR Part 63	Yes	No	No	Requires Federal agencies to take into account the effect of any Federally assisted undertaking or licensing on any property with historic, architectural, archeological, or cultural value that is included in or eligible for inclusion in the National Register of Historic Places. Regulates inventory, assessment and consultation on project effects and protection measures for cultural properties on federal lands.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
The Historic and Archeological Preservation Act of 1974	16 USC § 469 40 CFR Part 6.301(c)	Yes	No	No	Establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archeological data that might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.
Native American Graves Protection and Repatriation Act	25 USC §§ 3001-3013 43 CFR Part 10	Yes	No	No	Regulations that pertain to the identification, protection and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony. None known at Site.
Historic Sites Act of 1935	16 USC §§ 461-467 40 CFR Part 6.301(a)	Yes	No	No	Preserves for public use historic sites, buildings, and objects of natural significance. There are no historic sites, buildings or objects of natural significance as defined in the Historic Sites Act of 193 at the Site.
Executive Order 11593 Protection and Enhancement of the Cultural Environment	16 USC § 470	Yes	No	No	Requires Federal agencies to consider the existence and location of potential and existing National Natural Landmarks to avoid undesirable impacts on them. None known at Site.
The Archaeological Resources Protection Act of 1979	43 CFR Part 7	Yes	Yes	No	Regulates requirements for authorized removal of archeological resources from public or tribal lane. May be relevant and appropriate if archeological resources are encountered during removal action activity.
Endangered Species Act	16 USC §§ 1531(h)-1543 40 CFR Part 6.302 (b) 50 CFR Parts 17 & 402	Yes	Yes	No	Regulates the protection of threatened or endangered species and critical habitat. Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.
Bald Eagle Protection Act	16 USC § 668 et seq.	Yes	No	No	Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle.
Migratory Bird Treaty Act	16 USC § 703 et seq.	Yes	No	No	Establishes federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Management of National Forest Systems Lands; Forest Plan	36 USC § 1604	Yes	No	No	Is applicable to the Site as it is located entirely within the Umatilla and Wallowa Whitman National Forests.
Federal Land Policy and Management Act of 1976	43 USC § 1701	No	Yes	No	Provides for multiple use and inventory, protection, and planning for cultural resources on public lands.
STATE OF OREGON					
ODNR's Plant Conservation Biology Program Plants: Wildflowers and Endangered, Threatened, and Candidate Species	OAR 603-73	Yes	No	No	Provides for protection of certain plants, wildflowers, and shrubs; guidelines on the listing, reclassification, and delisting of plant species as threatened or endangered.
Oregon's Endangered Species Rule, Wildlife Diversity Program	OAR 635-100	No	No	No	Provides rules for maintaining Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges.
Oregon State Police Wildlife Enforcement and Penalties		No	No	No	Protects wildlife from detrimental actions.
Oregon Historical and Archaeological Resources Rules and Regulations	ORS 358 & 390 OAR 736-50 & 51	Yes	No	No	Regulations for historic and archaeological resources.
Oregon Register of Historic Places		No	No	No	Review of potential impacts to historic places and structures.

ACTION SPECIFIC ARARS

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
National Pollutant Discharge Elimination System	33 USC § 1314 40 CFR Parts 122 - 125, 131	No	Yes	No	Regulates the discharge of treated effluent and storm water runoff to waters of the U.S. Defer to ORS 468B. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Effluent Limitations	33 USC § 1311 40 CFR Part 440	No	Yes	No	Sets standards for discharge of treated effluent to waters of the U.S.
Toxic Pollutant Effluent Standards	33 USC § 1317 40 CFR Part 129	No	Yes	No	Establishes standards or sets prohibitions for certain hazardous constituents.
Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328 30 CFR Part 816	No	No	No	Performance standards for surface mining activities.
Hazardous Materials Transportation Act	49 USC §§ 1801-1813 40 49 CFR Parts 107, 171-177	Yes	Yes	No	Regulates the transportation of hazardous material. May be considered relevant and appropriate for transportation of hazardous material offsite to a hazardous waste landfill.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	No	Yes	No	Regulates the transportation of hazardous material. May be considered relevant and appropriate for transportation of hazardous waste offsite to a hazardous waste landfill.
RCRA Subtitle C	42 USC §§ 6901-6992k 40 CFR Parts 260 - 270 RCRA Section 3001(b) (Bevill Amendment)	No	No	No	Establishes requirements for hazardous waste treatment, storage, and disposal of hazardous wastes. Excludes certain solid waste resulting from mining operations from the definition of hazardous wastes and Subtitle C requirements (Bevill Exemption).
RCRA Subtitle D	42 USC §§ 6901 et seq. 40 CFR Parts 258 & 261.2	No	Yes	No	Establishes definitions of solid wastes and establishes requirements for municipal solid waste landfills. Requirements may be relevant or appropriate for onsite repository design.
Off-site Disposal	40 CFR Part 300.440	Yes	No	No	Establishes criteria and procedures for determining whether facilities are acceptable for the receipt of CERCLA hazardous substances from response actions authorized or funded under CERCLA.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities	42 USC §§ 6924 & 6925 40 CFR Part 264.13.14 264	No	No	No	Requirements for proper handling, treatment, storage, and disposal of hazardous wastes. General regulations for the design, operation, and maintenance of hazardous waste treatment, storage, and disposal (TSD) facilities.
Closure Requirements	40 CFR Part 264, Subpart G	No	No	No	Closure of hazardous waste repositories must meet protective standards. Regulations to minimize contaminant migration, provide leachate collection and prevent contaminant exposure will be met.
Landfill Design and Construction	40 CFR Part 264, Subpart N	No	No	No	Hazardous waste landfills must meet minimum design standards.
Groundwater Monitoring	40 CFR Part 264, Subparts F & X	No	No	No	Establishes standards for detection and compliance monitoring.
Criteria for Municipal Solid Waste Landfills	40 CFR Part 258 40 CFR Part 257.3-1 through 257.3-4	No	Yes	No	Establishes criteria for municipal solid waste landfills. Criteria may be relevant or appropriate for repository design, if used. Defer to OAR 340-95.
Standards Applicable to Generation of Hazardous Waste	40 CFR Part 262	No	No	No	Establishes standards for the generation of hazardous waste. Exempt through 40 CFR Part 261.4(b)(7).
Land Disposal Restrictions (LDR)	40 CFR Part 268	No	Yes	No	LDRs place specific restrictions (conc. or trmt) on RCRA hazardous wastes prior to their placement in a land disposal unit. Relevant and appropriate LDR requirements will be met if any material accumulations are treated ex situ.
Disposal of Solid Waste Criteria for Classification of Solid Waste Disposal Facilities and Practices	42 USC §§ 6901 et seq. 40 CFR 257	No	Yes	No	Facility or practices in floodplains will not restrict flow of basic flood, reduce the temporary water storage capacity of the floodplain or otherwise result in a wash-out of solid waste. Establishes criteria for determining which solid waste disposal practices pose threats to human health and the environment. May be considered relevant and appropriate for any repository.
Invasive Species	Executive Order 13112	No	No	Yes	Prohibits federal agencies from taking actions that are likely to cause the introductions or spread of invasive species. A potential exists for the introduction of nonnative invasive species.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
STATE OF OREGON					
Oregon Mined Land Reclamation Rules	OAR 632-30	No	No	Yes	Regulates permitting of surface mining activities and specifies reclamation plan requirements as part of the permitting process. Though this is applicable to permitting of surface mining activities, minimum standards for reclamation will be considered.
Solid Waste: Land Disposal Sites other than MSW Landfills	OAR 340-95	No	Yes	No	Regulates the siting, operation and maintenance of any non-municipal land disposal site. Criteria may be relevant or appropriate for the siting of a repository.
Oregon Statutes on Solid Waste Disposal and Recycling	ORS 459-459A	No	No	No	Regulates the storage and handling of solid waste.
Oregon Hazardous Waste Regulations	OAR 340-100 to 340-135	No	No	No	Regulates the storage and handling of hazardous waste.
Storage, Treatment and Disposal of Hazardous Waste	ORS 466	No	No	No	Regulates the transportation and disposal of hazardous waste.
Standards for Owner and Operators of Hazardous Waste TSDF	OAR 340-104	No	No	No	Establishes minimum State standards which define the acceptable management of hazardous waste.
Oil and Hazardous Materials Spills and Releases	OAR 340-108	No	No	No	Specifies the reporting requirements, cleanup standards and liability that attaches to a spill or release or threatened spill or release involving oil or hazardous material. Specified cleanup standards of hazardous substances apply to removal actions.
Oregon Soil Cleanup Standards	OAR 340-122 ORS 465.200 through 465.455 and 465.900	No	Yes	No	Establish the standards and procedures to be used under Oregon's Environmental Cleanup Law (ORS 465.200 through 465.455 and 465.900) for the determination of removal and remedial actions necessary to assure protection of the present and future public health, safety and welfare, and the environment in the event of a release or threat of a release of a hazardous substance. Criteria may be relevant or appropriate for this site. However, USFS retains its CERCLA authority for work on this site.

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Regulations Pertaining to NPDES and WPCF Permits	OAR 340-45	No	Yes	No	Prescribe limitations on discharge of wastes and the requirements and procedures for obtaining NPDES and WPCF permits from the ODEQ. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Well Construction Standards	OAR 690-200 & 210	No	No	No	Provides well construction and maintenance and construction standards applicable to water wells. No site monitoring wells.
Water Control Regulations	OAR 340-045	No	Yes	No	Regulations and statutes governing water pollution control permits, and general storm water permits. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.

APPENDIX 10

Wetland Treatment Conceptual Design Documents

Memorandum

To: *Paul Hunter, P.G., Applied Intellect*

From: *Nick Anton, P.E., CDM Smith*

Date: *November 8, 2019*

Subject: *Blackjack and Bluebird Passive Treatment Sizing and Costs for EE/CA*

The purpose of this memorandum is to provide conceptual passive treatment system design and associated costs for the Blackjack and Bluebird mine adit discharges. The conceptual design and cost are being developed as part of the revised engineering evaluation/cost analysis (EE/CA) for these abandoned mine sites that are managed by the United States Forest Service in the Umatilla National Forests near Granite, Oregon. Previous EE/CAs were completed for both mine sites in 2005 by others (Science Applications International Corporation [SAIC] 2005a, 2005b). This memorandum presents a brief evaluation of the effectiveness of existing adit water management system (ponds and volunteer wetlands), conceptual passive treatment designs for both mine discharges, and planning-level costs estimates for design and construction.

1.0 Existing Adit Water Management

Adit water discharges at each mine site are currently managed by collection of water via a small dam within each adit tunnel, a discharge pipeline through each dam, and diversion to a series of open unlined ponds, volunteer wetlands, and infiltration channels/ponds. Water samples have been collected from adit discharges and subsequent ponds and presented in numerous reports over the last 2 decades, although water management conditions have changed over the years. Therefore, this current assessment only focuses on existing conditions.

1.1 Blackjack Mine

The Blackjack mine has an upper (main) adit that has near neutral pH with high iron and trace metals, while the lower adit is acidic but much lower flow. A limited amount of recent data is available on the effectiveness of metal removal in the water management ponds (e.g., samples collected from the outfall or end of the ponds). The Sludge Disposal Options memorandum (Cascade Earth Sciences [CES] 2015) indicated that the Blackjack settling ponds had a wet sludge volume of approximately 18,000 cubic feet (CF) or 134,640 gallons. At the adit flow rate of 75 gallons per minute (gpm) as measured in June 2019, this equates to approximately a 35-hour theoretical hydraulic retention time (HRT) if the ponds were empty of sludge and could contain this volume of water.

This HRT may be adequate to aerate the water and promote iron oxidation and sludge generation to a certain degree; however, based on recent sludge generation evaluation (CDM Smith 2019) that evaluated the rate and quantity of iron-based sludge generation, the degree of iron oxidation is kinetically limited and highly dependent on the pH of the water. Carbon dioxide degassing increases the water pH but the oxidation of ferrous to ferric iron decreases pH, which limits the kinetic sludge generation rate.

A revision to the sludge generation model in PHREEQC was recently completed for the passive treatment design task. The same references were used (King et al. 1995, Parkhurst and Appelo 2013), but a time-step model was developed to better evaluate the kinetic relationships between carbon dioxide degassing and iron oxidation impacts to solution pH. The model was set up using the RATES and KINETICS data blocks and a Basic subroutine to perform the kinetic modeling using 200 to 2,000 time steps. The ferrous/ferric equilibrium was decoupled by defining two new variables, "Fe_di" and "Fe_tri," to represent ferrous and ferric iron, respectively. All of the important iron aqueous species and iron oxyhydroxide solid were defined using the new variables. Amorphous iron oxyhydroxide was allowed to precipitate as the reaction proceeded. The solutions were assumed to be in equilibrium with atmospheric oxygen partial pressures (log ppO2 = -0.7) to simulate aeration via cascades, riffles, or other means. The solutions were assumed to be partially equilibrated with atmospheric carbon dioxide partial pressures (i.e., log pCO2-0.5).

The approach taken was more rigorous than that performed for the initial conditions calculations (CDM Smith 2019) in which the speciation was performed using PHREEQC and the kinetics using the King (1995) equations and a series of spreadsheets, with each spreadsheet representing a time step. Due to the large number of spreadsheets required to simulate the various remediation scenarios (200 to 2,000 spreadsheets each), it was necessary to incorporate the kinetic equations into PHREEQC.

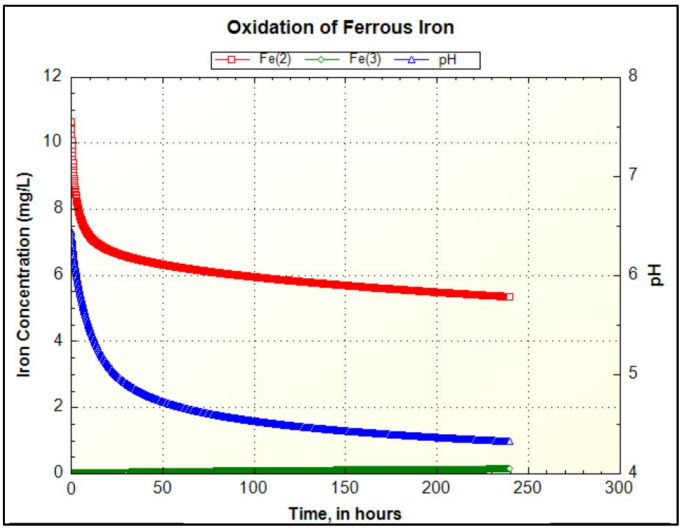


Exhibit 1. Blackjack Mine Ferrous Iron Oxidation and pH with No Alkalinity Addition

The model output shows that oxidation of ferrous iron based on the June 2019 data appears to have a greater decrease in pH than carbon dioxide degassing can offset, as illustrated in **Exhibit 1**. Oxidation of ferrous iron becomes asymptotic after approximately 2 days at about 6 milligrams per liter (mg/L), followed by several days of additional retention time needed to promote further sludge generation

A second run in the same model was implemented, but with equilibration with

calcite assumed to occur through reaction with a limestone treatment. This model output (**Exhibit 2**) shows that elevated pH could be maintained and the sludge generation rate greatly increased to within near complete removal after approximately 2 hours. Therefore, an additional source of alkalinity is recommended in a passive treatment scenario to offset this pH decrease and maintain the solution pH at a more near neutral level to kinetically promote iron sludge generation. This approach would have the added benefit of reducing the size of ponds and wetlands needed to settle and filter iron sludge. That said, these modeling results are for abiotic iron oxidation only and do not account for biological oxidation or other reactions (e.g., plant uptake).

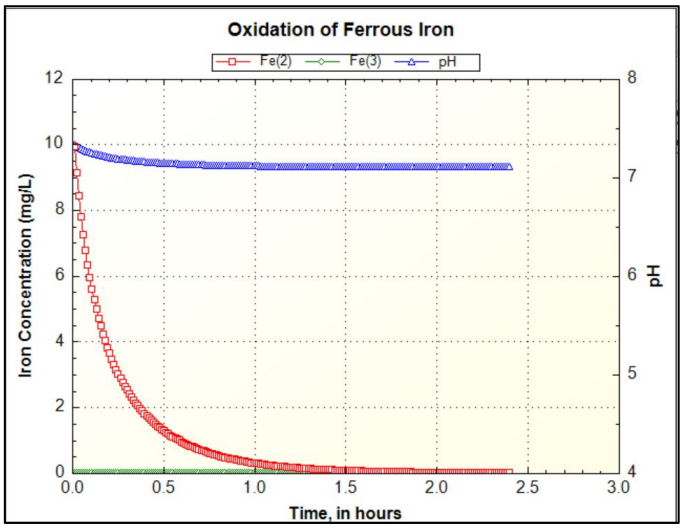


Exhibit 2. Blackjack Mine Ferrous Iron Oxidation and pH with Calcite Equilibrium

1.2 Bluebird Mine

Water management at the Bluebird mine has the added complexity of mixing with the acidic Red Boy mine discharge. The 2010 Post Removal Action Sampling Report (CES 2011) and Mining District Site Recon and Prioritization for Granite Creek Watershed, Oregon Report (Ecology and Environment [E&E] 2017) both have several samples collected along the flow path of the Bluebird and Red Boy combined water management ponds.

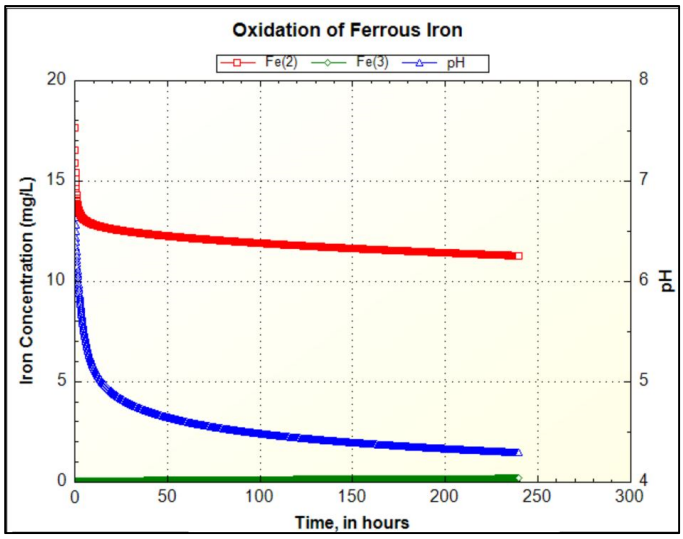


Exhibit 3. Bluebird Mine Ferrous Iron Oxidation and pH with No Alkalinity Addition

In general, both reports indicate that pH in the ponds decreases along the flow path regardless of the initial pH prior to the mixing point of the two discharges. E&E 2017 results show a decrease in pH from over 6 to less than 4 near the end of the settling ponds. CES 2011 has several results taken over a several-year period. Results in October 2008 through July 2010 show that the Red Boy discharge was acidic (less than 4) as it mixed with the Bluebird mine discharge, and water remained acidic throughout the remaining samples downstream. As a result of the two mine discharges mixing, samples collected along

the flow path through the Bluebird ponds has the influence of the Red Boy discharge and is not representative of the characteristics of the Bluebird mine by itself. As a result, conclusions about the effectiveness or size of the water management ponds cannot be made.

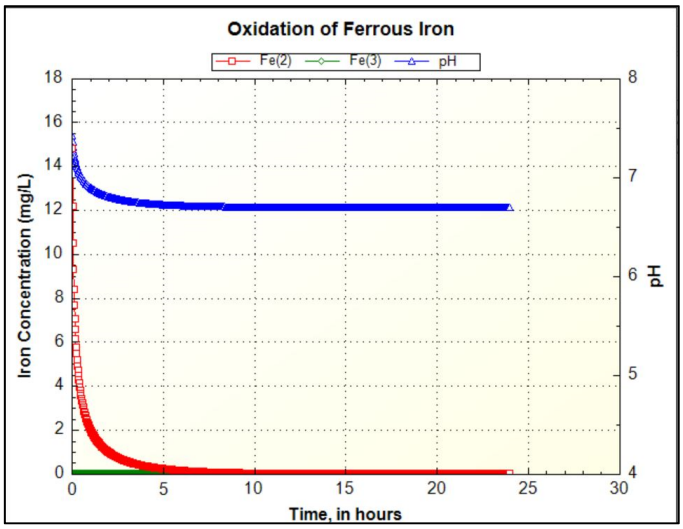


Exhibit 4. Bluebird Mine Ferrous Iron Oxidation and pH with Calcite Equilibrium

To better evaluate the impact of acidity produced by iron oxidation, the same analysis and PHREEQC modeling was completed as described above for the Blackjack mine. Initial pH and acidity are greater in the Bluebird water versus the Blackjack. The model output (**Exhibit 3**) shows that iron removal becomes asymptotic quickly (within a day) at about 13 mg/L, followed by several days required to promote much additional iron oxidation. In addition, results show that pH decreases to less than 5 with the first several hours.

The calcite equilibrium case shows similar results where a much faster ferrous iron oxidation occurs. Results (**Exhibit 4**) indicate that near complete oxidation occurs with 10 hours and pH remains stable near neutral. Therefore, an additional source of alkalinity is recommended in a passive treatment scenario to offset the pH decrease. That said, these modeling results are for abiotic iron oxidation only and do not account for biological oxidation or other reactions (e.g., plant uptake).

2.0 Passive Treatment Design

This section provides the basis for design, assumptions, and specific components of the passive treatment options for the Bluebird and Blackjack mines. Several assumptions common for both sites are listed first, followed by additional specifics (where applicable) for each mine and a summary of sizing.

2.1 Water Quality and Flow

Sample results from a June 2019 sampling event were used in the design analysis. Sample results are shown in **Table 1**.

Table 1. June 2019 Blackjack and Bluebird Adit Surface Water Analytical Data (mg/L unless noted)

Analyte	Blackjack		Bluebird	
	Total	Dissolved	Total	Dissolved
Laboratory Parameters				
Aluminum	0.56	0.4	< 0.08	< 0.08
Arsenic	< 0.025	< 0.025	< 0.025	< 0.025
Cadmium	< 0.002	< 0.002	< 0.002	< 0.002
Calcium	5.54	5.4	5.92	5.86
Chromium	< 0.006	< 0.006	< 0.006	< 0.006
Copper	0.0825	0.0702	< 0.01	< 0.01
Iron	11.8	10.9	22.8	19.7
Lead	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Magnesium	8.22	7.91	13.5	12.9
Manganese	2.24	2.2	7.01	6.95
Nickel	0.0871	0.0844	0.102	0.0989
Potassium	1.12	1.08	1.47	1.42
Selenium	< 0.04	< 0.04	< 0.04	< 0.04
Silicon	5.23	5	6.27	5.82
Silver	< 0.005	< 0.005	< 0.005	< 0.005
Sodium	2.83	2.74	2.78	2.73
Zinc	0.121	0.12	0.112	0.109
Mercury	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Acidity to pH 8.3	< 10	-	64.7	-
Alkalinity	7.3	-	12.1	-
Total Dissolved Solids	103	-	177	-
Chloride	0.47	-	0.6	-
Fluoride	0.109	-	0.185	-
Sulfate (as SO_4)	51.4	-	94	-
Field Parameters				
pH	6.03	-	6.5	-
Eh (millivolts)	0.2	-	-4	-
Specific conductivity (microS/cm)	163	-	260	-
Temperature (centigrade)	9.5	-	9.97	-
Dissolved oxygen (mg/L)	7.02	-	8.22	-
Flow (gpm)	75	-	60	-

2.2 Design Assumptions for Both Sites

- Utilized water quality and flow measured in June 2019 by Applied Intellect.

- Treatment basis of design utilized the recent sludge generation evaluation (CDM Smith 2019), additional PHREEQC modeling (as described above), and experience from other sites.

- Treatment goals are not well defined, such as whether discharge will need to meet strict Oregon Department of Environmental Quality chronic aquatic standards. Assuming these criteria could apply at some point in the future, the primary contaminants are elevated iron concentrations and trace concentrations of cadmium, copper, nickel, and zinc that may exceed criteria at certain times with no treatment. The passive treatment designs provided in this memorandum are intended to provide options that help to reduce iron concentrations and, in turn, may coprecipitate some of the trace metals, but are not intended to meet strict aquatic water quality standards without further design, analysis, and treatability testing.

- Treatment areas and topographic data are derived from Google Earth. Treatment areas were selected based on site inspections and recommendations by Applied Intellect. Approximate configurations of the treatment options are provided on Google Earth sketched maps. A lack of detailed topographic information (e.g., 1- to 2-foot contours) is available to adequately plan the location of ponds and channels or predict balances of cut and fill to build berms. Locations and configurations are meant to illustrate what could fit into the proposed treatment areas to achieve treatment goals.

- Redesign of adit water diversion piping to the proposed treatment areas are not included in this conceptual design or cost estimate.

- Gravity flow is assumed between each pond or channel. As noted above, inadequate information is available to design the treatment options to the level of detail needed to maintain positive gravity flow. Further design would determine the size and locations needed to maintain positive gravity flow.

- Ponds and channels are assumed to be constructed into the hillside in a way that can balance the cut and fill requirements. In addition, the hillslope present in the treatment areas is assumed to have enough surficial overburden that can be excavated to level out a bench area for pond construction, or in other words, the hillslope does not have near surface bedrock. Therefore, no off-site fill is assumed to be necessary. Should further design be conducted, other local fill borrow sources could be developed as needed for pond and channel berm construction.

- None of the ponds or channels in the passive treatment options are assumed to be lined with a low permeability liner to prevent infiltration. Not lining ponds and channels will likely lead to some infiltration of water to the subsurface along the treatment flow path, rather than containing and treating all water through the flow path that is collected from the adit discharges. This was assumed to reduce implementation costs and complexity of the project and assumed to be acceptable to have infiltration as a component of the water management approach for the sites.

- Riprap-lined channels are assumed between all treatment ponds or channel sections.

2.2.1 Successive Alkalinity Producing Systems

Optional successive alkalinity producing systems (SAPS) are provided in the design and costs that follow. These limestone-based treatment systems are recommended to provide the needed alkalinity to overcome the acidity produced by oxidation from ferrous to ferric iron. As discussed in Sections 1.1 and 1.2 above, without added alkalinity, pH may continue to decrease through the ponds/wetlands and lead to a lack of iron and, potentially, trace metal removal.

SAPS are constructed with a layer of limestone gravel overlain by a layer of organic material. These systems are most commonly utilized to reduce ferric to ferrous iron, increase alkalinity, and treat only trace levels of metals. The organic layer provides a reduced environment to reduce the iron oxidation state, followed by increasing alkalinity through the limestone layer to precipitate metals. By reducing the iron oxidation state, armoring of the limestone by ferric iron precipitates can be mitigated, allowing alkalinity to be added to the water. Assumptions are as follows:

- A standard design sizing approach for a SAPS is based on the acidity loading and assumed acidity removal rate of 40 grams acidity per meter squared per day (g acidity/m^2-day) (Younger et. al. 2002). However, this acidity removal rate is believed to be conservatively high and was originally intended for use as a primary treatment for a coal mine discharge to treat aluminium, iron, and manganese. Since these adit discharges do not have aluminum, the sizing requirements may be less. As a conservative base design for the EE/CA, the 40 g acidity/ m^2-day was assumed. If inadequate space is available for the proposed sizes, a faster acidity rate could be assumed to decrease the SAPS sizes. With treatability testing, it may be determined that the SAPS sizing requirement is much less.

- Each SAPS is assumed to consist of a limestone gravel layer (2 feet) overlain by an organic and inert gravel mixture (2 feet) and an upper infiltration gravel layer (0.5 feet). The SAPS is assumed to operate as a downflow cell to allow for periodic maintenance of iron precipitate sludge on the top of the cell.

- The organic layer is assumed to be a mixture of locally available materials including compost (50%), wood chips (25%), and inert gravel (25%) for structural support to minimize compaction.

- A 9-inch inert gravel layer is assumed to be placed on top of the organic layer to keep light materials from floating and provide a maintenance surface.

- A starting operational water depth of 1.25 feet above the inert gravel layer is assumed to provide driving head for the system. An additional 1.5 feet of freeboard is assumed in the pond above this water level. As substrate compacts and sludge accumulates over time, permeability decreases and a greater head is needed to force water through the substrate.

- Road berms are assumed on one end and one side of the SAPS ponds for maintenance. Sludge will accumulate over time on the surface of the SAPS and require periodic maintenance using a vacuum truck.
- 2:1 (H:V) side slopes are assumed for SAPS ponds. Since they will be mostly filled with substrate material, there are less risks for wildlife entrapment and/or human health and safety issues.
- Water will be collected using a perforated pipe array within the bottom of the limestone layer, connected to a solid wall pipe exiting the pond berm and connected to a water level control structure. For this project, the water level control structure is assumed to be a set riser pipe encased within a frost-free manhole to allow for year-round operations. Clean-out ports are also assumed for the effluent pipe array to allow for maintenance of sludge accumulation through hydraulic or pneumatic means.

2.2.2 Settling Ponds

Settling ponds are assumed needed right at the adit discharges and after the optional SAPS ponds. In either case, the ponds are intended to promote and contain iron-based precipitate sludge. Assumptions are as follows:

- Open settling ponds and aeration cascades are assumed to increase dissolved oxygen to near saturation in order to maximize sludge generation. Exact configuration of cascades, channels, piping, or other connections between ponds are not determined in this conceptual design.
- To provide for peak flow and maintenance capability (e.g., sludge removal), at least two settling ponds are assumed for each option. This approach allows for bypass of water flow around one pond to another, dewatering, and sludge removal.
- Road berms are assumed on one end and one side of the ponds for maintenance. Sludge will accumulate over time and require periodic maintenance using a vacuum truck.
- 3:1 (H:V) side slopes are assumed for open settling ponds rather than a steeper side wall for safety reasons. This approach makes the pond footprint larger but mitigates entrapment risks by wildlife and improves worker and construction safety.

2.2.3 Constructed Wetlands

Constructed wetlands are assumed to be placed last in the treatment system. Wetlands, in and of themselves, will provide additional filtration, aeration, and help to promote iron-based sludge production. Rather than rely solely on a vegetative wetland for treatment, the optional SAPS ponds are proposed prior to the wetlands.

- Wetlands are designed more as a series of channels rather than one or two ponds. This design approach utilizes aeration between each channel to the extent feasible based on actual

ground elevations. A series of stepped narrow channels may also be more appropriate than wider ponds for the terrain located along a hillslope.

- The design of passive treatment wetlands for mine discharges can be subjective in definition, highly dependent on the water quality and treatment goals and often based on experience from field studies. For the Bluebird and Blackjack mines, inadequate sulfate is present in the adit discharges to implement a sulfate reduction (anaerobic) based passive treatment system. Therefore, the wetland treatment is assumed to be aerobic-based and provide more of a filtration and coprecipitation treatment approach using growth medium and wetland plants. Aerobic wetlands are often utilized as a polishing treatment to an anaerobic system rather than the primary treatment.

- Based on a surface flow wetland sizing range provided by Kadlec (1996) for wastewater treatment, a sizing estimate of a 10- to 100-square-meter area per cubic meters per day flow could be assumed (Kadlec 1996). However, even on the low end of this estimate, the wetland size would need to be nearly an acre for the Blackjack mine, and three-quarters of acre for the Bluebird mine, based on June 2019 flows. Given the limited area for this type of wetland system, the aerobic wetland channel designs are based on available area for construction. Approximate HRTs for each site are calculated based on the assumed configuration that could fit into the treatment area.

- Channel sizes assumed a water depth of 3 feet, a bottom gravel/soil medium 18 inches thick with a 3-foot bottom width, and additional 6 inches of freeboard.

- Wetland channel side slopes were assumed at 2:1 (H:V) with a berm width of 4 feet on all sides.

- No liner is assumed to allow plant growth into the subgrade and some natural infiltration of treated water into the subsurface.

- Wetland plants are assumed to be from a combination of local transplants from nearby wetland environments, purchased plantings, and a riparian broadcast seed mix.

2.3 Blackjack Mine

Two treatment options were developed for sizing and costs, one with and one without the SAPS pond for alkalinity addition. Sizing worksheets and Mathcad calculation worksheets are provided in **Attachment 1**.

2.3.1 Option 1 Settling Ponds and Aerobic Wetland Channel

Limited space is available along the hillslope adjacent to the south of Clear Creek. **Figure 1** shows a potential configuration for two in-series open settling ponds and an aerobic wetland channel. A summary of the sizing for the system is provided in **Table 2**.

Table 2. Blackjack Mine Adit Water Passive Treatment Summary Option 1

Treatment Cell	Bottom Width (ft)	Bottom Length (ft)	Top Width (ft)	Top Length (ft)	Outside Berm Width (ft)	Outside Berm Length (ft)	Top Surface Area (SF)
Settling Pond 1	16	76	52	112	64	124	7,936
Settling Pond 2	16	76	52	112	64	124	7,936
Aerobic Wetland Channel	3	434	17	448	25	456	11,412

Treatment Cell	Approximate HRT (h)	Side Slopes	Operational Water Depth (ft)	Freeboard Depth (ft)
Settling Pond 1	48.0	3:1	5.0	1.0
Settling Pond 2	48.0	3:1	5.0	1.0
Aerobic Wetland Channel	6.5	2:1	3.0	0.5

ft – feet; SF – square feet; h - hours

Settling ponds are sized at an HRT of 48 hours each to provide a conservative amount of time and depth to settle and contain sludge. This is due to the lack of alkalinity in the adit water and slow iron oxidation times. The areas on **Figure 1** include 12-foot-wide road berms on one side and one end of each pond for maintenance access.

The wetland channel was configured with a series of stepped channels winding down the hillslope towards Clear Creek. This configuration may need to be modified to maintain positive gravity flow upon further analysis of site topography. The overall length was determined based on a sketch in Google Earth, and the approximate hydraulic retention time was calculated based on that total length and equivalent wetland volume.

2.3.2 Option 2 SAPS, Settling Ponds, and Aerobic Wetland Channel

Figure 2 shows a potential configuration for a settling pond 1, SAPS, settling pond 2, and an aerobic wetland channel. A summary of the sizing for the system is provided in **Table 3.**

Table 3. Blackjack Mine Adit Water Passive Treatment Summary Option 2

Treatment Cell	Bottom Width (ft)	Bottom Length (ft)	Top Width (ft)	Top Length (ft)	Outside Berm Width (ft)	Outside Berm Length (ft)	Top Surface Area (SF)
Settling Pond 1	4	19	40	55	52	67	3,484
SAPS	17	80	47	110	59	122	7,189
Settling Pond 2	4	19	40	55	52	67	3,484
Aerobic Wetland Channel	3	434	17	448	25	456	11,412

Table 3 (Cont.)

Treatment Cell	Approximate HRT (h)	Side Slopes	Operational Water Depth (ft)	Freeboard Depth (ft)
Settling Pond 1	12.0	3:1	5.0	1.0
SAPS	5.8	2:1	6.0	1.5
Settling Pond 2	12.0	3:1	5.0	1.0
Aerobic Wetland Channel	6.5	2:1	3.0	0.5

The first settling pond provides initial removal iron sludge, followed by a SAPS system in order to provide alkalinity to the system. This approach will result in some sludge formation on the surface of the SAPS, which over time, can impact the hydraulic head needed to force water through the substrate. In other words, the water level must increase in order to maintain positive flow as sludge accumulates. This sludge will need to be removed periodically to maintain permeability through the substrate and maintain the operational water level.

Settling ponds are sized for an average 12-hour HRT each. Although revised PHREEQC kinetic modeling shows iron will oxidize faster than 12 hours (24 hours total for two ponds), this is a conservative sizing and appears to be able to fit within the potential treatment area.

For simplicity, the same wetland configuration and sizing is assumed for Option 2 as in Option 1.

2.4 Bluebird Mine

More space is available for construction at the Bluebird mine compared to the Blackjack mine, and while the adit flow is lower, the acidity is greater. Treatment options presented herein are intended for the Bluebird mine adit only and do not include the Red Boy adit flow. If the Red Boy adit flow were intended to be included, relative sizes of treatment ponds and channels should be increased based on the added flow and added acidity. Sizing worksheets and Mathcad calculation worksheets are provided in **Attachment 1**.

2.4.1 Option 1 Settling Ponds and Aerobic Wetland Channel

Figure 3 shows a potential configuration for two in-series open settling ponds and an aerobic wetland channel for the Bluebird mine adit. A summary of the sizing for the system is provided in **Table 4**.

Table 4. Bluebird Mine Adit Water Passive Treatment Summary Option 1

Treatment Cell	Bottom Width (ft)	Bottom Length (ft)	Top Width (ft)	Top Length (ft)	Outside Berm Width (ft)	Outside Berm Length (ft)	Top Surface Area (SF)
Settling Pond 1	12	68	48	104	60	116	6,960
Settling Pond 2	12	68	48	104	60	116	6,960
Aerobic Wetland Channel	3	578	17	592	25	600	14,989

Table 4 (Cont.)

Treatment Cell	Approximate HRT (h)	Side Slopes	Operational Water Depth (ft)	Freeboard Depth (ft)
Settling Pond 1	48.0	3:1	5.0	1.0
Settling Pond 2	48.0	3:1	5.0	1.0
Aerobic Wetland Channel	10.8	2:1	3.0	0.5

The same design assumptions, including HRT, are used for Bluebird mine settling ponds for as for the Blackjack mine. Sizes are smaller due to the slower flow rate from the adit discharge.

The wetland channel was configured with a series of channels winding along the existing infiltration basin area. This configuration may need to be modified to maintain positive gravity flow upon further analysis of site topography. The overall length was determined based on a sketch in Google Earth, and the approximate hydraulic retention time was calculated based on that total length and equivalent wetland volume.

2.4.2 Option 2 SAPS, Settling Ponds, and Aerobic Wetland Channel

Figure 4 shows a potential configuration for a settling pond 1, SAPS, settling pond 2, and an aerobic wetland channel. A summary of the sizing for the system is provided in **Table 5**.

Table 5. Bluebird Mine Adit Water Passive Treatment Summary Option 2

Treatment Cell	Bottom Width (ft)	Bottom Length (ft)	Top Width (ft)	Top Length (ft)	Outside Berm Width (ft)	Outside Berm Length (ft)	Top Surface Area (SF)
Settling Pond 1	4	12	40	48	52	60	3,120
SAPS	32	134	62	164	74	176	13,030
Settling Pond 2	4	12	40	48	52	60	3,120
Aerobic Wetland Channel	3	578	17	592	25	600	14,989

Treatment Cell	Approximate HRT (h)	Side Slopes	Operational Water Depth (ft)	Freeboard Depth (ft)
Settling Pond 1	12.0	3:1	5.0	1.0
SAPS	18.9	2:1	6.0	1.5
Settling Pond 2	12.0	3:1	5.0	1.0
Aerobic Wetland Channel	10.8	2:1	3.0	0.5

The same design assumptions are used for the Bluebird SAPS and settling ponds as for the Blackjack mine. The resulting SAPS is much larger than the Blackjack mine due to the greater acidity in the adit water.

For simplicity, the same wetland configuration and sizing is assumed for Option 2 as in Option 1.

3.0 Cost Estimate

Costs were developed for each option and site for a total of four estimates. Cost worksheets are provided as **Attachment 2**. Worksheets provide a list of components, assumptions, quantities, unit rates, and total costs. A summary of rounded costs is provided in **Table 6**.

Table 6. Blackjack and Bluebird Passive Treatment Option Costs

Site	Option 1	Option 2
Blackjack mine	$42,800	$93,200
Bluebird mine	$56,800	$183,500

The following were assumed for the cost estimate:

- Unit rates for materials or construction aspects were obtained from other similar projects and escalated accordingly based on their original estimate date or as obtained from CostWorks 2019. The CostWorks location was assumed to be Bend, Oregon when referencing local costs.
- The cost estimate applies contingency (assumed to be a combined scope/bid contingency of 20%) after subtotaling the costs for major work activities. Scope contingency was applied to account for design changes between the design submittal phases. Bid contingency reflects the unknown costs associated with constructing a given project, such as adverse weather conditions, materials costs, or unfavorable market conditions.
- Percentages from Exhibit 5-8 in U.S. Environmental Protection Agency (EPA) 540-R-00-002 (EPA 2000) were utilized for potential additional costs that may be a part of the construction project, depending on contract structure and implementation approach.
    - Project management cost at 5% of the total cost for the option.
    - Remedial design cost at 12% of the total cost for the option.
    - Construction oversight and management cost at 6% of the total cost of the option.
- Costs for adit water diversion piping are not included in this estimate.
- Operations and maintenance costs are not included in this estimate.
- Excavation and regrade volumes were calculated using a version of the pond Mathcad sheets by entering pond bottom width and length and total pond depth. Additional volume was added for a portion of the downslope embankment or berm that would be needed to stabilize the pond and key into existing ground.
- To account for the existing ponds already in place at the Bluebird mine:

- Pond excavation and regrade volumes would be less than predicted by the above assumptions. Therefore, volumes are decreased by an estimated 25%. This percentage may vary upon further design.

- The exiting pond in the wetland channel area would be filled partly, followed by additional fill to form the channel shape. Fill is assumed to come from the existing mine piles adjacent to the pond. The cost for fill placement is assumed to be less than that for excavation and regrade.

- Large cost drivers for Option 2 for both mine sites are excavation and regrade volumes and substrate volumes. Relative sizes of the SAPS (and costs) could potentially decrease and still achieve a similar treatment result to increase alkalinity to a sufficient concentration.

4.0 References

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Figures

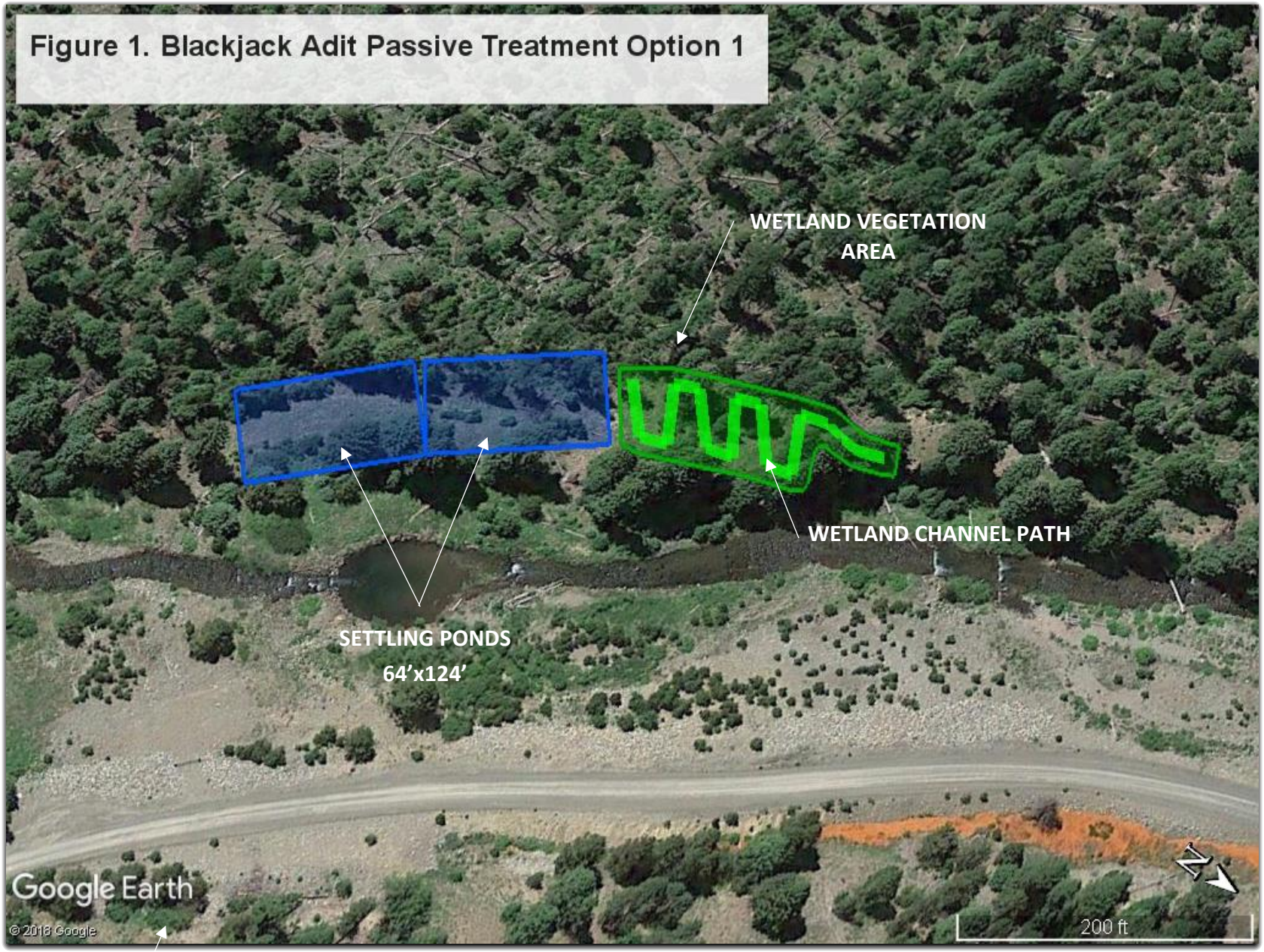
Figure 1. Blackjack Adit Passive Treatment Option 1

Figure 2. Bluebird Adit Passive Treatment Option 2
Figure 3. Blackjack Adit Passive Treatment Option 1
Figure 4. Bluebird Adit Passive Treatment Option 2

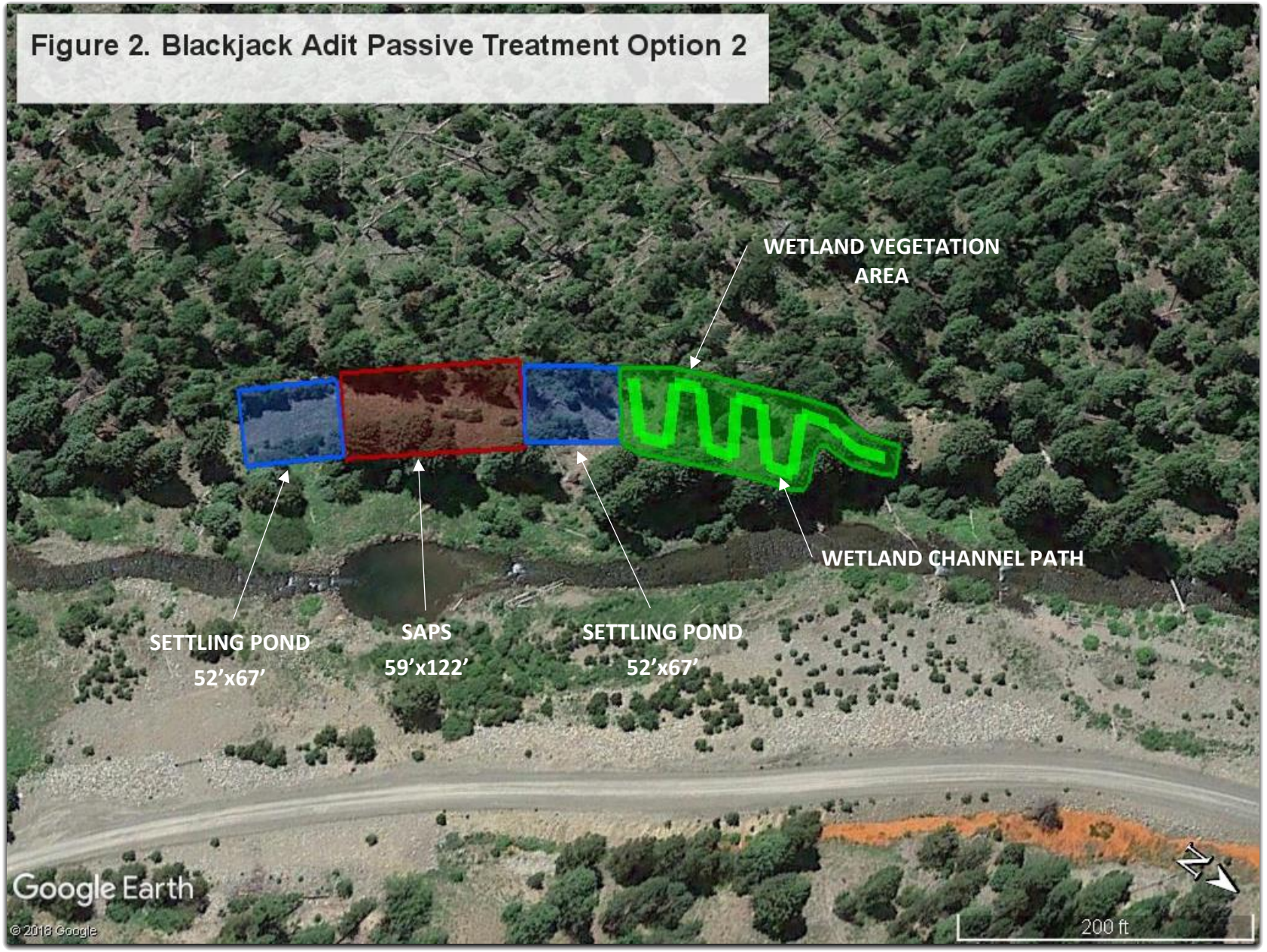
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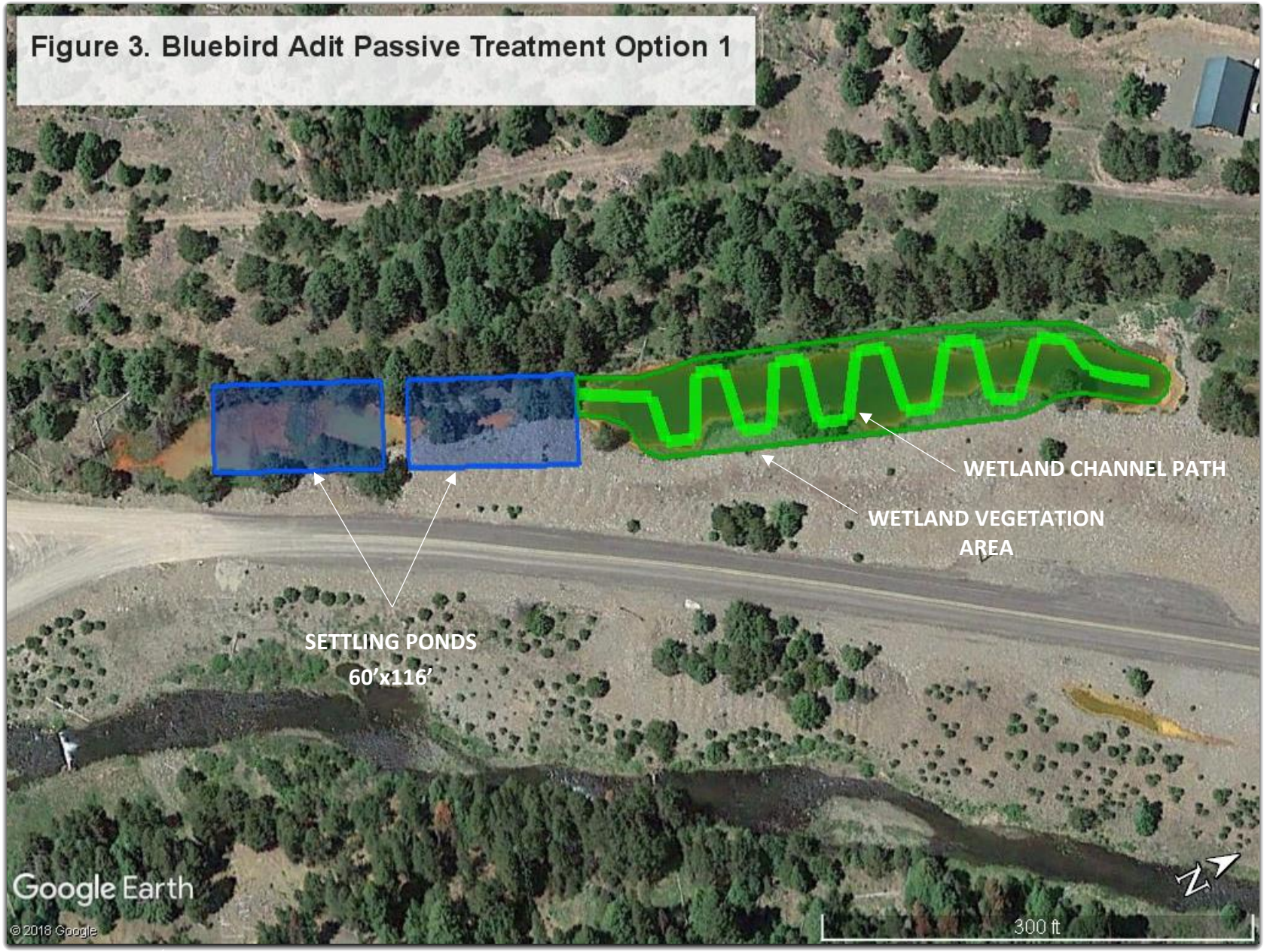
Attachment 1. Blackjack and Bluebird Passive Sizing Worksheets
Attachment 2. Blackjack and Bluebird Cost Estimate Worksheets

cc: Derek Wintle, CDM Smith

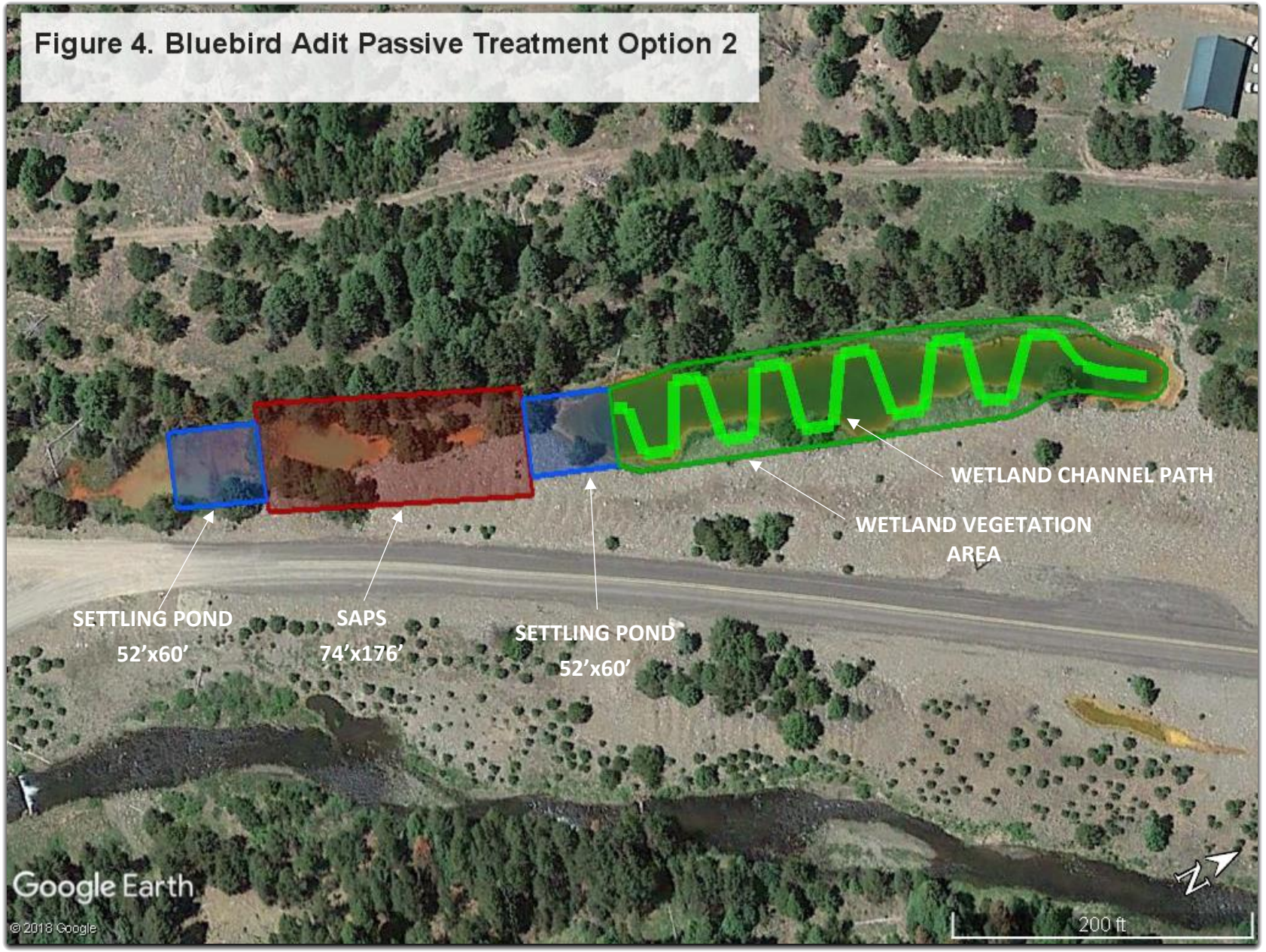

Figure 1. Blackjack Adit Passive Treatment Option 1
WETLAND VEGETATION AREA
WETLAND CHANNEL PATH
SETTLING PONDS
64'x124'
Google Earth
© 2018 Google
200 ft

CDM Smith


Figure 2. Blackjack Adit Passive Treatment Option 2
WETLAND VEGETATION AREA
WETLAND CHANNEL PATH
SETTLING POND 52'x67'
SAPS 59'x122'
SETTLING POND 52'x67'
Google Earth
© 2018 Google
200 ft


Figure 3. Bluebird Adit Passive Treatment Option 1
WETLAND CHANNEL PATH
WETLAND VEGETATION AREA
SETTLING PONDS
60'x116'
Google Earth
© 2018 Google
300 ft
N

CDM Smith


Figure 4. Bluebird Adit Passive Treatment Option 2
WETLAND CHANNEL PATH
WETLAND VEGETATION AREA
SETTLING POND 52'x60'
SAPS 74'x176'
SETTLING POND 52'x60'
Google Earth
© 2018 Google
200 ft
N

BlackJack Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

Settling Pond Sizing for Option 1

Hand-entered from Mathcad

Design Flow Rate 75.00 gpm
4.725 L/s

Item	Value	Unit	Comment
Settling Pond Sizing			
System Design Flow, Q_d	75.00	gpm	Design basis
Hydraulic Retention Time, t_{dp}	48.00	h	Assumption
Total Pond Volume , calculated	216,000.00	gal	Calculated from HRT and Q
Half of Pond Volume	108,000.00	gal	Assume two ponds in series to make up total volume needed
Pond water depth, D_{dp}	5.00	ft	Max design water surface
Bottom Width	**16.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Length	**76.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Area Check	**1,216.00**	**SF**	
Length/Width Ratio	4.75		
Side Slope	0.33		3:1 (H:V) - open pond max slope
Water Surface Width	46.00	ft	
Water Surface Length	106.00	ft	
Water Surface Area	4,876.00	SF	
Length/Width Ratio	2.30		Closer to 2:1 desired L:W to promote settling
Pond volume, mathcad, without freeboard	108,318.00	gal	hand entered from mathcad sheet
Freeboard depth	1.00	ft	
Total Depth	6.00	ft	includes freeboard
Side width (all sides)	18.00	ft	From bottom to top of pond
Top of Pond Width	**52.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Length	**112.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Area	**5,824.00**	**SF**	
Length/Width Ratio	2.15		
Max Pond Volume (includes freeboard)	148,294.00	gal	hand entered from mathcad sheet by modifying depth to top of pond
Berm/road width around pond	12.00	ft	Assumed width around one side and one end of pond
Top Width including berm top	**64.00**	ft	
Top Length including berm top	**124.00**	ft	
Total surface area of pond including berm	**7,936.00**	SF	

BlackJack Adit Process Sizing and Calculations
Settling Pond Sizing for Option 2

Green Cells can be modified to adjust sizing and costs
Hand-entered from Mathcad

Design Flow Rate 75.00 gpm
4.725 L/s

Item	Value	Unit	Comment
Settling Pond Sizing			
System Design Flow, Q_d	75.00	gpm	Design basis
Hydraulic Retention Time, t_{dp}	12.00	h	Assumption
Total Pond Volume , calculated	54,000.00	gal	Calculated from HRT and Q
Half of Pond Volume	27,000.00	gal	Assume two ponds in series to make up total volume needed
Pond water depth, D_{dp}	5.00	ft	Max design water surface
Bottom Width	**4.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Length	**19.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Area Check	**76.00**	**SF**	
Length/Width Ratio	4.75		
Side Slope	0.33		3:1 (H:V) - open pond max slope
Water Surface Width	34.00	ft	
Water Surface Length	49.00	ft	
Water Surface Area	1,666.00	SF	
Length/Width Ratio	1.44		Closer to 2:1 desired L:W to promote settling
Pond volume, mathcad, without freeboard	26,967.00	gal	hand entered from mathcad sheet
Freeboard depth	1.00	ft	
Total Depth	6.00	ft	includes freeboard
Side width (all sides)	18.00	ft	From bottom to top of pond
Top of Pond Width	**40.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Length	**55.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Area	**2,200.00**	**SF**	
Length/Width Ratio	1.38		
Max Pond Volume (includes freeboard)	41,382.00	gal	hand entered from mathcad sheet by modifying depth to top of pond
Berm/road width around pond	12.00	ft	Assumed width around one side and one end of pond
Top Width including berm top	**52.00**	ft	
Top Length including berm top	**67.00**	ft	
Total surface area of pond including berm	**3,484.00**	SF	

BlackJack Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

SAPS Sizing for Option 2

Design Flow Rate, full scale 75.00 gpm
4.7 L/s

Item	Value	Unit	Comment
SAPS sizing			
System Design Flow, Q_d	75.00	gpm	For sizing
Acidity removal rate	40.00	g acidity/ m^2-day	Area loading factor, Per Younger et al 2002, p 375 - Design basis per guidance
Influent Acidity	20.00	mg/L CaCO3	Measured >10 value is unlikely. Estimated based on acidity calculation.
Design area, mid-depth, per literature	**204.12**	**m2**	area of slice between organic layer and limestone layer (i.e., top of limestone)
=	**2,196.00**	**SF**	
SAPS limestone substrate depth	2.00	ft	Per Younger et al 2002, p 375
SAPS organic substrate depth	2.00	ft	Per Younger et al 2002, p 375
Top coarse inert gravel layer	0.75	ft	To keep organic layer contained and provide surface for sludge maintenance
Water depth over inert gravel layer	1.25	ft	Water depth to provide driving head
Operating pond depth (no freeboard)	6.00	ft	
Freeboard	1.50	ft	Extra depth to manage rain/snow and potential changes in hydraulic head
Total pond depth with freeboard	7.50	ft	
Side Slope	0.50		2:1 (H:V) (maximum water depth would be 3 feet)
Top width, limestone	25.00	ft	hand enter
Top length, limestone	87.84	ft	
Top limestone area	2,196.00	SF	
Length/Width Ratio	3.51		
Bottom Width pond	**17.00**	**ft**	
Bottom Length pond	**79.84**	**ft**	
Bottom Pond Area	**1,357.28**	**SF**	
Length/Width Ratio	4.70		
Top width, organic substrate	33.00	ft	
Top length, organic substrate	95.84	ft	
Area, top of organic substrate	3,162.73	SF	
Top of Pond Width	**47.00**	**ft**	
Top of Pond Length	**109.84**	**ft**	
Top of Pond Area	**5,162.49**	**SF**	
Length/Width Ratio	2.34		
Berm/road width around pond	12.00	ft	Assumed width around one side and one end of pond for access and maintenance
Top Width including berm top	**59.00**	**ft**	
Top Length including berm top	**121.84**	**ft**	
Total surface area of pond with berm	**7,188.57**	**SF**	
Effective porosity all substrate	0.40		Assumed based on previous projects
Volume substrate	8,784.02	CF	Assumed rectangular prism at top of limestone over limestone + organic depth
Hydraulic Retention Time, t_{BCR}	5.84	hr	$V_s = t_{BCR} * Q_d / \eta_s$ based on Darcy equation and flow, retention time, and porosity

BlackJack Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

Wetland Sizing for Option 1 and 2

Design Flow Rate 75.00 gpm
4.725 L/s

Aerobic Wetland Channel			
Pond water depth, D_{dp}	3.00	ft	Assumed depth include substrate media
Hydraulic Retention Time, t_{dp}	6.50	h	Set based on Google Earth sketch length
Detention Pond Area, A_{dp}	1,303.48	SF	$A_{dp} = t_{dp}*Q_d/D_{dp}$
Bottom Width	**3.00**	**ft**	bottom trapezoidal channel
Bottom Length	**434.49**	**ft**	total length based on retention time and that can fit in the area
Bottom Area	**1,303.48**	**SF**	
No. Wetland Sections	7		From Google Earth sketch
Length of each run	62.07	ft	Average including transition/cascade
Side Slope	0.50	NA	2:1 (H:V)
Water Surface Width	15.00	ft	
Water Surface Length	446.49	ft	
Water Surface Area	6,697.38	SF	
Freeboard	0.50	ft	
Total wetland depth to top of berm	3.50	ft	
Additional side width (all sides)	1.00	ft	
Top Width	17.00	ft	Drawn with ~ 20' spacing between channel lines
Top Length	448.49	ft	
Total surface area	**7,624.36**	**SF**	
Berm/road width around pond	4.00	ft	
Top Width including berm top	**25.00**	**ft**	
Top Length including berm top	**456.49**	**ft**	
Total surface area of pond including berm	**11,412.30**	**SF**	
Kadlec Wastewater Sizing (for reference)	10	m^2/m^3/day	low end of wetland sizing based on wastewater treatment
Design flow, coversion	408.24	m^3/day	
Design area	4082	m^2	minimum area needed based on wastewater principles
Design area, conversion	43920	SF	

Calculation Brief
Blackjack Adit Treatment Passive Treatment System
Pond Water Volume

1.0 Purpose/Objective

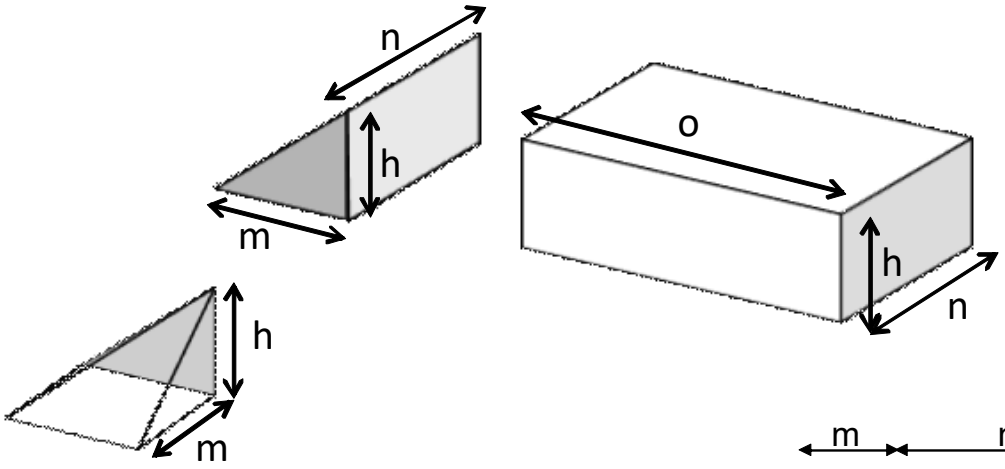
Calculate the operational pond water volumes for settling ponds at the Blackjack adit.

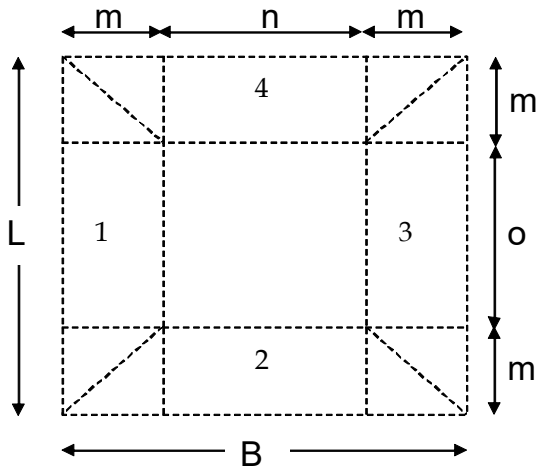
2.0 Procedure

- Utilize calculations for pond dimensions, area,side slopes, and pond depths.
- Calculate the excavation volumes for the treatment ponds.

3.0 References/Data Sources

The volume of a rectangular pond can be simplified by summing the volumes of a Pyramid, a Rectangular Prism and four Wedges. The shapes shown below can be flipped 180 degrees to represent a pond.





Volume Equations are defined below:

$V_{Pyramid} = 1/3\ (2m)^2\ h$

$V_{Wedge,1} = V_{Wedge,3} = 1/2\ h\ m\ o$

$V_{Wedge,2} = V_{Wedge,4} = 1/2\ h\ m\ n$

$V_{Rectangular\ Prism} = n*o*h$

$V_{total} = V_{Pyramid} + 2 * V_{Wedge,1} + 2 * V_{Wedge,2} + V_{Rectangular\ Prism}$

4.0 Assumptions

The pond dimensions are entered to achieve the desired water volume based on assumed hydraulic retention time design flow rate. Aproximate length and width dimensions were then chosen to approximate the calculated areas. These dimensions, along with pond depth are used to calculate volumes below.

5.0 Calculations

$CF := 7.48gal$ $CY := 27ft^3$ Unit Conversions

Volume of Pre-Treatment Oxidation/Sedimentation Pond Blackjack Option 1

Target volume of sedimentation pond for a 48 hour retention time is approximately 216,000 gallons based on 75 gpm maximum flow rate. Two ponds are assumed in series for purposes of estimating the surficial area. For each pond, the target water volume is approximately 108,000 gallons, not including freeboard (see spreadsheet). Calculation below is to determine the dimensions for the ponds to make up this total volume requirement.

$S_{pond0} := \frac{1}{3}$ Pond side slope is 3:1 (H:V)

$h_0 := 5ft$ Depth of operational water level in ponds

$n_0 := 16ft$

$o_0 := 76ft$ Length and width of bottom of pond

$m_0 := \frac{h_0}{S_{pond0}} = 15\,ft$

$B_0 := n_0 + 2 \bullet m_0 = 46\,ft$ $L_0 := o_0 + 2 \bullet m_0 = 106\,ft$

$$V_{total0} := \left[\left(\frac{1}{3}\right) \bullet (2 \bullet m_0)^2 \bullet h_0\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet n_0 \bullet h_0 \bullet m_0\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet o_0 \bullet h_0 \bullet m_0\right] + (n_0 \bullet h_0 \bullet o_0)$$

$V_{total0} = 14481 \bullet CF$ $V_{total0} = 108317.92 \bullet gal$

$V_{Total0T} := V_{total0} \bullet 2 = 216635.83\,gal$ Total volume is approximately 216,600 gallons

Volume of Pre-Treatment Oxidation/Sedimentation Pond Blackjack Option 2

Target volume of sedimentation pond for a 12 hour retention time is approximately 54,000 gallons based on 75 gpm maximum flow rate. Two ponds are assumed in series for purposes of estimating the surficial area. For each pond, the target water volume is approximately 27,000 gallons, not including freeboard (see spreadsheet). Calculation below is to determine the dimensions for the ponds to make up this total volume requirement.

$S_{pond1} := \frac{1}{3}$ Pond side slope is 3:1 (H:V)

$h_1 := 5ft$ Depth of operational water level in ponds

$n_1 := 4ft$

$o_1 := 19ft$ Length and width of bottom of pond

$m_1 := \frac{h_1}{S_{pond1}} = 15\,ft$

$B_1 := n_1 + 2 \bullet m_1 = 34\,ft$ $L_1 := o_1 + 2 \bullet m_1 = 49\,ft$

$$V_{total1} := \left[\left(\frac{1}{3}\right) \bullet (2 \bullet m_1)^2 \bullet h_1\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet n_1 \bullet h_1 \bullet m_1\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet o_1 \bullet h_1 \bullet m_1\right] + (n_1 \bullet h_1 \bullet o_1)$$

$V_{total1} = 3605.25 \bullet CF$ $V_{total1} = 26967.27 \bullet gal$

$V_{Total2} := V_{total1} \bullet 2 = 53934.54\,gal$ Total volume is approximately 54,000 gallons

6.0 Conclusions/Results

A summary of pond volumes are provided below for each pond.

$V_{Total0T} = 216635.83 \bullet gal$ Volume of water in influent oxidation/settling ponds for Option 1 with no SAPS

$V_{Total2} = 53934.54 \bullet gal$ Volume of water in influent oxidation/settling ponds for Option

Bluebird Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

Settling Pond Sizing for Option 1

Hand-entered from Mathcad

Design Flow Rate 60.00 gpm
3.78 L/s

Item	Value	Unit	Comment
Settling Pond Sizing			
System Design Flow, Q_d	60.00	gpm	Design basis
Hydraulic Retention Time, t_{dp}	48.00	h	
Total Pond Volume , calculated	172,800.00	gal	Calculated from HRT and Q
Half of Pond Volume	86,400.00	gal	Assume two ponds in series to make up total volume needed
Pond water depth, D_{dp}	5.00	ft	Max design water surface
Bottom Width	**12.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Length	**68.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Area Check	**816.00**	**SF**	
Length/Width Ratio	5.67		
Side Slope	0.33		3:1 (H:V) - open pond max slope
Water Surface Width	42.00	ft	
Water Surface Length	98.00	ft	
Water Surface Area	4,116.00	SF	
Length/Width Ratio	2.33		Closer to 2:1 desired L:W to promote settling
Pond volume, mathcad, without freeboard	86,624.00	gal	hand entered from mathcad sheet
Freeboard depth	1.00	ft	
Total Depth	6.00	ft	includes freeboard
Side width (all sides)	18.00	ft	From bottom to top of pond
Top of Pond Width	**48.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Length	**104.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Area	**4,992.00**	**SF**	
Length/Width Ratio	2.17		
Max Pond Volume (includes freeboard)	120,646.00	gal	hand entered from mathcad sheet by modifying depth to top of pond
Berm/road width around pond	12.00	ft	Assumed width around one side and one end of pond
Top Width including berm top	**60.00**	ft	
Top Length including berm top	**116.00**	ft	
Total surface area of pond including berm	**6,960.00**	SF	

Bluebird Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

Settling Pond Sizing for Option 2

Hand-entered from Mathcad

Design Flow Rate 60.00 gpm
3.78 L/s

Item	Value	Unit	Comment
Settling Pond Sizing			
System Design Flow, Q_d	60.00	gpm	Design basis
Hydraulic Retention Time, t_{dp}	12.00	h	
Total Pond Volume , calculated	43,200.00	gal	Calculated from HRT and Q
Half of Pond Volume	21,600.00	gal	Assume two ponds in series to make up total volume needed
Pond water depth, D_{dp}	5.00	ft	Max design water surface
Bottom Width	**4.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Length	**12.00**	**ft**	Based on Mathcad calculation to achieve required volume
Bottom Area Check	**48.00**	**SF**	
Length/Width Ratio	3.00		
Side Slope	0.33		3:1 (H:V) - open pond max slope
Water Surface Width	34.00	ft	
Water Surface Length	42.00	ft	
Water Surface Area	1,428.00	SF	
Length/Width Ratio	1.24		Closer to 2:1 desired L:W to promote settling
Pond volume, mathcad, without freeboard	21,993.00	gal	hand entered from mathcad sheet
Freeboard depth	1.00	ft	
Total Depth	6.00	ft	includes freeboard
Side width (all sides)	18.00	ft	From bottom to top of pond
Top of Pond Width	**40.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Length	**48.00**	**ft**	Rough dimensions for pond grading work
Top of Pond Area	**1,920.00**	**SF**	
Length/Width Ratio	1.20		
Max Pond Volume (includes freeboard)	34,470.00	gal	hand entered from mathcad sheet by modifying depth to top of pond
Berm/road width around pond	12.00	ft	Assumed width around one side and one end of pond
Top Width including berm top	**52.00**	ft	
Top Length including berm top	**60.00**	ft	
Total surface area of pond including berm	**3,120.00**	SF	

Bluebird Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

SAPS Sizing for Option 2

Design Flow Rate, full scale 60.00 gpm
3.8 L/s

Item	Value	Unit	Comment
SAPS sizing			
System Design Flow, Q_d	60.00	gpm	For sizing
Acidity removal rate	40.00	g acidity/ m^2-day	Area loading factor, Per Younger et al 2002, p 375 - Design basis per guidance
Influent Acidity	64.70	mg/L CaCO3	As measured
Design area, mid-depth, per literature	**528.26**	**m2**	area of slice between organic layer and limestone layer (i.e., top of limestone)
=	**5,683.26**	**SF**	
SAPS limestone substrate depth	2.00	ft	Per Younger et al 2002, p 375
SAPS organic substrate depth	2.00	ft	Per Younger et al 2002, p 375
Top coarse inert gravel layer	0.75	ft	To keep organic layer contained and provide surface for sludge maintenance
Water depth over inert gravel layer	1.25	ft	Water depth to provide driving head
Operating pond depth (no freeboard)	6.00	ft	
Freeboard	1.50	ft	Extra depth to manage rain/snow and potential changes in hydraulic head
Total pond depth with freeboard	7.50	ft	
Side Slope	0.50		2:1 (H:V) (maximum water depth would be 3 feet)
Top width, limestone	40.00	ft	hand enter
Top length, limestone	142.08	ft	
Top limestone area	5,683.26	SF	
Length/Width Ratio	3.55		
Bottom Width pond	**32.00**	**ft**	
Bottom Length pond	**134.08**	**ft**	
Bottom Pond Area	**4,290.61**	**SF**	
Length/Width Ratio	4.19		
Top width, organic substrate	48.00	ft	
Top length, organic substrate	150.08	ft	
Area, top of organic substrate	7,203.91	SF	
Top of Pond Width	**62.00**	**ft**	
Top of Pond Length	**164.08**	**ft**	
Top of Pond Area	**10,173.05**	**SF**	
Length/Width Ratio	2.65		
Extra berm height to anchor liner	0.00	ft	N/A Not lined
Additional side width (all sides)	0.00	ft	N/A Not lined
Top width at inside of pond berm	62.00	ft	N/A Not lined
Top length at inside of pond berm	164.08	ft	N/A Not lined
Berm/road width around pond	12.00	ft	Assumed width around one side and one end of pond for access and maintenance
Top Width including berm top	**74.00**	**ft**	
Top Length including berm top	**176.08**	**ft**	
Total surface area of pond with berm	**13,030.03**	**SF**	
Effective Porosity all substrate	0.40		Assumed based on previous projects
Volume substrate	22,733.04	CF	Assumed rectangular prism at top of limestone over limestone + organic depth
Hydraulic Retention Time, t_{BCR}	18.89	hr	$V_s = t_{BCR} * Q_d / \eta_s$ based on Darcy equation and flow, retention time, and porosity

Bluebird Adit Process Sizing and Calculations

Green Cells can be modified to adjust sizing and costs

Wetland Sizing for Option 1 and 2

Design Flow Rate 60.00 gpm
3.78 L/s

Aerobic Wetland Channel			
Pond water depth, D_{dp}	3.00	ft	
Hydraulic Retention Time, t_{dp}	10.80	h	Set based on Google Earth sketch length
Detention Pond Area, A_{dp}	1,732.62	SF	$A_{dp} = t_{dp}*Q_d/D_{dp}$
Bottom Width	**3.00**	**ft**	bottom trapezoidal channel
Bottom Length	**577.54**	**ft**	total length based on retention time and that can fit in the area
Bottom Area	**1,732.62**	**SF**	
No. Wetland Sections	11		From Google Earth sketch
Length of each run	52.50	ft	Average including transition/cascade
Side Slope	0.50	NA	2:1 (H:V)
Water Surface Width	15.00	ft	
Water Surface Length	589.54	ft	
Water Surface Area	8,843.10	SF	
Freeboard	0.50	ft	
Total wetland depth to top of berm	3.50	ft	
Additional side width (all sides)	1.00	ft	
Top Width	17.00	ft	Drawn with ~ 20' spacing between channel lines
Top Length	591.54	ft	
Total surface area	**10,056.18**	**SF**	
Berm/road width around pond	4.00	ft	
Top Width including berm top	**25.00**	**ft**	
Top Length including berm top	**599.54**	**ft**	
Total surface area of pond including berm	**14,988.50**	**SF**	
Kadlec Wastewater Sizing (for reference)	10	m^2/m^3/day	low end of wetland sizing based on wastewater treatment
Design flow, coversion	326.592	m^3/day	
Design area	3266	m^2	minimum area needed based on wastewater principles
Design area, conversion	35136	SF	

Calculation Brief
Bluebird Adit Treatment Passive Treatment System
Pond Water Volume

1.0 Purpose/Objective

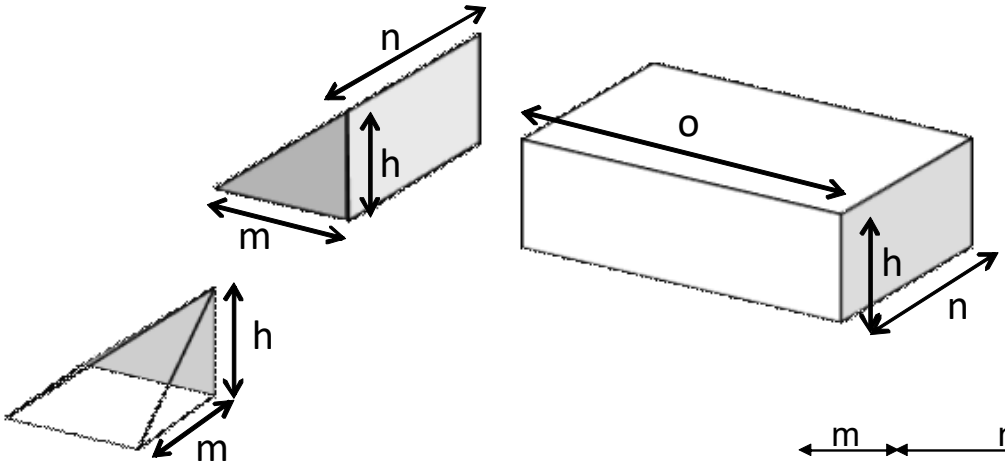
Calculate the operational pond water volumes for settling ponds at the Bluebird adit.

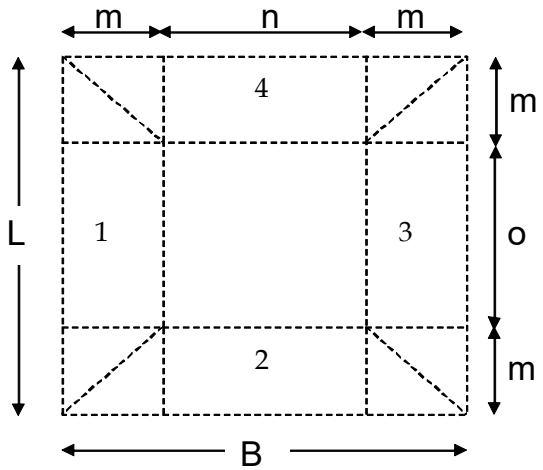
2.0 Procedure

- Utilize calculations for pond dimensions, area,side slopes, and pond depths.
- Calculate the excavation volumes for the treatment ponds.

3.0 References/Data Sources

The volume of a rectangular pond can be simplified by summing the volumes of a Pyramid, a Rectangular Prism and four Wedges. The shapes shown below can be flipped 180 degrees to represent a pond.





Volume Equations are defined below:

$V_{Pyramid} = 1/3\ (2m)^2\ h$

$V_{Wedge,1} = V_{Wedge,3} = 1/2\ h\ m\ o$

$V_{Wedge,2} = V_{Wedge,4} = 1/2\ h\ m\ n$

$V_{Rectangular\ Prism} = n*o*h$

$V_{total} = V_{Pyramid} + 2 * V_{Wedge,1} + 2 * V_{Wedge,2} + V_{Rectangular\ Prism}$

4.0 Assumptions

The pond dimensions are entered to achieve the desired water volume based on assumed hydraulic retention time design flow rate. Aproximate length and width dimensions were then chosen to approximate the calculated areas. These dimensions, along with pond depth are used to calculate volumes below.

5.0 Calculations

$CF := 7.48gal$ $CY := 27ft^3$ Unit Conversions

Volume of Pre-Treatment Oxidation/Sedimentation Pond Bluebird Option 1

Target volume of sedimentation pond for a 48 hour retention time is approximately 172,800 gallons based on 60 gpm maximum flow rate. Two ponds are assumed in series for purposes of estimating the surficial area. For each pond, the target water volume is approximately 86,400 gallons, not including freeboard (see spreadsheet). Calculation below is to determine the dimensions for the ponds to make up this total volume requirement.

$S_{pond0} := \frac{1}{3}$ Pond side slope is 3:1 (H:V)

$h_0 := 5ft$ Depth of operational water level in ponds

$n_0 := 12ft$

$o_0 := 68ft$ Length and width of bottom of pond

$m_0 := \frac{h_0}{S_{pond0}} = 15\,ft$

$B_0 := n_0 + 2 \bullet m_0 = 42\,ft$ $L_0 := o_0 + 2 \bullet m_0 = 98\,ft$

$$V_{total0} := \left[\left(\frac{1}{3}\right) \bullet (2 \bullet m_0)^2 \bullet h_0\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet n_0 \bullet h_0 \bullet m_0\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet o_0 \bullet h_0 \bullet m_0\right] + (n_0 \bullet h_0 \bullet o_0)$$

$V_{total0} = 11580.8 \bullet CF$ $V_{total0} = 86624.41 \bullet gal$

$V_{Total0T} := V_{total0} \bullet 2 = 173248.82\,gal$ Total volume is approximately 173,200 gallons

Volume of Pre-Treatment Oxidation/Sedimentation Pond Bluebird Option 2

Target volume of sedimentation pond for a 12 hour retention time is approximately 43,200 gallons based on 60 gpm maximum flow rate. Two ponds are assumed in series for purposes of estimating the surficial area. For each pond, the target water volume is approximately 21,600 gallons, not including freeboard (see spreadsheet). Calculation below is to determine the dimensions for the ponds to make up this total volume requirement.

$S_{pond1} := \frac{1}{3}$ Pond side slope is 3:1 (H:V)

$h_1 := 5ft$ Depth of operational water level in ponds

$n_1 := 4ft$

$o_1 := 12ft$ Length and width of bottom of pond

$m_1 := \frac{h_1}{S_{pond1}} = 15\,ft$

$B_1 := n_1 + 2 \bullet m_1 = 34\,ft$ $L_1 := o_1 + 2 \bullet m_1 = 42\,ft$

$$V_{total1} := \left[\left(\frac{1}{3}\right) \bullet (2 \bullet m_1)^2 \bullet h_1\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet n_1 \bullet h_1 \bullet m_1\right] + 2 \bullet \left[\left(\frac{1}{2}\right) \bullet o_1 \bullet h_1 \bullet m_1\right] + (n_1 \bullet h_1 \bullet o_1)$$

$V_{total1} = 2940.2 \bullet CF$ $V_{total1} = 21992.73 \bullet gal$

$V_{Total2} := V_{total1} \bullet 2 = 43985.45\,gal$ Total volume is approximately 44,000 gallons

6.0 Conclusions/Results

A summary of pond volumes are provided below for each pond.

$V_{Total0T} = 173248.82 \bullet gal$ Volume of water in influent oxidation/settling ponds for Option 1 with no SAPS

$V_{Total2} = 43985.45 \bullet gal$ Volume of water in influent oxidation/settling ponds for Option

Blackjack Cost Summary

Component	Comment	Quantity	Unit	Unit Cost	Total
Option 1					
Settling Ponds					
Excavation and Consolidation Volume	From mathcad calculation at total pond depth + embankment	1,970	CY	$ 6	$ 11,820
Riprap for influent channel	2 ft deep X 12 ft wide X 10 ft long	9	CY	$ 52	$ 462
Riprap channel between ponds	2 ft deep X 12 ft wide X 20 ft long	18	CY	$ 52	$ 924
Access Road Gravel	One side and one end of each pond at 4" deep	56	CY	$ 19	$ 1,058
Seeding	Disturbed areas around ponds for erosion control	0.50	AC	$ 1,800	$ 907
Wetland Channels					
Excavation and Consolidation Volume	Cross sectional area X total length	560	CY	$ 6	$ 3,360
Growth media	Cross sectional area of growth media X total length	110	CY	$ 39	$ 4,290
Inert filter gravel	Cross sectional area of growth media X total length	30	CY	$ 42	$ 1,260
Vegetation transplants and seeding	Approximate area within and surrounding wetland channels	0.30	AC	$ 10,000	$ 3,000
Riprap cascade between each channel	2 ft deep X 12 ft wide X 10 ft long (X7)	62	CY	$ 52	$ 3,236
Other					
Clear and grub for site	Estimated from Google Earth	1.0	AC	$ 5,000	$ 5,000
Additional access road gravel	From creek to first pond, 12' wide, 4" deep	20.0	CY	$ 19	$ 380
Subtotal:					***$ 35,698***
Contingency (Scope and Bid)				20%	$ 7,140
Subtotal with Contingency:					***$ 42,837***
Additional Costs per EPA Guidance					
Project Management				5%	$ 2,142
Remedial Design				12%	$ 5,140
Construction Management				6%	$ 2,570
Subtotal of Additional Costs:					***$ 9,853***
Additional Cost Contingency (Scope and Bid)				20%	$ 1,971
Total:					**$ 54,660**

Blackjack Cost Summary

Component	Comment	Quantity	Unit	Unit Cost	Total
Option 2					
SAPS					
Excavation and Consolidation Volume	From mathcad calculation at total pond depth + embankment	2,030	CY	$ 6	$ 12,180
Riprap for influent channel	2 ft deep X 12 ft wide X 10 ft long	9	CY	$ 52	$ 462
SAPS substrate	Includes all materials, delivery, mixing, and placement	390	CY	$ 39	$ 15,210
Level control structure and piping	Includes perforated and solid pipe, valves, and structure	1	LS	$ 6,500	$ 6,500
Access Road Gravel	One side and one end the pond at 4" deep	27	CY	$ 19	$ 509
Settling Ponds					
Excavation and Consolidation Volume	From mathcad calculation at total pond depth + embankment	570	CY	$ 6	$ 3,420
Riprap for influent channel	2 ft deep X 12 ft wide X 10 ft long	9	CY	$ 52	$ 462
Riprap channel between ponds	2 ft deep X 12 ft wide X 20 ft long	18	CY	$ 52	$ 924
Access Road Gravel	One side and one end of each pond at 4" deep	35	CY	$ 19	$ 670
Wetland Channels					
Excavation and Consolidation Volume	Cross sectional area X total length	560	CY	$ 6	$ 3,360
Growth media	Cross sectional area of growth media X total length	110	CY	$ 39	$ 4,290
Inert filter gravel	Cross sectional area of growth media X total length	30	CY	$ 42	$ 1,260
Vegetation transplants and seeding	Approximate area within and surrounding wetland channels	0.30	AC	$ 10,000	$ 3,000
Riprap cascade between each channel	2 ft deep X 12 ft wide X 10 ft long (X7)	62	CY	$ 52	$ 3,236
Other					
Clear and grub for site	Estimated from Google Earth	1.0	AC	$ 5,000	$ 5,000
Additional access road gravel	From creek to first pond, 12' wide, 4" deep	20.0	CY	$ 19	$ 380
Seeding	Disturbed areas around ponds for erosion control	0.50	AC	$ 1,800	$ 907
Subtotal:					***$ 60,863***
Contingency (Scope and Bid)				20%	$ 12,173
Subtotal with Contingency:					***$ 73,036***
Additional Costs per EPA Guidance					
Project Management				5%	$ 3,652
Remedial Design				12%	$ 8,764
Construction Management				6%	$ 4,382
Subtotal of Additional Costs:					***$ 16,798***
Additional Cost Contingency (Scope and Bid)				20%	$ 3,360
Total:					**$ 93,194**

Bluebird Cost Summary

Component	Comment	Quantity	Unit	Unit Cost	Total
Option 1					
Settling Ponds					
Excavation and Consolidation Volume	From mathcad calculation at total pond depth + embankment	1,250	CY	$ 6	$ 7,500
Riprap for influent channel	2 ft deep X 12 ft wide X 10 ft long	9	CY	$ 52	$ 462
Riprap channel between ponds	2 ft deep X 12 ft wide X 20 ft long	18	CY	$ 52	$ 924
Access Road Gravel	One side and one end of each pond at 4" deep	52	CY	$ 19	$ 991
Seeding	Disturbed areas around ponds for erosion control	0.30	AC	$ 1,800	$ 540
Wetland Channels					
Fill volume to build wetland embankments	Existing pond area X 2 ft + Channel embankment X total length	1,680	CY	$ 3	$ 5,040
Growth media	Cross sectional area of growth media X total length	150	CY	$ 39	$ 5,850
Inert filter gravel	Cross sectional area of growth media X total length	40	CY	$ 42	$ 1,680
Vegetation transplants and seeding	Approximate area within and surrounding wetland channels	0.60	AC	$ 10,000	$ 6,000
Riprap between each channel	2 ft deep X 12 ft wide X 10 ft long (X11)	98	CY	$ 52	$ 5,084
Other					
Clear and grub for site	Estimated from Google Earth	0.60	AC	$ 5,000	$ 3,000
Subtotal:					***$ 37,072***
Contingency (Scope and Bid)				20%	$ 7,414
Subtotal with Contingency:					***$ 44,486***
Additional Costs per EPA Guidance					
Project Management				5%	$ 2,224
Remedial Design				12%	$ 5,338
Construction Management				6%	$ 2,669
Subtotal of Additional Costs:					***$ 10,232***
Additional Cost Contingency (Scope and Bid)				20%	$ 2,046
Total:					**$ 56,765**

Bluebird Cost Summary

Component	Comment	Quantity	Unit	Unit Cost	Total
Option 2					
SAPS					
Excavation and Consolidation Volume	From mathcad calculation at total pond depth + embankment	3,260	CY	$ 6	$ 19,560
Riprap for influent channel	2 ft deep X 12 ft wide X 10 ft long	9	CY	$ 52	$ 462
SAPS substrate	Includes all materials, delivery, mixing, and placement	980	CY	$ 39	$ 38,220
Level control structure and piping	Includes perforated and solid pipe, valves, and structure	1	LS	$ 7,500	$ 7,500
Access Road Gravel	One side and one end the pond at 4" deep	37	CY	$ 19	$ 704
Settling Ponds					
Excavation and Consolidation Volume	From mathcad calculation at total pond depth + embankment	4,120	CY	$ 6	$ 24,720
Riprap for influent channel	2 ft deep X 12 ft wide X 10 ft long	9	CY	$ 52	$ 462
Riprap channel between ponds	2 ft deep X 12 ft wide X 20 ft long	18	CY	$ 52	$ 924
Access Road Gravel	One side and one end of each pond at 4" deep	33	CY	$ 19	$ 631
Wetland Channels					
Fill volume to build wetland embankments	Existing pond area X 2 ft + Channel embankment X total length	1,680	CY	$ 3	$ 5,040
Growth media	Cross sectional area of growth media X total length	150	CY	$ 39	$ 5,850
Inert filter gravel	Cross sectional area of growth media X total length	40	CY	$ 42	$ 1,680
Vegetation transplants and seeding	Approximate area within and surrounding wetland channels	0.60	AC	$ 10,000	$ 6,000
Riprap between each channel	2 ft deep X 12 ft wide X 10 ft long (X7)	98	CY	$ 52	$ 5,084
Other					
Clear and grub for site	Estimated from Google Earth	0.60	AC	$ 5,000	$ 3,000
Seeding	Disturbed areas around ponds for erosion control	0.30	AC	$ 1,800	$ 540
Subtotal:					***$ 119,838***
Contingency (Scope and Bid)				20%	$ 23,968
Subtotal with Contingency:					***$ 143,805***
Additional Costs per EPA Guidance					
Project Management				5%	$ 7,190
Remedial Design				12%	$ 17,257
Construction Management				6%	$ 8,628
Subtotal of Additional Costs:					***$ 33,075***
Additional Cost Contingency (Scope and Bid)				20%	$ 6,615
Total:					**$ 183,496**

APPENDIX 11

Detailed Cost Summary of Proposed Alternatives

Alternative 2 - Remove Sludge to an On-Site Repository

			Task 1 Repository Design		Task 2 Preparation of Repository Bid Specifications		Task 3 Preparation of Ponds Access (2 days)		Task 4 Preparation of Work Plan & HASP		Task 5 Mobilization-Demobilization (3 days)		Task 6 Repository Construction & Pond Prep. Cost (3 days)		Task 7 Sludge Removal to Repository +Closure (15 + 3 days)		Task 8 Preparation of O&M Plan		Task 9 Project Closeout & Report		PROJECT TOTALS	
Labor Categories	**Labor Rate**	**Units**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**
Program Manager	$135.00	/hr	4	$540.00	2	$270.00	4	$540.00	4	$540.00	8	$1,080.00	8	$1,080.00	24	$3,240.00	4	$540.00	8	$1,080.00	66	$8,910.00
Project Manager	$120.00	/hr	8	$960.00	4	$480.00	2	$240.00	8	$960.00	4	$480.00	4	$480.00	8	$960.00	4	$480.00	2	$240.00	44	$5,280.00
Senior Engineer/PE	$130.00	/hr	24	$3,120.00	8	$1,040.00	16	$2,080.00	8	$1,040.00	14	$1,820.00	30	$3,900.00	90	$11,700.00	4	$520.00	40	$5,200.00	234	$30,420.00
Geotechnical Engineer/PE	$130.00	/hr	16	$2,080.00	8	$1,040.00	16	$2,080.00	8	$1,040.00	0	$0.00	0	$0.00	4	$520.00	0	$0.00	4	$520.00	56	$7,280.00
Engineer	$95.00	/hr	24	$2,280.00	16	$1,520.00	0	$0.00	24	$2,280.00	24	$2,280.00	30	$2,850.00	180	$17,100.00	24	$2,280.00	40	$3,800.00	362	$34,390.00
Senior Geologist	$120.00	/hr	8	$960.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$960.00
Geologist	$90.00	/hr	16	$1,440.00	4	$360.00	4	$360.00	4	$360.00	4	$360.00	0	$0.00	4	$360.00	0	$0.00	0	$0.00	36	$3,240.00
Chemist	$95.00	/hr	4	$380.00	0	$0.00	0	$0.00		$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00
Toxicologist	$125.00	/hr	0	$0.00	0	$0.00	0	$0.00	4	$500.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$500.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	0	$0.00	4	$500.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$500.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	0	$0.00	0	$0.00	0	$0.00	4	$520.00	8	$1,040.00	0	$0.00	8	$1,040.00	0	$0.00	2	$260.00	22	$2,860.00
Field Technician	$60.00	/hr	24	$1,440.00	0	$0.00	0	$0.00		$0.00		$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	24	$1,440.00
Draftsperson	$60.00	/hr	24	$1,440.00	4	$240.00	0	$0.00	16	$960.00	4	$240.00	0	$0.00	8	$480.00	4	$240.00	8	$480.00	68	$4,080.00
Admin/Clerical	$45.00	/hr	8	$360.00	4	$180.00	4	$180.00	8	$360.00	4	$180.00	4	$180.00	8	$360.00	4	$180.00	8	$360.00	52	$2,340.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	4	$360.00	0	$0.00	8	$720.00	4	$360.00	8	$720.00	0	$0.00	0	$0.00	24	$2,160.00
Labor Cost Subtotal			**160**	**$15,000.00**	**50**	**$5,130.00**	**50**	**$5,840.00**	**92**	**$9,060.00**	**78**	**$8,200.00**	**80**	**$8,850.00**	**342**	**$36,480.00**	**44**	**$4,240.00**	**112**	**$11,940.00**	**1008**	**$104,740.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	4	$400.00	0	$0.00	2	$200.00	0	$0.00	6	$600.00	6	$600.00	25	$2,500.00	0	$0.00	0	$0.00		$4,300.00
Gasoline	$0.25	/mile	400	$100.00	0	$0.00	400	$100.00	0	$0.00	1,100	$275.00	1000	$250.00	3000	$750.00	0	$0.00	0	$0.00		$1,475.00
Airfare	$600.00	/rt	1	$600.00	0	$0.00	1	$600.00	0	$0.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,800.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	2	$50.00	0	$0.00	0	$0.00	5	$125.00	0	$0.00	0	$0.00	0	$0.00		$175.00
Per Diem	$151.00	/day	5	$755.00	0	$0.00	4	$604.00	0	$0.00	5	$755.00	6	$906.00	23	$3,473.00	0	$0.00	0	$0.00		$6,493.00
PPE	$15.00	/day	0	$0.00	0	$0.00	4	$60.00	0	$0.00	5	$75.00	6	$90.00	23	$345.00	0	$0.00	0	$0.00		$570.00
LAB-Soil	$100.00	/ea	3	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,000.00	0	$0.00	0	$0.00		$1,000.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,000.00	0	$0.00	0	$0.00		$1,300.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	5	$900.00	0	$0.00	0	$0.00		$1,900.00
LAB-Geotechnical	$1,000.00	/ea	2	$2,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$2,000.00
Field Equipment	$200.00	/day	1	$200.00	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$400.00
Digital camera	$5.00	/day	4	$20.00	0	$0.00	4	$20.00	0	$0.00	4	$20.00	6	$30.00	23	$115.00	0	$0.00	0	$0.00		$205.00
Shipping	$100.00	/ea	2	$250.00	0	$0.00	2	$200.00	0	$30.00	1	$100.00	2	$200.00	5	$500.00	1	$0.00	0	$0.00		$1,280.00
Document Charges	$50.00	/ea	2	$100.00	5	$250.00	0	$0.00	5	$300.00	1	$50.00	0	$0.00	1	$50.00	0	$0.00	0	$0.00		$750.00
Photocopies	$0.10	/ea	100	$10.00	250	$25.00	50	$5.00	250	$25.00	100	$10.00	50	$5.00	100	$10.00	200	$20.00	400	$40.00		$150.00
Satellite phone	$25.50	/day	4	$102.00	0	$0.00	2	$51.00	0	$0.00	3	$76.50	3	$76.50	18	$459.00	0	$0.00	0	$0.00		$765.00
Miscellaneous		LS	1	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,000.00
Direct Cost Subtotal				**$6,837.00**		**$275.00**		**$1,890.00**		**$355.00**		**$2,761.50**		**$2,282.50**		**$11,102.00**		**$20.00**		**$40.00**		**$25,563.00**
Fee		15%		$1,025.55		$41.25		$283.50		$53.25		$414.23		$342.38		$1,665.30		$3.00		$6.00		$3,834.45
Total Direct Costs				**$7,862.55**		**$316.25**		**$2,173.50**		**$408.25**		**$3,175.73**		**$2,624.88**		**$12,767.30**		**$23.00**		**$46.00**		**$29,397.45**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Repository Excavation (for existing sludge)			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Mobe-Demobe	$14,800.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$14,800.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$14,800.00
Excavation	$7,365.00	/day	0	$0.00	0	$0.00	2	$14,730.00	0	$0.00	0	$0.00	5	$36,825.00	15	$110,475.00	0	$0.00	0	$0.00		$162,030.00
Sludge Removal (for existing sludge)	$10,865.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	15	$162,975.00	0	$0.00	0	$0.00		$162,975.00
Materials	$1,600.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	15	$24,000.00	0	$0.00	0	$0.00		$24,000.00
Repository closeout (for existing sludge)			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Soil Cover	$5,565.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	3	$16,695.00	0	$0.00	0	$0.00		$16,695.00
Geosythetic Material (installed)	$20.00	/sy	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	333	$6,660.00	0	$0.00	0	$0.00		$6,660.00
Fencing	$30.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	250	$7,500.00	0	$0.00	0	$0.00		$7,500.00
Revegetation	$2,000.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$2,000.00	0	$0.00	0	$0.00		$2,000.00
Geotechnical sampling	$1,000.00	/ea	2	$2,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$2,000.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00
Subcontractors Subtotal				**$7,000.00**		**$0.00**		**$14,730.00**		**$0.00**		**$14,800.00**		**$36,825.00**		**$330,305.00**		**$0.00**		**$0.00**		**$403,660.00**
Fee		15%		$1,050.00		$0.00		$2,209.50		$0.00		$2,220.00		$5,523.75		$49,545.75		$0.00		$0.00		$60,549.00
Total Subcontract				**$8,050.00**		**$0.00**		**$16,939.50**		**$0.00**		**$17,020.00**		**$42,348.75**		**$379,850.75**		**$0.00**		**$0.00**		**$464,209.00**
TOTAL COST				**$30,912.55**		**$5,446.25**		**$24,953.00**		**$9,468.25**		**$28,395.73**		**$53,823.63**		**$429,098.05**		**$4,263.00**		**$11,986.00**		**$598,346.45**

Alternative 3 - Remove Sludge to an Off-Site Repository

			Task 1 Preparation of Ponds Access Design		Task 2 Preparation of Work Plan & HASP		Task 3 Mobilization-Demobilization (3 days)		Task 4 Pond Access Prep. Cost (2 days)		Task 5 Sludge Removal to Off-Site Repository (15 days)		Task 8 Preparation of O&M Plan		Task 9 Project Closeout & Report		PROJECT TOTALS	
Labor Categories	**Labor Rate**	**Units**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**
Program Manager	$135.00	/hr	2	$270.00	2	$270.00	8	$1,080.00	4	$540.00	24	$3,240.00	4	$540.00	4	$540.00	48	$6,480.00
Project Manager	$120.00	/hr	4	$480.00	4	$480.00	4	$480.00	2	$240.00	24	$2,880.00	4	$480.00	2	$240.00	44	$5,280.00
Senior Engineer/PE	$130.00	/hr	4	$520.00	4	$520.00	14	$1,820.00	16	$2,080.00	75	$9,750.00	4	$520.00	20	$2,600.00	137	$17,810.00
Geotechnical Engineer/PE	$130.00	/hr	4	$520.00	2	$260.00	0	$0.00	16	$2,080.00	8	$1,040.00	0	$0.00	2	$260.00	32	$4,160.00
Engineer	$95.00	/hr	16	$1,520.00	16	$1,520.00	24	$2,280.00	0	$0.00	150	$14,250.00	16	$1,520.00	24	$2,280.00	246	$23,370.00
Geologist	$90.00	/hr	2	$180.00	2	$180.00	4	$360.00	4	$360.00	4	$360.00	0	$0.00	0	$0.00	16	$1,440.00
Toxicologist	$125.00	/hr	0	$0.00	4	$500.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$500.00
Risk Assessor	$125.00	/hr	0	$0.00	4	$500.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$500.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	0	$0.00	4	$520.00	8	$1,040.00	0	$0.00	8	$1,040.00	0	$0.00	2	$260.00	22	$2,860.00
Draftsperson	$60.00	/hr	4	$240.00	8	$480.00	4	$240.00	0	$0.00	8	$480.00	4	$240.00	4	$240.00	32	$1,920.00
Admin/Clerical	$45.00	/hr	4	$180.00	4	$180.00	4	$180.00	4	$180.00	8	$360.00	4	$180.00	4	$180.00	32	$1,440.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	8	$720.00	4	$360.00	8	$720.00	0	$0.00	0	$0.00	20	$1,800.00
Labor Cost Subtotal			**40**	**$3,910.00**	**54**	**$5,410.00**	**78**	**$8,200.00**	**50**	**$5,840.00**	**317**	**$34,120.00**	**36**	**$3,480.00**	**62**	**$6,600.00**	**637**	**$67,560.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	0	$0.00	0	$0.00	6	$600.00	2	$200.00	28	$2,800.00	0	$0.00	0	$0.00		$3,600.00
Gasoline	$0.25	/mile	0	$0.00	0	$0.00	1,100	$275.00	400	$100.00	2800	$700.00	0	$0.00	0	$0.00		$1,075.00
Airfare	$600.00	/rt	0	$0.00	0	$0.00	1	$600.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00		$1,200.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	0	$0.00	2	$50.00	0	$0.00	0	$0.00	0	$0.00		$50.00
Per Diem	$151.00	/day	0	$0.00	0	$0.00	5	$755.00	4	$604.00	28	$4,228.00	0	$0.00	0	$0.00		$5,587.00
PPE	$15.00	/day	0	$0.00	0	$0.00	5	$75.00	4	$60.00	23	$345.00	0	$0.00	0	$0.00		$480.00
LAB-Soil	$100.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,000.00	0	$0.00	0	$0.00		$1,000.00
LAB-Water	$100.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,000.00	0	$0.00	0	$0.00		$1,000.00
LAB-Waste Profile	$180.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,800.00	0	$0.00	0	$0.00		$1,800.00
Field Equipment	$200.00	/day	0	$0.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$200.00
Digital camera	$5.00	/day	0	$0.00	0	$0.00	4	$20.00	4	$20.00	28	$140.00	0	$0.00	0	$0.00		$180.00
Shipping	$100.00	/ea	0	$0.00	0	$30.00	1	$100.00	2	$200.00	5	$500.00	1	$0.00	0	$0.00		$830.00
Document Charges	$50.00	/ea	2	$100.00	2	$300.00	1	$50.00	0	$0.00	1	$50.00	0	$0.00	0	$0.00		$500.00
Photocopies	$0.10	/ea	100	$10.00	100	$10.00	100	$10.00	50	$5.00	200	$20.00	200	$20.00	400	$40.00		$115.00
Satellite phone	$25.50	/day	0	$0.00	0	$0.00	3	$76.50	2	$51.00	15	$382.50	0	$0.00	0	$0.00		$510.00
Direct Cost Subtotal				**$110.00**		**$340.00**		**$2,761.50**		**$1,890.00**		**$12,965.50**		**$20.00**		**$40.00**		**$18,127.00**
Fee		15%		$16.50		$51.00		$414.23		$283.50		$1,944.83		$3.00		$6.00		$2,719.05
Total Direct Costs				**$126.50**		**$391.00**		**$3,175.73**		**$2,173.50**		**$14,910.33**		**$23.00**		**$46.00**		**$20,846.05**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Repository Excavation (for existing sludge)			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Mobe-Demobe	$12,800.00	LS	0	$0.00	0	$0.00	1	$12,800.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$12,800.00
Excavation	$5,510.00	/day	0	$0.00	0	$0.00	0	$0.00	2	$11,020.00	0	$0.00	0	$0.00	0	$0.00		$11,020.00
Sludge Removal (for existing sludge	$9,065.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	15	$135,975.00	0	$0.00	0	$0.00		$135,975.00
Materials	$1,600.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	15	$24,000.00	0	$0.00	0	$0.00		$24,000.00
Offsite Disposal			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Transport	$1,200.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	15	$18,000.00	0	$0.00	0	$0.00		$18,000.00
Tipping Fee	$2,052.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	15	$30,780.00	0	$0.00	0	$0.00		$30,780.00
Subcontractors Subtotal				**$0.00**		**$0.00**		**$12,800.00**		**$11,020.00**		**$208,755.00**		**$0.00**		**$0.00**		**$232,575.00**
Fee		15%		$0.00		$0.00		$1,920.00		$1,653.00		$31,313.25		$0.00		$0.00		$34,886.25
Total Subcontract				**$0.00**		**$0.00**		**$14,720.00**		**$12,673.00**		**$240,068.25**		**$0.00**		**$0.00**		**$267,461.25**
TOTAL COST				**$4,036.50**		**$5,801.00**		**$26,095.73**		**$20,686.50**		**$289,098.58**		**$3,503.00**		**$6,646.00**		**$355,867.30**

Alternative 4 - Upgrade Sludge Ponds at Blackjack Mine

			Task 1 Limited Repository and Pond Designs		Task 2 Preparation of Bid Specifications		Task 3 Preparation of Work Plan & HASP		Task 4 Mobilization-Demobilization (3 days)		Task 5 Repository(ies) Construction Cost (2 days)		Task 6 Pond and Dam Improvement (3 days)		Task 7 Debris Removal to Repository +Closure (3 + 2 days)		Alternative Task 7 Bluebird Pond North Repository Use (3 days)		Task 8 Preparation of O&M Plan		Task 9 Project Closeout & Report		Task 10 Polylog Box (1 day)		Task 11 Relocated Pipeline (7 days)		PROJECT 4 TOTALS		ALTERNATIVE PROJECT 4a TOTALS	
Labor Categories	**Labor Rate**	**Units**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**
Program Manager	$135.00	/hr	4	$540.00	4	$540.00	2	$270.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	4	$540.00	8	$1,080.00	1	$135.00	8	$1,080.00	63	$8,505.00	63	$8,505.00
Project Manager	$120.00	/hr	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	8	$960.00	4	$480.00	4	$480.00	4	$480.00	0	$0.00	4	$480.00	44	$5,280.00	40	$4,800.00
Senior Engineer/PE	$130.00	/hr	16	$2,080.00	8	$1,040.00	4	$520.00	24	$3,120.00	20	$2,600.00	30	$3,900.00	50	$6,500.00	30	$3,900.00	4	$520.00	40	$5,200.00	2	$260.00	35	$4,550.00	233	$30,290.00	213	$27,690.00
Geotechnical Engineer/PE	$130.00	/hr	16	$2,080.00	4	$520.00	2	$260.00	0	$0.00	10	$1,300.00	0	$0.00	4	$520.00	30	$3,900.00	0	$0.00	2	$260.00	10	$1,300.00	4	$520.00	52	$6,760.00	78	$10,140.00
Engineer	$95.00	/hr	16	$1,520.00	16	$1,520.00	16	$1,520.00	24	$2,280.00	0	$0.00	30	$2,850.00	50	$4,750.00	24	$2,280.00	16	$1,520.00	40	$3,800.00	10	$950.00	70	$6,650.00	288	$27,360.00	262	$24,890.00
Senior Geologist	$120.00	/hr	4	$480.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$480.00	4	$480.00
Geologist	$90.00	/hr	4	$360.00	2	$180.00	2	$180.00	4	$360.00	2	$180.00	0	$0.00	4	$360.00	4	$360.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	26	$2,340.00	26	$2,340.00
Hydrologist	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	8	$720.00	8	$720.00
Chemist	$95.00	/hr	4	$380.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00	4	$380.00
Biologist	$85.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$680.00	8	$680.00	8	$680.00
Toxicologist	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00	2	$250.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00	2	$250.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	0	$0.00	0	$0.00	2	$260.00	4	$520.00	0	$0.00	0	$0.00	4	$520.00	0	$0.00	0	$0.00	2	$260.00	0	$0.00	2	$260.00	14	$1,820.00	10	$1,300.00
Draftsperson	$60.00	/hr	8	$480.00	8	$480.00	8	$480.00	2	$120.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$240.00	8	$480.00	2	$120.00	4	$240.00	44	$2,640.00	44	$2,640.00
Admin/Clerical	$45.00	/hr	4	$180.00	4	$180.00	4	$180.00	2	$90.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	2	$90.00	4	$180.00	40	$1,800.00	40	$1,800.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$360.00	0	$0.00	8	$720.00	8	$720.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	20	$1,800.00	20	$1,800.00
Labor Cost Subtotal			**80**	**$8,580.00**	**50**	**$4,940.00**	**48**	**$4,650.00**	**72**	**$8,050.00**	**52**	**$6,180.00**	**76**	**$8,490.00**	**140**	**$15,590.00**	**112**	**$12,900.00**	**36**	**$3,480.00**	**108**	**$11,740.00**	**27**	**$2,855.00**	**163**	**$16,800.00**	**852**	**$91,355.00**	**824**	**$88,665.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	2	$200.00	0	$0.00	0	$0.00	3	$300.00	6	$600.00	6	$600.00	10	$1,000.00	6	$600.00	0	$0.00	0	$0.00	2	$200.00	14	$1,400.00		$4,300.00		$3,900.00
Gasoline	$0.25	/mile	400	$100.00	0	$0.00	0	$0.00	1,500	$375.00	600	$150.00	600	$150.00	1400	$350.00	600	$150.00	0	$0.00	0	$0.00	200	$50.00	2300	$575.00		$1,750.00		$1,550.00
Airfare	$600.00	/rt	0	$0.00	0	$0.00	0	$0.00	1	$600.00	1	$600.00	0	$0.00	1	$600.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,800.00		$1,800.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$25.00	1	$25.00	0	$0.00	1	$25.00	0	$0.00	0	$0.00	0	$0.00	1	$25.00		$75.00		$100.00
Per Diem	$151.00	/day	5	$755.00	0	$0.00	0	$0.00	6	$906.00	6	$906.00	6	$906.00	10	$1,510.00	6	$906.00	0	$0.00	0	$0.00	2	$302.00	14	$2,114.00		$7,399.00		$6,795.00
PPE	$15.00	/day	0	$0.00	0	$0.00	0	$0.00	6	$90.00	6	$90.00	6	$90.00	10	$150.00	6	$90.00	0	$0.00	0	$0.00	0	$0.00	14	$210.00		$630.00		$570.00
LAB-Soil	$100.00	/ea	3	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$100.00	4	$400.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$500.00		$100.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$500.00		$300.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$180.00	2	$360.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,540.00		$1,180.00
LAB-Geotechnical	$1,000.00	/ea	1	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,000.00		$1,000.00
Field Equipment	$200.00	/day	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$200.00		$200.00
Digital camera	$5.00	/day	2	$10.00	0	$0.00	0	$0.00	6	$30.00	6	$30.00	6	$30.00	10	$50.00	6	$30.00	0	$0.00	0	$0.00	2	$10.00	14	$70.00		$230.00		$210.00
Shipping	$100.00	/ea	1	$250.00	0	$0.00	0	$30.00	3	$300.00	1	$100.00	1	$100.00	2	$200.00	1	$0.00	1	$0.00	0	$0.00	0	$0.00	2	$200.00		$1,180.00		$980.00
Document Charges	$50.00	/ea	1	$50.00	1	$50.00	1	$300.00	3	$150.00	0	$0.00	1	$50.00	1	$50.00	0	$0.00	0	$0.00	0	$0.00	1	$50.00	1	$50.00		$750.00		$700.00
Photocopies	$0.10	/ea	100	$10.00	100	$10.00	100	$10.00	200	$20.00	50	$5.00	200	$20.00	200	$20.00	100	$10.00	200	$20.00	400	$40.00	20	$2.00	200	$20.00		$177.00		$167.00
Satellite phone	$25.50	/day	2	$51.00	0	$0.00	0	$0.00	3	$76.50	3	$76.50	3	$76.50	5	$127.50	3	$76.50	0	$0.00	0	$0.00	1	$25.50	7	$178.50		$612.00		$561.00
Miscellaneous		LS	1	$200.00	0	$0.00	0	$0.00	1	$500.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$700.00		$700.00
Direct Cost Subtotal				**$3,926.00**		**$60.00**		**$340.00**		**$3,547.50**		**$2,582.50**		**$2,327.50**		**$5,017.50**		**$2,487.50**		**$20.00**		**$40.00**		**$639.50**		**$4,842.50**		**$23,343.00**		**$20,813.00**
Fee		15%		$588.90		$9.00		$51.00		$532.13		$387.38		$349.13		$752.63		$373.13		$3.00		$6.00		$95.93		$726.38		$3,501.45		$3,121.95
Total Direct Costs				**$4,514.90**		**$69.00**		**$391.00**		**$4,079.63**		**$2,969.88**		**$2,676.63**		**$5,770.13**		**$2,860.63**		**$23.00**		**$46.00**		**$735.43**		**$5,568.88**		**$26,844.45**		**$23,934.95**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Repository/Basin Exc. or dam constr.			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00		$0.00
Mobe-Demobe	$13,300.00	LS	0	$0.00	0	$0.00	0	$0.00	1	$13,300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$13,300.00		$13,300.00
Excavation	$8,865.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$17,730.00	2	$17,730.00	3	$26,595.00	3	$26,595.00	0	$0.00	0	$0.00	0	$0.00	7	$62,055.00		$124,110.00		$124,110.00
Repository closeout			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00		$0.00
Soil Cover	$5,565.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$11,130.00	0	$0.00	2	$11,130.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$22,260.00		$11,130.00
Geosythetic Material	$20.00	/sy	0	$0.00	0	$0.00	0	$0.00	0	$0.00	205	$4,100.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$4,100.00		$4,100.00
Fencing	$30.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	200	$6,000.00	0	$0.00	200	$6,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$12,000.00		$6,000.00
Revegetation	$2,000.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$2,000.00	0	$0.00	1	$2,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$4,000.00		$2,000.00
Pipeline Rerouting	$20.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	660	$13,200.00		$13,200.00		$13,200.00
Excavating	$3,710.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$3,710.00	7	$25,970.00		$29,680.00		$29,680.00
			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	Box	$5,000.00	0	$0.00		$5,000.00		$5,000.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00		$5,000.00
Subcontractors Subtotal				**$5,000.00**		**$0.00**		**$0.00**		**$13,300.00**		**$40,960.00**		**$17,730.00**		**$45,725.00**		**$26,595.00**		**$0.00**		**$0.00**		**$8,710.00**		**$109,225.00**		**$240,650.00**		**$221,520.00**
Fee		15%		$750.00		$0.00		$0.00		$1,995.00		$6,144.00		$2,659.50		$6,858.75		$3,989.25		$0.00		$0.00		$1,306.50		$16,383.75		$36,097.50		$33,228.00
Total Subcontract				**$5,750.00**		**$0.00**		**$0.00**		**$15,295.00**		**$47,104.00**		**$20,389.50**		**$52,583.75**		**$30,584.25**		**$0.00**		**$0.00**		**$10,016.50**		**$125,608.75**		**$276,747.50**		**$254,748.00**
TOTAL COST				**$18,844.90**		**$5,009.00**		**$5,041.00**		**$27,424.63**		**$56,253.88**		**$31,556.13**		**$73,943.88**		**$46,344.88**		**$3,503.00**		**$11,786.00**		**$13,606.93**		**$147,977.63**		**$394,946.95**		**$367,347.95**

Note: Yellow Highlight indicates Tasks required for Alternative 4a only, disposal od excavated debris in the Bluebid Pond North rather than a constructed Repository.

Alternative 5 - Upgrade Sludge Ponds at Bluebird Mine

Labor Categories	Labor Rate	Units	Task 1 Llimited Repository Design Hours	Task 1 Cost	Task 2 Preparation of Repository Bid Specifications Hours	Task 2 Cost	Task 3 Preparation of Work Plan & HASP Hours	Task 3 Cost	Task 4 Mobilization-Demobilization (2 days) Hours	Task 4 Cost	Task 5 Repository Construction & Pond Prep. Cost (3 days) Hours	Task 5 Cost	Task 6 Pond Dam Improvement and Construction (2 days) Hours	Task 6 Cost	Task 7 Debris Removal to Repository +Closure (3 + 2 days) Hours	Task 7 Cost	Alternative Task 7 Use of Bluebird Pond North as a Repository (3 days) Hours	Alternative Task 7 Cost	Task 8 Preparation of O&M Plan Hours	Task 8 Cost	Task 9 Project Closeout & Report Hours	Task 9 Cost	Task 10 Polylog Box (1 day) Hours	Task 10 Cost	PROJECT 5 TOTALS Hours	PROJECT 5 TOTALS Cost	ALTERNATIVE PROJECT 5a TOTALS Hours	ALTERNATIVE PROJECT 5a TOTALS Cost
Program Manager	$135.00	/hr	4	$540.00	2	$270.00	2	$270.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	4	$540.00	8	$1,080.00	1	$135.00	53	$7,155.00	45	$6,075.00
Project Manager	$120.00	/hr	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	8	$960.00	4	$480.00	4	$480.00	4	$480.00	0	$0.00	40	$4,800.00	32	$3,840.00
Senior Engineer/PE	$130.00	/hr	16	$2,080.00	4	$520.00	4	$520.00	16	$2,080.00	30	$3,900.00	0	$0.00	50	$6,500.00	30	$3,900.00	4	$520.00	40	$5,200.00	2	$260.00	166	$21,580.00	116	$15,080.00
Geotechnical Engineer/PE	$130.00	/hr	8	$1,040.00	4	$520.00	2	$260.00	0	$0.00	8	$1,040.00	0	$0.00	4	$520.00	8	$1,040.00	0	$0.00	2	$260.00	10	$1,300.00	38	$4,940.00	34	$4,420.00
Engineer	$95.00	/hr	16	$1,520.00	8	$760.00	16	$1,520.00	16	$1,520.00	0	$0.00	20	$1,900.00	50	$4,750.00	0	$0.00	16	$1,520.00	40	$3,800.00	10	$950.00	192	$18,240.00	142	$13,490.00
Senior Geologist	$120.00	/hr	8	$960.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$960.00	8	$960.00
Geologist	$90.00	/hr	4	$360.00	2	$180.00	2	$180.00	4	$360.00	2	$180.00	0	$0.00	4	$360.00	2	$180.00	0	$0.00	0	$0.00	0	$0.00	18	$1,620.00	14	$1,260.00
Chemist	$95.00	/hr	4	$380.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00	4	$380.00
Toxicologist	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00	2	$250.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00	2	$250.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	0	$0.00	0	$0.00	2	$260.00	4	$520.00	0	$0.00	0	$0.00	4	$520.00	0	$0.00	0	$0.00	2	$260.00	0	$0.00	12	$1,560.00	8	$1,040.00
Field Technician	$60.00	/hr	16	$960.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00	0	$0.00	16	$960.00	16	$960.00
Draftsperson	$60.00	/hr	8	$480.00	4	$240.00	8	$480.00	2	$120.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$240.00	8	$480.00	2	$120.00	36	$2,160.00	36	$2,160.00
Admin/Clerical	$45.00	/hr	4	$180.00	4	$180.00	4	$180.00	2	$90.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	2	$90.00	36	$1,620.00	32	$1,440.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	0	$0.00	8	$720.00	8	$720.00	0	$0.00	0	$0.00	0	$0.00	16	$1,440.00	8	$720.00
Labor Cost Subtotal			**92**	**$8,980.00**	**32**	**$3,150.00**	**48**	**$4,650.00**	**56**	**$6,250.00**	**64**	**$7,580.00**	**36**	**$3,640.00**	**140**	**$15,590.00**	**64**	**$7,580.00**	**36**	**$3,480.00**	**108**	**$11,740.00**	**27**	**$2,855.00**	**639**	**$67,915.00**	**499**	**$52,325.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	2	$200.00	0	$0.00	0	$0.00	4	$400.00	6	$600.00	2	$200.00	10	$1,000.00	6	$600.00	0	$0.00	0	$0.00	2	$200.00		$2,600.00		$1,600.00
Gasoline	$0.25	/mile	400	$100.00	0	$0.00	0	$0.00	9	$2.25	600	$150.00	200	$50.00	1400	$350.00	600	$150.00	0	$0.00	0	$0.00	200	$50.00		$702.25		$352.25
Airfare	$600.00	/rt	1	$600.00	0	$0.00	0	$0.00	1	$600.00	1	$600.00	0	$0.00	0	$0.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00		$1,800.00		$1,800.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$25.00	1	$25.00	0	$0.00	1	$25.00	0	$0.00	0	$0.00	0	$0.00		$50.00		$50.00
Per Diem	$151.00	/day	5	$755.00	0	$0.00	0	$0.00	1	$151.00	6	$906.00	2	$302.00	10	$1,510.00	6	$906.00	0	$0.00	0	$0.00	2	$302.00		$3,926.00		$2,416.00
PPE	$15.00	/day	0	$0.00	0	$0.00	0	$0.00	4	$60.00	6	$90.00	2	$30.00	10	$150.00	6	$90.00	0	$0.00	0	$0.00	0	$0.00		$330.00		$180.00
LAB-Soil	$100.00	/ea	3	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$100.00	4	$400.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$500.00		$100.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$100.00	2	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$600.00		$400.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$360.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,360.00		$1,000.00
LAB-Geotechnical	$1,000.00	/ea	1	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,000.00		$1,000.00
Field Equipment	$200.00	/day	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$200.00		$200.00
Digital camera	$5.00	/day	2	$10.00	0	$0.00	0	$0.00	4	$20.00	6	$30.00	2	$10.00	10	$50.00	6	$30.00	0	$0.00	0	$0.00	2	$10.00		$130.00		$80.00
Shipping	$100.00	/ea	1	$250.00	0	$0.00	0	$30.00	1	$100.00	1	$100.00	1	$100.00	2	$200.00	1	$0.00	1	$0.00	0	$0.00	0	$0.00		$780.00		$480.00
Document Charges	$50.00	/ea	1	$50.00	1	$50.00	1	$300.00	1	$50.00	0	$0.00	1	$50.00	1	$50.00	0	$0.00	0	$0.00	0	$0.00	1	$50.00		$600.00		$550.00
Photocopies	$0.10	/ea	100	$10.00	100	$10.00	100	$10.00	100	$10.00	50	$5.00	100	$10.00	100	$10.00	50	$5.00	200	$20.00	400	$40.00	20	$2.00		$127.00		$117.00
Satellite phone	$25.50	/day	2	$51.00	0	$0.00	0	$0.00	2	$51.00	3	$76.50	2	$51.00	5	$127.50	3	$76.50	0	$0.00	0	$0.00	1	$25.50		$382.50		$255.00
Miscellaneous		LS		$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$200.00		$200.00
Direct Cost Subtotal				**$4,526.00**		**$60.00**		**$340.00**		**$1,644.25**		**$2,582.50**		**$1,028.00**		**$4,407.50**		**$2,482.50**		**$20.00**		**$40.00**		**$639.50**		**$15,287.75**		**$10,780.25**
Fee		15%		$678.90		$9.00		$51.00		$246.64		$387.38		$154.20		$661.13		$372.38		$3.00		$6.00		$95.93		$2,293.16		$1,617.04
Total Direct Costs				**$5,204.90**		**$69.00**		**$391.00**		**$1,890.89**		**$2,969.88**		**$1,182.20**		**$5,068.63**		**$2,854.88**		**$23.00**		**$46.00**		**$735.43**		**$17,580.91**		**$12,397.29**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Repository Exc. or dam constr.			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00		$0.00
Mobe-Demobe	$13,300.00	LS	0	$0.00	0	$0.00	0	$0.00	1	$13,300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$13,300.00		$13,300.00
Excavation	$7,365.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	3	$22,095.00	2	$14,730.00	5	$36,825.00	3	$22,095.00	0	$0.00	0	$0.00	0	$0.00		$73,650.00		$36,825.00
Repository closeout			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$5,000.00		$5,000.00		$5,000.00
Soil Cover	$5,565.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$11,130.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$11,130.00		$0.00
Geosythetic Material	$20.00	/sy	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	250	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00		$0.00
Fencing	$30.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	200	$6,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$6,000.00		$0.00
Revegetation	$2,000.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$2,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$2,000.00		$0.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00		$5,000.00
Subcontractors Subtotal				**$5,000.00**		**$0.00**		**$0.00**		**$13,300.00**		**$22,095.00**		**$14,730.00**		**$60,955.00**		**$22,095.00**		**$0.00**		**$0.00**		**$5,000.00**		**$121,080.00**		**$60,125.00**
Fee		15%		$750.00		$0.00		$0.00		$1,995.00		$3,314.25		$2,209.50		$9,143.25		$3,314.25		$0.00		$0.00		$750.00		$18,162.00		$9,018.75
Total Subcontract				**$5,750.00**		**$0.00**		**$0.00**		**$15,295.00**		**$25,409.25**		**$16,939.50**		**$70,098.25**		**$25,409.25**		**$0.00**		**$0.00**		**$5,750.00**		**$139,242.00**		**$69,143.75**
TOTAL COST				**$19,934.90**		**$3,219.00**		**$5,041.00**		**$23,435.89**		**$35,959.13**		**$21,761.70**		**$90,756.88**		**$35,844.13**		**$3,503.00**		**$11,786.00**		**$9,340.43**		**$224,737.91**		**$133,866.04**

Note: Yellow Highlight indicates Tasks required for Alternative 4a only, disposal od excavated debris in the Bluebid Pond North rather than a constructed Repository.

Alternative 6 - Construction New Wetlands Areas at Blackjack Mine

			Task 1 Treatment System Design		Task 2 Wetlands Segment Design		Task 3 Preparation of Bid Specifications		Task 4 Preparation of Work Plan & HASP		Task 5 Mobilization-Demobilization (3 days)		Task 6 New Pipeline Construction (4 days)		Task 7 Wetlands System Construction (5 days)		Task 8 New Lower Adits Dams, Bat Gates, & Pipe (7 days)		Task 9 Preparation of O&M Plan		Task 10 Project Closeout & Reporting		PROJECT TOTALS	
Labor Categories	**Labor Rate**	**Units**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**
Program Manager	$135.00	/hr	8	$1,080.00	4	$540.00	2	$270.00	4	$540.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	4	$540.00	8	$1,080.00	62	$8,370.00
Project Manager	$120.00	/hr	4	$480.00	2	$240.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	8	$960.00	4	$480.00	4	$480.00	42	$5,040.00
Senior Engineer/PE	$130.00	/hr	24	$3,120.00	8	$1,040.00	4	$520.00	8	$1,040.00	24	$3,120.00	40	$5,200.00	50	$6,500.00	70	$9,100.00	4	$520.00	40	$5,200.00	272	$35,360.00
Geotechnical Engineer/PE	$130.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	40	$5,200.00	50	$6,500.00	0	$0.00	0	$0.00	2	$260.00	92	$11,960.00
Engineer	$95.00	/hr	24	$2,280.00	16	$1,520.00	16	$1,520.00	24	$2,280.00	24	$2,280.00	32	$3,040.00	40	$3,800.00	70	$6,650.00	16	$1,520.00	60	$5,700.00	322	$30,590.00
Senior Geologist	$120.00	/hr	4	$480.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$480.00
Geologist	$90.00	/hr	8	$720.00	4	$360.00	2	$180.00	4	$360.00	0	$0.00	4	$360.00	4	$360.00	8	$720.00	0	$0.00	0	$0.00	34	$3,060.00
Hydrologist	$90.00	/hr	8	$720.00	4	$360.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	20	$1,800.00
Chemist	$95.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00	4	$380.00
Biologist	$85.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$340.00	4	$340.00
Toxicologist	$125.00	/hr	0	$0.00	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	0	$0.00	0	$0.00	0	$0.00	4	$520.00	8	$1,040.00	0	$0.00	8	$1,040.00	8	$1,040.00	0	$0.00	2	$260.00	30	$3,900.00
Draftsperson	$60.00	/hr	8	$480.00	4	$240.00	4	$240.00	8	$480.00	4	$240.00	0	$0.00	8	$480.00	8	$480.00	4	$240.00	8	$480.00	56	$3,360.00
Admin/Clerical	$45.00	/hr	8	$360.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	8	$360.00	8	$360.00	4	$180.00	4	$180.00	52	$2,340.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	4	$360.00	8	$720.00	8	$720.00	0	$0.00	0	$0.00	28	$2,520.00
Labor Cost Subtotal			**96**	**$9,720.00**	**46**	**$4,480.00**	**36**	**$3,390.00**	**64**	**$6,380.00**	**84**	**$9,140.00**	**136**	**$15,900.00**	**188**	**$21,320.00**	**196**	**$21,110.00**	**36**	**$3,480.00**	**144**	**$15,080.00**	**1026**	**$110,000.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$600.00	8	$800.00	10	$1,000.00	14	$1,400.00	0	$0.00	0	$0.00		$3,800.00
Gasoline	$0.25	/mile	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1,300	$325.00	1300	$325.00	1500	$375.00	2300	$575.00	0	$0.00	0	$0.00		$1,600.00
Airfare	$600.00	/rt	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$600.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,200.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$25.00	0	$0.00	1	$25.00	0	$0.00	0	$0.00		$50.00
Per Diem	$151.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$906.00	8	$1,208.00	10	$1,510.00	14	$2,114.00	0	$0.00	0	$0.00		$5,738.00
PPE	$15.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$90.00	8	$120.00	10	$150.00	14	$210.00	0	$0.00	0	$0.00		$570.00
LAB-Soil	$100.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,000.00	2	$200.00	0	$0.00	0	$0.00		$1,200.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	10	$1,000.00	2	$200.00	0	$0.00	0	$0.00		$1,500.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$360.00	0	$0.00	0	$0.00		$1,360.00
Digital camera	$5.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$30.00	5	$25.00	10	$50.00	14	$70.00	0	$0.00	0	$0.00		$175.00
Shipping	$100.00	/ea	1	$250.00	0	$0.00	0	$0.00	0	$30.00	1	$100.00	2	$200.00	2	$200.00	2	$200.00	1	$100.00	0	$0.00		$1,080.00
Document Charges	$50.00	/ea	1	$50.00	5	$250.00	5	$250.00	5	$300.00	1	$50.00	0	$0.00	1	$50.00	2	$100.00	0	$0.00	0	$0.00		$1,050.00
Photocopies	$0.10	/ea	200	$20.00	250	$25.00	250	$25.00	250	$25.00	100	$10.00	100	$10.00	200	$20.00	250	$25.00	400	$40.00	200	$20.00		$220.00
Satellite phone	$25.50	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	3	$76.50	4	$102.00	4	$102.00	7	$178.50	0	$0.00	0	$0.00		$459.00
Miscellaneous		LS	1	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	1	$500.00	0	$0.00	0	$0.00		$1,700.00
Direct Cost Subtotal				**$2,620.00**		**$275.00**		**$275.00**		**$355.00**		**$2,787.50**		**$3,615.00**		**$5,457.00**		**$6,157.50**		**$140.00**		**$20.00**		**$21,702.00**
Fee		15%		$393.00		$41.25		$41.25		$53.25		$418.13		$542.25		$818.55		$923.63		$21.00		$3.00		$3,255.30
Total Direct Costs				**$3,013.00**		**$316.25**		**$316.25**		**$408.25**		**$3,205.63**		**$4,157.25**		**$6,275.55**		**$7,081.13**		**$161.00**		**$23.00**		**$24,957.30**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Excavation			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Mobe-Demobe	$13,200.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$13,200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$13,200.00
Underground			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Excavation	$7,420.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	7	$51,940.00	0	$0.00	0	$0.00		$51,940.00
Dams	$10,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$20,000.00	0	$0.00	0	$0.00		$20,000.00
Bat Gates	$3,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$6,000.00	0	$0.00	0	$0.00		$6,000.00
Pipe	$30.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	200	$6,000.00	0	$0.00	0	$0.00		$6,000.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00
Surface Pipe	$20.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	830	$16,600.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$16,600.00
CDMSmith Estimate	$93,194.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$93,194.00	0	$0.00	0	$0.00	0	$0.00		$93,194.00
Surveyor			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Surveyor			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Subcontractors Subtotal				**$5,000.00**		**$0.00**		**$0.00**		**$0.00**		**$13,200.00**		**$16,600.00**		**$93,194.00**		**$83,940.00**		**$0.00**		**$0.00**		**$211,934.00**
Fee		15%		$750.00		$0.00		$0.00		$0.00		$1,980.00		$2,490.00		$13,979.10		$12,591.00		$0.00		$0.00		$31,790.10
Total Subcontract				**$5,750.00**		**$0.00**		**$0.00**		**$0.00**		**$15,180.00**		**$19,090.00**		**$107,173.10**		**$96,531.00**		**$0.00**		**$0.00**		**$243,724.10**
TOTAL COST				**$18,483.00**		**$4,796.25**		**$3,706.25**		**$6,788.25**		**$27,525.63**		**$39,147.25**		**$134,768.65**		**$124,722.13**		**$3,641.00**		**$15,103.00**		**$378,681.40**

Alternative 7 - Construction New Wetlands Areas at Bluebird Mine

			Task 1 Treatment System Design		Task 2 Wetlands Segment Design		Task 3 Preparation of Bid Specifications		Task 4 Preparation of Work Plan & HASP		Task 5 Mobilization-Demobilization (3 days)		Task 6 Wetlands System Construction (20 days)		Task 7 Preparation of O&M Plan		Task 8 Project Closeout & Reporting		PROJECT TOTALS	
Labor Categories	**Labor Rate**	**Units**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**
Program Manager	$135.00	/hr	8	$1,080.00	4	$540.00	2	$270.00	4	$540.00	8	$1,080.00	24	$3,240.00	4	$540.00	8	$1,080.00	62	$8,370.00
Project Manager	$120.00	/hr	4	$480.00	2	$240.00	4	$480.00	4	$480.00	4	$480.00	8	$960.00	4	$480.00	4	$480.00	34	$4,080.00
Senior Engineer/PE	$130.00	/hr	24	$3,120.00	8	$1,040.00	4	$520.00	8	$1,040.00	24	$3,120.00	160	$20,800.00	4	$520.00	40	$5,200.00	272	$35,360.00
Geotechnical Engineer/PE	$130.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$260.00	2	$260.00
Engineer	$95.00	/hr	24	$2,280.00	16	$1,520.00	16	$1,520.00	24	$2,280.00	24	$2,280.00	160	$15,200.00	16	$1,520.00	60	$5,700.00	340	$32,300.00
Senior Geologist	$120.00	/hr	4	$480.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$480.00
Geologist	$90.00	/hr	8	$720.00	4	$360.00	2	$180.00	4	$360.00	0	$0.00	24	$2,160.00	0	$0.00	0	$0.00	42	$3,780.00
Hydrologist	$90.00	/hr	8	$720.00	4	$360.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	20	$1,800.00
Chemist	$95.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00	4	$380.00
Biologist	$85.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$340.00	4	$340.00
Toxicologist	$125.00	/hr	0	$0.00	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	0	$0.00	0	$0.00	0	$0.00	4	$520.00	8	$1,040.00	16	$2,080.00	0	$0.00	2	$260.00	30	$3,900.00
Draftsperson	$60.00	/hr	8	$480.00	4	$240.00	4	$240.00	8	$480.00	4	$240.00	12	$720.00	4	$240.00	8	$480.00	52	$3,120.00
Admin/Clerical	$45.00	/hr	8	$360.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	12	$540.00	4	$180.00	4	$180.00	44	$1,980.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	8	$720.00	24	$2,160.00	0	$0.00	0	$0.00	32	$2,880.00
Labor Cost Subtotal			**96**	**$9,720.00**	**46**	**$4,480.00**	**36**	**$3,390.00**	**64**	**$6,380.00**	**84**	**$9,140.00**	**440**	**$47,860.00**	**36**	**$3,480.00**	**144**	**$15,080.00**	**946**	**$99,530.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$600.00	40	$4,000.00	0	$0.00	0	$0.00		$4,600.00
Gasoline	$0.25	/mile	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1,300	$325.00	3000	$750.00	0	$0.00	0	$0.00		$1,075.00
Airfare	$600.00	/rt	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00		$600.00
Per Diem	$151.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$906.00	40	$6,040.00	0	$0.00	0	$0.00		$6,946.00
PPE	$15.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$90.00	40	$600.00	0	$0.00	0	$0.00		$690.00
LAB-Soil	$100.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	5	$500.00	0	$0.00	0	$0.00		$500.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	5	$500.00	0	$0.00	0	$0.00		$800.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	5	$900.00	0	$0.00	0	$0.00		$1,900.00
Field Equipment	$200.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	3	$600.00	0	$0.00	0	$0.00		$600.00
Digital camera	$5.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	6	$30.00	40	$200.00	0	$0.00	0	$0.00		$230.00
Shipping	$100.00	/ea	1	$250.00	0	$0.00	0	$0.00	0	$30.00	1	$100.00	2	$200.00	1	$100.00	0	$0.00		$680.00
Document Charges	$50.00	/ea	1	$50.00	5	$250.00	5	$250.00	5	$300.00	1	$50.00	1	$50.00	0	$0.00	0	$0.00		$950.00
Photocopies	$0.10	/ea	200	$20.00	250	$25.00	250	$25.00	250	$25.00	100	$10.00	400	$40.00	400	$40.00	200	$20.00		$205.00
Satellite phone	$25.50	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	3	$76.50	20	$510.00	0	$0.00	0	$0.00		$586.50
Miscellaneous		LS	1	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$1,000.00
Direct Cost Subtotal				**$2,620.00**		**$275.00**		**$275.00**		**$355.00**		**$2,787.50**		**$14,890.00**		**$140.00**		**$20.00**		**$21,362.50**
Fee		15%		$393.00		$41.25		$41.25		$53.25		$418.13		$2,233.50		$21.00		$3.00		$3,204.38
Total Direct Costs				**$3,013.00**		**$316.25**		**$316.25**		**$408.25**		**$3,205.63**		**$17,123.50**		**$161.00**		**$23.00**		**$24,566.88**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Excavation			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Mobe-Demobe	$13,200.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$13,200.00	0	$0.00	0	$0.00	0	$0.00		$13,200.00
Excavation	$5,925.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00
Pipe	$20.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
CDMSmith Estimate	$183,496.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$183,496.00	0	$0.00	0	$0.00		$183,496.00
Subcontractors Subtotal				**$5,000.00**		**$0.00**		**$0.00**		**$0.00**		**$13,200.00**		**$183,496.00**		**$0.00**		**$0.00**		**$201,696.00**
Fee		15%		$750.00		$0.00		$0.00		$0.00		$1,980.00		$27,524.40		$0.00		$0.00		$30,254.40
Total Subcontract				**$5,750.00**		**$0.00**		**$0.00**		**$0.00**		**$15,180.00**		**$211,020.40**		**$0.00**		**$0.00**		**$231,950.40**
TOTAL COST				**$18,483.00**		**$4,796.25**		**$3,706.25**		**$6,788.25**		**$27,525.63**		**$276,003.90**		**$3,641.00**		**$15,103.00**		**$356,047.28**

Alternative 8 - Upgrade Water Collection and Pipeine System at Blackjack Mine

Labor Categories	Labor Rate	Units	Task 1 Pipeline Design Hours	Task 1 Cost	Task 2 Preparation of Bid Specifications Hours	Task 2 Cost	Task 3 Preparation of Work Plan & HASP Hours	Task 3 Cost	Task 4 Mobilization-Demobilization (3 days) Hours	Task 4 Cost	Task 5 Clear Access Road to Upper Blackjack, Remove Pipeline (2 days) Hours	Task 5 Cost	Task 6 Replace Upper Blackjack Dam & Bat Gate (4 days) Hours	Task 6 Cost	Task 7 Replace Upper Pipeline w/8" (5 days) Hours	Task 7 Cost	Task 8 Remove Lower Pipeline (2 days) Hours	Task 8 Cost	Task 9 Replace Lower Pipeline w/8" (5 days) Hours	Task 9 Cost	Task 10 Preparation of O&M Plan Hours	Task 10 Cost	Task 11 Project Closeout & Report Hours	Task 11 Cost	PROJECT 8 TOTALS Hours	PROJECT 8 TOTALS Cost
Program Manager	$135.00	/hr	4	$540.00	4	$540.00	4	$540.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	4	$540.00	4	$540.00	68	$9,180.00
Project Manager	$120.00	/hr	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	2	$240.00	42	$5,040.00
Senior Engineer/PE	$130.00	/hr	24	$3,120.00	16	$2,080.00	16	$2,080.00	24	$3,120.00	16	$2,080.00	32	$4,160.00	40	$5,200.00	16	$2,080.00	20	$2,600.00	4	$520.00	32	$4,160.00	240	$31,200.00
Geotechnical Engineer/PE	$130.00	/hr	8	$1,040.00	4	$520.00	2	$260.00	0	$0.00	8	$1,040.00	0	$0.00	4	$520.00	0	$0.00	0	$0.00	0	$0.00	2	$260.00	28	$3,640.00
Engineer	$95.00	/hr	24	$2,280.00	24	$2,280.00	24	$2,280.00	24	$2,280.00	16	$1,520.00	32	$3,040.00	40	$3,800.00	0	$0.00	40	$3,800.00	16	$1,520.00	32	$3,040.00	272	$25,840.00
Geologist	$90.00	/hr	4	$360.00	2	$180.00	2	$180.00	4	$360.00	2	$180.00	2	$180.00	2	$180.00	2	$180.00	2	$180.00	0	$0.00	0	$0.00	22	$1,980.00
Chemist	$95.00	/hr	4	$380.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	4	$520.00	0	$0.00	4	$520.00	4	$520.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$260.00	14	$1,820.00
Draftsperson	$60.00	/hr	8	$480.00	8	$480.00	8	$480.00	2	$120.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$240.00	8	$480.00	38	$2,280.00
Admin/Clerical	$45.00	/hr	4	$180.00	4	$180.00	4	$180.00	2	$90.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	42	$1,890.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$360.00	8	$720.00	8	$720.00	8	$720.00	4	$360.00	0	$0.00	0	$0.00	32	$2,880.00
Labor Cost Subtotal			**88**	**$9,380.00**	**66**	**$6,740.00**	**70**	**$7,250.00**	**72**	**$8,050.00**	**62**	**$6,920.00**	**90**	**$9,840.00**	**110**	**$12,160.00**	**42**	**$4,720.00**	**82**	**$8,680.00**	**36**	**$3,480.00**	**86**	**$9,160.00**	**804**	**$86,380.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	2	$200.00	0	$0.00	0	$0.00	6	$600.00	4	$400.00	8	$800.00	10	$1,000.00	2	$200.00	8	$800.00	0	$0.00	0	$0.00		$4,000.00
Gasoline	$0.25	/mile	400	$100.00	0	$0.00	0	$0.00	1,100	$275.00	900	$225.00	1,300	$325.00	2500	$625.00	200	$50.00	1100	$275.00	0	$0.00	0	$0.00		$1,875.00
Airfare	$600.00	/rt	0	$0.00	0	$0.00	0	$0.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00	1	$600.00	0	$0.00	0	$0.00	0	$0.00		$1,200.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$25.00	1	$25.00	1	$25.00	1	$25.00	1	$25.00	0	$0.00	0	$0.00		$125.00
Per Diem	$151.00	/day	5	$755.00	0	$0.00	0	$0.00	6	$906.00	4	$604.00	8	$1,208.00	10	$1,510.00	2	$302.00	8	$1,208.00	0	$0.00	0	$0.00		$6,493.00
PPE	$15.00	/day	0	$0.00	0	$0.00	0	$0.00	6	$90.00	4	$60.00	8	$120.00	14	$210.00	2	$30.00	8	$120.00	0	$0.00	0	$0.00		$630.00
LAB-Soil	$100.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$200.00	0	$0.00	0	$0.00	2	$200.00	0	$0.00	0	$0.00	0	$0.00		$400.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	2	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$500.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	2	$360.00	0	$0.00	0	$0.00	2	$360.00	0	$0.00	0	$0.00	0	$0.00		$1,720.00
Sampling Equipment	$150.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$150.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$150.00
Field Equipment	$200.00	/day	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$200.00
Digital camera	$5.00	/day	2	$10.00	0	$0.00	0	$0.00	6	$30.00	4	$20.00	8	$40.00	10	$50.00	2	$10.00	16	$80.00	0	$0.00	0	$0.00		$240.00
Shipping	$100.00	/ea	1	$250.00	0	$0.00	0	$30.00	3	$300.00	1	$100.00	1	$100.00	2	$200.00	1	$100.00	2	$200.00	1	$0.00	0	$0.00		$1,280.00
Document Charges	$50.00	/ea	1	$50.00	1	$50.00	1	$300.00	3	$150.00	0	$0.00	1	$50.00	1	$50.00	0	$0.00	1	$50.00	0	$0.00	0	$0.00		$700.00
Photocopies	$0.10	/ea	200	$20.00	200	$20.00	200	$20.00	200	$20.00	50	$5.00	200	$20.00	100	$10.00	50	$5.00	50	$5.00	200	$20.00	100	$10.00		$155.00
Satellite phone	$25.50	/day	0	$0.00	0	$0.00	0	$0.00	3	$76.50	2	$51.00	4	$102.00	7	$178.50	2	$51.00	5	$127.50	0	$0.00	0	$0.00		$586.50
Miscellaneous		LS	1	$200.00	0	$0.00	0	$0.00	0	$500.00	0	$0.00	1	$200.00	1	$200.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00		$1,300.00
Direct Cost Subtotal				**$2,885.00**		**$70.00**		**$350.00**		**$3,747.50**		**$2,400.00**		**$2,990.00**	.	**$4,058.50**		**$1,933.00**		**$3,090.50**		**$20.00**		**$10.00**		**$21,554.50**
Fee		15%		$432.75		$10.50		$52.50		$562.13		$360.00		$448.50		$608.78		$289.95		$463.58		$3.00		$1.50		$3,233.18
Total Direct Costs				**$3,317.75**		**$80.50**		**$402.50**		**$4,309.63**		**$2,760.00**		**$3,438.50**		**$4,667.28**		**$2,222.95**		**$3,554.08**		**$23.00**		**$11.50**		**$24,787.68**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Road Exc.			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Mobe-Demobe	$13,800.00	LS	0	$0.00	0	$0.00	0	$0.00	1	$13,800.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$13,800.00
Excavation	$5,925.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$11,850.00	0	$0.00	5	$29,625.00	2	$11,850.00	2	$11,850.00	0	$0.00	0	$0.00		$65,175.00
Underground			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Preparation	$7,420.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$29,680.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$29,680.00
Dams	$10,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$10,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$10,000.00
Bat Gates	$3,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$3,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$3,000.00
Pipe	$20.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	100	$2,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$2,000.00
New 8" Pipeline w/Rerouting	$20.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	670	$13,400.00	0	$0.00	660	$13,200.00	0	$0.00	0	$0.00		$26,600.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00
Subcontractors Subtotal				**$5,000.00**		**$0.00**		**$0.00**		**$13,800.00**		**$11,850.00**		**$44,680.00**		**$43,025.00**		**$11,850.00**		**$25,050.00**		**$0.00**		**$0.00**		**$155,255.00**
Fee		15%		$750.00		$0.00		$0.00		$2,070.00		$1,777.50		$6,702.00		$6,453.75		$1,777.50		$3,757.50		$0.00		$0.00		$23,288.25
Total Subcontract				**$5,750.00**		**$0.00**		**$0.00**		**$15,870.00**		**$13,627.50**		**$51,382.00**		**$49,478.75**		**$13,627.50**		**$28,807.50**		**$0.00**		**$0.00**		**$178,543.25**
TOTAL COST				**$18,447.75**		**$6,820.50**		**$7,652.50**		**$28,229.63**		**$23,307.50**		**$64,660.50**		**$66,306.03**		**$20,570.45**		**$41,041.58**		**$3,503.00**		**$9,171.50**		**$289,710.93**

Alternative 9 - Install Adit Plug at Blackjack Mine (Assume 400 foot plug depth)

			Task 1 Investigation Design		Task 2 Preparation of Investigation Bid Specifications		Task 3 Preparation of Work Plan & HASP		Task 4 Mobilization-Demobilization (3 days)		Task 5 Clear Access Road to Upper Blackjack (2 days)		Task 6 Remove Dam & Bat Gate; Clear & Support Caved Area (5 days)		Task 7 Slash & Support Adit to 400 ft (25 days)		Task 8 Complete RQD/RMD & Hydrogeologic Evaluations (10 days)		Task 9 Design Plug(s)		Task 10 Mobilize for Installation (3 days)		Task 11 Install Plug(s) & Grout (25 days)		Task 12 Install Seepage Dam (2 days)		Task 13 Connect Pipe & Install Bat Gate (2 days)		Task 14 Install Access Road Erosion Control (1 days)		Task 15 Preparation of O&M Plan		Task 16 Project Closeout & Reporting		PROJECT 9 TOTALS	
Labor Categories	**Labor Rate**	**Units**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**	**Hours**	**Cost**
Program Manager	$135.00	/hr	4	$540.00	4	$540.00	4	$540.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	32	$4,320.00	8	$1,080.00	8	$1,080.00	8	$1,080.00	16	$2,160.00	2	$270.00	2	$270.00	1	$135.00	4	$540.00	8	$1,080.00	125	$16,875.00
Project Manager	$120.00	/hr	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	4	$480.00	16	$1,920.00	8	$960.00	4	$480.00	4	$480.00	8	$960.00	2	$240.00	2	$240.00	1	$120.00	4	$480.00	8	$960.00	81	$9,720.00
Senior Engineer/PE	$130.00	/hr	24	$3,120.00	16	$2,080.00	40	$5,200.00	24	$3,120.00	16	$2,080.00	40	$5,200.00	200	$26,000.00	80	$10,400.00	40	$5,200.00	24	$3,120.00	200	$26,000.00	0	$0.00	0	$0.00	8	$1,040.00	16	$2,080.00	40	$5,200.00	768	$99,840.00
Geotechnical Engineer/PE	$130.00	/hr	8	$1,040.00	4	$520.00	2	$260.00	0	$0.00	8	$1,040.00	0	$0.00	16	$2,080.00	40	$5,200.00	40	$5,200.00	0	$0.00	16	$2,080.00	0	$0.00	0	$0.00	0	$0.00	4	$520.00	20	$2,600.00	158	$20,540.00
Engineer	$95.00	/hr	24	$2,280.00	24	$2,280.00	40	$3,800.00	24	$2,280.00	16	$1,520.00	40	$3,800.00	200	$19,000.00	0	$0.00	20	$1,900.00	24	$2,280.00	100	$9,500.00	16	$1,520.00	16	$1,520.00	0	$0.00	16	$1,520.00	40	$3,800.00	600	$57,000.00
Geologist	$90.00	/hr	4	$360.00	2	$180.00	8	$720.00	4	$360.00	2	$180.00	8	$720.00	16	$1,440.00	80	$7,200.00	20	$1,800.00	4	$360.00	100	$9,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	20	$1,800.00	268	$24,120.00
Chemist	$95.00	/hr	4	$380.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$380.00
Toxicologist	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Risk Assessor	$125.00	/hr	0	$0.00	0	$0.00	2	$250.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$250.00
Health and Safety Specialist/Industrial Hygienist	$130.00	/hr	4	$520.00	0	$0.00	4	$520.00	4	$520.00	0	$0.00	0	$0.00	16	$2,080.00	8	$1,040.00	0	$0.00	4	$520.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$520.00	44	$5,720.00
Draftsperson	$60.00	/hr	8	$480.00	8	$480.00	16	$960.00	2	$120.00	0	$0.00	0	$0.00	0	$0.00		$0.00	20	$1,200.00	2	$120.00	8	$480.00	4	$240.00	0	$0.00	0	$0.00	8	$480.00	16	$960.00	92	$5,520.00
Admin/Clerical	$45.00	/hr	4	$180.00	4	$180.00	8	$360.00	2	$90.00	4	$180.00	4	$180.00	4	$180.00	4	$180.00	8	$360.00	2	$90.00	4	$180.00	2	$90.00	2	$90.00	1	$45.00	4	$180.00	8	$360.00	65	$2,925.00
Onsite Inspector (Remedial/Removal Actions)	$90.00	/hr	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$360.00	8	$720.00	16	$1,440.00	8	$720.00	0	$0.00	0	$0.00	16	$1,440.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	60	$5,400.00
Labor Cost Subtotal			**88**	**$9,380.00**	**66**	**$6,740.00**	**130**	**$13,340.00**	**72**	**$8,050.00**	**62**	**$6,920.00**	**112**	**$12,180.00**	**516**	**$58,460.00**	**236**	**$26,780.00**	**160**	**$17,220.00**		**$8,050.00**		**$51,800.00**		**$2,360.00**		**$2,840.00**		**$1,340.00**	**56**	**$5,800.00**	**164**	**$17,280.00**	**2269**	**$248,540.00**
Direct Cost			**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**	**Unit**	**Cost**
Vehicle Rental	$100.00	/day	0	$0.00	0	$0.00	0	$0.00	6	$600.00	4	$400.00	10	$1,000.00	50	$5,000.00	20	$2,000.00	0	$0.00	6	$600.00	50	$5,000.00	2	$200.00	2	$200.00	1	$100.00	0	$0.00	0	$0.00		$15,100.00
Gasoline	$0.25	/mile	0	$0.00	0	$0.00	0	$0.00	1,100	$275.00	900	$225.00	1,300	$325.00	3600	$900.00	1700	$425.00	0	$0.00	1,100	$275.00	3600	$900.00	900	$225.00	900	$225.00	600	$150.00	0	$0.00	0	$0.00		$3,925.00
Airfare	$600.00	/rt	0	$0.00	0	$0.00	0	$0.00	1	$600.00	0	$0.00		$0.00	2	$1,200.00	2	$1,200.00	0	$0.00	1	$600.00	2	$1,200.00	0	$0.00	0	$0.00	1	$600.00	0	$0.00	0	$0.00		$5,400.00
Consumables	$25.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$25.00	1	$25.00	2	$50.00	2	$50.00	1	$25.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$175.00
H&S Monitoring Equip	$50.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	5	$250.00	25	$1,250.00	10	$500.00	0	$0.00	0	$0.00	25	$1,250.00	2	$100.00	1	$50.00	0	$0.00	0	$0.00	0	$0.00		$3,400.00
Per Diem	$151.00	/day	5	$755.00	0	$0.00	0	$0.00	6	$906.00	4	$604.00	10	$1,510.00	50	$7,550.00	20	$3,020.00	0	$0.00	6	$906.00	50	$7,550.00	2	$302.00	2	$302.00	1	$151.00	0	$0.00	0	$0.00		$23,556.00
PPE	$15.00	/day	0	$0.00	0	$0.00	0	$0.00	6	$90.00	4	$60.00	10	$150.00	50	$750.00	20	$300.00	0	$0.00	6	$90.00	50	$750.00	2	$30.00	2	$30.00	1	$15.00	0	$0.00	0	$0.00		$2,265.00
LAB-Soil	$100.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$200.00	3	$300.00	4	$400.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$900.00
LAB-Water	$100.00	/ea	0	$300.00	0	$0.00	0	$0.00	0	$0.00	1	$100.00	1	$100.00	4	$400.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$900.00
LAB-Waste Profile	$180.00	/ea	0	$1,000.00	0	$0.00	0	$0.00	0	$0.00	2	$360.00	1	$180.00	4	$720.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$2,260.00
Sampling Equipment	$150.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$150.00		$0.00	1	$150.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$300.00
Field Equipment	$200.00	/day	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$600.00
Digital camera	$5.00	/day	2	$10.00	0	$0.00	0	$0.00	6	$30.00	4	$20.00	10	$50.00	50	$250.00	20	$100.00	0	$0.00	6	$30.00	50	$250.00	2	$10.00	2	$10.00	1	$5.00	0	$0.00	0	$0.00		$765.00
Shipping	$100.00	/ea	1	$250.00	0	$0.00	0	$30.00	3	$300.00	1	$100.00	3	$300.00	2	$200.00	5	$500.00	0	$0.00	3	$300.00	2	$200.00	0	$0.00	0	$0.00	0	$0.00	1	$0.00	1	$0.00		$2,180.00
Document Charges	$50.00	/ea	1	$50.00	1	$50.00	1	$300.00	3	$150.00	0	$0.00	1	$50.00	1	$50.00	1	$50.00	1	$50.00	3	$150.00	1	$50.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$950.00
Photocopies	$0.10	/ea	200	$20.00	200	$20.00	200	$20.00	200	$20.00	50	$5.00	100	$10.00	200	$20.00	200	$20.00	200	$20.00	200	$20.00	200	$20.00	20	$2.00	20	$2.00	20	$2.00	200	$20.00	400	$40.00		$261.00
Satellite phone	$25.50	/day	0	$0.00	0	$0.00	0	$0.00	3	$76.50	2	$51.00	2	$51.00	25	$637.50	10	$255.00	5	$127.50	3	$76.50	25	$637.50	2	$51.00	2	$51.00	1	$25.50	0	$0.00	0	$0.00		$2,040.00
Miscellaneous		LS	1	$200.00	1	$200.00	0	$0.00	1	$500.00	0	$0.00	1	$200.00	1	$200.00	0	$0.00	1	$200.00	0	$0.00	1	$200.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$200.00		$1,900.00
Direct Cost Subtotal				**$2,585.00**		**$270.00**		**$350.00**		**$3,747.50**		**$2,300.00**		**$4,701.00**	.	**$19,727.50**		**$8,420.00**		**$422.50**		**$3,247.50**		**$18,007.50**		**$920.00**		**$870.00**		**$1,048.50**		**$20.00**		**$240.00**		**$66,877.00**
Fee		15%		$387.75		$40.50		$52.50		$562.13		$345.00		$705.15		$2,959.13		$1,263.00		$63.38		$487.13		$2,701.13		$138.00		$130.50		$157.28		$3.00		$36.00		$10,031.55
Total Direct Costs				**$2,972.75**		**$310.50**		**$402.50**		**$4,309.63**		**$2,645.00**		**$5,406.15**		**$22,686.63**		**$9,683.00**		**$485.88**		**$3,734.63**		**$20,708.63**		**$1,058.00**		**$1,000.50**		**$1,205.78**		**$23.00**		**$276.00**		**$76,908.55**
Subcontractors				**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**		**Cost**
Access Road			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Mobe-Demobe	$11,800.00	LS	0	$0.00	0	$0.00	0	$0.00	**1**	$11,800.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$11,800.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$23,600.00
Excavation	$3,230.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$6,460.00	0	$0.00	0	$0.00	2	$6,460.00	2	$6,460.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$3,230.00	0	$0.00	0	$0.00		$22,610.00
Underground			0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$0.00
Preparation	$6,165.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	5	$30,825.00	25	$154,125.00	0	$0.00	0	$0.00	0	$0.00	25	$154,125.00	2	$12,330.00	2	$12,330.00	0	$0.00	0	$0.00	0	$0.00		$363,735.00
Caved Ground Support	$50,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$50,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$50,000.00
Dams	$10,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$10,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$10,000.00
Bat Gates	$3,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$3,000.00	0	$0.00	0	$0.00	0	$0.00		$3,000.00
Plugs	$30,000.00	/ea	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	2	$60,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$60,000.00
Pipe	$30.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	300	$9,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$9,000.00
Road Erosion Control Materils	$5,000.00	/ft	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$5,000.00	0	$0.00	0	$0.00		$5,000.00
Simple Ground Support	$288.00	/day	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	300	$86,400.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$86,400.00
Packer Testing	$100,000.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$100,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$100,000.00
Grouting	$200,000.00	LS	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1	$200,000.00	0	$0.00	0	$0.00	1	$200,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$400,000.00
Surveyor	$5,000.00	LS	1	$5,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00		$5,000.00
Subcontractors Subtotal				**$5,000.00**		**$0.00**		**$0.00**		**$11,800.00**		**$6,460.00**		**$80,825.00**		**$240,525.00**		**$306,460.00**		**$6,460.00**		**$11,800.00**		**$423,125.00**		**$22,330.00**		**$15,330.00**		**$8,230.00**		**$0.00**		**$0.00**		**$1,138,345.00**
Fee		15%		$750.00		$0.00		$0.00		$1,770.00		$969.00		$12,123.75		$36,078.75		$45,969.00		$969.00		$1,770.00		$63,468.75		$3,349.50		$2,299.50		$1,234.50		$0.00		$0.00		$170,751.75
Total Subcontract				**$5,750.00**		**$0.00**		**$0.00**		**$13,570.00**		**$7,429.00**		**$92,948.75**		**$276,603.75**		**$352,429.00**		**$7,429.00**		**$13,570.00**		**$486,593.75**		**$25,679.50**		**$17,629.50**		**$9,464.50**		**$0.00**		**$0.00**		**$1,309,096.75**
TOTAL COST				**$18,102.75**		**$7,050.50**		**$13,742.50**		**$25,929.63**		**$16,994.00**		**$110,534.90**		**$357,750.38**		**$388,892.00**		**$25,134.88**		**$25,354.63**		**$559,102.38**		**$29,097.50**		**$21,470.00**		**$12,010.28**		**$5,823.00**		**$17,556.00**		**$1,634,545.30**