REMOVAL ACTION WORK PLAN & DESIGN DRAWINGS
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest
Whatcom County, Washington

April 2011

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Conserving Resources. Improving Life

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Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest
(Administered by the Okanogan and Wenatchee National Forests)
Whatcom County, Washington

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1.0 INTRODUCTION

The United States Forest Service (Forest Service) retained Cascade Earth Sciences (CES) to perform a Removal Action (RA) at the Azurite Mine (Site). The Engineering Evaluation / Cost Analysis (EECA) prepared by ASARCO outlines the following RA objectives for the Site:

- **Tailings Pile:** Reduce the potential for contaminant migration that would result in unacceptable risk to human health and the environment. Reduce the potential for unacceptable risks to human or ecological receptors due to the ingestion of soil/dust/tailings. Reduce the potential for the erosion of the tailings pile by runoff.
- **Wasterock Piles:** Reduce the potential for contaminant migration that would result in unacceptable risk to human health and the environment. Reduce the potential for unacceptable risks to human or ecological receptors due to the ingestion of soil/dust/wasterock. Reduce or eliminate the potential for mass failure of the larger wasterock pile into Mill Creek due to a flood or seismic event. Reduce the potential for the erosion of the wasterock piles by runoff.
- **Mine Adit Water**: Reduce the potential for human ingestion of mine adit water and contaminant migration through mine water discharges, including discharges into Mill Creek that would result in unacceptable risk to human health and the environment.
- **Surface Seep Water:** Reduce the potential for human ingestion of surface seep water and mine contaminant migration that would result in unacceptable risk to human health and the environment.

As outlined in the EECA, the risk-based cleanup concentration is 104 milligrams per kilogram (mg/kg) total arsenic. Cleanup of wasterock, tailings, and soil to this concentration is expected to be protective of both human and ecological receptors. This document comprises the RA Work Plan; a stand-alone site-specific Health and Safety Plan (HASP) has also been prepared for planned field activities and is included in Appendix A.

1.1 Site Description

The Site is located in the Mt. Baker-Snoqualmie National Forest (administered by the Okanogan and Wenatchee National Forests) in Whatcom County, Washington, near the southern edge of the Pasayten Wilderness Area, and approximately 19 air miles northwest of Mazama, Washington. Driving time one way from Mazama to the Site is estimated to be a minimum of 2.5 hours, depending on road and trail conditions.

To access the Site from Mazama, take County Road (CR) 9140 (Mazama/Lost River/Goat Creek Road) northwesterly. It will eventually turn into Forest Road (FR) 5400. Continue on FR 5400 to Harts Pass (approximately ten miles from Mazama to the pass). At Harts Pass, turn left onto FR 700. Follow FR 700 to Forest Trail (FT) 475 and go left. Take FT 475 past the Whistler Mine, over Cady Pass, and down to Mill Creek. At FT 755, go left and along Mill Creek to the Azurite Mine and Tailing area (total distance traveled from Mazama is about 24 miles).

According to the U.S. Geological Survey (USGS) Quadrangle Map – Azurite Peak, WA. (1963)**,** as published in the Washington Atlas (1995), the Site is located in the north half of Section 18, Township 37 north, Range 17 east of the Willamette Meridian. The Site is situated at elevations ranging from approximately 4,600 feet above mean sea level (amsl) at the tailings pile to 4,350 feet amsl at Mill Creek below the tailings pile. Gold was historically mined at the Site, but the mine has been inactive for at least 60 years (pre-World War II). The Site is situated adjacent to Mill Creek, which discharges into Canyon Creek, then Ruby Creek, and eventually Ross Lake.

Features of the Site include four adits: the Wenatchee, Tinson (flowing), Burnham, and Discovery. There is also a concrete foundation from a dismantled 100-ton per day flotation mill, along with a related tailings pile covering approximately five acres. The tailings pile is estimated at 55,000 bank cubic yards (bcy). In addition, two wasterock piles are located adjacent to the Wenatchee Adit, with a total estimated volume of 25,000 bcy (22,000 bcy of wasterock and 3,000 bcy of cover material).

1.2 Summary of Data Gap Investigation

CES conducted a Data Gap Investigation (DGI) on October 1 – 4, 2007. In addition, CES conducted a follow-up DGI on September 21-23, 2010 to gather additional field data and information to finalize the designs and details. Each of the data gaps are discussed in the following sections, with a brief description of the results.

1.2.1 Data Gap 1 – Mill Creek Fish and Fish Barrier Survey

CES submitted a technical memorandum on October 30, 2007, that summarized the results of the survey (Appendix B). In summary, multiple fish passage barriers (both temporary and permanent) were observed between the Site and the confluence with Canyon Creek. Dip nets were used opportunistically in pool and riffle habitats along the entire length of Mill Creek; no fish were caught. Only three very small unidentified, fish were observed, all downstream of Fish Barrier 05 which is approximately 2.4 miles downstream from the Site. Because of these conditions, and the presence of other bedrock fish passage barriers, it is deemed unlikely that fish have ever migrated upstream of Fish Barrier 04 (two miles downstream from Site) and most recently have not been able to migrate upstream of Fish Barrier 05. In addition, no records were found during the earlier Site Inspection (CES, 2004) indicating that fish had been transplanted into the upper reaches of Mill Creek. Thus, fish are unlikely to have ever inhabited Mill Creek within two miles of the Site.

1.2.2 Data Gap 2 – ViroMine Adit/Seep Sampling and Bench Testing

Due to weather and safety conditions, CES was only able to collect one water sample. CES selected the tailings seep as the best seep to sample because the Wenatchee wasterock seep water quality and quantity will likely significantly change once the wasterock has been removed and the native ground is exposed; and the low flow and metal concentrations of the Tinson Adit are most likely not impacting Mill Creek. Ten gallons of water from the tailings seep was collected and shipped to Virotec USA on October 10, 2007, for jar and bench testing using the ViroMine™ technology. CES was in communication several times with Virotec personnel following submittal of the sample regarding field parameters, flow rates, etc. Based on our signed agreement with Virotec, CES was expecting to receive the draft results of the testing in late November 2007. In late November and early December 2007, CES attempted repeatedly to contact Virotec personnel via email and phone regarding the status of the testing. On December 6, 2007, CES received an email from Lee Fergusson (CEO of Virotec International – parent company of Virotec USA) stating that there had been some organizational changes and that our contact (Jim Jonas) was no longer with Virotec and that he would check into the status of the sample and testing. After several weeks of communication with Mr. Fergusson, CES discovered that the bench testing had not been performed and the sample was being stored at the Virotec facility in Denver, Colorado. CES requested that the sample be shipped back to CES; however, it was discovered that the sample was not properly stored. Based on this, the sample was discarded. CES will work with the Forest Service to further assess appropriate water treatment technologies prior to implementation of the RA.

1.2.3 Data Gap 3 – Borrow Material Assessment

During the 2007 DGI, CES planned on using a helicopter and all terrain vehicles (ATV) to assess borrow material areas in the Barron and Harts Pass areas. However, these areas could not be assessed due to snow levels and lack of visibility in the helicopter. CES did assess potential sources of on-site cover soil. There appears to be 3,000 to 5,000 bcy of uncontaminated cover soil / overburden at the Wenatchee wasterock area. In addition, there appears to be additional cover soil resources approximately 0.35 to 0.5 miles south of the Site along the trail on the eastern side of Mill Creek. CES was not able to mobilize equipment to this area to collect samples but, based on visual observations, there appears to be a significant amount of suitable cover soil on a bench above Mill Creek. In addition, there appears to be sufficient quantities of talus and riprap that can be scavenged from the general vicinity around the Site.

During the September 2011 DGI, CES performed additional reconnaissance of the talus borrow area, located in the drainage to the south of the Site. Based on CES assessment and field mapping, there appears to be ample talus material to construct the repository cover. Sheet C-8 shows the general dimensions of the talus source area. If additional source material is needed, CES will work with the Forest Service to identify additional suitable sources around the Site. Screening will need to be performed in order to remove the large and small talus material. In general, the talus will be screened from 8-inches to ½-inch, which will serve as the cover for the repository. Screened material that is larger than 8-inches will be used as riprap around the Site and potentially in the toe berm on the repository. Screened material ½-inch and less will be used as road bedding, and potentially fill material for the reinforced mechanically stabilized toe berm.

1.2.4 Data Gap 4 – Road Improvements Assessment

CES performed a general assessment of the access road to determine areas where improvement is required for equipment access to the Site. Specifically, CES assessed the bridges, culverts, and switchbacks. Suggested improvements are outlined in Section 2 of the Work Plan and shown on the Drawings.

1.2.5 Data Gap 5 – Geotechnical Assessment

CES subcontracted with GeoEngineers in Spokane, Washington to perform the Geotechnical Assessment and slope stability modeling of the Site and recommended RA alternative. As part of the assessment, test pits were excavated to investigate the subsurface soil conditions on the downgradient side of the tailings pile and repository location. In addition, test pits were excavated in the wasterock piles, samples were collected and a soil cover stability analysis was completed. Results of the investigation and analysis are outlined in the technical memorandum (Appendix C), and were incorporated into the overall Removal Design and layout.

In order to provide a surface that is more practical for construction of a cover, we are proposing to place wasterock on top of the tailings pile and raise the toe berm (height will vary between 5 and 15-ft) to provide a uniform slope on which to construct the cover. The proposed configuration would be a surface slope of 2.5H:1V with 8-foot wide anchor benches located a minimum of every 20 feet of slope distance. The benches would direct precipitation away from the slope face to the north or south drainage channels. The impervious cover is detailed on Sheet C-14 and technical specifications, and will consist of the following:

1. 6 to 12 inch talus cover (generally screened from 8-inchs to ½-inch)
2. Uniaxial geogrid
3. 12 oz. non woven geotextile
4. 40-mil HDPE geomembrane
5. 12 oz. non woven geotextile
6. Wasterock
7. Tailings

This system will protect the HDPE geomembrane from damage due to rocks either above or below the geomembrane, and the geogrid will provide the strength to protect against pullout or tearing.

1.2.6 Data Gap 6 – Humidity Cell and Sequential Batch Soil Attenuation Results

Although prior work at the Site indicated that the wasterock is acid producing, CES elected to obtain rates of acid production and neutralization/attenuation potential of soil underlying the proposed repository to determine if underlying soil will attenuate metals in the leachate and potentially limit the need for an impermeable cover. CES obtained samples of wasterock, tailings, and underlying soil for metals analyses, static acid based accounting (ABA), dynamic ABA, and soil attenuation testing. CES contracted with ACZ Laboratories (ACZ) for chemical analyses and static ABA testing. CES also contracted with McClelland

Laboratories, Inc. (MLI) for dynamic ABA (humidity cell [HC]) testing and soil attenuation (sequential batch [SB]) testing. As the first step, MLI conducted HC tests in accordance with ASTM protocol for five weeks. A portion of the leachate from each weekly event was sent to ACZ for analysis; the remainder of the leachate was frozen for SB testing. The assumption was that the HC leachate would simulate discharge from the wasterock for use in SB tests using underlying soil to determine metals attenuation. MLI's report is provided in Appendix D – Laboratory Results. Results of all analyses and tests are provided in Tables 1 through 4. The results and conclusions of all tests are summarized as follows:

- Table 1 indicates that the upper wasterock is clearly pyritic and strongly acid producing. The lower wasterock; however, is non-acidic and actually produces alkalinity.
- Table 2 indicates that the upper wasterock is rich in metal sulfide minerals with an acid-base potential of -99 $tCaCO_3/Kt$ (ABP units are presented as tons of calcium carbonate needed to neutralize a kiloton of waste). The lower wasterock and a portion of the upper wasterock; however, exhibited an acid base potential of 12 to 20 $tCaCO_3/Kt$ (acid neutralizing). The soil at the proposed repository location exhibited an average acid base potential of average of 3.7 $tCaCO_3/Kt$.
- Table 3 shows that neither the upper nor the lower wasterock will exceed the toxicity characteristic leaching procedure (TCLP) limits and be considered as Dangerous Waste as defined by the Washington State Department of Ecology (Ecology). The data further indicates that the synthetic precipitation leaching procedure (SPLP) leachate did not exceed the Ecology Model Toxics Control Act (MTCA) for protection of groundwater.
- Table 4 illustrates the results of the SB tests. These were performed by collecting adequate HC leachate to simulate a 24-hour 100-year storm event of 6.5 inches of precipitation. The HC effluent (SEQ-INF) was passed through the first column of repository underlying soil (S-1). The S-1 discharge was passed through a second soil column (S-2), and this effluent was in turn passed through a third column (S-3). Based on the results, the underlying soil provides a high ability to attenuate acid and metals. Attenuation efficiencies ranged from 66.4% for sulfate to 99.9% for iron. However, a small amount of lead was actually added by the repository underlying soil. Again, it appears unlikely that any MTCA criteria for protection of groundwater will be exceeded. The soil will clearly attenuate small leaks and discharges, but it has not been determined if the soil will attenuate all available acid and metal from the wasterock and preclude the need for an impermeable cover.

1.2.7 Data Gap 7 – 2010 Spring and Fall Aquatic Sampling and Monitoring

In June and September 2010, CES collected additional surface water and sediment samples from the eight established aquatic stations in Mill Creek and Canyon Creek, plus two additional background stations in Mill Creek. In addition, surface water samples were collected from the three seep (Tinson Adit, Wenatchee wasterock seep, and tailings seep). Results of the 2010 sampling and monitoring events are provided in Appendix D.

1.3 Schedule and Key Personnel

Implementation of the RA is expected to be accomplished in one field season. The field season at the Site is typically between late June and early October, depending on snow levels. The timeframe of the RA construction activities has not been planned or established and will be based on Forest Service budgets and priority of projects.

The field team scheduled to perform work during field operations include:

• Dustin Wasley, PE – CES	Project Manager / Principal-in-Charge
• Jay Williams, PE – CES	Senior Engineer / Engineer of Record
• Tim Otis, PE – CES	Senior Engineer / Field Inspector
• Ryan Tobias – CES	Project Biologist / Field Inspector
• Kaylan Smyth – CES	Staff Engineer / Field Inspector

All personnel who will be performing invasive activities (i.e., sampling, construction oversight, etc.) during the RA are trained to work in hazardous environments as defined by the Occupational Safety and Health Act (OSHA) 1910.120. In addition, Mr. Tobias and Ms. Washington are certified under the Mine Safety & Health Administration (MSHA) training requirements outlined in Public Laws 91-173 and 95-164.
Other personnel who will periodically be on site are listed below. The Contracting Officer Representative (COR) will be kept informed regarding project activities, plans, schedules, budget/invoicing, and other issues through monthly phone meetings.

• Rod Lentz – Forest Service	On-Scene Coordinator (OSC)/COR
• Others	Authorized Forest Service Personnel

1.4 Logistics

Due to the remoteness of the Site, the existing office building will be minimally improved to serve as the office for the RA implementation. In addition, a temporary camp will be established for the implementation of the RA (see Sheet C-8). The camp will include tents, a cooking and eating area, as well as shower and sanitary facilities (porta potties). Care will be taken to avoid any significant impacts to forest resources and to reduce the potential for non-work related exposure to potentially hazardous materials known to be present at the Site. All food, equipment, and other supplies will be packed in and out, and will be stored in bear-proof containers and in a manner not to attract wildlife. All refuse will be stored in bear-proof containers, and routinely packed out of the Site and properly disposed at an approved solid waste facility. The camp area will be cleaned-up and left in good condition prior to departure, and if needed graded and revegetated in accordance with the other reclamation at the Site. ATVs will likely be used as part of the Removal Action, which will require that a small supply of fuel be kept available at the Site. To control problems, the following fuel handling procedures will be employed:

- Only containers approved for gasoline will be used.
- A storage area with secondary containment will be established at the Site.
- Care will be taken to avoid spills during refueling.
- Refueling will be done near the fuel storage area, to the greatest practical degree.
- There will be no open flames or other sources of ignition allowed in the vicinity of the fuel storage area or during refueling operations.

2.0 REMOVAL ACTION ACTIVITIES

2.1 Summary of RA Activities

The work will consist of, but not be limited to, providing all labor, materials, earthwork, and incidentals necessary to excavate and transport wasterock piles from the west side of Mill Creek to the repository, located over the tailings pile. The face of the repository will be wrapped with a Uniaxial Geogrid to maintain long-term structural stability. The upper wasterock pile will be placed as the bottom lift over the tailings, while the lower wasterock pile will be placed on top of the upper wasterock pile material in the repository. In addition, lower wasterock material will be placed in the mill area to fill in the benches and provide a uniform slope. In addition, minor amounts of eroded tailings that have deposited on or near the access road will be scrapped and placed within the repository. The tailings pile will also be minimally graded to promote positive drainage along the various benches. An impervious cover will be placed over the repository and mill area, and will consist of the following:

1. 6 to 12 inch talus cover (generally screened from 8-inches to ½-inch)
2. Uniaxial geogrid
3. 12 oz. non woven geotextile
4. 40-mil HDPE geomembrane
5. 12 oz. non woven geotextile
6. Wasterock/Tailings/Soil

Other work will consist of maintaining the access road by keeping culverts cleaned and flowing, and repairing minor erosion issues. In addition, bat gates will be installed at the five adits/workings. Water discharging from tailings seep, wasterock seep, and Tinson Adit will be treated/managed using a method to be determined in the future. Related mobilization, clearing and grubbing, road improvement and maintenance, erosion control, roadway obliteration, and revegetation will also be performed. Signs will also be posted to warn the public of the general hazards (both chemical and physical) associated with the tailings, wasterock, and metal-impacted seeps/drainages.

Logistical difficulties associated with the performance of this project include the remoteness of the Site and generally steep slopes located throughout the area, which will require special handling. The remote location may cause mobilization difficulties and may complicate delivery of the required materials.

The following sections are the main components of the RA and are listed in order of sequence. Construction drawings/sheets are attached, the exact layout and RA activities will be determined in the field through consultation between CES and the OSC/COR. All “field engineering” procedures, plans, and designs will be discussed with and approved by the OSC/COR prior to implementation. Technical Specifications (in CSI format) and the Construction Quality Assurance (CQA) Plan are attached in Appendix E.

2.2 Mobilization

Mobilization will be performed in accordance with Section 00190 of the Technical Specifications. The initial mobilization date will be determined in the future. The following general equipment will be used during the RA activities; CES assumes that the bridge weight limits are sufficient to allow transportation of equipment to the Site (the highest weight equipment is 80,000 lbs or 40 tons):

- 3 Pickup trucks
- 3, 35-ton rock trucks
- 2 wheeled loaders
- 2 Caterpillar D6 bulldozers or equivalent
- 2 Caterpillar 330 Excavators or equivalent
- 1 small backhoe/excavator for road maintenance

Equipment will be thoroughly pressure washed and cleaned to remove dirt/weeds prior to arrival on-site; the equipment will be made available for inspection prior to mobilization to the Site. Historic and archeologically significant areas will be marked with orange flagging after consultation with the Forest Service.

Equipment staging areas are planned to be on the south side of the Site (Sheet C-8). Equipment will also be staged on roadways as not to block access to and from the Site. In addition, a temporary camp is proposed to be on the south side of the Site (see Sheet C-8). The Office Building may also be partially improved to serve as a temporary office/storage building.

2.3 Road Use, Maintenance, and Traffic Control

The main access road/trail will close for public use for the construction season during the RA implementation. Signs will be posted at the beginning of the road/trail (near the Slate Creek bridge) advising the public that the road is not open for public use and warning of construction equipment usage. The gate will be closed and locked at all times. Flaggers will not be needed because of the limited traffic on this road/trail.

The existing access road was improved by the Forest Service during the summer/fall of 2010, additional improvements are scheduled to be performed by the Forest Service during the spring of 2011, before mobilization for the RA. During the course of the RA, the access road will be maintained, culverts kept clean, and erosion repairs will be made in a timely manner.

The unimproved access road from the tailings pile to the wasterock pile (estimated at 0.2 miles) will be improved to allow 35-ton rock trucks to transport wasterock to the repository. Improvements will consist of grading and placement of road material, and installation of erosion control devices (see Section 2.5). A temporary crossing will be constructed in Mill Creek (Sheet C-14) to allow vehicular access and minimize disturbance to the aquatic environment.

CES will erect warning signs, in advance, on any place on the project where operations may interfere with the use of the road or trail by traffic and at all intermediate points where the new work crosses or coincides with an existing road or trail. CES will notify the District Ranger two weeks prior to mobilization of substantial equipment that will limit the public use of the Harts Pass Road. In addition, the Contractor will provide pilot cars or flaggers at Dead Horse Point to stop other vehicles at designated turnouts.

2.4 Clearing and Grubbing

Clearing and grubbing, performed at the direction of CES and in accordance with Section 02130 of the Technical Specifications, will be kept to a minimum, and will only disturb areas within the limits of the Site and other minor areas for access. Grubbed material and slash will be stockpiled on-site for shredding as mulch to use during the revegetation.

2.5 Surface Water Diversion / Erosion Control Measures

Prior to invasive activities, sediment control devices (i.e., straw bale barrier or silt fencing) must be installed adjacent to Mill Creek and tributaries to control the migration of sediment into surface water bodies. The location of the sediment control devices will be determined by CES after consultation with the OSC/COR. The sediment control devices will be installed in accordance with manufacturer details and specifications and at the direction of CES. In addition, flocculants will be available at the Site in case of discharge from the sedimentation basins; CES will work with the Contractor and manufacturer to identify the most appropriate flocculants. Typical details are shown in the Design Drawings on Sheet C-9. Specifications are located in Appendix E, Section 02251.

Mill Creek will be temporarily diverted away from the wasterock piles towards the eastern bank to minimize the amount of spillage that falls into the creek during removal. Wasterock that deposits in the floodplain will be removed in an expeditious manner, to the extent practical based on high river flows and wasterock stability.

In addition, at the direction of CES and as shown on the Drawings, stormwater and snowmelt run-on would be controlled on the upgradient side by constructing run-on control ditches or berms that channel the water around the revegetated areas. Typical details are shown on Sheet C-14; run-on ditches were sized for the 100-year, 24-hour storm event.

2.6 Wasterock Excavation and Placement

The upper and lower wasterock piles will be excavated to the limits shown on the Drawings and in accordance with Section 02220 – Excavation and Embankment of the Technical Specifications. The approximate lines and grades are shown on the Drawings, the extent and depth of the removal will be based on field observations and results of x-ray fluorescent (XRF) in-situ field screening (the risk-based cleanup concentration is 104 mg/kg total arsenic). The estimated volume of wasterock to be removed is 22,000 bcy. In order to control the release of wasterock and sediments into Mill Creek, excavation and transport of the wasterock will proceed in a careful manner working from the top of the slope down. In addition, Mill Creek will be diverted away from the wasterock pile to the eastern bank during the excavation activities. Details have been included on Sheet C-8.

The excavated wasterock will be transported and placed over the tailings and mill area as shown on the Drawings and in accordance with Section 02220 of the Technical Specifications. Based on the HC and SB testing and laboratory analysis, the upper wasterock pile (which has the highest acid generating material) will first be placed over the tailings and the lower wasterock pile (which has the highest acid buffering capacity) will be placed over the upper wasterock. Wasterock will be placed in six-inch to 12-inch lifts and equipment compacted to 90% of standard proctor (Specification 02220.3.12 – Method 2).

During the excavation of the wasterock and construction of the repository, the Contractor shall not discharge dust or any other air contaminants into the atmosphere in such quantity as will violate the regulations of any legally constituted authority. At the first sign of fugitive emissions, water will be applied using an atomized spray until visually damp. Special consideration will be given not to over water the wasterock. No ponding or runoff from the wasterock will be allowed. CES assumes that water can be pumped directly from Mill Creek.

The Contractor will provide access to the excavation areas, and shall sequence excavation and other activities to accommodate sampling and analysis work by the Engineer and OSC/COR. Haul trucks will not be overfilled in order to minimize spillage of wasterock. If spillage occurs, the Engineer may require the trucks to be covered during transport. Loading areas and spur roads shall remain free of spilled material, to the extent practical, to avoid tracking of wasterock and contaminated soil along the haul routes. Wood and metal debris that is encountered in the excavation area shall be separated and either burned on-site or transported offsite for disposal following approval by the OSC/COR.

2.7 Reinforced Stabilized Slope and Compacted Berm

In order to provide structural integrity to the repository, an engineered reinforced stabilized slope and a compacted berm will be constructed at the toe of the repository. The reinforced stabilized slope will be constructed using fill material at the Site (talus screens, talus, and uncontaminated overburden beneath the wasterock pile), and will be the first 385 feet along the toe, and 15-feet in height as shown on Sheet C-8, in details on Sheet C-13, and in Specifications 00270.

In addition, a compacted berm (5-feet high and 8-feet wide) will be constructed along the remaining toe of the repository, as shown on C-8 and in details on Sheet C-13. The compacted berm will be constructed with uncontaminated overburden beneath the wasterock pile, or another suitable source identified by CES or the COR.

2.8 Repository Cover Construction

To meet the RA objectives as outlined in Section 1 and the EECA, an impervious cover will be constructed over the consolidated tailings and wasterock to control the migration of contaminates and erosion potential, including both the tailings and mill area repositories. The cover will consist of the following:

- Benches will be constructed every 20 feet at the tailings repository and sloped 2% to the north to manage and divert water away from the slope face. Benches will not be needed at the mill site repository because of the low final slope angle.
- A 12-oz geotextile will be placed directly over the tailings/wasterock overlain with a 40-mil HDPE liner, followed by a 12-oz ounce non-woven geotextile, and finally a uniaxial geogrid (approximately 160,000 square feet each layer of HDPE liner, geogrid, and geotextile).
- Available talus will be placed on each of the benches as shown on the Drawings.
- Talus material will be generated from the borrow area shown on Sheet C-8. Screening will need to be performed in order to remove the large and small talus material. In general, the talus will be screened from 8-inches to ½-inch, which will serve as the cover for the repository and mill area. Screened material that is larger than 8-inches will be used as riprap around the Site and potentially in the toe berm on the repository. Screened material ½-inch and less will be used as road bedding, and fill material for the reinforced mechanically stabilized toe berm.
- The 8,000 bcy of talus material needed for the cover is available in the vicinity of the Site as shown on drawing C-10.
- Tailings slope will be 2.5 H:1V or greater between benches, unless otherwise approved by the Engineer.

2.9 Passive Water Treatment Systems for Adit Discharges and Seeps

Passive water treatment systems, if needed, will be assessed, selected, designed, and installed after field monitoring confirms stabilization of flow rates and water quality parameters.

2.10 Building Material, Equipment, and Miscellaneous Debris Removal and Disposal

All building material, process equipment, and nuisance debris (estimated at ten tons) at the Site that pose a potential physical and chemical hazard to Site users will be removed following review and approval by the OSC/COR. Material will be transported and disposed at a local landfill.

The former Office Building and all concrete foundations will be left intact, unless the foundations need to be removed due to contamination. This will be discussed with the OSC/COR before any foundations are removed. Special care will be taken not to disturb areas that will be identified by the Forest Service as archeologically or historic significant areas. These areas will be marked with orange flagging at the start of the project by the Forest Service.

2.11 Revegetation

All disturbed areas (estimated at two acres) will be recontoured and revegetated in accordance with Section 02801 - Seeding of the Technical Specifications. Growth media may be added where substrate is inadequate as directed by the Engineer, this is dependent on available growth media onsite. Prior to placement, growth media will be checked with an XRF to document that metal concentrations are below the cleanup goal. The Forest Service will provide grass and forb seeds, and no fertilizer will be applied during the revegetation activities.

In addition, at the direction of the Engineer and the Forest Service, a trench (2-feet deep, by 2-feet wide, by ~400-feet long) will be excavated in the area of the former wasterock pile, along the Mill Creek. The trench will be used to plant live willow cuttings (provided by the Forest Service). Following planting, the trench will be backfilled with trench spoils. The Forest Service will also supply approximately 1,670 seedling tublings for planting around the former wasterock pile area. Extra and left over tublings may be planted in other areas as directed by the COR.

2.12 Adit/Working Closures

To minimize human access, while allowing small mammal access (e.g., bats), closures will be installed at each of the five adits/openings, including the Tinson Adit, Wenatchee Adit, Burnham Adit, Discovery Adit, and the Discovery Winze. Bat gates and bat culvert typical details are shown on Sheet C-15, stiffeners are not required for the closures, with the exception of the Wenatchee Adit. The final layout of the gates and locking mechanism will be determined following consultation with the Forest Service, the Contractor, and assessment in the field. Access to several of the adits/workings (Discovery Adit, Discovery Winze, and Burnham Adit) will require the use of a helicopter. To the extent practical, closures will be fabricated at the Site and flown into place with the helicopter. Access to the Tinson Adit and Wenatchee Adit will be accomplished with the use of ATVs or standard equipment/trucks. In general, the following sections provide a summary of the dimensions and logistics of the workings.

2.12.1 Tinson Adit

- Dimensions: (~6-ft wide x 6.5-ft high)
- Access: ATVs
- Water: Flowing
- Preferred closure: Bat Gate

2.12.2 Discovery Adit

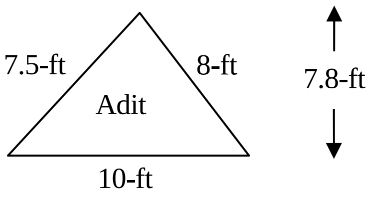
- Dimensions: (~6-ft x 6-ft)
- Access: Hiking and helicopter
- Water: None
- Preferred closure: Bat Gate

2.12.3 Discovery Winze

- Dimensions: (3-ft x 3-ft)
- Access: Hiking and helicopter
- Water: None
- Preferred closure: Grate

2.12.4 Burnham Adit

- Dimensions: (Triangle, see to right)
- Access: Hiking and helicopter
- Water: None
- Preferred closure: Culvert with gate



2.12.5 Wenatchee Adit

- Dimensions: Unknown, likely 6-ft x 6-ft
- Access: Truck/ATV
- Water: Unknown
- Preferred closure: Bat Gate, with stiffeners

2.13 Road Obliteration

Upon completion of RA construction activities, roads within the limits of the Site and other access roads constructed during the RA will be decommissioned. Decommissioning will consist of recontouring the road for proper drainage, ripping to 12 inches, seeding, fertilizing, and mulching as specified in Section 02110 – Obliteration of Abandoned Roadways of the Technical Specifications. The main access road will be left open to allow access for operation and maintenance activities.

2.14 Schedule

The implementation of the RA is anticipated to be completed in one season, assuming a three-month construction window. The proposed schedule is attached as Appendix G, and assumes an initial mobilization of June 28, 2010. This schedule is considered preliminary and will most likely change depending on field conditions. In addition, following the completion of the RA, CES or the Forest Service will provide an annual assessment of the repository and mill area covers, water treatment system (to be determined), and other improvements. Surface water and sediment samples should also be collected from the established aquatic stations to help evaluate the overall success of the RA. Details of the annual inspection and sampling will be determined following consultation with the Forest Service.

2.15 Cost Estimate

A Construction Cost Estimate was determined by CES and is attached as Appendix H.

3.0 CONFIRMATION SAMPLING

This section presents the sampling plan that will be employed at the Site to document that impacted wasterock and tailings above the risk-based cleanup concentration of 104 mg/kg total arsenic is contained within the wasterock repository and tailings cover.

3.1 Wasterock and Soil Screening and Analysis

During the RA activities, CES will use an XRF (model to be determined) to field test the limits of excavation. CES will follow the EPA recommended protocols (i.e., drying, sieving, splitting, etc.) for using the XRF. As a general rule, concentrations measured with an XRF are typically higher than laboratory results. Therefore, confirmation samples will also be collected when XRF results are below the cleanup concentration of 104 mg/kg total arsenic. The number and locations of the confirmation samples will be determined in the field.

Due to the nature of the RA activities sequence, delays in receiving analytical results, and the screening level nature of the XRF, there is a possibility that confirmation sample results could be slightly higher than the cleanup goal of 104 mg/kg. The confirmation sample results will be reviewed with the Forest Service to determine if additional excavation is needed. If soil is left in place higher than the cleanup goal, a residuals risk assessment will be prepared to review the average concentrations, and to provide documentation that there are no unacceptable risks.

3.2 Sampling Protocol

All confirmation samples shall be collected as discrete samples from specific locations. Confirmation samples shall be collected from fresh, undisturbed material from the walls and bottom of the excavation using a stainless steel spoon. Sample material will be placed in laboratory-supplied four ounce glass jars with Teflon-lined lids, and stored in a cooler on ice.

3.3 Sampling Designation and Labeling

The following sample numbering system will be used to identify conformation samples:

Waste and Soil Sample Number Example: AMRA-UWR1-5’

Where:

AMRA = Azurite Mine Removal Action
UWR = Upper Wasterock (LWR = Lower Wasterock)
SS = Site Soils
NS = Native Soils
1 = Sample Number
5’ = Depth of sample from below ground surface

3.4 Decontamination Methods

All sampling equipment (bowls, trowels, augers, etc.) will be stainless steel, and will be decontaminated before sampling. Equipment decontamination consists of a tap water rinse, a soap and tap water wash, a dilute nitrate acid (HNO_3) rinse (ten parts DI water to one part concentrated HNO_3), and a DI water rinse followed by air drying. Decontamination water will be discharged directly to soils at the Site.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL PLAN

The following standards will be maintained during sampling and analysis to see that the data generated for the assessment meets data quality objectives outlined in *Data Quality Objectives for Remedial Response Activities, Development Process*. All laboratory and field data will be subject to EPA Level II quality assurance/quality control (QA/QC) standards. All values between the method detection limit (MDL) and the practical quantitation limit (PQL) will be noted on the laboratory analytical reports.

4.1 Field QA/QC

According to the EPA QA/QC Guidelines, one duplicate and one equipment rinsate blank should be analyzed for every ten samples collected. The intent of these guidelines is to assess the precision of field sampling, and verify that contamination has not occurred in the field and that decontamination procedures were followed. Equipment rinsate blank samples will be collected during sampling activities to test for cross-contamination between samples by pouring distilled water over decontaminated sampling equipment into the sampling container. The rinsate and duplicate samples will be given unique labels; the samples will be analyzed for total arsenic.

All samples will be collected in laboratory-supplied jars and bottles, labeled, and transported according to the protocol described above. A chain-of-custody will be maintained from the time of sample collection until the time the samples are received by the analytical laboratory. The chain-of-custody will be signed by anyone who accepts responsibility for the samples, except the shipper. Shipping documents will represent custody of the samples by the shipper.

4.2 Laboratory QA/QC

The laboratory will follow all requirements for analysis and reporting under the EPA Level II protocols, including, laboratory blanks, laboratory duplicates, matrix spikes, and matrix spike duplicates. All samples will be analyzed within the holding times specified for the individual analytical procedure. Any sample analysis completed after the specified holding time will be noted in the laboratory analytical report. All analytical reports will be reviewed to see that all spikes, duplicates, and lab blanks are within acceptable limits.

4.3 Construction Quality Assurance Plan

The Construction Quality Assurance Plan is included in Appendix E.

5.0 HEALTH AND SAFETY PLAN

The Site-Specific HASP has been prepared as a separate document, and is included as Appendix A.

6.0 OPERATIONS AND MAINTENANCE PLAN

A Draft Operation and Maintenance Plan is included as Appendix I.

TABLES

Table 1. Wasterock Humidity Cell Leachate Analytical Results
Azurite Mine Removal Action Work Plan, Okanogan National Forest, Washington

Sample I.D.	Sample Date	ACZ Laboratories, Inc.												McClelland Laboratories, Inc.																		
		Aluminum, Diss. M200.7	Arsenic Total, Diss. M200.8	Cadmium, Diss. M200.8	Calcium, Diss. M200.7	Copper, Diss. M200.8	Iron, Diss. M200.7	Lead, Diss. M200.8	Magnesium, Diss. M200.7	Manganese, Diss. M200.7	Mercury, Diss. M245.1	Sodium, Diss. M200.7	Zinc, Diss. M200.8	Volume	Effluent pH	Redox Potential	Specific Conductivity	Total Iron	Total Iron (Extracted per sample weight)	Total Iron, Cumulative (Extracted per sample weight)	Total Fe^{2+}	Total Fe^{3+}	Total SO^{4-} (Effluent)	Total SO^{4-} (Extracted per sample weight)	Total SO^{4-}, Cumulative (Extracted per sample weight)	Acidity, $CaCO_3$, Equivalents	Acidity, $CaCO_3$, Equivalents (Extracted per sample weight)	Acidity, $CaCO_3$, Equivalents, Cumulative (Extracted per sample weight)	Alkalinity, $CaCO_3$, Equivalents	Alkalinity, $CaCO_3$, Equivalents (Extracted per sample weight)	Alkalinity, $CaCO_3$, Equivalents, Cumulative (Extracted per sample weight)
		Results in mg/L												liters	S.U.	mV	mS/cm	mg/L	mg/kg		mg/L			mg/kg		mg/L	mg/kg		mg/L	mg/kg	
Tailings Humidity Cell Leachate																																
Upper Wasterock																																
UWR-1 WK 0	11/13/2007	130	0.027	0.0705	137.0	7.8	342	0.0189	48.7	10.7	0.0003 B	7.3	3.74	0.820	2.66	416	2.75	313.00	103.309	103.309	243.00	70.00	1,170.0	386.17	386.17	1,548.0	510.93	510.93	0.00	0.00	0.00
UWR-1 WK 1	11/20/2007	133	0.028	0.0572	135.0	3.1	372	0.0151	80.7	12.8	< 0.0002	7.2	4.57	1.113	2.64	410	2.64	317.00	142.015	245.324	162.00	155.00	930.0	416.64	802.81	1,568.0	702.46	1,213.39	0.00	0.00	0.00
UWR-1 WK 2	11/27/2007	129	0.0409	0.0457	128.0	3.6	325	0.0155	70.0	12.1	< 0.0002	5.4	4.80	1.160	2.54	436	2.63	328.00	153.148	398.472	201.00	127.00	557.0	260.07	1,062.88	1,652.0	771.34	1,984.73	0.00	0.00	0.00
UWR-1 WK 3	12/4/2007	NA	NA	NA	NA	NA	NA	NA	NA	NR	NA	NA	NA	1.109	2.38	478	2.61	244.00	108.918	507.390	63.00	181.00	1,170.0	522.27	1,585.15	1,444.0	644.58	2,629.31	0.00	0.00	0.00
UWR-1 WK 4	12/11/2007	NR	0.10 B	0.0430	98.5	6.1	245	0.008	41.1	5.7	0.0002 B	4.1	5.30	1.135	2.39	466	3.31	428.00	195.532	702.922	168.00	260.00	1,510.0	689.84	2,274.99	2,284.0	1,043.45	3,672.76	0.00	0.00	0.00
UWR-1 WK 5	12/18/2007	182	0.208	0.0541	NR	8.7	NR	0.0124	NR	5.1	NR	NR	6.90	1.099	2.31	501	3.18	348.00	153.941	856.863	124.00	224.00	2,270.0	######	3,279.15	2,298.0	1,016.54	4,689.30	0.00	0.00	0.00
UWR-1 WK 6	12/24/2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.139	2.35	532	2.17	268.00	122.867	979.730	35.00	233.00	2,140.0	981.11	4,260.26	1,546.0	708.78	5,398.08	0.00	0.00	0.00
Lower Wasterock																																
LWR-1 WK 0	11/13/2007	0.194	0.0035	0.0006	133.0	0.0292	0.53	0.0008	8.4	0.0543	< 0.0002	8.5	0.014	0.708	7.05	125	0.67	0.07	0.020	0.020	0.01	0.06	280.0	80.17	80.17	0.00	0.00	0.00	46.00	13.17	13.17
LWR-1 WK 1	11/20/2007	0.032	0.0031	0.0001	48.4	0.0063	0.03	0.0006	2.9	0.0051	< 0.0002	3.7	0.003	1.099	7.08	195	0.25	0.01	0.004	0.024	0.00	0.01	61.0	27.11	107.28	0.00	0.00	0.00	52.00	23.11	36.28
LWR-1 WK 2	11/27/2007	0.033	0.0049	0.0003 B	44.2	0.0068	< 0.02	0.0004	2.6	0.0411	< 0.0002	3.1	0.013	1.156	6.60	196	0.24	0.03	0.014	0.038	0.01	0.02	11.4	5.33	112.61	0.00	0.00	0.00	56.00	26.18	62.46
LWR-1 WK 3	12/4/2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.202	6.20	200	0.20	0.09	0.044	0.082	0.00	0.09	30.1	14.63	127.24	0.00	0.00	0.00	62.00	30.14	92.60
LWR-1 WK 4	12/11/2007	NR	0.0041	< 0.0001	28.7	0.0104	< 0.02	0.0001 B	1.8	0.0042	< 0.0002	1.8 B	0.005 B	1.196	6.45	229	0.19	0.01	0.005	0.087	0.00	0.01	16.5	7.98	135.22	0.00	0.00	0.00	46.00	22.25	114.85
LWR-1 WK 5	12/18/2007	0.081	0.0041	0.0005 B	NR	0.0097	NR	0.0002 B	NR	0.0054	NR	NR	0.007 B	1.169	6.77	192	0.18	0.02	0.009	0.096	0.00	0.02	7.4	3.50	138.72	0.00	0.00	0.00	56.00	26.47	141.32
LWR-1 WK 6	12/24/2007	NA	NA	NA	NA	NA	NA	NA	NR	NA	NA	NA	NA	1.161	6.5	228	0.18	0.00	0.000	0.096	0.00	0.00	9.2	4.32	143.04	0.00	0.00	0.00	70	32.78	174.19

GENERAL NOTES:

All metal analyses were conducted by ACZ Laboratories, Inc. in Steamboat Springs, Colorado.

Non-metal analyses and field parameters were obtained at McClelland Laboratories, Inc. in Sparks, Nevada.

Abbreviations: < value = analyte not detected above indicated Method Detection Limit (MDL), B = analyte detected between MDL and Practical Quantification Limit (PQL),. Diss. = Dissolved, mg/L = milligrams per liter, mg/kg = milligrams per kilogram, mS/cm = millisiemans per centimeter, mV = millivolts, NA = not analyzed, NR = results not received by the lab, s.u. = standard units.

Table 2. Wasterock and Soil Analytical Results

Azurite Mine Removal Action Work Plan, Okanogan National Forest, Washington

Sample ID	Sample Date	Sample Depth (feet)	Solids Present CLPSOW390, PART F, D-98	Paste pH USDA No. 60 (21)	Arsenic, Total M6020	Cadmium, Total M6020	Chromium, Total M6010B	Cobalt, Total M6010B	Copper, Total M6010B	Iron, Total M6010B	Lead, Total M6020	Mercury, Total M7471A	Vanadium, Total M6010B	Zinc, Total M6010B	Sulfur Forms M600/2-78-054 3.2.4 Sulfur, Organic	Sulfur, Total	Sulfur, Pyritic Calculated	Sulfur, Sulfate	ABAs M600/2-78-054 1.3 & 3.2.3 Acid Generation Potential	Acid Neutralization Potential	Acid-Base Potential	Neutralization Potential as $CaCO^3$
			%	s.u.	Results in mg/kg										%				t $CaCO_3$/Kt			%
Wasterock																						
UWR-1	10/4/2007	0-6	91.5	3.3	195	0.44	55	41	546	137,000	16.30	0.92	91.0	115	1.95	3.16	0.3	0.91	99	0	-99	< 0.01
UWR-2	10/4/2007	0-6	91.4	6.6	177	4.07	115	29	88	56,200	49.60	0.09 BH	121	648	0.04 B	0.05 B	0.01 B	< 0.01	2 B	15	13	1.5
LWR-1	10/4/2007	0-6	88.2	7.1	97.8	4.62	123	29	118	56,800	60.70	< 0.04 H	128	850	0.03 B	0.02 B	< 0.01	< 0.01	0	20	20	2.0
LWR-2	10/4/2007	0-6	87.6	7.1	71.6	3.25	114	27	97	55,300	44.40	0.21 H	120	695	0.19	0.24	< 0.01	0.06 B	8	20	12	2.0
Native Soil																						
TP-1, S-2	10/3/2007	5-9	76.4	3.3	79.3	0.51	148	22	349	88,600	23.30	0.06	161	205	0.29	0.98	0.05 B	0.64	31	0	-31	< 0.01
TP-2, S-2	10/3/2007	6-9	76.1	3.4	121.0	0.34	129	26	518	78,400	41.40	0.05	137	191	0.35	0.95	< 0.01	0.64	30	0	-30	< 0.01
TP-4, S-2	10/3/2007	5-8	67.4	3.8	62.5	0.34	131	23	502	64,300	16.40	< 0.04 H	154	158	0.21	0.66	0.02 B	0.43	21	0	-21	< 0.01
TP-5, S-1	10/3/2007	0-5	82.6	5.5	72.2	0.61	131	25	180	53,000	14.50	0.05 BH	159	199	0.03 B	0.06 B	0.01 B	0.02 B	2 B	2	0	0.2
TP-5, S-2	10/3/2007	5-7	88.1	6.0	88.4	0.95	133	26	262	54,600	14.10	< 0.04 H	162	223	0.02 B	0.03 B	< 0.01	0.01 B	0	8	8	0.8
TP-6 S-1	10/3/2007	0-5	74.8	5.6	93.4	1.51	129	22	306	62,300	829	0.70 H	168	479	0.04 B	0.06 B	< 0.01	0.02 B	2 B	5	3	0.5

GENERAL NOTES:

All analysis was conducted by ACZ Laboratories, Inc. in Steamboat Springs, Colorado.

Sulfur, Pyritic was calculated from the difference between sulfur, total and sulfur, sulfate.

Paste pH criteria is a Dangerous Waste/RCRA Hazardous Waste designation.

Abbreviations: < value = analyte not detected above indicated the Method Detection Limit (MDL), B = analyte detected between the MDL and the Practical Quantification Limit (PQL), H = analysis exceeded method hold time, mg/kg = milligrams per kilogram, s.u. = standard units.
t $CaCO_3$/Kt = tons of calcium carbonate needed to neutralize 1,000 tons of waste/soil (Negative number indicates lack of $CaCO_3$; positive value indicates excess [no need]), TP = test pit,

Table 3. TCLP and SPLP Results for Wasterock
Azurite Mine Removal Action Work Plan, Okanogan National Forest, Washington

Sample ID	Sample Date	Sample Depth (feet)	Arsenic, TCLP M6010B	Arsenic, SPLP M6010B	Cadmium, TCLP M6010B	Cadmium, SPLP M6010B	Copper, TCLP M6010B	Copper, SPLP M6010B	Lead, TCLP M6010B	Lead, SPLP M6010B	Mercury, TCLP M7470	Mercury, SPLP M7470	Zinc, TCLP M6010B	Zinc, SPLP M6010B
			mg/L											
Wasterock														
UWR-1	10/4/2007	0-6	< 0.04	< 0.04	< 0.005	0.006	0.08	0.40	< 0.04	< 0.04	< 0.0002	< 0.0002	0.14	0.38
UWR-2	10/4/2007	0-6	**0.05** B	< 0.04	0.027	< 0.005	0.07	< 0.01	< 0.04	< 0.04	< 0.0002	< 0.0002	1.34	0.03 B
LWR-1	10/4/2007	0-6	< 0.04	< 0.04	0.016	< 0.005	0.03 B	< 0.01	< 0.04	< 0.04	< 0.0002	< 0.0002	2.54	0.52
LWR-2	10/4/2007	0-6	< 0.04	< 0.04	0.017 B	< 0.005	0.04 B	< 0.01	< 0.04	< 0.04	< 0.0002	< 0.0002	1.91	0.03
Applicable Standards														
TCLP - Dangerous Waste Limits			5		1		NS		5		0.2		NS	
MTCA Groundwater Protection Criteria			0.005		0.005		NS		0.15		0.002		NS	

GENERAL NOTES:

Analysis was conducted by ACZ Laboratories, Inc. in Steamboat Springs, Colorado.

Bold values - sample exceeded one or more standard

Abbreviations: < value = analyte not detected above the Method Detection Limit (MDL), B = analyte detected between the MDL and the Practical Quantification Limit (PQL), mg/L = milligrams per liter, NC = not calculated, NS = no standard.

Table 4. Sequential Batch Test Leachate Analytical Results
Azurite Mine Removal Action Work Plan, Okanogan National Forest, Washington

Sample I.D.	Sample Date	ACZ Laboratories, Inc.												McClelland Laboratories, Inc.														
		Aluminum, Diss. M200.7	Arsenic Total, Diss. M200.8	Cadmium, Diss. M200.8	Calcium, Diss. M200.7	Copper, Diss. M200.8	Iron, Diss. M200.7	Lead, Diss. M200.8	Magnesium, Diss. M200.7	Manganese, Diss. M200.7	Mercury, Diss. M245.1	Sodium, Diss. M200.7	Zinc, Diss. M200.8	Soil Weight	Soil Volume	Soil Bulk Density	Influent Volume	Effluent Volume	Start T	End T	Redox Potential	pH	Specific Conductivity	Dissolved Oxygen	Total Iron	Total SO^{4-}	Acidity, $CaCO_3$ Equivalents	Alkalinity, $CaCO_3$ Equivalents
		Results in mg/L												Kg	ft^3	lb/ft^3	L		°C		mV	s.u.	mS/cm	mg/L				
Composite Leachant																												
SEQ-INF	12/13/2007	NR	0.0562	0.0482	117	5.2000	293.00	0.007	55.1	10.6	< 0.0002	5.1	5.10	NA	NA	NA	3.750	NA	NA	NA	444	2.51	2.79	6.1	328.00	1,054	1,717	0
Sequential Batch Tests																												
S-1	12/16/2007	NR	0.0009 B	0.0217	221	0.0174	0.16	0.077	57.9	14.5	0.0002 B	7.9	6.70	2.500	0.074	74.4	3.750	3.568	18.6	19.3	268	4.54	1.43	8.1	0.06	774	44	0
S-2	12/18/2007	NR	0.0009 B	0.0091	139	0.0099	0.07	0.040	39.3	1.8	< 0.0002	8.6	1.85	2.097	0.064	72.2	3.145	2.787	19.3	20.2	325	5.35	0.90	6.8	0.16	564	12	4
S-3	12/21/2007	1.4	0.0007 B	0.0055	NR	0.0587	NR	0.014	NR	0.5	NR	NR	1.40 B	1.747	0.053	72.6	2.620	2.296	20.2	18.0	271	6.02	0.56	6.8	0.03	354	8	2
Attenuation Efficiency After S-3 (%)																												
	NC	99.02	98.77	88.61	NC	99.06	NC	-103.01	NC	95.28	NC	NC	72.51	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	99.90	66.40	99.53	NC
Default MTCA Leachability Groundwater Protection Criteria																												
	NC	NC	0.01	0.05	NC	NC	NC	0.15	NC	NC	0.002	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

GENERAL NOTES:

All metal analyses were conducted by ACZ Laboratories, Inc. in Steamboat Springs, Colorado.

Non-metal analyses and field parameters were obtained at McClelland Laboratories, Inc. in Sparks, Nevada.

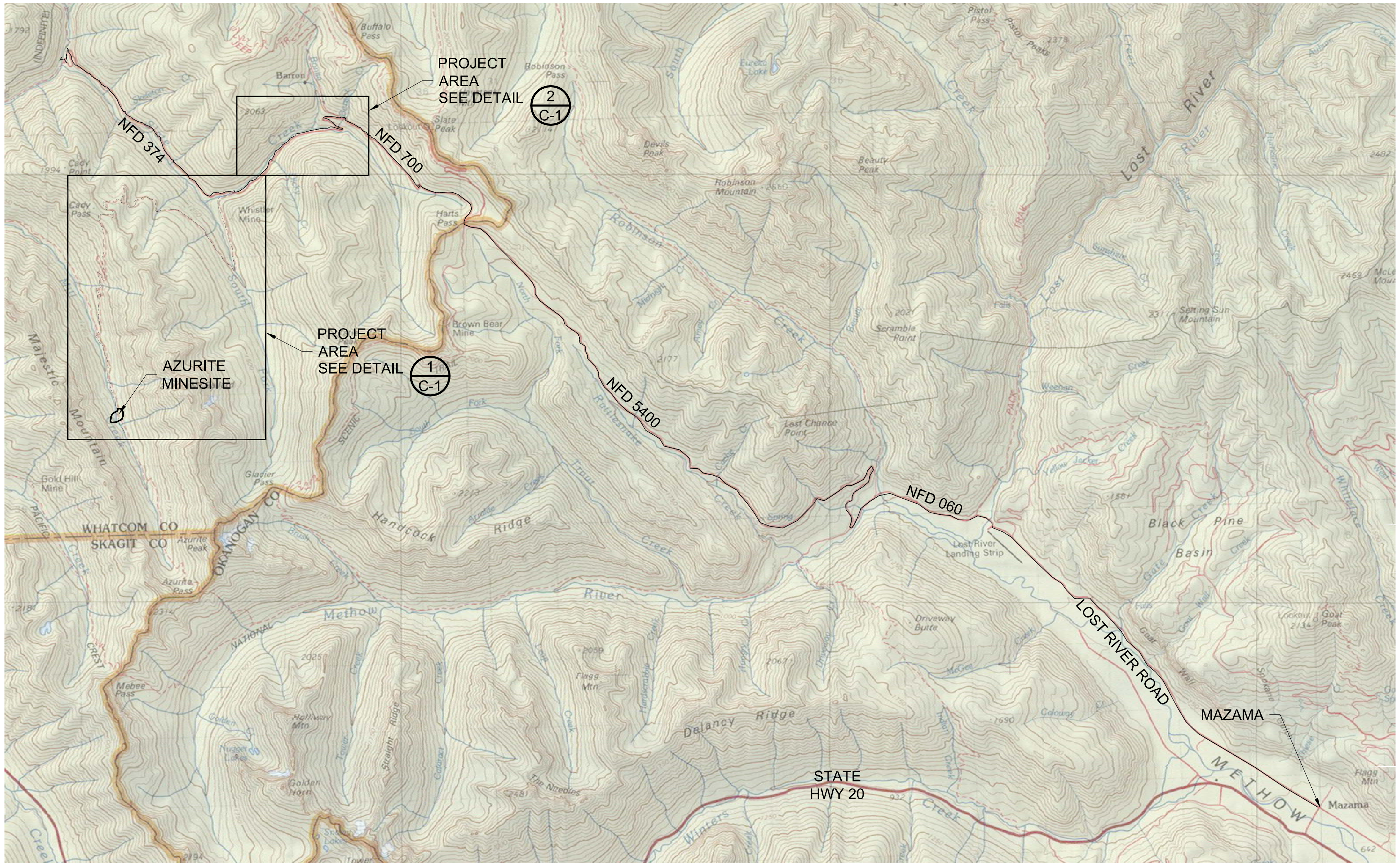
Abbreviations: < value = analyte not detected above indicated the Method Detection Limit (MDL), °C = degrees centigrade, B = analyte detected between the MDL and the Practical Quantification Limit (PQL), Diss. = dissolved, ft^3 = cubic foot, Kg = kilograms, L = liters, lb/ft^3 = pounds per cubic foot, mg/L = milligrams per liter, mg/kg = milligrams per kilogram, mS/cm = millisiemans per centimeter, mV = millivolts, NA = not analyzed, NC = not calculated, NR = not received, s.u. = standard units

DRAWINGS

Sheet G-1.	**Vicinity Map and Sheet Index**
Sheet C-7.	**Camp and Borrow Areas**
Sheet C-8.	**Grading Plan**
Sheet C-9.	**Drainage and Erosion Control Details**
Sheet C-10.	**Tailings Cross Sections**
Sheet C-11.	**Tailings Cross Sections**
Sheet C-12.	**Tailings Cross Sections**
Sheet C-13.	**Repository Slope Face Details**
Sheet C-14.	**Supplemental Details**
Sheet C-15.	**Supplemental Details**
Sheet C-16.	**Existing Wasterock Pile Cross Sections**

AZURITE MINE REMOVAL ACTION

MAZAMA, WASHINGTON



0 5000 10,000 FEET
SCALE

(SOURCE: NATIONAL GEOGRAPHIC 7.5 MINUTE TOPOGRAPHIC MAPS OF WASHINGTON ON CD-ROM, 2003)

INDEX OF DRAWINGS

SHEET	GENERAL	
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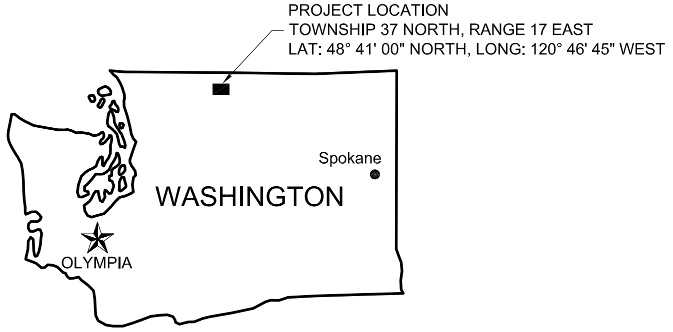

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S:\[Working Drafting]\P201023065 USFS Azurite Mine Removal\Drawings\2723031 G-1,C-9.dwg Billings, Kyle 4/15/11

AZURITE MINE
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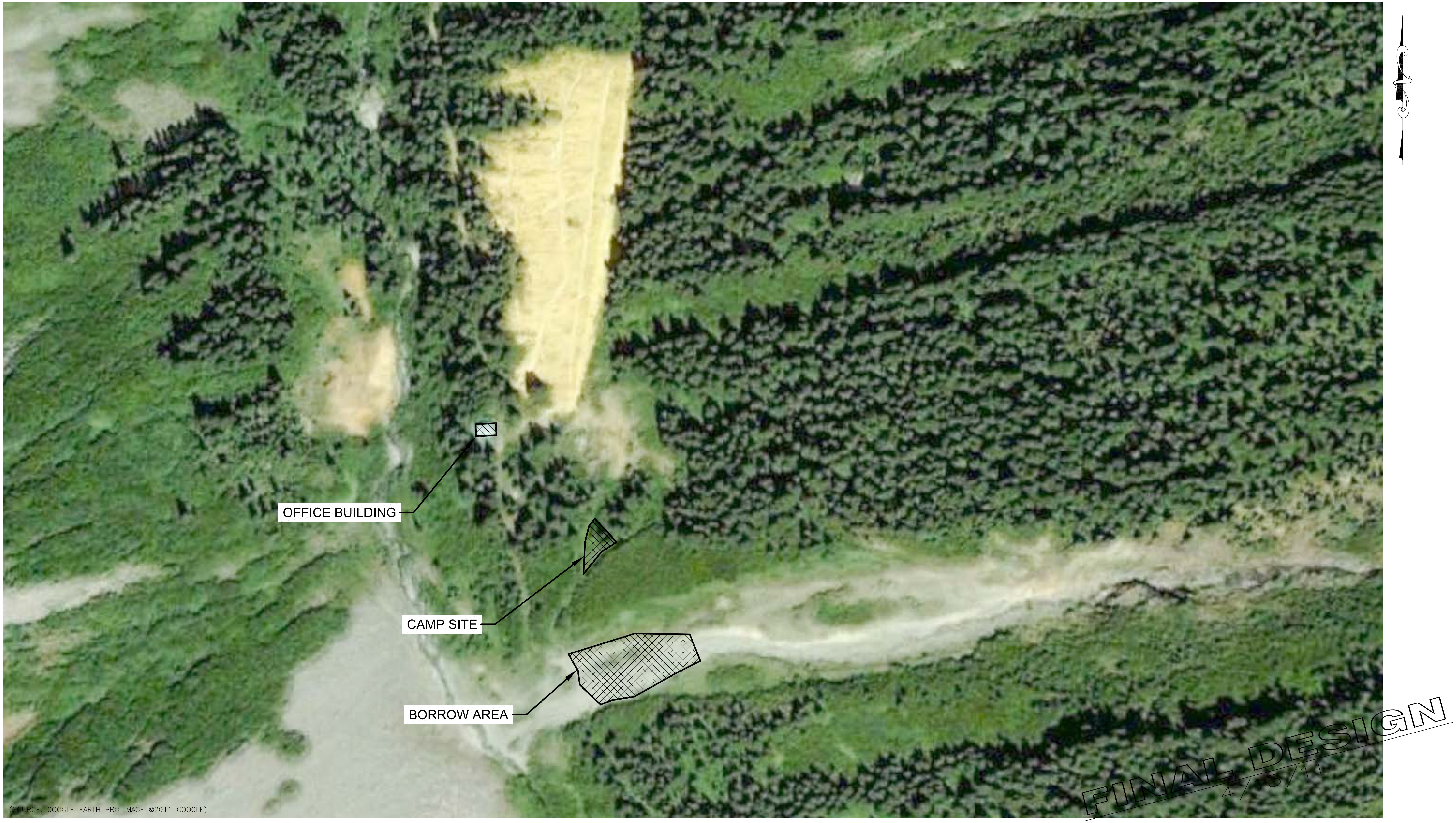
VICINITY MAP &
SHEET INDEX

REMOVAL ACTION

SHEET
G-1



(SOURCE: GOOGLE EARTH PRO IMAGE ©2011 GOOGLE)

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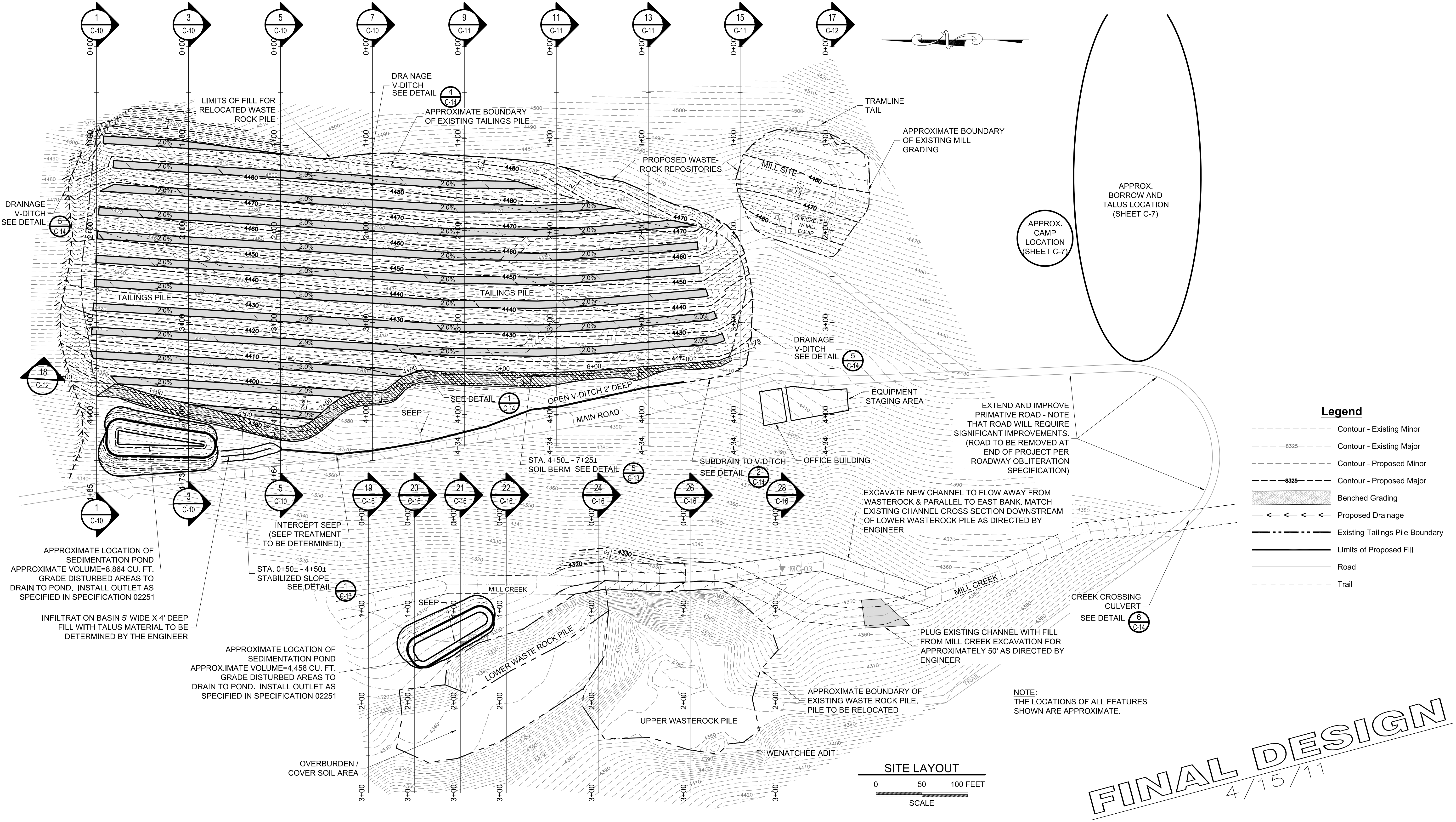
CAMP AND BORROW AREAS

REMOVAL ACTION

SHEET
C-7



Legend

- - - - -	Contour - Existing Minor
- - -8325- - -	Contour - Existing Major
- - - - -	Contour - Proposed Minor
- - -8325- - -	Contour - Proposed Major
▨	Benched Grading
← ← ← ←	Proposed Drainage
—·—·—	Existing Tailings Pile Boundary
———	Limits of Proposed Fill
———	Road
- - - - -	Trail

NOTE:
THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

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GRADING PLAN

REMOVAL ACTION

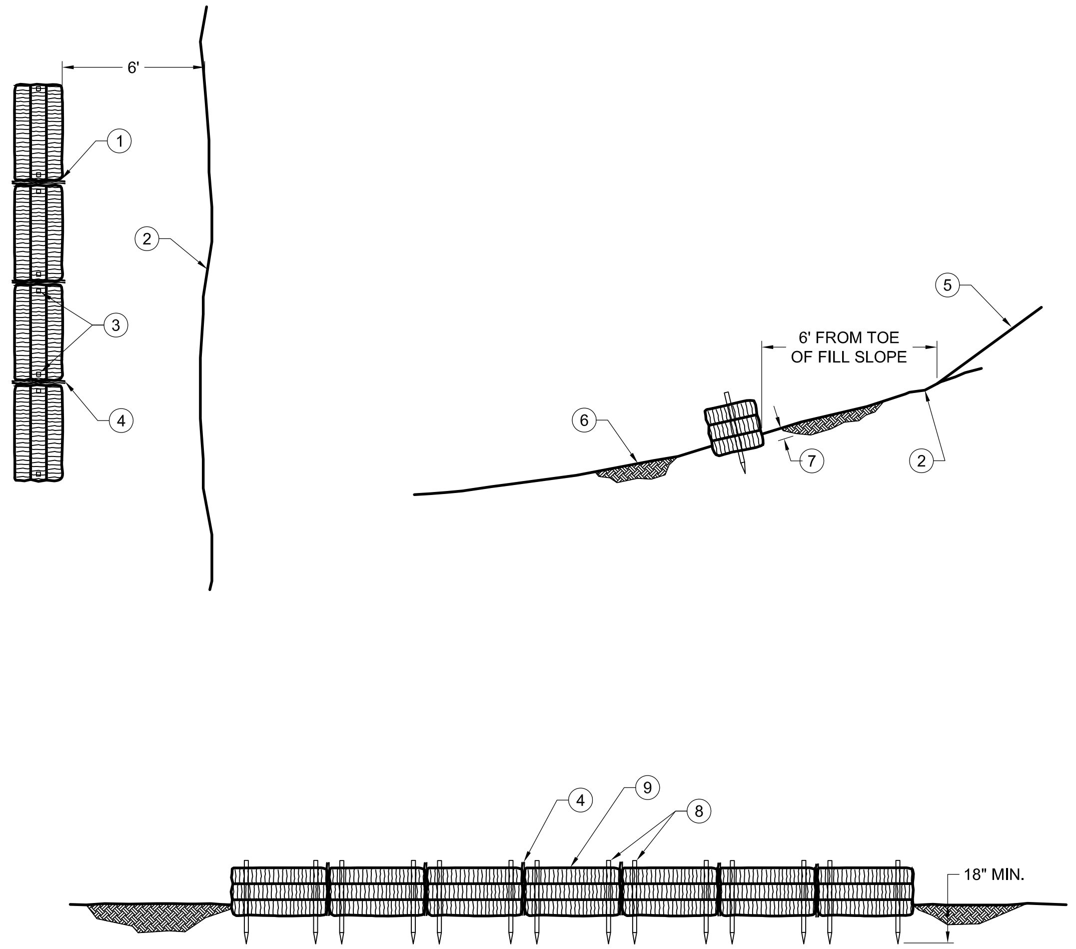
SHEET
C-8

KEYED NOTES:

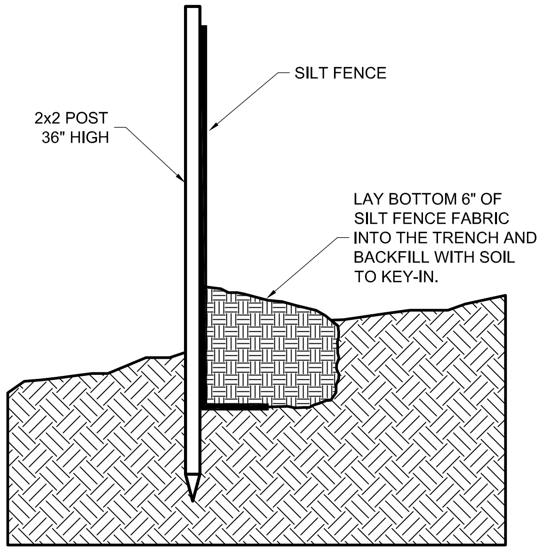
1. PLACE BALES END TO END.
2. TOE OF SLOPE.
3. (2) STAKES PER BALE MIN. 2" x 2" x 3'.
4. TAMP LOOSE STRAW INTO JOINTS.
5. FILL SLOPE.
6. UNDISTURBED SLOPE.
7. PLACE BALES APPROXIMATELY 6" INTO THE GROUND.
8. DRIVE STAKE THROUGH EACH BALEA AT BUTTED ENDS
9. STRAW BALES.

NOTES:

1. PLACE EROSION BARRIERS TO FOLLOW ALONG THE SLOPE CONTOUR. PLACE BALES WITH STRINGS ON SIDES TO PROLONG THE LIFE OF THE BARRIER. METAL POSTS MAY BE USED IN PLACE OF STAKES IN AREAS WHERE STAKES ARE UNSTABLE OR UNABLE TO BE DRIVEN.
2. MATERIAL COLLECTED BEHIND STRAW BALES TO BE REDEPOSITED IN REPOSITORY.



1 STRAW BALE BARRIER DETAILS
- NOT TO SCALE



2 SILT FENCE
- NOT TO SCALE

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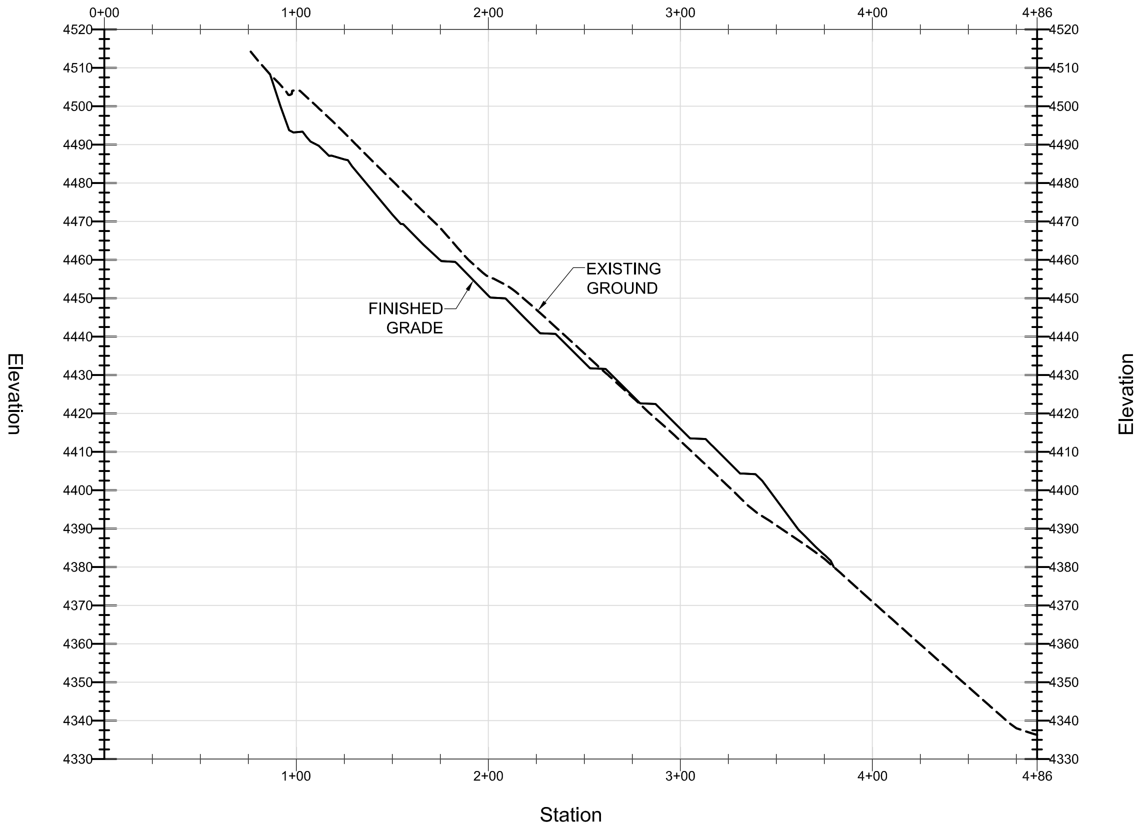
DRAINAGE & EROSION CONTROL DETAILS

REMOVAL ACTION

SHEET
C-9

Section 1



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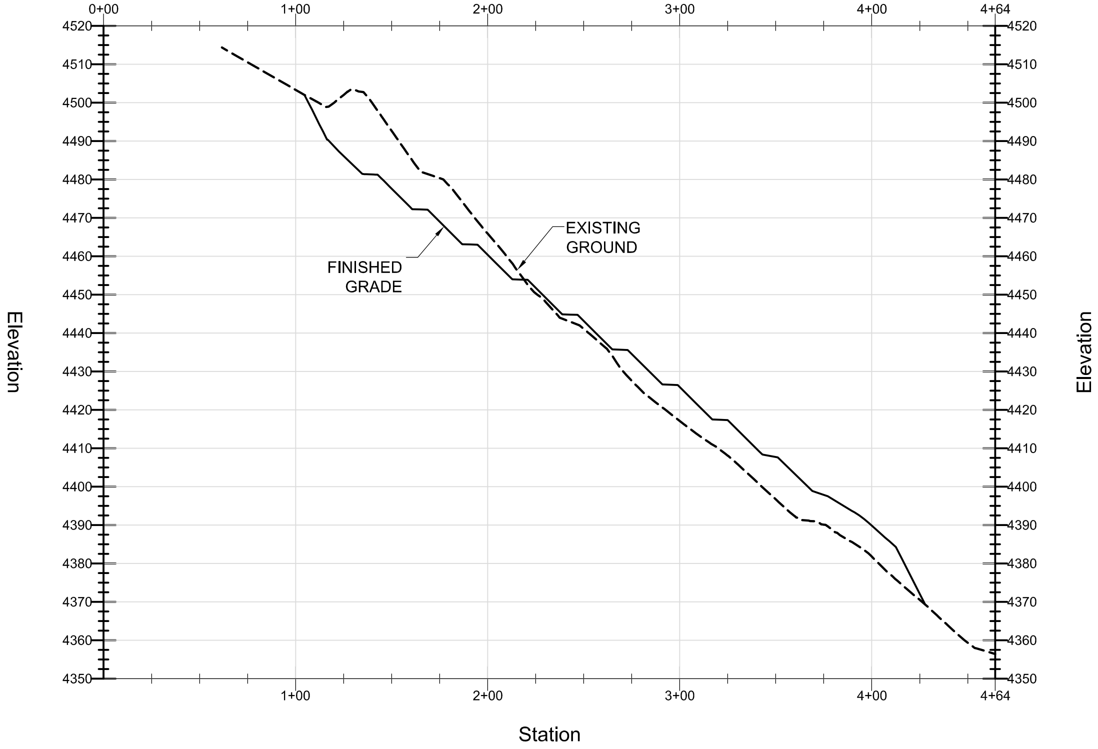

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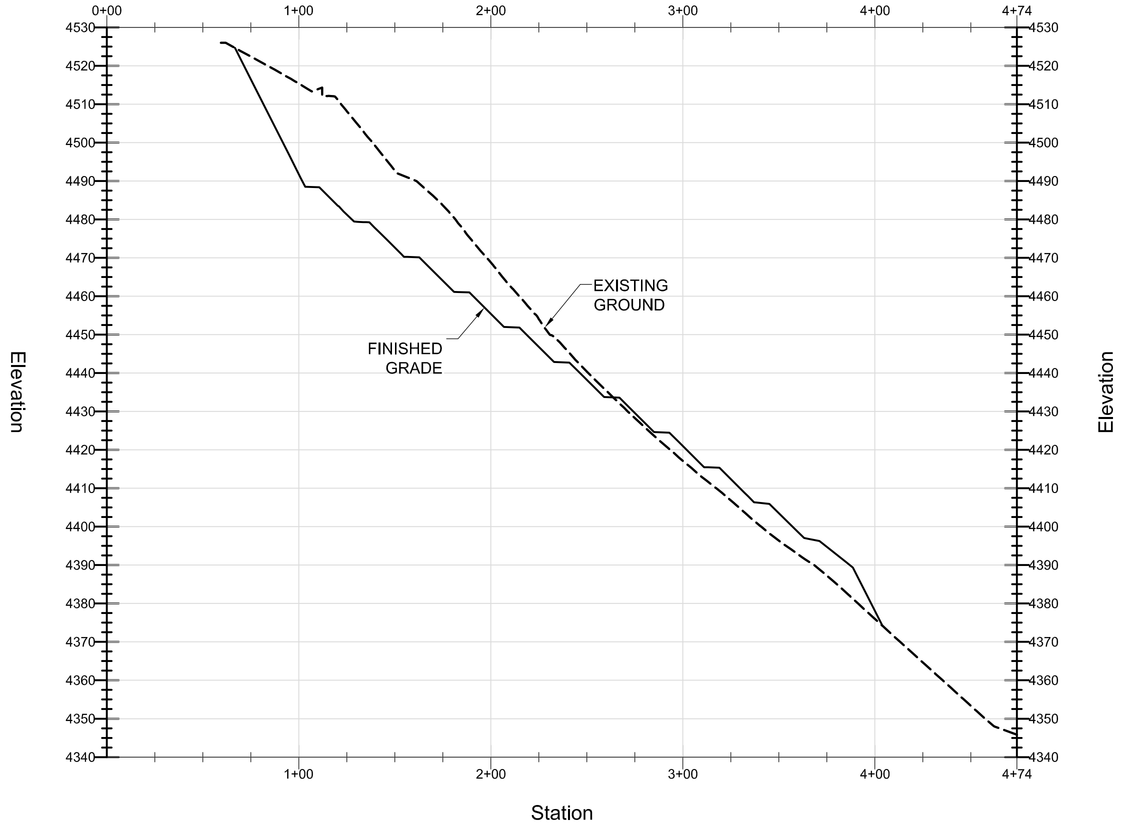

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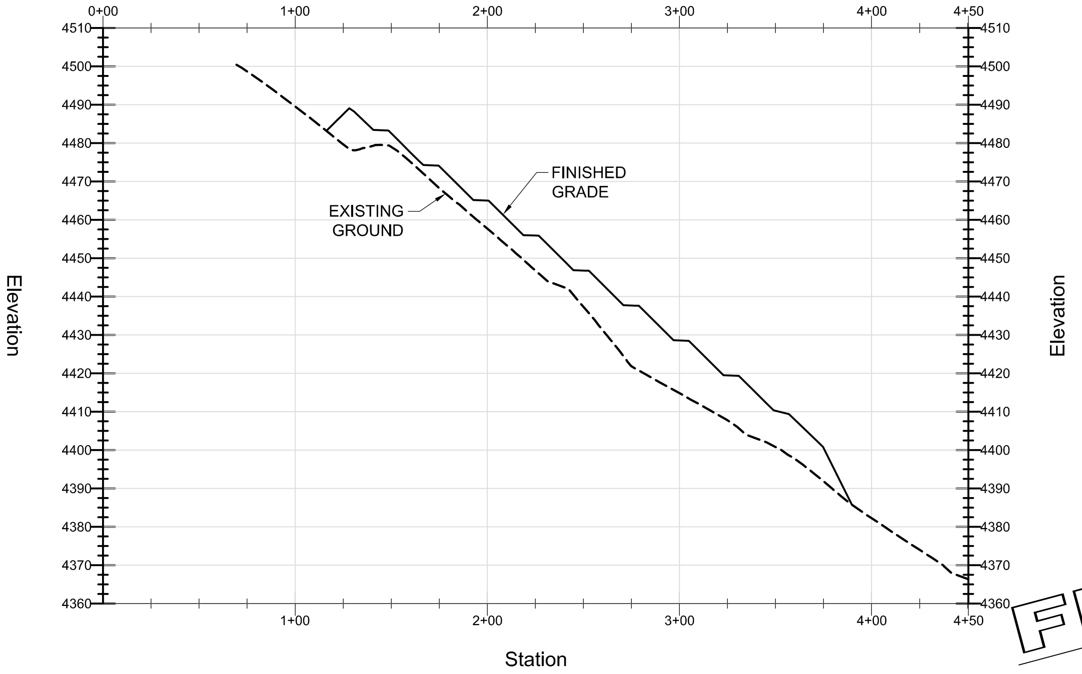

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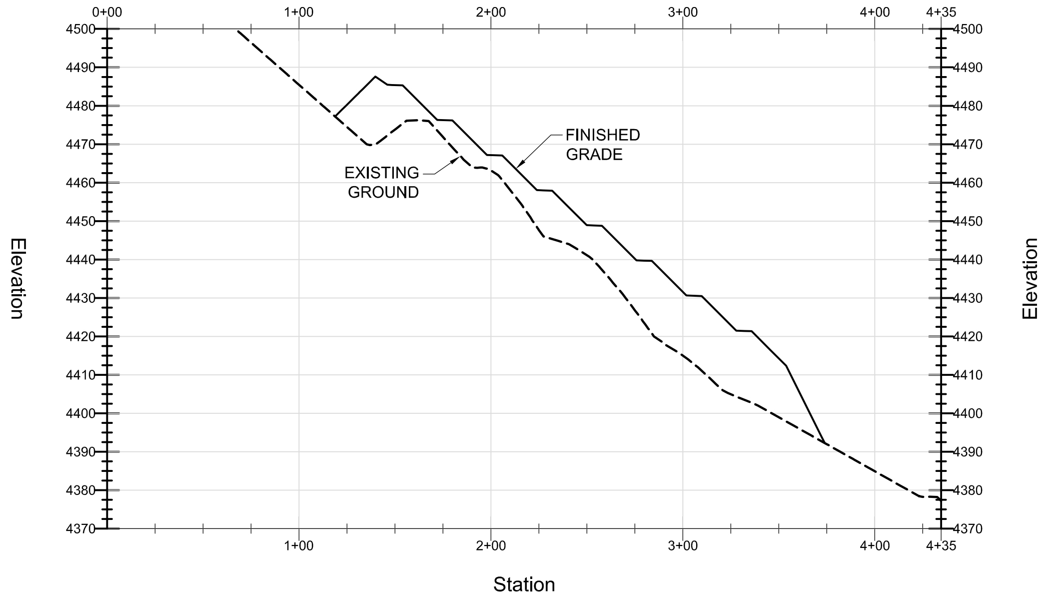
TAILINGS CROSS SECTIONS

REMOVAL ACTION

SHEET
C-10

Section 9



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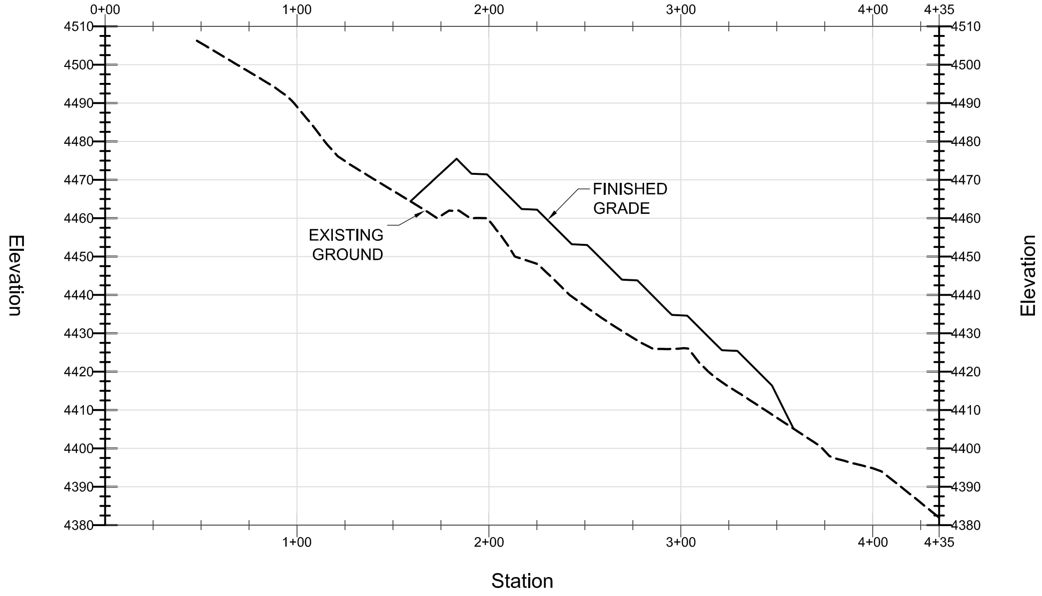

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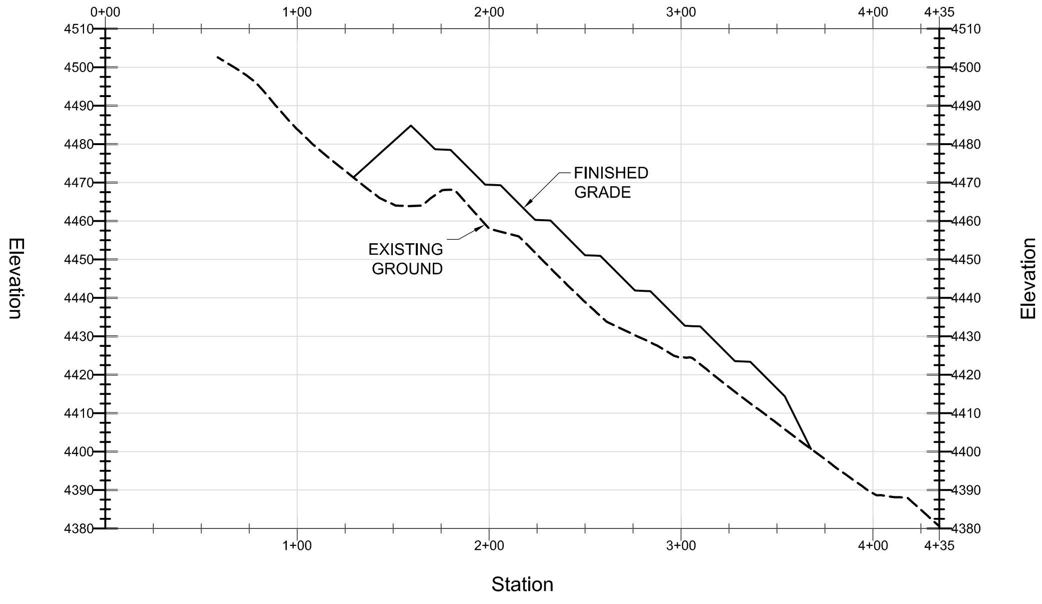

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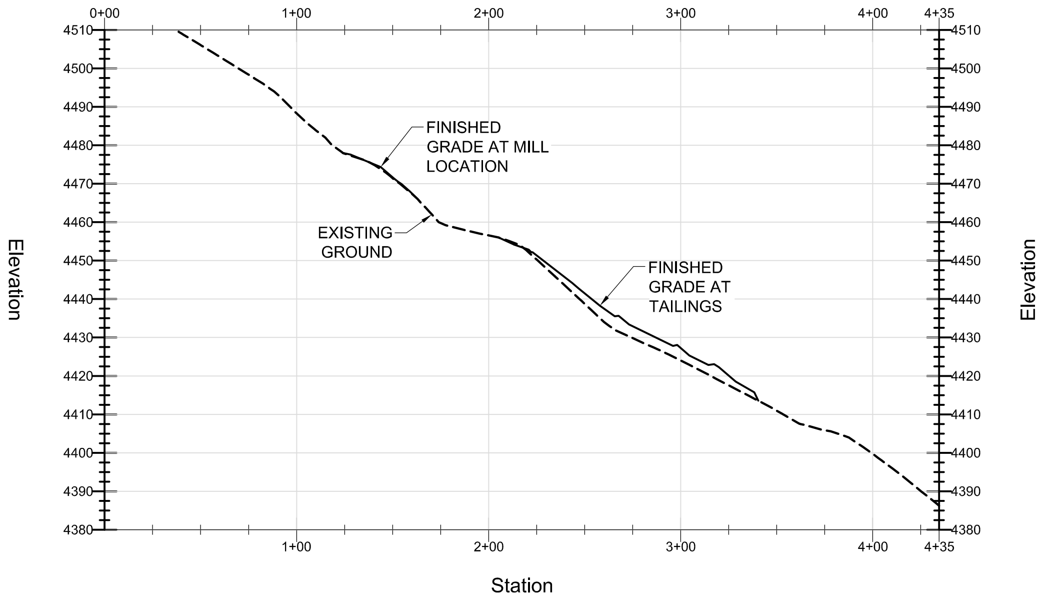

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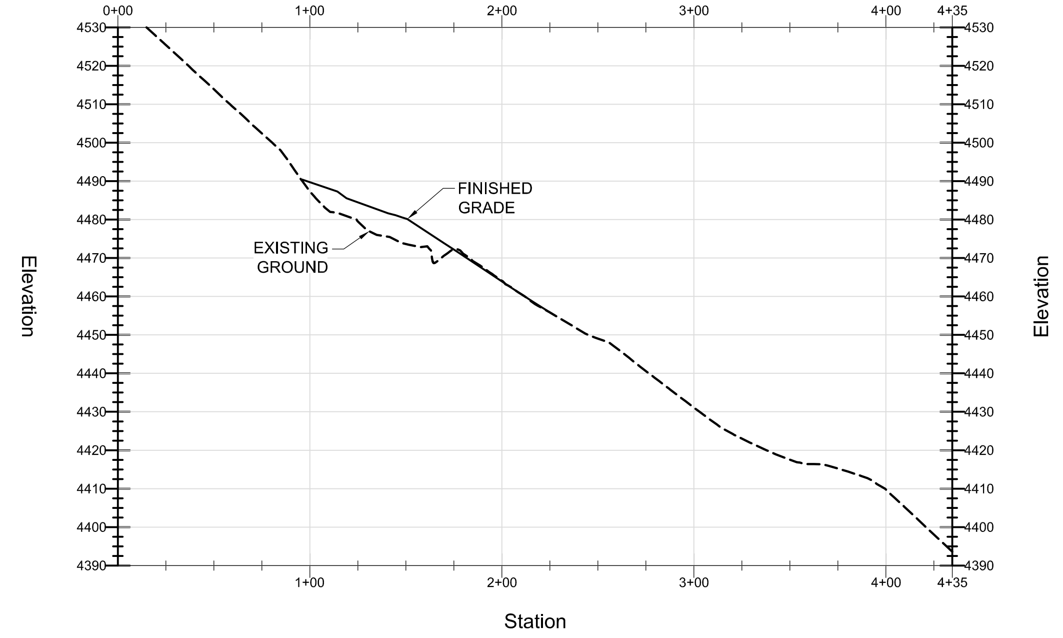
TAILINGS CROSS SECTIONS

REMOVAL ACTION

SHEET
C-11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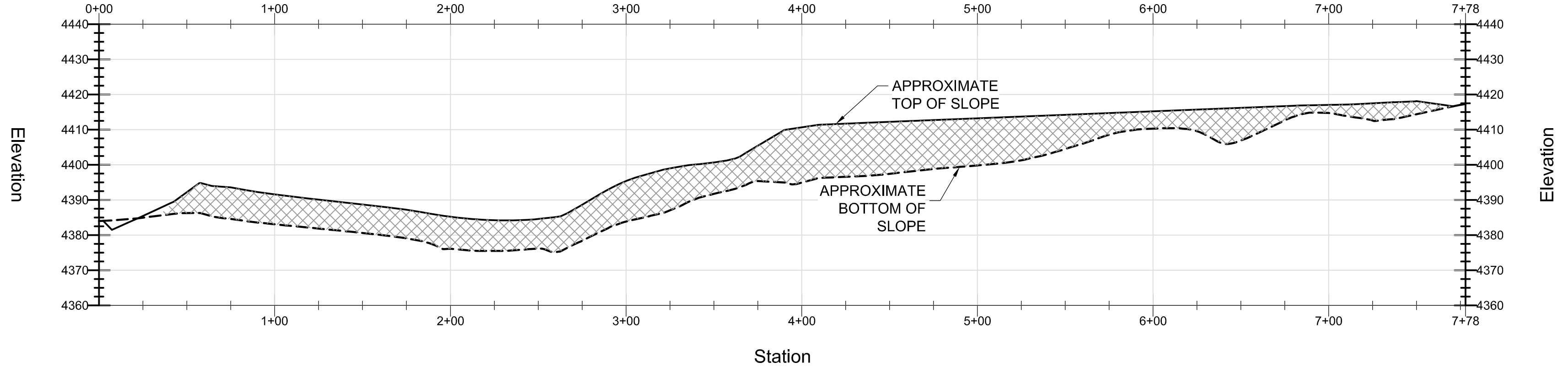
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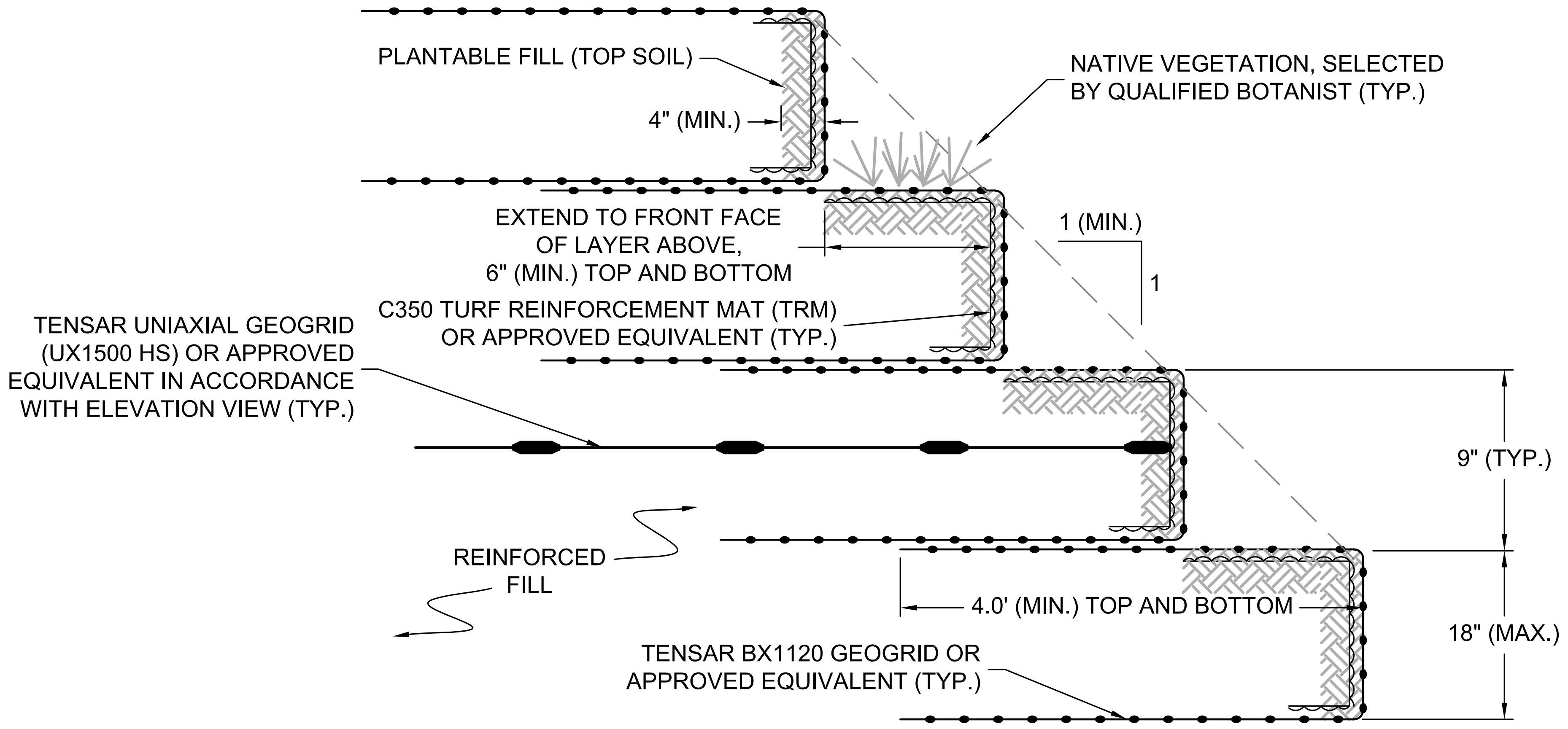
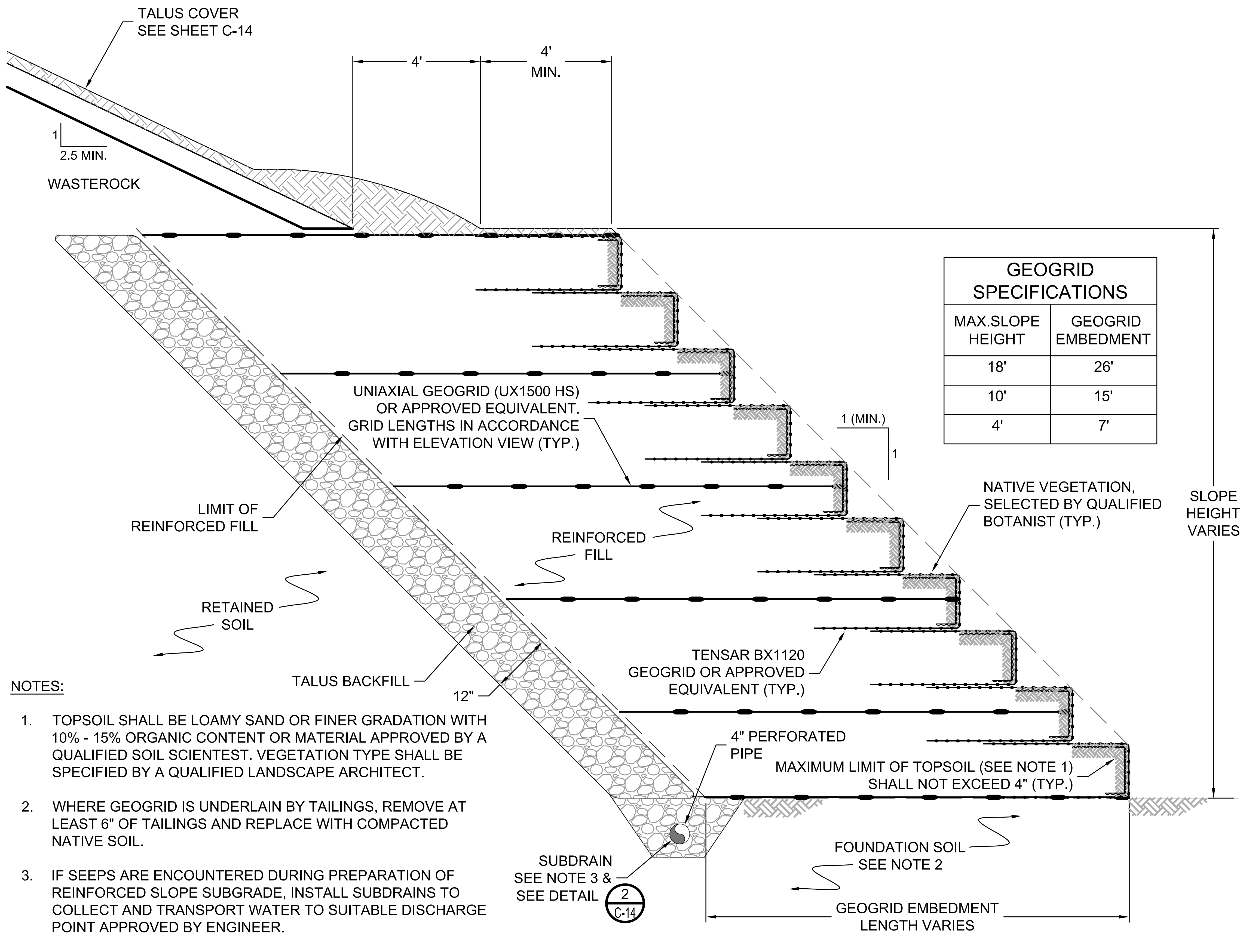
TAILINGS CROSS SECTIONS

REMOVAL ACTION

SHEET
C-12



1 STABILIZED SLOPE DETAIL
C-8 NOT TO SCALE

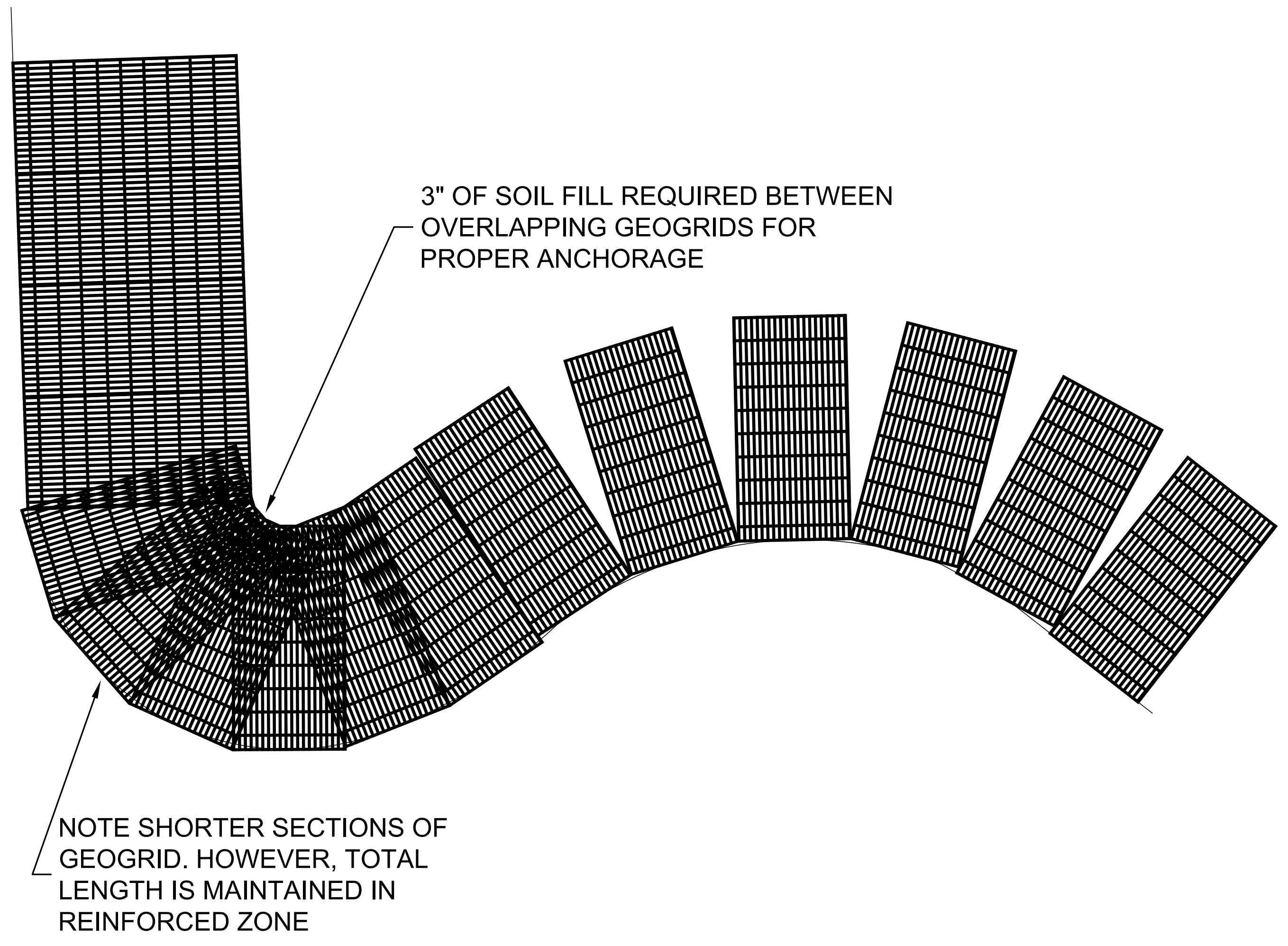


GEOGRID SPECIFICATIONS	
MAX.SLOPE HEIGHT	GEOGRID EMBEDMENT
18'	26'
10'	15'
4'	7'

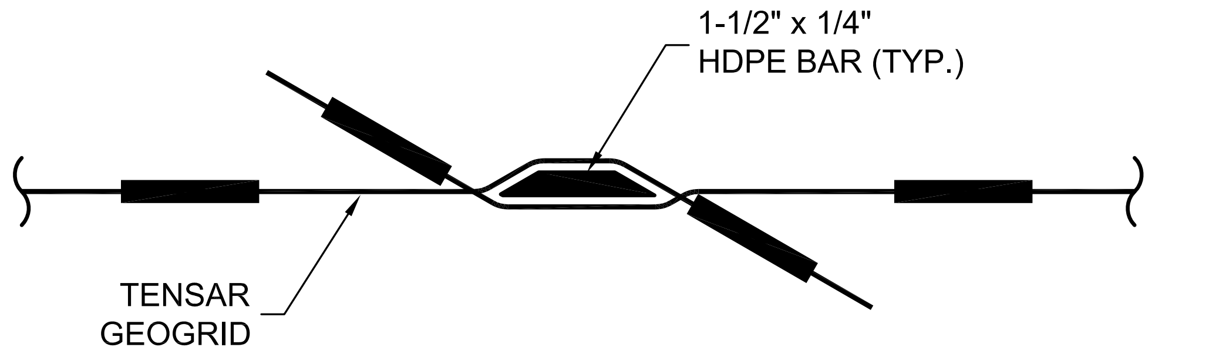
NOTES:

1. TOPSOIL SHALL BE LOAMY SAND OR FINER GRADATION WITH 10% - 15% ORGANIC CONTENT OR MATERIAL APPROVED BY A QUALIFIED SOIL SCIENTEST. VEGETATION TYPE SHALL BE SPECIFIED BY A QUALIFIED LANDSCAPE ARCHITECT.
2. WHERE GEOGRID IS UNDERLAIN BY TAILINGS, REMOVE AT LEAST 6" OF TAILINGS AND REPLACE WITH COMPACTED NATIVE SOIL.
3. IF SEEPS ARE ENCOUNTERED DURING PREPARATION OF REINFORCED SLOPE SUBGRADE, INSTALL SUBDRAINS TO COLLECT AND TRANSPORT WATER TO SUITABLE DISCHARGE POINT APPROVED BY ENGINEER.

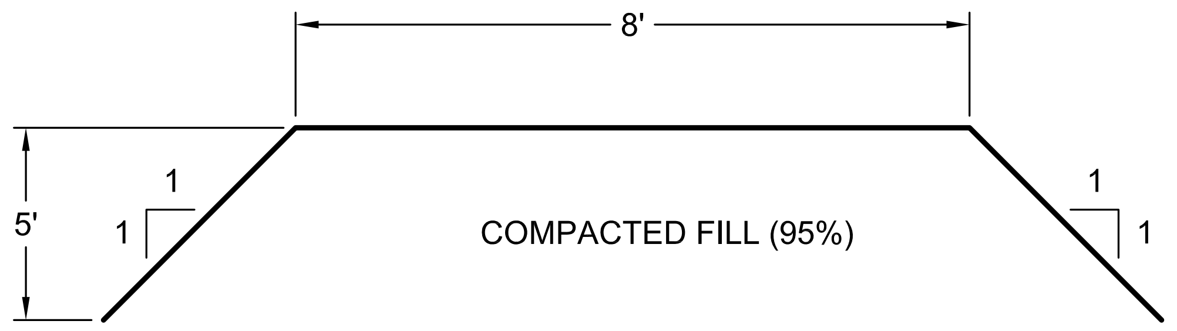
2 STABILIZED SLOPE TYP CROSS SECTION
C-8 NOT TO SCALE



3 GEOGRID PLACEMENT ON CURVES
- NOT TO SCALE



4 BODKIN CONNECTION FOR SPLICING UNIAXIAL GEOGRID
- NOT TO SCALE



5 COMPACTED BERM DETAIL
- NOT TO SCALE

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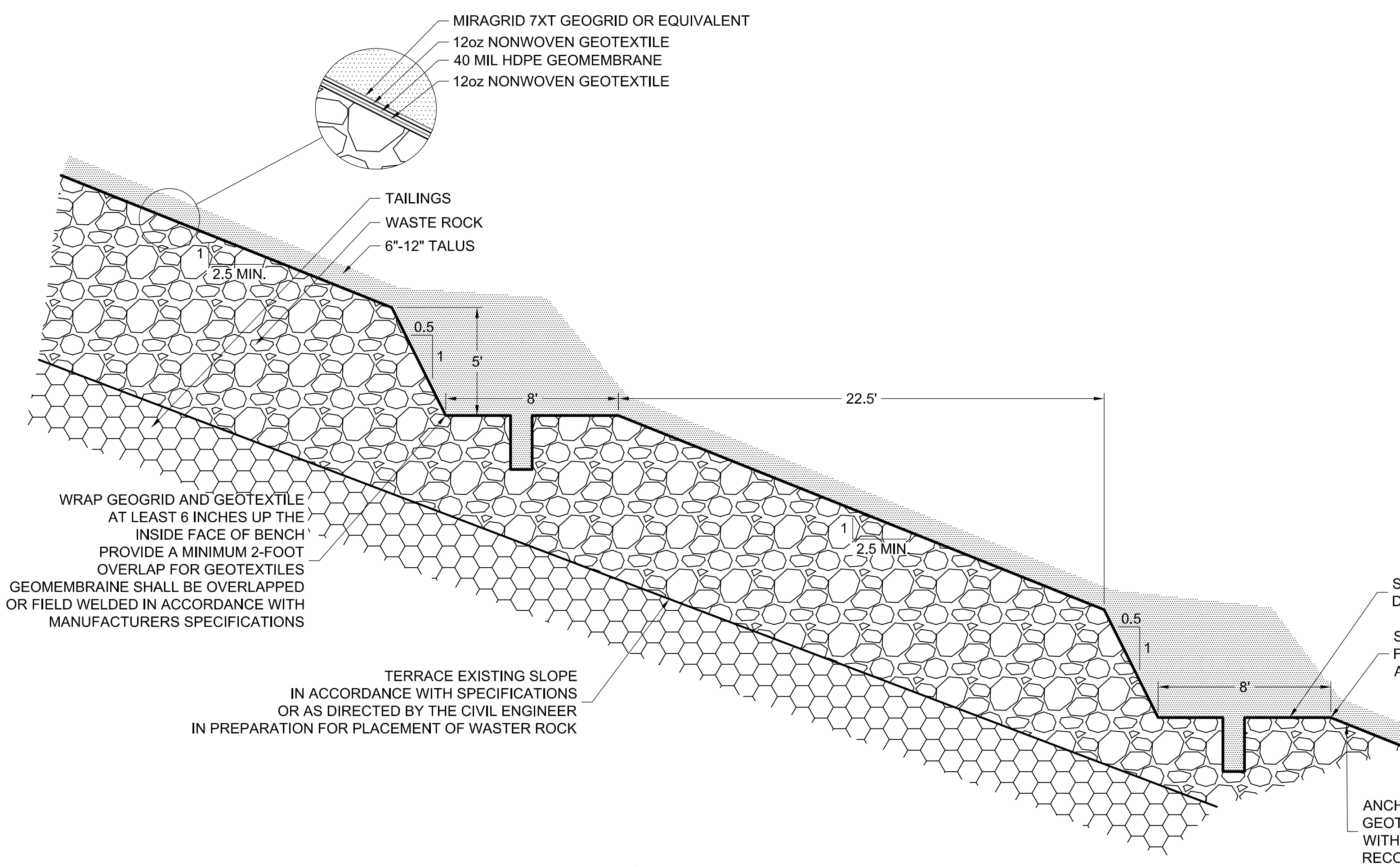
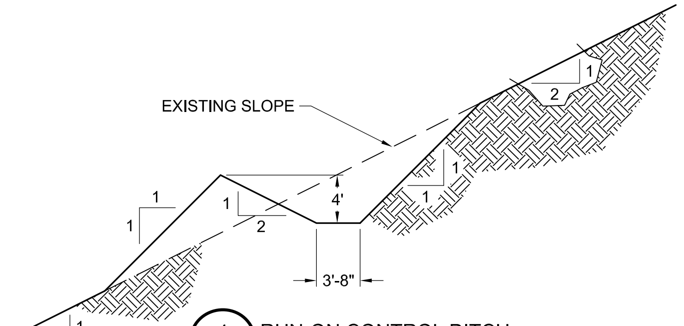
REPOSITORY SLOPE
FACE DETAILS

REMOVAL ACTION

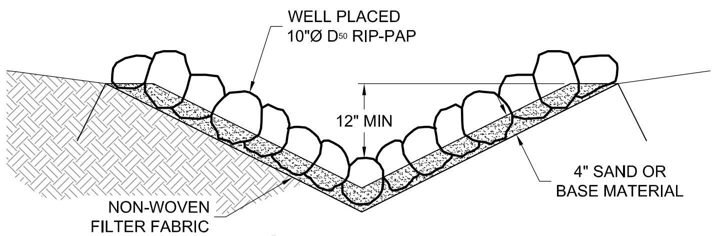
SHEET
C-13



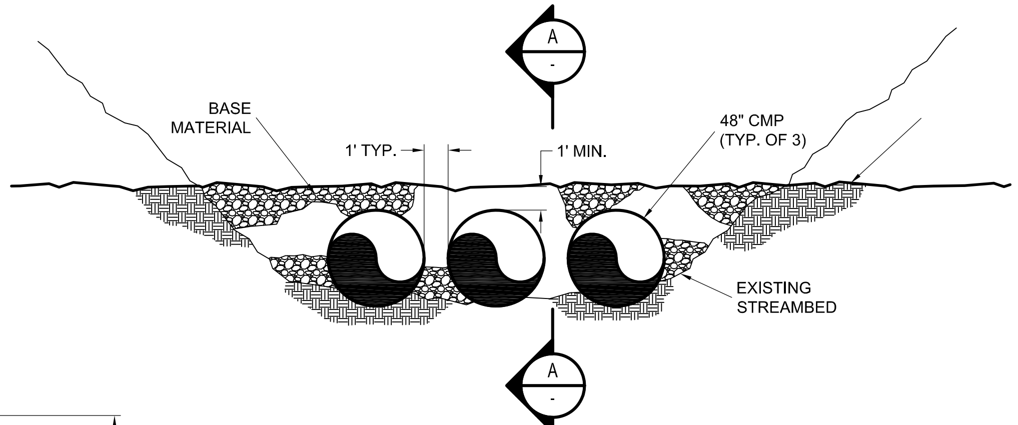
1 / C-8 BENCHING & TAILINGS COVER DETAIL
NOT TO SCALE



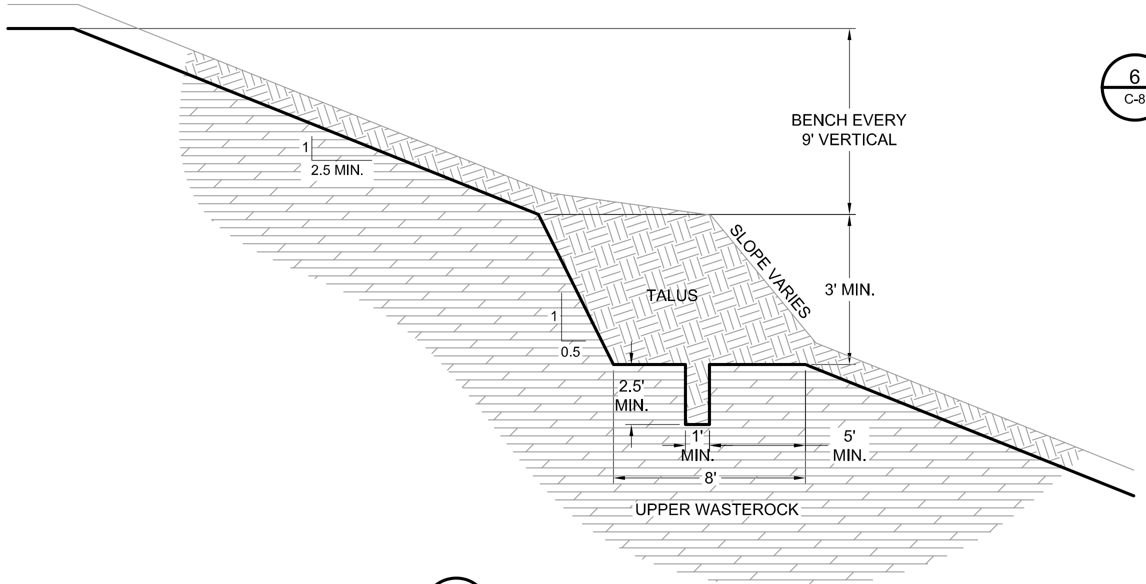
4 / C-8 RUN-ON CONTROL DITCH
NOT TO SCALE

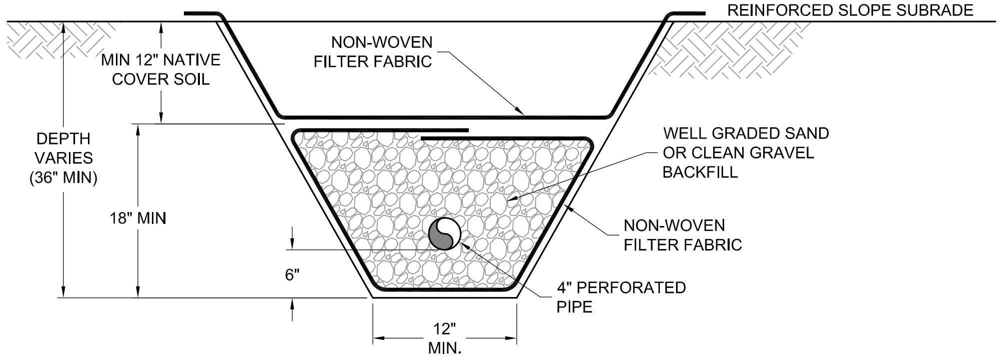


5 / C-8 DRAINAGE V-DITCH
NOT TO SCALE



6 / C-8 CREEK CROSSING CULVERT
NOT TO SCALE





2 / C-8 INTERCEPTOR DRAIN SECTION
NOT TO SCALE

3 / - BENCHING DETAIL
NOT TO SCALE

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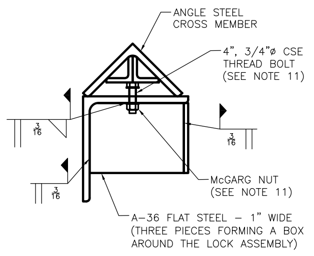
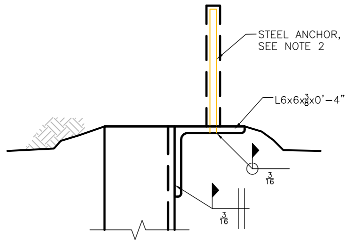
DETAILS
REMOVAL ACTION

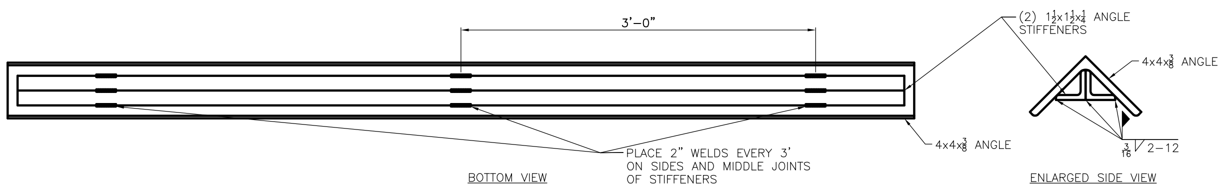
SHEET
C-14



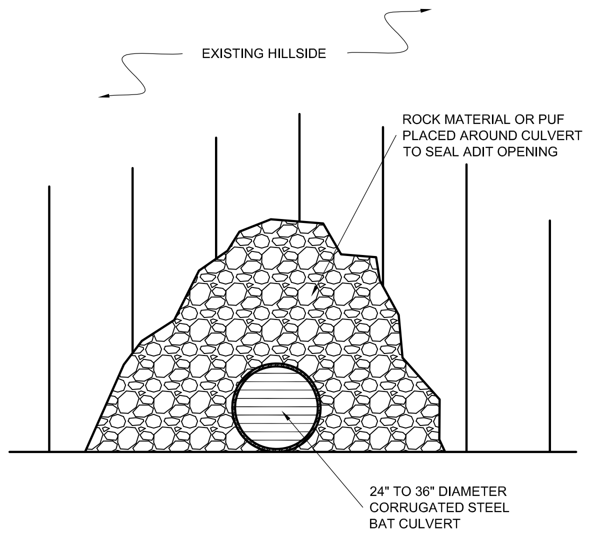
2 LOCK TAB DETAIL
NOT TO SCALE



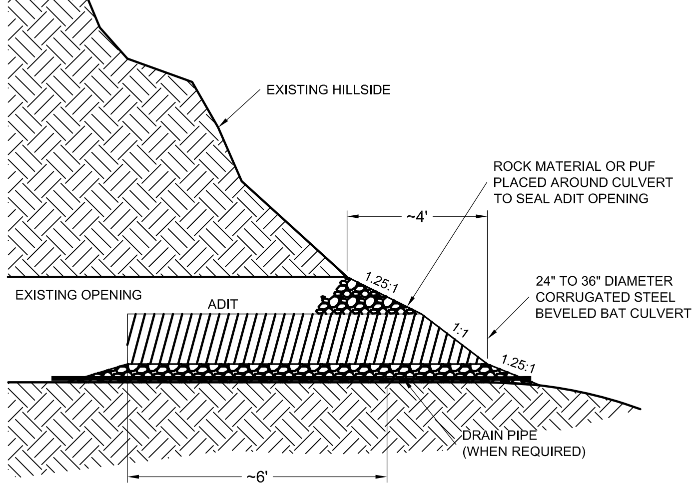
3 ANCHOR DETAIL
NOT TO SCALE



CROSS MEMBER WITH STIFFENER DETAIL 2/–
N.T.S.



4 BAT CULVERT - FRONT VIEW
NOT TO SCALE



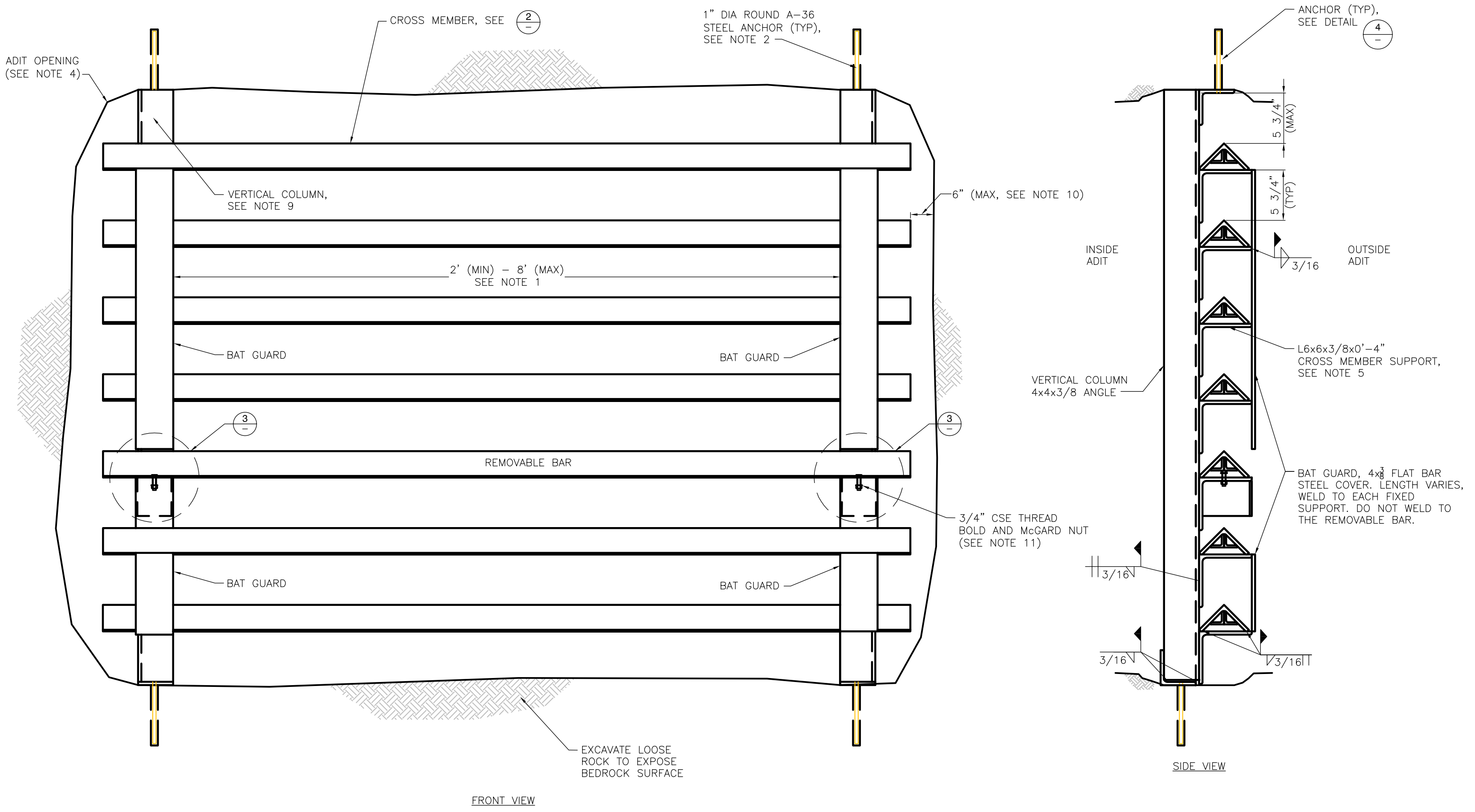
5 BAT CULVERT - PROFILE
NOT TO SCALE

NOTES

1. REMOVAL OF EXISTING PORTAL STRUCTURE AND TIMBERS MAY BE REQUIRED. SCATTER OR PILE AS DIRECTED BY THE ENGINEER WITHIN 30 FEET OF THE INSTALLATION.

2. OBTAIN BACKFILL AND BEDDING MATERIAL LOCALLY WITHIN 30 FEET AS DIRECTED BY THE ENGINEER.

3. INSTALL LOCK BOX AND BARS A MINIMUM OF 7 FEET FROM THE OUTSIDE END OF THE OPENING



1 ADIT GATE DETAIL
NOT TO SCALE

NOTE:
ADIT GATE DETAIL TAKEN FROM URS KELLY CAMP MINE REMOVAL PROJECT

NOTES

1. LOCATION OF UPRIGHTS TO BE PLACED AS CLOSE AS POSSIBLE TO SIDES OF THE OPENING TO MAXIMIZE BAT ACCESS. WIDTH BETWEEN UPRIGHTS SHALL RANGE FROM 2' (MIN) TO 8' (MAX) AT THE DIRECTION OF THE ENGINEER.
2. ANCHORS SHALL CONSIST OF A 1" DIA A-36 STEEL PIN DRIVEN THROUGH AND WELDED TO A PIECE OF L4x4x3/8 ANGLE STEEL. THE ANCHOR SHALL BE EPOXY GROUTED IN AN 8" DEEP BOREHOLE (18" IN SOFT OR FRACTURED ROCK).
3. ALL CROSS MEMBERS AND VERTICAL COLUMNS SHALL BE L4X4X3/8.
4. ALL CROSS MEMBERS SHALL BE MACHINE OR FLAME CUT TO LENGTH AS NEEDED TO FIT THE IRREGULARITIES OF THE OPENING.
5. CROSS MEMBER STIFFENERS SHALL BE L11/2x11/2x1/4 AND PLACED ON ALL CROSS MEMBERS.
6. CROSS MEMBER SUPPORTS SHALL BE L6x6x3/8 (4" IN LENGTH) PLACED ON ALL CROSS MEMBERS.
7. UPON COMPLETION, THE ENTIRE STRUCTURE SHOULD BE INSPECTED FOR SHARP EDGES AND CORNERS. ANY SHARP EDGES SHALL BE SMOOTHED WITH A GRINDER TO REDUCE THE CHANCE OF INJURY TO BATS ENTERING OR EXITING THE GATE.
8. CROSS MEMBERS MAY EXTEND PASS UPRIGHTS 30" (MAX) WITHOUT ADDITIONAL SUPPORT. ANY ADDITIONAL SUPPORTS THAT ARE NEEDED SHALL BE LOCATED AT THE DIRECTION OF THE ENGINEER.
9. FLAT STEEL COVER PLATE SHALL BE ATTACHED TO ALL SUPPORTS, EXCEPT THOSE SUPPORTING THE REMOVABLE BAR.
10. SPACE BETWEEN END OF CROSS MEMBER AND ADIT WALL SHALL BE NO GREATER THAN 6".
11. 3/6" CSE THREAD BOLD AND McGARD NUT SHALL BE PROVIDED BY THE CO.
12. ADIT GATES TO BE INSTALLED AT EACH OF THE ADIT OPENINGS WITHIN THE PROJECT LIMITS.
13. ADIT GATES TO BE LOCATED NEAR PORTAL, AS DIRECTED BY THE ENGINEER.
14. STIFFENERS NOT REQUIRED AT AZURITE ADITS, EXCEPT AT THE WENATCHEE ADIT CLOSURE.

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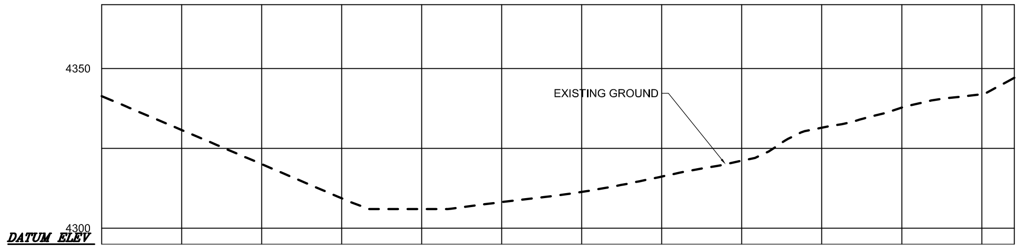
SUPPLEMENTAL DETAILS

REMOVAL ACTION

SHEET
C-15



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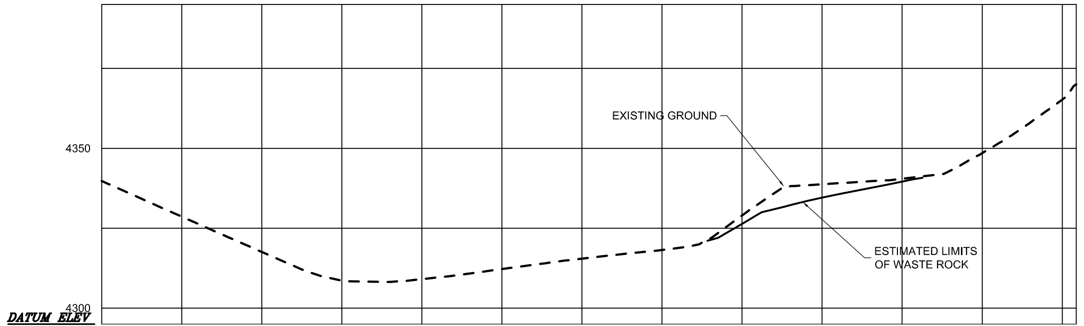

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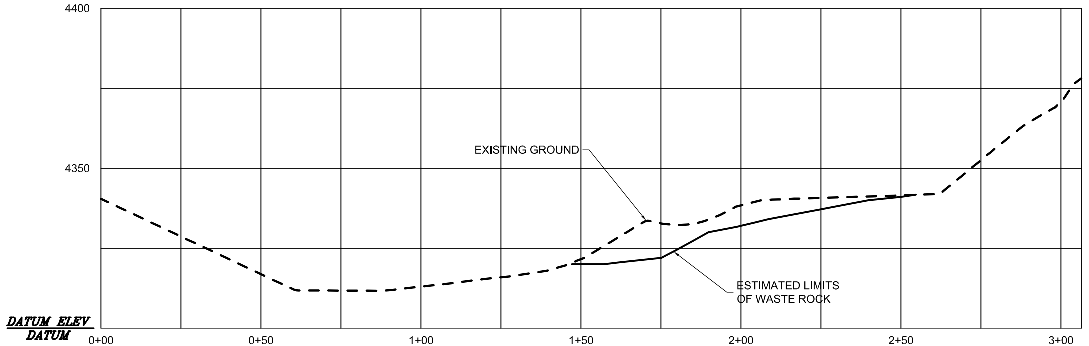

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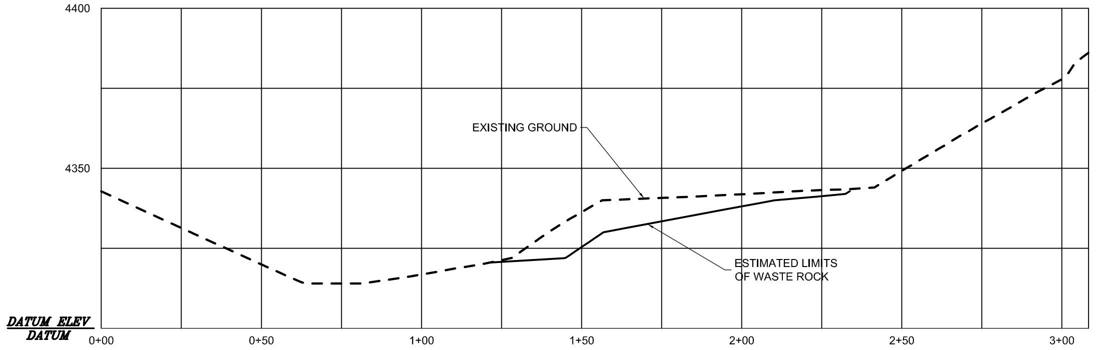

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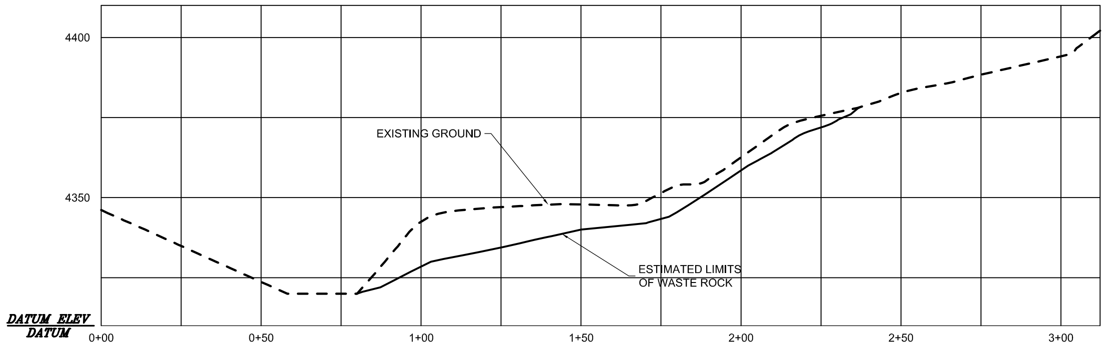

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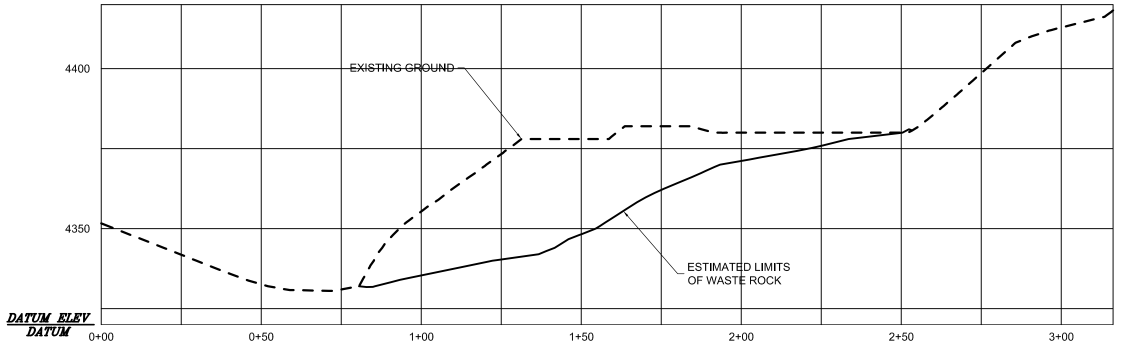

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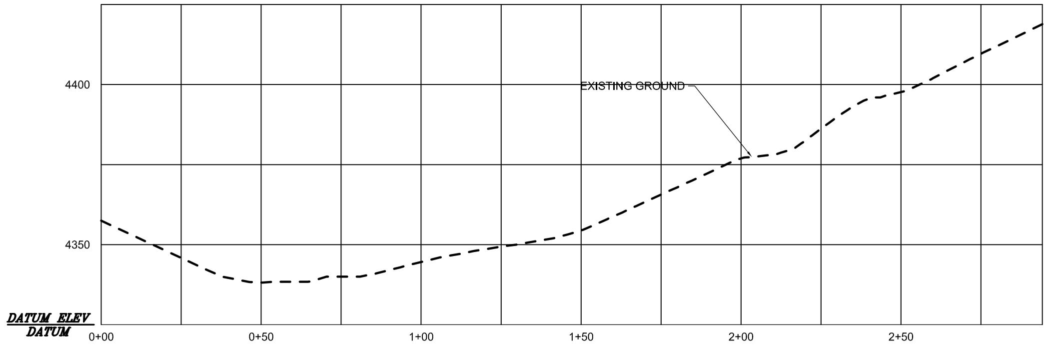

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FINAL DESIGN
4/15/11

S:\[WORKING DRAFTING]\P201023065 USFS AZURITE MINE REMOVAL\DRAWINGS\2723031 C-16.DWG BILLINGS, KYLE 4/15/2011

AZURITE MINE
OKANOGAN NATIONAL FOREST,WASHINGTON

REV #	DESCRIPTION	BY	DATE
1	–	–	MO/DAY/YR
2	–	–	MO/DAY/YR
3	–	–	MO/DAY/YR
4	–	–	MO/DAY/YR
5	–	–	MO/DAY/YR

DES. BY 8JSG
DRG. BY 8JSG
CHK. BY JW
DATE CREATED 1/27/2011
JOB No. 2723031

CES
CASCADE EARTH SCIENCES
A Valmont Industries Company
CALL 1-800-728-8322
FOR NATIONAL OFFICE LOCATIONS

EXISTING WASTE ROCK PILE
CROSS SECTIONS

REMOVAL ACTION

SHEET
C-16

APPENDICES

Appendix A.

Health and Safety Plan

Health and Safety Plan for
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest
Whatcom County, Washington

EMERGENCY PHONE NUMBERS

Medical Emergency/Ambulance	911
Police	911
Fire	911
CES Spokane Office	509-921-0290

Forest Service Methow Valley Ranger District-Winthrop	509-996-4000
Okanogan County Sheriff's Office.	509-422-7232
Winthrop Fire Dept	509-997-4040
WA Dept. of Natural Resources (fires)	1-800-562-6010
County Clinic 1116 Highway 20 Winthrop, WA 98862	509-996-8180

April 2011

Health and Safety Plan for
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest
Whatcom County, Washington

Author(s)/Reviewer(s):	*John D. Martin, RG, Principal Geologist (original)* *Dustin G. Wasley, PE, Principal Engineer (revised by)*
Prepared For:	Rod Lentz, PE, COR Forest Service Region 6
Site Address:	Azurite Mine Mt. Baker-Snoqualmie National Forest Whatcom County, Washington
Prepared By:	Cascade Earth Sciences 3511 Pacific Blvd, SW Albany, Oregon 97321 (541) 926-7737

PN: 2010230015
April 2011

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ATTACHMENTS

1.0 INTRODUCTION

The United States Forest Service (Forest Service) has requested that Cascade Earth Sciences (CES) perform a Removal Action (RA) at the Azurite Mine (Site) located in the Mt. Baker-Snoqualmie National Forest of Washington, near the Pasayten Wilderness Area. This Health and Safety Plan (HASP) has been prepared to protect employees undertaking the activities scheduled to be performed at the Site.

The purpose of this HASP is to identify, evaluate, and minimize potential health and safety hazards, as well as to provide emergency response to accidents during field operations at the Site. The Azurite Mine is a former gold mine, though smaller amounts of base metals were also produced. Heavy metals have been identified in surface water, soil, and sediment at the Site. The objectives of this HASP include the following:

- Identification and evaluation of potential hazards
- Definition of levels of protection required for the activities
- Formulation of emergency action plans
- Assurance of medical monitoring (as needed)
- Requirements of appropriate personnel receiving hazardous waste operations and emergency response (HAZWOPER) training
- Requirements for first aid and CPR training
- Implementation of appropriate record keeping.

This HASP covers CES personnel working at the Site who have the potential for exposure to hazardous waste, hazardous substances, or a combination of these materials. It also provides guidance for any CES subcontractors who will be performing support activities. This HASP is intended to comply with the requirements of the Occupational Safety and Health Administration (OSHA) Standards as stated in 29 Code of Federal Regulations (CFR) 1910.120 (HAZWOPER), as well as other applicable OSHA requirements. Amendments to this HASP may be made as the contaminant profile is updated; a change in the work status or tasks is made, or as regulatory requirements dictate. Any changes will be brought to the attention of those covered under the plan through additional training.

This HASP addresses the procedures to be followed during the RA. It also addresses vehicle use while gaining access to the study area. All personnel working at this Site will follow the safety provisions outlined in this plan. The CES Principal-in-Charge for this project, Dustin Wasley, is responsible for the implementation of this HASP, and all questions or concerns regarding site safety should be directed to him.

2.0 HAZARD ASSESSMENT

2.1 Chemical Hazards

The primary chemical hazards discovered at the Site during previous investigations include arsenic, copper, iron, and lead. A summary of the potential hazards of the metals is presented below:

2.1.1 Arsenic

Arsenic is carcinogenic to humans. Arsenic III is the most toxic form of arsenic and may be present at the Sites. Arsenic ingestion is associated with skin cancer and may cause cancers of the lung, liver, bladder, kidney, and colon. Chronic inhalation of arsenicals is closely linked with lung cancer. Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. **Ingesting high concentrations of inorganic arsenic can result in death**. Lower concentrations of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands.

The principal risk for arsenic exposure to personnel at the Site is through inhalation of arsenic-bearing dusts and ingestion of contaminated soil if proper hygiene is not practiced.

2.1.2 Copper

Concentrations of copper such as those observed at the Site can have an adverse affect on human health. Chronic exposure to copper can discolor and irritate the skin, cause mild dermatitis, runny nose, and irritation of the mucous membranes. Repeated ingestion of copper can damage the liver and kidneys.

The principal risk for copper exposure to personnel at the Site is through incidental ingestion of copper-contaminated water and inhalation of copper-bearing dusts.

2.1.3 Iron

Iron can be absorbed in the soluble reduced (ferrous) state by cells of the intestinal mucous. However, the ferrous form is easily converted to the insoluble oxidized iron (ferric) in surface waters. Hence, the ferrous form of iron should not be present in large quantities in surface water at the Sites. As such, incidental ingestion of iron-contaminated surface water should not pose a major health risk to personnel at the Site.

The principal risk for iron exposure to personnel at the Site is inhalation of iron-bearing dusts or ingestion of contaminated soil if proper hygiene is not practiced. Overexposure to iron-bearing dusts can create a build up in the body and eventually cause such diseases as hemochromatosis and siderosis. In addition, complications such as damaged blood vessles, bloody vomitus and stools, damage to the liver and kidneys, and eventual death can occur.

2.1.4 Lead

Although children under the age of 6 are most susceptible to lead exposure, adults can also experience adverse affects. In adults, overexposure to lead can cause increased blood pressure, fertility issues, nerve disorders, muscle pain, and memory and concentration problems. Damage to adult kidneys from ingested or inhaled lead can occur at 40 micrograms per deciliter (µg/dL), while nerve damage and anemia can occur at 60 µg/dL. Ingestion or inhalation of high levels of lead can lead to convulsions, paralysis, and even death.

The principal risk for lead exposure to personnel at the Site is through incidental ingestion of lead-contaminated surface water or soil.

2.2 Physical Hazards

A checklist of physical hazards is provided as follows. Details on several items are presented in sections following the table.

Description	Hazard		Comments
	Yes	No	
Overhead Power Lines		X	None present at Site.
Heavy Equipment	X		Several excavators, bulldozers, and haul trucks will be used during the removal action.
Tree Snags	X		Likely present at the Site. Will work with the On-Scene Coordinator (OSC) to determine methods for removal.
Fuel (gas and diesel)	X		Generator and equipment fuel will be transported in and stored on Site. Appropriate precautions including transport safety, selection of safe storage locations, safe dispensing procedures, and fire safety equipment will be employed.
Buried Conduit	X		There are likely buried water lines at the Site; however, no power lines will be present.
Fatigue	X		Sleeping in tents. Personnel will monitor each other for alertness and the SSO will require fatigued personnel to leave the work area and rest. A two-week work rotation limit will be employed.
Gastro-intestinal illness	X		Diarrhea and other GI tract illnesses can be a hazard due to poor hygiene. Personnel will wash their hands with soap after visiting the toilet and before eating.
Pinch Points on Rig	X		Excavators and bulldozers will be used during the removal action – personnel should approach with caution.
Uneven Ground	X		Appropriate precautions will be taken while traversing the area.
Fall Hazards	X		Appropriate precautions will be taken while traversing the area.
Steep Slopes	X		Appropriate precautions will be taken while traversing the area.
Ice	X		Ice may be present depending on season and weather conditions.
Extreme Temperatures	X		Field activities are scheduled for and mid-July through September and temperatures could be a factor.
Slippery Conditions	X		Slippery conditions may be present depending on weather conditions. Appropriate precautions will be taken while traversing the area.
Rain	X		Rain may exacerbate hazardous conditions.
Open adits	X		No personnel will enter adits open to the surface.
Rodent Droppings	X		Possible in Site building.
Potential Collapsed Workings	X		There is the potential for adits to collapse. Appropriate precautions will be taken while traversing the Site. No personnel will knowingly enter an adit.
Abandoned Structures	X		There is one abandoned structure at the Site. It should be inspected by a competent person prior to entry or use.

As shown in the checklist, physical hazards at the Site are primarily due to steep slopes in the mountainous terrain, weather conditions, heavy equipment, and mine openings. These include hazards such as operating a field vehicle in steep terrain with poor roads, twisting an ankle while traversing the slopes, slipping or tripping on obstructions, falls into collapsed underground mine workings, and exposure to the heat or cold. Activities will follow standard operating procedures to minimize the chance of human error and will be conducted in a safe and prudent manner.

2.2.1 Remote Location

In addition to the above, added physical hazards will be created due to the extended work (several months) in a remote location. A remote camp will be set up, which will include generators, tents, camp staff, cooking, and poor communication. Hazards associated with the above include fatigue from poor sleeping conditions, gastro-intestinal illnesses from poor hygiene, burns and injury. Personnel will be expected to monitor each other for fatigue, practice good hygiene, and be current in first aid and CPR. Personnel will be restricted to a maximum 2-week rotation to reduce chances for fatigue and injury.

2.3 Biological Hazards

Biological hazards can include encounters with wildlife species, insects, poisonous plants, and/or exposure to disease-causing bacterial and viral pathogens. Exposure to the most dangerous of these biological hazards is unlikely and will probably not occur during DGI field activities. However, biological hazards can be dangerous, even deadly, and should be recognizable to prevent exposure during investigative field activities.

2.3.1 Black Bears

Black bears have a natural fear of humans and tend to avoid people or developed areas. However, black bears should be considered unpredictable and potentially dangerous. A black bear will usually detect the presence of humans and flee an area unless the bear has been conditioned to people and their foods. The best way to avoid a black bear encounter is to make your presence known by shouting or making loud noises and watching for bear signs such as scat, claw marks, diggings, and logs or stumps torn apart. The following steps should be taken in the event of an encounter with a black bear:

- If a bear is visible, but not close, alter your route to move away from the bear's area.
- If a black bear approaches, *do not* run. Remain calm, continue facing the bear, and slowly back away. If the bear continues to approach, attempt to scare the bear away by shouting and acting aggressively.
- If a black bear attacks, fight back using fists, sticks, rocks, and EPA registered bear pepper spray.

2.3.2 Cougars

Cougar sightings in Washington are rare. Cougars are active mainly at dusk and dawn, although they will roam and hunt at any time of the day or night in all seasons. During late-spring and summer, one and two-year old cougars become independent of their mothers and roam vast areas in search of a home range. It is during this time that cougars are most dangerous and most likely to come into contact with humans.

Cougars are predators, and their actions are unpredictable. Any cougar that approaches, follows, disappears then reappears, or displays other stalking behavior is acting in a predatory manner. The best way to prevent a cougar encounter is to avoid startling any cougar by making noise and traveling in groups. However, the following steps should be taken in the event of an encounter with a cougar:

- *Never* approach a cougar. Although most cougars will avoid a confrontation, all cougars are unpredictable.
- Always give a cougar an avenue of escape.
- Stay clam. Talk to the cougar in a confident voice.
- *Do not* run. Back away from the cougar slowly and always keep eye contact. Sudden movement may trigger an attack.
- Make yourself appear as large as possible with arms extended. *Do not* crouch or attempt to hide. If possible, pick up sticks or branches and wave them around.
- If a cougar attacks, fight back. Use rocks, sticks, fists, etc. to defend yourself.

2.3.3 Spiders

Approximately 760 species of spiders occur in Washington State. All spiders are technically "venomous", however; the black widow and Hobo Spiders are the only species in Washington considered as being dangerously venomous to humans. Black widows occur only sporadically throughout Whatcom County and hobo spiders have been documented in the Puget Sound area. The likelihood of encountering these two spiders is considered extremely low and the possibility of a bite resulting from an encounter is even lower. Spiders will often occupy dark, dry spaces such as firewood piles, old lumber, dry crawl spaces, barns, and sheds. Care should be taken in these environments not to disturb or agitate spiders located in these habitats.

2.3.4 Ticks

Ticks are obligate vertebrate parasites, which are closely related to spiders. Lyme disease is a tickborne illness known to cause muscle pain, arthritis, and neurological symptoms. In addition, ticks can cause relapsing fever and tick paralysis. Occurrences of these diseases in Washington are low, however; exposure to Lyme disease occurs primarily west of the Cascade Mountains. The only suspected carrier of Lyme disease in Washington is the Western Black-Legged Tick.

The risk of contracting Lyme disease can be reduced by the following appropriate preventative measures:

- Wear light colored, long-sleeved shirts and long pants so ticks are easy to spot.
- Pants should be tucked into socks and wear closed-toed boots.
- Check periodically for ticks on the body.
- Attempt to avoid grassy or brushy areas that may harbor ticks.
- Tick repellents such as N,N diethylmeta-toluamide (DEET) can be an effective deterrent.

If a tick is found on the body, the following measures should be taken:

- Ticks can be removed with forceps or tweezers by grasping the tick's body as close to the skin as possible.
- Apply gentle, steady pressure to the tick and pull the tick directly away from the skin. Care should be taken not to apply too much pressure to the tick's body because an engorged tick can release spirochetes into the skin.
- *Do not* twist or jerk the tick because mouthparts may break off in the skin.
- *Do not* apply a match or hot stick to the tick's body.
- *Do not* apply Vaseline in an attempt to suffocate the tick.

2.3.5 Hantavirus

Hantavirus is a virus that causes Hantavirus Pulmonary Syndrome (HPS), a form of adult respiratory disease syndrome. The infection caused by Hantavirus is a serious illness, with 38 percent of those infected dying from acute respiratory failure. Deer mice are the primary carriers of the Hantavirus observed in the northwest United States. They can carry the disease without showing any outward signs of sickness. Deer mice can shed the virus via urine, saliva, and droppings. Transmission of the disease can occur when fresh or dried materials contaminated with rodent excreta are disturbed and dust particles are breathed. In addition, direct introduction into broken skin, introduction into the eyes, ingestion, and bites from deer mice are believed to cause infection. The following steps can be taken to avoid exposure:

- Avoid contact with rodents or rodent nests.
- Avoid cabins and shelters unless they have been aired and disinfected.
- Avoid areas where burrows or droppings are present.
- Wear a HEPA filter mask (if available) when working in areas assumed to be infested with rodents.

2.3.6 Poison Oak

Poison oak is a deciduous shrub native to Western Washington. The easiest way to identify poison oak is by the leaflets that grow alternately in threes from the plant's stem. Leaflets often times appear glossy and in autumn, they usually have a brilliant red coloration. Poison oak can be found in a wide range of temperatures, elevations, soil types, moisture conditions, and light intensities. However, it is commonly found on hillsides with shallow soils. In addition, it can be found in fencerows, waste areas, cut over forests, stream banks, and rocky canyons.

All parts of the poison oak plant, except the pollen, contain a poisonous, oily substance called urushiol. The only methods of contraction are direct contact with the plant and skin or indirect contact with other objects that have come into direct contact with the plant. Exposure to poison oak can be prevented by avoiding the plant or by wearing protective clothing such as gloves and long sleeved shirts.

In the event of exposure, the following steps should be taken:

- Wash the affected area with cold water, followed with isopropyl (rubbing) alcohol or equal parts alcohol and water or TechNu (follow directions) to dissolve the unabsorbed poison.
- Take a regular shower with soap and warm water. *Do not* use soap before this point because soap can pick up urushiol and distribute it over a larger area of the body.
- Clothes, shoes, tools, and any other objects that may have come into contact with the poison oak should be wiped with alcohol and water or TechNu. Wear gloves while cleaning equipment and clothes and discard immediately after use.

Often times when a person is exposed to poison oak, there is not enough time to properly cleanse the body of the urushiol. The resulting rash or blisters can be relieved with calamine lotion and/or a cool compress. Moreover, over-the-counter corticosteroids can be effective in temporarily relieving symptoms.

2.4 Weather Hazards

2.4.1 Wind

Wind is the most likely meteorological event to create a hazard by generating dust clouds. This allows an exposure pathway to personnel through possible inhalation of contaminated airborne particulates. If winds are strong enough to cause significant dust to rise off of contaminated areas, especially tailing piles, all field personnel in the vicinity will stop work until wind conditions are favorable.

2.4.2 Hot Weather

In hot weather, heat stress can be a serious hazard for workers at waste sites. Heat stress usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated temperatures.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur. These reactions range from mild (fatigue, irritability, anxiety, and decreased dexterity) to fatal. Because heat stress is one of the most common and potentially serious illnesses that workers face, regular monitoring and other preventative measures are vital.

2.4.2.1 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by failure of heat regulating mechanisms of the body (i.e., the individual's temperature control system that causes sweating stops working correctly). If the victim is not cooled quickly, the body temperature will rise to a point at which brain damage and/or death may occur.

Symptoms – Red, hot, dry skin, although the person may have been sweating earlier; nausea, dizziness, confusion, extremely high body temperature, rapid respiratory and pulse rates, unconsciousness or coma.

Treatment – Cool the victim quickly. This can be done by soaking the victim in an ice water bath, to reduce the temperature to a safe level (102 °F). If cell/satellite phone transmission is possible, call 911 and advise them of the situation. Follow their instructions about where to meet an ambulance.

2.4.2.2 Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. This condition is much less dangerous than heat stroke, but it must be treated.

Symptoms – Pale, clammy, moist skin, profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, may vomit, and may be dizzy.

Treatment – Remove the person to a cool place, loosen clothing, place in a head-low position and provide bed rest. Consult a physician by satellite phone, especially in severe cases. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have patient drink 1 to 2 cups of water immediately, and every 20 minutes thereafter, until symptoms subside. Total water consumption should be 1 to 2 gallons per day.

2.4.3 Cold Weather

The conditions that promote cold-related illnesses are not always apparent. Therefore, it is essential that personnel wear appropriate clothing to protect against the elements. During extreme cold (<45 °F), raining or chilly wind conditions, personnel should wear appropriate clothing to protect hands, feet, and exposed body extremities, as well as the head and neck areas. If an employee becomes over-exhausted due to exertion during extreme weather conditions, curtailing of activities should be considered rather than shedding protective clothing. All indications of cold-related illnesses will be treated immediately by the designated on-site first aid responder. The physical health of all on-site personnel will be monitored closely throughout all remedial activities.

2.4.3.1 Frostnip

Frostnip occurs when cooling occurs in the tissues, cheeks, chin, fingers, toes, and ears.

Symptoms – Pale, white, grayish, glassy patches and tissues are soft and resilient.

Treatment – Use steady, firm pressure on the cooled area with a warm body part (e.g., put fingers in armpit, put toes against a friend’s abdomen).

2.4.3.2 Frostbite

Frostbite occurs when there is freezing of body tissues. Frostbite most commonly affects the hands and feet.

Symptoms – Tissues pale, cold, solid; feels wood-like; tissues not resilient; grayish patches.

Treatment – Check breathing, airway, circulation. Protect frozen areas from further damage, but DO NOT thaw. If feet are frozen, they can be walked on if necessary. However, once they begin to thaw, DO NOT walk on them. Seek professional medical aid for re-warming. WARNING: Improper warming can increase tissue loss.

2.4.3.3 Hypothermia

Hypothermia is the lowering of body temperature to below normal levels. Hypothermia can occur in cool and wet or cold environments. Water, wet clothing, and wind accelerate heat loss.

Symptoms – Shivering, weakness, loss of coordination, difficulty performing tasks and making decisions, loss of consciousness, slow or absent breathing and heartbeat.

Treatment – Check breathing, airway, circulation. Protect from further heat loss by sheltering patient from wind and water. Replace wet clothing with dry attire if possible. Cover patient's head. WARNING: Jarring the patient can cause an abnormal heart rhythm. If mild signs/symptoms, add heat to the neck, armpits and groin. If moderate to severe signs and symptoms, prevent further heat loss and seek additional medical aid for re-warming.

2.4.4 Storms

Storms strong enough to endanger operations may require termination of sampling activities until the storm has passed. Storms are hazardous due to the potential for lightning strikes and falling trees. Electrical storms with high gusty winds are particularly hazardous to drilling towers. All activities involving this type of equipment should be halted until the risk to personnel has subsided. The possibility for being struck by lightning during a thunderstorm does exist. In order to minimize the possibility of this happening the following should be observed during storms:

- *Do not* make a human lightning rod of yourself by being the highest point around.
- *Do not* stand under solitary trees or other isolated objects in a filed.
- *Do not* hold metal objects in your hands, which may attract a strike.
- *Do not* take refuge near wire fences or above ground pipes that could carry lightning currents to you from a strike, which has hit some distance away.
- Do get inside if possible, (but not in an isolated building in the middle of a field). Once you are inside, avoid open doors and windows.
- Do crouch or lie down if you are in an open field.
- Do stay away from open water.
- Do stay in a vehicle with the windows rolled up. The vehicle will provide a path around you for the current of the lightning bolt.

3.0 PERSONNEL

The CES Principal-in-Charge for this project is Dustin Wasley. In this capacity, Mr. Wasley will oversee compliance with all applicable health and safety regulations. The designated Site Safety Officer (SSO) will oversee day-to-day site safety activities. Safety is affected by all involved parties or organizations. For this reason, the following key personnel and their organization have been identified:

Principal-in-Charge	Dustin Wasley - CES	(509) 921-0290
Site Safety Officer	TBD	TBD
USFS COR	Rod Lentz – USFS	(509) 826-3274

All site personnel will receive copies of the HASP for review prior to the start of activities. After review, each person will sign the acknowledgement form included as Attachment A. The signed acknowledgments and copies of hazardous waste training certificates will be attached to the HASP or otherwise available for inspection at the Site.

3.1 Check-In

Due to the remote nature of the Site, the SSO or PM will check in with Principal-in-Charge or other designee (to be arranged prior to commencement of field operations) twice per week: Monday morning and Friday afternoon. In the event that check-in is not performed, the appropriate authorities, including the USFS will be notified of a potential problem.

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) AND OTHER REQUIRED EQUIPMENT

The following basic Level D safety equipment and other PPE are required to be available for activities at the Site. PPE will be used as appropriate and as directed by the CES Site Safety Officer.

4.1 Summary of Safety Equipment Required for this Project

- First aid kit
- 1 – A, B, C Fire extinguisher
- Hand-held radios
- Satellite telephone (a repeater may also be employed in order to access the USFS radio system)
- Wash station to rinse dust and dirt from exposed skin
- Insect bite kit

4.2 Personal Protective Equipment (PPE) – Level D

- Work uniform with long pants and appropriate cold-weather gear (including rain protection)
- Steel-toed boots, leather or PVC
- Outer gloves, green Viton or equivalent (optional)
- Inner gloves, latex/nitrile disposable for sampling
- Safety glasses
- Disposable Tyvek coveralls (optional)
- Hard hat (used when working around heavy equipment or where there is the possibility of objects falling from overhead)

5.0 OPERATIONAL PROCEDURES

Invasive activities involving heavy equipment require Level D PPE. These guidelines are primarily intended to address site work involving drilling. Such activities will initially be approached under Level D conditions, and will incorporate designated exclusion zones (EZ). The EZ will include all areas with contaminated material. Personnel at the Site that are not HAZWOPER-certified will not be allowed access to the EZ. Other activities such as water sampling will be performed using appropriate PPE. The use of a hard hat, steel-toed boots, and safety glasses may not be necessary for many types of sampling. A formal exclusion area also may not be required for such routine monitoring. However, reasonable effort should be made to keep non-essential personnel away from sampling activities.

5.1 Physical Hazards

The physical hazards associated with the Site include traversing steep terrain, working within flowing water, working around heavy equipment, fatigue, GI-tract illness, and injury in a remote location. Equipment will need to be carried near the creeks; waders and non-slip soled boots will be necessary for any work performed in the creeks. Precaution will be needed in traversing the Site and sampling the waste piles due to steep terrain. Very steep terrain will be avoided when slick from rain, as the slip and fall hazard is greatly increased. The SSO will hold a safety team meeting at the beginning of the project to set up hand or horn signals to be used for communication with equipment operators; and to establish working procedures around the equipment.

6.0 DECONTAMINATION / DISPOSAL PROCEDURES

Extensive decontamination procedures have been determined to be unnecessary for this project. However, should comprehensive decontamination become necessary due to PPE Level upgrade, the SSO will devise a decontamination plan according to the table below.

Personnel and equipment leaving the EZ shall be decontaminated. Level **D** decontamination protocol shall be used with the following decontamination stations:

LEVEL C DECONTAMINATION STEPS		LEVEL D DECONTAMINATION STEPS	
1	Equipment Drop	1	Equipment Drop
2	Outer Garment, Boots, and Glove Wash and Rinse	2	Outer Glove Disposal and Boot Wash and Rinse
3	Disposable Garment, Boots, and Glove Removal	3	Outer Boot and Inner Glove Removal, as necessary
4	Cartridge Change (if necessary)	4	Field Wash
5	Remove Respiratory Protection		
6	Field Wash		

The following decontamination equipment is required at the boring Site.

DECONTAMINATION EQUIPMENT CHECKLIST			
X	Scrub Brushes	X	Garbage Bags
X	Waste Containers	X	Paper Towels
X	Soap		Isopropyl Alcohol
X	Plastic Tubs	X	Pump Spray Bottles
X	Plastic Drop Cloths	X	Pump Spray Bottles (DI water)
X	De-Ionized (DI) or distilled water		

7.0 DISPOSAL OF DECONTAMINATION WASTES

All equipment and liquids used for decontamination shall be disposed of properly according to local, state, and federal regulations. Whenever field clothing is sent to commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures. Skin exposed to Site dust will be washed periodically with soap and water or waterless hand cleaner.

7.1 Standard Operating Procedures

The major pathways for the ingestion of chemicals at the Site are through inhalation of dust particles and ingestion of contaminated surface water. Therefore, all activities should be performed with minimal disruption of the soils and sediments. No eating, drinking, smoking, gum or tobacco chewing, or application of cosmetics will occur in the field while investigative activities are conducted. Skin exposed to Site dust will be washed periodically with soap and water, and always before ingesting food or drink. In addition, activities at the Site will include wearing gloves, which should minimize exposure to contaminated surface water. If personnel are exposed to surface water in areas identified in previous investigations as having detectable levels of contaminants, skin will be washed immediately following completion of sampling activities with soap and water or waterless hand cleaner.

- The instructions of the SSO will be followed.
- No horseplay will be tolerated.
- Work practices that minimize airborne release of contaminants will be used.
- Contact with waste material will be minimized.
- The hands and face of personnel must be thoroughly washed as soon as possible upon leaving the work area and before eating, drinking, or other non-work related activities.

All involved personnel are responsible for reading and understanding the provisions of this plan and will agree to abide by it. Their signature at the end of the HASP signifies their personal review and acceptance of this plan.

8.0 HAZWOPER TRAINING

All persons conducting invasive activities at the Site must have at least 40 hours of HAZWOPER training plus three (3) days of field experience, or be under the direct supervision of a trained experienced supervisor, pursuant to 29 CFR 1920.120. If initial training took place more than 12 months prior to the job, an 8-hour refresher course must be taken.

Copies of training certificates documenting the required training must be available at the Site. The SSO is responsible for inspecting documentation to ensure the requirements of this section are met.

9.0 FIRST AID/CPR TRAINING

All persons working at the Site must be current in an accredited (e.g., American Red Cross) first aid and CPR certification. Copies of training certificates documenting the required training must be available at the Site. The SSO is responsible for inspecting documentation to ensure the requirements of this section are met.

10.0 MEDICAL MONITORING

Employees are required by OSHA to have a full hazardous materials physical if exposed to concentrations of toxic substances above permissible exposure limits (PEL) for 30 or more days per year. It is the policy of CES that any person exposed at or above the toxic exposure limit (TEL) of a toxic substance will receive a full physical following exposure. The TEL for arsenic is 0.002 micrograms per cubic meter (mg/m^3) as dust particles in a 15-minute interval. The TEL for copper is 1.0 mg/m^3, while the TEL for iron is 10 mg/m^3 during a standard 8-hour workday. The TEL for lead is 0.050 mg/m^3 during a standard 8-hour workday. Sampling activities are not anticipated to disturb soils to the extent that wind-borne dust concentrations approaching the TEL will be of concern for field personnel. Medical monitoring for activities during the implementation of the Work Plan will not be required, although CES field staff are routinely managed under our medical monitoring program.

11.0 EMERGENCY RESPONSE PLAN AND SERVICES

In the unlikely event of a fire or explosion, proper action is required to safeguard personnel and the environment. In the event of a fire, emergency services will be immediately contacted (fire, police, etc.) by calling 911 and/or the local fire departments, or by whatever means is practical when working in remote areas. In addition, CES will contact the Forest Service Methow Valley Ranger District office in Winthrop, Washington, as well as the Washington Department of Natural Resources office in Sedro Woolley. CES has implemented extra forest fire plan precautions; a copy of the supplement is provided in Attachment C. Site personnel will be notified of the problem. Only small fires may be extinguished by workers at the Site. If the fire is too large, or if in doubt, the area will be evacuated. In the event of an accident or emergency during Site work, the following services are available:

Azurite Mine Site

Medical emergency/Ambulance	911
Aero Methow Rescue Service (Twisp)	509-997-4013
County Clinic 1116 Highway 20 Winthrop, WA 98862	509-996-8180
Fire	911
WA Dept. of Natural Resources (fires)	800-562-6010
Winthrop Fire Dept	509-997-4040
Police	911
CES Spokane Office	509-921-0290
Methow Valley Ranger District-Winthrop	509-996-4000
Okanogan County Sheriff’s Office.	509-422-7232
WA DNR-Sedro Woolley	360-856-3500

Hand-held radios and satellite telephones will be made available to field personnel during implementation of the Work Plan. Radio or telephone contact will be made to the Forest Service office in Winthrop the event of an emergency, as it is staffed seven days a week.

Directions and a map to clinic in Winthrop, Washington is included in Attachment B.

ATTACHMENTS

Attachment A.	**Acknowledgement Form**
Attachment B.	**Hospital Route Maps**
Attachment C.	**Supplemental Forest Fire Precautions**
Attachment D.	**Injury Report Form**

Attachment A.

Acknowledgement Form

ACKNOWLEDGEMENT

To Be Signed and Returned To

Cascade Earth Sciences (CES) Health and Safety Officer

I have received and carefully read the Site Health and Safety Plan (HASP) for the RA at the Azurite Mine. I agree to abide by these safety rules, regulations, and guidelines while working at the Site. I understand that any violation of these rules may result in my removal from the work area.

I have had a 40-Hour Health and Safety Training course and an annual refresher course(s), and I have provided certificates of these courses to the Site Safety Officer.

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Signature ______________________________ Date ____________________

Print Name ______________________________

Safety Officer

Signature ______________________________ Date ____________________

Print Name ______________________________

Attachment B.

Hospital Route Maps

MAP: Azurite Mine to the County Clinic, Winthrop, Washington

Directions (Distance and time approximate due to remote location)			Distance
Total Est. Time: 2 hours **Total Est. Distance:** 52.5 miles			
START	**1:**	From the Site travel generally EAST approximately 10 miles over primitive road to the parking area at Slate Creek.	11 miles
→	**2:**	Travel East approximately 5 miles on NF-374 and NF-700 to Junction with NF-5400 (Hart Pass).	5 miles
↑	**3:**	Then SOUTHEAST on NF-5400 to Junction with NF-060	9.7 miles
←	**4:**	Turn Left onto NF-060.	2.4 miles
↑	**5:**	Continue on Lost Creek Road 0.1 mile, stay left and continue on Lost Creek Road.	6.5 miles
→	**6:**	Turn RIGHT on Mazama Road	0.4 miles
←	**6:**	Turn LEFT at WA-20.	17.5 miles
END	**7:**	End at **Country Clinic:** 1116 Highway 20, Winthrop, WA 98862, US	
Total Est. Time: 2 hours. **Total Est. Distance:** 52.5 miles			

Attachment C.

Supplemental Forest Fire Precautions

<u>Because of the potential for elevated forest fire danger during the Azurite Mine Removal Action construction period, the following precautions will be adhered to.</u>

1. <u>Fire Period and Closed Season</u>

   Specific fire prevention measures are listed below and shall be effective for the period April 1 to October 31 of each year. The Forest Service may change the dates of said period by advance written notice if justified by unusual weather or other conditions. Required tools and equipment shall be kept currently in serviceable condition and immediately available for initial attack on fires.

2. <u>Fire Plan</u>

   Before starting any operations on the project, the Contractor, Permittee, Licensee, or Purchaser, hereinafter referred to as the "Contractor," shall prepare a fire plan in cooperation with the Engineer providing for the prevention and control of fires in the project area.

   The Contractor shall certify compliance with fire protection and suppression requirements before beginning operations during the fire period and closed season, and shall update such certification when operations change.

3. <u>Substitute Measures</u>

   The Engineer may by written notice authorize substitute measures or equipment or may waive specific requirements during periods of low fire danger.

4. <u>Emergency Measures</u>

   The Forest Service may require emergency measures, including the necessary shutting down of equipment or portions of operations in the project area during periods of fire emergency created by hazardous climatic conditions.

5. <u>Fire Control</u>

   The Contractor shall, independently and in cooperation with the Forest Service, take all reasonable action to prevent and suppress fires in the project area. Independent initial action shall be prompt and shall include the use of all personnel and equipment available in the project area.

   For the purpose of fighting forest fires on or in the vicinity of the project which are not caused by the Contractor's operations, the Contractor shall place employees and equipment temporarily at the disposal of the Forest Service. Any individual hired by the Forest Service will be employed in accordance with the Interagency Pay Plan for Emergency Firefighters. The Forest Service will compensate the Contractor for equipment rented at fire fighting equipment rates common in the area, or at prior agreed to rates.

6. Compliance with State Forest Laws

Listing of specific fire precautionary measures herein is not intended to relieve the Contractor in any way from compliance with the State Fire Laws covering fire prevention and suppression equipment, applicable to operations under this contract, permit or license.

7. Fire Precautions

Specific fire precautionary measures are as follows:

a. Smoking and Open Fires

Smoking and fires shall be permitted only at the option of the Contractor. The Contractor shall not allow open fires on the project area without advance permission in writing from Forest Service.

Unless restricted by State Law or Federal Regulation, smoking shall be permitted only in such portions of the project area that are free of flammable material. Smokers shall sit down to smoke in such a position that any burning material will fall within a cleared area, and shall extinguish and press out in mineral soil all burning material before leaving the cleared area.

b. Fire Extinguishers and Equipment on Trucks, Tractors, etc.

All power-driven equipment operated by the Contractor on National Forest land, except portable fire pumps, shall be equipped with one fire extinguisher having a UL rating of at least 5 BC, and one "D" handled or long handled round point shovel, size "0" or larger. In addition, each motor patrol, truck and passenger-carrying vehicle shall be equipped with a double-bit axe or Pulaski, 3-1/2 pounds or larger.

Equipment shall be kept in a serviceable condition and shall be readily available.

c. Power Saws

Each gasoline power saw operator shall be equipped with a pressurized chemical fire extinguisher of not less than 8-ounce capacity by weight, and one long-handled round point shovel, size "0" or larger. The extinguisher shall be kept in possession of the saw operator at all times. The shovel shall be accessible to the operator within 1 minute.

d. Extinguishers

One refill for each type or one extra extinguisher sufficient to replace each size extinguisher required on equipment shall be safely stored in the fire tool box or other agreed upon place on the project area that is protected and readily available.

e. Spark Arresters and Mufflers

Each internal combustion engine shall be equipped with a spark arrester meeting either (1) USDA Forest Service Standard 5100-1a, or (2) appropriate Society of Automotive Engineers (SAE) recommended practice J335(b) and J350(a) as now or hereafter amended unless it is:

(1)Equipped with a turbine-driven exhaust supercharger such as the turbocharger. There shall be no exhaust bypass.

(2)A passenger-carrying vehicle or light truck, or medium truck up to 40,000 GVW, used on roads and equipped with a factory-designed muffler complete with baffles and an exhaust system in good working condition.

(3)A heavy duty truck, such as a dump or log truck, or other vehicle used for commercial hauling, used only on roads and equipped with a factory designed muffler and with a vertical stack exhaust system extending above the cab.

Exhaust equipment described in this subsection, including spark arresters and mufflers, shall be properly installed and constantly maintained in serviceable condition.

f. Emergency Fire Precautions

The Contractor shall restrict operations in accordance with the Industrial Fire Precaution Levels listed below. The Forest Service may change the Industrial Fire Precaution Levels to other values upon revision of the National Fire Danger Rating System and may change the specific Industrial Fire Precaution Levels when such changes are necessary for the protection of the National Forest. When sent to the Contractor, the revised Industrial Fire Precaution Levels will supersede the attached levels.

INDUSTRIAL FIRE PRECAUTIONS SCHEDULE

LEVEL INDUSTRIAL FIRE PRECAUTION (IFPL)

I. Closed season - Fire precaution requirements are in effect. A fire watch/security is required at this and all higher levels unless otherwise waived.

II. Partial hootowl - The following may operate only between the hours of 8 p.m. and 1 p.m., local time:

a. power saws, except at loading sites;
b. cable yarding;
c. blasting;
d. welding or cutting of metal.

III. Partial shutdown - The following shall be prohibited except as indicated:

Cable yarding - except that gravity operated logging systems employing non-motorized carriages may be operated between the hours of 8 p.m. and 1 p.m., local time, when all block and moving lines, except the line between the carriage and the chokers, are suspended 10 feet above the ground;

Power saws - except power saws may be used at loading sites and on tractor/skidder operations between the hours of 8 p.m. and 1 p.m., local time.

In addition, the following are permitted between the hours of 8 p.m. and 1 p.m., local time:

a. tractor/skidder operations;
b. mechanized loading and hauling of any product or material;
c. blasting;
d. welding or cutting of metal;
e. any other spark-emitting operation not specifically mentioned.

IV. General shutdown - All operations are prohibited.

The following definitions shall apply to these Industrial Fire Precaution Levels:

Cable yarding systems: A yarding system employing cables and winches in a fixed position.

Closed season (Fire Precautionary Period): That season of the year when a fire hazard exists as declared by the responsible agency official.

Engineer: The person executing the contract, permit or license on behalf of the Government and includes that person's designated representative, acting within the limits of their authority or the duly appointed successor to the individuals.

Loading sites/woods site/project area: A place where any product or material (including but not limited to logs, firewood, slash, soil, rock, poles, posts, etc.) is placed in or upon a truck or other vehicle.

Low hazard area: Means any area where the responsible agency representative (WDNR, ORF, BIA, BLM) determines the combination of elements reduces the probability of fire starting and/or spreading.

Tractor/skidder operations: include a harvesting operation, or portion of a harvesting operation, where tractors, skidders, or other harvesting equipment capable of constructing fireline, are actively yarding forest products and can quickly reach and effectively attack a fire start.

Waivers, written in advance, may be used for any and all activities. Activities for which waivers may be issued include, but are not limited to:

a. mechanized loading and hauling;
b. road maintenance such as sprinkling, graveling, grading and paving;
c. cable yarding using gravity systems or suspended lines and blocks, or other yarding systems where extra prevention measures will significantly reduce the risk of fire;
d. powers saws at loading sites or in felling and bucking where extra prevention measures will significantly reduce the risk of fire;
e. maintenance of equipment (other than metal cutting and welding) or improvements such as structures, fences and powerlines.

Such waiver, or substitute precautions will prescribe measures to be taken by the Contractor to reduce the risk of ignition, and/or the spread of fire. The Engineer shall consider site specific weather factors, fuel conditions, and specific operations that result in less risk of fire ignition and/or spread than contemplated when precaution level was predicted. Consideration shall also be given to measures that reduce the precaution levels above. The Contractor shall assure that all conditions of such waivers or substitute precautions are met.

The Contractor shall obtain the predicted Industrial Fire Precaution Level daily, prior to the start of work, from the appropriate Ranger District headquarters. If predictions made after 6:00 p.m., local time, are significantly different than the original prediction, the Forest Service will inform the Contractor when changes in restrictions or industrial precautions are made.

NOTE:The IFPL system does not apply on lands protected by ODF east of the summit of the Cascades.

Where hauling involves transit through more than one shutdown/regulated use area, the precaution level at the woods loading site shall govern the level of haul restriction, unless otherwise prohibited by other than industrial precaution level system.

8. Fire Tools

The Contractor shall furnish serviceable fire fighting tools in a readily accessible fire tool box or compartment of sound construction with a hinged lid and hasp so arranged that the box can be secured or sealed. The box shall be red and marked "Fire Tools" in letters one inch high. It shall contain a minimum of:

a. 2 axes or Pulaskis with a 32-inch handle;

b. 3 adze eye hoes. One Pulaski may be substituted for 1 adze eye hoe;

c. 3 long-handled, round point shovels, size "0" or larger.

9. Fire Security

When the Industrial Fire Precautions Level is "I" or higher, unless a waiver is granted, the Contractor shall designate a person who shall perform fire security services listed below on the project area and vicinity. The designated person shall be capable of operating the Contractor's communications and fire fighting equipment specified in the contract, excluding helicopters, and of directing the activities of the Contractor's personnel on forest fires. In lieu of having the designated person perform the required supervisory duties, the Contractor may provide another person meeting the qualifications stated above to direct the activities of Contractor's personnel and equipment during all fire fighting activities.

Services described shall be for at least 1 hour from the time the Contractor's operations are shut down. For the purposes of this provision, personnel servicing equipment, and their vehicles, who are not engaged in cutting or welding metal are excluded.

Fire security services shall consist of moving throughout the operation area or areas constantly looking, reporting, and taking suppression action on any fires detected. Where possible, the designated person shall observe inaccessible portions of helicopter operating areas from vantage points within or adjacent to project area.

10. Blasting

Whenever the Industrial Fire Precaution Level is "II" or greater, a fire security person equipped with a long-handled, round point, No. "0" or larger, shovel, and a five-gallon backpack pump can filled with water will stay at location of blast for 1 hour after blasting is done. Blasting may be suspended by Forest Service in writing, in an area of high rate of spread and resistance to control.

Fuses shall not be used for blasting. Explosive cords shall not be used without written permission of Forest Service, which may specify conditions under which such explosives may be used and precautions to be taken.

USDA Forest Service - Pacific Northwest Region
Fire Protection and Suppression

Additional Fire Precautionary Measure 1 - Tank Truck

The Contractor shall provide a tank truck or trailer containing not less than 300 gallons of water during yarding, loading, land clearing, right of way clearing, and mechanical treatment of slash. A tank truck or trailer will not be required if power saw falling and bucking is the only operation. Such tank truck or trailer shall be maintained in a serviceable condition and located within 10 minutes, round trip, from each project area during fire period and closed season.

The tank truck or trailer shall be equipped with a pump capable of discharging 20 gallons of water per minute, using a ¼ inch nozzle tip, through a 50-foot length of rubber lined hose. In addition, 500 feet of serviceable fabric jacket rubber lined hose of not less than 1 inch outside diameter, fitted with a nozzle capable of discharging a straight stream of ¼ inch diameter and a spray pattern shall be immediately available for use. The tank, pump, and at least 250 feet of hose and nozzle shall be connected and ready for use at all times.

If a trailer is used, it shall be equipped with a hitch to facilitate prompt movement. A serviceable tow vehicle shall be immediately available for attachment to the trailer and must meet the time requirements stated above. Such truck or trailer shall be equipped to operate for a minimum of 8 hours. Tank truck or trailer shall be available from the start of work to the end of the Fire Watch/Fire Security service.

R6-FS-6300-53

Additional Fire Precautionary Measure 2 - Communications

The Contractor shall provide adequate two-way communication facilities to report a fire to the Forest Service within 15 minutes of detection. FCC regulations prohibit commercial use of Citizen Band (CB) radios. CB's are not considered adequate two-way communications.

Such communications shall be operable during periods of operation of power driven equipment, including the time fire security is required.

R6-FS-6300-54

Attachment D.

Injury Report Form

LOSS REPORT & DIAGNOSIS

valmont

Location ________________ **Section I – WHAT HAPPENED** **Incident # ______** **OSHA Claim # ______**

*Part I contains basic, standard information which must be filled out for every report. **Part II must be filled out for every injury loss, and the front page of this report must be turned into Safety & Health within 24 hours of the incident. A report must be made to the Workers Compensation Insurer within 3-days.** Part III is for recording losses involving property damage. Part IV is a description of all events. Complete Parts I, II, and IV for injury events. Complete Parts I, III, and IV for property damage events. **Section II on the backside of this form must be completed for every loss** during the diagnosis review. Also, have the employee note the location of the pain on the Workers' Compensation Pain Drawing form.*

PART I BASIC INFO

Employee Name ____________________ ☐ Male ☐ Female SSN ________________ DOB __________

Address ____________________ City & Zip ________________ Clock # ________

(Optional) Marital Status______ Spouse's Name____________________ # of Dependant Children ________

Date of Event __________ Time ________ ☐ AM ☐ PM Report Date __________ Time ________ ☐ AM ☐ PM

Department # ________Exact Location ____________________ Home Phone # ________________

Originated By ________________Title ________________ Date Hired ________ Wage ________

PART II INJURY

Title ________________ Job at Time of Incident ____________________ Time on this Job ________

Time Began Work ______ Nature of Injury-(cut, burn, puncture) ________________ Body Part ____________

What Harmed Employee (pipe, hammer, etc.) ____________ Date expected back __________

PART III PROPERTY

Property Damaged ____

Nature of Damage ____________________ Work Order # ____________________

Repair/Replacement Cost: Estimated ________________ Actual ____________________

PART IV DESCRIPTION OF INCIDENT

DESCRIBE IN YOUR OWN WORDS HOW THE LOSS OCCURRED. (Must be completed by employee)

____

____

____

____

____

____

TO BE COMPLETED BY SAFETY & HEALTH DEPARTMENT OR RESPONDING MEDICAL PERSONNEL

DESCRIBE FIRST AID GIVEN ____

____

☐ First Aid – On-Site ☐ First Aid – Off-Site Treated in Emergency Room? ☐ Yes ☐ No Hospitalized Overnight? ☐ Yes ☐ No

☐ Sutures ☐ Fracture Medication(s) ________________________________

NAME OF TREATING PHYSICIAN AND/OR MEDICAL CENTER ________________________________

TO BE COMPLETED BY PERSON RESPONSIBLE FOR OSHA RECORDKEEPING

☐ INJURY ☐ ILLNESS OSHA RECORDABLE? ☐ Yes ☐ No Why ________________________

☐ Lost Workday ☐ Restricted Duty ☐ Report Only Fatality? ☐ Yes ☐ No If yes, Date of Death ________________

SEND TOP COPY OF FRONT TO SAFETY & HEALTH. Retain second copy of front and complete back. Return completed report to Safety & Health.

Section II – BEHAVIORAL ANALYSIS

Department Supervisors are to complete this section by conducting an interview with the employee involved in the incident. Each supervisor must record responses to each question in the space provided. Answers to the questions will most likely call for follow-up questions to obtain a better understanding of the response. (See instructions for completing this form in the file entitled “Loss Report & Diagnosis – Guidelines” in the Safety Cyber Library). THE FISHBONE ANALYSIS IS TO BE USED WITH THIS SECTION.

1. ARE THERE WORK/JOB INSTRUCTIONS FOR THIS JOB/TASK?
Responses to Question: ____
____

2. WERE YOU DOING THE TASK AS YOU WERE TRAINED? PLEASE DESCRIBE TRAINING
Responses to Question: ____
____

3. WHAT WERE THE POSITIVE RESULTS FOR THE METHOD YOU CHOSE?
Responses to Question: ____
____

4. DID YOU THINK THERE WAS A BETTER WAY TO PERFORM THE TASK?
Responses to Question: ____
____

5. IS THERE ANYTHING ABOUT THE TASK THAT MAKES IT DIFFICULT FOR ANYONE TO COMPLETE CORRECTLY?
Responses to Question: ____
____

6. SHOULD A HAZARD REPORT BE FILLED OUT?
Responses to Question: ____
____

7. WERE THERE OTHER PRESSURES AT THE TIME THAT CAUSED SAFETY TO BE COMPROMISED?
Responses to Question: ____
____

Section III – ADMINISTRATIVE DETAILS

WHAT TYPE OF EVENTS CONTRIBUTED THE MOST TO THE INJURY?

_____ Factors away from work _____ Non-Production tasks _____ Production tasks

ASSESSMENT OF RISK

Loss Severity Potential:	__ minor	__ major	__ serious	__ catastrophic
Probable Occurrence Rate:	__ negligible	__ low	__ moderate	__ high
Cost of Control:	__ minor	__ low	__ medium	__ high
Degree of Control Achieved:	__ low	__ moderate	__ substantial	__ complete

Names of persons participating in the Incident Diagnosis. These persons are responsible for assuring that the "Actions to Prevent a Recurrence" are completed. (All Positions must sign)

Employee ______________________ Date ______________ Supervisor ______________________ Date _____________

Manager _______________________ Date ______________ Safety Coor.______________________ Date _____________

Other ____ Title __________________________ Date _____________

Other ____ Title __________________________ Date _____________

ACTIONS TO PREVENT A RECURRENCE

ACTION #1: _____________________________________ PERSON RESPONSIBLE: ______________ PROJECTED COMP. DATE______

ACTION #2: _____________________________________ PERSON RESPONSIBLE: ______________ PROJECTED COMP. DATE______

ACTION #3: _____________________________________ PERSON RESPONSIBLE: ______________ PROJECTED COMP. DATE______

<u>This Diagnosis must be reviewed and signed by the site manager</u>

____ Date: ______________________________

ISRS Ref: 5.1; 5.5 Rev Date: 1/02, 10/02, 5/03, 6/03, 7/04;3/05

Appendix B.

Final Mill Creek Fish Presence and Fish Passage Barrier Assessment Memo

Cascade Earth Sciences
A valmont COMPANY
Conserving Resources. Improving Life.
12720 E. Nora Ave., Ste. A
Spokane, WA 99216
Ph: 509.921.0290
Fax: 509.921.1788

TECHNICAL MEMORANDUM

DATE: October 30, 2007

TO: Rod Lentz – U.S. Forest Service

FROM: Rone Brewer – Sound Ecological Endeavors
Dustin Wasley – Cascade Earth Sciences

SUBJECT: Mill Creek Fish Presence and Fish Passage Barrier Assessment - Azurite Mine, Mazama, Washington

---

On October 2, 2007, Sound Ecological Endeavors (SEE) and Cascade Earth Sciences (CES) walked the entire length of Mill Creek from the Azurite Mine (Site) to the confluence with Canyon Creek. The goal was to identify fish passage barriers and determine fish presence. Heavy rain and wet snowfall occurred before and during the survey. Water flow in the creek was continuous (i.e., did not disappear into the streambed) and increased in volume with distance downstream from the mine. However, based on observed areas of high volume instream gravel deposits, it was deemed likely that the streambed is dry in places during the summer/fall.

While proceeding downstream from the Site, SEE and CES identified five permanent and nine temporary fish passage barriers as shown in Figure 1. Permanent fish passage barriers are those expected to remain within Mill Creek over very long periods of time (i.e., tens to hundreds of years) and are typically waterfalls with a bedrock substrate. Temporary barriers are those that may change seasonally or annually, often created by accumulations of woody debris; or those that may be barriers to small fish but not larger adult fish due to height of, or seasonally limited flow over, the barrier. Pictures of the fish barriers are provided in the attached log of photographs.

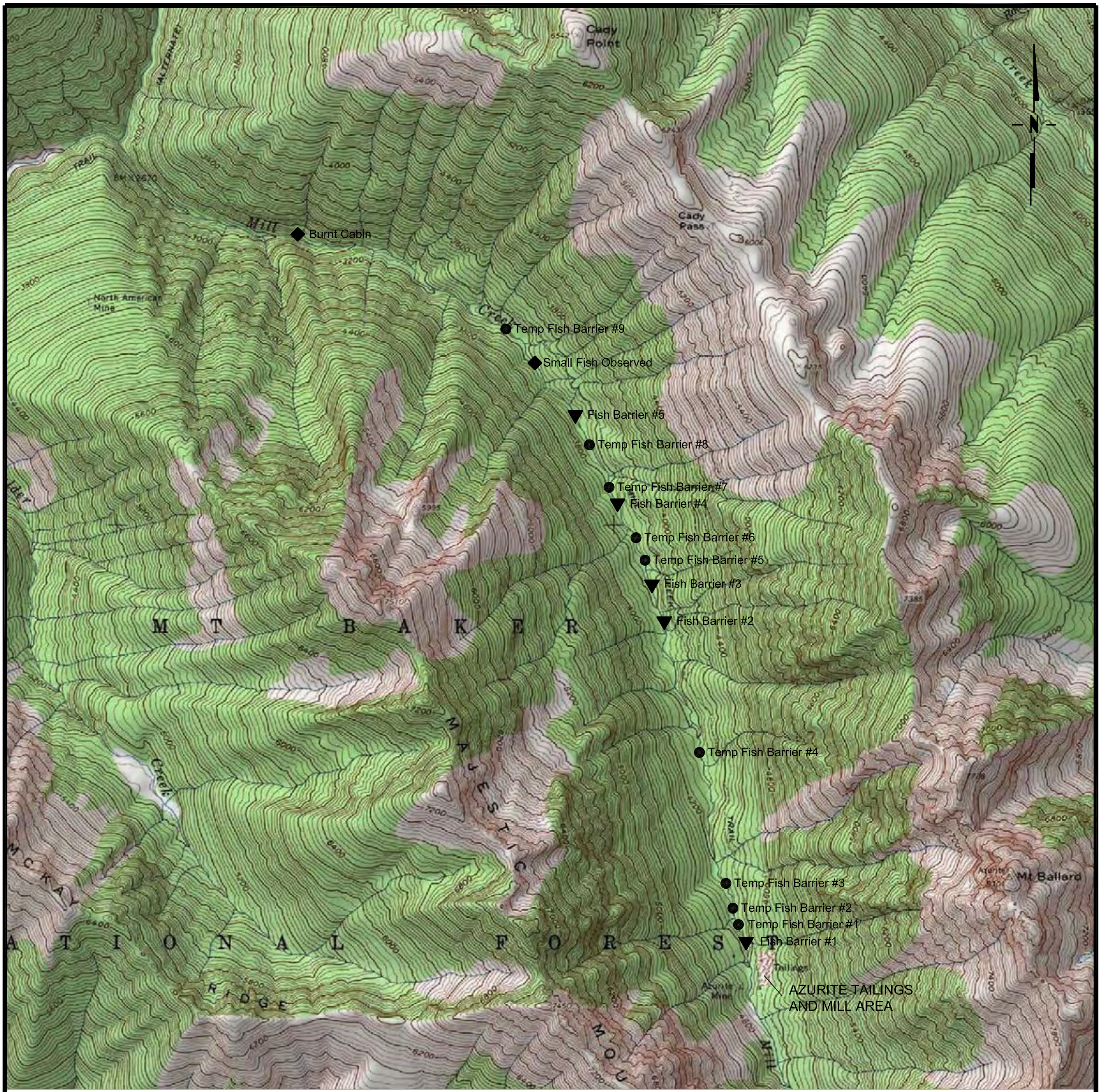
Fourteen inch square dip nets with ¼ inch mesh were used in an attempt to collect and identify fish in Mill Creek. The dip nets were opportunistically pulled through pool and riffle habitats along the entire length of the creek. No fish were caught. Only three very small unidentified fish were observed, all downstream of Fish Barrier 05 which is approximately 2.4 miles downstream from the Site.

Given the large log jam at Fish Barrier 05 and other instream woody debris, it is apparent that extremely high volumes of water and debris scour Mill Creek each spring. Then, in the fall, flow becomes very low with likely areas of dry streambed. Because of these conditions, and the presence of other bedrock fish passage barriers, it is deemed unlikely that fish have ever migrated upstream of Fish Barrier 04 (two miles downstream from Site) and most recently have not been able to migrate upstream of Fish Barrier 05. In addition, no records were found during the earlier Site Inspection (CES, 2004) indicating that fish had been transplanted into the upper reaches of Mill Creek. Thus, fish are unlikely to have ever inhabited Mill Creek in the within two miles of Site.

RB:DGW/sjr
PN: 2723031
Doc: Tech Memo - Azurite Fish Barrier 10-26-07.doc

FIGURE 1

MILL CREEK FISH PASSAGE BARRIERS



SCALE 1 INCH = 500 FEET
ELEVATION IN METERS

Figure 1. Mill Creek Fish Passage Barriers and Fish Presence Assessment

PROJECT NUMBER: 2723031
DATE: 10-22-07
DWG BY: 6DGW
DWG NO: MC - Fish.dwg
PROJECT MANAGER: 6DGW
REVISED:

AZURITE MINE REMOVAL ACTION

USFS REGION 6
MT. BAKER - SNOQUALMIE NATIONAL FOREST
WHATCOM COUNTY

CASCADE EARTH SCIENCES
A Valmont Industries Company

ATTACHMENT A

LOG OF PHOTOGRAPHS

Fish Barrier 01

Temp. Fish Barrier 01


Temp. Fish Barrier 02


Temp. Fish Barrier 03

Temp. Fish Barrier 04

Fish Barrier 02

Fish Barrier 03

Temp. Fish Barrier 05

Temp. Fish Barrier 06

Fish Barrier 04

Temp. Fish Barrier 07

Temp. Fish Barrier 08

Fish Barrier 05

Temp. Fish Barrier 09

Appendix C.

Final Engineering Assessment: Slope Stability Memo (2007)/ Supplemental Geotechnical Analysis - Soil Cover Stability Analysis (2009)/ Supplement Geotechnical Memo-Correspondence (2011)

GEOENGINEERS

December 20, 2007

Cascade Earth Sciences
12720 East Nora Avenue, Suite A
Spokane, Washington 99216

Attention: Dustin Wasley, PE

Subject: Geotechnical Engineering Services
Azurite Mine
Mt. Baker-Snoqualmie National Forest
File No. 0347-076-01

INTRODUCTION

This letter transmits the results of our field explorations and slope stability analyses for the proposed remediation alternatives in support of disposal and capping of mine tailings and waste rock at the Azurite Mine site, herein referred to as the “Site”. The Azurite Mine is located within the Mt. Baker-Snoqualmie National Forest in Whatcom County, Washington, approximately as shown on the Vicinity Map, Figure 1. The Site is located within the Mill Creek drainage, a U-shaped glacial valley surrounded by rugged mountainous terrain. There are two main waste rock piles, located on the east-facing slopes of the drainage, which encroach upon Mill Creek. The remains of the mill and a large tailings pile are located on the opposite side of the creek from the waste rock piles. The approximate locations of the existing site features are presented in the Site Plan, Figure 2.

We understand that MFG, Inc. (MFG) conducted an engineering evaluation of remediation alternatives for the Site. One alternative developed by MFG included excavating the waste rock piles and placing the material on top of the tailings pile, followed by construction of a soil cap on top of the relocated waste rock. MFG also included a retaining wall at the base of the tailings pile to retain the waste rock as part of their preliminary design. As part of MFG’s preliminary design, they performed slope stability analyses of the existing and proposed slopes.

Our services included visiting the site and collecting samples of the tailings and native soil; reviewing MFG’s preliminary design from a slope stability standpoint; and providing an alternative disposal location for the waste rock stockpile. Our services were completed in general accordance with our Subcontractor Agreement for Services dated September 20, 2007.

SITE CONDITIONS

GENERAL

We completed a limited site investigation in conjunction with Cascade Earth Sciences (CES) on October 1 and 3, 2007. Our investigation included six test pits (TP-1 through TP-6) in the vicinity of the existing tailings pile at the approximate locations shown on Figure 2. The test pits were excavated to depths in the range of about 9 to 13½ feet below existing site grade.

Representative soil samples from the test pits, as well as soil samples obtained from test pits excavated in the waste rock piles under the supervision of CES, were returned to our laboratory for review and testing. Detailed descriptions of our site exploration and laboratory testing programs along with test pit logs are presented in Attachment A.

SURFACE CONDITIONS

The existing tailings pile is sloped at inclinations in the range of about 2H:1V (horizontal to vertical) to about 3H:1V. Steeper slopes generally are located on the north portions of the tailings pile, with site inclinations generally decreasing in steepness towards the south. The mill site area is located to the south of the tailings pile, and has been graded and benched. The tailings pile is barren, as is most of the mill site area. Surrounding vegetation consists of coniferous trees and an understory of brush. A seep is located downgradient from the tailings pile adjacent to an existing access road.

SUBSURFACE CONDITIONS

General

Test pit TP-1 was excavated near a topographical “bowl” feature in the tailings pile, where it appears that additional material could be placed with relatively limited grading or benching requirements. Test pits TP-2 through TP-4 were excavated in the general vicinity of the proposed retaining wall as presented in the plans developed by MFG. Test pits TP-5 and TP-6 were excavated outside of the tailings pile in order to characterize shallow soil in areas for an alternative location for placement of the waste rock. Test pits also were excavated within the waste rock piles and observed by CES. Bulk samples from the waste rock pile test pits were provided to us by CES. The following paragraphs provide a brief description of the subsurface conditions at the locations of our test pits.

Tailings

Test pits TP-1 through TP-4 were advanced through the tailings near the bottom of the existing tailings pile. The tailings pile consists of fine-grained soil (silt and clay) that is weakly to strongly cemented. At the locations of our test pits, we observed that the consistency of the tailings in an undisturbed condition is very stiff to hard. We also observed that when the tailings were disturbed and subjected to moisture, they became soft. Based on discussions with CES, We understand that maximum thickness of the tailings pile is on the order of about 15 feet.

Native Soil

At the locations of our test pits, the native soil generally consisted of fine to coarse angular to subangular gravel with variable amounts of silt, sand, cobbles and occasional boulders. Results of grain-size analyses indicate that the fines (silt- and clay-sized soil particles passing the U.S. No. 200 sieve) content of the native soil was in the range of about 7 to 19 percent. Based on difficulty of excavation, results of probing and observation of caving within test pits, the relative density of most of the native soil appears to be medium dense to dense. However, at the locations of test pits TP-1 and TP-3, we observed a buried topsoil layer at and below the base of the tailings pile. At the locations of test pits TP-3 and TP-4, we also observed a layer of loose to very loose poorly graded gravel and cobbles.

Waste Rock

Samples of waste rock obtained from test pits conducted under the supervision of CES were returned to our laboratory for review and testing. Results of laboratory testing indicate that the waste rock generally consists of fine to coarse angular to subangular gravel with silt and sand. The fines content of the waste rock samples was in the range of about 7 to 13 percent.

GROUNDWATER

We encountered slight groundwater seepage at the location of test pit TP-6 at a depth of about 5 feet below current ground surface. The seep appeared to be limited in extent. Seepage was limited to one corner of the test pit, and groundwater was not observed below the elevation of the seepage.

SLOPE STABILITY ANALYSES

GENERAL

We used the computer program Slope/W to analyze the stability of existing and proposed slopes in support of proposed grading for the waste rock repository. In particular, we analyzed the global stability of the existing tailings pile, and the proposed waste rock placement designed by MFG. We also analyzed global stability of existing slopes and an alternative waste rock placement plan within the mill area.

ENGINEERING PARAMETERS OF SITE SOILS

We developed engineering parameters of site soil units based on the results of our site exploration and laboratory analyses. In general, our engineering parameters for the site soil units and conditions are based on the following assumptions.

- Tailings at the site will be left in an undisturbed state. Disturbance to the tailing will result in significant loss of cohesive strength and reduction of shear strength.
- The poorly graded loose gravel and cobble deposit encountered in test pits TP-3 and TP-4 likely consists of colluvium and resulted in our selection of lower engineering parameters than what would be representative for the medium dense to dense soil encountered elsewhere on site.
- Because layers of poorly graded colluvium could be present at other locations and at depths below the limits of our excavations, we used lower engineering parameters for all of the native soil profile where it was encountered at the base of the tailings pile.
- We used engineering parameters representative of the medium dense to dense soil for analyses in the vicinity of test pits TP-5 and TP-6. However, the use of these higher values was limited to the depth of our excavations.
- Waste rock will be compacted to a minimum density of 90 percent of maximum dry density based on the American Society for Testing and Materials D 698 test procedure.
- A phreatic water surface is present approximately 40 feet below the existing ground surface.

The parameters used in our slope stability analyses are presented in Table 1.

Table 1. Engineering Parameters of Site Soils

Soil Type	Moist Unit Weight (pcf)	Saturated unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)
Waste Rock	120	125	33	0
Tailings	110	115	0	1,500

Soil Type	Moist Unit Weight (pcf)	Saturated unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)
Native Soil	120	125	Varies	Varies
TP-3 and TP-4			32	0
TP-5 and TP-6 (top 10 feet)			36	50
TP-5 and TP-6 (below 10 feet)			32	0

SEISMIC PARAMETERS

Figure 6-5 in the Washington State Department of Transportation (WSDOT) Geotechnical Design Manual (GDM) indicates that the peak bedrock acceleration in the site vicinity is about 0.20g, where g is the acceleration due to gravity. This acceleration is based on a 10 percent probability of exceedance in 50 years. Based on the review of geologic literature, it is our opinion that the Site classifies as a Site Class D in accordance with International Building Code (IBC) criteria. The amplification factor to account for site response in accordance with the IBC is 1.21. Therefore, the peak ground acceleration for the Site is 0.24g. For slope stability analyses and seismic design of flexible structures, such as native slopes and reinforced slopes, the WSDOT GDM recommends using a value of one-half the peak ground acceleration and ignoring the vertical acceleration. Therefore, we used a horizontal acceleration coefficient of 0.12g and a vertical acceleration coefficient of zero in our seismic slope stability analyses.

RESULTS

Results of our slope stability analyses are presented in Table 2 with supporting output files presented in Attachment B. Locations of slope cross-sections listed in Table 2 are shown in Figure 2.

As part of our slope stability study, we analyzed Section 4 which traverses the tailings pile near the middle of the waste rock repository proposed by MFG. We also analyzed Section 15 which traverses the mill area near our proposed alternate waste rock repository. Based on the results of our analyses, we conclude that placing waste rock to the south of the existing tailings pile, in the vicinity of the mill area, will result in higher safety factors against slope instability than placing waste rock on top of the tailings pile near the north end of the Site.

Table 2. Results of Slope Stability Analyses (rounded to nearest 0.05)

Location, condition	Static S.F.	Seismic S.F.
Section 4, existing	1.5	1.1
Section 4, with waste rock	1.15	1.1
Section 15, existing	2.2	1.45
Section 15, with waste rock	1.5	1.2

DISCUSSION AND CONCLUSIONS

It should be noted that our field explorations were limited in depth and number, due in part to weather conditions and access limitations at the time of exploration. Based on our observations at the site and associated laboratory testing and analysis, it appears that site slopes are stable and can support fills on the order of 15 to 20 feet in height. However, on the basis of our analysis, it is our opinion that placing an additional 15 to 20 feet of fill on top of the existing tailings pile could result in safety factors less than 1.2 and 1.1 for the static and seismic conditions, respectively. These safety factors are marginal, in our opinion, because the limited data increases uncertainty related to parameters used in the analysis. In our opinion, a more feasible option from the standpoint of stability and constructability is to place the waste rock on top of native site soil in the mill area located to the south of the Site. Based on the results of our slope stability analyses and apparent stability of existing site slopes, we recommend limiting the thickness of the waste rock to about 20 to 25 feet, unless additional subsurface explorations can be completed that would allow for additional refinement of our slope stability analysis.

We trust this information meets your present needs. Please contact the undersigned should you have any questions regarding the contents of this letter or if you require additional information.

Sincerely,

GeoEngineers, Inc.

David R. Lauder, PE
Project Geotechnical Engineer

DAVID RYAN LAUDER
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Senior Principal

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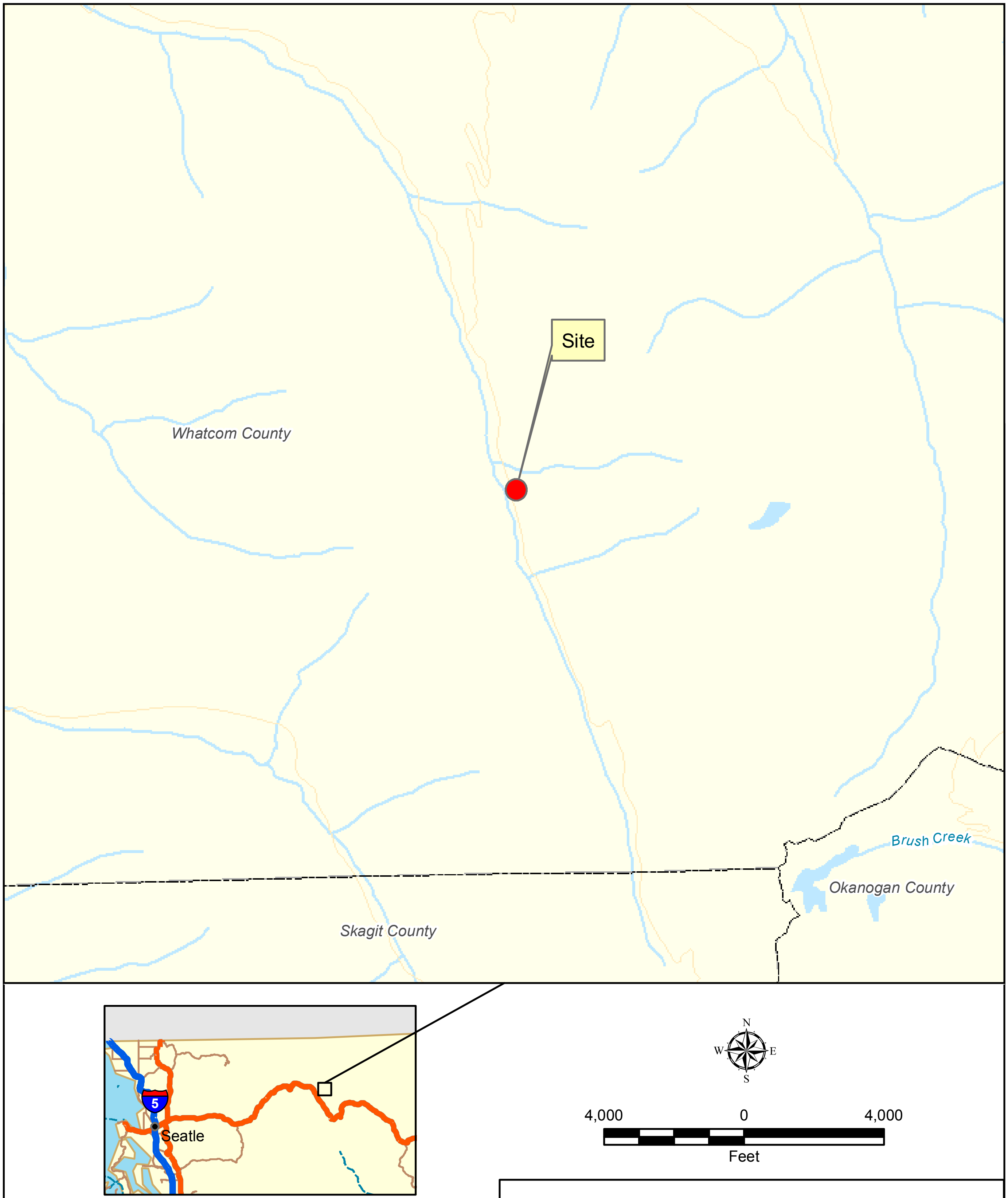
Attachments:

- Figure 1 – Vicinity Map
- Figure 2 - Site Plan
- Attachment A – Subsurface Explorations and Laboratory Testing
    - Figure A-1 – Key to Explorations Logs
    - Figures A-2…A-7 – Logs of Test Pits
    - Figures A-8…A-10 – Sieve Analysis Results

- Attachment B – Slope/W Computer Output



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

Map Revised: December 19, 2007

Path: P:\00\0347076\01\GIS\MXDs\034707601Figure1.mxd

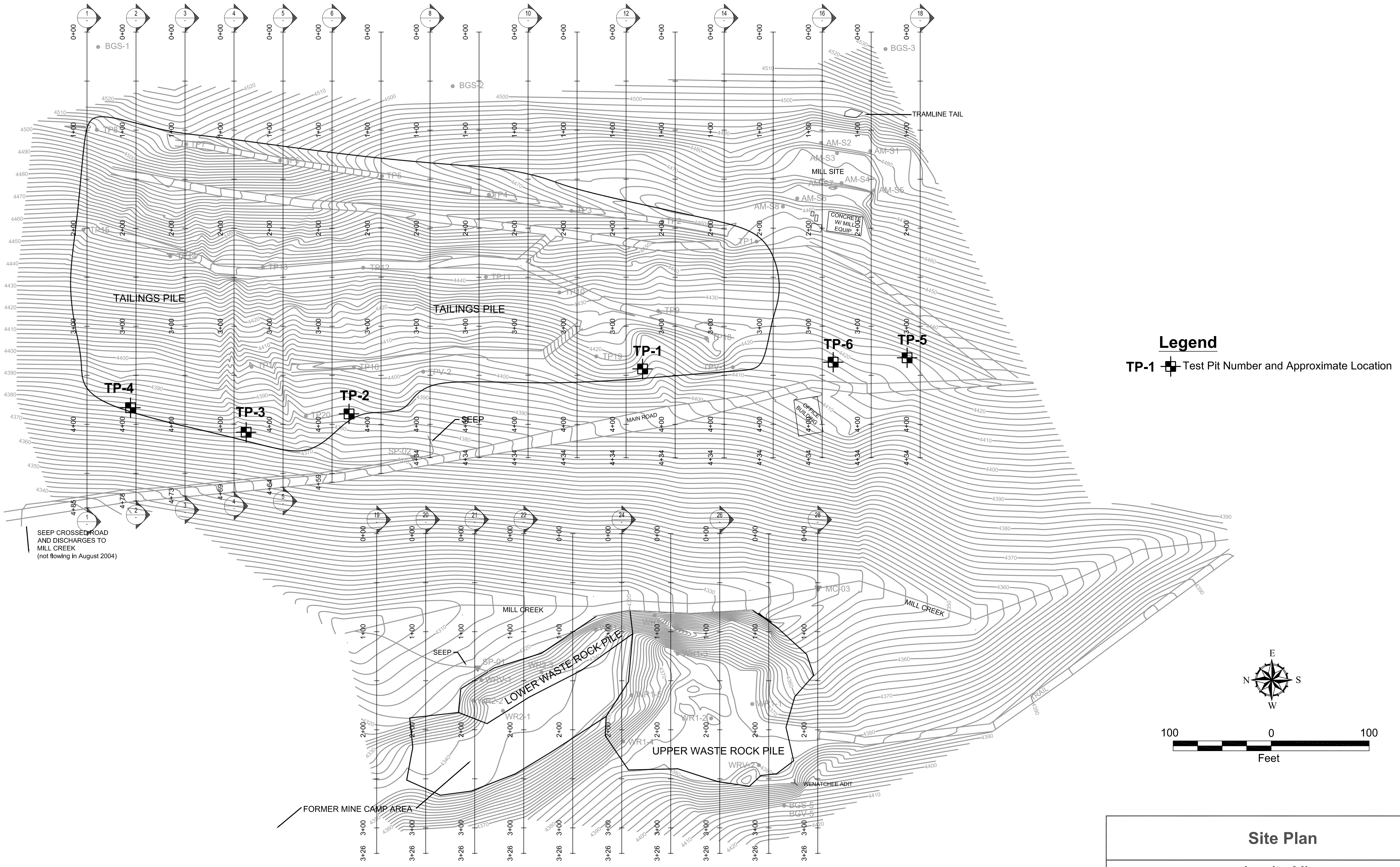
Office: SPOK

Vicinity Map

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

GeoEngineers

Figure 1



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Drawing provided by Cascade Earth Sciences titled "Azurite Minae, Site Inspection" dated 2/7/05.

Site Plan

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

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Figure 2

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ATTACHMENT A

SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

ATTACHMENT A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

SUBSURFACE EXPLORATIONS

Soil and groundwater conditions at the subject site were explored on October 3, 2007 by excavating six test pits (TP-1 through TP-6) at the approximate locations shown on Figure 2. The test pits were excavated with a small tracked excavator under subcontract to CES. The locations of the explorations were established by pacing and taping from existing site features and should be considered approximate.

The explorations were monitored by an engineer from our firm who examined and classified the soil encountered and obtained representative samples. Soil encountered in the test pits was classified in general accordance with ASTM D 2488 and the classification chart listed in Key to Exploration Logs, Figure A-1. Logs of the test pits are presented in Log of Test Pits, Figures A-2 through A-7. The logs are based on interpretation of the field and laboratory data, and indicate the depth at which subsurface materials or their characteristics change, although these changes might actually be gradual.

LABORATORY TESTING

Soil samples obtained from test pits TP-1 through TP-6, as well as samples from test pits excavated in the waste rock piles under the supervision of CES [denoted as Lower Waste Rock (LWR-1 and LWR-2) and Upper Waste Rock (UWR-1 and UWR-2)], were returned to our laboratory for further examination and testing. Gradation tests (ASTM C136) were accomplished on representative soil samples. Results of ASTM C136 analyses are presented in Sieve Analysis Results, Figures A-8 through A-10.

Selected samples also were tested to estimate their natural moisture content in general accordance with ASTM D2216. Results are presented on the exploration logs at the respective sample depths.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	▨	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
			▨	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	▨	SW	WELL-GRADED SANDS, GRAVELLY SANDS
			▨	SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▨	ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▨	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▨	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			▨	OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			▨	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS		TYPICAL DESCRIPTIONS
GRAPH	LETTER	
▨	CC	Cement Concrete
■	AC	Asphalt Concrete
▨	CR	Crushed Rock/ Quarry Spalls
▨	TS	Topsoil/ Forest Duff/Sod

▽	**Measured groundwater level in exploration, well, or piezometer**
▼	**Groundwater observed at time of exploration**
≡	**Perched water observed at time of exploration**
▼	**Measured free product in well or piezometer**

Stratigraphic Contact

—	**Distinct contact between soil strata or geologic units**
╱	**Gradual change between soil strata or geologic units**
– – – –	**Approximate location of soil strata change within a geologic soil unit**

Sampler Symbol Descriptions

■	**2.4-inch I.D. split barrel**
◨	**Standard Penetration Test (SPT)**
□	**Shelby tube**
▤	**Piston**
◧	**Direct-Push**
☒	**Bulk or grab**

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	**Percent fines**
AL	**Atterberg limits**
CA	**Chemical analysis**
CP	**Laboratory compaction test**
CS	**Consolidation test**
DS	**Direct shear**
HA	**Hydrometer analysis**
MC	**Moisture content**
MD	**Moisture content and dry density**
OC	**Organic content**
PM	**Permeability or hydraulic conductivity**
PP	**Pocket penetrometer**
SA	**Sieve analysis**
TX	**Triaxial compression**
UC	**Unconfined compression**
VS	**Vane shear**

Sheen Classification

NS	**No Visible Sheen**
SS	**Slight Sheen**
MS	**Moderate Sheen**
HS	**Heavy Sheen**
NT	**Not Tested**

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

Figure A-1

Date Excavated: 10/03/07

Equipment: Excavator

Logged by: DRL

Surface Elevation (ft): Not measured

Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0	☒	1		CL/ML	Orange cemented silty clay with sand (oxidized tailings) (undisturbed state: very stiff to hard, PP > 4 tsf; disturbed state: very soft, PP 0-1 tsf, moist to wet)		
					ML	Gray cemented silt (partially oxidized to unoxidized tailings) (undisturbed state: very stiff to hard, PP > 4 tsf; disturbed state: very soft, PP 0-1 tsf, moist)		
	5	☒	2		GM	Brown to dark brown silty fine to coarse angular to subangular gravel with sand and cobbles (reworked native soil mixed with tailings in the upper 2 to 4 feet) (dense, moist)	22	SA
	10				TS	Dark brown to black silty fine to coarse angular to subangular gravel with sand and organic matter (loose, moist) (buried topsoil layer)		
	15							
	20							
	25							

Test pit completed at approximately 11 foot depth
No groundwater seepage observed
Moderate caving observed

Note: cementation most intense in upper 1 to 4 feet, decreases with depth, cementation consists of ferracrete and gypsum

Notes: See Figure A-1 for explanation of symbols.

LOG OF TEST PIT TP-1

GeoEngineers

Project: Azurite Mine
Project Location: Mt. Baker-Snoqualmie National Forest, Washington
Project Number: 0347-076-01

Figure: A- 2
Sheet 1 of 1

Date Excavated: 10/03/07

Logged by: DRL

Equipment: Excavator

Surface Elevation (ft): Not measured

Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0			▨	CL/ML	Approximately 2 inches orange silty clay with sand (oxidized tailings) (undisturbed state: very stiff to hard, PP > 4 tsf; disturbed state: very soft, PP 0-1 tsf) (moist to wet)		
		◧	1		ML	Gray cemented silt (partially oxidized to unoxidized tailings) (undisturbed state: very stiff to hard, PP > 4 tsf; disturbed state: very soft to medium stiff, PP 0-2 tsf; moist)		
	5				ML	Approximately 6-inch-thick layer rust colored oxidized tailings (cemented) (stiff to hard)		
				○	GP-GM	Dark brown fine to coarse gravel with silt, sand, cobbles and occasional organic matter (medium dense, moist) (upper 1 to 2 feet weakly cemented) Grades to grayish brown in color		
		☒	2	○			26	SA
	10					Test pit completed at approximately 9 foot depth No groundwater seepage observed No caving observed		
	15							
	20							
	25							

Notes: See Figure A-1 for explanation of symbols.

LOG OF TEST PIT TP-2

GEOENGINEERS

Project: Azurite Mine

Project Location: Mt. Baker-Snoqualmie National Forest, Washington

Project Number: 0347-076-01

Figure: A- 3

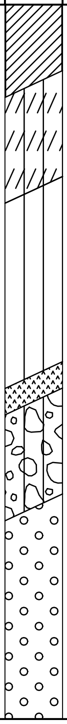
Sheet 1 of 1

Date Excavated: 10/03/07

Logged by: DRL

Equipment: Excavator

Surface Elevation (ft): Not measured



Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0				ML/CL	Orange silty clay with sand (oxidized tailings) (undisturbed state: very stiff to hard; disturbed state: very soft)		
					ML GY	Light gray tailings (mostly gypsum) (undisturbed state: hard; disturbed state: soft, moist)		
	5				ML	Gray cemented silt (partially oxidized to unoxidized tailings) (undisturbed state: very stiff to hard; disturbed state: soft, moist)		
					TS	Approximately 6 inches dark brown silty fine to coarse sand with gravel and organic matter (buried topsoil layer)		
					GM	Brown silty fine to coarse angular to subangular gravel with sand and cobbles (partially cemented) (dense, moist)		
	10				GP	Brown fine to coarse angular gravel with cobbles (loose, moist)		

Test pit completed at approximately 13 1/2 foot depth
No groundwater seepage observed
Severe caving observed below approximately 9 1/2 foot depth

15

20

25

Notes: See Figure A-1 for explanation of symbols.

LOG OF TEST PIT TP-3

GEOENGINEERS

Project: Azurite Mine
Project Location: Mt. Baker-Snoqualmie National Forest, Washington
Project Number: 0347-076-01

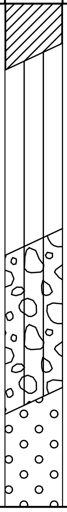
Figure: A- 4
Sheet 1 of 1

Date Excavated: 10/03/07

Logged by: DRL

Equipment: Excavator

Surface Elevation (ft): Not measured



Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0			▨	ML/CL	Orange silty clay with sand (oxidized tailings) (undisturbed state: very stiff to hard; disturbed state: soft, moist)		
		☒	1		ML	Gray cemented silt (partially oxidized to unoxidized tailings) (undisturbed state: very stiff to hard; disturbed state: soft, moist)		
	5	☒	2		GM	Brown silty fine to coarse angular to subangular gravel with sand and cobbles (dense, moist) (weakly cemented upper 2 to 4 feet, cementation decreases with depth)		
					GP	Brown fine to coarse angular to subangular gravel with cobbles and boulders (loose, moist)		
	10							

Test pit completed at approximately 9 1/2 foot depth
No groundwater seepage observed
Severe caving observed below approximately 7 foot depth

15

20

25

Notes: See Figure A-1 for explanation of symbols.

LOG OF TEST PIT TP-4

GeoEngineers

Project: Azurite Mine

Project Location: Mt. Baker-Snoqualmie National Forest, Washington

Project Number: 0347-076-01

Date Excavated: 10/03/07

Logged by: DRL

Equipment: Excavator

Surface Elevation (ft): Not measured

Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0				GP-GM	Orangish brown fine to coarse angular to subangular gravel with silt, sand, cobbles and occasional boulders (medium dense to dense, moist)		
		☒	1				20	SA
	5							
		☒	2				11	SA
	10					Test pit completed at approximately 10 foot depth No groundwater seepage observed No caving observed		
	15							
	20							
	25							

Notes: See Figure A-1 for explanation of symbols.

LOG OF TEST PIT TP-5

GeoEngineers

Project: Azurite Mine

Project Location: Mt. Baker-Snoqualmie National Forest, Washington

Project Number: 0347-076-01

Date Excavated: 10/03/07

Logged by: DRL

Equipment: Excavator

Surface Elevation (ft): Not measured

Elevation feet	Depth feet	Sample	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
	0				TS	6 to 12 inches forest duff and roots		
					SM	Brown silty fine to coarse sand with gravel, cobbles, boulders and debris (water pipes) (loose, moist) (fill)		
		☒	1		GM	Light brown silty fine to coarse gravel with sand, cobbles and occasional boulders (dense, moist)	21	SA
	5	▼				Small seep at northwest corner of test pit at approximately 5 foot depth		
	10					Test pit completed at approximately 10 foot depth Slight groundwater seepage observed at approximately 5 1/2 foot depth No caving observed		
	15							
	20							
	25							

Notes: See Figure A-1 for explanation of symbols.

LOG OF TEST PIT TP-6

GEOENGINEERS

Project: Azurite Mine

Project Location: Mt. Baker-Snoqualmie National Forest, Washington

Project Number: 0347-076-01

Figure: A- 7

Sheet 1 of 1

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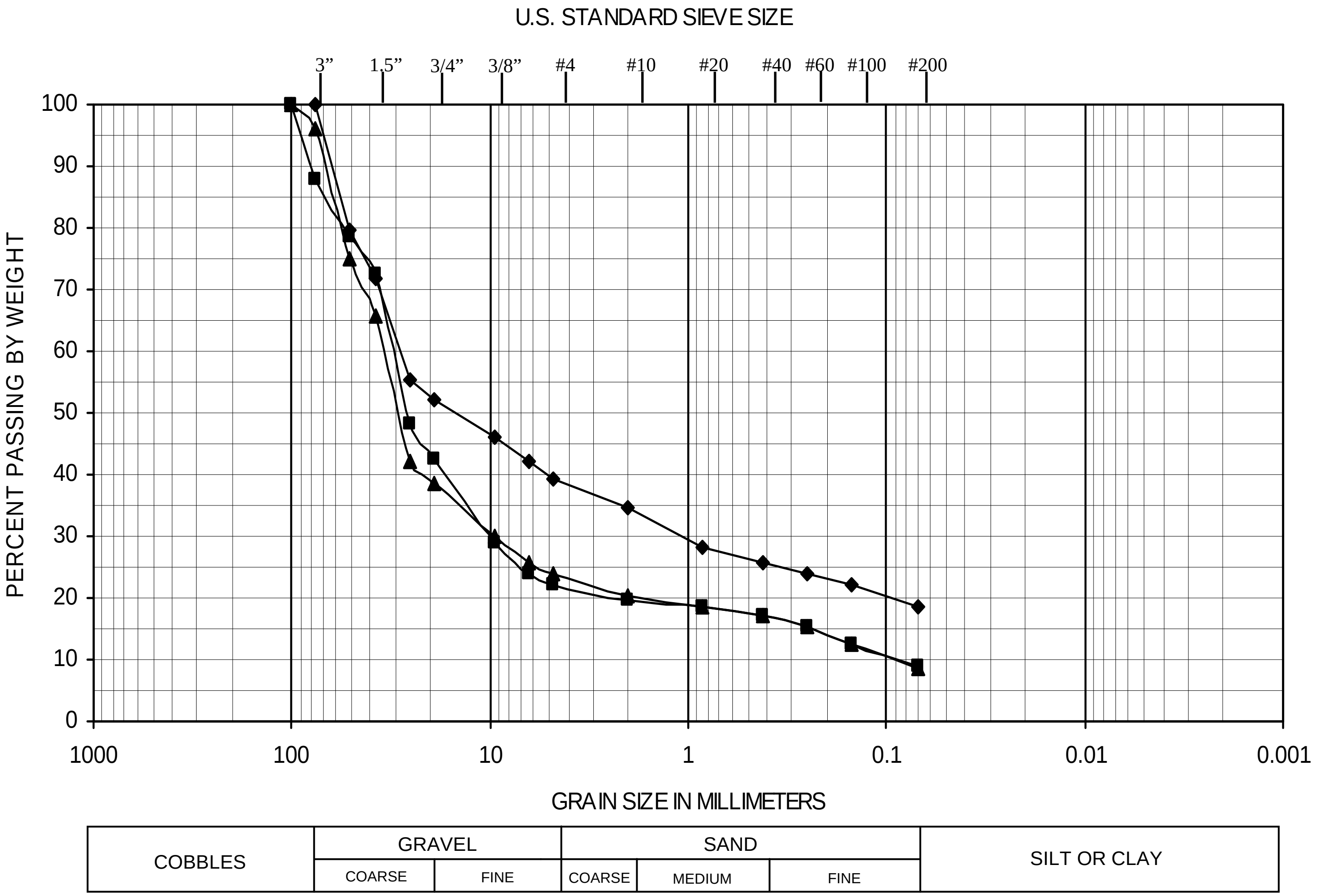


SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	SOIL CLASSIFICATION
◆	TP-1	4	Silty fine to coarse gravel with sand
■	TP-2	8	Fine to coarse gravel with silt and sand
▲	TP-5	4	Fine to coarse gravel with silt and sand

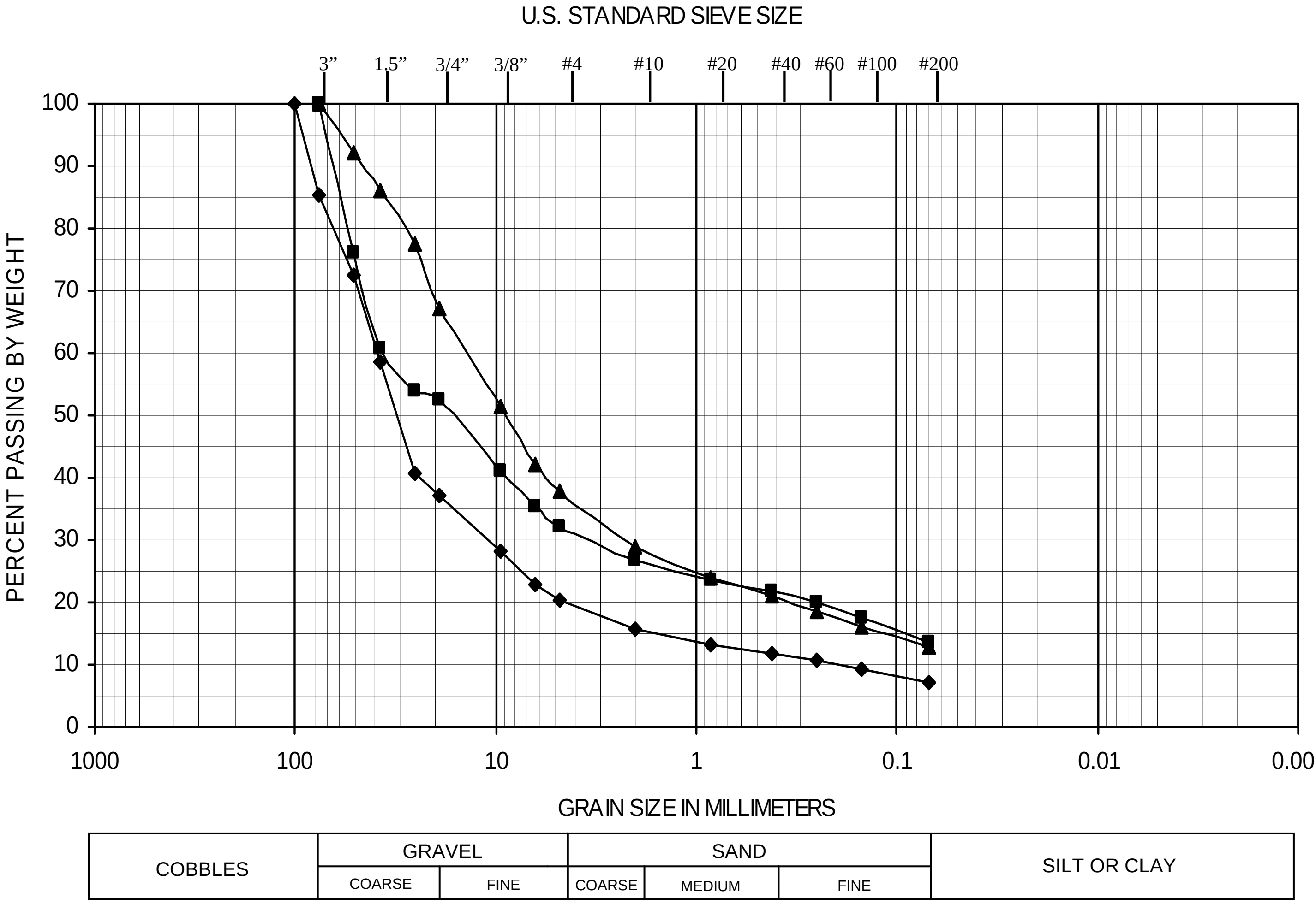
Sieve Analysis Results

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

GEOENGINEERS

Figure A-8

SPO:\00\0347-076\01\finals\034707601s1.ppt 12/18/07 DRL:tlm



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	SOIL CLASSIFICATION
◆	TP-5	8	Fine to coarse gravel with silt and sand
■	TP-6	4	Silty fine to coarse gravel with sand
▲	LWR-1	NA	Silty fine to coarse gravel with sand

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Sieve Analysis Results

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

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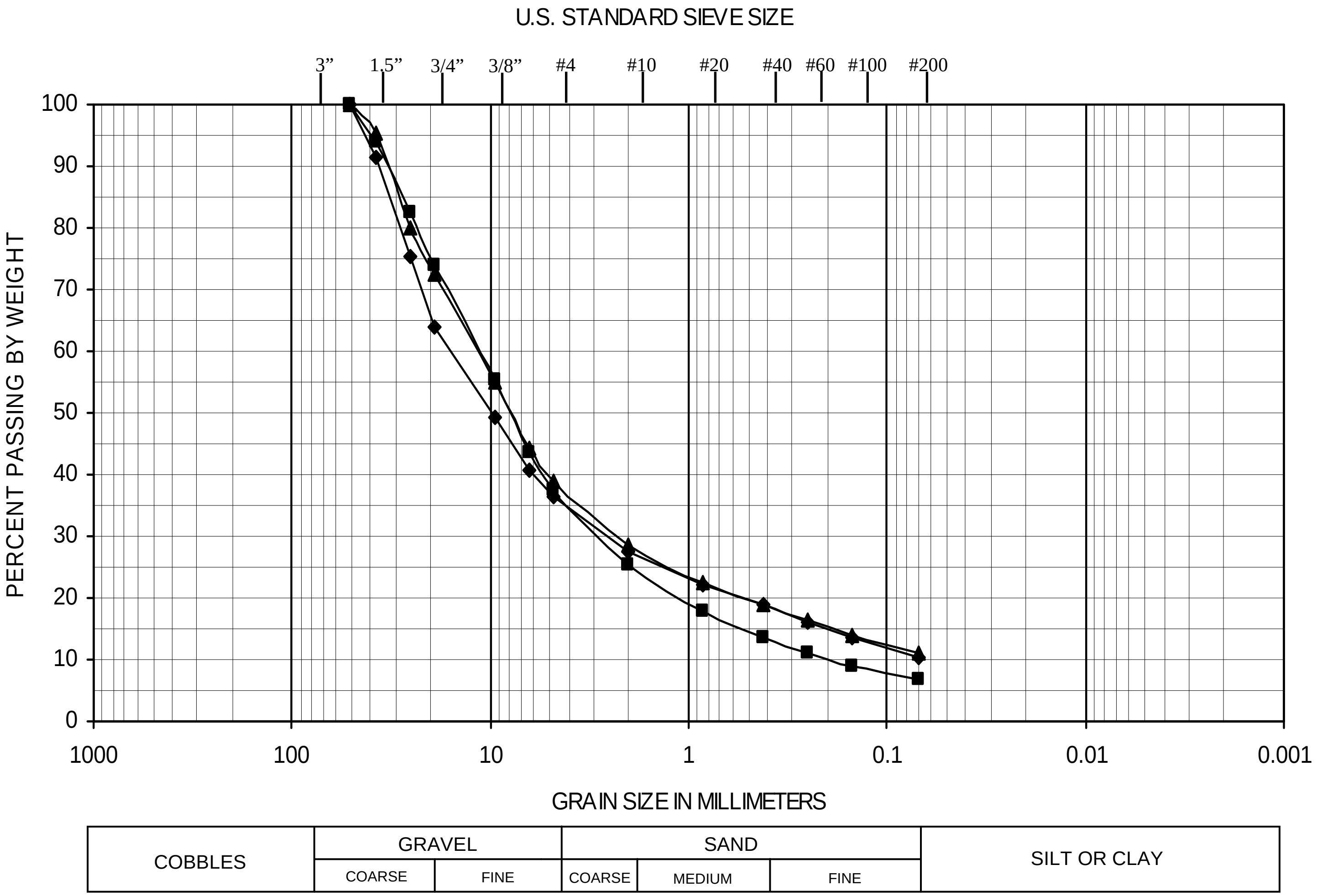
Figure A-9



SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	SOIL CLASSIFICATION
◆	LWR-2	NA	Fine to coarse gravel with silt and sand
■	UWR-1	NA	Fine to coarse gravel with silt and sand
▲	UWR-2	NA	Fine to coarse gravel with silt and sand

Sieve Analysis Results

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

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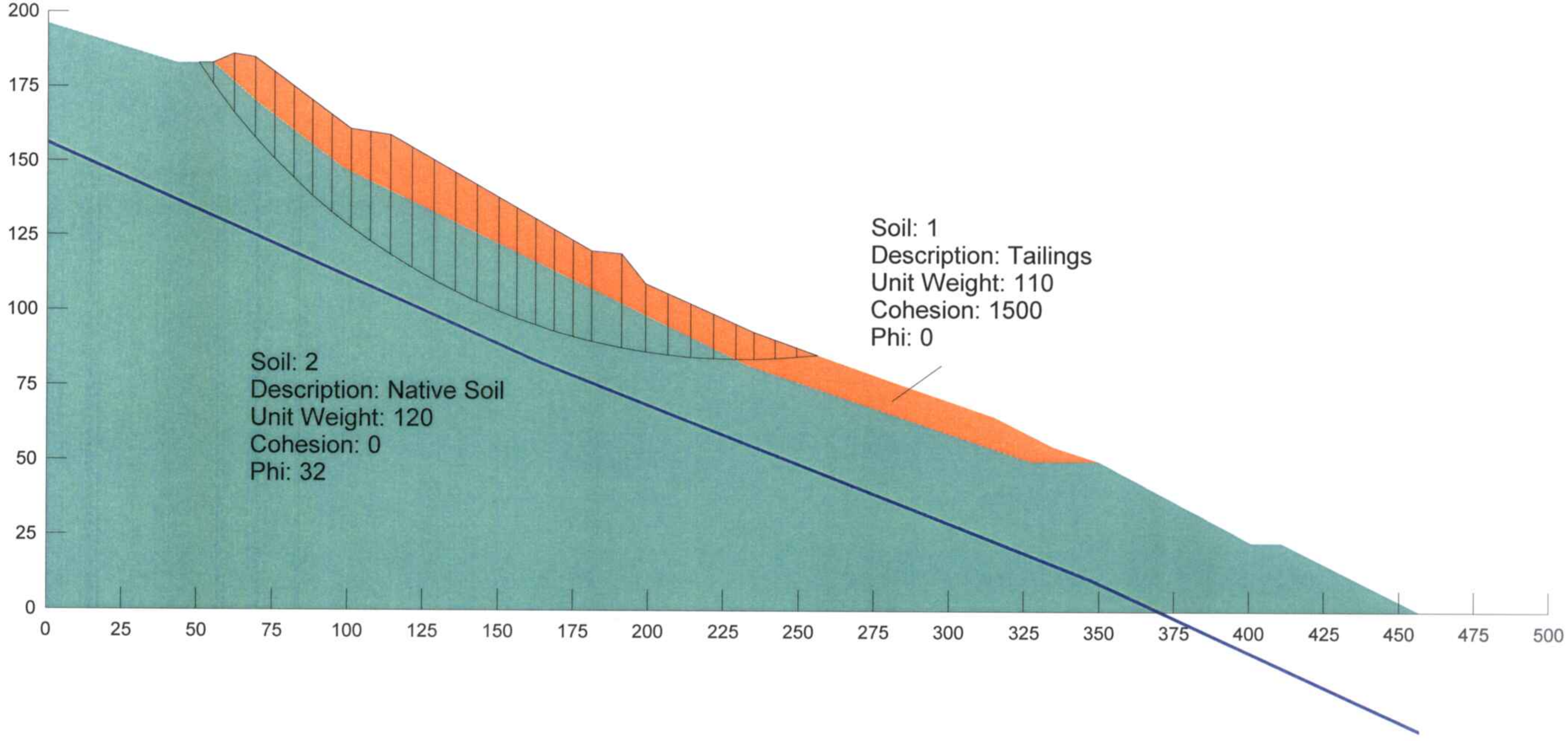
Figure A-10

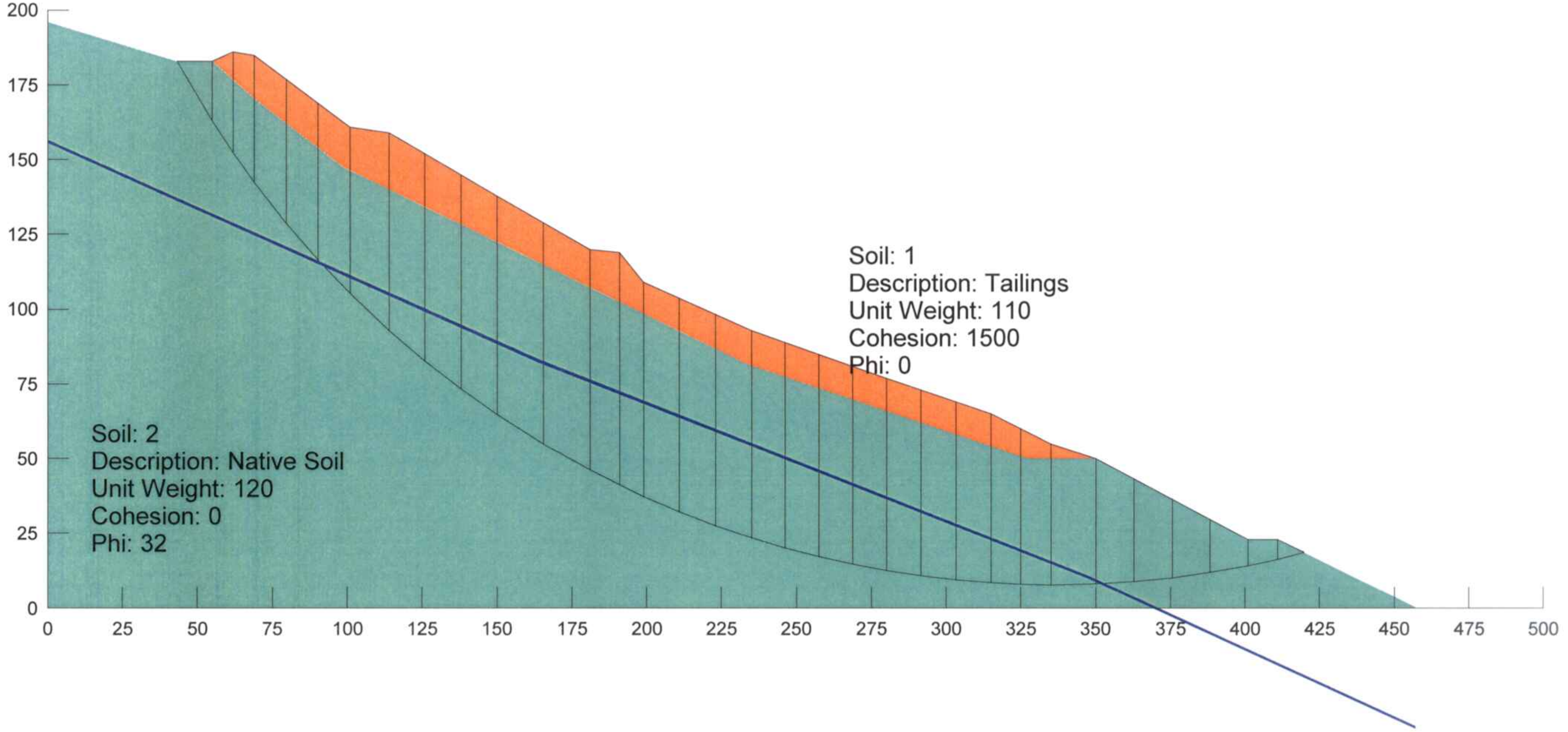
ATTACHMENT B

SLOPE/W COMPUTER OUTPUT

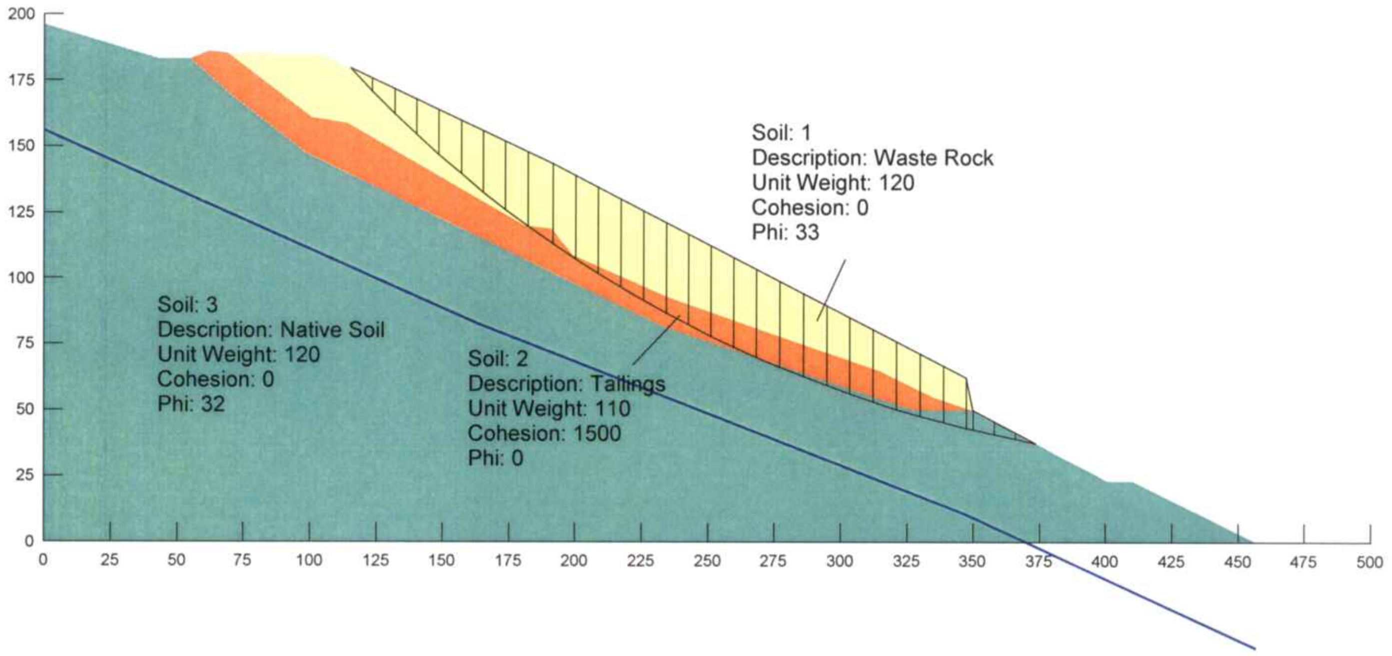
Description: Azurite Mine
Comments: Section 4, existing conditions
File Name: MFG_existingslope_static.slz
Safety Factor = 1.5



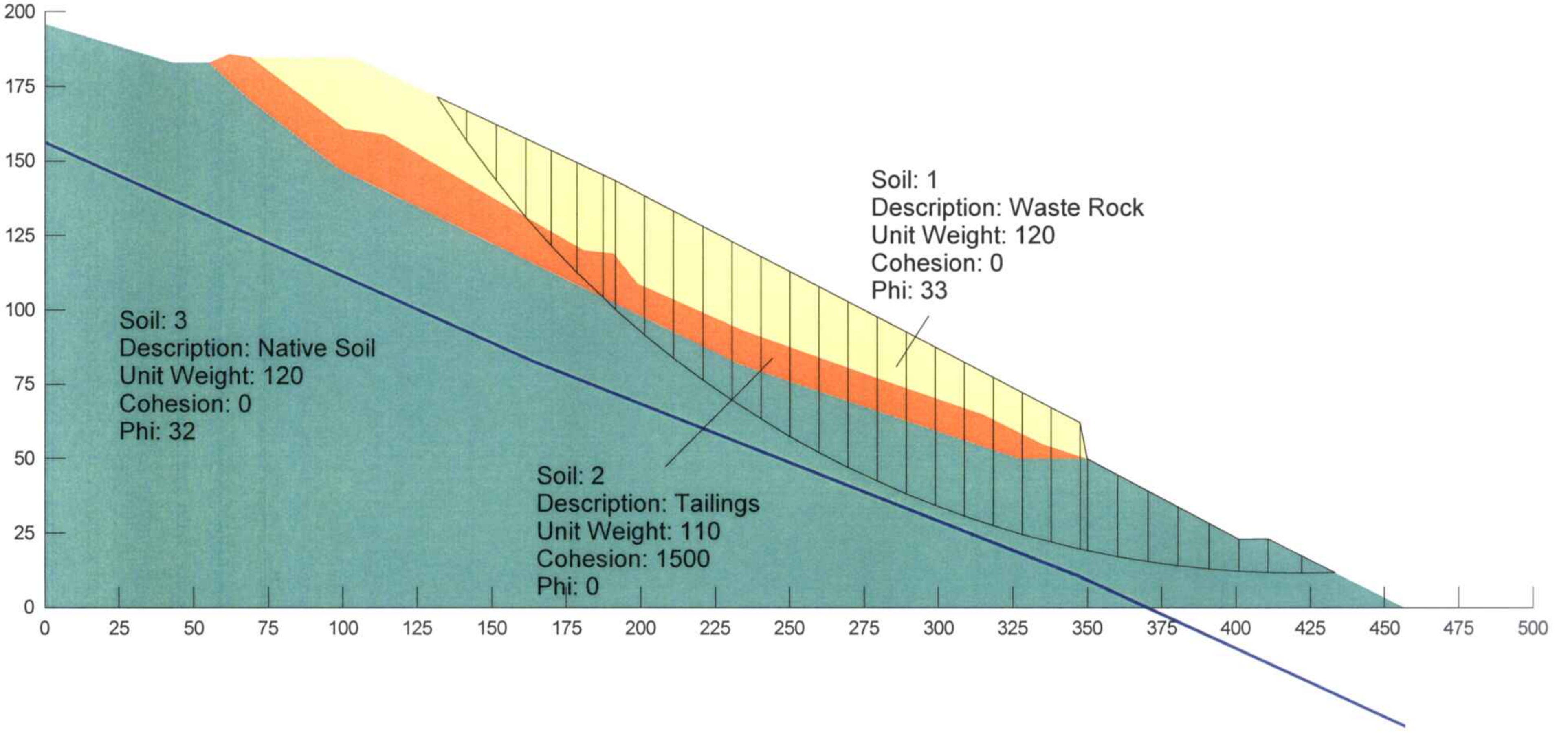
Description: Azurite Mine
Comments: Section 4, existing conditions
File Name: MFG_existingslope_seismic.slz
Seismic Coefficient: Horizontal
Safety Factor = 1.1



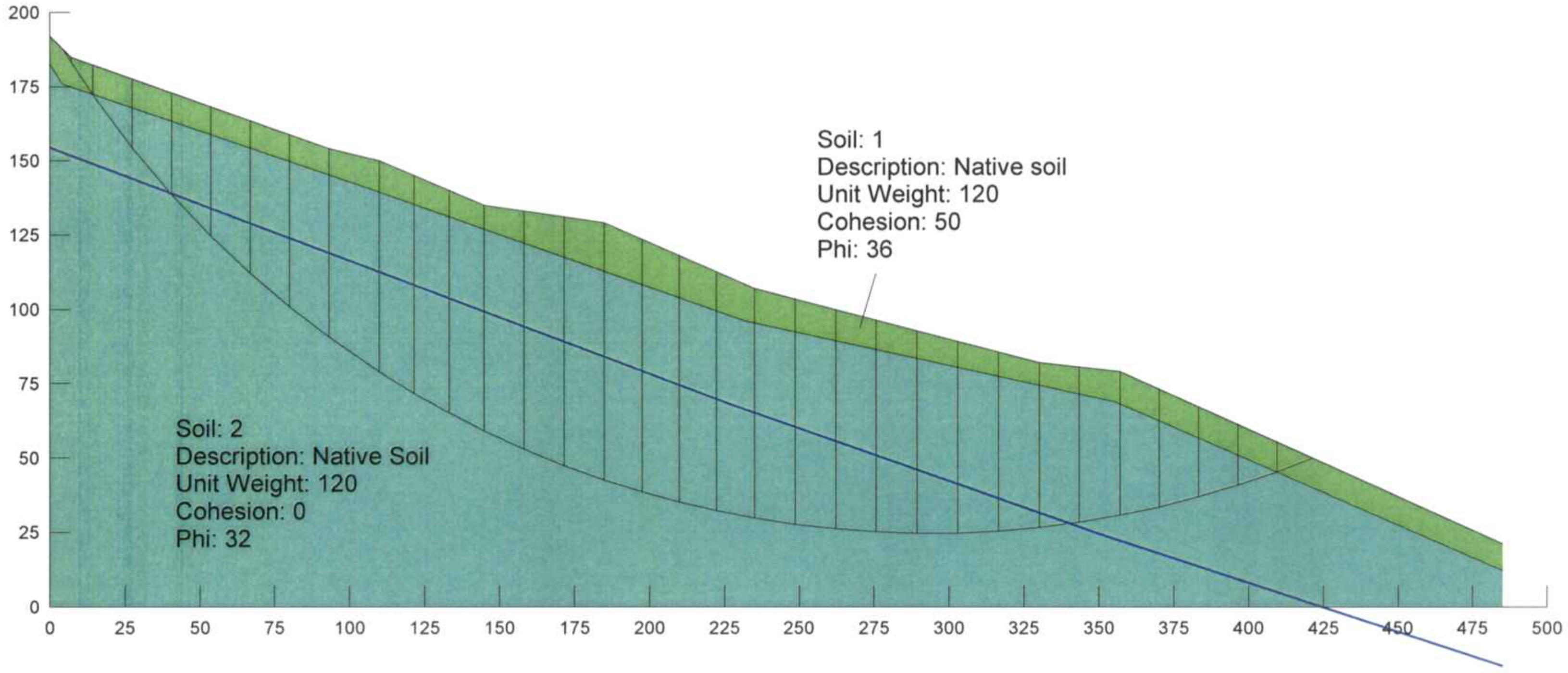
Description: Azurite Mine
Comments: Section 4, proposed waste rock placement
File Name: MFG_proposedwasterockplacement_static.slz
Seismic Coefficient: (none)
Safety Factor = 1.15



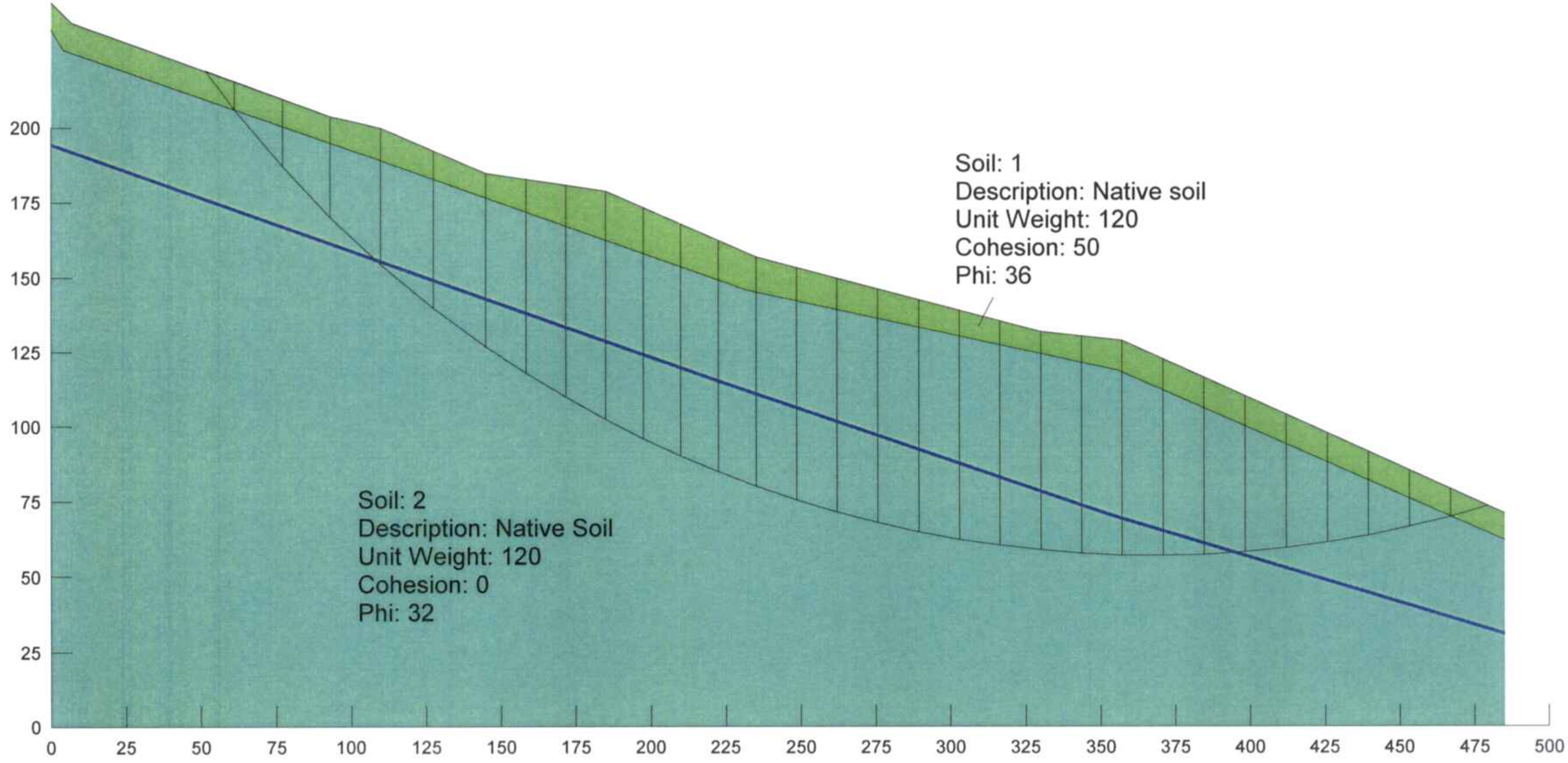
Description: Azurite Mine
Comments: Section 4, proposed waste rock placement
File Name: MFG_proposedwasterockplacement_seismic.slz
Seismic Coefficient: Horizontal
Safety Factor = 1.08



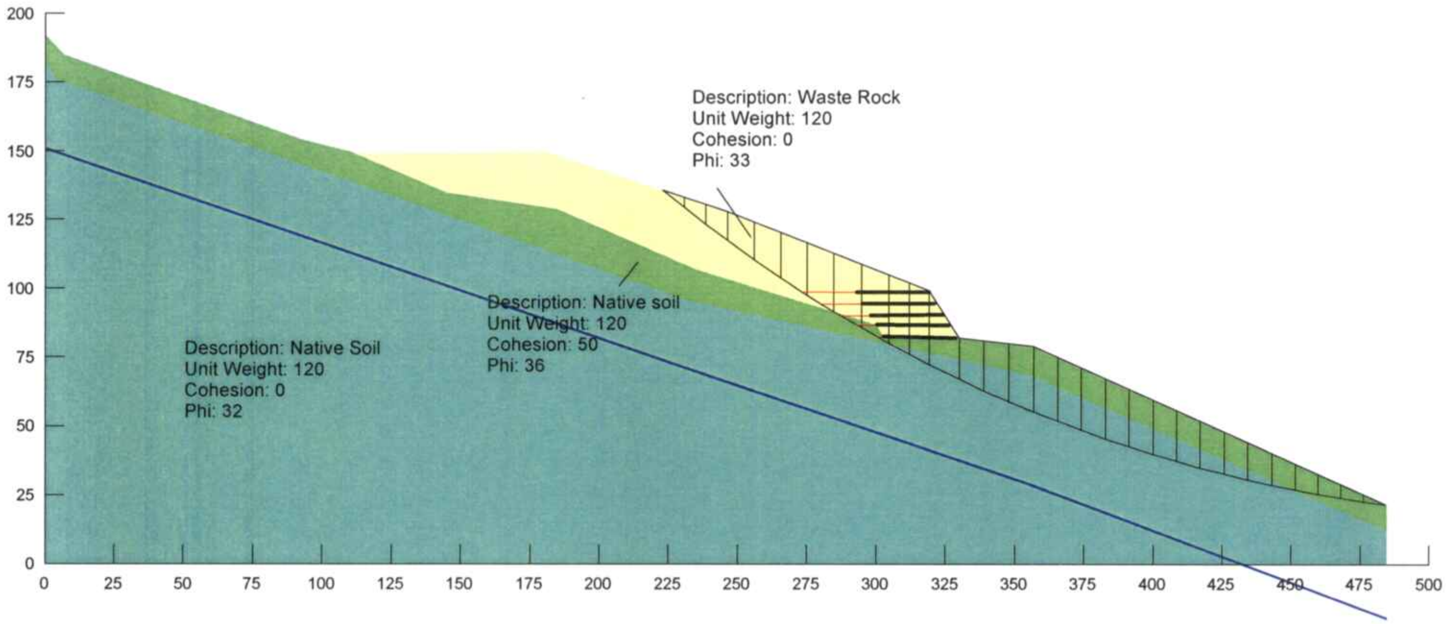
Description: Azurite Mine
Comments: Section 15, existing conditions
File Name: section15_existingslope_static.slz
Seismic Coefficient: (none)
Safety Factor = 2.2



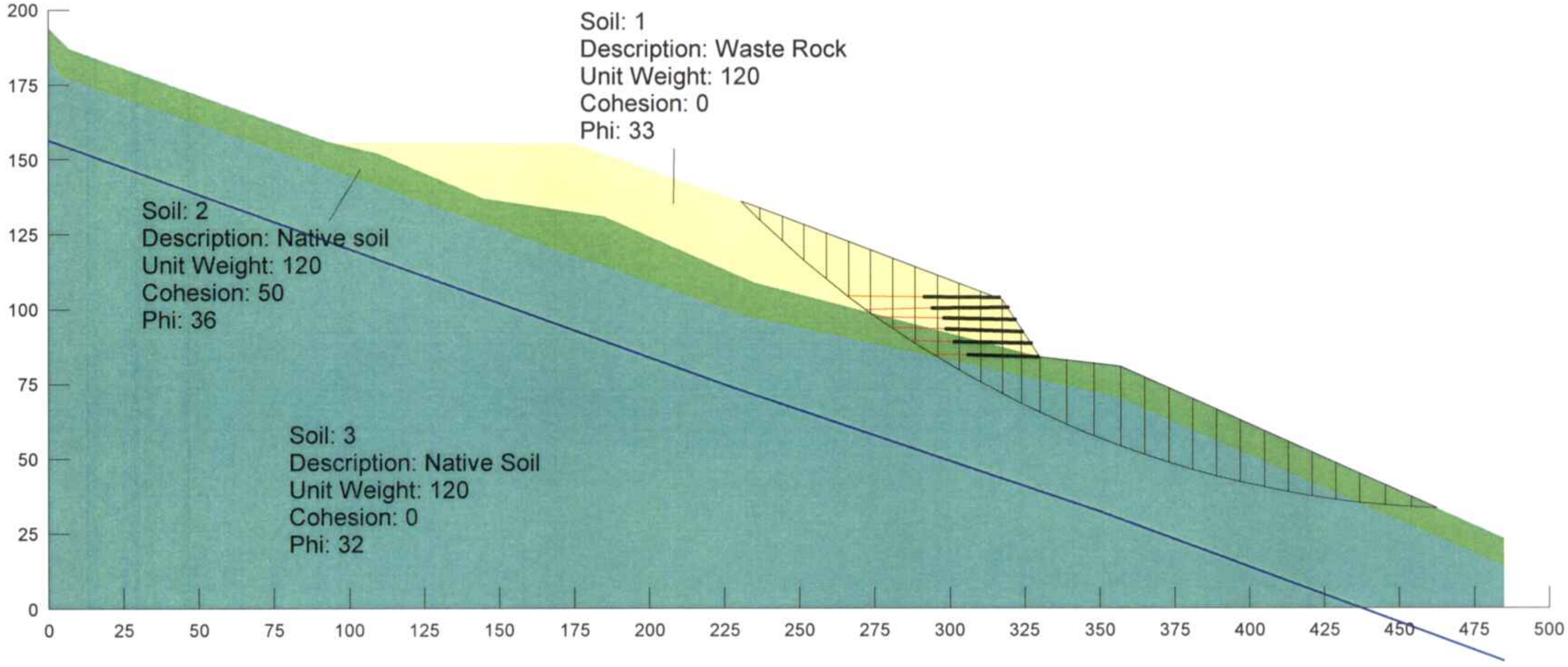
Description: Azurite Mine
Comments: Section 15, existing conditions
File Name: section15_existingslope_seismic.slz
Seismic Coefficient: Horizontal
safety Factor = 1.45



Description: Azurite Mine
Comments: Section 15, proposed waste rock placement
File Name: section15_proposedwasterockplacement_static.slz
Safety Factor = 1.5



Description: Azurite Mine
Comments: Section 15, proposed waste rock placement
File Name: section15_proposedwasterockplacement_seismic.slz
Seismic Coefficient: Horizontal
Safety Factor = 1.2



GEOENGINEERS

September 16, 2009

Cascade Earth Sciences, Inc.
12720 East Nora Avenue, Suite A
Spokane, Washington 99216

Attention: Dustin Wasley, PE

Subject: Supplemental Geotechnical Engineering Services
Azurite Mine
Mt. Baker-Snoqualmie National Forest
File No. 0347-076-02

INTRODUCTION AND PROJECT OVERVIEW

This letter transmits the results of our supplemental geotechnical engineering services during design of a low-permeability cover which will be part of the proposed remediation for disposal and capping of mine tailings and waste rock at the Azurite Mine site, herein referred to as the "Site". The Azurite Mine is located within the Mt. Baker-Snoqualmie National Forest in Whatcom County, Washington, approximately as shown on the Vicinity Map, Figure 1.

The Site is located within the Mill Creek drainage, a U-shaped glacial valley surrounded by rugged mountainous terrain. Two waste rock piles are located on the east-facing slopes of the drainage and encroach upon Mill Creek. The remains of the mill and a large tailings pile are located opposite of the waste rock piles on the east side of the creek. The approximate locations of the existing site features are shown on the Site Plan, Figure 2.

We previously completed slope stability analyses of the mine tailings and waste rock. Results of our analyses were presented in our December 20, 2007 report. Following completion of that report, we submitted a draft grading plan, cross-sections and details depicting our proposed recommendations for stockpiling, and capping tailings and waste rock at the site. The proposed grading plan, presented as Sheet 1 in Attachment A in this report, includes reconstructing the tailings pile with a series of benches and a protective cover. Proposed improvements include relocating the waste rock to the east side of Mill Creek and south of the tailings pile, and supporting the waste rock disposal slope with wrapped-face geogrid reinforcement. Please refer to Sheet 1 of the draft design drawings in Attachment A.

Following submittal of our December 20, 2007 report, we understand the United States Forest Service (USFS) requested additional design information regarding the low-permeability liner and overlying cover material. Our supplemental geotechnical engineering services were completed in general accordance with Cascade Earth Sciences (CES) authorization letter, dated August 12, 2009 and included:

1. Performing a slope stability analysis of a low-permeable cover and overlying cap material at the Azurite Mine.

SOIL COVER STABILITY ANALYSES

GENERAL

In our referenced report, our recommendations included benching the slope and constructing a low-permeability cover over the tailings and waste rock. The regrading process will involve constructing approximate 8-foot-wide benches spaced at approximate 25- to 30-foot horizontal intervals along the slope. The low-permeability cover will include a geomembrane, protective geotextile layer and soil consisting of talus or topsoil. A typical detail for the tailings and waste rock benching and cover is presented as Sheet 5 of our draft design drawings in Attachment A.

There are three main design issues with respect to stability of a lined slope: stability of the subgrade soil; pullout of the cover consisting of geomembrane, geotextile and soil; and adequate tensile strength of the geomembrane and geotextile (geosynthetic) layers. A summary of our analysis and results for our evaluation of slope stability, pullout and tensile strength is provided below.

SLOPE STABILITY

The slope stability analysis involves evaluating the factor of safety against shear failure along a critical failure surface. The driving force is the applied stress along the failure surface that results from body and surcharge forces. The resistance is provided by the cohesive and frictional strength of the soil and other materials along the failure surface. A deep-seated slope stability analysis was one element of our December 2007 report and is not discussed as part of our current analysis, which focuses on near-surface failures below the soil component of the cover.

We used the computer program Slope/W to analyze the stability of the proposed benched slopes. We evaluated the stability of the soil layer directly overlying the geosynthetic layers on a slope inclined at 2.5H:1V (horizontal to vertical). We also evaluated the same scenario with an additional 100 pounds per square foot (psf) snow load overlying the soil layer. The results of our slope stability analyses for static conditions are presented in Table 1 with supporting output files presented in Attachment B.

Table 1. Results of Slope Stability Analyses (rounded to nearest 0.05)

Condition	Factor of Safety
Soil Cover Only	1.85
Soil Cover Plus Snow Load	1.80

Ideally, acceptable stability factors typically are in the range of 1.4 to 1.5 for static conditions and diminish by roughly 0.1 to 0.3 for the seismic case. Because of the relatively high safety factors in Table 1, we did not complete a seismic stability analysis.

PULLOUT STABILITY

We evaluated the resistance of the geomembrane and geotextile against pullout. The pullout resistance on the geosynthetics is developed by the applied normal load of the soil layer above the geotextile that creates frictional resistance between the geomembrane and the underlying soil. We initially analyzed two possible pullout scenarios:

- Case 1 – Failure is caused by one or both layers of geosynthetics pulling out from the overlying soil component of the cover, or underlying tailings or waste rock.

- Case 2 – Failure is caused by one or both layers of geosynthetics moving down the slope along with the upper soil cover component.

Our analyses were completed based on the following assumptions:

- The friction angle between the geosynthetics is less than that between geosynthetics and overlying and underlying soil, and was used for design calculations.
- The geosynthetics extend along the full length of the slope bench and extend an additional 6 inches onto the upper slope, in accordance with the preliminary plans.
- A minimum of 2 feet of soil overlies the geosynthetics on the benched portions of the slope, in accordance with the preliminary plans.

On the basis of our initial analysis with an 8-foot-wide bench, we concluded that an inadequate safety factor (1.3) results for the Case 2 design condition. For this reason, we re-evaluated the pullout resistance using an approximate 2-foot-wide by 1-foot-deep anchor trench installed on each bench. We re-evaluated the resistance of the geosynthetics against pullout for the following three scenarios:

- Case 3 – Failure is caused by one or both layers of geosynthetics pulling out from the overlying soil component of the cover, or underlying tailings or waste rock.

- Case 4 – Failure includes mobilization of the passive soil wedge behind the anchor trench and causes one or both layers of the geosynthetic to slide along with the upper soil cover.

- Case 5 – Failure includes shearing of the soil behind the anchor trench and causes one or both layers of geosynthetics to slide along with the upper soil cover.

Soil and geosynthetic parameters and design calculations for Cases 1 through 5 are presented in Attachment C. The results of our pullout stability analyses are presented in Table 2.

Table 2. Results of Pullout Stability Analyses

Design Case	Anchor Trench	Factor of Safety
1	No	1.5
2	No	1.3
3	Yes	1.7
4	Yes	3.1
5	Yes	2.0

TENSILE STRENGTH

We also evaluated the required tensile strength of the geosynthetics by calculating the force that the soil cover and snow load imposes on the materials. Our analysis was completed based on the following assumptions:

- An approximate 1-foot-thick layer of talus will be placed directly on the geotextile layer, in accordance with the preliminary plans.

- Approximate 8-foot-wide benches will be spaced approximately 25 to 30 feet horizontally on-center, in accordance with the preliminary plans.
- A minimum 2-foot-high toe berm is located at the base of each slope, in accordance with the preliminary plans.
- The proposed slope will not exceed 2.5H:1V, in accordance with the preliminary plans.
- The snow cover will not exceed 10 feet.

Soil and geosynthetic parameters along with the design calculations are presented in Attachment C.

On the basis of our analysis, the geosynthetics will be required to withstand a tensile force of approximately 350 pounds per foot against sliding.

CONCLUSIONS AND RECOMMENDATIONS

On the basis of our design review and analysis, it is our opinion that the proposed benching and multi-layer cover are suitable for a slope inclination on the order on 2.5H:1V provided anchor trenches beneath each bench are incorporated into the final design. The anchor trench should consist of a minimum 2-foot-wide by 1-foot-deep excavation into the undisturbed tailings unit. The manufacturer’s criteria for anchoring should be used if they are more stringent than this recommendation. In addition, in order to fully mobilize the shear resistance of the anchor trench, it is imperative that the trench be set back a minimum of 2 feet into undisturbed tailings.

Our analyses include a factor of safety exceeding 1.5 for slope stability and 2 for pullout resistance. If greater safety factors are required for any of the design cases, we recommend increased-dimensions for the toe berm trench key, or reduced slope inclination be evaluated.

On the basis of our tensile strength analysis, we estimated that an allowable tensile strength of 350 pounds per foot is required. However, we estimate a maximum tensile force of 1,250 pounds per foot could be transferred through geosynthetics during the pullout design condition. Therefore, we recommend a tensile strength of 1,250 pounds per foot be specified for the geosynthetic materials. This tensile strength is an ultimate strength and is based on a safety factor of 1.5 applied to the driving force.

In addition, the tensile strength relative to strain also must be considered when specifying geosynthetics. Prior to approval of the draft design concept and during the plans and specifications development, we should be consulted to assess the appropriate allowable strain as a function of tensile strength.

We trust this information meets your present needs. Please contact the undersigned should you have any questions regarding the contents of this letter or if you require additional information.

Sincerely,

GeoEngineers, Inc.

David R. Lauder, PE
Project Geotechnical Engineer

Teresa A. Dugger

Teresa A. Dugger, PE
Senior Geotechnical Engineer

TERESA ANN DUGGER
37984
9/16/09

James B. Harakas, PE, LEG
Senior Principal

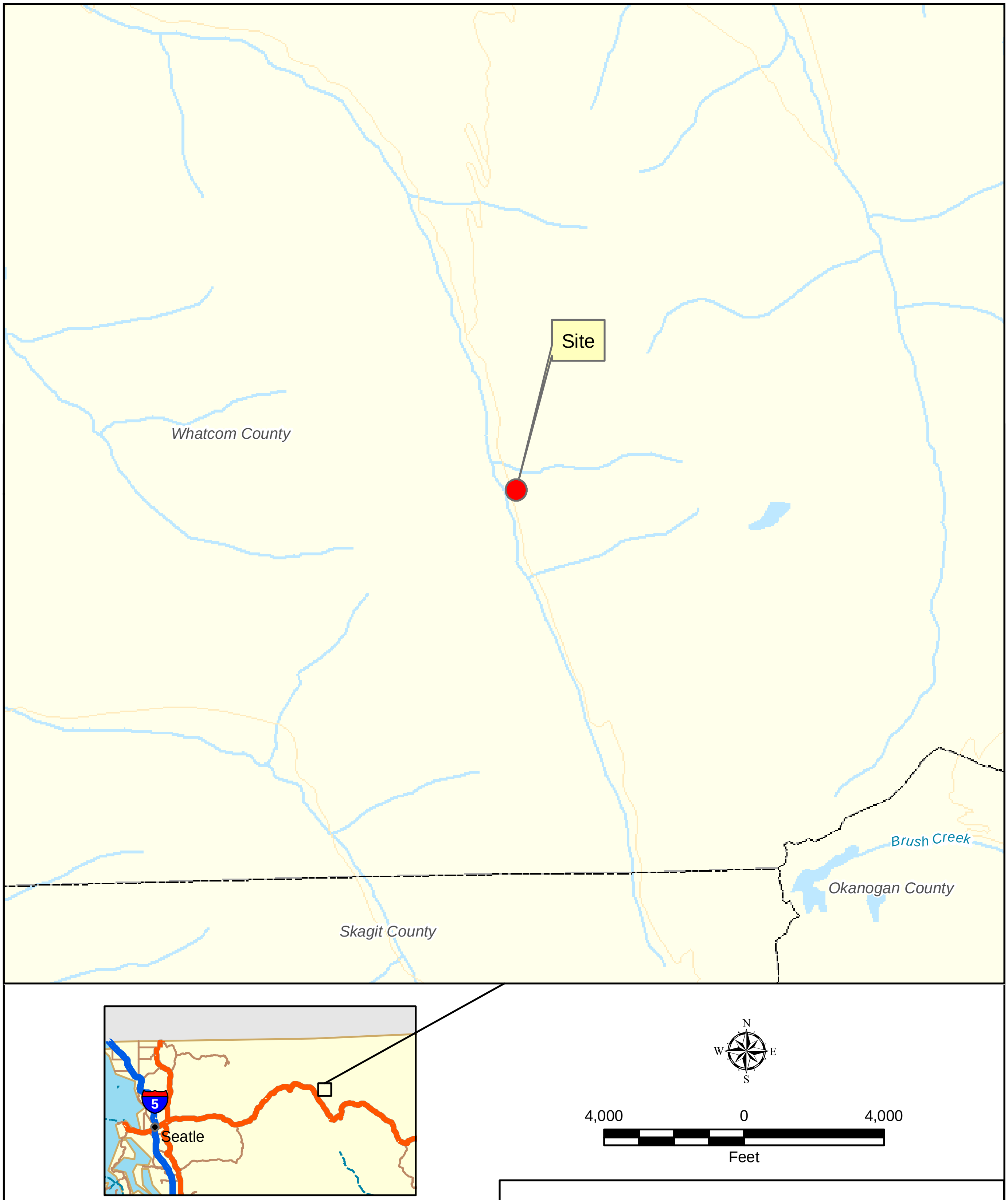
DRL:TAD:JBH:tlm
Spok:\\P:\0\0347076\02\Finals\034707602ltr_1.doc

Attachments:

Figure 1 – Vicinity Map
Figure 2 - Site Plan

Attachment A –Grading Plan (Sheet 1) and Details (Sheet 5) "Draft"
Attachment B – Slope/W Computer Output
Attachment C – Hand Calculations for Pullout and Tensile Resistance

Map Revised: December 19, 2007



Vicinity Map

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

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Figure 1

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
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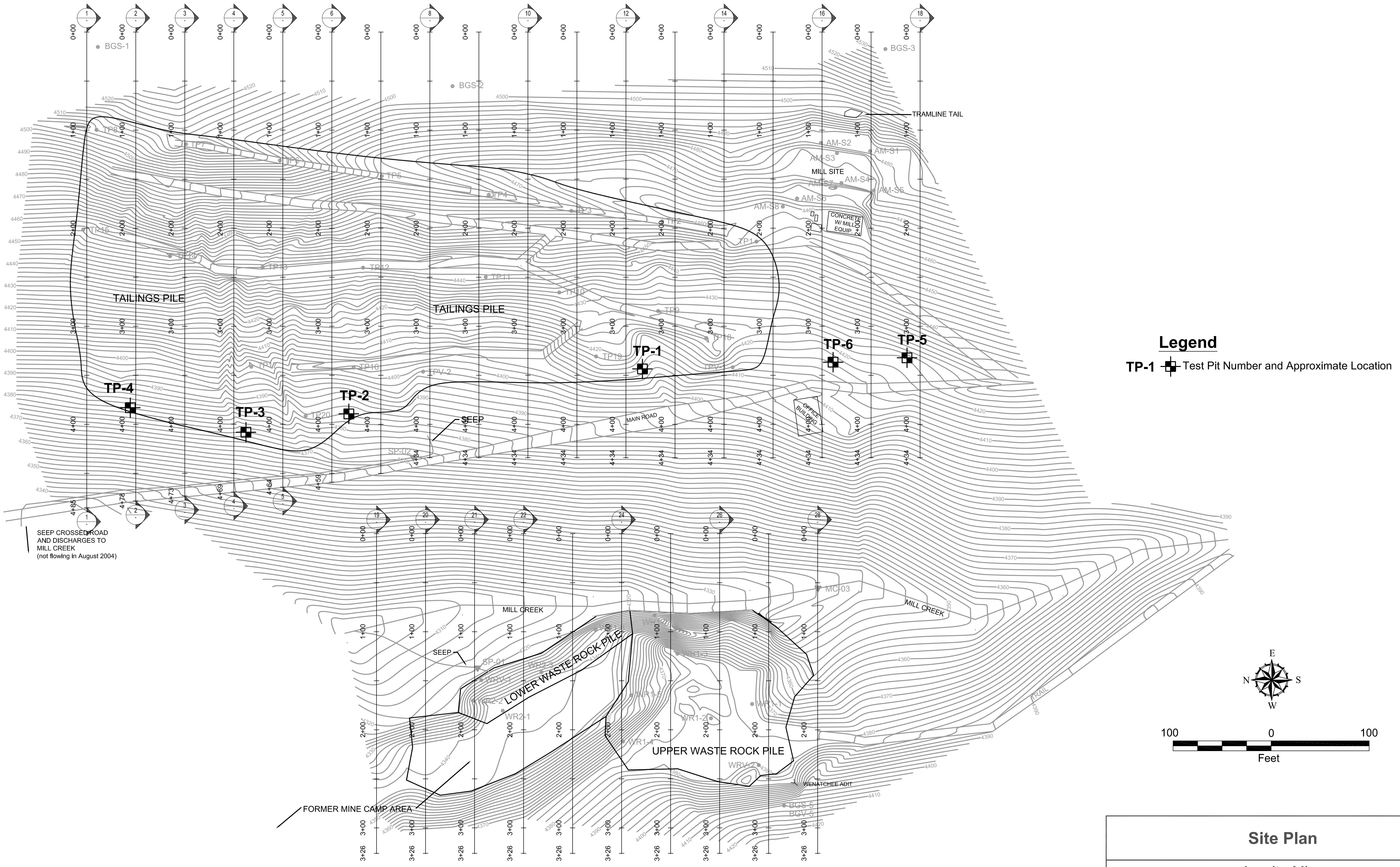
Data Sources: ESRI Data & Maps, Street Maps 2005

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

Office: SPOK Path: P:\00\0347076\02\GIS\MXDs\034707602Figure1.mxd



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Drawing provided by Cascade Earth Sciences titled "Azurite Minae, Site Inspection" dated 2/7/05.

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Site Plan

Azurite Mine
Mt. Baker-Snoqualmie National Forest, Washington

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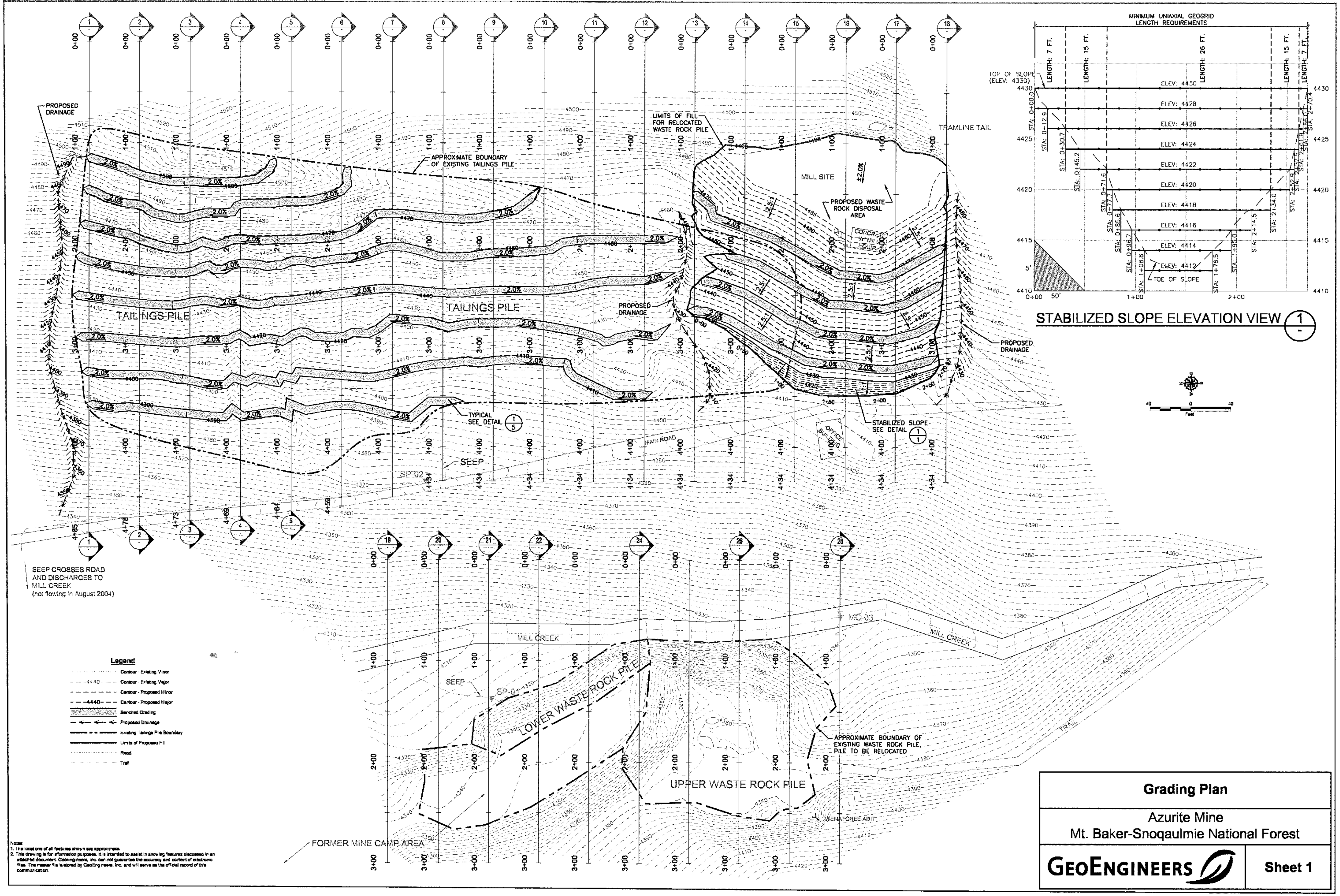
Figure 2

ATTACHMENT A

GRADING PLAN (SHEET 1) AND DETAILS (SHEET 5)

"DRAFT"

DRAFT



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Grading Plan

Azurite Mine
Mt. Baker-Snoqaulmie National Forest

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Sheet 1

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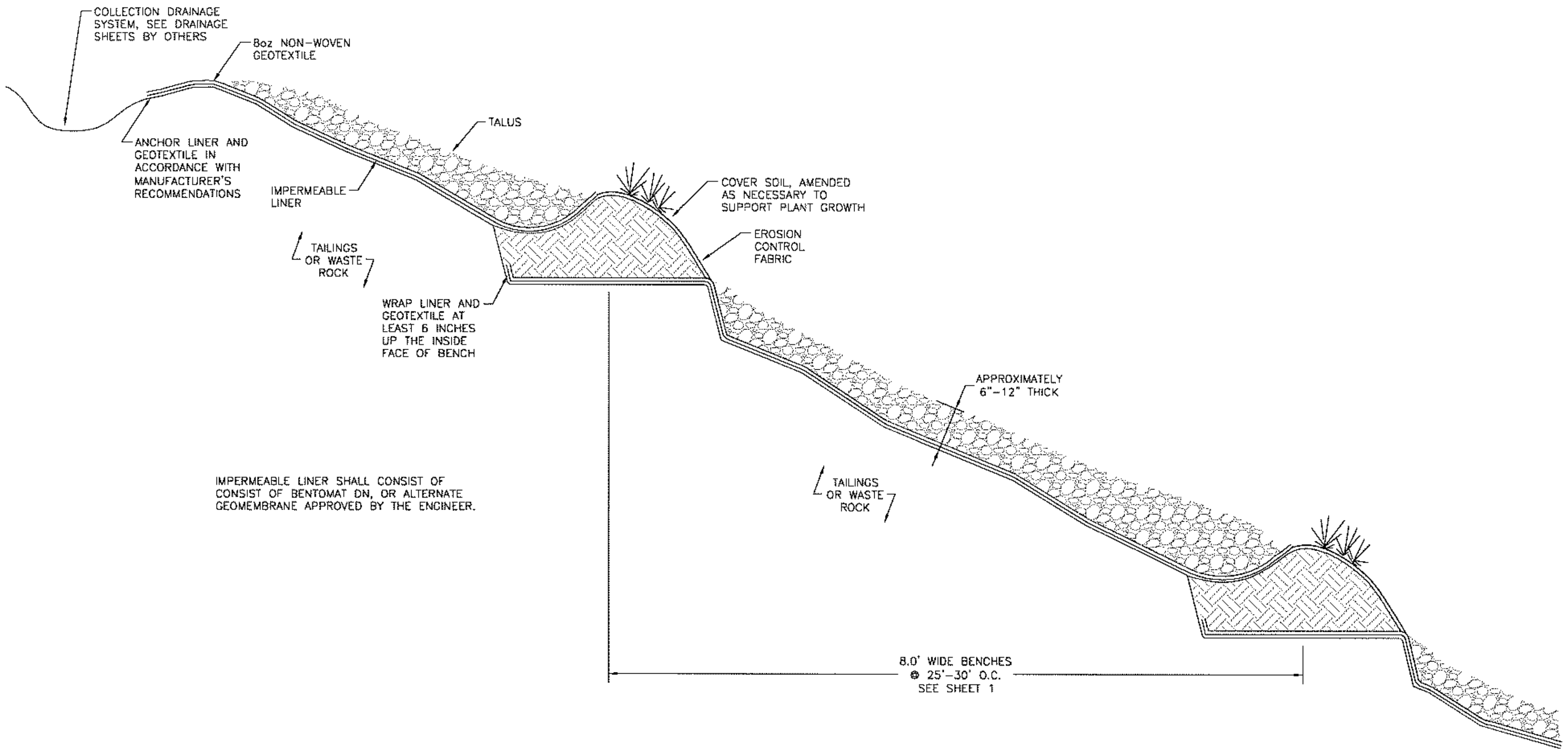
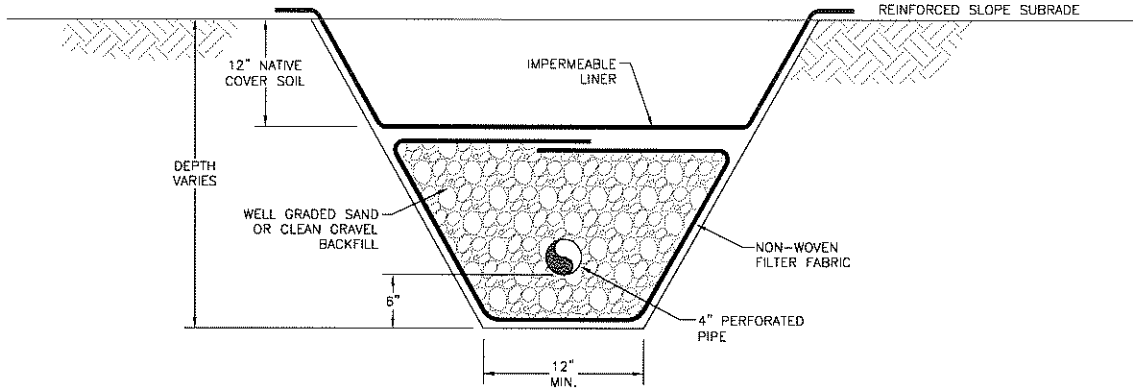


IMPERMEABLE LINER SHALL CONSIST OF CONSIST OF BENTOMAT DN, OR ALTERNATE GEOMEMBRANE APPROVED BY THE ENGINEER.

TYPICAL BENCHING & COVER DETAIL FOR SOIL COVER OVER TAILINGS & WASTE ROCK DISPOSAL AREA (1/5)
NOT TO SCALE



INTERCEPTOR DRAIN BELOW REINFORCED SLOPE SUGRADE (2/5)
NOT TO SCALE

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Details

Azurite Mine
Mt. Baker-Snoqaulmie National Forest

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Sheet 5

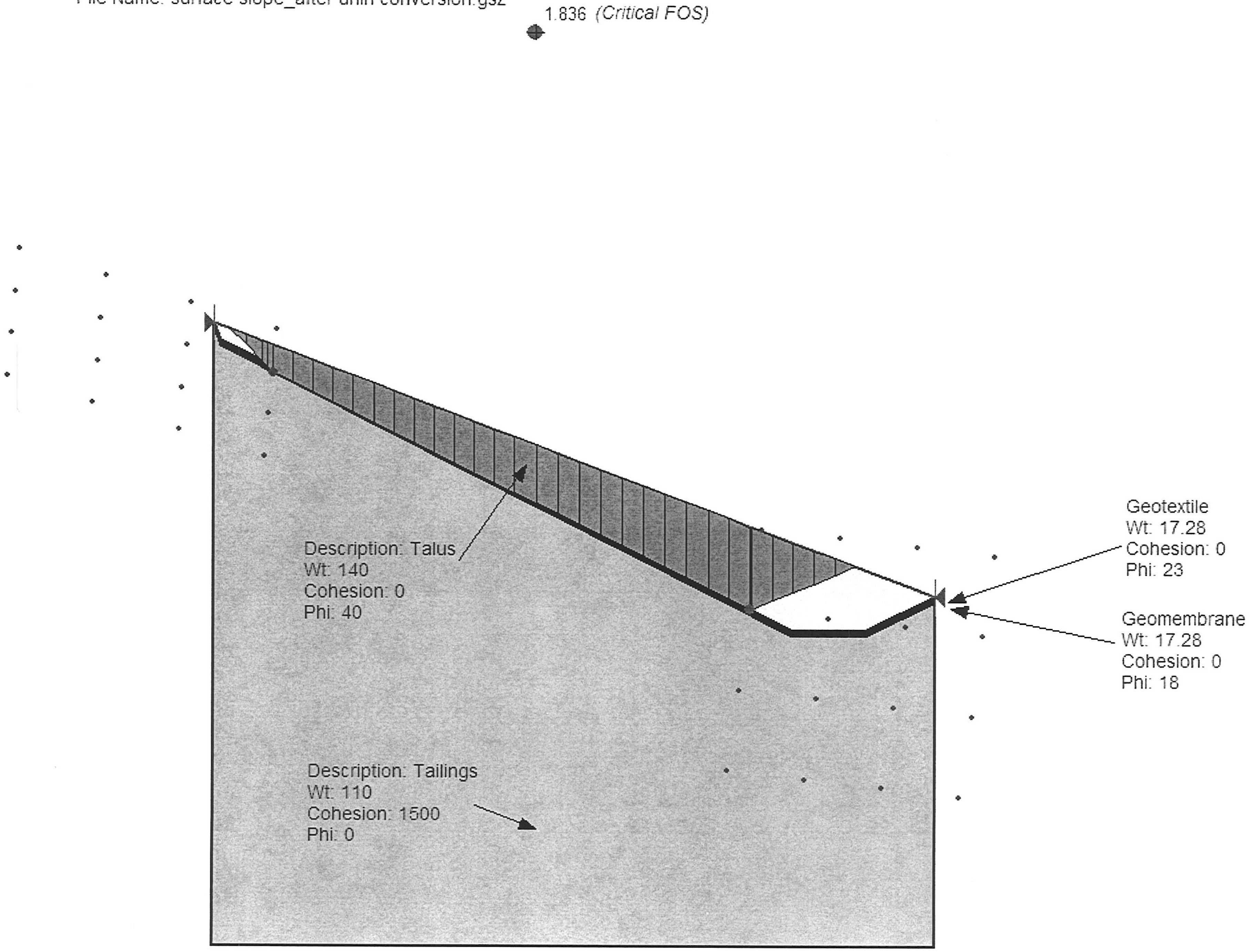
ATTACHMENT B

SLOPE/W COMPUTER OUTPUT

Project Name : Azurite Mine (0347-076-02)

Comment : Surface Slope

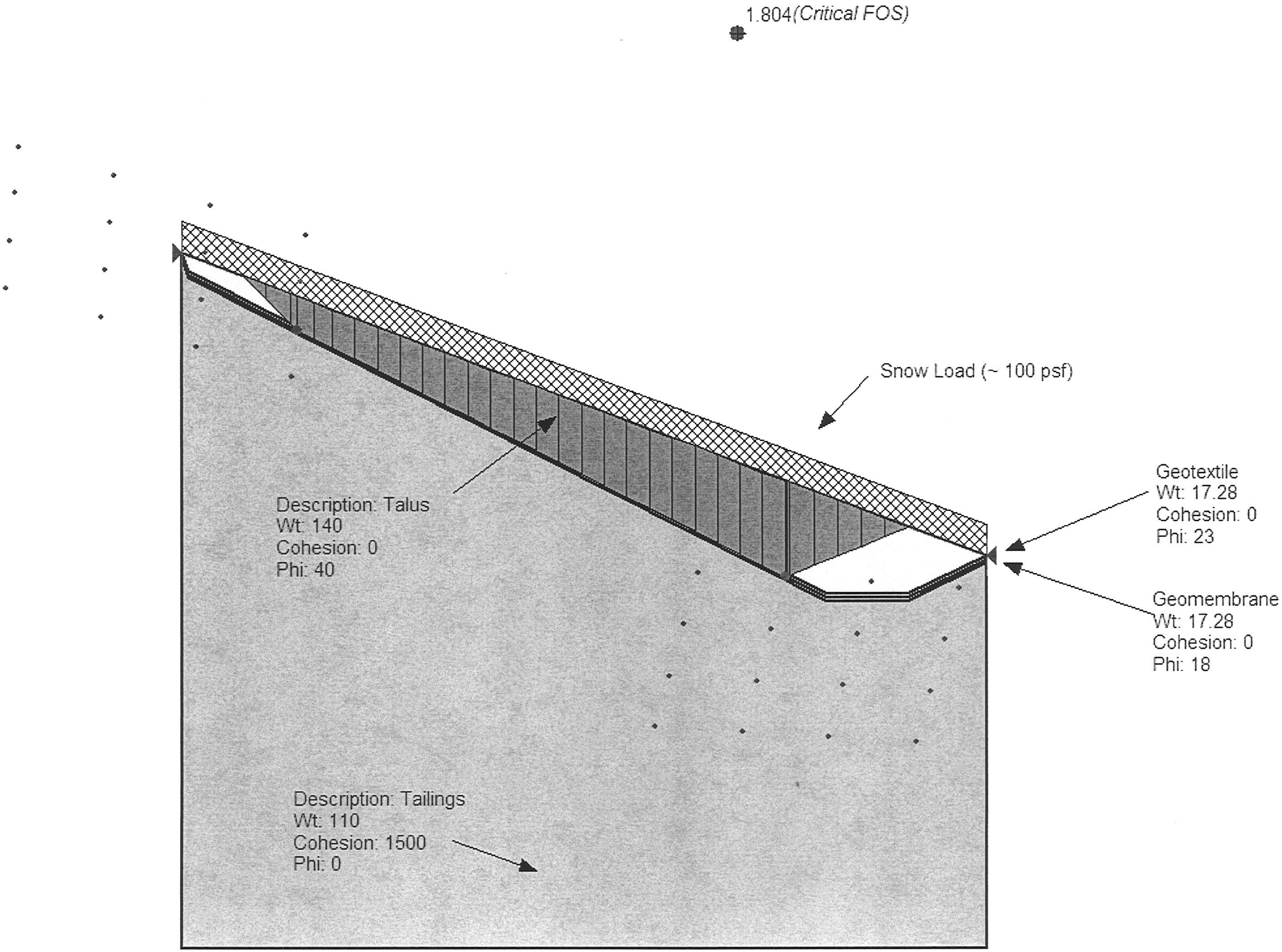
File Name: surface slope_after unin conversion.gsz



Project Name : Azurite Mine (0347-076-02)

Comment : Surface Slope - Snow Load

File Name: surface slope_snow load_after unin conversion.gsz

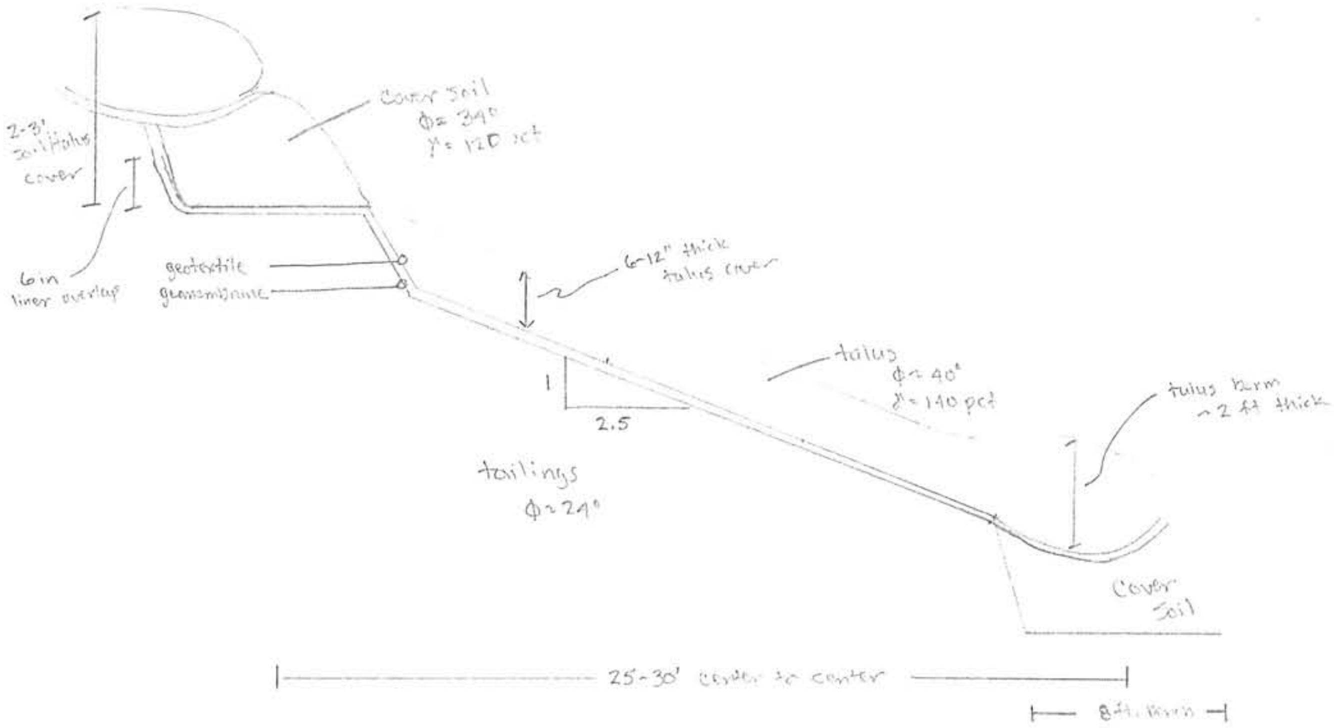


ATTACHMENT C

HAND CALCULATIONS FOR PULLOUT AND TENSILE RESISTANCE

project Azurite Mine project no. 0347-076-02

by TAD date 9/9/09 sheet 1 of 8 checked by DRL



Soil to geomembrane friction angle (Martin, Koerner & Whitty,

- soft, flexible, smooth membrane to tailings, $\delta = 24^\circ$

Soil to geotextile friction angle

- non-woven geotextile to talus, $\delta = 26^\circ - 30^\circ$
- woven geotextile to talus, $\delta = 24^\circ - 26^\circ$

Geotextile to geomembrane friction angle

- soft, flexible, smooth membrane to non-woven geot, $\delta = 18^\circ - 23^\circ$
- soft, flexible, smooth membrane to woven geot, $\delta = 17^\circ - 21^\circ$

project Azurite Mine project no. 0347-076-02

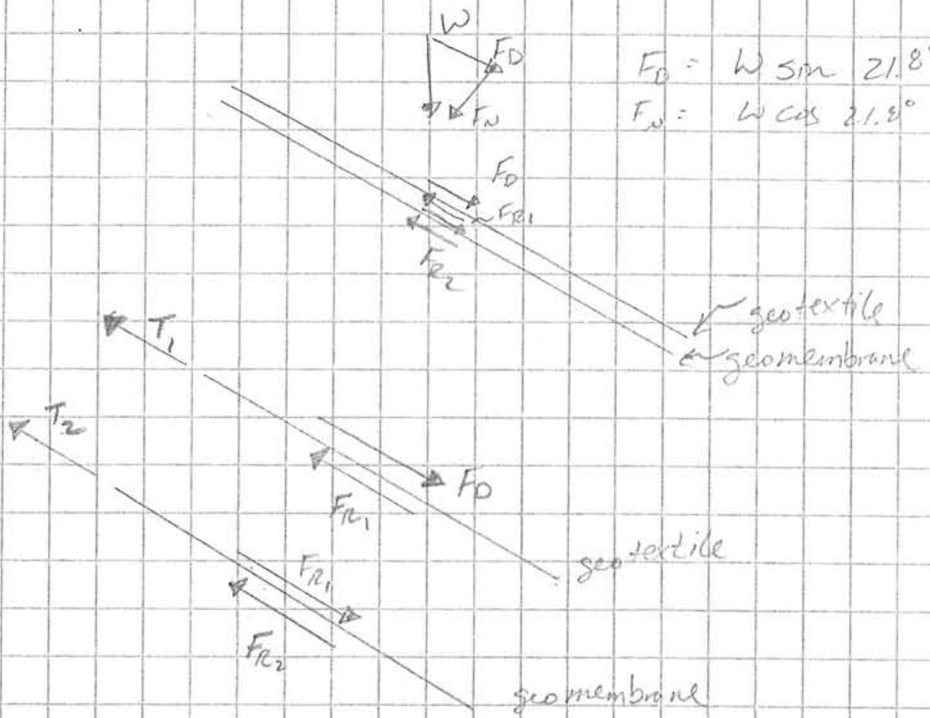
by TAD date 9/14/09 sheet 2 of 8 checked by DRL

PULLOUT RESISTANCE

MAXIMUM DRIVING FORCE

$F_D = W \sin 21.8°$

$F_N = W \cos 21.8°$



* assume max. driving length = 20 ft

$F_{R_2} = W \cos 21.8° \tan 24° =$

$= (140)(1 \text{ ft.})(20) \cos 21.8° \tan 24° = 1157.5$ lb/ft (cover) ✓

$(100)(20) \cos 21.8° \tan 24° = 826.8$ lb/ft (snow) ✓

$\underline{F_{R_2} = 1157.5 + 826.8 = 1984.3 \text{ lb/ft}}$ ✓

$F_{R_1} = (140)(1 \text{ ft.})(20) \cos 21.8° \tan 18° = 844.7$ lb/ft (cover) ✓

$(100)(20) \cos 21.8° \tan 18° = 603.4$ lb/ft ✓ (snow)

- tension in geomembrane if tailings are saturated

$F_{R_1} = \underline{844.7 + 603.4 = 1448.1}$ lb/ft ✓

$F_D = (140)(1 \text{ ft})(20) \sin 21.8° = 1039.8$ lb/ft ✓

$(100)(20) \sin 21.8° = 742.7$ lb/ft ✓

$\underline{F_D = 1039.8 + 742.7 = 1782.6}$ lb/ft ✓

$T_1 = F_D - F_{R_1} = 1782.6 - 1448.1 = 334.5$ lb/ft

project Azurite Mine project no. 0347-076-02

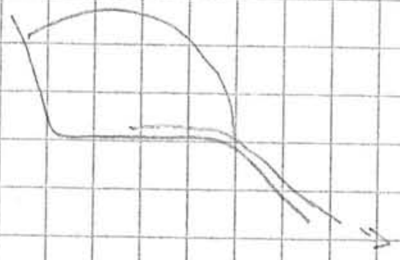
by TAD date 09/9/09 sheet 3 of 8 checked by DRL

RESISTANCE AGAINST PULLOUT

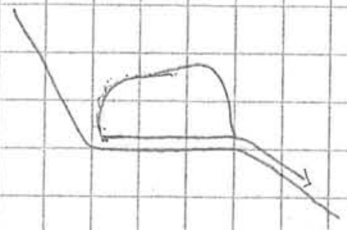
2 CASES : 1: SLIPPAGE OF MEMBRANE /GEOTEXTILE BETWEEN SOIL

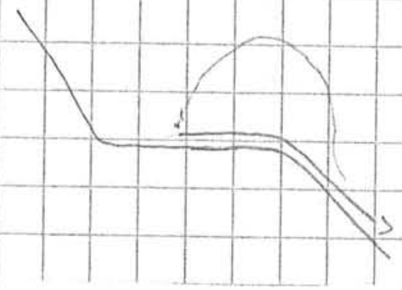
2: SLIDING OF MEMBRANE /GEOTEXTILE ALONG W/ COVER SOIL

CASE 1:



CASE 2:





Case 1:

$F_1 = W k_o \cdot 2 \tan \delta$ $K_o = 1 - \sin \phi = 1 - \sin 34° = 0.44°$

$F_1 = [(2ft)(120pcf)(0.5ft)(0.44)] \times 2 \tan 18°$

$= 34$ lb/ft.

$F_2 = W \times 2 \tan \delta$

$= (120 pcf)(2')(8') \times 2 \tan 18° = 1,247$ lb/ft

Resisting Force Pullout $= F_1 + F_2 = 34 + 1247$ lb/ft $= 1281$ lb/ft

- does not include snow load - sl. conservative

$$SF = \frac{F_{R1} + F_P}{F_D} = \frac{1448.1 + 1281}{1782.6} = 1.53$$

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project Azurite Mine project no. 0347-076-02

by TAD date 09/09/09 sheet 4 of 8 checked by DRL

Case 2:

$F_1 = 0$

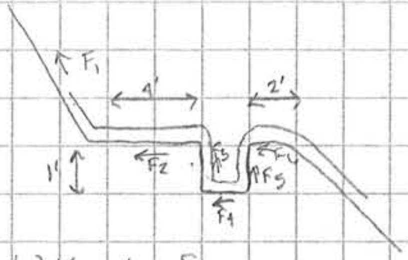
$F_2 = (2')(120\,pcf)(8') \times \tan 18° = 623\ lb/ft.$

$F_{2(max)} = (100\,psf)(8') \times \tan 18° = 260\ lb/ft.$

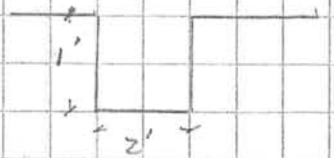
$$SF = \frac{F_{R_1} + F_2}{F_D} = \frac{1448.1 + 883\,lb/ft}{1782.6} = 1.3$$

- too low
- create anchor trench

CASE 3:



Anchor Trench Dimensions



$F_1 = W K_o z \tan \delta$ $K_o = 1 - \sin \phi = 1 - \sin 34° = 0.44$

$F_1 = [(2)(120)(0.5)(0.44)] \times 2 \tan 18°$

$F_1 = 34\ lb/ft$ ✓

$F_2 = W \times 2 \tan \delta$

$= (120)(2)(4) \times 2 \tan 18° = 623.8\ lb/ft$ ✓

$F_5 = F_3 = W K_o\ 2 \tan \delta$

$= [(3)(120)(0.44)] \times 2 \tan 18° = 103\ lb/ft$ ✓

$F_4 = W \times 2 \tan \delta$

$= (120 \cdot 2ft \cdot 3ft) \times 2 \tan 18° = 467.9\ lb/ft$ ✓

$F_6 = W \times 2 \tan \delta = 2(120)(\underset{avg.\ ht}{1.5'}) \times 2 \tan 18° = 233.9\ lb/ft.$ ✓

project Azurite Mine project no. 0347-076-02

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Case 3 - Cont' $F_P = 1.0 \cdot F_G = 1565.6$ lb/ft ✓

Resistance to pullout - Case 1

$$S.F. = \frac{F_R + F_P}{F_D} = \frac{1448.1 + 1565.6}{1782.6} = 1.69$$ ✓

- 1.69 is conservative
  - * snow load not used for Fp
  - * assumed $\delta = 18°$ for both sides (not true soil could be up to 24°)

- add snow load.

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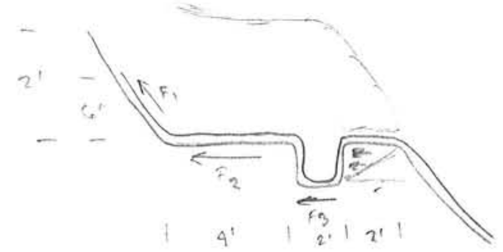
Case 4 - Shear failure passive soil wedge



$F_1 = 0$

$F_2 = (2')(120\ pcf)(4') \times \tan 18° = 311.9$ lb/ft ✓

$F_3 = (3')(120\ pcf)(2') \times \tan 18° = 233.9$ lb/ft ✓

$F_P = \frac{1}{2}\gamma H^2 + 2cH$

$= \frac{1}{2}(120\ pcf)(3 ft)^2 + 2\ (1500\ psf)(1 ft)$

$= 3,540$ lb/ft ✓ $F_P = 311.9 + 233.9 + 3,540 = 4,085.8$ lb/ft

Continuation for sliding case 2 :

$$\frac{F_{R1} + F_P}{F_D} = \frac{1446.1\ lb/ft + 4,085.8\ lb/ft}{1782.6} = 3.1$$ ✓

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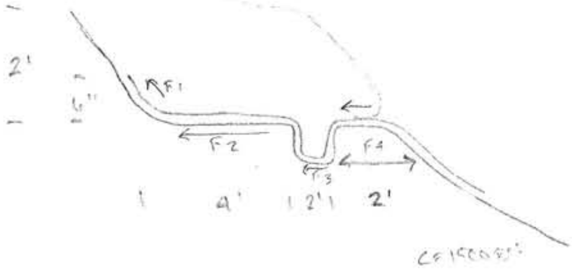
Case 5 -



$F_1 = 0$

$F_2 = [2'(120\ pcf)(4')] \times \tan 18° =$ 311.9 lb/ft ✓

[illegible]

$F_3 = [3'(120\ pcf)(2')] \times \tan 18° =$ 233.9 lb/ft (233.9) ✓

$F_4 =$ 1500 psf × 1 ft = 1,500 lb/ft ✓ (Rely on 1 ft)

$F_P =$ 311.9 lb/ft + 233.9 lb/ft + 1,500 lb/ft = 2,046 lb/ft ✓

Resistance to vertical force 3

$\dfrac{\Sigma R_s + F_P}{F_D} = \dfrac{1448.1\ lb/ft + 2{,}046\ lb/ft}{1752.6\ lb/ft} =$ 1.96 lb/ft ✓

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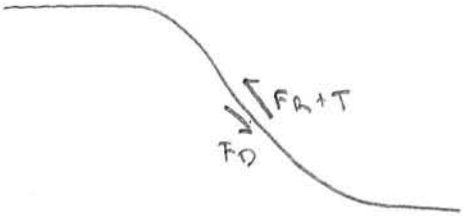
by TAR date 9/15/04 sheet 8 of 8 checked by

Max. tensile force in geotextile

$F_D = 1782.6$ lb/ft
$F_{R_1} = 1448.1$ lb/ft
} Snow load condition



$$SF = \frac{F_{R_1} + T}{F_D}$$

for SF = 1.0 $1.0 = \frac{1448.1 + T}{1782.6}$ T = 334.5 lb/ft
(28 ppi)

for SF = 1.5 $1.5 = \frac{1448.1 + T}{1782.6}$ T = 1,225.8 lb/ft

GeoEngineers
523 East Second Avenue
Spokane, Washington 99202
509.363.3125

January 18, 2011

Cascade Earth Sciences
12720 East Nora Avenue, Suite A
Spokane, Washington 99216

Attention: Dustin Wasley, PE

Subject: Geotechnical Engineering Services
Azurite Mine
Mt. Baker-Snoqualmie National Forest
File No. 0347-076-02

INTRODUCTION

This letter transmits supplemental recommendations for site grading and geotextile specifications in support of the design of capping of mine tailings and waste rock at the Azurite Mine site, herein referred to as the “site”. This project was the subject of a previous letter report by GeoEngineers, the results of which are presented in our reports dated December 19, 2007, April 9, 2010, and preliminary plans.

We understand that since submittal of our report and preliminary plans, the project now will involve placing an approximate 5-foot-thick layer of waste rock (where existing site grades allow) across the existing tailings pile, and elimination of the planned reinforced slope to the south of the tailings pile as the main waste rock repository. The supplemental recommendations contained in this letter are based on completion of stability evaluations of the liner/cap veneer stability, and assumed interface friction properties of the liner fabrics, cover soil and subgrade.

RECOMMENADITONS

We recommend the following parameters be used in designing grading plans for the tailings pile/waste rock repository.

- Maximum slope inclinations of 2.5H:1V (horizontal to vertical) should be utilized for most of the site. A maximum slope inclination of 2H:1V may be used within the northeast portion of the tailings pile where current slopes are inclined steeper than 2H:1V. The intent of this recommendation is to reduce the amount of earthwork and cutting into the currently stable tailings pile. In our opinion, maintaining a steeper slope inclination over a relatively short slope length will be more practical than completing significant earthwork within the tailings pile. However, we recommend that some additional explorations be completed within the upper (steep) portion of the tailings pile before earthwork is completed in order to assess the condition of the tailings.

- For 2.5H:1V slopes, we recommend constructing benches along the slopes at approximate 30 foot intervals (i.e. a 30-foot slope length measured from the back of one bench to the face of the next bench). For 2H:1V slopes, we recommend constructing benches along the slope at approximate 20 foot intervals. The benches should be about 8 feet wide. The purpose of the benches will be to assist the contractor in placing cover soil, and to provide buttresses of cover soil (talus) along the slope face to provide anchorage trenches for geotextile, geomembrane and geogrid. These buttresses and anchorage trenches will provide stability for the cap (cover soil, geogrid, getoextiles and geomembrane.
- We recommend that soil intended as cover material over the tailings pile be placed in maximum 12-inch thick loose lifts and compacted to at least 90 percent of maximum dry density based on the ASTM International (ASTM D 1557) laboratory test procedure. The actual lift thickness may be adjusted in the field based on compaction test results, and requirements to protect underlying geotextiles. Cover soil (talus) placed above the line should not be compacted.
- We recommend that a three or four layer system of geosynthetics be utilized for the cap. This includes: a lower geotextile fabric to provide a cushion between the sugrade soil (tailings and waste rock) and the geomembrane; a low-permeability geomembrane; an upper layer of geotextile fabric to provide a cushion between the geomembrane and the cover soil (talus); and a layer of uniaxial geogrid to provide tensile strength to support the cover soil. The geogrid layer may be omitted if the upper geotextile fabric meets the specifications provided herein for geogrid.
- We recommend that the geotextile fabric meet the specifications presented in Table 1:

TABLE 1 RECOMMENDED GEOTEXTILE FABRIC SPECIFICATIONS

Property	Unit	Minimum Average Roll Value (MARV)
Grab Tensile Strength (ASTM D 4632)	Lbs	300
Trapezoidal Tear Strength (ASTM D 4533)	Lbs.	115
Puncture Resistance (ASTM D 6241)	Lbs.	800
Apparent Opening Size (AOS)	U.S. Sieve	U.S. No. 30 max
Permittivity (ASTM D 4491)	Sec-1	0.02 min
UV Resistance (ASTM D 4355)	% Strength Retained	70%

For reference, Mirafi 1120N 12 oz. non-woven fabric meets these specifications.

- We recommend that geogrid meet the specifications presented in Table 2:

TABLE 2 RECOMMENDED GEOGRID FABRIC SPECIFICATIONS

Property	Unit	Minimum Average Roll Value (MARV)*
Long-Term Design Strength (LTDS) (GRI GG4-MD)	(lb/ft)	3,100

* Based on a creep reduction factor (RF_{CR}) for 10% strain, and installation damage reduction factor (RF_{ID}) for crushed gravel)

For reference, Tensar UX1600, Synteen SF65 and Miragrid 7XT meet these specifications.

- We recommend that the geomembrane meet the specifications presented in Table 3:

TABLE 3 RECOMMENDED GEOMEMBRANE FABRIC SPECIFICATIONS

Property	Unit	Minimum Average Roll Value (MARV)
Thickness (ASTM D 5994)	Mils	40
Tensile Strength at yield (ASTM D 6693)	Lb/in	120
Tensile Strength at break (ASTM D 6693)	Lb/in	80
Elongation at yield (ASTM D 6693)	%	11 (minimum)
Elongation at break (ASTM D 6693)	%	50 (minimum)
Tear Resistance (ASTM D 1004)	Lb	40
Puncture Resistance (ASTM D 4833)	Lb	100

- Finally, we recommend that interface shear testing be completed by a qualified laboratory to estimate the interface friction angles between the component cap materials after the final products have been selected in order to evaluate the stability of the selected materials at the planned slope inclinations before construction commences.

We trust this information meets your present needs. Please contact the undersigned should you have any questions regarding the contents of this letter or if you require additional information.

Sincerely,

GeoEngineers, Inc.

David R. Lauder, PE
Senior Geotechnical Engineer

James B. Harakas, PE, LEG
Senior Principal

DAVID RYAN LAUDER
STATE OF WASHINGTON
42304
REGISTERED PROFESSIONAL ENGINEER
1/18/11

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www.geoengineers.com

FILE

Letter of Transmittal

To: Cascade Earth Sciences
12720 E. Nora Ave., Ste A
Spokane, Washington 99216

Attention: Dustin Wasley

Date: 02/09/11

File: 0347-076-02

Regarding: Azurite Tailings pile, cover stability calculations

We are sending: ☒ Attached ☐ Under Separate Cover

Copies	Date	Description
1	01/18/11	Azurite

These are transmitted as checked below:

☒ For Your Use ☐ As Requested ☐ Returned

☐ For Review and Comment ☐ Other (see remarks)

We are sending via:

☒ US Mail ☐ Overnight ☐ Courier

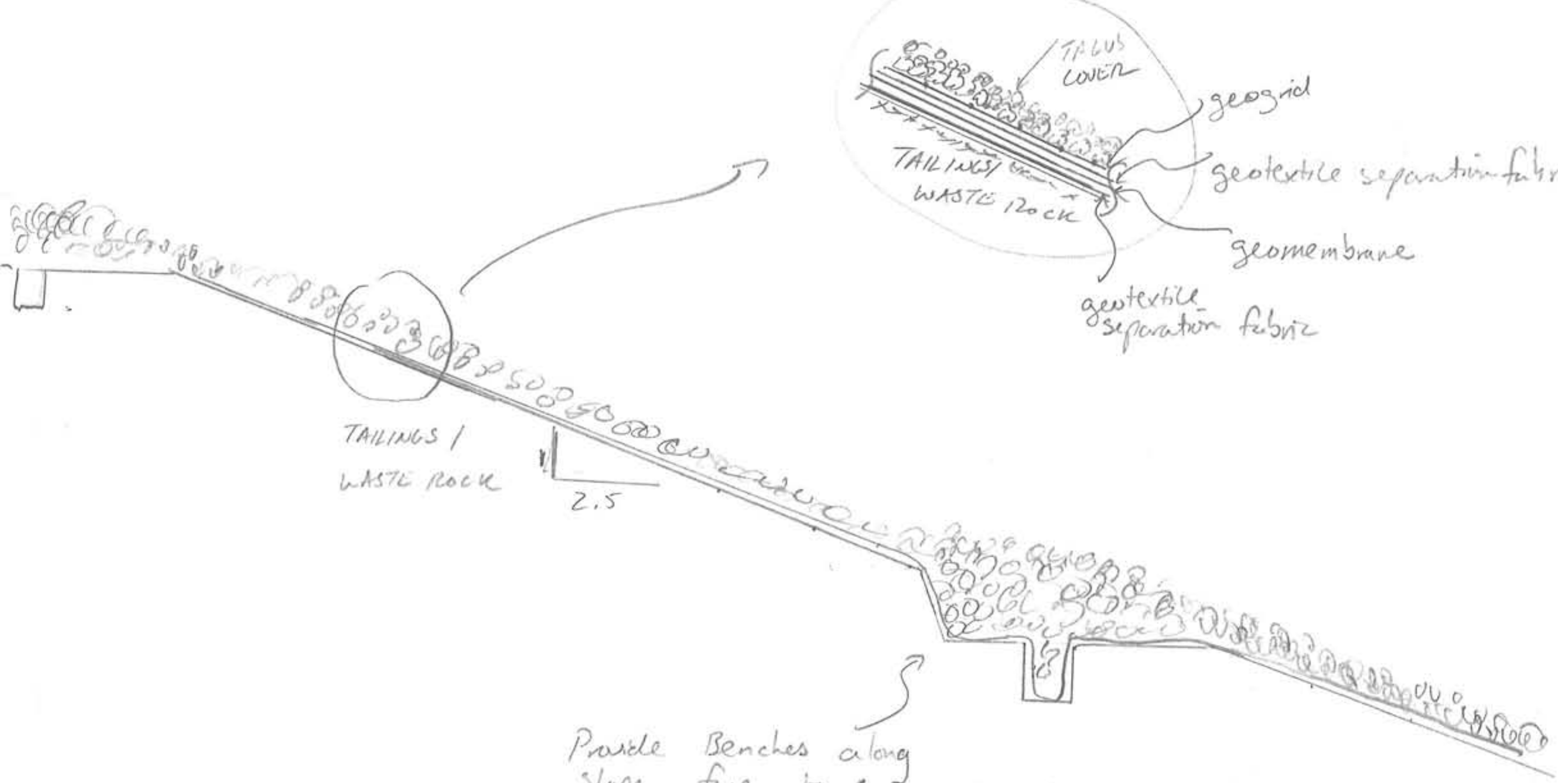
Remarks:

Copy To: File

Signed:

project Azurite project no. 0347-076-02

by DRL date 1/18/11 sheet 1 of 7 checked by



Provide Benches along slope face to:

1) Reduce tensile forces on geotextiles
2) Provide Keys to anchor geotextiles
3) Buttresses to provide stability against sliding of cover
4) working platforms for construction.

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Sliding Stability of cover:

Assumptions:

1) Assume low interface friction between geotextiles and geomembrane ⟹ Design top geotextile/geogrid to provide tensile resistance for talus cover.

From Giroud, J.P and Beech "Stability of Geosynthetic - Soil Layered Systems in Soils," Geosynthetics International 1995

$$F.S. = \frac{\tan\delta}{\tan\beta} + \overset{0}{\cancel{\frac{a}{\gamma t\sin\beta}}} + \frac{t}{h}\,\frac{\sin\phi}{(\sin 2\beta)(\cos(\beta+\phi))} + \overset{0}{\cancel{\frac{c}{\gamma h}}}\,\frac{\cos\phi}{\sin\beta\cos(\beta+\phi)} + \frac{T}{\gamma h t}$$

where:

F.S. = Factor of safety against sliding / tensile breakage = 1.5

a = interface adhesion = 0

c = soil cohesion = 0

β = slope angle = 22° for 2.5H:1V slope

δ = interface friction angle between geotextile and soil, or geotextile/geotextile; use δ = 5° for critical interface friction angle

✓ γt = 230 lb/ft² = unit weight (accounts for 12" of talus cover @ 130 pcf + 100 psf snow load)

✓ h = height of slope; for 30' slope length h = 30 sin 22° = 11.5 ft

✓ φ = friction angle of cover soil; use φ = 38° for talus

T = ? Required tensile force to be carried by upper geotextile/geogrid

$$1.5 = \frac{\tan 5°}{\tan 22°} + \frac{1}{11.5}\,\frac{\sin 38°}{(\sin 44°)(\cos 60°)} + \frac{T}{(230)(11.5)(1)}$$

$$✓\ 1.5 = 0.2165 + 0.154 + \frac{T}{2645}$$

✓ $T = 3{,}000$ lb/ft ⟹ use $T_{min} = 3{,}100$ lb/ft

T_{min} = Long Term Design Strength (LTDS) taking into account Strength Reduction factors for creep, installation damage durability

project Azurite project no. 0347-076-02

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FOR PORTION OF EXISTING SLOPE @ ≈ 2H:1V SLOPE

$\beta = 26.6°$

$$1.5 = \frac{\tan 5°}{\tan 26.6°} + \frac{1}{h}\frac{\sin 38°}{(\sin 44°)(\cos 64.6°)} + \frac{3,100}{(230)(h)(1)}$$

$$1.5 = \overset{\checkmark}{0.175} + \frac{2.07}{h} + \frac{13.48}{h}$$

$$1.325 h = 2.07 + 13.48$$

✓ $h = 11.7$ ft $= L \sin 26.6°$

$L = 26$ ft ⇒ Recommend 20 slope length for 2H:1V slope

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Stability of cover soil (Talus) over geotextile/geogrid:

Typical interaction coefficients $\left(\frac{\phi_{soil-geotextile}}{\phi_{soil}}\right)$ for geotextiles and geogrids and granular soil ≈ 0.80 - 0.90

Assume $C_i = 0.85$

$\phi_{soil-geotextile} = 0.85\ \phi_{soil} = (0.85)(38°) = 32°$

✓ $\frac{\tan 32°}{\tan 22°} = 1.56$ S.F. => O.K.

For 2H:1V Slope

$\frac{\tan 32°}{\tan 26.6°} = 1.25$ S.F

=> Benches will provide buttressing

Lab testing should be completed on talus and geotextiles to confirm interface friction angles before construction

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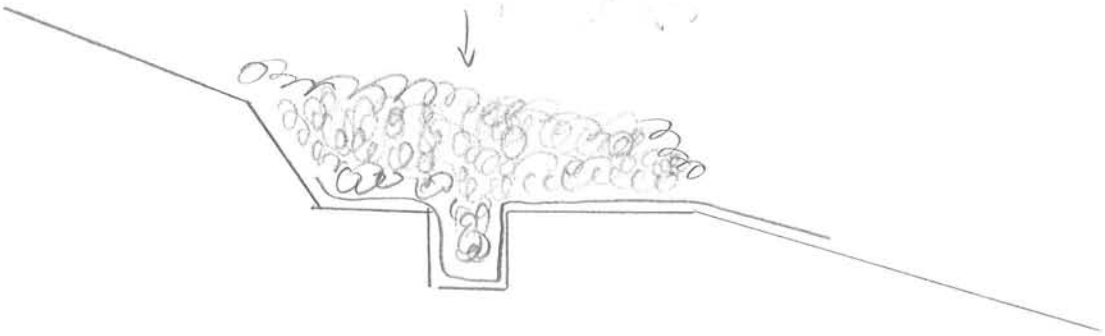
Anchor Trench Requirements:



Total Driving Force = W sin 22° L

For 30' slope length : $F = (230) \sin 22° \times 30 = 2,600$ lb/ft

Pull out Resistance:

$T_{max} \leq \frac{1}{FS_{po}} F^* \gamma Z_p L_e C R_c \alpha$

From FHWA - NHI - 00 - 043 "Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines" 2001

where:

FS_{po} : Safety factor against pullout ≥ 1.5
T_{max} = Maximum reinforcement tension
C = 2 for geogrid geotextile
α = scale correction factor
F^* = Pullout Resistance factor
R_c = coverage ratio
γZ_p = overburden pressure
L_e = length of embedment

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$F.S. \geq 1.5$

$T_{max} = 2,600$ lb/ft

$c = 2$

$\alpha = 0.8$

$F^* \approx C_i \tan\phi = 0.85 \tan 38° \cong 0.664$ ✓

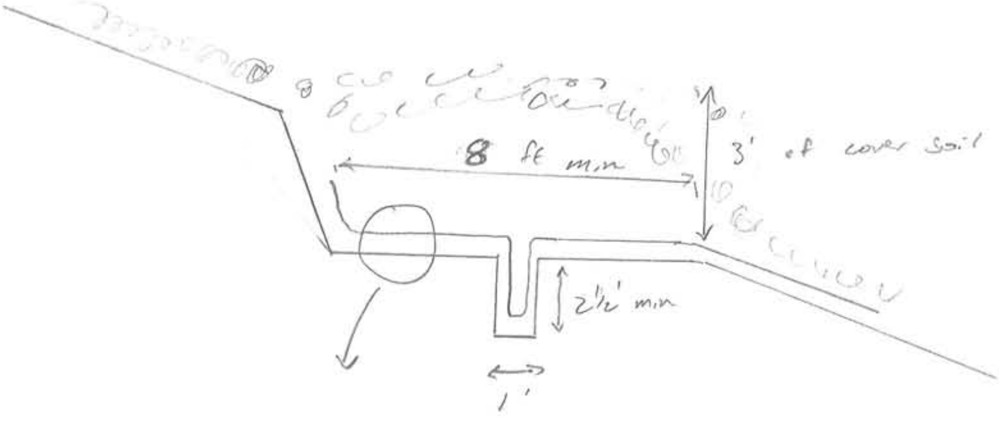
$R_c = 1.0$

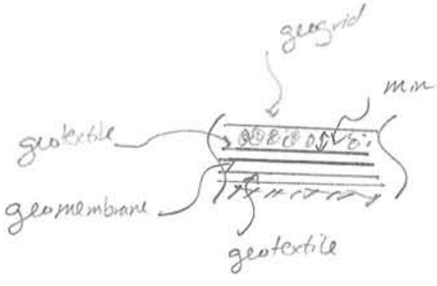
$\gamma z_p = (3)(130) = 390$ psf

$L_c = ?$

$$L_c \geq \frac{1.5\,T_{max}}{c F^* \gamma z R_c \alpha}$$

$$L_c \geq \frac{(1.5)(2,600)}{(2)(0.664)(390)(1)(0.8)} = 9.4 \text{ ft}$$ = minimum length of geogrid embedment on bench





min 3" of cover soil between geotextile and geogrid for sliding resistance

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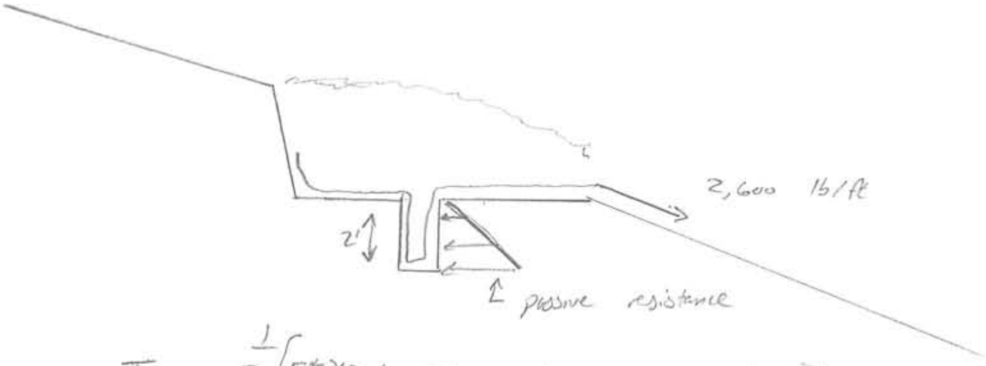
Sliding Resistance

FOR DIRECT SLIDING, C = 1.0



$$T_{max} = \frac{1}{FS}\left[F^{*}\gamma Z L_e C R_c \alpha + \text{passive resistance}\right]$$

$$2{,}600 = \frac{1}{FS}\left[(0.664)(390)(8)(1.)(1.0)(08) + K_p \gamma H^2\right]$$

$$K_p = \tan^2\left[45 + \frac{34}{2}\right] = 3.54$$

$$2{,}600 = \frac{1}{FS}\left[1{,}657^{\checkmark} + (3.54)(120)(4)\right]$$

$$2{,}600 = \frac{1}{FS}\left[1657 + 1698^{\checkmark}\right]$$

$$FS = \frac{3355}{2{,}600} = 1.30$$

INCREASE Anchor trench depth to 3'

$$2{,}600 = \frac{1}{FS}\left[1657 + (3.54)(120)(9)\right]$$

$$FS = \frac{5480}{2{,}600} = 2.10$$

Minimum Anchor trench depth = 2½'

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Appendix D.

Laboratory Analyses

Table 1. **Surface Water Analytical Results**
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest - Whatcom County, Washington

Sample I.D.	Sample Date	Sampling Entity (CES, MFG)	Aluminum, TR	Antimony, TR	Arsenic (III), TR	Arsenic (V), TR Calculated	Arsenic Total, TR	Barium, TR	Beryllium, TR	Cadmium, TR	Calcium, TR	Chromium, TR	Cobalt, TR	Copper, TR	Iron, TR*	Lead, TR	Magnesium, TR	Manganese, TR*	Mercury, Total	Mercury, Total, Trace	Nickel, TR	Potassium, TR	Selenium, TR	Silver, TR	Sodium, TR	Thallium, TR	Vanadium, TR	Zinc, TR
			Results in µg/L																									
Tinson Adit Seep																												
AM-AS-01	8/27/2004	CES	40 B	< 0.2	0.52	19.3	19.8	< 3	< *2*	0.1 B	22,100	< 10	< 10	0.9 B	80	0.1 B	####	< 5	< *0.2*	0.00125	< 10	< 300	< *1*	< 0.05	900 B	< 0.1	< 5	< 10
TTDIS	9/8/2005	MFG	NA	NA	NA	NA	26.4	NA	NA	0.19	NA	< 1.25	NA	2.97	NA	< 0.5	NA	5.74	< *0.2*	NA	NA	NA	NA	NA	NA	NA	NA	16.4
AM-AS-01	6/24/2010	CES	90.9	NA	NA	NA	29.2	0.92	NA	0.17	19,100	0.28 J	NA	3.6	504	0.066 J	NA	NA	NA	NA	1	157 B	NA	NA	651	NA	NA	53.1
AM-AS-01	9/22/2010	CES	41.6 B				24.8	1.3		0.092		< 0.24		2	145	0.033 J					0.66							11.5
Wenatchee Waste Seep																												
AM-SP-01	8/28/2004	CES	720	< 0.2	0.25	2.75	3	< 3	< *2*	0.7	17,300	< 10	20 B	81.2	430	1	####	153	< *0.2*	0.000774	10 B	1,100	< *1*	< 0.05	2,100	0.07 B	< 5	40
Seep-2	9/8/2005	MFG	NA	NA	NA	NA	5.27	NA	NA	0.2	NA	1.48	NA	6.78	NA	0.74	NA	15.4	< *0.2*	NA	NA	NA	NA	NA	NA	NA	NA	29.3
AM-SP-01	6/24/2010	CES	284	NA	NA	NA	2.5	2.8	NA	0.28	20,000	< 0.24	NA	4.9	14.2 J	0.056 J	NA	NA	NA	NA	3.8	616 B	NA	NA	1,260	NA	NA	41.9
AM-SP-01	9/22/2010	CES	121 B				2.4	3.1		0.12		< 0.24		3.4	16.2 J	0.11					1.7							13.1
Tailings Seep																												
AM-SP-02	8/28/2004	CES	90 B	< 0.2	NA	NC	1.8 B	< 3	< *2*	0.1 B	11,900	< 10	< 10	1.7 B	< 10	0.2 B	####	10 B	< *0.2*	NA	< 10	600 B	< *1*	< 0.05	1,200	0.05 B	< 5	< 10
Seep-1	9/8/2005	MFG	NA	NA	NA	NA	12.6	NA	NA	4.61	NA	9.7	NA	1,180	NA	6.34	NA	688	< *0.2*	NA	NA	NA	NA	NA	NA	NA	NA	542
AM-SP-02	6/24/2010	CES	24,800	NA	NA	NA	0.45 J	14.3	NA	2.9	NA	1.5	NA	592	251	2.3	NA	NA	NA	NA	43.9	3,200 B	NA	NA	4,590	NA	NA	410
AM-SP-02	9/22/2010	CES	12,300 B				1.4	12.7		2.6		1.3		206	660	1.3					23							330
Canyon Creek																												
CC-SW-01	8/26/2004	CES	< 30	0.2 B	0.14	1.46	1.6 B	9 B	< *2*	< 0.1	20200	< 10	< 10	< 0.5	20 B	0.1 B	3500	< 5	< *0.2*	0.000385	< 10	< 300	< *1*	< 0.05	2000	0.05 B	< 5	< 10
CC-SW-01	6/23/2010	CES	185	NA	NA	NA	1.3	6.5	NA	< 0.02	NA	0.32 J	NA	0.6	200	0.085 J	NA	NA	NA	NA	0.25 J	NA	NA	NA	NA	NA	NA	15.8
CC-SW-01	9/20/2010	CES	36.8 B				1.5	8.4		< 0.02		0.46 J		0.34 J	80.9	< 0.02					< 0.19							4.5 J
CC-SW-02	8/26/2004	CES	< 30	0.2 B	0.11	1.59	1.7 B	6 B	< *2*	< 0.1	17600	< 10	< 10	0.6 B	10 B	0.1 B	2800	< 5	< *0.2*	0.000422	< 10	< 600	< *1*	< 0.05	1600	0.06 B	< 10	< 10
CC-SW-02	6/23/2010	CES	382	NA	NA	NA	2.1	4.3	NA	0.021 J	NA	1	NA	2.5	458	0.32	NA	NA	NA	NA	0.6	NA	NA	NA	NA	NA	NA	11.4
CC-SW-02	9/20/2010	CES	36.2 B				1.5	5.9		< 0.02		0.29 J		0.42 J	39.8 J	< 0.02					< 0.19							4.1 J
Mill Creek																												
MC-SW-01a	6/24/2010	CES	213	NA	NA	NA	1.4	2.7	NA	< 0.02	NA	0.55	NA	1.1	337	0.15	NA	NA	NA	NA	0.45 J	NA	NA	NA	NA	NA	NA	10.9
MC-SW-01a	9/22/2010	CES	6.7 B				0.6	1.7		< 0.02		< 0.24		< 0.2	< 4.5	< 0.02					< 0.19							2.4 J
MC-SW-01b	6/24/2010	CES	425	NA	NA	NA	1.6	3.9	NA	< 0.02	NA	1.2	NA	2.4	695	0.19	NA	NA	NA	NA	0.84	NA	NA	NA	NA	NA	NA	11.6
MC-SW-01b	9/22/2010	CES	21.4 B				0.55	2		< 0.02		< 0.24		< 0.2	28 J	< 0.02					< 0.19							2.1 J
MC-SW-01	8/27/2004	CES	90 B	< 0.2	0.04	NC	< *0.5*	< 3	< *2*	< 0.1	4,700	< 10	< 10	< 0.5	20 B	0.1 B	400 B	< 5	< *0.2*	0.000174 B	< 10	400 B	< *1*	< 0.05	800 B	0.07 B	< 5	< 10
MC-SW-02	8/27/2004	CES	30 B	< 0.2	0.04	0.46	0.5 B	< 3	< *2*	< 0.1	4,900	< 10	< 10	< 0.5	30 B	0.1 B	500	< 5	< *0.2*	0.000104 B	< 10	400 B	< *1*	< 0.05	900 B	< 0.05	< 5	< 10
MC-SW-02a	6/24/2010	CES	498	NA	NA	NA	1.5	4.4	NA	< 0.02	NA	1.4	NA	3	783	0.21	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	34.4
MC-SW-02a	9/21/2010	CES	56.1 B				0.67	2.3		< 0.02		< 0.24		1.1	70.5	< 0.02					0.39 J							3 J
MC-SW-02b	6/24/2010	CES	681	NA	NA	NA	2.2	5.2	NA	0.038 J	NA	1.8	NA	3.8	1110	0.28	NA	NA	NA	NA	1.3	NA	NA	NA	NA	NA	NA	13.2
MC-SW-02b	9/21/2010	CES	71.5 B				0.89	2.7		0.045 J		0.26 J		1.2	102	0.043 J					0.44 J							3.6 J
SW-1	9/8/2005	MFG	NA	NA	NA	NC	0.853	NA	NA	< 0.12	NA	< 1.25	NA	NA	NA	< 0.5	NA	0.46	< *0.2*	NA	NA	NA	NA	NA	NA	NA	NA	< 2
Average			**209.27**	**< 0.1**	**0.04**	**0.46**	**1.024**	**3.2**	**< 1**	**0.02377**	**4800**	**2.225**	**< 5**	**1.8**	**318**	**0.183**	**450**	**1.82**	**< 0.1**	**0.000139**	**2.265**	**400**	**< 0.5**	**< 0.03**	**850**	**0.03**	**< 2.5**	**11.59**
MC-SW-03	8/25/2004	CES	40 B	< 0.2	0.05	1.15	1.2 B	< 3	< *2*	< 0.1	5600	< 10	< 10	1.1 B	60	0.3 B	500 B	< 5	< *0.2*	0.000316	< 10	400 B	< *1*	< 0.05	700 B	< 0.05	< 5	< 10
MC-SW-03	6/24/2010	CES	724	NA	NA	NA	2.9	5	NA	0.04 J	NA	2.1	NA	3.9	1140	0.41	NA	NA	NA	NA	1.3	NA	NA	NA	NA	NA	NA	20.8
MC-SW-03	9/21/2010	CES	61.2				1.2	2.4		0.042 J		< 0.24		0.99	81.4	0.035 J					0.34 J							4.1 J
MC-SW-04	8/25/2004	CES	60 B	< 0.2	0.6	0.7	1.3 B	< 3	< *2*	< 0.1	5900	< 10	< 10	2.6 B	80	0.2 B	500 B	6 B	< *0.2*	0.000279	< 10	500 B	< *1*	< 0.05	700 B	0.09 B	< 5	< 10
MC-SW-04	6/24/2010	CES	702	NA	NA	NA	2.5	5.4	NA	0.048 J	NA	2	NA	5	1100	0.44	NA	NA	NA	NA	1.6	NA	NA	NA	NA	NA	NA	33.1
MC-SW-04	9/21/2010	CES	55.7 B				1.1	2.4		0.054 J		< 0.24		1.2	60.6	< 0.02					0.36 J							3.2 J
SW-2	9/8/2005	MFG	NA	NA	NA	NC	1.31	NA	NA	< 0.12	NA	< 1.25	NA	NA	NA	< 0.5	NA	0.29	< *0.2*	NA	NA	NA	NA	NA	NA	NA	NA	2.3
MC-SW-05	8/28/2004	CES	< 30	< 0.2	0.11	1.49	1.6 B	< 3	< *2*	< 0.1	7700	< 10	< 10	0.9 B	10 B	0.1 B	700 B	< 5	< *0.2*	NA	< 10	500 B	< *1*	< 0.05	800 B	0.07 B	< 5	< 10
MC-SW-05	6/24/2010	CES	784	NA	NA	NA	3.3	5	NA	0.041 J	NA	2.1	NA	5.2	1160	0.48	NA	NA	NA	NA	1.4	NA	NA	NA	NA	NA	NA	9.3
MC-SW-05	9/21/2010	CES	37.5 B				1.6	2.6		0.033 J		0.26 J		1.4	38 J	< 0.02					0.21 J							1.8 J
SW-3	9/8/2005	MFG	NA	NA	NA	NC	2.12	NA	NA	< 0.12	NA	< 1.25	NA	NA	NA	0.72	NA	7.36	< *0.2*	NA	NA	NA	NA	NA	NA	NA	NA	8.57
MC-SW-06	8/26/2004	CES	< 200	< 0.2	0.15	1.75	1.9 B	< *20*	< *10*	< 0.1	12000	< 50	< *50*	0.7 B	< 50	0.6	1000 B	< 30	< *0.2*	0.000234 B	< *50*	< 2000	< *1*	< 0.05	< 2000	0.07 B	< *30*	< 50
MC-SW-06	6/23/2010	CES	398	NA	NA	NA	2	3.1	NA	0.035 J	NA	1.1	NA	2.7	499	0.36	NA	NA	NA	NA	0.68	NA	NA	NA	NA	NA	NA	13.5
MC-SW-06	9/20/2010	CES	58.3 B				1.9	2.9		0.025 J		0.43 J		1.1	69.8	0.052 J					0.21 J							2.4 J
Standards, corrected for hardness where applicable (used 24 mg/L average for surface water samples, excluding portal and other seeps)																												
Washington - Aquatic Life (Chronic) [1]			NS	NS	NS	NS	*190*	NS	NS	0.37	NS	NS	NS	3.5	NS	0.52	NS	NS	0.012	0.012	76.4	NS	5	NS	NS	NS	NS	31.72
Washington - Human Health [2]			NS	14	NS	NS	0.018	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.14	0.14	610	NS	170	NS	NS	1.7	NS	NS
Washington Drinking Water Criteria [3]			NS	6	NS	NS	10	####	4	5	NS	100	NS	NS	300	NS	NS	50	2	2	100	NS	50	100	NS	2	NS	50,000
EPA - Aquatic Life (CCC) [4]			87	NS	NS	NS	*150*	NS	NS	0.091	NS	NS	NS	*2.7*	1,000	*0.52*	NS	NS	*0.77*	*0.77*	15.59	NS	5	NS	NS	NS	NS	35.36
EPA - Human Health (Water+Organism) [5]			NS	5.6	NS	NS	*0.018*	####	NS	NS	NS	NS	NS	1,300	300	NS	NS	50	NS	NS	610	NS	170	NS	NS	1.7	NS	7,400
ORNL - Surface Water PRGs [6]			87	30	190	3.1	NS	4	0.66	1.10	NS	NS	23	12	1,000	3.20	NS	120	1.3	1.3	160	NS	0.39	0.36	NS	9	20	110

Table 1. Surface Water Analytical Results
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest - Whatcom County, Washington

Sample I.D.	Sample Date	Sampling Entity (CES, MFG)	Flow Rate	Temperature (Field)	pH (Field)	pH (Lab)	Turbidity (Field)	Conductivity (Field)	Conductivity @25C (Lab)	Dissolved Oxygen (Field)	Oxygen Reduction Potential (Field)	Hardness as $CaCO_3$, TR	TDS (Field)	TDS, Residue, Filterable @180C	TSS, Residue, Non-Filterable @105C	Sulfate	Chloride	Alkalinity (Total as $CaCO_3$)
			cfs	°C	s.u.		NTU	mS/cm		mg/L	mV	mg/L						
Tinson Adit Seep																		
AM-AS-01	8/27/2004	CES	0.04	7.2	7.65	7.3	0	140	107	12.5	184	63	90	70	6 B	10 B	NA	NA
TTDIS	9/8/2005	MFG	0.0013	NM	NM	NA	NM	NM		NM	NM	NA	NM	NA	14	NA	NA	NA
AM-AS-01	6/24/2010	CES	0.008	5.43	6.02	7.4 H	NM	64	NM	9.28	56.7	53.5	NM	62	< 2	11	0.1 J	41.8
AM-AS-01	9/22/2010	CES	0.009	4.38	7.46	7.4 H	NM	74	117	11.72	-171	55.8	NM	75	11	11.3	0.11 J	51.3
Wenatchee Waste Seep																		
AM-SP-01	8/28/2004	CES	NM	4.8	4.33	5.5	10	200	172	13	354	70	130	120	< 5	80	NA	NM
Seep-2	9/8/2005	MFG	0.0006	NM	NM	NA	NM	NM	NA	NM	NM	NA	NM	NA	< 5	NA	NA	NA
AM-SP-01	6/24/2010	CES	0.007	3.94	6.17	7 H	NM	77	NA	9.59	28.2	60.4	NM	83	< 2	35.2	6.2	20
AM-SP-01	9/22/2010	CES	0.002	5.13	6.97	4.2 H	NM	72	108	10.81	-138	47.5	NM	72	< 2	27.7	0.13 J	26.8
Tailings Seep																		
AM-SP-02	8/28/2004	CES	NM	6.8	6.53	6.5	0	90	76	12.6	215	36	60	60	< 5	20 B	NM	NM
Seep-1	9/8/2005	MFG	NM	NM	NM	NA	NM	NM	NA	NM	NM	NA	NM	NA	262	NA	NA	NA
AM-SP-02	6/24/2010	CES	0.0002	8.83	5.51	3.9 H	NM	437	NM	8.06	128	16.8	NM	21	3	337	0.22 J	< 2
AM-SP-02	9/22/2010	CES	NM	5.94	6.97	6.6 H	NM	228	371	9.43	-120	11.6	NM	293	47	186	0.2 J	< 2
Canyon Creek																		
CC-SW-01	8/26/2004	CES	85.5	10.9	7.63	7.7	0	140	119	12.3	179	65	90	90	6 B	10 B	NA	NA
CC-SW-01	6/23/2010	CES	NM	6.44	NM	7.6 H	NM	45	NA	9.53	110.2	33	NM	44	< 2	NA	NA	NA
CC-SW-01	9/20/2010	CES	78.7	8.95	7.46	8 H	NM	90	127	11.87	-26.4	61	NM	73 H	3 H			
CC-SW-02	8/26/2004	CES	111	10.6	7.24	7.2 H	26	130	103	12.4	191	56	80	70	< 5	< 10	NA	NA
CC-SW-02	6/23/2010	CES	NM	7.67	NM	7.4	NM	27	NM	9.62	125.7	28.3	NM	33	8	NA	NA	NA
CC-SW-02	9/20/2010	CES	77.9	9	7.53	7.9 H	NM	76	104	11.78	-25.6	49.7	NM	68 H	2 H			
Mill Creek																		
MC-SW-01a	6/24/2010	CES	16.4	3.28	NM	6.8 H	NM	14	NM	10.35	105.6	10	NM	18	6	NA	NA	NA
MC-SW-01a	9/22/2010	CES	1.4	5.47	6.84	7.1 H	NM	19	28.8	11.91	-121	11.8	NM	26	< 2			
MC-SW-01b	6/24/2010	CES	40.6	3.7	NM	5.6 H	NM	15	NM	10.33	148.8	10.9	NM	29	14	NA	NA	NA
MC-SW-01b	9/22/2010	CES	1.8	5.66	6.97	7.3 H	NM	24	36	13	-175	15.1	NM	27	2			
MC-SW-01	8/27/2004	CES	12.6	6	7.08	7.1	1	40	31	12.1	138	13	30	20	< 5	< 10	NA	NA
MC-SW-02	8/27/2004	CES	6.71	6.1	7.03	7.1	1	40	33	12.2	149	14	30	20	6 B	10 B	NA	NA
MC-SW-02a	6/24/2010	CES	40.3	3.73	NM	7.2 H	NM	15	NM	10.42	127.9	11.9	NM	22	16	NA	NA	NA
MC-SW-02a	9/21/2010	CES	2.8	6.24	7.02	7.3 H	NM	23	36	12.15	-53.4	13.7	NM	24 H	4 H			
MC-SW-02b	6/24/2010	CES	41.4	3.45	NM	7.1 H	NM	16	NM	10.37	128.4	NA	NM	19	17	NA	NA	NA
MC-SW-02b	9/21/2010	CES	11.3	6.53	6.92	7.4 H	NM	24	36.7	11.92	-51.4	13.9	NM	24 H	27 H			
SW-1	9/8/2005	MFG	0.6	NM	NM	NA	NM	NM	NM	NM	NM	NA	NM	NA	< 5	NA	NA	NA
Average			**15.992**	**5.02**	**6.98**	**7**	**1**	**23**	**33.583**	**11.475**	**39.69**	**12.7**	**30**	**22.9**	**9.455**	**10**		
MC-SW-03	8/25/2004	CES	5.05	6.4	6.61	7.3	0	50	34	12.7	201	16	30	30	< 5	< 10	NA	NA
MC-SW-03	6/24/2010	CES	64.7	4.15	NM	6.9 H	NM	14	NM	9.92	140.3	13.3	NM	17	35	NA	NA	NA
MC-SW-03	9/21/2010	CES	7.6	6.19	7.08	7.5 H	NM	26	39.7	12.16	-74.6	16.4	NM	< 5 H	3 H			
MC-SW-04	8/25/2004	CES	8.26	6.5	6.34	7.2	3	50	37	12.7	211	17	30	40	< 5	< 10	NA	NA
MC-SW-04	6/24/2010	CES	90.9	4.02	NM	6.6 H	NM	16	NM	10.35	71.2	16.8	NM	26	12	NA	NA	NA
MC-SW-04	9/21/2010	CES	7	5.36	7.8	7.6 H	NM	29	43.3	12.51	-7.2	17.3	NM	30 H	3 H			
SW-2	9/8/2005	MFG	NM	NM	NM	NA	NM	NM	NM	NM	NM	NA	NM	NA	< 5	NM	NA	NA
MC-SW-05	8/28/2004	CES	18.8	7.4	7.28	7.1	0	60	49	12.7	164	22	40	30	< 5	< 10	NA	NA
MC-SW-05	6/24/2010	CES	123.6	4.35	NM	7.5 H	NM	24	NM	9.28	56.4	17	NM	17	16	NA	NA	NA
MC-SW-05	9/21/2010	CES	13.7	5.68	7.78	7.6 H	NM	37	58.1	12.31	-71	25	NM	36 H	2 H			
SW-3	9/8/2005	MFG	3.1	NM	NM	NA	NM	NM	NM	NM	NM	NA	NM	NA	8	NA	NA	NA
MC-SW-06	8/26/2004	CES	22	10.5	7.08	7.4	12	80	63	12.4	217	34	50	50	< 5	< 10	NA	NA
MC-SW-06	6/23/2010	CES	179.2	8.29	NM	7.5 H	NM	32	NM	9.39	104.9	24	NM	31	4	NA	NA	NA
MC-SW-06	9/20/2010	CES	18.1	9.09	7.45	7.9 H	NM	55	74.8	11.94	-34	35.5	NM	51 H	3 H			
Standards																		
Washington - Aquatic Life[1]			NS	12	6.5-8.5	6.5-8.5	5>Bkg	NS	NS	9.5	NS	NS	NS	NS	NS	NS	NS	NS
Washington - Human Health[2]			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Washington Drinking Water Criteria[3]			NS	NS	6.5-8.5	6.5-8.5	NS	700	700	NS	NS	NS	500	500	NS	250	250	NS
EPA - Aquatic Life[4]			NS	9-19	6.5-9	6.5-9	NS	NS	NS	9.5	NS	NS	NS	NS	NS	NS	NS	NS
EPA - Human Health (Water+Organism)[5]			NS	NS	5-9	5-9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ORNL - Surface Water PRGs[6]			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

GENERAL NOTES:

All CES 2004 analyses except Arsenic (III), TR & Mercury, Total, Trace were conducted by ACZ Laboratories, Inc. in Steamboat Springs, Colorado per EPA Method 200.7/200.8.

All MFG 2005 analyses were completed by SVL Analytical in Kellogg, Idaho per EPA Method 200.7/200.8.

All CES 2010 analyses were conducted by Pace Analytical Services, Inc. in Seattle, Washington per EPA Method 6010/6020.

Arsenic (III), TR and Mercury, Total, Trace analyses were conducted by Brooks Rand in Seattle, Washington.

Arsenic (V) was calculated from difference between Arsenic, TR and Arsenic (III), TR.

Surface water metals concentrations in samples collected by MFG from Mill Creek are presented as the mean concentration of three replicates.

Abbreviations: < value = analyte not detected above Method Detection Limit (MDL), B = analyte detected between MDL and Practical Quantification Limit (PQL), H = hold time exceeded, J = estimated concentration above the adjusted MDL and below the adjusted reporting limit, µg/L = micrograms per liter, mg/L = milligrams per liter, mS = microSiemans, NA = not analyzed, NC = not calculated, NM = not measured, s.u. = standard units.

Bold identifies the average background concentration from the CES (2004) SI; MFG (2005); and CES (2010) RA DGI field investigations.

Italic values indicate that the MDL exceeds the lowest standard.

Shaded cells indicate that the value exceeds one or more standard; corresponding criteria also shaded.

STANDARD NOTES:

1 - State of Washington Aquatic Life criteria (WAC 173-201A), underline - corrected for hardness, *italics* - expressed as Dissolved

2 - State of Washington criteria for protection of human health (CLARC-Part IIIf)

3 - State of Washington drinking water criteria (WAC 246-290)

4 - EPA recommended chronic ambient water quality criteria for 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

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

NS = No Standard

Table 2. **Sediment Analytical Results**
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest - Whatcom County, Washington

Sample ID	**Sample Date**	**Sampling Entity (CES, MFG)**	**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**
			mg/kg																						
Canyon Creek																									
CC-SS-01	8/26/2004	CES	21,900	0.3 B	31.3	97.2	0.4 B	0.4	5230	52	17	43.3	41,400	11.4	12,600	686	< 0.04	41.5	2,410	< 0.5	0.31	450	0.9 B	76.2	99
CC-SS-01	6/23/2010	CES	25,700	NA	37.1	32.3	NA	< 0.051	NA	77.5	NA	99.7	42,300	6.7	NA	NA	NA	52.1	NA	NA	NA	NA	NA	NA	96.5
CC-SS-01	9/20/2010	CES	16,900		31.5	49.9		< 0.051		43.2		92.4	43,800	9.5				47.7							162
CC-SS-02	8/26/2004	CES	28,300	0.3 B	28.6	71.2	0.3 B	0.74	7560	99	23	64.7	42,400	8.27	19,200	683	< 0.04	47.7	2,480	< 0.5	0.5	990	0.15 B	116	101
CC-SS-02	6/23/2010	CES	26,500	NA	42	NA	NA	< 0.054	NA	72.8	NA	109	45,200	8.4	NA	NA	NA	49	NA	NA	NA	NA	NA	NA	130
CC-SS-02	9/20/2010	CES	21,000		21	29.5		< 0.052		73.7		86.3	43,700	7.9				52							159
Mill Creek																									
MC-SS-01a	6/24/2010	CES	9,150	NA	80.1	29.8	NA	< 0.057	NA	25.4	NA	81.5	42,900	6.5	NA	NA	NA	29.4	NA	NA	NA	NA	NA	NA	81.9
MC-SS-01a	9/22/2010	CES	9,870		28.1	26		< 0.11		19.2		79.4	52,800	0.7				39 J							15.8
MC-SS-01b	6/24/2010	CES	13,900	NA	37.7	44	NA	< 0.06	NA	44.6	NA	117	47,000	5.6	NA	NA	NA	30.1	NA	NA	NA	NA	NA	NA	75.1
MC-SS-01b	9/22/2010	CES	17,400		50.6	37.5		< 0.061		116		114	56,200	4.9				56.9							58.2
MC-SS-01	8/27/2004	CES	13,900	0.3 B	19.6	46.9	0.4 B	0.38	1980	40	11	59.1	34,200	4.72	7,240	615	< 0.05	20.2	2,150	0.5	0.23	290	0.18 B	65.3	62
MC-SS-02	8/27/2004	CES	15,800	0.4 B	20.5	57.4	0.4 B	0.51	2930	40	12	50.4	34,800	4.7	8,000	636	< 0.04	20.3	2,360	0.5	0.26	420	0.19 B	71.1	66
MC-SS-02a	6/24/2010	CES	10,800	NA	22.9	36.7	NA	< 0.056	NA	25.3	NA	59	32,400	6.1	NA	NA	NA	20.1 J	NA	NA	NA	NA	NA	NA	86.6
MC-SS-02a	9/21/2010	CES	11,500		18.6	32		< 0.042		17.4		58.7	34,200	0.57				27.3							1.7 J
MC-SS-02b	6/24/2010	CES	12,000	NA	133	36.7	NA	< 0.054	NA	19.3	NA	74.8	39,900	4.2	NA	NA	NA	23.6	NA	NA	NA	NA	NA	NA	111
MC-SS-02b	9/21/2010	CES	10,600		22.6	28.2		< 0.048		24.9		64.6	37,700	3				29.7							55.9
SW-1	9/8/2005	MFG	NA	NA	23.2	NA	NA	2.66	NA	38.77	NA	93.83	NA	5.37	NA	NA	< 0.033	22.83	NA	NA	NA	NA	NA	NA	113.2
Average			**16,576**	**0.33**	**38.1**	**43.7**	**0.38**	**0.3168**	**4425**	**48.7688**	**15.8**	**79.278**	**41,931**	**5.796**	**11,760**	**655**	**0.041**	**35.85**	**2,350**	**0.5**	**0.33**	**538**	**0.36**	**82.2**	**86.8**
MC-SS-03	8/25/2004	CES	23,900	0.4 B	59.1	59.2	0.3 B	1.7	5030	81	20	130	46,200	11.6	14,100	730	0.06 B	29.4	3,640	< 1	0.33	960	0.5 B	98.8	201
MC-SS-03	6/24/2010	CES	31,300	NA	170	58.8	NA	0.58 J	NA	100	NA	318	57,600	29.6	NA	NA	NA	60.8	NA	NA	NA	NA	NA	NA	176
MC-SS-03	9/21/2010	CES	16,800		104	52.4		< 0.059		57.8		204	48,400	11.2				50.4							154
MC-SS-04	8/25/2004	CES	25,000	0.3 B	108	54	0.3 B	1.3	5110	80	24	183	57,600	16.9	14,900	771	< 0.05	37.8	2,850	< 1	0.4	940	0.3 B	102	178
MC-SS-04	6/24/2010	CES	28,200	NA	60.4	53.1	NA	< 0.056	NA	88.1	NA	220	48,500	12.1	NA	NA	NA	45.9	NA	NA	NA	NA	NA	NA	201
MC-SS-04	9/21/2010	CES	24,500		64.3	64.5		< 0.059		67.9		187	52,600	13.6				59.5							250
SW-2	9/8/2005	MFG	NA	NA	58.8	NA	NA	3.76	NA	47.8	NA	201.67	NA	23.73	NA	NA	0.08	26.97	NA	NA	NA	NA	NA	NA	201
MC-SS-05	8/28/2004	CES	27,100	0.6 B	73.3	55.7	0.3 B	1.7	6930	86	33	175	46,200	19.2	17,900	924	< 0.04	47.5	2,260	< 1	0.71	850	0.2 B	106	207
MC-SS-05	6/24/2010	CES	301,000	NA	108	44.6	NA	< 0.06	NA	76.6	NA	224	58,300	38.3	NA	NA	NA	56	NA	NA	NA	NA	NA	NA	214
MC-SS-05	9/21/2010	CES	22,000		75.8	36.8		0.11 J		70.9		166	41,500	28.3				42.6							148
SW-3	9/8/2005	MFG	NA	NA	61.4	NA	NA	3.32	NA	65.6	NA	154.33	NA	11.4	NA	NA	< 0.033	35.5	NA	NA	NA	NA	NA	NA	166
MC-SS-06	8/26/2004	CES	25,100	0.3 B	27.7	40.9	0.2 B	0.65	6700	85	21	56.3	38,700	5.93	16,900	540	< 0.04	43	1,640	< 0.5	0.22	760	0.13 B	97.1	91
MC-SS-06	6/23/2010	CES	15,200	NA	30.5	53.6	NA	< 0.061	NA	40.2	NA	49.4	42,000	7	NA	NA	NA	40.1	NA	NA	NA	NA	NA	NA	115
MC-SS-06	9/20/2010	CES	23,100		48	40.9		< 0.052		79.3		113	39,000	17				48.7							206
Standards																									
WA - Freshwater (under development) [1]			NS	0.6	51	NS	NS	1	NS	100	NS	830	NS	430	NS	NS	0.75	70	NS	NS	2.5	NS	NS	NS	160
WA - Marine [2]			NS	NS	57	NS	NS	5.1	NS	260	NS	390	NS	450	NS	NS	0.41	NS	NS	NS	6.1	NS	NS	NS	410
EPA - Freshwater TEL [3]			NS	NS	5.9	NS	NS	0.596	NS	37.3	NS	35.7	NS	35	NS	NS	0.174	18	NS	NS	NS	NS	NS	NS	123.1
EPA - Freshwater PEL [4]			NS	NS	17	NS	NS	3.53	NS	90	NS	197	NS	91.3	NS	NS	0.486	35.9	NS	NS	NS	NS	NS	NS	315
ORNL - Freshwater [5]			NS	NS	42	NS	NS	4.2	NS	159	NS	77.7	NS	110	NS	NS	0.7	38.5	NS	NS	1.8	NS	NS	NS	270

Table 2. Sediment Analytical Results
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest - Whatcom County, Washington

Sample ID	Sample Date	Sampling Entity (CES, MFG)	Total Organic Carbon	Size Fraction by Hydrometer			Solids (ACZ)	Texture Classification
				Clay	Sand	Silt		
			%					
Canyon Creek								
CC-SS-01	8/26/2004	CES	0.5	6.3	83.8	10.0	85.4	LS
CC-SS-01	6/23/2010	CES	NA	NA	NA	NA	NA	NA
CC-SS-01	9/20/2010	CES						
CC-SS-02	8/26/2004	CES	0.3 B	5.0	82.5	12.5	83.0	LS
CC-SS-02	6/23/2010	CES	NA	NA	NA	NA	NA	NA
CC-SS-02	9/20/2010	CES						
Mill Creek								
MC-SS-01a	6/23/2010	CES	NA	NA	NA	NA	NA	NA
MC-SS-01a	9/22/2010	CES						
MC-SS-01b	6/23/2010	CES	NA	NA	NA	NA	NA	NA
MC-SS-01b	9/22/2010	CES						
MC-SS-01	8/27/2004	CES	0.5	2.5	87.5	10.0	87.6	LS
MC-SS-02	8/27/2004	CES	0.7	5.0	80.0	15.0	84.6	LS
SW-1	9/8/2005	MFG	NA	NA	NA	NA	79.9	
Average			**0.5**	**4.7**	**83.5**	**11.9**	**84.1**	
MC-SS-03	8/25/2004	CES	0.4 B	2.5	86.3	11.3	76.1	LS
MC-SS-03	6/23/2010	CES	NA	NA	NA	NA	NA	NA
MC-SS-03	9/21/2010	CES						
MC-SS-04	8/25/2004	CES	0.4 B	3.8	82.5	13.8	77.0	LS
MC-SS-04	6/23/2010	CES	NA	NA	NA	NA	NA	NA
MC-SS-04	9/21/2010	CES						
SW-2	9/8/2005	MFG	NA	NA	NA	NA	81.6	NA
MC-SS-05	8/28/2004	CES	1.2	6.3	77.5	16.3	68.5	LS
MC-SS-05	6/23/2010	CES	NA	NA	NA	NA	NA	NA
MC-SS-05	9/21/2010	CES						
SW-3	9/8/2005	MFG	NA	NA	NA	NA	79.7	NA
MC-SS-06	8/26/2004	CES	0.5	1.3	88.8	10.0	79.2	S
MC-SS-06	6/23/2010	CES	NA	NA	NA	NA	NA	NA
MC-SS-06	9/22/2010	CES						

GENERAL NOTES:

All CES 2004 analyses were conducted by ACZ Laboratories, Inc., Steamboat Springs, CO per EPA Method 6010/6020

All MFG 2005 analyses were completed by SVL Analytical in Kellogg, ID per EPA Method 6010/6020

All CES 2010 analyses were conducted by Pace Analytical Services, Inc., Seattle, WA per EPA method 6010/6020

Method Detection Limit (MDL) and Practical Quantification Limit (PQL) are not consistent among samples.

Abbreviations: % = percent, -- = not applicable, < value = Analyte not detected above MDL (MDL shown), J = estimated concentration above the adjusted MDL and below the adjusted reporting limit, mg/kg = milligrams per kilogram, NA = not analyzed.

Bold identifies the average background concentration from the CES (2004) SI; MFG (2005); and CES (2010) RA DGI field investigations.

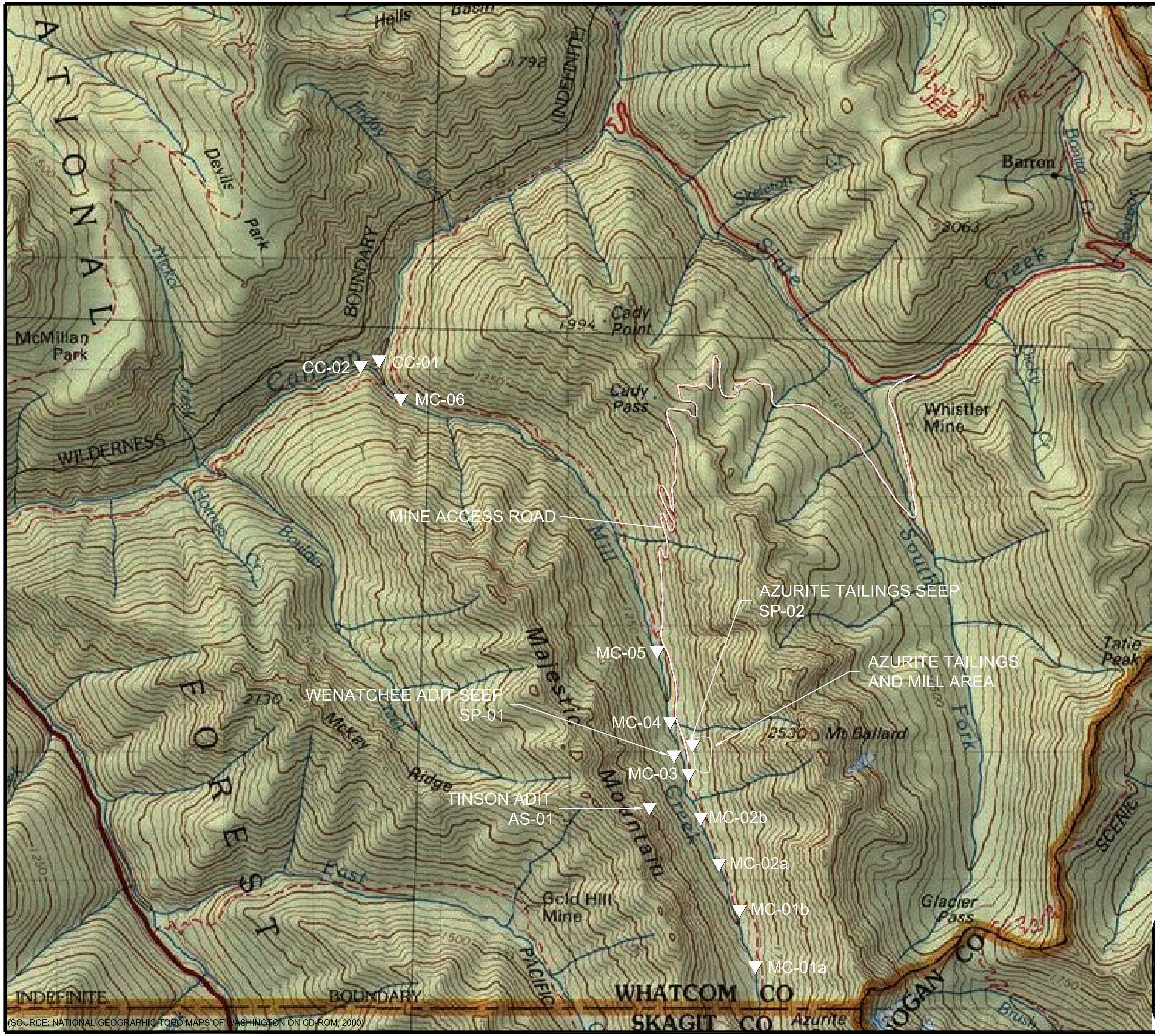
Shaded values indicate that the value exceeds one or more standard; corresponding criteria also shaded.

STANDARD NOTES:

1 - State of Washington, Development of Freshwater Sediment Quality Values (DOE recommendations, Sept 2003)
2 - State of Washington, Marine Sediment Management Standards (WAC 172-204-320)
3 - EPA Threshold Effects Level (NOAA, 1999)
4 - EPA Probable Effects Level (NOAA, 1999)
5 - ORNL ecological screening level values for freshwater, lowest chronic value used (ORNL, 1997)
NS = No Standard

Table 3. QA/QC Summary
Azurite Mine Removal Action
Mt. Baker-Snoqualmie National Forest - Whatcom County, Washington

Sample I.D.	Sample Date	Aluminum, TR	Arsenic Total, TR	Barium, TR	Cadmium, TR	Chromium, TR	Copper, TR	Iron, TR	Lead, TR	Nickel, TR	Zinc, TR
		Results in µg/L									
Duplicates											
MC-SW-04	6/24/2010	702 B	2.5	5.4	0.048 J	2	5	1,100	0.44	1.6	33.1 B
MC-SW-07	6/24/2010	662 B	2.3	5	0.028 J	1.9	4.6	1,020	0.32	1.4	19.3 B
% Difference		**6%**	**8%**	**8%**	**53%**	**5%**	**8%**	**8%**	**32%**	**13%**	**53%**
MC-SW-04	9/21/2010	55.7 B	1.1	2.4	0.054 J	< 0.24	1.2	60.6	< 0.02	0.36 J	3.2 J
MC-SW-07	9/21/2010	66 B	1.1	2.6	0.049 J	0.32 J	1.5	73.4	0.086 J	0.38 J	5.2
% Difference		**17%**	**0%**	**8%**	**10%**	**29%**	**22%**	**19%**	**125%**	**5%**	**48%**
Rinsate Blanks											
MC-SW-08	6/25/2010	7.8	< 0.062	0.086 J	< 0.02	0.27 J	0.93	5.1 J	0.12	< 0.19	6.3
MC-SW-08	9/21/2010	3.3 J	< 0.062	0.18 J	< 0.02	< 0.024	< 0.02	< 4.5	< 0.02	< 0.19	3.2 J



(SOURCE: NATIONAL GEOGRAPHIC TOPO MAPS OF WASHINGTON ON CD-ROM, 2000)

EXPLANATION

▼ Aquatic Sampling Station

SCALE 1 INCH = 4,000 FEET
ELEVATION IN METERS

QUADRANGLE LOCATION

Figure 1. Aquatic Sampling Stations

PROJECT NUMBER: 2010230015		AZURITE MINE REMOVAL ACTION 2010 DATA GAP INVESTIGATION
DATE: 06/17/2010		
DWG BY DGW	DWG NO: 2010DGIF1.dwg	USDA FOREST SERVICE OKANOGAN NATIONAL FOREST HARTS PASS, WASHINGTON
PROJECT MANAGER: DGW		
REVISED:		CES CASCADE EARTH SCIENCES A Valmont Industries Company

Pace Analytical Services, Inc.
940 South Harney
Seattle, WA 98108
(206)767-5060

July 13, 2010

Ryan Tobias
Cascade Earth Sciences
3511 Pacific Blvd. SW
Albany, OR 97321

RE: Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Dear Ryan Tobias:

Enclosed are the analytical results for sample(s) received by the laboratory on June 26, 2010. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

Samples requiring thermal preservation were received outside of recommended temperature limits of 0-6 degrees Celsius.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Heidi Geri for
Jennifer Gross
jennifer.gross@pacelabs.com
Project Manager

Enclosures

cc: Dustin Wasley, Cascade Earth Sciences

CERTIFICATIONS

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254069

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
EPA Region 8 Certification #: Pace
Florida/NELAP Certification #: E87605
Georgia Certification #: 959
Idaho Certification #: MN00064
Illinois Certification #: 200011
Iowa Certification #: 368
Kansas Certification #: E-10167
Louisiana Certification #: 03086
Louisiana Certification #: LA080009
Maine Certification #: 2007029
Maryland Certification #: 322
Michigan DEQ Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT CERT0092
Nebraska Certification #: Pace
Nevada Certification #: MN_00064
New Jersey Certification #: MN-002
New Mexico Certification #: Pace
New York Certification #: 11647
North Carolina Certification #: 530
North Dakota Certification #: R-036
North Dakota Certification #: R-036A
Ohio VAP Certification #: CL101
Oklahoma Certification #: D9921
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Tennessee Certification #: 02818
Texas Certification #: T104704192
Washington Certification #: C754
Wisconsin Certification #: 999407970

Washington Certification IDs

940 South Harney Street, Seattle, WA 98108
Alaska CS Certification #: UST-025
Alaska Drinking Water VOC Certification #: WA01230
Alaska Drinking Water Micro Certification #: WA01230
California Certification #: 01153CA
Florida/NELAP Certification #: E87617
Oregon Certification #: WA200007
Washington Certification #: C1229

SAMPLE SUMMARY

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Lab ID	Sample ID	Matrix	Date Collected	Date Received
254069001	**MC-SW-01a**	Water	06/24/10 16:00	06/26/10 10:20
254069002	**MC-SW-01b**	Water	06/24/10 15:00	06/26/10 10:20
254069003	**MC-SW-02a**	Water	06/24/10 14:20	06/26/10 10:20
254069004	**MC-SW-03**	Water	06/24/10 11:30	06/26/10 10:20
254069005	**MC-SW-04**	Water	06/24/10 10:35	06/26/10 10:20
254069006	**MC-SW-05**	Water	06/24/10 09:45	06/26/10 10:20
254069007	**MC-SW-06**	Water	06/23/10 12:40	06/26/10 10:20
254069008	**CC-SW-01**	Water	06/23/10 11:40	06/26/10 10:20
254069009	**CC-SW-02**	Water	06/23/10 12:20	06/26/10 10:20
254069010	**AM-AS-01**	Water	06/24/10 17:45	06/26/10 10:20
254069011	**AM-SP-01**	Water	06/24/10 19:15	06/26/10 10:20
254069012	**AM-SP-02**	Water	06/24/10 18:40	06/26/10 10:20
254069013	**MC-SW-07**	Water	06/24/10 10:10	06/26/10 10:20
254069014	**MC-SW-08**	Water	06/25/10 07:30	06/26/10 10:20
254069015	**MC-SW-02b**	Water	06/24/10 13:15	06/26/10 10:20

SAMPLE ANALYTE COUNT

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
254069001	**MC-SW-01a**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069002	**MC-SW-01b**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	BPR	1	PASI-S
254069003	**MC-SW-02a**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069004	**MC-SW-03**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069005	**MC-SW-04**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069006	**MC-SW-05**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069007	**MC-SW-06**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069008	**CC-SW-01**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069009	**CC-SW-02**	EPA 6020	RJS	11	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
254069010	**AM-AS-01**	EPA 6020	RJS	14	PASI-M

SAMPLE ANALYTE COUNT

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		SM 2320B	KMT	1	PASI-S
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
		EPA 300.0	BPR	2	PASI-S
254069011	**AM-SP-01**	EPA 6020	RJS	14	PASI-M
		SM 2320B	KMT	1	PASI-S
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S
		EPA 300.0	BPR	2	PASI-S
254069012	**AM-SP-02**	EPA 6020	RJS	14	PASI-M
		SM 2320B	KMT	1	PASI-S
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	BPR	1	PASI-S
		EPA 300.0	BPR	2	PASI-S
254069013	**MC-SW-07**	EPA 6020	RJS	10	PASI-M
254069014	**MC-SW-08**	EPA 6020	RJS	10	PASI-M
254069015	**MC-SW-02b**	EPA 6020	RJS	10	PASI-M
		SM 2540C	KMT	1	PASI-S
		SM 2540D	KMT	1	PASI-S
		SM 4500-H+B	KMT	1	PASI-S

PROJECT NARRATIVE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Method: **EPA 6020**
Description: 6020 MET ICPMS
Client: Cascade Earth Sciences
Date: July 13, 2010

General Information:
15 samples were analyzed for EPA 6020. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: ICPM/21220

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 254060001,254069009

M0: Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.

- MS (Lab ID: 817219)
  - Calcium
  - Zinc
- MSD (Lab ID: 817218)
  - Calcium
  - Sodium

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Method: **SM 2320B**
Description: 2320B Alkalinity
Client: Cascade Earth Sciences
Date: July 13, 2010

General Information:
3 samples were analyzed for SM 2320B. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254069

Method: **SM 2540C**
Description: 2540C Total Dissolved Solids
Client: Cascade Earth Sciences
Date: July 13, 2010

General Information:
13 samples were analyzed for SM 2540C. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

QC Batch: WET/2110

D8: The sample and duplicate results for this parameter are less than 5 times the reporting limit, the RPD may not be statistically valid.

- DUP (Lab ID: 31626)
  - Total Dissolved Solids

Additional Comments:

PROJECT NARRATIVE

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254069

Method: **SM 2540D**
Description: 2540D Total Suspended Solids
Client: Cascade Earth Sciences
Date: July 13, 2010

General Information:
13 samples were analyzed for SM 2540D. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

QC Batch: WET/2109

D6: The relative percent difference (RPD) between the sample and sample duplicate exceeded laboratory control limits.
- DUP (Lab ID: 31623)
  - Total Suspended Solids

D8: The sample and duplicate results for this parameter are less than 5 times the reporting limit, the RPD may not be statistically valid.
- DUP (Lab ID: 31622)
  - Total Suspended Solids

Additional Comments:

PROJECT NARRATIVE

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254069

Method: **SM 4500-H+B**
Description: 4500H+ pH, Electrometric
Client: Cascade Earth Sciences
Date: July 13, 2010

General Information:
13 samples were analyzed for SM 4500-H+B. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

H6: Analysis initiated more than 15 minutes after sample collection.
- AM-AS-01 (Lab ID: 254069010)
- AM-SP-01 (Lab ID: 254069011)
- AM-SP-02 (Lab ID: 254069012)
- CC-SW-01 (Lab ID: 254069008)
- CC-SW-02 (Lab ID: 254069009)
- MC-SW-01a (Lab ID: 254069001)
- MC-SW-01b (Lab ID: 254069002)
- MC-SW-02a (Lab ID: 254069003)
- MC-SW-02b (Lab ID: 254069015)
- MC-SW-03 (Lab ID: 254069004)
- MC-SW-04 (Lab ID: 254069005)
- MC-SW-05 (Lab ID: 254069006)
- MC-SW-06 (Lab ID: 254069007)

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Method: **EPA 300.0**
Description: 300.0 IC Anions 28 Days
Client: Cascade Earth Sciences
Date: July 13, 2010

General Information:
3 samples were analyzed for EPA 300.0. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: WETA/1602

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 254052001

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 32288)
  - Chloride
  - Sulfate
- MSD (Lab ID: 32289)
  - Chloride
  - Sulfate

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-01a **Lab ID: 254069001** Collected: 06/24/10 16:00 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**213**	ug/L	4.0	2.0	1	07/06/10 11:10	07/10/10 23:26	7429-90-5	B
Arsenic	**1.4**	ug/L	0.50	0.062	1	07/06/10 11:10	07/10/10 23:26	7440-38-2	
Barium	**2.7**	ug/L	0.30	0.043	1	07/06/10 11:10	07/10/10 23:26	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	07/06/10 11:10	07/10/10 23:26	7440-43-9	
Chromium	**0.55**	ug/L	0.50	0.24	1	07/06/10 11:10	07/10/10 23:26	7440-47-3	
Copper	**1.1**	ug/L	0.50	0.20	1	07/06/10 11:10	07/10/10 23:26	7440-50-8	
Iron	**337**	ug/L	50.0	4.5	1	07/06/10 11:10	07/10/10 23:26	7439-89-6	
Lead	**0.15**	ug/L	0.10	0.020	1	07/06/10 11:10	07/10/10 23:26	7439-92-1	
Nickel	**0.45J**	ug/L	0.50	0.19	1	07/06/10 11:10	07/10/10 23:26	7440-02-0	
Total Hardness by 2340B	**10000**	ug/L	355	178	5	07/06/10 11:10	07/12/10 17:58		
Zinc	**10.9**	ug/L	5.0	1.3	1	07/06/10 11:10	07/10/10 23:26	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**18.0**	mg/L	10.0	5.0	1		06/29/10 15:24		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**6.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**6.8**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-01b **Lab ID: 254069002** Collected: 06/24/10 15:00 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**425**	ug/L	4.0	2.0	1	07/06/10 11:10	07/10/10 23:34	7429-90-5	B
Arsenic	**1.6**	ug/L	0.50	0.062	1	07/06/10 11:10	07/10/10 23:34	7440-38-2	
Barium	**3.9**	ug/L	0.30	0.043	1	07/06/10 11:10	07/10/10 23:34	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	07/06/10 11:10	07/10/10 23:34	7440-43-9	
Chromium	**1.2**	ug/L	0.50	0.24	1	07/06/10 11:10	07/10/10 23:34	7440-47-3	
Copper	**2.4**	ug/L	0.50	0.20	1	07/06/10 11:10	07/10/10 23:34	7440-50-8	
Iron	**695**	ug/L	50.0	4.5	1	07/06/10 11:10	07/10/10 23:34	7439-89-6	
Lead	**0.19**	ug/L	0.10	0.020	1	07/06/10 11:10	07/10/10 23:34	7439-92-1	
Nickel	**0.84**	ug/L	0.50	0.19	1	07/06/10 11:10	07/10/10 23:34	7440-02-0	
Total Hardness by 2340B	**10900**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:02		
Zinc	**11.6**	ug/L	5.0	1.3	1	07/06/10 11:10	07/10/10 23:34	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**29.0**	mg/L	10.0	5.0	1		06/29/10 15:24		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**14.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**5.6**	Std. Units	0.10	0.10	1		06/30/10 18:22		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-02a **Lab ID: 254069003** Collected: 06/24/10 14:20 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**498**	ug/L	4.0	2.0	1	07/06/10 11:10	07/10/10 23:43	7429-90-5	B
Arsenic	**1.5**	ug/L	0.50	0.062	1	07/06/10 11:10	07/10/10 23:43	7440-38-2	
Barium	**4.4**	ug/L	0.30	0.043	1	07/06/10 11:10	07/10/10 23:43	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	07/06/10 11:10	07/10/10 23:43	7440-43-9	
Chromium	**1.4**	ug/L	0.50	0.24	1	07/06/10 11:10	07/10/10 23:43	7440-47-3	
Copper	**3.0**	ug/L	0.50	0.20	1	07/06/10 11:10	07/10/10 23:43	7440-50-8	
Iron	**783**	ug/L	50.0	4.5	1	07/06/10 11:10	07/10/10 23:43	7439-89-6	
Lead	**0.21**	ug/L	0.10	0.020	1	07/06/10 11:10	07/10/10 23:43	7439-92-1	
Nickel	**1.0**	ug/L	0.50	0.19	1	07/06/10 11:10	07/10/10 23:43	7440-02-0	
Total Hardness by 2340B	**11900**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:06		
Zinc	**34.4**	ug/L	5.0	1.3	1	07/06/10 11:10	07/10/10 23:43	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**22.0**	mg/L	10.0	5.0	1		06/29/10 15:25		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**16.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.2**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-03 **Lab ID: 254069004** Collected: 06/24/10 11:30 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**724**	ug/L	4.0	2.0	1	07/06/10 11:10	07/10/10 23:51	7429-90-5	B
Arsenic	**2.9**	ug/L	0.50	0.062	1	07/06/10 11:10	07/10/10 23:51	7440-38-2	
Barium	**5.0**	ug/L	0.30	0.043	1	07/06/10 11:10	07/10/10 23:51	7440-39-3	
Cadmium	**0.040J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/10/10 23:51	7440-43-9	
Chromium	**2.1**	ug/L	0.50	0.24	1	07/06/10 11:10	07/10/10 23:51	7440-47-3	
Copper	**3.9**	ug/L	0.50	0.20	1	07/06/10 11:10	07/10/10 23:51	7440-50-8	
Iron	**1140**	ug/L	50.0	4.5	1	07/06/10 11:10	07/10/10 23:51	7439-89-6	
Lead	**0.41**	ug/L	0.10	0.020	1	07/06/10 11:10	07/10/10 23:51	7439-92-1	
Nickel	**1.3**	ug/L	0.50	0.19	1	07/06/10 11:10	07/10/10 23:51	7440-02-0	
Total Hardness by 2340B	**13300**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:10		
Zinc	**20.8**	ug/L	5.0	1.3	1	07/06/10 11:10	07/10/10 23:51	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**17.0**	mg/L	10.0	5.0	1		06/29/10 15:26		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**35.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**6.9**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-04 **Lab ID: 254069005** Collected: 06/24/10 10:35 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**702**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 00:00	7429-90-5	B
Arsenic	**2.5**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 00:00	7440-38-2	
Barium	**5.4**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 00:00	7440-39-3	
Cadmium	**0.048J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 00:00	7440-43-9	
Chromium	**2.0**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 00:00	7440-47-3	
Copper	**5.0**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 00:00	7440-50-8	
Iron	**1100**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 00:00	7439-89-6	
Lead	**0.44**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 00:00	7439-92-1	
Nickel	**1.6**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 00:00	7440-02-0	
Total Hardness by 2340B	**16800**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:14		
Zinc	**33.1**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 00:00	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**26.0**	mg/L	10.0	5.0	1		06/29/10 15:27		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**12.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**6.6**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-05 **Lab ID: 254069006** Collected: 06/24/10 09:45 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**784**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 00:21	7429-90-5	B
Arsenic	**3.3**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 00:21	7440-38-2	
Barium	**5.0**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 00:21	7440-39-3	
Cadmium	**0.041J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 00:21	7440-43-9	
Chromium	**2.1**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 00:21	7440-47-3	
Copper	**5.2**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 00:21	7440-50-8	
Iron	**1160**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 00:21	7439-89-6	
Lead	**0.48**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 00:21	7439-92-1	
Nickel	**1.4**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 00:21	7440-02-0	
Total Hardness by 2340B	**17000**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:31		
Zinc	**9.3**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 00:21	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**17.0**	mg/L	10.0	5.0	1		06/29/10 15:28		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**16.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.5**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-06 **Lab ID: 254069007** Collected: 06/23/10 12:40 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**398**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 00:29	7429-90-5	B
Arsenic	**2.0**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 00:29	7440-38-2	
Barium	**3.1**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 00:29	7440-39-3	
Cadmium	**0.035J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 00:29	7440-43-9	
Chromium	**1.1**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 00:29	7440-47-3	
Copper	**2.7**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 00:29	7440-50-8	
Iron	**499**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 00:29	7439-89-6	
Lead	**0.36**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 00:29	7439-92-1	
Nickel	**0.68**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 00:29	7440-02-0	
Total Hardness by 2340B	**24000**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:35		
Zinc	**13.5**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 00:29	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**31.0**	mg/L	10.0	5.0	1		06/29/10 15:21		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**4.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.5**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: CC-SW-01 **Lab ID: 254069008** Collected: 06/23/10 11:40 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**185**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 00:37	7429-90-5	B
Arsenic	**1.3**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 00:37	7440-38-2	
Barium	**6.5**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 00:37	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 00:37	7440-43-9	
Chromium	**0.32J**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 00:37	7440-47-3	
Copper	**0.60**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 00:37	7440-50-8	
Iron	**200**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 00:37	7439-89-6	
Lead	**0.085J**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 00:37	7439-92-1	
Nickel	**0.25J**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 00:37	7440-02-0	
Total Hardness by 2340B	**33000**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:39		
Zinc	**15.8**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 00:37	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**44.0**	mg/L	10.0	5.0	1		06/29/10 15:22		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**<2.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.6**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: CC-SW-02 **Lab ID: 254069009** Collected: 06/23/10 12:20 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**382**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 00:46	7429-90-5	B
Arsenic	**2.1**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 00:46	7440-38-2	
Barium	**4.3**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 00:46	7440-39-3	
Cadmium	**0.021J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 00:46	7440-43-9	
Chromium	**1.0**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 00:46	7440-47-3	
Copper	**2.5**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 00:46	7440-50-8	
Iron	**458**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 00:46	7439-89-6	
Lead	**0.32**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 00:46	7439-92-1	
Nickel	**0.60**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 00:46	7440-02-0	
Total Hardness by 2340B	**28300**	ug/L	355	178	5	07/06/10 11:10	07/12/10 18:44		
Zinc	**11.4**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 00:46	7440-66-6	B,M0
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**33.0**	mg/L	10.0	5.0	1		06/29/10 15:23		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**8.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.4**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: AM-AS-01 **Lab ID: 254069010** Collected: 06/24/10 17:45 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**90.9**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 01:11	7429-90-5	B
Arsenic	**29.2**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 01:11	7440-38-2	
Barium	**0.92**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 01:11	7440-39-3	
Cadmium	**0.17**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 01:11	7440-43-9	
Calcium	**19100**	ug/L	20.0	5.0	1	07/06/10 11:10	07/11/10 01:11	7440-70-2	
Chromium	**0.28J**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 01:11	7440-47-3	
Copper	**3.6**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 01:11	7440-50-8	
Iron	**504**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 01:11	7439-89-6	
Lead	**0.066J**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 01:11	7439-92-1	
Nickel	**1.0**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 01:11	7440-02-0	
Potassium	**157**	ug/L	20.0	5.1	1	07/06/10 11:10	07/11/10 01:11	7440-09-7	B
Sodium	**651**	ug/L	50.0	12.5	1	07/06/10 11:10	07/11/10 01:11	7440-23-5	
Total Hardness by 2340B	**53500**	ug/L	71.0	35.5	1	07/06/10 11:10	07/11/10 01:11		
Zinc	**53.1**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 01:11	7440-66-6	B
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**41.8**	mg/L	2.0	2.0	1		07/08/10 20:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**62.0**	mg/L	10.0	5.0	1		06/29/10 15:29		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**<2.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.4**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**0.10J**	mg/L	1.0	0.076	1		07/03/10 17:51	16887-00-6	
Sulfate	**11.0**	mg/L	1.0	0.17	1		07/03/10 17:51	14808-79-8	

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: AM-SP-01 **Lab ID: 254069011** Collected: 06/24/10 19:15 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**284**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 01:19	7429-90-5	B
Arsenic	**2.5**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 01:19	7440-38-2	
Barium	**2.8**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 01:19	7440-39-3	
Cadmium	**0.28**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 01:19	7440-43-9	
Calcium	**20000**	ug/L	20.0	5.0	1	07/06/10 11:10	07/11/10 01:19	7440-70-2	
Chromium	**<0.24**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 01:19	7440-47-3	
Copper	**4.9**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 01:19	7440-50-8	
Iron	**14.2J**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 01:19	7439-89-6	
Lead	**0.056J**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 01:19	7439-92-1	
Nickel	**3.8**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 01:19	7440-02-0	
Potassium	**616**	ug/L	20.0	5.1	1	07/06/10 11:10	07/11/10 01:19	7440-09-7	B
Sodium	**1260**	ug/L	50.0	12.5	1	07/06/10 11:10	07/11/10 01:19	7440-23-5	
Total Hardness by 2340B	**60400**	ug/L	71.0	35.5	1	07/06/10 11:10	07/11/10 01:19		
Zinc	**41.9**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 01:19	7440-66-6	B
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**20.0**	mg/L	2.0	2.0	1		07/08/10 20:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**83.0**	mg/L	10.0	5.0	1		06/29/10 15:30		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**<2.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.0**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**6.2**	mg/L	1.0	0.076	1		07/03/10 18:08	16887-00-6	
Sulfate	**35.2**	mg/L	20.0	3.4	20		07/08/10 20:47	14808-79-8	

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: AM-SP-02 **Lab ID: 254069012** Collected: 06/24/10 18:40 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**24800**	ug/L	20.0	10.0	5	07/06/10 11:10	07/11/10 01:32	7429-90-5	B
Arsenic	**0.45J**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 01:28	7440-38-2	
Barium	**14.3**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 01:28	7440-39-3	
Cadmium	**2.9**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 01:28	7440-43-9	
Calcium	**39300**	ug/L	100	24.8	5	07/06/10 11:10	07/11/10 01:32	7440-70-2	
Chromium	**1.5**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 01:28	7440-47-3	
Copper	**592**	ug/L	2.5	1.0	5	07/06/10 11:10	07/11/10 01:32	7440-50-8	
Iron	**251**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 01:28	7439-89-6	
Lead	**2.3**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 01:28	7439-92-1	
Nickel	**43.9**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 01:28	7440-02-0	
Potassium	**3200**	ug/L	20.0	5.1	1	07/06/10 11:10	07/11/10 01:28	7440-09-7	B
Sodium	**4590**	ug/L	50.0	12.5	1	07/06/10 11:10	07/11/10 01:28	7440-23-5	
Total Hardness by 2340B	**168000**	ug/L	355	178	5	07/06/10 11:10	07/11/10 01:32		
Zinc	**410**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 01:28	7440-66-6	B
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**<2.0**	mg/L	2.0	2.0	1		07/08/10 20:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**21.0**	mg/L	10.0	5.0	1		06/29/10 15:31		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**3.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**3.9**	Std. Units	0.10	0.10	1		06/30/10 18:22		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**0.22J**	mg/L	1.0	0.076	1		07/07/10 12:39	16887-00-6	
Sulfate	**337**	mg/L	50.0	8.5	50		07/08/10 23:15	14808-79-8	

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-07 **Lab ID: 254069013** Collected: 06/24/10 10:10 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**662**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 01:36	7429-90-5	B
Arsenic	**2.3**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 01:36	7440-38-2	
Barium	**5.0**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 01:36	7440-39-3	
Cadmium	**0.028J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 01:36	7440-43-9	
Chromium	**1.9**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 01:36	7440-47-3	
Copper	**4.6**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 01:36	7440-50-8	
Iron	**1020**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 01:36	7439-89-6	
Lead	**0.32**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 01:36	7439-92-1	
Nickel	**1.4**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 01:36	7440-02-0	
Zinc	**19.3**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 01:36	7440-66-6	B

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-08 **Lab ID: 254069014** Collected: 06/25/10 07:30 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**7.8**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 01:40	7429-90-5	B
Arsenic	**<0.062**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 01:40	7440-38-2	
Barium	**0.086J**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 01:40	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 01:40	7440-43-9	
Chromium	**0.27J**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 01:40	7440-47-3	
Copper	**0.93**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 01:40	7440-50-8	
Iron	**5.1J**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 01:40	7439-89-6	
Lead	**0.12**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 01:40	7439-92-1	
Nickel	**<0.19**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 01:40	7440-02-0	
Zinc	**6.3**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 01:40	7440-66-6	B

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Sample: MC-SW-02b **Lab ID: 254069015** Collected: 06/24/10 13:15 Received: 06/26/10 10:20 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**681**	ug/L	4.0	2.0	1	07/06/10 11:10	07/11/10 01:44	7429-90-5	B
Arsenic	**2.2**	ug/L	0.50	0.062	1	07/06/10 11:10	07/11/10 01:44	7440-38-2	
Barium	**5.2**	ug/L	0.30	0.043	1	07/06/10 11:10	07/11/10 01:44	7440-39-3	
Cadmium	**0.038J**	ug/L	0.080	0.020	1	07/06/10 11:10	07/11/10 01:44	7440-43-9	
Chromium	**1.8**	ug/L	0.50	0.24	1	07/06/10 11:10	07/11/10 01:44	7440-47-3	
Copper	**3.8**	ug/L	0.50	0.20	1	07/06/10 11:10	07/11/10 01:44	7440-50-8	
Iron	**1110**	ug/L	50.0	4.5	1	07/06/10 11:10	07/11/10 01:44	7439-89-6	
Lead	**0.28**	ug/L	0.10	0.020	1	07/06/10 11:10	07/11/10 01:44	7439-92-1	
Nickel	**1.3**	ug/L	0.50	0.19	1	07/06/10 11:10	07/11/10 01:44	7440-02-0	
Zinc	**13.2**	ug/L	5.0	1.3	1	07/06/10 11:10	07/11/10 01:44	7440-66-6	B
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**19.0**	mg/L	10.0	5.0	1		06/29/10 15:32		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**17.0**	mg/L	2.0	2.0	1		06/29/10 13:30		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.1**	Std. Units	0.10	0.10	1		06/29/10 16:30		H6

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: ICPM/21220 Analysis Method: EPA 6020
QC Batch Method: EPA 6020 Analysis Description: 6020 MET
Associated Lab Samples: 254069001, 254069002, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009

METHOD BLANK: 817215 Matrix: Water

Associated Lab Samples: 254069001, 254069002, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009, 254069010, 254069011, 254069012, 254069013, 254069014, 254069015

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	ug/L	2.9J	4.0	07/12/10 17:37	
Arsenic	ug/L	<0.062	0.50	07/12/10 17:37	
Barium	ug/L	<0.043	0.30	07/12/10 17:37	
Cadmium	ug/L	<0.020	0.080	07/12/10 17:37	
Calcium	ug/L	<5.0	20.0	07/12/10 17:37	
Chromium	ug/L	<0.24	0.50	07/12/10 17:37	
Copper	ug/L	<0.20	0.50	07/12/10 17:37	
Iron	ug/L	<4.5	50.0	07/12/10 17:37	
Lead	ug/L	<0.020	0.10	07/12/10 17:37	
Nickel	ug/L	<0.19	0.50	07/12/10 17:37	
Potassium	ug/L	7.8J	20.0	07/12/10 17:37	
Sodium	ug/L	<12.5	50.0	07/12/10 17:37	
Total Hardness by 2340B	ug/L	<35.5	71.0	07/12/10 17:37	
Zinc	ug/L	1.9J	5.0	07/12/10 17:37	

LABORATORY CONTROL SAMPLE: 817216

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/L	80	84.3	105	80-120	
Arsenic	ug/L	80	81.0	101	80-120	
Barium	ug/L	80	80.2	100	80-120	
Cadmium	ug/L	80	80.2	100	80-120	
Calcium	ug/L	1000	1050	105	80-120	
Chromium	ug/L	80	81.1	101	80-120	
Copper	ug/L	80	84.2	105	80-120	
Iron	ug/L	1000	1020	102	80-120	
Lead	ug/L	80	77.6	97	80-120	
Nickel	ug/L	80	84.1	105	80-120	
Potassium	ug/L	1000	1040	104	80-120	
Sodium	ug/L	1000	1000	100	80-120	
Total Hardness by 2340B	ug/L		6790			
Zinc	ug/L	80	80.1	100	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 817217 817218

Parameter	Units	254060001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	ug/L	<20.0	80	80	95.6	95.9	98	99	75-125	.4	20	
Arsenic	ug/L	68.4	80	80	151	152	104	105	75-125	.7	20	

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 817217 817218

Parameter	Units	254060001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Barium	ug/L	91.0	80	80	166	173	94	103	75-125	4	20	
Cadmium	ug/L	0.053J	80	80	77.0	81.2	96	101	75-125	5	20	
Calcium	ug/L	82800	1000	1000	84000	86500	115	367	75-125	3	20	M0
Chromium	ug/L	0.51	80	80	80.7	83.1	100	103	75-125	3	20	
Copper	ug/L	4.4	80	80	87.4	88.9	104	106	75-125	2	20	
Iron	ug/L	107	1000	1000	1110	1160	100	106	75-125	5	20	
Lead	ug/L	0.83	80	80	76.9	79.0	95	98	75-125	3	20	
Nickel	ug/L	2.4	80	80	85.4	86.1	104	105	75-125	.8	20	
Potassium	ug/L	3000	1000	1000	4060	4080	106	108	75-125	.6	20	
Sodium	ug/L	15300	1000	1000	16400	16700	114	138	75-125	1	20	M0
Total Hardness by 2340B	ug/L	325000			332000	343000				3	20	
Zinc	ug/L	11.4	80	80	91.9	95.6	101	105	75-125	4	20	

MATRIX SPIKE SAMPLE: 817219

Parameter	Units	254069009 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/L	382	80	470	111	75-125	
Arsenic	ug/L	2.1	80	80.6	98	75-125	
Barium	ug/L	4.3	80	84.0	100	75-125	
Cadmium	ug/L	0.021J	80	78.1	98	75-125	
Calcium	ug/L		1000	9900	47	75-125	M0
Chromium	ug/L	1.0	80	81.6	101	75-125	
Copper	ug/L	2.5	80	85.2	103	75-125	
Iron	ug/L	458	1000	1450	99	75-125	
Lead	ug/L	0.32	80	75.9	94	75-125	
Nickel	ug/L	0.60	80	84.1	104	75-125	
Potassium	ug/L	410	1000	1430	102	75-125	
Sodium	ug/L	715	1000	1750	103	75-125	
Total Hardness by 2340B	ug/L	28300		33700			
Zinc	ug/L	11.4	80	113	127	75-125	M0

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: WET/2129
Analysis Method: SM 2320B
QC Batch Method: SM 2320B
Analysis Description: 2320B Alkalinity
Associated Lab Samples: 254069010, 254069011, 254069012

METHOD BLANK: 32404
Matrix: Water
Associated Lab Samples: 254069010, 254069011, 254069012

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<2.0	2.0	07/08/10 20:00	

LABORATORY CONTROL SAMPLE: 32405

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	100	96.9	97	90-110	

SAMPLE DUPLICATE: 32406

Parameter	Units	254069010 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	41.8	41.8	0	10	

SAMPLE DUPLICATE: 32906

Parameter	Units	254127045 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<2.0	<2.0		10	

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: WET/2110
Analysis Method: SM 2540C
QC Batch Method: SM 2540C
Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 254069001, 254069002, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009, 254069010, 254069011, 254069012, 254069015

METHOD BLANK: 31624
Matrix: Water

Associated Lab Samples: 254069001, 254069002, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009, 254069010, 254069011, 254069012, 254069015

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	10.0	06/29/10 15:20	

LABORATORY CONTROL SAMPLE: 31625

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	300	296	99	80-120	

SAMPLE DUPLICATE: 31626

Parameter	Units	254069007 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	31.0	23.0	30	20	D8

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: WET/2109
Analysis Method: SM 2540D
QC Batch Method: SM 2540D
Analysis Description: 2540D Total Suspended Solids
Associated Lab Samples: 254069001, 254069002, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009, 254069010, 254069011, 254069012, 254069015

METHOD BLANK: 31621
Matrix: Water
Associated Lab Samples: 254069001, 254069002, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009, 254069010, 254069011, 254069012, 254069015

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Suspended Solids	mg/L	<2.0	2.0	06/29/10 13:30	

SAMPLE DUPLICATE: 31622

Parameter	Units	254069007 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	4.0	6.0	40	20	D8

SAMPLE DUPLICATE: 31623

Parameter	Units	254069006 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	16.0	12.0	29	20	D6

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: WET/2111
Analysis Method: SM 4500-H+B
QC Batch Method: SM 4500-H+B
Analysis Description: 4500H+B pH
Associated Lab Samples: 254069001, 254069003, 254069004, 254069005, 254069006, 254069007, 254069008, 254069009, 254069010, 254069011, 254069015

SAMPLE DUPLICATE: 31628

Parameter	Units	254069008 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.6	7.6	.3	10	H6

SAMPLE DUPLICATE: 31629

Parameter	Units	254069010 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.4	7.4	.9	10	H6

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: WET/2117
QC Batch Method: SM 4500-H+B
Analysis Method: SM 4500-H+B
Analysis Description: 4500H+B pH
Associated Lab Samples: 254069002, 254069012

SAMPLE DUPLICATE: 31907

Parameter	Units	254069002 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	5.6	5.5	2	10	H6

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

QC Batch: WETA/1602 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions
Associated Lab Samples: 254069010, 254069011, 254069012

METHOD BLANK: 32286 Matrix: Water
Associated Lab Samples: 254069010, 254069011, 254069012

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Chloride	mg/L	<0.076	1.0	07/03/10 16:24	
Sulfate	mg/L	<0.17	1.0	07/03/10 16:24	

LABORATORY CONTROL SAMPLE: 32287

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.7	95	90-110	
Sulfate	mg/L	15	15.5	104	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 32288 32289

Parameter	Units	254052001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	56.8	100	100	174	175	117	118	90-110	.6	11	M1
Sulfate	mg/L	69400 ug/L	300	300	426	436	119	122	90-110	2	10	M1

QUALIFIERS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-S	Pace Analytical Services - Seattle

ANALYTE QUALIFIERS

B	Analyte was detected in the associated method blank.
D6	The relative percent difference (RPD) between the sample and sample duplicate exceeded laboratory control limits.
D8	The sample and duplicate results for this parameter are less than 5 times the reporting limit, the RPD may not be statistically valid.
H6	Analysis initiated more than 15 minutes after sample collection.
M0	Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
254069001	**MC-SW-01a**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069002	**MC-SW-01b**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069003	**MC-SW-02a**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069004	**MC-SW-03**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069005	**MC-SW-04**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069006	**MC-SW-05**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069007	**MC-SW-06**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069008	**CC-SW-01**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069009	**CC-SW-02**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069010	**AM-AS-01**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069011	**AM-SP-01**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069012	**AM-SP-02**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069013	**MC-SW-07**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069014	**MC-SW-08**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069015	**MC-SW-02b**	EPA 6020	ICPM/21220	EPA 6020	ICPM/8704
254069010	**AM-AS-01**	SM 2320B	WET/2129		
254069011	**AM-SP-01**	SM 2320B	WET/2129		
254069012	**AM-SP-02**	SM 2320B	WET/2129		
254069001	**MC-SW-01a**	SM 2540C	WET/2110		
254069002	**MC-SW-01b**	SM 2540C	WET/2110		
254069003	**MC-SW-02a**	SM 2540C	WET/2110		
254069004	**MC-SW-03**	SM 2540C	WET/2110		
254069005	**MC-SW-04**	SM 2540C	WET/2110		
254069006	**MC-SW-05**	SM 2540C	WET/2110		
254069007	**MC-SW-06**	SM 2540C	WET/2110		
254069008	**CC-SW-01**	SM 2540C	WET/2110		
254069009	**CC-SW-02**	SM 2540C	WET/2110		
254069010	**AM-AS-01**	SM 2540C	WET/2110		
254069011	**AM-SP-01**	SM 2540C	WET/2110		
254069012	**AM-SP-02**	SM 2540C	WET/2110		
254069015	**MC-SW-02b**	SM 2540C	WET/2110		
254069001	**MC-SW-01a**	SM 2540D	WET/2109		
254069002	**MC-SW-01b**	SM 2540D	WET/2109		
254069003	**MC-SW-02a**	SM 2540D	WET/2109		
254069004	**MC-SW-03**	SM 2540D	WET/2109		
254069005	**MC-SW-04**	SM 2540D	WET/2109		
254069006	**MC-SW-05**	SM 2540D	WET/2109		
254069007	**MC-SW-06**	SM 2540D	WET/2109		
254069008	**CC-SW-01**	SM 2540D	WET/2109		
254069009	**CC-SW-02**	SM 2540D	WET/2109		
254069010	**AM-AS-01**	SM 2540D	WET/2109		
254069011	**AM-SP-01**	SM 2540D	WET/2109		
254069012	**AM-SP-02**	SM 2540D	WET/2109		
254069015	**MC-SW-02b**	SM 2540D	WET/2109		
254069001	**MC-SW-01a**	SM 4500-H+B	WET/2111		
254069002	**MC-SW-01b**	SM 4500-H+B	WET/2117		

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254069

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
254069003	**MC-SW-02a**	SM 4500-H+B	WET/2111		
254069004	**MC-SW-03**	SM 4500-H+B	WET/2111		
254069005	**MC-SW-04**	SM 4500-H+B	WET/2111		
254069006	**MC-SW-05**	SM 4500-H+B	WET/2111		
254069007	**MC-SW-06**	SM 4500-H+B	WET/2111		
254069008	**CC-SW-01**	SM 4500-H+B	WET/2111		
254069009	**CC-SW-02**	SM 4500-H+B	WET/2111		
254069010	**AM-AS-01**	SM 4500-H+B	WET/2111		
254069011	**AM-SP-01**	SM 4500-H+B	WET/2111		
254069012	**AM-SP-02**	SM 4500-H+B	WET/2117		
254069015	**MC-SW-02b**	SM 4500-H+B	WET/2111		
254069010	**AM-AS-01**	EPA 300.0	WETA/1602		
254069011	**AM-SP-01**	EPA 300.0	WETA/1602		
254069012	**AM-SP-02**	EPA 300.0	WETA/1602		

Pace Analytical Services, Inc.
940 South Harney
Seattle, WA 98108
(206)767-5060

July 16, 2010

Ryan Tobias
Cascade Earth Sciences
3511 Pacific Blvd. SW
Albany, OR 97321

RE: Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Dear Ryan Tobias:

Enclosed are the analytical results for sample(s) received by the laboratory on June 26, 2010. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jenni Gross

Jennifer Gross

jennifer.gross@pacelabs.com
Project Manager

Enclosures

cc: Dustin Wasley, Cascade Earth Sciences

CERTIFICATIONS

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254070

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
EPA Region 8 Certification #: Pace
Florida/NELAP Certification #: E87605
Georgia Certification #: 959
Idaho Certification #: MN00064
Illinois Certification #: 200011
Iowa Certification #: 368
Kansas Certification #: E-10167
Louisiana Certification #: 03086
Louisiana Certification #: LA080009
Maine Certification #: 2007029
Maryland Certification #: 322
Michigan DEQ Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT CERT0092
Nebraska Certification #: Pace
Nevada Certification #: MN_00064
New Jersey Certification #: MN-002
New Mexico Certification #: Pace
New York Certification #: 11647
North Carolina Certification #: 530
North Dakota Certification #: R-036
North Dakota Certification #: R-036A
Ohio VAP Certification #: CL101
Oklahoma Certification #: D9921
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Tennessee Certification #: 02818
Texas Certification #: T104704192
Washington Certification #: C754
Wisconsin Certification #: 999407970

Washington Certification IDs

940 South Harney Street, Seattle, WA 98108
Alaska CS Certification #: UST-025
Alaska Drinking Water VOC Certification #: WA01230
Alaska Drinking Water Micro Certification #: WA01230
California Certification #: 01153CA
Florida/NELAP Certification #: E87617
Oregon Certification #: WA200007
Washington Certification #: C1229

SAMPLE SUMMARY

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Lab ID	Sample ID	Matrix	Date Collected	Date Received
254070001	**MC-SS-01a**	Solid	06/24/10 16:05	06/26/10 10:20
254070002	**MC-SS-01b**	Solid	06/24/10 15:00	06/26/10 10:20
254070003	**MC-SS-02a**	Solid	06/24/10 14:30	06/26/10 10:20
254070004	**MC-SS-02b**	Solid	06/24/10 13:20	06/26/10 10:20
254070005	**MC-SS-03**	Solid	06/24/10 11:40	06/26/10 10:20
254070006	**MC-SS-04**	Solid	06/24/10 10:45	06/26/10 10:20
254070007	**MC-SS-05**	Solid	06/24/10 09:50	06/26/10 10:20
254070008	**MC-SS-06**	Solid	06/23/10 12:50	06/26/10 10:20
254070009	**CC-SS-01**	Solid	06/23/10 12:00	06/26/10 10:20
254070010	**CC-SS-02**	Solid	06/23/10 12:30	06/26/10 10:20

SAMPLE ANALYTE COUNT

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254070

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
254070001	**MC-SS-01a**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070002	**MC-SS-01b**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070003	**MC-SS-02a**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070004	**MC-SS-02b**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070005	**MC-SS-03**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070006	**MC-SS-04**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070007	**MC-SS-05**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070008	**MC-SS-06**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	ERB	1	PASI-S
254070009	**CC-SS-01**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	CC	1	PASI-S
254070010	**CC-SS-02**	EPA 6010	BGA	8	PASI-S
		EPA 6020	CJS	2	PASI-M
		ASTM D2974-87	CC	1	PASI-S

PROJECT NARRATIVE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Method: **EPA 6010**
Description: 6010 MET ICP
Client: Cascade Earth Sciences
Date: July 16, 2010

General Information:
10 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: MPRP/1627

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 254070001

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 32339)
  - Aluminum
  - Copper
  - Iron
  - Nickel
- MSD (Lab ID: 32340)
  - Aluminum
  - Arsenic
  - Copper
  - Iron
  - Nickel

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254070

Method: **EPA 6020**
Description: 6020 MET ICPMS
Client: Cascade Earth Sciences
Date: July 16, 2010

General Information:
10 samples were analyzed for EPA 6020. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-01a **Lab ID: 254070001** Collected: 06/24/10 16:05 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**9150**	mg/kg	57.3	1.2	1	07/06/10 08:09	07/07/10 15:09	7429-90-5	
Arsenic	**80.1**	mg/kg	11.5	0.97	5	07/06/10 08:09	07/07/10 14:32	7440-38-2	
Barium	**29.8**	mg/kg	22.9	0.023	1	07/06/10 08:09	07/07/10 15:09	7440-39-3	
Cadmium	**<0.057**	mg/kg	5.7	0.057	5	07/06/10 08:09	07/07/10 14:32	7440-43-9	
Chromium	**25.4**	mg/kg	1.1	0.057	1	07/06/10 08:09	07/07/10 15:09	7440-47-3	
Copper	**81.5**	mg/kg	14.3	0.69	5	07/06/10 08:09	07/07/10 14:32	7440-50-8	
Iron	**42900**	mg/kg	115	1.9	5	07/06/10 08:09	07/07/10 14:32	7439-89-6	
Nickel	**29.4**	mg/kg	22.9	0.11	5	07/06/10 08:09	07/07/10 14:32	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**6.5**	mg/kg	0.60	0.048	20	07/01/10 17:28	07/14/10 14:26	7439-92-1	
Zinc	**81.9**	mg/kg	6.0	1.6	20	07/01/10 17:28	07/14/10 14:26	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**26.1**	%	0.10	0.10	1		06/30/10 18:14		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-01b **Lab ID: 254070002** Collected: 06/24/10 15:00 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**13900**	mg/kg	59.7	1.3	1	07/06/10 08:09	07/07/10 15:17	7429-90-5	
Arsenic	**37.7**	mg/kg	11.9	1.0	5	07/06/10 08:09	07/07/10 14:40	7440-38-2	
Barium	**44.0**	mg/kg	23.9	0.024	1	07/06/10 08:09	07/07/10 15:17	7440-39-3	
Cadmium	**<0.060**	mg/kg	6.0	0.060	5	07/06/10 08:09	07/07/10 14:40	7440-43-9	
Chromium	**44.6**	mg/kg	1.2	0.060	1	07/06/10 08:09	07/07/10 15:17	7440-47-3	
Copper	**117**	mg/kg	14.9	0.72	5	07/06/10 08:09	07/07/10 14:40	7440-50-8	
Iron	**47000**	mg/kg	119	2.0	5	07/06/10 08:09	07/07/10 14:40	7439-89-6	
Nickel	**30.1**	mg/kg	23.9	0.12	5	07/06/10 08:09	07/07/10 14:40	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**5.6**	mg/kg	0.42	0.033	20	07/01/10 17:28	07/14/10 14:31	7439-92-1	
Zinc	**75.1**	mg/kg	4.2	1.1	20	07/01/10 17:28	07/14/10 14:31	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**19.5**	%	0.10	0.10	1		06/30/10 18:18		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-02a **Lab ID: 254070003** Collected: 06/24/10 14:30 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**10800**	mg/kg	55.8	1.2	1	07/06/10 08:09	07/07/10 15:19	7429-90-5	
Arsenic	**22.9**	mg/kg	11.2	0.95	5	07/06/10 08:09	07/07/10 14:43	7440-38-2	
Barium	**36.7**	mg/kg	22.3	0.022	1	07/06/10 08:09	07/07/10 15:19	7440-39-3	
Cadmium	**<0.056**	mg/kg	5.6	0.056	5	07/06/10 08:09	07/07/10 14:43	7440-43-9	
Chromium	**25.3**	mg/kg	1.1	0.056	1	07/06/10 08:09	07/07/10 15:19	7440-47-3	
Copper	**59.0**	mg/kg	14.0	0.67	5	07/06/10 08:09	07/07/10 14:43	7440-50-8	
Iron	**32400**	mg/kg	112	1.9	5	07/06/10 08:09	07/07/10 14:43	7439-89-6	
Nickel	**20.1J**	mg/kg	22.3	0.11	5	07/06/10 08:09	07/07/10 14:43	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**6.1**	mg/kg	0.47	0.037	20	07/01/10 17:28	07/14/10 14:40	7439-92-1	
Zinc	**86.6**	mg/kg	4.7	1.3	20	07/01/10 17:28	07/14/10 14:40	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**12.2**	%	0.10	0.10	1		06/30/10 18:21		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-02b **Lab ID: 254070004** Collected: 06/24/10 13:20 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**12200**	mg/kg	54.1	1.2	1	07/06/10 08:09	07/07/10 15:22	7429-90-5	
Arsenic	**133**	mg/kg	10.8	0.92	5	07/06/10 08:09	07/07/10 14:45	7440-38-2	
Barium	**36.7**	mg/kg	21.7	0.022	1	07/06/10 08:09	07/07/10 15:22	7440-39-3	
Cadmium	**<0.054**	mg/kg	5.4	0.054	5	07/06/10 08:09	07/07/10 14:45	7440-43-9	
Chromium	**19.3**	mg/kg	1.1	0.054	1	07/06/10 08:09	07/07/10 15:22	7440-47-3	
Copper	**74.8**	mg/kg	13.5	0.65	5	07/06/10 08:09	07/07/10 14:45	7440-50-8	
Iron	**39900**	mg/kg	108	1.8	5	07/06/10 08:09	07/07/10 14:45	7439-89-6	
Nickel	**23.6**	mg/kg	21.7	0.11	5	07/06/10 08:09	07/07/10 14:45	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**4.2**	mg/kg	0.39	0.031	20	07/01/10 17:28	07/14/10 14:46	7439-92-1	
Zinc	**111**	mg/kg	3.9	1.1	20	07/01/10 17:28	07/14/10 14:46	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**11.2**	%	0.10	0.10	1		06/30/10 18:23		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-03 **Lab ID: 254070005** Collected: 06/24/10 11:40 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**31300**	mg/kg	290	6.2	5	07/06/10 08:09	07/07/10 14:48	7429-90-5	
Arsenic	**170**	mg/kg	11.6	0.99	5	07/06/10 08:09	07/07/10 14:48	7440-38-2	
Barium	**58.8**	mg/kg	23.2	0.023	1	07/06/10 08:09	07/07/10 15:35	7440-39-3	
Cadmium	**0.58J**	mg/kg	5.8	0.058	5	07/06/10 08:09	07/07/10 14:48	7440-43-9	
Chromium	**100**	mg/kg	1.2	0.058	1	07/06/10 08:09	07/07/10 15:35	7440-47-3	
Copper	**318**	mg/kg	14.5	0.70	5	07/06/10 08:09	07/07/10 14:48	7440-50-8	
Iron	**57600**	mg/kg	116	2.0	5	07/06/10 08:09	07/07/10 14:48	7439-89-6	
Nickel	**60.8**	mg/kg	23.2	0.12	5	07/06/10 08:09	07/07/10 14:48	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**29.6**	mg/kg	0.50	0.040	20	07/01/10 17:28	07/14/10 14:50	7439-92-1	
Zinc	**176**	mg/kg	5.0	1.4	20	07/01/10 17:28	07/13/10 00:30	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**26.3**	%	0.10	0.10	1		06/30/10 18:28		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-04 **Lab ID: 254070006** Collected: 06/24/10 10:45 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**28200**	mg/kg	280	6.0	5	07/06/10 08:09	07/07/10 14:50	7429-90-5	
Arsenic	**60.4**	mg/kg	11.2	0.95	5	07/06/10 08:09	07/07/10 14:50	7440-38-2	
Barium	**53.1**	mg/kg	22.4	0.022	1	07/06/10 08:09	07/07/10 15:38	7440-39-3	
Cadmium	**<0.056**	mg/kg	5.6	0.056	5	07/06/10 08:09	07/07/10 14:50	7440-43-9	
Chromium	**88.1**	mg/kg	1.1	0.056	1	07/06/10 08:09	07/07/10 15:38	7440-47-3	
Copper	**220**	mg/kg	14.0	0.67	5	07/06/10 08:09	07/07/10 14:50	7440-50-8	
Iron	**48500**	mg/kg	112	1.9	5	07/06/10 08:09	07/07/10 14:50	7439-89-6	
Nickel	**45.9**	mg/kg	22.4	0.11	5	07/06/10 08:09	07/07/10 14:50	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**12.1**	mg/kg	0.45	0.036	20	07/01/10 17:28	07/13/10 00:43	7439-92-1	
Zinc	**201**	mg/kg	4.5	1.2	20	07/01/10 17:28	07/13/10 00:43	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**15.8**	%	0.10	0.10	1		06/30/10 18:30		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-05 **Lab ID: 254070007** Collected: 06/24/10 09:50 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**30100**	mg/kg	300	6.4	5	07/06/10 08:09	07/07/10 14:58	7429-90-5	
Arsenic	**108**	mg/kg	12.0	1.0	5	07/06/10 08:09	07/07/10 14:58	7440-38-2	
Barium	**44.6**	mg/kg	24.0	0.024	1	07/06/10 08:09	07/07/10 15:41	7440-39-3	
Cadmium	**<0.060**	mg/kg	6.0	0.060	5	07/06/10 08:09	07/07/10 14:58	7440-43-9	
Chromium	**76.6**	mg/kg	1.2	0.060	1	07/06/10 08:09	07/07/10 15:41	7440-47-3	
Copper	**224**	mg/kg	15.0	0.72	5	07/06/10 08:09	07/07/10 14:58	7440-50-8	
Iron	**58300**	mg/kg	120	2.0	5	07/06/10 08:09	07/07/10 14:58	7439-89-6	
Nickel	**56.0**	mg/kg	24.0	0.12	5	07/06/10 08:09	07/07/10 14:58	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**38.3**	mg/kg	0.47	0.037	20	07/01/10 17:28	07/13/10 00:48	7439-92-1	
Zinc	**214**	mg/kg	4.7	1.3	20	07/01/10 17:28	07/13/10 00:48	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**19.0**	%	0.10	0.10	1		06/30/10 18:33		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: MC-SS-06 **Lab ID: 254070008** Collected: 06/23/10 12:50 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**15200**	mg/kg	61.0	1.3	1	07/06/10 08:09	07/07/10 15:44	7429-90-5	
Arsenic	**30.5**	mg/kg	12.2	1.0	5	07/06/10 08:09	07/07/10 15:01	7440-38-2	
Barium	**53.6**	mg/kg	24.4	0.024	1	07/06/10 08:09	07/07/10 15:44	7440-39-3	
Cadmium	**<0.061**	mg/kg	6.1	0.061	5	07/06/10 08:09	07/07/10 15:01	7440-43-9	
Chromium	**40.2**	mg/kg	1.2	0.061	1	07/06/10 08:09	07/07/10 15:44	7440-47-3	
Copper	**49.4**	mg/kg	15.2	0.73	5	07/06/10 08:09	07/07/10 15:01	7440-50-8	
Iron	**42000**	mg/kg	122	2.1	5	07/06/10 08:09	07/07/10 15:01	7439-89-6	
Nickel	**40.1**	mg/kg	24.4	0.12	5	07/06/10 08:09	07/07/10 15:01	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**7.0**	mg/kg	0.53	0.043	20	07/01/10 17:28	07/13/10 00:52	7439-92-1	
Zinc	**115**	mg/kg	5.3	1.4	20	07/01/10 17:28	07/13/10 00:52	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**19.6**	%	0.10	0.10	1		06/30/10 18:36		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: CC-SS-01 **Lab ID: 254070009** Collected: 06/23/10 12:00 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**25700**	mg/kg	257	5.5	5	07/06/10 08:09	07/07/10 15:04	7429-90-5	
Arsenic	**37.1**	mg/kg	10.3	0.87	5	07/06/10 08:09	07/07/10 15:04	7440-38-2	
Barium	**32.3**	mg/kg	20.6	0.021	1	07/06/10 08:09	07/07/10 15:46	7440-39-3	
Cadmium	**<0.051**	mg/kg	5.1	0.051	5	07/06/10 08:09	07/07/10 15:04	7440-43-9	
Chromium	**77.5**	mg/kg	1.0	0.051	1	07/06/10 08:09	07/07/10 15:46	7440-47-3	
Copper	**99.7**	mg/kg	12.9	0.62	5	07/06/10 08:09	07/07/10 15:04	7440-50-8	
Iron	**42300**	mg/kg	103	1.7	5	07/06/10 08:09	07/07/10 15:04	7439-89-6	
Nickel	**52.1**	mg/kg	20.6	0.10	5	07/06/10 08:09	07/07/10 15:04	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**6.7**	mg/kg	0.52	0.041	20	07/01/10 17:28	07/13/10 00:57	7439-92-1	
Zinc	**96.5**	mg/kg	5.2	1.4	20	07/01/10 17:28	07/13/10 00:57	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**21.6**	%	0.10	0.10	1		07/01/10 16:20		

ANALYTICAL RESULTS

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Sample: CC-SS-02 **Lab ID: 254070010** Collected: 06/23/10 12:30 Received: 06/26/10 10:20 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**26500**	mg/kg	268	5.7	5	07/06/10 08:09	07/07/10 15:06	7429-90-5	
Arsenic	**42.0**	mg/kg	10.7	0.91	5	07/06/10 08:09	07/07/10 15:06	7440-38-2	
Barium	**34.0**	mg/kg	21.4	0.021	1	07/06/10 08:09	07/07/10 15:49	7440-39-3	
Cadmium	**<0.054**	mg/kg	5.4	0.054	5	07/06/10 08:09	07/07/10 15:06	7440-43-9	
Chromium	**72.8**	mg/kg	1.1	0.054	1	07/06/10 08:09	07/07/10 15:49	7440-47-3	
Copper	**109**	mg/kg	13.4	0.64	5	07/06/10 08:09	07/07/10 15:06	7440-50-8	
Iron	**45200**	mg/kg	107	1.8	5	07/06/10 08:09	07/07/10 15:06	7439-89-6	
Nickel	**49.0**	mg/kg	21.4	0.11	5	07/06/10 08:09	07/07/10 15:06	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**8.4**	mg/kg	0.49	0.039	20	07/01/10 17:28	07/13/10 01:01	7439-92-1	
Zinc	**130**	mg/kg	4.9	1.3	20	07/01/10 17:28	07/13/10 01:01	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**16.6**	%	0.10	0.10	1		07/01/10 16:25		

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

QC Batch: MPRP/1627
Analysis Method: EPA 6010
QC Batch Method: EPA 3050
Analysis Description: 6010 MET
Associated Lab Samples: 254070001, 254070002, 254070003, 254070004, 254070005, 254070006, 254070007, 254070008, 254070009, 254070010

METHOD BLANK: 32337
Matrix: Solid
Associated Lab Samples: 254070001, 254070002, 254070003, 254070004, 254070005, 254070006, 254070007, 254070008, 254070009, 254070010

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	mg/kg	<1.1	50.0	07/07/10 14:27	
Arsenic	mg/kg	<0.17	2.0	07/07/10 14:27	
Barium	mg/kg	<0.020	20.0	07/07/10 14:27	
Cadmium	mg/kg	<0.010	1.0	07/07/10 14:27	
Chromium	mg/kg	<0.050	1.0	07/07/10 14:27	
Copper	mg/kg	<0.12	2.5	07/07/10 14:27	
Iron	mg/kg	<0.34	20.0	07/07/10 14:27	
Nickel	mg/kg	<0.020	4.0	07/07/10 14:27	

LABORATORY CONTROL SAMPLE: 32338

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	mg/kg	500	430	86	80-120	
Arsenic	mg/kg	25	21.8	87	80-120	
Barium	mg/kg	25	21.6	86	80-120	
Cadmium	mg/kg	25	22.0	88	80-120	
Chromium	mg/kg	25	23.7	95	80-120	
Copper	mg/kg	25	22.2	89	80-120	
Iron	mg/kg	500	457	91	80-120	
Nickel	mg/kg	25	23.2	93	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 32339 32340

Parameter	Units	254070001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	mg/kg	9150	568	568	11200	10200	366	193	75-125	9	20	M1
Arsenic	mg/kg	80.1	28.4	28.4	115	124	121	156	75-125	8	20	M1
Barium	mg/kg	29.8	28.4	28.4	61.4	57.1	111	96	75-125	7	20	
Cadmium	mg/kg	<0.057	28.4	28.4	29.6	31.9	104	112	75-125	8	20	
Chromium	mg/kg	25.4	28.4	28.4	57.7	53.3	114	98	75-125	8	20	
Copper	mg/kg	81.5	28.4	28.4	122	138	144	199	75-125	12	20	M1
Iron	mg/kg	42900	568	568	48500	48600	982	992	75-125	.1	20	M1
Nickel	mg/kg	29.4	28.4	28.4	65.5	65.9	127	129	75-125	.6	20	M1

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

QC Batch: ICPM/21217
Analysis Method: EPA 6020
QC Batch Method: EPA 6020
Analysis Description: 6020 MET
Associated Lab Samples: 254070001, 254070002, 254070003, 254070004, 254070005, 254070006, 254070007, 254070008, 254070009, 254070010

METHOD BLANK: 817122
Matrix: Solid
Associated Lab Samples: 254070001, 254070002, 254070003, 254070004, 254070005, 254070006, 254070007, 254070008, 254070009, 254070010

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Lead	mg/kg	<0.035	0.44	07/14/10 13:16	
Zinc	mg/kg	<1.2	4.4	07/14/10 13:16	

LABORATORY CONTROL SAMPLE: 817123

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Lead	mg/kg	17.7	19.5	110	80-120	
Zinc	mg/kg	17.7	19.6	111	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 817124 817125

Parameter	Units	254049001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Lead	mg/kg	4.7	20.3	17.4	27.8	21.7	114	98	75-125	25	30	
Zinc	mg/kg		20.3	17.4	63.4	56.8	125	108	75-125	11	30	

MATRIX SPIKE SAMPLE: 817126

Parameter	Units	254070002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Lead	mg/kg	5.6	20	28.5	114	75-125	
Zinc	mg/kg	75.1	20	92.2	85	75-125	

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

QC Batch: PMST/1250
Analysis Method: ASTM D2974-87
QC Batch Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 254070001, 254070002, 254070003, 254070004, 254070005, 254070006, 254070007, 254070008

SAMPLE DUPLICATE: 31913

Parameter	Units	254059001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	12.3	14.0	13	30	

SAMPLE DUPLICATE: 31914

Parameter	Units	254059011 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	16.2	15.7	3	30	

QUALITY CONTROL DATA

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

QC Batch: PMST/1252
QC Batch Method: ASTM D2974-87
Analysis Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 254070009, 254070010

SAMPLE DUPLICATE: 32077

Parameter	Units	254070009 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	21.6	21.0	3	30	

QUALIFIERS

Project:	Azurite Mine-RD-DGI 2010230015
Pace Project No.:	254070

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-S	Pace Analytical Services - Seattle

ANALYTE QUALIFIERS

M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Azurite Mine-RD-DGI 2010230015
Pace Project No.: 254070

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
254070001	**MC-SS-01a**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070002	**MC-SS-01b**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070003	**MC-SS-02a**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070004	**MC-SS-02b**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070005	**MC-SS-03**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070006	**MC-SS-04**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070007	**MC-SS-05**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070008	**MC-SS-06**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070009	**CC-SS-01**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070010	**CC-SS-02**	EPA 3050	MPRP/1627	EPA 6010	ICP/1551
254070001	**MC-SS-01a**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070002	**MC-SS-01b**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070003	**MC-SS-02a**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070004	**MC-SS-02b**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070005	**MC-SS-03**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070006	**MC-SS-04**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070007	**MC-SS-05**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070008	**MC-SS-06**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070009	**CC-SS-01**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070010	**CC-SS-02**	EPA 6020	ICPM/21217	EPA 6020	ICPM/8718
254070001	**MC-SS-01a**	ASTM D2974-87	PMST/1250		
254070002	**MC-SS-01b**	ASTM D2974-87	PMST/1250		
254070003	**MC-SS-02a**	ASTM D2974-87	PMST/1250		
254070004	**MC-SS-02b**	ASTM D2974-87	PMST/1250		
254070005	**MC-SS-03**	ASTM D2974-87	PMST/1250		
254070006	**MC-SS-04**	ASTM D2974-87	PMST/1250		
254070007	**MC-SS-05**	ASTM D2974-87	PMST/1250		
254070008	**MC-SS-06**	ASTM D2974-87	PMST/1250		
254070009	**CC-SS-01**	ASTM D2974-87	PMST/1252		
254070010	**CC-SS-02**	ASTM D2974-87	PMST/1252		

Sample Condition Upon Receipt

Pace Analytical

Client Name: Cascade Earth Sciences

Project # 254070

Optional:
Proj. Due Date:
Proj. Name:

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☑ Client ☐ Commercial ☐ Pace Other ______

Tracking #: ______

Custody Seal on Cooler/Box Present: ☑ yes ☐ no Seals intact: ☑ yes ☐ no

Packing Material: ☐ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other ______

Thermometer Used: Horiba 132013

Type of Ice: [✓ Wet] Blue None

☐ Samples on ice, cooling process has begun

Cooler Temperature: 3.7

Temp should be above freezing to 6°C

Biological Tissue is Frozen: Yes No

Date and Initials of person examining contents: 6/28/10 AR

Comments:

Chain of Custody Present:	☑ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out:	☑ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished:	☑ Yes	☐ No	☐ N/A	3.
Sampler Name & Signature on COC:	☐ Yes	☑ No	☐ N/A	4.
Samples Arrived within Hold Time:	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72hr):	☐ Yes	☑ No	☐ N/A	6.
Rush Turn Around Time Requested:	☐ Yes	☑ No	☐ N/A	7.
Sufficient Volume:	☑ Yes	☐ No	☐ N/A	8.
Correct Containers Used:	☑ Yes	☐ No	☐ N/A	9.
-Pace Containers Used:	☑ Yes	☐ No	☐ N/A	
Containers Intact:	☑ Yes	☐ No	☐ N/A	10.
Filtered volume received for Dissolved tests	☐ Yes	☐ No	☑ N/A	11.
Sample Labels match COC:	☑ Yes	☐ No	☐ N/A	12.
-Includes date/time/ID/Analysis Matrix: SL				
All containers needing preservation have been checked.	☐ Yes	☐ No	☑ N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☐ Yes	☐ No	☑ N/A	
exceptions: VOA, coliform, TOC, O&G, WI-DRO (water)	☐ Yes	☑ No		Initial when completed / Lot # of added preservative
Samples checked for dechlorination:	☐ Yes	☐ No	☑ N/A	14.
Headspace in VOA Vials (>6mm):	☐ Yes	☐ No	☑ N/A	15.
Trip Blank Present:	☐ Yes	☐ No	☑ N/A	16.
Trip Blank Custody Seals Present	☐ Yes	☐ No	☑ N/A	
Pace Trip Blank Lot # (if purchased): ______				

Field Data Required? Y / N

Client Notification/ Resolution:

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: JENNI GROSS

Date: 6/28/10

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

1318851

Section A
Required Client Information:

Company: Cascade Earth Sciences
Address: 3511 Pacific Blvd SW
Albany, OR 97321
Email To: ryan.tobias@cascade-earth.com
Phone: 503-931-3157 Fax: 541-967-7619
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Ryan Tobias
Copy To:
Purchase Order No.:
Project Name: Azurite Mine ZD-DGI
Project Number: 2010230015

Section C
Invoice Information:

Attention: Dustin Wesley
Company Name: CES
Address:
Pace Quote Reference: 061010
Pace Project Manager: Jennifer Gross
Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☒ OTHER CERCLA

Site Location STATE: WA

WO# 254070

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Matrix Codes

MATRIX	CODE
Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

Requested Analysis Filtered (Y/N)

Analysis Test: Total Al, As, Ba, Cd, Cr, Cu, Fe, Pb, Ni, Zn

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Total Al, As, Ba,	Cd, Cr, Cu, Fe,	Pb, Ni, Zn												Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	MC-SS-01a	SL	G	~~6/24/10~~	~~1300~~	6/24/10	1605		2	✓									✓	✓	✓													254070 001
2	MC-SS-01b	↓	↓			6/24/10	1500		2	✓									✓	✓	✓													002
3	MC-SS-02a					6/24/10	1430		2	✓									✓	✓	✓													003
4	MC-SS-02b					6/24/10	1320		2	✓									✓	✓	✓													004
5	MC-SS-03					6/24/10	1140		2	✓									✓	✓	✓													005
6	MC-SS-04					6/24/10	1045		2	✓									✓	✓	✓													006
7	MC-SS-05					6/24/10	950		2	✓									✓	✓	✓													007
8	MC-SS-06					6/23/10	1250		2	✓									✓	✓	✓													008
9	CC-SS-01					6/23/10	1200		2	✓									✓	✓	✓													009
10	CC-SS-02	↓	↓			6/23/10	1230		2	✓									✓	✓	✓													010
11																																		
12																																		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	/ CES	6/26/10	900	Amanda Ruby / Pace	6/28/10	1020	4.7 3.7 5.7	Y	Y	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

wo # 254070

CLIENT: Cascade Earth Sciences

COC PAGE 1 of 1

COC ID# 1318851

Sample Line Item	VG9H	AG1H	AG1U	BG1H	BP1U	BP2U	BP3U	BP2N	BP2S	WGFU	WGKU				Comments
1										1	1				
2															
3															
4															
5															
6															
7															
8										↓	↓				
9															Trip Blank? N/A
10															
11															
12															

AG1H	1 liter HCL amber glass		BP2S	500mL H2SO4 plastic	JGFU	4oz unpreserved amber wide
AG1U	1liter unpreserved amber glass		BP2U	500mL unpreserved plastic	R	terra core kit
AG2S	500mL H2SO4 amber glass		BP2Z	500mL NaOH, Zn Ac	U	Summa Can
AG2U	500mL unpreserved amber glass		BP3C	250mL NaOH plastic	VG9H	40mL HCL clear vial
AG3S	250mL H2SO4 amber glass		BP3N	250mL HNO3 plastic	VG9T	40mL Na Thio. clear vial
BG1H	1 liter HCL clear glass		BP3S	250mL H2SO4 plastic	VG9U	40mL unpreserved clear vial
BG1U	1 liter unpreserved glass		BP3U	250mL unpreserved plastic	VG9W	40mL glass vial preweighted (EPA 5035)
BP1N	1 liter HNO3 plastic		DG9B	40mL Na Bisulfate amber vial	VSG	Headspace septa vial & HCL
BP1S	1 liter H2SO4 plastic		DG9H	40mL HCL amber voa vial	WGFU	4oz clear soil jar
BP1U	1 liter unpreserved plastic		DG9M	40mL MeOH clear vial	WGFX	4oz wide jar w/hexane wipe
BP1Z	1 liter NaOH, Zn, Ac		DG9T	40mL Na Thio amber vial	ZPLC	Ziploc Bag
BP2N	500mL HNO3 plastic		DG9U	40mL unpreserved amber vial		
BP2O	500mL NaOH plastic		I	Wipe/Swab		

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Pace Analytical Services, Inc.
940 South Harney
Seattle, WA 98108
(206)767-5060

October 23, 2010

Ryan Tobias
Cascade Earth Sciences
3511 Pacific Blvd. SW
Albany, OR 97321

RE: Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Dear Ryan Tobias:

Enclosed are the analytical results for sample(s) received by the laboratory on September 24, 2010. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

REVISED REPORT

Sample 003 through 010 were analyzed out of hold. The samples were received late in the day on Friday, October 1, 2010 after being sampled the previous Monday. Our receiving personnel did not recognize that the samples were close to hold time and were logged in with little or no holding time left.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Ronald Boquist for
Jennifer Gross
jennifer.gross@pacelabs.com
Project Manager

Enclosures

CERTIFICATIONS

Project:	USFS Azurite Mine DGI
Pace Project No.:	255105

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
EPA Region 8 Certification #: Pace
Florida/NELAP Certification #: E87605
Georgia Certification #: 959
Idaho Certification #: MN00064
Illinois Certification #: 200011
Iowa Certification #: 368
Kansas Certification #: E-10167
Louisiana Certification #: 03086
Louisiana Certification #: LA080009
Maine Certification #: 2007029
Maryland Certification #: 322
Michigan DEQ Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT CERT0092
Nebraska Certification #: Pace
Nevada Certification #: MN_00064
New Jersey Certification #: MN-002
New Mexico Certification #: Pace
New York Certification #: 11647
North Carolina Certification #: 530
North Dakota Certification #: R-036
North Dakota Certification #: R-036A
Ohio VAP Certification #: CL101
Oklahoma Certification #: D9921
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Tennessee Certification #: 02818
Texas Certification #: T104704192
Washington Certification #: C754
Wisconsin Certification #: 999407970

Montana Certification IDs

602 South 25th Street, Billings, MT 59101
EPA Region 8 Certification #: 8TMS-Q
Idaho Certification #: MT00012
Montana Certification #: MT CERT0040
NVLAP Certification #: 101292-0
Minnesota Dept of Health Certification #: 030-999-442

Washington Certification IDs

940 South Harney Street, Seattle, WA 98108
Alaska CS Certification #: UST-025
Alaska Drinking Water VOC Certification #: WA01230
Alaska Drinking Water Micro Certification #: WA01230
California Certification #: 01153CA
Florida/NELAP Certification #: E87617
Oregon Certification #: WA200007
Washington Certification #: C1229

SAMPLE SUMMARY

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	Matrix	Date Collected	Date Received
255105001	**MC-SW-01a**	Water	09/22/10 12:05	09/24/10 14:10
255105002	**MC-SW-01b**	Water	09/22/10 10:55	09/24/10 14:10
255105003	**MC-SW-02a**	Water	09/21/10 14:30	09/24/10 14:10
255105004	**MC-SW-02b**	Water	09/21/10 13:50	09/24/10 14:10
255105005	**MC-SW-03**	Water	09/21/10 12:50	09/24/10 14:10
255105006	**MC-SW-04**	Water	09/21/10 11:50	09/24/10 14:10
255105007	**MC-SW-05**	Water	09/21/10 10:55	09/24/10 14:10
255105008	**MC-SW-06**	Water	09/20/10 12:35	09/24/10 14:10
255105009	**CC-SW-01**	Water	09/20/10 12:00	09/24/10 14:10
255105010	**CC-SW-02**	Water	09/20/10 11:25	09/24/10 14:10
255105011	**MC-SS-01a**	Solid	09/22/10 12:10	09/24/10 14:10
255105012	**MC-SS-01b**	Solid	09/22/10 11:00	09/24/10 14:10
255105013	**MC-SS-02a**	Solid	09/21/10 14:35	09/24/10 14:10
255105014	**MC-SS-02b**	Solid	09/21/10 13:55	09/24/10 14:10
255105015	**MC-SS-03**	Solid	09/21/10 12:50	09/24/10 14:10
255105016	**MC-SS-04**	Solid	09/21/10 12:00	09/24/10 14:10
255105017	**MC-SS-05**	Solid	09/21/10 11:00	09/24/10 14:10
255105018	**MC-SS-06**	Solid	09/20/10 12:45	09/24/10 14:10
255105019	**CC-SS-01**	Solid	09/20/10 12:25	09/24/10 14:10
255105020	**CC-SS-02**	Solid	09/20/10 11:50	09/24/10 14:10
255105021	**AM-AS-01**	Water	09/22/10 15:00	09/24/10 14:10
255105022	**AM-AS-02**	Water	09/22/10 16:35	09/24/10 14:10
255105023	**AM-SP-01**	Water	09/22/10 16:15	09/24/10 14:10
255105024	**MC-SW-07**	Water	09/21/10 11:55	09/24/10 14:10
255105025	**MC-SW-08**	Water	09/21/10 18:40	09/24/10 14:10
255105026	**BKG-06**	Solid	09/22/10 13:00	09/24/10 14:10
255105027	**BKG-07**	Solid	09/22/10 13:20	09/24/10 14:10
255105028	**BKG-08**	Solid	09/22/10 14:35	09/24/10 14:10
255105029	**BKG-09**	Solid	09/22/10 14:00	09/24/10 14:10

SAMPLE ANALYTE COUNT

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
255105001	**MC-SW-01a**	EPA 6020	RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105002	**MC-SW-01b**	EPA 6020	RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105003	**MC-SW-02a**	EPA 6020	RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105004	**MC-SW-02b**	EPA 6020	RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105005	**MC-SW-03**	EPA 6020	RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105006	**MC-SW-04**	EPA 6020	RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105007	**MC-SW-05**	EPA 6020	CJS, RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105008	**MC-SW-06**	EPA 6020	CJS, RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S

SAMPLE ANALYTE COUNT

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105009	**CC-SW-01**	EPA 6020	CJS, RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105010	**CC-SW-02**	EPA 6020	CJS, RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
255105011	**MC-SS-01a**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105012	**MC-SS-01b**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105013	**MC-SS-02a**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105014	**MC-SS-02b**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105015	**MC-SS-03**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105016	**MC-SS-04**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105017	**MC-SS-05**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105018	**MC-SS-06**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S

SAMPLE ANALYTE COUNT

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
255105019	**CC-SS-01**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105020	**CC-SS-02**	EPA 6010	BGA	8	PASI-S
		EPA 6020	RJS	2	PASI-M
		ASTM D2974-87	KJ1	1	PASI-S
255105021	**AM-AS-01**	EPA 6020	CJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2320B	BPR	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
		EPA 300.0	CMS	2	PASI-S
255105022	**AM-AS-02**	EPA 6020	CJS, RJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2320B	BPR	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
		EPA 300.0	CMS	2	PASI-S
255105023	**AM-SP-01**	EPA 6020	CJS	11	PASI-M
		EPA 120.1	KMT	1	PASI-S
		SM 2320B	BPR	1	PASI-S
		SM 2540C	CMS	1	PASI-S
		SM 2540D	CMS	1	PASI-S
		SM 4500-H+B	CMS	1	PASI-S
		EPA 300.0	CMS	2	PASI-S
255105024	**MC-SW-07**	EPA 6020	CJS	10	PASI-M
255105025	**MC-SW-08**	EPA 6020	RJS	10	PASI-M
255105026	**BKG-06**	EPA 6020	RJS	10	PASI-M
		USDA 21A	SC1	1	
		ASTM D2974-87	KJ1	1	PASI-S
255105027	**BKG-07**	EPA 6020	RJS	10	PASI-M
		USDA 21A	SC1	1	
		ASTM D2974-87	KJ1	1	PASI-S
255105028	**BKG-08**	EPA 6020	RJS	10	PASI-M
		USDA 21A	SC1	1	

SAMPLE ANALYTE COUNT

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		ASTM D2974-87	KJ1	1	PASI-S
255105029	**BKG-09**	EPA 6020	RJS	10	PASI-M
		USDA 21A	SC1	1	
		ASTM D2974-87	KJ1	1	PASI-S

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **EPA 6010**
Description: 6010 MET ICP
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
10 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: MPRP/1805

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 255105011

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 42996)
  - Aluminum
  - Barium
  - Chromium
  - Copper
  - Iron
  - Nickel
- MSD (Lab ID: 42997)
  - Aluminum
  - Arsenic
  - Barium
  - Chromium
  - Copper
  - Iron
  - Nickel

R1: RPD value was outside control limits.

- MSD (Lab ID: 42997)

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **EPA 6010**
Description: 6010 MET ICP
Client: Cascade Earth Sciences
Date: October 23, 2010

QC Batch: MPRP/1805

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 255105011

R1: RPD value was outside control limits.

- Arsenic
- Barium
- Copper
- Iron

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **EPA 6020**
Description: 6020 MET ICPMS
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
14 samples were analyzed for EPA 6020. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

General Information:
15 samples were analyzed for EPA 6020. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **EPA 6020**
Description: 6020 MET ICPMS
Client: Cascade Earth Sciences
Date: October 23, 2010

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project:	USFS Azurite Mine DGI
Pace Project No.:	255105

Method: **USDA 21A**
Description: USDA 21A pH
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
4 samples were analyzed for USDA 21A. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project:	USFS Azurite Mine DGI
Pace Project No.:	255105

Method: **EPA 120.1**
Description: 120.1 Specific Conductance
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
13 samples were analyzed for EPA 120.1. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **SM 2320B**
Description: 2320B Alkalinity
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
3 samples were analyzed for SM 2320B. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project:	USFS Azurite Mine DGI
Pace Project No.:	255105

Method: **SM 2540C**
Description: 2540C Total Dissolved Solids
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
13 samples were analyzed for SM 2540C. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

H1: Analysis conducted outside the EPA method holding time.
- CC-SW-01 (Lab ID: 255105009)
- CC-SW-02 (Lab ID: 255105010)
- MC-SW-02a (Lab ID: 255105003)
- MC-SW-02b (Lab ID: 255105004)
- MC-SW-03 (Lab ID: 255105005)
- MC-SW-04 (Lab ID: 255105006)
- MC-SW-05 (Lab ID: 255105007)
- MC-SW-06 (Lab ID: 255105008)

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **SM 2540D**
Description: 2540D Total Suspended Solids
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
13 samples were analyzed for SM 2540D. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

H1: Analysis conducted outside the EPA method holding time.
- CC-SW-01 (Lab ID: 255105009)
- CC-SW-02 (Lab ID: 255105010)
- MC-SW-02a (Lab ID: 255105003)
- MC-SW-02b (Lab ID: 255105004)
- MC-SW-03 (Lab ID: 255105005)
- MC-SW-04 (Lab ID: 255105006)
- MC-SW-05 (Lab ID: 255105007)
- MC-SW-06 (Lab ID: 255105008)

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

Analyte Comments:

QC Batch: WET/2287

- DUP (Lab ID: 42536)
  - Total Suspended Solids
  - Total Suspended Solids

PROJECT NARRATIVE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Method: **SM 4500-H+B**
Description: 4500H+ pH, Electrometric
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
13 samples were analyzed for SM 4500-H+B. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

H6: Analysis initiated more than 15 minutes after sample collection.
- AM-AS-01 (Lab ID: 255105021)
- AM-AS-02 (Lab ID: 255105022)
- AM-SP-01 (Lab ID: 255105023)
- CC-SW-01 (Lab ID: 255105009)
- CC-SW-02 (Lab ID: 255105010)
- MC-SW-01a (Lab ID: 255105001)
- MC-SW-01b (Lab ID: 255105002)
- MC-SW-02a (Lab ID: 255105003)
- MC-SW-02b (Lab ID: 255105004)
- MC-SW-03 (Lab ID: 255105005)
- MC-SW-04 (Lab ID: 255105006)
- MC-SW-05 (Lab ID: 255105007)
- MC-SW-06 (Lab ID: 255105008)

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

PROJECT NARRATIVE

Project:	USFS Azurite Mine DGI
Pace Project No.:	255105

Method: **EPA 300.0**
Description: 300.0 IC Anions 28 Days
Client: Cascade Earth Sciences
Date: October 23, 2010

General Information:
3 samples were analyzed for EPA 300.0. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: WETA/1715

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 255076002

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 42916)
  - Chloride
  - Sulfate

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

Analyte Comments:

QC Batch: WETA/1715

E: Analyte concentration exceeded the calibration range. The reported result is estimated.

- MS (Lab ID: 42916)
  - Sulfate
- MSD (Lab ID: 42917)
  - Sulfate

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-01a **Lab ID: 255105001** Collected: 09/22/10 12:05 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**6.7**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 04:45	7429-90-5	B
Arsenic	**0.60**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 04:45	7440-38-2	
Barium	**1.7**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 04:45	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 04:45	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 04:45	7440-47-3	
Copper	**<0.20**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 04:45	7440-50-8	
Iron	**<4.5**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 04:45	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 04:45	7439-92-1	
Nickel	**<0.19**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 04:45	7440-02-0	
Total Hardness by 2340B	**11800**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 04:45		
Zinc	**2.4J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 04:45	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**28.8**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**26.0**	mg/L	10.0	5.0	1		09/29/10 15:42		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**<2.0**	mg/L	2.0	2.0	1		09/29/10 16:50		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.1**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-01b **Lab ID: 255105002** Collected: 09/22/10 10:55 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**21.4**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 05:16	7429-90-5	B
Arsenic	**0.55**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 05:16	7440-38-2	
Barium	**2.0**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 05:16	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 05:16	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 05:16	7440-47-3	
Copper	**<0.20**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 05:16	7440-50-8	
Iron	**28.0J**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 05:16	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 05:16	7439-92-1	
Nickel	**<0.19**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 05:16	7440-02-0	
Total Hardness by 2340B	**15100**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 05:16		
Zinc	**2.1J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 05:16	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**36.0**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**27.0**	mg/L	10.0	5.0	1		09/29/10 15:44		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**2.0**	mg/L	2.0	2.0	1		09/29/10 16:50		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.3**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-02a **Lab ID: 255105003** Collected: 09/21/10 14:30 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**56.1**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 05:25	7429-90-5	B
Arsenic	**0.67**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 05:25	7440-38-2	
Barium	**2.3**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 05:25	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 05:25	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 05:25	7440-47-3	
Copper	**1.1**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 05:25	7440-50-8	
Iron	**70.5**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 05:25	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 05:25	7439-92-1	
Nickel	**0.39J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 05:25	7440-02-0	
Total Hardness by 2340B	**13700**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 05:25		
Zinc	**3.0J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 05:25	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**36.0**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**24.0**	mg/L	10.0	5.0	1		09/29/10 15:37		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**4.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.3**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-02b **Lab ID: 255105004** Collected: 09/21/10 13:50 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**71.5**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 05:34	7429-90-5	B
Arsenic	**0.89**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 05:34	7440-38-2	
Barium	**2.7**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 05:34	7440-39-3	
Cadmium	**0.045J**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 05:34	7440-43-9	
Chromium	**0.26J**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 05:34	7440-47-3	
Copper	**1.2**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 05:34	7440-50-8	
Iron	**102**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 05:34	7439-89-6	
Lead	**0.043J**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 05:34	7439-92-1	
Nickel	**0.44J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 05:34	7440-02-0	
Total Hardness by 2340B	**13900**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 05:34		
Zinc	**3.6J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 05:34	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**36.7**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**24.0**	mg/L	10.0	5.0	1		09/29/10 15:37		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**27.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.4**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-03 **Lab ID: 255105005** Collected: 09/21/10 12:50 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**61.2**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 05:43	7429-90-5	B
Arsenic	**1.2**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 05:43	7440-38-2	
Barium	**2.4**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 05:43	7440-39-3	
Cadmium	**0.042J**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 05:43	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 05:43	7440-47-3	
Copper	**0.99**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 05:43	7440-50-8	
Iron	**81.4**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 05:43	7439-89-6	
Lead	**0.035J**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 05:43	7439-92-1	
Nickel	**0.34J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 05:43	7440-02-0	
Total Hardness by 2340B	**16400**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 05:43		
Zinc	**4.1J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 05:43	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**39.7**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**<5.0**	mg/L	10.0	5.0	1		09/29/10 15:39		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**3.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.5**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-04 **Lab ID: 255105006** Collected: 09/21/10 11:50 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**55.7**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 05:52	7429-90-5	B
Arsenic	**1.1**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 05:52	7440-38-2	
Barium	**2.4**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 05:52	7440-39-3	
Cadmium	**0.054J**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 05:52	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 05:52	7440-47-3	
Copper	**1.2**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 05:52	7440-50-8	
Iron	**60.6**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 05:52	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 05:52	7439-92-1	
Nickel	**0.36J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 05:52	7440-02-0	
Total Hardness by 2340B	**17300**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 05:52		
Zinc	**3.2J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 05:52	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**43.3**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**30.0**	mg/L	10.0	5.0	1		09/29/10 15:40		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**3.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.6**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-05 **Lab ID: 255105007** Collected: 09/21/10 10:55 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**37.5**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 19:43	7429-90-5	B
Arsenic	**1.6**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 06:15	7440-38-2	
Barium	**2.6**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 06:15	7440-39-3	
Cadmium	**0.033J**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 06:15	7440-43-9	
Chromium	**0.26J**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 19:43	7440-47-3	
Copper	**1.4**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 06:15	7440-50-8	
Iron	**38.0J**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 19:43	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 06:15	7439-92-1	
Nickel	**0.21J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 06:15	7440-02-0	
Total Hardness by 2340B	**25000**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 19:43		
Zinc	**1.8J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 06:15	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**58.1**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**36.0**	mg/L	10.0	5.0	1		09/29/10 15:41		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**2.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.6**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-06 **Lab ID: 255105008** Collected: 09/20/10 12:35 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**58.3**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 19:47	7429-90-5	B
Arsenic	**1.9**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 06:24	7440-38-2	
Barium	**2.9**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 06:24	7440-39-3	
Cadmium	**0.025J**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 06:24	7440-43-9	
Chromium	**0.43J**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 19:47	7440-47-3	
Copper	**1.1**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 06:24	7440-50-8	
Iron	**69.8**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 19:47	7439-89-6	
Lead	**0.052J**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 06:24	7439-92-1	
Nickel	**0.21J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 06:24	7440-02-0	
Total Hardness by 2340B	**35500**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 19:47		
Zinc	**2.4J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 06:24	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**74.8**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**51.0**	mg/L	10.0	5.0	1		09/29/10 15:32		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**3.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.9**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: CC-SW-01 **Lab ID: 255105009** Collected: 09/20/10 12:00 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**36.8**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 19:52	7429-90-5	B
Arsenic	**1.5**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 06:33	7440-38-2	
Barium	**8.4**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 06:33	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 06:33	7440-43-9	
Chromium	**0.46J**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 19:52	7440-47-3	
Copper	**0.34J**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 06:33	7440-50-8	
Iron	**80.9**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 19:52	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 06:33	7439-92-1	
Nickel	**<0.19**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 06:33	7440-02-0	
Total Hardness by 2340B	**61000**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 19:52		
Zinc	**4.5J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 06:33	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**127**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**73.0**	mg/L	10.0	5.0	1		09/29/10 15:35		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**3.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**8.0**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: CC-SW-02 **Lab ID: 255105010** Collected: 09/20/10 11:25 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**36.2**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 19:56	7429-90-5	B
Arsenic	**1.5**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 06:42	7440-38-2	
Barium	**5.9**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 06:42	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 06:42	7440-43-9	
Chromium	**0.29J**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 19:56	7440-47-3	
Copper	**0.42J**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 06:42	7440-50-8	
Iron	**39.8J**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 19:56	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 06:42	7439-92-1	
Nickel	**<0.19**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 06:42	7440-02-0	
Total Hardness by 2340B	**49700**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 19:56		
Zinc	**4.1J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 06:42	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**104**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**68.0**	mg/L	10.0	5.0	1		09/29/10 15:36		H1
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**2.0**	mg/L	2.0	2.0	1		09/29/10 16:50		H1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.9**	Std. Units	0.10	0.10	1		09/27/10 16:38		H6

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-01a **Lab ID: 255105011** Collected: 09/22/10 12:10 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**9870**	mg/kg	52.7	1.1	1	10/01/10 08:58	10/04/10 13:06	7429-90-5	
Arsenic	**28.1**	mg/kg	21.1	1.8	10	10/01/10 08:58	10/04/10 19:51	7440-38-2	
Barium	**26.0**	mg/kg	21.1	0.021	1	10/01/10 08:58	10/04/10 13:06	7440-39-3	
Cadmium	**<0.11**	mg/kg	10.5	0.11	10	10/01/10 08:58	10/04/10 19:51	7440-43-9	
Chromium	**19.2**	mg/kg	1.1	0.053	1	10/01/10 08:58	10/04/10 13:06	7440-47-3	
Copper	**79.4**	mg/kg	26.3	1.3	10	10/01/10 08:58	10/04/10 19:51	7440-50-8	
Iron	**52800**	mg/kg	211	3.6	10	10/01/10 08:58	10/04/10 19:51	7439-89-6	
Nickel	**39.0J**	mg/kg	42.1	0.21	10	10/01/10 08:58	10/04/10 19:51	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**0.70**	mg/kg	0.47	0.038	20	10/04/10 16:26	10/07/10 00:35	7439-92-1	
Zinc	**15.8**	mg/kg	4.7	1.3	20	10/04/10 16:26	10/07/10 00:35	7440-66-6	M6
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**5.0**	%	0.10	0.10	1		09/30/10 13:51		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-01b **Lab ID: 255105012** Collected: 09/22/10 11:00 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**17400**	mg/kg	60.7	1.3	1	10/01/10 08:58	10/04/10 13:21	7429-90-5	
Arsenic	**50.6**	mg/kg	12.1	1.0	5	10/01/10 08:58	10/04/10 12:24	7440-38-2	
Barium	**37.5**	mg/kg	24.3	0.024	1	10/01/10 08:58	10/04/10 13:21	7440-39-3	
Cadmium	**<0.061**	mg/kg	6.1	0.061	5	10/01/10 08:58	10/04/10 12:24	7440-43-9	
Chromium	**116**	mg/kg	1.2	0.061	1	10/01/10 08:58	10/04/10 13:21	7440-47-3	
Copper	**114**	mg/kg	15.2	0.73	5	10/01/10 08:58	10/04/10 12:24	7440-50-8	
Iron	**56200**	mg/kg	121	2.1	5	10/01/10 08:58	10/04/10 12:24	7439-89-6	
Nickel	**56.9**	mg/kg	24.3	0.12	5	10/01/10 08:58	10/04/10 12:24	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**4.9**	mg/kg	1.1	0.085	50	10/04/10 16:26	10/07/10 01:24	7439-92-1	
Zinc	**58.2**	mg/kg	10.6	2.9	50	10/04/10 16:26	10/07/10 01:24	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**18.4**	%	0.10	0.10	1		09/30/10 13:52		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-02a **Lab ID: 255105013** Collected: 09/21/10 14:35 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**11500**	mg/kg	42.0	0.90	1	10/01/10 08:58	10/04/10 13:25	7429-90-5	
Arsenic	**18.6**	mg/kg	8.4	0.71	5	10/01/10 08:58	10/04/10 12:27	7440-38-2	
Barium	**32.0**	mg/kg	16.8	0.017	1	10/01/10 08:58	10/04/10 13:25	7440-39-3	
Cadmium	**<0.042**	mg/kg	4.2	0.042	5	10/01/10 08:58	10/04/10 12:27	7440-43-9	
Chromium	**17.4**	mg/kg	0.84	0.042	1	10/01/10 08:58	10/04/10 13:25	7440-47-3	
Copper	**58.7**	mg/kg	10.5	0.50	5	10/01/10 08:58	10/04/10 12:27	7440-50-8	
Iron	**34200**	mg/kg	84.0	1.4	5	10/01/10 08:58	10/04/10 12:27	7439-89-6	
Nickel	**27.3**	mg/kg	16.8	0.084	5	10/01/10 08:58	10/04/10 12:27	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**0.57**	mg/kg	0.51	0.041	20	10/04/10 16:26	10/07/10 12:22	7439-92-1	
Zinc	**1.7J**	mg/kg	5.1	1.4	20	10/04/10 16:26	10/07/10 12:22	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**9.1**	%	0.10	0.10	1		09/30/10 13:53		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-02b **Lab ID: 255105014** Collected: 09/21/10 13:55 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**10600**	mg/kg	48.1	1.0	1	10/01/10 08:58	10/04/10 13:28	7429-90-5	
Arsenic	**22.6**	mg/kg	9.6	0.82	5	10/01/10 08:58	10/04/10 12:30	7440-38-2	
Barium	**28.2**	mg/kg	19.2	0.019	1	10/01/10 08:58	10/04/10 13:28	7440-39-3	
Cadmium	**<0.048**	mg/kg	4.8	0.048	5	10/01/10 08:58	10/04/10 12:30	7440-43-9	
Chromium	**24.9**	mg/kg	0.96	0.048	1	10/01/10 08:58	10/04/10 13:28	7440-47-3	
Copper	**64.6**	mg/kg	12.0	0.58	5	10/01/10 08:58	10/04/10 12:30	7440-50-8	
Iron	**37000**	mg/kg	96.1	1.6	5	10/01/10 08:58	10/04/10 12:30	7439-89-6	
Nickel	**29.7**	mg/kg	19.2	0.096	5	10/01/10 08:58	10/04/10 12:30	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**3.0**	mg/kg	1.1	0.088	50	10/04/10 16:26	10/07/10 01:33	7439-92-1	
Zinc	**55.9**	mg/kg	11.0	3.0	50	10/04/10 16:26	10/07/10 01:33	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**13.3**	%	0.10	0.10	1		09/30/10 13:55		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-03 **Lab ID: 255105015** Collected: 09/21/10 12:50 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**16800**	mg/kg	59.5	1.3	1	10/01/10 08:58	10/04/10 13:31	7429-90-5	
Arsenic	**104**	mg/kg	11.9	1.0	5	10/01/10 08:58	10/04/10 12:33	7440-38-2	
Barium	**52.4**	mg/kg	23.8	0.024	1	10/01/10 08:58	10/04/10 13:31	7440-39-3	
Cadmium	**<0.059**	mg/kg	5.9	0.059	5	10/01/10 08:58	10/04/10 12:33	7440-43-9	
Chromium	**57.8**	mg/kg	1.2	0.059	1	10/01/10 08:58	10/04/10 13:31	7440-47-3	
Copper	**204**	mg/kg	14.9	0.71	5	10/01/10 08:58	10/04/10 12:33	7440-50-8	
Iron	**48400**	mg/kg	119	2.0	5	10/01/10 08:58	10/04/10 12:33	7439-89-6	
Nickel	**50.4**	mg/kg	23.8	0.12	5	10/01/10 08:58	10/04/10 12:33	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**11.2**	mg/kg	1.3	0.10	50	10/04/10 16:26	10/07/10 01:37	7439-92-1	
Zinc	**154**	mg/kg	12.8	3.5	50	10/04/10 16:26	10/07/10 01:37	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**22.2**	%	0.10	0.10	1		09/30/10 14:02		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-04 **Lab ID: 255105016** Collected: 09/21/10 12:00 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**24500**	mg/kg	59.1	1.3	1	10/01/10 08:58	10/04/10 13:34	7429-90-5	
Arsenic	**64.3**	mg/kg	11.8	1.0	5	10/01/10 08:58	10/04/10 12:36	7440-38-2	
Barium	**64.5**	mg/kg	23.6	0.024	1	10/01/10 08:58	10/04/10 13:34	7440-39-3	
Cadmium	**<0.059**	mg/kg	5.9	0.059	5	10/01/10 08:58	10/04/10 12:36	7440-43-9	
Chromium	**67.9**	mg/kg	1.2	0.059	1	10/01/10 08:58	10/04/10 13:34	7440-47-3	
Copper	**187**	mg/kg	14.8	0.71	5	10/01/10 08:58	10/04/10 12:36	7440-50-8	
Iron	**52600**	mg/kg	118	2.0	5	10/01/10 08:58	10/04/10 12:36	7439-89-6	
Nickel	**59.5**	mg/kg	23.6	0.12	5	10/01/10 08:58	10/04/10 12:36	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**13.6**	mg/kg	1.5	0.12	50	10/04/10 16:26	10/07/10 01:42	7439-92-1	
Zinc	**250**	mg/kg	14.8	4.0	50	10/04/10 16:26	10/07/10 01:42	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**21.6**	%	0.10	0.10	1		09/30/10 14:04		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-05 **Lab ID: 255105017** Collected: 09/21/10 11:00 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**22000**	mg/kg	56.8	1.2	1	10/01/10 08:58	10/04/10 13:37	7429-90-5	
Arsenic	**75.8**	mg/kg	11.4	0.97	5	10/01/10 08:58	10/04/10 20:00	7440-38-2	
Barium	**36.8**	mg/kg	22.7	0.023	1	10/01/10 08:58	10/04/10 13:37	7440-39-3	
Cadmium	**0.11J**	mg/kg	5.7	0.057	5	10/01/10 08:58	10/04/10 20:00	7440-43-9	
Chromium	**70.9**	mg/kg	1.1	0.057	1	10/01/10 08:58	10/04/10 13:37	7440-47-3	
Copper	**166**	mg/kg	14.2	0.68	5	10/01/10 08:58	10/04/10 20:00	7440-50-8	
Iron	**41500**	mg/kg	114	1.9	5	10/01/10 08:58	10/04/10 20:00	7439-89-6	
Nickel	**42.6**	mg/kg	22.7	0.11	5	10/01/10 08:58	10/04/10 20:00	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**28.3**	mg/kg	1.3	0.10	50	10/04/10 16:26	10/07/10 01:46	7439-92-1	
Zinc	**148**	mg/kg	12.8	3.5	50	10/04/10 16:26	10/07/10 01:46	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**17.8**	%	0.10	0.10	1		09/30/10 14:05		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SS-06 **Lab ID: 255105018** Collected: 09/20/10 12:45 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**23100**	mg/kg	52.4	1.1	1	10/01/10 08:58	10/04/10 13:40	7429-90-5	
Arsenic	**48.0**	mg/kg	10.5	0.89	5	10/01/10 08:58	10/04/10 20:03	7440-38-2	
Barium	**40.9**	mg/kg	21.0	0.021	1	10/01/10 08:58	10/04/10 13:40	7440-39-3	
Cadmium	**<0.052**	mg/kg	5.2	0.052	5	10/01/10 08:58	10/04/10 20:03	7440-43-9	
Chromium	**79.3**	mg/kg	1.0	0.052	1	10/01/10 08:58	10/04/10 13:40	7440-47-3	
Copper	**113**	mg/kg	13.1	0.63	5	10/01/10 08:58	10/04/10 20:03	7440-50-8	
Iron	**39000**	mg/kg	105	1.8	5	10/01/10 08:58	10/04/10 20:03	7439-89-6	
Nickel	**48.7**	mg/kg	21.0	0.10	5	10/01/10 08:58	10/04/10 20:03	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**17.0**	mg/kg	1.1	0.086	50	10/04/10 16:26	10/07/10 02:22	7439-92-1	
Zinc	**206**	mg/kg	10.8	2.9	50	10/04/10 16:26	10/07/10 02:22	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**19.1**	%	0.10	0.10	1		09/30/10 14:06		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: CC-SS-01 **Lab ID: 255105019** Collected: 09/20/10 12:25 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**16900**	mg/kg	50.7	1.1	1	10/01/10 08:58	10/04/10 13:43	7429-90-5	
Arsenic	**31.5**	mg/kg	10.1	0.86	5	10/01/10 08:58	10/04/10 20:06	7440-38-2	
Barium	**49.9**	mg/kg	20.3	0.020	1	10/01/10 08:58	10/04/10 13:43	7440-39-3	
Cadmium	**<0.051**	mg/kg	5.1	0.051	5	10/01/10 08:58	10/04/10 20:06	7440-43-9	
Chromium	**43.2**	mg/kg	1.0	0.051	1	10/01/10 08:58	10/04/10 13:43	7440-47-3	
Copper	**92.4**	mg/kg	12.7	0.61	5	10/01/10 08:58	10/04/10 20:06	7440-50-8	
Iron	**43800**	mg/kg	101	1.7	5	10/01/10 08:58	10/04/10 20:06	7439-89-6	
Nickel	**47.7**	mg/kg	20.3	0.10	5	10/01/10 08:58	10/04/10 20:06	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**9.5**	mg/kg	1.2	0.093	50	10/04/10 16:26	10/07/10 02:26	7439-92-1	
Zinc	**162**	mg/kg	11.6	3.2	50	10/04/10 16:26	10/07/10 02:26	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**19.2**	%	0.10	0.10	1		09/30/10 14:07		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: CC-SS-02 **Lab ID: 255105020** Collected: 09/20/10 11:50 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Aluminum	**21000**	mg/kg	51.5	1.1	1	10/01/10 08:58	10/04/10 13:46	7429-90-5	
Arsenic	**21.0**	mg/kg	10.3	0.88	5	10/01/10 08:58	10/04/10 20:09	7440-38-2	
Barium	**29.5**	mg/kg	20.6	0.021	1	10/01/10 08:58	10/04/10 13:46	7440-39-3	
Cadmium	**<0.052**	mg/kg	5.2	0.052	5	10/01/10 08:58	10/04/10 20:09	7440-43-9	
Chromium	**73.7**	mg/kg	1.0	0.052	1	10/01/10 08:58	10/04/10 13:46	7440-47-3	
Copper	**86.3**	mg/kg	12.9	0.62	5	10/01/10 08:58	10/04/10 20:09	7440-50-8	
Iron	**43700**	mg/kg	103	1.8	5	10/01/10 08:58	10/04/10 20:09	7439-89-6	
Nickel	**52.0**	mg/kg	20.6	0.10	5	10/01/10 08:58	10/04/10 20:09	7440-02-0	
6020 MET ICPMS	Analytical Method: EPA 6020								
Lead	**7.9**	mg/kg	1.2	0.099	50	10/04/10 16:26	10/07/10 02:31	7439-92-1	
Zinc	**159**	mg/kg	12.3	3.4	50	10/04/10 16:26	10/07/10 02:31	7440-66-6	
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**11.8**	%	0.10	0.10	1		09/30/10 14:08		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: AM-AS-01 **Lab ID: 255105021** Collected: 09/22/10 15:00 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**41.6**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 20:01	7429-90-5	B
Arsenic	**24.8**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 20:01	7440-38-2	
Barium	**1.3**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 20:01	7440-39-3	
Cadmium	**0.092**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 20:01	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 20:01	7440-47-3	
Copper	**2.0**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 20:01	7440-50-8	
Iron	**145**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 20:01	7439-89-6	
Lead	**0.033J**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 20:01	7439-92-1	
Nickel	**0.66**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 20:01	7440-02-0	
Total Hardness by 2340B	**55800**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 20:01		
Zinc	**11.5**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 20:01	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**117**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**51.3**	mg/L	2.0	2.0	1		10/05/10 15:38		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**75.0**	mg/L	10.0	5.0	1		09/29/10 15:44		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**11.0**	mg/L	2.0	2.0	1		09/29/10 16:50		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**7.4**	Std. Units	0.10	0.10	1		09/29/10 18:37		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**0.11J**	mg/L	1.0	0.076	1		10/02/10 01:36	16887-00-6	
Sulfate	**11.3**	mg/L	1.0	0.17	1		10/02/10 01:36	14808-79-8	

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: AM-AS-02 **Lab ID: 255105022** Collected: 09/22/10 16:35 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**12300**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 20:10	7429-90-5	B
Arsenic	**1.4**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 06:51	7440-38-2	
Barium	**12.7**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 06:51	7440-39-3	
Cadmium	**2.6**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 06:51	7440-43-9	
Chromium	**1.3**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 20:10	7440-47-3	
Copper	**206**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 06:51	7440-50-8	
Iron	**660**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 20:10	7439-89-6	
Lead	**1.3**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 06:51	7439-92-1	
Nickel	**23.0**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 06:51	7440-02-0	
Total Hardness by 2340B	**116000**	ug/L	355	178	5	10/05/10 14:36	10/07/10 20:14		
Zinc	**330**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 06:51	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**371**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**<2.0**	mg/L	2.0	2.0	1		10/05/10 15:38		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**293**	mg/L	10.0	5.0	1		09/29/10 15:46		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**47.0**	mg/L	2.0	2.0	1		09/29/10 16:50		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**6.6**	Std. Units	0.10	0.10	1		09/29/10 18:37		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**0.20J**	mg/L	1.0	0.076	1		10/02/10 01:53	16887-00-6	
Sulfate	**186**	mg/L	20.0	3.4	20		10/05/10 12:26	14808-79-8	

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: AM-SP-01 **Lab ID: 255105023** Collected: 09/22/10 16:15 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**121**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 20:28	7429-90-5	B
Arsenic	**2.4**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 20:28	7440-38-2	
Barium	**3.1**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 20:28	7440-39-3	
Cadmium	**0.12**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 20:28	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 20:28	7440-47-3	
Copper	**3.4**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 20:28	7440-50-8	
Iron	**16.2J**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 20:28	7439-89-6	
Lead	**0.11**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 20:28	7439-92-1	
Nickel	**1.7**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 20:28	7440-02-0	
Total Hardness by 2340B	**47500**	ug/L	71.0	35.5	1	10/05/10 14:36	10/07/10 20:28		
Zinc	**13.1**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 20:28	7440-66-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**108**	umhos/cm	1.0	0.70	1		09/29/10 17:55		
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**26.8**	mg/L	2.0	2.0	1		10/05/10 15:38		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**72.0**	mg/L	10.0	5.0	1		09/29/10 15:47		
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**<2.0**	mg/L	2.0	2.0	1		09/29/10 16:50		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH at 25 Degrees C	**4.2**	Std. Units	0.10	0.10	1		09/29/10 18:37		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**0.13J**	mg/L	1.0	0.076	1		10/02/10 02:11	16887-00-6	
Sulfate	**27.7**	mg/L	2.0	0.34	2		10/02/10 02:11	14808-79-8	

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-07 **Lab ID: 255105024** Collected: 09/21/10 11:55 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**66.0**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 20:32	7429-90-5	B
Arsenic	**1.1**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 20:32	7440-38-2	
Barium	**2.6**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 20:32	7440-39-3	
Cadmium	**0.049J**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 20:32	7440-43-9	
Chromium	**0.32J**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 20:32	7440-47-3	
Copper	**1.5**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 20:32	7440-50-8	
Iron	**73.4**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 20:32	7439-89-6	
Lead	**0.086J**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 20:32	7439-92-1	
Nickel	**0.38J**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 20:32	7440-02-0	
Zinc	**5.2**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 20:32	7440-66-6	

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: MC-SW-08 **Lab ID: 255105025** Collected: 09/21/10 18:40 Received: 09/24/10 14:10 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**3.3J**	ug/L	4.0	2.0	1	10/05/10 14:36	10/07/10 07:17	7429-90-5	
Arsenic	**<0.062**	ug/L	0.50	0.062	1	10/05/10 14:36	10/07/10 07:17	7440-38-2	
Barium	**0.18J**	ug/L	0.30	0.043	1	10/05/10 14:36	10/07/10 07:17	7440-39-3	
Cadmium	**<0.020**	ug/L	0.080	0.020	1	10/05/10 14:36	10/07/10 07:17	7440-43-9	
Chromium	**<0.24**	ug/L	0.50	0.24	1	10/05/10 14:36	10/07/10 07:17	7440-47-3	
Copper	**<0.20**	ug/L	0.50	0.20	1	10/05/10 14:36	10/07/10 07:17	7440-50-8	
Iron	**<4.5**	ug/L	50.0	4.5	1	10/05/10 14:36	10/07/10 07:17	7439-89-6	
Lead	**<0.020**	ug/L	0.10	0.020	1	10/05/10 14:36	10/07/10 07:17	7439-92-1	
Nickel	**<0.19**	ug/L	0.50	0.19	1	10/05/10 14:36	10/07/10 07:17	7440-02-0	
Zinc	**3.2J**	ug/L	5.0	1.3	1	10/05/10 14:36	10/07/10 07:17	7440-66-6	

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: BKG-06 **Lab ID: 255105026** Collected: 09/22/10 13:00 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**12600**	mg/kg	9.5	4.7	50	10/04/10 16:26	10/07/10 02:35	7429-90-5	
Arsenic	**31.3**	mg/kg	1.2	0.24	50	10/04/10 16:26	10/07/10 02:35	7440-38-2	
Barium	**29.6**	mg/kg	0.71	0.047	50	10/04/10 16:26	10/07/10 02:35	7440-39-3	
Cadmium	**0.15J**	mg/kg	0.19	0.047	50	10/04/10 16:26	10/07/10 02:35	7440-43-9	
Chromium	**53.0**	mg/kg	1.2	0.33	50	10/04/10 16:26	10/07/10 02:35	7440-47-3	
Copper	**81.1**	mg/kg	1.2	0.33	50	10/04/10 16:26	10/07/10 02:35	7440-50-8	
Iron	**44100**	mg/kg	118	25.7	50	10/04/10 16:26	10/07/10 02:35	7439-89-6	
Lead	**4.4**	mg/kg	1.2	0.095	50	10/04/10 16:26	10/07/10 02:35	7439-92-1	
Nickel	**33.7**	mg/kg	1.2	0.24	50	10/04/10 16:26	10/07/10 02:35	7440-02-0	
Zinc	**61.4**	mg/kg	11.8	3.2	50	10/04/10 16:26	10/07/10 02:35	7440-66-6	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.5**	Std. Units	0.10		1		10/04/10 14:30		
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**8.8**	%	0.10	0.10	1		09/30/10 14:08		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: BKG-07 **Lab ID: 255105027** Collected: 09/22/10 13:20 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**57500**	mg/kg	12.1	6.1	50	10/04/10 16:26	10/07/10 03:20	7429-90-5	
Arsenic	**11.6**	mg/kg	1.5	0.30	50	10/04/10 16:26	10/07/10 03:20	7440-38-2	
Barium	**160**	mg/kg	0.91	0.061	50	10/04/10 16:26	10/07/10 03:20	7440-39-3	
Cadmium	**0.14J**	mg/kg	0.24	0.061	50	10/04/10 16:26	10/07/10 03:20	7440-43-9	
Chromium	**51.7**	mg/kg	1.5	0.43	50	10/04/10 16:26	10/07/10 03:20	7440-47-3	
Copper	**93.0**	mg/kg	1.5	0.43	50	10/04/10 16:26	10/07/10 03:20	7440-50-8	
Iron	**43300**	mg/kg	152	33.0	50	10/04/10 16:26	10/07/10 03:20	7439-89-6	
Lead	**5.1**	mg/kg	1.5	0.12	50	10/04/10 16:26	10/07/10 03:20	7439-92-1	
Nickel	**27.1**	mg/kg	1.5	0.30	50	10/04/10 16:26	10/07/10 03:20	7440-02-0	
Zinc	**63.5**	mg/kg	15.2	4.1	50	10/04/10 16:26	10/07/10 03:20	7440-66-6	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.3**	Std. Units	0.10		1		10/04/10 14:30		
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**40.8**	%	0.10	0.10	1		09/30/10 14:09		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: BKG-08 **Lab ID: 255105028** Collected: 09/22/10 14:35 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**27100**	mg/kg	12.7	6.4	50	10/04/10 16:26	10/07/10 03:25	7429-90-5	
Arsenic	**122**	mg/kg	1.6	0.32	50	10/04/10 16:26	10/07/10 03:25	7440-38-2	
Barium	**25.9**	mg/kg	0.95	0.064	50	10/04/10 16:26	10/07/10 03:25	7440-39-3	
Cadmium	**2.2**	mg/kg	0.25	0.064	50	10/04/10 16:26	10/07/10 03:25	7440-43-9	
Chromium	**60.0**	mg/kg	1.6	0.44	50	10/04/10 16:26	10/07/10 03:25	7440-47-3	
Copper	**154**	mg/kg	1.6	0.44	50	10/04/10 16:26	10/07/10 03:25	7440-50-8	
Iron	**87600**	mg/kg	159	34.5	50	10/04/10 16:26	10/07/10 03:25	7439-89-6	
Lead	**32.1**	mg/kg	1.6	0.13	50	10/04/10 16:26	10/07/10 03:25	7439-92-1	
Nickel	**21.5**	mg/kg	1.6	0.32	50	10/04/10 16:26	10/07/10 03:25	7440-02-0	
Zinc	**676**	mg/kg	15.9	4.3	50	10/04/10 16:26	10/07/10 03:25	7440-66-6	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.0**	Std. Units	0.10		1		10/04/10 14:30		
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**38.1**	%	0.10	0.10	1		09/30/10 14:11		

ANALYTICAL RESULTS

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Sample: BKG-09 **Lab ID: 255105029** Collected: 09/22/10 14:00 Received: 09/24/10 14:10 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020								
Aluminum	**41800**	mg/kg	9.2	4.6	50	10/04/10 16:26	10/07/10 03:29	7429-90-5	
Arsenic	**87.2**	mg/kg	1.2	0.23	50	10/04/10 16:26	10/07/10 03:29	7440-38-2	
Barium	**106**	mg/kg	0.69	0.046	50	10/04/10 16:26	10/07/10 03:29	7440-39-3	
Cadmium	**0.99**	mg/kg	0.18	0.046	50	10/04/10 16:26	10/07/10 03:29	7440-43-9	
Chromium	**154**	mg/kg	1.2	0.32	50	10/04/10 16:26	10/07/10 03:29	7440-47-3	
Copper	**341**	mg/kg	1.2	0.32	50	10/04/10 16:26	10/07/10 03:29	7440-50-8	
Iron	**55400**	mg/kg	115	25.0	50	10/04/10 16:26	10/07/10 03:29	7439-89-6	
Lead	**17.1**	mg/kg	1.2	0.092	50	10/04/10 16:26	10/07/10 03:29	7439-92-1	
Nickel	**76.2**	mg/kg	1.2	0.23	50	10/04/10 16:26	10/07/10 03:29	7440-02-0	
Zinc	**251**	mg/kg	11.5	3.1	50	10/04/10 16:26	10/07/10 03:29	7440-66-6	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.2**	Std. Units	0.10		1		10/04/10 14:30		
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**20.8**	%	0.10	0.10	1		10/04/10 13:31		

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: MPRP/1805
Analysis Method: EPA 6010
QC Batch Method: EPA 3050
Analysis Description: 6010 MET
Associated Lab Samples: 255105011, 255105012, 255105013, 255105014, 255105015, 255105016, 255105017, 255105018, 255105019, 255105020

METHOD BLANK: 42994
Matrix: Solid
Associated Lab Samples: 255105011, 255105012, 255105013, 255105014, 255105015, 255105016, 255105017, 255105018, 255105019, 255105020

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	mg/kg	<1.1	50.0	10/04/10 12:09	
Arsenic	mg/kg	<0.17	2.0	10/04/10 12:09	
Barium	mg/kg	0.024J	20.0	10/04/10 12:09	
Cadmium	mg/kg	<0.010	1.0	10/04/10 12:09	
Chromium	mg/kg	<0.050	1.0	10/04/10 12:09	
Copper	mg/kg	<0.12	2.5	10/04/10 12:09	
Iron	mg/kg	0.89J	20.0	10/04/10 12:09	
Nickel	mg/kg	<0.020	4.0	10/04/10 12:09	

LABORATORY CONTROL SAMPLE: 42995

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	mg/kg	500	471	94	80-120	
Arsenic	mg/kg	25	24.1	97	80-120	
Barium	mg/kg	25	22.9	92	80-120	
Cadmium	mg/kg	25	25.0	100	80-120	
Chromium	mg/kg	25	24.4	97	80-120	
Copper	mg/kg	25	24.8	99	80-120	
Iron	mg/kg	500	458	92	80-120	
Nickel	mg/kg	25	25.9	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 42996 42997

Parameter	Units	255105011 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	mg/kg	9870	516	521	9080	9260	-152	-116	75-125	2	20	M1
Arsenic	mg/kg	28.1	25.8	26.1	58.5	80.7	118	202	75-125	32	20	M1,R1
Barium	mg/kg	26.0	25.8	26.1	59.5	44.0	130	69	75-125	30	20	M1,R1
Cadmium	mg/kg	<0.11	25.8	26.1	26.4	25.6	102	98	75-125	3	20	
Chromium	mg/kg	19.2	25.8	26.1	35.4	38.1	63	72	75-125	7	20	M1
Copper	mg/kg	79.4	25.8	26.1	60.8	116	-72	139	75-125	62	20	M1,R1
Iron	mg/kg	52800	516	521	28000	36800	-4810	-3070	75-125	27	20	M1,R1
Nickel	mg/kg	39.0J	25.8	26.1	38.0J	55.6	-4	64	75-125		20	M1

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: ICPM/22644 Analysis Method: EPA 6020
QC Batch Method: EPA 6020 Analysis Description: 6020 MET
Associated Lab Samples: 255105011, 255105012, 255105013, 255105014, 255105015, 255105016, 255105017, 255105018, 255105019, 255105020, 255105026, 255105027, 255105028, 255105029

METHOD BLANK: 863609 Matrix: Solid

Associated Lab Samples: 255105011, 255105012, 255105013, 255105014, 255105015, 255105016, 255105017, 255105018, 255105019, 255105020, 255105026, 255105027, 255105028, 255105029

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	mg/kg	<1.4	2.7	10/07/10 00:26	
Arsenic	mg/kg	<0.068	0.34	10/07/10 00:26	
Barium	mg/kg	0.019J	0.20	10/07/10 00:26	
Cadmium	mg/kg	<0.014	0.054	10/07/10 00:26	
Chromium	mg/kg	<0.095	0.34	10/07/10 00:26	
Copper	mg/kg	<0.095	0.34	10/07/10 00:26	
Iron	mg/kg	<7.3	33.8	10/07/10 00:26	
Lead	mg/kg	<0.027	0.34	10/07/10 00:26	
Nickel	mg/kg	<0.068	0.34	10/07/10 00:26	
Zinc	mg/kg	<0.92	3.4	10/07/10 00:26	

LABORATORY CONTROL SAMPLE: 863610

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	mg/kg	16	16.5	103	75-125	
Arsenic	mg/kg	16	15.5	97	75-125	
Barium	mg/kg	16	15.1	94	75-125	
Cadmium	mg/kg	16	15.3	96	75-125	
Chromium	mg/kg	16	15.6	98	75-125	
Copper	mg/kg	16	15.6	97	75-125	
Iron	mg/kg	200	193	97	75-125	
Lead	mg/kg	16	16.0	100	75-125	
Nickel	mg/kg	16	16.1	101	75-125	
Zinc	mg/kg	16	15.3	96	75-125	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 863611 863612

Parameter	Units	255105011 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	mg/kg		19	16.2	4810	6470	-12300	-4120	75-125	30	20	
Arsenic	mg/kg		19	16.2	35.5	32.9	143	152	75-125	8	20	
Barium	mg/kg		19	16.2	31.7	29.7	98	103	75-125	6	20	
Cadmium	mg/kg		19	16.2	20.8	17.4	110	107	75-125	18	20	
Chromium	mg/kg		19	16.2	49.4	24.3	217	99	75-125	68	20	
Copper	mg/kg		19	16.2	53.9	54.0	206	242	75-125	.2	20	
Iron	mg/kg		237	202	14100	20500	-248	2850	75-125	37	20	
Lead	mg/kg	0.70	19	16.2	23.8	19.9	122	118	75-125	18	20	
Nickel	mg/kg		19	16.2	38.0	28.1	153	118	75-125	30	20	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 863611 863612

Parameter	Units	255105011 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Zinc	mg/kg	15.8	19	16.2	59.3	41.1	229	156	75-125	36	20	D6,M6

MATRIX SPIKE SAMPLE: 863613

Parameter	Units	255105026 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Aluminum	mg/kg	12600	20.7	11000	-7830	75-125	
Arsenic	mg/kg	31.3	20.7	46.7	74	75-125	
Barium	mg/kg	29.6	20.7	55.8	127	75-125	
Cadmium	mg/kg	0.15J	20.7	20.2	97	75-125	
Chromium	mg/kg	53.0	20.7	68.6	75	75-125	
Copper	mg/kg	81.1	20.7	107	127	75-125	
Iron	mg/kg	44100	259	46100	779	75-125	
Lead	mg/kg	4.4	20.7	24.8	98	75-125	
Nickel	mg/kg	33.7	20.7	51.2	85	75-125	
Zinc	mg/kg	61.4	20.7	86.9	124	75-125	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: ICPM/22647
Analysis Method: EPA 6020
QC Batch Method: EPA 6020
Analysis Description: 6020 MET
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022

METHOD BLANK: 863624
Matrix: Water
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023, 255105024, 255105025

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	ug/L	2.3J	4.0	10/07/10 04:36	
Arsenic	ug/L	<0.062	0.50	10/07/10 04:36	
Barium	ug/L	<0.043	0.30	10/07/10 04:36	
Cadmium	ug/L	<0.020	0.080	10/07/10 04:36	
Chromium	ug/L	<0.24	0.50	10/07/10 04:36	
Copper	ug/L	<0.20	0.50	10/07/10 04:36	
Iron	ug/L	<4.5	50.0	10/07/10 04:36	
Lead	ug/L	<0.020	0.10	10/07/10 04:36	
Nickel	ug/L	<0.19	0.50	10/07/10 04:36	
Total Hardness by 2340B	ug/L	<35.5	71.0	10/07/10 04:36	
Zinc	ug/L	<1.3	5.0	10/07/10 04:36	

LABORATORY CONTROL SAMPLE: 863625

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/L	80	81.7	102	80-120	
Arsenic	ug/L	80	81.6	102	80-120	
Barium	ug/L	80	81.0	101	80-120	
Cadmium	ug/L	80	83.2	104	80-120	
Chromium	ug/L	80	83.8	105	80-120	
Copper	ug/L	80	80.4	101	80-120	
Iron	ug/L	1000	1020	102	80-120	
Lead	ug/L	80	85.1	106	80-120	
Nickel	ug/L	80	83.9	105	80-120	
Total Hardness by 2340B	ug/L		6700			
Zinc	ug/L	80	83.3	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 863626 863627

Parameter	Units	255105001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	ug/L	6.7	80	80	88.8	88.3	103	102	75-125	.6	20	
Arsenic	ug/L	0.60	80	80	84.0	81.8	104	101	75-125	3	20	
Barium	ug/L	1.7	80	80	82.9	83.2	101	102	75-125	.3	20	
Cadmium	ug/L	<0.020	80	80	83.7	83.6	105	104	75-125	.1	20	
Chromium	ug/L	<0.24	80	80	85.9	84.0	107	105	75-125	2	20	
Copper	ug/L	<0.20	80	80	81.8	86.0	102	108	75-125	5	20	
Iron	ug/L	<4.5	1000	1000	1060	1040	106	104	75-125	2	20	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 863626 863627

Parameter	Units	255105001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Lead	ug/L	<0.020	80	80	86.0	85.6	108	107	75-125	.4	20	
Nickel	ug/L	<0.19	80	80	85.0	85.5	106	107	75-125	.5	20	
Total Hardness by 2340B	ug/L	11800			19000	18500				2	20	
Zinc	ug/L	2.4J	80	80	83.4	86.6	101	105	75-125	4	20	

MATRIX SPIKE SAMPLE: 863628

Parameter	Units	255105021 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/L	41.6	80	128	108	75-125	
Arsenic	ug/L	24.8	80	112	109	75-125	
Barium	ug/L	1.3	80	86.8	107	75-125	
Cadmium	ug/L	0.092	80	86.8	108	75-125	
Chromium	ug/L	<0.24	80	86.6	108	75-125	
Copper	ug/L	2.0	80	89.6	109	75-125	
Iron	ug/L	145	1000	1210	107	75-125	
Lead	ug/L	0.033J	80	85.6	107	75-125	
Nickel	ug/L	0.66	80	86.8	108	75-125	
Total Hardness by 2340B	ug/L	55800		65800			
Zinc	ug/L	11.5	80	97.8	108	75-125	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch:	MT/5015	Analysis Method:	USDA 21A
QC Batch Method:	USDA 21A	Analysis Description:	USDA 21A pH saturated paste

Associated Lab Samples: 255105026, 255105027, 255105028, 255105029

LABORATORY CONTROL SAMPLE: 864940

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
pH, Saturated Paste	Std. Units	7.3	7.0	95	91-109	

SAMPLE DUPLICATE: 864941

Parameter	Units	10139415001 Result	Dup Result	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	7.8	7.8	.1	20	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: PMST/1372
Analysis Method: ASTM D2974-87
QC Batch Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 255105011, 255105012, 255105013, 255105014, 255105015, 255105016, 255105017, 255105018, 255105019, 255105020, 255105026, 255105027, 255105028

SAMPLE DUPLICATE: 42847

Parameter	Units	255112001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	26.0	25.8	.9	30	

SAMPLE DUPLICATE: 42848

Parameter	Units	255105014 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	13.3	14.6	10	30	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: PMST/1374
QC Batch Method: ASTM D2974-87
Analysis Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 255105029

SAMPLE DUPLICATE: 43340

Parameter	Units	255095027 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	11.0	11.3	3	30	

SAMPLE DUPLICATE: 43341

Parameter	Units	255167002 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	64.0	60.8	5	30	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WET/2288
Analysis Method: EPA 120.1
QC Batch Method: EPA 120.1
Analysis Description: 120.1 Specific Conductance
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023

METHOD BLANK: 42594
Matrix: Water
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Specific Conductance	umhos/cm	<0.70	1.0	09/29/10 17:55	

LABORATORY CONTROL SAMPLE: 42595

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Specific Conductance	umhos/cm	445	434	98	90-110	

SAMPLE DUPLICATE: 42596

Parameter	Units	255004001 Result	Dup Result	RPD	Max RPD	Qualifiers
Specific Conductance	umhos/cm	ND	<0.70		10	

SAMPLE DUPLICATE: 42597

Parameter	Units	255105008 Result	Dup Result	RPD	Max RPD	Qualifiers
Specific Conductance	umhos/cm	74.8	72.4	3	10	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WET/2304
Analysis Method: SM 2320B
QC Batch Method: SM 2320B
Analysis Description: 2320B Alkalinity
Associated Lab Samples: 255105021, 255105022, 255105023

METHOD BLANK: 43202
Matrix: Water
Associated Lab Samples: 255105021, 255105022, 255105023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<2.0	2.0	10/05/10 15:38	

LABORATORY CONTROL SAMPLE: 43203

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	100	96.3	96	90-110	

SAMPLE DUPLICATE: 43204

Parameter	Units	255076004 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	359	349	3	10	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WET/2286
Analysis Method: SM 2540C
QC Batch Method: SM 2540C
Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023

METHOD BLANK: 42531 Matrix: Water

Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	10.0	09/29/10 15:30	

LABORATORY CONTROL SAMPLE: 42532

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	300	320	107	80-120	

SAMPLE DUPLICATE: 42533

Parameter	Units	255105008 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	51.0	48.0	6	20	

SAMPLE DUPLICATE: 42534

Parameter	Units	255105021 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	75.0	73.0	3	20	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WET/2287
Analysis Method: SM 2540D
QC Batch Method: SM 2540D
Analysis Description: 2540D Total Suspended Solids
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023

METHOD BLANK: 42535 Matrix: Water

Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010, 255105021, 255105022, 255105023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Suspended Solids	mg/L	<2.0	2.0	09/29/10 16:50	

SAMPLE DUPLICATE: 42536

Parameter	Units	255105008 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	3.0	4.0	29	20	R3

SAMPLE DUPLICATE: 42537

Parameter	Units	255105021 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	11.0	11.0	0	20	

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WET/2278
Analysis Method: SM 4500-H+B
QC Batch Method: SM 4500-H+B
Analysis Description: 4500H+B pH
Associated Lab Samples: 255105001, 255105002, 255105003, 255105004, 255105005, 255105006, 255105007, 255105008, 255105009, 255105010

SAMPLE DUPLICATE: 42314

Parameter	Units	255105010 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.9	7.9	.1	10	H6

SAMPLE DUPLICATE: 42315

Parameter	Units	255092001 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.7	7.7	.4	10	H6

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WET/2285
QC Batch Method: SM 4500-H+B
Analysis Method: SM 4500-H+B
Analysis Description: 4500H+B pH
Associated Lab Samples: 255105021, 255105022, 255105023

SAMPLE DUPLICATE: 42529

Parameter	Units	255105021 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	7.4	7.4	.3	10	H6

QUALITY CONTROL DATA

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

QC Batch: WETA/1715
Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 255105021, 255105022, 255105023

METHOD BLANK: 42914
Matrix: Water
Associated Lab Samples: 255105021, 255105022, 255105023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Chloride	mg/L	<0.076	1.0	10/01/10 16:00	
Sulfate	mg/L	<0.17	1.0	10/01/10 16:00	

LABORATORY CONTROL SAMPLE: 42915

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	5.3	105	90-110	
Sulfate	mg/L	15	16.1	107	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 42916 42917

Parameter	Units	255076002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	434	250	250	717	681	113	99	90-110	5	11	M1
Sulfate	mg/L	920	750	750	1790	1710	116	105	90-110	5	10	E,M1

QUALIFIERS

Project:	USFS Azurite Mine DGI
Pace Project No.:	255105

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-S	Pace Analytical Services - Seattle

ANALYTE QUALIFIERS

B	Analyte was detected in the associated method blank.
D6	The relative percent difference (RPD) between the sample and sample duplicate exceeded laboratory control limits.
E	Analyte concentration exceeded the calibration range. The reported result is estimated.
H1	Analysis conducted outside the EPA method holding time.
H6	Analysis initiated more than 15 minutes after sample collection.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
M6	Matrix spike and Matrix spike duplicate recovery not evaluated against control limits due to sample dilution.
R1	RPD value was outside control limits.
R3	RPD value was outside control limits due to uncertainty of values at or near the PRL.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
255105011	**MC-SS-01a**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105012	**MC-SS-01b**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105013	**MC-SS-02a**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105014	**MC-SS-02b**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105015	**MC-SS-03**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105016	**MC-SS-04**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105017	**MC-SS-05**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105018	**MC-SS-06**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105019	**CC-SS-01**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105020	**CC-SS-02**	EPA 3050	MPRP/1805	EPA 6010	ICP/1719
255105011	**MC-SS-01a**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105012	**MC-SS-01b**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105013	**MC-SS-02a**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105014	**MC-SS-02b**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105015	**MC-SS-03**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105016	**MC-SS-04**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105017	**MC-SS-05**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105018	**MC-SS-06**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105019	**CC-SS-01**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105020	**CC-SS-02**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105026	**BKG-06**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105027	**BKG-07**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105028	**BKG-08**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105029	**BKG-09**	EPA 6020	ICPM/22644	EPA 6020	ICPM/9249
255105001	**MC-SW-01a**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105002	**MC-SW-01b**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105003	**MC-SW-02a**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105004	**MC-SW-02b**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105005	**MC-SW-03**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105006	**MC-SW-04**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105007	**MC-SW-05**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105008	**MC-SW-06**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105009	**CC-SW-01**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105010	**CC-SW-02**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105021	**AM-AS-01**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105022	**AM-AS-02**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105023	**AM-SP-01**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105024	**MC-SW-07**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105025	**MC-SW-08**	EPA 6020	ICPM/22647	EPA 6020	ICPM/9258
255105026	**BKG-06**	USDA 21A	MT/5015		
255105027	**BKG-07**	USDA 21A	MT/5015		
255105028	**BKG-08**	USDA 21A	MT/5015		
255105029	**BKG-09**	USDA 21A	MT/5015		
255105011	**MC-SS-01a**	ASTM D2974-87	PMST/1372		
255105012	**MC-SS-01b**	ASTM D2974-87	PMST/1372		
255105013	**MC-SS-02a**	ASTM D2974-87	PMST/1372		
255105014	**MC-SS-02b**	ASTM D2974-87	PMST/1372		

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
255105015	**MC-SS-03**	ASTM D2974-87	PMST/1372		
255105016	**MC-SS-04**	ASTM D2974-87	PMST/1372		
255105017	**MC-SS-05**	ASTM D2974-87	PMST/1372		
255105018	**MC-SS-06**	ASTM D2974-87	PMST/1372		
255105019	**CC-SS-01**	ASTM D2974-87	PMST/1372		
255105020	**CC-SS-02**	ASTM D2974-87	PMST/1372		
255105026	**BKG-06**	ASTM D2974-87	PMST/1372		
255105027	**BKG-07**	ASTM D2974-87	PMST/1372		
255105028	**BKG-08**	ASTM D2974-87	PMST/1372		
255105029	**BKG-09**	ASTM D2974-87	PMST/1374		
255105001	**MC-SW-01a**	EPA 120.1	WET/2288		
255105002	**MC-SW-01b**	EPA 120.1	WET/2288		
255105003	**MC-SW-02a**	EPA 120.1	WET/2288		
255105004	**MC-SW-02b**	EPA 120.1	WET/2288		
255105005	**MC-SW-03**	EPA 120.1	WET/2288		
255105006	**MC-SW-04**	EPA 120.1	WET/2288		
255105007	**MC-SW-05**	EPA 120.1	WET/2288		
255105008	**MC-SW-06**	EPA 120.1	WET/2288		
255105009	**CC-SW-01**	EPA 120.1	WET/2288		
255105010	**CC-SW-02**	EPA 120.1	WET/2288		
255105021	**AM-AS-01**	EPA 120.1	WET/2288		
255105022	**AM-AS-02**	EPA 120.1	WET/2288		
255105023	**AM-SP-01**	EPA 120.1	WET/2288		
255105021	**AM-AS-01**	SM 2320B	WET/2304		
255105022	**AM-AS-02**	SM 2320B	WET/2304		
255105023	**AM-SP-01**	SM 2320B	WET/2304		
255105001	**MC-SW-01a**	SM 2540C	WET/2286		
255105002	**MC-SW-01b**	SM 2540C	WET/2286		
255105003	**MC-SW-02a**	SM 2540C	WET/2286		
255105004	**MC-SW-02b**	SM 2540C	WET/2286		
255105005	**MC-SW-03**	SM 2540C	WET/2286		
255105006	**MC-SW-04**	SM 2540C	WET/2286		
255105007	**MC-SW-05**	SM 2540C	WET/2286		
255105008	**MC-SW-06**	SM 2540C	WET/2286		
255105009	**CC-SW-01**	SM 2540C	WET/2286		
255105010	**CC-SW-02**	SM 2540C	WET/2286		
255105021	**AM-AS-01**	SM 2540C	WET/2286		
255105022	**AM-AS-02**	SM 2540C	WET/2286		
255105023	**AM-SP-01**	SM 2540C	WET/2286		
255105001	**MC-SW-01a**	SM 2540D	WET/2287		
255105002	**MC-SW-01b**	SM 2540D	WET/2287		
255105003	**MC-SW-02a**	SM 2540D	WET/2287		
255105004	**MC-SW-02b**	SM 2540D	WET/2287		
255105005	**MC-SW-03**	SM 2540D	WET/2287		
255105006	**MC-SW-04**	SM 2540D	WET/2287		
255105007	**MC-SW-05**	SM 2540D	WET/2287		

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: USFS Azurite Mine DGI
Pace Project No.: 255105

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
255105008	**MC-SW-06**	SM 2540D	WET/2287		
255105009	**CC-SW-01**	SM 2540D	WET/2287		
255105010	**CC-SW-02**	SM 2540D	WET/2287		
255105021	**AM-AS-01**	SM 2540D	WET/2287		
255105022	**AM-AS-02**	SM 2540D	WET/2287		
255105023	**AM-SP-01**	SM 2540D	WET/2287		
255105001	**MC-SW-01a**	SM 4500-H+B	WET/2278		
255105002	**MC-SW-01b**	SM 4500-H+B	WET/2278		
255105003	**MC-SW-02a**	SM 4500-H+B	WET/2278		
255105004	**MC-SW-02b**	SM 4500-H+B	WET/2278		
255105005	**MC-SW-03**	SM 4500-H+B	WET/2278		
255105006	**MC-SW-04**	SM 4500-H+B	WET/2278		
255105007	**MC-SW-05**	SM 4500-H+B	WET/2278		
255105008	**MC-SW-06**	SM 4500-H+B	WET/2278		
255105009	**CC-SW-01**	SM 4500-H+B	WET/2278		
255105010	**CC-SW-02**	SM 4500-H+B	WET/2278		
255105021	**AM-AS-01**	SM 4500-H+B	WET/2285		
255105022	**AM-AS-02**	SM 4500-H+B	WET/2285		
255105023	**AM-SP-01**	SM 4500-H+B	WET/2285		
255105021	**AM-AS-01**	EPA 300.0	WETA/1715		
255105022	**AM-AS-02**	EPA 300.0	WETA/1715		
255105023	**AM-SP-01**	EPA 300.0	WETA/1715		

Sample Condition Upon Receipt

Pace Analytical

Client Name: Cascade Earth Science Project # 255105

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☑ Client ☐ Commercial ☐ Pace Other ________

Tracking #: ________________

Custody Seal on Cooler/Box Present: ☐ Yes ☑ No Seals intact: ☐ Yes ☐ No

Packing Material: ☑ Bubble Wrap ☐ Bubble Bags ☐ None ☐ Other ________ Temp. Blank [✓ Yes] ______ No ______

Thermometer Used 132013 or [✓ 101731962] or 226099 Type of Ice: [✓ Wet] Blue None ☐ Samples on ice, cooling process has begun

Cooler Temperature 4.1 Biological Tissue is Frozen: Yes No

Temp should be above freezing ≤ 6°C

Date and Initials of person examining contents: NJS 9/25/10

		Comments:
Chain of Custody Present:	☑ Yes ☐ No ☐ N/A	1.
Chain of Custody Filled Out:	☑ Yes ☐ No ☐ N/A	2.
Chain of Custody Relinquished:	☑ Yes ☐ No ☐ N/A	3.
Sampler Name & Signature on COC:	☐ Yes ☑ No ☐ N/A	4.
Samples Arrived within Hold Time:	☐ Yes ☑ No ☐ N/A	5. pH
Short Hold Time Analysis (<72hr):	☑ Yes ☐ No ☐ N/A	6. pH, TSS
Rush Turn Around Time Requested:	☐ Yes ☑ No ☐ N/A	7.
Sufficient Volume:	☑ Yes ☐ No ☐ N/A	8.
Correct Containers Used:	☑ Yes ☐ No ☐ N/A	9.
-Pace Containers Used:	☑ Yes ☐ No ☐ N/A	
Containers Intact:	☑ Yes ☐ No ☐ N/A	10.
Filtered volume received for Dissolved tests	☐ Yes ☐ No ☑ N/A	11.
Sample Labels match COC:	☑ Yes ☐ No ☐ N/A	12.
-Includes date/time/ID/Analysis Matrix: Soil, Water		
All containers needing preservation have been checked.	☑ Yes ☐ No ☐ N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☑ Yes ☐ No ☐ N/A	
Exceptions: VOA, coliform, TOC, O&G		Initial when completed | Lot # of added preservative
Samples checked for dechlorination:	☐ Yes ☐ No ☑ N/A	14.
Headspace in VOA Vials (>6mm):	☐ Yes ☐ No ☑ N/A	15.
Trip Blanks Present:	☐ Yes ☑ No ☐ N/A	16.
Trip Blank Custody Seals Present	☐ Yes ☐ No ☑ N/A	
Pace Trip Blank Lot # (if purchased): ________		

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: ________________ Date/Time: ________________

Comments/ Resolution: ________________

Project Manager Review: Jenni Gross Date: 9/27/10

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical™
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

~~[illegible]~~ NSS 9/25/10
255105

Page: 1 of 3

Section A
Required Client Information:

Company: Cascade Earth Sciences
Address: 3511 Pacific Boulevard SW
Albany, Oregon 97321
Email To: ryan.tobias@cascade-earth.com
Phone: 503-931-3157 Fax: 541-967-7619
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Ryan Tobias
Copy To:
Purchase Order No.:
Project Name: USFS Azurite Mine DGI
Project Number: 2010230015

Section C
Invoice Information:

Attention: Dustin Wasley
Company Name: Cascade Earth Sciences
Address: 12720 E. Nora, Ste. A Spokane, WA 9
Pace Quote Reference: 16719
Pace Project Manager: Jennifer Gross
Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☒ OTHER CERCLA

Site Location STATE: WA

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes MATRIX	CODE
DRINKING WATER	DW WT
WATER	WW
WASTE WATER	P
PRODUCT	SL
SOIL/SOLID	OL
OIL	WP
WIPE	AR
AIR	OT
OTHER	TS
TISSUE	

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Y/N ➡ ⬇Analysis Test ➡	Total Rec. Al, As, Ba, Cd	Cr, Cu, Fe, Pb, Ni, and Zn	pH, hardness, conductivity	TSS, TDS	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	MC-SW-01a	WT	G			9/22/10	1205		2			x							x	x	x	x	N	
2	MC-SW-01b	WT	G			9/22/10	1055		2			x							x	x	x	x	N	
3	MC-SW-02a	WT	G			9/21/10	1430		2			x							x	x	x	x	N	
4	MC-SW-02b	WT	G	~~[illegible]~~		9/21/10	1350		2			x							x	x	x	x	N	
5	MC-SW-03	WT	G			9/21/10	1250		2			x							x	x	x	x	N	
6	MC-SW-04	WT	G			9/21/10	1150		2			x							x	x	x	x	N	
7	MC-SW-05	WT	G			9/21/10	1055		2			x							x	x	x	x	N	
8	MC-SW-06	WT	G			9/20	1235		2			x							x	x	x	x	N	
9	CC-SW-01	WT	G			9/20/10	1200		2			x							x	x	x	x	N	
10	CC-SW-02	WT	G			9/20	1125		2			x							x	x	x	x	N	
11																								
12																								

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	/ CES	9/24/10	1410	Jyothi Swamy	9/24/10	14:10	4.1	Y	N	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

NJS 9/25/10
~~2205~~ 255105

Page: 2 of 3

Section A
Required Client Information:

Company: Cascade Earth Sciences
Address: 3511 Pacific Boulevard SW
Albany, Oregon 97321
Email To: ryan.tobias@cascade-earth.com
Phone: 503-931-3157 Fax: 541-967-7619
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Ryan Tobias
Copy To:
Purchase Order No.:
Project Name: USFS Azurite Mine DGI
Project Number: 2010230015

Section C
Invoice Information:

Attention: Dustin Wasley
Company Name: Cascade Earth Sciences
Address: 12720 E. Nora, Ste. A Spokane, WA 99
Pace Quote Reference: 16719
Pace Project Manager: Jennifer Gross
Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☒ OTHER CERCLA

Site Location STATE: WA

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

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ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Total Al, As, Ba, Cd	Cr, Cu, Fe, Pb, Ni, Zn	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	MC-SS-01a	SL	G			9/22/10	1210			x									x	x	N	
2	MC-SS-01b	SL	G			9/22/10	1100			x									x	x	N	
3	MC-SS-02a	SL	G			9/21/10	1435			x									x	x	N	
4	MC-SS-02b	SL	G			9/21/10	1355			x									x	x	N	
5	MC-SS-03	SL	G			9/21/10	1250			x									x	x	N	
6	MC-SS-04	SL	G			9/21/10	1200			x									x	x	N	
7	MC-SS-05	SL	G			9/21/10	1100			x									x	x	N	
8	MC-SS-06	SL	G			9/20	1245			x									x	x	N	
9	CC-SS-01	SL	G			9/20	1225			x									x	x	N	
10	CC-SS-02	SL	G			9/20	1150			x									x	x	N	
11																						
12																						

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	/ CES	9/24/10	1410	Jyothi [illegible]	9/24/10	14:10	0.4	Y	N	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:
SIGNATURE of SAMPLER:
DATE Signed (MM/DD/YY):

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NSS 9/25/10
~~22105~~ 255105

Page: 3 of 3

Section A
Required Client Information:
Company: Cascade Earth Sciences
Address: 3511 Pacific Boulevard SW
Albany, Oregon 97321
Email To: ryan.tobias@cascade-earth.com
Phone: 503-931-3157 Fax: 541-967-7619
Requested Due Date/TAT: Standard

Section B
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Report To: Ryan Tobias
Copy To:
Purchase Order No.:
Project Name: USFS Azurite Mine DGI
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Invoice Information:
Attention: Dustin Wasley
Company Name: Cascade Earth Sciences
Address: 12720 E. Nora, Ste. A Spokane, WA 99
Pace Quote Reference: 16719
Pace Project Manager: Jennifer Gross
Pace Profile #:

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1	AM-AS-01	WT	G			9/22/10	1500					x							x	x	x	x	x	x							N	
2	AM-AS-02	WT	G			9/22/10	1635					x							x	x	x	x	x	x							N	
3	AM-SP-01	WT	G			9/22/10	1615					x							x	x	x	x	x	x							N	
4	MC-SW-07	WT	G			9/21/10	1155		1			x							x	x											N	
5	MC-SW-08	WT	G			9/22/10	1840		1			x							x	x											N	
6	BKG-06	SL	G			9/24/10	1300		↓	x																x	x	x	x			
7	BKG-07	↓	↓			↓	1320		↓	x																x	x	x	x			
8	BKG-08	↓	↓			↓	1435		↓	x																x	x	x	x			
9	BKG-09	↓	↓			↓	1400		↓	x																x	x	x	x			
10																																
11																																
12																																

Requested Analysis Filtered (Y/N)

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	/ CES	9/24/10	1410	Jyoth Sway	9/24/10	14:10	5.3	Y	N	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER:
SIGNATURE of SAMPLER:
DATE Signed (MM/DD/YY):

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Sample Container Count

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CLIENT: CES WO#255105

COC PAGE 1 of 3
COC ID# /

Sample Line Item	VG9H	AG1H	AG1U	BG1H	BP1U	BP2U	BP3U	BP2N	BP2S	WGFU	WGKU	BP3N			Comments
1					1							1 C2			
2					↓							↓			
3					↓							↓			
4					↓							↓			
5					↓							↓			
6					↓							↓			
7					↓							↓			
8					↓							↓			
9					↓							↓			
10					↓							↓			
11															
12															Trip Blank? No

AG1H	1 liter HCL amber glass		BP2S	500mL H2SO4 plastic	JGFU	4oz unpreserved amber wide
AG1U	1liter unpreserved amber glass		BP2U	500mL unpreserved plastic	R	terra core kit
AG2S	500mL H2SO4 amber glass		BP2Z	500mL NaOH, Zn Ac	U	Summa Can
AG2U	500mL unpreserved amber glass		BP3C	250mL NaOH plastic	VG9H	40mL HCL clear vial
AG3S	250mL H2SO4 amber glass		BP3N	250mL HNO3 plastic	VG9T	40mL Na Thio. clear vial
BG1H	1 liter HCL clear glass		BP3S	250mL H2SO4 plastic	VG9U	40mL unpreserved **clear** vial
BG1U	1 liter unpreserved glass		BP3U	250mL unpreserved plastic	VG9W	40mL glass vial preweighted (EPA 5035)
BP1N	1 liter HNO3 plastic		DG9B	40mL Na Bisulfate amber vial	VSG	Headspace septa vial & HCL
BP1S	1 liter H2SO4 plastic		DG9H	40mL HCL amber voa vial	WGFU	4oz clear soil jar
BP1U	1 liter unpreserved plastic		DG9M	40mL MeOH clear vial	WGFX	4oz wide jar w/hexane wipe
BP1Z	1 liter NaOH, Zn, Ac		DG9T	40mL Na Thio amber vial	ZPLC	Ziploc Bag
BP2N	500mL HNO3 plastic		DG9U	40mL unpreserved **amber** vial		
BP2O	500mL NaOH plastic		I	Wipe/Swab		

Sample Container Count

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CLIENT: CES WO# 255105

COC PAGE 2 of 3
COC ID# —

Sample Line Item	VG9H	AG1H	AG1U	BG1H	BP1U	BP2U	BP3U	BP2N	BP2S	WGFU	WGKU				Comments
1										1	1				
2															
3															
4															
5															
6															
7															
8															
9															
10															
11										~~2~~ NJS	9/25/10				
12															Trip Blank? No

AG1H	1 liter HCL amber glass		BP2S	500mL H2SO4 plastic	JGFU	4oz unpreserved amber wide
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AG2S	500mL H2SO4 amber glass		BP2Z	500mL NaOH, Zn Ac	U	Summa Can
AG2U	500mL unpreserved amber glass		BP3C	250mL NaOH plastic	VG9H	40mL HCL clear vial
AG3S	250mL H2SO4 amber glass		BP3N	250mL HNO3 plastic	VG9T	40mL Na Thio. clear vial
BG1H	1 liter HCL clear glass		BP3S	250mL H2SO4 plastic	VG9U	40mL unpreserved **clear** vial
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BP2O	500mL NaOH plastic		I	Wipe/Swab		

Sample Container Count

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CLIENT: CES WO#255105

COC PAGE 3 of 3

COC ID# ____

Sample Line Item	VG9H	AG1H	AG1U	BG1H	BP1U	BP2U	BP3U	BP2N	BP2S	WGFU	WGKU	BP3N	Ziplock bag		Comments
1					1	1						1 c2			
2					1	1						↓			
3					1	1									
4												1			
5												1			
6													1		
7													1		
8													1		
9													1		
10															
11															
12															Trip Blank? No

AG1H	1 liter HCL amber glass		BP2S	500mL H2SO4 plastic	JGFU	4oz unpreserved amber wide
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AG2S	500mL H2SO4 amber glass		BP2Z	500mL NaOH, Zn Ac	U	Summa Can
AG2U	500mL unpreserved amber glass		BP3C	250mL NaOH plastic	VG9H	40mL HCL clear vial
AG3S	250mL H2SO4 amber glass		BP3N	250mL HNO3 plastic	VG9T	40mL Na Thio. clear vial
BG1H	1 liter HCL clear glass		BP3S	250mL H2SO4 plastic	VG9U	40mL unpreserved **clear** vial
BG1U	1 liter unpreserved glass		BP3U	250mL unpreserved plastic	VG9W	40mL glass vial preweighted (EPA 5035)
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BP1U	1 liter unpreserved plastic		DG9M	40mL MeOH clear vial	WGFX	4oz wide jar w/hexane wipe
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BP2N	500mL HNO3 plastic		DG9U	40mL unpreserved **amber** vial		
BP2O	500mL NaOH plastic		I	Wipe/Swab		

McCLELLAND LABORATORIES, INC.

1016 Greg Street, Sparks, Nevada 89431 (775) 356-1300
FAX (775) 356-8917
E-MAIL mli@mettest.com

December 27, 2007

Mr. Bob Lambeth
Cascade Earth Sciences
12720 E. Nora Ave., Suite A
Spokane, WA 99216

Dear Bob:

Enclosed is our summary report concerning results obtained from short term (7 weeks) humidity cell (HC) kinetic ARD potential tests conducted on samples LWR-1 and UWR-1 and for the sequential batch soils attenuation test conducted on the soils weighted composite (soils samples TP-5, S-1 @ 4'; TP-5, S1 (or 2) @ 8'; and TP-6, S-1 @ 4') using the volume weighted HC test extract composite (weeks 0, 1, 2, 3, 4) from sample UWR-1, as influent. A complete written report can be provided later if necessary for your report.

The invoice for this work (MLI Job No. 3237 / 7035) was sent under separate cover.

We appreciated the opportunity to serve you on this project and hope the data reached you in a timely manner. We look forward to a lasting association.

Sincerely,

Gene

Gene E. McClelland
Metallurgist/President

GEM:cd
Enclosure

McCLELLAND LABORATORIES, INC.

1016 Greg Street, Sparks, Nevada 89431 (775) 356-1300
FAX (775) 356-8917
E-MAIL mli@mettest.com

Summary Report
on
Short Term HC Tests (LWR-1 and UWR-1) and Sequential
Batch Soils Attenuation Test (Soils Weighted Composite)

MLI Job No. 3237
December 27, 2007

for

Mr. Bob Lambeth
Cascade Earth Sciences
12720 E. Nora Ave., Suite A
Spokane, WA 99216

TABLE OF CONTENTS

McCLELLAND LABORATORIES, INC.

1016 Greg Street, Sparks, Nevada 89431 (775) 356-1300
FAX (775) 356-8917
E-MAIL mli@mettest.com

Summary Report
on
Short Term HC Tests (LWR-1 and UWR-1) and Sequential Batch Soils Attenuation Test (Soils Weighted Composite)

MLI Job No. 3237
December 27, 2007

for

Mr. Bob Lambeth
Cascade Earth Sciences
12720 E. Nora Ave., Suite A
Spokane, WA 99216

EXECUTIVE SUMMARY

Samples designated LWR-1 (25% acid rock, 75% inert fill) and UWR-1 (acid producing waste rock) were received for short term (7 weeks total) humidity cell (HC) kinetic ARD potential tests. HC test extracts from week 0, 1, 2, 3 and 4 from the UWR-1 HC test were composited on a volume weighted basis for use as influent (sample I.D. = SEQ-Inf) for a subsequent sequential batch soils attenuation test. Sample UWR-1 was acid producing waste rock and HC test extract (composite) would provide the “worst case” solution for determining the attenuation capacity of the site native soils (weighted composite of 3 soils samples).

Objectives for short term HC tests were to determine the potential of the solids (LWR-1 and UWR-1) to generate or neutralize acid in a natural weathering and oxidizing environment and to produce sufficient UWR-1 HC test extract for the subsequent sequential batch soils attenuation tests.

Modified acid/base accounting (Mod ABA) static ARD potential test data indicated that sample LWR-1 displayed a significantly greater potential to neutralize rather than generate acid in a natural environment (NNP = +20, ratio >66.7), while sample UWR-1 would be a significant acid producer (NNP = -9.4, ratio <0.03).

Short term HC test data were in agreement with Mod ABA data predictions. Extract pH from sample LWR-1 was above pH 6 during the seven week test. Redox potential (Ag/AgCl reference) ranged from 125 to 229 mV indicating that strong oxidizing conditions were not established. EC (mS/cm) ranged from 0.67 (week 0) to 0.18 (weeks 5 and 6). Iron mobility was slight. Sulfate concentrations ranged from 280 to 7.4 mg/L. Acidity was not detected in any extract and demonstrates that none of the sulfate generated resulted from oxidation of sulfide minerals. Alkalinity concentrations were high and ranged from 46 (week 0) to 70 (week 6) $mgCaCO_3/L$.

HC test data show that sample UWR-1 was likely acid producing before sample acquisition. Extract pH ranged from 2.66 (week 0) to 2.31 (week 5). Redox potential ranged from 410 (week 1) to 532 (week 6) mV and demonstrate that strong oxidizing conditions were established during the kinetic test. EC was fairly constant during the test and ranged from 2.17 (week 6) to 3.31 (week 4) mS/cm. Iron mobility was fairly significant (313 to 428 mg/L) and the ferric to ferrous ratio was greater than 1 after week 2. Sulfate and acidity concentrations were high the duration of the test, and all the sulfate generated resulted from oxidation of contained sulfide minerals. Alkalinity was not detected in any HC test extract.

Sequential batch soils attenuation test data show that site native soils display a significant capacity to attenuate acidic components and regulated metals from the UWR-1 composite extract solution. Soils readily attenuated acidic components; 99.99% of the Fe, 66.40% of the sulfate, 99.53% of the acidity contained in the extract composite used as influent for the attenuation test. Metals analysis results available show that the soils attenuated 98.77% of the As, 88.61% of the Cd, 99.06% of the Cu, 95.28% of the Mn, 72.51% of the Zn. Lead was mobilized from the soils.

(Text to be completed after ACZ results.)

SAMPLE PREPARATION AND FEED ANALYSES

About 4 kg each of samples LWR-1 and UWR-1 were received for short term HC kinetic ARD potential tests. Each sample was stage crushed in entirety to 100%-1/4" (~P_{80}10 mesh) in size, and was blended and split to obtain 2.5 kg for HC tests.

Three soil samples were received at a minus 3/4" feed size. The entire quantity of each soil sample was composited to produce sufficient sample for the three sequence, sequential batch soils attenuation test. Composite make-up information is provided in Table 1.

Table 1. - Composite Make-Up Information, Site Native Soils Samples

	Weight, kg		Weight,
Soil Sample I.D.	Rec'd	To Comp	percent
TP-5, S-1 @ 4'	2.2	2.2	30.6
TP-5, S-1 @ 8' 1)	2.6	2.6	36.1
TP-6, S-1 @ 4'	2.4	2.4	33.3
Composite	7.2	7.2	100.0

1) Sample I.D. on sample bag was T-5, S-2 @ 8', but on the packing list was as above.

The soils composite (7.2 kg) was thoroughly blended and split to obtain 2.500 kg for sequence 1 (S-1), 2.097 kg for sequence 2 (S-2) and 1.747 kg for sequence 3 (S-3). Rejects (0.856 kg) were used to determine feed moisture content (11.7% moisture).

Cascade Earth Sciences (CES) had all feed analyses conducted on all feed solids and provided MLI respective results. Metals analysis results are provided in Table 2. Mod ABA results for LWR-1, UWR-1 and the three soils samples are provided in Tables 3 and 4, respectively.

Table 2. - Metals Analysis Results, UWR-1 and Soils Feed Solids

	Feed Solid Sample				
Metal, mg/kg	UWR-1	TP-5, S-1	TP-5, S-2[1]	TP-6, S-1	TP Wt'd. Avg.[2]
Aluminum	NR	NR	NR	NR	NR
Arsenic	195	72.2	88.4	93.4	84.7
Cadmium	0.44	0.61	0.95	1.51	1.02
Calcium	NR	NR	NR	NR	NR
Copper	546	180	262	306	249
Iron	137,000	53,000	54,600	62,300	56,633
Lead	16.30	14.50	14.10	829	285.87
Magnesium	NR	NR	NR	NR	NR
Manganese	NR	NR	NR	NR	NR
Mercury	0.92	0.05	ND	0.70	0.25
Sodium	NR	NR	NR	NR	NR
Zinc	115	199	223	479	300

NR = No Result; ND = Not Detected

1) Sample I.D. on sample bag was TP-5, S-2 @ 8', but on packing list was TP-5, S-1 @ 8'

2) Each soil sample received was essentially the same weight (2.4 kg), so the soils composite (total wt. of each combined) was a weighted composite.

Note: Metals analysis results for feed solids provided by Cascade Earth Sciences.

Metals analysis results show that sufficient quantities of As, Cd, Cu, Fe, Pb, Hg and Zn are contained in the UWR-1 feed to be mobilized during the HC test, especially because acid producing conditions were established. Calculated results for the site native soils composite show that sufficient quantities of those same metals are contained in the soils to be mobilized from the soils during the sequential batch soils attenuation test.

Table 3. - Modified Acid/Base Accounting (Mod ABA)
Static ARD Potential Test Data, HC Test Feed Solids

Sample	Sulfur, weight percent (as S)							
I.D.	Total	SO_4	Pyritic $S^=$	Org. S	AGP[1]	ANP	NNP	Ratio
LWR-1	0.02	<0.01	<0.01	0.03	<0.3	20	+20	>66.67
UWR-1	3.16	0.91	0.30	1.95	9.4	<0.3	-9.4	<0.03

1) AGP based on pyritic $S^=$ content ($S^=$% x 31.25). AGP, ANP, NNP in units of tons $CaCO_3$ equivalents per 1000 tons of solids.

Note: Mod ABA results provided by Cascade Earth Sciences.

Table 4. - Modified Acid/Base Accounting (Mod ABA)
Static ARD Potential Test Results, Soils Samples

Soil	Sulfur, weight percent (as S)							
Sample	Total	SO_4	Pyritic $S^=$	Org. S	AGP[1]	ANP	NNP	Ratio
TP-5, S-1 @ 4'	0.06	0.02	0.01	0.03	0.3	2	+1.7	6.67
TP-5, S-1 @ 8'	0.03	0.01	<0.01	0.02	<0.3	8	+8.0	>16.67
TP-6, S-1 @ 4'	0.06	0.02	<0.01	0.04	<0.3	5	+5.0	>16.67
Composite	0.05	0.017	0.003	0.03	<0.3	5	+5.0	>16.67

1) AGP based on pyritic $S^=$ content ($S^=$% x 31.25). AGP, ANP, NNP in units of tons $CaCO_3$ equivalents per 1000 tons of solids.

Note: Mod ABA results provided by Cascade Earth Sciences, and were used to calculate the soils composite Mod ABA data on a weighted basis.

Mod ABA results were summarized in the Executive Summary of this report.

HC KINETIC ARD POTENTIAL TEST PROCEDURES AND RESULTS

Short term HC kinetic ARD potential tests were conducted on 2.5 kg charges of LWR-1 and UWR-1 at a 100%-1/4" (~ P_{80}10 mesh) feed size to assess the potential of the solids to generate or neutralize acid in a natural weathering and oxidizing environment.

The short term HC tests were conducted for 7 weeks (including week 0 saturation) using ASTM Standard Method D5744-96 (02). Detailed test procedures are not provided in this summary report. Weekly HC test extract volumes were measured by weighing. Samples of each extract were analyzed immediately by MLI personnel for Temp., DO content, Eh (redox potential), pH, conductivity (EC), sulfate, acidity, alkalinity, Fe_t, Fe^{2+} and Fe^{3+} (by difference). Temperatures for both HC tests ranged from 19.3 to 22.0 °C. Dissolved oxygen contents ranged from 3.9 to 7.3 ppm. Those data are not included in the HC test tables (Tables 6 and 7). Remaining extract was filtered through a 0.45µm filter, preserved for metals analyses (pH <2.0 w/HNO_3) and shipped overnight to ACZ Laboratories for the suite of metals analyses requested by CES.

HC test extract solution rejects (minus volumes required for all analyses) from the UWR-1 HC test were stored frozen (unfiltered, unpreserved) until the volume weighted extract composite could be prepared. Volume weighted extract composite make-up information is provided in Table 5.

Table 5. - UWR-1 HC Test Extract Composite Make-Up Information

HC Test Week	Extract Vol., mL	Volume, percent
0	500.0	11.7
1	928.4	21.7
2	975.3	22.8
3	924.2	21.6
4	949.9	22.2
Composite	4,227.8	100.0

The volume weighted HC test extract composite was prepared by thawing each weekly extract and combining the total available volume of each. A sample was obtained from the composite (150 mL), was filtered through a 0.45µm filter, was preserved for metals analysis (pH <2.0 w/HNO_3) and was shipped overnight to ACZ for the sequential suite of metals analyses. That sample was labeled SEQ-Inf. Remaining extract composite (unfiltered, unpreserved) was used as influent (SEQ-Inf) for the subsequent sequential batch soils attenuation test.

Both HC tests continued through 6 weeks (7 weeks with week 0). HC test data for samples LWR-1 and UWR-1 are provided in Tables 6 and 7, respectively. On the sample page of Tables 6 and 7 are Figures 1 a & b and 2 a & b which depict graphically weekly pH, sulfate, acidity and alkalinity (a figures) and cumulative (b figures) data on a mass basis.

Table 6. - Humidity Cell Analytical Results, LWR-1 (2.4728 kg)

					Total Fe					SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity mS/cm	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.708	7.05	125	0.67	0.07	0.020	0.020	0.01	0.06	280.0	80.17	80.17	0.0	0.00	0.00	46.00	13.17	13.17
1	1.099	7.08	195	0.25	0.01	0.004	0.024	0.00	0.01	61.0	27.11	107.28	0.0	0.00	0.00	52.00	23.11	36.28
2	1.156	6.60	196	0.24	0.03	0.014	0.038	0.01	0.02	11.4	5.33	112.61	0.0	0.00	0.00	56.00	26.18	62.46
3	1.202	6.20	200	0.20	0.09	0.044	0.082	0.00	0.09	30.1	14.63	127.24	0.0	0.00	0.00	62.00	30.14	92.60
4	1.196	6.45	229	0.19	0.01	0.005	0.087	0.00	0.01	16.5	7.98	135.22	0.0	0.00	0.00	46.00	22.25	114.85
5	1.169	6.77	192	0.18	0.02	0.009	0.096	0.00	0.02	7.4	3.50	138.72	0.0	0.00	0.00	56.00	26.47	141.32
6	1.161	6.50	228	0.18	0.00	0.000	0.096	0.00	0.00	9.2	4.32	143.04	0.0	0.00	0.00	70.00	32.87	174.19

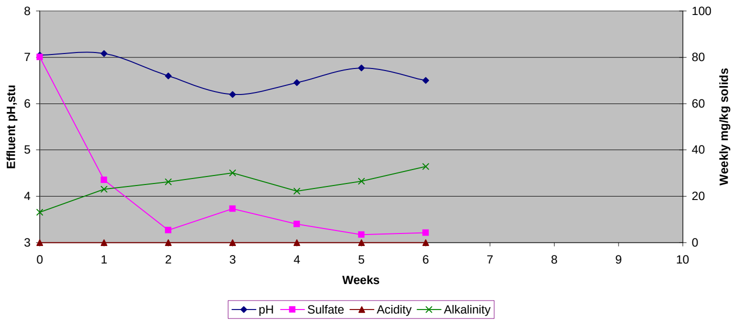
Figure 1a.- Weekly Humidity Cell Analytical Results, LWR-1

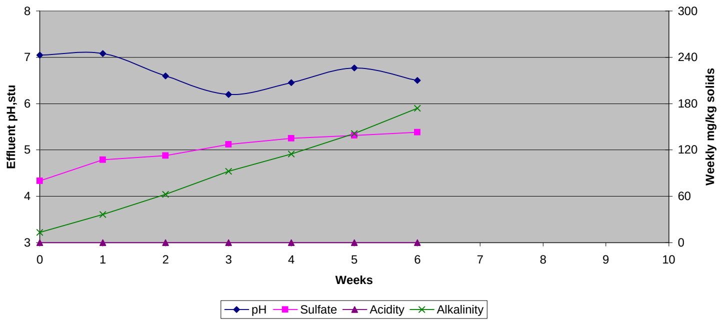
Figure 1b.- Cumulative Humidity Cell Analytical Results, LWR-1

Table 7. - Humidity Cell Analytical Results, UWR-1 (2.4844 kg)

					Total Fe					SO$_4$=			Acidity, CaCO$_3$ Equivalents			Alkalinity, CaCO$_3$ Equivalents		
Week	Vol. L	Effluent pH	Redox, mV (vs Ag/AgCI)	Conductivity mS/cm	mg/l	mg/kg	Cum. mg/kg	Fe^{2}+ mg/l	Fe^{3}+ mg/l	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg	mg/l	mg/kg	Cum. mg/kg
0	0.820	2.66	416	2.75	313.00	103.309	103.309	243.00	70.00	1170.0	386.17	386.17	1548.0	510.93	510.93	0.00	0.00	0.00
1	1.113	2.64	410	2.64	317.00	142.015	245.324	162.00	155.00	930.0	416.64	802.81	1568.0	702.46	1213.39	0.00	0.00	0.00
2	1.160	2.54	436	2.63	328.00	153.148	398.472	201.00	127.00	557.0	260.07	1062.88	1652.0	771.34	1984.73	0.00	0.00	0.00
3	1.109	2.38	478	2.61	244.00	108.918	507.390	63.00	181.00	1170.0	522.27	1585.15	1444.0	644.58	2629.31	0.00	0.00	0.00
4	1.135	2.39	466	3.31	428.00	195.532	702.922	168.00	260.00	1510.0	689.84	2274.99	2284.0	1043.45	3672.76	0.00	0.00	0.00
5	1.099	2.31	501	3.18	348.00	153.941	856.863	124.00	224.00	2270.0	1004.16	3279.15	2298.0	1016.54	4689.30	0.00	0.00	0.00
6	1.139	2.35	532	2.17	268.00	122.867	979.730	35.00	233.00	2140.0	981.11	4260.26	1546.0	708.78	5398.08	0.00	0.00	0.00

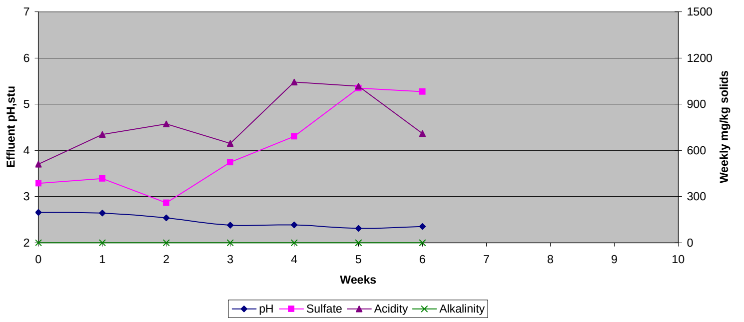
Figure 2a.- Weekly Humidity Cell Analytical Results, UWR-1

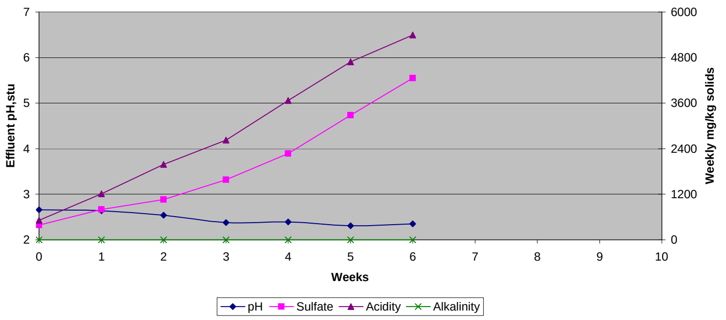
Figure 2b.- Cumulative Humidity Cell Analytical Results, UWR-1

HC test data was discussed in some detail in the Executive Summary of this report. Data show that sample LWR-1 would neutralize acid, but sample UWR-1 would generate acid in a natural weathering and oxidizing environment.

Multi-element ICP metals analysis results for weeks 0, 1, 2, 3 and 4 HC test extracts for LWR-1 and UWR-1 are provided in Tables 8 and 9, respectively. ACZ report sheets for these analyses are on file at CES and are not appended to this summary report.

Table 8. - Multi-Element ICP Metals Analysis Results, Humidity Cell Test Extracts, Sample LWR-1

	Extract				
Analysis, mg/L	Week 0	Week 1	Week 2	Week 3	Week 4
Aluminum	0.194	0.032	0.033*	Pending	0.022
Arsenic	0.0035	0.0031	0.0049		0.0041
Cadmium	0.0006	0.0001 1)	0.0003 1)		<0.0001
Calcium	133	48.4	44.2		28.7
Copper	0.0292	0.0063	0.0068*		0.0104
Iron	0.53	0.03 1)	<0.02		<0.02
Lead	0.0008	0.0006	0.0004 1)		0.0001 1)
Magnesium	8.4	2.9	2.6		1.8
Manganese	0.0543	0.0051	0.0411*		0.0042
Mercury	<0.0002	<0.0002	<0.0002		<0.0002
Sodium	8.5	3.7	3.1		1.8 1)
Zinc	0.014	0.003 1)	0.013*		0.005 1)

* Refer to ACZ extended qualifier report for detail.
1) ACZ report qualified result with a B designation. B = analyte conc. detected at a value between MDL and PQL.

Table 9. - Multi-Element ICP Metals Analysis Results, Humidity Cell Test Extracts, Sample UWR-1

	Extract				
Analysis, mg/L	Week 0	Week 1	Week 2	Week 3	Week 4
Aluminum	130	133	129	Pending	137
Arsenic	0.027	0.028	0.0409*		0.1 1)
Cadmium	0.0705	0.0572	0.0457		0.0430
Calcium	137	135	128		98.5
Copper	7.8	3.1	3.6		6.1
Iron	342	372	325		245
Lead	0.0189	0.0151	0.0155		0.0080
Magnesium	48.7	80.7	70.0		41.1
Manganese	10.7	12.8	12.1		5.7
Mercury	0.0003*1)	<0.0002	<0.0002		0.0002 1)
Sodium	7.3	7.2	5.4		4.1
Zinc	3.74	4.57	4.8		5.3

* Refer to ACZ extended qualifier report for detail.
1) ACZ report qualified result with a B designation. B = analyte conc. detected at a value between MDL and PQL.

HC test extract metals analysis results show that potential for metals mobility was significantly less from sample LWR-1 (acid neutralizing) than from sample UWR-1 (acid generating).

SEQUENTIAL BATCH SOILS ATTENUATION TEST PROCEDURE AND RESULTS

A sequential batch soils attenuation test, using volume weighted composite extract from the UWR-1 HC test as influent, was conducted to assess the capacity of the site soils composite for attenuating acid components and metals contained in the “worst case” influent. It was decided to conduct a column percolation sequential batch test rather than a bottle roll sequential batch test to better simulate site conditions. At site, seepage solution from UWR-1 would pass through the underlying site native soils only once, and equilibrium conditions would not be established. The bottle roll (agitated) sequential batch test procedure is a dynamic test (percolation is a static test) and equilibrium conditions (24 hours of rolling/sequence) would be established. The percolation method is more conservative because constituent mobility from the soils is typically higher in non-equilibrium conditions, and attenuation capacity of the soils, for some constituents, is less for non-equilibrium conditions.

Influent solution volume available was used to back calculate the appropriate soils charge for each of the three sequences. Appropriate weights of soils were placed into three 4" I.D. x 12" high clear acrylic columns and bed heights were measured. For sequence 1, influent (SEQ-Inf) was pumped onto the first soils composite charge at a rate equivalent to the site 100 yr/24 hr storm event rate (6.5" rain in 24 hrs). That application rate was 0.00325 gpm/ft^2 of column cross-sectional area (1.074 mL/min, 1.546 L/24 hrs). Influent was pumped at constant rate using a peristaltic pump. At the pumping rate, 2.43 days was required to complete sequence 1. After some drain time (~ 2 hrs), effluent volume from sequence 1 soils was measured by weighing and samples were taken for required analyses. A pre-calculated volume of sequence 1 effluent (S-1) was applied at the same rate to the pre-calculated weight of soils in the sequence 2 column. The above procedure was used through three sequences. The total volume of influent applied to the respective soils charges was equivalent to 1.5 tons solution applied per ton of soils, which is in-turn equivalent to 6 pore volumes passing through the soils.

Effluents from each sequence (S-1, S-2, S-3) were sampled and analyzed immediately for Eh, pH, EC, sulfate, acidity, alkalinity and Fe_t by MLI personnel. Another 75 mL sample of each effluent was filtered through a 0.45μm filter, preserved for metals analysis (pH <2.0 w/HNO_3), and shipped overnight to ACZ for requested metals analyses.

Sequential batch soils attenuation test data is provided in Table 10. Metals analysis results for test influent and effluents is provided in Table 11.

Table 10. - Sequential Batch Soils Attenuation Test Data, UWR-1 HC Test Extract Composite Used as Influent

		Sequence Effluent		
	Influent	S-1	S-2	S-3
Soil Wt., kg	N/A	2.500	2.097	1.747
Soil Vol., ft^3	N/A	0.074	0.064	0.053
Soil Bulk Density, lb/ft^3	N/A	74.4	72.2	72.6
Influent Volume, L	3.750	3.750	3.145	2.620
Effluent Volume, L	N/A	3.568	2.787	2.296
Temperature, °C Start		18.6	19.3	20.2
Temperature, °C End		19.3	20.2	18.0
Eh, mV	444	268	325	271
pH, s.u.	2.51	4.54	5.35	6.02
EC, mS/cm	2.79	1.43	0.90	0.56
DO, ppm	6.1	8.1	6.8	6.8
Iron, mg/L	328	0.06	0.16	0.03
Sulfate, mg/L	1,054	774	564	354
Acidity, mg/L (as $CaCO_3$)	1,717	44	12	8
Alkalinity, mg/L (as $CaCO_3$)	0	0	4	2

Note: Eh, pH, EC, DO, Fe, SO_4, acidity and akalinity data were from MLI analytical results from the UWR-1 HC test (weeks 0, 1, 2, 3, 4) and were calculated on a volume weighted basis.

Table 11. - Metals Analysis Results, Influent and Effluents, Sequential Batch Soils Attenuation Test, UWR-1 Composite HC Test Extract (Weeks 0, 1, 2, 3, 4) Used as Influent

		Sequence Effluent		
Metal, mg/L	Influent	S-1	S-2	S-3
Aluminum	143	2.7	0.19	1.4
Arsenic	0.0562	0.0009	0.0009 1)	0.0007 1)
Cadmium	0.0482	0.0217	0.0091	0.0055
Calcium	117	221	139	
Copper	5.2	0.0174	0.0099	0.0487
Iron	293	0.16	0.07	
Lead	0.0071	0.0774	0.0402	0.0144
Magnesium	55.1	57.9	39.3	
Manganese	10.6	14.5	1.83	0.5
Mercury	<0.0002	0.0002 1)	<0.0002	
Sodium	5.1	7.9	8.6	
Zinc	5.1	6.7	1.85	1.4

1) ACZ report qualified result with a B designation. B = analyte conc. detected at a value between MDL and PQL

Solution volumes and constituent concentrations were used to calculate soils attenuation/mobilization data on a mass basis. Effluent volume through three soils sequences was equivalent to the influent volume (3.75 L) based on the assumption, that at site, all solution applied would pass through the total soils volume (0.191 ft^3). Using equivalent volumes provides a conservative assessment of soils attenuation capacity because the volume of effluent from sequence 3 (S-3) was much less at 2.296 L. Mass balance calculations were not made for individual sequences, but only for the overall three sequence test series.

Overall attenuation data on a mass basis is provided in Table 12.

Table 12. - Overall Attenuation Data (Mass Basis), Sequential Batch Soils Attenuation Test, UWR-1 Composited HC Test Extract Used as Influent

	Influent			Effluent (S-3)					
	Vol.,	Conc.,		Vol.,	Conc.,		Attenuated		
Constituent	L	mg/L	mg	L[2]	mg/L	mg	mg	mg/ft^3	%
Iron[1]	3.750	328	1,230.000	3.750	0.03	0.112	1,229.888	6,439	99.99
Sulfate[1]	3.750	1,054	3,953	3.750	354	1,328	2,625	13,743	66.40
Acidity[1]	3.750	1,717	6,439	3.750	8	30	6,409	33,555	99.53
Alkalinity[1]	3.750	0	0	3.750	2	7.5	-7.5	-39.3	N/A
Aluminum	3.750	143	536.3	3.750	1.4	5.25	531.05	2,780.4	99.02
Arsenic	3.750	0.0562	0.2108	3.750	0.0007	0.0026	0.2082	1.09	98.77
Cadmium	3.750	0.0482	0.1808	3.750	0.0055	0.0206	0.1602	0.84	88.61
Calcium	3.750	117	438.75	3.750					
Copper	3.750	5.2	19.5	3.750	0.0487	0.183	19.317	101.14	99.06
Iron	3.750	293	1,098.750	3.750					
Lead	3.750	0.0071	0.0266	3.750	0.0144	0.0540	-0.0274	-0.14	-103.01
Magnesium	3.750	55.1	206.6	3.750					
Manganese	3.750	10.6	39.75	3.750	0.5	1.875	37.875	198.30	95.28
Mercury	3.750	<0.0002	0.00	3.750					
Sodium	3.750	5.1	19.1	3.750					
Zinc	3.750	5.1	19.1	3.750	1.4	5.25	13.85	72.51	72.51

1) Consituent concentrations calculated on a volume weighted basis from weekly ARD analyses from the UWR-1 HC test.
2) The 3.750 L volume was used assuming all influent applied would pass through the soils - provides worst case data because the S-3 effluent volume was 2.296 L.

Overall mass data, for available solution analyses, show that site native soils display a significant attenuation capacity for acidic components (Fe, SO_4, acidity, Eh, pH and EC). Site native soils attenuated 99.99% of Fe, 66.40% of SO_4, 99.53% of acidity. Alkalinity was mobilized, to some degree, from the soils. Available attenuation test effluent constituent concentration data indicate that the soils effectively attenuate As, Cd, Cu, Fe, Mn and Zn. Lead and Na appeared to mobilize from the soils.

Gene E McClelland

Gene E. McClelland
Metallurgist/President

Appendix E.

Technical Specifications and Construction Quality Assurance Plan

CES

A valmont COMPANY

Conserving Resources. Improving Life.

Azurite Mine

(PN: 2010230015)

Technical Specifications

TECHNICAL SPECIFICATION INDEX

AZURITE MINE

DIVISION 01

SECTION 00100
MEASUREMENT AND PAYMENT

1.0 PART I - GENERAL

1.1 Measurement and Payment

Measurement and payment for contract work will be made only for and under those pay items included in the SCHEDULE OF ITEMS. All other work and materials will be considered as included in the payment for items shown.

When more than one class, size, or thickness is specified in the SCHEDULE OF ITEMS for any pay item, suffixes will be added to the item number to differentiate between items to be bid.

1.2 Determination of Quantities

The following methods of measurement are used to determine contract quantities for payment.

For individual construction items, longitudinal and lateral measurements for area computations will be made horizontally or corrected to horizontal measurement unless otherwise specified. Measurements for seeding, mulching, geotextiles, netting, erosion control blankets, and sodding will be along slope lines.

The average end area method will be used to compute volumes of excavation or embankment. However, if in the judgment of the ENGINEER, the average end area method is impractical, measurement will be made by volume in hauling vehicles or by other three dimensional methods.

Structures will be measured according to neat lines SHOWN ON THE DRAWINGS or as altered by the ENGINEER in writing to fit field conditions.

For items that are measured by the linear foot, such as pipe culverts, fencing, guardrail, and under drains, measurements will be made parallel to the base or foundation upon which the structures are placed. Pipe and pipe arch culverts shall be measured along center of invert; arches shall be measured at spring line.

For aggregates weighed for payment, the tonnage will not be adjusted for moisture content, unless otherwise provided in SPECIAL PROJECT SPECIFICATIONS.

For bituminous material, volumes will be measured at 60°F or will be corrected to the volume at 60°F by using ASTM D 1250 for asphalts. Emulsified asphalt will be measured at 60°F, or measured by converting the gallonage at another temperature to gallonage at 60°F by means of the following formula:

$$\text{Gallons at } 60°F = \frac{\text{Gallons at } A°F}{1+0.00025\,(A°F - 60°F)}$$

in which A°F is the temperature of the material at the time the gallonage is measured.

For vehicular shipments, net certified scale weights or weights based on certified volumes will be used as a basis of measurement. Measurements will be adjusted when bituminous material has been lost from the vehicle or the distributor, has been wasted, or has otherwise not been incorporated into this work. Determining true weights of hauling vehicles shall be made by weighing the empty vehicles at least once a day at the times the ENGINEER directs. Each vehicle shall bear a plainly legible identification mark.

When bituminous materials are shipped, net certified weights, or volume corrected for loss of foaming, can be used for computing quantities.

For standard manufactured items, such as fence, wire, plates, rolled shapes, pipe conduits, etc., identified by gauge, weight, section dimensions, etc., such identification shall be considered the nominal weights or dimensions. Unless controlled by tolerances in cited specifications, manufacturer's tolerances will be accepted.

1.3 Units of Measurement

Payment will be by units defined and determined according to U.S. Standard measure as follows:

A. **Cubic Yard** - A measurement computed by one of the following methods:

   1. Excavation, Embankment, or Borrow - The measurement computed by the average end area method from measurements made longitudinally along a centerline or reference line.

   2. Material in Place or Stockpile - The measurement computed with dimensions of the in-place material.

   3. Material in the Delivery Vehicle - The measurement computed using measurements of material in the hauling vehicles at the point of delivery. Vehicles shall be loaded to at least their water level capacity. Leveling of the loads may be required when vehicles arrive at the delivery point.

B. **Cubic Yard Mile -** A combination of linear and volumetric measurement meaning the movement of a cubic yard of material 1 mile.

C. **Each -** One complete unit, which may consist of one or more parts.

D. **MFBM** - One thousand board feet measure based on nominal widths, thickness, and extreme usable length of each piece of lumber or timber actually incorporated in the job.

E. **Station** - One hundred linear feet measured horizontally.

F. **Station Yard** - A combination of linear and volumetric measurement meaning the movement of a cubic yard of material one station.

G. **Thousand Gallons Mile** - A combination of linear and volumetric measurement meaning the movement of 1,000 gallons of material 1 mile.

H. **Ton** - Short ton consisting of 2,000 pounds.

I. **Ton Mile** - A combination of linear and weight measurement meaning the movement of 1 ton of material 1 mile.

1.4 Methods of Measurement

One of the following methods of measurement for determining final payment is DESIGNATED on the SCHEDULE OF ITEMS for each pay item:

A. **Designed Quantities (DQ)** - These quantities denote the final number of units to be paid for under the terms of the contract. They are based upon the original design data available prior to advertising the project. Original design data include the preliminary survey information, design assumptions, calculations, drawings, and the presentation in the contract. Changes in the number of units SHOWN in the SCHEDULE OF ITEMS may be authorized under any of the following conditions:

   1. As a result of changes in the work authorized by the Contracting Officer.

   2. As a result of the Contracting Officer determining that errors exist in the original design data used to determine designed quantities that cause a pay item to change by 15 percent or more.

   3. As a result of the CONTRACTOR submitting to the Contracting Officer a written request showing evidence of errors in the original design data used to determine design quantities that cause a pay item total to change by 15 percent or more. The evidence must be verifiable and consist of calculations, drawings, or other data that show how the designed quantity is believed to be in error.

B. **Staked Quantities (SQ)** - These quantities are determined from staked measurements prior to construction.

C. **Actual Quantities (AQ)** - These quantities are determined from measurements of completed work.

D. **Vehicle Quantities (VQ)** - These quantities are measured or weighed in hauling vehicles.

E. **Lump Sum Quantities (LSQ)** - These quantities denote one complete unit of work as required by or described in the contract, including necessary materials, equipment, and labor to complete the job. They will not be measured.

1.5 Price Adjustment for Out-of-Specification Bituminous Materials

Bituminous materials are defined as all types and grades of asphalt cement, liquid asphalt, emulsified asphalt, and dust oil.

If bituminous material fails one or more test requirements, and the Contracting Officer determines it is in the public interest to accept the material at a reduced price, the price reduction shall be based on the test results giving the largest percent price adjustment. The CONTRACTOR may remove and replace the defective material or accept the adjustment.

The price reduction shall apply to all pay items affected.

Price adjustment will be based on samples taken in duplicate in accordance with AASHTO T 40 under the supervision of the ENGINEER. Samples shall be sent to an authorized laboratory. The laboratory shall test one of each duplicate sample and retain the other. When any test result is not within the specification limits, the laboratory shall immediately notify the supplier and the ENGINEER. The ENGINEER will then authorize check testing of the retained sample.

If the retained sample tests satisfactorily, the material will be accepted. If the retained sample also fails, the following schedule of price adjustments shall apply. The average of test values for the two samples will determine the basis for price adjustment, except when test results on the samples differ by more than the applicable AASHTO or ASTM Repeatability Unit; then, the test result numerically nearest the specification requirement will be used. (A repeatability unit is defined as D2S or D2S% limit for single operator precision described in ASTM recommended practice C 670.)

The schedule of price adjustments shall not apply to the following tests:

Test	AASHTO Test Method
Spot Test	T 102
Particle Charge	T 59
Ductility	T 51

Bituminous materials failing to meet specifications for these tests shall be removed and replaced.

See Table 00100-1 for the schedule of price adjustments for bituminous materials that do not meet specifications.

Table 00100-1

Schedule of Price Adjustments for Out-of-Specification Bituminous Materials.

Application	Deviation from Specification Limit Measured in Reproducibility Units*.			
	Less than 1	1 but less than 2	2 but less than 3	3 or greater
Price reduction applicable to bituminous base course and pavement mixture or to seal coat and bituminous material paid for as a separate item.	0%	5%	25%	Remove & Replace
Price reduction applicable to bituminous material paid for as a separate item.	0%	10%	25%	Remove & Replace

* A reproducibility unit is defined as D2S or D2S% limit for multi-laboratory precision described in ASTM recommended practice C 670.

The Sieve Test (AASHTO T 59) results may be exempt from the Schedule of Price Adjustments provided the CONTRACTOR's quality assurance program includes checking the uniformity of bituminous spread rates in increments no greater than 1 foot over the width of the spray bar and variation between increments is no greater than 5 percent.

1.6 Earthwork Tolerances

Adjustments of horizontal or vertical alignment, within the tolerances specified in this contract, or shifts of balance points up to 100 feet shall be made by the CONTRACTOR as necessary to produce the designed roadway section and to balance earthwork. Such adjustments shall not be considered as "Changes."

1.7 Pay Items, Unit Quantities, and Units of Measurement

The following table outlines the pay items, unit quantities, and the unites of measurement for the project.

Pay Item	Quantity	Unit Quantities	Units of Measurement
Logistics			
Mobilize/Demob	1	EA	LSQ
Erosion / Sediment Control	1	EA	LSQ
Site Seeding (USFS Provided seed)	2	AC	AQ
Access Road Maintenance	1	EA	LSQ
Misc. Onsite Road Construction/Obliteration	1	EA	LSQ
Remote Camp/Porta Potties/Logistics	1	EA	LSQ
Wasterock - Excavation and Placement			
Lower WR Excavation and Placement	6000	CY	AQ
Upper WR Excavation and Placement	16000	CY	AQ
Site Grading - WR footprint	6000	SY	AQ
15-ft Stabilized Slope (300-ft)			
Earth Fill (1/2-inch minus talus)	3200	CY	AQ
Turf Reinforcement Mat	6000	SF	AQ
Uniaxial Geogrid	42000	SF	AQ
Tensar BX 1120 mat	35000	SF	AQ
5-ft Berm (450-ft)			
Berm (Borrow Soil)	500	CY	AQ
Repository - Regrading and Cover Construction			
Wasterock and Mill Area Bench Grading	180000	SF	AQ
Non-Woven Filter Fabric (12oz)	180000	SF	AQ
40-mil HDPE Geomembrane	180000	SF	AQ
Non-Woven Filter Fabric (12oz)	180000	SF	AQ
Miragrid 7XT Geogrid	180000	SF	AQ
Talus Cover (12-inch depths)	7000	CY	AQ
Runon / Runoff Control			
4" Perforated Pipe	400	LF	AQ
8 oz fabric	3500	SF	AQ
Impermeable Liner	4500	SF	AQ
Runon Control Ditch	1100	CY	AQ
V Ditches	250	CY	AQ
Infiltration basin	150	CY	AQ
Mill Creek Crossing			
48" Culvert	60	FT	AQ
Install and Maintenance	1	EA	LSQ

2.0 PART II - PRODUCTS (Not Applicable)

3.0 PART III - EXECUTION (Not Applicable)

END OF SECTION

DIVISION 00

SECTION 00190
MOBILIZATAION

1.0 PART I - GENERAL

This item is intended to compensate the CONTRACTOR for operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for payment of premiums for bonds and insurance for the project; and for any other work and operations which must be performed or costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided for under the contract.

Also included are:

- Camp set up and tear down
- Provide bear proof trash containers and regular removal of trash/debris
- Provide Porta Potties, with regular maintenance and disposal

2.0 PART II - PRODUCTS (NOT APPLICABLE)

3.0 PART III – EXECUTION (NOT APPLICABLE)

END OF SECTION

DIVISION 02

SECTION 02110
OBLITERATION OF ABANDONDED ROADWAYS

1.0 PART I - GENERAL

1.1 Description

This item shall consist of obliteration and work to prevent erosion and encourage revegetation, in accordance with these specifications, of such old roadways or areas as are indicated on the drawings or designated on the ground for obliteration.

2.0 PART II - PRODUCTS (NOT APPLICABLE)

3.0 PART III - EXECUTION

3.1 Performance

Sections of the abandoned roadway shall be obliterated where shown on the DRAWINGS. The natural drainage pattern shall be restored or maintained or both. The roadbed shall be ripped, plowed, or scarified to promote the establishment of vegetation, and the slopes shall be rounded to approximate the original contour.

Water bars for drainage and barricade berms to control erosion and vehicle access shall be constructed where shown on the DRAWINGS or every 20 vertical feet along roadway.

Structures shall be dismantled, buried, or removed or shown on the Drawings.

Where shown on the DRAWINGS, materials required for the new roadway shall be taken from the abandoned roadway, and excess or unsuitable material or both taken from the new roadway shall be used in obliterating the abandoned roadway.

4.0 PART IV - MEASUREMENT

4.1 Method

The Method of measurement will be as described in Section 00100 Measurement and Payment.

The number of miles will be to the nearest 0.1 mile of roadway measured along the centerline.

Only those units and fractions thereof that are outside the limits of the new roadway will be measured. Areas of less than 200 square feet will not be measured.

5.0 PART V - BASIS

5.1 Quantities

The accepted quantities will be paid for at the contract unite price for each pay item shown in Section 00100, Measurement and Payment.

END OF SECTION

DIVISION 02

SECTION 02130
CLEARING AND GRUBBING

1.0 PART I - GENERAL

1.1 Description

This item shall consist of clearing, grubbing, removing and disposing of all vegetation, dead woody material, and debris within the clearing limits except objects designated to remain. Specifications for other items may refer to these specifications.

1.2 Areas to be Cleared and Grubbed

The limits of clearing and grubbing will be established by this Section, by other Section items, or on the DRAWINGS. The clearing and grubbing limits will normally coincide with the designated working limits, however, the ENGINEER may also designate individual trees and snags outside the clearing limits for selective removal and disposal, or he may designate areas within the working limits where clearing and grubbing is not required or allowed within the provisions of this specification.

Grading Limits: Area that is to be excavated or covered with additional materials during construction.

Working Limits: Area consisting of the grading limits plus room for equipment to maneuver to perform the necessary clearing and grubbing. These limits, to be held to a minimum, will be designated for each project.

Clearing Limits: Area consisting of the working limits plus any additional area for a boom or other above ground clearance requirement.

2.0 PART II - PRODUCTS (NOT APPLICABLE)

3.0 PART III - EXECUTION

3.1 General

Clearing and grubbing shall be confined to designated areas. The ENGINEER will designate the trees, shrubs, and other plants and objects to remain. The CONTRACTOR is to keep the clearing to a minimum and to exercise care to not damage trees and shrubbery within clearing limits when there is no reason for grubbing.

3.2 Felling

Trees shall be felled within the clearing limits, usually towards the center, so as to prevent damage to the trees that are to be left standing. When necessary to prevent damage to structures, other trees or property, or to minimize danger to traffic, trees shall be cut in sections from the top downward.

3.3 Clearing Area Within Grading Limits

Clearing shall consist of the removal of all biodegradable material (trees, snags, shrubs, brush, dead woody debris, or plants). Branches of trees extending over the grading limits shall be trimmed.

3.4 Grubbing Area Within Grading Limits

A. Embankment Areas - In embankment sections where the total depth of fill will be less than three feet above undisturbed earth, grubbing shall consist of the removal of all biodegradable material (stumps, roots larger than two inches in diameter, matted roots, duff, and other protruding or surface objects). The resulting depressions shall be filled and compacted with material specified for the embankment.

In embankment sections where the total depth of fill will be three feet or greater above undisturbed earth, all loose biodegradable material shall be removed. Undisturbed stumps, roots, and nonperishable solid objects which will be a minimum of three feet below the finished surface of embankments, except those in embankments designed to impound water, need not be removed. The stumps that remain shall be cut off not more than six inches above the original ground line.

B. Areas to be Excavated - In cut sections, the removal of stumps and roots shall be done to such depth that in no case will any portion remaining extend closer than 18 inches to any subgrade or slope surface.

3.5 Area Outside Grading Limits but within Clearing Limits

On areas designated for clearing and grubbing outside of the grading limits, stumps may be cut within four inches of the ground and left, in lieu of being removed. All trees, shrubs, and other protruding or surface objects shall be cleared, except the vegetation and objects designated to remain.

3.6 Trimming of Trees

All required trimming shall be done in accordance with approved horticultural practices.

3.7 Timber Used by the Contractor

Timber cut from within the clearing limits, meeting specification requirements, may be utilized by the CONTRACTOR for constructing temporary structures, false-work, etc., as required in the project and also for camp purposes, provided written authorization for such use is obtained from the ENGINEER.

3.8 Timber to be Saved

All sound, green logs or poles, not used by the CONTRACTOR in the project, having a top diameter of two inches or more and a length of four feet or more, as determined by the ENGINEER, shall be saved. Material to be saved shall be trimmed of limbs and tops, sawed into such lengths designated below, and stacked in an area readily accessible for loading and hauling equipment, and where they will not interfere with the grading. Skidding timber outside staked working limits will not be approved.

All timber designated to be saved will be cut as follows:

- Logs over 15 inches in diameter are to be cut in eight-foot lengths.
- Logs with diameters between eight inches and 15 inches will be cut in 12-foot lengths.
- Limbs, treetops, etc., from two inches to eight inches in diameter will be cut in maximum four-foot lengths (two-foot lengths within campground areas).

Title to all such timber cut from National Forest land shall remain with the United States, subject to disposal by the Forest Service, U.S. Department of Agriculture, in accordance with its regular procedures, unless otherwise specified.

3.9 Clearing or Clearing and Grubbing Requirements for Various Items:

Buildings

Construction work shall disturb a minimum of the existing terrain and plant life adjacent to the building site. Only trees, shrubs, stumps, and major roots, which interfere, may be removed. When excavation reveals the major roots of a live and significant tree nearby, the CONTRACTOR shall not remove the tree unless it interferes with the construction and removal is authorized by the ENGINEER.

Disposal of Refuse

Debris and refuse shall be disposed of in accordance with Section 02135 or stockpiled onsite to be shredded used as mulch as part of the reclamation activities.

4.0 PART IV - MEASUREMENT AND PAYMENT

Clearing and Grubbing will not be paid for separately. Costs incurred shall be covered by the Pay Items indicated in Section 00100.

END OF SECTION

DIVISION 02

SECTION 02135
WASTE MATERIAL DISPOSAL

1.0 PART I - GENERAL

1.1 Description

This item shall consist of the loading, handling, transporting, and placing of excess excavation material and construction debris. The waste disposal area shall be shown on the DRAWINGS or designated by the CONTRACTING OFFICER.

2.0 PART II- PRODUCTS (NOT APPLICABLE)

3.0 PART III - EXECUTION

All excavated material not used in the construction of embankments, backfilling of trenches, or other specified areas within the project limits, along with clearing debris, shall be hauled to the designated disposal area. After this material has been hauled to the disposal area, the piled material shall, at the descretion of the engineer, be shredded and used as mulch or be covered with soil to a uniform depth of six inches minimum and sloped to 2.5:1 or flatter. The size and shape of the piled waste material shall be designated by the ENGINEER and/or CONTRACTING OFFICER. The disposal area shall be left suitable for reseeding.

END OF SECTION

DIVISION 02

SECTION 02136
WASTE MATERIAL DISPOSAL (LANDFILL)

1.0 PART 1 - GENERAL

1.1 Description

This item shall consist of loading, handling, hauling, and disposal of unsuitable excavated material, oversize boulders, stumps, brush, slash, roots, and other vegetable refuse resulting from the clearing and grubbing operation; and trash resulting from construction activities, or rubbish dumped by others. The waste disposal site shall be off National Forest lands at the county landfill. The CONTRACTOR shall be responsible for all costs, royalties, arrangements, procurement, cleanup, and work associated with a waste disposal area.

2.0 PART II - PRODUCTS (NOT APPLICABLE)

3.0 PART III - EXECUTION

All unsuitable excavated material, oversize boulders, stumps, brush, slash, roots, and other vegetable refuse resulting from the clearing and grubbing operation along with other construction refuse shall be hauled to a disposal area. All requirements of disposal and disposal site finish work are the responsibility of the CONTRACTOR. The Government is not responsible for material to be disposed of upon its departure from the project area.

END OF SECTION

DIVISION 02

SECTION 02204
LOOSE ROCK RIPRAP

1.0 PART I - GENERAL

1.1 Description

This item shall consist of furnishing and placing a protective covering of stone on slopes or around or below culverts, in accordance with these specifications, in conformity with the DRAWINGS and to the lines and grades established.

1.2 Method of Measurement

The quantity to be measured shall be the number of cubic yards, measured in place, completed and accepted. The limiting dimensions shall not exceed those shown on the DRAWINGS or established. No separate measurement shall be made for the polyfiber fabric material placed beneath the riprap when shown on the DRAWINGS, rather, measurement shall be considered to be included in the measurement for loose rock riprap.

2.0 PART II - PRODUCTS

2.1 Physical Properties

The stones used for this work shall be durable, angular, field, or quarry stones which are sound, hard, and free from laminations, fractures, or other structural defects. They shall be of such quality that they will not disintegrate on exposure to water or weathering.

Stones used shall be such that at least 50 percent (d_{50})of the individual stones shall have a minimum diameter as shown on DRAWING. Not more than 10 percent of the stone shall have a diameter of less than 30% of the d_{50} measured in the smallest section.

2.2 Source

Riprap shall be obtained from a designated borrow source, salvaged from project excavations, or from a private or commercial source as indicated on the Schedule of Items.

2.3 Polyfiber Fabric

Polyfiber fabric shall be Mirafi No. 700X unwoven, as manufactured by Mirafi, Inc. of Charlotte, North Carolina, or an approved equal.

3.0 PART III - EXECUTION

3.1 Foundation

The slope or area upon which the riprap is to be placed shall be shaped to the required lines and grades. The surface shall be roughened to provide a surface to which the base stones will key and be firmly bedded. Foundation trenches shall be excavated at the toe of the slope or area to receive the base stones and provide a secure footing. These trenches shall be of sufficient width and extend a minimum of two feet below the bed of the stream or wash. Slopes and trenches shall be approved before the placing of riprap is begun.

3.2 Placing Riprap

The stones shall be placed or dumped on the approved slope and in the trench to form the cross section desired. They shall be manipulated sufficiently to secure a roughly regular surface and mass stability. All stones shall be firmly keyed or bedded. Insofar as possible, the larger stones shall be placed at the bottom.

When the thickness of the riprap is not shown on the DRAWINGS, it shall be at least 1 ½ times the indicated d_{50} measured perpendicular to the slope.

When the rock riprap is completed, the area shall be cleaned up by removing all debris and material not used. Material excavated from foundation trenches, etc., shall be satisfactorily disposed of.

END OF SECTION

DIVISION 02

SECTION 02220
EXCAVATION AND EMBANKMENT

1.0 PART I - GENERAL

1.1 Description

This item shall consist of excavation and shaping of roadways, and filling of subsidences, borrow excavation, drainage excavation, shaping of stream channels, removal of slide material, excavation of unsuitable material, embankment construction, and disposal of all excavated material necessary for the completion of construction including roadway ditches, channel changes, furrows, slope rounding, benches, berms, dips, approaches, and subsidiary work.

1.2 Excavation

Excavation shall consist of the excavation and disposal of all excavated material at designated locations, regardless of its nature, that is not included under other pay items listed in the Schedule of Items.

1.3 Borrow Excavation

Borrow excavation shall consist of the excavation and utilization of material from sources shown on the DRAWINGS or from commercial sources. Additional sources of borrow excavation shall be approved in advance by the CONTRACTING OFFICER.

1.4 Method of Measurement

The method of measurement will be designated in the schedule of items and measured in accordance with Section 00100.

The measurement of excavation will include:

- Construction excavation
- Rock and unsuitable material below the required grade and unsuitable material beneath embankment areas
- Furrow ditches outside the roadway, except when furrow ditches are included in the Schedule of Items
- Topsoil and other material removed and stockpiled as directed
- Borrow material used in the work, except when borrow is included in the Schedule of Items
- The volume of conserved materials taken from stockpiles and used in the WORK.
- Slide material not attributable to negligence of the CONTRACTOR.
- Developing and/or reshaping stream channels.

The measurement of excavation will not include the following:

- Material used for other than approved purposes.
- Unauthorized excavation or borrow.
- Quantity of material excavated from slope rounding.
- Overbreakage from the backslope in rock excavation requiring blasting.
- Material scarified in place to receive the first layer of embankment.
- Benching or stepping existing ground for embankment foundation.
- Stepping or scaling cut slopes.

When designed quantities are designated in the Schedule of Items as the method of measurement, the original design data has been established on the basis of the undisturbed ground surface elevations.

When staked quantities are shown in the Schedule of Items, excavation quantities will be determined by the average end area method using slope stake information taken prior to construction.

When actual quantities are designated in the Schedule of Items as the method of measurement, preliminary cross sections or comparable measurements will be taken of the undisturbed ground surface and quantities finally measured in accordance with the following.

- When excavation is designated as a pay item in the Schedule of Items, final cross sections or comparable measurements will be taken of the completed and accepted work.
- When embankment is designated as a pay item in the Schedule of Items, measurement will be in the final position.
- When borrow is designated as a pay item in the Schedule of Items, measurement will be in the original position.

1.5 Basis of Payment

The accepted quantities will be paid at the contract unit price for each Pay Item shown in the Section 00100.

2.0 PART II - PRODUCTS

2.1 Drainage Gravel

Drainage gravel to meet Washington State Department of Transportation, 2006 Standard Specifications 9-03.12 (4) – Gravel Backfill for Drains or the following:

Drainage gravel shall consist of crushed, processed, or naturally occurring granular material. It shall be free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact and shall meet the following specifications for grading and quality:

Sieve Size	Percent Passing
1″ square	100 - —
3⁄4″ square	80-100
3⁄8″ square	0-40
U.S. No. 4	0-4
U.S. No. 200	0-2

All percentages are by weight.

2.2 Base Material

Base Material shall consist of granular material, either naturally occurring or processed. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following test requirements:

Stabilometer "R" Value 72 min.
Swell pressure 0.3 psi max.

The maximum particle size shall not exceed 2/3 of the depth of the layer being placed.

Base material shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the ENGINEER.

Sieve Size	Percent Passing
2″ square	75-100
U.S. No. 4	22-100
U.S. No. 200	0-10

Dust Ratio: 2⁄3 max.
Sand Equivalent 30 min.

All percentages are by weight.

Gravel base material retained on a U.S. No. 4 sieve shall contain not more than 0.20 percent by weight of wood waste.

2.3 Wasterock

Shall be unclassified material excavated from the upper wasterock pile and the lower wasterock pile as directed by the ENGINEER and indicated on the DRAWINGS.

2.4 Soil Cushion

Shall be a fine grained soil with a maximum particle size of ½ inch and 80% passing the #60 sieve (0.25mm)

2.5 Talus

Shall be loose rock taken from the site as directed by the ENGINEER.

3.0 PART III – EXECUTION

3.1 Clearing and Grubbing

Clearing and grubbing shall be accomplished in accordance with Section 02130 before work under Section 02220 begins, except the grubbing of stumps, which may proceed concurrently with excavation, and the burning of slash, which may be delayed until weather permits. Excavation and placement operations shall be conducted so material to be treated under Section 02130 will not be incorporated in the roadway.

3.2 Pioneering

Pioneering operations for the top of excavation slopes, toe of embankments, or pioneer road construction shall prevent undercutting of the final excavation slope, depositing of materials outside of the construction limits, and any restriction of drainage.

3.3 Utilization of Excavated Materials

All suitable, excavated material shall be used in the construction of embankments, subgrades, shoulders, slopes, bedding, and backfill for subsidences and for other purposes as shown on the DRAWINGS.

3.3.1 Excess Excavation

Designed excess excavation shall be disposed of as shown on the DRAWINGS.

3.3.2 Rock for Slope Protection

Excavated rock suitable for protection of embankments or backfill of subsidences may be conserved and used in lieu of a designated materials source.

3.3.3 Conserving Material

Material encountered in the excavation, suitable for cushion, finishing, topsoil, or other purposes, may be conserved and utilized instead of materials from designated sources. Excessively wet material that is otherwise suitable for embankment or fill shall be field drained and dried before placement.

3.3.4 Excavation of Unsuitable Material

Unsuitable material shall be excavated. Disposal will be as shown on the DRAWINGS. Excavated areas shall be backfilled with suitable material when necessary to complete the work. Frozen material shall not be placed in embankments. Rocks that are too large to be incorporated into the embankment shall be broken for incorporation, maneuvered to the face of the embankment, and embedded so that they will not roll or obstruct the use and maintenance of the roadbed, or moved to approved locations.

3.3.5 Conservation of Topsoil

When shown on the DRAWINGS, suitable topsoil shall be removed, transported, and deposited in the designated stockpile areas.

3.4 Drainage Excavation

Drainage excavation shall include construction of side ditches, minor channel changes, inlet and outlet ditches, furrow ditches, ditches constructed along roads but beyond the roadway limits, subsidence areas, and other minor earth drainage structures as shown on the DRAWINGS. Excavated material shall be utilized in accordance with paragraph 3.03.

3.5 Finishing Roadbed

Rock requiring blasting, rippable rock, and boulders shall be excavated to a minimum depth of six inches below subgrade unless otherwise shown on the DRAWINGS, and replaced with suitable cushion material obtained from within the construction limits or from sources shown on the DRAWINGS. Undrained pockets in a rock surface, within the limits of the roadbed, shall be excavated to properly drain or be filled with approved impermeable material.

For facilities receiving base or surface course, rocks larger than four inches that do not protrude above the subgrade more than one-third of the depth of the base or surface course, or three inches, whichever is less, may be left in place.

For unsurfaced facilities, unless other wise shown on the drawings, the top four inches below the finished surface shall consist of cushion material containing rocks less than four inches in greatest dimension that are developed by scarification, rolling, or importing suitable material obtained from sources shown on the drawings.

The subgrade shall be shaped, dressed, and compacted when required. Low sections, holes, or depressions shall be brought to grade with suitable material.

3.6 Finishing Slopes

Finished slopes shall conform reasonably to the lines staked on the ground or shown on the DRAWINGS. The finished slope shall be left in a roughened condition to facilitate the establishment of vegetative growth. The finish associated with template and stringline or handraking methods will not be permitted. Loose rock, debris, and other material larger than six inches in diameter shall be removed from the slope.

The tops of excavations, excluding areas of solid rock, shall be blended with the adjacent terrain by rounding where shown on the DRAWINGS. Decomposed rock that may be cut without blasting or ripping shall be rounded. Earth overlying rock shall be rounded above the rock.

All rock excavations that require blasting shall be formed with controlled blasting techniques unless otherwise shown on the DRAWINGS. Controlled blasting is defined as the controlled usage of explosives and blasting accessories in appropriately alined and spaced drill holes for the purpose of producing a free surface or shear plane in the rock excavation slopes and of minimizing landscape damage, adjacent ground vibration and overbreak. Presplitting is not intended unless shown on the drawings.

The CONTRACTOR shall drill, blast, and excavate short test sections (not to yield in excess of 1,000 cubic yards) to determine the controlled blasting method, hole spacing, and charge best suited to the material encountered.

3.7 Overbuilding and Landscape and Stream Protection

Excavated or embankment material shall be confined within the construction limits to avoid overbuilding and to protect the landscape and streams.

3.8 Subgrade Treatments

Subgrade treatment shall consist of soil modification by admixing aggregates, placing filter cloth, fiber mat, wood corduroy, rock blanket, or other similar materials over areas of unsuitable embankment material that are shown on the DRAWINGS. The construction and material requirements for the type of subgrade treatment will be specified or shown on the DRAWINGS.

3.9 Earth Berms

Permanent earth berms shall be constructed along the shoulder of roads or streams at locations shown on the DRAWINGS. Material used in the construction of berms shall be well graded with no rocks having a diameter greater than one-fourth of the height of the berm.

Acceptable material for the berm may be windrowed as the roadbed is constructed or stockpiled at a designated area as specified by the CONTRACTING OFFICER for later use. When the local material is not acceptable, material shall be imported from approved locations or from commercial sources. Material used for berm construction shall contain no frozen material, roots, sod, or other deleterious material. Material shall not be wasted over the embankment slope.

Compaction density of the berm shall be 90% of the maximum density as determined by AASHTO T-99, Method C or D. Compaction equipment shall be capable of obtaining compaction requirements without detrimentally affecting the compacted material. The compaction units may be of any type, provided they are capable of compacting each lift of material as specified. Maximum lift will be 12 inches.

3.10 Stream Channel Construction

This work entails the excavation and/or shaping of stream channels as shown on the DRAWINGS. All construction of the channel will conform to all grades, bank slopes, etc., as specified on the DRAWINGS or in other Sections of this Contract. Under no circumstances is coal, gob, or toxic susbstances to be included in this work. Should coal, gob, or toxic substances be encountered during excavation, the CONTRACTOR will notify the CONTRACTING OFFICER immediately. Basically, if coal, gob, or toxic substances are encountered, the CONTRACTOR will over excavate the channel by three feet, place protective liners as specified in other Sections of this Contract, and haul in suitable fill material to bring the centerline of the channel back up to the desired grade. The CONTRACTING OFFICER will determine the quantities involved for Contract price adjustments for this work. Excavation of the channels will be paid under this Section and according to the units shown in the Schedule of Items. Channel protective measures, such as liners, riprap, etc., will be paid for under other Sections of this Contract.

3.11 Water

Water sources and access are shown on the DRAWINGS. If the CONTRACTOR elects to obtain water from other sources, the CONTRACTOR shall be responsible for obtaining the right to use the water including any royalty costs.

Mobile watering equipment shall have reasonable watertight tanks of known capacity. Equipment used for dust control and finishing operations of subgrade and surfaces shall provide uniform and controlled application of water without ponding or washing. Positive control of water from the driver's position is required at all times.

Payment for furnishing, hauling, and applying water shall be included in the contract unit price for this specification.

3.12 Embankment and Backfill Placing Methods

A. All Methods - When an embankment or backfill is to be placed across swampy ground or a swampy subsidence and removal of unsuitable material or subgrade treatment is not required, the lower part of the embankment or backfill shall be constructed in a single layer to the minimum depth necessary to support construction equipment or subsequent backfill material. Rocks larger than six-inch diameter shall not be concentrated in any areas of the embankment or backfill.

B. **Specific Methods** - All embankments or backfill shall be placed by one or more of the following methods as shown on the DRAWINGS and listed in the schedule of items:

Method 1 - Side Casting and End Dumping. Embankment or backfill may be placed by side casting and end dumping. Where material containing a large amount of rock is used to construct embankments or backfill, a solid embankment or base for additional backfill material shall be provided by working smaller rocks and fines in with the larger rocks and fines to fill the voids.

Method 2 - Layer Placement. Surfaces steeper than a ratio of three to one, upon which embankment is to be placed, shall be roughened or stepped when shown on the drawings to provide permanent bonding of new and old materials.

Embankment or backfill shall be layer placed, except over rock surfaces, in which case material may be placed by end dumping to the minimum depth needed for operation of spreading equipment. Each embankment or backfill layer shall be leveled and smoothed before placement of subsequent layers. Hauling and spreading equipment shall be operated uniformly over the full width of each layer.

Suitable material shall be placed in layers no more than 12 inches thick, except when the material contains rock more than nine inches in diameter, in which case layers may be of sufficient thickness to accommodate the material involved. No layer shall exceed 24 inches before compaction.

Placing individual rocks or boulders greater than 24 inches will be permitted provided the embankment or backfill will accommodate them. Such rocks and boulders shall be at least six inches below subgrade. They shall be carefully distributed and the voids filled with finer material to form a dense and compacted mass.

Where material containing large amounts of rock is used to construct embankments or backfills, the layers may be of sufficient thickness to accommodate the material involved. A solid embankment or backfill with compaction to at least 90% of maximimum density as determined by ASTM D698 or as approved by the ENGINEER shall be constructed by working smaller rock and fines in with the larger rocks to fill the voids and by operating hauling and spreading equipment uniformly over the full width of each layer as the embankment or backfill is constructed.

Method 3 - Controlled Compaction. Embankments or backfills shall be placed as specified in Method 2, except earth embankment or backfill shall be placed in horizontal layers not exceeding eight inches (loose measure) and compacted. Material shall be at a moisture content suitable for attaining the required compaction. Embankments and backfills and the top one foot of excavation sections shall be compacted to at least 95 percent of the maximum density as determined by AASHTO T 99, Method C or D.

The density of the embankment or backfill material will be determined during the progress of the WORK in accordance with AASHTO T 191, T 205, and T 217; or T 238, and T 239. Corrections for coarse particles will be made in accordance with AASHTO T 114.

Density requirements will not apply to portions of rock embankments or backfills that cannot be tested in accordance with approved methods. When this condition exists, compaction shall be provided by working smaller rock and fines in with the larger rocks to fill the voids and by operating equipment over the embankment materials.

3.13 Construction Tolerances

The tolerance class shall be as shown on the DRAWINGS. Roadway ditches shall be constructed to flow in the direction of design with the gradient no flatter than one-half of one percent.

Tolerance Class[a]

	Tolerance Class[a]					
Item	**A**	**B**	**C**	**D**	**E**	**F**
Roadbed Width (Feet)	+/- 0.5	+/- 1	+/- 1	+/- 1	+/- 1	+/- 2
Subgrade Elevation (Feet)	+/- 0.1	+/- 0.2	+/- 0.5	+/- 1	+/- 2	+/- 3
Centerline Alignment (Feet)	0.2	0 .5	1	1	2	3
Slopes, Excavation, Embankment, Backfill (Percent)	+/- 3	+/- 5	+/- 5	+/- 5	+/- 10	+/- 10

[a]Maximum allowable deviation from construction stakes and DRAWINGS.

Deviations shall be uniform in the direction of change for a distance of 200 feet or more along the project centerline.

3.14 Grading Plans

Cross sections and grading plans are provided on the DRAWINGS. The CONTRACTOR shall be held to fixed elevations, as determined by a registered surveyor. Proposed channels shall be construction staked by a registered surveyor and subsequent re-staking shall be included based on field adjustment made by the CONTRACTING OFFICER. A verification survey by a registered surveyor shall be completed and submitted to the CONTRACTING OFFICER for approval at the end of the project. All costs shall be included in a separate line item if survey work is required for the completion of the project. A smooth and finish-graded surface shall be required on all areas before placing topsoil.

3.15 Positive Drainage

The CONTRACTOR shall provide positive drainage for all areas during and after construction. No water should be impounded during or after construction.

All areas which settle below plan elevation or impounded water before completion of the Contract shall be filled in, regraded, and reseeded.

3.16 Erosion Control

The CONTRACTOR shall be responsible for the repair of slope erosion up to the final acceptance of the project. In areas not designated for sheet runoff, the CONTRACTOR shall make an attempt to grade the embankment to drain into existing or proposed swale areas. This shall include the use of diversion swales and other measures to direct runoff to rock dams, rock channels, etc.

All drainage swales and ditches must be approved by the CONTRACTING OFFICER prior to placing topsoil and reseeding. The cost of the swales and ditches, if not already in a separate line item, shall be included with the line item for placeing of embankments or fill.

3.17 Wasterock Repository

The repository shall be built by placing material in maximum 8-inch loose lifts at near optimum moisture and compacted to 90% maximum dry density as determined by ASTM D-698. Maximum thickness of the completed repository shall be 25 feet, exclusive of cover material

END OF SECTION

DIVISION 02

SECTION 02228
CULVERT PIPE AND PIPE ARCHES

1.0 PART I – GENERAL

1.1 Description

This WORK shall consist of furnishing and installing, or installing only, metal pipe and pipe appurtenances, including all excavation, bedding, and backfilling required to complete the WORK.

1.2 Method of Measurement

Culvert pipe and pipe arches will be measured by the actual number of linear feet of the kind, class or shape, and the several sizes and metal thickness, bedded, backfilled, and accepted in place. When ends of a round pipe culvert are cut on a skew or slope, measurement will be the average of the top and bottom centerline lengths. When ends of a pipe arch culvert are cut on a slope, measurement will be the bottom centerline length.

Metal end sections, elbows, and branch connections shall be measured separately as "Each" under this Section.

2.0 PART II – PRODUCTS

2.1 Corrugated Iron or Steel Pipe and Pipe Arches

A. **Riveted Pipe and Pipe Arches** - These pipes shall meet the requirements of AASHTO M 36.

B. **Welded Pipe and Pipe Arches** - Corrugated metal pipe and pipe arches fabricated by resistance spot welding shall meet the applicable requirements of AASHTO M 36.

C. **Helical Pipe** - Unperforated helically corrugated pipe with continuous lock or welded seams shall meet the applicable requirements of AASHTO M 36.

D. **Coupling Bands** - Coupling bands shall meet the requirements of AASHTO M 36.

E. **Special Sections** - Special sections such as elbows, tees, wyes, etc., shall be the same thickness as the conduit to which they are joined and meet the applicable requirements of AASHTO M 36.

F. **Flared End Sections** - Flared end sections for inlet and outlet ends of pipe and pipe arch culverts shall meet the applicable requirements of AASHTO M 36. End sections shall be fabricated in accordance with the details and dimensions shown on the DRAWINGS, except minor variations may be accepted to permit the use of the manufacturer's standard methods of fabrication.

2.2 Bituminous Coated Corrugated Iron or Steel Pipe and Pipe Arches

These conduits and their coupling bands shall meet the requirements of AASHTO M 190. The coating shall be Type A, B, C, or D as specified. Coupling bands shall be fully coated with bituminous material.

Special sections, such as elbows and prefabricated flared end sections, shall meet the applicable requirements of AASHTO M 190. Coating and invert paving shall be of the type specified. Flared end sections shall meet the requirements of AASHTO M 243 or M 190 for the coating specified. The CONTRACTING OFFICER may waive the imperviousness test for coated pipe if no separation of coating from metal is observed.

2.3 Polymeric Precoated Steel Pipe, Pipe Arches, and Underdrains

A. Pipe shall meet the requirements of AASHTO M 245

B. Coupling bands shall meet the requirements of AASHTO M 245

C. Special sections such as elbows, tee, wyes, etc., shall be the same thickness as the conduit to which they are joined.

D. Flared end sections for attachment to the inlet and outlet ends of pipe and pipe arch culverts shall meet the applicable requirements of AASHTO M 243 and M 246. End sections shall be fabricated in accordance with the details and dimensions shown on the DRAWINGS, except that minor variations may be accepted to permit the use of the manufacturer's standard methods of fabrication.

2.4 Corrugated Iron or Steel Pipe for Underdrains, Plain Galvanized or Precoated

Plain galvanized pipe shall meet the requirements of AASHTO M 36. Precoated underdrains shall meet the requirements of AASHTO M 245.

2.5 Bituminous Coated Iron or Steel Pipe for Underdrains

Pipe shall meet the requirements of AASHTO M 36 and shall be coated with bituminous material to meet the requirements of AASHTO M 190, Type A coating, except that minimum coating thickness shall be 0.03 inch. Coupling bands shall be fully coated. The specified minimum diameter of perforations shall apply after coating. The CONTRACTING OFFICER may waive the imperviousness test if no separation of coating from metal is observed.

2.6 Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches

Pipe shall meet the requirements of AASHTO M 196.

2.7 Corrugated Aluminum Alloy Pipe for Underdrains

Pipe shall meet the requirements of AASHTO M 196.

2.8 Bituminous Coated Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches

Pipe shall meet the requirements of AASHTO T 196 and shall be coated with bituminous material meeting the requirements of AASHTO M 190. Coating and invert paving shall be of the type specified.

2.9 Bituminous Coated Corrugated Aluminum Alloy Pipe Underdrains

Pipe shall meet the requirements of AASHTO M 196 and shall be coated with bituminous material meeting the requirements of AASHTO M 190.

2.10 Structural Plate for Pipe, Pipe Arches, and Arches

The pipes and bolts and nuts for connecting plates shall meet the requirements of AASHTO M 167.

2.11 Full Bituminous Coated Structural Plate Pipe, Pipe Arches, and Arches

Pipes shall meet the requirements of AASHTO M 167 and shall be coated with bituminous material meeting the requirements of AASHTO M 243.

2.12 Aluminum Alloy Structural Plate for Pipe, Pipe Arches, and Arches

Pipes and the bolts and nuts for connecting plates shall meet the requirements of AASHTO M 219.

2.13 Aluminum Coated (Aluminized Type 2) Corrugated Steel Pipe and Pipe Arches

A. Pipe and coupling bands shall meet the requirements of AASHTO M 36 except that they shall be made from material meeting the requirements of AASHTO M 274.

B. Special sections such as elbows, tee, wyes, etc., shall be the same thickness as the conduit to which they are joined and shall meet the applicable requirements of AASHTO M 36 and M 274.

Bedding and backfill material shall meet the requirements of paragraph 3.08.

Damaged spelter coating caused by welding, field cutting, or mishandling shall be cleaned and painted as specified in AASHTO M 36.

End sections shall be constructed of a material meeting the requirements of AASHTO M 218 or AASHTO M 196.

Bituminous coated end sections shall be coated to meet the requirements of AASHTO M 243 or AASHTO M 190.

The materials used in each pipe installation shall be compatible with each other to prevent electrolysis or physical failure. Either annular or helical pipe corrugations will be acceptable, but each pipe installation shall consist of only one class of corrugation.

The lengths and locations of individual pipe shown on the DRAWINGS are approximate. Pipe should not be ordered until culvert locations are designated on the ground and a written list of the correct lengths is issued by the CONTRACTING OFFICER.

3.0 PART III – EXECUTION

3.1 Water Pollution and Stream Degradation

Water Pollution and stream degradation shall be controlled.

Pipe which is installed in or which will affect streams that are designated as important fisheries shall be installed only during those periods shown on the DRAWINGS or in Special Project Specifications.

3.2 Excavation

Excavation for culverts shall be to the lines and grades or elevations shown on the DRAWINGS or as designated on the ground. Excavations shall be of sufficient size to permit the placing and backfilling of culverts. Boulders, logs, and any other unsuitable materials encountered shall be removed and disposed of in areas designated on the DRAWINGS. The width of trenches shall permit satisfactory jointing and thorough tamping of the bedding material under and around the culvert.

Unsuitable foundation material shall be excavated below the invert of the culvert to an approximate depth of two feet and a width of at least the culvert diameter plus four feet. Unsuitable material shall be replaced with selected granular foundation material and compacted in accordance with paragraph 3.08.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least one foot. The width of the excavation shall be at least two feet greater than outside width of the culvert. This excavated material shall be replaced with selected granular foundation material and compacted in accordance with paragraph 3.08.

3.3 Utilization of Excavated Materials

All suitable excavated material shall be utilized as backfill or embankment. No excavated material shall be placed in live streams. All surplus material shall be disposed of as shown on the DRAWINGS. No excavated material shall be deposited in a manner that will endanger the partly finished structure.

3.4 Bedding

Bedding shall consist of bedding the pipe to a depth of not less than 10 percent of its total height. The foundation surface, after excavation in accordance with paragraph 3.02, shall be compacted in accordance with paragraph 3.08 and shaped to fit the pipe.

The completed bedding shall have a longitudinal camber when shown on the DRAWINGS.

The bedding material shall be selected mineral soil meeting the requirements for backfill in paragraph 3.08.

3.5 Laying Pipe

No pipe shall be placed in service until a suitable outlet is provided.

Paved or partially lined pipe shall be laid so the longitudinal centerline of the paved segment coincides with the flowline.

Elliptical pipe shall be placed with the major axis within five degrees of a vertical plane through the longitudinal axis of the pipe.

The final installed alignment of all pipe shall have no sag and no point shall vary from a straight line drawn from inlet to outlet by more than two percent horizontally and vertically of the culvert length or one foot, whichever is less, unless otherwise shown on the DRAWINGS.

Helically corrugated lock-seam pipe shall be installed with the seam at the inlet end placed below the horizontal centerline.

Longitudinal laps on riveted or spot-welded pipe shall be positioned at any location between 45 degrees above or below horizontal.

3.6 Joining Pipes

Pipe shall be firmly joined by form-fitting coupling bands. End sections shall be attached to pipe by connecting bands or other means as recommended by the manufacturer. Rubber gaskets shall be installed at each joint to form a watertight connection when shown on the DRAWINGS. Dimpled bands shall not be used when the slope of the pipe is greater than 25 percent.

The coupling bands shall meet the strength requirements of field joints for Non-Erodible Soil Condition--Special Joint Type according to Division 2, Section 23 of the "Standard Specification for Highway Bridges" by AASHTO.

3.7 Shop Elongation

When shown on the DRAWINGS, the vertical diameter of round pipe shall be increased five percent by shop elongation.

<u>3.8</u> <u>Backfilling</u>

Pipe meeting any of the following conditions shall not be placed or back-filled until the excavation and foundation have been approved by the CONTRACTING OFFICER:

A. Embankment height greater than 10 feet at subgrade centerline

B. Installation in a live stream

C. Round pipe with a diameter of 48 inches or greater

D. Pipe arches with a span of 50 inches or greater

After the bedding is prepared and the pipe is placed, selected material shall be placed in layers not exceeding six inches loose thickness and compacted under the haunches and alongside the pipe. The material shall have the moisture content needed for effective compacting. Backfill shall be readily compactible material free of frozen lumps, chunks of highly plastic clay, or other objectionable material. Rocks larger than three inches in diameter shall not be used within one foot of the pipe. On each side of the pipe there shall be an area of compacted material at least as wide as two diameters of the pipe or 12 feet, whichever is less. Backfill shall be compacted without damaging or displacing the pipe. The density shall be that of the surrounding embankment or 95 percent of the maximum density as determined by AASHTO T 99 Method C or D, whichever is greater. Backfilling and compacting shall be continued until the backfill is 12 inches above the top of the culvert. After being bedded and backfilled pipe shall be protected by an adequate cover of embankment before heavy equipment is permitted to cross during roadway construction. Pipe distorted more than five percent of nominal dimension, ruptured, or broken shall be replaced.

4.0 PART IV – MEASUREMENT AND PAYMENT

Culvert pipe shall be paid for as indicated in the Pay Items listed in Section 00100.

END OF SECTION

DIVISION 02

SECTION 02251
SEDIMENT CONTROL

1.0 PART I - GENERAL

1.1 General

Short-term sediment collection for construction activities.

1.2 Submittals

A. Submit manufacturer’s certification that sediment collection systems meet or exceed specified requirements.

B. Submit manufacturer’s installation instructions and maintain copy at the jobsite.

1.3 Delivery, Storage and Handling

A. Unload, store and load sediment collection materials in a manner which prevents damage or excessive exposure to sunlight and weather.

2.0 PART II - PRODUCTS

2.1 Erosion and Sediment Control Systems

A. Comply with type of sediment collection systems indicated in the Contract Documents.

B. If sediment collection systems are not specified, use any of the alternate materials meeting the minimum requirements of this section and the approved Erosion Control Plan.

C. Notify the ENGINEER if installation conditions do not match those in the DRAWINGS.

D. Provide sediment collection materials and use in accordance with the governing agency.

2.2 Inlet Protection

A. Provide a filtering system around an inlet or drain to trap sediment and prevent the sediment from entering the storm drain system in accordance with the STANDARD DRAWINGS.

B. Filter Fabric Inlet Protection:

1. Filter Fabric: Refer to specifications for Silt Fence.
2. Wooden Stakes: 2 inches x 2 inches or 2 inches x 4 inches with a minimum length of 3.0 feet.
3. Staples: Heavy-duty wire at least 3/8 inches long.
4. Washed Gravel: ¾ inches to 1-1/4 inches in diameter, with less than 5% fines.

C. Gravel Inlet Protection:

1. Mesh: hardware cloth or wire mesh with 3/8 inch to ½ inch openings.
2. Filter Fabric: Refer to specifications for Silt Fence.
3. Washed Gravel: ¾ inch to 4 inches is diameter.

D. Block and Gravel Inlet Protection:

1. Mesh: Hardware cloth or wire mesh with 3/8 to ½ inch openings.
2. Filter Fabric: Refer to specifications for Silt Fence.
3. Washed Gravel: ¾ inch to 4 inches in diameter.

2.3 Straw Bale Barrier

A. Provide a temporary sediment barrier consisting of a row of entrenched and anchored straw bales in accordance with the DRAWINGS.

B. Bales to be made of densely packed cut straw securely bundled by bailing twine or wire. The material must be certified as weed-free.

2.4 Temporary Berm

A. Provide a temporary berm or ridge of compacted soil or sandbags, which will intercept and divert runoff from the construction areas.

B. Construct soil berm from embankment materials.

C. Construct sandbag berms with high quality sandbags. Each bag to have the following dimensions: length - 24 inches to 30 inches; width – 16 inches to 20 inches; depth or thickness – six inches to eight inches; and weight – 90 pounds to 130 pounds.

2.5 Sediment Basin

A. Provide a temporary basin to collect, trap, and store sediment produced by construction activities in accordance with the size requirements outlined in Section 3.4.

B. Construct sediment basins using excavation and embankment materials by either excavating the basin or by placing an earthen embankment across a low area or drainage swale. Provide a riser and pipe outlet with a gravel outlet or spillway to slow the release of runoff.

C. Fill material should be taken from approved designated borrow areas, and should be of the type and quality conforming to that specified for the adjoining fill material. It should be free of roots, woody vegetation, oversize stones, rocks exceeding 6-inch diameter, or other objectionable materials. Do not use frozen material.

2.6 Silt Fence

A. Provide temporary sediment barrier consisting of a filter fabric stretched and attached to supporting posts, with wire fence backing as required by the type of fabric employed as indicated on the DRAWINGS.

B. Silt fences may be made of burlap or various synthetic materials. Acceptable synthetic materials are pervious polypropylene, nylon, and polyester or polyethylene yarn conforming to the performance specifications listed in Table 1.

Table 1. Silt Fence Performance Specifications

Physical Property	Requirement
Filtering efficiency	75% to 85% (minimum)
Tensile strength at 20% (maximum) elongation	Standard strength – 360 lbs./ft. (minimum)
	Extra strength – 600 lbs./ft. (minimum)
Slurry flow rate	0.3 gpm/ft.^{2} (minimum)

C. Design Life: 6 months for synthetic fences, two months for burlap.

D. Wire Reinforced Backing (if used): 14 gage minimum, with mesh spacing and a width of 2-4 feet.

E. Post Specifications:

1. Length: 4 feet minimum.
2. Material: 2 inches x 2 inches or 2 inches x 4 inches pine (or equivalent) or 1.0 pound/foot to 1.3 pound/foot steel.

2.7 Culvert Riser

A. Provide a perforated metal pipe attached to a culvert inlet and extending upward to allowing the inlet area to serve as a temporary sediment trap for the construction area.

B. Provide materials for the culvert riser that are consistent with the culvert upon which they are attached.

3.0 PART III - EXECUTION

3.1 Examinations

A. Verify that slope contours are to required alignment and grade. Place sediment collection system on all drainage ways downstream of disturbed areas of construction and as directed by the ENGINEER and as indicated in the CONTRACT DOCUMENTS.

B. Examine sediment collection material and equipment for defect or damage.

C. Verify sediment collection material and equipment delivered to site meet the requirements of the CONTRACT DOCUMENTS.

D. Provide sediment collection facilities in accordance with governing agency.

E. Install sediment collection systems in accordance with the DRAWINGS.

3.2 Inlet Protection

A. Height of Filter Fabric: Limit height of the filter fabric to 15 inches above the crest of the drop inlet.

B. Sump: Where possible, provide a filter fabric or block-and-gravel protection device with a sediment-trapping sump 12 inches to 18 inches deep as measured from the crest of the inlet. Side slopes should be 2:1. Provide 30 cubic yards of excavation for each acre of ground disturbed.

C. Orientation: Place the longest dimension of the basin toward the area of greatest flow.

D. Filter fabric:

1. Stakes: Place a stake at each corner of the inlet and around the edges at no more that 3 feet apart. Drive the stakes into the ground, if possible, or a minimum of 8 inches.

2. Frame: For stability, install a framework of wood strips around the stakes at the crest of the overflow area, 18 inches above the crest of the drop inlet.

3. Excavate: Excavate a trench eight inches to 12 inches deep around the outside perimeter of the stakes. If a sediment-trapping sump is being provided, then the excavation may be as deep as 24 inches.

4. Staple: Staple the filter fabric to the wooden stakes with heavy-duty staples, overlapping the joints to the next stake. Ensure that 12 inches to 30 inches of filter fabric extends at the bottom so it can be formed into the trench.

5. Completion: Place the bottom of the fabric in the trench and backfill the trench all the way around, using washed gravel to minimum depth of four inches. Use enough gravel to ensure contact between the filter fabric and the underlying surface.

E. Gravel and Mesh:

1. Preparation: Remove any obstructions to excavating and grading. Excavate sump area, grade slopes, and properly dispose of soil.

2. Secure Inlet: Prevent seepage of sediment-laden-water.

3. Wire Mesh: Place wire mesh over the drop inlet so the wire extends a minimum of 12 inches beyond each side of the inlet structure. Overlap the strips of mesh if more than one is necessary.

4. Fabric: Place filter fabric over the mesh, extending it at least 18 inches beyond the inlet opening on all sides. Ensure that weep holes in the inlet structure are protected by filter fabric and gravel.

5. Stone: Place stone or gravel over the fabric/wire mesh to a depth of at least 12 inches.

F. Block and Gravel

1. Preparation: Secure the inlet grate to prevent seepage of sediment-laden water.

2. Wire Mesh: Place wire mesh over the drop inlet so the wire extends a minimum of 12 to 18 inches. Overlap the strips of mesh if more than one is necessary.

3. Fabric: Place filter fabric (optional) over the mesh and extend it at lease 18 inches beyond the inlet structure.

4. Blocks: Place concrete blocks over the filter fabric in a single row lengthwise on their sides along the sides on the inlet. Excavate the foundation a minimum of 2 inches below the crest of the inlet. The bottom row of blocks should be against the edge of the structure for lateral support.

5. Orientation: The open ends of the block should face outward, not upward, and the ends of adjacent blocks should abut. Lay one block on each side o the structure on its side to allow for dewatering of the pool.

6. Dimensions: The block barrier should be at least 12 inches high and may be up to a maximum of 24 inches high. It may be from 4 inches to 12 inches deep, depending on the size of block used.

7. Finishing: Prior to backfilling, place wire mesh over the outside vertical end of the blocks so that stone does not wash down the inlet.

8. Gravel: Place gravel against the wire mesh to the top of the blocks.

G. Inspect regularly and after every storm. Make any repairs necessary to ensure the sediment control device is in good working order.

H. Remove accumulated sediment and restore the trap to its original dimensions when sediment has accumulated to half the design depth of the trap. Sediment should be disposed at an approved site in a manner that will not contribute to additional siltation.

1. Gravel-and-Mesh Devices: Clean (or remove and replace) the stone filter or filter fabric if it becomes clogged.

2. Filter Fabric Devices: Replace the fabric immediately if it becomes clogged. Make sure the stakes are firmly in the ground and that the filter fabric continues to be securely anchored.

I. Inlet protection should remain in place and operational until the drainage area is completely stabilized or up to 30 days after the permanent site stabilization is achieved.

3.3 Straw Bale Barriers

A. Do not use straw bale barriers where flow rate exceed 1 cubic foot/second or the drainage area is greater than 1.25 acres.

B. Provide an undisturbed buffer zone of 3 to 6 feet is necessary between the barriers and surface waters to allow safe removal of the barrier and of accumulated sediments.

C. Embed bales to a minimum depth of 6 inches and backfill for the entire length of the barrier. Each bale should be securely anchored with 2 stakes 2 inches x 2 inches x 36 inches or steel drift pins driven at least 18 inches into the ground.

D. Install straw bale barriers at the toe of slopes prior to disturbing the slopes. Install the bales a short distance away from the toe of the slope and outside of any ditch channel.

E. Place the bales in a single row lengthwise on the contour for sheet flow applications, or perpendicular to the contour in concentrated flow applications. When flows are expected to be high enough to surpass the infiltration capacity of the bales, the center (low point) bales shall be wrapped in filter fabric with a three foot tail stapled securely and extending from the down gradient side of the barrier to prevent scouring. The ends of the adjacent bales must tightly abut one another.

F. Fill all gaps between bales with tightly wedged straw. For concentrated flow applications, extend the end of the barrier so that the bottom of the end bales are at a higher elevation than the top of the lowest middle bale to assure that sediment laden water flows through or over the barrier instead of around the ends of the barrier.

G. Perform one inspection during the first runoff-producing event after the installation of the barriers to assure proper functioning. Immediately repair damaged bales, undercutting, or end runs. Replace bales as needed due to disintegrations or rotting.

H. Remove accumulated sediment and disposed at an approved site in a manner that will not contribute to additional siltation.

3.4 Temporary Berms

A. Provide berms to prevent minor runoff onto newly constructed slopes until vegetation is established or until permanent measure are in place. Provide berms to intercept flow from the construction area and direct it to sediment removal facilities prior to discharge.

B. Dimensions:

   1. Soil Berm: A berm of soil with an approximate height of 12 to 18 inches with a minimum top width of 24 to 28 inches and side slopes of 2:1 or flatter. Berms should be high enough to prevent flow from overtopping. Berms are normally constructed from embankment materials.

   2. Sandbag Berm: Height = 1.5 feet minimum, top width = 1.5 minimum, bottom width = approximately 4 to 5 feet.

   3. Sandbag Size: Length = 24 to 30 inches, depth or thickness = 6 to 8 inches, and weight = 90 to 130 pounds.

C. Construction:

   1. Soil Berm: Grade to drain to a slope drain inlet. Construct embankments with a gradual slope to one side of the embankment to permit the placement of all temporary berms and slope drains on one side of the embankment. When fills are constructed on side hill slopes, slope the top surface toward the inside so that surface runoff will be away from the fill slope. Compact the entire width of the berm.

   2. Sandbag Berm: Install so that flow under or between bags is prevented. Stack the sandbags in an interlocking fashion to provide additional strength for resisting the force of the flowing water. However, do not stack them more than three high without broadening the foundation using additional sandbags, or providing additional stability.

D. Inspect and repair temporary berms periodically as well as after each significance rainfall. For sandbag berms, reshaped or replaced sandbags as needed during inspection. When sediment reaches six inches, remove the accumulated sediment and disposed at an approved site in a manner that will not contribute to additional siltation. Leave berms in place until all upstream areas are stabilized and accumulated sediment has been removed. Remove sandbags by hand.

3.5 Sedimentation Basins

A. Provide sediment basins where physical site conditions or land ownership restrictions preclude the effective use of barrier-type erosion control measures. Provide sediment basins for disturbed areas of more than 10 acres within the same drainage basin or where operations expose critical areas to soil erosion.

B. Volume and Configuration of Basin:

1. Small Areas: Provide at least 65 cubic yards/acre of total drainage area.

2. Larger Areas: For areas greater that 10 acres within the same drainage basin provide at least 130 cubic yards/acre of total drainage area.

4. Baffles and Spillway: Install baffles or other deflectors to spread the flow throughout the basin. Install an emergency spillway and riser pipe(s).

5. Depth and Surface Area: Determine the surface area based on the Standard Drawing with a minimum of three feet of sediment storage and 3:1 side slopes

6. Approval: Submit design of the sediment basin and obtain ENGINEER'S approval prior to construction.

C. Construction Requirements:

1. Placement: Install the temporary sediment basin before clearing and grading is undertaken. Locate the dam to provide maximum volume capacity for sediment behind the structure. It should not be built within an active stream channel. Install fencing around the basin, as necessary to endure public safety.

2. Preparation: Prepare the dam site by clearing vegetation and removing topsoil before beginning dam construction. For areas under the embankment and any structural works, lea, grub, strip topsoil to remove all trees, vegetation, roots and other objectionable material. To facilitate clean out and restoration, clear the pool area of all brush, tress or other debris.

3. Spillway Bed: Level the bed for the pipe spillway to provide uniform support through its entire length under the dam.

4. Spillway: Construct an emergency spillway on undisturbed soil and not on fill. Line the spillway with four inches of concrete, reinforced with 6 inch x 6 inch, 6 inch x 6 inch diameter W1.4 each way wire mesh extending to a minimum of 36 inches down each face of the embankment. The spillway should be at lease 18 inches deep with 1:1:5 side slopes.

5. Piping: Secure all pipe joints and fasten watertight. Fasten the riser rigidly and securely to the barrel and seal watertight. Place the barrel on a firm foundation according to the lines and grades shown on the approved CONTRACT DOCUMENTS.

6. Backfill: Place at least 24 inches of hand-compacted backfill (maximum 6 inch lifts) over the pipe spillway before crossing it with construction equipment. Control the movement of the hauling and spreading equipment over the fill so that the entire surface of each lift will be traversed by not less than one tread tract of the equipment.

7. Discharge: The pipe spillway should discharge at ground elevation below the dam, and not more than 12 inches above any streambed.

8. Placement of Fill: Scarify areas on which fill is to be placed prior to placement of fill. Place fill materials in 6-inch maximum lifts, compacted by construction equipment. Provide continuous horizontal lifts over the entire length of the fill.

9. Stabilization: Stabilize the embankment and emergency spillway with vegetation or other stabilization measures.

D. Sediment basins should be readily accessible for maintenance and sediment removal. Inspect after each rainfall and clean out when half the available sediment storage volume has been filled with sediment. Dispose of removed sediment and stabilize in an approved location such that sediment does not re-enter waters. Sediment may not be dumped into any water of the U.S without appropriate permitting.

E. Operate and maintain the sediment basin until the drainage area is permanently stabilized by vegetation or other permanent controls.

3.6 Silt Fence Barriers

A. Provide silt fences near the perimeter of a disturbed area to intercept sediment while allowing water to percolate through.

B. Provide silt fences along the toe of fills, on the downhill side of large through-cut areas, along streams, at natural drainage areas and above interceptor dikes and as indicated in the CONTRACT DOCUMENTS.

C. Construct the silt fence after cutting and slashing of trees and before excavating haul roads, fill benches, or any soil disturbing construction activity in the drainage areas.

D. The silt fences must remain in place until the disturbed areas are permanently stabilized.

E. Configuration:

   1. Maximum Drainage Area: 0.25 acres/100 feet of fence length.

   1. Maximum Fence Length: 300 feet for 100-foot slope length.

   2. Maximum Slope Length (Upstream Drainage Distance) to Fence:
      a. 100 feet for slopes flatter than 5:1.
      b. 15 feet for slopes steeper than 2:1.

   3. Maximum Slope Steepness Above Fence: 1:1 grade.

   4. Minimum Toe-in Depth: 6 inches.

   5. Post Spacing:
      a. With wire support fence – 10 feet maximum.
      b. Without wire fence – 6 feet maximum.

   6. Post Depth (Below Ground Surface): 18 inches minimum.

   7. Undisturbed Buffer Zone: 3 feet minimum between fence and surface waters.

F. Construction Requirements:

   1. Maximum Height of the Filter Fence: Between 1.5 feet and 3 feet above the ground surface (depending on the amount of upslope ponding expected).

   2. Post Spacing: 10 feet apart when a wire mesh support fence is used and no more than 6 feet apart when using extra-strength filter fabric (without a wire fence). The posts should extend at least 18 inches into the ground.

   3. Trench: Excavate a trench about 6 inches wide and 4 to 12 inches deep along the upslope side of the line of posts.

   4. Fastening: If standard strength filter fabric is to be used, fasten the optional wire mesh support fence to the upslope side of the posts using heavy duty wire staples, tie wires, or hog rings. Extend the wire mesh support to the bottom of the trench.

5. Extra Strength Filter Fabric: Does not require a wire mesh support fence. Staple or wire the filter fabric directly to the posts and extend 8 to 18 inches of the fabric into the trench.

6. Trees: Do not attach filter fabric to trees.

7. Joints: Splice fabric together only at a support post, with a minimum 6 inches overlap, and securely seal the joint.

8. Backfill: Backfill the trench with compacted soil or ¾ inch minimum diameter gravel placed over the filter fabric.

G. Inspect silt fences periodically for damage (such as tearing by wind, animals, or equipment) and for the amount of sediment, which has accumulated. Remove the sediment when it reaches one-half the height of the silt fence. In situations where access is available, machinery can be used. Otherwise, the silt must be removed manually.

H. Remove sediment deposits when heavy rain or high water is anticipated. Place the sediment deposits in an area where there is little danger of erosion.

3.7 Culvert Risers

A. Provide risers at culvert inlet that receive runoff from upstream construction sites or from other erodible areas at indicated on the DRAWINGS. Do not use for drainage areas larger than a 1.25 acres.

B. Determine the volume of the water storage for the culvert riser based on the total drainage area upstream in accordance with the specifications for Sediment Basins. Ensure water impoundment will not extend to private property unless authorized in writing by the property owner.

C. Install the culvert riser according to the CONTRACT DOCUMENTS. Fasten the riser pipe rigidly and securely to the culvert barrel. Seal the joint so that it is watertight.

D. Inspect the rise periodically and following runoff-producing storms. Remove accumulated sediments to restore the design capacity of the sediment deposit area. Dispose of sediment where they are not likely to reenter stream flow or surface runoff.

E. Remove culvert risers after permanent erosion control measure are in place.

END OF SECTION

DIVISION 02

SECTION 02270
MECHANICALLY STABILIZED EMBANKMENTS AND ABUTMENTS

1.0 PART I - GENERAL

1.1 Description

This work shall consist of providing a stabilized embankment wall system and drainage appurtenances designed and constructed in accordance with these specifications and in reasonably close conformity with the lines, grades,and dimensions shown on the drawings. All concrete shall be Class A as defined in Item Specification 03300.

1.2 Method of Measurement

The quanity to measured shall be the number of square feet of completed wall measured in accordance with Item Specification 100.

2.0 PART II - DESIGN

The CONTRACTOR shall submit the wall design and construction details of the system declared at the time of bidding, after award of the contract. The ENGINEER will determine the adequacy of the submittal and interpretations of conformance with these specifications.

The time required for preparation and review of the wall system shall be charged to the allowable contract time. Inadequate information, details, or design shall be considered a faulty submission and will not be considered justification for time extensions. No additional compensation will be made for any additional material, equipment, or other items found necessary to comply with these specifications as a result of the ENGINEER's review.

When plan dimensions are revised, as directed by the ENGINEER, due to field conditions or for other reasons, the CONTRACTOR shall be responsible for revising the alternate wall plans, design calculations, and summary of quantities. For changes in wall facing area, the CONTRACTOR shall be compensated in accordance with Item Specification 100.

The wall shall follow the lines, grades, and location as shown on the drawings relative to the road centerline. Prior to wall fabrication, the CONTRACTOR shall survey and stake the wall location using horizontal and vertical control provided by the ENGINEER. The wall construction shall be based upon the CONTRACTOR's survey.

Where retaining walls are to tie into existing bridge wingwalls, the locations and elevations of the existing features are approximate and shall be field verified by the CONTRACTOR prior to designing the retaining wall. The CONTRACTOR shall provide a smooth profile along the top of the retaining wall such that the end of the proposed wall matches the top of the existing wingwall.

2.1 Submittals

The CONTRACTOR shall provide final calculations and drawings of the proposed wall system which are stamped and signed by a Professional Civil Engineer registered in the state in which the project is located. The calculations shall include, but not be limited to, those items herein noted. Only wall system designs that have a minimum 5-year history of documented satisfactory performance can be constructed for this contract. This documentation shall be provided if requested by the ENGINEER.

The design shall include all details, dimensions, quantities, and cross sections necessary to construct the wall. The drawings shall include, as a minimum, the following items:

A. Plan and elevation sheets for the wall which will contain the following:

   1. An elevation view of the wall which shall indicate the elevation at the top of the wall at all horizontal and vertical break points, location of facing elements, elevations at the top of leveling pads and footings, the length, distribution, and size of stabilization elements, and the distance along the face of the wall to where changes in length of the stabilization elements occur, and an indication of the original and final ground line.

   2. A plan view of the wall which shall indicate the offset from the construction centerline to the face of the wall at all changes in horizontal alignment, limits of different stabilization modules, and the centerline of any drainage structure or drainage pipe behind, passing through, or under the wall.

   3. Any general notes required for constructing the wall including recommended construction sequence/method.

   4. All horizontal and vertical curve data affecting the wall shall be given.

   5. All appurtenances including guard rails, etc.

   6. A listing of the summary of quantities shall be provided on the elevation sheet of each wall.

B. All typical details shall be shown including reinforcing bar bending details. Bar bending details shall be in accordance with ACI 315 (current revision).

C. All typical details for foundations and leveling pads shall be shown, including details for steps in the footings or leveling pads.

D. All facing panel types shall be detailed. The details shall show all dimensions necessary to construct the element, all reinforcing steel in the element, and the location of stabilization and anchor devices embedded or attached to the panels.

E. All details for construction of walls interfacing with drainage facilities and other structures shall be clearly indicated.

F. All details of the architectural treatment shall be shown if required in sec. 02270.04.

At the time the wall drawings are submitted for review, they shall be accompanied with a set of design calculations for the walls. The notes shall be legible and shall include an explanation of any symbols and computer programs used in the design of the walls. The factors of safety for sliding, pullout, and over-turning which shall be specified hereinafter, and the bearing pressure beneath the wall footing and earth stabilized mass shall be clearly indicated.

Calculations shall be on 8-1/2" x 11" sheets, shall contain the project number, wall designation, date of preparation, initials of designer and checker, and page number at the top of the page. The design calculations shall contain an index page when the number of calculation pages exceed 5.

The initial submission shall include three sets of the wall drawings and notes. One set of notes and drawings shall be returned to the CONTRACTOR with any indicated changes. If revisions are necessary, the CONTRACTOR shall have the necessary changes made and shall resubmit three revised sets of drawings and notes. All submissions shall be processed through the CONTRACTOR unless the CONTRACTOR gives his written permission for the wall designer/supplier and the ENGINEER to communicate directly. The ENGINEER will be allowed 30 days to review and determine the adequacy of the final drawings. No work, fabricating, or ordering of materials for the structure shall be done by the CONTRACTOR until the submittal has been approved in writing by the ENGINEER. Only complete submissions of individual wall design will be reviewed.

2.2 Design Criteria and Considerations

The design shall consider the internal and the external stability of the wall mass including the bearing pressure, overturning, base sliding, foundation slope stability, and stability of temporary construction slopes. The Forest Service will assume responsibility for foundation slope stability of the completed walls designed according to the criteria and considerations:

A. Vehicle loading: AASHTO HS 20-44 or construction equipment, whichever is greater.

B. The structural capacity of any metal component which is exposed to soil shall be based upon a reduction of metal area caused by 75 years of corrosion.

Backfill material shall be assumed to have resistivity values greater than 1000 ohm-cm.

C. The internal stability of the wall mass shall be analyzed in order to ensure that the wall shall function as intended.

Failure planes must be analyzed so that the soil stabilizing component extends sufficiently beyond the failure plane to stabilize the material. The failure plane may be established by acceptable theories of soil mechanics or by well-documented experimental data. External loads which affect the internal stability, such as those applied through bridge footings, shall be accounted for in the design. The size of all structural elements shall be determined such that the design load stresses do not exceed the allowable stresses found in the latest issue of the AASHTO Standard Specifications for Highway Bridges, including any interims.

Assumed pull-out resistance of each size and configuration of the stabilization elements shall be verified by field or laboratory pull-out tests for walls over 30 feet high. The ENGINEER, at his discretion, may waive the pull-out tests requirement after CONTRACTOR's submittal of documents demonstrating satisfactory instrumented performance of constructed walls with similar materials and to similar heights. For design purposes, a factor of safety for pull-out resistance shall be not less than 1.50 based on pull-out resistance at 0.75 inches deflection.

D. Common excavation material shall be utilized as backfill. The CONTRACTOR shall determine the soil classification of backfill material for design purposes.

E. The stabilization elements shall extend a minimum horizontal distance back from the face of the wall a distance equal to .7 times the wall height, but not less than 8 feet. The face of the wall shall be set back a minimum horizontal distance of 3 feet from the ground surface of the slope below.

F. Bearing support for the stabilized embankment is expected to include colluvium, river gravels, or other insitu materials. The CONTRACTOR is required to determine bearing material. Allowable toe bearing pressures shall be based upon a foundation friction angle of 34 degrees and a minimum safety factor of 2 to 3. Fill shall not be used for foundation support unless approved by the ENGINEER to replace unsuitable subexcavation material.

G. The backfill material shall be assumed to be cohesionless and have a friction angle of 34 degrees and a unit weight of 125 pounds per cubic foot.

H. The wall facing elements may consist of galvanized steel or wire mesh, or pressure treated timber. Facing elements shall not easily attract or be subject to vandalism.

I. The factor of safety for overturning of the wall mass shall be not less than 2.0. The factor of safety for base sliding of the wall mass shall be not less than 1.5. Passive pressure in front of the wall mass will be assumed to be zero for design purposes.

J. The CONTRACTOR shall be responsible for obtaining additional site information for design if needed.

K. The wall design shall include the alignment, grade, and installation of culverts within the stabilized embankment section at locations indicated on the plan. The culvert placements shall not create erosion or stability hazards for the wall foundation.

L. All appurtenances behind, in front of, under, mounted upon, or passing through the wall such as drainage structures or other items shown on the plans must be accounted for in the stability design of the wall.

M. Backfill drainage measures shall be provided at wall locations which will become temporarily submerged by rising river levels.

3.0 PART III - MATERIALS

Materials not conforming to this section of the specifications shall not be used without written consent from the ENGINEER.

A. **Wire or steel facing** - Facing components shall be galvanized to conform to ASTM Standards. Galvanization shall be applied after the facing modules are fabricated. The facing shall contain and **prevent** the loss of backfill material. The facing components shall conform to ASTM manufacturing standards.

B. **Timber facing** - Timber facing components shall be pressure treated and treatment shall conform to AWPA standards. The facing shall contain and prevent the loss of the backfill material.

C. **Soil Stabilization and Attachment Devices** - All stabilization and attachment devices shall be true to size and free from defects that may impair their strength and durability.

D. **Steel Components** - Steel components touching backfill shall be manufactured and galvanized according to ASTM standards. Galvanization shall be applied after fabrication.

E. **Backfill Material** - All backfill material used shall be reasonably free from organic or otherwise deleterious materials. All material used as backfill shall conform to the soil parameters used in the design.

F. **Acceptance of Material** - The CONTRACTOR shall furnish the Contracting Officer a Certificate of Compliance certifying the prefabricated wall materials comply with the applicable contract specifications. A copy of all test results performed by the CONTRACTOR necessary to assure contract compliance shall also be furnished to the Contracting Officer. Acceptance will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the ENGINEER.

4.0 PART IV - CONSTRUCTION METHODS

4.1 Wall Excavation

Unclassified excavation shall be in accordance with the requirements of Item Specification 02220 and in reasonably close conformity to the limits and construction stages shown on the plans.

4.2 Foundation Preparation

The foundation for the structure shall be graded level for a width equal to the length of stabilization elements plus 1.0 foot or as shown on the drawings. Prior to wall construction, except where constructed on rock, the foundation shall be compacted with a smooth wheel vibratory roller. Any foundation soils found to be unsuitable shall be removed and replaced with select granular backfill as approved by the ENGINEER. Wall erection shall not start until the foundation has been approved in writing by the ENGINEER.

4.3 Wall Erection

A field representative of the designer shall be available at start-up and to assist in resolving construction problems at no additional cost to the project.

For wire faced structures, backing mats and the 1/4" hardware cloth shall be placed in successive horizontal lifts in the sequence shown on the drawings as backfill placement proceeds. Horizontal alignment tolerances shall not exceed 2" vertically when measured at the junction of the wire facing and soil reinforcement along a 10' straight edge. The overall vertical tolerance of the wall (top to bottom) shall not exceed 1" per 10' of wall height. These criteria are applicable to both vertical and battered structures. Reinforcement elements shall be placed normal to the face of the wall, unless otherwise shown on the plans. Prior to placement of the reinforcing elements, backfill shall be compacted in accordance with section 4.04.

4.4 Backfill Placement

Backfill placement shall closely follow erection of each course of wall section. Backfill shall be placed in such a manner as to avoid any damage or disturbance of the wall materials or misalignment of the wall. Any wall materials which become damaged during backfill placement, shall be removed and replaced at the CONTRACTOR's expense. Any misalignment or distortion of the wall due to placement of backfill outside the limits of this specification, shall be corrected by the CONTRACTOR at his expense.

Backfill shall be compacted to 95 percent of the maximum density as determined by AASTHO T-99, Method C or D (with oversize corrections as outlined in Note

7 of that test). For applications, where spread footings are used to support bridge or other structural loads, the top 5.0' below the footing elevation should be compacted to 100 percent AASHTO T-99.

The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content less than, or equal to, the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

The maximum lift thickness after compaction shall not exceed 12". The CONTRACTOR shall decrease this lift thickness, if necessary, to obtain the specified density.

Compaction within 3' of the back face of the wall, shall be achieved by at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

At the end of each day's operation, the CONTRACTOR shall slope the last level of backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the CONTRACTOR shall not allow surface runoff from adjacent areas to enter the wall face construction site.

END OF SECTION

DIVISION 02

SECTION 02801
SEEDING

1.0 PART 1 - GENERAL

1.1 Description

This item shall consist of broadcast seeding designated areas using seed mixtures provided by the Forest Service.

The areas to be seeded shall be all cut slopes, fill slopes and other disturbed areas.

2.0 PART 2 - PRODUCTS

2.1 Seed

The seed mix shall be supplied by the Forest Service

2.2 Mulch

Mulch shall consist of materials salvaged from clearing (shredded), 100% agricultural straw certified as weed free, or Woodstraw™.

3.0 PART 3 - EXECUTION

3.1 General

The specified seed mixture shall be uniformly spread on the designated areas to the density in pounds of live seed per acre as specified.

Each area or suitable section of the area to be seeded shall be seeded in the fall or as directed by the Engineer. Seeding shall be done before the ground has become packed or hardened. No seeding shall be done during windy weather or when the ground is excessively wet or deeply frozen.

3.2 Preparation of Seeding Area

Cut slopes, fill slopes, embankments or other areas to be seeded shall be shaped and finished as specified under the Sections involved. The area, where necessary, shall be worked such that the surface is loose to a depth of at least one inch. Each area shall be approved for seeding by the ENGINEER before seed is applied.

3.3 Seeding and Mulching

The seed or seed mixtures shall be accurately proportioned as stipulated and thoroughly mixed. They shall be remixed as necessary so that a uniform mixture will result as each loading of the seeder is made. Seed shall be applied with a rotary hand seeder or other approved type commercial seeder or by an agreed upon method. All portions of the area shall be uniformly covered to the required density.

Mulch straw be applied at a depth of two to four inches using certified weed-free straw, or or Woodstraw™ will be applied according to manufactorers recommendations, except for areas located in shady areas, in which case mulching is not required. The Contractor shall install mulch on the embankment slopes and other exposed areas when they are finished and after seeding. All mulched areas will be thoroughly wetted following application.

3.4 Maintenance of Seeded Area

The CONTRACTOR will not be required to maintain an area which has been satisfactorily seeded except that he shall protect the area against traffic by warning signs or barricades or other methods approved by the ENGINEER.

When a seeded area has become damaged by storm or otherwise prior to final acceptance of the project, the ENGINEER may order the area reworked. The damage shall then be repaired as directed and the area reseeded.

END OF SECTION

DIVISION 13

SECTION 13001
HDPE LINER

1.0 PART I – GENERAL

1.1 Description

This section specifies the manufacture, delivery, and installation and testing of the flexible membrane liner system, including the high-density polyethylene (HDPE) liner, and related work as specified herein.

1.2 Quality Assurance

A. Liner Guarantee and Certification

The HDPE liner manufacturer/installer shall guarantee, in writing, the HDPE liner material against deterioration or defects for 20 years from the date of acceptance by the ENGINEER. The guarantee shall be against defects in material or workmanship and against deterioration due to ozone, ultraviolet light, bacteria, or other deteriorating processes. The HDPE liner manufacturer/installer shall guarantee, in writing, the HDPE liner installation workmanship for five years from the date of acceptance by the ENGINEER. All guarantees shall be made by the manufacturer/installer directly to the OWNER.

The CONTRACTOR and the HDPE liner manufacturer/installer shall also certify, in writing that the installed flexible membrane liner system meets the requirements of these specifications.

B. Quality Assurance/Quality Control

The CONTRACTOR shall establish and maintain a quality assurance/quality control (QA/QC) and testing program throughout the project. The QA/QC program shall include a Quality Assurance/Quality Control Manual describing inspections and reports, sampling and testing (destructive and nondestructive) of the HDPE resin, the HDPE sheet, factory seams, and field seams.

The QA/QC program shall provide and maintain documentation sufficient to assure the ENGINEER that the repository cover has been lined with HDPE liner, meeting or exceeding all of the requirements of these specifications, and that the liner has been fabricated, installed, and seamed to provide leakproof performance during the guarantee period.

C. Quality Assurance/Quality Control Manual

Within seven days after notification of contract award, the CONTRACTOR shall submit to the ENGINEER a complete QA/QC Manual prepared by the HDPE liner manufacturer/installer, for ENGINEER review and approval. At a minimum the QA/QC Manual shall contain the following:

1. General description of the manufacturer/installer's QA/QC organization, personnel, and facilities.

2. Inspection, sampling, testing, and report procedures for evaluating the quality of raw materials used in the manufacture of HDPE sheet for this project.

3. Inspection, sampling, testing, and report procedures for evaluating the quality of the HDPE sheet during manufacture.

4. Inspection, sampling, testing, and report procedures for evaluating factory seams and seaming equipment during fabrication (if factory seams are required) and methods and procedures for correcting defective seams.

5. Inspection and report procedures for evaluating and correcting damage to HDPE sheets during storage and delivery to the job site.

6. Inspection, sampling, testing, and report procedures for evaluating the HDPE sheet during installation.

7. Inspection, sampling, testing, and report procedures for evaluating field seams and field seaming equipment during installation.

8. Methods and procedures for correcting defective field seams during installation.

9. Methods and procedures for assuring material control.

10. Methods and procedures for assuring documentation control.

11. Methods and procedures for the testing and calibration of all laboratory and field-testing equipment.

12. Methods and procedures for the maintenance of all records in a project life.

13. Methods and procedures for the development of "as-built" drawings for the project.

14. In addition to the number, location, and type of inspections and tests, the Manual shall stipulate the range of acceptable results or parameters for

each inspection/test type. The inspection/test method should also be delineated.

15. The manual shall include copies of the CONTRACTOR'S Standard Guarantees and Warranties for materials and installation.

D. Testing

Laboratory or field tests required to maintain the QA/QC program described above will be the paid for by and the responsibility of the CONTRACTOR and liner manufacturer/installer.

1.3 Submittals

A. HDPE Liner

The CONTRACTOR shall obtain the following information from the HDPE liner manufacturer/installer:

1. Four complete sets of SHOP DRAWINGS showing seaming, anchoring, and any other installation details required. Site preparation drawings shall be submitted within 30 days after notification of contract award and shall indicate the proposed liner panel layout.

2. Certificates of Compliance with the requirements of the standards and testing methods specified shall be provided within 30 days after contract award.

3. At the time of delivery, the manufacturer/installer and CONTRACTOR shall certify that the liner material is free of holes, delaminations, blisters, air pockets, undispersed raw materials, and any other defects.

4. Within 30 days after notification of Contract award, an installation plan including procedures for unrolling and unfolding, positioning filed seaming, any special details, protection against wind, and anchoring of materials.

5. Within 30 days after notification of Contract award, the manufacturer/installer and CONTRACTOR shall submit the names and qualifications of supervisors assigned to this project, indicating the number of installations completed quantity of area installed, and other pertinent information.

6. A written guarantee/warranty issued to the OWNER.

7. Two 3-foot by 3-foot samples of the HDPE sheet seamed and unseamed.

8. After acceptance of liner material submittals an interface shear test shall be completed by a qualified laboratory to establish the interface friction

angle between the component cap materials to evaluate the stability of the selected materials at the planned slope inclinations before construction commences.

2.0 PART II - MATERIALS

2.1 Materials

A. 40-Mil HDPE Liner

1. HDPE sheeting shall be manufactured from a composition of high quality ingredients suitably compounded of 100% virgin high-density polyethylene resin and specifically compounded for use in hydraulic structures. Reprocessed or reground materials shall not be used. The use of water-soluble formulation ingredients is prohibited.

2. The nominal thickness of all liner sheets shall be 40 mils. The HDPE membrane material shall consist of thoroughly mixed HDPE compound. It shall be shall be uniform in color, thickness, size and surface texture. The sheeting shall contain no undispersed materials, divots, deep gas checks, and shall not exhibit cold flow.

3. The liner shall be resistant to tear propagation, fires, rot, mildew, insects, rodents, bacteria, chemicals, and sunlight. The liner shall conform to the physical properties specified below.

4. The chemical resistance of the HDPE membrane liner and seams shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources.

B. Miscellaneous Materials

1. Extrudate: Extrudate for fusion welding shall be formulated from the same HDPE resin as the liner and shall meet the applicable physical and chemical property requirements.

Properties of HDPE liner shall be as follows:

Property	Unit	Minimum Average Roll Value (MARV)
Thickness (ASTM D 5994)	Mils	40
Tensile Strength at yield (ASTM D 6693)	Lb/in	120
Tensile Strength at break (ASTM D 6693)	Lb/in	80
Elongation at yield (ASTM D 6693)	%	11 (minimum)
Elongation at break (ASTM D 6693)	%	50 (minimum)
Tear Resistance (ASTM D 1004)	Lb	40
Puncture Resistance (ASTM D 4833)	Lb	100

3.0 PART III - EXECUTION

3.1 Delivery and Handling

A. Each roll of HDPE liner shall have a waterproof label containing the identification number, thickness, width, length, and proper direction of unrolling and/or unfolding. The HDPE liner manufacturer/installer shall be responsible for the repair or replacement of material damaged or made unserviceable during delivery and handling at no additional cost to the ENGINEER. The HDPE liner manufacturer/installer and CONTRACTOR shall be responsible for delivery, handling, and installation of all of the materials at no additional cost to the ENGINEER.

B. Liner material shall not be delivered to the site until all required submittal information has been submitted and approved.

3.2 Installation

The liner system shall be installed as shown on the drawings.

A. HDPE Liner

The liner shall be constructed as soon as practical after the completion and approval by the ENGINEER of the subgrade. The HDPE liner installer shall certify in writing that the surface of the subgrade is in acceptable condition to receive the HDPE liner. Each sequential section of HDPE liner shall be secured in an anchor trench and continuously welded to the adjacent sections.

B. The HDPE liner installer shall be properly trained and qualified to install synthetic liners. All personnel performing field seaming shall be qualified by experience or by passing seaming tests. Qualifications of the seamers shall be provided to the ENGINEER seven days prior to the start of installation of the HDPE liner.

C. The installation is to be performed in strict conformance with the approved shop drawings, the liner shall be laid out in such a manner as to minimize the number and length of field seams. The edges of the liner shall be permanently anchored in a trench, in accordance with the approved shop drawings. The surface of the areas in contact with the liner shall be free of loose rocks and debris. The liner shall be placed over the prepared surfaces in such a manner as to assure minimum handling and in accordance with the manufacturer’s approved installation procedures. No sharp angular rocks or hard objects shall be in contact with the liner.

D. Liner sheets damaged during installation shall be removed or repaired, in accordance with approved details, at no additional cost to the ENGINEER. A minimum of a four-inch over lap shall be provided for all field seams. The liner shall be placed so as to be free of all wrinkles and air pockets.

E. The areas to be seamed shall be cleaned and prepared in accordance with the manufacturer's approved recommendations. The seaming equipment used shall be of the fusion welding type. Extrusion Welding may be used if approved by ENGINEER, in situations where hot wedge welding is impractical, such as for repair patches and fabrications. All welding shall be capable of providing a uniform and continuous seam with a minimum width of one inch. All factory and field seams shall be tightly bonded and 100 percent leak proof.

F. No fish mouths are allowed within the seam area. If fish mouths occur, the material shall be cut, overlapped, and an overlap seam shall be applied. Any liner sheets or seams showing damage by equipment, wind, or other causes, shall be replaced or repaired by the CONTRACTOR, at no additional cost to the ENGINEER.

G. The liner shall be deployed in a manner allowing the appropriate amount of slackness into the membrane to provide for thermal expansion and contraction.

3.3 Testing

A. Factory Seams

Where factory seams are used, the seams shall be tested for watertightness and mechanical strength and meet the requirements of these specifications. When the fabricated sheets are shipped to the project site, all factory welds must be 100 percent watertight and meet the strength requirements of the specifications.

B. Field Seams

1. Water tightness will be tested over 100 percent of the seam lengths by the vacuum method or by the air pressure method (for double fusion seams only).

2. Physical strength of field welds shall be tested by both destructive and nondestructive test methods in the field and in the laboratory in accordance with methods described in the approved QA/QC manual. Locations where samples are taken shall be repaired in accordance with the manufacturer's approved repair procedures. Seams not meeting the strength requirements of these specifications shall be repaired and/or replaced in accordance with approved procedures. All repaired seams shall be retested for water tightness.

END OF SECTION

DIVISION 13
SPECIAL CONSTRUCTION

SECTION 13002
NON-WOVEN GEOTEXTILE

1.0 PART I - GENERAL

1.1 Scope

This specification covers the technical requirements for the Manufacturing and Installation of the nonwoven geotextile. All materials shall meet or exceed the requirements of this specification, and all work will be performed in accordance with the procedures provided in these project specifications.

1.2 References

American Society for Testing and Materials (ASTM)

ASTM D 5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles

ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

ASTM D 4533, Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles

ASTM D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

ASTM D 4491, Standard Test Method for Water Permeability of Geotextiles by Permittivity

ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile

ASTM D 4354, Standard Practice for Sampling of Geosynthetics for Testing

ASTM D 4759, Standard Practice for Determining the Specifications Conformance of Geosynthetics

1.3 Submittals

A. Prior to material delivery to project site, the contractor shall provide the engineer with a written certification or manufacturers quality control data which displays that the geotextile meets or exceeds minimum average roll values (MARV) specified herein.

B. The contractor shall submit, if required by the engineer, manufacturer’s quality control manual for the geotextile to be delivered to the site.

2.0 PART II - PRODUCT

2.1 Geotextile

A. The non-woven needle punched geotextile specified herein shall be made from polypropylene staple fiber.

B. The geotextile shall be manufactured from prime quality virgin polymer.

C. The geotextile shall be able to withstand direct exposure to ultraviolet radiation from Sun for up to 30 days without any noticeable effect on index or performance properties.

D. Geotextile shall meet or exceed all material properties listed in Table 1.

Table 1. Recommended Geotextile Fabric Specifications

Property	Unit	Minimum Average Roll Value (MARV)
Grab Tensile Strength (ASTM D 4632)	Lbs.	300
Trapezoidal Tear Strength (ASTM D 4533)	Lbs.	115
Puncture Resistance (ASTM D 6241)	Lbs.	800
Apparent Opening Size (AOS)	U.S. Sieve	U.S. No. 30 max
Permittivity (ASTM D 4491)	Sec-1	0.02 min
UV Resistance (ASTM D 4355)	% Strength Retained	70%

2.2 Manufacture

All rolls of the geotextile shall be identified with permanent marking on the roll or packaging, with the manufacturers name, product identification, roll number and roll dimensions.

Geotextile shall be Mirafi 1120N 12 oz. non-woven fabric or approved equal.

2.3 Transport

A. Transportation of the geotextile shall be the responsibility of the contractor.

B. During shipment, the geotextile shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, or other damaging or deleterious conditions.

C. Upon delivery at the job site, the contractor shall ensure that the geotextile rolls are handled and stored in accordance with the manufacturer’s instructions as to prevent damage.

3.0 PART III - EXECUTION

3.1 Quality Assurance

A. The engineer shall examine the geotextile rolls upon delivery to the site and report any deviations from project specifications to the contractor.

B. The engineer may decide to arrange conformance testing of the rolls delivered to the job site. For this purpose, the engineer shall take a sample three feet (along roll length) by roll width according to ASTM Practice D 4354 The sample shall be properly marked, wrapped and sent to an independent laboratory for conformance testing.

C. The pass or fail of the conformance test results shall be determined according to ASTM Practice D 4759.

3.2 Installation

A. The geotextile shall be handled in such a manner as to ensure that it is not damaged in any way. Should the contractor damage the geotextile to the extent that it is no longer usable as determined by these specifications or by the engineer, the contractor shall replace the geotextile at his own cost.

B. The geotextile shall be installed to the lines and grades as shown on the contract drawings and as described herein.

C. The geotextile shall be rolled down the slope in such a manner as to continuously keep the geotextile in tension by self weight. The geotextile shall be securely anchored in an anchor trench where applicable, or by other approved or specified methods.

D. In the presence of wind, all geotextiles shall be weighted by sandbags or approved equivalent. Such anchors shall be installed during placement and shall remain in place until replaced with cover material.

E. The contractor shall take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile. Should damage to such material occur due to the fault of the contractor, the latter shall repair the damaged materials at his own cost and to the satisfaction of the engineer.

F. During placement of the geotextile, care shall be taken not to entrap soil, stones or excessive moisture that could hamper subsequent seaming of the geotextile as judged by the engineer.

G. The geotextile shall not be exposed to precipitation prior to being installed and shall not be exposed to direct Sun light for more than 15 days after installation.

H. The geotextile shall be seamed using heat seaming or stitching methods as recommended by the manufacturer and approved by the engineer. Sewn seams shall be made using polymeric thread with chemical resistance equal to or exceeding that of the geotextile. All sewn seams shall be continuous. Seams shall be oriented down slopes perpendicular to grading contours unless otherwise specified.   For heat seaming, fusion welding techniques recommended by the manufacturer shall be used.

I. The contractor shall not use heavy equipment to traffic above the geotextile without approved protection.

J. The geotextile shall be covered as soon as possible after installation and approval. Installed geotextile shall not be left exposed for more than 15 days.

K. Material overlying the geotextile shall be carefully placed to avoid wrinkling or damage to the geotextile.

END OF SECTION

DIVISION 13

SECTION 13003
UNIAXIAL GEOGRID

SPECIFICATION FOR GEOSYNTHETIC USED AS SOIL REINFORCEMENT

1.0 PART I – GENERAL

1.1 Section Includes

A. Geosynthetic to provide reinforcement for repository cover liner. The primary function of the geosynthetic is reinforcement.

1.2 Related Sections

A. Section 02220 – Excavation and Embankments

B. Section 13001 – HDPE Liner

C. Section 13002 – Nonwoven Geotextile

1.3 Unit Prices

A. Method of Measurement: By the square yard including seams, overlaps, and wastage.

B. Basis of Payment: By the square yard - as indicated in contract documents) installed.

1.4 References

A. AASHTO Standards

1. T88 - Particle Size Analysis of Soils
2. T90 - Determining the Plastic Limit and Plasticity Index of Soils
3. T99 - The Moisture-Density Relations of Soils Using a 5.5lb (2.5 kg) Rammer and a 12in (305 mm) Drop
4. Standard Specifications for Highway Bridges

B. American Society for Testing and Materials (ASTM)

1. D 123 - Standard Terminology Relating to Textiles
2. D 276 - Test Method for Identification of Fibers in Textiles
3. D 4354 - Practice for Sampling of Geosynthetics for Testing

4. D 4355 - Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)

5. D 4439 - Terminology for Geotextiles

6. D 4595 - Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

7. D 4759 - Practice for Determining the Specification Conformance of Geosynthetics

8. D 4873 - Guide for Identification, Storage, and Handling of Geotextiles

9. D 5262 - Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics

10. D 5321 - Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

11. D 6637 - Standard Test Method for Determining the Tensile Properties of Geogrids by the Single Rib or Multi-Rib Tensile Method B. National Concrete Masonry Association (NCMA) - Design Manual for Segmental Retaining Walls, Second Edition, 1997.

C. Geosynthetic Research Institute

1. GRI-GT6 - Geotextile Pullout

2. GRI-GT7 - Determination of the Long-Term Design Strength of Geotextiles

3. GRI-GG4(b) - Determination of the Long-Term Design Strength of Flexible Geogrids

4. GRI-GG5 - Test Method for Geogrid Pullout

5. GRI-GG7 - Carboxyl End Group Content of PET Yarns

6. GRI-GG8 - Determination of the Number Average Molecular Weight of PET Yarns Based on a Relative Viscosity Value

D. Federal Highway Administration (FHWA)

1. FHWA SA-96-071 - Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines

2. FHWA SA-96-072 - Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes

E. American Association for Laboratory Accreditation (A2LA)

F. Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP).

1.5 Definitions

A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

1.6 Submittals

A. Submit the following

1. Certification: The CONTRACTOR shall provide to the ENGINEER a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geosynthetic. The Certification shall state that the furnished geosynthetic meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer.

1.7 Quality Assurance

A. Manufacturer Qualifications

1. Geosynthetic Accreditation Institute (GAI)- Laboratory Accreditation Program (LAP)

2. American Association for Laboratory Accreditation (A2LA)

1.8 Delivery, Storage, And Handling

A. Geosynthetic labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

B. Each geosynthetic roll shall be wrapped with a material that will protect the geosynthetic from damage due to shipment, water, sunlight, and contaminants.

C. During storage, geosynthetic rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geosynthetic.

2.0 PART II – PRODUCTS

2.1 Manufacturers

A. TenCate Geosynthetics
365 South Holland Drive
Pendergrass, GA, USA 30567
Miragrid 7XT or approved equal

2.2 Materials

A. Reinforcement Geosynthetics:

1. The geosynthetic shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

2. The geosynthetic shall meet the requirements of Table 1. All numeric values in Table 1 represent MARV in the principal reinforcement direction.

Table 1 - Reinforcement Geogrids

Property	Unit	Minimum Average Roll Value (MARV)
Long-Term Design Strength	lb/ft	3,100

2.3 Quality Control

A. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP and A2LA for tests required for the geosynthetic, at frequency meeting or exceeding ASTM D 4354.

B. Ultraviolet Stability shall be verified by an independent laboratory on the geosynthetic or a geosynthetic of similar construction and yarn type.

3.0 PART III – EXECUTION

3.1 Preparation

A. Foundation soil shall be excavated to the line and grades as shown on the construction drawings or as directed by the ENGINEER. Over-excavated areas shall be filled with compacted backfill material as per project specifications or as directed by the ENGINEER. As a minimum, foundation soil shall be proof rolled prior to backfill and geosynthetic placement.

3.2 Installation

A. Geosynthetic shall be laid at the proper elevation and orientation as shown on the construction drawings or as directed by the ENGINEER. Correct orientation of the geosynthetic shall be verified by CONTRACTOR.

B. Geosynthetic may be temporarily secured in-place with sand bags or backfill as required by fill properties, fill placement procedure or weather condition, or as directed by the ENGINEER.

C. Primary geosynthetic may not be overlapped or connected mechanically to form splices in the primary strength direction. Single panel lengths are required in the primary strength direction. No overlapping is required between adjacent rolls unless specified by the ENGINEER.

D. Backfill material shall be placed in lifts and compacted as directed under project specifications. Backfill shall be placed, spread and compacted in such a manner as to minimize the development of wrinkles in and/or movement of the geosynthetic. A minimum fill thickness of 150 mm (6 in) is required prior to the operation of tracked vehicles over the geosynthetic.

E. Turning of tracked vehicles should be kept to minimum to prevent tracks from displacing the fill and damaging the geosynthetic. Rubber tired equipment may pass over the geosynthetic reinforcement at low speeds, less than 16 km/hr (10 mph). Sudden braking and sharp turns shall be avoided. Any geosynthetic damaged during installation shall be replaced by the CONTRACTOR at no additional cost to the Owner.

END OF SECTION

DIVISION 15
MECHANICAL

SECTION 15050
PIPE AND FITTINGS

1.0 PART I – GENERAL

1.1 General

A. Scope: The CONTRACTOR shall furnish and install pipe, fittings and related items, complete as specified herein and as indicated on the DRAWINGS. Special pipe, fittings or installation requirements may be specified with the particular equipment involved.

B. DRAWINGS: The DRAWINGS indicated the general arrangement of pipe, fixtures, etc. It is desired that the indicated positions be followed as closely as possible. The exact location of the various items is subject to building construction and the actual equipment furnished by the CONTRACTOR. The CONTRACTOR shall verify the location of all items furnished, installed or connected by him.

2.0 PART II - PRODUCTS

2.1 Pipe Materials

A. General: All pipe and fittings shall be of the type and size indicated on the DRAWINGS. There are two pipe sizes utilized for this project, 4” and 6” SDR 17 HDPE pipe.

B. HDPE Pipe:

1. High Density Polyethylene solid wall pipe shall be Chevron Plexco PE3408 pipe, meeting classification 345434C/E of ASTMD3350 and ASTMD1248, Type III, class B or C, category 5, Grade P34. Fittings shall have heat fusion joining of pipe, sheet stock, or molded fittings with a service rating at least equal to the mating pipe or H20 loading, whichever is greater.

2. Bolts and nuts used at buried joints shall be of materials suitable to resist corrosion by outside media, and electrolytically compatible with the flange unit to which the HDPE pipe may be connected, or alternatively, the nuts and bolts shall be insulated from the same.

3. HDPE pipe connected to heavy fittings, valves, and rigid structures shall be supported in such a manner that no subsequent relative movement between the HDPE pipe at the flanged joint and rigid structure is possible.

2.2 Joints

A. Flange Adapters: Flange adapters shall be Smith Blair Style 912 or Peerless Style 127 to join plain end ductile iron pipe to flanged fittings. The flange adapter shall consist of a flange with a shoulder to fit over the plain end of ductile iron pipe and set screws located around the shoulder to lock the flange on the pipe. The face of the flange shall have a seal groove to accept a standard mechanical joint gasket. The adapter flange shall be ductile iron ASTM A536 grade 65-45-12. Flange shall conform to ANSI B16.5 300 pound drilling. Gasket shall be SBR BUNA-S. Set screws shall be heat treated AISI 4140 steel with double break away heads that shear at the torque limit of the set screw.

2.3 Perforations

A. Perforated pipes shall have ¼” perforations located every 6” along pipeline at 0º, 90º, 180º and 270º. Pipes shall be wrapped in minimum 4oz geotextile fabric to prevent fines from clogging pipe.

END OF SECTION

CONSTRUCTION QUALITY ASSURANCE PLAN

for the

AZURITE MINE REMOVAL ACTION

April 2011

CONSTRUCTION QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

LIST OF APPENDICES

CQA SECTION 01000
INTRODUCTION

PART 1 GENERAL

1.01 PROJECT DESCRIPTION

A. The Azurite Mine is located in the Mt. Baker-Snoqualmie National Forest in Whatcom County, Washington approximately 19 air-miles northwest of Mazama, WA.

B. This Construction Quality Assurance (CQA) Manual applies to the construction of the Removal Action described in the Azurite Mine Removal Action Work Plan dated January 2011. The construction is approximately 10 acres in area and includes the following construction features:

1. Excavate wasterock piles from west side of Mill Creek
2. Transport wasterock to the tailings repository
3. Build impermeable cover for wasterock pile and tailings
4. Provide temporary and long term drainage improvements
5. Remove site structures
6. Install bat gates/culvert closures
7. Post signage

C. A detailed scope of construction for each unit of construction is presented in Section 01010 of this CQA Manual.

1.02 PURPOSE

A. The purpose of this CQA Manual is to provide a detailed guidance document for correct and thorough CQA verification procedures implemented during construction. This CQA Manual is also intended to identify, prevent and correct problems and deficiencies that may occur during construction. This manual details general and specific requirements of the CQA program that will be implemented during construction to verify and document that construction is in compliance with the contract documents and the design intent. Requirements of the CQA program include the following:

1. Product quality assurance verification testing to verify that all materials are in compliance with the technical specifications.

2. Construction monitoring and documentation to verify that each unit of construction is in compliance with the technical specifications and that construction was executed correctly using industry-standard construction methods and the proper materials

3. Review and approval of product submittals to verify that construction materials are in compliance with the technical specifications.

4. Testing to verify that installed or constructed units are in compliance with the technical specifications.

5. CQA documentation consisting of daily summary reports, CQA field logs, testing forms, installation logs, document control binders, material control logs, testing reports, photographic documentation, technical revisions, design modifications, record as-built drawings and corrective action determination and verification reports.

6. Preparation of the final certification report that documents the CQA program implemented during construction and that construction was completed in compliance with the contract documents and the design intent. The final certification report will be submitted to the United States Forest Service (USFS).

B. Although this manual provides a foundation for the CQA program, this manual may be modified and revised as appropriate prior to and during construction. All modifications and revisions to the CQA program will be documented in the final certification report.

1.03 PROJECT ORGANIZATION

A. The USFS is the owner and has ultimate responsibility for the project, including overall project management and project funding. For purposes of this CQA Manual, USFS will be referred to as “Owner”. The Owner has contracted with the following organizations to complete construction in accordance with the project documents listed in Section 01090-1.02.

1. Cascade Earth Sciences (CES) - Engineer and CQA Certifying Engineer.

2. Construction Contractor including: - To Be Determined

   - Geosynthetics Installation Subcontractor

   - Geosynthetics Supplier

B. CES is the Engineer and CQA Certifying Engineer for the project. As the Engineer, CES is responsible for the design and site engineering related to the design. Site engineering includes: 1) review and approval of product and construction submittals required by the contract documents; 2) technical issues related to construction; 3) interpretation of the technical specifications and the construction drawings; and 4) design modifications and technical revisions.

As the CQA Certifying Engineer, CES is responsible for certifying to the Owner that construction is in compliance with the contract documents and the design intent. Specific responsibilities of the CQA Certifying Engineer include: 1) providing a professional engineer registered in the State of Washington; 2) implementing and managing the CQA program outlined in Part 1.02 of this Section; 3) review of all CQA documentation; and 4) preparation of the final certification report. CES will provide an on-site CQA Team to implement and manage the CQA program consisting of a CQA Officer, CQA Monitors, a CQA Surveyor, and Soils and Geosynthetics CQA Testing Laboratories.

C. The Construction Contractor is responsible for overall performance of the earthwork, including construction of drainage and erosion control measures including best management practices for storm water pollution prevention, in accordance with the contract documents and as shown on the construction drawings. For purposes of this CQA Manual, the Construction Contractor will be referred to as “Contractor”.

D. The Geosynthetics Installation Subcontractor is responsible for overall performance of geosynthetic installations in accordance with the contract documents and as shown on the construction drawings. For purposes of this CQA Manual, the Geosynthetics installation Contractor will be referred to as “Installer”.

1.04 CQA MANUAL FORMAT

A. This CQA Manual closely parallels the format of the technical specifications in the contract documents. The intent of this parallel format is to avoid discrepancies between the two documents, therefore preventing misinterpretations and misunderstandings between the Owner, Contractor, Installer, and Engineer. This format also organizes all necessary quality assurance verification procedures for each unit of construction into a single section.

B. Division I of this manual presents general information about the construction project and the CQA program.

C. Sections 02210 through 02776 of this manual provide detailed and specific CQA procedures to be implemented by the Engineer for each unit of construction. Sections 02210 through 02776 are written instruction and direction for members of the CQA team.

END OF CQA SECTION 01000
INTRODUCTION

CQA SECTION 01010
SCOPE OF CONSTRUCTION

PART I GENERAL

1.0 SECTION SUMMARY

A. Work to be performed by the Owner

B. Contractor's scope of work

C. Installer's scope of work

D. Other Subcontractor's scope of work

1.02 WORK TO BE PERFORMED BY THE OWNER

A. The Owner will provide three reference control points with benchmark elevations in the vicinity of the project. All other necessary control or reference points needed to perform construction will be established by the Contractor.

B. The Owner will provide a topographic survey of waste rock piles and repository area prior to construction. A final topographic survey will be the basis to determine quantity of material moved to the repository.

C. The Owner will provide the following construction materials:

1. Talus for cover
2. Water Supply
3. Seed for revegetation

1.03 CONTRACTOR'S SCOPE OF WORK

A. The Contractor's scope of work includes the following:

1. Improve access road from the north end of the tailings pile south for the site
2. Post signage
3. Remove site structures marked for removal
4. Provide temporary and long term drainage improvements
5. Excavate wasterock piles from west side of Mill Creek and transport to tailings pile
6. Build repository over the tailings pile
7. Build impermeable cover for repository
8. Revegetate disturbed areas
9. Install bat gates

1.04 INSTALLER’S SCOPE OF WORK

A. The Installer’s scope of work includes the following:

1. Mobilization of construction equipment and personnel
2. Installation of impervious liner system
3. Installation of reinforcement geotextile
4. Installation of geotextile filter

END OF CQA SECTION 01010
SCOPE OF CONSTRUCTION

CQA SECTION 01039
PROJECT MEETINGS

PART I GENERAL

1.01 SECTION SUMMARY

A. Communication and coordination between the Owner, Engineer, Contractor, Installer, and CQA Team are most important to achieve the common goals of quality construction and successful completion of the project.

B. A series of project meetings will be held for the purpose of establishing a successful environment of communications, coordination, and overall teamwork; the meetings will be administered by the Engineer or CQA Officer to: 1) clearly define responsibility and authority of each organization involved in the project; 2) resolve communication problems, misunderstandings, and misinterpretations; 3) find solutions to unanticipated developments; and 4) identify, prevent and correct problems and deficiencies that may occur during the construction process.

C. Project meetings include the following.

1. A Preconstruction Meeting
2. Progress Meetings
3. Preparatory Meetings

1.02 PRECONSTRUCTION MEETING

A. A preconstruction meeting will be held to discuss topics relating to the commencement of the project.

B. The objectives of this meeting are to: 1) clearly define the roles, responsibility, and authority of each organization and individual involved in the project; 2) review specific requirements of the CQA program; and 3) establish a foundation of cooperation to achieve quality construction. The following agenda, as related to construction quality assurance, will be addressed by the Engineer:

1. Introduce and discuss role, authority, and responsibilities of each organization and individual involved in the project
2. Establish lines of communication
3. Review Plans and Specifications
4. Distribution of the CQA Plan
5. Review of CQA activities to be performed
6. Discuss Contractor's construction schedule and workplan
7. Discuss Contractor's Construction Quality Control (CQC) procedures and responsibilities
8. Discuss submittal review and approval procedures

9. Discuss non-conformance and corrective action procedures
10. Discuss construction restrictions due to weather conditions
11. Discuss and schedule weekly progress meetings
12. Discuss preparatory meetings

C. A Meeting/Discussion Summary Report (See Section 01400-1.08) will be completed by the CQA Officer and distributed to all parties in attendance.

D. The following representatives from each organization are required to attend the preconstruction meeting:

1. Owner or representative
2. Contractor’s Project Manager and on-site Superintendent
3. Installer’s Project Manager and on-site Superintendent
4. Engineer’s Project Manager
5. CQA Officer
6. Regulatory Agency Representative(s) (optional)

1.03 PROGRESS MEETINGS

A. In coordination with the Engineer, the CQA Officer will schedule and administer weekly progress meetings. The objectives of these meetings are to: 1) maintain lines of communication; 2) review work progress and CQA activities performed previously: 3) discuss upcoming construction and related CQA activities: and 4) maintain and improve the established foundation of cooperation to achieve quality construction. The following agenda will be addressed by the CQA Officer:

1. Review minutes of previous progress meeting
2. Review work progress
3. Review and update construction schedule and obtain a two-week look-ahead schedule from the Contractor
4. Discuss CQA and CQC related field observations, testing results, problems, decisions, and conflicts
5. Review and update Submittal log

B. A Meeting/Discussion Summary Report (See Section 01400-1.08) will be completed by the CQA Officer and distributed to all parties in attendance.

C. The following representatives from each organization are required to attend the weekly progress meetings:

1. Owner or representative
2. Contractor’s on-site Superintendent

3. Installer's on-site Superintendent (during geosynthetic installation)
4. Engineer's Project Manager or representative
5. CQA Officer

1.04 PREPARATORY MEETINGS

A. In coordination with the Engineer, the CQA Officer will schedule and administer informal preparatory meetings prior to beginning construction of the following items:

1. Mass excavation and subgrade preparation
2. Engineered fill placement
3. Impervious Liner installation
4. Protective soil placement
5. General earthwork and drainage and erosion control construction, as needed.

B. The objective of these preparatory meetings is to establish a complete understanding of the upcoming unit of construction and CQA activities that will be implemented during construction. To achieve this objective, the following agenda will be addressed by the CQA Officer:

1. Review "Products" or "Materials" part of the applicable section of the Specifications
2. Review "Execution" part of the applicable section of the Specifications
3. Discuss any construction and grade control staking needed to perform and complete the work
4. Discuss CQA testing, observation, and surveying to be performed
5. Verify that all submittals have been, or will be, received by the CQA Officer and approved by the Engineer in accordance with the schedule
6. Discuss Contractor's CQC responsibilities
7. Discuss Contractor's coordination, scheduling, and sequencing of the work
8. Discuss Contractor's proposed equipment and manpower

C. A Meeting/Discussion Summary Report (See Section 01400-1.08) will be completed by the CQA Officer and distributed to all parties in attendance.

D. The following representatives from each organization are required to attend the preparatory meetings:

1. Contractor's on-site Superintendent
2. On-site Superintendent of Installer or other subcontractor(s), as applicable to the unit of construction
3. CQA Officer
4. CQA Monitor(s), as applicable to the unit of construction

END OF CQA SECTION 01039
PROJECT MEETINGS

CQA SECTION 01090
REFERENCES

PART 1 GENERAL

1.01 SECTION SUMMARY

A. Project Reference Documents

B. Industry Standards and Technical Reference Documents

C. Soils Testing Standards and Methods

D. Geosynthetics Testing Standards and Methods

E. Acronyms

F. Contact Addresses and Telephone Numbers

1.02 PROJECT REFERENCE DOCUMENTS

A. The following project reference documents provide support and background information for use in conjunction with this CQA Plan.

1. *Removal Action Work Plan & Design Drawings.* CES January 2011, referred to in this CQA Plan as: Plans.
2. *Technical Specifications, Azurite Mine,* CES January 2011, referred to in this CQA Plan as: Specifications.

1.03 INDUSTRY STANDARDS AND TECHNICAL REFERENCE DOCUMENTS

A. The following industry standards and technical reference documents were used in the preparation of this CQA Plan.

As listed in Specifications

1.04 SOILS TESTING STANDARDS AND METHODS

A. The following standard soils testing methods and procedures apply as referenced in the technical specifications and this CQA Plan.

1.	ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
2.	ASTM D 422	Standard Test Method for Particle-Size Analysis of Soils
3.	ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
4.	ASTM D 1140	Standard Test Method for Amount of Material in Soils Finer Than the No. 200 (75-µm) Sieve
5.	ASTM D 1587	Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soils

6.	ASTM D 2216	Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures
7.	ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
8.	ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
9.	ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual - Manual Procedure)
10.	ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
11.	ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
12.	ASTM D 3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
13.	ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
14.	ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

1.05 GEOSNYTHETICS TESTING STANDARDS AND METHODS

A. The following standard geosynthetics testing methods and procedures apply as referenced in the technical specifications and this CQA Plan.

1.	ASTM D 638	Standard Test Method for Tensile Properties of Plastics
2.	ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
3.	ASTM D 792	Standard Test Method for Specific Gravity and Density of Plastics by Displacement
4.	ASTM D 1004	Test Method for Initial Tear Resistance of Plastic Film and Sheeting
5.	ASTM D 1204	Standard Test Method for Linear Dimensional Changes to Nonrigid Thermoplastic Sheeting or Film at Elevated Temperatures
6.	ASTM D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
7.	ASTM D 1603	Test Method for Carbon Black in Olefin Plastics
8.	ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
9.	ASTM D 2412	Determination of External Loading Characteristics of Plastic Pipe by Parallel-plate Loading

10.	ASTM D 3350	Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
11.	ASTM D 5261	Test Methods for Mass Per Unit Area (weight) of Woven Fabrics
12.	ASTM D 3895	Standard Test Method for Copper Induced Oxidative Induction Time of Polyolefins by Thermal Analysis
13.	ASTM D 4355	Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water
14.	ASTM D 6392	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
15.	ASTM D 4491	Test Methods for Water Permeability of Geotextiles by Permitivity
16.	ASTM D 4533	Test Method for Trapezoid Tearing Strength of Geotextiles
17.	ASTM D 4632	Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
18.	ASTM D 4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
19.	ASTM D 4751	Test Method for Determining the Apparent Opening Size of a Geotextile
20.	ASTM D 4833	Standard Test Method for index Puncture of Geotextiles. Geomembranes, and Related Products
21.	ASTM D 5035	Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
22.	ASTM D 5994	Standard Test Method for Measuring Nominal Thickness Geotextiles and Geomembranes
23.	ASTM D 5321/6345	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic Friction by the Direct Shear Method
24.	ASTM D 5397	Standard Test Method for Notched Constant Tensile Load Test of Geomembrane
25.	ASTM D 5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
26.	ASTM D 5617	Standard Test Method for Multi-Axial Tension Test for Geosynthetics
27.	ASTM D 5890	Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
28.	ASTM D 5993	Standard Test Method for Measuring the Mass per Unit Area of Geosynthetic Clay Liners
29.	ASTM E 946	Standard Test Method for Water Absorption of Bentonite by the Porous Plate Method

30.	ASTM F 904	Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials
31.	FTMS 101C	Puncture Resistance
32.	ASTM D 5887	Standard Test Method for “Permeability of Geosynthetic Clay Liners (GCLs)”
33.	GRI GCL-3	Standard Test Method for ‘GCL Overlap Seam Permeability”

1.06 ACRONYMS

A. Whenever the following acronyms are referenced in the Specifications or this CQA Plan, the following meanings apply.

1.	ACI	American Concrete Institute
2.	APWA	American Public Works Association
3.	ASTM	American Society for Testing and Materials
4.	CFR	Code of Federal Regulations
5.	CMP	Corrugated Metal Pipe
6.	CQA	Construction Quality Assurance
7.	CQC	Construction Quality Control
8.	EBA	EBA Engineering
9.	EPA	United States Environmental Protection Agency
10.	FTB	Film Tear Bond
11.	FTMS	Federal Test Method Standard
12.	CCL	Geosynthetic Clay Liner
13.	GML	Geomembrane Liner
14.	GRI	Geosynthetics Research Institute
15.	HDPE	High Density Polyethylene
16.	IDEQ	Idaho Department of Environmental Quality
17.	LCS	Leachate Collection System
18.	MQA	Manufacturing Quality Assurance
19.	MQC	Manufacturing Quality Control
20.	MSHA	Mine Safety and Health Administration
21.	MSL	Mean Sea Level
22.	NFTB	Non-Film Tear Bond
23.	SDR	Standard Dimension Ratio
24.	WWF	Welded Wire Fabric

1.07 CONTACT ADDRESSES AND TELEPHONE NUMBERS

A. The following are addresses, telephone numbers, and fax numbers for individual contacts at each organization involved in the project.

United States Department of Agriculture, Forest Service
Okanogan-Wenatchee National Forest
1240 South Second Avenue
Okanogan, WA 98840
Contact Name: Mr. Rod Lentz
Telephone: (509) 826-3274

CES
P.O. Box 6807
Boise, ID 83707
Contact Name: Jay E. Williams, .P.E.
Telephone: (208) 388-1030

END OF CQA SECTION 01090
REFERENCES

CQA SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.0l SECTION SUMMARY

A. Submittal Control Log

B. Submittal review and approval procedures

1.02 SUBMITTAL CONTROL LOG

A. The Submittal Control Log, Appendix A, lists all submittals required by the technical specifications. The Submittal Control Log will be maintained by the CQA Officer in coordination with the Contractor and Installer during construction. The Submittal Control Log documents: 1) submittal number; 2) referenced specification section; 3) submittal description; 4) submitter; 5) date received; 6) reviewer; 7) action taken determination; and 8) return date.

1.03 SUBMITTAL REVIEW AND APPROVAL PROCEDURES

A. Three copies of each submittal listed in the Submittal Control Log will he submitted to the CQA Officer by the Contractor or Installer in accordance with the technical specifications. The submittals will be forwarded by the CQA Officer to the Owner and Engineer for review and approval. The Engineer may perform a preliminary review of submittals for compliance with the technical specifications and issue a verbal *Approval for Use* to the CQA Officer who, in turn, will notify the Contractor or Installer that no corrective action determinations were required prior to issuing a verbal *Approval for Use*. All submittals which are not in compliance with the technical specifications must be immediately forwarded to the Engineer for review and corrective action determinations.

B. At the completion of the review process, the Owner or Engineer will return two copies of each submittal to the CQA Officer with *Action Taken* determinations stamped on both copies of the submittal. The *Action Taken* determinations and the return dates wil1 be recorded on the Submittal Control Log. One copy of the reviewed submittal will be returned to the Contractor or Installer and the other copy will he archived by the CQA Officer in the submittal documentation control binder.

C. The Submittal Control Log will be reviewed and updated in coordination with the Contractor and Installer at the weekly progress meetings.

END OF CQA SECTION 01300
SUBMITTALS

CQA SECTION 01400
DOCUMENTATION

PART I GENERAL

1.01 SECTION SUMMARY

1.02 DAILY SUMMARY REPORT

A. A summary report will be prepared daily by the CQA Officer. This report will organize and summarize all construction and CQA activities (monitoring and testing) completed during each day. The Daily Summary Report will contain or reference the following information:

1. Title block containing: 1) project name; 2) project number; 3) project location; 4) name of Owner; 5) name of Contractor; 6) date and day; 7) Document Control Number (See Part 1.10); and 8) weather conditions.
2. Summary of construction activities for each unit of construction including equipment, personnel, and subcontractors utilized for each unit of construction and identification of the general area(s) where construction took place.
3. General summary of CQA activities (monitoring and testing) completed for each unit of construction with reference to attached Daily Field Logs (See Part 1.03) which describe construction monitoring, construction testing results, and quality control procedures and test results.
4. General description of any non-conformance with the Plans or Specifications and the corrective action measures taken with reference to attached Non-conformance/Corrective Action Forms (See Part 1.06) which contain a more detailed description of the non-conformance issue and its corrective action.
5. List of any materials received and status of submittal(s).

6. List of project meetings or pertinent discussions with reference to attached. Meeting/Discussion Summary Report (See Part 1.08).
7. Other miscellaneous information
8. Signature of CQA Officer

B. A sample Daily Summary Report is included in Appendix B, Project Documentation Forms.

1.03 DAILY FIELD LOG (INSPECTION DATA SHEET)

A. Each CQA Monitor will maintain an individual Daily Field Log (or Inspection Data Sheet) which will be assigned a cross-referencing Document Control Number (See Part 1.10) and contain daily entries of the CQA Monitor.

B. On the Daily Field Log, the CQA Monitors will provide a written account of construction activities, construction monitoring, construction testing, and quality control procedures performed during the day for the monitored Construction Unit(s), as well as any observations (i.e., notes, charts, sketches, or photograph reference).

C. Construction monitoring forms (See Part 1.04) and laboratory testing forms (See Part 1.05) will be attached to, or referenced in, the Daily Field Log.

1.04 CONSTRUCTION MONITORING FORMS

A. Construction activities, construction monitoring, and construction testing will be recorded on appropriate Construction Monitoring Forms. The following Construction Monitoring Forms, or similar forms, will be issued by the CQA Officer for this project and are presented in the following appendices:

Appendix C - Soils Monitoring Forms
Master Testing Control Log – Soils
Soils Test Request - Sample Custody Log
Nuclear Density/Moisture Test Data

Appendix D- Geosynthetics Monitoring Forms
Master Testing Control Log - Geosynthetics
Geosynthetics Delivery and Control Logs
Geosynthetic Tests Request - Sample Custody Log
GML Deployment/Welding Log
GCL Deployment/Seaming Log
GML/GCL Repair Log

B. Completed Construction Monitoring Forms will be submitted by the CQA Monitor to the CQA Officer for review with Daily Field Logs, or at the completion of testing, and will be addressed by the CQA Officer in the Daily Summary Reports.

1.05 LABORATORY TESTING REPORTS

A. Laboratory testing reports will be issued by the Soils and Geosynthetics CQA Testing Laboratories for conformance and construction testing. Laboratory testing reports will be issued for the following testing during the project.

1. Sieve analysis, Atterberg limits, Unified Soil Classification, and Moisture-Density relationship testing for engineered fill material

2. Sieve analysis and permeability for LCS and LDS gravel
3. Conformance testing for geotextiles
4. Conformance testing and seam strength testing for GML
5. Conformance testing for geonet composite
6. Conformance testing for GCL

B. Laboratory testing reports will be addressed by the CQA Officer in the Daily Summary Report on the date of receipt.

1.06 NON-CONFORMANCE/CORRECTIVE ACTION FORM

A. A Non-Conformance/Corrective Action Form will be issued by the Engineer to the CQA Officer who will notify the Contractor or Installer of construction or materials not in compliance with the Plans or Specifications, or for defective workmanship or materials even if in compliance with the Plans and Specifications. The Non-Conformance/Corrective Action Form will contain or reference the following information:

1. Title block containing: 1) project name; 2) project number; 3 project location; 4) name of Owner; 5) name of Contractor; 6) date and day: and 7) Document Control Number (See Part 1.10)
2. Description of the non-conformance issue, construction unit, and location
3. Reference to specification(s) or drawing(s) for which materials or construction are not in compliance
4. Description of Corrective Action measures necessary to fully correct the area of nonconformance with the Plans or Specifications as determined by the Engineer.
5. Specification variance or revisions to the As-built Record Drawings (See Part 1.11) required
6. If necessary, any Daily Field Log, Construction Monitoring Forms, laboratory testing report(s), Meeting/Discussion Summary Report, or Photograph Log pertaining to the non-conformance issue will be referenced by Document Control or Photograph Number to fully substantiate the non-conformance issue and corrective action determination.
7. Signature of the CQA Officer verifying that corrective measures determined by Engineer have been taken by the Contractor or Installer

B. A sample Non-conformance/Corrective Action Form is included in Appendix B, Project Documentation Forms.

1.07 ACCEPTANCE REPORT

A. An Acceptance Report will be prepared for each Construction Unit to verify that all materials and construction are in compliance with the Plans and Specifications. The Acceptance Report will reference all relevant Daily Summary Reports, Daily Field Logs (Inspection Data Sheets), and Non-Conformance/Corrective Action Forms by the Document Control Number.

B. A sample Acceptance Report is included in Appendix B, Project Documentation Forms.

1.08 MEETING/DISCUSSION SUMMARY REPORT

A. A Meeting/Discussion Summary Report will be prepared for each scheduled Project Meeting (See Section 01039) and any pertinent discussion between the Contractor and CQA personnel. The Meeting/Discussion Summary Report will contain the following information:

1. Title block containing: 1) project name; 2) project number; 3) project location; 4) name of Owner; 5) name of Contractor; 6) date and time; 7) meeting location; and 8) Document Control Number (See Part 1.10).
2. Meeting name or general discussion subject matter
3. List of meeting attendees or discussion participants
4. Minutes of scheduled Project Meetings or synopsis of discussion
5. List of any items needing resolution resulting from the meeting or discussion
6. Signature of CQA Officer

B. A sample Meeting/Discussion Summary Report is included in Appendix B, Project Documentation Forms.

1.09 PHOTOGRAPH LOG

A. All construction activities will be continually photographed to clearly show and define construction methods and as-built conditions of completed units of construction. Photographs will include: 1) product or material sources; 2) construction methods in progress for each unit of construction; 3) completed units of construction; 4) damaged, rejected, or substandard materials and construction; 5) corrective action measures to rectify damaged, rejected, or substandard construction; 6) completed units of construction after completion of corrective action measures; and 7) design modifications. Photographs will be identified by number, date, and time of the photograph. The CQA Officer will maintain a cross-referencing photography log documenting the subject matter of each photograph.

B. A sample Photograph Log is included in Appendix B, Project Documentation Forms.

1.10 DOCUMENT CONTROL

A. A unique Document Control Number will be assigned to all CQA documents generated during construction and implementation of this CQA Plan.

B. The Document Control Number will organize and index all CQA documentation for cross-referencing, to allow easy access to all documents, and to enable a reviewer to identify and retrieve original CQA documentation for any completed unit of construction.

C. Complete documentation of all CQA activities will be controlled and secured in a series of three-ring binders maintained at the site by the CQA Officer with a duplicate copy maintained at the offices of the Engineer, at the option of the Engineer. This documentation control structure organizes and indexes all CQA documents and is intended to allow easy access to all documents for review and audit by the Owner, Engineer, or regulatory agencies.

The following is a preliminary list and contents of the *CQA Documentation Binders* to be established and maintained by the CQA Officer.

1. Title: *Daily Summary Reports and Field Logs*
   Color code (optional): Blue
   Contents: Daily Summary Reports prepared by the CQA Officer and Daily Field Logs completed by the CQA Monitors
2. Title: *Project Administration Documentation.*
   Color code (optional): Red
   Contents: Non-conformance/Corrective Action Forms, Acceptance Reports, Meeting/Discussion Summary Reports, Owner correspondence, Engineer correspondence, Installer and Contractor correspondence, and miscellaneous correspondence
3. Title: *Contractor Daily Field Reports*
   Color code (optional): Green
   Contents: Any daily field reports prepared by the Contractor (or Installer)
4. Title: *Submittals*
   Color code (optional): Purple
   Contents: Updated Submittal Control Log, submittal transmittal cover sheets, and all reviewed and approved (or other status) submittals
5. Title: *Soils CQA*
   Color code (optional): White
   Contents: Construction Monitoring Forms and laboratory testing reports for soils
6. Title: Geosynthetics CQA
   Color code (optional) Orange
   Contents Construction Monitoring Forms and laboratory testing reports for geosynthetics
7. Title: *CQA Plan*
   Color code (optional) Teal
   Contents CQA Plan
8. Title: *Photography Log*
   Color code (optional) Yellow
   Contents Construction and CQA photographs and cross-referencing Photograph Logs

1.11 AS-BUILT RECORD DRAWINGS

A. As-built Record Drawings will be maintained by the CQA Officer and will be reviewed and verified by the Engineer.

B. The As-built Record Drawings will show actual as-built conditions of construction and will adequately reflect that construction is in substantial compliance with the design intent of the Plans and Specifications; irrelevant deviations in actual construction that do not substantially affect the design intent will not be incorporated into the As-built Record Drawings but will be addressed in the Certification Report (See Part 1.12).

C. As-built Record Drawings will be prepared during the construction process by making modifications as they occur to a single set of construction drawings designated as the *Site As-built Record Drawings;* at the completion of construction the CQA Officer will incorporate all as-built conditions into the *Final As-built Record Drawings.*

D. The final As-built Record Drawings will contain revision numbers, dates, and reviewer initials; and will be signed and stamped by the CQA Certifying Engineer.

E. The CQA Surveyor will perform as-built verification surveys and provide record data for the following units of construction which will be incorporated into the final As-built Record Drawings as appropriate:

1. Prepared subgrade and engineered fill limits, lines, and grades (As-built Plan to be prepared by the Contractor)
2. Limits of geosynthetics
3. Limits, flowlines, thickness, and grades of drainage and erosion control measures

1.12 CERTIFICATION REPORT

A. At the completion of the project, the CQA Certifying Engineer will prepare a Certification Report and submit it to the Engineer. The Certification Report will consist of information and data generated by the CQA program and will document that landfill construction is in compliance with the design intent of the Plans and Specifications. At a minimum, the Certification Report will contain the following information.

1. Summary of construction methods for each unit of construction completed
2. Summary of the CQA program implemented during construction and specific CQA activities (monitoring and testing) performed for each unit of construction completed
3. Results of conformance testing and construction testing
4. Revisions made to Plans and variances from Specifications allowed
5. Final As-built Record Drawings
6. Statement of compliance with the design intent of the Plans and Specifications, signed and stamped by the CQA Certifying Engineer, a professional engineer or certified engineering geologist registered in the State of Washington.

1.13 DOCUMENTATION ARCHIVE STORAGE

A. At the completion of the project and after submittal of the Certification Report and As-built Record Drawings to the Engineer, all original documentation generated by construction and the CQA program will be archived at the on-site office of the Owner with duplicate copies stored at the offices of the Engineer and CQA Certifying Engineer.

END OF CQA SECTION 01400
DOCUMENTATION

CQA SECTION 02220
GENERAL EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. The CQA Officer shall perform CQA procedures as outlined in this Section and follow guidelines for monitoring and testing to verify and document that all general earthwork, including minor excavations for anchor trenches, drainage and erosion control structures, stabilized slopes; roadway berms and fills, backfill of anchor trenches and runouts shown on the Drawings are in compliance with the Specifications.

1.02 SUBMITTALS

A. Collect three copies of each submittal required in the Specifications

B. Verify compliance with the submittal schedule and update Submittal Log

C. Perform submittal review and approval procedures in Section 01300-1.03

PART 2 MATERIALS

2.01 ANCHOR TRENCH AND RUN OUT BACKFILL

A. Verify that anchor trench backfill material meets the requirements shown on the Drawings.

B. Verify that anchor-trench and runout backfill meets the requirements in the section of the Specifications applicable to that type of material shown on the Drawings.

2.02 CONFORMANCE TESTING

A. Prior to the beginning of construction for any portion of the general earthwork, perform, sample materials and send the samples to the Soils Testing Laboratory for, or verify that the Contractor has performed all tests required in the sections of the Standard Specifications referenced in the Specifications showing compliance with the material requirements in the Specifications.

PART 3 EXECUTION

3.01 GENERAL

A. If any portion of the general earthwork does not meet the requirements of the Specifications, based on either testing or observations, verify that the Contractor reworks or removes and replaces that portion to meet the requirements of the Specifications.

B. After construction of any portion of general earthwork is completed, perform the following:

1. Verify all grades and dimensions of completed general earthwork by either field survey or physical measurement.
2. If it is demonstrated by the CQA verification surveying that any portion of the general earthwork does not meet the required grades or dimensions shown on the Plans, verify that the Contractor reworks or removes and replaces that portion to

bring the deficient area to grade or the proper dimension in accordance with the Plans and all requirements of the Specifications.

3.02 PREPARATION

A. Prior to beginning construction of any portion of general earthwork, hold a preparatory meeting in accordance with Section 01039-1.04 of this CQA Plan.

3.03 EXCAVATION

A. Verify that excavation for anchor trenches, drainage and erosion control structures, and the containment berm keyway conforms to Drawings and Specifications.

B. Verify that the sides and bottom of excavated anchor trenches are relatively smooth and free of individual particles or protrusions greater than 0.75 inches in diameter, ruts or ridges greater in depth or height than 1.0 inches, organics, deleterious material, unsuitable matter, or other objects which could potentially damage the GCL or GML.

C. Verify that the leading edge of anchor trenches is rounded to avoid sharp bends when placing the GML.

D. Verify that where excavation is inadvertently carried below subgrade elevations, suitable provision is made by the Contractor for adjustment of same as determined by the Engineer to meet requirements incurred by the deeper excavation; also, verify that inadvertent over-excavation in such locations is rectified by backfilling with engineered fill and compacting to provide a firm and unyielding subgrade in accordance with the requirements of the Specifications.

E. Verify that the Contractor provides and maintains at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations.

F. Verify that the Contractor has located all underground utilities prior to performing any minor excavation for drainage and erosion control structures outside the limit of excavation shown on the Drawings.

3.04 BACKFILLING

A. Verify that anchor trench backfill material is placed in accordance with the requirements shown on the Drawings.

B. Verify that runout backfill is placed in accordance with the requirements in the section of the technical specifications for placement and compaction applicable to that type of material shown on the Drawing.

C. Verify that anchor trench backfill is compacted as shown on the Drawings.

D. Verify compaction requirements are met, where applicable.

END OF CQA SECTION 02220
GENERAL EARTHWORK

CQA SECTION 02222
MASS EXCAVATION

PART 1 GENERAL

1.01 SUMMARY

A. The CQA Officer shall perform CQA procedures as outlined in this Section and follow guidelines for monitoring and testing to verify and document that all mass excavation, including all clearing, grubbing, excavation, grading, and subgrade preparation, construction of any necessary haul roads, stockpiling of all excavated materials, and provision of temporary dust, erosion, and drainage control measures are as shown on Drawings and in compliance with the Specifications.

PART 2 MATERIALS (Not Used)

PART 3 EXECUTION

3.01 GENERAL

A. If any portion of the mass excavation does not meet the requirements of the Specifications, based on either testing or periodic observations, verify that the Contractor reworks or replaces that portion to meet the requirements of the Specifications.

B. After any portion of mass excavation is completed, perform the following:

1. Verify all grades and dimensions of completed areas of the mass excavation by field survey.
2. As mass excavation is completed to the final elevation shown on the Drawings, verify by survey that the excavation and the slope above is in conformance with the applicable requirements of the Specifications and report survey results to the Engineer.
3. Perform tests using an x-ray fluorescence (XRF) meter to confirm contaminated material has been removed to the satisfaction of the Owner.
4. If it is demonstrated by the CQA verification surveying that any portion of the mass excavation does not meet the required lines, grades, or dimensions shown on the Plans, verify that the Contractor reworks or replaces that portion to bring the deficient area to grade or the proper dimension in accordance with all requirements of the Specifications.

3.02 PREPARATION

A. Prior to beginning construction of any portion of mass excavation, hold a preparatory meeting in accordance with Section 0l039-1.04 of this CQA Plan.

3.03 CLEARING AND GRUBBING

A. Verify that the area above the natural ground surface within the limits of the excavation is cleared of all vegetation, such as trees, logs, upturned stumps and roots, brush, grass, weeds, or other deleterious material.

B. Verify that the area below the natural ground surface within the limits of the excavation is grubbed to a depth necessary to remove all stumps, roots, buried logs, and other deleterious material.

C. Verify that clearing and grubbing is performed prior to beginning excavation in any area.

D. Verify that cleared and grubbed debris are stockpiled separately from excavated material or disposed of in accordance with the Specifications.

3.04 EXCAVATION

A. Verify that boulders encountered by the Contractor during mass excavation, which cannot be picked up by a scraper are removed, separated by size as directed by the Engineer, and stockpiled in the location shown on the Drawings.

3.05 GRADING

A. Verify that the excavation is constructed in conformance with the lines, grades, and dimensions shown on the Drawings.

B. Verify that, when completed, the average plane of all excavated slopes conforms to those shown on the Drawings or directed by the Engineer.

C. Verify that unsuitable materials, as determined by the Engineer, encountered at the subgrade elevation are removed and stockpiled separately from excavated material or disposed in accordance with the Specifications. If, after removal of the unsuitable materials, a surface in accordance with this Section 02222-3.05 and the Specifications does not result, monitor and verify that overexcavation correction procedures in the Specifications are followed.

3.06 SUBGRADE PREPARATION

A. Verify that all completed excavated surfaces (subgrade) shown on the Drawings are free of deleterious material.

B. Verify that the subgrade surface corrective actions by the Contractor are in conformance with the method approved by the Engineer, the applicable Standard Specifications, and the special provisions in the Specifications.

3.07 SUBGRADE MATERIAL EVALUATION

A. In order to demonstrate that the engineered subgrade materials meet the gradation criteria a Subgrade Material Evaluation shall be performed prior to compaction, using the following test methods and test frequencies:

Property	**Test Method**	**Frequency**	**Specification for Passing**	**Number of Tests**
Moisture/Density	ASTM D 698	1/5,000 CY or change in material	For CQA program reference only	7
Construction Oversight	Visual Observation	Continuous	Maximum particle size 1/2 inch	N/A
Gradation	ASTM D 422	1/1,000 CY (1/acre/lift)	Well-graded. amenable to compaction	14

3.08 HAUL ROAD CONSTRUCTION

A. Verify that the location of all haul roads constructed and used by the Contractor are as approved by the Engineer.

3.09 STOCKPILING

A. Verify that the Contractor places all excavated materials in the appropriate stockpile areas designated in the Drawings and in accordance with all requirements in the Specifications.

3.10 EROSION CONTROL

A. Verify that erosion and sediment control measures are implemented by the Contractor in accordance with the approved Erosion and Sediment Control Plan, and as directed by the Owner for all mass excavation work areas including haul roads and stockpile areas; adjacent areas which have been disturbed; or other affected areas.

B. Verify that the Contractor maintains erosion and settlement control measures until the final graded surface (prepared subgrade) of the excavation is approved by the Engineer and the Owner, and until the surface is covered with geosynthetic liner materials. If erosion creates a final subgrade surface which is not in accordance with any requirements of the Specifications, verify that overexcavation correction procedures in the Specifications are performed by the Contractor.

3.11 DRAINAGE CONTROL

A. Verify that the Contractor provides ample means and devices with which to promptly remove and dispose of all water from any source entering the excavation or stockpile area(s) and maintains these at all times during mass excavation and until the final graded surface of the excavation and stockpile are approved by the Engineer and the Design Engineer.

END OF CQA SECTION 02222
MASS EXCAVATION

CQA SECTION 02224
ENGINEERED FILL

PART 1 GENERAL

1.01 SUMMARY

A. The CQA Officer shall perform CQA procedures as outlined in this Section and follow guidelines for monitoring and testing to verify and document that fill materials and construction methods are in compliance with the Specifications.

1.02 SUB MITTALS (Not Used)

PART 2 MATERIALS

2.01 ENGINEERED FILL

A. Verify that fill material is free of organic, deleterious, or other unsuitable matter and has the following properties required in the Specifications:

1. Maximum particle size of 0.50 inch within 6 inches of geosynthetics in liner.

2.02 CONFORMANCE TESTING

A. Prior to fill placement operations, sample the actual engineered fill material to be used at the site and send the samples to the Soils Testing Laboratory to perform at least one of each of the following tests for every 5000 cubic yards of material to be placed or a minimum of two tests, whichever results in the greater number of tests:

1. Particle Size Analysis (ASTM D 422)
2. Atterberg Limits (ASTM D 4318)
3. Unified Soil Classification (ASTM D 2487)
4. Moisture-Density Relationship Curve (ASTM D 698)

B. Perform conformance test sampling, and verify that the engineered fill material is free of organic, deleterious, or other unsuitable matter at the borrow area before loading into trucks for delivery to the work area.

PART 3 EXECUTION

3.01 PREPARATION

A. Prior to engineered fill placement operations, hold a preparatory meeting in accordance with Section 01039-1.04 of this CQA Plan.

3.02 PLACEMENT

A. Continuously observe all placement operations to verify that the fill material is consistent and has no oversized particles, overly wet or dry areas, organic matter, deleterious matter, or other unsuitable matter.

B. Verify that engineered fill material is spread in uniform loose lifts not exceeding 12 inches in thickness.

C. Verify that each loose lift is moisture conditioned and thoroughly mixed to ensure uniformly distributed moisture content.

3.03 COMPACTION

A. Continuously observe all compaction operations to verify that the engineered fill material is consistent and has no oversized particles, overly wet or dry areas, organic matter, or deleterious matter.

B. Verify that the final thickness of compacted lifts does not exceed nine inches.

C. Perform the following field tests at the frequency shown to verify that the compacted fill has the minimum dry density required in the Specifications and is at a moisture content within three percent of the optimum determined from ASTM D 698:

   1. Dry Density and Moisture Content - Nuclear (ASTM D 2922 and D 3017); at least one test per 5000 square feet per lift or a minimum of two tests per lift, whichever results in the greater number of tests or at a change in material.
   2. If testing with nuclear gage is impractical, prepare a test pad and observe contractor operations to meet specified compaction. Continuously observe subsequent operations and verify contractor meets procedural requirements to obtain compaction as approved by the Engineer.

D. If any portion of the fill does not meet the requirements of the Specifications, based on either field test results or observations, verify that that portion is reworked or removed and replaced to meet the requirements of the Specifications.

E. Verify that the surface of the completed fill conforms to the grades shown on the Plans and at no point on the completed grading plane does the grade vary above or below the designated grades by more than the amount specified in the project specifications; if it is demonstrated by the CQA verification surveying that any portion of the engineered fill does not meet the required lines, grades, or dimensions shown on the Drawings, verify that the Contractor reworks or replaces that portion to bring the deficient area to grade or the proper dimension in accordance with all requirements of the Specifications.

END OF CQA SECTION 02224
ENGINEERED FILL

CQA SECTION 13001
GEOMEMBRANE LINER

1.01 SUMMARY

A. The CQA Officer shall perform CQA procedures as outlined in this Section and follow guidelines for monitoring and testing to verify and document that GML materials and installation are in compliance with the Drawings and Specifications.

1.02 SUBMITTALS

A. Collect three copies of each submittal listed in the Specifications

B. Verify compliance with the submittal schedule and update Submittal Log

C. Perform submittal review and approval procedures in Section 01300-1.03

1.03 TRANSPORT AND STORAGE

A. During unloading of the GML rolls at the site, perform the following procedure:

1. Obtain a copy of the packing list

2. Complete the GML Delivery and Control Log for each shipment and attach a copy of the packing list. The GML Delivery and Control Log documents the following:

    a. delivery date;

    b. roll numbers;

    c. batch/lot numbers or production dates;

    d. roll dimensions;

    e. receipt of MQC test reports;

    f. CQA conformance test sampling;

    g. receipt of CQA conformance test results;

    h. Manufacturer and Product Name or Designation;

    i. name of CQA monitor observing delivery and storage;

    j. total quantity delivered with each shipment and the a cumulative total quantity delivered to date; and

    k. additional notes including rejection of materials, condition of delivered materials, and other materials included with the shipments.

3. Obtain written certification from the Supplier that unloading and storage of the GML rolls has been done in accordance with the Manufacturer's recommended procedures.

4. Verify that GML rolls are transported, unloaded, handled, and stored in a manner that does not damage the GML rolls in accordance with the Manufacturer's recommended procedures and the following requirements:

   a. Stinger or straps (nylon or other cloth) shall be used to unload and handle the GML rolls to protect the rolls from damage.

   b. The GML rolls shall be stacked no more than three rolls high and with a three-foot wide access path between the stacked rows.

5. Identify and separate damaged or rejected GML rolls.

6. If CQA conformance test sampling, in accordance with Part 2.02C, is to be performed during delivery to the site, determine which GML rolls will be sampled by either individual roll numbers, batch/lot numbers, or production dates and position the rolls for convenient sampling.

PART 2 PRODUCTS

2.01 GML

A. Verify that GML material consists of a high density polyethylene (HDPE) GML meeting the product requirements of the Specifications.

2.02 CONFORMANCE TESTING

A. Conduct sampling for CQA conformance testing at the site upon delivery or at the manufacturing plant prior to shipment and delivery to the site.

B. For every 100,000 square feet of material delivered to the site, select at least one GML roll to sample for CQA conformance testing.

C. Sample the selected GML rolls for CQA conformance testing using the following procedure:

1. Cut and discard the first three feet of GML material from across the entire width of the roll.

2. Cut the next 12 inches of material from across the entire width of the roll; this section of material is the CQA conformance testing sample.

3. Assign a CQA test number to the sample and mark the following information directly on the sample with a paint marker:

   a. Machine direction of the sample

        b. Manufacturer’s roll number

        c. CQA test number

    4. Complete the GML Test Request and Sample Custody Log and ship samples to the Geosynthetics Testing Laboratory via overnight delivery.

D. The following CQA conformance tests will be performed by the Geosynthetics Testing Laboratory to verify compliance with the product requirements of the Specifications:

    1. Tensile Properties (ASTM D638)

    2. Density ASTM D 1505)

    3. Carbon Black Content (ASTM D 1603)

    4. Carbon Black Dispersion (ASTM D 5596)

    5. Sheet Thickness (ASTM D 5994)

E. Upon completion of CQA conformance testing and receipt of the results, review all results for compliance with the Specifications and report any test results which are not in compliance with the Specifications to the Engineer.

F. Additional CQA conformance testing or corrective action to be performed in the event of test results which are not in compliance with the Specifications will be determined by the Engineer.

2.03 EXTRUDATE ROD

A. Verify that extrudate rod is made from the same resin as the GML.

2.04 FIELD TESTING EQUIPMENT

A. Verify that the Installer provides and uses a field tensiometer for seam testing that has been calibrated within the last year and is accurate to within two pounds.

B. Verify that the installer provides and uses a one-inch (width) by six-inch (length) cutting die for cutting seam test specimens.

PART 3 EXECUTION

3.01 PREPARATION AND EXAMINATION

A. Prior to GML installation, hold a preparatory meeting in accordance with Section 01039-1.04 of this CQA Plan.

B. Prior to GML installation, verify that all underlying material installation and construction has been completed in accordance with the Specifications.

C. Verify that prior to and at the middle of each GML welding work shift and whenever adjustments are made to the welding machines, the installer prepares and tests trial welds for each welding machine that is being used or will be used during that work shift.

D. Verify that trial welds are prepared for both fusion and extrusion welding machines and sampled using the following guidelines:

1. Trial weld samples for fusion welding machines should be a minimum of six feet in length.

2. Trial weld samples for extrusion welding machines should be a minimum of three feet in length.

3. The trial weld should be centered along and run the entire length of the sample.

E. Verify that trial welds are tested as follows:

1. Trial welds should be allowed to cool to ambient conditions prior to testing.

2. After cooling, excessive material should be cut from the beginning and the end of the trial weld sample (approximately four-inches from each end).

3. Using the cutting die, four one-inch specimens should be cut at an even spacing along the length of the trial weld.

4. Using the field tensiometer with a rate of separation of two inches per minute, two nonadjacent specimens shall be tested for peel adhesion (peel) and two for bonded seam strength (shear); both sides of fusion welds shall be tested for peel.

F. Record peel and shear test results for trial welds on the QML Deployment/Welding Log using the following criteria:

1. Peel test specimens:

    a. The break is either a film tear bond (FTB-passing) or a non-film tear bond (NFTB-failing).

    b. Percent of peel penetration into the weld (maximum of 10%)

    c. Quantitative value for peel strength (minimum of *78* ppi)

2. Shear test specimens:

    a. The break is either a film tear bond (FTB-passing) or a non-film tear bond (NFTB-failing).

    b. Elongation of shear specimen (minimum of 2 inches)

c. Quantitative value for bonded seam strength (minimum of 120 ppi)

G. If any of the four test specimens do not meet the peel or shear criteria, reject the entire trial weld and verify that the welding machine is not used for installation of the GML until passing a retest consisting of repeating the entire trial weld sampling and testing procedure on a new weld performed with the failing machine.

H. If the retested trial weld fails, verify that the welding machine is not used for installation of the GML until proper adjustments or repairs are made and passing a retest; if the welding machine continually fails field trial weld testing, verify that the welding machine is tagged and completely removed from work area.

3.02 INSTALLATION

A. Verify that GML panels are deployed parallel to the slope by unrolling down the entire length of the slope and that corrections or adjustments are made to panels which become askew to the parallel line of the slope.

B. Verify that adjacent GML panel edges are overlapped a minimum of four-inches for fusion welding and alignment of the overlap is kept consistent by marking overlap indicator points.

C. Verify that GML damaged during handling, transport, or deployment is removed or repaired.

D. Verify that the underlying soil subgrade or installed geosynthetics are not damaged by GML installation equipment or methods and that any damaged soil subgrade or installed geosynthetics are completely repaired in accordance with the requirements of the applicable section of the Specifications.

E. Verify that the Installer only deploys the quantity of GML which can be completely welded and anchored by the end of the work shift or day.

F. Verify that the Installer prepares an adequate number of sandbags to ballast the GML during deployment in accordance with the following guidelines:

1. Only plastic ties should be used to close sandbags; no metal or wire ties are allowed.

2. Sandbags should be removed prior to deploying overlying materials and after completion of permanent GML anchorage.

3. Sandbag fill should not be disposed of within the limits of work unless the fill consists of material which meets the Specification for the material it is disposed upon.

4. GML rolls may also be used for ballast provided that no damage to the deployed GML occurs.

G. Verify that the Installer deploys and seams the geomembrane in a manner which minimizes wrinkles and provides the proper amount of slack in the installed GML to compensate for contraction due to local temperature extremes prior to covering; no stress-bridging or "fishmouths" are allowed.

H. Verify that immediately after GML panels running through ditch flow lines or at toes of slopes are welded, sandbags are placed end-to-end along the entire length of the flow or toe line to prevent stress-bridging at those locations; alternatively, to reduce the number of sandbags required and to further prevent stress-bridging, the Installer may anchor the GML near the toes of slopes within a backfilled anchor trench constructed in accordance with the Specifications.

I. Verify that GML panels are not overlapped or seamed perpendicular to the slope on slopes with a gradient of more than 10 percent, within 20 feet of the top of any slope, and unless the GML is anchored within a backfilled anchor trench constructed in accordance with the Specifications.

J. Verify that when cutting any GML above another GML, the Installer uses a knife with a hooked blade.

K. Record the following information on the GML Deployment/Welding Log:

<u>Note</u>: *The abbreviations in parenthesis following each verification procedure are used on the GML Deployment/Welding Log.*

1. Temperature (T). Ambient and GML surface temperatures with a description of the current weather conditions. Record every two hours and document dramatic changes in temperature and weather conditions.

2. Trial Welds (TW). Time of trial weld, type of welding equipment, welding equipment number, welding operator, and results of field peel and shear testing of trial welds.

3. Panel (P). Assigned panel number, GML roll number, panel dimensions, and area of panel.

L. Using a graph computation sheet, field sketch a panel layout drawing of the GML panels deployed during the day and attach this field sketch to the completed GML Deployment/Welding Log; the daily field sketches will be transposed to the master panel layout drawing.

3.03 FUSION WELDING

A. Verify that fusion welding operations only take place when the ambient temperature is between 40°F and 110°F unless the special weather welding plans have been submitted by the Installer and approved by Engineer to weld outside this range; measure ambient temperature six-inches above the in-place GML and record readings every two hours on the GML Deployment/Welding Log.

B. Verify that all GML seams are fusion welded by the double-track method leaving an air gap for leak testing; extrusion welding can only be used for repairs, patches, fabrications, and inaccessible areas.

C. Prior to welding, verify that all fusion welding machines have performed trial welds and passed field trial weld testing.

D. Verify that the Installer's power source is capable of producing sufficient and constant voltage under the combined line load of multiple welders and other equipment.

E. Verify that surfaces to be welded are thoroughly cleaned.

F. Verify that seams are welded at the same speed, temperature, roller pressure, and gauge settings used to prepare the trial weld and that the welding operators record welding machine numbers, operators, machine settings, times, and dates on each seam welded.

G. Closely observe each fusion welding machine to verify that the machine is not adversely affecting or damaging the parent GML material outside the welding area.

H. Record the following information on the GML Deployment/Welding Log:

Note: *The abbreviations in parenthesis following each verification procedure are used on the GML Deployment/Welding Log.*

1. Seam (S). Assigned seam number, welding equipment number that welded the seam, welding operator, and length of the welded seam.

2. End of Seam Test. (EST). If the Installer's quality control program requires that specimens be taken from the end of each welded seam and tested for peel adhesion, record these results using the same criteria as for trial welds. If the Installer records these results, request a copy of the results and this information can be omitted from the GML Deployment/Welding Log.

3. Seam Test Sample (STS). Assigned sample number, seam number sample is located on, location of sample within the seam, welding machine number, welding operator, and results of field seam testing.

3.04 EXTRUSION WELDING

A. Verify that extrusion welding is used only for repairs, patches, fabrications, and inaccessible areas.

B. Prior to welding, verify that all extrusion welding machines have performed trial welds and passed field trial weld testing.

C. Verify that GML patches overlap the underlying GML panel a minimum of four inches.

D. Verify that GML patches are cut square with rounded corners and are large enough to extend a minimum of four inches in all directions over the repair area.

E. Verify that GML patches are tack-welded to the underlying GML panel to prevent movement during grinding and extrusion welding operations.

F. Verify that the outer edge of repair patches and the adjacent underlying GML are disc-ground to remove surface debris and oxidation and that grinding is not parallel to seam.

G. Verify that the nozzles of extrusion guns are purged before each use to remove solidified extrudate.

H Verify that the extrusion weld completely covers the entire width of the grind area and that extrusion safety welds extend four inches up any intersecting fusion weld.

I. Verify that a cap strip patch is extrusion welded at all fusion welded seam intersections of three or more GML panels.

3.05 QUALITY CONTROL

A Verify that quality control procedures are performed by the Installer in accordance with the installer's GML Installation Quality Control Manual except where amended or modified by the Engineer or the Specifications.

B Verify that the Installer maintains the following quality control documentation during the GML installation in accordance with the Specifications.

1 An accurate GML panel layout drawing which includes; 1) roll and panel numbers, 2) seam numbers; 3) GML limits; 4) anchor trench locations, and 5) seam test sample locations.

2. Daily deployment logs and panel layout drawings to be submitted to the CQA Officer daily which include; 1) panel and seam numbers; 2) panel dimensions; and 3) deployment quantities.

3. Daily welding logs to be submitted to the CQA Officer daily which include; 1) welding machine numbers; 2) operators; 3) machine settings; and 4) times and dates for each seam welded.

C. Verify that the entire length of each fusion welded seam is air-pressure tested by the installer, with an air pump capable of generating and maintaining 40 psi of pressure and equipped with a regulator and pressure gauge and pressure feed needles having pressure gauges accurate to one psi, in accordance with the following procedure:

1. Seal both ends of the fusion welded seam with vise-grip plate clamps or an extrusion weld; heat may be applied to the seam ends to aid in sealing the seam in conjunction with the clamps but due to the potential hazard of igniting landfill gas, propane torches or any other flame producing device are not allowed.

2. At one end of the seam, insert air pressure needle into the fusion weld channel.

3. Pressurize the channel to 40 psi and maintain pressure for five minutes.

4. Release air from the opposite end of the seam to verify that the entire length of the fusion weld channel was pressurized.

5. If channel pressure is not maintained with a maximum allowable pressure loss of two psi over the five-minute test period or does not stabilize at all, locate the defective area, isolate it, and repeat air pressure test procedures in each direction from the defective area.

D. Verify that the Installer maintains air-pressure test logs on which are recorded seam numbers, beginning and ending air pressures, beginning and ending test times, lengths of tested seam, defective areas found, and confirmation of repair.

E. Record the following air-pressure testing information on the GML Deployment/Welding Log:

Note: *The abbreviations in parenthesis following each verification procedure are used on the GML Deployment/ Welding Log*

1. Air-Pressure Test (AP). Seam number tested, start time of the air pressure test and initial air pressure (psi), termination time of the air pressure test and ending air pressure (psi), and length of seam or portion of seam successfully tested.

F. Verify that the entire length of each extrusion welded seam and repair is vacuum tested by the Installer in accordance with the following procedures, with a vacuum pump capable of generating and maintaining 30 inches of mercury and equipped with a clean view window, regulator, and vacuum gauge accurate to one psi:

1. Saturate the extrusion weld with a soap and water solution.

2. Place view box over the saturated weld, create an air tight seal, and apply vacuum in the box.

3. Maintain the vacuum for 15 seconds and examine weld for forming bubbles which indicate leaks; mark detected leaks for follow-up extrusion weld repair and retest detected leaks after repair to verify that the leaks were successfully repaired.

G. Verify that the Installer maintains vacuum test logs on which are recorded repair numbers, vacuum test dates, and vacuum test results.

H. Record the following vacuum testing information on the GML Repair Log.

1. Assigned repair number, location and description of repair, vacuum test dates, and vacuum test results.

3.06 SEAM TEST SAMPLING

A. Determine seam analysis sample locations by the *stratified random sampling method.* The stratified random sampling method allows random selection of a single sewn analysis sample location anywhere within the required 500-lineal feet sampling interval required in the technical specifications. In coordination with the Installer, perform the following seam analysis sampling procedures.

1. Seam analysis samples will be 12-inches wide by 36-inches long with the weld centered down the length of the sample. Samples sizes may be modified at the request of the Installer or CQA Officer. Cut one one-inch specimen from each end of the sample, and field test specimens for peel adhesion in accordance with the Technical specifications. If these specimens pass the field peel test, submit sample for laboratory seam analysis. If either of the specimens fail the field peel test, perform Faded Seam Analysis Procedures in accordance with Section 3.08 of this Section.

2. Divide the sample into equal two sections, submit one Section for seam analysis and archive storage the second section.

3. Installer may obtain and test any seam analysis sample at its option.

4. Repair sample holes and vacuum test repair in accordance with Section 3.04 of this Section.

B. Based on the seam analysis ***sampling method of attributes,*** the CQA Officer may decrease or increase the 500-foot sampling interval based on the following control chart of passing percentages of seam analysis results.

Percent Of Passing Seam Analysis	**Sampling Modifications**
100	Decrease sampling interval to 1000 lf.
90 - 100	Decrease sampling interval to 750 lf.
60 - 90	Maintain sampling interval at 500 lf.
30 - 60	Increase sampling interval to 250 lf,

<u>Note</u>: Sampling modifications will he considered only after 20 percent of seam analysis is completed.

3.07 LABORATORY TESTING

A. Laboratory seam analysis will be performed at the Geosynthetics Testing Laboratory, which is independent of the GML Manufacturer and Installer, and will be performed in accordance with the following procedures.

1. Seam analysis will include peel adhesion and bonded seam strength (ASTM D 6392). Five specimens will be tested for each method.

2. Both sides of fusion welded seams will be tested for peel adhesion.

3. All five of the specimens must meet the Fail Criteria specified in the technical specifications.

B. Acceptance of the welded GML seams will be based on the results of laboratory seam analysis.

C. Allow the Geosynthetics Testing, Laboratory 24 hours to complete seam analysis after submission of the samples.

3.08 FAILED SEAM ANALYSIS PROCEDURES

A. In coordination with the Installer, perform the following quality assurance verification procedures in the event of a seam analysis sample failure determined by either field testing or laboratory seam analysis.

1. Track the welded seam 10 feet in both directions away from the failed seam analysis sample location. Cut a small 12-inch wide by 12-inch long sample from each location. Cut one one-inch specimen from each end of the sample, and field test specimens for peel adhesion in accordance with Part 3.01 of this Section. If these specimens pass the field peel test, submit a 12-inch wide by 18-inch long re-test sample from both locations for laboratory seam analysis. If either of the specimens fail, the field peel test at either location, continue tracking the welded seam at 10-foot intervals until specimens successfully pass the field peel tests and a sample can be submitted for laboratory seam analysis. If specimens continually fail field peel tests at 10-foot intervals, the entire seam or portion of the welded seam will be repaired at the discretion of the CQA Officer.

2. Verify that the failed length of seam is repaired with an 18-inch wide extrusion welded cap strip. Tack and extrusion welding the leading flap of the fusion welded seam is not permitted. Verify that the extrusion welded cap strip is vacuum tested in accordance with the technical specifications.

3. If the re-test sample fails laboratory seam analysis, repeat the above procedures.

B. Sample extrusion welded cap strips exceeding 100 feet in length for seam analysis.

END OF CQA SECTION 13001
GEOMEMBRANE LINER

CQA SECTION 13002
GEOTEXTILE

PART 1 GENERAL

1.01 SUMMARY

A. The CQA Officer shall perform CQA procedures as outlined in this Section and follow guidelines for monitoring and testing to verify and document that geotextile materials and installation are in compliance with the Drawings and Specifications.

1.02 SUBMITTALS

A. Collect three copies of each submittal listed in the Specifications

B. Verify compliance with the submittal schedule and update Submittal Log

C. Perform submittal review and approval procedures in Section 01300-1.03

1.03 TRANSPORT AND STORAGE

A. Upon delivery of the geotextile rolls to the site, verify that the rolls have been transported with opaque protective coverings and within a closed trailer.

B. During unloading of the geotextile rolls at the site, perform the following procedure:

1. Obtain a copy of the packing list
2. Complete the Geotextile Delivery and Control Log for each shipment and attach a copy of the packing list. The Geotextile Delivery and Control Log documents the following:
    a. Delivery date
    b. Roll numbers
    c. Batch/lot numbers or production dates
    d. Roll dimensions
    e. Receipt of MQC test reports
    f. CQA conformance test sampling
    g. Receipt of CQA conformance test results
    h. Manufacturer and Product Name or Designation
    i. Name of CQA monitor observing delivery and storage
    j. Total quantity delivered with each shipment and the cumulative total delivered to date
    k. Additional notes including rejection of materials, condition of delivered materials, and other materials included with the shipments

3. Obtain written certification from the Supplier that unloading and storage of the geotextile rolls has been done in accordance with the Manufacturer’s recommended procedures.
4. Verify that geotextile rolls are transported, unloaded, handled, and stored in a manner that does not damage the geotextile rolls or their protective coverings in

accordance with the Manufacturer’s recommended procedures and the following requirements:

  a. Nylon or other cloth straps shall be used to unload and handle the geotextile rolls to protect the rolls and their protective coverings from damage.
  b. The geotextile rolls shall be stacked no more than five rolls high and with a three-foot wide access path between the stacked rows.

5. Verify that damaged protective coverings are repaired or replaced.
6. Identify and separate damaged or rejected geotextile rolls.
7. If CQA conformance test sampling, in accordance with Part 2.03C, is to be performed during delivery to the site, determine which geotextile rolls will be sampled by either individual roll numbers, batch/lot numbers, or production dates and position the rolls for convenient sampling.

PART 2 PRODUCTS

2.01 GEOTEXTILE

A. Verify that geotextiles of each type meets the applicable product requirements of the Specifications.

2.02 SEWING THREAD

A. Verify that sewing thread for geotextiles meets the product requirements of the Specifications.

2.03 CONFORMANCE TESTING

A. Conduct sampling for CQA conformance testing at the site upon delivery or at the manufacturing plant prior to shipment and delivery to the site.

B. For every 100,000 square feet of material delivered to the site, select at least one geotextile roll of each type to sample for CQA conformance testing.

C. Sample the selected geotextile rolls for CQA conformance testing using the following procedure:

  1. Cut and discard the first three feet of geotextile material from across the entire width of the roll.
  2. Cut the next 18 inches of material from across the entire width of the roll; this section of material is the CQA conformance testing sample.
  3. Assign a CQA test number to the sample and mark the following information directly on the sample with a paint marker:
     a. Machine direction of the sample
     b. Manufacturer’s roll number
     c. CQA test number

4. Immediately re-wrap the sampled geotextile roll with its protective covering; use additional opaque plastic sheeting, if needed, to completely cover the roll.

5. Complete the Geotextile Test Request and Sample Custody Log and ship samples to the Geosynthetics Testing Laboratory via overnight delivery.

D. The following CQA conformance tests will be performed by the Geosynthetics Testing Laboratory to verify compliance with the product requirements of the Specifications:

1. Mass Per Unit Area (ASTM D 5261)
2. Grab Strength (ASTM D 4632)
3. Trapezoidal Tear Strength (ASTM D 4533) for filter only
4. Puncture (ASTM D 4833) for filter only
5. Permittivity (ASTM D 4491) for filter only
6. Apparent Opening Size (ASTM D 4751) for filter only

E. Upon completion of CQA conformance testing and receipt of the results, review all results for compliance with the Specifications and report any test results which are not in compliance with the Specifications to the Engineer.

F. Additional CQA conformance testing or corrective action to be performed in the event of test results which are not in compliance with the Specifications will be determined by the Engineer.

PART 3 EXECUTION

3.01 PREPARATION AND EXAMINATION

A. Prior to geotextile installation, hold a preparatory meeting in accordance with Section 01039-1.04 of this CQA Plan.

B. Prior to geotextile installation, verify that all underlying material installation and construction has been completed in accordance with the Specifications.

3.02 INSTALLATION

A. Verify that the geotextile is installed in accordance with Manufacturer’s instructions for deployment, seaming, and exposure.

B. Verify that the geotextile is installed with the machine direction (lengthwise) of the roll oriented down the slope.

C. Verify that the geotextile is installed with sufficient tension to prevent excessive overlapping, insufficient overlapping, wrinkles, and folds.

D. Verify that geotextile panels are overlapped with sufficient material to create a prayer fold for sewing.

E. Verify that the geotextile is adequately ballasted during installation and until geotextile is covered with the overlying material.

F. Verify that the geotextile is permanently anchored as shown on the Drawings when installation is complete.

G. Verify that geotextile damaged during installation is removed and/or repaired with a sewn patch.

H. Verify that terminal ends of geotextile, where the type and purpose of the geotextile changes as shown on the Drawings, are overlapped a minimum of four feet.

I. Verify that when cutting any geotextile above the GML, the Installer uses a knife with a hooked blade.

J. Verify that the underlying soil subgrade or installed geosynthetics are not damaged by geotextile installation equipment or methods and that any damaged soil subgrade or installed geosynthetics are completely repaired in accordance with the requirements of the applicable section of the Specifications.

K. Verify that rocks, excessive dust, excessive moisture or other matter that could cause damage, hamper sewing operations, or clog the geotextile are not trapped under the geotextile or within the overlap.

3.03 SEAMING AND REPAIR

A. Verify that all seams are sewn unless an alternate seaming method is allowed by the Engineer based on the Installer’s demonstration of the alternative acceptability.

B. Verify that overlaps are clean and free of soil materials which could adversely affect sewing operations.

C. Verify that a prayer fold is made within the overlap prior to sewing.

D. Verify that a continuous 401 two-thread chain stitch is used to sew the prayer fold.

E. Verify that damaged geotextile is removed entirely and replaced or repaired in accordance with the following guidelines:

    1. Repair (patching) material shall be of the same type as the damaged geotextile.
    2. Patches shall extend a minimum of 12 inches in all directions beyond the damaged area with the machine direction of the patch aligned with the machine direction of the damaged geotextile.
    3. Patches shall be seamed using the same method used for seaming the damaged geotextile.

END OF CQA SECTION 13002
GEOTEXTILE

CQA SECTION 13003
GEOGRID

PART 1 GENERAL

1.01 SUMMARY

A. The CQA Officer shall perform CQA procedures as outlined in this Section and follow guidelines for monitoring and testing to verify and document that geogrid materials and installation are in compliance with the Drawings and Specifications.

1.02 SUBMITTALS

A. Collect three copies of each submittal listed in the Specifications

B. Verify compliance with the submittal schedule and update Submittal Log

C. Perform submittal review and approval procedures in Section 01300-1.03

1.03 TRANSPORT AND STORAGE

A. Upon delivery of the geotextile rolls to the site, verify that the rolls have been transported with opaque protective coverings.

B. During unloading of the geogrid rolls at the site, perform the following procedure:

1. Obtain a copy of the packing list
2. Complete the Geogrid Delivery and Control Log for each shipment and attach a copy of the packing list. The Geogrid Delivery and Control Log documents the following:
   a. Delivery date
   b. Roll numbers
   c. Batch/lot numbers or production dates
   d. Roll dimensions
   e. Receipt of MQC test reports
   f. CQA conformance test sampling
   g. Receipt of CQA conformance test results
   h. Manufacturer and Product Name or Designation
   i. Name of CQA monitor observing delivery and storage
   j. Total quantity delivered with each shipment and the cumulative total delivered to date
   k. Additional notes including rejection of materials, condition of delivered materials, and other materials included with the shipments
3. Obtain written certification from the Supplier that unloading and storage of the geotextile rolls has been done in accordance with the Manufacturer’s recommended procedures.

4. Verify that geogrid rolls are transported, unloaded, handled, and stored in a manner that does not damage the geogrid rolls or their protective coverings in accordance with the Manufacturer's recommended procedures and the following requirements:
    a. Nylon or other cloth straps shall be used to unload and handle the geogrid rolls to protect the rolls and their protective coverings from damage.
    b. The geogrid rolls shall be stacked no more than five rolls high and with a three-foot wide access path between the stacked rows.
5. Verify that damaged protective coverings are repaired or replaced.
6. Identify and separate damaged or rejected geogrid rolls.
7. If CQA conformance test sampling, in accordance with Part 2.03C, is to be performed during delivery to the site, determine which geogrid rolls will be sampled by either individual roll numbers, batch/lot numbers, or production dates and position the rolls for convenient sampling.

PART 2 PRODUCTS

2.01 GEOGRID

A. Verify that geogrids of each type meets the applicable product requirements of the Specifications.

2.02 NOT USED

2.03 CONFORMANCE TESTING

A. Conduct sampling for CQA conformance testing at the site upon delivery or at the manufacturing plant prior to shipment and delivery to the site.

B. For every 100,000 square feet of material delivered to the site, select at least one geogrid roll of each type to sample for CQA conformance testing.

C. Sample the selected geogrid rolls for CQA conformance testing using the following procedure:

1. Cut and discard the first three feet of geogrid material from across the entire width of the roll.
2. Cut the next 18 inches of material from across the entire width of the roll; this section of material is the CQA conformance testing sample.
3. Assign a CQA test number to the sample and mark the following information directly on the sample with a paint marker:
    a. Machine direction of the sample
    b. Manufacturer's roll number
    c. CQA test number

4. Immediately re-wrap the sampled geogrid roll with its protective covering; use additional opaque plastic sheeting, if needed, to completely cover the roll.
5. Complete the Geogrid Test Request and Sample Custody Log and ship samples to the Geosynthetics Testing Laboratory via overnight delivery.

D. The following CQA conformance tests will be performed by the Geosynthetics Testing Laboratory to verify compliance with the product requirements of the Specifications:

1. Long-Term Strength (LTDS) (GRI GG4-MD)

E. Upon completion of CQA conformance testing and receipt of the results, review all results for compliance with the Specifications and report any test results which are not in compliance with the Specifications to the Engineer.

F. Additional CQA conformance testing or corrective action to be performed in the event of test results which are not in compliance with the Specifications will be determined by the Engineer.

PART 3 EXECUTION

3.01 PREPARATION AND EXAMINATION

A. Prior to geogrid installation, hold a preparatory meeting in accordance with Section 01039-1.04 of this CQA Plan.

B. Prior to geogrid installation, verify that all underlying material installation and construction has been completed in accordance with the Specifications.

3.02 INSTALLATION

A. Verify that the geogrid is installed in accordance with Manufacturer's instructions for deployment, seaming, and exposure.

B. Verify that the geogrid is installed with the machine direction (lengthwise) of the roll oriented down the slope.

C. Verify that the geogrid is installed with sufficient tension to prevent excessive overlapping, insufficient overlapping, wrinkles, and folds.

D. Verify that the geogrid is adequately ballasted during installation and until geotextile is covered with the overlying material.

E. Verify that the geogrid is permanently anchored as shown on the Drawings when installation is complete.

F. Verify that geogrid damaged during installation is removed and/or repaired with a sewn patch.

G. Verify that when cutting any geogrid above the GML, the Installer uses a knife with a hooked blade.

H. Verify that the underlying soil subgrade or installed geosynthetics are not damaged by geogrid installation equipment or methods and that any damaged soil subgrade or installed geosynthetics are completely repaired in accordance with the requirements of the applicable section of the Specifications.

END OF CQA SECTION 13003
GEOGRID

Appendix F.

HELP Model Results

CES
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Conserving Resources. Improving Life.
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Spokane, WA 99216
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TECHNICAL MEMORANDUM

DATE: December 28, 2007

TO: Rod Lentz – U.S. Forest Service

FROM: Jay Williams – Cascade Earth Sciences

SUBJECT: HELP Model Summary of Results
Azurite Mine Removal Action, Mazama, Washington

The attached seepage analysis was performed to estimate the relative amount of seepage that would flow through the repository designed for the Azurite Mine Removal Action either with or without an impervious (Bentomat) liner as part of the repository cover. It can also be used to estimate the amount of treatment that may be necessary to remove leached contaminants from the leachate stream. The modeling was performed using HELP Model Version 3.07, developed for U.S. EPA.

The runs named AZURAVE1 and AZURAVE2 were constructed using daily average temperatures, precipitation, solar radiation, and evapotranspiration data for Mazama Washington. The daily averages for a year were used repeatedly through the multiyear model. Other parameters are given in Table 1. AZURAVE1 is modeled with a relatively impervious bentomat liner between the cover and the wasterock, whereas AZURAVE2 is modeled with the same climatic, cover, wasterock and native soil parameters but without the impervious liner. Seepage out of the repository averages 0.3 inches per year when modeled with the impervious liner. Seepage out of the repository averages 2.4 inches per year when modeled without the impervious liner.

The runs named AZURSYN1 and AZURSYN2 were constructed using a synthesized data set from the model for temperatures, precipitation, solar radiation, and evaportranspiration for Yakima Washington. Soil parameters are given in Table 1. AZURSYN1 is modeled with a relatively impervious bentomat liner between the cover and the wasterock, whereas AZURSYN2 is modeled with the same climatic, cover, wasterock and native soil parameters but without the impervious liner. Seepage out of the repository averages 0.01 inches per year when modeled with the impervious liner. Seepage out of the repository averages 0.1 inches per year when modeled without the impervious liner. Using the synthesized data allowed us to see how much variability occurred from year to year in a relatively short time. AZURSYN 1 seepage averaged 42 cubic feet per year (CF/Y) but varied from 0 CF/Y to 606 CF/Y with 84% of years showing zero seepage. AZURSYN 2 seepage averaged 294 CF/Y and varied from 0 CF/Y to 4,114 CF/Y with 60% of years showing zero seepage.

The climatic data from Mazama may be more representative of conditions at the mine site. It would appear reasonable to assume that seepage rates with an impervious cover would average about 900 CF/Y and vary from 0 to 12,000 CF/Y. Without the impervious cover seepage rates would average about 7000 CF/Y and vary from 0 to 98,000 CF/Y.

jw
PN: 2723031
Doc: HELP Tech Memo.doc

Table 1. HELP Model Paramaters

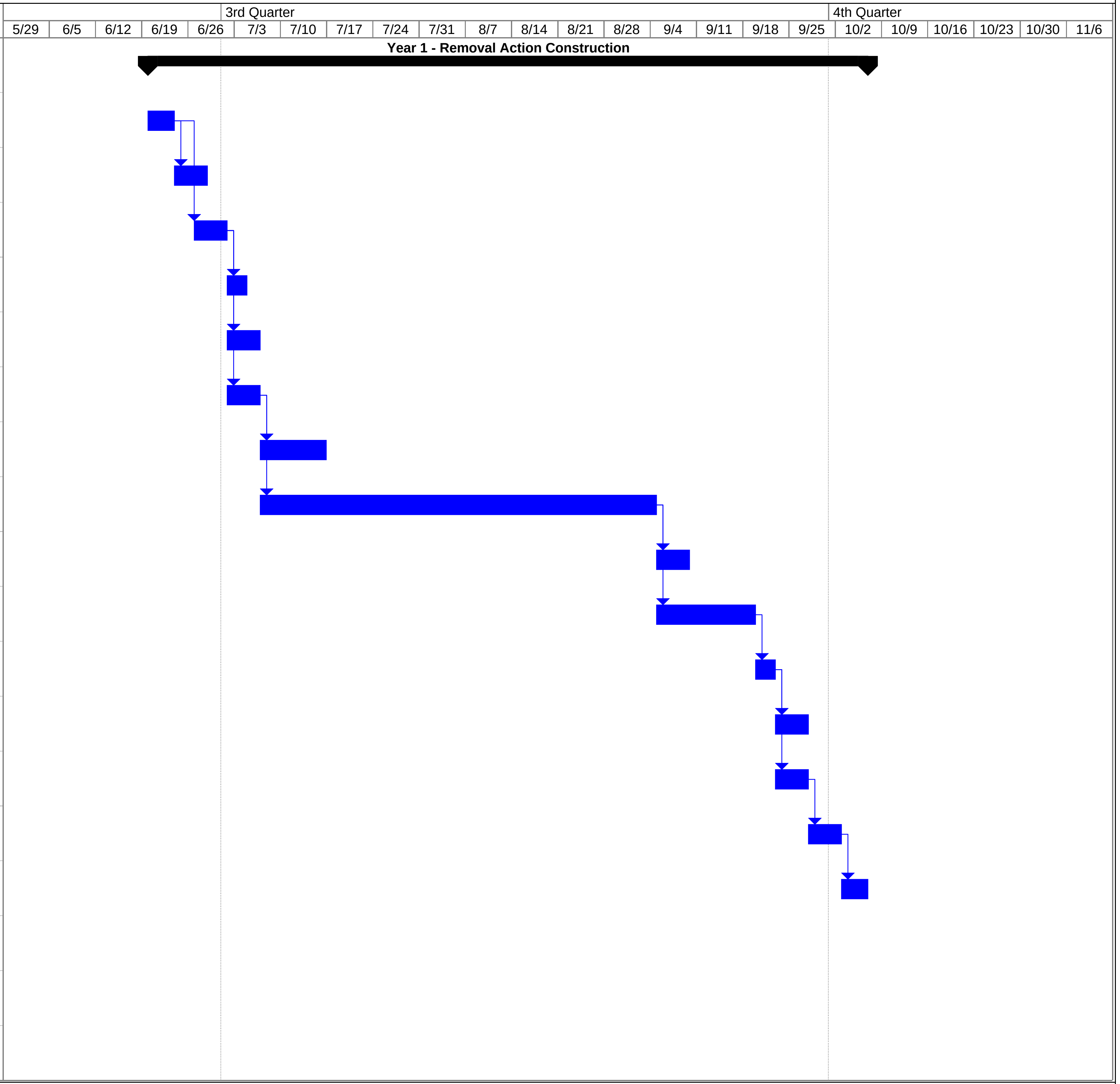
		HELP Runs			
		AZURAVE1	**AZURAVE2**	**AZURSYN1**	**AZURSYN2**
Precipitation		Mazama Avg	Mazama Avg	Yakima Syn	Yakima Syn
Temperature		Mazama Avg	Mazama Avg	Yakima Syn	Yakima Syn
Solar Radiation		Mazama Avg	Mazama Avg	Yakima Syn	Yakima Syn
Evapotranspiration		Mazama Avg	Mazama Avg	Yakima Syn	Yakima Syn
Cover Soil	Thickness, inches	24	24	24	24
	Porosity	0.463	0.463	0.463	0.463
	Field Capacity	0.232	0.232	0.232	0.232
	Wilting Point	0.116	0.116	0.116	0.116
	Initial Soil Water Content	0.1639	0.1652	0.1829	0.1829
	Hydraulic Conductivity	3.70E-04	3.70E-04	3.70E-04	3.70E-04
Barrier Layer	Thickness, inches	0.24	N/A	0.24	N/A
	Porosity	0.75	N/A	0.75	N/A
	Field Capacity	0.747	N/A	0.747	N/A
	Wilting Point	0.4	N/A	0.4	N/A
	Initial Soil Water Content	0.75	N/A	0.75	N/A
	Hydraulic Conductivity	3.00E-09	N/A	3.00E-09	N/A
Wasterock Layer	Thickness, inches	264	264	264	264
	Porosity	0.419	0.419	0.419	0.419
	Field Capacity	0.307	0.307	0.307	0.307
	Wilting Point	0.18	0.18	0.18	0.18
	Initial Soil Water Content	0.307	0.3086	0.307	0.307
	Hydraulic Conductivity	1.90E-05	1.90E-05	1.90E-05	1.90E-05
Native Soil	Thickness, inches	120	120	120	120
	Porosity	0.46	0.46	0.46	0.46
	Field Capacity	0.36	0.36	0.36	0.36
	Wilting Point	0.203	0.203	0.203	0.203
	Initial Soil Water Content	0.36	0.36	0.36	0.36
	Hydraulic Conductivity	9.00E-06	9.00E-06	9.00E-06	9.00E-06

Appendix G.

Project Construction Schedule

Azurite Mine Removal Action Preliminary Schedule

ID	Task Name	Duration	Start	Finish
1	**Year 1 - Removal Action Construction**	**79 days**	**Mon 6/20/11**	**Fri 10/7/11**
2	Spring 2011 Aquatic Monitoring	4 edays	Mon 6/20/11	Fri 6/24/11
3	Pre Construction Survey	5 edays	Fri 6/24/11	Wed 6/29/11
4	Mobilize equipment, Install Stormwater Controls, Setup Camp	5 edays	Mon 6/27/11	Sat 7/2/11
5	Clearing and Grubbing	3 edays	Sat 7/2/11	Tue 7/5/11
6	Construct Road from Repository to Wasterock	5 edays	Sat 7/2/11	Thu 7/7/11
7	Setup Talus Screen	5 edays	Sat 7/2/11	Thu 7/7/11
8	Construct Re-Enforced Berm and Toe	10 edays	Thu 7/7/11	Sun 7/17/11
9	Wasterock Excavation, Placement, and Repository Construction	60 edays	Thu 7/7/11	Mon 9/5/11
10	Construct Final Runon/Runoff Ditches	5 edays	Mon 9/5/11	Sat 9/10/11
11	Install Bat Gates	15 edays	Mon 9/5/11	Tue 9/20/11
12	Building Material Disposal	3 edays	Tue 9/20/11	Fri 9/23/11
13	Post Construction Survey	5 edays	Fri 9/23/11	Wed 9/28/11
14	Road Obliteration and Revegetation	5 edays	Fri 9/23/11	Wed 9/28/11
15	Demobilize	5 edays	Wed 9/28/11	Mon 10/3/11
16	Fall 2011 Aquatic Monitoring	4 edays	Mon 10/3/11	Fri 10/7/11
17	**Year 2 - 2012 Post RA Monitoring**	**70 days**	**Mon 6/25/12**	**Mon 10/1/12**
20	**Year 3 - 2013 Post RA Monitoring**	**70 days**	**Mon 6/24/13**	**Mon 9/30/13**
23	**Year 4 - 2014 Post RA Monitoring**	**70 days**	**Mon 6/23/14**	**Mon 9/29/14**



Task	🟦	Progress	▬	Summary	▬	External Tasks	▬	Deadline	⇩
Split	⋯	Milestone	◆	Project Summary	▬	External Milestone	◆		

Appendix H.

Construction Cost Estimate

Appendix H. Construction Cost Estimate

Azurite Mine Removal Action Work Plan, Okanogan National Forest, Washington

Description	Total Cost
Direct Capital	
Contractor Mobilization	$ 72,000
Erosion / Sediment Control - 2 events	$ 31,000
Site Seeding (USFS Provided seed)	$ 2,400
Access Road Maintenance	$ 24,000
Misc. Onsite Road Construction/Obliteration	$ 12,000
Remote Camp/Logistics	$ 120,000
Demolition / Haul Away Debris	$ 5,000
Wasterock Excavation and Repository Construction	$ 349,000
Stabilized Slope/Berm - Repository Face	$ 171,000
Tailings Regrade and Cover Construction	$ 862,000
Mill Area Grading and Cover Construction	$ 121,000
Runon / Runoff Control	$ 66,000
Mill Creek Crossing and Maintenance	$ 8,000
Bat Gates (5 closures, including helicopter use and fabrication)	$ 50,000
Direct Capital Subtotal	**$ 1,893,400**
Project Management/Oversight @ 20% Direct Capital Cost - includes remote logistics, supplies, oversight, reporting, etc.	$ 378,680
Indirect Capital Subtotal	**$ 378,680**
Total Direct and Indirect Costs	**$ 2,272,080**

Appendix I.

Draft Operation and Maintenance Plan

Draft Operations and Maintenance Plan
Azurite Mine Removal Action
Okanogan National Forest
Whatcom County, Washington

March 2010

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Cascade Earth Sciences
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www.cascade-earth.com

Draft Operations and Maintenance Plan
Azurite Mine Removal Action
Okanogan National Forest
Whatcom County, Washington

Prepared For:	Mr. Rod Lentz U.S. Forest Service Okanogan and Wenatchee National Forests 1240 2nd Avenue South Okanogan, Washington 98840
Prepared By:	Cascade Earth Sciences 12720 E. Nora Avenue, Suite A Spokane, Washington 99216 (509) 921-0290
Author:	Jay E. Williams, PE, Managing Engineer II
Reviewed By:	Dustin G. Wasley, PE, Principal Engineer
Report Date:	March 2010
Project Number:	2721031
Submitted By:	
	Dustin G. Wasley, PE, Principal Engineer

CONTENTS

DRAWING

ATTACHMENTS

1.0 SUMMARY OF EXISTING FACILITIES

The Azurite Mine (Site), as delineated on Drawing G-1 is located in Whatcom County, Washington, in Section 18, Township 37 north, and Range 17 east of the Willamette Meridian. This location is in the Mt. Baker-Snoqualmie National Forest (administered by the Okanogan and Wenatchee National Forests), near the southern edge of the Pasayten Wilderness Area, and approximately 19 air miles northwest of Mazama, Washington. The driving time, one-way, from Mazama to the Site is approximately 2.5 hours, depending on road and trail conditions.

The Site is accessed from Mazama, Washington by taking County Road (CR) 9140 northwesterly. It will turn into Forest road (FR) 5400. Continue on FR 5400 to Harts Pass (approximately ten miles from Mazama to the pass). At Harts Pass, turn left onto FR 700. Follow FR 700 to Forest Trail (FT) 475 and go left. Take FT 475 past the Whistler Mine, over Cady Pass, and down to Mill Creek. At FT 755, go left and along Mill Creek to the Azurite Mine and Tailing area (total distance traveled from Mazama is about 24 miles).

The Removal Action at the Site includes the excavation and transport of wasterock piles from the west side of Mill Creek to the repository on the south side of the tailings pile, stabilize the tailings pile in place by providing positive drainage and covering with an impermeable liner, and installing bat gates at the Wenatchee and Tinson Adits.

The upper wasterock pile will be placed as the bottom lift in the repository, while the lower wasterock pile will be placed on top of the upper wasterock pile. The face of the repository will be wrapped with a Uniaxial Geogrid to maintain long-term structural stability. The repository cover will consist of an impermeable liner, an eight-ounce non-woven geotextile, cover soil, and vegetation.

The tailing pile will be minimally disturbed to promote positive, non-erosional drainage along the various benches. The tailings pile cover will consist of an impermeable liner, an eight-ounce non-woven geotextile, and talus material. Cover soil will also be placed along the benches of the tailings pile to help promote and establish the native vegetation.

Other work will consist of improving the access road by installing multiple culverts, repairing several bridges, and widening the road to allow equipment access to the Site.

In addition, water discharging from the tailings seep, the wasterock seep, and the Tinson Adit may be treated/managed using a method to be determined in the future.

Signs will also be posted to warn the public of the general hazards (both chemical and physical) associated with the tailings, wasterock, and metal-impacted seeps/drainages.

2.0 EMERGENCY CONTACT NAMES AND NUMBERS

The following calling list must be updated annually with the appropriate contact information. The numbers are listed according to priority. In the event of an immediate emergency, contact the appropriate Emergency Responder. Second, call the Forest Service. If the event being reported presents a potential endangerment to the public or Forest Service personnel, call and report the event to the Forest Service Safety and Occupational Health Manager then notify the remaining Forest Service personnel in priority of the list.

Emergency Phone Numbers

Medical Emergency/Ambulance	911
Police	911
Fire	911
CES Spokane Office	(509) 921-0290
Forest Service Methow Valley Ranger District-Winthrop	(509) 996-4000
Okanogan County Sheriff's Office.	(509) 422-7232
Winthrop Fire Dept	(509) 997-4040
Washington Department of Natural Resources (fires)	(800) 562-6010
County Clinic 1116 Highway 20 Winthrop, Washington 98862	(509) 996-8180

3.0 DESCRIPTION OF NORMAL OPERATIONS AND MAINTENANCE

Operation and maintenance is composed of two separate tasks:

- Operational tasks which are undertaken to allow for the continued effective operation of the system in accordance with the design. Given the nature of the Azurite Mine Removal Action, operational tasks are limited.
- Maintenance tasks, which are undertaken to inspect and correct problems with the system and to control disruptions in service. Maintenance tasks typically consist of routine inspection and repair activities, as well as, regular ongoing tasks to maintain the system.

The following table summarized the tasks and involved.

Operation Task [1] (Inspection)	Maintenance Task	Frequency	Min. No. of People Required [2]	Conducted By	Health and Safety Training and Guidelines Responsibility
Above Ground Visual Inspection		Annually	1	TBD	TBD
Underground Visual Inspection		As Needed	3	TBD	TBD
	Water Treatment Systems [3]	TBD	TBD	TBD	TBD

NOTES:
1 See Attachment A for checklists that may be used as a tool to facilitate inspections both above and underground.
2 Underground entry shall be by Health and Safety Code Handbook 6709.2007-1, which requires three people.
3 To Be Determined (TBD)

3.1 Logistics

Should bat gate keys be needed for underground entry, they can be obtained from the local Forest Service office. Bring appropriate safety equipment and the site-specific health and safety plan (HASP) to the Site. Review the Job Hazard Analysis (JHA; Attachment B) with all employees onsite and have them sign that they understand the hazards and mitigation recommendations.

- Appropriate equipment list for above ground work:
  - gloves
  - hardhat
  - weather appropriate clothing
  - eye protection
  - nonskid steel-toed safety boots
- Appropriate equipment list for underground work:
  - gloves
  - Forest Service approved hardhat with mine light
  - long pants, long sleeve shirts
  - eye protection
  - nonskid steel-toed safety boots
  - multi-gas meter that is
    - capable of detecting at least oxygen, and
    - has an audible and visual display alarm indicator.
  - first aid kit
  - two-way radio for check-in
  - specific items for condition requiring additional protective measures as identified in the JHA
  - optional personal protective equipment (includes a self-rescuer)
- Before leaving the Site:
  - confirm that the Site is free of trash and all gear has been removed;
  - verify that all bat gates are locked; and
  - replace and bolt all service gates.

3.2 Operations

The Forest Service is not responsible for contractor safety and has rules and requirement regarding health and safety. Forest Service personnel should comply with required safety documentation prior to working on the Site. The Forest Service is not responsible for the contractors' safety documentation. A HASP for the Site will be provided by the contractor prior to working onsite. Underground and above ground inspection checklists are available in Attachment A.

3.2.1 Above Ground Visual Inspection (Annually)

Work will be performed annually by the Forest Service. Visually inspect the Site for damage, erosion, and proper operations of the access road and gate, bridges, drainage ditches/culverts, repositories, and other features. If issues arise during visual inspection, proceed to the contingency operations and maintenance portion of this document (Section 4.0).

1. Is there flow from the pipeline discharging into the drainage ditch on the west side of the repository?
2. Is there any visual evidence of system failure?
   - Iron stains on hillside?
   - Iron stains or iron precipitate in Mill Creek?

3. Has the backfill over the tailing pile or wasterock repository been eroded or suffered other damage?
4. Are the adits clear of debris?
5. Are the bat gates locked and intact?

3.2.2 Water Treatment Systems

To be determined at a later date.

4.0 CONTINGENCY OPERATIONS AND MAINTENANCE

If a situation is encountered that will potentially impact the health and safety of the public immediately notify the Contracting Officer Representative (COR), Rod Lentz at (509) 826-3274.

- If embankment failure, increased seepage, or other damage are encountered during inspection, take the following steps:
  1. Notify the following personnel immediately and request instruction on how to proceed:
     - Local Forest Service main office: (509) 996-4000
     - Forest Service Minerals and Special Use Administrator: Laurie Dowie (509) 996-4071
     - Forest Service Regional Environmental Engineer: Julie Creed (503) 808-2526
     - Forest Service COR: Rod Lentz (509) 826-3274
  2. Document the event and send a copy to the Safety and Occupational Health Manager and the District Minerals and Special Use Administrator.

4.1 Safety Plan

For Forest Service employees to go underground (enter at portal): All Forest Service employees must comply with FSH 6709-11 (Forest Service Health and Safety Code Handbook), Chapter 20, Interim Directive 6709-11-2007-1, which requires at least one Qualified Certified Mineral Examiner or Qualified Mineral Safety Lead to lead any underground mine assessment. The Interim Directive also specifies the personal protective equipment required for underground entry, including hardhat, safety-toed boots, eye protection, headlamp, safety belt, multi-gas meter, first aid kit, two-way radio, other items identified in the JHA, communication, and optionally a self-rescuer. Follow Interim Directive 6709-11-2007-1 for any underground entry.

For Contractors: All contractors and non-Forest Service personnel onsite to perform work must provide their own HASP according to Occupational Safety and Health Administration regulations for hazardous waste sites (see *CPL 02-02-071 – Technical Enforcement and Assistance Guidelines for Hazardous Waste Site and RCRA Corrective Action Clean-up Operations HAZWOPER 1910-120 (b) – (o) Directive* and others).

Potentially hazardous or unsafe underground environments include: Confined space hazard, rock falls, slip/trip/fall hazards, low oxygen, elevated carbon monoxide or other hazardous atmospheres, adit or portal collapse, and wildlife (snakes, bats, etc.). The site entry JHA or HASP must address these and any other onsite hazards. Specifically, inspection of any underground bulkhead must be addressed in the JHA or HASP.

Emergency Contacts: Contacting emergency assistance is difficult from the Site. Cell phone and two-way radio (other than tactical frequency) will not work at the Site. Satellite radios do work at the Site and should be used for communications. Forest Service employees should attempt to contact Dispatch as well as initiating medical assistance response. Forest Service employees should fill out a Serious Incident Information Report ("pink sheet") when time allows.

The following table gives emergency contact information in case of an accident or incident at the Site. **After summoning any needed emergency medical assistance and stabilizing people involved, contact the District Ranger or Acting District Ranger for the Site**. If after hours, call the after-hours number for Dispatch, which in turn will contact the Safety Manager / Hazardous Waste Lead, and the appropriate level of management.

Azurite Mine Site

Medical emergency/Ambulance	911
Aero Methow Rescue Service (Twisp)	(509) 997-4013
County Clinic 1116 Highway 20 Winthrop, WA 98862	(509) 996-8180
Fire	911
Washington Department of Natural Resources (fires)	(800) 562-6010
Winthrop Fire Dept	(509) 997-4040
Police	911
CES Spokane Office	(509) 921-0290
Methow Valley Ranger District-Winthrop	(509) 996-4000
Okanogan County Sheriff's Office.	(509) 422-7232
Washington Department of Natural Resources -Sedro Woolley	(360) 856-3500

5.0 EMERGENCY PROCEDURES – IMMEDIATE

1. ASSESS SITUATION
    - What is the Hazard?
    - Can the Site be entered?
    - Does the hazard still exist? Because the Site requires mine entry atmospheric and rock fall hazards must be assessed.
2. MAKE THE SITE SAFE
    - Is Site entry safe for others?
3. ASSESS THE VICTIM
    - breathing
    - heartbeat
    - other life threatening conditions

4. CALL 911: Follow oral reporting procedures below. If injuries are life threatening, request instructions from dispatch. If injuries are not life threatening, remove the victim from the contamination zone or injury area. Consider the need for decontamination prior to transport. Provide the following to dispatch:
    - Name, location, and phone number of person reporting;
    - Location of accident/incident;
    - How many victims need help;
    - Description of injuries;
    - Details of any chemicals or other contamination involved;
    - Summary of the accident including its suspected cause and the time it occurred;
    - Summary of what is being done for the victim(s);
    - Depending on the severity of the accident you may want to suggest helicopter transport, or meeting the ambulance somewhere along the transport route; and
    - Do not hang up until the other party has done so.
5. APPLY EMERGENCY FIRST AID IF TRAINED: Remove the injured party from contaminated or other unsafe zones, per Occupational Safety and Health Administration HAZWOPER guidelines. Ensure victim is breathing and reduce any immediate threat to life.

6.0 EMERGENCY PROCEDURES - SECONDARY

1. Transport to hospital, if possible, otherwise call ambulance (911).
2. Notify Forest Service and other key personnel.

7.0 HOSPITAL ROUTE TO THE COUNTY CLINIC IN WINTHROP, WASHINGTON

7.1 County Clinic (1116 Highway 20, Winthrop, Washington 98862)

For severe injuries (i.e., loss of appendage or heart attack), a helicopter could be used to airlift the injured to the hospital. The first responder will coordinate with the Forest Service to establish a suitable landing site.

MAP: Azurite Mine to the County Clinic in Winthrop, Washington

	Directions (Distance and time approximate due to remote location)	**Distance**
	Total Est. Time: 2 hours **Total Est. Distance:** 52.5 miles	
START	**1:** From the Site, travel generally EAST approximately 10 miles over primitive road to the parking area at Slate Creek.	11 miles
→	**2:** Travel East approximately 5 miles on NF-374 and NF-700 to Junction with NF-5400 (Hart Pass).	5 miles
↑	**3:** Then SOUTHEAST on NF-5400 to Junction with NF-060	9.7 miles
←	**4:** Turn Left onto NF-060.	2.4 miles
↑	**5:** Continue on Lost Creek Road 0.1 mile, stay left and continue on Lost Creek Road.	6.5 miles
→	**6:** Turn RIGHT on Mazama Road	0.4 miles
←	**6:** Turn LEFT at WA-20.	17.5 miles
END	**7:** End at **Country Clinic:** 1116 Highway 20, Winthrop, WA 98862, US	
	Total Est. Time: 2 hours. **Total Est. Distance:** 52.5 miles	

7.2 Potential Physical Hazards

A checklist of physical hazards is provided as follows. Details on several items are presented in the sections following the table.

Description	Hazard		Comments
	Yes	No	
Overhead Power Lines		X	None present at Site.
Tree Snags	X		Likely present at the Site. Will work with the On-Scene Coordinator to determine methods for removal.
Buried Conduit	X		There are likely buried water lines at the Site; however, no power lines will be present.
Fatigue	X		Sleeping in tents. Personnel will monitor each other for alertness and the Site Safety Officer will require fatigued personnel to leave the work area and rest.
Gastro-intestinal illness	X		Diarrhea and other GI tract illnesses can be a hazard due to poor hygiene. Personnel will wash their hands with soap after visiting the toilet and before eating.
Uneven Ground	X		Appropriate precautions will be taken while traversing the area.
Fall Hazards	X		Appropriate precautions will be taken while traversing the area.
Steep Slopes	X		Appropriate precautions will be taken while traversing the area.
Ice	X		Ice may be present depending on season and weather conditions.
Extreme Temperatures	X		Field activities are scheduled for mid-July through September and temperatures could be a factor.
Slippery Conditions	X		Slippery conditions may be present depending on weather conditions. Appropriate precautions will be taken while traversing the area.
Rain	X		Rain may exacerbate hazardous conditions.
Open adits	X		No personnel will enter adits open to the surface.
Rodent Droppings	X		Possible in buildings at the Site.
Potential Collapsed Workings	X		There is the potential for adits to collapse. Appropriate precautions will be taken while traversing the Site. No personnel will knowingly enter an adit.
Abandoned Structures	X		There is one abandoned structure at the Site. It should be inspected by a competent person prior to entry or use.

As shown in the checklist, physical hazards at the Site are primarily due to steep slopes in the mountainous terrain, weather conditions, heavy equipment, and mine openings. These include hazards such as operating a field vehicle in steep terrain with poor roads, twisting an ankle while traversing the slopes, slipping or tripping on obstructions, falls into collapsed underground mine workings, and exposure to the heat or cold. Activities will follow standard operating procedures to minimize the chance of human error and will be conducted in a safe and prudent manner.

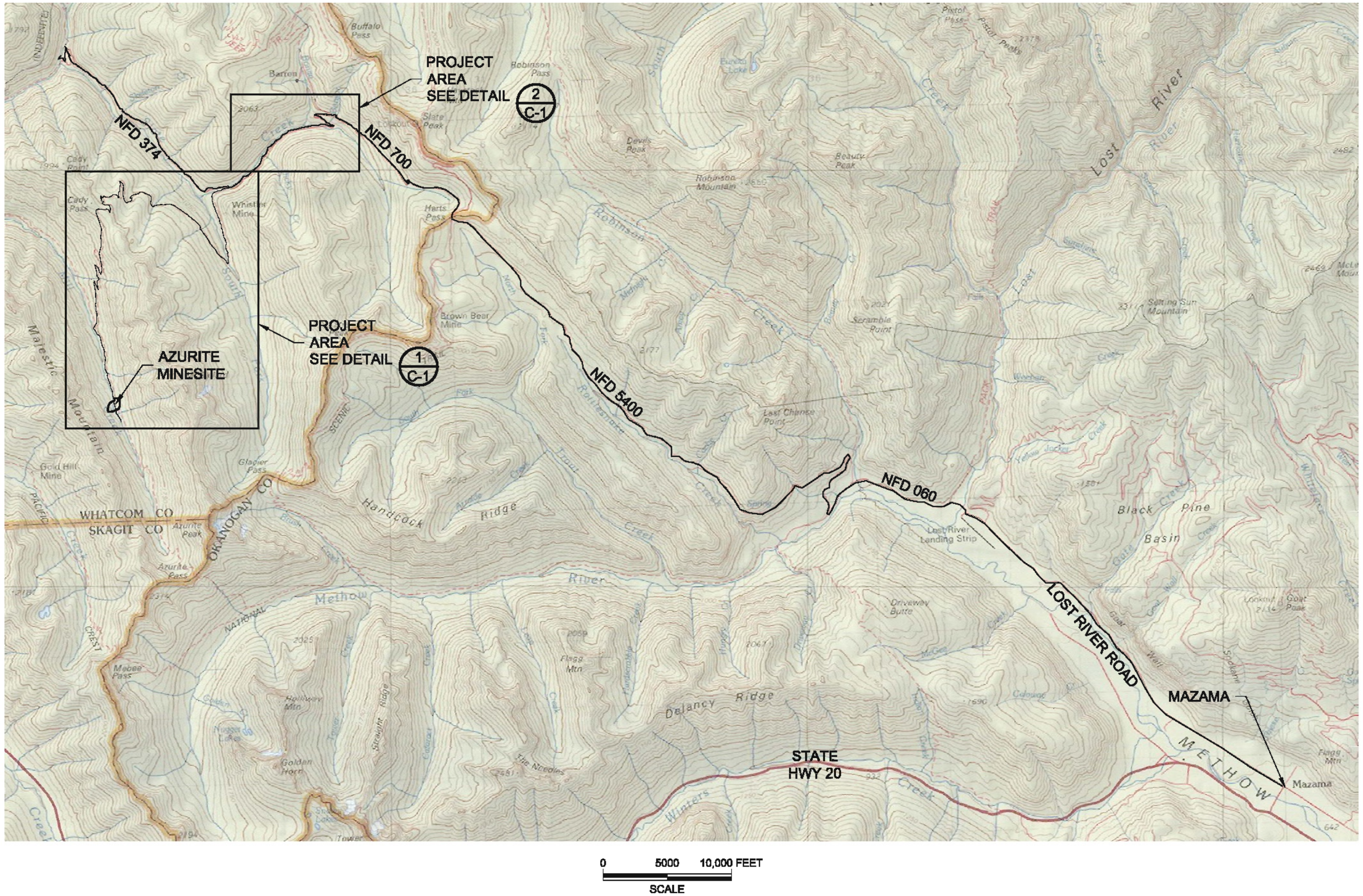
Forest Service Disclaimer: This abandoned mine/mill site was created under the General Mining Law of 1872 and is located solely on National Forest System (NFS) lands administered by the United States Department of Agriculture (USDA) Forest Service. The Forest Service has conducted a potentially responsible party search relating to this site and has been unable to identify any current claimants or viable PRPs at this time. The United States has taken the position and courts have held that the United States is not liable as an "owner" under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 107 for mine contamination left behind on National Forest System lands by miners operating under the 1872 Mining Law. Therefore, USDA Forest Service believes that this site should not be considered a "federal facility" within the meaning of CERCLA Section 120 and should not be listed on the Federal Agency Hazardous Waste Compliance Docket. Instead, this site should be included on U.S. Environmental Protection Agency's (EPA) CERCLIS database. Consistent with the June 24, 2003 Office of Enforcement and Compliance Assurance/ Federal Facilities Enforcement Office "Policy on Listing Mixed Ownership Mine or Mill Sites Created as a Result of the General Mining Law of 1872 on the Federal Agency Hazardous Waste Compliance Docket," we respectfully request that the EPA Regional Docket Coordinator consult with the Forest Service and EPA Headquarters before making a determination to include this site on the Federal Agency Hazardous Waste Compliance Docket.

Figure

Sheet G-1. Site Location Map

AZURITE MINE REMOVAL ACTION

MAZAMA, WASHINGTON



INDEX OF DRAWINGS

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SHEET C-2	ACCESS ROAD SWITCHBACK DETAILS
SHEET C-3	ACCESS ROAD DETAILS
SHEET C-4	NOT USED
SHEET C-5	DRAINAGE & EROSION CONTROL DETAILS
SHEET C-6	NOT USED
SHEET C-7	NOT USED
SHEET C-8	NOT USED
SHEET C-9	NOT USED
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PROJECT LOCATION
TOWNSHIP 37 NORTH, RANGE 17 EAST
LAT: 48° 41' 00" NORTH, LONG: 120° 46' 45" WEST

FINAL DESIGN
2/25/10

(SOURCE: NATIONAL GEOGRAPHIC 7.5 MINUTE TOPOGRAPHIC MAPS OF WASHINGTON ON CD-ROM, 2003)

S:\1PROJECT\2007\2723 Government\2723031 Azurite Mine\dd\dwg\2723031 G-1,C-1,2,3,4,5.dwg Odell, David E. 2/25/10

AZURITE MINE
OKANOGAN NATIONAL FOREST,WASHINGTON

REV #	DESCRIPTION	BY	DATE
1	–	–	MO/DAY/YR
2	–	–	MO/DAY/YR
3	–	–	MO/DAY/YR
4	–	–	MO/DAY/YR
5	–	–	MO/DAY/YR

DES. BY SJSG
DRG. BY SJSG
CHK. BY JW
DATE CREATED 12/10/2007
JOB No. 2723031

CASCADE EARTH SCIENCES
A Valmont Industries Company
CALL 1-800-728-8322
FOR NATIONAL OFFICE LOCATIONS

VICINITY MAP &
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REMOVAL ACTION

SHEET
G-1

ATTACHMENTS

Attachment A.	**Inspection Checklists (to be developed following Removal Action)**
Attachment B.	**Job Hazard Analysis (to be developed following Removal Action)**

Attachment A.

Inspection Checklists
(to be developed following Removal Action)

Attachment B.

Job Hazard Analysis
(to be developed following Removal Action)