APPENDIX A

SAP/QAPP

Final

Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) for Phase II Reclamation Investigation of Lilly/Orphan Boy Mine, Powell County, Montana

Prepared for:

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Acronyms and Abbreviations

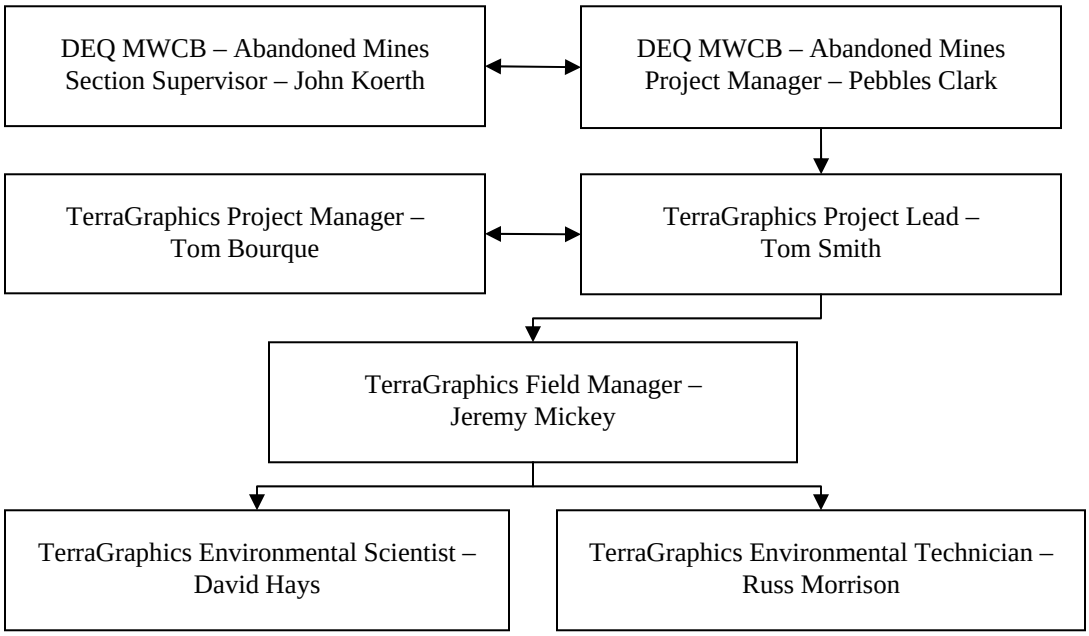
amsl	above mean sea level
ARD	acid rock drainage
CLP	Contract Laboratory Program
COC	contaminants of concern
DEQ	Montana Department of Environmental Quality
DOE	US Department of Energy
DQO	data quality objective
EPA	US Environmental Protection Agency
GPS	global positioning system
HASP	Health and Safety Plan
LOB	Lilly/Orphan Boy
mL	milliliter
PQL	practical quantitation limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	Reclamation Investigation
RWP	Reclamation Investigation Work Plan
SAP	Sampling and Analysis Plan
TerraGraphics	TerraGraphics Environmental Engineering, Inc.
Tetra Tech	Tetra Tech EM, Inc.
USGS	United States Geological Survey

Section 1.0 Project Management

TerraGraphics Environmental Engineering, Inc. (TerraGraphics) developed this Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) on behalf of the Montana Department of Environmental Quality (DEQ) to provide guidance for field sampling activities at the Lilly/Orphan Boy Mine. The Lilly/Orphan Boy Mine Site is an abandoned hard rock mine located within the Elliston Mining District. The mine is listed on the DEQ/Mine Waste Cleanup Bureau priorities sites.

The following sections list the key project personnel and their responsibilities, an explanation of the problem and history, project schedules, data quality objectives, sampling, oversight, and data management. This SAP/QAPP references the Hydrogeology Investigation Plan for the installation of groundwater monitoring wells and the Mine Investigation Plan for the analysis of the mine workings (sampling of mine water and infiltrating groundwater).

1.1 Project/Task Organization



1.2 Problem Definition/Background

The Lilly/Orphan Boy Mine site is located approximately 10.5 miles south of Elliston, Montana near the headwaters of Telegraph Creek (Figure 1). The mine is situated at an elevation of approximately 6,800 feet above mean sea level (amsl) and is composed of approximately 1½ acres of land contaminated by historic metal mining along Telegraph Creek. The Lilly lode and the adjacent Orphan Boy lode were likely discovered in the early summer of 1890 by a group of four men with the Grand Republic Mining Company. They presumably had the intent to develop

the Lilly and Orphan locations along with a few other lode locations on what is now known as O'Keefe Mountain. In 1891, the Lilly was noted in a report by the Montana Inspector of Mines as a mine "held in high estimation" whose ores were treated at a local arrastra during the year (FHC 2002).

In late 1893, the Lilly/Orphan Boy and other mines owned by the Grand Republic Mining Company were acquired by Empire State Mining Company of New York. Development work at the Lilly/Orphan Boy mines presumably started soon thereafter, but it wasn't until nearly three years later that Empire State Mining requested and received permission from Montana officials to conduct business in the state (FHC 2002).

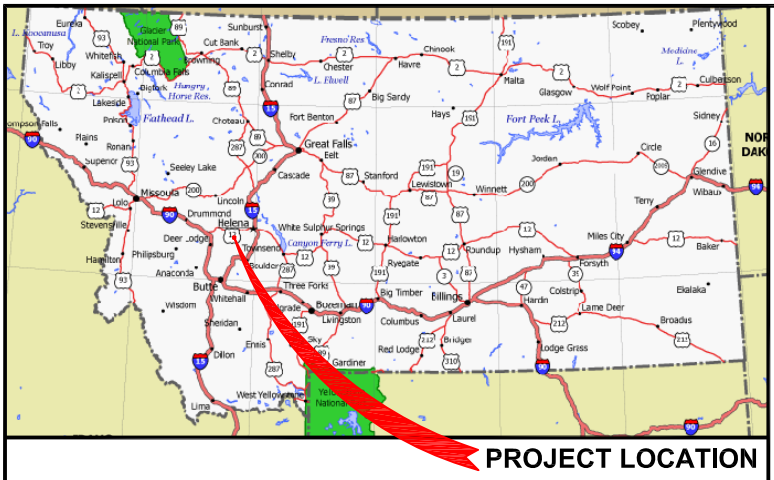
In November 1899, the courts ordered that the Lilly/Orphan Boy Mine properties be sold at public auction to satisfy a mortgage debt held by the Empire State Mining Company. The president of the company, T.H. Teall, obtained ownership of the Lilly/Orphan Boy Mine properties and received a sheriff's deed in December 1900. Ownership of the mine remained under Teall's name until 1927 when the taxes on the claims became delinquent. Powell County obtained a tax deed to the property early in the following year (FHC 2002).

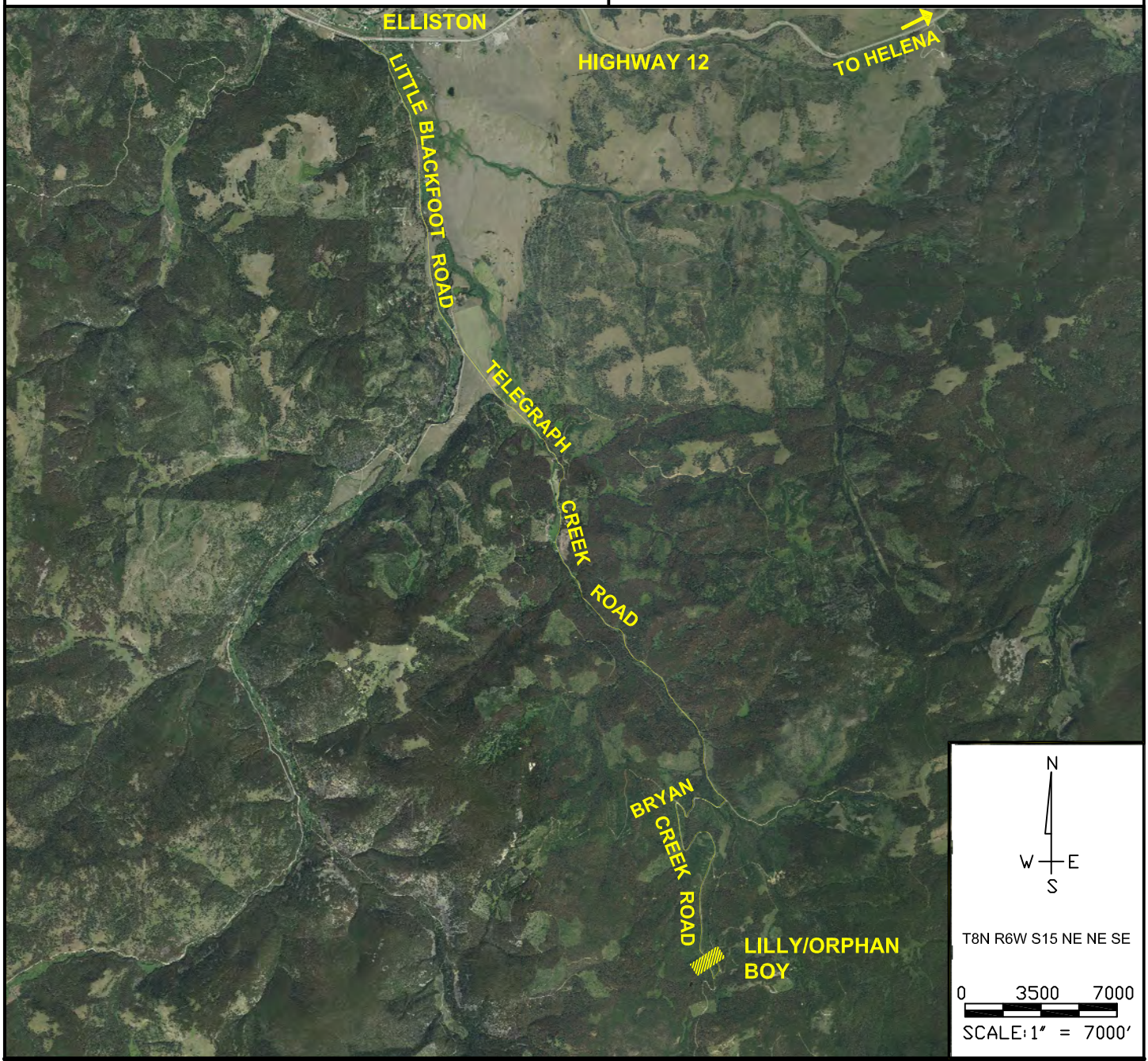
A rise in the price of metals soon after the onset of the Great Depression rejuvenated active interest in the Lilly and Orphan Boy Mines. A new lease was issued by Powell County to a Butte miner named Ed Linquist around 1934. In 1943, Powell County entered into a new lease agreement on the Lilly/Orphan Boy claims with Dave and Leo Newman, who had been mining at other properties in the Telegraph Creek area for the previous several years. It is reported that during the period from 1934 to 1951, the mine produced a total of 1,228 tons of ore, yielding 333 ounces of gold; 12,520 ounces of silver; 2,753 pounds of copper; 85,377 pounds of lead; and 39,899 pounds of zinc (FHC 2002). The last production of ore from the Lilly/Orphan Boy Mine Site was a 50-ton shipment of ore that occurred in either 1954 or 1955.

In August 1994, MSE Technology Applications (MSE) began an 11-year field demonstration for the US Environmental Protection Agency (EPA) and the US Department of Energy (DOE) at the Lilly/Orphan Boy Mine Site to treat and control the acid rock drainage (ARD) of metal and arsenic contaminated water by introducing organic material into the workings to promote sulfate-reducing bacteria. The study was concluded in July 2005. As part of the technical study, five monitoring wells were installed on the Lilly/Orphan Boy Mine Site: two angled wells were constructed near the head frame and main shaft; two injection wells were drilled vertically into the Lilly tunnel; and one "tunnel" well was installed downgradient of the injection wells to monitor treated water prior to its discharge at the end of the collapsed adit. Water filling the mine workings (lower shaft and Lilly tunnel) was presumed groundwater by MSE during their investigation (MSE 2008). Other characteristics of the site include a headframe and 250-foot deep shaft, three collapsed adits, and three waste rock piles.

This SAP/QAPP describes the sampling program for the onsite soil and water samples and discusses the analysis for the repository and the borrow areas. A Health and Safety Plan (HASP) has also been prepared as a separate stand-alone document and is included in Appendix B of the Phase II Reclamation Work Plan (RWP).

SITE LOCATION MAP





TerraGraphics Environmental Engineering, Inc.	SCALE: As shown DRAWN BY: TS ENGINEER: TS	PROJECT: *LILLY/ORPHAN BOY MINE* *Powell County, Montana*	PROJECT NO: 09210 DATE: 5/14/2010 FIGURE: 1

1.3 Project/Task Description and Schedule

1.3.1 Goals and Objectives

The primary objectives of the site characterization are to collect data required to:

- Characterize the spatial extent of soil contamination around the waste rock piles.
- Characterize surface and mine water.
- Identify all mine investigation activities necessary to characterize the mine workings to support a detailed evaluation of source control alternatives.

1.3.2 Resources and Relevant Deadlines

This project is being funded by DEQ Mine Waste Cleanup Bureau – Abandoned Mines Section. Field work is currently anticipated to begin in September 2010.

Planning Team Members

Planning Team Members, their affiliations, and their roles are as follows:

- Montana Department of Environmental Quality:
  John Koerth (Section Supervisor) and Pebbles Clark (Project Manager).
- TerraGraphics Environmental Engineering, Inc.:
  Tom Bourque (Project Manager), Tom Smith (Project Lead), Jeremy Mickey (Field Manager), David Hays and Russ Morrison (Environmental Scientist and Technician).

TerraGraphics staff will review technical issues. Tom Smith will discuss these issues with Tom Bourque. Based on these decisions, TerraGraphics will make recommendations to DEQ.

1.4 Data Quality Objectives

1.4.1 State the Problem

Based on the findings from the *Final Reclamation Investigation Report, Lilly/Orphan Boy Mine Site, Powell County, Montana* (Tetra Tech 2009) and from recent observations by TerraGraphics personnel during field visits in 2009 and 2010, human health risks and environmental risks to aquatic life exist at this site. The known contaminants of concern (COCs) at the site are: arsenic, cadmium, copper, lead, manganese, and zinc. These COCs have been found in the soil, sediment, surface water, groundwater, and mine water discharge at the site. The waste rock piles onsite also contain these COCs; one waste rock pile, WR-3, is in direct contact with surface water in Telegraph Creek and the mine water discharge originating from the collapsed adit above Telegraph Creek. Other risks at the site include safety hazards associated with open mine workings, potential subsidence, and abandoned mine equipment.

1.4.2 Identify the Decision

Soil, surface water, groundwater, and mine water samples will be collected for those analytes shown in Table 1. Soil concentrations will be compared to recreational risk-based cleanup goals. Surface water, groundwater and mine water will be compared to Circular DEQ-7. Site concentrations above the relevant standards will be identified.

1.4.3 Identify the Inputs to the Decision

1.4.3.1 Information Needed

In order to meet the objectives and goals of the Phase II RWP, the following information will be collected:

1. Define the extent of heavy metals contamination at the site and set baseline information through geochemical and physical analysis of the surficial soil.
2. Gather analytical and physical baseline information of the surface water chemistry and stream discharge that flows through the site.
3. Gather analytical and hydrogeologic data for the evaluation of groundwater quality, quantity, and flow direction as identified in the Hydrogeology Investigation Plan.
4. Gather analytical and physical data to characterize the mine water chemistry in the underground mine workings located at the site.

1.4.3.2 Sources for Information

Existing information has been gathered and summarized from the *Final Reclamation Investigation Report, Lilly/Orphan Boy Mine Site, Powell County, Montana* (Tetra Tech 2009) and the *Final Report – In Situ Source Control of Acid Generation Using Sulfate-Reducing Bacteria* (MSE Technology Applications, Inc. June, 2008).

1.4.3.3 Sampling and Analysis Methods

Samples will be collected in general accordance with the sampling plan described in Section 2.1. All sample handling procedures will follow the guidelines for handling and documentation discussed in Sections 1.5.2 and 2.6.

Soil, surface water, groundwater, and mine water samples will be analyzed using the following methods:

- Surface water, groundwater, and mine water samples will be collected for water quality analyses and analyzed according to the constituents shown in Table 1.
- Surficial soil samples will be collected for geochemical analyses and analyzed according to the constituents shown in Table 1.

Table 1. Parameters, Methods, and Reporting Limits for Analyses

Parameter	Analyte	Method	Report Limit[a]
Surface water, Mine water, and Groundwater:			
Physical Properties (for all water samples)	pH	A4500-H B	0.1 s.u.
	Conductivity	A2510 B	1umhos/cm
	Total Dissolved Solids[b]	A2540 C	10 mg/L
	Total Suspended Solids[b]	A2540 D 06	10 mg/L
	Acidity-Total as $CaCO_3$[c]	A2310 B	None
Dissolved Inorganics (for all water samples)	Bicarbonate as HCO_3[d]	A2320 B	4 mg/L
	Carbonate as CO_3[d]	A2320 B	4 mg/L
	Chloride	EPA 300.0	1 mg/L
	Sulfate	EPA 300.0	1 mg/L
Inorganics (for all water samples)	Alkalinity, Total as $CaCO_3$	A2320 B	4 mg/L
	Bicarbonate as HCO_3[b]	A2320 B	4 mg/L
	Carbonate as CO_3[b]	A2320 B	4 mg/L
	Chloride	EPA 300.0	1 mg/L
	Sulfate	EPA 300.0	1 mg/L
Metals (Surface water samples to be tested for total and dissolved metals, per DEQ-7.) (Mine water samples to be tested for total metals.) (Groundwater samples to be tested for total metals only.)	Aluminum (Total and Dissolved)	EPA 200.8	0.03 mg/L
	Arsenic (Total and Dissolved)	EPA 200.8	0.003 mg/L
	Cadmium (Total and Dissolved)	EPA 200.8	0.00008 mg/L
	Calcium (Dissolved)	EPA 200.7	1 mg/L
	Copper (Total and Dissolved)	EPA 200.8	0.001 mg/L
	Iron (Total and Dissolved)	EPA 200.7	0.05 mg/L
	Lead (Total and Dissolved)	EPA 200.8	0.0005 mg/L
	Magnesium (Dissolved)	EPA 200.7	1 mg/L
	Manganese (Total and Dissolved)	EPA 200.8	0.005 mg/L
	Potassium (Dissolved)	EPA 200.7	1 mg/L
	Sodium (Dissolved)	EPA 200.7	1 mg/L
	Zinc (Total and Dissolved)	EPA 200.8	0.01 mg/L
	Hardness, Total as $CaCO_3$		
Soil:			
Acid Base Accounting	Acid Potential w/ Sulfur Forms	Sobek Modified	0.005 t/kt
	Acid/Base Potential	Sobek Modified	-5000 t/kt
	Neutralization Potential	Sobek Modified	-5000 t/kt
Conductivity	Saturated Paste Conductivity	ASA10-3	0.01 mmhos/c
Metals- Total	Aluminum	EPA 6010.20	5 mg/kg
	Arsenic	EPA 6010.20	5 mg/kg
	Cadmium	EPA 6010.20	1 mg/kg
	Copper	EPA 6010.20	5 mg/kg

	Iron	EPA 6010.20	5 mg/kg
	Lead	EPA 6010.20	5 mg/kg
	Manganese	EPA 6010.20	5 mg/kg
	Zinc	EPA 6010.20	5 mg/kg

Notes:

a. Reporting Limits are less than or equal to Circular DEQ-7 required reporting values for PQL

b. Only surface water will be analyzed for these parameters

c. Acidity will be analyzed only if pH is less than 4.5

d. Only groundwater will be analyzed for these parameters

PQL = practical quantitation limit

mg/L = milligrams per liter

t/kt = tons per thousand ton

mg/kg = milligrams per kilogram

Nitrogen, potassium, phosphorus, organic matter content, cation exchange capacity and lime parameters are not included for analysis as the proposed sampling areas either do not have a topsoil layer or the topsoil layer is thin and previous sampling efforts have shown that the metal contamination is affecting vegetation and coversoil will need to come from an off site source.

The proposed number of samples to be obtained for analytical analyses listed in Table 1 are as follows:

- Soil – 13 samples + 1 duplicate sample + 1 field blank + 1 rinsate blank – 1 sample event
- Groundwater – 5 samples + 1 duplicate sample + 1 field blank + 1 rinsate blank – 1 sample event
- Surface water – 4 samples + 1 duplicate sample per quarter for one year
- Mine water – 20 samples + 1 duplicate sample – 1 sample event

The laboratory analyzing the environmental samples will be a DEQ contracted laboratory. Laboratory analyses will be performed with routine turn-around times. Associated lab quality controls are sufficient to support decisions based on these results.

1.4.3.4 Data Uses

The parameters listed in Table 1 are defined and data uses are listed in Table 2.

Table 2. Analytical Parameter Definitions and Data Uses

Parameter	Analyte	Definition	Data Use(s) / Comments
Surface water, Mine water, and Groundwater:			
Physical Properties	pH	pH is a measure of how acidic/basic water is. The pH of water determines the solubility and bioavailability of chemical constituents such as nutrients and metals.	In the case of metals, the degree to which they are soluble determines their toxicity. Metals tend to be more toxic at lower pH because they are more soluble.

	Conductivity	Conductivity (specific conductance) is a measure of the ability of water to conduct an electrical current. Conductivity is an important water-quality measurement because it gives a good idea of the amount of dissolved material in the water.	Conductivity can be used for comparing with other water quality parameters to show potential gross errors in analysis. For example, an increase or decrease in conductance of a particular water source will result in a similar increase or decrease in other water quality parameters such as total dissolved solids, sulfate, and metals. If this is not observed, analysis should be considered suspect and repeated.
	Total Dissolved Solids	TDS is the measure of the amount of material dissolved in water (mostly inorganic salts). Total dissolved solids should approximate the sum of all dissolved cations and anions analyzed in a water sample.	TDS will be used primarily as a general check of other water quality parameters and for the correlation of other analytes to decrease sample costs during monitoring. For example, sulfate concentration can be calibrated to TDS allowing reduction in frequency of analysis of either parameter.
	Total Suspended Solids	Total suspended solids (TSS) is a measure of all suspended (not dissolved) particles in a solution that do not pass a given filter size. These are small particles of solid contaminants that resist separation by conventional methods.	TSS is a commonly measured water quality parameter. Waters high in suspended solids may be aesthetically unsatisfactory for purposes such as recreation or drinking. Suspended solids can be used as a surrogate for measurement of pathogens since direct measurement of pathogens is extremely difficult.
	Acidity - Total as $CaCO_3$	Acidity is the capacity of a system to neutralize base. The more acid a solution, the more base that must be added to raise the pH to an acceptable level.	By monitoring acidity in runoff, receiving waters, and mine waste, it can be determined when acid is being produced. The ability to define the amount of base (based on the acidity of the solution) that must be added to raise the pH to a certain level is important for remediation of acid mine drainage.
Inorganics (for all water samples)	Bicarbonate as HCO_3	A compound containing the HCO_3^- group, for example, sodium bicarbonate ($NaHCO_3$), which ionizes in solution (water) to produce HCO_3	Used for determining the natural buffering capacity of a solution. When acid (hydrogen ions) are added to a system, carbonate ions combine with the hydrogen ions to form bicarbonate.
	Carbonate as CO_3	The concentration of the CO_3^{-2} ion formed by the organic or inorganic precipitation from aqueous solution of carbonates of calcium, magnesium, or iron. Combined with one proton, it becomes *Bicarbonate*, HCO_3^- and with two protons, *Carbonic Acid*.	The carbonate buffer system is the most important buffer system in natural surface waters, consisting of a carbon dioxide, water, carbonic acid, *Bicarbonate*, and c*arbonate* ion equilibrium that resists changes in the water's pH. When acid materials (hydrogen ions) are added to this buffer solution, the equilibrium is shifted and carbonate ions combine with the hydrogen ions to form bicarbonate. Subsequently, the bicarbonate then combines with hydrogen ions to form carbonic acid, which can dissociate into carbon dioxide and water. Thus the system pH is unaltered even though acid was introduced.
	Chloride	Concentration of dissolved chloride ions in solution.	Material which have a high content of chloride develop hydrochloric acid and affect the pH balance of a solution.

	Sulfate	Sulfate (SO_4^{2-}) is a naturally occurring ion and may be present in waters over a wide concentration range. SRB reduce sulfate to sulfide during the course of their growth process.	Acidic drainage may contribute large amounts of sulfate from oxidation of pyrite and other sulfide minerals. Increased levels of sulfate are usually the first indication of acid generation. Sulfate concentration monitoring can be used to indirectly verify the existence and proliferation of SRB in the mine water. Sulfate can be used primarily for the correlation of other analytes (metals) to decrease sample costs during monitoring.
	Alkalinity, Total as $CaCO_3$	Alkalinity is the capacity of a system to neutralize acid. It is quite common to add alkalinity to a water source to raise the pH. Alkalinity is commonly added in the solid form of calcium carbonate ($CaCO_3$), aka- limestone.	When limestone dissolves in water, the calcium carbonate molecule dissociates and large concentrations of CO_3^{2-} are released into solution which will chemically bond with H^+ ions. When all the H^+ ions have chemically bonded with the CO_3^{2-} molecules, CO_3^{2-} and HCO_3^- will accumulate in solution, increasing the alkalinity of the water source and also raising the pH.
Metals (Surface water - total and dissolved metals.) (Mine water samples - total metals only.) (Ground-water - total metals only.)	Al, As, Cd, Ca, Cu, Fe, Pb, Mg, Mn, K, Na, and Zn	Metal leaching into the environment is the principal concern of acidic drainage. Metal analysis is one of the key parameters in assessing the impacts of mine waste and for determining the effectiveness of reclamation.	Metal analyses of water samples are applicable for evaluating the quality of water that will contact mine waste, determining and monitoring the water quality of runoff, receiving surface water, and groundwater after it has contacted mine waste.
	Hardness, Total as $CaCO_3$	The Total Hardness of water represents primarily the total concentration of Calcium and Magnesium ions expressed as calcium carbonate.	Freshwater Aquatic Life Standards shown in DEQ-7 for Cd, Cu, Cr, Pb, Ni, Ag, and Zn are expressed as a function of total hardness (mg/l, $CaCO_3$).
Soil:			
Acid Base Accounting	Acid Potential w/ Sulfur Forms	Acid-Base Accounting (ABA) is the balance between the acid-production and acid-consumption properties of a mine-waste material. The Modified Acid Base Accounting method calculates AP based on the sulfide sulfur content.	Minerals in mine waste material (mostly sulfides) react with water and oxygen to produce sulfuric acid. Acid leaches metals from material and introduces them into the environment. The type of sulfide minerals present affects the rate of acid generation.
	Acid/Base Potential	AP is the sulfur content (expressed in weight percent) of a sample multiplied by the conversion factor 31.25.	The net neutralizing potential (NNP), or acid-base account (ABA) is determined by subtracting the AP from the NP and is a measure of the difference between the neutralizing and acid forming potentials. The value for NNP may be either positive or negative.
	Neutralization Potential	Neutralization potential (NP) is a measure of the carbonate material available to neutralize acid.	NNP values less than 20 (kg $CaCO_3$/ton) are likely to form acid. Those with NNP values greater than 20 are not likely to form acid. For NNP values between -20 and 20 it is difficult to determine the acid potential.

Conduct-ivity	Saturated Paste Conductivity	Electrical conductivity (EC) is the most common measure of soil salinity. The sample is saturated with distilled water and mixed to the consistency of a paste. After standing for one hour, the salts will dissolve and the electrical conductivity of water extracted from the paste is measured using electrodes.	Salinity is a soil property referring to the amount of soluble salt in the soil. It is generally a problem in arid and semiarid regions. Plants are detrimentally affected, both physically and chemically, by excess salts in some soils and by high levels of exchangeable sodium in others.
Metals - Total	Al, As, Cd, Cu, Fe, Pb, Mn, and Zn	Metal leaching into the environment is the principal concern of acidic drainage. Metal analysis is one of the key parameters in assessing the weathering characteristics of mine waste.	Metal analyses of soil samples are applicable for evaluating the quantity of material that will require reclamation, predicting the water quality of runoff, and determining the reclamation techniques to be implemented.

1.4.4 Define the Boundaries of Cleanup and Remediation

1.4.4.1 Target Population

The target population(s) for these sampling efforts includes soils from approximately 0-3 inches in depth, surface water samples of Telegraph Creek upstream and downstream of the subject site, groundwater samples collected from new monitoring wells and piezometers installed at the site, and mine water samples obtained while dewatering the underground mine workings and performing the activities included in the Hydrogeology Investigation Plan.

1.4.4.2 Spatial Boundaries

Data collection will be concentrated on areas within the Lilly patented claim site and along Telegraph Creek upstream and downstream of the subject site. The locations of the soil, mine water, and groundwater sampling sites are shown on Figure 2. The locations of the surface water sampling sites are shown on Figure 3. Some sampling efforts may extend outside these boundaries as deemed appropriate by DEQ.

1.4.5 Time Frame

Updates to this document will occur on an as-needed basis to accommodate changes to the sampling program.

Field work and quarterly surface water sampling shall be performed in accordance with the schedule included in the task order to perform the work. TerraGraphics will develop a tentative schedule for sampling and analysis as well as submittal of a Phase II Reclamation Investigation (Phase II RI) Report in accordance with the schedule included in the task order to perform the work.

1.4.5.1 Constraints

Holding time limitations for water samples are presented in Table 4.

Practical constraints on collecting environmental data include sample refusals caused by excessive vegetation, tree roots, hard rock areas, and other sampling obstacles. If obstacles are encountered, a new subsample location will be chosen.

Constraints also include equipment failures, which will be resolved within 24 hours or as soon as feasibly possible.

Sampling may also be hindered by weather constraints such as snow cover and blizzards (winter and spring sampling periods) and/or thunderstorms. Sampling activities will recommence after weather hazards have cleared.

1.4.6 Develop a Decision Rule

1.4.6.1 Decision Parameters and Action Levels

The reporting limits for water and soil samples are presented in Table 1. Analytical results for the constituents of concern from water samples collected prior to any remedial or reclamation action will be compared to the standards presented in Circular DEQ-7 to gain an understanding of the baseline water quality data for the site.

The subject site does not have suitable sources of borrow or cover soil, nor is there an appropriate location for a repository that could accept the volume of on-site mine waste. As part of the Phase II RI Report, a GIS evaluation of possible borrow sources and repository locations will be made through review of aerial photographs, USGS topographic quadrangles, and land ownership layers. A search radius of approximately 10 miles will be used to complete this evaluation.

1.4.6.2 Decision Rule

The potential receptor at the site is a recreational user. Targeted reclamation of the site will be necessary if levels of COCs in the soil samples exceed the recreational risk-based clean-up goals developed in the Reclamation Investigation Report (Tetra Tech 2009). The recreational risk-based clean-up goals are based on the 50 day gold panner/rock hound scenario. A reclamation plan targeting the removal of the COC's is anticipated to ensure removal of other potential contaminants associated with the previous mining operations at the site.

1.4.7 Specify Tolerable Limits on Decision Errors

There are inherent errors throughout the data collection and analysis process. These errors can be introduced during physical sample collection, sample handling, sample preparation, sample analysis, data reduction, transmission, and storage. Samples will be collected and analyzed in accordance with the sampling methodologies described in Section 2.1 and handled following the procedures discussed in Section 2.6. In addition, the quality assurance/quality control (QA/QC) requirements and data review and validation procedures discussed in Section 2.3 and Section 4.0 will be applied to samples collected during each sampling event. Therefore, the amount of error throughout the data collection and analysis process will be reduced and the ramifications of these errors are anticipated to be few.

Section 2.0 outlines all the specified tolerable limits and decision errors for the data obtained during this project.

1.4.8 Optimize the Design for Obtaining Data

Some degree of judgment was used in siting the sample locations shown on Figures 2 and 3. Actual field conditions may require adjustment of the final sample locations based on physical

NOTE:
Metals concentrations (mg/kg) shown are soils sampling results obtained from table in Appendix D of the 2009 RI Report.

N

0 50 100

SCALE: 1" = 50'

EDGE OF WATER

SS-16
AS 725
PB 534

SW/SD-03
AS 294
PB 50
MN 5930
ZN 823

SS-17
AS 641
PB 834

TELEGRAPH CREEK

BRYAN CREEK ROAD

WASTE ROCK PILE 1

BG-03
AS 57
PB 42
FE 16,000

SS-06
AS 188
PB 244

SS-07
AS 11,600
PB 2,300

STEEL SHAFT COLLAR AROUND MINE SHAFT

MW-INJECTION 2

ADIT

BG-02
AS 159
PB 228
FE 15,800

SS-02
AS 6,420
PB 7,840

SS-05
AS 1,370
PB 1,190

FENCE

HEAD FRAME

MW-DRIFT

WASTE ROCK PILE 3 EAST

SW/SD-04
AS 24,400
PB 1,670
ZN 554

WASTE ROCK PILE 3 WEST

SS-13
AS 74,100
PB 7,440

WASTE ROCK PILE 2

SS-08
AS 793
PB 608

SS-03
AS 36,600
PB 43,800

SS-11
AS 6,640
PB 622

SS-15
AS 31,200
PB 1,320

SS-09
AS 8,180
PB 19,900

SS-04
AS 444
PB 501

MW-SHAFT

SS-10
AS 734
PB 909

SS-01
AS 140
PB 117

CABIN

SS-12
AS 5,060
PB 6,040

SD-05
AS 160
PB 13
ZN 967

MW-LOBIII

MW-INJECTION 1

BUILDING RUINS

SS-14
AS 5,120
PB 1,610

ADIT

SW/SD-02
AS 19,300
PB 298

EDGE OF WATER

SW/SD-01
AS 327
PB 34
MN 1,670

TOP OF CUT (TYP)

BG-01
AS 21
PB 35
FE 9,990

LEGEND

- ADIT
- CULVERT
- PROPOSED SOIL SAMPLE
- MARCH 2009 RI SAMPLE LOCATION
- SWAMP
- MAJOR CONTOUR (3575)
- MINOR CONTOUR
- EDGE OF ROAD
- DITCH
- FENCE
- MARCH 2009 RI WASTE ROCK BOUNDARY

DRAWN: TLS	PROJECT NO.: 09210	TerraGraphics Environmental Engineering, Inc.	PROPOSED SAMPLING LOCATIONS
ENGINEER: TLS	SCALE: AS SHOWN		SITE MAP
CHECKED: JCM	APPROVED: TLS		LILLY/ORPHAN BOY ABANDONED MINE SITE
	DATE: 8/19/10		FIGURE: 2
			DATE: 8/19/2010

NOTE:
Surface water sampling stations LOB-SW01 and LOB-SW03 are the same sample locations sampled for the 2009 RI Report.

N

0 50 100

SCALE: 1" = 50'

TOP OF CUT (TYP)
TOP OF BANK (TYP)
EDGE OF WATER
12" CMP
PROPERTY BOUNDARY
LOB–SW03
LOB–SW06
TELEGRAPH CREEK
BRYAN CREEK ROAD
WASTE ROCK PILE 1
WASTE ROCK PILE 3 EAST
WASTE ROCK PILE 3 WEST
WASTE ROCK PILE 2
STEEL SHAFT COLLAR AROUND MINE SHAFT
ADIT
FENCE
HEAD FRAME
DRAINAGE DITCH (?)
POND
Ponding area and ditch up above the Lilly/Orphan Boy workings.
WEIR
ADIT
EDGE OF WATER
LOB–SW01
New Weir at Collapsed Adit
BUILDING RUINS
CABIN
TOP OF CUT (TYP)
BUILDING RUINS
TOP OF CUT (TYP)
TOP OF CUT (TYP)
16–DJA 1" RPC
17–DJA 1" RPC
LOB–SW05
BRYAN CREEK ROAD
TELEGRAPH CREEK
cabin

LEGEND

- ADIT
- CULVERT
- PROPOSED SURFACE WATER SAMPLE SITE
- SWAMP
- 3575 MAJOR CONTOUR
- MINOR CONTOUR
- EDGE OF ROAD
- DITCH
- FENCE
- MARCH 2009 RI WASTE ROCK BOUNDARY

DRAWN: TLS	PROJECT NO.: 09210	TerraGraphics Environmental Engineering, Inc.	FIGURE: 3
ENGINEER: TLS	SCALE: AS SHOWN	SURFACE WATER SAMPLING LOCATIONS	DATE: 8/19/2010
CHECKED: JCM	APPROVED: TLS	SITE MAP	LILLY/ORPHAN BOY ABANDONED MINE SITE
	DATE: 8/19/10		

barriers or the judgment of the sampler. The locations of the sampling sites were selected using best professional judgment based on: i) regulatory requirements; ii) information known about the site from site visits, geologic maps, historic data, and aerial photographs; and iii) the goals of the Phase II RI. Sample locations will be recorded with a sub-meter accuracy GPS (Trimble GeoXM or GeoXT).

1.5 Documentation and Records

This section describes sample handling and documentation procedures. The procedures described are designed to provide a thorough record of events surrounding the collection of each sample, and to ensure, as far as can be accomplished in the field, that data collected are usable.

1.5.1 Field Operation Records

Permanently bound field logbooks with water-proof paper will be used due to their compact size, durability, and secure page binding (e.g., Rite in the Rain®). Field logbooks will be pre-numbered and will contain the date and signature lines. Entries will be made in black, waterproof, indelible ink throughout each workday.

Logbooks will document the procedures performed by field personnel. Each entry should be dated, legible, and contain accurate and complete documentation of the individual's activities. Documentation in the field logbook will be at a level of detail sufficient to explain and reconstruct field activities without relying on recollection by the field team members. Because the logbook is a complete documentation of field procedures, it should contain only facts and observations. Language should be objective, clear, concise, and free of personal interpretation or terminology which might be misconstrued.

No erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark and the change initialed and dated by the team member making the change.

Field logbooks will be identified by the project name and a project-specific number, and stored in the field project files when not in use. Field logbooks will be photocopied after the field investigation, and photocopies will be provided to DEQ in the Phase II RI Report and stored in the project files.

1.5.1.1 Sample Collection Records

Entries into the logbook or other relevant sampling forms for sampling events may include, but are not limited to, the following:

- The name of the project and sampling personnel.
- The date, time, number, and media of the sample.
- The sample preservation and the analyses requested.
- Type and quantity of containers used for each sample.
- A cross-reference of numbers for field duplicates and blank samples.

- A sketch and description of the geographical location of the sample location in reference to site facilities or structures (e.g. trees, roads, etc.). Sample locations will be recorded with a sub-meter accuracy GPS (Trimble GeoXM or GeoXT).
- Information such as well depth, well diameter, sampling device, pump placement, water level (static), water level (pumping), and pump rate.
- The method of sampling, including procedures, equipment, and any departure from the procedures specified in the SAP/QAPP.
- The results of field measurements (e.g., water quality measurements).
- Weather conditions at the time of sampling and other events which may influence the representative nature of a sample. At a minimum, include the temperature and sky cover.
- Descriptions of photographs including: why it was taken, the date and time it was taken, the location and compass direction of the picture, and photograph number.
- Disposition of the sample (i.e., where it is being analyzed).
- Tracking number of sample shipment when applicable.
- Other pertinent observations, such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passersby), and actions by others that may affect performance of site tasks.

Each collected sample will have a unique identification code that will catalog the sample site, the sample type, and the sampled depth. The field sample ID number will be recorded on the sample tag and/or label and coded as follows:

1. The first three numbers will identify the project area:
   - LOB - Lilly/Orphan Boy
2. The next four positions identify the sample location and the sample number:
   - SW01 – Surface water sample from station 1
   - SG02 – Soil grab sample from location 2
   - MW03 – groundwater sample from monitoring well 3.
   - SH01 – Mine water sample number 1 from the shaft
     - Notes in log book or sample sheet will include depth sample was obtained and any other pertinent information
   - AD01 – adit discharge water sample 1
3. The next letter indicates if the sample is a QA/QC sample:
   - A – Actual Sample
   - B – Field Blank
   - C – Rinsate Blank
   - D – Duplicate

4. The last eight numbers are the date

- 20100723 for July 23, 2010

An example of a complete sample ID number could be: LOB-SW04-D-20100709, which is the Lilly/Orphan Boy site, surface water sample, and is a duplicate collected on July 9, 2010.

Sample labels, whether blank or pre-printed, will contain an abbreviated summary of the logbook entry for the sample. The following information should be included on sample container labels:

- Sample identification number,
- Date and time of sampling,
- Initials of sampling personnel, and
- Type of sample preservatives added.

1.5.1.2 Chain-of-Custody Records

Verifiable sample custody is an integral part of all field and laboratory operations associated with this site investigation. The primary purpose of chain-of-custody procedures is to document the possession of the samples from collection through storage and analysis to reporting. Chain-of-custody forms will become the permanent record of sample handling and shipment. The Field Manager, or his/her designee, will be responsible for monitoring compliance with chain-of-custody procedures.

Field sampling personnel are responsible for the care and security of samples from the time the samples are collected until they have been turned over to the analytical laboratory. A sample is considered to be in one's custody if it is in plain view at all times, in the physical possession of the sampler, or stored in a locked place where tampering is prevented. All samples will be stored in shipping coolers immediately following sample collection.

Chain-of-custody forms will be filled out at the end of each day. Each chain-of-custody form will contain the following information:

- Sample identification numbers;
- Date and time of sampling;
- Sample matrix;
- Number of sample containers associated with each sampling point;
- List of analyses requested;
- Name and signature of sampling personnel;
- Shipping number, when applicable; and
- Spaces for transfer of custody acknowledgment.

When the chain-of-custody form is complete, field team members will cross-check the form against the labeled samples for possible errors. Any corrections will be made to the record with a single strike mark that is dated and initialed. The person who initials corrections will be the same person that relinquishes custody of the samples.

Samples will be delivered to the analytical laboratory by the sampling crew. The chain-of-custody form will be signed and dated, placed in a sealable plastic bag, and either placed on top of the samples or taped to the inside lid of the cooler. If additional coolers are required, each cooler will have a chain-of-custody form for the contained samples.

1.5.1.3 Quality Assurance/Quality Control Sample Records

Quality Assurance/Quality Control (QA/QC) samples (i.e., field and equipment rinsate blanks, and field duplicates) will be documented in the field logbook. This documentation will include custody seals, calibration history, level of standards, and the frequency and type of the QA/QC sample.

1.5.1.4 General Field Procedures

All field procedures will be documented in the field logbook and will specify the method of collection, location, and other potential areas of difficulty in the actual gathering of the specimens.

1.5.1.5 Corrective Action Reports

Should the primary method of sample collection fail, the corrective action or alternative method will be documented in the field logbook and reported in the subsequent final Phase II RI Report.

1.5.2 Laboratory Records

1.5.2.1 Sample Data

The laboratory will follow the *Final USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 2004), which includes the recording of the dates and times that samples were analyzed to verify holding times were met. The overall number of samples, sample location information, and date will be reported as well as any corrective action procedures for samples violating the work plan protocol.

1.5.2.2 Sample Management Records

The laboratory will provide original sample analysis documentation to TerraGraphics and to Pebbles Clark, of DEQ. After a technical data review the data will be included in the Phase II RI Report.

1.5.2.3 Test Methods

The test methods used will be those identified as appropriate for the specific analyses listed in Table 1. Should an alternative analysis be required, the laboratory will document and describe how the analyses were carried out in the laboratory. This will include sample preparation and analysis, instrument standardization, detection and reporting limits, and test-specific QC criteria.

1.5.2.4 Quality Assurance/Quality Control Reports

Laboratory QA/QC will follow EPA guidance (EPA 2004). The report will include blanks, matrix spikes, matrix spike duplicates, and laboratory duplicates. TerraGraphics will complete an internal QA/QC to ensure the validity and usability of the data.

1.5.3 Data Handling Records

The laboratory's quality assurance personnel will perform the preliminary QA/QC. TerraGraphics will perform the data validation. The data validation will convert raw data into reportable quantities and units by the proper use of significant figures, recording extreme values, and identification of any data qualifiers. The data will then be transmitted electronically to TerraGraphics which will perform an internal data validation, and report the data in summary tables in the Phase II RI Report.

Section 2.0 Measuring Data Acquisition

This section describes the field activities that will be conducted at the Lilly/Orphan Boy site. The field activities consist of the following:

- Surficial soil sampling to delineate the extent of surface contamination as it extended further than anticipated in the 2008 RI activities.
- Drilling and installation of 5 monitoring wells and up to 4 piezometers around the underground workings for the evaluation of groundwater flow, groundwater connection with the workings, and groundwater quality (in the monitoring wells only).
- Sampling of the raw mine water as it is removed from the workings and monitoring of treated water to meet water quality requirements.
- Quarterly sampling of surface water from Telegraph Creek to establish a baseline on the water quality prior to any removal activities. At this time we anticipate that quarterly sampling will occur for one year; however, the length of time will be per approval of DEQ.

2.1 Sampling Process Design

2.1.1 Soil Sample Collection

Up to 13 soil samples will be obtained from 0-3 inches below ground surface using clean trowels. Soil samples will be placed in quart-size or larger Ziploc® bags or whirl-pak bags and labeled with the sample number, location, time, date, and other required information. The soil samples will be analyzed for the constituents shown in Table 1.

2.1.2 Groundwater Sample Collection

Five groundwater wells will be installed at the site as part of the Reclamation Investigation Work Plan (RWP) (Figure 4). The monitoring wells are proposed to be sampled one time prior to commencement of dewatering activities. The hydrogeology investigation methods to be used during the Phase II RI are discussed in the Hydrogeology Investigation Plan. The methods for collecting groundwater will vary depending on well depth and completion details. The proposed methods include: hand bailing, peristaltic pumping, and submersible pumping. The samples will be analyzed for total metals to allow comparison with the mine water quality. The samples will be deposited directly into pre-preserved, laboratory supplied bottles as described in Table 4. Table 4 also lists preservation requirements for groundwater constituents.

2.1.2.1 Monitoring Well Purging Procedure

If a pump is used for purging, the pump intake will be positioned at a level at/or slightly above the mid-point of the screened interval. During pump deployment, care will be taken to gently insert the pump to minimize the disruption of potential fine-grained sediment that may have accumulated in the well. The flow rate will be measured by filling a 5-gallon container and measuring the rate of filling using a stop watch. During purging, the water level in the well will be monitored using a water level meter.

A low-flow, minimal drawdown technique will be used for groundwater purging and sampling depending on the depth to groundwater. This technique is described below and in *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures* (Puls and Barcelona 1996) and *Standard Operating Procedure for Low-Stress (Low Flow)/Minimal Drawdown Ground-Water Sample Collection* (USEPA 2008b). This procedure minimizes disturbance to the aquifer and is designed to ensure that samples collected from the well are representative of groundwater.

Purging and sampling of the groundwater monitoring wells will be performed with a non-dedicated bladder pump suitable for low-flow sampling. The pump will be attached to a chemically inert discharge line and an air line, and suspended in the well. The air line will extend to the ground surface where it will be connected to an oil-less compressor. The chemically inert discharge hose will also extend to the surface where it will be attached to a discharge port. Purging will proceed by pumping groundwater from the well at a rate of approximately 0.2-0.3 liters per minute. During purging, the water level in the well will be monitored to ensure that the water level drawdown is stable and that water is not allowed to cascade down the sides of the well screen.

During purging, specific conductance, temperature, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured using either a flow cell or in a 5-gallon bucket. The flow cell will be calibrated each morning prior to sampling according to manufacturers' instructions. The well will be purged by using the parameter stabilization method, which is the preferred method for low-flow sampling. Water quality measurements will be taken at the start of the purging, and when readings have stabilized over three measurements, purging may cease and samples may be collected. According to Puls and Barcelona (1996), the general order of stabilization is pH, temperature, and specific conductance followed by ORP and DO. Stabilization is reached when three successive readings are within ± 0.2 for pH; ± 0.3 milligrams per liter (mg/L) for DO; and ± 20 millivolts for ORP. All water quality measurements made during purging will be recorded on a groundwater sampling sheet. A copy is included in Appendix D. If one or more of the readings have not stabilized within 45 minutes after the three well volumes have been purged, samples will be collected, and the unstable readings will be noted on the sampling form.

If a standard purge and sample technique is employed, a minimum water volume equivalent to three times the well volume of standing water will be purged from the well. The volume of water present in each well shall be computed based on the length of the water column and well casing diameter. The water volume shall be computed using the following formula:

$$V = 0.041D^2\left(d_2 - d_1\right)$$

where:
- V = volume in gallons
- D = inside diameter of well casing in inches
- d_2 = total depth of well in feet

d_1 = Depth to water surface in feet

Field notes shall reflect the single well volume calculations or determinations that clearly identify the purge volume goal. Stabilization should be achieved within three well volumes. If stabilization is not achieved after removing three well volumes of groundwater, purging will continue until it does or to a maximum of five well volumes. The TerraGraphics field manager shall determine when the most representative sample can be obtained based upon available site information. With respect to groundwater chemistry, the following conditions can generally be used to determine purge stabilization: specific conductance varies no more than ten percent, and temperature and pH are constant for at least three consecutive readings. During sample collection, these field parameters will be measured and recorded.

In some instances a well may be pumped or bailed dry (evacuated). When this occurs, the well can be assumed to be adequately purged and the well can be sampled following sufficient recovery (enough volume to allow filling all sample containers). Sampling will commence as soon as possible after purging.

2.1.2.2 Sample Collection Protocol

After field parameters have stabilized or at least three well volumes have been purged, one sample will be collected from each well. The pump will not be turned off, nor will the pumping rate be changed, between purging and sample collection. The unfiltered samples will be obtained directly from the discharge port and will be collected prior to the filtered samples. The filtered samples will be collected using an in-line, disposable, cartridge filter capable of filtering to 0.45 micrometers. The cartridge filter will be attached to the sample discharge line and the filtered samples will be collected into the sample container directly from the discharge end of the cartridge filter. The field crew will collect both filtered and non-filtered samples from each well with the filtered sample being collected last. The filtered and unfiltered samples will be analyzed for the constituents identified in Table 1. All sample containers will be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

2.1.3 Mine Water Sample Collection

A minimum of 20 raw mine water samples will be obtained during mine dewatering operations. Through observation of water levels in the wells during mine dewatering operations, the information gathered will be used to estimate groundwater flow direction, infiltration rates, equilibrium levels, and hydrologic connection with the underground mine workings. The mine dewatering will include either water treatment to water quality standards determined by DEQ or land applied on the Lilly Claim and/or adjacent patent claims if permission is given by the landowners. The frequency of sampling will be based on the water treatment or application rate.

Field parameters (temperature, pH, DO, conductivity, and ORP) of the raw and treated mine water will be monitored while dewatering or land application operations are being performed. The field parameters will be recorded hourly during the day, when possible or as practical, and at least once each night, if dewatering is continuous.

2.1.4 Surface Water Sample Collection

Four surface water samples will be collected on Telegraph Creek on a quarterly basis to obtain baseline information regarding surface water chemistry upstream and downstream of the immediate area. Quarterly sampling will be performed as access allows. Field tasks associated with the surface water investigation will include: identifying and surveying each sampling station with a handheld global positioning system (GPS); measuring stream discharge at each station; field measurement and recording of chemical and physical parameters; and collecting surface water samples for laboratory analyses according to the constituents identified in Table 1. Surface water sample locations are shown in Figure 3 and are described in Table 2.

Table 3. Proposed Surface Water Sampling Locations

Station Identification (from upstream to downstream)	Surface Water Sample Location
LOB-0SW05	Approximately 530 feet upstream of Waste Rock Pile 3 where the property line crosses Telegraph Creek
LOB-SW01[a]	Approximately 70 feet upstream of Waste Rock Pile 3
LOB-SW06	Approximately 90 feet downstream of Waste Rock Pile 3
LOB-SW03[a]	Approximately 190 feet downstream of Waste Rock Pile 3

Notes:

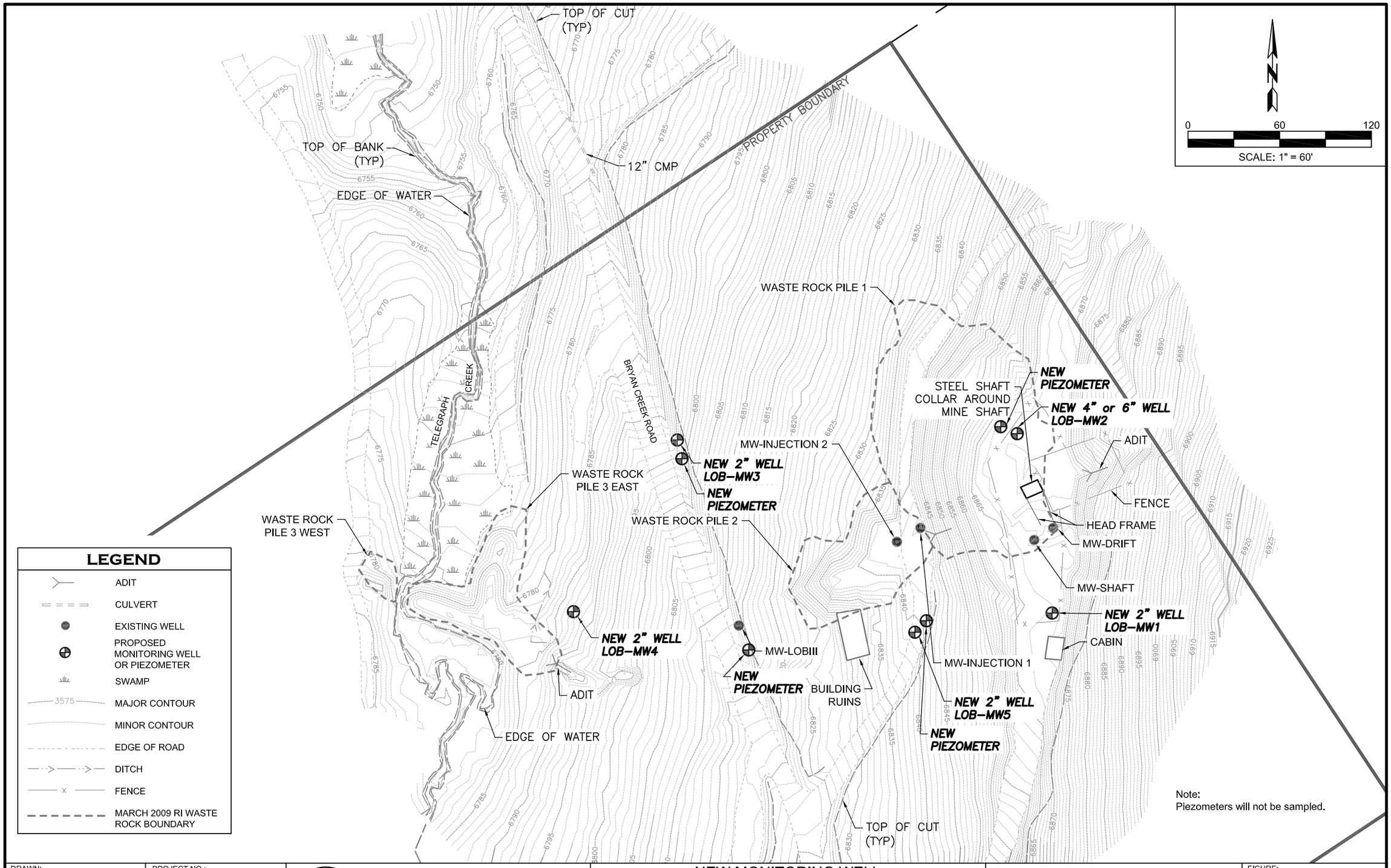
a. Same sample location as Reclamation Investigation Report (Tetra Tech 2009).

Surface water samples will be collected in general accordance with the United States Geological Survey (USGS) techniques used for water-resource investigations (Wilde et al. 1998) and summarized in Section 2.3.1. Table 4 illustrates the sample containers, preservation, and necessary filtration to use during sampling. Sample collection will proceed in a downstream to upstream direction to avoid possible contamination of downstream samples due to upstream sampling activities.

This surface water sampling procedure has been developed in general accordance with the National Manual for the Collection of Water Quality Data (Wilde, F.D., et al. 1998). The methods described below may vary or change as required depending on site conditions, lack of accessibility, and/or limitations imposed by the procedure itself. Information regarding each sample station and the samples collected will be recorded in the logbook and on the Surface Water Sampling Record Sheet attached in Appendix A. Surface water sampling will be accomplished through the use of one of the following methods that best suits the sampling situation.

2.1.4.1 Direct Method

The Direct Method will be utilized to collect water samples directly into the sample container when conditions warrant such an approach. For shallow stream situations, water will be collected from below the water surface and in an upstream direction. The sample bottles will be triple rinsed with stream water at the sample site prior to obtaining the sample.



LEGEND

- ADIT
- CULVERT
- EXISTING WELL
- PROPOSED MONITORING WELL OR PIEZOMETER
- SWAMP
- MAJOR CONTOUR (3575)
- MINOR CONTOUR
- EDGE OF ROAD
- DITCH
- FENCE
- MARCH 2009 RI WASTE ROCK BOUNDARY

Note:
Piezometers will not be sampled.

DRAWN: TLS	PROJECT NO.: 09210	NEW MONITORING WELL & PIEZOMETER LOCATIONS	FIGURE: 4
ENGINEER: TLS	SCALE: AS SHOWN	SITE MAP	DATE: 8/19/2010
CHECKED: JM	APPROVED: TLS	LILLY/ORPHAN BOY ABANDONED MINE SITE	
	DATE: 8/19/10		

TerraGraphics Environmental Engineering, Inc.

This method is not suitable when retrieving representative samples from multiple depths, or when the approach to the sampling point interferes with flow conditions or substrate that would subsequently affect the sample. This method is also not suitable when using pre-preserved sample bottles as the method may dilute the preservative concentration required for proper preservation.

2.1.4.2 Dip Sampler

The Dip Sampler will be utilized to collect samples from an outfall pipe or along a bank where access is limited. The water sample will be collected from a distance so as not to disturb the slope of the bank or other surrounding substrate. Samples will be transferred directly from the Dip Sampler into sample containers. The Dip Sampler will be decontaminated between sample locations.

2.1.4.3 Peristaltic Pump

Using a small portable generator as a power source, a "low-flow" peristaltic pump will be used to collect all filtered and possibly some unfiltered surface water samples directly from the streams. The pump intake tubing will be positioned at the mid-point of the water column using care to gently insert the pump tubing into the stream to minimize disturbing the stream sediments. The pump speed will be adjusted to achieve a uniform, laminar flow at the discharge point. Once the optimum pump speed is achieved, the pump will be allowed to run for an additional 30 seconds prior to collecting the samples. Pump speeds may need to be adjusted when using an in-line cartridge to filter the samples. The same pump speed adjustment process described above will be repeated after the filter has been installed. All sample containers will be filled directly from the peristaltic pump tubing/filter discharge with minimal turbulence by allowing the surface water to flow from the tubing gently down the inside of the container.

2.1.4.4 Stream Flow Measurements

Flow measurements will consist of one or more of the following methods: 1) Area-velocity method with an electronic hand-held flowmeter using wading technique; 2) Portable flume method; or 3) Timed volumetric method. Field personnel will estimate flow at sample locations when gauging limited amounts of water or when gauging a specific cross-section is difficult. In these cases, field personnel may estimate flow using the time-velocity method. The USGS Method for Measurement and Computation of Stream Flow is attached in Appendix B (Rantz, S.E., et al. 1982). Data collected during flow measurement at each sample location will be recorded in the logbook and on the Stream Discharge Form attached in Appendix C.

2.1.5 Sample Preservation

Soil samples will be secured in either plastic bags or whirl-pak bags, and stored in a custody-sealed cooler. Water samples will be cooled to 4ºC in a custody-sealed cooler. The custody-sealed coolers will be shipped to the DEQ contracted laboratory for analyses. The 6 month holding time for metals for soil samples should not be exceeded.

Table 4. Recommended Container, Preservation, and Holding Times for Samples

Analysis	Container and Type	Preservation	Holding Time	
Surface water, Mine water, and Groundwater				
Total Recoverable Metals	250 mL polyethylene	HNO_3 to pH < 2; Iced to 4°C	6 months	
Dissolved Metals	250 mL polyethylene	Filtered through 0.45 micron filter; HNO_3 to pH < 2; Iced to 4°C	6 months	
Ions / Physiochemical	500 mL polyethylene	Iced to 4°C	pH	Upon arrival at lab
			Total dissolved & suspended solids	7 days
			Acidity, Bicarbonate, and Carbonate	14 days
			Specific Conductivity, Chloride, Sulfate	28 days
			Common Cations and Hardness	6 months
Soil				
EPA 6010 Metals	Quart size Ziploc® bag	Ice	180 days	

2.1.6 Decontamination Procedures

2.1.6.1 Soil Collection Equipment

Field personnel will wear disposable gloves while decontaminating equipment at the project site and will be required to take precautions against contaminating themselves with the wash water and rinse water used in the decontamination process. The following procedures will be followed to ensure that non-disposable sampling equipment is thoroughly decontaminated between sample collections.

1. Visually inspect sampling equipment for soil; a stiff brush will be used to remove any visible material.
2. Wash the field equipment with phosphate-free soap (Liqui-Nox® or equivalent) and water. Rinse the field equipment with distilled water and air dry or wipe with disposable paper towels.
3. Disposable items such as paper towels, gloves, and washcloths will be deposited into a garbage bag and disposed of in a solid waste landfill. Wash and rinse water will be disposed of on site so as not to flow into an active water way.

Heavy equipment, such as excavators and drilling equipment will be scraped free of material remaining on the excavator bucket or down-hole drilling implements prior to moving to another site. The scraped materials will be placed back into the holes or land applied.

2.1.6.2 Groundwater Sample Collection Equipment

Meter probes that encounter sample water will be thoroughly rinsed with distilled water to prevent cross-contamination from one well to another. The water level indicator probe and attached tape will be thoroughly washed with a solution of laboratory-grade detergent and distilled water at the start of each monitoring event, and rinsed with distilled water prior to use in each well.

Bailers:

1. Use a dedicated, one-time bailer if a bailer is used to purge the well. A single bailer will not be used at multiple well sites to prevent cross-contaminating the wells.
2. The wetted (contaminated) portion of the bailer cord will be cut off and disposed of with the bailer.

Pumps and tubing:

1. If a pump is used to purge/sample the wells, one gallon of distilled water will be pumped through the tubing immediately after each use.
2. Wash the exterior surfaces of the pump and hose with phosphate-free soap (Liqui-Nox® or equivalent) and water.
3. Rinse with tap water and then rinse three times with distilled or deionized water.
4. Air dry the equipment before reuse.

2.1.6.3 Surface Water Collection Equipment

If surface water samples are collected using the direct method, decontamination is not necessary as new sampling containers are used at each sampling location. For the dip sampling and peristaltic sampling techniques, the following decontamination procedure will be used to ensure that non-disposable sampling equipment is thoroughly decontaminated between sample collections.

1. Wash the interior and exterior surfaces with phosphate-free soap (Liqui-Nox® or equivalent) and water.
2. Rinse the field equipment with distilled or deionized water three times.
3. Air dry the decontaminated equipment.
4. Disposable items such as paper towels, gloves, and washcloths will be deposited into a garbage bag and disposed of in a solid waste landfill. Wash and rinse water will be disposed of on site so as not to flow into an active water way.

2.2 Analytical Methods Requirements

The analytical parameters list for this project has been identified as the constituents exceeding Montana water quality standards as listed in Circular DEQ-7 (DEQ 2008). The DEQ-7 water

quality standards for metals are defined as total recoverable metals, except for aluminum. If the field measured pH for the surface water samples is between 6.5 and 9.0, an aluminum water sample will be field filtered with a 0.45 micron filter and will be analyzed for dissolved aluminum. If the field measured pH is below 6.5 or above 9.0, the aluminum water sample will be analyzed for total aluminum in general accordance with Circular DEQ-7 (DEQ 2008). For the groundwater and mine water quality comparison of water quality, only total metals will be analyzed. Tables 1 and 4 summarize laboratory analytical parameters, analytical method numbers, reporting limits, required bottle sizes, sample preservation, and holding times.

2.3 Quality Control Requirements

Quality control (QC) samples will be employed to evaluate data quality. QC sample results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of QC sample, collection and analysis frequency, and evaluation criteria are described in this section.

2.3.1 Field Quality Control Requirements

Sample QC protocols will include the collection of one field blank for every batch of samples to be submitted blind to the laboratory. Soil samples will be sent to the analytical laboratory in one batch unless DEQ requests additional testing.

2.3.1.1 Field Duplicate Samples

Field duplicates will be used as QC indicators to ensure that field sampling and laboratory methods are consistent and reliable. One field duplicate will be completed for each batch of water samples and for every 20 soil samples. Only one duplicate soil sample will be obtained; one surface water duplicate will be obtained per quarterly sampling event; one duplicate groundwater sample will be obtained per sampling event; and one duplicate mine water sample will be obtained during the mine investigation activities.

2.3.1.2 Field Blank Samples

Field blanks ensure that contaminants are not originating from the water (distilled or deionized) that is used for decontaminating field equipment. Field blanks are prepared by filling a 250 mL polyethylene container with a stream of distilled or deionized water directly from the container. Field blanks are preserved as needed for the requested analyses.

2.3.1.3 Rinsate Blank Samples

Rinsate blanks ensure non-disposable equipment is properly decontaminated and reduce the risk of cross-contamination between different sample depths and areas. The following procedure will be used to prepare a rinsate blank:

1. Spray a stream of distilled water on a decontaminated piece of equipment, such as a trowel or shovel.
2. Collect the water directly into a 250 mL polyethylene container without touching the opening of the bottle.
3. Add specified preservative (only for bottles that are not pre-preserved).

4. Screw on the cap.

2.3.2 Laboratory Quality Control Requirements

The laboratory QC requirements for this project were selected to meet the project DQOs. While the utmost effort will be made to achieve the project DQOs, there may be cases in which it is not possible to meet the specified goals. Any limitation in data quality due to analytical problems (e.g., elevated detection limits due to highly contaminated samples) will be identified within 48 hours and brought to the attention of the TerraGraphics Project Manager. In addition, this information will be discussed in the Phase II RI Report.

The QC procedures and requirements are based on current analytical protocols described in the following:

- *Final USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 2004);
- Superfund Analytical Services/Contract Laboratory Program Multi-Media, Multi-Concentration Inorganic Analysis Statement of Work, ILM05.4 (EPA 2007);
- EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2008a);

All QC measurements and data assessment for this project will be conducted from and within batches of samples from this project alone; in other words, no "other project" samples will be used with samples from this project for assessment of data quality. Examples of laboratory QC samples include method blanks, spikes, and duplicates. Documentation will include custody seals, calibration history, level of standards, and the frequency and type of the QA/QC sample. The QC sample frequencies are summarized in Table 5.

Table 5. Quality Control Sample Frequency

Quality Control Check	Frequency
Duplicates	
Field Duplicate	1:Batch/matrix
Laboratory Duplicate	1:Batch/matrix
Blanks	
Field Blank	1:Batch
Rinsate Blank	1:Batch
Laboratory Matrix Spike	1:Batch

Notes:

One batch equals 20 samples for soil

2.4 Instrument Calibration and Frequency

Instrument calibration and frequency will follow the guidance outlined in the EPA CLP SOW (EPA 2007), the *Final USEPA CLP National Functional Guidelines for Inorganic Data Review* (EPA 2004) or the EPA publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2008a). Metals analysis will use ICP-ICPMS instrumentation

with appropriate calibration and frequencies for the constituents of concern. All laboratory instruments will be maintained as specified in the QA plans submitted by the project laboratory and according to manufacturers' instructions.

Field instrumentation will be examined and tested prior to being put into service and will be maintained according to the manufacturer's instructions. Sampling personnel will maintain a supply of typical maintenance replacement items available in the field to help prevent downtime because of equipment malfunctions. Examples of typical equipment maintenance items may include but are not limited to: filters, tubing, fittings, sample containers, batteries, and calibration standards.

2.5 Data Acquisition Requirements

The DQOs for the project are designed to ensure sufficient data accuracy and precision and to certify that the data will be useful for decision making related to any proposed reclamation or remedial action, analysis or additional investigation. The data quality parameters presented in this section are: precision, accuracy (bias), completeness, and comparability.

2.5.1 Precision

Precision is a measure of data variation when more than one measurement is taken on the same sample. The precision estimate for duplicate measurements can be expressed as the RPD:

$$RPD = \left| \frac{(C_1 - C_2)}{\left(\frac{(C_1 + C_2)}{2} \right)} \right| \times 100\%$$

where: RPD = relative percent difference
C_1 = concentration of QA/QC sample
C_2 = concentration of associated original

The resultant RPD will be compared to the acceptance criteria present in Table 6 and deviations from specified limits will be reported. If the objective criteria are not met, the laboratory will supply a justification of why the acceptability limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data quality review, deviations from the specified limits will be noted, and the effect on reported data commented upon by the data reviewer. Laboratory duplicate measurements will be obtained for each set of samples submitted and analyzed.

2.5.2 Accuracy

Accuracy of laboratory analysis is assessed by measuring spiked samples. Laboratory reference materials are utilized to calibrate laboratory measurement instruments.

Spike recovery is determined by splitting a sample into two portions, spiking one portion with a known quantity of a constituent of interest, and analyzing both portions to determine spike recovery. Spike recovery is expressed as percent recovery:

$$\%R_S = \left| \frac{(SC - OC)}{TV} \right| \times 100\%$$

where: $\%R_S$ = percent recovery of spike
SC = spiked sample concentration
OC = original concentration
TV = true value of the added spike

The resultant percent recoveries will be compared to the acceptance criteria presented in Table 6 and deviations from specified limits will be reported. If the objective criteria are not met, the laboratory will supply a justification of why the acceptability limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be reviewed during data quality review, and deviations from the specified limits will be noted and the effect on reported data commented upon by the data reviewer.

2.5.3 Completeness

Completeness is an estimate of the amount of valid data obtained from the analytical measurement system for a given set of data. Percent completeness is defined as the number of samples analyzed that meet the data quality goals, divided by the total number of samples analyzed, multiplied by 100. The completeness goal for this project is 95%.

$$\%C = \left(\frac{N_q}{N_t} \right) \times 100\%$$

where: %C = percent completeness
N_q = number of quality samples (i.e., those that meet data quality acceptance criteria)
N_t = total number of samples analyzed

Non-valid data (i.e., data qualified as "R" rejected) will be identified during the QA review (section 2.6.1).

2.5.4 Comparability

Using standard EPA protocols, all matrix-specific samples will be collected, processed, and analyzed at sufficient detection limits, precision, and accuracy for correlation with other data collected at the Lilly/Orphan Boy Mine.

Table 6. Data Quality Criteria

Data Quality Parameter	Acceptable Criteria
Precision	±20%
Accuracy	75% - 125%
Completeness	95%

2.6 Data Management

2.6.1 Data Recording

The laboratory will maintain detailed procedures for laboratory record keeping supporting the validity of all analytical work. Each data report package submitted to TerraGraphics will contain written certification that the requested analytical method was run and that all QA/QC checks

were performed. The laboratory program administrator will provide TerraGraphics with QC reports of their external audits if appropriate, which will become part of the central project files.

2.6.2 Data Transformation

Laboratory qualifiers as described and defined in the laboratory QA plans will include:

- Concentration below required reporting limit,
- Estimated concentration due to poor spike recovery,
- Concentrations of the chemical also found in laboratory blank, and
- Other sample-specific qualifiers necessary to describe QC conditions.

2.6.3 Data Transmittal

The laboratory will provide the following hard copy information for each analytical data package submitted for the project:

- The cover sheet will list the samples included in the report, provide narrative comments describing problems encountered in analysis, and identify any analyses not meeting quality control criteria, including holding times.
- Chain-of-custody forms and cooler receipt forms will be provided.
- Tabulated results and reporting limits will be provided for all analytes shown. All analytes will be reported for each sample as a detected concentration or as not detected above the reporting limits, which must be stated. The laboratory will also report dilution factors, date of extraction, extraction batch number, date of analysis, and analytical batch number for each sample.
- Analytical results will be provided for QC sample spikes, laboratory duplicates, initial and continuing calibration verifications of standards and laboratory blanks, standard procedural blanks, laboratory control samples, surrogates, laboratory reference materials, interference check samples, and detection limit check samples.
- Data reduction and QC review steps will be documented, signed, and dated by an authorized representative.

2.6.4 Data Reduction

The laboratory will perform in-house analytical data reduction under the direction of the laboratory Project Manager. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed: for attainment of QC criteria as outlined in this SAP/QAPP and/or established in EPA methods; for overall reasonableness; and for transcription or calculation errors.
- The laboratory Project Manager will decide whether any sample re-analysis is required and will discuss re-analysis of the samples with the appropriate TerraGraphics personnel as soon as possible. If corrective actions have been taken and data still do not meet project QA requirements, the TerraGraphics Project Manager will be notified within 48 hours of the corrective action.

Laboratory data reduction procedures will be: those specified in the EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2008); those specified for the analytical test methods presented in Section 2; and those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst.

2.6.5 Data Tracking

The laboratory review will be conducted by a laboratory QA reviewer who has the initial responsibility for the correctness and completeness of the data. The laboratory QA reviewer will evaluate the quality of the work based on an established set of laboratory guidelines and this SAP/QAPP to ensure that:

- Sample preparation information is correct and complete,
- Analysis information is correct and complete,
- Appropriate procedures have been followed,
- Analytical results are correct and complete,
- QC sample results are within appropriate QC limits,
- Laboratory blanks are within appropriate QC limits,
- Special sample preparation and analytical requirements have been met, and
- Documentation is complete (all anomalies in the preparation and analysis have been documented; holding times are documented).

2.6.6 Data Storage and Retrieval

The laboratory will prepare and retain (as per in-house laboratory procedures) full analytical and associated QC documentation. All data submitted to TerraGraphics for this project will be retained for 5 years or until termination of the contract. An electronic copy of the data will be sent to DEQ with the Phase II RI Report.

Section 3.0 Assessment/Oversight

3.1 Assessment and Response Actions

3.1.1 Readiness Review

The ultimate responsibility for maintaining quality throughout the sampling event rests with the TerraGraphics Project Manager.

3.1.2 Surveillance

The day-to-day responsibility for assuring the quality of field and laboratory data rests with the TerraGraphics Project Manager and the DEQ approved laboratory Project Manager, respectively.

3.1.3 Technical Systems Audit

Nonconformance with the established QC procedures will be expeditiously identified and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work which depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

3.1.4 Performance Evaluation Audits

The TerraGraphics Field Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc. will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be field documented and reported to the TerraGraphics Project Manager. Corrective actions will be defined by the TerraGraphics Field and Project Managers and will be documented and implemented as appropriate.

3.1.5 Audit of Data Quality

TerraGraphics will review the data generated for this project to ensure that all project QA/QC objectives are met. Should nonconformance be identified in the field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, or data evaluation and quality review procedures, the impact of said nonconformance on the overall project objectives will be assessed. Appropriate actions, including re-sampling and re-analysis may be recommended, as directed by the TerraGraphics Project Manager, so that the project objectives can be accomplished.

3.2 Reports Management

Results of the QA/QC review and validation will be included in the Phase II RI Report, which will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions and/or comprehensive data validation. The data quality review will be summarized in a technical memorandum and included as an Appendix of the Phase II RI Report.

Section 4.0 Laboratory Data Deliverables, Quality Assurance Review, and Reporting

The chemical data reduction and review process for this project will include data generation and reduction and QA review. TerraGraphics will prepare a Phase II RI Report to summarize the analytical results and the QA/QC review. Data quality review responsibilities are summarized in Table 7.

Table 7. Data Quality Review Responsibilities

Task	Project Laboratory	TerraGraphics
Laboratory data quality review and data reduction	X	
Data Quality Review		X
Phase II RI (include summary of QA/QC review)		X

4.1 Laboratory Data Reduction Procedures

The laboratory will perform in-house analytical data reduction under the direction of the laboratory Project Manager. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for attainment of QC criteria as outlined in this SAP/QAPP and/or established in USEPA methods, for overall reasonableness, and for transcription or calculation errors.

- The laboratory Project Manager will decide whether any sample re-analysis is required and will discuss re-analysis of the samples with the appropriate TerraGraphics personnel as soon as possible. If corrective actions have been taken and data still do not meet project QA requirements, the TerraGraphics Project Manager will be notified within 48 hours of the corrective action.

Laboratory data reduction procedures will be those specified in the EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2008); those specified for the analytical test methods presented in Section 2, and; those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst.

4.2 Laboratory Qualifiers

Laboratory qualifiers as described and defined in the laboratory QA plans will include:

- Concentration below required reporting limit,
- Estimated concentration due to poor spike recovery,
- Concentrations of the chemical also found in laboratory blank, and
- Other sample-specific qualifiers necessary to describe QC conditions.

4.3 Laboratory Recordkeeping

The laboratory will maintain detailed procedures for laboratory recordkeeping in order to support the validity of all analytical work. Each data report package submitted to TerraGraphics will contain written certification that the requested analytical method was run and that all QA/QC checks were performed. The laboratory program administrator will provide TerraGraphics with QC reports of their external audits if appropriate, which will become part of the central project files.

4.4 In-House Laboratory Data Review

The laboratory review will be conducted by a laboratory QA reviewer who has the initial responsibility for the correctness and completeness of the data. The laboratory QA reviewer will evaluate the quality of the work based on an established set of laboratory guidelines and this SAP/QAPP to ensure that:

- Sample preparation information is correct and complete,
- Analysis information is correct and complete,
- Appropriate procedures have been followed,
- Analytical results are correct and complete,
- QC sample results are within appropriate QC limits,
- Laboratory blanks are within appropriate QC limits,
- Special sample preparation and analytical requirements have been met, and
- Documentation is complete (all anomalies in the preparation and analysis have been documented; holding times are documented).

4.5 Data Deliverables

To ensure that project chemical data are sufficient to meet both qualitative and quantitative DQOs, the laboratory will provide laboratory data deliverables that will permit a limited data quality assessment following the general requirements of the *Final USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004); USEPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (USEPA 2008a); and *USEPA Guidance on Environmental Data Verification and Data Validation* (USEPA 2002a).

Information provided will be sufficient to review the data with respect to:

- Holding times and conditions,
- Detection/quantitation limits,
- Surrogate recoveries,
- Laboratory duplicates and MS/MSDs,
- Precision and accuracy,
- Representativeness,
- Comparability,
- Completeness, and
- Method SOP adherence.

All data submitted to TerraGraphics for this project will be retained for five years or until termination of the contract. An electronic copy of the data will be sent to DEQ with the Phase II RI Report.

The laboratory will prepare and retain (as per in-house laboratory procedures) full analytical and associated QC documentation. The laboratory will report the data as an analytical batch of 20 samples or less, along with associated QC reporting data. The final analytical data will be provided in a limited deliverable data format as described below.

The analytical results will be submitted to TerraGraphics via hard copy and electronic files.

The laboratory will provide the following hard copy information for each analytical data package submitted for the project:

- The cover sheet will list the samples included in the report; provide narrative comments describing problems encountered in analysis; and identify any analyses not meeting quality control criteria, including holding times.

- Chain-of-custody forms and cooler receipt forms will be provided.

- Tabulated results and reporting limits will be provided for all analytes shown. All analytes will be reported for each sample as a detected concentration or as not detected above the specific limits of quantitation, which must be stated. The laboratory will also report dilution factors, date of extraction, extraction batch number, date of analysis, and analytical batch number for each sample.

- Analytical results will be provided for QC sample spikes, laboratory duplicates, initial and continuing calibration verifications of standards and laboratory blanks, standard procedural blanks, laboratory control samples, surrogates, laboratory reference materials, interference check samples, and detection limit check samples.

- Data reduction and QC review steps will be documented, signed, and dated by an authorized representative.

4.6 Data Quality Review / Data Validation

The second level of review will be performed by TerraGraphics and will include a review of laboratory performance criteria and sample-specific criteria. One hundred percent of the data will be reviewed. Additionally, TerraGraphics will determine whether the DQOs have been met and will calculate the data completeness for the project.

Data quality review is a process to determine if the data meet project-specific DQOs. The data quality review will include verification of the following:

- Compliance with the SAP/QAPP,
- Proper sample collection and handling procedures,
- Holding times,
- Field QC results,
- Instrument calibration verification,
- Laboratory blank analysis,

- Detection limits,
- Laboratory duplicates,
- MS/MSD percent recoveries and relative percent differences,
- Surrogate percent recoveries,
- Data completeness and format, and
- Data qualifiers assigned by the laboratory.

Qualifiers that may be applied to the data include the following:

U The analyte was analyzed for but was not detected above the reporting limit.

J The analyte was positively identified; the associated numerical value is an estimate of the concentration of the analyte in the sample.

UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Results of the QA review and/or validation will be included in the Phase II RI Report, which will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions.

Section 5.0 References

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US Environmental Protection Agency (EPA). 1993. Method 300.0: Determination of Inorganic Anions by Ion Chromatography.

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EPA. 1994b. Method 200.8: Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry.

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<http://water.usgs.gov/owq/FieldManual/index.html>

http://water.usgs.gov/owq/FieldManual/mastererrat.html

Appendix A

Water Sampling Record Sheet

TerraGraphics
Environmental Engineering, Inc.

SURFACE WATER SAMPLING RECORD

PROJECT:	STATION NAME:
PROJECT NUMBER:	SAMPLE NUMBER:
LOCATION:	WEATHER:
DATE: TIME:	SAMPLERS:

WATER QUALITY PARAMETERS

pH	Temperature (^{o}C)	S.C. (___/cm)	D.O. (mg/l)	D.O. (% Sat)	ORP (mV)

SAMPLES

Analyte*					
Sample ID					
Time					
Preservative					
Filtered?					
Container					

Analyte*					
Sample ID					
Time					
Preservative					
Filtered?					
Container					

Streambank Description: _____
Water Flow Type (circle one): Laminar Stagnant Turbulent Other(describe):
Stream-bed Description: _____
Water Quality Description (i.e. cloudy, odor, etc.): _____

FLOW MEASUREMENTS:
Area (ft^2):
Velocity (ft/sec):
Discharge (Q) (cfs):

NOTES:

*Fill in prior to field work

Appendix B

USGS Method for Measurement and Computation of Stream Flow

CHAPTER 5.—MEASUREMENT OF DISCHARGE BY CONVENTIONAL CURRENT-METER METHOD

INTRODUCTION

Streamflow, or discharge, is defined as the volume rate of flow of water, including any substances suspended or dissolved in the water. Discharge is usually expressed in cubic feet per second or cubic meters per second.

Discharge measurements are made at each gaging station to determine the discharge rating for the site. The discharge rating may be a simple relation between stage and discharge or a more complex relation in which discharge is a function of stage, slope, rate of change of stage, or other factors. Initially the discharge measurements are made with the frequency necessary to define the station rating, as early as possible, over a wide range of stage. Measurements are then made at periodic intervals, usually monthly, to verify the rating or to define any changes in the rating caused by changes in stream-channel conditions.

Discharge measurements may be made by any one of the methods discussed in chapters 5–8. However, the conventional current-meter method is most commonly used in gaging streams. When using this

method, observations of width, depth, and velocity are taken at intervals in a cross section of the stream, while the hydrographer is wading or supported by a cableway, bridge, ice cover, or boat. A current meter is used to measure velocity. This chapter describes the conventional current-meter method.

GENERAL DESCRIPTION OF A CONVENTIONAL CURRENT-METER MEASUREMENT OF DISCHARGE

A current-meter measurement is the summation of the products of the subsection areas of the stream cross section and their respective average velocities. The formula

$$Q = \Sigma(a\ v) \tag{9}$$

represents the computation, where Q is total discharge, a is an individual subsection area, and v is the corresponding mean velocity of the flow normal to the subsection.

In the midsection method of computing a current-meter measurement, it is assumed that the velocity sample at each vertical represents the mean velocity in a rectangular subsection. The subsection area extends laterally from half the distance from the preceding observation vertical to half the distance to the next, and vertically from the water surface to the sounded depth. (See fig. 41.)

The cross section is defined by depths at verticals 1, 2, 3, 4, . . . n. At each vertical the velocities are sampled by current meter to obtain the mean velocity for each subsection. The subsection discharge is then computed for any subsection at vertical x by use of the equation,

$$q_x = v_x \left[\frac{(b_x - b_{(x-1)})}{2} + \frac{(b_{(x+1)} - b_x)}{2}\right] d_x$$

$$= v_x \left[\frac{b_{(x+1)} - b_{(x-1)}}{2}\right] d_x \tag{10}$$

where

q_x = discharge through subsection x,
v_x = mean velocity at vertical x,
b_x = distance from initial point to vertical x,
$b_{(x-1)}$ = distance from initial point to preceding vertical,
$b_{(x+1)}$ = distance from initial point to next vertical, and
d_x = depth of water at vertical x.

Thus, for example, the discharge through subsection 4 (heavily outlined in fig. 41) is

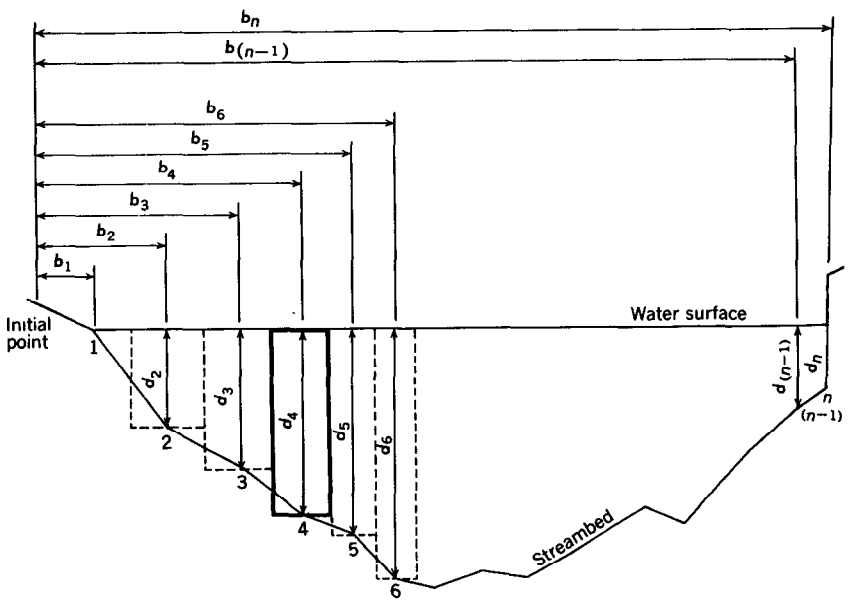
$$q_4 = v_4 \left[\frac{b_5 - b_3}{2}\right] d_4.$$

The procedure is similar when x is at an end section. The "preceding vertical" at the beginning of the cross section is considered coincident with vertical 1; the "next vertical" at the end of the cross section is considered coincident with vertical n. Thus,

$$q_1 = v_1 \left[\frac{b_2 - b_1}{2}\right] d_1$$

and

$$q_n = v_n \left[\frac{b_n - b_{(n-1)}}{2}\right] d_n.$$



EXPLANATION

1, 2, 3 ..... n	Observation verticals
$b_1, b_2, b_3, \ldots . b_n$	Distance, in feet or meters, from the initial point to the observation vertical
$d_1, d_2, d_3, \ldots . d_n$	Depth of water, in feet or meters, at the observation vertical
Dashed lines	Boundaries of subsections; one heavily outlined is discussed in text

FIGURE 41.—Definition sketch of midsection method of computing cross-section area for discharge measurements.

For the example shown in figure 41, q_1 is zero because the depth at observation point 1 is zero. However, when the cross-section boundary is a vertical line at the edge of the water as at vertical n, the depth is not zero and velocity at the end vertical may or may not be zero. The formula for q_1 or q_n is used whenever there is water only on one side of an observation vertical such as at piers, abutments, and islands. It is necessary to estimate the velocity at an end vertical, usually as some percentage of the adjacent vertical, because it is impossible to measure the velocity accurately with the current meter close to a boundary. There is also the possibility of damage to the equipment if the flow is turbulent. Laboratory data suggest that the mean vertical velocity in the vicinity of a smooth sidewall of a rectangular channel can be related to the mean vertical velocity at a distance from the wall equal to the depth. The tabulation below gives values that define the relation.

Distance from wall, as a ratio of the depth	*Mean vertical velocity, as related to* V_n
0.00	$0.65V_n$
.25	$.90V_n$
.50	$.95V_n$
1.00	$1.00V_n$

NOTE—V_n is the mean vertical velocity at a distance from the vertical wall equal to the depth.

The summation of the discharges for all the subsections—usually 25 to 30 in number—is the total discharge of the stream. An example of the measurement notes used by the U.S. Geological Survey is shown in figure 42.

The mean-section method, used by the U.S. Geological Survey prior to 1950, differs from the midsection method, described above, in computation procedure. In the older method discharges are computed for subsections between successive observation verticals. The velocities and depths at successive verticals are each averaged, and each subsection extends laterally from one observation vertical to the next. Subsection discharge is the product of the average of two mean velocities, the average of two depths, and the distance between observation verticals. In both methods total discharge is the sum of the subsection discharges. A study by Young (1950) concluded that the midsection method is simpler to compute and is a slightly more accurate procedure than the mean-section method.

Current-meter meaurements are usually classified in terms of the means used to cross the stream during the measurement, such as wading, cableway, bridge, boat, or ice cover.

INSTRUMENTS AND EQUIPMENT

Current meters, timers, and a means of counting meter revolutions are needed for the measurement of discharge, along with additional

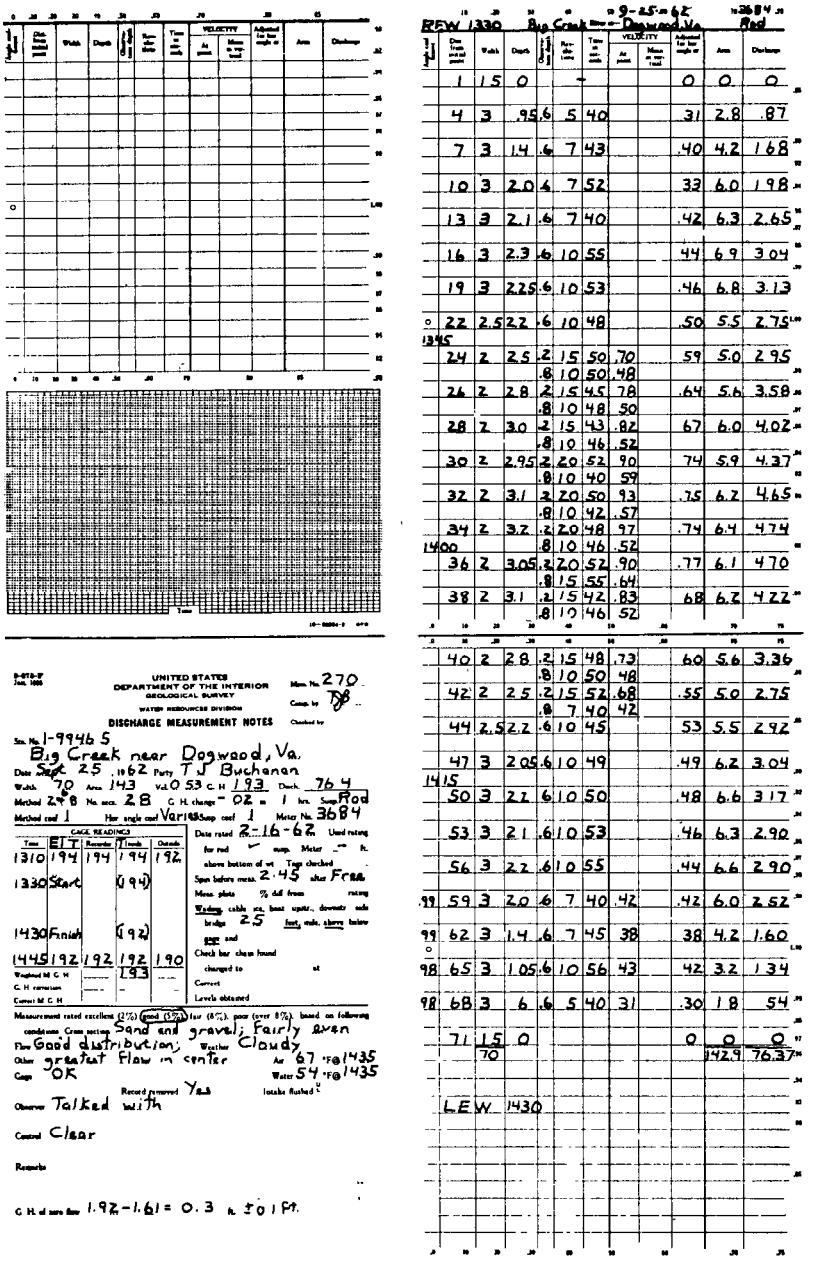


FIGURE 42.—Computation notes of a current-meter measurement by the midsection method.

equipment that depends on the manner in which the measurement is to be made—that is, whether by wading, cableway, bridge, boat, or from ice cover. Instruments and equipment used in making the current-meter measurements are described in this section of the manual under the following categories: current meters, sounding equipment, width-measuring equipment, equipment assemblies, and miscellaneous equipment.

CURRENT METERS

A current meter is an instrument used to measure the velocity of flowing water. The principle of operation is based on the proportionality between the velocity of the water and the resulting angular velocity of the meter rotor. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined.

The number of revolutions of the rotor is obtained by an electrical circuit through the contact chamber. Contact points in the chamber are designed to complete an electrical circuit at selected frequencies of revolution. Contact chambers can be selected having contact points that will complete the circuit twice per revolution, once per revolution, or once per five revolutions. The electrical impulse produces an audible click in a headphone or registers a unit on a counting device. The intervals during which meter revolutions are counted are timed with a stopwatch. A discussion of the required time interval follows.

Turbulent flow, which is ordinarily found in natural streams and in artificial channels, is always accompanied by local eddying, which results in pulsations in the velocity at any point. Figure 43, taken from a study by Pierce (1941), shows the pulsations observed in a laboratory flume for two different mean velocities. The greater magnitude of the pulsations, relative to the mean, at the lower velocity explains why current-meter observations at a point should cover a longer period when low velocities are being measured than when higher velocities are being measured. At high velocities, pulsations have only minor effect on the current-meter observations. In the U.S.A. it is customary to observe velocity at a point by current meter for a period that ranges from 40 to 70 s. It is recognized that the use of a period of from 40 to 70 s is not long enough to insure the accuracy of a single point-observation of velocity. However, because the pulsations are random and because velocity observations during a discharge measurement are made at 25 to 30 verticals, usually with two observations being made in each vertical, there is little likelihood that the pulsations will bias the total measured discharge of a stream. (See p. 181–182.) Longer periods of current-meter observation at a

point are not used, because it is desirable to complete a discharge measurement before the stage changes significantly and because the use of longer observation periods may add significantly to the operating cost of a large number of gaging stations.

Current meters generally can be classified with respect to two main types: those meters having vertical-axis rotors and those having horizontal-axis rotors. The comparative characteristics of these two types are summarized below:

1. Vertical-axis rotor with cups or vanes.
   a. Operates in lower velocities than do horizontal-axis meters.
   b. Bearings are well protected from silty water.
   c. Rotor is repairable in the field without adversely affecting the rating.
   d. Single rotor serves for the entire range of velocities.
2. Horizontal-axis rotor with vanes.
   a. Rotor disturbs flow less than do vertical-axis rotors because of axial symmetry with flow direction.
   b. Rotor is less likely to be entangled by debris than are vertical-axis rotors.
   c. Bearing friction is less than for vertical-axis rotors because bending moments on the rotor are eliminated.

VERTICAL-AXIS CURRENT METERS

A common type of vertical-axis current meter is the Price meter, type AA. (See fig. 44.) This meter is used extensively by the U.S. Geological Survey. The standard Price meter has a rotor 5 in (0.127

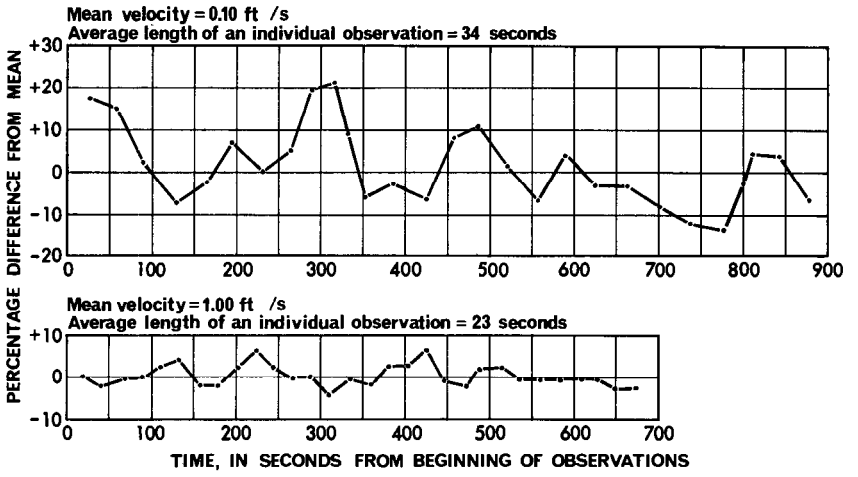


FIGURE 43.—Comparison of pulsations for two different mean velocities measured in a laboratory flume, 12 ft wide.

m) in diameter and 2 in (0.05 m) high with six cone-shaped cups mounted on a stainless-steel shaft. A pivot bearing supports the rotor shaft. The contact chamber houses both the upper part of the shaft and a slender bronze wire (cat's whisker) attached to a binding post. With each revolution an eccentric contact on the shaft makes contact with a bead of solder at the end of the cat's whisker. A separate reduction gear (pentagear), wire, and binding post provide a contact each time the rotor makes five revolutions. A tailpiece keeps the meter pointing into the current.

In addition to the standard type AA meter for general use there is a type AA meter for low velocities. No pentagear is provided. This modification reduces friction. The shaft usually has two eccentrics making two contacts per revolution. The low-velocity meter normally is rated from 0.2 to 2.5 ft/s (0.06 to 0.76 m/s) and is recommended for use when the mean velocity at a cross section is less than 1 ft/s (0.3 m/s).

In addition to the type AA meters, the U.S. Geological Survey uses a Price pygmy meter in shallow depths. (See fig. 44.) The pygmy meter is scaled two-fifths as large as the standard meter and has neither a tailpiece nor a pentagear. The contact chamber is an integral part of the yoke of the meter. The pygmy meter makes one contact per revolution and is used only with rod suspension.

The U.S. Geological Survey has recently developed a four-vane vertical-axis meter. (See fig. 45.) This meter is useful for measurements under ice cover because the vanes are less likely to fill with slush ice and because it requires a much smaller hole for passage through the ice. One yoke of the vane meter is made to be suspended at the end of a rod and will fit holes made by an ice drill. Another yoke

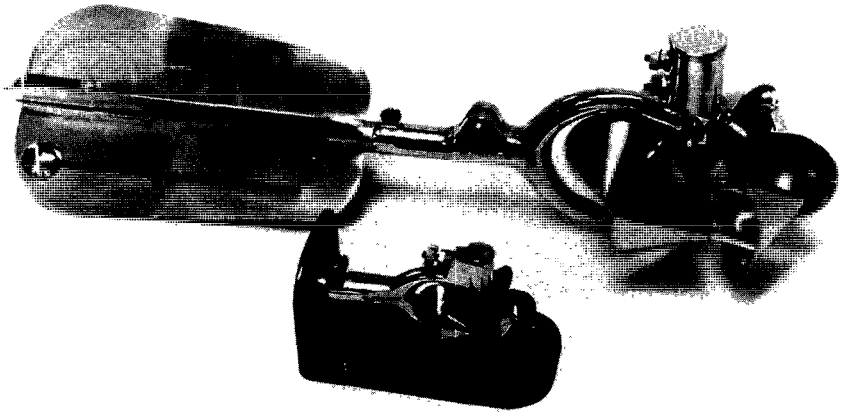


FIGURE 44.—Price type AA meter, top; Price pygmy meter, bottom.

is made for regular cable or rod suspension. (See fig. 45.) The vane meter has the disadvantage of not responding as well as the Price type AA meter at velocities less than 0.5 ft/s (0.15 m/s).

A new contact chamber has been designed by the U.S. Geological Survey to replace the wiper contact of the type AA and vane meters. The new contact chamber contains a magnetic switch, glass enclosed in a hydrogen atmosphere and hermetically sealed. The switch assembly is rigidly fixed in the top of the meter head just above the tip of the shaft. The switch is operated by a small permanent magnet rigidly fastened to the shaft. The switch quickly closes when the magnet is alined with it and then promptly opens when the magnet moves away. The magnet is properly balanced on the shaft. Any type AA meter can have a magnetic switch added by replacing the shaft and the contact chamber. The magnetic switch is placed in the special contact chamber through the tapped hole for the binding post. The rating of the meter is not altered by the change. An automatic counter (p. 130) is used with the magnetic-switch contact chamber. If a headphone is used, arcing may weld the contacts.

A Price meter accessory that indicates the direction of flow is described on page 129.

Vertical-axis current meters do not register velocities accurately when placed close to a vertical wall. A Price meter held close to a right-bank vertical wall will underregister because the slower water velocities near the wall strike the effective (concave) face of the cups. The converse is true at a left-bank vertical wall. (The terms "left bank" and "right bank" designate direction from the center of a stream for an observer facing downstream.) The Price meter also

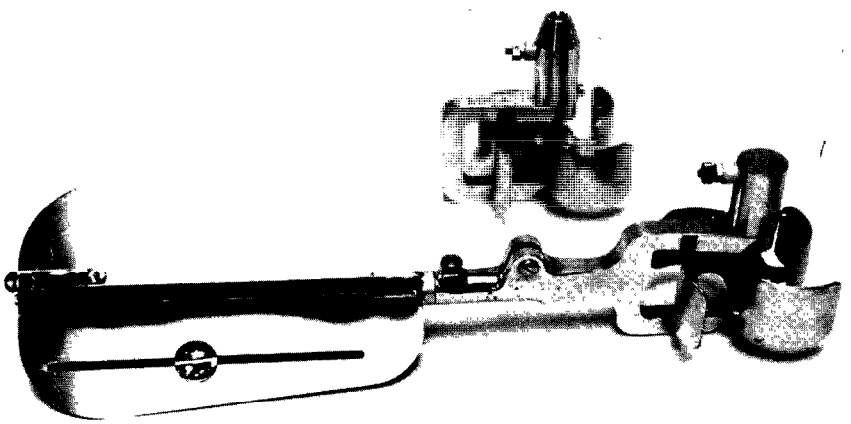


FIGURE 45.—Vane ice meter, top; vane meter with cable suspension yoke, bottom.

underregisters when positioned close to the water surface or close to the streambed.

HORIZONTAL-AXIS CURRENT METERS

The types of horizontal-axis meters most commonly used are the Ott, Neyrpic, Haskell, Hoff, and Braystoke. The Ott meter is made in Germany, the Neyrpic meter in France, and both are used extensively in Europe. The Haskell and Hoff meters were developed in the United States, where they are used to a limited extent. The Braystoke meter is used extensively in the United Kingdom. The Ott meter (fig. 46) is a precision instrument but is not widely used in the U.S.A. because it is not as durable as the Price meter under extreme conditions. The makers of the Ott meter have developed a component propeller that in oblique currents automatically registers the velocity component at right angles to the measuring section for angles as great as 45° and

FIGURE 46.—Ott current meter.

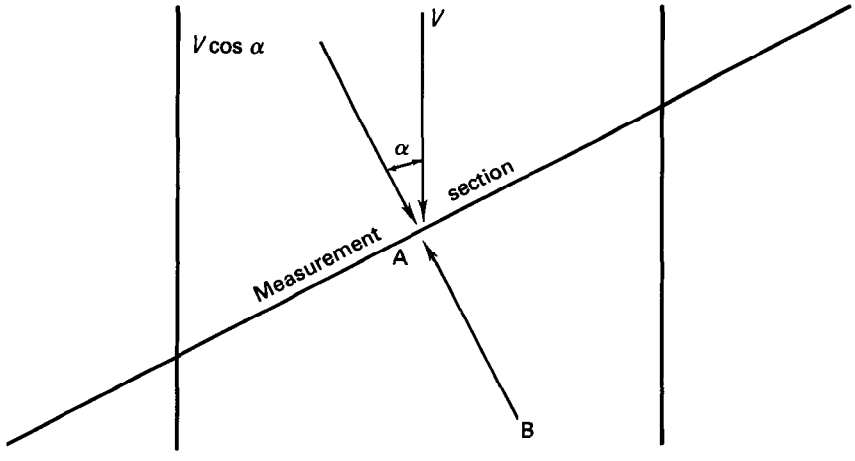


FIGURE 47.—Velocity components measured by Ott and Price current meters.

for velocities as great as 8 ft/s (2.4 m/s). For example, if this component propeller were held in the position AB in figure 47 it would register $V \cos \alpha$ rather than V, which the Price meter would register.

The Neyrpic meter is used rarely in the U.S.A. for the same reason that the Ott meter is rarely used there.

The Haskell meter has been used by the U.S. Lake Survey, Corps of Engineers, in streams that are deep, swift, and clear. By using propellers with a variety of screw pitches, a considerable range of velocity can be measured. The Haskell meter is more durable than most other horizontal-axis current meters.

The Hoff meter (fig. 48) is another current meter used in the U.S.A. The lightweight propeller has three or four vanes of hard rubber. The meter is suited for the measurement of low velocities but is not suited for rugged use.

COMPARISON OF PERFORMANCE OF VERTICAL-AXIS AND HORIZONTAL-AXIS CURRENT METERS

Comparative tests of the performance of vertical-axis and horizontal-axis current meters, under favorable measuring conditions, indicate virtually identical results from use of the two types of meter. That was the conclusion reached in 1958 by the U.S. Lake Survey, Corps of Engineers, after tests made with the Price, Ott, and Neyrpic current meters (Townsend and Blust, 1960). The results of one of their tests is shown in figure 49.

Between the years 1958 and 1960, the U.S. Geological Survey made 19 simultaneous discharge measurements on the Mississippi River using Price and Ott meters. The average difference in discharge between results from the two meters was -0.15 percent, using the measurements made with the Price meter as the standard for comparison. The maximum differences in discharge measured by the two meters was -2.76 and $+1.53$ percent.

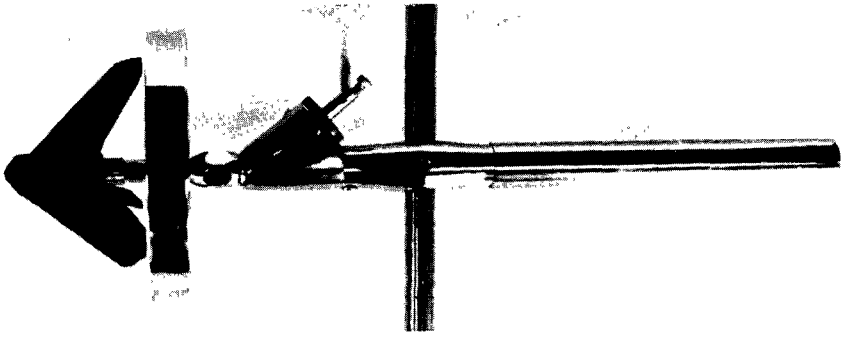


FIGURE 48.—Hoff current meter.

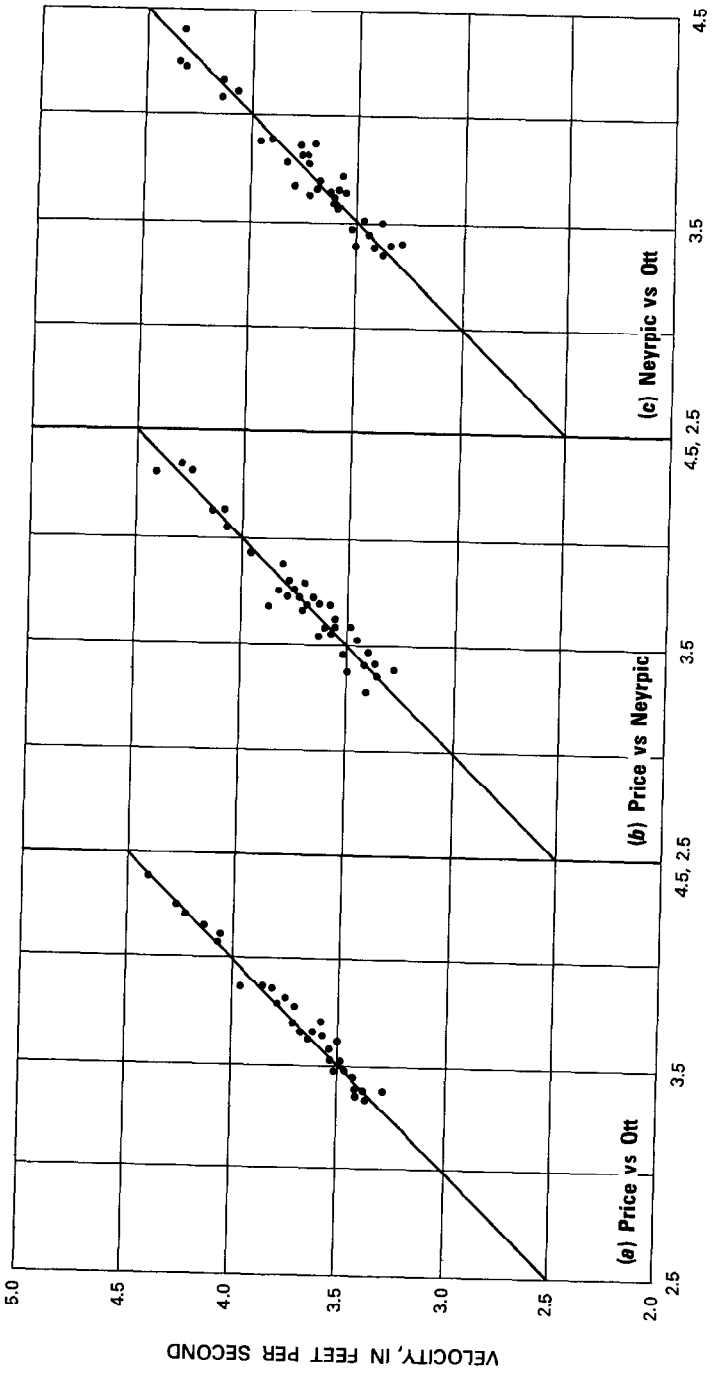


FIGURE 49.—*Comparison of mean velocities measured simultaneously by various current meters during 2-min periods, Stella Niagara section, Panel point 5.* (After Townsend and Blust, 1960.)

OPTICAL CURRENT METER

In recent years the U.S. Geological Survey has developed an optical current meter (fig. 50). The meter and its use have been described by Chandler and Smith (1971). The optical current meter is designed to measure surface velocities in open channels without immersing equipment in the stream. However, because it measures only surface velocity, the optical meter is not considered a substitute for conventional equipment in those situations where good measurements can be made by standard techniques. It is a device that has extended the capability of making discharge measurements to a range of situations under which standard current-meter techniques cannot be used. Those situations include flood velocities that are too high to be measured by conventional meter—for example, supercritical velocities in floodways—or the presence of a debris load during flood periods that makes it hazardous to immerse a current meter.

Basically, the meter is a stroboscopic device consisting of a low-power telescope, a single oscillating mirror driven by a cam, a variable-speed battery-operated motor, and a tachometer. The water surface is viewed from above through the meter, while gradually changing the speed of the motor to bring about synchronization of the

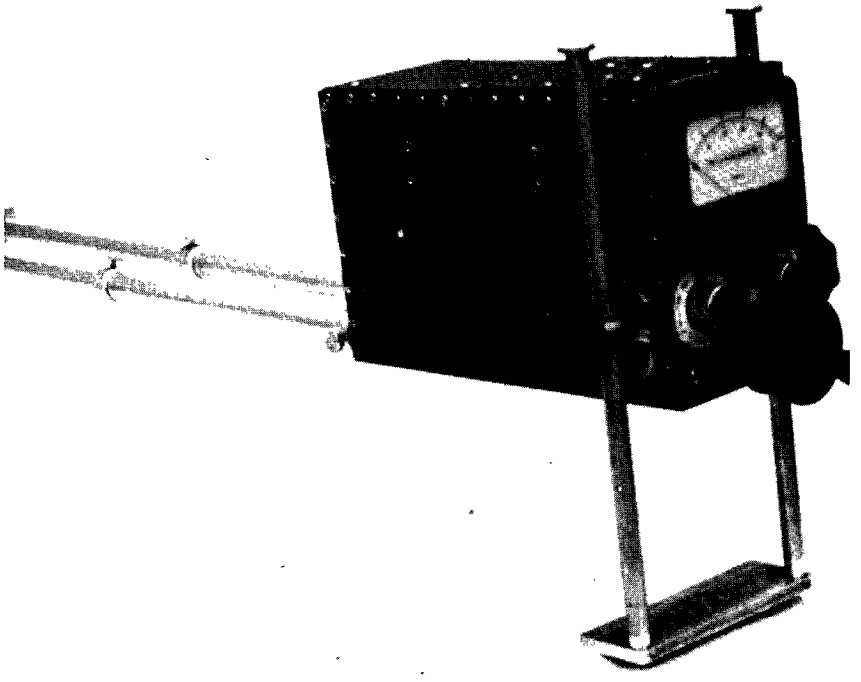


FIGURE 50.—Optical current meter.

angular velocity of the mirror and the surface velocity of the water. Synchronization is achieved when the motion of drift or disturbances on the water surface, as viewed through the meter, is stopped. A reading of the tachometer and height of the meter above the water surface are the only elements needed to compute the surface velocity.

The velocity measurement may be made from any bridge, walkway, or other structure that will support the optical meter. The vertical axis of the meter must be perpendicular to the water surface. Surface velocity (V_s) is computed from the equation

$$V_s = KRD,$$

where K is the constant for the meter, R is the readout from the tachometer, and D is the distance to the water surface in feet. The tachometer is scaled to produce a value of K equal to 1.00. The surface velocity computed from the above equation must be corrected by an appropriate coefficient to obtain the mean velocity in the vertical. The precise coefficient applicable is, of course, unique to the particular stream and to the location of the vertical in the stream cross section. However, data abstracted from conventional current-meter measurements show that application of a coefficient of 0.90 will not introduce errors of more than ±5 percent in concrete-lined channels. For natural channels a coefficient of 0.85 has been used.

A unique feature of the optical current meter is the automatic correction that is made for variations in the direction of the streamlines of flow. If the flow approaches the cross section at an angle other than the perpendicular, and if the axis of the oscillating mirror in the meter is parallel to the cross section, then at the null point of observation, the water will appear to move laterally across the field of view. The meter measures only the velocity vector normal to the cross section, and there is no need to apply horizontal angle corrections.

The range of velocities that can be measured with the optical current meter is limited at the lower end by the accuracy of the tachometer and at the upper end by the physical limitations of the human eye. Table 1 shows the range of velocities that can be meas-

TABLE 1.—*Range of velocities that can be measured with optical current meter*

Observation height (D)		Maximum velocity		Minimum velocity for ±5 percent resolution	
(ft)	(m)	(ft/s)	(m/s)	(ft/s)	(m/s)
5	1.52	25	7.62	1.6	0.49
10	3.05	50	15.2	3.2	.98
15	4.57	75	22.9	4.8	1.46
20	6.10	100	30.5	6.4	1.95

ured from various heights above the water surface with the U.S. Geological Survey model of the meter. The minimum velocities shown in column 3 of the table can be measured with an error of ±5 percent; the higher velocities at the various observation heights will be measured with lesser error.

CARE OF THE CURRENT METER

To insure reliable observations of velocity it is necessary that the current meter be kept in good condition. The care of conventional meters will be discussed first.

Before and after each discharge measurement the meter cups or vanes, pivot and bearing, and shaft should be examined for damage, wear, or faulty alinement. Before using the meter its balance on the cable-suspension hanger should be checked, the alinement of the rotor when the meter is on the hanger or wading rod should also be checked, and the conductor wire should be adjusted to prevent interference with meter balance and rotor spin. During measurements, the meter should periodically be observed when it is out of the water to be sure that the rotor spins freely.

Meters should be cleaned and oiled daily when in use. If measurements are made in sediment-laden water, the meter should be cleaned immediately after each measurement. For vertical-axis meters the surfaces to be cleaned and oiled are the pivot bearing, pentagear teeth and shaft, cylindrical shaft bearing, and thrust bearing at the cap.

After oiling, the rotor should be spun to make sure that it operates freely. If the rotor stops abruptly, the cause of the trouble should be sought and corrected before using the meter. The duration of spin should be recorded on the field notes for the discharge measurement. A significant decrease in the duration of spin indicates that the bearings require attention. In vertical-axis current meters the pivot requires replacement more often than other meter parts, and it therefore should be examined after each measurement. The pivot and pivot bearing should be kept separated, except during measurements, by use of the raising nut provided in the Price meter or by replacing the pivot with a brass plug in the pygmy meter. Fractured, worn, or rough pivots should be replaced.

Meter repairs by the hydrographer should be limited to minor damage only. That is particularly true of the rotor, where small changes in shape can significantly affect the meter rating. In vertical-axis meters, minor dents in the cups can often be straightened to restore the original shape of the cups, but in case of doubt, the entire rotor should be replaced with a new one. Badly sprung yokes, bent yoke stems, misalined bearings and tailpieces

should be reconditioned in shops equipped with the specialized facilities needed.

There are only few details connected with care of the optical current meter. The meter should be transported in a shock-proof carrying case and the battery should be checked periodically. Field performance of the tachometer should also be checked periodically. Three steps are involved in the checking process. First, a cam speed is measured by counting and timing mirror oscillations with a stopwatch, and the corresponding dial reading of the tachometer is observed. Next, a tachometer dial readout is computed from the measured cam speed and the known scale factor of the tachometer dial. In the final step the observed dial reading and the computed dial readout are compared.

RATING OF CURRENT METERS

To determine the velocity of the water from the revolutions of the rotor of a conventional current meter, a relation must be established between the angular velocity of the rotor and the velocity of the water that spins the rotor. That relation is known as the rating of the current meter. The rating is established by first towing the meter at a constant velocity through a long water-filled trough, and then relating the linear and rotational velocities of the current meter. The following paragraphs describe the rating of meters by the U.S. Geological Survey at the Hydrologic Instrumentation Facility in Mississippi.

The rating trough used is a sheltered concrete tank 450 ft (137 m) long, 12 ft (3.7 m) wide, and 12 ft (3.7 m) deep. An electrically driven car rides on rails extending the length of the tank. The car carries the current meter at a constant rate through the still water in the basin. Although the rate of travel can be accurately adjusted by means of an electronic regulating gear, the average velocity of the moving car is determined for each run by making an independent measurement of the distance it travels during the time that the revolutions of the rotor are electrically counted. Eight pairs of runs are usually made for each current meter. A pair of runs consists of two traverses of the basin, one in each direction, at the same speed. Practical considerations usually limit the ratings to velocities ranging from 0.1 to about 15 ft/s (0.03 to about 4.6 m/s), although the car can be operated at lower speeds. Unless a special request is made for a more extensive rating, the lowest velocity used in the rating is about 0.2 ft/s (0.06 m/s), and the highest is about 8.0 ft/s (2.5 m/s).

For convenience in field use, the data from the current-meter ratings are reproduced in tables, a sample of which is shown in figure 51.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

RATING TABLE FOR TYPE AA CURRENT METER

EQUATIONS V=2 180R + 020 (2 200) 2 170R + 030 Std Rating No 1

Time in Seconds	VELOCITY IN FEET PER SECOND								Time in Seconds
	Revolutions								
	3	5	7	10	15	20	25	30	40	
40	183	292	401	565	.837	1.11	1 38	1 65	2 20	40
41	180	286	392	552	818	1 08	1.35	1 62	2 15	41
42	176	280	383	539	799	1 06	1 32	1 58	2 10	42
43	172	273	375	527	780	1 03	1 29	1 54	2 05	43
44	.169	268	367	515	.763	1 01	1 26	1 51	2 00	44
45	165	262	359	504	747	989	1.23	1 47	1 96	45
46	162	257	352	494	.731	968	1 20	1 44	1 92	46
47	159	252	345	484	716	948	1.18	1 41	1 88	47
48	156	247	338	474	701	928	1 16	1 38	1 84	48
49	153	242	331	.465	687	910	1 13	1 35	1 80	49
50	.151	238	325	.456	.674	892	1.11	1 33	1 76	50
51	148	234	319	447	661	875	1 09	1 30	1 73	51
52	146	230	313	.439	649	858	1 07	1 28	1 70	52
53	143	226	308	431	637	843	1 05	1 25	1 67	53
54	141	222	303	424	626	827	1 03	1 23	1 63	54
55	139	218	297	416	615	813	1 01	1 21	1 61	55
56	.137	215	292	409	604	.799	.993	1 19	1 58	56
57	135	211	288	402	594	785	976	1 17	1 55	57
58	133	208	283	396	584	.772	960	1 15	1 52	58
59	131	205	279	389	574	759	944	1 13	1 50	59
60	129	202	274	383	565	747	928	1 11	1 47	60
61	127	199	270	377	556	735	913	1 09	1 45	61
62	125	196	266	.372	547	723	899	1.07	1 43	62
63	.124	193	.262	366	539	712	885	1 06	1 40	63
64	122	190	258	.361	531	.701	.872	1 04	1 38	64
65	121	188	255	355	523	691	858	1 03	1 36	65
66	119	185	251	350	515	681	846	1 01	1 34	66
67	118	.183	248	345	508	.671	.833	996	1 32	67
68	116	180	.244	341	501	661	821	982	1 30	68
69	115	178	241	336	494	652	810	968	1 28	69
70	113	176	238	331	487	643	799	954	1 27	70
	3	5	7	10	15	20	25	30	40	

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

RATING TABLE FOR TYPE AA CURRENT METER

Actual Rating Limits 0 25 to 8 0 feet per second Date 03-05-70

Time in Seconds	VELOCITY IN FEET PER SECOND									Time in Seconds
	Revolutions									
	50	60	80	100	150	200	250	300	350	
40	2 74	3 28	4 37	5 45	8.17	10 88	13 59	16 30	19 02	40
41	2 68	3 21	4 26	5 32	7 97	10 62	13 26	15 91	18 55	41
42	2 61	3 13	4 16	5 20	7 78	10 36	12 95	15 53	18 11	42
43	2 55	3 06	4 07	5 08	7 60	10 12	12 65	15.17	17 69	43
44	2 50	2 99	3 98	4 96	7 43	9 89	12 36	14 83	17 29	44
45	2 44	2 92	3 89	4 85	7 26	9.67	12 09	14 50	16 91	45
46	2 39	2 86	3 80	4 75	7 11	9 46	11 82	14 18	16 54	46
47	2 34	2 80	3 72	4 65	6 96	9 26	11 57	13 88	16 19	47
48	2 29	2 74	3 65	4 55	6 81	9 07	11 33	13 59	15 85	48
49	2 24	2 69	3 57	4 46	6 67	8 89	11 10	13 32	15 53	49
50	2 20	2 63	3 50	4 37	6 54	8 71	10 88	13 05	15 22	50
51	2 16	2 58	3 43	4 28	6 41	8 54	10 67	12 79	14 92	51
52	2 12	2 53	3 37	4 20	6 29	8 38	10 46	12 55	14 64	52
53	2 08	2 49	3 31	4 12	6 17	8 22	10 27	12 31	14 36	53
54	2 04	2 44	3 24	4 05	6 06	8 07	10 08	12 09	14 09	54
55	2 00	2 40	3 19	3 98	5 95	7 92	9 89	11 87	13 84	55
56	1 97	2 35	3 13	3 90	5 84	7 78	9 72	11 65	13 59	56
57	1 93	2 31	3 08	3 84	5 74	7 64	9 55	11 45	13 35	57
58	1 90	2 27	3 02	3 77	5 64	7 51	9 38	11 25	13 12	58
59	1 87	2 24	2 97	3 71	5 55	7 39	9 22	11 06	12 90	59
60	1 84	2 20	2 92	3 65	5 45	7 26	9 07	10 88	12 69	60
61	1 81	2 16	2 88	3 59	5 37	7 14	8 92	10 70	12 48	61
62	1 78	2 13	2 83	3 53	5 28	7 03	8 78	10 53	12 28	62
63	1 75	2 10	2 79	3 47	5 20	6 92	8 64	10 36	12 09	63
64	1 72	2 06	2 74	3 42	5 12	6 81	8 51	10 20	11 90	64
65	1 70	2 03	2 70	3 37	5 04	6 71	8 38	10 05	11 71	65
66	1 67	2 00	2 66	3 32	4 96	6 61	8 25	9 89	11 54	66
67	1 65	1 97	2 62	3 27	4 89	6 51	8 13	9 75	11 37	67
68	1 62	1 94	2 58	3 22	4 82	6 41	8 01	9 60	11 20	68
69	1 60	1 92	2 55	3 17	4 75	6 32	7 89	9 46	11 04	69
70	1 58	1 89	2 51	3 13	4 68	6 23	7 78	9 33	10 88	70
	50	60	80	100	150	200	250	300	350	

FIGURE 51.—Current-meter rating table.

The velocities corresponding to a range of 3 to 350 revolutions of the rotor within a period of 40 to 70 s are listed in the tables. This range in revolution and time has been found to cover general field requirements. To provide the necessary information for extending a table for the few instances where extensions are required, the equations of the rating table are shown in the spaces provided in the heading. The term, R, in the equations refers to revolutions of the rotor per second. The equation to the left of the figure in parentheses (2.20 in fig. 51) is the equation for velocities less than 2.20 ft/s (0.67 m/s), and the equation to the right is for velocities greater than 2.20 ft/s. The velocity 2.20 ft/s is common to both equations.

It should be noted that the equations given are those of the rating table and not necessarily those of the actual rating. If a rating table already on file matches a rating within close tolerances, that table is selected in preference to preparing a new one. The tolerances are listed below:

Revolutions of rotor per second (R)	*Tolerance, in percent*
Less than 1.0	1.0
1.0 and greater	.5

Because of the rigid control in the manufacture of the Price meter, virtually identical meters are now being produced, and their rating equations tend to be identical. Therefore, the U.S. Geological Survey now feels no need to calibrate the meters individually. Instead, an average standard rating is established by calibrating a large number of meters that have been constructed to U.S. Geological Survey specifications, and that rating is then supplied with each meter. To insure that all meters are virtually identical, the dies and fixtures for the construction of Price meters are supplied to the manufacturer.

Price meters that have been first rated using a wading-rod suspension, and then rated using a cable suspension with U.S. Geological Survey Columbus-type weights and hangers, have not shown significant differences in rating. Therefore, no suspension coefficients are needed, and none should be used, if Columbus-type weights and hangers are properly used. Tests that compared meters were discussed on pages 89–90. In those tests Columbus-type weights were used with all meters. The close agreement of results for all meters indicate that no suspension coefficients are required when horizontal-axis current meters are used with Columbus-type weights.

The rating of the optical current meter is relatively simple. Its operation is based on precise mathematical principles, and, given an accurate tachometer, meter accuracy is dependent only on the configuration of the cam that oscillates the mirror. A master cam is used in

the manufacture of the individual meter cams. The meter is rated by observation of a long endless belt driven at constant speed. That known belt speed is checked against the speed computed by multiplying the height of the meter above the belt by the tachometer reading. If the comparison of known and computed speeds shows a lack of agreement, the tachometer scaling is changed to bring about agreement.

SOUNDING EQUIPMENT

Sounding (determination of depth) is usually done mechanically, the equipment used being dependent on the type of measurement being made. Depth and position in the vertical are measured by a rigid rod or by use of a sounding weight suspended from a cable. The cable length is controlled either by a reel or by a handline. A sonic sounder is also available, but it is usually used in conjunction with a reel and a sounding weight.

Sounding equipment used by the U.S. Geological Survey is described in the following categories: wading rods, sounding weights, sounding reels, handlines, and sonic sounder.

WADING RODS

The two types of wading rods commonly used are the top-setting rod and the round rod. The top-setting rod is preferred because of the convenience in setting the meter at the proper depth and because the hydrographer can keep his hands dry in the process. The round rod can be used in making ice measurements as well as wading measurements and has the advantage that it can be disassembled to 1-ft (0.3-m) lengths for storing and transporting.

The top-setting wading rod has a 1/2-in (12.7-mm) hexagonal main rod for measuring depth and a 3/8-in (9.5-mm) diameter round rod for setting the position of the current meter (fig. 52).

The rod is placed in the stream so the base plate rests on the streambed, and the depth of water is read on the graduated main rod. When the setting rod is adjusted to read the depth of water, the meter is positioned automatically for the 0.6-depth method. (See p. 134.) The 0.6-depth setting might also be described as the 0.4-depth position measured up from the streambed. When the depth of water is divided by 2 and this new value is set, the meter will be at the 0.2 depth position measured up from the streambed. When the depth of water is multiplied by 2 and this value is set, the meter will be at the 0.8-depth position measured up from the streambed. These two positions represent the conventional 0.2- and 0.8-depth positions. (See p. 134.)

The round wading rod consists of a base plate, lower section, three or four intermediate sections, sliding support, and a rod end (not essential). The parts are assembled as shown in figure 53. The meter

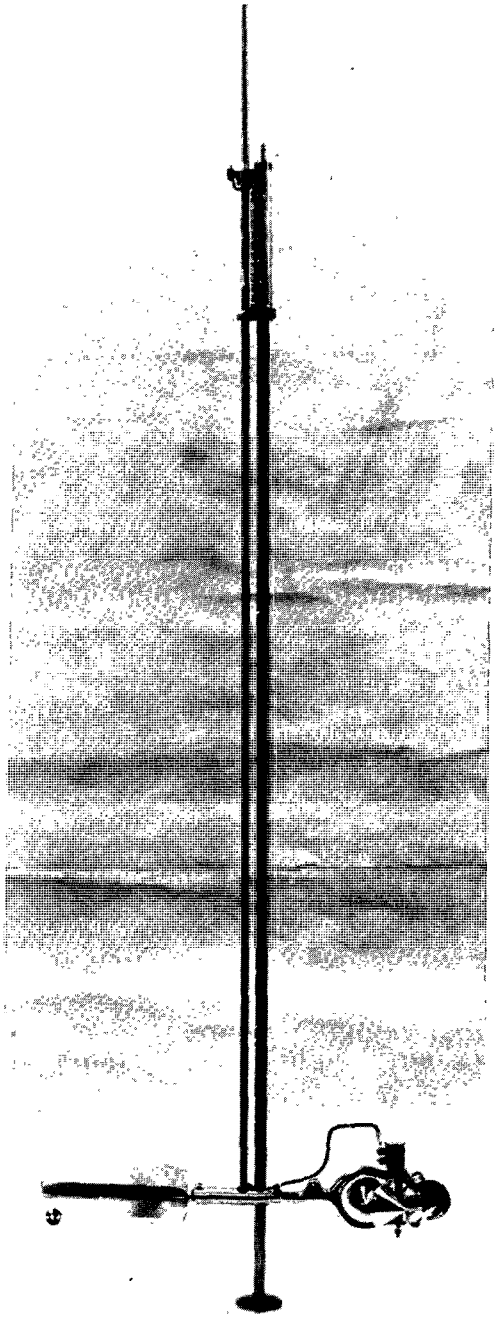


FIGURE 52.—Top-setting wading rod with meter attached.

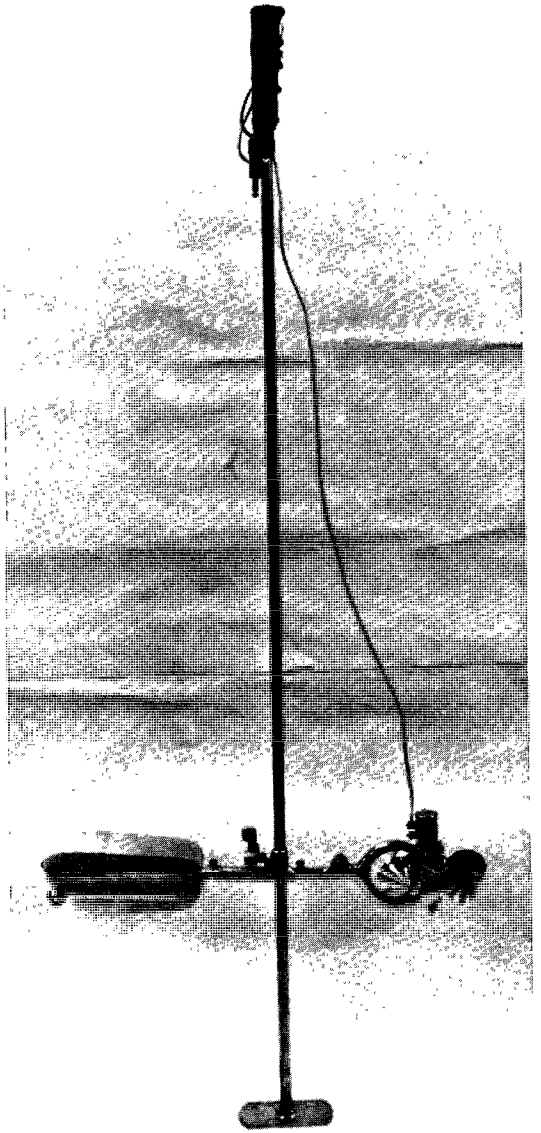


FIGURE 53.—Round wading rod with meter attached.

is mounted on the sliding support and is set at the desired position on the rod by sliding the support.

The round rod is also used in making ice measurements. Intermediate sections of the round rod are screwed together to make an ice

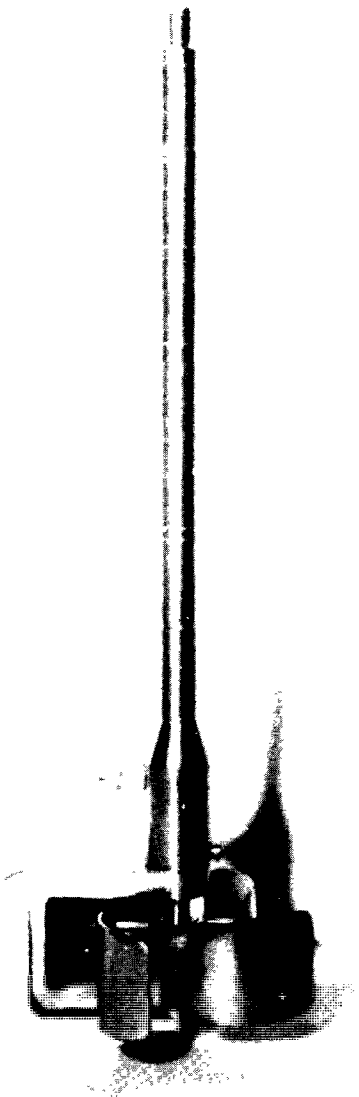


FIGURE 54.—Lower section of ice rod for use with vane ice meter.

rod of desired length (fig. 54). The most convenient length for an ice rod is about 3 ft (1 m) longer than the maximum depth of water to be found in a cross section. About 12 ft (4 m) is the maximum practical length for an ice rod; depths greater than 10 ft (3 m) are usually measured with a sounding weight and reel. The base plate, sliding support, and lower section are not used on an ice rod. Instead, a special lower section is screwed directly into the top of the contact chamber of the vane ice meter. (See fig. 54.) If a Price meter is used under ice cover, another special lower section is used to hold the meter by means of the hanger screw. (See fig. 55.) All lower sections for ice rods are now made so that the center of the vanes or cups is at the 0-ft point on the rod.

SOUNDING WEIGHTS AND ACCESSORIES

If a stream is too deep or too swift to wade, the current meter is suspended in the water by cable from a boat, bridge, or cableway. A sounding weight is suspended below the current meter to keep it

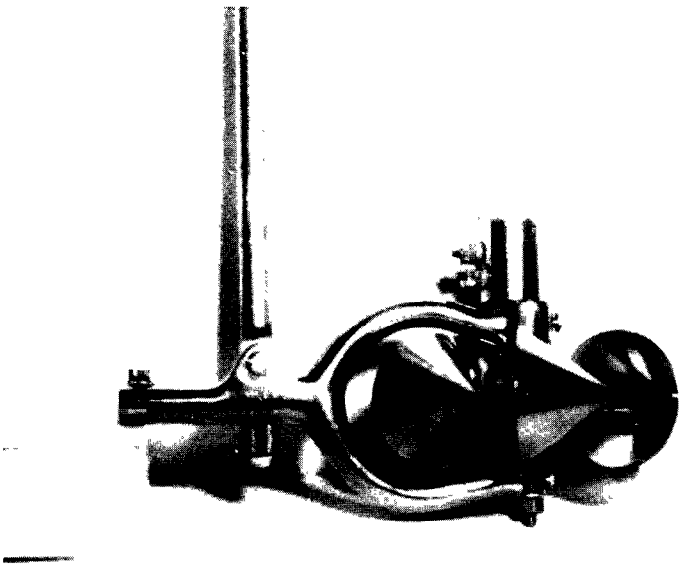


FIGURE 55.—Lower section of ice rod for use with Price meter.

stationary in the water. The weight also prevents damage to the meter when the assembly is lowered to the streambed.

The sounding weights now used in the U.S.A. are the Columbus weights, commonly called the C type. (See fig. 56.) The weights are streamlined to offer minimum resistance to flowing water. Each weight has a vertical slot and a drilled horizontal hole to accommodate a weight hanger and securing pin.

The weight hanger (fig. 57) is attached to the end of the sounding line by a connector. The current meter is attached beneath the connector, and the sounding weight is attached to the lower end of the hanger by means of the hanger pin.

In addition to the weights shown in figure 56, weights of 150, 200 and 300 lb (68, 91, and 136 kg) are used for measuring the discharge of deep, swift rivers. The sounding-weight hangers shown in figure 57 are designed to accommodate the weights of the various sizes. The height of the meter rotor above the bottom of the sounding weight must be considered in calculations to position the meter for velocity observations at various percentages of the stream depth.

SOUNDING REELS

A sounding reel has a drum for winding the sounding cable, a crank and ratchet assembly for raising and lowering the weight or holding it in any desired position, and a depth indicator. The U.S. Geological Survey has five types or sizes of sounding reel in common use, the choice of reel being dependent on the depth of water to be measured and on the weight required for sounding. The lightest of the reels, known as the Canfield reel (fig. 58), can be used with either single- or two-conductor cable; the other four reels use two-conductor cable, whose diameter ranges from 0.084 in to 0.125 in (2.13 to 3.18 mm),

FIGURE 56.—Columbus 15-, 30-, 50-, 75-, and 100-lb sounding weights.

depending on the weight to be handled. The three smaller reels have a hand crank for raising and lowering the meter and weight (fig. 58);

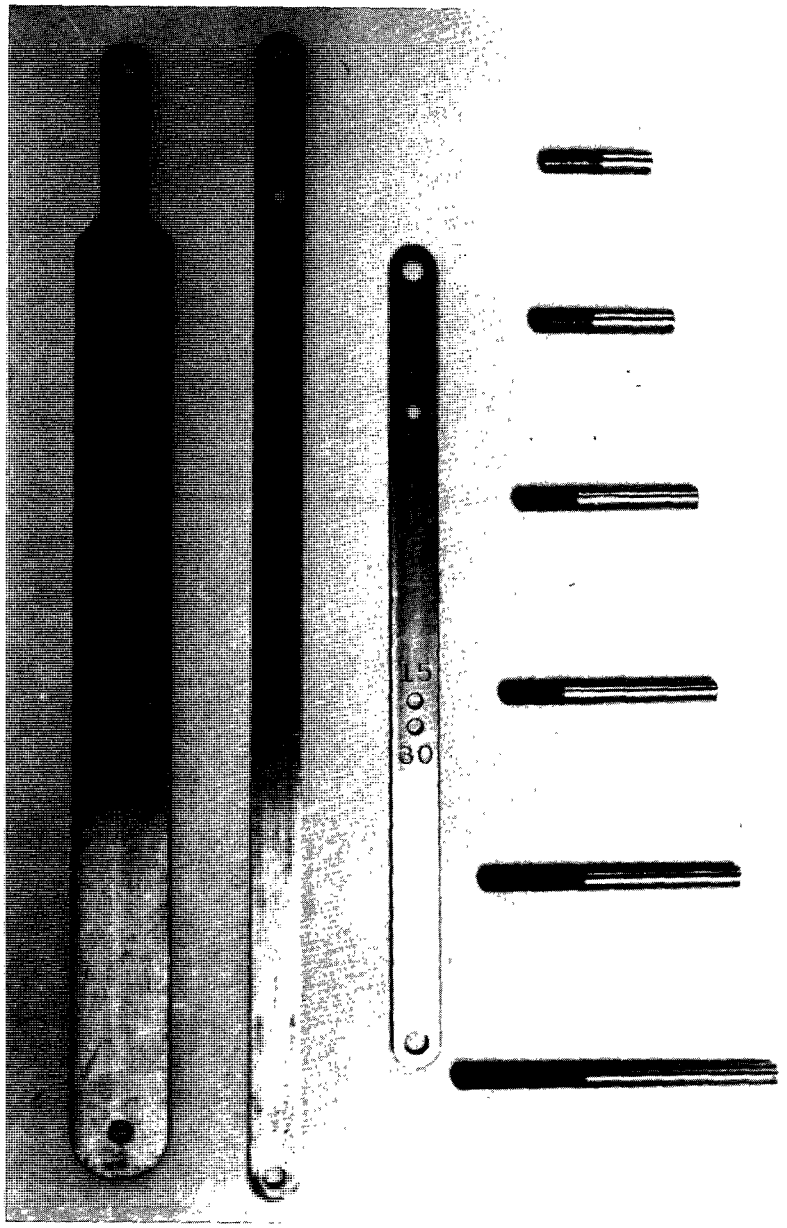


FIGURE 57.—Sounding-weight hangers and hanger pins.

Appendix C

Stream Discharge Form

TerraGraphics
Stream Discharge Form

TerraGraphics
ENVIRONMENTAL ENGINEERING, INC.

Site: _____ Gage Reading: _____ Gage Time: _____

Levelogger: Yes / No (circle one) Download Time: _____

Date: _____ Discharge Time: _____

Field Crew: _____

Discharge Measurements

	Tape (ft)	Width (ft)	Depth (ft)	Area (ft^2)	Velocity (ft/sec)	Velocity (ft/sec)	Discharge (cfs)
LWE							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
RWE							

Total Flow:

Comments:

Appendix D

Groundwater Sampling Sheet

TerraGraphics
ENVIRONMENTAL ENGINEERING, INC.

302 N. Last Chance Gulch, Suite 409
Helena, Montana 59601
(406) 441-5441 FAX (406) 441-5443

GROUNDWATER SAMPLING RECORD

Project:	Well Number:
Project Number:	Sample Number:
Location:	Weather:
Date:	Sampler(s):
Depth to Bottom:	Purge Time:
Depth to Water:	Purge Method:
DTB-DTW:	

GROUNDWATER DATA

Time	pH	Cond (___/cm)	Temp (^{o}C)	Dissolved Oxygen		ORP (mV)
				mg/L	%	

Sampling Date:		Sampling Method:		Time Sampled:	
Container	Volume	Preservative	Cooled	Filtered	Other

Chain of Custody: Yes/No	Duplicate Sample Number:
Chain of Custody Number:	Replicate Sample Number:
Laboratory:	
Method of Shipment:	
Split With:	
Notes:	

APPENDIX B

HASP

Final

Health and Safety Plan for Lilly/Orphan Boy Mine, Powell County, Montana

Prepared for:

Montana Department of Environmental Quality

P.O. Box 200901

Helena, MT 59620-0901

DEQ Contract No. 407041-TO12C

Prepared by:

TerraGraphics Environmental Engineering, Inc.

15 W 6th Avenue, Power Block 3rd Floor W

Helena, MT 59601

www.terragraphics.com

August 19, 2010

Approval Form

Approved by:

DATE:

TERRAGRAPHICS - PROJECT ENGINEER

Tom Smith

DATE:

TERRAGRAPHICS – SR. PROJECT MANAGER & PRINCIPAL IN CHARGE

Tom Bourque

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Acronyms and Abbreviations

amsl	above mean sea level
DEQ	Montana Department of Environmental Quality
H&S	Health and Safety
MSDS	Materials Safety Data Sheets
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
RWP	Reclamation Work Plan
SAP	Sampling and Analysis Plan

Table 1. Health and Safety Plan Commitment to Comply Signature Sheet

Health and Safety Plan Commitment to Comply: Signature below indicates that each individual has reviewed the attached Heath and Safety Plan, has received site-specific training (briefing), and agrees to comply with the requirements of this plan.		
Printed Name	**Signature**	**Date**

Section 1.0 Scope of Work & Background

1.1 Site Information & Description

Site:	Lilly/Orphan Boy Mine, Powell County, Montana
Client:	Pebbles Clark, Project Manager
	Montana Department of Environmental Quality
	(406) 841-5028 office; (406) 461-3660 cell
Sr. Project Manager:	Tom Bourque, TerraGraphics
Project Engineer:	Tom Smith, TerraGraphics
Dates of Site Work:	As requested by DEQ, July and August 2010
Location:	About 10.5 miles south of Elliston, MT
	Township 8 N, Range 6 W, Section 15

1.2 Purpose

The goals of this project are as follows:

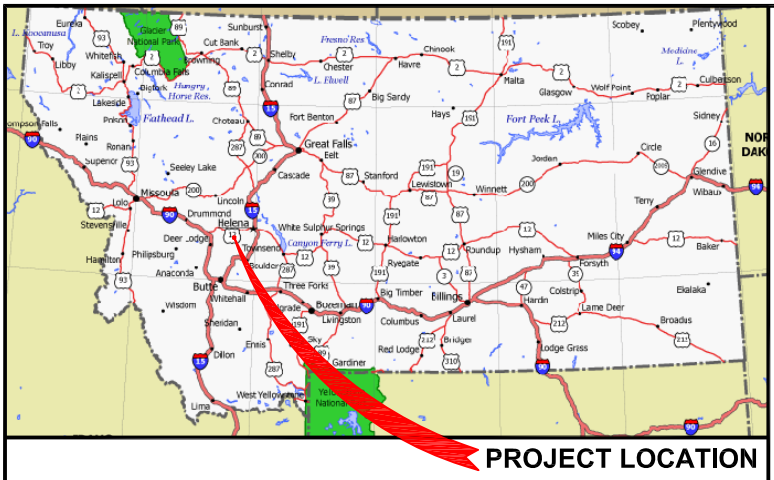
- Characterize the spatial extent of heavy metals contamination on the site;
- Characterize surface and mine water;
- Identify locations of potential borrow sources for cover and topsoil;
- Identify potential repository sites; and
- Identify all mine investigation activities necessary to characterize the mine workings to support a detailed evaluation of source control alternatives.

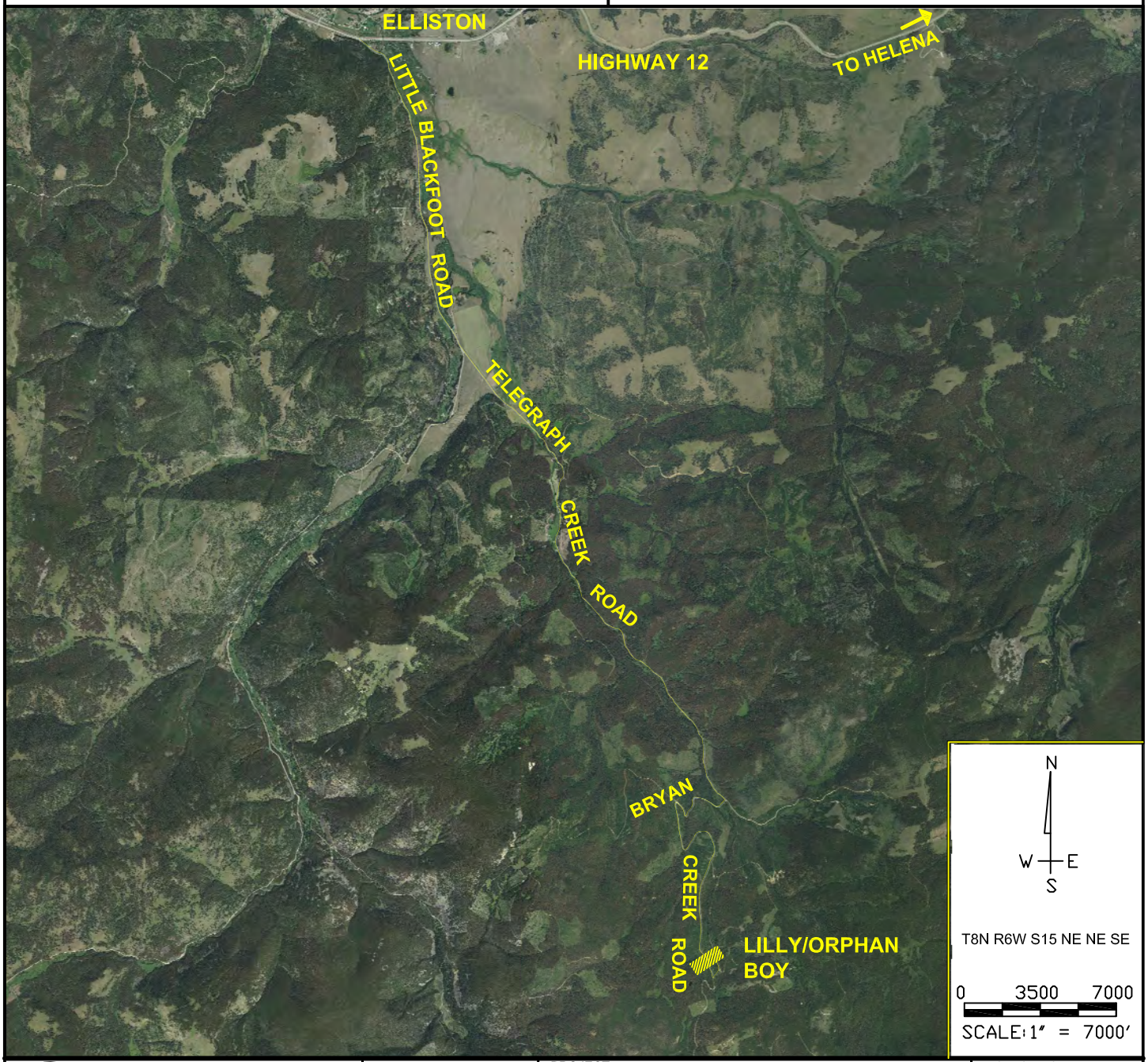
1.3 Site History

The Lilly/Orphan Boy Mine site is located approximately 10.5 miles south of Elliston, Montana near the headwaters of Telegraph Creek (Figure 1). The mine is situated at an elevation of approximately 6,800 feet above mean sea level (amsl) and is composed of approximately 1.5 acres of land contaminated by historical metal mining along Telegraph Creek.

The Lilly lode and the adjacent Orphan Boy lode were likely discovered in the early summer of 1890 by a group of four men with the Grand Republic Mining Company. The last production of ore from the Lilly/Orphan Boy Mine Site was a 50-ton shipment of ore that occurred in either 1954 or 1955. Significant site characteristics include a steel headframe and 250-foot deep shaft, three collapsed adits, and three waste rock piles. The Problem Definition/Background section of the SAP/QAPP contains a summary of the history surrounding the mining and land ownership of the Lilly and Orphan Boy Mines.

LOCATION MAP





TerraGraphics Environmental Engineering, Inc.	SCALE: As shown	PROJECT: *LILLY/ORPHAN BOY*	PROJECT NO: 09210
	DRAWN BY: TS		DATE: 5/14/2010
	ENGINEER: TS		FIGURE: 1 of 4

1.4 Scope of Work

TerraGraphics Environmental Engineering, Inc. developed a Phase II Reclamation Work Plan (RWP), on behalf of the Montana Department of Environmental Quality (DEQ), to provide guidance for field investigation activities at the Lilly/Orphan Boy Mine Site. The Phase II RWP addresses the Hydrogeology Investigation and Mine Investigation, where the platforms in the shaft are being removed, the mine workings dewatered, the shaft rehabilitated, and workings investigated for geology and water infiltration areas. Soil sampling; groundwater monitoring well installation; and surface water, mine water, and groundwater sampling in selected areas are proposed. Further details regarding the field investigation methods to be used are provided in the applicable sections of the Phase II RWP.

Subcontractors for this project will work under their own Health and Safety Plans.

1.5 Potential Site Hazards

The subject site is located within the Lilly/Orphan Boy Mine site. Several mining operations of various scales have occurred in this site and care must be observed when traveling through the area to identify and stay clear of potential obscured workings or buried objects. Since several areas have underground workings, subsidence is a concern. Avoid traveling over depression areas or above underground entries.

Dusts containing heavy metals may be encountered during soil sampling and drilling operations. Excessive noise during drilling and/or excavation equipment may be encountered.

Table 2 address potential site hazards that may be encountered during work at Lilly/Orphan Boy Mine. Section 3.0 contains specific job steps to reduce work and site hazards.

Table 2. Potential Site Hazards

Traffic accidents associated with travel to and from the site.
Abandoned mine site hazards associated with surface and underground workings.
Physical hazards (trips/falls, burns, cuts/contusions, etc.).
Exposure to onsite contaminants (heavy metals).
Exposure working around a drill rig, crane and other heavy equipment.
Exposure to a water treatment plant and caustic chemicals (mainly lime).
Exposure to loud noise generated by drilling and/or excavation equipment.
Contact with powered, pressurized, and/or hydraulic equipment.
Biological hazards (wildlife – bears, wolves, and moose, poisonous plants, stinging insects, venomous spiders, etc.).
Exposure to temperature extremes.

1.6 Identified Site Contaminants

Table 3 lists contaminant characteristics which may be encountered at the site.

Table 3. Possible Contaminant Characteristics

Waste Type(s):									
Liquid	X	Solid	X	Sludge	X*	Gas		Dust	X
Characteristic(s):									
Corrosive		Ignitable		Radioactive		Volatile		Toxic	X
Reactive	X**	Unknown		Other					

*sludge is a possibility if water treatment is performed on site.

**If lime is used for water treatment.

1.6.1 Exposure Pathways

1.6.1.1 Ingestion

All listed chemicals, including any brought onto the site to treat the mine water, have the potential for accidental ingestion; however, in work place settings it is not considered a primary route of entry. All accidental ingestions should be addressed by referring to the Materials Safety Data Sheets (MSDS) and seeking immediate medical attention.

1.6.1.2 Inhalation

Listed chemicals, including any brought onto the site to treat the mine water, capable of inhalation routes of entry should be maintained below the established exposure limits. If there is indication that the exposure limits are being exceeded, appropriate respiratory protection should be used.

1.6.1.3 Contact / Absorbance

Listed chemicals, including any brought onto the site to treat the mine water, presenting absorbance or contact hazards should be handled only with the use of appropriate Personal Protective Equipment (PPE). Waste rock and mine water at the subject site contain heavy metals and should be handled with care. Subcontractors bringing chemicals to the site to treat mine water shall deliver MSDS for those chemicals.

1.6.2 Identified Contaminant Information

Table 4 gives information on potential site contaminant exposure pathways, symptoms, and target organs.

Table 4. Identified Contaminant Information (2 pages)

Contaminant	Exposure Pathway	Symptoms	Target Organs
Aluminum (metal or powder)	Ingestion, Inhalation, Contact.	Eyes, skin, and respiratory tract irritant. Not carcinogenic.	Eyes, skin, respiratory tract.

Table 4. Identified Contaminant Information (2 pages)

Contaminant	Exposure Pathway	Symptoms	Target Organs
Arsenic (inorganic compounds as As)	Ingestion, Inhalation, Contact, Absorbance.	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, and hyperpigmentation of skin. Carcinogenic.	Liver, kidneys, skin, lungs, and lymphatic system (lung and lymphatic cancer).
Cadmium (dust and fumes)	Ingestion (dust), Inhalation.	Pulmonary edema, dyspnea, cough, tight chest, substernal pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, loss of smell, emphysema, proteinuria, and mild anemia. Carcinogenic.	Respiratory system, kidneys, prostate, and blood (prostate and lung cancer).
Chromium (Chromic acid and chromates as Cr(VI))	Ingestion, Inhalation, Contact.	Respiratory system irritation, nasal septum perforation, liver and kidney damage, leukocytosis, leukopenia, monocytosis, eosinophilia, eye injury, conjunctivitis, skin ulceration, and sensitization dermatitis. Carcinogenic.	Blood, respiratory system, liver, kidneys, eyes, and skin (lung cancer).
Chromium (metal & compounds as Cr(III))	Ingestion, Inhalation, Contact.	Eye irritation and sensitization dermatitis. Not carcinogenic.	Eyes, skin.
Copper (dusts, mists, and fumes)	Ingestion, Inhalation, Contact.	Dusts and mists - Irritant (eyes, nose, pharynx), nasal perforation, metallic taste, and dermatitis. Fumes - Irritant (eyes, upper respiratory system), metal fume fever, chills, muscle ache, nausea, fever, cough, exhaustion, metallic/sweet taste, and discoloration. Not carcinogenic.	Eyes, skin, respiratory system, liver, and kidneys. (Increased risk of Wilson's disease.)
Iron Oxide (dust and fumes)	Inhalation.	Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis). Not carcinogenic.	Respiratory System.
Lead (elemental and other compounds as Pb)	Ingestion, Inhalation, Contact.	Weakness, exhaustion, insomnia, facial pallor, anorexia, weight loss, malnutrition, constipation, abdominal pain, colic, anemia, tremor, wrist and ankle paralysis, encephalopathy, kidney disease, eye irritation, and hypotension. Not carcinogenic.	Eyes, GI tract, central nervous system, kidneys, blood, and gingival tissue.
Manganese (metal, compounds, and fumes)	Ingestion, Inhalation.	Parkinson's; asthenia; insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dypsnea, rales, flu-like fever; low-back pain; vomiting, malaise; fatigue; and kidney damage. Not carcinogenic.	Respiratory system, central nervous system, blood, and kidneys.

Table 4. Identified Contaminant Information (2 pages)

Contaminant	Exposure Pathway	Symptoms	Target Organs
Mercury (elemental and inorganic compounds as Hg)	Ingestion, Inhalation, Contact, Absorbance.	Irritant (eyes, skin), cough, chest pain, dyspnea, bronchial pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, proteinuria, GI disturbance, and weight loss. Not carcinogenic.	Eyes, skin, respiratory system, central nervous system, and kidneys.
Silver (metal and soluble compounds as Ag)	Ingestion, Inhalation, Contact	Blue-gray eyes, irritant (eyes, skin, nasal septum, throat), skin ulceration, and GI disturbance. Not carcinogenic.	Nasal septum, skin, and eyes.
Zinc Oxide (dust and fume)	Inhalation	Metal fume fever, chills, muscle ache, nausea, fever, dry throat, cough, weakness, exhaustion, metallic taste, headache, blurred vision, low back pain, vomiting, fatigue, tight chest, dyspnea, and decreased pulmonary function. Not carcinogenic.	Respiratory system.

Section 2.0 Site Specific Information and Emergency Information

2.1 Hospital Directions and Maps

St. Peter's Community Hospital

2475 East Broadway Street

Helena, MT 59601

(406) 442-2480

Total Travel Estimate: 54 minutes / 34.23 miles

Table 5 outlines driving directions from Lilly/Orphan Boy Mine to St. Peter's Hospital in Helena. Figures 2 and 3 show the mapped route from Lilly/Orphan Boy Mine to St. Peter's Hospital.

Table 5. Driving Route to St. Peter's Hospital, Helena, MT

Step	Street Names and Directions	Miles
1.	Start out going **north** toward **Telegraph Creek Road**.	0.3 mi
2.	Turn **slight left** onto **Telegraph Creek Road**.	0.9 mi
3.	Turn **right** to stay on **Telegraph Creek Road**.	0.1 mi
4.	**Telegraph Creek Road** becomes **Copper Queen Road**.	0.1 mi
5.	Turn **slight left**.	0.7 mi
6.	Turn **slight left** onto **Telegraph Creek Road**.	3.5 mi
7.	**Telegraph Creek Road** becomes **Hahn Creek Road/NF-1856**.	0.1 mi

8.	**Hahn Creek Road/NF-1856** becomes **Telegraph Creek Road**.	0.8 mi
9.	**Telegraph Creek Road** becomes **NF-1857**.	0.2 mi
10.	**NF-1857** becomes **NF-495/Telegraph Creek Road**.	0.4 mi
11.	**NF-495/Telegraph Creek Road** becomes **Little Blackfoot River Road**.	3.0 mi
12.	Turn **sharp right** onto **US-12**.	22.3 mi
13.	Turn **left** onto **11th Avenue/I-15 BR E/US-12 E**. Continue to follow **11th Avenue**.	1.0 mi
14.	**11th Avenue** becomes **Colonial Drive**.	0.6 mi
15.	Turn **right** onto **East Broadway Street**.	0.3 mi
16.	**2475 East Broadway Street** is on the **right**.	

Figure 2. Complete Driving Route to St. Peter's Hospital, Helena, MT

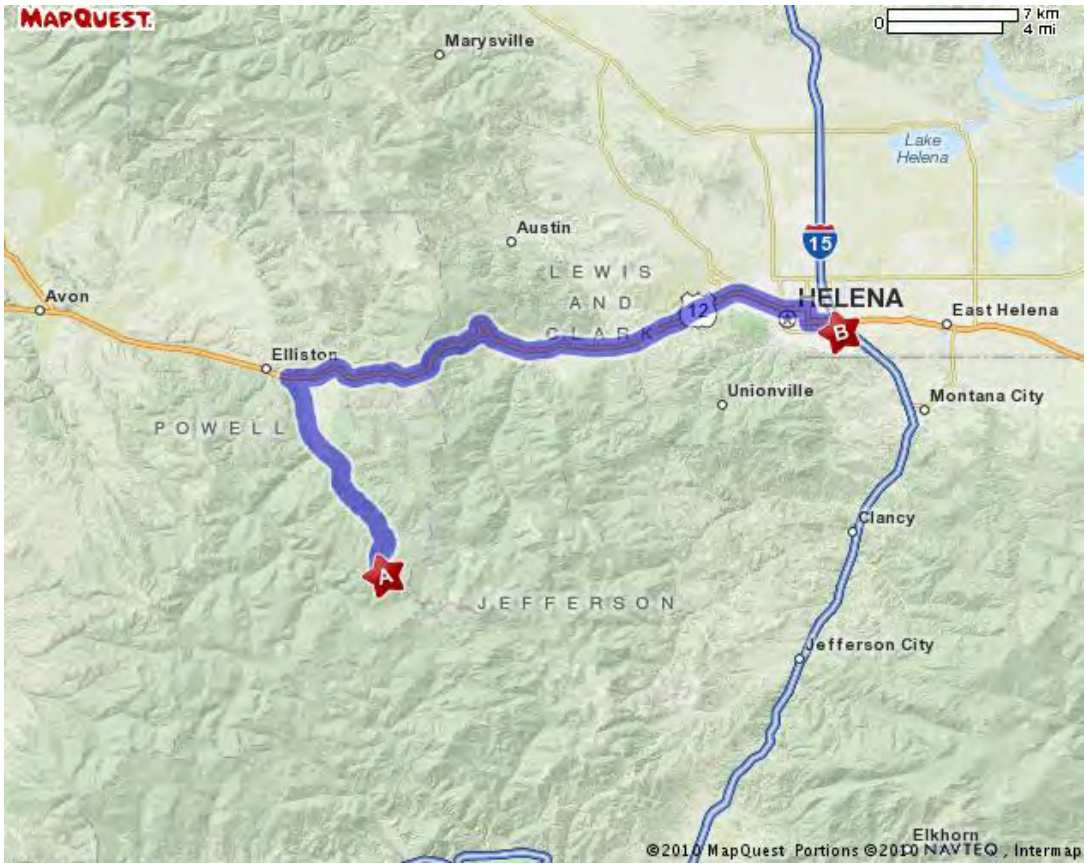
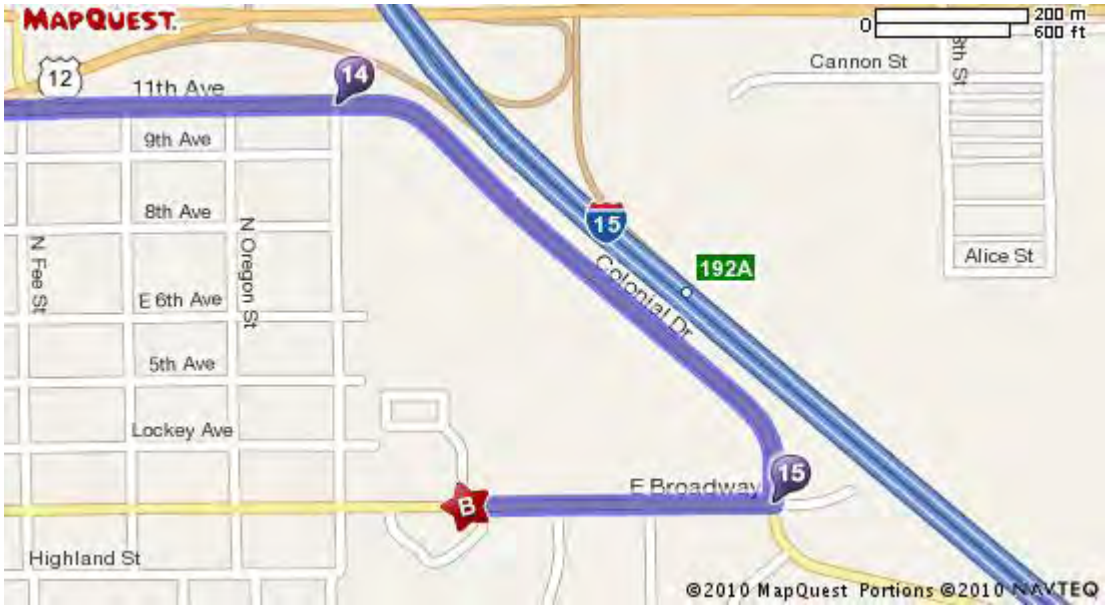


Figure 3. End Driving Route to St. Peter's Hospital, Helena, MT



2.2 Personal Protective Equipment (PPE)

Site-specific personal protective equipment varies by project type and quantity of contaminants/chemicals encountered. In this case, no construction activities will be performed and only minimal contact with metals contaminated materials is expected. Subcontractors may deliver chemicals, such as lime, to treat the mine water. The appropriate level of PPE for this project has been designated as Level D (see Table 6). If site conditions change or if the site safety manager/project manager recognizes potential health risks not identified in this plan, the PPE level will be upgraded accordingly. Subcontractors on this project are responsible for their own PPE and will operate under their Health and Safety Plan.

The site safety manager/project manager will ensure that applicable safety equipment and supplies are available on-site to meet the needs of project personnel during site visits. Examples of safety supplies to be maintained on-site include fire extinguisher(s), first aid kit, and eyewash. This equipment is to be inspected monthly by the site safety manager/project manager.

Due to field work generally coinciding with the forest fire season, either the excavation contractor or driller may be required to have a water truck or water tank onsite at all times to extinguish any fire that may start as a result of field activities. If the fire cannot be controlled, personnel shall evacuate the site and notify authorities (dial 911) about the fire immediately.

Table 6. Site Required Personal Protective Equipment

Project Required	PPE Level	Definition
X	Level D	A work uniform affording minimal protection: used for nuisance contamination only.
	Level C	The concentration(s) and type(s) of airborne substance(s) is/are known and the criteria for using air purifying respirators are met.
	Level B	The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.
	Level A	To be selected when the greatest level of skin, respiratory, and eye protection is required. The following constitute Level A equipment: pressure demand full-face SCBA or supplied air respirator plus a totally encapsulating chemical-protective suit.

2.3 Emergency Reporting

The TerraGraphics project manager or engineer will contact emergency response organizations (if needed) and notify:

- Jeremy Mickey, TerraGraphics H&S Officer at (406) 360-6505 during business hours or (406) 859-6505 after business hours,
- TerraGraphics Division Manager,

- Program Manager, and
- DEQ (as appropriate).

If the Senior Project Manager is not available, the project manager or engineer will contact the TerraGraphics Division Manager or other project managers, as necessary.

2.4 Emergency Evacuation

In the event that an emergency requires evacuation, all TerraGraphics personnel will assemble on the main road of the site (Figure 4).

Do not rely on e-mail or voice mails when reporting incidents. It is appropriate to leave a voice mail or send an e-mail, but all incidents shall be reported to a manager in person or on the phone. The person placing the calls shall continue to place phone calls using the list of personnel in the Incident Notification Contact List in Table 9 until a manager is reached in person.

2.5 Emergency Communication

See the Emergency Reporting section (Section 2.3), and Incident Notification Contact List (Table 9in this Health and Safety Plan for the emergency communication contacts.

Call emergency agencies for assistance. If Life Flight or other emergency medical caregivers are required, Table 7 contains the longitude and latitude coordinates that may be required for a meeting place.

Table 7. Life Flight Landing Coordinates

Helicopter Landing Site	Longitude	Latitude
Site Location (landing not likely possible).	112°20'30.99"W	46°26'33.71"N
Access road at Boy Scout tree planting area 2.3 miles down the road from the Lilly/Orphan Boy Mine site.	112°20'24.86"W	46°26'33.57"N

2.5.1 Protect people

- Clear the immediate danger area.
- Follow directions to the assembly point so the project manager can account for all onsite personnel.
- Keep all unauthorized personnel out of the emergency area.

2.5.2 Control the source

- Eliminate ignition sources.
- Shut down unnecessary equipment and power sources.
- Extinguish fires if within your skill and training.
- Contain spills and releases.

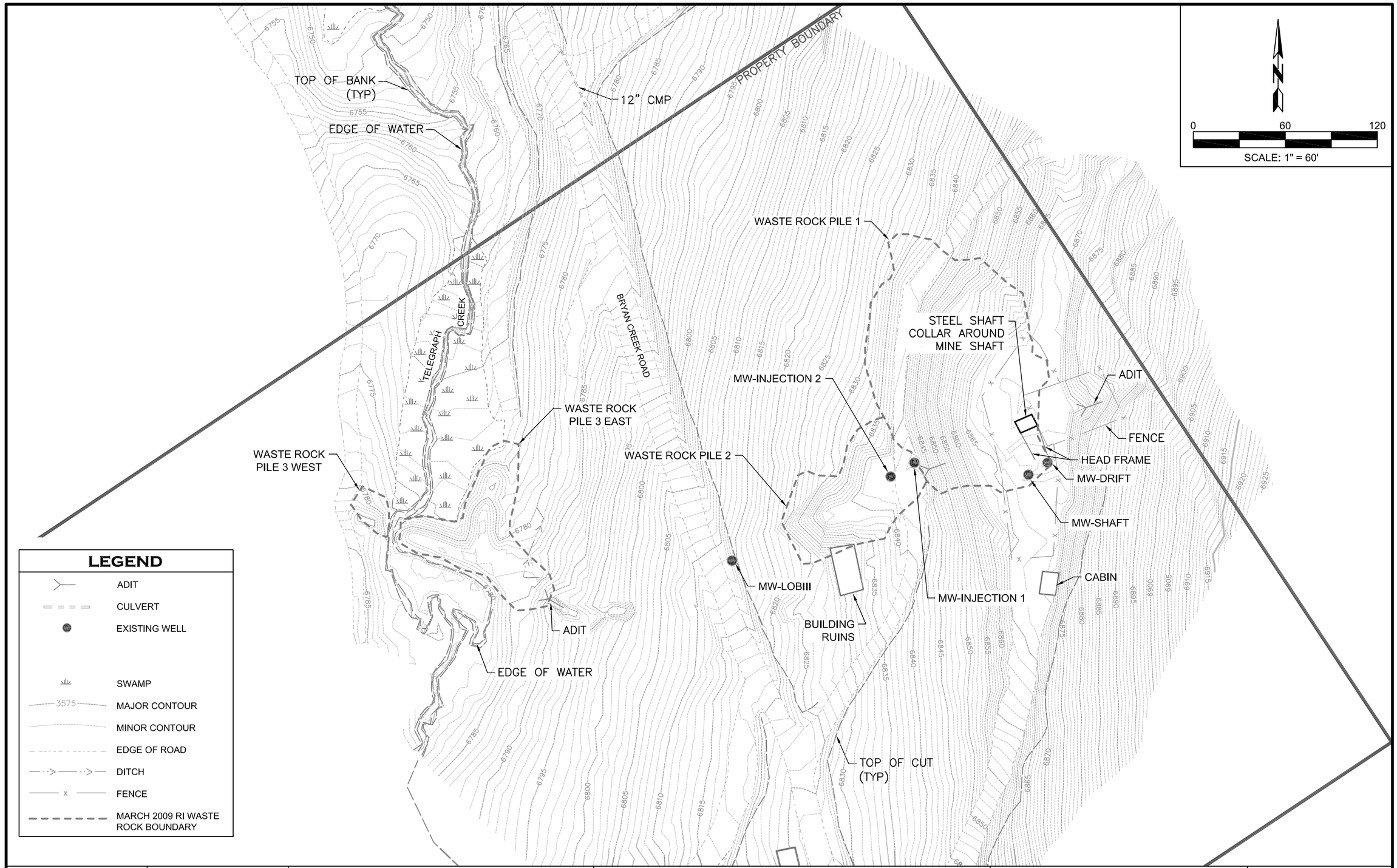
2.5.3 Attend to injured workers

- Do not attempt to rescue people; wait for emergency responders.

- Make the injured worker comfortable. Do not move the injured workers unless there is imminent danger.
- Give first aid to the level of your training.

2.5.4 Minimize losses to equipment

- Protect or remove exposed equipment, if safe to do so.



LEGEND

- ADIT
- CULVERT
- EXISTING WELL
- SWAMP
- 3575 MAJOR CONTOUR
- MINOR CONTOUR
- EDGE OF ROAD
- DITCH
- FENCE
- MARCH 2009 RI WASTE ROCK BOUNDARY

DRAWN: TLS	PROJECT NO.: 09210	TerraGraphics Environmental Engineering, Inc.	FIGURE: 4
ENGINEER: TLS	SCALE: AS SHOWN	EXISTING TOPOGRAPHIC SITE MAP	DATE: 8/19/2010
CHECKED: JM	APPROVED: TLS	LILLY/ORPHAN BOY ABANDONED MINE SITE	
	DATE: 8/19/10		

2.6 First Aid Procedures

If emergency response personnel (ambulance, fire, police, etc.) are called to the site, the site safety manager will send a member of the field team to the main access road to direct responders to the location of the emergency. In the event the nature of the emergency precludes sending an individual to the main access road (fire, toxic gas cloud, etc.) the site safety manager, or a designee, will call 911 to provide additional details of the emergency to the 911 dispatcher. See Table 7 for GPS coordinates of the Lilly/Orphan Boy Mine site and the preferred landing site for life flight helicopter if needed.

For all major and minor injuries (e.g., minor cuts and bruises), immediately contact your local human resources official if workers compensation applies, and complete an incident report.

For serious injuries refer to the first aid manual in the first aid kit, stabilize the person, and seek medical attention immediately. For any injury that occurs on the job and requires medical treatment, notify the hospital or treating facility that the injury is a workers compensation injury.

2.6.1 Insect Stings

Remove the stinger (if applicable), wash the sting area, and apply a cold compress to reduce swelling. If the victim is allergic to insect or bee stings, seek medical attention immediately. Ask the victim if they carry an allergic epinephrine-pen (epi-pen) with them; encourage them to use it if applicable. Review the first aid manual in the first aid kit for further instructions.

2.6.2 Minor Cuts, Scrapes, and Bruises

Don appropriate PPE, nitrile gloves, and apply pressure to limit bleeding. Wash the wound and then apply bandage and cold compress to reduce swelling. If bleeding persists, stabilize the victim and seek medical attention.

2.6.3 Difficulty Breathing

Move the victim to fresh air and/or a shaded area for heat stress, allow the victim to rest, and provide respiratory support (rescue breathing) if necessary. Call 911 if respiratory support is used or if there is any trouble with breathing normally.

2.6.4 Difficulty Swallowing

Seek medical attention immediately. Call 911.

2.6.5 Personal Decontamination Procedures

Site activities and tasks could potentially cause the skin to become exposed to tailings or dust containing heavy metals. After potential exposure of this nature:

- Thoroughly wash hands and face with soap and water before eating, drinking, or smoking. If water is not available, use pre-moistened towelettes to wash face and hands.
- Do not track contaminated soils, tailings, slimes, mud, and dust off-site.

2.7 Safety Equipment and Supplies

Each team will have access to a first aid kit, clean water, paper cups, and pre-moistened towelettes. TerraGraphics personnel will ensure appropriate safety gear is available for site operations. The site supervisor will also be equipped with a cell phone in case of an emergency requiring outside assistance. Cell service has been available at the site; however, in the event it is not available (as the subject site is remote), climbing or driving (if possible) to the top of a hill or mountain may be necessary to receive a signal strong enough to make a call. Table 8 lists safety equipment and supplies that are required for work at the site.

Table 8. Safety Equipment and Supplies

Equipment	Type	Required
SAFETY GLASSES WITH SIDE SHIELDS		X- during drilling/excavation
HARD HAT		X- during drilling/excavation
STEEL-TOED BOOTS		X- during drilling/excavation
GLOVES		X- during drilling/excavation
RESPIRATOR WITH CARTRIDGES		
HEARING PROTECTION		X- during drilling/excavation
HIGH VISIBILITY WEAR	Vest/Coat	X- during drilling/excavation
WASTE DISPOSAL BAGS / LABELS		
FIRE EXTINGUISHER		X
EYE WASH BOTTLE		
FIRST AID KIT		X
DRINKING WATER		X
WASH WATER		X
SOAP		X
INSECT REPELLENT		X
UV PROTECTION		X
FOOD		X
TOOL KIT		X
BEAR SPRAY		X

2.8 Incident Notification Contact List

Table 9 outlines the TerraGraphics incident notification contact list.

Table 9. TerraGraphics Incident Notification Contact List

Name	Agency	Office Phone	Cell Phone
Tom Smith	TerraGraphics	(406) 441-5441	(406) 461-5974
Tom Bourque	TerraGraphics	(208) 882-7858	(509) 330-1701
Jeremy Mickey	TerraGraphics	(406) 441-5441	(406) 360-6505
Jerry Lee	TerraGraphics	(208) 882-7858	(509) 330-1700

Section 3.0 Analysis of Job Safety

Field staff must review the Phase II RWP and coordinate with the project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to: permitting, access agreements, and notification to the required contacts (e.g., site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be

performed and documented at the beginning of each work day (Table 1). Also consider weather conditions – heat, cold, rain, snow, ice, lightning, wind, hail, etc.

3.1 Driving

3.1.1 Personal Protective Equipment

All company vehicles used for the project will have a complete first aid kit, a fire extinguisher, road-side emergency kit, and a cell phone (that is off during the trip).

3.1.2 Pre-Trip Job Steps

Check weather conditions prior to the start of the trip. Consider the worst case outcomes of vehicle operations (e.g., blowout, collision, injury, etc.). Inclement weather such as snow, ice, rain, fog, severe weather, and high winds significantly increase accident risk. Assess the potential hazards associated with driving. Analyze how to reduce the risk, and act to ensure safe operation of the vehicle. Consider cancellation or postponement of the trip when appropriate.

Prior to driving, perform a perimeter walk-around of the vehicle to inspect for damage or unusual conditions such as, but not limited to: flat tires; leaking fluids; vehicle damage; broken head lights, brake lights, or turn signals; defective horn, and broken windshield wiper. Assure the vehicle tires are properly inflated and there is sufficient tread on the tires. Additionally, look for cuts or bulges in the tires. Assure the windshield and windows are clean and the vehicle contains washer fluid. Lift wiper arms and check wiper blades for damage or deterioration.

Adjust the seat so that the back is fully supported, the upper arms are close to the body, and the pedals are within easy reach. Lower the steering wheel so that the hands are below the shoulders and the shoulders are relaxed. Check mirror adjustments each time the vehicle is restarted in order to reduce “blind spots”.

Assure that the seat belts are in good condition and work correctly. Assure all passengers and the driver have fastened their seat belts prior to starting the vehicle. The seatbelts should never be removed during vehicle operation.

Check the gauges and warning lights of the vehicle. If the engine light is on, do not drive the vehicle until the condition is thoroughly analyzed and fixed. Also check the fluids (e.g., oil, fuel, radiator, etc.) of the vehicle to prevent an overheated engine or a breakdown due to lack of critical fluids.

3.1.3 During the Trip Job Steps

Driving speed should neither be too fast nor too slow for driving conditions. Keep the vehicle from rolling by adjusting for driving conditions. Scan the mirrors frequently for changes in weather visibility, other drivers, and road conditions.

Demonstrate an eye lead time consistently in excess of 15 seconds. See and evaluate relevant information from among distant objects. The following distance to other vehicles should be 4 seconds; however, avoid being unnecessarily boxed in. Make and execute decisions early and choose the lane of least resistance. Check all mirrors and over the shoulder before changing lanes to ensure there is sufficient room in the new lane for your vehicle and there are not “blind spots”. Be aware that “blind spots” may change slightly from vehicle to vehicle depending on the type and make.

When parking, park away from other cars and always set the parking brake. If possible, your first move when restarting the vehicle should be forward; however, if backing is necessary, be sure to check for obstructions behind the vehicle prior to entering the car and again before backing-up the vehicle.

3.1.4 Post-Trip Job Steps

Immediately report all vehicle problems, mechanical problems, and/or maintenance issues to the company/rental car agency upon vehicle return.

3.2 Surface Water, Mine Water, and Groundwater Sampling

3.2.1 Personal Protective Equipment

Wear a hard hat within 25 feet of overhead hazards or as otherwise required by the property owner, client, or subcontractors.

Wear safety glasses with side shields when handling water in an open container. Also wear safety glasses with side shields when low-flow purging and sampling of surface water, mine water, and groundwater wells.

Wear appropriate footwear at all times while working onsite. At a minimum, this will include leather work boots that cover the ankles. No tennis shoes, sandals, or other footwear not designed for heavy construction-type work will be worn on site.

Knee pads or kneeling pads will be available for samplers during soil sampling.

Wear nitrile gloves during soil sampling, surface water sampling, mine water sampling, and groundwater sampling.

3.2.2 Surface Water, Mine water, Groundwater, and Soil Sampling Job Steps

Complete a pre-job inventory of all sample bottles and containers. Wear nitrile gloves and safety glasses during the inventory to protect against acids that have leaked from pre-preserved sample bottles and containers. Ensure that none of the sample containers are cracked or broken.

During sampling, verify that the working surface is free of any debris or materials that could cause loose or slippery footing or contact if kneeling. If sampling equipment uses batteries, use only the batteries recommended for the equipment. If no batteries are available, use the vehicle battery by making the final connection away from the battery or using the power take-off. Use the vehicle fire extinguisher (extinguishers are rated 2A and 5BC and are serviced annually and checked monthly) in all fuel use areas or in areas where fire is likely.

All site workers should have 40 hours of hazardous materials training (as defined by 29 CFR 1910.120) and current, annual refreshers. An additional 8 hours of training is recommended for all onsite supervisors. Site-specific training must address chemicals used onsite, site-specific hazards, and proper handling of potentially contaminated materials such as samples. This training will occur at the start of every work day and all site workers will sign the Health and Safety Plan Commitment to Comply sheet (Table 1). Ensure there are correct and current MSDSs onsite for all chemicals in use.

Always wear nitrile gloves when handling potentially contaminated material, chemical containers labeled with preservatives, and/or samples. After handling hazardous waste and/or samples, thoroughly wash hands before eating, drinking, or smoking.

Inspect sampling areas for biological hazards such as plants and organisms. Avoid areas where these hazards are common or found, if possible. Review the route to the hospital if the site contains any biological hazards. Wear clothing that covers potentially affected body parts and seal pants legs against contact with plants and access by organisms (e.g., ticks, chiggers, etc.). Additionally, use insect/tick repellant whenever possible. Wear boots with ankle protection to prevent snake bites and be aware of snake habitats like underbrush, high grass, and rubble or loose rock. If poisonous plants (i.e., poison ivy, poison oak, and poison sumac) are in the working areas of the site, thoroughly wash hand with detergent prior to touching unprotected body parts, drinking, eating, or smoking. After the work day is complete, check the body thoroughly to detect ticks and/or chiggers. Take a hot shower after field work and wash thoroughly.

Temperature stress is a threat to all site workers. If the temperature is above 80°F or below 40°F, administrative controls will be implemented (cooled or warmed drinks, routine breaks in heated or shaded area(s), and provisions for emergency heating or cooling as necessary). If temperature related injuries occur at the site, immediately call 911 and take the proper course of action to slow the victim's injuries while waiting for medical attention.

3.3 Drilling, Crane, and Work Around Equipment

3.3.1 Personal Protective Equipment

Wear a hard hat at all times when the crane, drill rig, or heavy equipment are on-site.

Wear high-visibility, reflective safety vests at all times when the crane, drill rig, and/or heavy equipment are on-site.

Wear safety glasses with side shields or goggles, as appropriate, when working at or near the drill rig, crane, heavy equipment, pump, generator, and/or water treatment plant.

Wear hearing protection within 25 feet of operating equipment, as needed.

Wear nitrile gloves for safe handling of potentially contaminated materials or water treatment chemicals, as needed.

Wear appropriate footwear at all times while working onsite.

In order to control/alert traffic and to exclude unauthorized personnel, use safety cones, barricades, and caution tape, where appropriate.

Maintain visibility with equipment operators so they know where you are and stay out of their blind spots while they are operating heavy equipment.

3.3.2 Drilling, Crane, and Heavy Equipment Job Steps

In order to prevent being struck by equipment, always ensure the equipment operator is aware of your location. If visibility is limited, move to an area where you can be seen by the operator. All rigs, cranes, utility trucks, and heavy equipment will be equipped with functional backup

alarms. Artificial lighting will be provided for even lighting (5-foot candles per 29 CFR 1926.26) in the work area, if necessary.

Clear all working areas of all unnecessary equipment and slip/trip hazards. Additionally, the Field Manager and drill rig, crane, or equipment operators will ensure that each boring location or work area has been cleared to preclude contact with buried or overhead utilities. If structures fall within the radius of the raised mast, the operators and the Field Manager will establish an exclusion zone boundary that unauthorized personnel cannot cross. No workers will work under suspended loads. Only experienced operators will be allowed to operate the rig, crane, and other equipment. The rig or crane will be operated per the subcontractor's standard procedures or per the manufacturer's directions; all hoses and cables will be inspected daily. Drill rigs will have two functional automatic control shutdown switches or "kill/dead-man switches". All personnel working around the rig will have knowledge of how these switches operate and where they can be found.

Use safe work practices when handling knives, shovels, or any other sharpened equipment. Avoid loose fitting gloves and clothing and tie back hair when working around rotating equipment. Allow all moving parts to stop before handling them. Identify, mark, and communicate pinch points on equipment. Ensure all hands are clear of potentially moving parts before energizing equipment.

Use proper hearing protection when within 25 feet of working machinery or whenever it is necessary to raise your voice to be heard over the machinery.

Work on or around the pump, generator, water treatment plant or land application system shall be directed by the water treatment subcontractor or project manager. Depending on how the dewatering and water handling process is set up, follow all subcontractor instructions and procedures for operation.

Keep a fire extinguisher (extinguishers are rated 2A and 5BC and are serviced annually and checked monthly) in all fuel use areas or in areas where fire could occur.

3.4 Abandoned Mine Entry

TerraGraphics personnel are not trained to enter any part of the abandoned mine workings at the site. Entrance into these areas will only be performed by trained professionals and will be completed by subcontract workers. Subcontract workers are responsible for their own site-specific health and safety plans regarding entrance into abandoned mine workings. These plans will be prepared to ensure the safety of all personnel working at, near, and in the abandoned mine workings. Once the site has been declared safe for entry, TerraGraphics personnel will be escorted by the trained subcontract workers during the performance of hydrogeology and mine investigations Access without the subcontractor escort shall not be permitted.

Section 4.0 References

29 CFR 1910.120. Occupational Safety and Health Standards: Hazardous waste operations and emergency response.

29 CFR 1926.26. Safety and Health Regulations for Construction: Illumination.

TerraGraphics Environmental Engineering, Inc. 2010. Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) for Site Characterization of Lilly/Orphan Boy Mine, Powell County, Montana. Prepared for MT DEQ.

APPENDIX C

Crane Subcontractor Cost Estimates

Lilly/Orphan Boy

Contacted Crane Contractors				
Cranes	**Contact**	**Phone Number**	**Email**	**Notes**
Dick Irvin, Inc.	Dwayne	(406) 450-0962		Not able to submit a cost estimate
H&H Enterprises*	Tom	(406) 452-4614	hhenter@3rivers.net	Cost estimate received
Montana Crane Service	Greg Poncelet	(406) 586-0909	info@montanacraneservice.com	Cost estimate received
Tom's Crane Service	Tom	(406) 431-0575		Crane capacity is 10 tons, good for unloading & loading from delivery truck & setting pump

*Propose hiring this subcontractor.

Lilly/Orphan Boy Scope of Work to Prepare a Proposal and Cost Estimate: Township 8 North, Range 6 West, Section 15, Powell County, Montana.

We are requesting cost estimates for performing the following crane work at the Lilly/Orphan Boy abandoned mine site located approximately 10.5 miles south of Elliston, Montana near the headwaters of Telegraph Creek. The mine is situated at an elevation of approximately 6,800 feet above mean sea level (amsl) and is composed of approximately 1½ acres of land contaminated by historic metal mining along Telegraph Creek. The site has a shaft where MSE Technologies of Butte performed a study where they lowered 2 platforms into the two-chambered shaft down to a level approximately 125' below existing grade. On these platforms, a total of approximately 60 cubic yards of compacted manure, straw, and wood chips (with the majority being the manure) were placed on the suspended platforms. Four cables approximately 1-inch in diameter suspend each platform and are connected to a steel frame at the surface that was also constructed by MSE for their study. MSE constructed their frame around a 1950s wooden headframe that cannot be disturbed. You can move the cables at the surface but cannot see the platforms as the water is approximately 73' below the surface. There are two steel cross members bolted onto the top of the steel frame that will need to be removed as they are in the way of the platform removals. Also, each cable is suspended by rings with screw-in connectors. If these cannot be removed, they can be cut; however, if the platforms cannot be removed then the cables will need to be reconnected. The platforms can be set off to the side out of the way once removed.

We are requesting cost estimates to either remove the platforms or lower them to the bottom of the shaft. The depth of the shaft is approximately 250 feet and it is at a slight incline of approximately 5 degrees from vertical. We would prefer to remove the platforms, but if lowering them to the bottom is easier and cheaper, than please let me know. This project is to be funded by the Montana Department of Environmental Quality – Abandoned Mine Land Section. We have discussed this project with you some, but the DEQ is requesting a formal cost estimate so a contractor can be selected. Attached are a site map and site photographs. A chain link fence is located around the shaft and working area. A gate opening just under 12 feet in width is located from the access road on the southern side. Portions of the fence can be removed if needed. The site map is scaled for you to measure what may need to be done to the site to perform the requested work. **Please have a cost estimate to me by Friday, August 6th.** If you would need a support vehicle with tools and equipment, please include those costs as well. Also feel free to call with any questions. Thank you.

H & H Crane Service,

P.O. Box 437
Black Eagle, MT 59414-0437
Phone (406) 452-4614
Fax (406) 771-4942

Proposal

DATE	Prop #
8/20/2010	2471

NAME / ADDRESS
TerraGraphics Attn: Tom Smith 302 Last Chance Gulch Helena, MT 59601

DESCRIPTION
Supply Crane, service truck, rigging to remove (2) suspended platforms in the Lilly/Orphan Boy Mine Shafts H & H will first try to lift the platforms out of the shafts and place off to the side. If the platforms get hung up, we will then lower them to the bottom of the shaft. Total Price: $12,500.00

APPROVED BY: _____...

Montana Crane Service

Corporate Office
209 East Cedar • Bozeman, Montana 59715
Phone: (406) 586-0909 • 1-800-406-LIFT • Fax: (406) 586-3836
Email: info@montanacraneservice.com

June 23, 2010

Via Regular Mail and Email tom.smith@terragraphics.com

Terra Graphics Environmental Engineering, Inc.
Attn: Tom Smith, PE, PG
302 North Last Chance Gulch, Suite 409
Helena, MT 59601

RE: Crane Service Quote: Lilly/Orphan Boy Mine

Dear Tom,

We appreciate the opportunity to quote this project. There is a lot of planning to be completed in order to pull this project off smoothly. We need to complete a work plan in order to effectively quote this; we are willing to work with you on this if need be. The site is not an easy one to get in or out of and we may have to build a pad for the crane to set up on. Due to these issues we have put together an *estimated* preliminary budget. The first part of the estimate is for the removal of the mine shaft platforms. This portion is further broken down into mobilization and site tasks costs. We have quoted our Bozeman based 70 Ton Link belt HTC 8670LB for the first part of the project. The second part of the project utilizes a Helena based 30 Ton National Boom Truck.

We provide many services with our large fleet of equipment and employ many experienced and hard working individuals. We would like to extend our services to the variety of other tasks this project may require. Please find our time and materials pricing (MCS/MRM 2010 price lists) enclosed for your reference. We would be happy to put together numbers for other tasks.

Following your review of the quote, please call us with any questions you may have.

Estimated Preliminary Budget
REMOVAL of Mine Shaft Platforms

Initial site visit and preliminary lift plan	400.00
Follow up site visit and lay out	800.00
Special rigging	1,200.00
Site visit/s and special rigging sub-total	*$2,400.00*

Mobilization to and from staging area, Bozeman based equipment and crew (Day 1 and 3)

70T Link Belt HTC 8670LB 1,794.00
MDOT Permits 221.00
Dump Truck and Equipment Trailer (D5, KX161, ASV30) 1,145.00
1T Service Truck (welding and mechanical equipment, rigging and blocking) 944.00
Mobilization sub-total $3,160.00

Day 1

Site Task: Off Load, stage equipment, set up crane and rig to platform (Day 1 includes mob)

Hourly crew and equipment (estimated at 5 hours) 1,975.00
Over time 120.00
Day 1 Crew and equipment sub-total..... $2,095.00

Daily crew travel 150.00
Per Diem 270.00
Day 1 Crew travel and Per Diem sub-total..... $420.00

Day 2

Site Task: Craning, rigging and handling to remove both suspended mine shaft manure containments.

Hourly crew and equipment (estimated 10 hours) 3,950.00
Over time 120.00
Day 2 Crew and equipment sub-total..... $4,070.00

Daily crew travel 300.00
Per Diem 270.00
Day 2 Crew travel and Per Diem sub-total..... $570.00

Day 3

Site Task: Tear crane down, return to staging area, load out equipment and prepare for departure.

Hourly crew and equipment (estimated 3 hours) 1,339.50
Day 3 Crew and Equipment Sub-total..... $1,339.50

Removal of Mine Shaft Platforms: Estimated Total $14,054.50

INSTALLATION of Pumps and Accessories

Mobilization to and from staging area (Day 1 and 3)

30T National Boom Truck (Helena based) 594.00
1T Service Truck (welding and mechanical equipment, rigging and blocking, Bozeman based) 944.00
Mobilization sub-total $1,538.00

Day 1

Site Task: Off load, set up crane (Day 1 includes mob)

Hourly crew and equipment (estimated 2 hours) 480.00

Day 1 Crew and equipment sub-total..... $480.00

Daily crew travel 100.00

Per Diem 90.00

Day 1 Travel and Per Diem sub-total..... $190.00

Day 2

Site Task: Craning, rigging and handling in order to place pumps and accessory equipment. Tear down boom truck and return to staging area.

Hourly crew and equipment (estimated 10 hours) 2,400.00

Over time 80.00

Day 2 Crew and equipment sub-total..... $2,480.00

Daily crew travel 100.00

Per Diem 90.00

Day 2 Travel and Per Diem sub-total..... $190.00

Day 3

Mobilize from staging area, included in mobilization.

Installation of Pumps and Accessories: Estimated Total $4,878.00

ESTIMATED Project Total (Removal/Installation)..... $18,932.50

Site Specific Notes (Read carefully before signing.)

1) We will transport and store existing rigging for up to one year should it need to be reused. If it does not get reused within one year we will retain possession to cover these handling costs.

SPECIAL CONDITIONS, Montana Crane Service, Ltd: (Read carefully before signing)

★ **Scheduling of a crane is on a first come first serve basis upon return of a signed quote.**

★ Unforeseen circumstances which affect cost to complete a priced item **will be billed as an extra charge** on a time and materials basis.

★ Standby time for the crane quoted due to the following and related circumstances will be charged at 60% of the hourly operated rate.

- ☐ poor site accessibility and in route delays
- ☐ not enough space to maneuver the crane or the trucks
- ☐ additional excavation required to make level, enlarge set area, or improve access
- ☐ additional compacting or blocking because of insufficient compaction or soft ground

- ☐ passageways being too narrow
- ☐ waiting for power lines to be turned off or dropped
- ☐ high winds
- ☐ late or non-arrival of crew
- ☐ late or non-arrival of materials

★ **Per Diem,** if applicable, is charged at the rate of $90.00 per man, per night.

★ **Overtime hours**, if not specifically addressed in the quote, will be charged at the rate of $20.00 per hour per man for all hours over eight per day.

★ **Prevailing Wage** hours, if not specifically addressed in the quote, will be charged at the rate of $ 15.00 per hour for all applicable hours.

★ Montana Crane Service, Ltd. assumes liability for legibly marked utilities. Montana Crane Service, Ltd. **will not pay** for non-located, miss-marked, or illegibly marked utilities.

★ Montana Crane Service **will not be held liable** for any problems or costs or delays associated with Montana Department of Transportation overweight and oversize permitting.

★ Detours, "return to base", or unforeseen extra travel or transport due to special road weight restrictions and height restrictions or limitations, government bridge weight restrictions or private bridges determined unsafe to cross by the crane operator **will be charged for**.

★ Montana Crane Service **will not be liable** for damage caused by overloading of structures to be crossed over or structures adjacent to set up area.

★ Our mobilization price includes the cost to transport fully assembled all of the equipment necessary to complete this project as priced. If it becomes necessary to disassemble the quoted equipment, to transport additional equipment, or to transport the quoted equipment extra times because of circumstances out of our control, **we will charge extra**.

★ **Credit arrangements must be made in advance** if you want to charge on account. Montana Crane Service will finance our services over a 12-month period. Financing must be pre-approved; down payment and monthly installments can be adjusted on an individual basis.

★ **Customer agrees to pay full attorney fees and collection costs** if payment is not received on a timely basis. Customer also agrees to pay periodic service charges on past due balances. Notice is hereby given of intent to file a lien if payment is not made when due. Service Charge is 1% monthly, 12% annually; minimum charge is $1.00/month.

★ Certificates of Worker's Compensation and Liability Insurance will be provided upon request by the customer.

★ We carry $ 250,000.00 in hook insurance. Increased coverage requires a quote from the underwriter. **If additional hook insurance is required, the additional cost will be charged to the customer at cost plus 15%.**

★ We have all the necessary rigging in our possession to do this work safely and efficiently. **The cost to build or purchase special rigging may be charged to customer.**

★ **Please review the quote for completeness.** We will be glad to offer pricing on any additional items you may need.

QUOTED BY:

Greg Poncelet 6-23-10

Greg Poncelet Date

ACCEPTED BY:

Name Title Date

Enclosures: MCS 2010 Hourly Price List
MRM 2010 Hourly Price List

Terra Graphics
Lilly / Orphan Boy Mine
6-21-10

Montana Crane Service

Corporate Office
209 East Cedar • Bozeman, Montana 59715
Phone: (406) 586-0909 • 1-800-406-LIFT • Fax: (406) 586-3836
Email: info@montanacraneservice.com

Effective January 12, 2010

2010 Hourly Price List

Cranes priced by the hour with licensed operator, Port to Port - Bare rental rates available.

Call Toll Free ☞ 1-800-406-LIFT (5438)

info@montanacraneservice.com

Please see reverse for additional services, billing policies & guidelines

Bozeman Based

06	14 Ton RO Single Axle Boom Truck	73' height	$ 95.00
03	15 Ton National Tandem Axle Boom Truck	101' height	$ 100.00
05	22 Ton National Tandem Axle Boom Truck	148' height	$ 110.00
08	23 Ton National Tandem Axle Boom Truck	105' height	$ 110.00
09	30 Ton National Tandem Axle Boom Truck	161' height	$ 120.00
20	22 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 120.00
22	22 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 120.00
25	28 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 125.00
26	28 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 125.00
21	30 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	161' height	$ 135.00
27	30 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	161' height	$ 135.00
24	50 Ton Linkbelt 4WD Rough Terrain Crane [1,2,3]	172' height	$ 155.00
41	50 Ton Linkbelt Hyd Truck Crane [1]	168' height	$ 160.00
* 44	70 Ton Linkbelt Hyd Truck Crane – Long Boom [1]	200' height	$ 195.00
43	100 Ton Linkbelt Hyd Truck Crane [1,3]	225' height	$ 225.00
90	140 Ton Linkbelt Conventional Truck Crane [1,2,3,4]	305' height	$ 250.00
	TH63 Cat Extended Reach 4WD Forklifts [2]	42' height (6,000 lb)	$ 90.00
	TH103 Cat Extended Reach 4WD Forklifts [2]	44' height (10,000 lb)	$ 95.00
	966F Cat 4WD Fork-Equipped Loader [1,2]	14' height (36,000 lb)	$ 150.00

Helena Based

07	14 Ton RO Single Axle Boom Truck	73' height	$ 95.00
04	23 Ton National Tandem Axle Boom Truck	120' height	$ 110.00
* 10	30 Ton National Tandem Axle Boom Truck	157' height	$ 120.00
23	22 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 120.00
45	75 Ton Linkbelt Hyd Truck Crane [1]	182' height	$ 195.00
	TH63 Cat Extended Reach 4WD Forklift [2]	42' height (6,000 lb)	$ 90.00

[1] Requires oversize & overweight permits at an additional cost
[2] Requires lowboy transport to & from most job sites
[3] Requires pilot car on some two lane roads
[4] Requires additional equipment for assembly & transport

All heights are maximum boom tip heights, including jibs
We provide most spreader bars and rigging required at no additional charge
A 0% to 5% fuel surcharge will be assessed on all equipment and vehicle time; subject to change without notice.

*	Lift Supervisor	$ 80.00/hr	
	Operator travel ½ Ton Service Truck	$ 50.00/hr	
*	Operator travel 1 Ton Service Truck	$ 60.00/hr	
	Pilot car and driver	$ 50.00/hr	
	6-Axle 40-ton lowboy (plus permits)	$100.00/hr	
	7-Axle 50-ton lowboy (plus permits)	$110.00/hr	
	8 Axle 55-ton lowboy (plus permits)	$120.00/hr	
	11 Axle 65-ton lowboy (plus permits)	$150.00/hr	
	Tractor/Trailers – various sizes	$80.00-140.00/hr	
	Service Truck (½ Ton)	$ 20.00/hr	
	Service Truck (1Ton)	$ 30.00/hr	
*	Rigger/laborer	$ 50.00/hr	
	Manbasket or work platform	$ 10.00/hr	
→	Davis-Bacon, prevailing wage	$ 15.00/hr	
*	Overtime	$ 20.00/hr	
*	Per Diem	$ 90.00/day	

TOWER CRANE: SALES • RENTAL • LEASING • SERVICE •INSPECTION • TRAINING

RENTAL ITEMS: CAT EXTENDED REACH 4WD (TELEHANDERS) • PORTABLE STORAGE UNITS

INDUSTRIAL MACHINERY MOVING

Bozeman • Helena • Butte

SPECIAL NOTES & BILLING POLICIES

- ❑ Written and verbal quotes are available upon request for all your lifting needs.
- ❑ A 0% to 5% fuel surcharge will be assessed on all equipment and vehicle time, and is subject to change without notice.
- ❑ Customer is responsible for equipment until equipment is off site, this includes a safe adequate tow back to dry ground if the equipment is required to leave paved or graveled roadway. All tows will be paid by the customer.
- ❑ Rigging and other items not normally carried with a specific crane require loading prior to departure and offloading upon return. Additional labor and equipment charges will be billed for the completion of these tasks.
- ❑ Rigging and other items that cannot be carried on the crane require separate transport. Additional labor and equipment associated with transport will be billed to the customer.
- ❑ Jobs requiring specialized or limited application rigging must be quoted. All or part of the cost to build or purchase special rigging will be billed to the customer.
- ❑ Specific crane tasks or job sites can require written lift plans. Costs to complete written lift plans will be billed to the customer. Lift plans, and quotes to complete, are available upon request.
- ❑ Personnel travel and transport to and from the job site are not included in overtime charge calculations. Saturdays and hours over eight hours per day on site will be charged as overtime hours.
- ❑ Crane set up and tear down is billed at the hourly crane rate. Set up and tear down can require additional labor and equipment which will be billed at the hourly rates included travel and transport. Written quotes are available upon request for difficult or time consuming set up and tear down.
- ❑ Lowboy transport costs will include loading prior to departure and offloading upon return.
- ❑ Montana Department of Transportation oversize permits are required for the transport of all cranes on lowboys and for the travel of all hydraulic truck and conventional cranes. All associated costs are billed to the customer. Written quotes are available upon request.
- ❑ Standard hook insurance is $ 250,000.00. Additional coverage requires quote from insurance underwriter and will be charged to the customer at cost plus 15%.
- ❑ A 20% Insurance surcharge will be assessed on all work involving machine and equipment moving requiring forking, jacking, rolling, or inside building placement. Written quotes are available upon request.
- ❑ Installation of tires chains, in-route, on-site, or pre-loading, will be billed to the customer at the labor and equipment rates listed.
- ❑ Job site conditions and specific crane tasks can require additional personnel. Additional labor will be billed to the customer at the labor rates listed.
- ❑ Prevailing wage adjustments will be added to listed rates if applicable.
- ❑ Montana Crane Service, Ltd. reserves the right to change rates and policies without notice.

Montana Ready-Mix Ltd.

Terra Graphics
Lilly/Orphan Boy Mine
6-22-10

Greg Poncelet, President
209 East Cedar • Bozeman, MT 59715
Phone: (406) 586-1234
Fax: (406) 586-3836

Effective January 12, 2010

2010 CONSTRUCTION SEASON
EQUIPMENT RATES

All equipment is quoted per hour, with operator, basis. Additional charges listed below may apply.

TRUCKING[1,2]

Dump Truck 4-axle	$ 80.00
Dump Truck w/ 2-axle pup trailer	$100.00
Dump Truck w/3-axle pup trailer	$110.00
Dump Trucks w/3-axle equipment trailer	$100.00
Transport Tractor w/40-ton Lowboy	$100.00
Transport Tractor w/50-ton Lowboy	$110.00
Transport Tractor w/55-ton Lowboy	$120.00
Transport Tractor w/65-ton Lowboy (depending on components)	$115.00 to $150.00
Tractor-Trailer Units (various sizes)(flats and vans)	$ 80.00 to $140.00
500 Gallon Water Truck	$ 65.00
4000 Gallon Water Truck	$ 80.00
Transport Tractor w/hydraulic roll off trailer	$110.00

EXCAVATING[1,2]

Skid Steer - Case 1840	$ 85.00
Tracked Skid Steer - ASV 30	$ 85.00
Wheel Loader - Cat 966, 4.5 cy	$125.00
Crawler Loader - Cat 955, 2.25 cy w/ripper	$100.00
Crawler Loader - Cat 977, 3.5 cy w/ripper	$125.00
Compactor – Cat 168D, Vib. smooth drum	$ 95.00
Compactor - Bomag K301, 4WD Sheepsfoot	$110.00
Telehandler Cat TH63	$ 90.00[5]
Backhoes - Case 590[3,4,6]	$ 95.00
Excavator - Kubota KX41 w/thumb	$ 85.00
Excavator - Kubota KX161 w/thumb	$100.00
Excavator - John Deere 690E LC[7]	$120.00
Dozer, 6-way - Cat D3 w/ripper	$100.00
Dozer, 6-way - Cat D5 high track	$120.00
Grader - Cat 120, 14' blade	$120.00
Tracked Dump Truck, 1/2 cy Kubota	$ 75.00

ADDITIONAL CHARGES & SERVICES

A 0% to 5% Fuel Surcharge will be assessed on all equipment and vehicle time.
Surcharge subject to change without notice

Per Diem (per day)	$ 90.00
Regular Labor	$ 50.00
Clerical Service	$ 35.00
Truck Driver Labor	$ 55.00
½ T Service Truck	$ 20.00
1T Service Truck	$ 30.00
Operator Labor	$ 65.00
Supervisor Labor	$ 90.00
Management	$110.00
Mechanic	$ 50.00
Welder	$ 50.00
Shop Charge	$ 15.00
Engineer	$100.00
[1]Add for each hour overtime	$ 20.00
[1]Add for Prevailing or Union Wage	$ 15.00
[1]Add for OSHA 40 trained personnel	$ 20.00
[3]Add for Concrete Breaker Attachment	$ 40.00
[4]Add for Sheep's Foot Wheel Packer Attachments	$ 25.00
[6]Add for vibratory plate attachment	$ 30.00
[7]Add for demolition grapple attachment	$ 30.00
[2]Add for Heavy Rock, Heavy Frost, Demolition	$ 20.00
[2]Add for Working in Water	$ 20.00
[5]Add for man basket or work platform	$ 10.00
Pilot or flag cars	$ 50.00
Add for MDOT Certified Flagger	$ 5.00
Add for sweeper attachment	$ 30.00

MORE EQUIPMENT & SERVICES ARE AVAILABLE.
CALL OUR OFFICE IF YOU NEED SOMETHING NOT LISTED ON THESE TWO PAGES
PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

GRAVEL, TOPSOIL, FILL DIRT- Prices on these items vary. Please call for a quote.

WE SELL CONCRETE SEPTIC TANKS

STORAGE TRAILER RENTAL

8x28 Trailer	$50.00/month	w/steps	$60.00/month
8x45 Trailer	$80.00/month	w/steps	$90.00/month

8x20 Ocean Going Container with side entry door $60.00/month
8x40 Ocean Going Container with side entry door $90.00/month
8x28 Skid-Mounted Ground Level Trailer $65.00/month
Delivery and Pickup Charges (round trip) $70.00/hour

Damage of any kind for any reason whatsoever to the storage trailer or its contents is solely the responsibility of the Lessee.

Customer is responsible for a safe adequate tow of all equipment back to dry ground if the equipment is required to leave paved or graveled roadway. All tows will be paid by customer.

EXTENDED REACH FORKLIFTS $200.00/day $750.00/week $2250.00/month

Note: Special low long term rates available. Please request separate price list.

LIFTING[1,5]

Boom Trucks - RO Stinger 14 Ton Hydraulic (SA)	73 ft height	$ 95.00
Boom Truck - National 14 Ton Hydraulic	101 ft height	$100.00
Boom Truck - National 22 Ton Hydraulic	148 ft height	$110.00
Boom Truck - National 23 Ton Hydraulic	148 ft height	$110.00
Boom Truck - National 30 Ton Hydraulic	161 ft height	$120.00
Truck Crane – Linkbelt 50 Ton Hydraulic	168 ft height	$160.00
Truck Crane - Linkbelt 70 Ton Hydraulic – Long Boom	200 ft height	$195.00*
Truck Crane - Linkbelt 75 Ton Hydraulic	182 ft height	$195.00*
Truck Crane - Linkbelt 100 Ton Hydraulic	225 ft height	$195.00*
Truck Crane - 238A 140 Ton Conventional	320 ft height	$250.00*
4WD RT Cranes - Linkbelt 22 Ton Hydraulic	122 ft height	$120.00
4WD RT Cranes - Linkbelt 28 Ton Hydraulic	122 ft height	$ 125.00
4WD RT Cranes - Linkbelt 30 Ton Hydraulic	161 ft height	$135.00*
4WD RT Crane - Linkbelt 50 Ton Hydraulic	172 ft height	$155.00*
4WD Telescoping Cat TH63 Material Handlers	6-8000 lbs	$90.00
4WD Telescoping Cat TH103 Material Handler	10,000 lbs	$95.00

All heights are maximum boom tip heights, including jibs.
All rates include operator.
***These cranes require an additional overweight permit.**
4WD RT Cranes require lowboy transport to and from job sites.

APPENDIX D

Driller Subcontractor Cost Estimates

Lilly/Orphan Boy

Contacted Drilling Contractors				
Driller	**Contact**	**Phone Number**	**Email**	**Notes**
Ace Drilling	Dave Bick	1-406-883-3300	acedrilling@hotmail.com	
O'Keefe Drilling	Terry	1-406-494-3310	office@okeefedrilling.com	cost estimate received
Axis Drilling	Lyle Ballenger	1-406-570-3030	axisdrilling@q.com	
Hayes Drilling	Will Hayes	1-406-222-3745	hayesdrilling@3riversdbs.net	
		1-406-586-2499		
H and L Drilling	Shawn	1-406-227-7435		cost estimate received
Boland Drilling*	Chris Boland	1-406-799-3121	chris@bolandconstruction.net	cost estimate received

*Propose hiring this subcontractor.

Lilly/Orphan Boy Scope of Work to Prepare a Proposal and Cost Estimate:
Township 8 North, Range 6 West, Section 15, Powell County, Montana.

Perform drilling and installing 5 monitoring wells on the Lilly/Orphan Boy mine site for Montana DEQ-AML. The bedrock in this area is Butte Quartz Monzonite and is fairly shallow.

Attached are the site map of the claim and the location map for directions to the mine. The old head frame is in place over a newer frame which can be seen from the road. The locations of the wells have not been marked in the field but will be prior to moving on site.

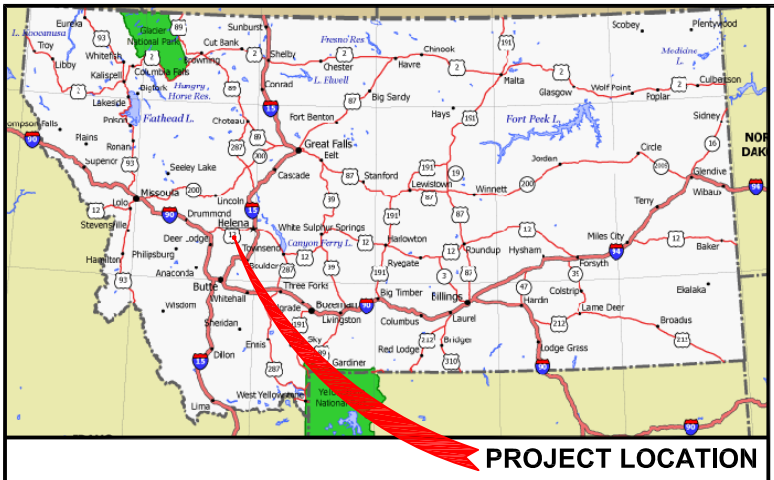
Scope of work:

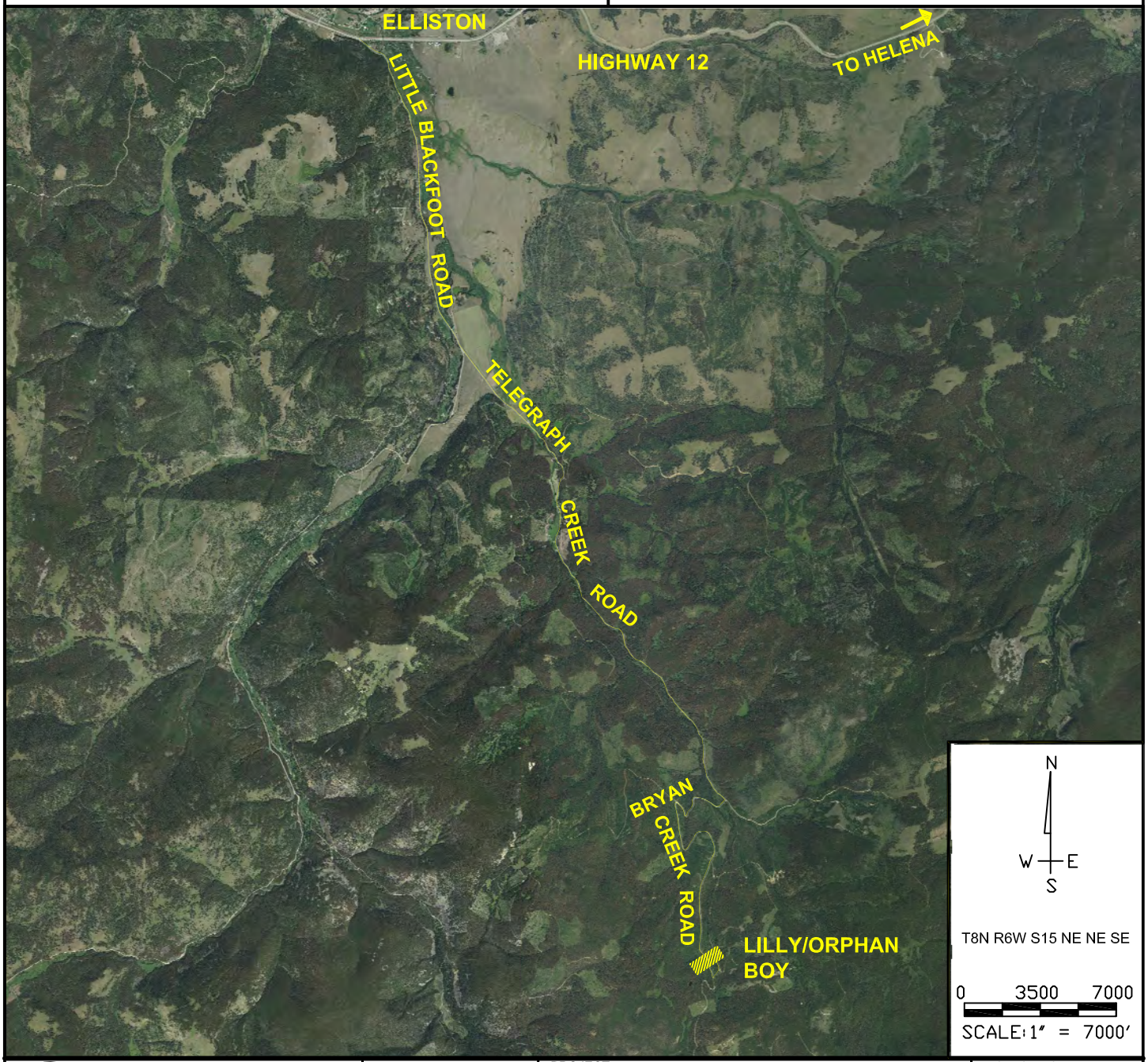
Drill & install 5 monitoring wells and develop the wells. We will collect chip samples at 5' intervals or at lithology changes. All wells shall be PVC with 6" or 8" steel collars and caps.

Below are the well numbers, PVC casing diameters, and estimated depths:
MW-1: 2" well to 125'
MW-2: 6" well to 125'
MW-3: 2" well to 30'
MW-4: 2" well to 25'
MW-5: 2" well to 55'

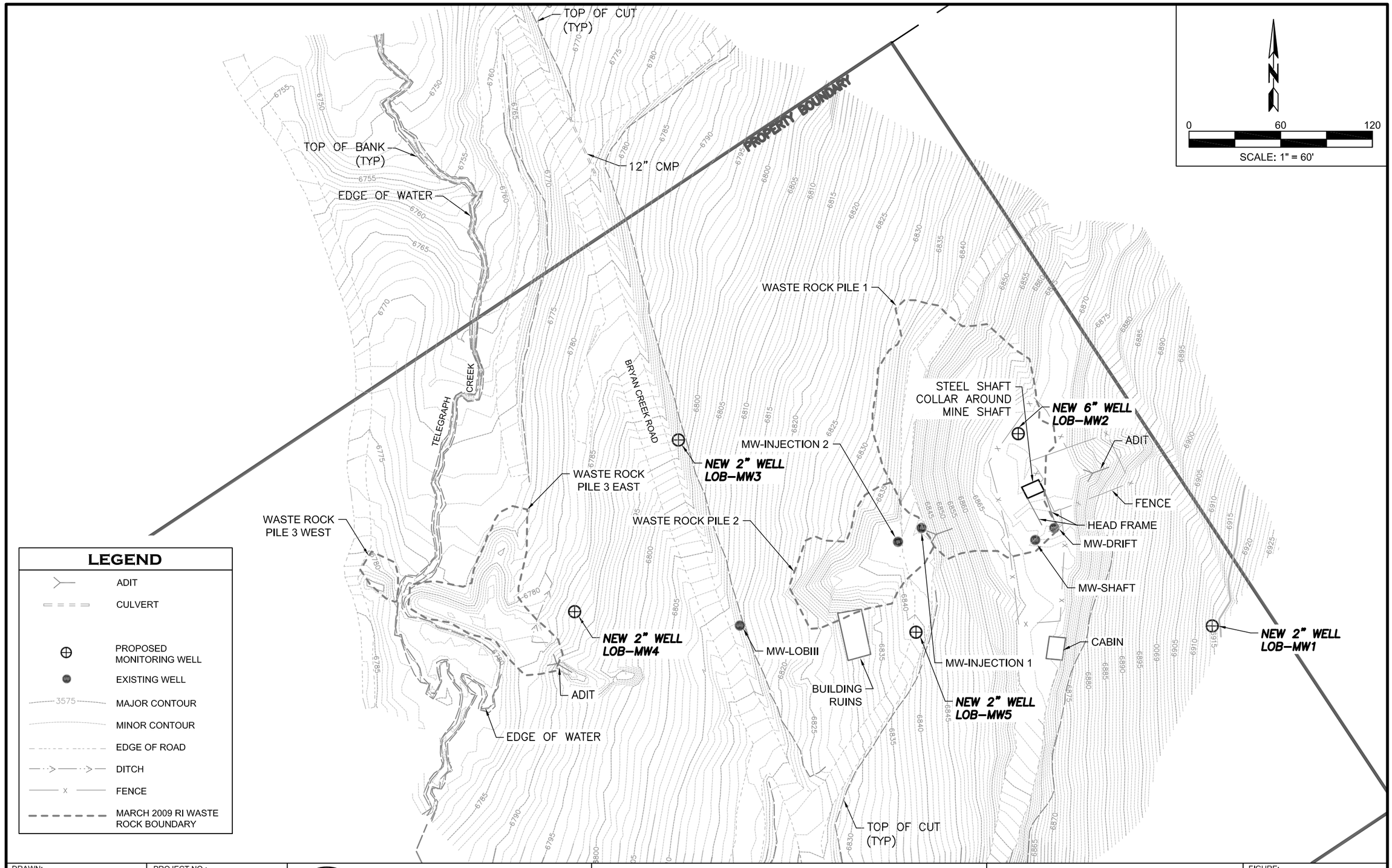
Anticipate drilling to start in mid-August. The wells will need to be developed. The bottom 20' will need to be screened for all wells. If additional screen is needed in the wells, include the change in cost.

SITE LOCATION MAP





TerraGraphics Environmental Engineering, Inc.	SCALE: As shown DRAWN BY: TS ENGINEER: TS	PROJECT: *LILLY/ORPHAN BOY MINE* *Powell County, Montana*	PROJECT NO: 09210 DATE: 5/14/2010 FIGURE: 1



LEGEND

- ADIT
- CULVERT
- PROPOSED MONITORING WELL
- EXISTING WELL
- MAJOR CONTOUR (3575)
- MINOR CONTOUR
- EDGE OF ROAD
- DITCH
- FENCE
- MARCH 2009 RI WASTE ROCK BOUNDARY

DRAWN: TLS	PROJECT NO.: 09210	TerraGraphics Environmental Engineering, Inc.	FIGURE: 4
ENGINEER: TLS	SCALE: AS SHOWN	NEW MONITORING WELL LOCATIONS	DATE: 6/28/2010
CHECKED: JM	APPROVED: XXXX	SITE MAP	LILLY/ORPHAN BOY ABANDONED MINE SITE
	DATE: XXXX		

Tom Smith

From: Chris Boland [chrisboland@prodigy.net]
Sent: Friday, August 06, 2010 4:23 PM
To: Tom Smith
Subject: Re: Lilly/Orphan Boy monitoring wells

Tom, Enclosed is the cost estimate for the Lilly/Orphan Boy mine site.

Mobilize and demobilize - 2,000.00
Per diem - 2 @ 300.00 each - 600.00
Drilling Footage - 360' @ 22.00 per foot - 7,920.00
4- 2" pvc bottom points @ 15.00 each - 60.00
80' - 2" pvc screen @ 4.00 per foot- 320.00
160' - 2" pvc casing @ 2.50 per foot - 400.00
1 - 6" pvc bottom point @ 85.00 each - 85.00
20' - 6" pvc screen @ 10.00 per foot - 200.00
110' - 6" pvc casing @ 4.50 per foot - 495.00
60 - sacks sand @ 15.00 each - 900.00
70 - sacks bentonite chips @ 8.00 each - 560.00
4 - 6" steel risers w/ locking caps and cemented @ 150.00 each - 600.00
1 - 8" steel riser w/ locking cap and cemented @ 185.00 each - 185.00

Total - $14,325.00

If you have any questions or need more information please let me know.

Respectfully,

Chris Boland

--- On **Fri, 7/30/10, Tom Smith <*tom.smith@terragraphics.com*>** wrote:

> From: Tom Smith <tom.smith@terragraphics.com>
> Subject: Lilly/Orphan Boy monitoring wells
> To: chris@bolandconstruction.net
> Date: Friday, July 30, 2010, 8:55 PM
>
> Chris,
>
> As we discussed over the phone today, we are requesting a cost estimate for drilling and installing 5 monitoring wells on the Lilly/Orphan Boy mine site for Montana DEQ-AML. The bedrock in this area is Butte Quartz Monzonite and is fairly shallow.
>
> Attached are the site map of the claim and the location map for directions to the mine. The old head frame is in place over a newer frame which can be seen from the road. The locations of the wells have not been marked in the field but will be prior to moving on site.
>
> Scope of work:

Drill & install 5 monitoring wells and develop the wells. We will collect chip samples at 5' intervals or at lithology changes. All wells shall be PVC with 6" or 8" steel collars and caps.

Below are the well numbers, PVC casing diameters, and estimated depths:
MW-1: 2" well to 125'
MW-2: 6" well to 125'
MW-3: 2" well to 30'
MW-4: 2" well to 25'
MW-5: 2" well to 55'

We are anticipating drilling in mid-August. The wells will need to be developed. The bottom 20' will need to be screened for all wells. If additional screen is needed in the wells, what would the change in cost be?

Please call if you need more information. Thanks and have a good weekend!

Regards,
Tom Smith, PE, PG
TerraGraphics Environmental Engineering, Inc.
302 N. Last Chance Gulch, Suite 409
Helena, MT 59601
Office: (406) 441-5441
Cell: (406) 461-5974

H & L Drilling, Inc.

P.O. Box 919
4150 Hwy 12 East
East Helena, MT 59635
Phone # 406-227-7435 Fax # 406-227-8949

handldrilling@msn.com www.handldrilling.com

Estimate

Date	Estimate #
7/13/2010	1782

TerraGraphics Environmental Engineering,
Jamie Mongoven, PE
302 N. Last Chance Gulch, Suite 409
Helena, MT 59601

P.O. No.
Lilly/Orphan Boy

Description	Qty	Cost	Total
6" x 2" Monitor Well - 20' Screen; 2" PVC Monoflex; Sand Pack and Bentonite Seal to Surface	235	41.00	9,635.00
10" x 6" Monitor Well - 20' Screen; 6" PVC Monoflex; Sand Pack and Bentonite Seal to Surface	125	54.00	6,750.00
Well Air Development	5	200.00	1,000.00
Drill Rig Standby $125.00 per Hour		0.00	0.00

Total $17,385.00

O'KEEFE DRILLING
P.O. Box 3810 Butte Montana 59702
406-494-3310 Fax 406-494-3301

Client:	TerraGraphics Environmental Engineering	Date:	06-Aug-10
Attention:	Tom Smith	Cell:	406-441-5441
Project:	Lilly/Orphan Boy Mine	Fax:	406-441-5443

PROJECT SPECIFICATIONS:

Type of Rig:	Air Rotary	**Number of Wells:**	4
Location:	Lilly/Orphan Boy Mine	**Depth of Wells:**	Various (125, 30, 25', 25')
Formation:	Gravels/Bed Rock	**Hole Size:**	6
Sampling:	Chip Samples	**Completion PVC Size:**	2
Decontamination:	Yes	**Screen Length:**	20
Other Details:		**Number of Wells:**	1
		Depth of Wells:	125
		Hole Size:	8
		Completion PVC Size:	4
		Screen Length:	50

Soil Boring/Monitoring Well Installation

Unit Cost Worksheet

Task			Unit Cost		Number of Units	Total Cost
Mobilization/Demobilization						
	Drill Rig		$ 195.00	Per Hour	5	$ 975.00
	Support Vehicle		$ 150.00	Per Hour	5	$ 750.00
	Interm Travel		$ 150.00	Per Hour		$ -
Per Diem		*Crew Members*				
	Motel	2	$ 70.00	Per Person Per Day	5	$ 700.00
	Food	2	$ 32.00	Per Person Per Day	5	$ 320.00
Soil Boring Installation						
6"	Drilling		$ 32.00	Per Foot	360	$ 11,520.00
Monitor Well Installation						
2"	Construct		$ 30.00	Per Foot	360	$ 10,800.00
Soil Boring Installation						
8"	Drilling		$ 36.00	Per Foot	125	$ 4,500.00
Monitor Well Installation						
4"	Construct		$ 35.00	Per Foot	125	$ 4,375.00
Drilling Standby & Safety Meeting						
	Prior Approval Needed		$ 175.00	Per Hour		$ -
OTHER						
	Well Development		$ 350.00	Per Hour		$ -
	Operating Rate		$ 350.00	Per Hour		
			Total Project Expenses			**$ 33,940.00**

APPENDIX E

Rain for Rent Cost Estimate

Custom Estimate Developed Especially for:

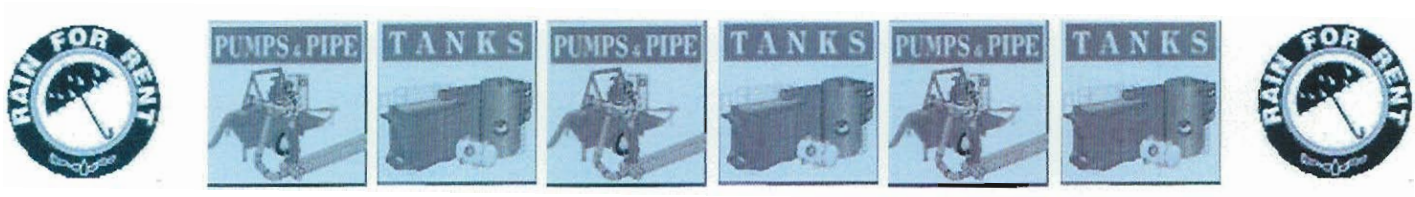
Tom Smith
Terragraphics Engineering
302 N. Last Ch. Gulch Ste. 409
Helena, MT 59601
Phone: 406-441-5441
Fax: 406-441-5443

Prepared on 9/17/2010 by:

Rain for Rent

Skyler Neibaur
Cell: (208) 521-6500
P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

www.rainforrent.com



RAIN FOR RENT SELLS PUMPS -- Those hard working & reliable Power Prime Pumps that you are renting can also be purchased. New & Used we have both in stock for immediate delivery. Call 800-742-7246 for information -- RAIN FOR RENT KEEPS YOU PUMPING.

Rain for Rent Idaho Falls

Rental/Sale Estimate

www.rainforrent.com

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-358189
Prepared By: Skyler Neibaur

Job Description:
Pump, adjust pH, and land apply water with metal components at mine; arsenic, cadmium, copper, lead, nickel, zinc, manganese, iron. pH adjustment to 5-6. System sized for up to 100 gpm flow rate.

Customer: Terragraphics Engineering
Customer ID: S08957
Address: 302 N. Last Ch. Gulch Ste. 409
City/State: Helena, MT 59601
Contact: Tom Smith
Office: 406-441-5441
Fax: 406-441-5443

Location:
Lilly/Orphan Boy Mine
Near Helena, MT

Rental Sub Total: $31,564.00

Sale Sub Total: $2,268.00

Sub Total: $33,832.00

*The Terms and Conditions of the Rain For Rent Rental and Acute Hazardous Waste Agreements, Credit Application, Invoice and this estimate contain the complete and final agreement between Rain For Rent and Customer and no other agreement in any way modifying or adding to any of said Terms and Conditions will be binding upon Rain For Rent unless made In writing and signed by a Rain For Rent Corporate Officer.
*Payment terms are net 30 days from invoice date. A 1.5%month late charge will be made on any past due invoices.
*Estimate is valid for 30 days and is subject to credit approval.
*Availability subject to change without notice.
*This is a Time & Material estimate. Customer will be invoiced actual time and equipment usage.

Est. Delivery Hauling	$7,980.00
Est. Pick-up Hauling	$4,080.00
Est. Install Labor	$8,400.00
Est. Removal Labor	$6,300.00
Est. Services	$0.00
Est. Fuel Surcharge	$685.00

(Does Not Include Sales Tax)

Estimate Total: $61,277.00

Date Prepared: 9/17/2010

Valid Until: 10/17/2010

Customer

Date

By signing this estimate, customer represents that customer has read and agreed to all terms of this estimate, including those on Terms & Conditions page and those on the Additional Specifications page (if applicable).

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-358189

Application: pH Adjustment and Land App Materials: Water w/ metal components Flow: Up to 100gpm Suction Lift: NA Friction Loss: NA Static Head: NA

*Rain for Rent Cycle = 28 Days.
This estimate has not been flagged as PREVAILING WAGE.

Rental Items

Qty	Unit	Duration	Item	Description	Day	Week	*Cycle	Extension
2	Each	1 *Cycle	MRC	10hp Submersible Pump - 100 gpm @ 65psi	$0.00	$0.00	$1,245.00	$2,490.00
1	Each	1 *Cycle	MRC	HH80 Diesel Booster pump w/ Connections and Discharge Valve (if necessary)	$0.00	$0.00	$1,650.00	$1,650.00
1	Each	1 *Cycle	MRC	35kw Genset w/ SO Power Cords-Burns 2 gallons of diesel fuel per hour	$0.00	$0.00	$1,500.00	$1,500.00
1	Each	1 *Cycle	+632005	BF200 Bag Filter	$0.00	$0.00	$1,200.00	$1,200.00
1	Each	1 *Cycle	+632505	Portable Water Quality Monitoring Box w/ Sodium Hydroxide pH adjustment	$0.00	$0.00	$10,000.00	$10,000.00
2	Each	1 *Cycle	MRC	2400 Gallon Poly Batch Tanks	$0.00	$0.00	$812.00	$1,624.00
1	Each	1 *Cycle	MRC	12'x50' Spillguard Secondary Containment w/ Ground and Track Mats	$0.00	$0.00	$525.00	$525.00
2	Each	1 *Cycle	MRC	12'x16' Spillguard Secondary Containment w/ Ground and Track Mats	$0.00	$0.00	$420.00	$840.00
1000	Feet	1 *Cycle	MRC	2" Poly Pipe w/ Sprinkler Nozzles	$0.00	$0.00	$4.40	$4,400.00
1	Each	1 *Cycle	MRC	Misc. Hoses, Valves, Adapters, RVT's, RVL's, etc.	$0.00	$0.00	$3,460.00	$3,460.00
2000	Feet	1 *Cycle	MRC	4" Header Discharge Pipe	$0.00	$0.00	$1.50	$3,000.00
1	Each	1 Week	MRC	2-8 Fusion Machine w/ Generator - Install Only	$0.00	$875.00	$0.00	$875.00

Rental Sub Total: $31,564.00

Sale Items

Qty	Unit	Item	Description	Unit Price	Extension
3	Each	MS	Sodium Hydroxide Drum	$685.00	$2,055.00
30	Each	MS	10 Micron Bag Filters	$7.10	$213.00

Sale Sub Total: $2,268.00

Sub Total: $33,832.00

Rain for Rent Idaho Falls

www.rainforrent.com

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-358189

Additional Specifications

Rain for Rent Responsibilities:

Deliver and install equipment.

Train on site personnell on operation and maintenance of equipment.

Removal of equipment at completion of pilot test.

Customer Responsibilities:

All permits, permit fees, and inspections as re-quired.

Free and clear access to treatment site. Loading dock access or material handling equipment capable of safely handling necessary equipment.

System operation, including maintenance and wastewater quality monitoring.

Provide fuel for generator and HH80 booster pump. Estimated usage 2 gallons per hour per unit.

Forklift to assist in offloading water quality box and poly tanks on site.

Influent Parameters:
100 gpm
*Water may need to be batch treated to achieve desired pH level prior to discharge.

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-358189

Terms & Conditions

Additional Terms

1. A cycle is defined as 4 weeks. A week is defined as one third of a cycle and a day is one third of a week. Customers will be invoiced at the appropriate cycle, weekly or daily rate based on actual equipment usage except for filtration, pipe, hose and fittings which will be billed at the cycle rates only and will not be pro-rated.
2. The rental rate for pumps and equipment with hour meters are based on an 8 hour day or 48 hour running week. The rental rate will be multiplied by 1.5 for greater than 8 hours per day or 49-96 operating hours per week and multiplied by 2.0 for more than 16 hours per day or 96 operating hours per week. Customer will be invoiced for 24 hours per day if the hour meter has stopped functioning.
3. Overtime will be invoiced at 1.5 times the regular rate for work occurring outside of normally scheduled business hours and 2.0 times the regular rate for work occurring on company recognized holidays.
4. Customer will authorize and pay for any changes to work scope including but not limited to schedule changes, material, labor, third party, permit, fee or service costs. It is the Customer's responsibility to cooperate in the timely processing, approval and payment of any charges within Rain For Rent's invoice terms.
5. Customer is responsible to determine the suitability of equipment for the application.
6. Delivery, Return, Installation and Removal costs are estimated. Customer will be invoiced for actual time. Transportation will be invoiced on a Portal to Portal basis.
7. Customer is responsible for flushing and cleaning tanks, roll off boxes, pipelines, pumps, filters and other Rain for Rent equipment prior to return.
8. Customer is responsible for equipment, repairs, maintenance and damage, excluding normal wear and tear. All returned equipment is subject to inspection by Rain for Rent personnel. Damages and accrued rent will be invoiced to Customer while equipment is out of service for repairs.
9. The Customer cannot alter the equipment without Rain For Rent's prior written approval.
10. Customer will provide "all risk" property insurance for rented equipment.
11. Customer will not allow any equipment to come in contact with any substance that will cause corrosion, damage or leakage.
12. The Customer assumes all risks of loss due to operation and use of the equipment.
13. Customer is responsible to obtain any permits, licenses, certificates, bonds and give all notices required by law.
14. The rental period begins the day the equipment is delivered and continues until returned to Rain For Rent's facility unless written confirmation of the release is provided to the Customer before that time.
15. Rental equipment must be returned to the renting Rain for Rent branch unless agreed to in writing before the rental period begins.
16. All material that comes in contact with Rain For Rent equipment including media is the responsibility of Customer as generator. Rain For Rent shall not be responsible for any fines or sanctions as a result of Customer's use of the equipment.
17. The equipment is sold "AS IS,WHERE IS" in its present condition. Seller makes no warranties, expressed or implied of any kind whatsoever with respect to the equipment. Buyer agrees that buyer has purchased the equipment based on his judgement and evaluation, without reliance upon any statements of representations of seller, and that seller is not responsible for any defects in its operation or for any repairs, parts or services, unless otherwise noted.
18. De-watering, Roll-off, Vacuum boxes and similar equipment are not liquid tight. Rentee accepts full responsibility for all losses, damages and costs caused by or arising out of spills, leakage or discharge from this equipment.
19. Customer will use the equipment in a careful and proper manner and in accordance with safety rules, industry standards, manufacturer's specifications, recommendations, regulations and applicable laws
20. Customer shall be responsible for environmental fees covering waste fluid, fuel, filter and other disposal costs.
21. A Fuel Surcharge will be calculated and invoiced based on the diesel fuel price as published by the Department of Energy on http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp
22. Customer shall pay Rain For Rent additional expenses caused by site, soil or underground conditions, including, but not limited to, rock formations, environmental conditions, regulations or restrictions, hard pan, boulders, cesspools, gas lines, water lines, drain pipes, underground electrical conduits or other above ground or underground obstructions.
23. Customer shall be responsible for acquiring and paying for, if necessary, all public and private property easements required by the project.
24. The estimated labor component of this quote is based on non-prevailing wage rates. If prevailing wage laws are applicable, Customer must notify Rain For Rent in writing before Rain For Rent estimate completed. If Rain For Rent was not properly notified, Customer shall promptly pay any change orders that adjust wages to prevailing wage rates. Customer is responsible for providing applicable prevailing wage rates to Rain for Rent. Rain For Rent will provide certified payrolls on a bi-weekly basis if notified in writing 10 days before the start of the project.
25. Customer is prohibited from deducting retention from Rain For Rent invoices and charging Rain for Rent liquidated damages.
26. Customer is responsible for all routine maintenance including fuel, fluids, lubrication and filters every 150 hours on engine driven equipment. Rain For Rent will charge Customer for servicing any equipment that is on rent or returned that has not been serviced in 150 hours. Rain For Rent can provide field service upon request for an additional service charge. Rain For Rent must be notified 2 business days in advance to schedule required field service.
27. This estimate excludes any additional costs to Rain For Rent associated with Owner Controlled Insurance (OCIP) or WRAP insurance programs that will be added to Rain For Rent's prices.
28. Customer is responsible to provide freeze protection for all equipment on site.
29. This estimate excludes any costs associated with ARRA (American Recovery and Reinvestment Act) reporting requirements that may be flowed down

to Rain For Rent.
30. Customer will be responsible for security, traffic control and road crossings. Traffic control shall meet all applicable Federal, State, and Municipal laws and regulations to assure a safe work environment.
31. Cold Weather Packages for tanks consist of up to 4 tank heaters and a submersible pump which is designed for use in a non-combustible or corrosive environment.
32. Tank heaters are operated on 120 volts, 12.5 amps each or 50 amps total. The submersible pump operates at 120 volts, 10 amps.
33. Customer is responsible for electrical connections and compliance with applicable permits, regulations and code requirements.
34. Tank Cold Weather Packages are not to be used in combustible or corrosive environments.
35. Tank Cold Weather Packages are a preventative measure that may keep fluids inside the tank from freezing. RFR will not guarantee fluids from freezing and any resulting damages.

Job Specific Terms

36. Rain for Rent does not warranty the degree of filtration associated with this equipment.
37. Field performance may vary if any of the system operating variables change. System variables in this context would include, but not be limited to: flow rate: composition or concentration of solids: contaminants or constituents in the fluid to be filtered:, etc.
38. Monitoring and operation of the filtration system is the responsibility of the customer.
39. It is the responsibility of the customer to clean and decontaminate all equipment prior to equipment pickup and removal by Rain for Rent.
40. All used filtration media, such as carbon, sand, cartridges, bags, coalescing packs, etc. become the property of the client and must be removed from the equipment prior to the return of this equipment to Rain for Rent.
41. A forklift may be required to offload and load the above equipment.
42. This estimate includes the filtration media (sand, carbon, cartridges, bags, and/or coalescing packs) required to initially fill and operate the equipment. Additional media will be provided at an additional cost.
43. A pilot test is recommended prior to shipment of equipment.
44. Due to the lack of information concerning the fluid stream to be filtered, no assumptions or guarantees are offered or implied as to the performance of the quoted filter units or the filter media.
45. This estimate is for budgetary purposes only. The prices shown are not firm and should not be considered as such. This is an estimate only and is solely based upon the available information as supplied by the user.
46. All filtration media is sold on a no-return/non-refundable basis.
47. Customer will be responsible for security, traffic control and road crossings. Traffic control shall meet all applicable Federal, State, and Municipal laws and regulations to assure a safe work environment.
48. Customer shall hold harmless, indemnify and defend Rain For Rent from any claims whatsoever, arising from or related to (A) any pollution, contamination, environmental impairment and/or similar condition directly or indirectly caused by or resulting in whole or in part from Customer's use of any Equipment or (B) any environmental statutory or regulatory compliance requirements applicable to any equipment (or any use thereof) and required under any and all foreign or domestic federal, state or local laws,ordinances, regulations, codes, or requirements of any governmental authorities which regulate or impose standards of liability or conduct concerning air, water, soils, wetlands and watercourses, solid waste, hazardous waste and/or materials, worker and community right-to-know, noise, resource protection, health protection and similar environmental, health, safety, and land use concerns as may now or at any time hereafter be in effect. This indemnification shall survive the termination of the agreement.

APPENDIX F

Mining Subcontractor Cost Estimate

Lilly/Orphan Boy

Contacted Mining Contractors				
Miners	**Contact**	**Phone Number**	**Email**	**Notes**
SMD	Ron Guill	(208) 338-8880	rguill@undergroundmining.com	Too busy to perform the work
Blue Range Engineering*	Larry Hoffman, PE	(406) 782-9354	blueranger@theglobal.net	cost estimate received
New Millennium Mining	Ben Gunsinger	(406) 442-4870	newmillenniummining@bell.net	cost estimate received

*Propose hiring this subcontractor.

Lilly/Orphan Boy Scope of Work to Prepare a Proposal and Cost Estimate:
Township 8 North, Range 6 West, Section 15, Powell County, Montana.

Perform a site investigation to identify hazards associated with further investigation of the abandoned underground mine workings. The investigation shall specifically identify hazards associated with opening/entering the discharging adit, stability of the mine workings, and identification of all other potential hazards associated with mine investigation activities. **Please address the following in your proposal and cost estimate;**

Plan for reopening/entering the discharging adit to investigate the mine workings, including but not limited to:

- All equipment necessary for opening the mine and entering the workings.
- Methods for determining if the mine can be safely entered. If Contractor determines that the mine cannot be safely entered, the mine shall not be entered. If Contractor determines the mine can be safely entered, investigation of the mine shall proceed.
- List personnel qualified to assess mine safety, determining the structural integrity of the mine, and determining if the mine can be safely entered.
- List personnel qualified for entering the mine and performing investigation activities.
- Identify location and describe and construction of potential sedimentation basins if opening the collapsed adit for entry into the workings.
- Identify areas for placement of excavated material.
- The mine will be dewatered; however, if there are areas that require additional dewatering, the contractor shall delineate methods for pumping water out of the mine workings.
- Describe methods for stabilization of the mine entrance.
- Describe methods to monitor air quality and provide fresh air to mine workings.
- Describe methods for securing the mine to prevent unauthorized entry.
- Describe methods for closing the mine after completion of investigation activities.
- Provide a map showing the proposed locations for all investigation activities, storage of equipment, placement of excavated materials, and other significant uses of the Site.

Once the mine has been entered, upon being determined safe for entry:

- Identify all mine investigation activities necessary to characterize the mine workings to support a detailed evaluation of source control alternatives. These investigation activities shall include but not be limited to:
  - Provide a physical layout of the mine
  - Describe obstructions in the mine workings and locations
  - Describe geology, stability, and rock quality in the workings.
  - Verify elevations of adit intersection at the shaft and wells.
  - Identify mineralization zones within the mine workings.
  - Identify locations of water infiltration and estimate flow rates into the mine workings.

Blue Range Engineering Co., Inc.

56 E. Mercury St.
Butte, MT 59701
406-782-9354 Phone 406-782-4990 FAX
blueranger@theglobal.net

May 17, 2010

TerraGraphics Environmental Engineering, Inc.
Suite 409
302 N. Last Chance Gulch
Helena MT 59601

Attention: Jamie Mongoven, Thomas L. Smith

Dear Jamie and Tom:

Attached is your scope of work with notes. Assuming TerraGraphics will be doing the pumping and all the related environmental permitting and preparation, I allowed for a week of underground work, including personnel, equipment, and travel, at a cost of $18,000. This includes some contingency to help, if necessary, with the pumping, as well as assistance with the underground geologic mapping which I assumed Tom would be doing. It also includes the cost of repair timber and other materials to create safe access wherever possible. Any serious obstacles would have to be addressed separately.

I hope this covers what you need. If you have any questions or need further detail, please let me know.

Thanks for the opportunity to work with you on this project.

Sincerely,

Via email

Larry C. Hoffman, P.E.
President

Draft Proposal and Cost Estimate
Examination of Underground Mine Workings
Lilly/Orphan Boy Property
Elliston Mining District
Powell County
Montana

Submitted to TerraGraphics Environmental Engineering, Inc.
302 N. Last Chance Gulch, Suite 409
Helena, MT 59601

Lilly/Orphan Boy Scope of Work **to Prepare a Proposal and Cost Estimate: Township 8 North, Range 6 West, Section 15, Powell County, Montana.**

Perform a site investigation to identify hazards associated with further investigation of the abandoned underground mine workings. The investigation shall specifically identify hazards associated with opening/entering the discharging adit, stability of the mine workings, and identification of all other potential hazards associated with mine investigation activities. **Please address the following in your proposal and cost estimate;**

Plan for reopening/entering the discharging adit to investigate the mine workings, including but not limited to:

1. All equipment necessary for opening the mine and entering the workings.
    a. Vehicles to transport personnel, equipment and supplies
    b. Generator, 3-phase, wire and controls (TG)
    c. Submersible pump, pipe, hose and fittings as necessary to pump shaft (TG)
    d. Ventilation fan and fabric duct
    e. Portable ladders and planking for staged descending access
    f. Personal Protective Equipment, including mine lights
    g. Harnesses and fall arresting equipment
    h. Air quality monitor, first aid supplies
    i. Internal and area communications equipment
    j. Spill containment supplies (TG)
    k. Heavy equipment if necessary for opening adit
    l. Lumber and tools to install/repair ground support
    m. Compressor, pipe, hose, drill, rock bolts if necessary for ground stabilization
    n. Air hoist for materials transport in shaft.

2. Methods for determining if the mine can be safely entered. If Contractor determines that the mine cannot be safely entered, the mine shall not be entered. If Contractor determines the mine can be safely entered, investigation

of the mine shall proceed.

   a. Physical inspection in progressive stages by a Registered Professional mining engineer with extensive experience in re-opening small mines as well as MSHA underground instructor certification and current First-Aid qualification.

3. List personnel qualified to assess mine safety, determining the structural integrity of the mine, and determining if the mine can be safely entered.
   a. Above specified mining engineer
   b. Experienced and MSHA-trained underground miners

4. List personnel qualified for entering the mine and performing investigation activities.
   a. Same as (3) above
   b. Personnel approved, site-specific trained, and accompanied by personnel in (3)

5. Identify location and describe and construction of potential sedimentation basins if opening the collapsed adit for entry into the workings.
   a. TerraGraphics domain

6. Identify areas for placement of excavated material.
   a. Same

7. The mine will be dewatered; however, if there are areas that require additional dewatering, the contractor shall delineate methods for pumping water out of the mine workings.
   a. All dewatering should be done from the shaft, isolating the adit and each level to identify water influx sources and quality.

8. Describe methods for stabilization of the mine entrance.
   a. The vertical shaft collar would be stabilized with additional wood structures as determined to be necessary by the engineer and underground personnel
   b. If the adit is excavated, the opening would most likely be secured by standard mine sets, 8”x8” timbers with 2”-3” lagging boards, with blocking to secure the sets against the rock and angle-bracing as necessary.

9. Describe methods to monitor air quality and provide fresh air to mine workings.
   a. Standard air-quality meter displaying O_2, CO, methane, and LEL, with calibration gas.
   b. Small (8” discharge) mine ventilation fan and 8” fabric ventilation duct

10. Describe methods for securing the mine to prevent unauthorized entry.
    a. Steel gates and grates locked when not open for use

11. Describe methods for closing the mine after completion of investigation activities.
    a. Standard methods applicable to the desired final treatment and disposition of the site and its problems. Methods may include backfilling, bulkheads, gratings/doors, polyurethane foam (PUF), and combinations thereof.

12. Provide a map showing the proposed locations for all investigation activities, storage of equipment, placement of excavated materials, and other significant uses of the Site.
    a. TerraGraphics domain

Once the mine has been entered, upon being determined safe for entry:

13. Identify all mine investigation activities necessary to characterize the mine workings to support a detailed evaluation of source control alternatives. These investigation activities shall include but not be limited to:
    - Provide a physical layout of the mine
    - Describe significant features (obstructions, hazards, etc.) in the mine workings and locations
    - Describe geology, stability, and rock quality in the workings.
    - Verify elevations of adit and level intersection at the shaft and wells.
    - Identify mineralization zones within the mine workings. Included in geology
    - Identify locations of water infiltration and estimate flow rates into the mine workings.
    - Characterize individual water sources re contents and ORP

Has anyone thought to isolate the workings from air infiltration and see what happens to the discharge water quality?

New Millennium Mining & Contracting
Rehabilitation, Development & Production Specialists
Ben Gunsinger, President

July 22, 2010

Tom Smith
Project Engineer
Terra Graphic's Environmental Engineering, Inc.
302 North Last Chance Gulch, Suite 409
Helena, MT 59601

Dear Mr. Smith,

This quote is for the rehabilitation work at the Lily/Orphan Boy Mine in Montana, at your request.

The shaft at the Lily/Orphan Boy Mine is 250' deep. New Millennium Mining & Contracting, LLC will install a new man-way and timber slide and ventilation to the 250 ft level,we will also map the water inflow and rate of water in the tunnels.

New Millennium's time frame for installing a new man-way down the shaft to make it safe for all personnel to enter the mine will be four weeks, working a 10 hour shift, 7 days per week. This is if all shaft timber is in good condition. In the event of unforeseen problems, cave-ins, bad timber, etc., New Millennium and Terra Graphics will work together to resolve them on a cost-plus rate of manpower/equipment/and materials

Terra Graphics is responsible for water discharge permit and all other permits pertaining to this job.

Price for installing new man-way to the 250' level and mapping is as follows:
$114,723.00 labor/equipment and materials - estimated 4 weeks completion.
Daily cost plus rates are $4,100.00 per 10 hour day – this includes labor and equipment.

I wish to thank you for the opportunity to quote on this work and hope that we can be of service to you. If this bid is successful we will provide our standard contract incorporating the above for appropriate signatures.

Sincerely,

Ben Gunsinger,
President

USA Office
PO Box 314, Sheridan, Montana 59749
Phone (406) 202-0416, Fax (406) 842-5036

Canadian Office
RR#1 7 Wiljala Drive, Kakabeka Falls, Ontario P0T 1W0
Phone (807) 620-2965, Fax (807) 933-4552

email: newmillenniummining@bell.net

APPENDIX G

Analytical Laboratory Cost Estimates

Price Quotation
Project Name: Lilly/Orphan Boy Mine
Creation Date: August 23, 2010

Contact Name: Tom Smith
Company: TerraGraphics Environmental Engineering

Quote #: 10082301.cjn revision
Initiator: Chris Norman

Address: 302 North Last Chance Gulch, Suite 409
City, State Zip: Helena, MT 59601
Email: tom.smith@terragraphics.com
Phone: 1 406 441-5441

Pace PM: Denise Jensen
Start Date:
Project TAT: 10-15 Work Days
Project Location: Montana
Data Package: Level 2

Invoice To: Montana DEQ
Report To: Tom Smith

Pace Lab: Pace Montana
EDD: Pace Standard
Certification:
Prog. Req.: RCRA, MDEQ, CWA

Additional Comments: Our reporting limit for sulfate by method 300.0 will be 5 mg/l, not 1 mg/l as requested. Acid Base accounting reporting limits are provided herein. These differ from those required by the SAP. Dissolved metals with reporting limits in mg/l are Al (0.03), As (0.003), Cd (0.00008), Ca (1.0), Cu (0.001),Fe (0.05), Pb (0.0005), Mg (1.0), Mn (0.005), K (1.0), Na (1.0) Zinc (0.01) Total metals with reporting limits in mg/l are Al (0.03), As (0.003), Cd (0.00008), Cu (0.001),Fe (0.05), Pb (0.0005), Mn (0.005), Zinc (0.01)

This quote was prepared using the assumption that standard Pace Analytical QA/QA, reporting limits, and terms and conditions apply.

Surface Water pricing is valid for 4 quarterly sampling events.

Qty	Matrix	Analysis/Method	Unit Price	TAT	Rush Surcharge	Total Price
Ground Water						
8	Water	A4500-H B 0.1 s.u.	$ 5.00	10 days		$ 40.00
8	Water	Conductivity A2510 B 1umhos/cm	$ 5.00	10 days		$ 40.00
8	Water	Total Dissolved Solids b A2540 C 10 mg/L	$ 8.00	10 days		$ 64.00
8	Water	Total Susp Solids b A2540 D 06 10 mg/L	$ 8.00	10 days		$ 64.00
8	Water	Acidity-Total as CaCO3 by A2310B	$ 12.00	10 days		$ 96.00
8	Water	Dissolved Bicarb & Carb to 4 mg/l 2320B	$ 8.00	10 days		$ 64.00
8	Water	Dissolved Cl & SO4 EPA 300.0 1 &5mg/L	$ 16.00	10 days		$ 128.00
8	Water	Unfiltered Alkalinity, Total A2320 B 4 mg/L	$ 6.00	10 days		$ 48.00
8	Water	Unfiltered Bicarb & Carbonate to 4 mg/l	$ 8.00	10 days		$ 64.00
8	Water	Unfiltered Cl & SO4 EPA 300.0 to 1 &5mg/l	$ 16.00	10 days		$ 128.00
8	Water	Single Metal by 200.8	$ 15.00	10 days		$ 120.00
8	Water	7 Additional Metals by 200.8	$ 42.00	10 days		$ 336.00
Surface Water (Quarterly)						
5	Water	A4500-H B 0.1 s.u.	$ 5.00	10 days		$ 25.00
5	Water	Conductivity A2510 B 1umhos/cm	$ 5.00	10 days		$ 25.00
5	Water	Total Dissolved Solids b A2540 C 10 mg/L	$ 8.00	10 days		$ 40.00
5	Water	Total Susp Solids b A2540 D 06 10 mg/L	$ 8.00	10 days		$ 40.00
5	Water	Acidity-Total as CaCO3 by A2310B	$ 12.00	10 days		$ 60.00
5	Water	Dissolved Bicarb & Carb to 4 mg/l 2320B	$ 8.00	10 days		$ 40.00
5	Water	Dissolved Cl & SO4 EPA 300.0 1 &5mg/L	$ 16.00	10 days		$ 80.00
5	Water	Unfiltered Alkalinity, Total A2320 B 4 mg/L	$ 6.00	10 days		$ 30.00
5	Water	Unfiltered Bicarb & Carbonate to 4 mg/l	$ 8.00	10 days		$ 40.00
5	Water	Unfiltered Cl & SO4 EPA 300.0 to 1 &5mg/l	$ 16.00	10 days		$ 80.00
5	Water	Single Metal by 200.8	$ 15.00	10 days		$ 75.00
5	Water	7 Additional Metals by 200.8	$ 42.00	10 days		$ 210.00
5	Water	12 Dissolved Metals by 200.7 and/or 200.8	$ 72.00	10 days		$ 360.00
5	Water	Total Hardness / Calculation	$ -	10 days		$ -
Mine Water						
21	Water	A4500-H B 0.1 s.u.	$ 5.00	10 days		$ 105.00
21	Water	Conductivity A2510 B 1umhos/cm	$ 5.00	10 days		$ 105.00
21	Water	Total Dissolved Solids b A2540 C 10 mg/L	$ 8.00	10 days		$ 168.00
21	Water	Total Susp Solids b A2540 D 06 10 mg/L	$ 8.00	10 days		$ 168.00
21	Water	Acidity-Total as CaCO3 by A2310B	$ 12.00	10 days		$ 252.00
21	Water	Dissolved Bicarb & Carb to 4 mg/l 2320B	$ 8.00	10 days		$ 168.00
21	Water	Dissolved Cl & SO4 EPA 300.0 1 &5mg/L	$ 16.00	10 days		$ 336.00
21	Water	Unfiltered Alkalinity, Total A2320 B 4 mg/L	$ 6.00	10 days		$ 126.00
21	Water	Unfiltered Bicarb & Carbonate to 4 mg/l	$ 8.00	10 days		$ 168.00
21	Water	Unfiltered Cl & SO4 EPA 300.0 to 1 &5mg/l	$ 16.00	10 days		$ 336.00
21	Water	Single Metal by 200.8	$ 15.00	10 days		$ 315.00
21	Water	7 Additional Metals by 200.8	$ 42.00	10 days		$ 882.00
Soils						
16	Soil	Acid Potential w/ Sulfur Forms Sobek Modified 0.5 t/kt	$ 45.00	15 days		$ 720.00
16	Soil	Acid/Base Potential Sobek Modified 0.5 t/kt	$ -	15 days		$ -
16	Soil	Neutralization Potential Sobek Modified 0.5 t/kt	$ 9.00	15 days		$ 144.00
16	Soil	Preparation of Saturated Paste	$ 5.00	15 days		
16	Soil	Conductivity Sat Paste ASA10-3 0.01 mmhos/c	$ 5.00	15 days		$ 80.00
16	Soil	Soil prep to include air dry, disaggreate & sieve at 2mm	$ 15.00	na		$ 240.00
16	Soil	Single metal by 6010 with 3050 digestion	$ 15.00	15 days		$ 240.00
16	Soil	7 additional metals by 6010 with 3050 digestion	$ 42.00	15 days		$ 672.00
			Estimated Total =			$ 7,522.00

Quote #: 10082301.cjn revision
Project Name: Lilly/Orphan Boy Mine

Project Considerations:

- Price proposal is valid for 60 days.
- Payment Terms: "Pace Net 30" from CRM
- Price Proposal includes cost of all containers, preservatives, coolers, and COCs.
- Pace Analytical reserves the right to return highly hazardous, toxic, or radioactive samples.
- All soil samples will be reported on dry weight basis unless otherwise requested.
- Quoted prices include Standard Pace Analytical QA/QA, reporting limits, and terms and conditions unless specifically indicated otherwise.
- TAT (Turn Around Time) is in work days.
- Any deviation from the above quoted scope of work, including sample arrival date and volume, may result in an adjustment of the listed prices.
- The laboratory does not accept responsibility for missed hold times due to clients delay in holding samples prior to shipping to the laboratory.
- Please include proposal number on Chain-of-custody to ensure proper billing.

Chris Norman

August 23, 2010

Submitted by **Date**

Client Signature **Date**

ENERGY LABORATORIES
www.energylab.com
Analytical Excellence Since 1952
Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
Gillette, WY 866-686-7175 • Rapid City, SD 888-672-1225 • College Station, TX 888-690-2218

Quotation for Analytical Services # H527

Company: MT DEQ
Contact: Pebbles Clark
Address: PO Box 200901
Helena, MT 59620-0901
Phone: (406) 841-5028 Fax:

Submitted By: Jonathan Hager
Project: Lilly/Orphan Boy Abandoned Mine
TAT: 10 Working days
QC Level: STD
Quote Date: 29-Apr-10 Expires: 31-Dec-11

Matrix	Test Name	Test	Remarks	# Samp	Unit Price		Test Total
Schedule:	**Table 1. Surface water**			**No. Samples: 20**			
Aqueous	Acidity, Total as CaCO3	A2310 B	Analyze if pH is <4.5	1	$15.00	1	$300.00
	Alkalinity	A2320 B		1	$10.00	1	$200.00
	Alkalinity	A2320 B	Dissolved needs to be filtered	1	$10.00	1	$200.00
	Hardness as CaCO3	A2340 B		1	$0.00	1	$0.00
	Conductivity	A2510 B		1	$10.00	1	$200.00
	Solids, Total Dissolved	A2540 C		1	$15.00	1	$300.00
	Preparation for TDS	A2540 C		1	$0.00	1	$0.00
	Solids, Total Suspended	A2540 D		1	$15.00	1	$300.00
	Preparation for TSS	A2540 D		1	$0.00	1	$0.00
	pH	A4500-H B		1	$10.00	1	$200.00
	Metals Digestion by EPA 200.2	E200.2		1	$15.00	1	$300.00
	Metals by ICP/ICPMS, Dissolved	E200.7_8		1	$210.00	1	$4,200.00
	Metals by ICP/ICPMS, Tot. Rec.	E200.7_8		1	$170.00	1	$3,400.00
	Anions by Ion Chromatography	E300.0		1	$20.00	1	$400.00
	Anions by Ion Chromatography	E300.0	Dissolved needs to be filtered	1	$20.00	1	$400.00
			Schedule Sample Price:		**$520.00**		
			Schedule Total:				**$10,400.00**
Schedule:	**Soil**			**No. Samples: 16**			
Soil	Acid Base Potential w/Sulfur Forms	Test Group		1	$55.00	1	$880.00
	*Acid/Base Potential	Sobek Modified		1		1	
	*Sulfur Forms	Sobek Modified		1		1	
	*Lime Percentage	USDA23c		1		1	
	Conductivity	ASA10-3		1	$15.00	1	$240.00
	Metals by ICP/ICPMS, Total	E6010.20		1	$80.00	1	$1,280.00
	Digestion, Total Metals	SW3050 B		1	$25.00	1	$400.00
	Saturated Paste Extraction	USDA2		1	$0.00	1	$0.00
			Schedule Sample Price:		**$175.00**		
			Schedule Total:				**$2,800.00**
Schedule:	**Table 1. Groundwater and Mine water**			**No. Samples: 29**			
	Acidity, Total as CaCO3	A2310 B	Analyze if pH is <4.5	1	$15.00	1	$435.00
	Alkalinity	A2320 B		1	$10.00	1	$290.00
	Alkalinity	A2320 B	Dissolved needs to be filtered	1	$10.00	1	$290.00
	Hardness as CaCO3	A2340 B		1	$0.00	1	$0.00
	Conductivity	A2510 B		1	$10.00	1	$290.00
	Solids, Total Dissolved	A2540 C		1	$15.00	1	$435.00
	Preparation for TDS	A2540 C		1	$0.00	1	$0.00
	Preparation for TSS	A2540 D		1	$0.00	1	$0.00

To assure that the quoted analysis and pricing specifications are provided, please include the Quote ID number referenced above on the Chain of Custody or sample submittal documents .

* Methods and/or parameters included in the indicated test group.
Subcontracting of sample analyses to an outside laboratory may be required. If so, Energy Laboratories will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

Quotation for Analytical Services # H527

Company:	MT DEQ	Submitted By:	Jonathan Hager
Contact:	Pebbles Clark	Project:	Lilly/Orphan Boy Abandoned Mine
Address:	PO Box 200901	TAT:	10 Working days
	Helena, MT 59620-0901	QC Level:	STD
Phone:	(406) 841-5028 Fax:	Quote Date:	29-Apr-10 Expires: 31-Dec-11

Matrix	Test Name	Test	Remarks	# Samp	Unit Price		Test Total
Schedule:	**Table 1. Groundwater and Mine water**			**No. Samples: 29**			
	Solids, Total Suspended	A2540 D		1	$15.00	1	$435.00
	pH	A4500-H B		1	$10.00	1	$290.00
	Metals Digestion by EPA 200.2	E200.2		1	$15.00	1	$435.00
	Metals by ICP/ICPMS, Tot. Rec.	E200.7_8		1	$170.00	1	$4,930.00
	Metals by ICP/ICPMS, Dissolved	E200.7_8		1	$20.00	1	$580.00
	Anions by Ion Chromatography	E300.0		1	$20.00	1	$580.00
	Anions by Ion Chromatography	E300.0	Dissolved needs to be filtered	1	$20.00	1	$580.00
				Schedule Sample Price:	**$330.00**		
				Schedule Total:			**$9,570.00**

Quote Comments: Shipping is $10.00 per cooler.

Quote Sub Total:	$22,770.00
Misc:	$0.00
Discount:	25.00%
WO Adjustment:	$0.00
QUOTE TOTAL:	**$17,077.50**

General Comments:

To assure that the quoted analysis and pricing specifications are provided, please include the Quote ID number referenced above on the Chain of Custody or sample submittal documents .

* Methods and/or parameters included in the indicated test group.
Subcontracting of sample analyses to an outside laboratory may be required. If so, Energy Laboratories will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

APPENDIX H

Subcontractor Cost Estimates

Tom Smith

From: Chris Boland [chris@bolandconstruction.net]
Sent: Wednesday, August 18, 2010 3:12 PM
To: Tom Smith
Subject: RE: Lilly/Orphan Boy monitoring wells

Tom,

The cost for back-hoe/dozer and grout mixing are:

- Mobilize and demobilize – 300 miles @ $2.25 per mile
- Hourly operating rate - $95.00 per hour
- Portland Cement - $15.00 per sack

If you have any questions or need more information please let me know. Thank you.

Chris Boland
Boland Drilling Company
4701 North Star Blvd.
Great Falls, MT 59405
Phone: (406) 761-1063
Fax: (406) 761-1076
www.bolandconstruction.net

From: Tom Smith [mailto:tom.smith@terragraphics.com]
Sent: Friday, July 30, 2010 8:55 PM
To: chris@bolandconstruction.net
Subject: Lilly/Orphan Boy monitoring wells

Chris,

As we discussed over the phone today, we are requesting a cost estimate for drilling and installing 5 monitoring wells on the Lilly/Orphan Boy mine site for Montana DEQ-AML. The bedrock in this area is Butte Quartz Monzonite and is fairly shallow.

Attached are the site map of the claim and the location map for directions to the mine. The old head frame is in place over a newer frame which can be seen from the road. The locations of the wells have not been marked in the field but will be prior to moving on site.

Scope of work:

Drill & install 5 monitoring wells and develop the wells. We will collect chip samples at 5' intervals or at lithology changes. All wells shall be PVC with 6" or 8" steel collars and caps.

Below are the well numbers, PVC casing diameters, and estimated depths:
MW-1: 2" well to 125'
MW-2: 6" well to 125'
MW-3: 2" well to 30'
MW-4: 2" well to 25'
MW-5: 2" well to 55'

We are anticipating drilling in mid-August. The wells will need to be developed. The bottom 20' will need to be screened for all wells. If additional screen is needed in the wells, what would the change in cost be?

Please call if you need more information. Thanks and have a good weekend!

Regards,
Tom Smith, PE, PG
TerraGraphics Environmental Engineering, Inc.
302 N. Last Chance Gulch, Suite 409
Helena, MT 59601
Office: (406) 441-5441
Cell: (406) 461-5974

APPENDIX I

Technical Memorandums

TerraGraphics
Environmental Engineering, Inc.

121 S. Jackson St., Moscow, ID 83843
Phone: (208) 882-7858; Fax: (208) 883-3785

108 W. Idaho Ave., Kellogg, ID 83837
Phone: (208) 786-1206; Fax: (208) 786-1209

3501 W. Elder St., Ste. 102, Boise, ID 83705
Phone: (208) 336-7080; Fax: (208) 908-4980

10905 E. Montgomery Dr., Ste. 3
Spokane Valley, WA 99206-6606
Phone: (509) 928-1063; Fax: (509) 928-1067

302 N. Last Chance Gulch, Ste. 409
Helena, MT 59601
Phone: (406) 441-5441; Fax: (406) 441-5443

7000 Smoke Ranch Rd. Las Vegas, NV 89128
Phone: (702) 685-2229; Fax: (702) 685-2223

www.terragraphics.com

TECHNICAL MEMORANDUM

To: Pebbles Clark, MT DEQ - AML, Helena

From: Tom Smith, PE, PG, TerraGraphics, Helena

Date: July 14, 2010

Project Code: 09210

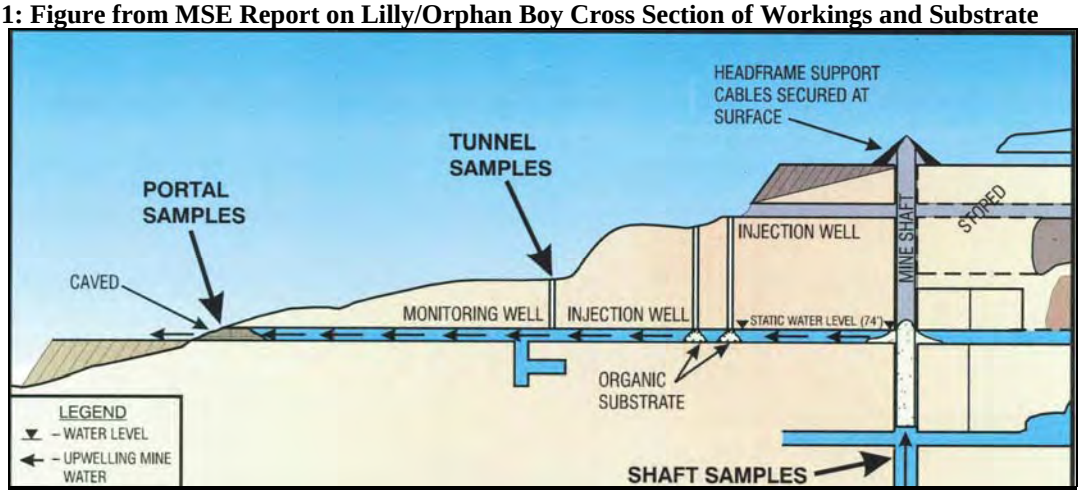
Subject: Removal or Lowering of Platforms from Shaft at Lilly/Orphan Boy Mine Site

1 Introduction and Background

This technical memorandum has been prepared for the dewatering pilot test or mine dewatering that will help determine the selection of a mine dewatering process at the Lilly/Orphan Boy Mine site to facilitate the Mine Investigation Plan. Before the pilot test or dewatering is performed, we recommend the suspended platforms in the Lilly shaft be removed or lowered to the bottom of the shaft, which will allow access to the water in the lower mine workings.

The Lilly mine shaft contains a suspended platform (reportedly installed at the 125-foot level) in each of its two compartments that suspends a total estimated volume of 60 cubic yards of substrate, which is composed of compacted cow manure, straw, and wood chips. The substrate was used as the source for sulfate reducing bacteria (SRB) and a method for reducing acid mine drainage from the collapsed adit that drains into Telegraph Creek. Figure 1 shows the figure that was included in MSE Technology Applications' (MSE) final report, *In Situ Control of Acid generation Using Sulfate Reducing Bacteria* (MSE, 2008) at the site.

Figure 1: Figure from MSE Report on Lilly/Orphan Boy Cross Section of Workings and Substrate



The MSE *Request for Proposal for Construction Services* (MSE, 1994) specifies a minimum crane capacity of 10 tons. We reviewed the construction photos provided by MSE and it appears two cranes were used for constructing the steel frame above the Lilly shaft and for installing the

platforms. A Pettibone 30 crane (15 ton capacity) and a crane from Otto's Crane and Rigging (an approximate 60 ton capacity) are shown in the photographs; one is included in Figure 2.

Figure 2: MSE Photo of Cranes Setting the Steel Headframe Prior to Installation of Platforms and Substrate

The August 14, 2009 submittal letter from MSE states "that 60 cubic yards of substrate were placed on the platforms within the shaft". This volume of substrate material appears to require at least a 30-ton crane for removing the platforms if the volume is split evenly between the platforms (assuming a unit weight of 65 pounds per cubic foot for the compacted substrate).

2 Recommendations

We recommend the suspended platforms in the Lilly shaft either be removed or lowered to the bottom of the shaft by a crane subcontractor. If the platforms cannot be removed, then we recommend leaving the platforms suspended in the shaft, which will limit the extent of the dewatering and the mine investigation to the areas that can be accessed. This will also limit the mapping of the mineralized zones and water producing zones in the mine. Nevertheless, since mine water flows through the Lilly tunnel, we may still obtain sufficient information to prepare and evaluate closure alternatives in the upcoming EEE/CA.

3 Cost Estimates

The crane subcontractors we contacted operate on an hourly basis. Hourly rates were received from H&H Enterprises and Dick Irvin Inc. A quote was received from Montana Crane Services for the site preparation, handling of the fence, platform removals, purchase of special rigging, installation of pumps, and accessories. Their cost in Table 1 is for the site preparation and

removing of platforms. Their time estimate covered 18 hours of time for mobilization, setup, removing the platforms, and demobilizing from the site. Only Montana Crane Services has made a visit to the site and has a better understanding of the access to the site and site conditions than the other crane subcontractors. Applying the hourly rates to a 24-hour time estimate for the other crane contractors, since they have not visited the site, provides the following estimated costs shown in Table 1. Based on several unknowns about the underground mine workings and the fact that the shaft is inclined at 85 degrees, more time and effort may be necessary. We will not know the required amount of time and effort until a subcontractor is on site and attempts to either remove the platforms or lower them to the bottom of the Lilly shaft.

Table 1 – Crane Subcontractor Cost Estimates

Crane Subcontractor	Hourly Cost	Total Estimated Cost	Notes
H&H Enterprises Great Falls, MT	$175.00	$5,800 for 24 hours	60-ton crane. Travel costs $5.25/mile. If more than one day of work, add $100/day for per diem. Hourly cost does not include mobilizing other equipment if site preparation is needed prior to working on platforms.
Dick Irvin Inc. Shelby, MT	$175.00	$6,650 for 24 hours	50-ton crane. Travel costs at hourly rate. 14 hours estimated from Shelby, MT to site. Hourly cost does not include mobilizing other equipment if site preparation is needed prior to working on platforms.
Montana Crane Services* Helena and Bozeman, MT (Crane and crew coming from Bozeman, MT)	$195.00	$14,054.50	70-ton crane. Cost includes $1,200 for special rigging to connect to the lines of the platform cables. Costs include 18 hours estimated from Bozeman, MT, fence removal, and site preparation to get in and start working on the platforms.
Tom's Crane Service Helena, MT	$125.00		10-ton crane. Crane does not appear large enough for the platforms but can be used for adjusting pump levels while dewatering the mine and unloading/loading of the water treatment equipment. Rate is charged from time leaving the office until the crane returns.

* Quote is attached. Total cost will be based on amount of time spent on site.

4 Conclusions

Based on our discussions with the crane subcontractors, we recommend subcontracting either Montana Crane Services or H&H Enterprises. We also recommend subcontracting Tom's Crane Service for unloading and loading water treatment equipment and setting and removing the pump(s) from the shaft.

Attachment:

Montana Crane Service

Corporate Office
209 East Cedar • Bozeman, Montana 59715
Phone: (406) 586-0909 • 1-800-406-LIFT • Fax: (406) 586-3836
Email: info@montanacraneservice.com

June 23, 2010

Via Regular Mail and Email tom.smith@terragraphics.com

Terra Graphics Environmental Engineering, Inc.
Attn: Tom Smith, PE, PG
302 North Last Chance Gulch, Suite 409
Helena, MT 59601

RE: Crane Service Quote: Lilly/Orphan Boy Mine

Dear Tom,

We appreciate the opportunity to quote this project. There is a lot of planning to be completed in order to pull this project off smoothly. We need to complete a work plan in order to effectively quote this; we are willing to work with you on this if need be. The site is not an easy one to get in or out of and we may have to build a pad for the crane to set up on. Due to these issues we have put together an *estimated* preliminary budget. The first part of the estimate is for the removal of the mine shaft platforms. This portion is further broken down into mobilization and site tasks costs. We have quoted our Bozeman based 70 Ton Link belt HTC 8670LB for the first part of the project. The second part of the project utilizes a Helena based 30 Ton National Boom Truck.

We provide many services with our large fleet of equipment and employ many experienced and hard working individuals. We would like to extend our services to the variety of other tasks this project may require. Please find our time and materials pricing (MCS/MRM 2010 price lists) enclosed for your reference. We would be happy to put together numbers for other tasks.

Following your review of the quote, please call us with any questions you may have.

Estimated Preliminary Budget
REMOVAL of Mine Shaft Platforms

Initial site visit and preliminary lift plan	400.00
Follow up site visit and lay out	800.00
Special rigging	1,200.00
Site visit/s and special rigging sub-total	*$2,400.00*

Mobilization to and from staging area, Bozeman based equipment and crew (Day 1 and 3)

70T Link Belt HTC 8670LB 1,794.00
MDOT Permits 221.00
Dump Truck and Equipment Trailer (D5, KX161, ASV30) 1,145.00
1T Service Truck (welding and mechanical equipment, rigging and blocking) 944.00
Mobilization sub-total $3,160.00

Day 1

Site Task: Off Load, stage equipment, set up crane and rig to platform (Day 1 includes mob)

Hourly crew and equipment (estimated at 5 hours) 1,975.00
Over time 120.00
Day 1 Crew and equipment sub-total..... $2,095.00

Daily crew travel 150.00
Per Diem 270.00
Day 1 Crew travel and Per Diem sub-total..... $420.00

Day 2

Site Task: Craning, rigging and handling to remove both suspended mine shaft manure containments.

Hourly crew and equipment (estimated 10 hours) 3,950.00
Over time 120.00
Day 2 Crew and equipment sub-total..... $4,070.00

Daily crew travel 300.00
Per Diem 270.00
Day 2 Crew travel and Per Diem sub-total..... $570.00

Day 3

Site Task: Tear crane down, return to staging area, load out equipment and prepare for departure.

Hourly crew and equipment (estimated 3 hours) 1,339.50
Day 3 Crew and Equipment Sub-total..... $1,339.50

Removal of Mine Shaft Platforms: Estimated Total $14,054.50

INSTALLATION of Pumps and Accessories

Mobilization to and from staging area (Day 1 and 3)

30T National Boom Truck (Helena based) 594.00
1T Service Truck (welding and mechanical equipment, rigging and blocking, Bozeman based) 944.00
Mobilization sub-total $1,538.00

Day 1

Site Task: Off load, set up crane (Day 1 includes mob)

Hourly crew and equipment (estimated 2 hours) 480.00

Day 1 Crew and equipment sub-total..... $480.00

Daily crew travel 100.00

Per Diem 90.00

Day 1 Travel and Per Diem sub-total..... $190.00

Day 2

Site Task: Craning, rigging and handling in order to place pumps and accessory equipment. Tear down boom truck and return to staging area.

Hourly crew and equipment (estimated 10 hours) 2,400.00

Over time 80.00

Day 2 Crew and equipment sub-total..... $2,480.00

Daily crew travel 100.00

Per Diem 90.00

Day 2 Travel and Per Diem sub-total..... $190.00

Day 3

Mobilize from staging area, included in mobilization.

Installation of Pumps and Accessories: Estimated Total $4,878.00

ESTIMATED Project Total (Removal/Installation)..... $18,932.50

Site Specific Notes (Read carefully before signing.)

1) We will transport and store existing rigging for up to one year should it need to be reused. If it does not get reused within one year we will retain possession to cover these handling costs.

SPECIAL CONDITIONS, Montana Crane Service, Ltd: (Read carefully before signing)

★ **Scheduling of a crane is on a first come first serve basis upon return of a signed quote.**

★ Unforeseen circumstances which affect cost to complete a priced item **will be billed as an extra charge** on a time and materials basis.

★ Standby time for the crane quoted due to the following and related circumstances will be charged at 60% of the hourly operated rate.

- ☐ poor site accessibility and in route delays
- ☐ not enough space to maneuver the crane or the trucks
- ☐ additional excavation required to make level, enlarge set area, or improve access
- ☐ additional compacting or blocking because of insufficient compaction or soft ground

- ☐ passageways being too narrow
- ☐ waiting for power lines to be turned off or dropped
- ☐ high winds
- ☐ late or non-arrival of crew
- ☐ late or non-arrival of materials

★ **Per Diem,** if applicable, is charged at the rate of $90.00 per man, per night.

★ **Overtime hours**, if not specifically addressed in the quote, will be charged at the rate of $20.00 per hour per man for all hours over eight per day.

★ **Prevailing Wage** hours, if not specifically addressed in the quote, will be charged at the rate of $ 15.00 per hour for all applicable hours.

★ Montana Crane Service, Ltd. assumes liability for legibly marked utilities. Montana Crane Service, Ltd. **will not pay** for non-located, miss-marked, or illegibly marked utilities.

★ Montana Crane Service **will not be held liable** for any problems or costs or delays associated with Montana Department of Transportation overweight and oversize permitting.

★ Detours, "return to base", or unforeseen extra travel or transport due to special road weight restrictions and height restrictions or limitations, government bridge weight restrictions or private bridges determined unsafe to cross by the crane operator **will be charged for**.

★ Montana Crane Service **will not be liable** for damage caused by overloading of structures to be crossed over or structures adjacent to set up area.

★ Our mobilization price includes the cost to transport fully assembled all of the equipment necessary to complete this project as priced. If it becomes necessary to disassemble the quoted equipment, to transport additional equipment, or to transport the quoted equipment extra times because of circumstances out of our control, **we will charge extra**.

★ **Credit arrangements must be made in advance** if you want to charge on account. Montana Crane Service will finance our services over a 12-month period. Financing must be pre-approved; down payment and monthly installments can be adjusted on an individual basis.

★ **Customer agrees to pay full attorney fees and collection costs** if payment is not received on a timely basis. Customer also agrees to pay periodic service charges on past due balances. Notice is hereby given of intent to file a lien if payment is not made when due. Service Charge is 1% monthly, 12% annually; minimum charge is $1.00/month.

★ Certificates of Worker's Compensation and Liability Insurance will be provided upon request by the customer.

★ We carry $ 250,000.00 in hook insurance. Increased coverage requires a quote from the underwriter. **If additional hook insurance is required, the additional cost will be charged to the customer at cost plus 15%.**

★ We have all the necessary rigging in our possession to do this work safely and efficiently. **The cost to build or purchase special rigging may be charged to customer.**

★ **Please review the quote for completeness.** We will be glad to offer pricing on any additional items you may need.

QUOTED BY:

Greg Poncelet 6-23-10

Greg Poncelet Date

ACCEPTED BY:

Name Title Date

Enclosures: MCS 2010 Hourly Price List
MRM 2010 Hourly Price List

Terra Graphics
Lilly / Orphan Boy Mine
6-21-10

Montana Crane Service

Corporate Office
209 East Cedar • Bozeman, Montana 59715
Phone: (406) 586-0909 • 1-800-406-LIFT • Fax: (406) 586-3836
Email: info@montanacraneservice.com

Effective January 12, 2010

2010 Hourly Price List

Cranes priced by the hour with licensed operator, Port to Port - Bare rental rates available.

Call Toll Free ☞ 1-800-406-LIFT (5438)

info@montanacraneservice.com

Please see reverse for additional services, billing policies & guidelines

Bozeman Based

06	14 Ton RO Single Axle Boom Truck	73' height	$ 95.00
03	15 Ton National Tandem Axle Boom Truck	101' height	$ 100.00
05	22 Ton National Tandem Axle Boom Truck	148' height	$ 110.00
08	23 Ton National Tandem Axle Boom Truck	105' height	$ 110.00
09	30 Ton National Tandem Axle Boom Truck	161' height	$ 120.00
20	22 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 120.00
22	22 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 120.00
25	28 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 125.00
26	28 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 125.00
21	30 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	161' height	$ 135.00
27	30 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	161' height	$ 135.00
24	50 Ton Linkbelt 4WD Rough Terrain Crane [1,2,3]	172' height	$ 155.00
41	50 Ton Linkbelt Hyd Truck Crane [1]	168' height	$ 160.00
* 44	70 Ton Linkbelt Hyd Truck Crane – Long Boom [1]	200' height	$ 195.00
43	100 Ton Linkbelt Hyd Truck Crane [1,3]	225' height	$ 225.00
90	140 Ton Linkbelt Conventional Truck Crane [1,2,3,4]	305' height	$ 250.00
	TH63 Cat Extended Reach 4WD Forklifts [2]	42' height (6,000 lb)	$ 90.00
	TH103 Cat Extended Reach 4WD Forklifts [2]	44' height (10,000 lb)	$ 95.00
	966F Cat 4WD Fork-Equipped Loader [1,2]	14' height (36,000 lb)	$ 150.00

Helena Based

07	14 Ton RO Single Axle Boom Truck	73' height	$ 95.00
04	23 Ton National Tandem Axle Boom Truck	120' height	$ 110.00
* 10	30 Ton National Tandem Axle Boom Truck	157' height	$ 120.00
23	22 Ton Linkbelt 4WD Rough Terrain Crane [1,2]	122' height	$ 120.00
45	75 Ton Linkbelt Hyd Truck Crane [1]	182' height	$ 195.00
	TH63 Cat Extended Reach 4WD Forklift [2]	42' height (6,000 lb)	$ 90.00

[1] Requires oversize & overweight permits at an additional cost
[2] Requires lowboy transport to & from most job sites
[3] Requires pilot car on some two lane roads
[4] Requires additional equipment for assembly & transport

All heights are maximum boom tip heights, including jibs
We provide most spreader bars and rigging required at no additional charge
A 0% to 5% fuel surcharge will be assessed on all equipment and vehicle time; subject to change without notice.

*	Lift Supervisor	$ 80.00/hr	
	Operator travel ½ Ton Service Truck	$ 50.00/hr	
*	Operator travel 1 Ton Service Truck	$ 60.00/hr	
	Pilot car and driver	$ 50.00/hr	
	6-Axle 40-ton lowboy (plus permits)	$100.00/hr	
	7-Axle 50-ton lowboy (plus permits)	$110.00/hr	
	8 Axle 55-ton lowboy (plus permits)	$120.00/hr	
	11 Axle 65-ton lowboy (plus permits)	$150.00/hr	
	Tractor/Trailers – various sizes	$80.00-140.00/hr	
	Service Truck (½ Ton)	$ 20.00/hr	
	Service Truck (1Ton)	$ 30.00/hr	
*	Rigger/laborer	$ 50.00/hr	
	Manbasket or work platform	$ 10.00/hr	
→	Davis-Bacon, prevailing wage	$ 15.00/hr	
*	Overtime	$ 20.00/hr	
*	Per Diem	$ 90.00/day	

TOWER CRANE: SALES • RENTAL • LEASING • SERVICE •INSPECTION • TRAINING

RENTAL ITEMS: CAT EXTENDED REACH 4WD (TELEHANDERS) • PORTABLE STORAGE UNITS

INDUSTRIAL MACHINERY MOVING

Bozeman • Helena • Butte

SPECIAL NOTES & BILLING POLICIES

- ❑ Written and verbal quotes are available upon request for all your lifting needs.
- ❑ A 0% to 5% fuel surcharge will be assessed on all equipment and vehicle time, and is subject to change without notice.
- ❑ Customer is responsible for equipment until equipment is off site, this includes a safe adequate tow back to dry ground if the equipment is required to leave paved or graveled roadway. All tows will be paid by the customer.
- ❑ Rigging and other items not normally carried with a specific crane require loading prior to departure and offloading upon return. Additional labor and equipment charges will be billed for the completion of these tasks.
- ❑ Rigging and other items that cannot be carried on the crane require separate transport. Additional labor and equipment associated with transport will be billed to the customer.
- ❑ Jobs requiring specialized or limited application rigging must be quoted. All or part of the cost to build or purchase special rigging will be billed to the customer.
- ❑ Specific crane tasks or job sites can require written lift plans. Costs to complete written lift plans will be billed to the customer. Lift plans, and quotes to complete, are available upon request.
- ❑ Personnel travel and transport to and from the job site are not included in overtime charge calculations. Saturdays and hours over eight hours per day on site will be charged as overtime hours.
- ❑ Crane set up and tear down is billed at the hourly crane rate. Set up and tear down can require additional labor and equipment which will be billed at the hourly rates included travel and transport. Written quotes are available upon request for difficult or time consuming set up and tear down.
- ❑ Lowboy transport costs will include loading prior to departure and offloading upon return.
- ❑ Montana Department of Transportation oversize permits are required for the transport of all cranes on lowboys and for the travel of all hydraulic truck and conventional cranes. All associated costs are billed to the customer. Written quotes are available upon request.
- ❑ Standard hook insurance is $ 250,000.00. Additional coverage requires quote from insurance underwriter and will be charged to the customer at cost plus 15%.
- ❑ A 20% Insurance surcharge will be assessed on all work involving machine and equipment moving requiring forking, jacking, rolling, or inside building placement. Written quotes are available upon request.
- ❑ Installation of tires chains, in-route, on-site, or pre-loading, will be billed to the customer at the labor and equipment rates listed.
- ❑ Job site conditions and specific crane tasks can require additional personnel. Additional labor will be billed to the customer at the labor rates listed.
- ❑ Prevailing wage adjustments will be added to listed rates if applicable.
- ❑ Montana Crane Service, Ltd. reserves the right to change rates and policies without notice.

Montana Ready-Mix Ltd.

Terra Graphics
Lilly/Orphan Boy Mine
6-22-10

Greg Poncelet, President
209 East Cedar • Bozeman, MT 59715
Phone: (406) 586-1234
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Effective January 12, 2010

2010 CONSTRUCTION SEASON
EQUIPMENT RATES

All equipment is quoted per hour, with operator, basis. Additional charges listed below may apply.

TRUCKING[1,2]

Dump Truck 4-axle	$ 80.00
Dump Truck w/ 2-axle pup trailer	$100.00
Dump Truck w/3-axle pup trailer	$110.00
Dump Trucks w/3-axle equipment trailer	$100.00
Transport Tractor w/40-ton Lowboy	$100.00
Transport Tractor w/50-ton Lowboy	$110.00
Transport Tractor w/55-ton Lowboy	$120.00
Transport Tractor w/65-ton Lowboy (depending on components)	$115.00 to $150.00
Tractor-Trailer Units (various sizes)(flats and vans)	$ 80.00 to $140.00
500 Gallon Water Truck	$ 65.00
4000 Gallon Water Truck	$ 80.00
Transport Tractor w/hydraulic roll off trailer	$110.00

EXCAVATING[1,2]

Skid Steer - Case 1840	$ 85.00
Tracked Skid Steer - ASV 30	$ 85.00
Wheel Loader - Cat 966, 4.5 cy	$125.00
Crawler Loader - Cat 955, 2.25 cy w/ripper	$100.00
Crawler Loader - Cat 977, 3.5 cy w/ripper	$125.00
Compactor – Cat 168D, Vib. smooth drum	$ 95.00
Compactor - Bomag K301, 4WD Sheepsfoot	$110.00
Telehandler Cat TH63	$ 90.00[5]
Backhoes - Case 590[3,4,6]	$ 95.00
Excavator - Kubota KX41 w/thumb	$ 85.00
Excavator - Kubota KX161 w/thumb	$100.00
Excavator - John Deere 690E LC[7]	$120.00
Dozer, 6-way - Cat D3 w/ripper	$100.00
Dozer, 6-way - Cat D5 high track	$120.00
Grader - Cat 120, 14' blade	$120.00
Tracked Dump Truck, 1/2 cy Kubota	$ 75.00

ADDITIONAL CHARGES & SERVICES

A 0% to 5% Fuel Surcharge will be assessed on all equipment and vehicle time.
Surcharge subject to change without notice

Per Diem (per day)	$ 90.00
Regular Labor	$ 50.00
Clerical Service	$ 35.00
Truck Driver Labor	$ 55.00
½ T Service Truck	$ 20.00
1T Service Truck	$ 30.00
Operator Labor	$ 65.00
Supervisor Labor	$ 90.00
Management	$110.00
Mechanic	$ 50.00
Welder	$ 50.00
Shop Charge	$ 15.00
Engineer	$100.00
[1]Add for each hour overtime	$ 20.00
[1]Add for Prevailing or Union Wage	$ 15.00
[1]Add for OSHA 40 trained personnel	$ 20.00
[3]Add for Concrete Breaker Attachment	$ 40.00
[4]Add for Sheep's Foot Wheel Packer Attachments	$ 25.00
[6]Add for vibratory plate attachment	$ 30.00
[7]Add for demolition grapple attachment	$ 30.00
[2]Add for Heavy Rock, Heavy Frost, Demolition	$ 20.00
[2]Add for Working in Water	$ 20.00
[5]Add for man basket or work platform	$ 10.00
Pilot or flag cars	$ 50.00
Add for MDOT Certified Flagger	$ 5.00
Add for sweeper attachment	$ 30.00

MORE EQUIPMENT & SERVICES ARE AVAILABLE.
CALL OUR OFFICE IF YOU NEED SOMETHING NOT LISTED ON THESE TWO PAGES
PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

GRAVEL, TOPSOIL, FILL DIRT- Prices on these items vary. Please call for a quote.

WE SELL CONCRETE SEPTIC TANKS

STORAGE TRAILER RENTAL

8x28 Trailer	$50.00/month	w/steps	$60.00/month
8x45 Trailer	$80.00/month	w/steps	$90.00/month

8x20 Ocean Going Container with side entry door $60.00/month
8x40 Ocean Going Container with side entry door $90.00/month
8x28 Skid-Mounted Ground Level Trailer $65.00/month
Delivery and Pickup Charges (round trip) $70.00/hour

Damage of any kind for any reason whatsoever to the storage trailer or its contents is solely the responsibility of the Lessee.

Customer is responsible for a safe adequate tow of all equipment back to dry ground if the equipment is required to leave paved or graveled roadway. All tows will be paid by customer.

EXTENDED REACH FORKLIFTS $200.00/day $750.00/week $2250.00/month

Note: Special low long term rates available. Please request separate price list.

LIFTING[1,5]

Boom Trucks - RO Stinger 14 Ton Hydraulic (SA)	73 ft height	$ 95.00
Boom Truck - National 14 Ton Hydraulic	101 ft height	$100.00
Boom Truck - National 22 Ton Hydraulic	148 ft height	$110.00
Boom Truck - National 23 Ton Hydraulic	148 ft height	$110.00
Boom Truck - National 30 Ton Hydraulic	161 ft height	$120.00
Truck Crane – Linkbelt 50 Ton Hydraulic	168 ft height	$160.00
Truck Crane - Linkbelt 70 Ton Hydraulic – Long Boom	200 ft height	$195.00*
Truck Crane - Linkbelt 75 Ton Hydraulic	182 ft height	$195.00*
Truck Crane - Linkbelt 100 Ton Hydraulic	225 ft height	$195.00*
Truck Crane - 238A 140 Ton Conventional	320 ft height	$250.00*
4WD RT Cranes - Linkbelt 22 Ton Hydraulic	122 ft height	$120.00
4WD RT Cranes - Linkbelt 28 Ton Hydraulic	122 ft height	$ 125.00
4WD RT Cranes - Linkbelt 30 Ton Hydraulic	161 ft height	$135.00*
4WD RT Crane - Linkbelt 50 Ton Hydraulic	172 ft height	$155.00*
4WD Telescoping Cat TH63 Material Handlers	6-8000 lbs	$90.00
4WD Telescoping Cat TH103 Material Handler	10,000 lbs	$95.00

All heights are maximum boom tip heights, including jibs.
All rates include operator.
***These cranes require an additional overweight permit.**
4WD RT Cranes require lowboy transport to and from job sites.

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T E C H N I C A L M E M O R A N D U M

To: Pebbles Clark, MT DEQ – AML, Helena

From: Matt Culpo, PE, TerraGraphics, Helena
Tom Smith, PE, PG, TerraGraphics, Helena

Date: July 21, 2010, revised August 18, 2010

Project Code: 09210

Subject: Lilly/Orphan Boy Mine Workings Dewatering Evaluation performed for the Work Plan

1.0 Introduction

This technical memorandum was prepared to evaluate various dewatering alternatives of the impounded water and groundwater inflows in the mine workings at the Lilly/Orphan Boy Mine so that a subsequent Mine Investigation can be conducted. This memorandum is to be used as a tool for DEQ to select a mine dewatering alternative and allow completion of the upcoming Work Plan. Once the alternative is selected as part of the Work Plan, the treatment system and associated costs can be refined and developed for implementation. Initially, the focus of the dewatering work plan was to provide alternatives that met the most stringent surface water quality standards provided by Circular DEQ-7 Montana Numeric Water Quality Standards (MDEQ, 2008), hereinafter referred to as DEQ-7. After an initial evaluation of direct discharge systems to meet DEQ-7 standards, system costs were found to be considerable and alternatives to direct discharge systems were requested to be considered which included evaluating alternatives to meeting the initially requested discharge standards.

In general, the dewatering system requirements include: setup, operation and removal in a remote location, and initial dewatering. Initial estimates range from approximately 400,000 gallons for the mine pool volume that could extend to 2,400,000 gallons, depending on the groundwater inflow and dewatering rate for an estimated 4 to 6 week time period. The following discussion presents a summary of the findings from our investigation and evaluation of the water quality standards, existing conditions, dewatering alternatives, cost estimates, schedule, risks and presents a recommended alternative.

2.0 Water Quality Standards

This section discusses the water quality standards initially evaluated for discharge of treated water into Telegraph Creek. Numeric standards for surface and groundwater quality are contained in DEQ-7. The reference surface water quality standards for this investigation and evaluation are the lowest allowable concentration of human health, chronic or acute aquatic life concentrations. These standards were requested by the MDEQ - Abandoned Mine Lands Section

Project Manager (AML) for discharges from dewatering the mine. Alternatives to these standards are presented in the evaluation of the dewatering alternatives discussed below. The contaminants of concern (COCs) identified in the Final Reclamation Investigation Report, Lilly/Orphan Boy Mine Site (Tetra Tech, 2009) for human health and ecological risk are arsenic, cadmium, copper, iron, lead, manganese, and zinc. The DEQ-7 limits for these contaminants are shown in Table 1.

Table 1. DEQ-7 Water Quality Standards

DEQ-7 Surface Water Standards	Arsenic (mg/L)	Cadmium* (mg/L)	Copper* (mg/L)	Iron (mg/L)	Lead* (mg/L)	Manganese (mg/L)	Zinc* (mg/L)
Acute	0.34	0.00052	0.00379	--	0.01398	--	0.037
Chronic	0.15	0.000097	0.00285	1.0	0.000545	--	0.037
Human Health	0.01	0.005	1.3	0.3 (aesthetic)	0.015	0.05 (aesthetic)	2.0

Notes:

Acute and Chronic levels are for aquatic life standards as listed in Circular DEQ-7, 2008

-- Indicates no standard

* These aquatic life standards are hardness dependent. Levels shown are at 25 mg/L hardness.

ND Not detected at the reporting limit

Most stringent standard to be met for water treatment and discharging into Telegraph Creek.

3.0 Existing Conditions

A discussion of the site's existing surface conditions is included in the Final Reclamation Investigation Report, Lilly/Orphan Boy Mine Site (RI). A summary of the existing conditions as they pertain to dewatering of the underground mine workings, in addition to supplemental data collected for this investigation and evaluation, are discussed below. The existing site facilities and water sample locations are shown on Figure 1.

3.1 Mine Water Quality

Lilly/Orphan Boy mine water samples were obtained for the RI in 2008 by Tetra Tech and on April 30, 2010 by TerraGraphics for laboratory analysis. The sample from the RI was obtained from flow discharging from the collapsed adit. The sample taken in 2010 was obtained from the Lilly mine shaft. The upper 10-15 feet of the mine shaft water was mixed to the extent practical prior to sampling. The results of the analysis for both samples are comparable with a difference of less than five times the concentration for any analyte. The mine water in the shaft and the adit discharge exceeds several of Montana's surface water quality standards including all of the COCs (arsenic, cadmium, copper, lead, and zinc). The mine water concentrations for the COCs are shown in Table 2. Laboratory analysis results for the 2008 and 2010 results are included in Attachment A.

Table 2. Water Quality Comparison of the Adit Discharge and the Mine Shaft Water

Water Sample	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Zinc (mg/L)
Adit Discharge 2009	0.874	0.163	0.04	29.6	0.07	5.64	17.7
Mine Shaft 2010	3.94	0.791	0.032	26.2	0.315	5.16	11.3

3.2 Surface Water Quality

Surface water samples from Telegraph Creek were taken at four locations along the site; at the discharging adit, upstream, downstream, and at the toe of the waste rock dump (WR3) in Telegraph Creek as part of the RI (See Figure 1). The laboratory analytical results are shown in Table 3. The results of the laboratory analyses show exceedances of the DEQ-7 water quality standards for arsenic, cadmium, and zinc downstream of the site. Iron and manganese levels are relatively high as well; however, the DEQ-7 human heath water quality standards are based on aesthetic properties. The results of the laboratory analyses also show non-detection for several metals (antimony, barium, chromium, mercury, and silver analyses below detection levels with mercury and silver having detection limits above DEQ-7 water quality standards). The surface water upstream of the site does not show any exceedances of the DEQ-7 water quality standards based on the detection limits. Laboratory analysis results from the surface water samples are contained in Attachment A.

Table 3. Telegraph Creek Surface Water Analytical Results

DEQ-7 Surface Water Standards	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Zinc (mg/L)
Detection Limit	0.005	0.001*	0.01*	0.03	0.01*	0.01	0.01
SW-01 Telegraph Creek Upstream	ND	ND	ND	0.37	ND	0.18	0.03
SW-03 Telegraph Creek Downstream	0.014	0.003	ND	0.61	ND	0.74	0.61
SW-04 Telegraph Creek Toe of WR3	0.854	0.067	0.10	8.28	0.05	5.25	9.31

Notes:

ND Not detected at the reporting limit.

* Detection limit exceeds the DEQ-7 surface water quality standard.

Exceeds Circular DEQ-7 Surface Water Quality Standards

3.3 Mine Pool Volume

The mine pool volume appears to remain relatively constant as groundwater flows in and out of the mine workings and as water flows through the Lilly tunnel and discharges out of the collapsed adit. The mine workings are inundated to the 73-foot level, as measured from the collar of the shaft. Mine water flows through the Lilly tunnel and discharges through the collapsed adit at an approximate elevation of 6,790 feet. The impounded water volume in the mine workings below this level is estimated at 375,000-400,000 gallons, not accounting for groundwater inflow. This volume is based on the *Lilly Mine, Geologic and Assay Plan* (MW Rankin, July, 1950) and estimated drift dimensions of 5 feet by 7 feet (TerraGraphics verbal communication with Dave Newman, January 2010). Calculations for the mine water volume are contained in Attachment B.

3.4 Adit Discharge Rate

The adit discharge rate was measured during a period from September 1994 to August 2001 as part of the *In Situ Control of Acid generation Using Sulfate Reducing Bacteria* (MSE, 2008). Measurements were generally taken monthly with some missing data or days when the weir was noted as being frozen. The measured flow rate ranged from 0.1 gallons per minute (gpm) to 7.6 gpm with a peak occurring in late spring and early summer before quickly declining to about 0.5-2 gpm by late summer. Based on verbal communication with TerraGraphics, these flow rate estimates were considered by MSE Technology Applications (MSE) to be rough estimates only and are included in Attachment B.

3.5 Groundwater Inflow Rate

The groundwater inflow rate to the mine is unknown and could be highly variable depending on seasonal conditions, water level in the mine, and hydraulic gradient effects during dewatering. Historical accounts from Dave Newman, one of the last miners to work the site, suggested that the groundwater inflow rate during operation and active dewatering in the 1960s at the 200-foot level was approximately 20 gpm (TerraGraphics verbal communication with Dave Newman, January 2010). The relatively rapid changes and range of adit discharge rates measured by MSE and discussed above also indicate the potential for variability in the groundwater inflow rate both seasonally and during the planned Mine Investigation.

During the spring runoff periods, we have observed groundwater flow into the shaft occurring at a height of 34 feet below the shaft collar (June 10, 2010 site visit). We have also observed water collecting in an offsite depression on a benched area to the east and above the mine. This pond is shown in Figure 2 and may be a source of surface water infiltration into the mine workings. At one time, it appears that the benched area may have had a drainage ditch running to the north that may have drained this pond. Re-establishing this ditch, or excavating a new ditch, to drain the bench is recommended to limit surface water infiltration into the mine workings. This benched area is located on the adjacent Orphan Boy claim, which is currently

owned by Dan Newman, and consent will be required. Based on our observations, control of surface water at and around the site will be important to the closure design of the mine.

4.0 Dewatering Alternatives Comparison

As part of our preparation for the Mine Investigation Work Plan at the Lilly/Orphan Boy mine site, we evaluated several alternatives for dewatering the mine. These evaluations and associated cost estimates were prepared *to a feasibility level for comparison of the alternatives*. We requested cost estimates for treatment of water at an assumed 60 gpm to permit dewatering of the impounded water for an estimated time period of 4 to 6 weeks, which was our preliminary estimated time frame for performing the upcoming mine investigation. The time frame allows 1 to 2 weeks for dewatering and up to 4 weeks for performing the mine investigation. Actual field conditions will vary and have an impact on the costs. If inflow rates are greater, the amount of water treated will increase and also impact the cost. On the other hand, if less time is required to perform the mine investigation, the water treatment costs could decrease. A summary of the alternatives are discussed below and do not include TerraGraphics costs.

4.1 Water Treatment Discharge Water Quality Standards

Dewatering the mine could be accomplished with a temporary water treatment system and direct discharge to the Telegraph Creek. Five water treatment contractors were contacted, of which three provided preliminary cost estimates and estimated treated water quality. In some instances, water treatment contractors claimed that they could meet the DEQ-7 water quality standards but would not provide a guarantee while others will only reduce the concentrations. Based on our discussions with the water treatment contractors, we are cautionary in our acceptance of their ability to meet DEQ-7 standards. However, we believe that high water quality can be achieved through water treatment such that if DEQ-7 is not meet, the current loading from the COCs to Telegraph Creek would be reduced during the investigation.

To meet the current loading, the total pounds of COCs flowing to the Telegraph Creek from the mine adit discharge would be compared to the total pounds of COCs discharging from the water treatment plant. As long as the total pounds discharging from the plant are lower than that discharging from the adit, the impacts from the Mine Investigation would be lower than the current conditions.

Loading to the Telegraph Creek could be estimated based on the discharge flow rate from the mine adit as measured by MSE, at a rate of 0.1-7.6 gpm, and as previously discussed. Based on the flow measurement data, discussions with MSE and TerraGraphics' observations of the flow measurement system, the accuracy of the measured flow rates appear questionable. TerraGraphics observed the potential for significant infiltration losses between the adit opening and the flow measuring device. If a loading comparison is to be incorporated into the water treatment dewatering plan, accurate measurements of the adit drainage during operation will improve the validity of the results. An improved flow measuring device could be installed at the collapsed adit which would attempt to reduce the mine drainage losses prior to measurement and provide a higher and more accurate loading estimate.

A summary of the water treatment contractor's proposals and associated water treatment plans are included below. Below are the three most viable alternatives we found that will meet, or come close to meeting, the DEQ-7 standards.

4.1.1 Water Treatment Alternative 1: Environmental Solutions

The proposal is for rental, set-up, and operation and maintenance of a pH adjustment and oxidation water treatment system. Environmental Solutions obtained a mine water sample and performed a bench scale test and shipped the water back to TerraGraphics for analysis by Energy Laboratories. The treated water did not meet DEQ-7 water quality standards; however, Environmental Solutions believes that they could achieve improved water quality results due to the lower than optimum pH measured in the treated water sample. According to Environmental Solutions, the optimum pH for removal of metals is 9.0 as compared with the treated water sample of 7.7. Table 4 shows the summary of the treated water quality results from Environmental Solutions. All the metals exceed the DEQ-7 water quality standards except for iron and nickel which were below the standard. The quote and information pertaining to the Environmental Solutions water treatment system are contained in Attachment C.

Table 4. Environmental Solutions Treated Water Quality

Water Sample	Arsenic (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Zinc (mg/L)
ES Treated Water	0.134	0.0113	0.013	0.10	0.004	1.77	ND	1.68

The Environmental Solutions process also produces an estimated 2,000 gallons of sludge that will require disposal either on site or in a RCRA facility. Additional considerations for this process include costs, power, a pumping system, and a 6-week lead time. Table 5 contains the cost estimate for this alternative.

Table 5. Environmental Solutions Water Treatment Cost Estimate

Item Description	Quantity	Unit	Unit Cost	Cost
ES Mine Pool Water	1	400,000 gal	$47,000	$47,000
ES Base Inflow	6	Week	$5,000	$30,000
Generator	1	Each	$2,000	$2,000
Submersible pump (200 ft)	1	Each	$4,000	$4,000
Piping	1	Each	$3,000	$3,000
Site preparation	1	Square Yard	$3,000	$3,000
Subtotal				$89,000
Contingency			20%	$17,800
Operations Management			10%	$8,900
Total				**$115,700**

4.1.2 Water Treatment Alternative 2: Blue Water Technologies Inc.

This proposal is for the purchase of a continuously regenerating reactive filtration water treatment system. Blue Water's proposal is for the sale of two optional equipment systems; rental systems are not available. Option 1 has a buy back option at the end of the project. Blue Water's treated water quality is estimated to meet DEQ-7 water quality. Blue Water did not perform any testing on the mine water and will not guarantee discharge water quality without performing a pilot test. Pilot testing is estimated at $5,000-$10,000. Bench scale testing could also be performed at $1,000 per pH adjustment but will not provide guaranteed results. Blue Water's system has an 8-12 gpm reject water stream of concentrates which will need to be disposed of on site by recirculation in the mine or hauled off site for disposal. Blue Water requires long lead times, approximately 18-24 weeks, for design, construction, and delivery of the system. Option 1 is estimated at $325,000 with a buy back at approximately 30-40%. Option 2 is estimated at $500,000 and does not have a buy back option. Neither option included operator costs nor other equipment needed at the site for operation. Due to costs, lead times and availability of resources to deal with reject concentrates the cost for this alternative was not evaluated any further. The quote and information pertaining to the Blue Water treatment system are contained in Attachment C.

4.1.3 Water Treatment Alternative 3: Rain for Rent

This proposal is for rental of a pH adjustment followed by mechanical filtration and an ion exchange water treatment system. Rain for Rent's system is a partnership with Siemens. Rain for Rent obtained a water sample for bench scale testing and provided results that met DEQ-7 water quality standards except for cadmium which was less than 0.001 parts per million (ppm), compared with the standard of 0.000097 ppm. Rain for Rent does not guarantee meeting the treatment water quality standard. Rain for Rent's proposal includes all cost to deliver, install, and remove the equipment from the site. Rain for Rent did not include operation costs. Rain for Rent estimates that two operators will be needed initially until the system is running and conditions are optimized, at which point only one operator is required. Disposal of bag filters and cartridge filters are necessary either on site or in a Resource Conservation and Recovery Act (RCRA) facility. Table 6 contains the cost estimate for this alternative. The quote and information pertaining to the Rain for Rent water treatment system are contained in Attachment C.

Table 6. Rain for Rent Water Treatment Cost Estimate

Item Description	Quantity	Unit	Unit Cost	Cost
R for R Treatment System	1	Lump Sum	$130,577	$130,577
Operator*	840	Hours	$100	$84,000
Generator	1	Each	$2,000	$2,000
Submersible pump (200 ft)	1	Each	$4,000	$4,000
Piping	1	Each	$3,000	$3,000
Site preparation	1	Square Yard	$3,000	$4,000
Subtotal				$227,577

Table 6. Rain for Rent Water Treatment Cost Estimate

Item Description	Quantity	Unit	Unit Cost	Cost
Contingency			20%	$45,515
Operations Management			10%	$22,757
Total				**$295,850**

Notes:
Two operators for 12 hours per day for 2 weeks plus one operator for 12 hours per day for 6 weeks.

4.2 Land Application with Pre-Treatment

Dewatering of the mine can be accomplished by land applying untreated or pre-treated water to the ground surface at a rate that permits infiltration. The simplicity and relatively low cost of land application makes this alternative attractive; however, discharging untreated mine water may result in adverse impacts to the site. The adverse impacts may affect the soil, vegetation and surface water and may include metals loading, vegetation die-off and/or degraded surface water quality in Telegraph Creek downstream of the site. Due to these risks, land application of untreated water was rejected in favor of pre-treatment with Environmental Solutions system and land application.

In order to evaluate the pre-treatment and land application process, we performed an analysis to estimate the metal loading to the soils using a conservative approach by estimating the metals loading of untreated mine water. Using the analytical data from the shaft mine water sample included in Table 2, the estimated weight of metals in the mine water to be land applied were estimated. Reviewing the NRCS soil survey data for the site (included in Attachment D), the site soils have a saturated hydraulic conductivity ranging from an estimated 4 μm/s to 42 μm/s. When converted to inches per hour (in/hr), the range is approximately 0.6 inches per hour (in/hr) to 2 in/hr. Since these conductivity measurements likely were not performed on or near the subject site, the use of a conservative infiltration rate of the fine soils fraction (silt or silty clay) appears suitable to account for the 20-30% slopes. If we estimate the infiltration rate of only the fine soils fraction to be 0.05 in/hr, obtained from a chart of typical soils permeability values, a minimum area of approximately 2 acres will be necessary to dewater the mine at 40 gpm without surface runoff as shown in Attachment D. A copy of the soil permeability chart is included in Attachment D. To refine the soils infiltration rate, percolation or infiltration tests should be performed on site. Without these tests, the project will utilize 0.05 in/hr as a conservative estimate.

Although the 2 acre area is available at the Lilly claim the topography is steep which increases the risk of runoff or will require a larger infiltration area or multiple land application zones that can be rotated when they become saturated. Regardless, we estimated the metals loading to the soil by assuming the metals will be absorbed in the top 1-inch of soil as shown in Table 7. Based on our review, the metals loading appears to be negligible when compared with recreational limits in the RI.

Pre-treatment will not meet DEQ-7 water quality standards but will improve the water quality. Environmental Solutions water treatment system is relatively simple involving a pH adjustment with oxidation. The Environmental Solutions system will require pilot testing, design,

TABLE 7:
LILLY/ORPHAN BOY LAND APPLICATION METAL LOADING ANALYSIS

LAND APPLICATION METAL LOADING TO SOIL AND VEGETATION ESTIMATES:

MINE WATER VOL.	As	Cd	Cu	Fe	Pb	Mn	Zn
mine water concentration, mg/L	3.94	0.0791	0.032	26.2	0.315	5.16	11.3

Pumped Volume to Land App.	As	Cd	Cu	Fe	Pb	Mn	Zn	
gallons	**lbs**	**lbs**	**lbs**	**lbs**	**lbs**	**lbs**	**lbs**	
400,000	13.15	0.26	0.11	87.46	1.05	17.22	37.72	estimated volume standing in workings
750,000	**24.66**	**0.50**	**0.20**	**163.99**	**1.97**	**32.30**	**70.73**	estimated total discharge volume

conversions: 1 mg/L = 8.34538E-06 lbs/gallon

LAND APPLICATION METAL LOADING TO SOIL AND VEGETATION ESTIMATES:

Available Land Application	As	Cd	Cu	Fe	Pb	Mn	Zn	
On-site area (acres)	**lbs/acre**	**lbs/acre**	**lbs/acre**	**lbs/acre**	**lbs/acre**	**lbs/acre**	**lbs/acre**	
11.9	2.07	0.04	0.02	13.78	0.17	2.71	5.94	total land available
6	**4.11**	**0.08**	**0.03**	**27.33**	**0.33**	**5.38**	**11.79**	estimated area suitable for land app.
3.5	**7.05**	**0.14**	**0.06**	**46.85**	**0.56**	**9.23**	**20.21**	for preliminary sprinkler line assessment

The available on site acreage does not take into account the slope or suitability for infiltration. Testing is recommended.

Land App Area	lbs/sf	lbs/sf	lbs/sf	lbs/sf	lbs/sf	lbs/sf	lbs/sf
6 acres	0.0000944	0.0000019	0.0000008	0.0006274	0.0000075	0.0001236	0.0002706
3.5 acres	0.0001618	0.0000032	0.0000013	0.0010756	0.0000129	0.0002118	0.0004639

If we assume the metals will collect in the top 1 inch of soil, then we can estimate the concentration of metals applied to the soils:
Volume = 6 acres * 1 inch = 21,780 cubic feet
Volume per square foot = 1' *1' * 1 inch = 0.083 cf
Assume a soil units weight of 125 lbs/cf 10.42 lbs

METAL CONCENTRATION INCREASE ADDED TO THE SOILS THROUGH LAND APPLICATION:

Land App Area	Water Volume	As	Cd	Cu	Fe	Pb	Mn	Zn
acres	**gallons/acre**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
6	125,000	9.06	0.18	0.07	60.23	0.72	11.86	25.98
3.5	214,286	15.53	0.31	0.13	103.26	1.24	20.34	44.53
2009 RI Recreational Limits		323	*	*	*	2,200	7,330	*

* Not identified as a risk in RA (2009 RI).

procurement, and installation. The estimated time for the Environmental Solutions system is approximately 6-8 weeks from the notice to proceed, which may delay the current project schedule.

The preferred method for pilot testing is to run a small scale land application test. Alternatively, percolation testing or ring infiltration tests could be used to estimate the infiltration rate for sizing a land application system. Pilot testing may determine that multiple land application areas are needed so that they can be rotated to allow saturated areas to infiltrate. Table 8 shows the cost estimate for the Environmental Solutions alternative.

Table 8. Environmental Solutions Pre-Treatment with Land Application Cost Estimate

Item Description	Quantity	Unit	Unit Cost	Cost
Pilot Testing	1	Lump Sum	$6,000	$6,000
ES Mine Pool Water	1	400,000 gal*	$47,000	$47,000
ES Base Inflow	6	Week	$5,000	$30,000
Pumps	3	Each	$2,500	$7,500
Generator	1	Each	$2,000	$2,000
Land Application System	1	Each	$6,000	$6,000
Site Preparation	1	Lump Sum	$4,000	$4,000
Subtotal				$102,500
Contingency			20%	$20,500
Operations Management			10%	$10,250
Total				**$133,250**

4.3 Evaporation

Dewatering of the mine may be accomplished by mechanical evaporation. Lake evaporation was considered impractical at this site due to cost, site constraints, reliability, and an estimated low net reduction in water volume. Mechanical evaporation involves pumping mine water through high pressure nozzles designed to atomize the water molecules which results in high evaporation rates capable of meeting the project needs.

The benefit of evaporation is that there will be no discharge from the site if properly managed. The evaporation process could result in up to approximately 80% return flows, depending on conditions, which will need to be collected and routed back to the mine or evaporators. Wind speed and direction will present challenges with sizing and locating a return flow area. Collection of unevaporated mine water would need to occur on a lined portion of the site. Some risk exists for overspray and discharge of untreated water offsite. Table 9 contains the cost

estimate for this alternative. Manufacture's information related to evaporators in contained in Attachment D.

Table 9. Evaporation Cost Estimate

Item Description	Quantity	Unit	Unit Cost	Cost
Evaporator	2	Each	$35,000	$70,000
Evaporator Pump (150 psi)	1	Each	$40,000	$40,000
Lined Area (180 ft x180 ft)	3600	Square Yard	$10	$36,000
Generator	1	Each	$2,000	$2,000
Submersible Pumps	3	Each	$2,500	$7,500
Collection Trench	100	Linear Foot	$20	$2,000
Site preparation	600	Square Yard	$5	$3,000
Piping and Fittings	1	Lump Sum	$3,000	$3,000
Subtotal				$163,500
Contingency			20%	$32,700
Operations Management			10%	$16,350
Total				**$212,550**

4.4 Land Application or Evaporation with Temporary Mine Water Storage

Temporary storage of the estimated 400,000 gallons of mine water currently impounded in the mine workings with land application of evaporation of the groundwater infiltration into the workings would improve the project schedule and limit evaporation, pre-treatment, and land applications requirements. Mine water could initially be pumped to a temporary storage facility until the Mine Investigation is complete and then pumped back into the mine. Temporary storage could occur in either a lined pond or in water storage bags.

A lined pond is necessary to minimize exfiltration of untreated mine water from the pond. The benefit of using a pond over water storage bags is that it provides an area to capture un-evaporated water droplets that may otherwise return to the ground for the evaporation alternative.

Temporary storage in water storage bags provides several benefits over a lined pond including: potentially lower cost, minimal design, limited site constraints issues, minimal construction, and shorter schedule. However, they do not provide an area to capture unevaporated mine water. The cost of the temporary water storage bags are high enough that their cost effectiveness is not substantiated. One 100,000 gallon water storage bag costs approximately $45,000. At least four bags will be necessary to store the estimated mine water volume of 400,000 gallons at a cost of approximately $200,000. Additional bags may be necessary for storing infiltrating groundwater while the Mine Investigations are being performed. Manufacture's information and cost data associated with evaporation and temporary storage are contained in Attachment D.

4.5 Reinjection

Dewatering of the mine through an injection well was evaluated for this site. An injection well involves pumping mine water back into the groundwater system through geologic features with adequate hydraulic conductivity and an acceptable flow path such that no direct discharges to surface water occur. This alternative requires testing in a monitoring well to evaluate the hydraulic conductivity of the subsurface features and their potential flow paths. The evaluation would assess the potential for hydraulic connections with the mine workings and the local ground surface or surface water. If either of these conditions is present, this alternative would not work. Based on the known geology in the area which consists of Butte quartz monzonite, a fractured system with sufficient capacity to accept the mine dewatering flows is unlikely without any information from wells in the area and the well's capacities. Reviewing the Montana Ground-Water Information Center (GWIC) online database, the flow rates for wells within a one mile radius of the site reportedly produce only 12 gpm. Since no wells exist in the vicinity where this alternative may appear to be feasible, new wells would need to be developed for testing. Due to the limited ability to test this alternative, project schedule and existing geology, this alternative was rejected.

4.6 In-Situ Treatment

In situ treatment of the mine water was requested to be investigated by DEQ as a water handling alternative. This method involves either pumping or gravity feeding liquid caustic soda down the shaft into the mine water. Based on the volume of water impounded within the mine workings, a pilot test volume between 2,000 and 5,000 gallons of liquid caustic soda are estimated to be needed to observe any neutralizing effects on the mine water at an estimated material cost of $6,000 to $15,000.

Mixing options are limited in the mine thereby making the overall neutralization of the impounded 400,000 gallons of mine water difficult. Dumping granular or powdered caustic soda into the shaft is not recommended because the material may collect on the timbers which could result in damage making the shaft rehabilitation and Mine Investigation more difficult and expensive. The caustic soda is also an exposure hazard to the workers as they are in a confined space (the shaft). Since MSE loaded the shaft and the Lilly tunnel with organics and timbers were used to rehabilitate the shaft to allow their work to proceed, bulk loading into the workings could cause a reaction where hydrogen sulfide gas could be released. Sulfate reducing bacteria create hydrogen sulfide as a byproduct of their conversion of organic matter (substrate). Hydrogen sulfide is also soluble in water. The reaction of the mine water with the dumping of caustic soda could release the dissolved hydrogen sulfide. Adding caustic soda will also increase the pH which can increase bacterial reactions and produce additional hydrogen sulfide.

In addition, dissolved aluminum has been reported in the analytical report of the April 30, 2010 shaft mine water sampling event (Energy Labs sample for dissolved aluminum = 0.8 mg/L and Siemens reported total aluminum at 1.34 mg/L and dissolved at 1.29 mg/L). The reaction of mixing liquid caustic soda with acidic water could also generate heat and react with the aluminum in the mine water to generate hydrogen gas. Hydrogen gas in the workings could create an explosive situation. The dissolved metals will begin to precipitate, and when combined with the generated heat, hydrogen and hydrogen sulfide gases, will cause cavitation and deposits in the suction pipe and pump, decreasing the pump efficiency and shortening its operational life.

These situations increase the hazards of the following Mine Investigation work and are not cost effective as these new conditions must be dealt with prior to entering the workings. These situations are also why we propose pumping the mine water to the surface to a treatment system where controlled volumes of mine water and treatment chemicals can be mixed in a controlled environment and monitored. Since we know little about the mine layout, conditions, contents, and operations and due to the hazardous conditions which may be generated due to the addition of liquid caustic soda to the acidic mine water this alternative is not recommended.

4.7 Evaporation or Land Application with pH Adjustment

Based on the risks, costs, schedule limitation and treatment results from the analysis of the various alternatives above we are including this treatment system which provides effective water disposal at the site to meet multiple objectives. Partial evaporation with pH adjustment involves adjusting the pH of the mine water to approximate natural rain water around pH 5.5 and discharging the adjusted water using mechanical evaporation over the waste rock piles below the mine workings. Mechanical evaporation does not evaporate all water unless the unevaporated water is captured and recirculated through the evaporators. The alternative does not propose to recirculate the water in order to provide a cost effective system. See Section 4.3 - Evaporation for system costs and requirements for recirculation. Mechanical evaporation rates can vary highly 20% to 60% depending on various equipment and environmental factors. For this alternative, unevaporated water will generally fall on the waste rock piles below the mine workings unless on-site management of the system cannot compensate for the effects of wind. Table 10 shows the cost estimate for this alternative. The quote and information pertaining to the Rain for Rent's evaporation with pH adjustment system are contained in Attachment E. This method is not preferred since the water may infiltrate through the waste rock piles and back into the mine workings. In this event, land application can be implemented as an alternative to evaporation. With this alternative, risks include the potential for the water to collect and drain down to Telegraph Creek

Table 10 Modified Rain for Rent Pre-Treatment with Land Application Cost Estimate

Item Description	Quantity	Unit	Unit Cost	Cost
pH Adjusting System, Pump and Generator	1	28 days (4 weeks)	$61,400	$33,550
Load & Unload System	1	Each	$2000	$2000
Evaporation System **or** Land Application System	1	Each	$6,000	$6,000
Site Preparation	1	Lump Sum	$4,000	$4,000
Subtotal				$45,550
Contingency			20%	$9,110
Operations Management			10%	$4,555
Total				**$59,215**

5.0 Recommended Alternative

If system costs were not a concern, we recommend a high quality water treatment system like Rain for Rent that will provide treated water quality at or very close to DEQ-7 standards.

Alternatively, to provide a cost effective system that has the highest likelihood of meeting the multiple objectives at this site, we recommend the modified Rain for Rent pre-treatment and land application system as discussed above Section 4.7. As with any of the systems evaluated, some risks are attributed to this alternative which include runoff and erosion. Some of which could end up in Telegraph Creek. Although these risks exists for this system, we believe that with careful on-site management they can be effectively managed so that the mine can be dewatered and the subsequent Mine Investigation can be safely carried out.

As a result of a meeting with MDEQ on June 22, 2010, a pilot test involving in-situ treatment was requested. Based on our evaluation of in-situ treatment, we do not recommend in-situ treatment as a viable treatment alternative for this application. If pilot testing remains desirable, we propose to test the land application or evaporation with pH adjustment system. If this system proves effective it may be possible to coordinate pilot testing with operation; however, some downtime and additional expenses are expected. If pilot testing is requested, we recommend that the platforms within the shaft either be removed or lowered to the bottom of the shaft to open the shaft for subsequent dewatering operation and the Mine Investigation. The removal of the platforms and the Mine Investigation are addressed under a separate technical memorandum.

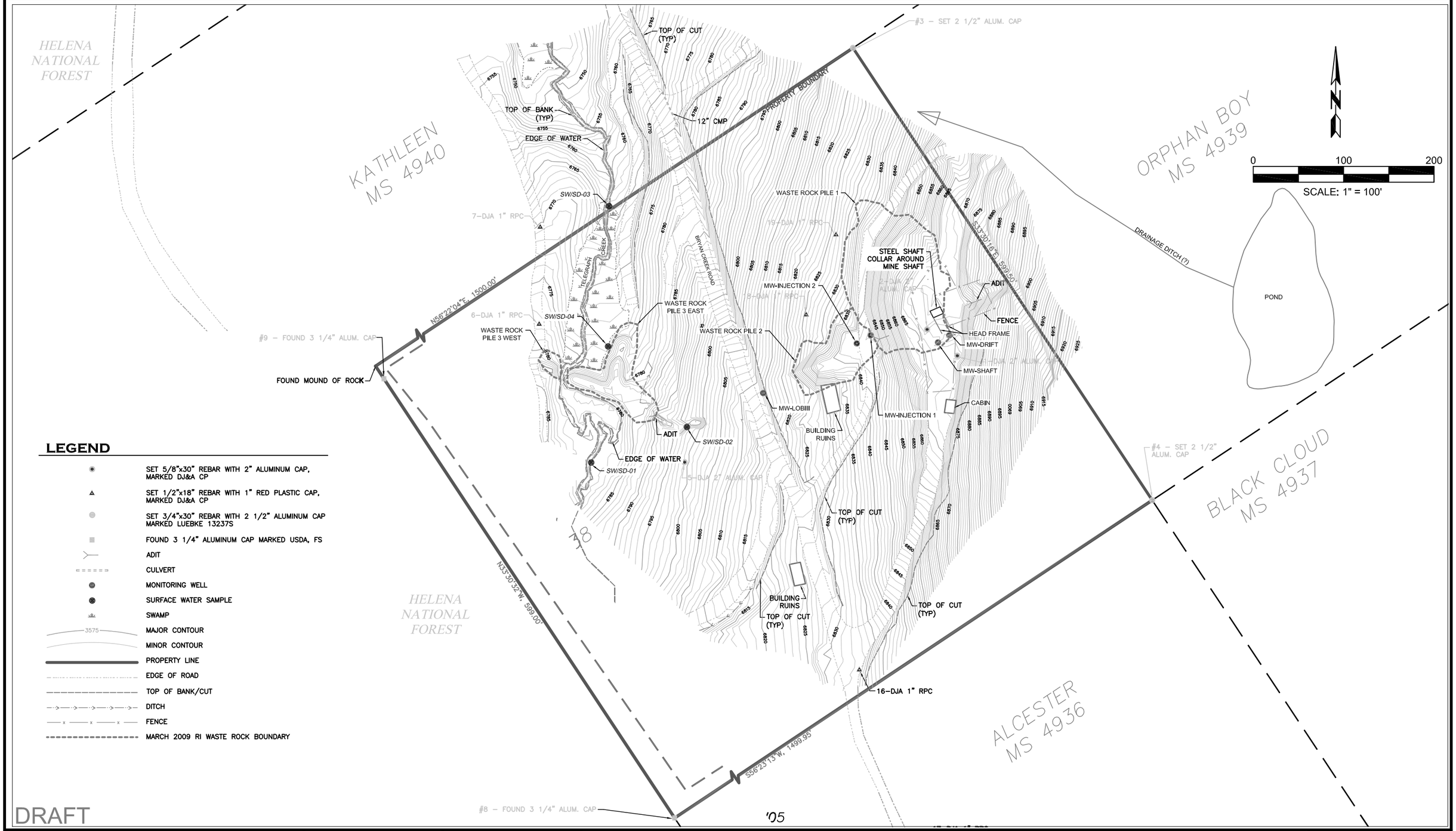
Based on this evaluation and our recommended dewatering alternatives, the following direction needs to be provided prior to completion of the Mine Investigation Work Plan for the Lilly/Orphan Boy Mine:

1. Select a dewatering alternative.
2. Authorize pilot testing for the land application with pH adjustment, if selected or authorize other pilot testing if another dewatering alternative is selected.
3. Authorize installation of a flow measuring device at the adit to monitor the metals loading to Telegraph Creek.

Attachments

Attachment A – Mine Water and Surface Water Quality
Attachment B – Mine Pool Volume and Adit Discharge Rates
Attachment C – Water Treatment Alternatives
Attachment D – Land Application, Evaporation and Temporary Storage
Attachment E – Evaporation with pH Adjustment

Figures



LEGEND

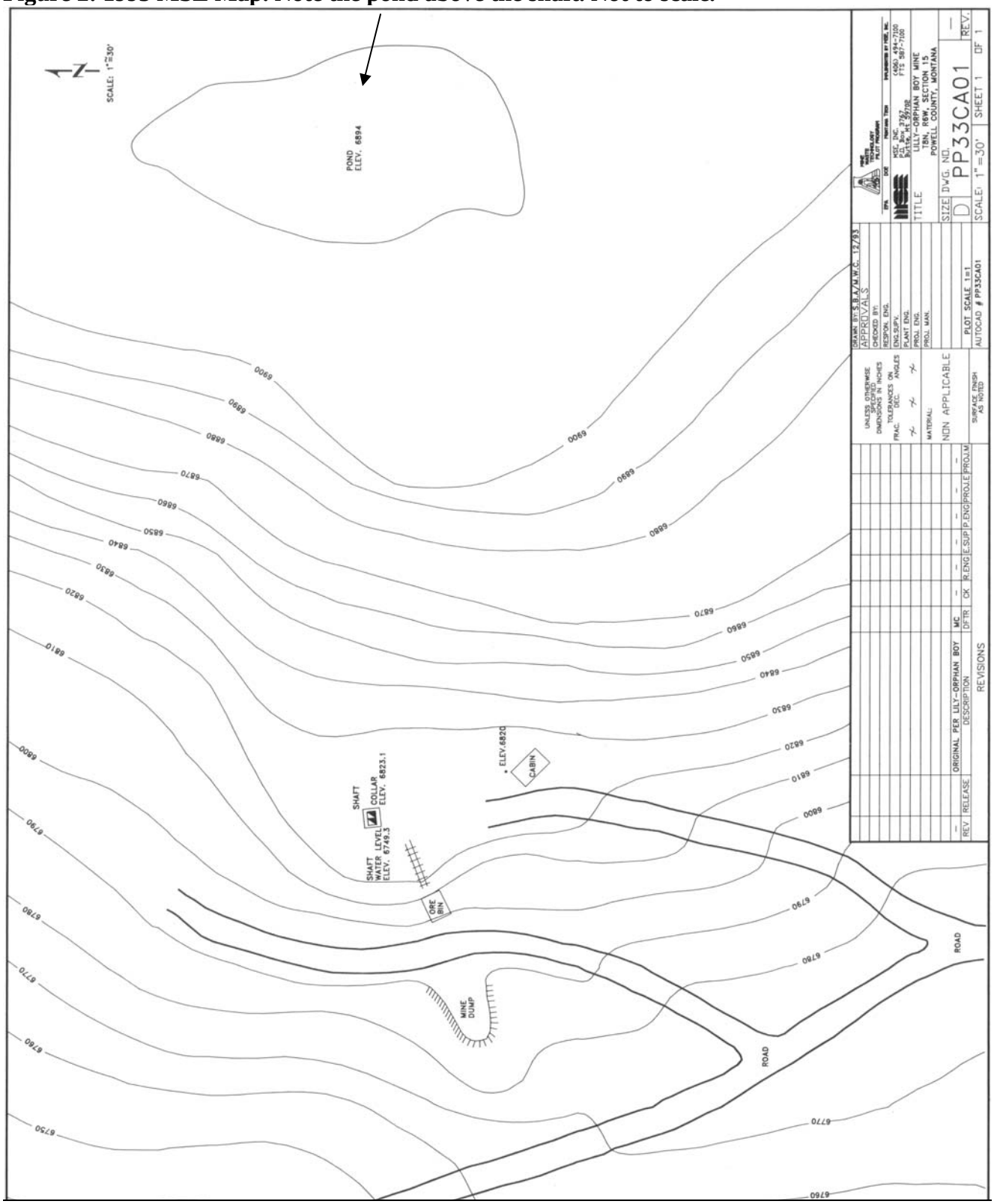
- SET 5/8"x30" REBAR WITH 2" ALUMINUM CAP, MARKED DJ&A CP
- SET 1/2"x18" REBAR WITH 1" RED PLASTIC CAP, MARKED DJ&A CP
- SET 3/4"x30" REBAR WITH 2 1/2" ALUMINUM CAP MARKED LUEBKE 13237S
- FOUND 3 1/4" ALUMINUM CAP MARKED USDA, FS
- ADIT
- CULVERT
- MONITORING WELL
- SURFACE WATER SAMPLE
- SWAMP
- 3575 MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY LINE
- EDGE OF ROAD
- TOP OF BANK/CUT
- DITCH
- FENCE
- MARCH 2009 RI WASTE ROCK BOUNDARY

DRAFT

TerraGraphics Environmental Engineering, Inc.	DRAWN: JCM ENGINEER: TLS CHECKED: TLS	PROJECT NO.: 09210 SCALE: AS SHOWN APPROVED: TLS DATE: 7/21/2010	EXISTING SITE FACILITIES & WATER SAMPLE LOCATIONS SITE MAP	LILLY/ORPHAN BOY ABANDONED MINE SITE	FIGURE: 1 DATE: 7/21/2010

Jul 21, 2010 - 4:13pm Y:\09210 - Lilly-Orphan Boy Mine\B. Correspondence\a. MDEQ\TO DEQ\7-14-10\Water Handling Tech Memo\Final\LOB-BASE SAP_050310 Fig 1.dwg

Figure 2: 1993 MSE Map. Note the pond above the shaft. Not to scale.



Attachment A

Mine Water and Surface Water Quality

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@enerylab.com

LABORATORY ANALYTICAL REPORT

Client: MT DEQ
Project: Lilly/Orphan Boy
Lab ID: H10040419-001
Client Sample ID: LOB-Shaft MINE SHAFT 2010

Report Date: 05/17/10
Collection Date: 04/16/10 18:00
DateReceived: 04/30/10
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	3.4	s.u.		0.1		A4500-H B	05/03/10 17:20 / hm
Conductivity	587	umhos/cm		1		A2510 B	05/03/10 17:20 / hm
Solids, Total Suspended TSS @ 105 C	104	mg/L	H	10		A2540 D	05/03/10 15:03 / hm
Solids, Total Dissolved TDS @ 180 C	332	mg/L	H	10		A2540 C	05/03/10 14:57 / hm
INORGANICS							
Acidity, Total as CaCO3	62	mg/L	H	4.0		A2310 B	05/07/10 16:15 / hm
Alkalinity, Total as CaCO3	ND	mg/L	H	4		A2320 B	05/03/10 17:20 / hm
Bicarbonate as HCO3	ND	mg/L	H	4		A2320 B	05/03/10 17:20 / hm
Carbonate as CO3	ND	mg/L	H	4		A2320 B	05/03/10 17:20 / hm
Chloride	ND	mg/L		1		E300.0	05/04/10 08:59 / hm
Sulfate	220	mg/L		1		E300.0	05/04/10 08:59 / hm
Hardness as CaCO3	135	mg/L		1		A2340 B	05/05/10 13:33 / sld
METALS, DISSOLVED							
Aluminum	0.8	mg/L		0.1		E200.7	05/04/10 13:55 / sld
Calcium	37	mg/L		1		E200.7	05/04/10 13:55 / sld
Magnesium	11	mg/L		1		E200.7	05/04/10 13:55 / sld
Potassium	3	mg/L		1		E200.7	05/04/10 13:55 / sld
Sodium	7	mg/L		1		E200.7	05/04/10 13:55 / sld
METALS, TOTAL							
Arsenic	3.94	mg/L		0.001		E200.8	05/12/10 02:00 / dck
Beryllium	ND	mg/L		0.001		E200.8	05/12/10 02:00 / dck
Cadmium	0.0791	mg/L		0.00008		E200.8	05/12/10 02:00 / dck
Copper	0.032	mg/L		0.001		E200.8	05/12/10 02:00 / dck
Iron	26.2	mg/L		0.03		E200.8	05/12/10 02:00 / dck
Lead	0.315	mg/L		0.001		E200.8	05/12/10 02:00 / dck
Manganese	5.16	mg/L		0.001		E200.8	05/12/10 10:03 / dck
Mercury	ND	mg/L		0.001		E245.1	05/11/10 10:55 / eau
Nickel	0.02	mg/L		0.01		E200.8	05/12/10 02:00 / dck
Zinc	11.3	mg/L		0.01		E200.8	05/12/10 10:03 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: MT DEQ
Client Sample ID: LOB-SW-02 MINE ADIT 2008
Project: Lilly/Orphan Boy Mine Site Contract #407045
Matrix: Aqueous

Lab ID: H08100143-021
Collection Date: 10/09/08 12:40
DateReceived: 10/09/08
Report Date: 11/22/08

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL PROPERTIES												
pH	3.2	s.u.		0.1		A4500-H B	10/15/08 13:57 / abb			PH2_081015A	3	081015A-PH-W
Conductivity	754	umhos/cm		1		A2510 B	10/14/08 14:12 / abb			COND_081014A	3	081014A-COND-PROBE W
INORGANICS												
Acidity, Total as CaCO3	100	mg/L		4.0		A2310 B	10/22/08 09:45 / abb			MISC WC_081022A	2	081022A
Chloride	ND	mg/L		1		E300.0	10/17/08 14:47 / abb			IC101-H_081017A	47	R49287
Sulfate	290	mg/L		1		E300.0	10/17/08 14:47 / abb			IC101-H_081017A	47	R49287
Hardness as CaCO3	131	mg/L		1		A2340 B	10/22/08 08:50 / wjj			WATERCALC_081022A	6	R49343
NUTRIENTS												
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/16/08 14:13 / stp			NUTRIENTS_081016C	9	A2008-10-16_5_NO3_01
METALS, DISSOLVED												
Calcium	35	mg/L		1		E200.7	10/15/08 13:32 / eli-b			SUB-B119262	3	B_R119262
Magnesium	10	mg/L		1		E200.7	10/15/08 13:32 / eli-b			SUB-B119262	3	B_R119262
METALS, TOTAL												
Antimony	ND	mg/L		0.005		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Arsenic	0.874	mg/L		0.005		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Barium	ND	mg/L		0.1		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Cadmium	0.163	mg/L		0.001		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Chromium	ND	mg/L		0.01		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Copper	0.04	mg/L		0.01		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Iron	29.6	mg/L		0.03		E200.7	10/15/08 17:58 / eli-b			SUB-B119262	2	B_R119262
Lead	0.07	mg/L		0.01		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Manganese	5.64	mg/L		0.01		E200.7	10/15/08 17:58 / eli-b			SUB-B119262	2	B_R119262
Mercury	ND	mg/L		0.001		E245.1	10/15/08 12:52 / eli-b	10/14/08 17:00		SUB-B119238	2	B_35240
Nickel	0.03	mg/L		0.01		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Silver	ND	mg/L		0.005		E200.8	10/15/08 13:37 / eli-b			SUB-B119244	1	B_R119244
Zinc	17.7	mg/L	D	0.1		E200.7	10/15/08 17:58 / eli-b			SUB-B119262	2	B_R119262

Report Definitions: RL - Analyte reporting limit. MCL - Maximum contaminant level. ND - Not detected at the reporting limit.
D - RL increased due to sample matrix interference.

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LABORATORY ANALYTICAL REPORT

Client: MT DEQ
Client Sample ID: LOB-SW-04 TOE OF WASTE ROCK
Project: Lilly/Orphan Boy Mine Site Contract #407045
Matrix: Aqueous

Lab ID: H08100143-023
Collection Date: 10/09/08 13:15
DateReceived: 10/09/08
Report Date: 11/22/08

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL PROPERTIES												
pH	3.6	s.u.		0.1		A4500-H B	10/15/08 14:00 / abb			PH2_081015A	5	081015A-PH-W
Conductivity	445	umhos/cm		1		A2510 B	10/14/08 14:14 / abb			COND_081014A	5	081014A-COND-PROBE W
INORGANICS												
Acidity, Total as CaCO3	56	mg/L		4.0		A2310 B	10/22/08 09:45 / abb			MISC WC_081022A	4	081022A
Chloride	ND	mg/L		1		E300.0	10/17/08 15:25 / abb			IC101-H_081017A	49	R49287
Sulfate	190	mg/L		1		E300.0	10/17/08 15:25 / abb			IC101-H_081017A	49	R49287
Hardness as CaCO3	80	mg/L		1		A2340 B	10/22/08 08:50 / wjj			WATERCALC_081022A	8	R49343
NUTRIENTS												
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/16/08 14:21 / slp			NUTRIENTS_081016C	13	A2008-10-16_5_NO3_01
METALS, DISSOLVED												
Calcium	22	mg/L		1		E200.7	10/15/08 13:40 / eli-b			SUB-B119262	7	B_R119262
Magnesium	6	mg/L		1		E200.7	10/15/08 13:40 / eli-b			SUB-B119262	7	B_R119262
METALS, TOTAL												
Antimony	ND	mg/L		0.005		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Arsenic	0.854	mg/L		0.005		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Barium	ND	mg/L		0.1		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Cadmium	0.067	mg/L		0.001		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Chromium	ND	mg/L		0.01		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Copper	0.10	mg/L		0.01		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Iron	8.28	mg/L		0.03		E200.7	10/15/08 18:09 / eli-b			SUB-B119262	6	B_R119262
Lead	0.05	mg/L		0.01		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Manganese	5.25	mg/L		0.01		E200.7	10/15/08 18:09 / eli-b			SUB-B119262	6	B_R119262
Mercury	ND	mg/L		0.001		E245.1	10/15/08 13:06 / eli-b	10/14/08 17:00		SUB-B119238	4	B_35240
Nickel	0.02	mg/L		0.01		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Silver	ND	mg/L		0.005		E200.8	10/15/08 19:21 / eli-b			SUB-B119244	3	B_R119244
Zinc	9.31	mg/L		0.01		E200.7	10/15/08 18:09 / eli-b			SUB-B119262	6	B_R119262

Report Definitions: RL - Analyte reporting limit. MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Client: MT DEQ
Client Sample ID: LOB-SW-03 - DOWN STREAM
Project: Lilly/Orphan Boy Mine Site Contract #407045
Matrix: Aqueous

Lab ID: H08100143-022
Collection Date: 10/09/08 13:05
DateReceived: 10/09/08
Report Date: 11/22/08

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL PROPERTIES												
pH	6.6	s.u.		0.1		A4500-H B	10/15/08 13:59 / abb			PH2_081015A	4	081015A-PH-W
Conductivity	101	umhos/cm		1		A2510 B	10/14/08 14:13 / abb			COND_081014A	4	081014A-COND-PROBE W
INORGANICS												
Alkalinity, Total as CaCO3	10	mg/L		4		A2320 B	10/21/08 13:08 / abb			TITTR_081021A	4	081021A-ALK-W
Chloride	ND	mg/L		1		E300.0	10/17/08 15:06 / abb			IC101-H_081017A	48	R49287
Sulfate	33	mg/L		1		E300.0	10/17/08 15:06 / abb			IC101-H_081017A	48	R49287
Hardness as CaCO3	23	mg/L		1		A2340 B	10/22/08 08:50 / wjj			WATERCALC_081022A	7	R49343
NUTRIENTS												
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/16/08 14:15 / stp			NUTRIENTS_081016C	10	A2008-10-16_5_NO3_01
METALS, DISSOLVED												
Calcium	7	mg/L		1		E200.7	10/15/08 13:36 / eli-b			SUB-B119262	5	B_R119262
Magnesium	1	mg/L		1		E200.7	10/15/08 13:36 / eli-b			SUB-B119262	5	B_R119262
METALS, TOTAL												
Antimony	ND	mg/L		0.005		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Arsenic	0.014	mg/L		0.005		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Barium	ND	mg/L		0.1		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Cadmium	0.003	mg/L		0.001		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Chromium	ND	mg/L		0.01		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Copper	ND	mg/L		0.01		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Iron	0.61	mg/L		0.03		E200.7	10/15/08 18:05 / eli-b			SUB-B119262	4	B_R119262
Lead	ND	mg/L		0.01		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Manganese	0.74	mg/L		0.01		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Mercury	ND	mg/L		0.001		E245.1	10/15/08 12:59 / eli-b	10/14/08 17:00		SUB-B119238	3	B_35240
Nickel	ND	mg/L		0.01		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Silver	ND	mg/L		0.005		E200.8	10/15/08 13:43 / eli-b			SUB-B119244	2	B_R119244
Zinc	0.61	mg/L		0.01		E200.7	10/15/08 18:05 / eli-b			SUB-B119262	4	B_R119262

Report Definitions: RL - Analyte reporting limit. MCL - Maximum contaminant level. ND - Not detected at the reporting limit

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LABORATORY ANALYTICAL REPORT

Client: MT DEQ
Client Sample ID: LOB-SW-01 - upstream
Project: Lilly/Orphan Boy Mine Site Contract #407045
Matrix: Aqueous

Lab ID: H08100143-020
Collection Date: 10/09/08 12:25
DateReceived: 10/09/08
Report Date: 11/22/08

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL PROPERTIES												
pH	7.0	s.u.		0.1		A4500-H B	10/15/08 13:56 / abb			PH2_081015A	2	081015A-PH-W
Conductivity	76	umhos/cm		1		A2510 B	10/14/08 14:10 / abb			COND_081014A	2	081014A-COND-PROBE W
INORGANICS												
Alkalinity, Total as CaCO3	14	mg/L		4		A2320 B	10/21/08 13:02 / abb			TITTR_081021A	3	081021A-ALK-W
Chloride	ND	mg/L		1		E300.0	10/17/08 14:27 / abb			IC101-H_081017A	46	R49287
Sulfate	19	mg/L		1		E300.0	10/17/08 14:27 / abb			IC101-H_081017A	46	R49287
Hardness as CaCO3	17	mg/L		1		A2340 B	10/22/08 08:50 / wjj			WATERCALC_081022A	5	R49343
NUTRIENTS												
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/16/08 14:11 / slp			NUTRIENTS_081016C	8	A2008-10-16_5_NO3_01
METALS, DISSOLVED												
Calcium	5	mg/L		1		E200.7	10/15/08 13:28 / eli-b			SUB-B119262	1	B_R119262
Magnesium	1	mg/L		1		E200.7	10/15/08 13:28 / eli-b			SUB-B119262	1	B_R119262
METALS, TOTAL												
Antimony	ND	mg/L		0.005		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Arsenic	ND	mg/L		0.005		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Barium	ND	mg/L		0.1		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Cadmium	ND	mg/L		0.001		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Chromium	ND	mg/L		0.01		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Copper	ND	mg/L		0.01		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Iron	0.37	mg/L		0.03		E200.7	10/16/08 17:48 / eli-b	10/14/08 17:00		SUB-B119317	7	B_35263
Lead	ND	mg/L		0.01		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Manganese	0.18	mg/L		0.01		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Mercury	ND	mg/L		0.001		E245.1	10/15/08 12:50 / eli-b	10/14/08 17:00		SUB-B119238	1	B_35240
Nickel	ND	mg/L		0.01		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Silver	ND	mg/L		0.005		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263
Zinc	0.03	mg/L		0.01		E200.8	10/15/08 17:48 / eli-b	10/14/08 17:00		SUB-B119254	18	B_35263

Report Definitions: RL - Analyte reporting limit MCL - Maximum contaminant level ND - Not detected at the reporting limit.

Attachment B

Mine Pool Volume

Adit Discharge Rates

LILLY MINE
GEOLOGIC AND ASSAY PLAN
ELLISTON MINING DISTRICT
POWELL COUNTY, MONTANA
1" = 50'

JULY 1950 - 6-15-51 M.W. Rankin

ASSAYS Width, Au, Ag, Pb, Zn

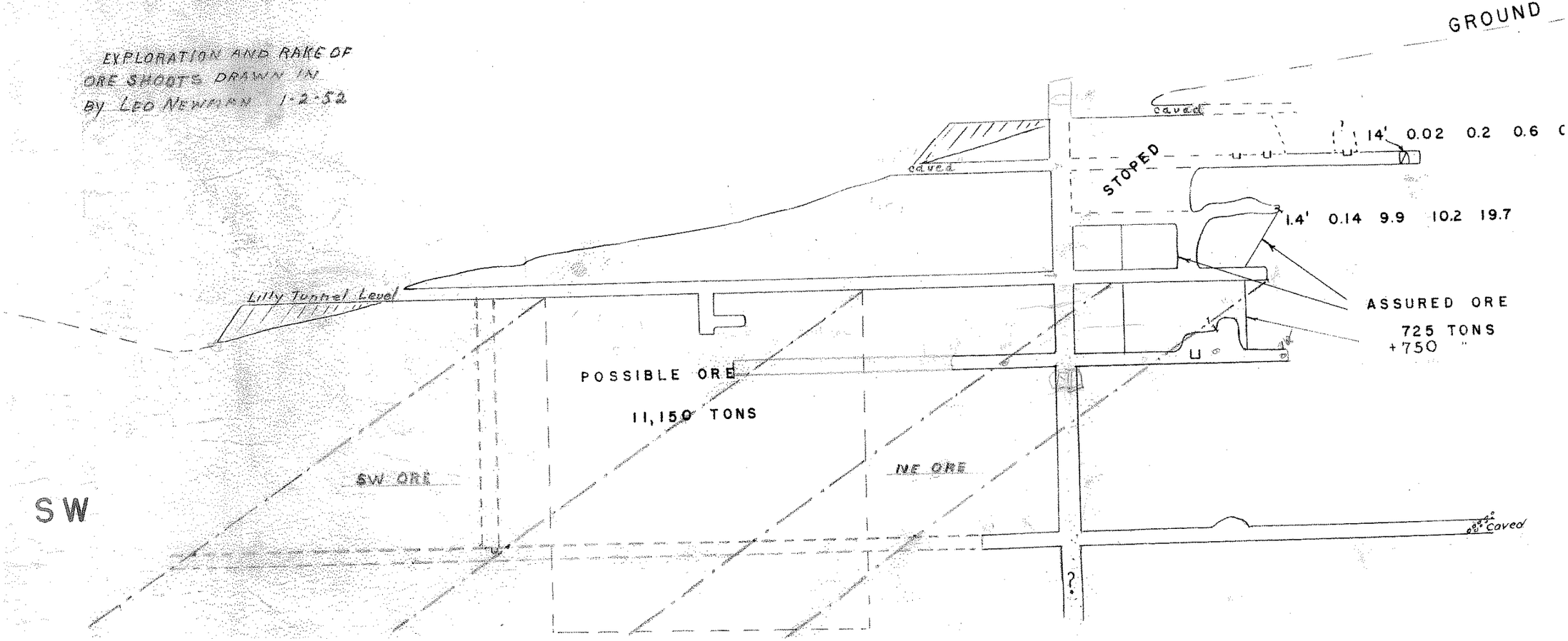
MINERALIZED VEINS

NOTE

_____ EXPLORATION

_____ RAKE OF ORE SHOOTS

EXPLORATION AND RAKE OF ORE SHOOTS DRAWN IN BY LEO NEWMAN 1-2-52



LOB | MINE WATER VOL

EXISTING POOL LEVEL ~

MAIN SHAFT

200' x 8' x 8' = 96,000 gal

200 LEVEL

240' x 5' x 7' = 62,800 gal

127' LEVEL

160' x 5' x 7' = 42,000 gal

30 x 15 x 5 = + 17,000 gal

80' LEVEL (LILLY ADIT)

420' x 5' x 7' = 110,000 gal

(30 + 50) x 5' x 7' = 21,000 gal

60' LEVEL => DISCHARGING ADIT / WATER SURFACE

100' x 5' x 7' = 26,000 gal

TOTAL VOLUME => 375,000 gal

FLOWRATE, Lilly/Orphan Boy Mine

Date	Flow (GPM)
09/06/94	0.26
09/20/94	0.55
10/04/94	1.5 U
10/19/94	1.5 U
11/01/94	1.5 U
11/22/94	0.84
12/13/94	1.5 U
01/26/95	1.5 U
02/16/95	1.17
03/14/95	1.66
04/18/95	0.87
05/18/95	7.62
06/22/95	1.91
07/11/95	2.67
08/08/95	1.79
09/15/95	1.3
10/12/95	0.71
11/16/95	0.55
11/30/95	0.55
12/20/95	0.54
01/23/96	0.27
02/21/96	0.11
03/26/96	
04/09/96	0.1
05/23/96	
06/18/96	2.6
07/18/96	0.62
08/22/96	3.87
09/19/96	0.64
10/23/96	0.41
12/02/96	0.31
01/21/97	0.19
02/18/97	0.15
03/05/97	0.11
04/15/97	
05/28/97	
06/30/97	0.25
07/31/97	
08/27/97	
09/30/97	
10/16/97	
11/11/97	
12/04/97	
01/27/98	
02/18/98	
03/24/98	
04/23/98	
05/19/98	3.31
06/18/98	7.33
07/29/98	1.69
09/28/98	0.3
11/24/98	0.14
12/30/98	0.09
01/14/98	0.08
03/31/99	
04/28/99	
05/18/99	0.17
06/17/99	1.49
07/21/99	0.1
08/30/99	0.11
09/29/99	0.104
10/20/99	0.104
11/03/99	0.104
12/28/99	frozen
01/20/00	frozen
02/09/00	frozen
03/02/00	frozen
04/20/00	frozen
06/15/00	0.101
07/13/00	
09/14/00	0.088
11/07/00	frozen
01/31/01	
03/28/01	frozen
05/29/01	2 approximately
08/02/01	0.54

Attachment C

Water Treatment Alternatives

Environmental Solutions

Environmental Solutions LLC

314 Polo Club Drive

Moon Township, Pa. 15108

Environmental Solutions proposes to set up operate and maintain a Maelstrom Oxidizer Acid Mine Drainage system at the Lil Orphan Boy mine site to dewater the mine pool. The Maelstrom Oxidizer will perform multiple functions.

Transfer of oxygen is one of the most important factors in cost effective treatment of acid mine drainage. The Maelstrom Oxidizer will transfer oxygen to oxidize and precipitate metals

The Maelstrom Oxidizer will aggressively mix chemical reagent into the raw water to raise the pH. Each 0.5 increase in pH increases the oxidation of iron 10 times. One point increases the oxidation rate 100 times. At 9 pH, 90% of iron will oxidize in 1.26 seconds.

The Maelstrom Oxidizer will increase the density of the sludge to decrease the volume of sludge that has to be disposed of. If sludge comprised only 0.5% of the 400,000 gallons estimated to be in the mine pool, there would be 2000 gallons of sludge equal to 270 cubic fee = to an area of 5'x5'x10't. Densification is a known process that mixes chemical reagent with sludge comprised of previously oxidized and precipitated metals that is recycled back to be injected into the incoming raw water. Metals in the raw water are oxidized onto the surface of the recycled particles. Repeated recycling of the same sludge can increase the density 30 times or more.

The proposed Maelstrom Oxidizer system will be comprised of an initial Maelstrom Oxidizer to transfer oxygen into 60 gallons per minute of the 400,000 gallons estimated to be in the mine pool. Chemical reagent pre mixed with recycled sludge will be injected into the 60 gallon per minute inflow and intimately mixed whereby metals will be rapidly oxidized and precipitated.

Water containing oxidized and precipitated metals will gravity flow from this unit into a trough. A polymer will be injected into the inflow and mixed within the trough.

Treated water will flow from this trough into a small settling tank with a cone shaped bottom. The bulk of the precipitated metals will settle out in the bottom of this tank A portion of this sludge will be recycled back to the Maelstrom Oxidizer for densification purposes and a portion into an area to contain excess sludge.

Treated water will flow into a small area for settling of all residual particles prior to discharge.

Proposal

Lil Orphan Mine

Environmental Solutions LLC proposes to set up, operate and maintain a Maelstrom Oxidizer Acid Mine Drainage system at the Lil Orphan Boy mine site to dewater the 400,000 gallons per minute estimated to be in the mine pool. The price quoted for the treatment includes the cost of chemical reagents, polymer and operation of the system.

Price for 400.000 gallons	$47,000
Price for each additional 100,000 gallons	$5,000
Price for treating the approximately 20 GPM outflow after dewatering	$5,000 per week

Pumping from the mine pool and disposal of sludge by others.

Don Budeit, President

Environmental Solutions LLC

314 Polo Club Drive

Moon Township, Pa. 15108

412 262-2606

Matt Culpo:

I have review the results of our processing of the water you sent to us. I noted that the pH of our treated water was 7.7 pH. If we increased the pH to 9.0, it would still be legal discharge but iron manganese zinc and other metals would be lower than but not as low as the extremely low amounts shown for Montana discharge. All of our results would meet Pa. and Federal discharge limitations. Manganese for example can be discharged with an average monthly amount of 2 milligrams per liter.

The list below is taken from the results data you sent to us. I have calculated the pounds per day of each of the metals based on the current average out flow and discharge of 20 gallons per minute and the pounds per day in 60 gallons per minute in our treated outflow using our initial results.

20 Gallons per minute Raw Water			Treated Water		
	mg/l	Pounds per Day	mg/l	20 gpm # per day	60 gpm # per day
Arsenic	3.94	0.95	0.14	0.033	0.099
Cadmium	0.791	0.19	0.134	0.0324	0.093
Copper	0.032	0.0076	0.013	0.003	0.009
Iron	26.2	6.29	0.1	0.02	0.07
Lead	0.315	0.075	0.004	0.00096	0.002
Manganese	5.16	1.24	1.77	0.425	1.275
Zinc	11.3	2.71	1.68	0.40	1.2
Total		11.46		0.91	2.74

Note that if we treated 60 gallons per minute of draw down water with results equal to our treated results, at 7.7 pH, we would put far less metals into our effluent than is currently out flowing with the average 20 gpm raw water. The small amounts we show in treated drawdown water should not harm the environment and should be permitted to enable sealing in the mine.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@enerylab.com

LABORATORY ANALYTICAL REPORT

Client: MT DEQ
Project: Lilly/Orphan Boy
Lab ID: H10050249-001
Client Sample ID: LOB-Shaft-Treated ES – Environmental Services

Report Date: 05/29/10
Collection Date: 05/04/10 17:00
DateReceived: 05/19/10
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	7.7	s.u.		0.1		A4500-H B	05/20/10 18:10 / WB
Conductivity	641	umhos/cm		1		A2510 B	05/20/10 18:10 / WB
Solids, Total Suspended TSS @ 105 C	ND	mg/L	H	10		A2540 D	05/21/10 16:43 / hm
Solids, Total Dissolved TDS @ 180 C	432	mg/L	H	10		A2540 C	05/21/10 16:27 / hm
INORGANICS							
Alkalinity, Total as CaCO3	57	mg/L	H	4		A2320 B	05/20/10 18:10 / WB
Bicarbonate as HCO3	70	mg/L	H	4		A2320 B	05/20/10 18:10 / WB
Carbonate as CO3	ND	mg/L	H	4		A2320 B	05/20/10 18:10 / WB
Chloride	5	mg/L		1		E300.0	05/21/10 17:19 / WB
Sulfate	240	mg/L		1		E300.0	05/21/10 17:19 / WB
Hardness as CaCO3	131	mg/L		1		A2340 B	05/28/10 13:48 / sld
METALS, DISSOLVED							
Aluminum	ND	mg/L		0.1		E200.8	05/21/10 22:37 / dck
Calcium	37	mg/L		1		E200.7	05/28/10 11:43 / sld
Magnesium	9	mg/L		1		E200.7	05/21/10 11:07 / sld
Potassium	7	mg/L		1		E200.7	05/21/10 11:07 / sld
Sodium	64	mg/L		1		E200.7	05/21/10 11:07 / sld
METALS, TOTAL							
Arsenic	0.134	mg/L		0.001		E200.8	05/21/10 22:44 / dck
Cadmium	0.0113	mg/L		0.00008		E200.8	05/21/10 22:44 / dck
Copper	0.013	mg/L		0.001		E200.8	05/21/10 22:44 / dck
Iron	0.10	mg/L		0.03		E200.8	05/21/10 22:44 / dck
Lead	0.004	mg/L		0.001		E200.8	05/21/10 22:44 / dck
Manganese	1.77	mg/L		0.001		E200.8	05/21/10 22:44 / dck
Nickel	ND	mg/L		0.01		E200.8	05/21/10 22:44 / dck
Zinc	1.68	mg/L		0.01		E200.8	05/21/10 22:44 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

Blue Water

BLUE WATER TECHNOLOGIES INC

Blue Water Technologies, Inc.

June 7, 2010

Matt Culpo, P.E.
TerraGraphics Environmental Engineering, Inc.
302 N. Last Chance Gulch
Helena, Montana 59601

Subject: **Blue PRO® (budgetary estimate)**
Above ground Fiberglass
Lily Orphan Boy, Mine, MT
Proposal #100155-1

Dear Mr. Culpo:

Blue Water Technologies, Inc. (Blue Water) appreciates the opportunity to provide this proposal to you for the above referenced project. Blue Water's core technology is the patent-pending Blue PRO® process, described in scientific literature as "Reactive Filtration". Critical and unique concepts in the reactive filtration patent are the "reactive filter media" and the "continuous regeneration" of that media. Reactive filter media maximizes the efficiency of the filter by promoting adsorption in combination with co-precipitation. Continuously regenerating the reactive filter media is accomplished by using a moving bed filter to constantly grind the surface of the media, creating fresh sites for adsorption. For this reason, no backwashing or exchange of media is necessary, which reduces operations and maintenance hassle and cost.

Blue Water offers a broad platform of water treatment technology products, from primary wastewater treatment to advanced effluent polishing steps to environmental remediation processes. Our team strives to meet customers' needs cost-effectively, considering both capital expense and ongoing operations and maintenance costs. Additionally, we keep an eye on the future by looking for sustainability in our technologies, including environmentally-friendly materials and energy conservation.

1.0 Equipment Features and Benefits:

- Unparalleled treatment efficiencies to ultra low levels.
- No back flushing or system cycling required, continuous operation. Reject solids can be recycled to the head of the plant and, thus, do not require separate disposal or processing.
- Use of ferric and recycling the rejects can replace or greatly reduce alum use and also provide the added benefit of plant-wide odor control and easier-to-dewater biosolids.
- Available in coated carbon steel, stainless steel, fiberglass, or in-ground concrete.
- Advanced washbox design to maximize performance.
- Patented recess chamber minimizes media bridging.
- Safety-minded design focused on easy operator access to filter and filter operation.

1.1 System Design:

The Blue PRO® process is depicted in Figure 1. Influent wastewater enters at the left of the diagram. A commonly available water treatment chemical (typically a form of iron) is added to the wastewater before it passes into the rapid conditioning zone. This zone allows the proper contact time for the mixture to be optimized for both co-precipitation and adsorption processes. This combination of removal mechanisms makes the system more effective than other treatment processes; Blue PRO® is able to overcome chemical equilibrium and diffusion limitations that other technologies have. The mixture enters the moving bed sand filter through distribution arms at the bottom of the sand bed, and then flows upward through the sand bed. After filtration, clean water discharges from the top of the filter on the right. In the filter the sand moves slowly from top to bottom, then returns to the top of the filter via an airlift located in the central assembly. A washbox at the top of the filter separates sand from waste particles. The sand falls back to the top of the bed. The residuals, including the iron and phosphorus or other contaminants, exit in a separate line and can be routed to the plant's existing solids handling system or recycled to another place in the plant.

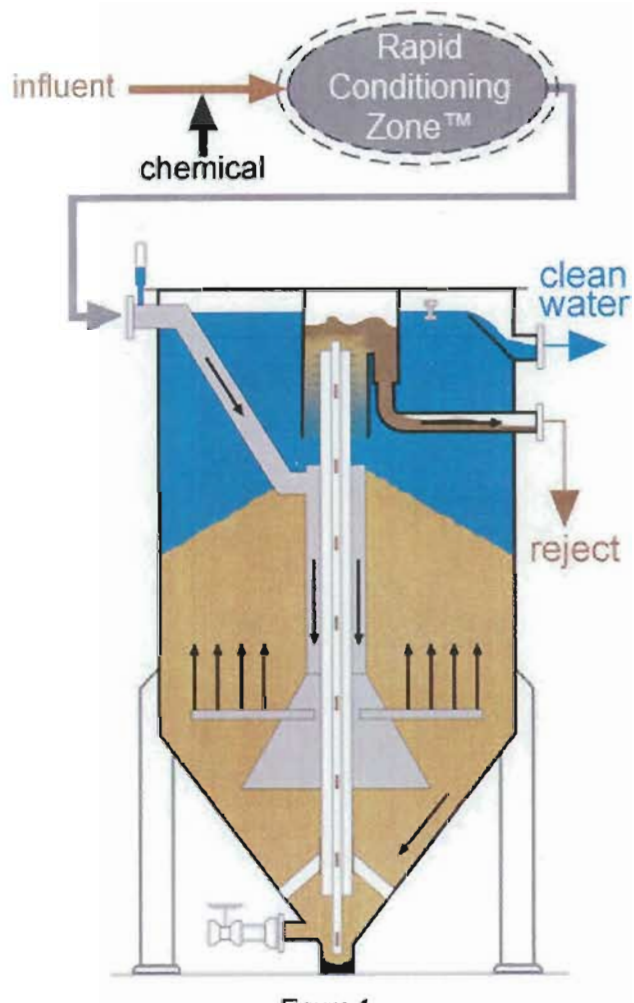


Figure 1

The Blue PRO® technology provides flexibility to a wastewater treatment plant. The modular system of filters is installed as tertiary treatment, which is located near the end of the plant's treatment train. Depending on the influent phosphorus concentration and the targeted permit

level, a plant may require one pass through Blue PRO® or may run the filters in series to attain even lower phosphorus concentrations. The Blue PRO® process has additional advantages beyond phosphorus removal, including suspended solids and turbidity removal.

2.0 Basis of Design:

	Filter Influent*	Effluent*
Average Flow (drain down, 2 weeks)	0.86 MGD (60 gpm)	
Average Flow (maintenance pump rate)	0.58 MGD (40 gpm)	
Total Suspended Solids (TSS)	< 10.0 mg/L	
Arsenic	3.94 mg/L	0.01 mg/L
Cadmium	0.0791 mg/L	0.000097 mg/L
Copper	0.032 mg/L	0.00285 mg/L
Iron	26.2 mg/L	0.3 mg/L
Lead	0.315 mg/L	0.000545 mg/L
Manganese	5.16 mg/L	0.05 mg/L
Nickel	0.02 mg/L	0.0161 mg/L
Zinc	11.3 mg/L	0.037 mg/L
Temperature	TBD	
pH	TBD	
Alkalinity	TBD	

* Arithmetic average.

3.0 Proposed Treatment System:

Option 1:

Blue Water is pleased to provide the Blue PRO® filter system with a total of two (2) Blue PRO® CF12UFAG80" filters in a single/dual pass configuration with associated ancillary equipment to treat the above referenced waste stream. The overall dimensions of each filter module are approximately 4' dia x 14' H with a total system footprint (except compressor) of approximately 6' W x 12' L x 14' H. 5" of head room above the filter is required to accommodate a headloss gauge. If housed inside a building, a roof hatch is recommended in the roof to allow the removal of the airlift for periodic maintenance. Compressors can be mounted where convenient.

Loading Rates (Parallel @ 60 gpm):
Combined filter area: 24 square feet
Average design loading rate: 3.0 gpm/ft^2 (rejects included)
Filter bed depth: 80 inches
Reject rate per washbox: 6 gpm (12 gpm total)

Loading Rates (Series @ 40 gpm):
Combined filter area: 12 square feet (per pass)
Average design loading rate: 4.3 gpm/ft^2 (rejects included)
Filter bed depth: 80 inches
Reject rate per washbox: 6 gpm (12 gpm total)

Notes:

- ***60"*** *of head will need to be provided above the water surface elevation of the filter.*

The proposed Blue PRO® filters system, will be complete and will include the following **(option 1):**

(2) Model CF64UFAG80" (fiberglass) Blue PRO® "Reactive Filters"
(2) Washboxes (fiberglass)
(2) Airlifts (Type schedule 80 PVC)
(2) Central feed chambers (fiberglass)
(2) Chemical feed system, duty and online spare chemical pumps
(1) Air control panel (NEMA 4)
(1) Lot walkways/handrails/ladder
(1) Air compressor and air system with dryer
(1) Filter control panel (NEMA 4, Blue Water standard components)
(1) Lot filter media delivered in super sac bags
(2) Filter influent flow meters
(1) Inclined plate settler
(1) Lot interconnecting piping

Option 2:

Blue Water is pleased to provide the Blue PRO® filter system with a total of one (1) Blue PRO® CF19UFAG80" filters in a single pass configuration with associated ancillary equipment to treat the above referenced waste stream. The overall dimensions of each filter module are approximately 5' dia x 15' H with a total system footprint (except compressor) of approximately 6' W x 10' L x 15' H. 5" of head room above the filter is required to accommodate a headloss gauge. If housed inside a building, a roof hatch is recommended in the roof to allow the removal of the airlift for periodic maintenance. Compressors can be mounted where convenient.

Loading Rates (@ 60 gpm):
Combined filter area: 19 square feet
Average design loading rate: 3.6 gpm/ft^2 (rejects included)
Filter bed depth: 80 inches
Reject rate per washbox: 8 gpm

Loading Rates (@ 40 gpm):
Combined filter area: 12 square feet
Average design loading rate: 2.5 gpm/ft^2 (rejects included)
Filter bed depth: 80 inches
Reject rate per washbox: 8 gpm

Notes:

- ***60"*** *of head will need to be provided above the water surface elevation of the filter.*

The proposed Blue PRO® filters system, will be complete and will include the following **(option 2):**

(1) Model CF19UFAG80" (fiberglass) Blue PRO® "Reactive Filter"
(1) Washbox (fiberglass)
(1) Airlift (Type schedule 80 PVC)
(1) Central feed chamber (fiberglass)
(2) Chemical feed system, duty and online spare chemical pumps
(1) Air control panel (NEMA 4)
(1) Lot walkways/handrails/ladder
(1) Air compressor and air system with dryer
(1) Filter control panel (NEMA 4, Blue Water standard components)
(1) Lot filter media delivered in super sac bags
(1) Filter influent flow meter
(1) Inclined plate settler
(1) Lot interconnecting piping

Optional Free Standing Cargo Container to include:

- Insulated with HVAC
- Air control panel as listed above (NEMA 4 enclosure)
- Influent feed pump/flow meters (25' suction head TBD)
- Chemical feed system as listed above
- Air compressor and air system with refrigerated dryer as listed above
- Electrical control panel as listed above (NEMA 4 enclosure, Blue Water standard components)

Installation Assumes and Includes:

- Davis-Bacon/Heavy wage rates and construction taking place in mild weather
- Concrete slab by others
- Influent/effluent piping roughed in by others
- Electrical power (240v/3 phase) run to building pad by others
- Building not erected
- All electrical from power supplied by others
- Installation of all piping and supports listed above
- Installation of sand
- Erection of filters and all equipment listed above
- Includes bonding, insurance, and included OH&P

4.0 Equipment Price and Included Field Engineering:

Blue Water budgetary price **(option 1)** ..... **$325,000.00.**
Buy back at end of project **(option 1)**..... **Negotiable.**

Blue Water budgetary price **(option 2)** .....**$230,000.00**.
Optional cargo container.....**$30,000.00**.
Installation costs.....**$220,000.00**.
Estimated shipping.....**$20,000.00**.

Equipment is **F.O.B. factory.** The price does not include any import, sales, use, excise or similar taxes, fees, permits, etc. This proposal is valid for a period of sixty (60) days unless extended in writing by Blue Water.

Proposed Terms:
50% (net 30 days) with order
25% (net 30 days) with approval of drawings and submittals
25% (net 30 days) with delivery of the equipment to the jobsite

The price includes an allowance for factory trained **Manufacturer's Services** as noted below:

- Up to twelve (12) – eight (8) hour days in up to three (3) trips for start-up and training.

Additional time, if requested by the Owner, shall be invoiced at prevailing rates. Expenses associated with any additional field engineering will be invoiced at actual cost plus 10%.

4.1 Estimated Operating Costs:

Oxidizing chemical	$ TBD per week
pH adjusting chemical	$ TBD per week
Power cost at ($0.11 per KWH)	$ 105 per week
Operations ($50/Man Hour)	$ 50 per week

Electrical service 460 VAC/3Ø/60 Hz 20 Amp

5.0 Estimated Submittal and Shipping Dates:

Blue Water is prepared to ship equipment in approximately twelve (12) to eighteen (18) weeks from the receipt of approved drawings, submittals, and a signed release to proceed. Submittals to be issued within six (6) weeks of countersigned purchase order. While drawings are issued for approval, they are intended for informational purposes only. The drawings will remain Blue Water property and may not be used by others for fabrication.

6.0 Warranty:

Equipment will be warranted against manufacturer's defects in accordance with Blue Water's standard warranty for twelve (12) months from start-up or fourteen (14) months from date of shipment, whichever comes first, when operated at stated conditions and according to the instructions in Blue Water's operations and maintenance manual.

7.0 Guarantee:

Blue Water will guarantee performance outlined in Section 2.0 Basis of design if a successful pilot is performed at the Lily Orphan Boy Mine site. If several pH adjusted bench scale tests are performed on water from the Lily Orphan Boy Mine and they are successful in meeting the limits

outlined in 2.0 Basis of Design, Blue Water will give a 90% probability that a full scale installation will be able to achieve the limits listed above.

8.0 Work by "Others":

The following items are not included in this **Scope of Supply**, but may be required for these systems:

- Preparation of structural engineering drawings for all concrete work.
- Concrete material and its placement.
- Site preparation, unloading, placement and installation of equipment. Installation of all Blue Water supplied equipment.
- Ancillary tanks (chemical feed tanks, flow equalization tanks, etc.).
- Buildings (if required) and building utilities and HVAC.
- Supply and connection of electrical service to Blue Water supplied control panel. Supply, installation, and connection of interconnecting circuits between Blue Water supplied panels and auxiliary panels and/or instrumentation and/or motorized devices.
- Supply and installation of required drain piping, influent piping, effluent piping, reject piping, all associated valves, required pipe support, and appurtenances to and from the connection point on Blue Water supplied equipment.
- Supply and installation of interconnecting vent, drain, and airlines and their associated valves and appurtenances.
- Reject disposal, handling and/or processing.
- Supply and installation of insulation and heat tracing of any piping or tubing (if required).
- Chemicals required for operation.

Thank you for your consideration on this project. If you have questions or need more information, please feel free to contact me at (208) 209-0391.

Sincerely,

Mark Lopp
Regional Sales Manager

Blue Water Technologies, Inc.
10450 N. Airport Drive
Hayden, Idaho 83835
Direct: (208) 209-0391 ext. 122
Fax: (208) 209-0396
Cell: (208) 691-3656
Email: mlopp@blueh2o.net
www.blueh2o.net

Rain for Rent

Custom Estimate Developed Especially for:

Matt Culpo
Terragraphics Engineering
302 N. Last Ch. Gulch Ste. 409
Helena, MT 59601
Phone: 406-441-5441
Fax: 406-441-5443

Prepared on 6/15/2010 by:

Rain for Rent

Skyler Neibaur
Cell: (208) 521-6500
P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

www.rainforrent.com

Rain for Rent's Engineering Department designs a wide spectrum of liquid handling systems. From the simplest pumping operation to the most complex bypass project, our engineers are available to assist you in designing a system to fit your needs.

Rain for Rent Idaho Falls

www.rainforrent.com

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Rental/Sale Estimate

Estimate Number: 10-098-318439

Prepared By: Skyler Neibaur

Job Description:

Filter metal components at mine; arsenic, cadmium, copper, lead, nickel, zinc, manganese, iron; at. System sized for up to 60 gpm flow rate. Estimate based on filtering 2.4 million gallons; 60 gpm for 2 weeks, 20 gpm for 6 weeks.

Customer: Terragraphics Engineering

Customer ID: S08957
Address: 302 N. Last Ch. Gulch Ste. 409
City/State: Helena, MT 59601
Contact: Matt Culpo
Office: 406-441-5441
Fax: 406-441-5443

Location:

Lilly/Orphan Boy Mine
Near Helena, MT

Rental Sub Total: $47,264.00

Sale Sub Total: $64,273.48

Sub Total: $111,537.48

*The Terms and Conditions of the Rain For Rent Rental and Acute Hazardous Waste Agreements, Credit Application, Invoice and this estimate contain the complete and final agreement between Rain For Rent and Customer and no other agreement in any way modifying or adding to any of said Terms and Conditions will be binding upon Rain For Rent unless made In writing and signed by a Rain For Rent Corporate Officer.
*Payment terms are net 30 days from invoice date. A 1.5%month late charge will be made on any past due invoices.
*Estimate is valid for 30 days and is subject to credit approval.
*Availability subject to change without notice.
*Estimates are based on Customer supplied information and are subject to change based on actual requirements and usage.

Est. Delivery Hauling	$12,160.00
Est. Pick-up Hauling	$1,960.00
Est. Install Labor	$2,460.00
Est. Removal Labor	$2,460.00
Est. Services	$0.00
Est. Fuel Surcharge	$0.00

(Does Not Include Sales Tax)

Estimate Total: $130,577.48

Date Prepared: 6/15/2010

Valid Until: 7/15/2010

Customer

Date

By signing this estimate, customer represents that customer has read and agreed to all terms of this estimate, including those on Terms & Conditions page and those on the Additional Specifications page (if applicable).

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-318439

Application: Filtration Materials: Water w/ metal components Flow: Up to 60gpm Suction Lift: NA Friction Loss: NA Static Head: NA

*Rain for Rent Cycle = 28 Days.
This estimate has not been flagged as PREVAILING WAGE.

Rental Items

Qty	Unit	Duration	Item	Description	Day	Week	*Cycle	Extension
1	Each	8 Week	MRC	3hp Submersible Pump - 60 gpm @ 35psi	$0.00	$175.00	$0.00	$1,400.00
1	Each	8 Week	MRC	15kw Genset	$0.00	$375.00	$0.00	$3,000.00
1	Each	8 Week	MRC	PF400 Bag/Cartridge Filtration System	$0.00	$1,135.00	$0.00	$9,080.00
1	Each	8 Week	MRC	24-3SSK Stainless Steel Sand Media Filter	$0.00	$900.00	$0.00	$7,200.00
1	Each	8 Week	MRC	Portable Water Quality Monitoring Box w/ Sodium Hydroxide - pH and turbidity adjustment	$0.00	$1,500.00	$0.00	$12,000.00
2	Each	8 Week	MRC	12'x50' Spillguard Secondary Containment w/ Ground and Track Mats	$0.00	$175.00	$0.00	$2,800.00
2	Each	8 Week	MRC	12'x16' Spillguard Secondary Containment w/ Ground and Track mats	$0.00	$140.00	$0.00	$2,240.00
1	Each	8 Week	MRC	6900 Gallon Poly Tank for addl. settling time after pH adjustment	$0.00	$168.00	$0.00	$1,344.00
1	Each	8 Week	MRC	Misc. Hoses, Valves, Adapters, etc.	$0.00	$350.00	$0.00	$2,800.00
2	Each	3 *Cycle	MRC	ARG Arsenic Media Tanks - 20 ft3	$0.00	$0.00	$450.00	$2,700.00
2	Each	3 *Cycle	MRC	SCU Special Metals Tanks - 30 ft3	$0.00	$0.00	$450.00	$2,700.00

Rental Sub Total: $47,264.00

Sale Items

Qty	Unit	Item	Description	Unit Price	Extension
2	Each	MS	ARG Resin Regeneration, Loading, and Media Processing	$13,486.67	$26,973.34
2	Each	MS	SCU Resin Regeneration, Loading, and Media Processing	$17,438.67	$34,877.34
1	Each	MS	Sample Analysis and Waste Profile Approval	$775.00	$775.00
4	Each	MS	10 Micron Bag Filters	$7.10	$28.40
24	Each	MS	5 Micron Cartridge Filters	$15.60	$374.40
1	Each	MS	450 lbs 3/4" Washed Gravel for initial Sand Media Filter loading	$45.00	$45.00
1	Each	MS	1200 lbs Green Sand for intital Sand Media Filter loading	$1,200.00	$1,200.00

Sale Sub Total: $64,273.48

Sub Total. $111,537.48

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-318439

Additional Specifications

Estimate is based on filtering 2.4 million gallons; 60 gpm for 2 weeks, 20 gpm for 6 weeks.

1.0 SCOPE OF WORK

Rain for Rent Responsibilities:

· All tanks will be processed at Siemens's fully permitted RCRA Part B facilities.

· All fresh tanks will be verified for proper flow, pressure tested for leaks and returned to the fresh tank float.

· Siemens will deliver fresh tanks within 3 working days from the request date.

· Iron and Manganese removal.

· All pre-filtration, a maximum of 20 micron cartridge pre-filtration is required with all ion exchange systems.

· All inlet and outlet hoses.

· Waste profiles detailing the operation of the tanks.

Customer Responsibilities:

· All permits, permit fees, and inspections as re-quired.

· If applicable, work schedules indicating times during which interruption in normal service are permissible. All labor rates quoted in this proposal are for straight time, non-union labor.

· Free and clear access to treatment site to change the portable tanks. Loading dock access or material handling equipment capable of safely handling specified ion exchange tanks.

· System operation, including maintenance and wastewater quality monitoring.

· Siemens has a scheduled hazardous waste tank pick up every 21 days. Customer's may be requested to hold the spent tanks until the next scheduled pick up date.

Influent Parameters:

60 gpm for 2 weeks = 1,209,600 gallons
20 gpm for 6 weeks = 1,209,600 gallons

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-318439

Terms & Conditions

Additional Terms

1. A cycle is defined as 4 weeks. A week is defined as one third of a cycle and a day is one third of a week. Customers will be invoiced at the appropriate cycle, weekly or daily rate based on actual equipment usage except for filtration, pipe, hose and fittings which will be billed at the cycle rates only and will not be pro-rated.
2. The rental rate for pumps and equipment with hour meters are based on an 8 hour day or 48 hour running week. The rental rate will be multiplied by 1.5 for greater than 8 hours per day or 49-96 operating hours per week and multiplied by 2.0 for more than 16 hours per day or 96 operating hours per week. Customer will be invoiced for 24 hours per day if the hour meter has stopped functioning.
3. Overtime will be invoiced at 1.5 times the regular rate for work occurring outside of normally scheduled business hours and 2.0 times the regular rate for work occurring on company recognized holidays.
4. Customer shall pay for any changes to work scope including but not limited to schedule changes, material, labor, third party, permit, fee or service costs. It is the Customer's responsibility to cooperate in the timely processing, approval and payment of any charges within Rain For Rent's invoice terms
5. Customer is responsible to determine the suitability of equipment for the application.
6. Delivery, Return, Installation and Removal costs are estimated. Customer will be invoiced for actual time. Transportation will be invoiced on a Portal to Portal basis.
7. Customer is responsible for flushing and cleaning tanks, roll off boxes, pipelines, pumps, filters and other Rain for Rent equipment prior to return.
8. Customer is responsible for equipment, repairs, maintenance and damage, excluding normal wear and tear. All returned equipment is subject to inspection by Rain for Rent personnel. Damages and accrued rent will be invoiced to Customer while equipment is out of service for repairs.
9. The Customer cannot alter the equipment without Rain For Rent's prior written approval
10 Customer will provide "all risk" property insurance for rented equipment.
11 Customer will not allow any equipment to come in contact with any substance that will cause corrosion, damage or leakage.
12. The Customer assumes all risks of loss due to operation and use of the equipment.
13 Customer is responsible to obtain any permits, licenses, certificates, bonds and give all notices required by law.
14. The rental period begins the day the equipment is delivered and continues until returned to Rain For Rent's facility unless written confirmation of the release is provided to the Customer before that time.
15. Rental equipment must be returned to the renting Rain for Rent branch unless agreed to in writing before the rental period begins
16. All material that comes in contact with Rain For Rent equipment including media is the responsibility of Customer as generator. Rain For Rent shall not be responsible for any fines or sanctions as a result of Customer's use of the equipment.
17 The equipment is sold "AS IS,WHERE IS" in its present condition. Seller makes no warranties, expressed or implied of any kind whatsoever with respect to the equipment. Buyer agrees that buyer has purchased the equipment based on his judgement and evaluation, without reliance upon any statements of representations of seller, and that seller is not responsible for any defects in its operation or for any repairs, parts or services, unless otherwise noted.
18. De-watering, Roll-off, Vacuum boxes and similar equipment are not liquid tight. Rentee accepts full responsibility for all losses, damages and costs caused by or arising out of spills, leakage or discharge from this equipment.
19. Customer will use the equipment in a careful and proper manner and in accordance with safety rules, industry standards, manufacturer's specifications, recommendations, regulations and applicable laws
20. Customer shall be responsible for environmental fees covering waste fluid, fuel, filter and other disposal costs.
21. A Fuel Surcharge will be calculated and invoiced based on the diesel fuel price as published by the Department of Energy on http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp
22 Customer shall pay Rain For Rent additional expenses caused by site, soil or underground conditions, including, but not limited to, rock formations, environmental conditions, regulations or restrictions, hard pan, boulders, cesspools, gas lines, water lines, drain pipes, underground electrical conduits or other above ground or underground obstructions.
23. Customer shall be responsible for acquiring and paying for, if necessary, all public and private property easements required by the project.
24. The estimated labor component of this quote is based on non-prevailing wage rates. If prevailing wage laws are applicable, Customer must notify Rain For Rent in writing before Rain For Rent estimate completed. If Rain For Rent was not properly notified, Customer shall promptly pay any change orders that adjust wages to prevailing wage rates. Customer is responsible for providing applicable prevailing wage rates to Rain for Rent. Rain For Rent will provide certified payrolls on a bi-weekly basis if notified in writing 10 days before the start of the project.
25. Customer is prohibited from deducting retention from Rain For Rent invoices and charging Rain for Rent liquidated damages.
26 Customer is responsible for all routine maintenance including fuel, fluids, lubrication and filters every 150 hours on engine driven equipment. Rain For Rent will charge Customer for servicing any equipment that is on rent or returned that has not been serviced in 150 hours. Rain For Rent can provide field service upon request for an additional service charge. Rain For Rent must be notified 2 business days in advance to schedule required field service.
27 This estimate excludes any additional costs to Rain For Rent associated with Owner Controlled Insurance (OCIP) or WRAP insurance programs that will be added to Rain For Rent's prices.
28. Customer is responsible to provide freeze protection for all equipment on site.
29. This estimate excludes any costs associated with ARRA (American Recovery and Reinvestment Act) reporting requirements that may be flowed down to Rain For Rent.

30 Customer will be responsible for security, traffic control and road crossings. Traffic control shall meet all applicable Federal, State, and Municipal laws and regulations to assure a safe work environment.
31 Cold Weather Packages for tanks consist of up to 4 tank heaters and a submersible pump which is designed for use in a non-combustible or corrosive environment.
32. Tank heaters are operated on 120 volts, 12.5 amps each or 50 amps total. The submersible pump operates at 120 volts, 10 amps.
33. Customer is responsible for electrical connections and compliance with applicable permits, regulations and code requirements.
34. Tank Cold Weather Packages are not to be used in combustible or corrosive environments.
35. Tank Cold Weather Packages are a preventative measure that may keep fluids inside the tank from freezing. RFR will not guarantee fluids from freezing and any resulting damages.

Job Specific Terms

36. Rain for Rent does not warranty the degree of filtration associated with this equipment.
37. Field performance may vary if any of the system operating variables change. System variables in this context would include, but not be limited to: flow rate: composition or concentration of solids: contaminants or constituents in the fluid to be filtered:, etc
38. Monitoring and operation of the filtration system is the responsibility of the customer.
39. It is the responsibility of the customer to clean and decontaminate all equipment prior to equipment pickup and removal by Rain for Rent.
40. All used filtration media, such as carbon, sand, cartridges, bags, coalescing packs, etc. become the property of the client and must be removed from the equipment prior to the return of this equipment to Rain for Rent.
41. A forklift may be required to offload and load the above equipment.
42. This estimate includes the filtration media (sand, carbon, cartridges, bags, and/or coalescing packs) required to initially fill and operate the equipment. Additional media will be provided at an additional cost
43. A pilot test is recommended prior to shipment of equipment.
44 Due to the lack of information concerning the fluid stream to be filtered, no assumptions or guarantees are offered or implied as to the performance of the quoted filter units or the filter media.
45 This estimate is for budgetary purposes only. The prices shown are not firm and should not be considered as such. This is an estimate only and is solely based upon the available information as supplied by the user.
46. All filtration media is sold on a no-return/non-refundable basis.
47 Customer will be responsible for security, traffic control and road crossings. Traffic control shall meet all applicable Federal, State, and Municipal laws and regulations to assure a safe work environment.
48. Customer shall hold harmless, indemnify and defend Rain For Rent from any claims whatsoever, arising from or related to (A) any pollution, contamination, environmental impairment and/or similar condition directly or indirectly caused by or resulting in whole or in part from Customer's use of any Equipment or (B) any environmental statutory or regulatory compliance requirements applicable to any equipment (or any use thereof) and required under any and all foreign or domestic federal, state or local laws,ordnances, regulations, codes, or requirements of any governmental authorities which regulate or impose standards of liability or conduct concerning air, water, soils, wetlands and watercourses, solid waste, hazardous waste and/or materials, worker and community right-to-know, noise, resource protection, health protection and similar environmental, health, safety, and land use concerns as may now or at any time hereafter be in effect. This indemnification shall survive the termination of the agreement.

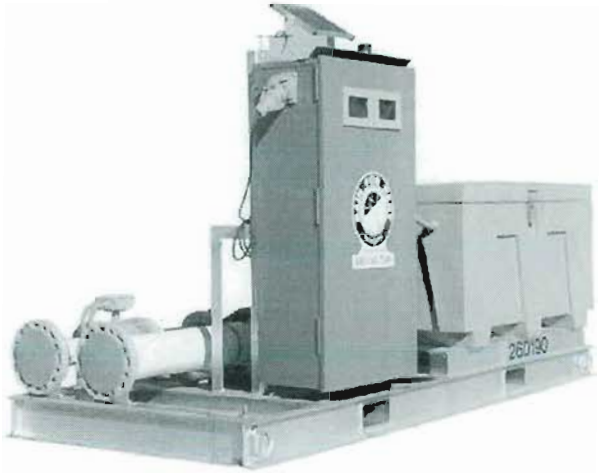
Portable Water Quality Monitoring System

Setting New Standards for Stormwater Compliance

Features

- 24 Hour Monitoring 7 Days a Week
- Equipped with pH & Turbidity Probes*
- Hach SC 100 Controller (downloadable data)
- Audio & Visual Status Alarms
- Maximum Flow Rate = 1,000 gpm
- Maximum Pressure = 80 psi
- Requires 110VAC/15amp power

* Other site specific probes available



RAIN FOR RENT®

Complete Solutions... Proven Results.

800-742-7246
rainforrent.com

Rain for Rent

Model PF 400

Particulate Filter

Features

- Quadruple bag and double cartridge filtration
- Four (4) bag filters for high solids holding capacity
- Two (2) multiple cartridge filters for fine solids removal
- Replaceable filtration cartridges from 100 to .5 micron nominal rating
- Manifold valving for ease of use
- Isolation valving for ease of service
- No moving parts
- Separate sampling ports for all chambers

Technical

- Bag filters are used with cartridge filters, in series, to provide efficient filtration
- Units fitted with bleed valves and pressure gauges
- Initial pressure drop is less than 5 psi at 400 gpm
- System can stand alone for sediment removal or be used in combination with media vessels
- Multiple cartridge filters provide large surface areafor longer service life
- Skid footprint: 90" long x 84" wide x 72" high
- Skid dry weight: 2,400 lbs

Material Specifications

- Chambers constructed of 304 Stainless Steel
- Piping constructed of 304 Stainless Steel
- 3", 150 lb flange inlet and outlet
- Each bag filter chamber holds one (1) 7" x 30" double-stitched filter bag
- Each cartridge chamber holds twelve (12) 40" single open-ended cartridges with 2-1/2" OD and 1" ID
- Maximum operating pressure: 125 psi
- HDPE pipe and fittingRoll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/ sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

Maximum PSI: 125
Maximum Flow: 400 GPM

Available Accessories

- Power Prime Pumps
- Spill Guard Containment berms
- Stainless Steel 304 and Carbon Steel storage tanks
- in Bi-Level, Mixer, Weir and Manifold configurations
- HDPE pipe and fittings
- Roll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

Rain for Rent
P.O. Box 2248
Bakersfield CA 93303
800-742-7246
661-393-1542
FAX 661-393-1542
www.rainforrent.com
info@rainforrent.com

Rain for Rent

Model 24-3 SSKH

Deep Bed

Sand Media Filtration

Features

- Filter tanks are constructed out of 304 stainless steel
- Skid is constructed out of carbon steel with integral forklift slots
- Stainless steel inlet, outlet and backwash manifolds
- Corrosion resistant
- AC and DC powered automatic filter backwash controller that allows for timed, pressure differential or manual backwash intervals
- Equipped with continuous acting air vents
- System can stand alone or be used in combination with additional filtration equipment

Technical

- Consists of three 24" filter tanks
- Fitted with air vents and pressure gauges
- Tanks provide 9.4 square feet of filtration area
- Inlet and outlet manifold connection are 4" Victaulic
- Backwash manifold connection is 3" female NPT
- 6" media loading ports
- 6" media removal ports
- 100 psig working pressure
- 150 lbs. of gravel per tank
- 800 lbs. of sand per tank
- Most effective backwash rate is 50 GPM min.
- Footprint: ~78" long by ~22" wide
- Pressure sustaining valve to aid in backwash operation
- Solar battery charger for DC operation in remote locations

Maximum PSI: 100
Maximum Flow: 189

Available Accessories

- Power Prime Pumps
- Spill Guard Containment berms
- Stainless Steel 304 and Carbon Steel storage tanks in
- Bi-Level, Mixer, Weir and Manifold configurations
- Polyethylene storage tanks
- Cartridge and bag filters
- HDPE pipe and fittings
- Roll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/ sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

Rain for Rent
P.O. Box 2248
Bakersfield CA 93303
800-742-7246
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RAIN FOR RENT

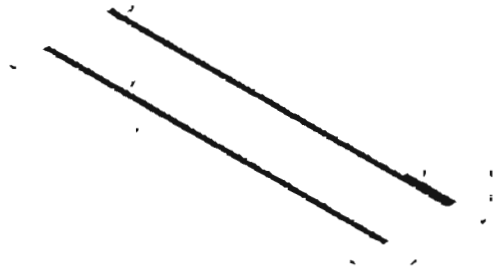
Spillguard™
Portable Containment Berms

FEATURES

- Lightweight
- Compact
- Portable
- Durable
- No Inflation Necessary, Sets Up in Minutes
- Heavy Duty, Chemical Resistant Materials

TECHNICAL

The SPILLGUARD™ berm is a compact, portable system ideal for use with temporary liquid storage tanks, pumps, or other equipment used in handling hazardous materials. The SPILLGUARD™ berm can be set up in minutes. The patentec, collapsible walls and light-weight materials allow for quick deployment. Tough, one piece construction, reinforced seams, and chemically resistant materials give extra protection under field conditions.



MATERIAL SPECIFICATIONS

The SPILLGUARD™ berm is manufactured of heavy duty 35 mil polyurethane coated fabric that offers excellent chemical resistance characteristics and durability. The unique design, patented collapsible walls, and compact size allow for convenient storage. SPILLGUARD™ units are available in a variety of sizes and can be made to fit specific applications. The heavy duty ground tarp and traffic belting supplied with the unit gives the drive-on capabilities and operator safety. Chemical and environmental resistance data available upon request.

Rain for Rent
P.O Box 2248 • Bakersfield, CA 93303
800-742-7246 • rainforent.com

RAIN FOR RENT

Rain for Rent

6,900 GALLON

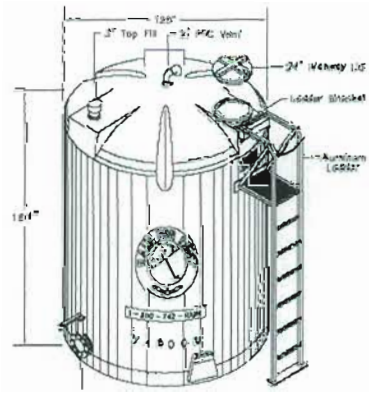
EZ KLEEN™ STORAGE TANK

Features

- 114% double containment for extra safety
- Completely enclosed tank inside of a tank
- Durable cross-linked polyethylene construction
- Highly chemical resistant
- EZ KLEEN™ tank with domed and sloped floor
- 3" PVC inlet and outlet valve with Viton seals
- 24" threaded manway
- Aluminum ladder with 24" work platform and safety chain
- Rain "light" top prevents rain water intrusion
- Top mounted valve with siphon tube to prevent leaks

Technical

EZ KLEEN™ 6,900 gallon crosslinked polyethylene storage tanks are durable, lightweight, compact and offer a wide range of chemical resistance. These tanks can be used to store waste water, storm water, caustics, acids, fertilizer, contaminated ground water and many other liquids. The EZ KLEEN™ sloped floor and domed top allows any liquid residue in the tank to be easily flushed out. Tank is designed to hold fluids up to 13.74 pounds per gallon. Can accept Ohmart Vega radar gauges.



Material Specifications

High density cross-linked polyethylene construction with a wide range of chemical resistance. (Chemicalresistance charts are available.) The EZ KLEEN™ secondary containment tank has a domed and sloped floor to facilitate cleaning. It also comes equipped with a 3" PVC fill and drainage line and a valve with Viton seals. Our aluminum ladder has a 24" work platform with safety chain. The valving is located next to the ladder platform for convenience and safety. The rain tight top prevents the accumulation of rainwater between the primary and secondary tank walls

Available Accessories

- Power Prime Pumps
- Spill Guard Containment berms
- Stainless Steel 304 and Carbon Steel storage tanks in
- Bi-Level, Mixer, Weir and Manifold configurations
- Polyethylene storage tanks
- Cartridge and bag filters
- HDPE pipe and fittings
- Roll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/ sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

Rain for Rent
P.O. Box 2248
Bakersfield CA 93303
800-742-7246
661-393-1542
FAX 661-393-1542
www.rainforrent.com
info@rainforrent.com

FlexTrex® Deionization Units
Temporary Systems

FlexTrex® deionization units from Siemens Water Technologies are ideal for polishing raw or RO permeate water. These skid-mounted ion exchange units are designed to treat flows ranging from 20 to 250 gpm per unit. FlexTrex® units have quick disconnects and can be installed and placed in service quickly using flexible hoses. Regenerated off-site, these portable units do not use any hazardous chemicals and do not generate any wastewater.

In certain instances, FlexTrex® units are an economical alternative to service deionization bottles. With their rugged design, small footprint and ability to treat high flow rates, these tanks are ideal for many applications. Constructed of 316 stainless steel, FlexTrex 42 units treat water up to 140°F and are ideally suited to short or long-term condensate polishing applications.

FlexTrex® units can be configured in parallel or series, and combined with other Siemens Water Technologies products for a fully integrated water treatment system that meets your plant's specific flow and quality requirements. They are serviced and exchanged by Siemens' fast, reliable local service network, which is available 24 hours a day. Our regeneration facilities and experienced service personnel ensure that you receive an uninterrupted, consistent supply of treated water that meets your quality and quantity requirements.

Typical Applications

- Power plants
- Refineries
- Chemical companies
- Petrochemical
- Pulp and paper
- Steel
- Food and beverage
- Semiconductor
- Electronics
- Automotive
- General industrial

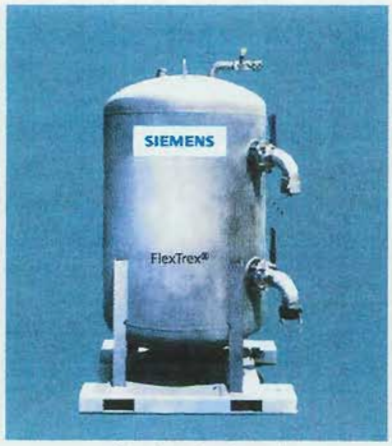
Features

- Portable
- Skid-mounted
- High flow rate
- Industrial design

Controls and Instrumentation

Siemens Water Technologies can add controls and instrumentation to these units on an as-needed basis, depending on your requirements.

FlexTrex® 36 unit



FlexTrex® 42 unit

FlexTrex® 48 unit

FlexTrex® Deionization Units Temporary Systems

FlexTrex® Units	FlexTrex® 36	FlexTrex® 42	FlexTrex® 48	Super 30
Vessel Size	36" dia. x 48" Side Sheet	42"dia. x 48" Side Sheet	48" dia. x 60" Side Sheet	36" dia. x 54" Side Sheet
Media Volume (ft^3)	30	42	60	30
Service Flow Rate (gpm) Min./Max.	20/100	35/150	35/250	20/100
Pressure Drop (psig) @ 77°F	Approx. 15 @100 gpm	Approx. 15 @150 gpm	Approx. 10 @ 250 gpm	Approx. 25 @100 gpm
Resin	SAC/SBA/MB	SAC/SBA/MB	SAC/SBA/MB	SAC/SBA/MB
Exchange Capacity (Kgr)	750/420/240	1050/588/336	1500/840/480	750/420/240
Operating Pressure (psi) Min./Max.	20/100	20/100	20/100	20/100
Operating Temperature (°F) - Max.	100	140 (SS Only)	100	100
Service Connections	2" or 3"	3"	4"	2"
Vessel Specifications Type Internal Lining	Carbon Steel Vulcanized Rubber Lined	316L SS None	Carbon Steel Vulcanized Rubber Lined	Carbon Steel Sprayed & Baked PVC
Piping/Internals	Sch. 80 PVC	Sch. 80 PVC or 316 SS	Sch. 80 PVC	Sch. 80 PVC
Weight (lbs.) Shipping/Operating	2,000/3,400	3,500/4,200	5,000/8,000	2,000/3,400
Dimensions (WxDxH)	40" x 42" x 78"	42" x 49" x 90"	50" x 61" x 92"	36" x 36" x 76"
Handling	Lifting Lugs & Fork Lift Ports Provided—Units Movable By Pallet Jack			
Media Options:	–Strong Acid Cation Resin (SAC) –Strong Base Anion Resin (SBA) –Weak Acid Cation Resin (WAC)	–Weak Base Anion Resin (WBA) –Mixed Bed Resin (MB) –Activated Carbon		–Organic Scavenging Media –Colloidal Removal Media

Siemens Water Technologies offers the widest range of mobile equipment solutions, and our extensive infrastructure fully supports your system and service requirements. Our experts can review your specific site conditions and make recommendations about the system that is best suited for your plant. To discuss your requirements for FlexTrex® units, mobile trailers or other water treatment systems, please call 800.435.3223.

FlexTrex® deionization units are ideal for:

- Polishing
- Pilot plant water
- Interim use until a permanent system is installed
- Process water quality changes
- Scheduled shutdowns
- Seasonal water needs
- Emergency water
- Feedwater quality changes
- Condensate polishing
- Softening
- Chlorine or chloramine removal

Siemens
Water Technologies
Phone: 800.435.3223
847.706.6900

Matt Culpo

From: Skyler Neibaur [SNEIBAUR@rainforrent.com]
Sent: Thursday, June 17, 2010 10:13 PM
To: Matt Culpo
Subject: RE: Rain for Rent Quote

Yes, that quote is based on the results in the table I sent a couple days ago.

From: Matt Culpo [mailto:matt.culpo@terragraphics.com]
Sent: Thu 6/17/2010 3:18 PM
To: Skyler Neibaur
Subject: RE: Rain for Rent Quote

Hey Skyler – One thing - Does this proposal meet the DEQ 7 water quality requirement similar to the table you sent a couple days ago or ???

Thanks

From: Skyler Neibaur [mailto:SNEIBAUR@rainforrent.com]
Sent: Thursday, June 17, 2010 4:09 PM
To: Matt Culpo
Subject: Rain for Rent Quote

Hello Matt,

Attached is the quote for the filtration at the mine. Please call my cell to discuss. Myself and a Siemens rep are going to try to get up to you next week sometime and maybe we can do a site visit and look at the situation if you think that would be possible.

Thank you!

Skyler Neibaur
Rain For Rent
Office: (208) 522-4500
Cell: (208) 521-6500
Fax: (208) 522-4511
sneibaur@rainforrent.com

From: SQL
Sent: Thursday, June 17, 2010 4:05 PM
To: Skyler Neibaur
Subject: E-Mail Copy of Estimate 10-098-318439

Customer: Terragraphics Engineering
Email: matt.culpo@terragraphics.com
Assigned To: Skyler Neibaur
Requested By: Skyler Neibaur

Download Adobe Acrobat Reader
http://www.adobe.com/products/acrobat/readstep2.html

Matt Culpo

From: Skyler Neibaur [SNEIBAUR@rainforrent.com]
Sent: Monday, June 14, 2010 8:04 AM
To: Matt Culpo
Subject: RE: Rain for Rent

Hey Matt,

Yes, their report is for the untreated water sample. The iron and manganese will be pulled out with Rain for Rent's filtration equipment as it is in suspension and our units will take care of them just fine.

If you can get a loading limit for the creek, we can have Siemens rerun the test to see what kind of cost savings we could help you with.

Skyler Neibaur
Rain For Rent
Office: (208) 522-4500
Cell: (208) 521-6500
Fax: (208) 522-4511
sneibaur@rainforrent.com

From: Matt Culpo [mailto:matt.culpo@terragraphics.com]
Sent: Friday, June 11, 2010 4:28 PM
To: Skyler Neibaur
Subject: RE: Rain for Rent

Thanks for Skyler.

We can talk Monday. Couple questions for what you sent below. The Seimens report appears to be for the untreated mine water. Is that right? The treated water estimates look good. It looks like cadmium is above the DEQ limit and there are no results for iron and manganese which is fine since they are aesthetic standards.

We are also working another discussion with DEQ to remove just enough of the metals such that the total loading in lbs per day to the creek does not increase above the existing. This would require treatment to reduce the concentration by 10-20 times instead of meeting the standard. Let me know if that approach would provide much of a treatment cost savings.

Thanks

Matt

From: Skyler Neibaur [mailto:SNEIBAUR@rainforrent.com]
Sent: Friday, June 11, 2010 1:22 PM
To: Matt Culpo
Subject: Rain for Rent

Hey Matt,

Got your voicemail. I am in meetings today so I'll shoot you a quick email. I have the quote tied up and I am just waiting for my regional filtration specialist to sign off on it. I will pass it on as soon as it's approved.

Below are the tables with Siemen's results:

Metal	Expected Conc. (ppb)	Siemens Estimated Media Effluent (ppb)	Discharge Limit from 5/21/10 Chart (ppb)
Arsenic	3940.0	<10	10
Cadmium	79.1	<1	0.097
Copper	32.0	<1	2.85
Lead	315.0	<.5	0.545
Nickel	20.0	<10	16.1
Zinc	11300.0	<25	37

SIEMENS

Siemens Water Technologies Corp.
2430 Rose Place
Roseville, Minnesota 55113
Telephone: (651) 638-1300
Facsimile: (651) 633-5074

ION EXCHANGE ANALYTICAL REPORT

CLIENT NAME: Rain for Rent - Terragraphics Environmental Engineering (Helena, MT)
SAMPLE DESCRIPTION: Abandoned Mine Wastewater
ANALYSIS DATE: April 21, 2010

Cations	Total mg/L ion	Dissolved mg/L ion
Aluminum (Al^{+3})	1.34	1.29
Barium (Ba^{+2})	BDL	BDL
Beryllium (Be^{+2})	BDL	BDL
Cadmium (Cd^{+2})	0.114	0.109
Calcium (Ca^{+2})	49.3	48.0
Chromium (Cr^{Total})	BDL	BDL
Cobalt (Co^{+2})	BDL	BDL
Copper (Cu^{+2})	BDL	BDL
Iron (Fe^{+3})	5.56	2.11
Lead (Pb^{+2})	BDL	BDL
Magnesium (Mg^{+2})	15.0	15.0
Manganese (Mn^{+2})	6.92	6.92
Mercury (Hg^{+2})	BDL	BDL
Nickel (Ni^{+2})	BDL	BDL
Potassium (K^{+1})	4.15	4.13
Silver (Ag^{+1})	BDL	BDL
Sodium (Na^{+1})	11.3	11.3
Thallium (Tl^{+2})	BDL	BDL
Titanium (Ti^{+2})	BDL	BDL
Tin (Sn^{+2})	BDL	BDL
Zinc (Zn^{+2})	11.3	11.2
Arsenic (As)	0.260	BDL
Antimony (Sb)	BDL	BDL
Molybdenum (Mo)	BDL	BDL
Selenium (Se)	BDL	BDL
Silicon (Si)	24.7	24.7
Vanadium (V)	BDL	BDL
Free Mineral Acidity	NA	mg/L $CaCO_3$
Total Acidity	NA	mg/L $CaCO_3$
Free Carbon Dioxide (CO_2)	NA	mg/L $CaCO_3$

Anions	mg/L ion	
Bicarbonate (HCO_3^{-1})	NA	
Carbonate (CO_3^{-2})	NA	
Chloride (Cl^{-1})	NA	
Chromium (Cr^{+6})	NA	
Fluoride (F^{-1})	NA	
Hydroxide (OH^{-1})	NA	
Nitrate (NO_3^{-1})	NA	
Phosphate (PO_4^{-3})	NA	
Sulfate (SO_4^{-2})	NA	

Other Parameters		
pH	3.81	electrometric
Conductivity	489	µS/cm
TDS (by evaporation)	NA	mg/L
TOC	15	mg/L
COD	NA	mg/L
TSS	NA	mg/L
Color	Orange	visual
Turbidity	NA	FTU
Cyanide (CN)	NEG	mg/L
Ferricyanide ($Fe[CN]_6$)	NEG	
Odor	None	

Discharge Limits: Not Given.
FlowRate: 60-120 Gallons Per Minute.
Treatment with ASG-SCN total metals:
- Cd 0.002ppm, Cu 0.003ppm, Fe 1.91 ppm, Mn 0.261ppm, Ni 0.007ppm, Zn 0.391 ppm.

Treatment with ASG-SCN 0.45µm filtration metals:
- Cu 0.001ppm, Zn 0.007ppm.

NOTES:
BDL = BelowDetection Limit
NA = Not Analyzed
POS = Positive Spot
NEG = Negative Spot

May 5, 2010

Christopher T. Riley, P.E.
Siemens Water Technologies Corp.
Roseville, Minnesota

Results are for information only and were obtained using internal analytical procedures. These procedures may not adhere to standards found in Standard Methods or required by USEPA or other regulatory bodies for certification as an independent, commercial laboratory and are not intended to be interpreted or used as such.

Skyler Neibaur
Rain For Rent

Attachment D

Land Application

Evaporation

Temporary Storage

Physical Soil Properties

Helena National Forest Area, Montana

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
12D:														
Typic Cryoboralfs	0-1	---	---	0	---	42.00-705.00	---	---	28-70	---	---	5	6	48
	1-10	---	---	18-27	1.10-1.30	4.00-14.00	0.10-0.14	0.0-2.9	2.0-4.0	.20	.37			
	10-17	---	---	20-35	1.35-1.60	1.40-4.00	0.09-0.10	0.0-2.9	0.0-1.0	15	.37			
	17-60	---	---	0-5	1.50-1.60	14.00-42.00	0.05-0.07	0.0-2.9	0.0-0.5	.05	.28			
76:														
Typic Cryochrepts	0-4	---	---	15-25	1.20-1.40	4.00-14.00	0.09-0.13	0.0-2.9	1.0-2.0	.20	.37	3	6	48
	4-20	---	---	7-15	1.30-1.50	14.00-42.00	0.07-0.08	0.0-2.9	0.5-2.0	.10	.20			
	20-45	---	---	7-15	1.30-1.50	14.00-42.00	0.07-0.08	0.0-2.9	0.5-2.0	.10	20			
	45-55	---	---	---	---	---	---	---	---	---	---			
77B:														
Typic Cryochrepts	0-4	---	---	20-27	1.10-1.30	4.00-14.00	0.09-0.12	0.0-2.9	2.0-5.0	.10	.37	3	7	38
	4-32	---	---	20-27	1.10-1.30	4.00-14.00	0.09-0.12	0.0-2.9	2.0-5.0	.10	.37			
	32-44	---	---	3-10	1.35-1.55	14.00-42.00	0.05-0.07	0.0-2.9	0.0-0.5	.05	.43			
	44-54	---	---	---	---	---	---	---	---	---	---			

$4\ \frac{mm}{s} = 0.000004\ \frac{m}{s}\left(\frac{60s}{min}\right)\left(\frac{60\ min}{hr}\right)\left(\frac{39.37\ in}{1\ m}\right) = 0.57\ \frac{in}{hr}$

$14\ \frac{mm}{s} = 0.000014\ \frac{m}{s}\left(\frac{60s}{min}\right)\left(\frac{60\ min}{hr}\right)\left(\frac{39.37\ in}{m}\right) = 1.98\ \frac{in}{hr}$

Table 4.1 TYPICAL PERMEABILITY VALUES FOR SOILS

Coefficient of permeability (log scale)	m/s	10^{-11}	10^{-10}	10^{-9}	10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1
	cm/s	10^{-9}	10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1	10	100
	ft/s	10^{-10}	10^{-9}	10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1	
Permeability:		Practically impermeable		Very low		Low		Medium		High			
Drainage conditions:		Practically impermeable			Poor			Good					
Typical soil groups:			GC→	GM→			SM		SW→		GW→		
			CH	SC MH MC–CL	SM–SC				SP→		GP→		
Soil types:		Homogeneous clays below the zone of weathering		Silts, fine sands, silty sands, glacial till, stratified clays				Clean sands, sand and gravel mixtures			Clean gravels		
				Fissured and weathered clays and clays modified by the effects of vegetation									

Note: the arrow adjacent to group classes indicates that permeability values can be greater than the typical value shown.

CLAY OPTION #7

FLOW RATE 40 gpm

INFILTRATION RATE 0.05 IN/HR ⇒ SILT ⇒ SILT/CLAY

$$40 \frac{gal}{min} = \text{AREA} \left(\text{INF RATE} \right)$$

$$40 \frac{gal}{min} \quad \frac{1 FT^3}{7.48 gal} \Rightarrow \frac{5.35 FT^3}{min} = \text{AREA} \left(0.0000694 \frac{ft}{min} \right)$$

$$0.05 \frac{IN}{hr} \left(\frac{1 hr}{60 min} \right) \left(\frac{1 ft}{12 in} \right) = 0.0000694 \frac{ft}{min}$$

AREA = 76945 ft^2

Models - Waste Water Evaporation Water Treatment Water Mister System

Evaporator Models and Purchasing

Start by choosing your Evaporator Model, and then customize it for maximum evaporation efficiency.

1. BASIC MODEL – **POWDER COATED** includes switchgear for the evaporator but requires a pump w/ switchgear & intake system to operate

Suggested retail price is $30,534.00 CANADIAN FUNDS

2. BASIC MODEL – **PAINTED ONLY**, includes switchgear for the evaporator but requires a pump w/switch gear & intake system to operate

Suggested retail price is $26,651.00 CANADIAN FUNDS

3. TRAILER MODEL – includes switch gear and pump/intake

Suggested retail price is $61,491.00 CANADIAN FUNDS

4. FLOAT MODEL – includes switch gear and pump/intake

Suggested retail price is $70,421.00 CANADIAN FUNDS

Models

Waste Water Evaporation Water Treatment Water Mister System

- Choose Your Model
- Standard Features Basic Model
- Standard Features Trailer Model
- Standard Features Float Model
- Freight Policy

- Home
- Corporate
- Design
- Specs
- Setup Variables
- Models
- Turbomist Evap Rates
- Pdf's
- Videos
- Contact

return to applications overview

Wastewater Evaporation with Rotary Atomizers

The best way to dispose of certain types of wastewater can be to get it up in the air and evaporate it. Air assisted rotary atomizers get more air mixed with more water for higher evaporation rates with lower energy use.

Ideal for:

- **wastewater evaporation**
- **water fracturing**
- **mine water removal**
- **Food process water**
- **Industrial process water**
- **CBM water**
- **oil and gas wastewater**
- **drillwater & drill mud**
- **other dewatering**

Advantages:

- Atomizer highly resistant to wear & clogging
- sprays mud and suspended particulates incl drill mud
- Resistant to salts, lime, and dissolved solids
- encrusted parts can be cleaned and reused

Let's start with the basics on what makes a good wastewater evaporation process work:

- **The amount of surface area you make from each gallon of water matters.** The smaller the droplets the more surface area you get out of the water. The more surface area, the faster the evaporation. The smaller the droplets, also the slower they fall back to earth. More time suspended means more time to evaporate.
- **The amount of air you can mix with the water matters.** Great air mixing is CRITICAL! You can only evaporate enough water to saturate the air. No matter how fine the drops or how high you spray them, if the air saturates with humidity, you're done evaporating. A high volume airflow that is highly turbulent to mix with and entrain surrounding air will *significantly* increase your evaporation rates.
- **How many gallons per minute you can remove matters.** If you have 20 million gallons of water to evaporate, what good is an evaporator that can do 10 or 12 gallons per minute? The array at right is shown atomizing approximately 64 gallons per minute. Current improvements allow it to reach over 80 GPM.

Which atomizer is right for the job?

Typical atomizer configuration: For raw atomizing and air power, with the most rugged durability, our PT100 Air-assisted and guarded, hydraulic drive atomizers (shown at left) are generally indicated. With a maximum airflow of 10,000 CFM (300 cmm) of highly turbulent air, and a maximum water capacity of 6 gallons per minute, each atomizer is capable of spraying over 8500 gallons (33,000 liters) per day.

An array of PT100 atomizers can make quick work of your wastewater. A 1 million gallon pond (1 acre, 3' deep) could be evaporated in as little as *1 month* with a 4 atomizer array, or *2 weeks* with 8 atomizers.

Learn More:

- Air-assisted and Guarded Atomizers
- Video- Viscous Spraying
- Video-evaporation applications
- Contact ASTON EVAPORATIVE SERVICES
- Contact us

For high volume, high dissolved solids applications:

- **Proptec PT100 Air-assisted** and gua hydraulic drive atomizer

For smaller jobs:

- **Penguin PT200** electric atomizer with or w air assist

Interstate Products, Inc.

"Quality Environmental Solutions"

RELATED PAGES

Tank Gallery


Fuel Bladders


Horizontal Water Tank

NEW BERM IMAGE COMING SOON
Ready Spill Berms


550 & 275 gal. Oval Containment


Custom Chemical Storage Bladders


Odd Shaped Bladders

Water Containment Bladders

IPI Water Bladders are available for relief situations and/or military use just ask for bladder special services. Civilian and Industrial Bladder Tank users should call our general call in number is **1-800-474-7294** for day time or normal business hours. South Florida shipping location at **941-377-8610**.

Anytime, anyplace there is a need for temporary potable water storage, Interstate Products has the solution. Disaster relief organizations can depend on IPI to deliver water containment bladders when emergency situations demand a fast response. We specialize in working with civilian, government and military organizations to coordinate the delivery of potable water, the most valuable commodity when a disaster strikes.

We understand that time is of the essence during emergency situations and have setup a specialized internal department to route emergency incoming calls for water bladders. When calling 1-800-474-7294 or 941-377-8610, just identify your organization and ask for Relief Services during normal business hours. After hours, please call 1-800-472-3392 and a product specialist will assist you immediately by gathering all the necessary information needed to make sure we can begin processing your order the very next day.

(Click to Enlarge)

Give us a call at 1-800-474-7294 for a free custom qoute

From our South Florida location, we currently have in stock and ready for immediate shipment 50,000, 25,000, 2,000, 1,000, 500 and 100 gallon potable water bladder tanks. We can also build custom potable water bladder tanks, grey water , fuel bladder and chemical containment bladder tanks to exact specifications. We also specialize in standard or custom bladder tanks for grey water, fuel and chemical storage that can be built to commercial or to mil specifications. Standard water bladder tanks are fabricated with top quality materials and fabric which provides ultra-violet light and chemical resistance. Many fabrics and connections available. Our water bladders are available with many connections for a wide variety of applications. Options for bladders include both sun shades and ground cloths for over and under the bladder protection.

Our water bladders are available with many connections for a wide variety of applications. Options for bladders include both sun shades and ground cloths for over and under the bladder protection.

Click here for Common Sizes & Capacities

Contact us via Email or Call us toll free at 1-800-474-7294

Call 1-800-472-3392 for after hours or emergency information on all water bladders or special inquiries.

- Bladder tanks built to meet Mil Specs. or Civilian
- 3" overlap welds
- Connection sizes from .25" - 4"
- Custom solutions
- Strict Quality Control
- Many high standards to improve durability

We use NSF 61 approved fabrics for potable water use.

News - Naval Support

"Florida Business Donates 10,000-Gallon Water Bladder to Navy Marine Corps Team"

Release Date: 1/7/2005 11:35:00 AM

"ABOARD USS BONHOMME RICHARD, At Sea (NNS) -- Interstate Products, Inc., donated a 10,000-gallon collapsible water bladder to the Navy/Marine Corps team aboard San Diego-based USS Bonhomme Richard (LHD 6) (BHR) as it prepared to conduct humanitarian assistance operations in Indonesia."

Contact us via Email or Call us toll free at 1-800-474-7294

Every bladder tank is manufactured to exacting quality standards using 3" overlap welds on all seams. All corners and fitting areas are reinforced for additional strength and durability. Bladder tanks are manufactured using materials best suited for the application to provide resistance against temperature extremes, humidity, ultra-violet, abrasion, impact, and corrosion. You can also choose from a variety of fittings and connectors that will best serve your needs. Our water and fuel containment bladders are used worldwide by emergency response, disaster relief, defense installations, homeland security and by chemical plants, utility companies, farms, refineries, construction sites, airports, fire departments, maritime fleets, and HazMat teams.

Notes:

The empty dimensions bladder tank sizes can vary a little depending on application, fabric used and/or military spec.

Options:

For use on rough terrain areas. Ground Mats are water proof and available for under the bladder for protection from rocks and sharp objects. **Extra matting extends life of the bladder and is made wider and longer than the tank to fully cushion our water bladders.**

For Questions & Orders: 1-800-474-7294 or Fax 1-866-333-3419

PORTABLE TANKGROUP
PO Box 780307
Sebastian, FL 32978
Phone: 772-646-4545
Fax: 772-646-0515

Quote

Date	Quote #
6/21/2010	1014

Name / Address	Ship To
TerraGraphics Matt Culpo	

Terms	Rep
Credit Card	JMR

Item	Description	Qty	Price	Total
PTZCUSTOM	Estimated Tank Capacity: 100,000 Gallons Filled Dimensions: 53.5' x 51.5' x 5' Fittings: One 2" Aluminum Center Vent with NPR Cap, Two 4" aluminum fill/drain ports each with ball vlave, male camlock adapter and cap. Accessories Included: Emergency Repair Kit and shippping/storage crate Material: WST18	1	42,750.00	42,750.00T
PTZCUSTOMAC...	Flat sheet Ground Cloth Dimension: 60' x 60' Material: WST01		189.00	189.00T

Have Questions/Comments? Info@PortableTankGroup.com

Terms for approved client accounts:
VISA, Master Card, American Express and Discover accepted.
Shipping terms: Ex-Works, unless otherwise specified. Portable Tank Group, Inc. Terms and Conditions apply.
NOTE: Dimensions and color will vary and are selected based on production efficiencies. should a specific color or size be required it must be requested prior to order and confirmed upon invoice.
All prices are valid for 30 days unless otherwise specified. Freight is not included unless otherwise specified.
NO WARRANTY PROVIDED WITHOUT AN APPROVED MSDS

Subtotal	USD 167,086.50
Sales Tax (0.0%)	USD 0.00
Total	USD 167,086.50

"The Collapsible, Flexible Liquid Storage People!"

www.PortableTankGroup.com

Ask me about our Low Price Guarantee! We will meet or beat a lower price for the same item. Send us a copy of the quote with your order and we will beat it by up to 5%. Same Quality, Better Service! We want your business! ****Subject to Management Approval****

Attachment E

Evaporation with pH Adjustment

Custom Estimate Developed Especially for:

Matt Culpo
Terragraphics Engineering
302 N. Last Ch. Gulch Ste. 409
Helena, MT 59601
Phone: 406-441-5441
Fax: 406-441-5443

Prepared on 6/28/2010 by:

Rain for Rent

Skyler Neibaur
Cell: (208) 521-6500
P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

www.rainforrent.com

Rain for Rent's Engineering Department designs a wide spectrum of liquid handling systems. From the simplest pumping operation to the most complex bypass project, our engineers are available to assist you in designing a system to fit your needs.

Rain for Rent Idaho Falls

Rental/Sale Estimate

www.rainforrent.com

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-344457

Prepared By: Skyler Neibaur

Job Description:

Pump and evaporate water with metal components at mine; arsenic, cadmium, copper, lead, nickel, zinc, manganese, iron. pH adjustment to 6-7. System sized for up to 20 gpm flow rate.

Customer: Terragraphics Engineering

Customer ID: S08957
Address: 302 N. Last Ch. Gulch Ste. 409
City/State: Helena, MT 59601
Contact: Matt Culpo
Office: 406-441-5441
Fax: 406-441-5443

Location:

Lilly/Orphan Boy Mine
Near Helena, MT

Rental Sub Total: $4,781.00

Sale Sub Total: $898.00

Sub Total: $5,679.00

*The Terms and Conditions of the Rain For Rent Rental and Acute Hazardous Waste Agreements, Credit Application, Invoice and this estimate contain the complete and final agreement between Rain For Rent and Customer and no other agreement in any way modifying or adding to any of said Terms and Conditions will be binding upon Rain For Rent unless made In writing and signed by a Rain For Rent Corporate Officer.
*Payment terms are net 30 days from invoice date. A 1.5%month late charge will be made on any past due invoices.
*Estimate is valid for 30 days and is subject to credit approval.
*Availability subject to change without notice.
*Estimates are based on Customer supplied information and are subject to change based on actual requirements and usage.

Est. Delivery Hauling	$5,350.00
Est. Pick-up Hauling	$3,200.00
Est. Install Labor	$3,300.00
Est. Removal Labor	$2,190.00
Est. Services	$0.00
Est. Fuel Surcharge	$0.00

(Does Not Include Sales Tax)

Estimate Total: $19,719.00

Date Prepared: 6/28/2010

Valid Until: 7/28/2010

Customer

Date

By signing this estimate, customer represents that customer has read and agreed to all terms of this estimate, including those on Terms & Conditions page and those on the Additional Specifications page (if applicable).

Rain for Rent Idaho Falls

Rental/Sale Estimate

www.rainforrent.com

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-344457

Application: Filtration Materials: Water w/ metal components Flow: Up to 20gpm Suction Lift: NA Friction Loss: NA Static Head: NA

*Rain for Rent Cycle = 28 Days.
This estimate has not been flagged as PREVAILING WAGE.

Rental Items

Qty	Unit	Duration	Item	Description	Day	Week	*Cycle	Extension
2	Each	1 Week	MRC	5hp Submersible Pump - 20 gpm @ 65psi	$0.00	$225.00	$0.00	$450.00
1	Each	1 Week	MRC	25kw Genset w/ SO Power Cords-Burns 1 gallon of diesel fuel per hour	$0.00	$475.00	$0.00	$475.00
1	Each	1 Week	+632005	BF100 Bag Filter	$0.00	$270.00	$0.00	$270.00
1	Each	1 Week	+632505	Portable Water Quality Monitoring Box w/ Sodium Hydroxide pH adjustment	$0.00	$1,500.00	$0.00	$1,500.00
2	Each	1 Week		2400 Gallon Poly Batch Tanks		$203.00		$406.00
1	Each	1 Week	MRC	12'x50' Spillguard Secondary Containment w/ Ground and Track Mats	$0.00	$175.00	$0.00	$175.00
2	Each	1 Week	MRC	12'x16' Spillguard Secondary Containment w/ Ground and Track Mats	$0.00	$140.00	$0.00	$280.00
1	Each	1 Week	MRC	Evaporator Gun System - 20 gpm flow	$0.00	$775.00	$0.00	$775.00
1	Each	1 Week	MRC	Misc. Hoses, Valves, Adapters, etc.	$0.00	$450.00	$0.00	$450.00

Rental Sub Total: $4,781.00

Sale Items

Qty	Unit	Item	Description	Unit Price	Extension
1	Each	MS	Sodium Hydroxide Drum	$685.00	$685.00
30	Each	MS	10 Micron Bag Filters	$7.10	$213.00

Sale Sub Total: $898.00

Sub Total: $5,679.00

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-344457

Additional Specifications

Rain for Rent Responsibilities:

Deliver and install equipment.

Train on site personnell on operation and maintenance of equipment.

Removal of equipment at completion of pilot test.

Customer Responsibilities:

All permits, permit fees, and inspections as re-quired.

If applicable, work schedules indicating times during which interruption in normal service are permissible. All labor rates quoted in this proposal are for straight time, non-union labor.

Free and clear access to treatment site. Loading dock access or material handling equipment capable of safely handling necessary equipment.

System operation, including maintenance and wastewater quality monitoring.

Provide fuel for generator. Estimated usage 1 gallon per hour.

Forklift to assist in offloading water quality box and poly tanks on site.

Influent Parameters:
20 gpm

P O Box 1743
Idaho Falls, ID 83403-1743
Phone: 208-522-4500
Fax: 208-522-4511

Estimate Number: 10-098-344457

Terms & Conditions

Additional Terms

1 A cycle is defined as 4 weeks. A week is defined as one third of a cycle and a day is one third of a week. Customers will be invoiced at the appropriate cycle, weekly or daily rate based on actual equipment usage except for filtration, pipe, hose and fittings which will be billed at the cycle rates only and will not be pro-rated.
2 The rental rate for pumps and equipment with hour meters are based on an 8 hour day or 48 hour running week. The rental rate will be multiplied by 1.5 for greater than 8 hours per day or 49-96 operating hours per week and multiplied by 2.0 for more than 16 hours per day or 96 operating hours per week. Customer will be invoiced for 24 hours per day if the hour meter has stopped functioning.
3. Overtime will be invoiced at 1.5 times the regular rate for work occurring outside of normally scheduled business hours and 2.0 times the regular rate for work occurring on company recognized holidays.
4. Customer will authorize and pay for any changes to work scope including but not limited to schedule changes, material, labor, third party, permit, fee or service costs. It is the Customer's responsibility to cooperate in the timely processing, approval and payment of any charges within Rain For Rent's invoice terms.
5. Customer is responsible to determine the suitability of equipment for the application.
6. Delivery, Return, Installation and Removal costs are estimated. Customer will be invoiced for actual time. Transportation will be invoiced on a Portal to Portal basis.
7. Customer is responsible for flushing and cleaning tanks, roll off boxes, pipelines, pumps, filters and other Rain for Rent equipment prior to return.
8. Customer is responsible for equipment, repairs, maintenance and damage, excluding normal wear and tear. All returned equipment is subject to inspection by Rain for Rent personnel. Damages and accrued rent will be invoiced to Customer while equipment is out of service for repairs.
9. The Customer cannot alter the equipment without Rain For Rent's prior written approval.
10. Customer will provide "all risk" property insurance for rented equipment.
11. Customer will not allow any equipment to come in contact with any substance that will cause corrosion, damage or leakage.
12. The Customer assumes all risks of loss due to operation and use of the equipment.
13. Customer is responsible to obtain any permits, licenses, certificates, bonds and give all notices required by law.
14. The rental period begins the day the equipment is delivered and continues until returned to Rain For Rent's facility unless written confirmation of the release is provided to the Customer before that time.
15. Rental equipment must be returned to the renting Rain for Rent branch unless agreed to in writing before the rental period begins.
16. All material that comes in contact with Rain For Rent equipment including media is the responsibility of Customer as generator. Rain For Rent shall not be responsible for any fines or sanctions as a result of Customer's use of the equipment.
17. The equipment is sold "AS IS,WHERE IS" in its present condition. Seller makes no warranties, expressed or implied of any kind whatsoever with respect to the equipment. Buyer agrees that buyer has purchased the equipment based on his judgement and evaluation, without reliance upon any statements of representations of seller, and that seller is not responsible for any defects in its operation or for any repairs, parts or services, unless otherwise noted.
18. De-watering, Roll-off, Vacuum boxes and similar equipment are not liquid tight. Rentee accepts full responsibility for all losses, damages and costs caused by or arising out of spills, leakage or discharge from this equipment.
19. Customer will use the equipment in a careful and proper manner and in accordance with safety rules, industry standards, manufacturer's specifications, recommendations, regulations and applicable laws
20. Customer shall be responsible for environmental fees covering waste fluid, fuel, filter and other disposal costs.
21. A Fuel Surcharge will be calculated and invoiced based on the diesel fuel price as published by the Department of Energy on http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp
22. Customer shall pay Rain For Rent additional expenses caused by site, soil or underground conditions, including, but not limited to, rock formations, environmental conditions, regulations or restrictions, hard pan, boulders, cesspools, gas lines, water lines, drain pipes, underground electrical conduits or other above ground or underground obstructions.
23. Customer shall be responsible for acquiring and paying for, if necessary, all public and private property easements required by the project.
24. The estimated labor component of this quote is based on non-prevailing wage rates. If prevailing wage laws are applicable, Customer must notify Rain For Rent in writing before Rain For Rent estimate completed. If Rain For Rent was not properly notified, Customer shall promptly pay any change orders that adjust wages to prevailing wage rates. Customer is responsible for providing applicable prevailing wage rates to Rain for Rent. Rain For Rent will provide certified payrolls on a bi-weekly basis if notified in writing 10 days before the start of the project.
25. Customer is prohibited from deducting retention from Rain For Rent invoices and charging Rain for Rent liquidated damages.
26. Customer is responsible for all routine maintenance including fuel, fluids, lubrication and filters every 150 hours on engine driven equipment. Rain For Rent will charge Customer for servicing any equipment that is on rent or returned that has not been serviced in 150 hours. Rain For Rent can provide field service upon request for an additional service charge. Rain For Rent must be notified 2 business days in advance to schedule required field service.
27 This estimate excludes any additional costs to Rain For Rent associated with Owner Controlled Insurance (OCIP) or WRAP insurance programs that will be added to Rain For Rent's prices.
28. Customer is responsible to provide freeze protection for all equipment on site
29. This estimate excludes any costs associated with ARRA (American Recovery and Reinvestment Act) reporting requirements that may be flowed down

to Rain For Rent

30 Customer will be responsible for security, traffic control and road crossings. Traffic control shall meet all applicable Federal, State, and Municipal laws and regulations to assure a safe work environment.

31. Cold Weather Packages for tanks consist of up to 4 tank heaters and a submersible pump which is designed for use in a non-combustible or corrosive environment.

32. Tank heaters are operated on 120 volts, 12.5 amps each or 50 amps total. The submersible pump operates at 120 volts, 10 amps.

33. Customer is responsible for electrical connections and compliance with applicable permits, regulations and code requirements.

34. Tank Cold Weather Packages are not to be used in combustible or corrosive environments.

35 Tank Cold Weather Packages are a preventative measure that may keep fluids inside the tank from freezing. RFR will not guarantee fluids from freezing and any resulting damages.

Job Specific Terms

36. Rain for Rent does not warranty the degree of filtration associated with this equipment.

37. Field performance may vary if any of the system operating variables change. System variables in this context would include, but not be limited to, flow rate composition or concentration of solids· contaminants or constituents in the fluid to be filtered:, etc

38. Monitoring and operation of the filtration system is the responsibility of the customer.

39. It is the responsibility of the customer to clean and decontaminate all equipment prior to equipment pickup and removal by Rain for Rent.

40. All used filtration media, such as carbon, sand, cartridges, bags, coalescing packs, etc. become the property of the client and must be removed from the equipment prior to the return of this equipment to Rain for Rent.

41 A forklift may be required to offload and load the above equipment.

42. This estimate includes the filtration media (sand, carbon, cartridges, bags, and/or coalescing packs) required to initially fill and operate the equipment. Additional media will be provided at an additional cost.

43. A pilot test is recommended prior to shipment of equipment.

44. Due to the lack of information concerning the fluid stream to be filtered, no assumptions or guarantees are offered or implied as to the performance of the quoted filter units or the filter media.

45 This estimate is for budgetary purposes only. The prices shown are not firm and should not be considered as such. This is an estimate only and is solely based upon the available information as supplied by the user.

46. All filtration media is sold on a no-return/non-refundable basis.

47. Customer will be responsible for security, traffic control and road crossings. Traffic control shall meet all applicable Federal, State, and Municipal laws and regulations to assure a safe work environment.

48. Customer shall hold harmless, indemnify and defend Rain For Rent from any claims whatsoever, arising from or related to (A) any pollution, contamination, environmental impairment and/or similar condition directly or indirectly caused by or resulting in whole or in part from Customer's use of any Equipment or (B) any environmental statutory or regulatory compliance requirements applicable to any equipment (or any use thereof) and required under any and all foreign or domestic federal, state or local laws,ordinances, regulations, codes, or requirements of any governmental authorities which regulate or impose standards of liability or conduct concerning air, water, soils, wetlands and watercourses, solid waste, hazardous waste and/or materials, worker and community right-to-know, noise, resource protection, health protection and similar environmental, health, safety, and land use concerns as may now or at any time hereafter be in effect. This indemnification shall survive the termination of the agreement.

RAIN FOR RENT

Portable Water Quality Monitoring System

Setting New Standards for Stormwater Compliance

Patent Pending

Features / Benefits

- 24 hour monitoring 7 days a week
- Cost savings – Reduce manpower required for monitoring
- Keeps you in compliance to avoid costly fines
- High flow rates
- Recognized BMP to help meet your NPDES requirements
- Notifies you if a problem arises
- Operates off 110 volts no special wiring required
- Compact design minimal intrusion on project location
- Completely contained & lockable

Rain for Rent

P.O. Box 2248 • Bakersfield, CA 93303

800-742-7246 • 661-399-9124

rainforrent.com

RAIN FOR RENT®

Rain for Rent

BF 100
Up to 100 GPM

Features

- Manifold connections are 2" 150 lb flanges
- Single bag filter
- Bag filter for high solids holding capacity
- Replaceable bag filters from 100 to 1 micron nominal rating
- No moving parts
- Skid mounted

Technical

- Bag filter chambers connect in parallel
- Units are fitted with bleed valves and pressure gauges
- System can stand alone for sediment removal or be used in combination with filter equipment
- Footprint 48" long x 36" wide x 66" high
- Dry weight 325 lbs.

Material Specifications

- Chambers constructed of 304 Stainless Steel
- Piping constructed of 304 stainless steel
- Each bag filter chamber holds one (1) 7" x 30" double- stitched filter bag
- Maximum operating pressure: 125psi
- Stainless Steel inlet and outlet manifolds

Available Accessories

- Power Prime Pumps
- Spill Guard Containment berms
- Stainless Steel 304 and Carbon Steel storage tanks in
- Bi-Level, Mixer, Weir and Manifold configurations
- Polyethylene storage tanks
- Cartridge and bag filters
- HDPE pipe and fittings
- Roll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/ sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

Rain for Rent
P.O. Box 2248
Bakersfield CA 93303
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