QUESTA ROCK PILE WEATHERING STUDY

QUALITY ASSURANCE PROJECT PLAN

From Original Molycorp RIFS QAPP by
URS Corporation

September 2003

Modified for the
Questa Rock Pile Stability Study

October 30, 2008

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List of Acronyms

µg/kg	micrograms per kilogram
µg/l	micrograms per liter
ºC	degrees Celsius
ADTI	Acid Drainage Technology Initiative
AOIs	Areas of Interest
ASTM	American Society of Testing and Materials
bgs	below ground surface
cc	cubic centimeter
CLP	Contract Laboratory Program
cm/s	centimeters per second
COC	chain of custody
CSM	conceptual site model
DFC	decision flow chart
DOT	Department of Transportation
DQA	Data Quality Assessment
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
ºF	degrees Fahrenheit
FD	field duplicate
ft	feet
FSP	Field Sampling Plan
G	glass
GC	gas chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
GW	groundwater sample
HASP	Health and Safety Plan
HCl	hydrochloric acid
HNO_3	nitric acid
HSM	Project Health and Safety Manager
H_2SO_4	sulfuric acid
HSP	Health and Safety Plan
ICP	inductively coupled plasma emission spectrometer
ICP-MS	inductively coupled plasma mass spectrometer
ICS	interference check sample
ID	identification
I.D.	inner diameter
IS	internal standard

LCS	laboratory control sample
LIMS	Laboratory Information Management System
m	meters
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
ml	milliliter
MMD	Mining and Minerals Department
MS	matrix spike
MSD	matrix spike duplicate
MSHA	Mine Safety and Health Administration
MSR	Management Systems Review
MW	monitoring well
NA	not applicable
NIST	National Institute for Standards and Technology
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OD	outer diameter
OSHA	Occupational Safety and Health Administration
oz	ounce
PARCC	precision, accuracy, representativeness, completeness, and comparability
PE	performance evaluation
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
QC	quality control
RB	rinsate blank
study	Questa rock weathering study
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
SHSM	Site Health and Safety Manager
SOPs	standard operating procedures
SOW	scope of work
TSA	technical systems audit
UCL	upper confidence limit

USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
WP	Work Plan

REVISION LOG		
Revision Number	Description/Revised By	Date
QAPP.0	Draft SOP/Hamilton	2/06/04
QAPP.1	Update to reflect SOPs/Hamilton	7/08/04

1.0 INTRODUCTION AND PROJECT MANAGEMENT

The Questa Rock Weathering Study utilizes a consortium of multiple universities and consultants to study the processes and effects of weathering on the rock piles located on Molycorp's mine property near Questa, New Mexico. The studies encompass a wide variety of technologies, ranging from microscopic to mountain-scale, investigating geologic, chemical, physical, and microbial processes.

The Quality Assurance Project Plan (QAPP) is a document designed to provide guidance for carrying out the project tasks in such a way that the data obtained will be valid and defensible from a Quality Assurance aspect. The QAPP provides a general guidance for the conduct of project activities. Each specific task will have a Standard Operating Procedure (SOP) that will include Data Quality Objectives (DQO) and Quality Control (QC) procedures for that task. **In cases where a discrepancy exists between the QAPP and the SOP, the SOP will take precedence.**

1.1 DISTRIBUTION LIST

This QAPP will be distributed to the Principal Investigators, the Project Manager, and Molycorp personnel. It will be made available on the project web site so all project personnel may have access to it. The initial distribution is shown in Table 1.

Table 1 - QAPP Distribution	
Name	**Organization**
Terrence Chatwin	University of Utah
Virginia McLemore	New Mexico Bureau of Geology and Mineral Resources
Ward Wilson	University of British Columbia
Kim Lapakka	Minnesota Dept. of Natural Resources
Bruce Walker	Molycorp
Ann Wagner	Molycorp
Ed Trujillo	University of Utah
Jack Adams	Weber State University
Dirk van Zyl	University of Nevada, Reno

1.2 PROJECT TASK ORGANIZATION

This project, with its multiple Principal Investigators (PIs) conducting research in different locations requires a sound management plan to function efficiently and keep the team focused on the project goals, and to perform within the allotted budget.

Dr. Terrence Chatwin will serve as Project Manager (PM) for this effort. He will be the focal point for coordinating activities, exchanging information, tracking budgets and schedules, and ensuring that the goals of the project are being achieved. Assistant Project Managers are Jack Hamilton and George Robinson. The Assistant Project Managers and the PM's normal office staff at the University of Utah will assist the Project Manager in his responsibilities. The Acid Drainage Technology Initiative (ADTI-MMS) Oversight Team (Oversight Team) will represent Molycorp and will communicate their needs and interests in the project to the Project Manager, as well as inform Molycorp of the project status. The Project Manager's primary responsibilities are summarized below and shown in Figure 1:

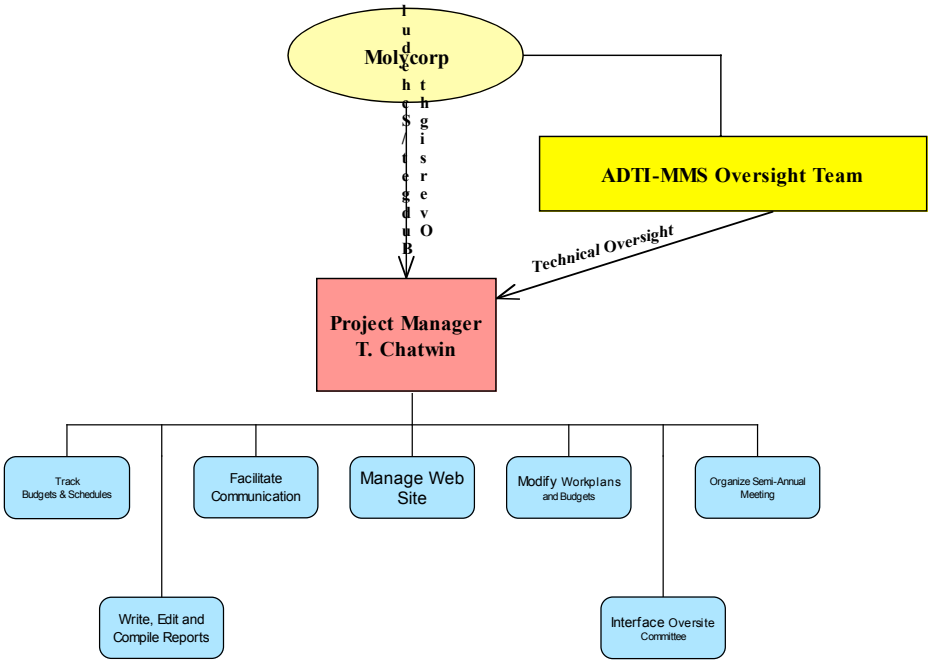


Figure 1 - Project Manager Responsibilities

Key personnel and Principal Investigators for the project are:

Dr. Virginia McLemore	Physical characterization and sampling	New Mexico Bureau of Geology and Mineral Resources
Dr. Kim Lappaka	Weathering cell testing	MN Dept. of Natural Resources
Dr. Ed Trujillo	Mathematical modeling of chemical weathering	U. Of Utah
Dr. Ward Wilson	Physical testing and mathematical modeling of rock pile stability	U. Of British Columbia
Dr. Jack Adams	Microbiological studies	Weber State University
Dr. Dirk van Zyl	Risk analysis	Univ. of Nevada, Reno

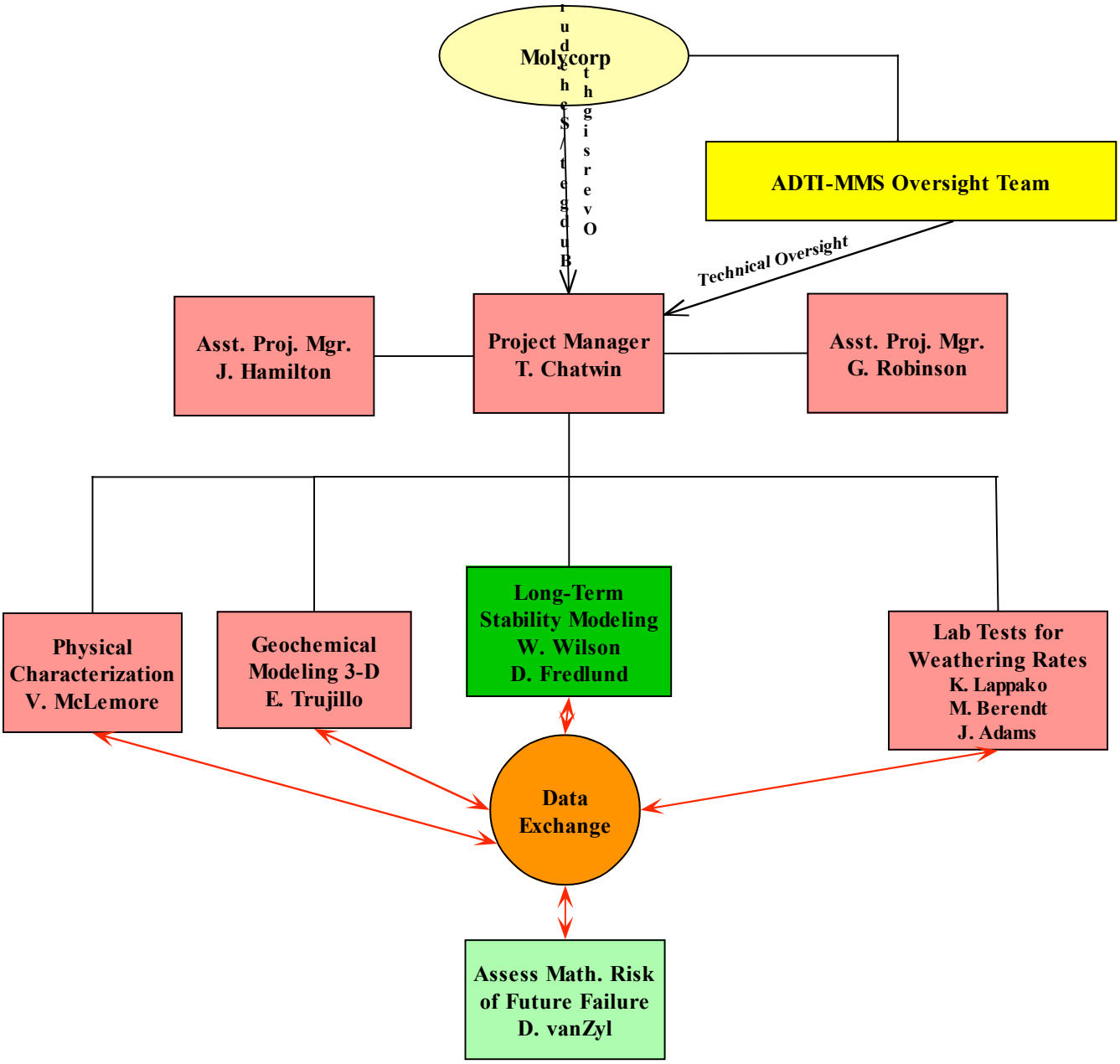


Figure 2 - Project Organization

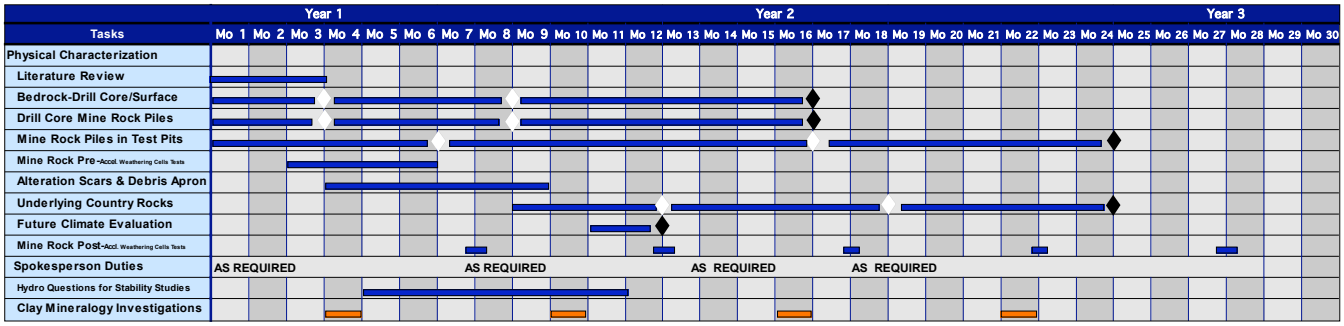
Clearly, the results of the long-term stability studies to be directed by Ward Wilson will determine the final success of the project. Likewise, the mathematical risk analysis headed by Dirk van Zyl will provide a tool to weigh the results of the stability studies for making decisions about future actions on the Questa mine rock piles. All the other project functions, while developing valuable data in their own right, essentially support the project goal of predicting the long-term stability of the mine rock piles.

Data and information will be exchanged between PIs through the mechanisms illustrated above (Figure 2). By posting verified and validated data on the project web site and enabling data download by authorized personnel (Table A-2), we will ensure that everyone is operating with the same information. The use of uniform software by the project team will ensure data compatibility and facilitate data integration and usage.

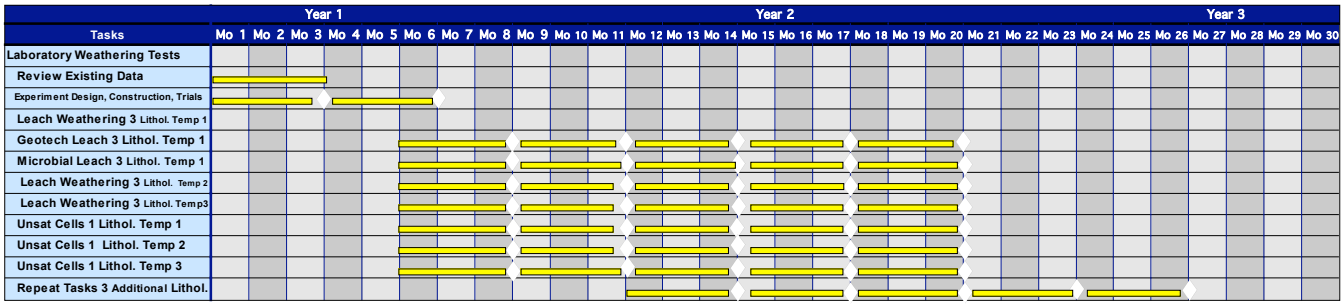
The project schedule is presented in the timeline graphics on the following two pages. The start is based on contract signing; however realizing that some project work has been initiated prior to the official project kickoff. The schedule has been broken down into major task groups so the information can be more easily visualized and compared from task to task.

Figure 3 – Schedule Timelines for Principal Investigations

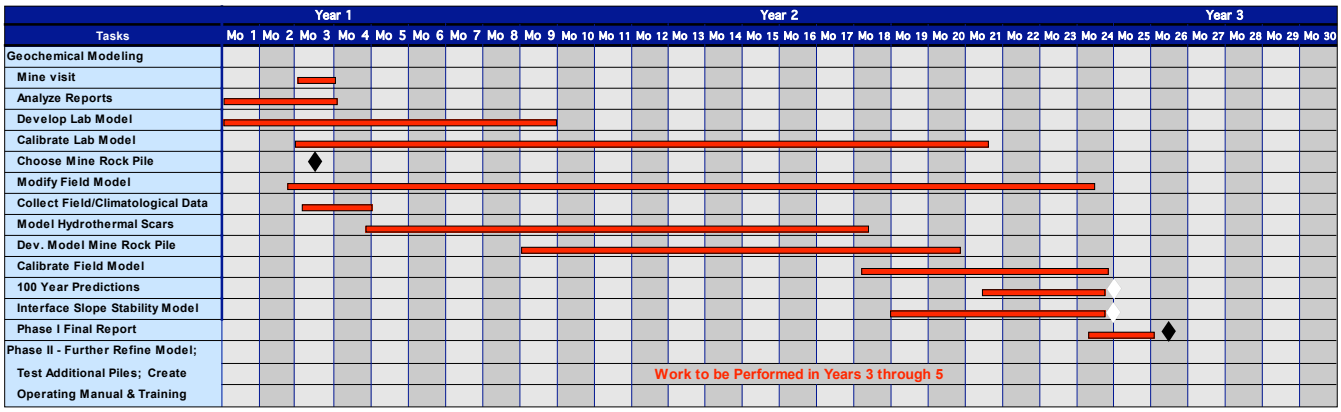
Physical Characterization Timeline



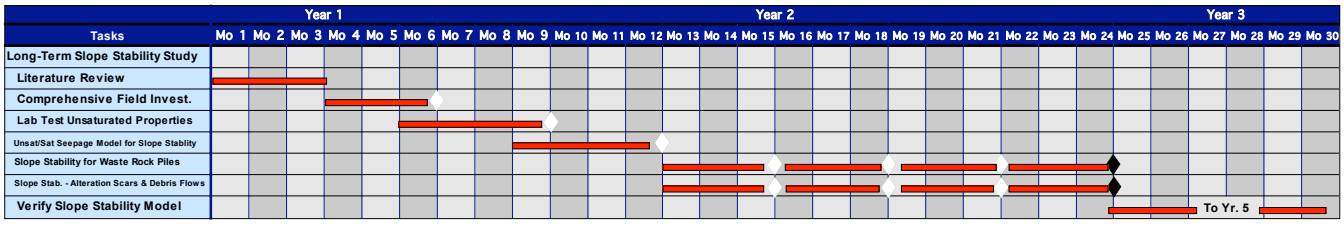
Weathering Cell Timeline



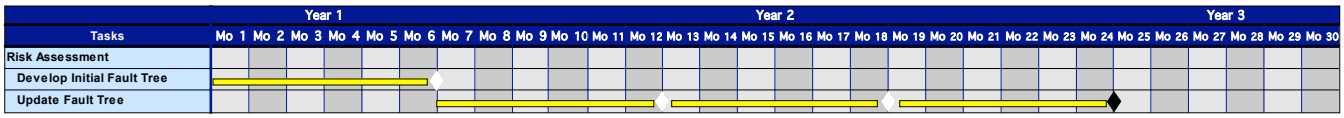
Geochemistry Timeline



Slope Stability Timeline



Risk Analysis Timeline



1.3 PROBLEM DEFINITION/BACKGROUND

Molycorp's Questa molybdenum mine has constructed rock piles over the years as a by-product of stripping overburden and other activities related to the open pit mining of molybdenum ore. These materials were piled on steep mountain slopes including alteration scar surfaces located on the mine property, mostly by end-dumping, but some by placement in lifts. The materials vary in size from boulders to clay-sized particles, and some contain varying amounts of pyrite. The rock piles are draped on slopes of 35^{o} or higher, and are up to 1600 feet high. Vegetation is sparse on the rock piles and erosion gullies are visible on the rock piles. A shear slope failure has occurred within one of the piles, Goat Hill North. Several of the rock piles are visible from State Highway 60.

The objective of this study is to determine the effect of long-term weathering on the rock piles. Many variables will affect the strength of the material over time, including the overall structure and composition of the piles, the oxidation of pyrite, the effect of the pyrite-generated acid on the overall mineralogy, the effect of heat developed by oxidation within the pile, microbial activity, movement of air and water throughout the pile, the conversion of feldspars to clay minerals, secondary cementation of the rock piles, other mineral diagenetic processes, and meteorology and climatology over time. This study will attempt to sample three rock piles and characterize their mineralogy, distribution and texture using several techniques. Dr. Virginia McLemore will supervise the rock pile characterization. Understanding how acid will be generated from pyrite oxidation is critical to predicting the future weathering of the rock piles. Therefore, Dr. George Brimhall will concurrently use samples to develop a geostatistical model of the pyrite distribution within the rock piles, including the amount and form of the pyrite. Samples will also be sent to Kim Lapakko for weathering-cell testing that will simulate and accelerate the natural leaching and weathering processes. The fluids generated by the testing, and the altered rock samples will be fully characterized. Based on this data, Dr. Ed Trujillo will use the weathering data to develop a mathematical geochemical model that will predict the changes expected to occur in the rock over time. Other work will define the hydrology of the rock piles, both present and predicted into the future. By understanding the chemistry and movement of fluids within the rock piles, the future characteristics of the rock piles can be predicted and the potential for future movement within the rock piles can be evaluated.

Geological and geochemical characterization information and predictive data will be used by Dr. Ward Wilson to predict the future rock behavior and stability of the rock piles. Dr. Wilson will examine trenches in the rock piles and will test rock pile samples to establish baseline data on which to base mathematical modeling of future behavior.

Dr. Dirk Van Zyl will evaluate all the data and attempt to assess the future risk of rock pile failure for the site.

It is important to keep in mind what this study is <u>not</u>. It is not an effort to determine hazardous waste that may be generated at the site from acid mine drainage in terms of heavy metals or other contaminants, nor is it an attempt to assess risk to human health or the environment from changes in the data quality objectives (DQO)s are designed to evaluate impacts on human health, and are thus extremely rigorous and detailed. That level of data quality is therefore inappropriate

for this quality assurance project plan (QAPP). Rather, because of the scale and nature of this study, data will be largely qualitative and semi-quantitative in nature. The distribution and diagenesis of minerals within the various rock types and rock mixtures is poorly understood, and little relevant outside information is available. To understand the critical elements of this research program, obtaining quality data is critical; therefore, the project DQOs, as defined in individual SOPs, will reflect the necessary level of data quality.

1.4 PROJECT TASK DESCRIPTION AND SCHEDULE

The project tasks description and schedule are shown in Figure 3. More detail on project tasks is found in individual PI's workplans and in the proposal document.

1.5 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

This section addresses the Data Quality Objectives (DQO) process applied in development of the Questa rock weathering study work plan. Because of the tremendous variety of tasks associated with this project, DQOs will be included, as appropriate, in the SOPs for the individual project tasks.

1.5.1 Purpose/Background

The DQO process is a systematic planning tool based on the Scientific Method that is used for establishing criteria for data quality and for developing data collection designs. Establishing formal DQOs during the Work Plan development allows a clear and unambiguous definition of project objectives, decisions, and decision criteria so that data of sufficient type, quality, and quantity are generated to meet project objectives. The formal implementation of a DQO process brings structure to the planning process, thereby resulting in defensible decision-making.

The U.S. Environmental Protection Agency's Guidance for the Data Quality Objectives Process (EPA QA/G-5, Final, December, 2002) was utilized during the planning process. This document, which is intended to provide general guidance on developing data quality criteria and performance specifications for decision-making, addresses application of the EPA's seven step DQO process for site investigations.

1.5.2 Specify Quality Objectives

The objectives of the study are as follows:

- To determine the long-term effect of weathering on the Questa rock piles. This overarching objective will be accomplished through the following objectives:
- To sample three representative rock piles (debris flows and alteration scars may also be sampled) and thoroughly characterize the mineralogy, distribution, and texture using visual observation, core and cutting data, thin-section analysis, microprobe analysis, spectral analysis, and other appropriate techniques.
- To develop a geostatistical model of pyrite distribution, including form and concentration, for the three rock piles.
- To use aerial 1-meter hyperspectral survey to develop a macro-characterization of the rock piles.

- To obtain samples for weathering-cell testing and to perform the geochemical and microbiological testing to determine the effect of weathering on the rock pile minerals.
- To study the movement and quality of water within the rock piles.
- To develop a geochemical mathematical model to predict mineralogical changes in the rock piles as a result of long-term weathering.
- To perform geotechnical testing of the rock pile and weathered material followed by mathematical modeling of the future stability of the rock piles.
- To do an assessment of the future risk of rock pile failure and evaluate long-term behavior.
- To meet these objectives, the DQO process was implemented in designing the study. DQOs are defined in the SOP for relevant procedures. DQOs and SOPs are posted on the project website
- The QA objectives established for the study are listed below. The methods and procedures used to implement and accomplish the following objectives are described throughout this QAPP. Implement standard operating procedures (SOPs) for field sampling, sample custody, equipment operation and calibration, laboratory sample analysis, data reduction, and data reporting that are designed to assure the consistency and thoroughness of data generation.
- Assess the quality of data generated to assure that all data are scientifically valid and of known and documented quality. This is largely accomplished by establishing acceptance limits for parameters such as precision, accuracy, completeness, representativeness, and comparability, and by testing generated data against acceptance criteria established for these parameters.
- Achieve an acceptable level of confidence in the decisions that are made from data by controlling the degree of total error permitted in the data using QC checks. Data that fail the QC checks or do not fall within the acceptance criteria established will be evaluated for usability in meeting project objectives during data review.
- Assure that the QAPP and associated project-specific plans are properly implemented by conducting compliance inspections and audits.

Precision, accuracy, representativeness, completeness, and comparability (PARCC) are the criteria used to evaluate data quality. A description of each measure is provided in Section 1.5.5. In order to meet the intended uses of the data, specific numeric acceptance limits will be established for precision, accuracy, and completeness. Precision and accuracy limits will be determined and specified for each procedure, and will stated in the DQOs where applicable. These limits will ensure that routinely generated data are significantly valid and defensible and are of known and acceptable precision and accuracy.

1.5.3 Area Characterization

Core of the rocks underlying the rock piles will be sampled, logged, and visually described. Reflectance spectroscopy will be used to select representative samples required for additional characterization because the technique can identify heterogeneity that is not obvious to the unaided eye. Chemical and physical characteristics of mineral grains and their secondary mineral oxidation rinds will be examined with the electron microprobe and petrographic techniques to determine composition and alteration pathways.

Piles will be characterized in a number of ways, including a geologic model based on stratigraphy, a model based on pyrite type and distribution, , hydrology, hydrostratigraphy, temperature, geotechnical (based on rock mechanical testing) and others, as variations in the rock piles become better understood.

The rock piles are heterogeneous and unique ; data from the surrounding area will help us to understand the parent material of the rock piles and natural weathering pathways. One approach to rock pile characterization is to view the rock piles from macro to microstructure, and characterize them on that basis. They can first be viewed in their entirety and in their relationship to the surrounding mountains. Several different types of waste rock were dumped on the piles, including tuff and andesite, which have different colors and weathering characteristics. Some of these variations are obvious to the observer. Hyperspectral analysis and closer inspection can be used to further define variations in the gross mineralogy. Preliminary sampling locations can then be based on this information. Core and cuttings descriptions, thin sections, microprobe analysis, and other techniques will then help to determine the variations on a much finer scale. Detailed study of the pyrite distribution will assist in this effort. The resulting data will be incorporated into the various models of the rock piles.

1.5.4 Specifying Measurement Performance Criteria

The overall quality assurance (QA) objective for this project is to develop and implement procedures for obtaining and evaluating data that meet the Data Quality Objectives (DQOs) to assure or confirm that the required decisions can be made at the specified level of acceptable uncertainty. The QA procedures defined in this QAPP and the associated SOPs are established to assure that field measurements, sampling methods, and analytical data provide information that is comparable and representative of actual field conditions, and that the data generated are technically defensible.

The analytical QA objectives are defined in terms of sensitivity and the PARCC parameters of precision, accuracy, representativeness, completeness, and comparability. The primary goal of this Quality Assurance Project Plan (QAPP) is to define procedures that assure the quality and integrity of the collected samples, the representativeness of the results, the precision and accuracy of the analyses, and the completeness of the data. Data that meets the QA objectives and goals will be deemed acceptable. Data that do not meet objectives and goals will be reviewed on a case-by-case basis to ascertain usefulness.

To achieve the required DQOs, the Field Sampling Plan (FSP) and associated Standard Operating Procedures (SOPs) are designed to assure that representative samples will be collected using technically valid scientific procedures. Utilization of the QAPP requires implementation of procedures for obtaining and evaluating data in a manner that will result in a quantitative or qualitative representation of the PARCC parameters. The parameters of precision, accuracy, and completeness provide a quantitative measure of the statistical significance of the data collected in this field program. The parameters of representativeness and comparability utilize documentation of the site and laboratory procedures to qualitatively evaluate the data. Specification of required sensitivity levels is also an integral component of obtaining data that will satisfy the DQOs. Following the collection and analysis of the samples, a determination will be made whether the DQOs established for the QAPP were satisfied.

1.5.5 Data Quality Indicators

Data quality indicators are defined in terms of the PARCC parameters in this section. The assessment of the data quality indicators is necessary to determine data usability and involves the evaluation of the PARCC parameters. Data quality indicators are summarized in the following subsections.

1.5.6 Precision and Accuracy

The precision and accuracy of a data set are generally a function of sample collection technique, the analytical method and sample matrix. Precision and accuracy objectives for definitive analyses are documented in laboratory Standard Operating Procedures (SOPs) that are based on standard EPA methods (where applicable). The precision and accuracy achieved by the laboratory will be consistent with the requirements outlined in the DQOs.

Samples that do not conform to data quality objectives will be reanalyzed or data will be qualified, as necessary, on the basis of the results of these evaluations. If accuracy and precision goals are not attained, the reasons will be investigated and corrective actions taken if needed.

1.5.7 Representativeness

Representativeness expresses the degree to which sample data precisely and accurately represents a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Representativeness is a qualitative parameter most concerned with the proper design of the sampling program, proper sampling locations, implementing proper sampling protocols, and collecting a sufficient number of investigative samples, such that the analytical data generated are representative of actual site conditions. Representativeness of data is critical to data usability assessments. Each time a sample is collected, every effort will be made to collect a sample that is typical (representative) of the area being sampled.

Representativeness is addressed throughout this document. The Work Plan (WP) portion provides details regarding the sampling rationale. The FSP summarizes the number of samples to be collected and the locations. The QAPP details the measures to be followed to obtain data that satisfy the DQOs. Finally, the SOPs describe the sampling technologies to be used. Representativeness will also be qualitatively evaluated using precision and accuracy information developed from the evaluation of quality control (QC) samples. The representativeness of the data will be maintained throughout the field investigation by designing a representative sampling program, following appropriate and consistent procedures for sample collection, and by the application of generally recognized and documented analytical methods. Following these procedures increases the probability that representative samples will be collected from the sampling areas each time a sample is collected. Additionally, as noted in the Data Validation SOP the results obtained for field water quality control blanks will be used to assess representativeness quantitatively (i.e., results less than five times amounts found in associated field quality control blanks [≤ 10x for common laboratory contaminants] will be qualified as nondetect).

1.5.8 Completeness

Data are considered valid if confirmed by the examination and prerequisites of objective evidence that designated requirements for a specified intended use were fulfilled. Determination of whether individual results are considered valid will be achieved following the procedures specified in Section 4.0,"Data Review, Validation, and Verification Requirements."

Following completion of the analytical testing and data validation, the overall percent analytical completeness will be calculated by the following equation:

$$\% \text{ Analytical Completeness} = \frac{\text{Number of valid results or acceptable measurements}}{\text{Total number of requested measurements}} \text{ x } 100$$

The number of valid results includes data qualified as estimated. Collecting additional samples to replace rejected data can increase the level of completeness.

1.5.9 Comparability

To evaluate the comparability of the data, sampling and analytical techniques must be considered. Comparability of the data within sample types generated during the field investigation will be maintained by strictly following sampling SOPs, using standard analytical methods, verifying and validating field and laboratory data, and comparing field sampling data with QC sample results.,

1.5.10 Sensitivity

To evaluate the utility of the data for comparison to numeric, it is important that the sensitivity of the methods utilized is acceptable. This QAPP specifies the use of routine and commercially available EPA approved methods as outlined in the Laboratory SOP.. In general, these methods provide the necessary level of sensitivity as defined in the DQOs.

1.6 STANDARD OPERATING PROCEDURES

A Standard Operating Procedure will be developed for each task in this project. The SOP will include Data Quality Objectives (DQO) and Quality Control (QC) procedures for that task The Principal Investigator for that task will develop the SOP and the Project Manager will approve the procedure. Because the project will evolve as it progresses, changes will be necessary for specific SOPs, and new SOPs will have to be added from time to time. Each SOP will be numbered in the format "SOP 3.0" where the first number (3) is the number of the SOP and the number after the decimal point (0) is the revision number. Thus, subsequent revisions would be numbered SOP 3.1, SOP 3.2, etc. Each SOP will include a revision log that will indicate the revision number, a description of the revision, and the date of the revision.

SOPs and revisions will be submitted as a Microsoft Word file (*.doc) to the Project Manager or his designated representative for review before posting. The SOP will then be converted to a *.pdf file and will be posted on the project web site at http://www.digit.utah.edu/questa/ . Access to the web site will be restricted by password, which may be obtained by contacting the Project Manager or his designated representative.

A list of SOPs as of March, 2004, is presented below. Updated lists can be obtained on the web site.

SOP	Title	Person writing	Date of Revisions
1	Data management (including verification and validation)	Robinson, McLemore	
2.2	Sample management (chain of custody)	Robinson, McLemore	1/3/04, 1/5/04
3.2	Surveying (GPS)	McLemore	11/10/03
4.1	Taking photographs	McLemore	11/18/03, 1/3/04
5.2	Sampling outcrops, rock piles, and drill core (solid)	McLemore, Gomez, Paul	2/4/04
6.1	Drilling, logging, and sampling of subsurface materials (solid)	McLemore, Raugust	12/3/03
7.0	Decontamination of sampling equipment	Raugust, McLemore	12/3/03
8.1	Sample preparation (solids)	McLemore	11/6/03
9	Test pit excavation, logging, and sampling (solid)	Wilson, McLemore	draft
10	Meteorological station maintenance	Raugust, Wenner	draft
11.1	Paste pH and paste conductivity	McLemore, Brandvold	10/23/03, 10/24/03
12.0	Field parameter measurements (including instrument calibration) (water)	Raugust, McLemore	12/2/03
13.0	Water elevation measurements	Raugust, Wenner	12/3/03
14.1	Field filtration of water samples	Raugust, Wenner	1/7/04
15.1	Surface water and seep sampling	Raugust	1/8/04
16.0	Ground-water sampling	Raugust	12/3/03
17	Routine site visits	Sigda	
18.0	Pump testing	Raugust, Wenner	12/3/03

19.1	Borehole geophysical logging	Paul, Raugust	1/8/04
20.0	Well development	Raugust, Wenner	12/3/03
21.0	Monitoring well installation	Raugust	12/3/03
22.1	Analytical data validation	McLemore	1/9/04
23.3	Geophysical surveys	Sigda	1/13/04
24.1	Petrographic analyses (including alteration)	McLemore, Gomez	1/14/04
25.2	Stable isotope analyses	Campbell	11/18/03, 12/2/03
26.3	Electron microprobe analyses	Dunbar	10/20/03, 10/23/03, 10/24/03
27.1	X-ray diffraction analyses	Lueth, McKee	11/12/03, 11/18/03
28.3			
29.3	Clay mineralogy analyses	McLemore, Guiterez	10/29/03, 11/13/03, 1/14/04
30	ICP-OES analyses	Thomas	
31	ICP-MS analyses	Thomas	
32.0	Bulk density	Sigda	11/6/03
33	Particle size analyses	McLemore	draft
34.2	Sampling for the Remaining Pyrite Model	Brimhall, McLemore	9/30/03
35.1	Volumetric moisture content	Sigda	1/14/04
36	Sample preservation, storage, and shipment	McLemore	
37	Microbe sampling	Jack Adams	
38.1	DI leach	Brandvold	1/14/04
39	Samples for Pore water measurements	Sigda	
40.2		McLemore, Sigda	10/23/03 11/6/03
41.0	Reflectance spectroscopy	Hauff	
42.1	Porosity	Sigda	11/26/03, 1/15/04
43.1	Tensiometer and thermal conductivity sensor	Sigda, Paul	1/15/04

	installation		
44.0	Argon/Argon dating	Peters, Lueth	11/25/03
45.1	Moisture retention relation (the drying curve from Del's SWCC) by laboratory hanging column	Sigda	12/8/03
46	Water vapor collection	Sigda	
47.2	Rain and snow collection	Sigda	2/12/04
48.0	Dye tracer studies	Sigda	3/18/04
49.0	Chip tray preparation	McLemore	3/25/04
50	Shear box tests	Guiterez, Aimone-Martin	

The SOPs are the **controlling documents** for field operations. If discrepancies exist between the SOP and the QAPP, FSP, Drilling Plan, or any other document, **the SOP will take precedence**.

1.7 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

All personnel assigned to the project, including employees, graduate students and consultants, will be qualified to perform the tasks to which they are assigned. The Project Manager will make appraisal of personnel qualifications, with approval by Molycorp personnel. The appraisal will include the comparison of the job assignment requirements with the relevant experience and training of the prospective assignee. It will also include a determination of whether further training is required, and, if required, by what method. On-the-job training is an acceptable training method if the training is provided by a person who is qualified to perform the trainee's assignment, and the results of such training are documented.

Field personnel will comply with MSHA and OSHA requirements for performing their tasks. Specific details are referenced to the Health and Safety Plan (HASP).Documentation and records

The following paragraphs define critical project records and information that will be included in reports. Reporting formats and document control procedures that will be used on this project are also defined. Specific requirements for data reporting are included in the SOPs for those tasks.

1.7.1 Purpose/Background

Accurate and complete records are necessary to validate project data. Essential records and recording procedures are outlined here.

1.7.2 Information Included in Reporting Packages

The data reporting packages will include data necessary to meet project requirements. Field and laboratory records will be integrated, as much as possible, to provide a continuous reporting track.

1.7.3 Field Operation Records

At a minimum, the following field operation records will be included in the reporting packages.

- Sample collection records which will contain the names of persons conducting the sampling activity, sample number and location, number and type of samples collected, equipment, any unusual observations, and references to bound field log books and the pertinent SOPs followed for sampling.
- Completed Chain of Custody (COC) Forms. Chain of custody forms will include QC sample documentation and results of preservation checks.
- Photographs of sample locations and samples, where taken.

Forms have been created for recording field operations and are available on the project website. The forms mirror data input forms for the database, and will be bound and page-numbered for recording field data.

1.7.4 Field Testing Records

At a minimum, the following field-testing records will be included in the reporting packages.

- Sample data sheets, which will contain analysis date and time, sample number and location, method and results.
- QC Summary containing sample duplicate, calibration and blank results, as applicable.
- A narrative detailing any deviations from the methods prescribed in the SOPs.

1.7.5 Laboratory Records

Laboratories will have written procedures (SOPs) for analytical work and for QA/QC. Laboratories will ensure that those procedures are followed and documented. At a minimum, the following laboratory records will be included in the reporting packages.

- Sample data which will contain analysis date and time, sample number, method, method detection/quantitation limits, parameter name and result, dilution factors, data file numbers and laboratory identification numbers.
- Sample management records, which will contain documentation of sample receipt and storage.
- A case narrative detailing any deviations from the methods prescribed in the SOPs and any QC non-conformances, problems or comments.
- QA/QC Report which will include all instrument calibration and calibration verification data, blank data, spike data, and replicate data that supports this project and any other relevant QC data.

- Data handling records, which will include copies of instrument, log book sheets, standard preparation logs, bench sheets, and calculation worksheets.
- The laboratory will also prepare an electronic deliverable containing results and QC information. The electronic deliverable will be submitted as part of the data reporting package.

1.8 DATA REPORTING PACKAGE FORMAT AND DOCUMENTATION CONTROL

For standard methods (metals and other inorganic parameters), the data-reporting package will include laboratory forms that summarize results and QC information and all raw data supporting the information on the summary forms (including bench sheets). Project PIs will determine the minimum requirements of what information will be included in data reporting packages.

Hardcopy data reporting packages will be paginated (including raw data) beginning with the case narrative.

Handwritten information or corrections will be in indelible ink, dated and initialed. All handwritten corrections will be made by a single strike through line, the correction clearly written, dated and initialed. All corrections to the hardcopy package will also be carried through to the project database at the University of Utah. The analyst, laboratory supervisor or Laboratory QA Manager, the task Principal Investigator, or a designated QA Manager may make corrections, with the appropriate documentation.

The task Principal Investigator or designee may initiate a revision of the laboratory data-reporting package. A revised laboratory data-reporting package, along with a narrative explaining the reasons for the revisions, would then be prepared by the laboratory and transmitted to the PI. All revised data will be clearly labeled as revised or additional data. If the data originates from the New Mexico Tech group, the PI will post data on the New Mexico Tech database, which will be used to update the project database at the University of Utah every two weeks. If the data originates from one of the PIs not associated with New Mexico Tech, then data will be furnished to the Project Manager or his designee within two weeks of origination. Both revised and original data will be kept in the project data file at the University of Utah.

1.9 REPORTING PACKAGE ARCHIVING AND RETRIEVAL

The laboratory will archive data reporting packages and instrument tapes and logs according to their normal written procedures. Laboratories will be expected to submit data reporting packages, instrument tapes, and data logs in a timely fashion.

A project document and analytical database will be established at the University of Utah to house all project information including current data, legacy data and documents. The Principal Investigator will be responsible for validating and posting all data in the project database in accordance with SOPs, where other project investigators, as needed, can access it. Data will be validated according to SOPs established by each PI, and will be posted as quickly as is functionally feasible for each task. Each PI will be a "gatekeeper," who will have sole authority to enter or modify data in the database in accordance with the SOP for that task. A log will be kept on the computer of all data access, entry, or modification. Data will not be transferred

directly between PIs without posting validated and verified data on the University of Utah's database.

1.10 DOCUMENT CONTROL

All controlled documents will include a document control component. Controlled documents include SOPs, the QAPP, Field Sampling Plans, Health and Safety Plans, and Drilling Plans. Other documents may be added to this list, as necessary. Controlled documents will be numbered with the revision number after a decimal point (ex. HASP.2). They will bear the date of the last revision, and the name of the reviser, plus any relevant information such as the reason for revision, if relevant. This information should be tabulated in a revision log, and the revision number and date should be included in the page header/footer. An example of a revision log is below:

REVISION LOG - SOP 6		
Revision Number	Description/Revised By	Date
6.0	Original SOP/McLemore	7/08/04

This component, together with the distribution list, facilitates control of the document to help ensure that the most current documents are in use by all project participants. Each revision of the documents should have a different revision number and date, and will be posted in the database. Controlled documents on the web site will be presented as *.pdf files that can only be altered by project management. This will ensure screening and consistency in these documents. The *.pdf files are the only authorized versions of controlled documents, and must be used for project activities.

2.0 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

The sampling process design is described in the Field Sampling Plan, posted on the project website. This section includes the rationale for the number of samples to be collected of each media and the locations to be sampled.

Drilling will be in four phases. Phase I drilling will include 6 exploratory holes for characterization. Phase II holes will be for monitoring and geotechnical testing. Phase III will be for detailed characterization of one rock pile, and Phase IV may include caisson drilling for geotechnical and hydrogeochemical testing.

2.1 SAMPLING METHODS REQUIREMENTS

The sampling method requirements are described in the SOPs that are included in the FSP.

2.1.2 Purpose/Background

The quality of data collected in this study is dependent upon the quality and thoroughness of field sampling activities. General field operations and practices and specific sample collection and inventory will be well planned and carefully implemented. The study field investigation FSP provides detailed descriptions of the sampling program.

2.1.3 Sample Collection, Preparation, and Handling Procedures

Standard sample collection procedures and data collection forms have been developed for sampling and related data gathering activities. The purpose for these procedures is to obtain samples that represent the environment under investigation and to ensure that all sampling activities are adequately documented. The procedures that will be used for sample collection and preparation for this investigation are included in the project SOPs.

A discussion of sample type, location and collection technique is included in the FSP. Representative samples will be split and segregated in the field prior to dispensing into sample containers and again at the laboratory prior to analysis, unless the SOP requires alternative procedures.

While recognizing the importance of striving to meet all project analytical goals, an effort will be made to have laboratories utilize consistent procedures for analysis. Samples may be sent to alternative or third-party laboratories for QA/QC purposes.

2.1.4 Sampling/Measurement System Failure Response and Corrective Action Process

During pre-mobilization activities for the field investigation, a field reconnaissance will be completed to locate and stake each proposed sampling location. Any location accessibility problems will be identified at that time and the designated field manager will propose an alternate location meeting the data need intended by the original location. This decision will be made with written concurrence from the Principal Investigator. If an alternate location is not available or accessible which still meets the original data need, the Principal Investigator will determine and document the proper course of action. Any field changes to the QAPP and FSP will be documented in the field logbook and initialed by the responsible PI.

Any serious flaws noted during implementation of the FSP will be documented in the field logbook and brought to the attention of the Principal Investigator and the Project Manager.

Any events noted prior to demobilization from the study field investigation which result in lost data will be rectified, as achievable, prior to demobilization. The PI, Project Manager, or designated representative will direct activities to recover lost data, and actions to recover data will be documented in writing.

2.1.5 Sampling Equipment, Preservation, and Holding Time Requirements

A description of sample equipment to be used and a discussion of steps taken to mitigate sample contamination are included in the FSP and supporting SOPs. Sample handling requirements are described in the SOP for each task. Clean sample containers for use in sample collection will be used in all cases.

2.2 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

2.2.1 Purpose/Background

Written documentation of sample custody from the time of sample collection through the generation of data by analysis of that sample is recognized as a vital aspect of an environmental study. The chain-of-custody of the physical sample and its corresponding documentation will be maintained throughout the handling of the sample. All samples will be identified, labeled, and logged onto a chain-of-custody form, as a part of the procedure designed to assure the integrity of the resulting data. The record of the physical sample (location and time of sampling) will be joined with the analytical results through accurate accounting of the sample custody. As described below, sample custody applies to both field and laboratory operations. Official custody of samples will be maintained from the time of sample collection, through preparation and analysis, and until sample disposal.

2.2.2 Sample Custody

All personnel collecting or handling samples will be required to maintain samples in a designated location with limited access from the time of sample receipt through sample disposal. Sample custody procedures within a laboratory will be dependent upon the laboratory ‘s quality assurance plan (QAP) and/or SOPs. Laboratories will furnish any applicable QAPs or SOPs to project management prior to undertaking analytical work on this project. Laboratories will be responsible for maintaining records that provide an uninterrupted custody record throughout sample preparation and analysis, in accordance with that laboratory’s written QA/QC procedures. For field operations, standard sample collection procedures have been developed for sample custody, labeling, analysis request, and tracking. Sample custody procedures for field operations are summarized below.

A sample is under custody if it is in:

- The possession of the sampler
- The view of the sampler after being in the possession of the sampler
- The possession of the sampler and then placed in a secured location, or

- A designated storage area.

Waterproof ink will be used for the completion of chain-of-custody forms unless prohibited by weather conditions. For example, a logbook notation will explain that a pencil was used to fill out the chain-of-custody form because the ballpoint pen would not function in freezing weather. Any necessary corrections are to be made by drawing a single line through the error, initialing and dating the line, then entering the correct information. Alternative electronic methods maybe used if approved by the Project Manager.

A properly completed chain-of-custody form will accompany all samples. An example chain-of-custody form is included in SOP 2.0 Sample Management. The sample numbers, locations, and requested analyses will be listed. When transferring the possession of samples, the individuals relinquishing and receiving custody will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the laboratory, and to/from a secure storage area. The relevant PI will retain Chain of Custody forms as part of the project documentation.

Samples will be properly packaged for shipment and dispatched to the appropriate laboratory in accordance with SOP 2. Shipping containers will be secured with strapping tape or equivalent. Custody seals will be placed on the shipping container for shipment to the laboratory. The custody seals are covered with clear plastic tape. The package is strapped shut with strapping tape or equivalent in at least two locations. Once samples have arrived at the laboratory, sample custody will be handled in a fashion consistent with the laboratory QAPP and SOPs.

The forms included as part of the study field investigation program are examples and may change depending upon the laboratory selected to complete the analyses. Example sample label, chain of custody, and custody seal forms are included in SOP 2.0 Sample Management.

2.2.3 Sample Identification System

A sample numbering system has been developed for the study field investigation and is discussed in SOP No. 2.

2.2.4 Sample Shipment

Samples collected during this investigation will be either shipped via an overnight carrier or will be hand delivered, if geographically possible. If the samples are sent by common carrier, an air bill will be used, in compliance with U.S. DOT regulations. The PIs are responsible to ensure compliance with all DOT requirements. The PI will retain receipts of air bills as part of the permanent documentation. Commercial carriers are not required to sign off on the chain-of-custody forms as long as the chain-of-custody forms are sealed inside the package and the custody seals remain intact.

2.2.5 Sample Container Tampering

If, at any time after samples have been secured, custody seals on the cooler are identified as having been tampered with, the following procedures will be conducted:

- Check with personnel having access to sample containers to evaluate whether inadvertent tampering can be documented.

- Document findings of the incident in a logbook.
- Notify the Principal Investigator and Project Manager in writing.

If it cannot be documented that inadvertent breaking of the custody seal did not affect the integrity of samples has occurred, the samples will be re-collected and the Principal Investigator and the Project Manager will be notified in writing.

2.2.6 Sample Archival and Disposal

As described in the FSP and SOP 6.0 Drilling and Sampling Subsurface, soil samples from some newly completed borings may be collected and archived for potential future evaluation. The laboratories, as described in the laboratory QAM, and in accordance with all applicable rules and regulations will dispose of any sample volume not consumed during sample analysis.

2.3 SAMPLING AND ANALYTICAL METHODS REQUIREMENTS

2.3.1 Purpose/Background

This section summarizes the sampling and analytical methods to be used to provide data necessary to meet the project objectives. A uniform format is used to summarize the variety of procedures used in this research program, from field to laboratory. In order to keep the volume of information in this section at a manageable level, references to SOPs, standard laboratory written procedures, and other easily obtainable documentation will be used wherever possible.

2.4 SAMPLING/ANALYTICAL REQUIREMENTS FOR PROJECT PROCEDURES

Sampling and analytical requirements will vary for each Principal Investigator. Each PI will establish his requirements and those will be made part of the DQOs and SOPs for the appropriate procedures. DQOs and SOPs will be posted on the project website.

2.5 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

The quality and availability of necessary supplies and consumables will affect the quality of the project.

2.5.1 Purpose

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the project.

2.5.2 Identification of Supplies and Consumables

Supplies and consumables consist of field and laboratory supplies and consumables, each described below.

2.5.3 Field Supplies and Consumables

The consumables that will be used during field will be new, where possible, and will be inspected by the PI or his designated field manager prior to use for signs of prior use or contamination. No material will be used beyond the manufacturers' suggested expiration date. Any water used for the preparation of the rinsate blanks or field blanks will be reagent-grade water. Only water certified by the manufacturer will be used to prepare equipment and ambient blanks. If detections are reported for rinsate or field blanks, any remaining water from the suspected lot will be discarded and replaced. The samples associated with a contaminated blank will be reviewed to determine if the potential contamination has affected the usability of the data. The data will be reviewed and determinations made on a case-by-case basis.

2.5.4 Laboratory Supplies and Consumables

The laboratory will inspect supplies and consumables prior to their use in analysis. The materials description in the analytical methods will be used a guideline for establishing acceptance criteria for those materials. Purity of reagents will be monitored according to the laboratory's standard procedures. An inventory and storage system for all supplies and consumables will be established. The inventory system will be documented in the laboratory's QAP. No material will be used beyond the manufacturers' suggested expiration date.

2.5.5 Inspection Requirements and Procedures

Maintenance of inventory, inspections and acceptance of the field supplies and consumables is the responsibility of the PI or his designated field manager. Maintenance of inventory, inspections and acceptance of the laboratory supplies and consumables will be completed as specified in the laboratory QAP.

2.5.6 Tracking and Quality Verification of Supplies and Consumables

Supplies and consumables requiring a degree of purity and received from vendors specifying the degree of purity will have the vendor specifications retained in the PI's permanent project file for field consumables and retained by the laboratory for laboratory consumables.

It is the responsibility of the PI or his designated field manager to ensure that field supplies and consumables that do not meet specification, have expired, or do not meet acceptance criteria are not used for the project.

2.6 DATA ACQUISITION REQUIREMENTS (HISTORICAL DATA)

Molycorp, various consultants, and agencies have collected substantial amounts of historic data for the mine site area. The quality of these data varies widely. Much of the data collected before 1998 is of unknown quality. Problems with these data include unavailable or inadequate documentation of well construction or sampling procedures, unacceptable field data collection procedures or documentation, failure to meet laboratory QA/QC requirements, and lack of data validation. These data also lack documentation of chain-of-custody and laboratory QA/QC procedures. Therefore, data will be evaluated and used as is determined to be appropriate for this project. The PI will do data qualification with approval by the Project Manager. The following factors will be considered in selecting historic data for use:

- Were data generated using current and agency-approved analytical methods?
- Are the data reflective of current site conditions (i.e. most recent data)?
- Have the data been validated?
- Were the data collected following an approved FSP and/or QAPP?
- Were the data collected following approved SOPs?

2.7 DATA MANAGEMENT

This section will describe the data recording, reduction, verification, and reporting procedures necessary for this project.

2.7.1 Purpose/Background

Data reduction, verification, and reporting procedures and project data management activities, data/information exchange, and reporting procedures must ensure that complete documentation is maintained, transcription and reporting errors are minimized, and all data including that received from laboratories are properly verified and validated.

2.7.2 Data Recording

Internal checks used to assure data quality during data entry are discussed in Section 2.7.5. Internal checks used to assure the quality of data resulting from calculations is discussed in Section 2.7.4.

2.7.3 Data Validation

The assurance that the method, instrument, or system performs the function it is intended to consistently, reliably, and accurately in generating the data is achieved through the validation and verification of analytical data as discussed in SOP 1.1, Analytical Data Validation and Management.

2.7.4 Data Transformation

Data requiring data transformations or calculations will be checked under the direction of the responsible PI to verify the correctness of the result or the software calculating the result.

Hand calculations will be recorded on calculation sheets and will be legible and in logical progression with sufficient descriptions. Major calculations (hand calculations or computer generated calculations) will be checked by an engineer or scientist of professional level equal to or higher than that of the originator. After ensuring mistakes have been corrected, the checker will sign and date the calculation sheet immediately below the originator. Both the originator and checker are responsible for the correctness of calculations. The following information will be recorded for each major calculation or a series of calculations, as applicable:

- Project title and brief description of the task;
- Task number, date performed, and signature of person who performed the calculation;

- Basis for calculation;
- Assumptions made or inherent in the calculation;
- Complete reference for each source of input data;
- Methods used for calculations, including reference;
- Results of calculations, clearly annotated;
- Problem statement;
- Input data clearly identified; and
- Variables listed.

2.7.5 Data Transmittal

All data that are manually entered from logbooks or field forms into a computer file will be verified after data entry for correctness under the direction of the responsible PI. Similarly, all data that are transcribed from one logbook or field form to another will be verified after data transcription for correctness. Data received electronically will be reviewed for signs of corruption and information loss prior to use.

A project computer database will be established on a server maintained by the University of Utah and will be maintained by the DIGIT Lab at the University. Microsoft SQL will be used for data management. Each PI will be a "gatekeeper" of hi/her own data, and will have sole authorization to enter data into the database, in accordance with data entry forms that will be established for each type of test. Data will reside with the PI until validated. All data will be checked and validated prior to entry into the database. Validated data will be transmitted to the project database at least every two weeks by the PI. Any changes in data after initial entry will be made only by the PI, and the date and reasons for the change will be forwarded to the Project Manager and stored on the project database. The Project Manager will control access authority to data by other PIs, project personnel, or outside parties, and the Project Manager will approve changes in access authority.

2.7.6 Data Reduction

This section outlines the methodology for assuring the correctness of the data reduction process.

2.7.6.1 Non-Laboratory Data Reduction

The procedures describe steps for verifying the accuracy of data reduction. Data will be reduced either manually on calculation sheets or by computer. The following responsibilities will be delegated in the data reduction process:

- Technical personnel will document and review their own work and are accountable for its correctness.
- Major calculations will receive both a method and an arithmetic check by an independent checker. The checker will be accountable for the correctness of the checking process.

- The PI will be responsible for assuring that data reduction is documented and performed in a manner that produces quality data through review and approval of calculations.

As data are reduced, care must be taken so that critical data (e.g., significant figures) are not lost.

2.7.6.2 Laboratory Data Reduction

The specific data reduction, verification, and reporting procedures and assigned personnel vary between laboratories; however, equivalent procedures must be performed by each laboratory to assure that accurate and consistent data handling, review, and reporting are achieved.

The laboratory analyst performing analyses is responsible for the reduction of raw data generated at the laboratory bench to calculate sample concentrations, and his name will be indicated with laboratory data. The data reduction procedures are described in the laboratory's method SOPs, which will be furnished to the PI and Project Manager. For many methods, data reduction software is included with the instrument or Laboratory Information Management System (LIMS). In those cases, the analyst must verify that the data reduction was correct. The system may require manual manipulation to correctly calculate sample concentrations. All manual manipulations must be documented.

The analytical process includes verification or a quality assurance (QA) review of the data. Specific requirements, acceptance criteria, and corrective actions for each analysis are included in the analytical method. The QC checks are reviewed at several levels by laboratory analysts, supervisors, designated QC specialists, document control staff, or by a combination of these staff. After the data have been reviewed and verified, the laboratory reports are signed by QA reviewer or team members and retained by the PI in his or her permanent project files.

Laboratories should use a LIMS to electronically track and report sample and QC data. The data are reported electronically from the LIMS to the project staff using pre-established formats. The LIMS files must also undergo a QC check under the direction of the responsible PI to verify that the results are complete and correct, and that the files are properly formatted.

2.7.8 Data Analysis

Computer analyses include the use of models and programs. Both systematic and random error analyses will be investigated and appropriate corrective action measures taken. The PI will evaluate, determine applicability, and document the use of automated data reduction techniques.

QC procedures for checking models (or programs) will involve reviewing the documentation, running the test case, and manually checking selected mathematical operations. Each computer run used to check a model or program will have a unique number, date, and time associated with it appearing on the printout.

2.7.9 Data Tracking

Laboratory and field data must flow properly to the project staff and data users. Procedures must be established to ensure that data are properly reported and undergo QC review before use.

Data management procedures will be established by each PI and will be addressed in the SOPs. All electronic and hard copy data received from laboratories will be auto or manual tracked for

completeness of delivery and ultimately filed in the project data file. Care must be taken to ensure that all laboratory data are received and documented.

All field measurements, lithologic data, and sample collection information will be recorded and filed in the field for use and reference before ultimately being filed into the project data file.

2.7.10 Data Storage and Retrieval

All data generated during this field investigation will be maintained in the project database located at the University of Utah. If the original data is on hardcopy, the, original hardcopy data will be placed in project data files to be maintained by each PI as soon as possible. If the information or data are needed for interpretation of results or report completion, copies will be used. The cover page of the copies will be labeled as such to avoid multiple copies of the same document in the files. The PI, prior to incorporation in the data files, will review all field-generated data, such as field forms and logbooks, for completeness and legibility. If corrections are needed, the document will be returned to the originator for correction. Laboratory data will be copied immediately upon receipt (or a second copy delivered by the laboratory) and the original placed in the data files. Information obtained from outside sources will be maintained in the project files or posted on the web site, as is appropriate and determined by the PI. Electronic data and electronically generated reports and data interpretations will be stored on the project database/web site. The database is backed up daily and weekly to avoid data loss. Retrieval of documents may be limited to personnel who have been granted access by the Project Manager. Sensitive or final electronic documents may be further protected to prevent inadvertent changes. Electronic laboratory data will be copied to the PI's permanent database prior to incorporation into the project database. Electronic project correspondence may be printed, and a hardcopy may be maintained in the PI's files. It is the PI's responsibility to assure that project personnel comply with this requirement. Auto tracking must be implemented for all calculations and modeling exercises.

3.0 PURPOSE/BACKGROUND

A process of evaluation and validation is necessary to assure that data collection is conducted according to this QAPP. The Project Manager, or his designated representatives will have the primary responsibility for implementing the internal and external assessments necessary to assure:

- All elements of this QAPP are correctly implemented as prescribed,
- The quality of the data generated through implementation of this QAPP is adequate to meet the stated DQOs, and
- Corrective actions are implemented in a timely manner, properly documented, and their effectiveness confirmed.

These internal and external assessments are described in the following sections. If at any time in the assessment process it is discovered that this QAPP is not being correctly implemented, the quality of the data being generated is not adequate to meet project DQOs, or corrective actions are not completed as necessary, the Project Manager will immediately notify the appropriate parties, and will act to resolve problems and/or issue stop work orders as necessary.

3.1 ASSESSMENT ACTIVITIES AND PROJECT PLANNING

Assessment activities to be implemented assuring data collection are conducted according to this QAPP follow.

3.1.1 Assessment of Subsidiary Organizations

The Project Manager will ensure that all laboratories or subcontractors have adequate QA/QC policies, appropriate SOPs in place for the proposed testing, and defined records retention and chain-of-custody policies.

A Technical Systems Audit may be completed on one or more contracted laboratories if deemed appropriate by the Project Manager.

3.1.2 Assessment of Project Activities

During the course of the project, the Project Manager will conduct a QA/QC review of the project, and will prepare a Data Quality Assessment (DQA). The assessment will include, at a minimum, the following elements:

Surveillance. The Project Manager or his designated representative will periodically review project records, such as field log books and field forms and question project personnel to assure that QAPP-specified requirements are being met. If surveillance reveals QAPP requirements are not being met, the Project Manager will suggest corrective actions to the PIs. The Project Manager will assure that the corrective action is implemented.

Review of Data Quality. The Project Manager may, based on PI reviews and other information, conduct a review to evaluate how project personnel handled data, made judgments, and whether uncorrected mistakes were made.

PI Review. PIs will continuously review and document QA/QC performance and will include a written summary in monthly reports to the Project Manager.

Data Quality Assessment (DQA). A DQA report will be prepared by the Project Manager prior to the end of the project to document the overall quality of data collected in terms of project DQOs and the effectiveness of the data collection and generation processes. The data assessment parameters calculated from the results of the field measurements and laboratory analyses will be reviewed to assure that all data used in subsequent evaluations are scientifically valid, of known and documented quality, and, where appropriate, legally defensible. In addition, the performance of the overall measurement system will be evaluated in terms of the completeness and effectiveness of field measurement and data collection procedures. Finally, the goal of the DQA is to present the findings in terms of data usability.

3.1.3 Schedule of Assessment Activities and Personnel

PI's monthly reports, and the Project Manager's Quarterly and Final Reports will include a Quality Assurance summary that will identify quality assurance actions taken and any exceptions or QA/QC problems that occurred.

3.2 NONCONFORMANCE AND CORRECTIVE ACTIONS

It is the intent of the quality assurance process to minimize corrective actions through the development and implementation of effective internal controls. To accomplish this, procedures are implemented that will activate a corrective action for a measurement system when acceptance criteria have been exceeded. In addition reviews and technical systems audits will be conducted on a periodic basis to check this implementation.

Provisions for establishing and maintaining QA reporting to the appropriate authority will be instituted to assure that early and effective corrective action can be taken when data quality falls outside project DQOs (acceptance criteria). In this context, corrective action involves the following steps:

- Discovery of a nonconformance,
- Identification of the responsible party to allow formulation of an appropriate corrective action,
- Planning and scheduling of corrective action,
- Review of the corrective action taken, and
- Confirmation that the desired results were produced.

Activities subject to QC and QA will be evaluated for compliance with project DQOs. These activities include both field and laboratory operations as described in this QAPP. A lack of compliance with these procedures will constitute a nonconformance. Any project member who discovers or suspects a nonconformance (including subcontractors) is responsible for reporting the nonconformance to the appropriate PI, who will report it to the Project Manager. The Project Manager will assure that no additional work, which is adversely affected by the nonconforming activity, is performed until a confirmed nonconformance is corrected.

The Project Manager will be responsible for reviewing all assessment, audit and nonconformance reports to determine areas of poor quality or failure to adhere to established procedures. Corrective actions will be selected to prevent or reduce the likelihood of future nonconformance and address the causes of the nonconformance. Corrective actions should be appropriate to the seriousness of the nonconformance and realistic in terms of the resources required for implementation.

Upon completion of the corrective action, the PI and the Project Manager will evaluate the effectiveness of the corrective action. If the corrective action is found inadequate, the Project Manager and the PI will confer to resolve the problem and determine any further corrective actions. The Project Manager will schedule implementation of any further action. The Project Manager may issue a stop work order in cases in which significant problems continue or corrective actions were not completed. Molycorp's project manager will be notified prior to any stop work order.

3.3 REPORTS TO MANAGEMENT

All audit finding reports, nonconformance reports, corrective action reports and stop work orders will be incorporated into the project records, and that information will be included in the regular reports to the ADTI Oversight Committee chairman, Molycorp, and other parties that are authorized to access project data and reports.

4.0 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

This section describes the process for determining that project data were collected in a way that meets at least the specified QC acceptance criteria (verification) and determining that project results are suitable for use in making the specified decision (validation).

4.1 INTRODUCTION

The analytical data review process for chemical analyses to be conducted under this QAPP will consist of two levels of review. The analytical laboratory performs the first level of review. The laboratory review program is designed to ensure that the laboratory has provided analytical data of known and acceptable quality. The second level of review is the responsibility of the PI. The review of data packages received from the laboratory is designed to evaluate whether the data generated are of sufficient quality for their intended use. The data validation process will be used to make an overall assessment of the data set and the usability of each analytical result.

The laboratory will review and verify 100% of all data generated at the laboratory and field personnel will review and verify 100% of all data generated in the field. The PI is responsible to ensure all data is validated and verified in accordance with this QAPP.

The following paragraphs specify criteria to be used in data review, verification and validation.

4.2 LABORATORY DATA REDUCTION, VERIFICATION, AND REPORTING

The specific data reduction, verification, and reporting procedures and assigned personnel will vary from laboratory to laboratory, but will be completed in accordance with the laboratory's QAP and SOPs. However, equivalent procedures must be performed to assure that accurate and consistent data handling, review, and reporting are achieved.

The laboratory analyst is responsible for the reduction of raw data generated at the laboratory bench. The analyst must verify that data reduction performed by an instrument or Laboratory Information Management System is correct.

After the data have been reviewed and verified, the laboratory or field reports are signed by the laboratory manager and released for distribution. This constitutes the first level of data validation.

4.3 FIELD DATA REDUCTION, VERIFICATION, AND REPORTING

The purpose of the validation process is to evaluate the usability of the field data that are collected or documented in accordance with specified protocols outlined in the QAPP and related SOPs.

First, all field data will be validated at the time of collection by following the QC checks outlined in the QAPP and SOPs. Field personnel should personally review their records at the end of each day for completeness and correctness.

Second, the PI or designee will validate data recorded on sample collection sheets. Field documentation will be reviewed to identify discrepancies or unclear entries. Field data will be validated against the following criteria, as appropriate:

- Sample locations and adherence to the FSP
- Field instrumentation utilized and calibration
- Sample collection protocol in accordance with pertinent SOPs
- Sample volume collected is adequate for intended analyses
- Sample preservation (if appropriate)
- Field QC samples collected and submitted at the proper frequency
- Field duplicate samples submitted at the proper frequency
- Sample documentation protocols were followed
- Chain-of-Custody protocols were followed
- Sample shipment protocols followed

4.4 DATA VALIDATION

The PI will review all analytical chemistry data. This review will consist of evaluation of laboratory performance parameters and sample-specific parameters.

The laboratory performance parameters are indicators of overall performance and ability of the laboratory to generate data of known quality. The laboratory performance parameters that will be evaluated are as follows:

- Initial Calibration
- Initial and continuing calibration verification
- Laboratory control sample results
- Compound identification
- Result calculation
- Method specific quality control requirements (e.g. thermal stability, tuning, resolution, mass calibration, interference check sample analysis).

Sample-specific parameters are those that are sample related. The sample matrix or the collection procedures could influence the results. The sample-specific parameters that will be evaluated are as follows:

- Case narrative comments
- Chain-of custody (COC) and sample conditions upon receipt
- Holding times
- Method blank results

- Surrogate recoveries
- Matrix spike recoveries
- ICP serial dilutions
- Laboratory duplicate or spike duplicate results
- Post-digestion recoveries
- Internal standard performance
- Results for field quality control samples (e.g. field duplicates, rinsate blanks, field blanks, and trip blanks.
- Any systematic problems noted in the review of the laboratory performance parameters.

All data will receive an evaluation of sample-specific parameters. Data qualifiers are defined in Section 4.4.1.

4.4.1 Flagging Conventions

All data will be validated and qualified using guidance from the U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 1994) and Organic Review (USEPA, 1999).

The following flags will be used to qualify the data as necessary.

J: The associated numerical value is an estimated quantity.

NJ: The analysis indicates the presence of an analyte that has been tentatively identified, and the associated numerical value represents its estimated concentration.

N: Presumptive evidence that the analyte is present, but the result was not confirmed.

R: The data are unusable (analyte may or may not be present)

U: The analyte was analyzed for, but not detected above the method detection limit. The associated numerical value is the method detection limit.

UJ: The analyte was analyzed for, but not detected above the method detection limit; the associated quantitation limit and method detection limit are considered as estimated values.

4.5 VALIDATION AND VERIFICATION METHODS

Data verification and validation will be completed in accordance with the specific procedure, as described in Section B.5. The PI is responsible for receiving and documenting data received from the analytical laboratories, assigning and recording the names of qualified data reviewers/validators, and reviewing completed data review/validation checklists or review narratives. Data reviewers/validators are responsible for completing data review/validation checklists or review narratives, assigning data qualifiers, tabulating results, and communicating nonconformance to the PI. The data reviewer/validator will notify the PI of any nonconformance

revealed in the data review or validation. The PI will be responsible for communicating the nonconformance and the corresponding corrective action to the Project Manager.

4.6 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Once the data verification and validation procedures have been completed, the PI will evaluate the results to determine if project DQOs have been meet. Both the analytical results and actual sampling procedures will be evaluated. The Project Manager will be responsible for preparing a Data Quality Assessment (DQA) report as described in Section 3.1.2, based on information from the PIs and his own review. The following tools may be used in evaluating the results against project DQOs.

4.6.1 Precision

Precision examines the spread of data about their mean. The spread represents how different the individual reported values are from the average reported values. Precision is thus a measure of the magnitude of errors and will be expressed as the Relative Percent Difference (RPD) or the relative standard deviation (RSD) for all methods. The lower these values are, the more precise are the data. These quantities are defined as follows:

$$\textbf{RPD (\%)} = 100 \times \frac{|S - D|}{(S + D)/2}$$

$$\textbf{RSD (\%)} = (s/X) \times 100$$

where:
- D = Concentration or value of an analyte in a duplicate sample
- S = Concentration or value of an analyte in a original sample
- X = Mean of replicate analyses
- s = Standard deviation

4.6.2 Accuracy

Accuracy measures the average or systematic error of an analytical method. This measure is defined as the difference between the measured value and the actual value. Accuracy will be expressed as the percent recovery. This quantity is defined as follows:

$$\textbf{Recovery (\%)} = \frac{|SC - UC|}{KC} \times 100$$

where:
- SC = Measured spiked concentration of an analyte
- UC = Measured unspiked concentration of an analyte (assume to be zero for LCS and surrogates)
- KC = Known concentration of an analyte

4.6.3 Completeness

Completeness establishes whether a sufficient amount of valid measurements were obtained. The closer this value is to 100, the more complete the measurement process. The overall project analytical completeness goal is 80%. Completeness will be calculated as follows:

$$\textbf{Completeness (\%)} = \frac{V \times 100}{R}$$

where: V = Number of valid measurements (includes data qualified as estimated)

R = Number of requested measurements

4.6.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent the environmental condition. Representativeness is achieved in part through using standard sampling and analytical procedures described in this QAPP and supporting FSP and SOPs. Representativeness is also influenced by appropriate program design and such elements as proper sample locations, drilling and installation procedures and sampling locations. Program design is documented in the QAPP and FSP, which are reviewed by data users and approved by the Project Manager to further assure that all representativeness issues are addressed. Each time a sample is collected, every effort will be made to collect a sample representative of the medium.

Co-located field duplicates will be used to evaluate how representative a sample collected is of a sample location. Laboratory or method duplicates will be used to evaluate how representative an aliquot taken from a sample is of a given sample. Following a determination of precision, a statement on representativeness will be prepared noting the degree to which data represents the environment.

4.6.5 Comparability

Comparability expresses the confidence with which one set of data can be compared to another. If appropriate, a statement on comparability will be prepared following the determination of both precision and accuracy. A statement on comparability will also be prepared when the data collected are used with data reported from another study.

5.0 REFERENCES

USEPA Region 6, 2001, Administrative Order on Consent for Remedial Investigation/Feasibility Study.

USEPA, 1992, Guidance for Data Usability in Risk Assessment.

USEPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Review.

USEPA, 1999, USEPA Contract Laboratory Program National Functional Guidelines for Organic Review.

USEPA, 2002, EPA QA/G-5 - Guidance for Quality Assurance Project Plans

URS, 2002a, Molycorp Questa Mine Remedial Investigation/Feasibility Site Study Health and Safety Plan.

URS, 2002b, Molycorp Questa Mine Remedial Investigation/Feasibility Study Work Plan.