

Prepared for

CYPRUS PLATEAU MINING CORPORATION

P.O. Box Drawer PMC

Price, Utah 84501

**BASELINE HYDROLOGIC MONITORING PLAN
WILLOW CREEK MINE
CYPRUS PLATEAU MINING CORPORATION**

June 1994

(Revised September 1994)

Prepared by

TerraMatrix Inc.

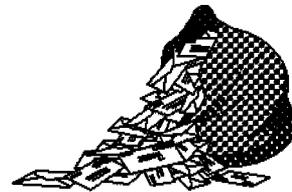
1475 Pine Grove Road, Suite 109

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Steamboat Springs, Colorado 80477

TRANSMITTAL LETTER

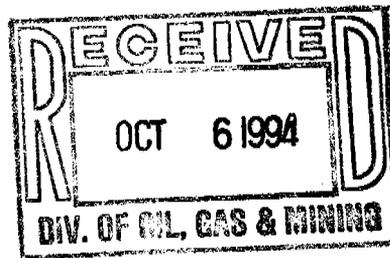
TERRAMATRIX/ACZ Inc.
Engineering and Environmental Services



September 30, 1994

Project No. 866

To: Mr. Daron Haddock
Utah Division of Oil Gas and Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84108



Sent by: Jerry M. Nettleton

Delivered by:

Other:

- Mail
- Air Freight
- Hand Carried

- _____
- _____
- _____

QUANTITY	ITEM DESCRIPTION
1	Plan Document - Cyprus Willow Creek Project - Final Baseline Hydrology Monitoring Plan
<p>REMARKS: Daron: We appreciate UDOGM's input on the Hydrologic Monitoring Plan for Cyprus's proposed Willow Creek Project. Accompanying this transmittal is a bound copy of the final monitoring plan incorporating appropriate changes responding to UDOGM's comments. Please review the plan document and return a copy of the acknowledgement provided in the front of the document by no later than 10/31/94. If we do not receive an acknowledgement, we will assume that the hydrologic monitoring activities outlined by the plan will provide adequate baseline information to support permit approvals.</p>	

**CYPRUS PLATEAU MINING COMPANY
WILLOW CREEK PROJECT**

By my signature below, I acknowledge receipt of the Baseline Hydrologic Monitoring Plan for the Willow Creek Project. The UDOGM staff has reviewed the referenced plan document and feels that the proposed activities outlined by the plans will provide adequate baseline information to support permit approvals.

Name _____

Title _____

Date _____

**CYPRUS PLATEAU MINING COMPANY
WILLOW CREEK PROJECT**

By my signature below, I acknowledge receipt of the Baseline Hydrologic Monitoring Plan for the Willow Creek Project. The UDOGM staff has reviewed the referenced plan document and feels that the proposed activities outlined by the plans will provide adequate baseline information to support permit approvals.

Name _____

Title _____

Date _____



State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

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October 1, 1994

Mr. Jerry Nettleton
TerraMatrix/ACZ Inc.
P. O. Box 774018
Steamboat Springs, Colorado 80477

RE: Baseline Hydrologic Monitoring, Willow Creek Mine, Cyprus Plateau Mining Corp.,
PRO/007/038, Folder #2, Carbon County, Utah

Dear Mr. Nettleton:

This letter acknowledges receipt of the Baseline Hydrologic Monitoring Plan for the Willow Creek Mine. The Division is in the process of reviewing the submittal. We will attempt to have the plan reviewed by October 31, 1994, but the review may require more time. We will provide the results upon completion of the review. Please do not assume that the plans are adequate until you have been notified accordingly.

Sincerely,

A handwritten signature in cursive script that reads "Daron R. Haddock".

Daron R. Haddock
Permit Supervisor

cc: S. Johnson
jerryn.let

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A	Sample Container Coding System
B	Sample Label
C	Chain of Custody Form
D	Field Information Forms
E	Laboratory Quality Assurance Program

1.0 INTRODUCTION

1.1 BACKGROUND

Cyprus Plateau Mining Corporation (CPMC) currently operates the Plateau Mine located approximately 20 miles southwest of Price, Utah. Anticipating the depletion of reserves at this facility, CPMC proposes to develop a nearby coal reserve, designated the Willow Creek Mine. As shown in Figure 1, General Location Map, the proposed Willow Creek Mine complex is located five miles north of Helper and east and south of the old town of Castlegate in Carbon County, Utah.

To facilitate the transition from production at the Plateau Mine to production at the Willow Creek Mine, CPMC has actively begun an evaluation of environmental conditions at the proposed facility. The purpose of the evaluation is to collect environmental data necessary to complete required permit applications for the new mine. As part of this evaluation, a baseline hydrologic monitoring program was developed and is presented in this document.

1.2 PURPOSE

The purpose of this document is to present a detailed plan for the collection and evaluation of baseline hydrologic data from the proposed Willow Creek Mine. Data collected under this plan will be used to characterize existing surface water and ground water resources in the area and evaluate potential impacts to these resources from proposed mining and reclamation activities. This plan was developed in accordance with applicable regulatory guidelines (R614-301-700) and provides for the characterization of surface and groundwater flows, water quality conditions, and any seasonal variations in these characteristics.

The remainder of this document has been divided into five sections:

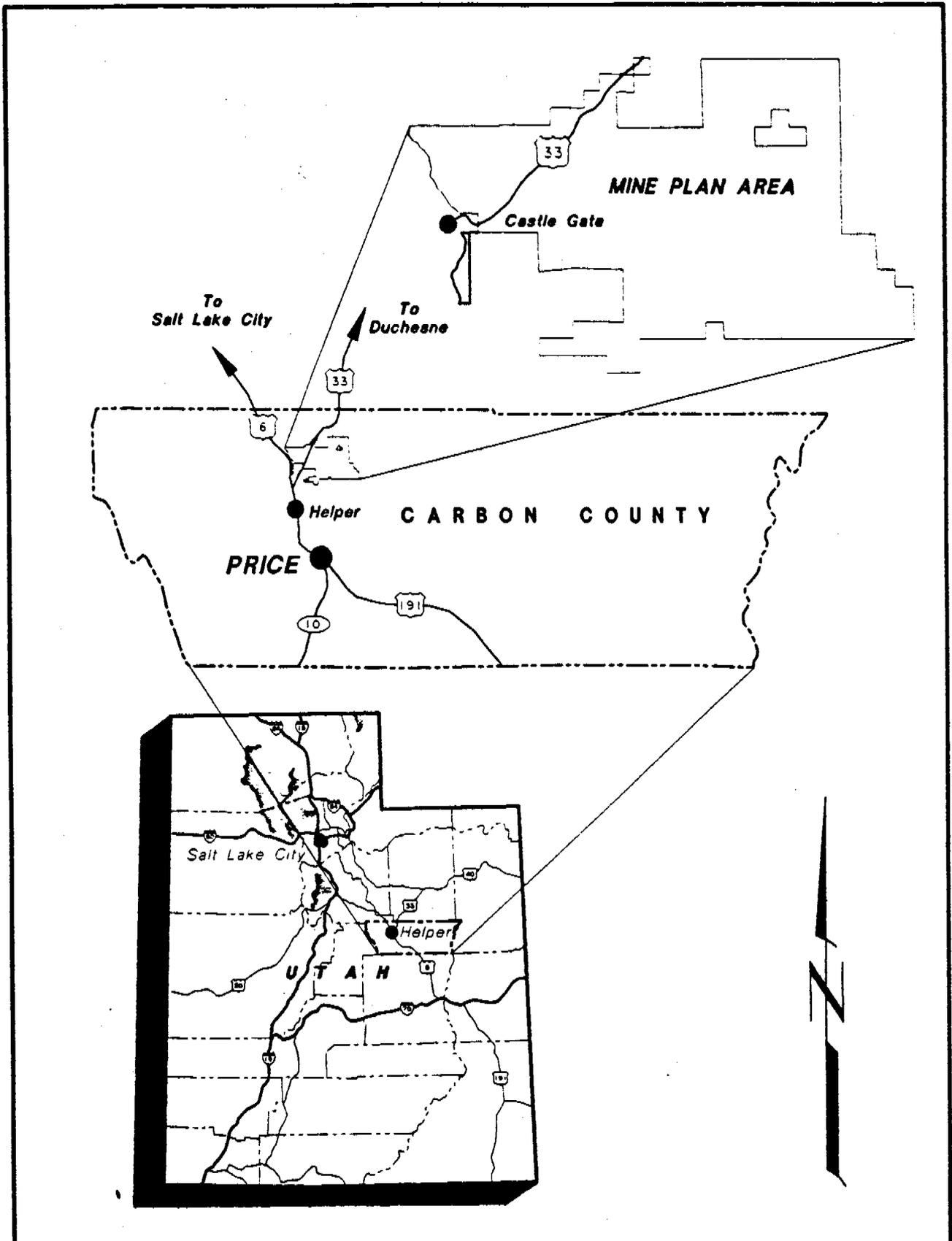
Section 2 (Field Reconnaissance) - This section describes a spring and seep and stream survey conducted in June 1994 and the proposed installation of ground water wells in Autumn 1994

Section 3 (Sampling Plan) - This section describes the location of hydrologic monitoring stations, sampling frequency, field measurements, collection of samples for laboratory analysis, and equipment decontamination

Section 4 (Sample Handling and Field Documentation) - This section describes the handling of field samples and completion of field documents

Section 5 (Laboratory Analysis) - This section describes the laboratory analysis of samples, analytical methods, and detection limits

Section 6 (Data Management and Evaluation) - This section describes the reporting and review of field and laboratory data and preparation of a baseline hydrologic information report for inclusion in the permit application document



Project No.: 500-5000	Design By: J.METTLER	Scale: NOT TO SCALE
File: PLATGLOC.DWG	Drawn By: K.CONRATH	Date: MARCH 1994

CYPRUS Plateau Mining

TerraMatrix
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FIGURE 1

GENERAL LOCATION MAP

Figure 1

1.3 STATUS OF MONITORING PLAN

Baseline hydrologic monitoring for the Willow Creek Project was initiated in June 1994 with the completion of a spring and seep survey and establishment of several surface water monitoring stations. Hydrologic monitoring activities will continue at these sites on a monthly basis during the active flow period (March through September) for a period of one year.

Permit applications to install ground water monitoring wells on the property were also recently submitted to the Utah Division of Oil, Gas and Mining (UDOGM) and the Bureau of Land Management (BLM). Drilling of these wells is expected to begin in August or September 1994, followed by one year of baseline monitoring.

2.0 FIELD RECONNAISSANCE

2.1 SPRING AND SEEP SURVEY

In June 1994, TerraMatrix and CPMC performed a survey of springs and seeps in the project area. The purpose of the survey was to identify significant springs and seeps which could be potentially impacted from the proposed mining operation. Before conducting this survey, local water rights records and topographic and geologic maps for the region were reviewed to identify potential monitoring locations. In addition, a local rancher was contacted regarding the occurrence of springs and seeps on his property.

Due to the steep terrain and the relatively large area to cover (12,000 acres), the spring and seep survey was conducted from a helicopter. Potential monitoring locations were identified in the air and then verified on the ground. Springs were distinguished from seeps based on the presence of observable flow. Springs were classified as having observable flow whereas seeps were classified as those areas of vary shallow standing water or saturated soils.

A total of 10 springs and 3 seeps were identified during the survey. The location of the springs and seeps are shown on Figure 2, Monitoring Station Location Map. Note that spring B271 is believed to be a continuation of flow from upgradient site B342.

In addition to the springs and seeps, numerous stock ponds were observed along drainages in the northeastern project area. The ponds consisted of impoundments that had been excavated into the drainages to collect surface runoff. At the time of the survey, many of the ponds were filled with water, presumably from spring snowmelt.

2.2 STREAM SURVEY

As part of the June 1994 spring and seep survey, canyons within the project area were investigated for signs of surface flow. The purpose of the stream survey was to identify potential streams in the project area that could also be potentially impacted from mining. The following streams were identified:

- Price River
- Willow River
- Antony Creek
- Mathis Canyon
- Deep Canyon/Buck Canyon

The location of these streams are shown on Figure 2. Note that the stream identified in Deep Canyon/Buck Canyon was found to stop flowing approximately 1/4 mile upgradient of its confluence with Willow Creek.

Figure 2

2.3 MONITORING WELL INSTALLATION

Consistent with ongoing discussions with UDOGM, CPMC proposes to drill and complete three ground water monitoring wells in order to characterize ground water conditions in the project area and evaluate potential mining related impacts. The three wells would be located in Dry Canyon, Alrad Canyon, and Panther Canyon as shown by Figure 2.

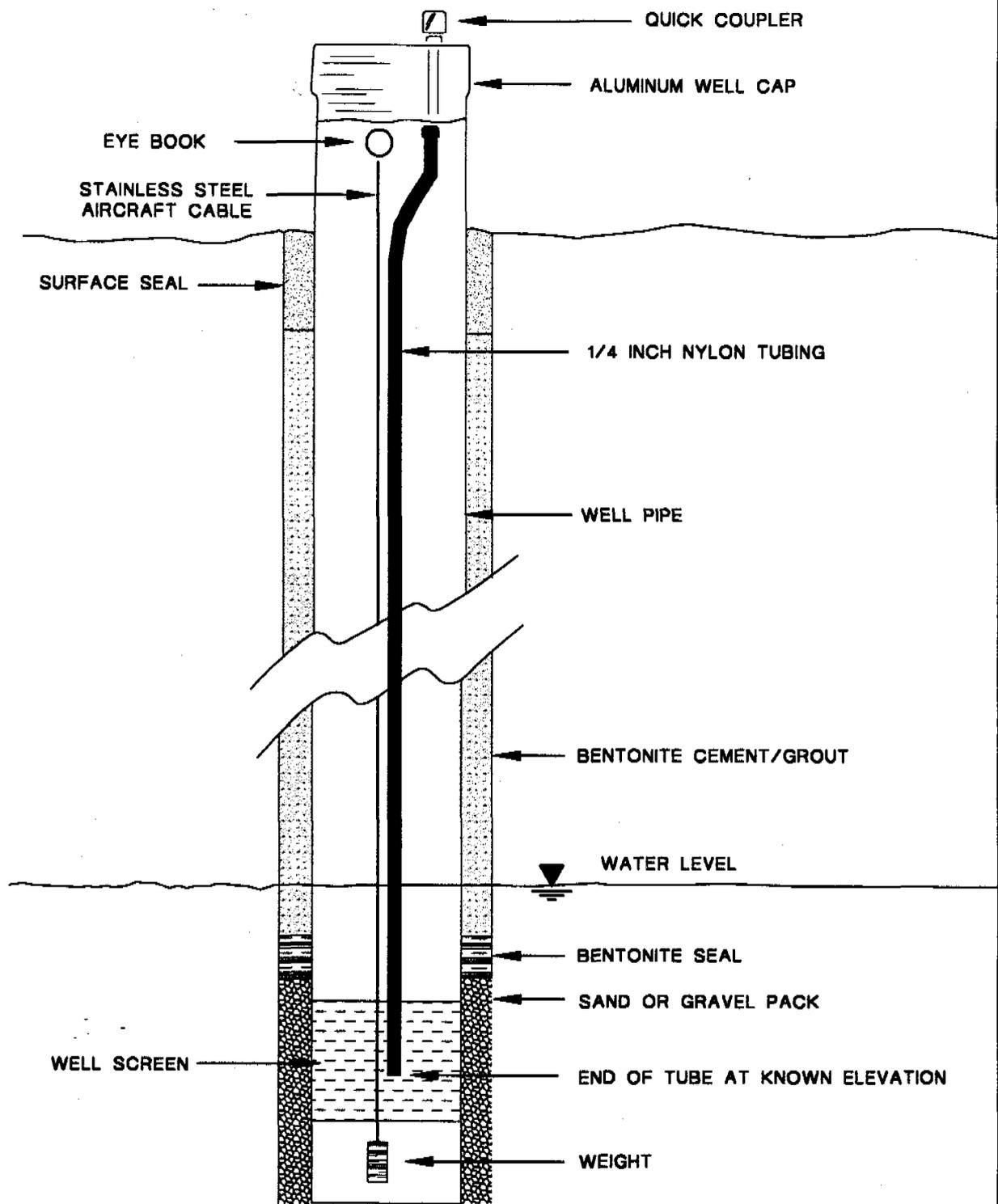
2.3.1 Drilling

The proposed monitoring wells will be drilled with a conventional air rotary drill rig using air/foam drilling methods in order to minimize contamination of either the core, which will be recovered in conjunction with well drilling activities, or the wells. Wells will be drilled at a nominal diameter of 6 inches and expanded to a nominal diameter of 9 inches where surface casing is required. The following summarizes basic drilling parameters for the proposed wells:

<u>Site</u>	<u>Total Depth</u>	<u>Surface Casing</u>	<u>Core</u>
Dry Canyon	1,800'	350'	80'
Alrad Canyon	1,000'	200'	80'
Panther Canyon	400'	150'	200'

2.3.2 Construction and Development

Wells will be cased with standard steel well casing due to their depth and surface casing will be placed where necessary to stabilize the upper portion of the drillholes. It is anticipated that all wells will be single completion wells with the screened interval near the base of the Aberdeen Sandstone which is the only known regional aquifer in the area and underlies the lowermost coal seam to be mined. All wells will be installed with a sand or gravel filter pack and completion will include a bentonite seal and surface concrete grout. Well completion details are illustrated by Figure 3. All wells will be developed by blowing the wells with compressed air from the drill rig for at least one hour or until no more fluid is detected in the discharge stream (well blown dry).



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File: WELLCOMP.DWG	Drawn By: K.CONRATH	Date: SEPT. 1994

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FIGURE 3

WELL COMPLETION DIAGRAM

3.0 SAMPLING PLAN

3.1 MONITORING STATIONS

Baseline hydrologic monitoring will be performed at a total of 18 monitoring stations including:

- 10 springs
- 8 stream stations
- 3 monitoring wells

General information on each of these stations is listed in Table 1, Monitoring Stations. Note that due to insignificant discharge, and disturbance from cattle, seeps identified during the June 1994 survey will not be included in the monitoring program. Also not included will be the numerous stock ponds observed along drainages in the northeastern project area. These ponds were constructed by ranchers to collect snowmelt and storm runoff for their cattle and are considered ephemeral surface water features.

3.2 SITE ACCESS

Under favorable weather conditions, access to most of the monitoring stations will be possible with a 4-wheel drive truck or all-terrain vehicle (ATV). Exceptions to this include a few springs identified in the northeastern project area which will require a long hike from a vehicle. Access, particularly during the winter may be limited by weather and ground conditions.

At this time, access requirements are being evaluated by CPMC personnel.

3.3 SAMPLE FREQUENCY

As agreed upon by UDOGM, baseline hydrologic monitoring will be performed for the Willow Creek Project at the following frequency:

Springs - Discharge measurements, field water quality parameters, and laboratory samples will be taken in June, August, and October of 1994 and March or April 1995

Stream Stations - Flow and field water quality parameters will be measured on a monthly basis from June through October 1994, with confirmation monitoring of high flows in March or April 1995. Water samples will be collected for laboratory analysis in June, September, and December of 1994 with confirmation sampling in March or April 1995

Monitoring Wells - Ground water level measurements, field water quality parameters, and laboratory samples will be taken following well installation and development in August (or September) 1994 and then in April, June and August of 1995

These sample frequency requirements are summarized in Table 2, Sample Frequency.

**TABLE 1
MONITORING STATIONS**

Station No.	Station Type	Location	Notes
B41*	Spring	SE¼ SE¼ Sec. 4, T13S, R10E	Developed spring with stock tank, previous monitoring site B-33
B71*	Spring	NE¼ NE¼ Sec. 7, T13S, R10E	Developed spring with stock tank
B161*	Spring	NE¼ SW¼ Sec. 16, T13S, R10E	Located near collapsed Kenilworth Adit
B241*	Spring	NW¼ NW¼ Sec. 24, T12S, R10E	Undeveloped spring near historic cabin, possibly 'Robb' Spring
B261*	Spring	NE¼ SE¼ Sec. 26, T12S, R10E	Developed spring with stock tank, referred to as Pace Spring
B262*	Spring	NE¼ NE¼ Sec. 26, T12S, R10E	Undeveloped spring
B341*	Spring	SW¼ NE¼ Sec 34, T12S, R10E	Developed spring with stock tank, referred to as 'Mathis Spring,' previous monitoring site B-32
B342*	Spring	NE ¼ NE¼ Sec. 34, T12S, R10E	Developed spring with stock tank
B351*	Spring	NW¼ SE¼ Sec. 35, T12S, R10E	Undeveloped spring located below stock pond
B352*	Spring	SE¼ SE¼ Sec. 35, T12S, R10E	Undeveloped spring on tributary to Mathis Creek
B3N	Stream	SW¼ NE¼ Sec. 1, T13S R9E	Downgradient Willow Creek station, above power plant facilities, near previous monitoring site B-3
B5	Stream	SE ¼ NW¼ Sec. 1, T13S, R9E	Downgradient Price River station, above confluence with Willow Creek, previous monitoring site
B6	Stream	S½ NE¼ Sec. 35, T12S, R9E	Upgradient Price River station, previous monitoring site
B131*	Stream	SW¼ SE¼ Sec. 13, T12S, R10E	Downgradient Anthony Creek station
B151	Stream	SE¼ SW¼ Sec. 15, T12S, R10E	Upgradient Willow Creek station, at location of abandoned USGS gaging station
B211*	Stream	SW¼ NE¼ Sec. 21, T12S, R10E	Mathis Canyon above confluence with Willow Creek
B263*	Stream	NE¼ NE½ Sec. 26, T12S, R10E	Intermediate reach of Buck/Deep Canyon adjacent to spring station B262
B353*	Stream	NW¼ NW¼ Sec. 35, T12S, R10E	Upper reach of Mathis Creek near headwaters area below spring station B351
B33*	Monitoring Well	NE¼ NW¼ Sec 33, T12S, R10E	Dry Canyon Well
B51*	Monitoring Well	SE¼ SW¼ Sec. 5, T13S, R10E	Panther Canyon Well
B121*	Monitoring Well	SW¼ NW¼ Sec. 12, T13S, R10E	Aldred Canyon Well

Note: Stations designated with asterisk are either not accessible or do not flow during winter months.

TABLE 2 SAMPLE FREQUENCY								
	June 1994	July 1994	August 1994	September 1994	December 1994	March/ April ¹ 1995	June 1995	August 1995
SPRINGS								
Discharge	X		X		X	X		
Field Water Quality	X		X		X	X		
Laboratory Samples	X		X		X	X		
STREAM STATIONS								
Stream Flow	X	X	X	X	X	X		
Field Water Quality	X	X	X	X	X	X		
Laboratory Samples	X			X	X	X		
MONITORING WELLS²								
Depth to Ground Water				X		X	X	X
Field Water Quality				X				
Laboratory Samples				X				
Notes: ¹ Monitoring for springtime monitoring period (especially stream monitoring stations) to occur on flexible schedule in order to obtain data for peak flow/discharge condition.								
² Initial sampling for monitoring wells will occur as soon as the wells are completed (currently projected as late September)								

3.4 FIELD MEASUREMENTS

3.4.1 Spring Discharge

Spring discharge will be measured using a calibrated bucket and stopwatch. A plastic pipe will be used to channel flow from the spring into the bucket, taking care not to allow flow to bypass the pipe. A few of the springs have been developed by ranchers and currently flow into stock tanks. At these springs, discharge will be measured by simply placing the bucket beneath the tank inlet pipe.

Discharge measurements will be taken at least twice and an average discharge value recorded.

3.4.2 Stream Flow

Stream flows will be monitored using a sharp-crested weir, a current meter, or a calculated flow balance. The particular method used will depend on stream conditions at the time of measurement. If the stream width is less than about 1 foot and flow is relatively low (less than 0.3 cubic feet per second (cfs)), a sharp-crested weir will be used.

A sharp-crested weir was constructed for the monitoring program using a 1/4 inch thick piece of plywood, 1.5 feet long and 1.0 feet high with a 0.5-foot deep, 90 degree V-notch cut in its center. To measure stream flow with the weir, the following procedures will be used:

- 1) Place the weir in a narrow trench excavated perpendicular to the stream channel near the station
- 2) Partially bury the weir so that no flow occurs around its base or sides
- 3) If leakage does occur, estimate and record its volume
- 4) After flow has stabilized, measure the depth of water in the V-notch using the scale painted on side of the weir
- 5) Calculate and record the flow using the equation $Q = 2.5 (h)^{2.5}$ where Q is discharge in cfs and h is the depth of water in the V-notch

If the stream is too wide, and/or stream flow is too large to use the weir, and the stream can be crossed safely, a direct flow measurement will be made using a current meter. A detailed description of this field method is found in the document "Measurement and Computation of StreamFlow" (USGS Water Supply Paper 2175, 1982). A brief outline of the procedure to be used for this project is provided below:

- 1) Select a channel section near the station that is well defined and generally clear of debris, has a relatively smooth bottom, and does not exhibit excessive turbulence
- 2) Stretch a steel tape across the channel perpendicular to flow and divide the section into several subsections. Record the width of each subsection and its depth at the center. Depending on the total channel width, the number of subsections could vary from 3 or 4 to as many as 20, so long as variations in the flow regime are accounted for
- 3) Using a current meter, measure the average velocity of flow along the center of each subsection and record
- 4) Multiply the area of each subsection (width X depth) by the average flow velocity and calculate discharge in cfs. Finally, sum the discharge values for each subsection

Flows in the Price River (Stations B5 and B6) are frequently so high as to preclude safe crossing of the stream and flow measurement using a current meter. The USGS, however, maintains an active stream monitoring station near Heiner, approximately 1.5 miles downstream from the project area. When flow conditions do not allow direct flow measurement at Stations B5 and B6, flows on the Price River upstream of its junction with Willow Creek can be calculated with reasonable accuracy by adjusting the recorded flow volumes for the USGS station at Heiner to reflect inflows from Willow Creek and any stream inputs or withdrawals recorded for the Utah Power and Light - Carbon Generating Station.

3.4.3 Depth to Groundwater

Due to the deep aquifer system in the area (as much as 1500 feet below ground surface), it is not practical to measure groundwater levels using a convention electric water level sounder. Rather, water levels will be measured by installing an air line in each monitoring well. Air will be pumped into a line using an air compressor and the pressure monitored with a gauge connected to a tee in the line. When the gauge readings stabilize, the pressure will be recorded and depth to water calculated based on the depth of the bottom of the air line and the amount of pressure

build-up. Further discussion of this method of groundwater level measurement is presented in the text "Groundwater and Wells" (Driscoll, 1986)

3.4.4 Field Water Quality Analyses

Temperature, pH, specific conductivity, and dissolved oxygen will also be analyzed in the field as part of baseline monitoring. Measurements will be made using a portable field meter that, at a minimum, is calibrated at the beginning of each day's use and checked at the end of each day. More frequent calibration and/or checks may be necessary if anomalous reading occur. Instructions provided by the equipment manufacturer will be followed to properly calibrate and operate the meter and all calibration results will be recorded in a field book.

Field water quality measurement of streams and springs will be made by directly placing the probe of the meter into flowing water. Ground water from monitoring wells will be analyzed by collecting a sample in a glass or plastic beaker and then placing the probe into the container. Dissolved oxygen measurements will only be made at the stream stations.

3.5 SAMPLE COLLECTION

3.5.1 Springs

Since many of the springs in the area are developed and feed stock tanks, samples will be collected directly at the tank inlet pipes. At undeveloped springs or where this is not possible, a small depression will be made near the spring mouth and the ponded water transferred via a beaker into sample containers. Care will be taken to allow the water to clear of sediment before samples are collected.

Pre-cleaned plastic and glass containers will be supplied by the laboratory and used for sample collection. Sample preservatives will be pre-added to these containers by the laboratory and, therefore, the containers will not be rinsed before filling in the field. Table 3, Water Quality Parameters, lists the sample containers and preservatives that will be provided by the laboratory.

3.5.2 Streams

If the stream is sufficiently deep, samples will be collected by dipping the laboratory sample containers into the center of flow, facing upstream. Care will be taken not to stir up streambed sediments during sampling or to overfill the bottles as this could dilute the sample preservatives. In the event the stream is too shallow to directly fill the containers, a beaker will be used to transfer the samples. Note that only stream water that is flowing will be sampled. Ponded or stagnant water in the stream channels may not be representative of the surface water flow and, therefore, will not be sampled.

3.5.3 Monitoring Wells

Site monitoring wells will be sampled once for water quality analysis immediately following well development. Airlifting will be used to develop the wells and either airlifting or a specially adapted deep well pumping technique will be used to collect ground water samples. To ensure that drilling fluids have been removed from the well and fresh aquifer water is being pumped, field water quality parameters will be measured during development. Wells will only be sampled after the field parameter reading have stabilized and, as is practical, at least three casing volumes of well water have been purged. A beaker will be used to transfer ground water from the well head to the laboratory sample containers.

3.6 SAMPLE FILTRATION

At the request of UDOGM, water samples collected for analysis of dissolved cations and trace elements will be filtered **in the field** rather than in the laboratory. Sample filtration will be performed using a peristaltic pump and disposable 0.45 micron cartridge filters. Specific procedures for field filtration are outlined below.

- 1) Obtain a pre-cleaned 1000 ml plastic "transfer" container from the laboratory for each sample site
- 2) Rinse the transfer container twice with sample water and then fill
- 3) If the sample cannot be immediately filtered, label the transfer container with the site number and time of collection and take to the filtering station
- 4) Set up the filtering station either by connecting the peristaltic pump to a car battery or, if the filtration will be done at the field office, by plugging the pump into a wall outlet
- 5) Rinse the outside end of the pump tubing that will be placed in the transfer container with sample water from the transfer container. After rinsing, place the tubing in the transfer container
- 6) Attach a new disposable cartridge filter to the other end of the pump tubing. It is imperative that a new filter be used for each sample
- 7) Turn on the pump and pass a minimum of 250 ml of sample water through the tubing and cartridge filter before collecting the sample
- 8) After rinsing the filter, proceed to fill up the proper sample container (green dot bottle). Filtered water should be passed directly into the sample container from the outlet of the filter
- 9) Note on the sample container label and chain of custody form that the dissolved cation/metals sample has been field filtered
- 10) Disconnect the filter from the tubing and dispose along with the transfer container
- 11) Flush the pump tubing with about 100 to 200 ml of deionized water
- 12) Carefully store the pump and pump tubing in the carrying case to avoid contamination with dirt, etc.

Due to the potential chemical instability caused by exposing groundwater to surface conditions, groundwater samples must be filtered at the well head immediately after collection. Surface water and spring samples should also be filtered as soon as possible, although if field conditions make this impractical, these samples may be filtered within a few hours after collection. These samples are considered more chemically stable due to their natural exposure to surface conditions.

3.7 QUALITY CONTROL SAMPLES

To assure adequate quality control, one water quality duplicate sample will be collected during each sampling event and submitted for laboratory analysis. Duplicate samples will be collected following the same procedures as the original sample. To avoid confusion between the samples, duplicates will be designated with the suffix "-D" after the station name. Duplicates will be used to check on the precision of the laboratory analysis and to determine whether field collection methods are reproducible.

3.8 DECONTAMINATION OF FIELD EQUIPMENT

The following water quality sampling equipment will require regular decontamination:

- Field water quality meter
- Glass or plastic beakers used to transfer samples
- Peristaltic pump and tubing

The field water quality meter will be decontaminated at each monitoring location before testing by rinsing the probe tip 2 or 3 times with sample water. Similarly, beakers used to transfer samples will be rinsed once with deionized water followed by 2 or 3 sample rinses before use and stored in a plastic bag between monitoring locations. Decontamination procedures for the peristaltic pump and tubing are outlined in Section 3.6.

4.0 SAMPLE HANDLING AND FIELD DOCUMENTATION

4.1 SAMPLE HANDLING

Laboratory sample containers will be filled one by one at the monitoring locations, secured with the container lid, and any excess water wiped off the exterior. Immediately after collection, the containers will be placed in field coolers with ice. Glass containers will be wrapped with bubble wrap or other appropriate shipping material to prevent breakage.

To meet recommended holding times, the samples will be shipped to the laboratory in coolers with packing material and ice within 24 to 36 hours of collection. Table 3, Water Quality Parameters, lists holding time requirements for the various parameters to be analyzed.

4.2 FIELD DOCUMENTATION

4.2.1 Sample Labels

A sample label will be completed and attached to each laboratory sample container just before it is filled. The labels will be filled out with a permanent marker and include the following information:

- Sample Identification (same as the station number)
- Sample Date
- Sample Time
- Sample Preservative (if any)
- Sample Type

Because a variety of preservatives and analytical methods will be employed, care will be taken to avoid mislabelling the containers. To assist in keeping track of sample preservatives, the laboratory to be used has adopted a color-coding system for the sample containers. A copy of this system is provided in Appendix A, Sample Container Coding System. A copy of a standard sample label is presented in Appendix B, Sample Label.

4.2.2 Chain of Custody

The field sampler will be responsible for the care and custody of the water quality samples until they are transferred to a licensed courier. The sampler's responsibility will include:

- Labelling and sealing all sample containers
- Properly packing the samples with ice for shipment to the laboratory
- Initiating Chain of Custody forms
- Filling out airbills to assure that the samples are received at the laboratory within the required holding times
- Physically transporting the samples to the courier
- Notifying the laboratory of all sample shipments

**TABLE 3A
WATER QUALITY PARAMETERS - SPRINGS AND MONITORING WELLS**

PARAMETER	SAMPLE CONTAINER	PRESERVATION/LABORATORY FILTERING REQUIREMENTS	METHOD OF ANALYSES	LABORATORY DETECTION LIMIT (MG/L, UNLESS OTHERWISE NOTED)	RECOMMENDED HOLDING TIME
FIELD MEASUREMENTS					
pH	N/A	N/A	Field Meter	N/A	Immediately
Specific Conductance					
Temperature					
GENERAL CHARACTERISTICS					
Alkalinity (including bicarbonate/carbonate)	1 - 250 ml plastic	4°C/lab filter for dissolved solids	EPA 310.1, Titrimetric	1 (as CaCO ₃)	14 days
Specific Conductance			EPA 120.1, Meter	1 (umhos/cm)	28 days
Total Dissolved Solids			EPA 160.1, Gravimetric	2	7 days
NUTRIENTS					
Nitrogen, Ammonia	1 - 125 ml plastic	H ₂ SO ₄ and 4°C/no filtration	EPA 350.1, Auto-Phenate	0.05 (as NH ₃)	28 days
Nitrite			EPA 353.2, Auto-CD Reduction	0.01 (as N)	7 days
Nitrate			EPA 353.2, Auto-CD Reduction	0.02 (as N)	7 days
ANIONS					
Chloride	1 - 250 ml plastic	4°C/lab filter	EPA 325.2, Auto-Ferro CN	1	28 days
Sulfate			EPA 375.3, Gravimetric	2	28 days
Phosphate (Ortho)			EPA 365.1, Auto Ascorbic	0.005	48 hours

**TABLE 3A
WATER QUALITY PARAMETERS - SPRINGS AND MONITORING WELLS**

PARAMETER	SAMPLE CONTAINER	PRESERVATION/LABORATORY FILTERING REQUIREMENTS	METHOD OF ANALYSES	LABORATORY DETECTION LIMIT (MG/L, UNLESS OTHERWISE NOTED)	RECOMMENDED HOLDING TIME
DISSOLVED CATIONS/TRACE ELEMENTS					
Aluminum	1 - 125 ml plastic	HNO ₃ /field filter (HNO ₃ added by lab after field filtering)	EPA 200.7, ICP	0.05	6 months
Arsenic			EPA 206.2, GFAA	0.001	
Boron			EPA 200.7, ICP	0.02	
Cadmium			EPA 200.7, ICP	0.005	
Calcium			EPA 200.7, ICP	1	
Copper			EPA 200.7, ICP	0.01	
Total Hardness			EPA 130.2, Calculation	1 (as CaCO ₃)	
Iron			EPA 200.7, ICP	0.02	
Lead			EPA 200.7, ICP	0.02	
Magnesium			EPA 200.7, ICP	1	
Manganese			EPA 200.7, ICP	0.01	
Molybdenum			EPA 200.7, ICP	0.05	
Potassium			EPA 200.7, ICP	1	
Selenium			EPA 270.2, GFAA	0.001	
Sodium			EPA 200.7, ICP	1.0	
Zinc	EPA 200.7, ICP	0.01			
TOTAL TRACE ELEMENTS					
Iron	250 ml pastic	HNO ₃ /no filtration	EPA 3015, acid digestion/ EPA 200.7, ICP	0.02	6 months
Manganese				0.01	
CATION/ANION BALANCE	N/A	N/A	By Calculation	N/A	N/A
Note: N/A = Not Applicable					

TABLE 3B
WATER QUALITY PARAMETERS - STREAM STATIONS

PARAMETER	SAMPLE CONTAINER	PRESERVATION/LABORATORY FILTERING REQUIREMENTS	METHOD OF ANALYSES	LABORATORY DETECTION LIMIT (MG/L, UNLESS OTHERWISE NOTED)	RECOMMENDED HOLDING TIME
FIELD MEASUREMENTS					
pH	N/A	N/A	Field Meter	N/A	Immediately
Specific Conductance					
Temperature					
Dissolved Oxygen					
GENERAL CHARACTERISTICS					
Specific Conductance	1 - 1000 ml plastic	4°C/lab filter for dissolved solids	EPA 120.1, Meter	1 (umhos/cm)	28 days
Total Dissolved Solids			EPA 160.1, Gravimetric	2	7 days
Total Settleable Solids			EPA 160.5, Gravimetric	2 (mg/l/hour)	48 hours
Total Suspended Solids			EPA 160.2, Gravimetric	2	7 days
NUTRIENTS					
Nitrogen, Ammonia	1 - 125 ml plastic	H ₂ SO ₄ and 4°C/no filtration	EPA 350.1, Auto-Phenate	0.05 (as NH ₃)	28 days
Nitrite			EPA 353.2, Auto-CD Reduction	0.01 (as N)	7 days
Nitrate			EPA 353.2, Auto-CD Reduction	0.02 (as N)	7 days
ORGANICS					
Oil & Grease	1 - 1000 ml amber glass	H ₂ SO ₄ and 4°C/no filtration	EPA 413.1, Gravimetric	1	28 days
ANIONS					
Alkalinity (including bicarbonate/carbonate)	1 - 250 ml plastic	4°C/lab filter	EPA 310.1, Titrimetric	1 (as CaCO ₃)	14 days
Chloride			EPA 325.2, Auto-Ferro CN	1	28 days
Sulfate			EPA 375.3, Gravimetric	2	28 days
Phosphate (Ortho)			EPA 365.1, Auto Ascorbic	0.005	48 hours

**TABLE 3B
WATER QUALITY PARAMETERS - STREAM STATIONS**

PARAMETER	SAMPLE CONTAINER	PRESERVATION/LABORATORY FILTERING REQUIREMENTS	METHOD OF ANALYSES	LABORATORY DETECTION LIMIT (MG/L, UNLESS OTHERWISE NOTED)	RECOMMENDED HOLDING TIME
DISSOLVED CATIONS/TRACE ELEMENTS					
Aluminum	1 - 125 ml plastic	HNO ₃ /field filter (HNO ₃ added by lab after field filtering)	EPA 200.7, ICP	0.05	6 months
Arsenic			EPA 206.2, GFAA	0.001	
Boron			EPA 200.7, ICP	0.02	
Cadmium			EPA 200.7, ICP	0.005	
Calcium			EPA 200.7, ICP	1	
Copper			EPA 200.7, ICP	0.01	
Total Hardness			EPA 130.2, Calculation	1 (as CaCO ₃)	
Iron			EPA 200.7, ICP	0.02	
Lead			EPA 200.7, ICP	0.02	
Magnesium			EPA 200.7, ICP	1	
Manganese			EPA 200.7, ICP	0.01	
Molybdenum			EPA 200.7, ICP	0.05	
Potassium			EPA 200.7, ICP	1	
Selenium			EPA 270.2, GFAA	0.001	
Sodium			EPA 200.7, ICP	1	
Zinc			EPA 200.7, ICP	0.01	
TOTAL TRACE ELEMENTS					
Iron	1 - 250 ml pastic	HNO ₃ /no filtration	EPA 3015, acid digestion/ EPA 200.7, ICP	0.02	6 months
Manganese			0.01		
CATION/ANION BALANCE	N/A	N/A	By Calculation	N/A	N/A
Note: N/A = Not Applicable					

A Chain of Custody form will accompany each sample cooler and include the following information:

- Project name or number
- Sampler's name and signature
- Sample identification
- Date and time of sample collection
- Sample matrix
- Number of sample containers
- Analyses requested
- Filtration completed or required
- Method of shipment

An example Chain of Custody form is presented in Appendix C, Chain of Custody Form.

Upon receipt, laboratory personnel will inspect the samples and record their condition and temperature on the Chain of Custody form. The forms will then be completed by the laboratory and forwarded with the final laboratory results.

4.2.3 Field Information Forms

In addition to Chain of Custody documentation, the following information will be recorded in the field at each monitoring station:

- Weather conditions including recent precipitation and approximate air temperature
- Field water quality measurements
- Spring discharge or stream flow (if applicable)
- Depth to ground water (if applicable)
- Well purge volumes and time (if applicable)
- Time and date of sample collection
- Any unusual conditions or activities in the area

This information will be recorded on field information forms and enclosed with Chain of Custody forms in the sample coolers. Examples of field information forms to be used on the project are provided in Appendix D, Field Information Forms.

4.3 SAMPLE CONTACT

Field sampling activities will be performed by or under the direction of Ben Grimes of Cyprus Plateau Mining Corporation. Mr. Grimes' address and phone number are provided below:

Ben Grimes
Cyprus Plateau Mining Corporation
P.O. Box Drawer PMC
Price, Utah 84501
(801) 637-2227

5.0 LABORATORY ANALYSIS

5.1 PARAMETERS

Table 3, Water Quality Parameters, lists the water quality parameters that will be analyzed during baseline monitoring at Willow Creek. This table is based on a parameter list originally presented by the Utah Department of Oil, Gas and Mining (UDOGM) in their January 1986 document "Guidelines for Establishment of Surface and Ground Water Monitoring Programs for Coal Mining and Reclamation Operations." and later revised on June 29, 1993. Note that surface water samples and spring and monitoring well samples will be analyzed for slightly different parameters.

Laboratory analyses will be performed under strict Quality Assurance (QA) procedures by ACZ Laboratories, Inc. (ACZ) of Steamboat Springs, Colorado. ACZ is an EPA certified laboratory that is approved in the State of Utah. For reference, a copy of ACZ's QA Program is presented in Appendix E, Laboratory Quality Assurance Program.

5.2 ANALYTICAL METHODOLOGIES AND DETECTION LIMITS

Laboratory analytical methods and parameter detection limits are included in Table 3. All methods are approved by the EPA.

5.3 LABORATORY CONTACT

Laboratory analyses of the baseline samples will be managed by Russ Renkin of ACZ. Mr. Renkin's address and phone number are provided below:

Russ Renkin
ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, Colorado 80487
(800) 334-5493

6.0 DATA MANAGEMENT AND EVALUATION

6.1 LABORATORY REPORTING

ACZ will report site water quality data by paper copy and on computer diskette. Paper laboratory reports and associated field documentation will be copied and filed at the CPMC field office. The electronic data will be stored by CPMC in a computer database set up for the project.

6.2 DATA REVIEW

The following steps will be taken by CPMC to review the baseline hydrologic monitoring data:

- Field measurements of spring discharge, stream flow, and ground water level will be rechecked for calculation errors and compared to prior measurements for accuracy. Anomalous or suspect values will be noted and an explanation provided
- Chain of Custody forms and laboratory data sheets will be checked to verify that samples were analyzed within specified holding times. Samples which do not satisfy holding time and preservation requirements will be noted and the reliability of the data assessed
- The precision of the laboratory data will be evaluated by comparing original and duplicate sample results. The laboratory will calculate Relative Percent Difference (RPD) values for the duplicate samples and compare these to EPA guidelines. If RPD values are unacceptable, action will be taken by the laboratory to improve the precision of the analytical results
- The accuracy of the major ion analyses will be evaluated by reviewing charge balance errors to verify that values are below 5 to 10%. Errors greater than this range will be brought to the attention of the laboratory and, if necessary, the sample(s) reanalyzed
- Finally, all the data will be carefully reviewed for potential transcription errors, detection limit discrepancies (laboratory only), data omissions, and suspect or anomalous values. If such errors or deficiencies are found, the laboratory and/or field sampler will be contacted and the appropriate corrective action taken

When the review is completed and it is determined that the data are complete and reasonable, final entry of the information will be made in the computer database.

6.3 SUMMARY REPORT

The summary report for the baseline hydrology data collection program will consist of the Hydrology - Environmental Description Section (Section 301-720) of the permit application document. This section will include a description of baseline methodologies, summaries of all baseline hydrologic monitoring results, a discussion of evaluation approach, and resulting conclusions relative to baseline surface and ground water hydrologic systems and conditions.

6.4 PROJECT CONTACTS

Review and evaluation of baseline hydrologic data for the Willow Creek project will be performed by Mr. Grimes of CPMC and Rich Burtell of TerraMatrix. Mr. Grimes' address and phone number were provided in Section 4.3. Mr. Burtell's address and phone number are given below:

Rich Burtell
TerraMatrix Inc.
1475 Pine Grove Road, Suite 109
P.O. Box 774018
Steamboat Springs, Colorado 80477
(303) 879-6260

APPENDIX A
SAMPLE CONTAINER CODING SYSTEM

**ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(303) 879-6590
FAX: (303) 879-2216**

**Sample Preservation Requirements
and Sample Shipping Instructions**

Additional Comments:

- Please fill out Chain-of-Custody Forms completely including: Name, Billing Address, Telephone Number, Project Number (if applicable), and Analyses Requested. This helps to ensure accurate and timely analysis of your samples.
- Clean field debris from the sample container exterior to lessen the chance of contamination.
- All samples should be cooled to 4 C for transport to ACZ Laboratories, Inc.
- Please contact us before shipping any samples which have 24 hour holding times [e.g., Coliforms or BOD] so that we may assist with sample transport and schedule the analyses to ensure holding times are met.
- Pack glass containers with adequate foam, bubble wrap, or other packing material (UPS recommends four [4] inches on each side) to prevent breakage.
- Filtered samples (except DOC) should be passed through a 0.45 um membrane filter before acidification. DOC samples should be passed through a 0.45 um silver mesh filter.
- We include sample labels for your convenience. Please use a waterproof marker for writing on labels and properly attach labels to bottles.
- Samples should be shipped to ACZ Laboratories, Inc. on the same day as taken. Please notify us if samples are shipped on Friday for Saturday delivery.
- Please contact us with any sample analyses, sample preservation, or sample transportation questions.

Inorganic Water Sample Bott

Color Code:	None	White	Red	Green	Yellow	Yellow (Glass)
Letter Code:	U	W	R	G	Y	YG
Sample Type:	Raw	Filtered	Raw	Filtered	Raw	Raw
Preservative:	None	None	Nitric Acid	Nitric Acid	Sulfuric Acid	Sulfuric Acid
Bottle Type:	Plastic	Plastic	Plastic	Plastic	Plastic	Glass w/ Teflon Co
Bottle Volume:	250-500 ml	250-500 ml	250 ml	250 ml	250 ml	250 ml
Analyses:	Acidity BOD Chlorine Conductivity Odor Orthophosphate pH Solids: Settleable Suspended Volatile Sulfite Surfactants Turbidity	Alkalinity: (Bicarbonate & Carbonate & Hydroxide) Boron Bromide Chloride Chromium VI Color Fluoride Iodide Nitrogen Nitrate/Nitrite Orthophosphate (Dissolved Only) Silica Sodium Sulfate (Dissolved; TDS Only) Sulfate	Metals (Total Only) Metals (Total Recoverable)	Metals (Dissolved Only) Calcium Magnesium Sodium	*Nitrogen (Total Only) Ammonia Organic Total *Phosphorus (Total Only)	COD (Total Only) *Nitrogen (Total Only) Ammonia Organic Total Phenolic (Total Only) *Phosphorus (Total Only) TOC

* Parameters may be analyzed

C.

Descriptive Information

Blue	Blue (Glass)	Tan	Orange	Pink	White
B	BG	T	O	P	ST
Filled	Filled	Raw	Raw	Raw	Raw
Sulfuric Acid	Sulfuric Acid	Sodium Hydroxide and Zinc Acetate	Sulfuric Acid	Sodium Hydroxide	Sodium Thiocyanate
Plastic	Glass with Teflon Cap	Plastic	Glass	Plastic	Plastic
250 ml	250 ml	250 ml	1000 ml	500 ml	125 ml
Nitrogen (Dissolved Only) Ammonia Organic Total *Phosphorus (Dissolved Only)	COD: (Dissolved Only) DOC Nitrogen (Dissolved Only) Phenols (Dissolved Only) *Phosphorus (Dissolved Only)	Sulfide	Oil & Grease	Cyanide Free Total WAD	Coliforms Fecal Total

in glass or plastic containers.

APPENDIX B
SAMPLE LABEL

ACZ Laboratories, Inc.

30400 Downhill Drive
(800) 334-5493

Steamboat Springs, CO 80487
Fax (303) 879-2216

Company: _____

Sample ID: _____

Sample Date: _____ Time: _____

Inorganic Preservative:

HNO₃ HCl NaOH H₂SO₄ Zn Acetate

Organic Analysis:

VOA BNA
BTX TPH Pests PCB Herbs

Sample Type:

Raw Filtered Solid

APPENDIX C
CHAIN OF CUSTODY FORM

APPENDIX D
FIELD INFORMATION FORMS

FIELD INFORMATION FORM

Site: _____

Sampling Location: _____

Sample ID: _____

Project No: _____

PURGING INFORMATION

_____|_____|_____|_____|_____|_____|
Purge Date (yy/mm/dd)

_____|_____|_____|_____|_____|_____|
Start Purge (24 hour clock)

_____|_____|_____|_____|_____|_____|
Elapsed Hrs.

_____|_____|_____|_____|_____|_____|
Water Vol in Casing (gallons)

_____|_____|_____|_____|_____|_____|
Actual Volume Purged (gallons)

_____|_____|_____|_____|_____|_____|
Time of Sample Collection

PURGING AND SAMPLING EQUIPMENT

Purging EquipmentDedicated Y N

Sampling EquipmentDedicated Y N

Purging Device A-Submersible Pump D-Gas Lift Pump G-Bailer X- _____
Purging other (specify)

Sampling Device B-Peristaltic Pump E-Venturi Pump H-Scoop/Shovel X- _____
Sampling other (specify)

C-Bladder Pump F-Dipper/Bottle I-Piston Pump

Purging Material A-Teflon C-Polypropylene E-Polyethylene X- _____
Purging other (specify)

Sampling Material B-Stainless Steel D-PVC F-Tygon X- _____
Sampling other (specify)

Filtering Devices A-In-line Disposable B-Pressure C-vacuum D-Peristaltic Pump X- _____
(0.45u) Filtering other (specify)

FIELD MEASUREMENTS

_____|_____|_____|_____|_____|_____|
Land Surface Elevation (ft/mal)

_____|_____|_____|_____|_____|_____|
Depth to water from top of well casing (ft)

_____|_____|_____|_____|_____|_____|
Depth to water from land surface (ft)

_____|_____|_____|_____|_____|_____|
Well Diameter (in)

_____|_____|_____|_____|_____|_____|
Groundwater Elevation (ft/mal)

_____|_____|_____|_____|_____|_____|
Well Depth (ft)

_____|_____|_____|_____|_____|_____|
Stickup (ft)

pH (STD)

1st _____ 2nd _____ 3rd _____ 4th _____

Conductivity ($\mu\text{m/cm}$ at 25°C)

1st _____ 2nd _____ 3rd _____ 4th _____

Sample Temperature

(°C/°F) _____ (°C/°F) _____ (°C/°F) _____ (°C/°F) _____

Other Parameters

1st - _____ 2nd _____ 3rd _____ 4th _____

Volume Purged (gallons)

_____|_____|_____|_____|_____|_____|

Time

_____|_____|_____|_____|_____|_____|

FIELD COMMENTS

Sample Appearance: _____ Odor: _____ Color: _____ Turbidity: _____

Weather conditions:
Wind Speed: _____ Direction: _____ Precipitation Y/N Outlook: _____

Specific Comments:

I certify that sampling procedures were in accordance with applicable EPA, State and laboratory protocols.

Date: _____ Signed: _____ Employer: _____

APPENDIX E
LABORATORY QUALITY ASSURANCE PROGRAM

LABORATORY
QUALITY ASSURANCE PROGRAM

Prepared by:

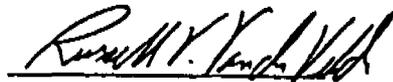
ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487

Revision 4.2
April 1992

Document Description: The following pages summarize the quality assurance protocols and plans for all analyses performed by ACZ Laboratories, Inc.

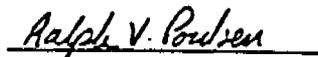
APPROVALS:

Russell V. Vande Velde
President



Dated: 4/27/92

Ralph V. Poulsen
Vice President



Dated: 4/27/92

Scott Habermehl
QA Officer



Dated: 4/27/92

ACZ LABORATORIES, INC.
QUALITY ASSURANCE PROGRAM

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Appendices

- I Preservatives, Containers & Holding Times
- II Methods & Method Detection Limits
- III External Audit QC Data
 - Water Supply (WS) Reports
 - Water Pollution (WP) Reports
 - EPA Round Robin Studies - RadChem
 - Double Blind Studies

1 INTRODUCTION

ACZ Laboratories, Inc. is an independent analytical testing laboratory located in Steamboat Springs, CO. We specialize in the analysis of environmental samples for organic, inorganic, and radiochemical parameters. We pride ourselves on the ability to generate litigation-quality data for all clients within a reasonable time period. We built a new laboratory in 1990 with special attention given to sample flow, air flow and data transfer. Our new facility is approximately 13,000 square feet of which about two-thirds is actual lab space. We installed a state-of-the-art HVAC system to address the need for positive pressure in certain areas of the lab (i.e. VOA instrument lab) and negative pressure in other areas of the lab (i.e. sample preparation areas). The entire building was pre-wired for a Local Area Network (LAN) to accommodate direct data acquisition and a total Laboratory Information Management System (LIMS). The set-up of our new LIMS is still in progress with the ultimate goal of direct client access to designated, secure file directories for ease of electronic data transfer.

We have an excellent infrastructure in place to facilitate the production of accurate and valid data. Our lab personnel are provided with new, automated instrumentation to improve reproducibility and increase productivity. Each department is headed by qualified environmental scientists with many years of hands-on laboratory experience. We have a full time QA Officer, three full time Project Management people, and a full time Client Services Representative. The following Quality Assurance Program has been developed with considerable attention given to the regulatory community requirements and to our clients' needs

Please keep in mind this document is constantly evolving and that it represents only an outline of our day-to-day QA commitment. If there are areas within this document that you feel are not adequately addressed, we would appreciate your comments. This document does not include Standard Operating Procedures (SOP) as we prefer to present SOPs as part of a lab audit. SOPs are written for all aspects of the laboratory operations from sample log-in through sample disposal.

2 QUALITY ASSURANCE OBJECTIVES

Our Quality Assurance Program encompasses all laboratory operations and dictates specific procedures and guidelines to control all activities influencing data quality. Our Quality Assurance/Quality Control (QA/QC) plans and protocols provide a framework which helps our chemists/technicians achieve our Data Quality Objectives (DQOs). ACZ Laboratories, Inc. QA/QC framework ensures the precision, accuracy, completeness, and consistency of the analytical data we generate.

We strive for consistent standards of quality that conform to each client's overall project quality assurance requirements. If a client has specific project goals that require modification of our quality assurance guidelines, we may deviate from our Quality Assurance Program, but only if more stringent controls are requested.

3 ORGANIZATION AND RESPONSIBILITY

Mr. Scott Habermehl is the Director of our Quality Assurance Program. Mr. Habermehl reports directly to the President of ACZ Laboratories, Inc. An organizational chart has been provided (Figures 3-1 and 3-2) as a visual overview of where the QA Department fits in relationship to the lab operations departments. Mr. Habermehl is accountable for all aspects of our QA Program and his specific job responsibilities are outlined in the job description following the organizational charts.

Our chemists and laboratory technicians devote twenty to thirty percent of their time fulfilling specific quality control related tasks outlined in our Quality Assurance Program. Each chemist/technician performs quality control check sample analyses and reports his/her findings to the lab section supervisor with particular attention towards any irregularities or deficiencies in the quality control data.

We thoroughly train new laboratory personnel in the analytical techniques and operating principles of the methods employed by various sample analyses. A designated chemist and the lab section supervisor closely supervise every new employee until he/she exhibits proficiency in accepted laboratory techniques. Once a chemist/ technician demonstrates a technological aptitude within the framework of our Quality Assurance Program, he/she will be assigned to oversee a particular laboratory procedure. We document this training process and retain copies of all documentation in the employee's personnel file. All new employees are given a copy of this QA Program and are required to attend a QA/QC orientation course provided by Mr. Habermehl. The new employees must study the QA Program and sign appropriate documentation stating that they understand our QA Program.

We recognize the necessity and ultimate benefit of continuing education. We strongly encourage and support employee participation in advanced training courses, seminars, and professional organizations and meetings. Additionally, we hold weekly laboratory meetings to discuss procedures, work schedules, and problems requiring immediate attention. We encourage all employees to become actively involved in the laboratory's operations and believe this is a tremendous benefit to employees, managers and administrators.

3.1 QA Officer - Job Responsibilities

The main focus of our QA Officer is to implement ACZ Laboratories, Inc. QA Program. The implementation of this plan will allow for the identification of problems and will result in the proper corrective action. The major job responsibilities for the QA Officer are as follows:

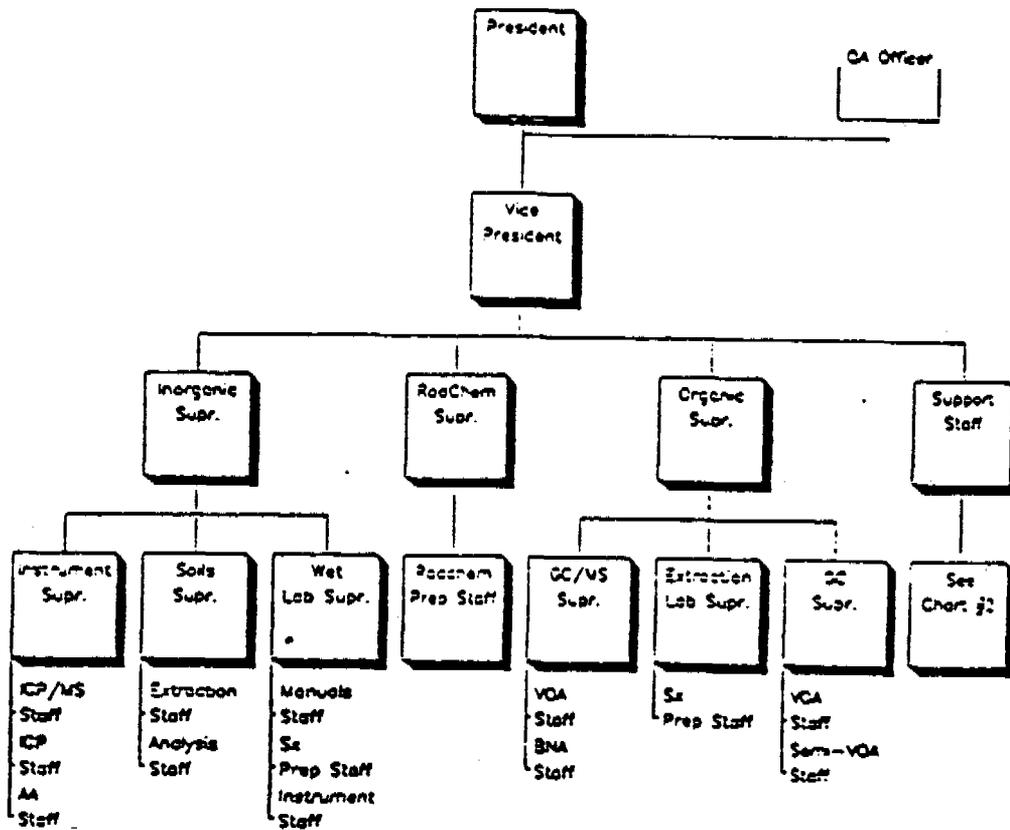
- o Establish control charts and routinely evaluate data quality for all laboratory departments.
- o Provide QA/QC orientation to new employees and QA/QC refresher courses to more experienced employees.
- o Advise management of problems and recommend corrective actions through weekly management meetings (see Figure 3-3).
- o Organize all laboratory audits and respond to any deficiencies.
- o Attend all laboratory department meetings to provide QA/QC updates and respond to employee concerns.
- o Coordinate analyses and compile data packages for all performance evaluation (PE) samples that are received by the laboratory. Provide corrective action statements to agencies or clients in regard to PE samples.
- o Review and validate a management-determined percentage of all data packages.
- o Develop QC reports/summaries for assigned projects.
- o Perform internal audits at a specified frequency, presently set at twice per year.
- o Work with marketing/client service representatives on QA aspects of proposals.
- o Work with laboratory computer specialist to develop and deliver diskette deliverables.

- o Participate in software validation as it relates to data acquisition, data transfer and report generation.
- o Monitor all QA activities to verify conformance with established QA program and laboratory SOPs.
- o Maintain records of PE samples, audits, state certification programs, and other correspondence involving QA issues.
- o Coordinate all certification programs.

Organizational Chart - Figure 3-1

ACZ Laboratories, Inc.

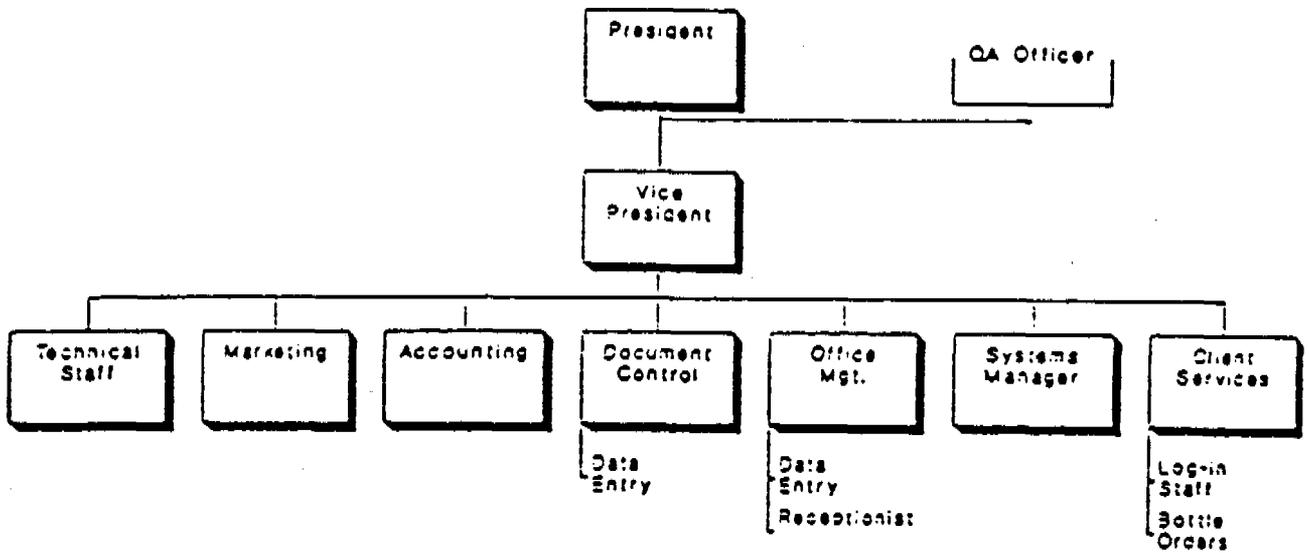
Technical Staff



March, 1992

Organizational Chart - Figure 3-2

ACZ Laboratories, Inc. Support Staff



March, 1992

Chart #2

4 SAMPLING PROCEDURES

Sampling procedures are well documented by EPA and other agencies. Most of our clients are aware of the necessity to provide the laboratory with representative samples. We feel it is our responsibility to provide clients with containers and shipping materials to maintain sample integrity from the time of sample collection through sample analysis. We prefer to discuss sampling events with our clients prior to shipping sample containers to ensure proper volume of sample collected and to verify that the requested methods meet regulatory guidelines. Our client service representatives have access to various regulatory agency phone numbers.

The following sections include information on sample containers, preservatives and holding times. These areas are essential components in maintaining the chemical and physical properties which the sample possessed at the time of collection. Analytical data is only as good as the sample taken.

4.1 Sampling Containers and Preservatives

The U.S. EPA and other agencies strictly outline sample container and preservation requirements. ACZ sample container inventory includes numerous sizes of plastic and glass containers with different levels of cleanliness. We stock containers which range from pre-sterilized to certified-clean by the supplier. The level of cleanliness is determined by the nature of the project. We purchase all glass containers from I-Chem Corp, including "300-series" bottles when low detection limits are specified by our client. All sample containers shipped to our clients are new, pre-charged with the appropriate preservatives, and color-coded to identify the type of preservative. Appendix I includes a list of EPA-approved sample containers and preservatives, which is enclosed in all coolers shipped out by ACZ. Containers are carefully packed in clean ice chests with bottle labels, blue ice packs, sampling information, chain of custody record and return shipping labels. Trip blanks and rinsate water are included when requested.

4.2 Holding Times

Samples are collected, preservatives are added, and the samples are cooled to 4 degrees Celsius. Holding times are established by EPA following lengthy studies of deterioration versus time. The results of these studies are compiled into holding time tables as necessary guidelines for litigation purposes. Samples analyzed outside of the established holding times are most difficult to defend in court. Holding times will vary slightly from regulation to regulation, thus further emphasizing the need for pre-collection consultation with laboratory personnel. The holding time begins from the date/time of collection in the field. Most samples are shipped to the lab by overnight services to maintain sample integrity and to allow the laboratory as much time as possible before holding times are exceeded.

A summary of holding times for organic, inorganic, and radiochemical parameters in water, soil, and solid waste is presented in Appendix I.

5 SAMPLE CUSTODY

ACZ Laboratories, Inc. provides strict sample custody enforcement conforming to the guidelines in "EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-600/4-79-019" and "Test Methods for Evaluating Solid Waste, EPA SW-846." Our laboratory operations were designed for efficient flow of samples through the facility. Sample custody begins with the shipment of sample containers to a client and continues through the documentation of proper sample disposal. There are many key elements to sample custody including laboratory security, chain of custody records, sample storage, internal transfer logs, sample tracking within the laboratory and sample control of subcontracted work. These items are discussed in some detail below.

5.1 Security of Laboratory

A secure laboratory is essential in maintaining sample/data integrity and providing safety to non-employees. Security of the laboratory is kept by controlling access to the laboratory and limiting this access only to authorized personnel. The following list of steps have been taken to ensure this security:

- o Access points into the laboratory are secured by stationed lab personnel (i.e. receptionist and sample custodian) with buzzer-activated doors.
- o Only three doors in the entire building are keyed. Only one of these doors can be operated by employees. The other two keyed access points are always locked and can be opened from within manually or buzzer-activated.
- o All visitors must enter through buzzer-activated and manned access points.
- o All visitors must sign register to enter and exit laboratory.
- o All visitors are escorted by lab personnel.
- o All rooms and/or file cabinets, where client records are kept, are locked during non-business hours.

5.2 Sample Receipt and Log-in

Delivery of samples to ACZ is accomplished in a number of different ways, including direct delivery by client, Federal Express (FEDX), UPS, Greyhound Bus Service, and other third party transport services.

Prior to signing the chain-of-custody, the sample custodian thoroughly checks the coolers for any apparent damages and compares the number of samples received with the number on the chain-of-custody. Custody seals on the cooler are also checked for integrity and seal numbers are verified against those listed on the chain of custody form. Figure 5-1 is a chain-of-custody record and Figure 5-2 is an example of a custody seal and sample labels.

When the coolers are opened by the sample custodian to determine the condition of the samples, sample integrity is noted (i.e. broken containers, warm contents, etc.), and chain of custody forms are inspected for any parameters that have holding times less than 48 hours (BOD, Hexavalent Chromium, Coliforms, etc.) The Data Manager is notified as to the status of these samples. Any problems are noted on the chain of custody form and client is notified by telephone for corrective action (i.e. resampling.)

Samples are set up on the log-in benches in an organized fashion with all subsamples associated with an individual sample. The samples are then checked against the chain of custody form to insure that all samples and subsamples have been received and are properly preserved. Sample information on the sample containers (I.D., date, time, matrix, etc.) is verified against the information on the chain of custody forms. If any problems arise, they are noted on the chain of custody form and the client is immediately contacted. The chain of custody forms are then signed and dated by the sample custodian, a copy is made for the client's file, and the signed original is mailed back to the client.

Samples are now ready to be logged-in. Smooth sample flow through the laboratory is facilitated by the use of a Laboratory Information Management System (LIMS) developed by Hewlett Packard, called LABSAM. This software is run on a HP-1000 A-Series Hewlett Packard mini-computer. LABSAM automatically assigns a sequential lab number and prompts for the following information are brought up on the computer screen. The following is a list of the information entered into the computer:

- o Client Name*
- o Address (Mailing)*

- o Address (City, State, Zip)*
- o Attention*
- o P.O. No.*
- o Test Group*
- o Chain of Custody Number
- o Project Number
- o Sub Samples (Types of preserved samples received)
- o Sample Identification
- o Sample Date and Time
- o Date Received
- o Remarks
- o Price*
- o Parameters to be analyzed
- o Priority of the Sample

*Coded inputs can be made at these prompts to facilitate the log-in process.

Clients with standard parameter lists are assigned Test Group Codes for those lists. When a particular Test Group Code is entered during log-in, parameters corresponding to that code are automatically assigned to the sample. After the log-in process is completed, a work sheet and master data listing with the above information are printed by the computer. Sample numbers are attached to the corresponding bottles and are then dispatched to an assigned storage area.

CHAIN OF CUSTODY RECORD

ACZ Laboratories, Inc. 30400 Downhill Drive Steamboat Springs, CO 80487 (303) 879-6590 (800) 334-5493				FROM: _____ _____ _____																																																																									
				PROJECT NO. _____				NUMBER OF CONTAINERS	ANALYSES REQUESTED 						REMARKS																																																														
SAMPLERS: <i>(Signature)</i>				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">SAMPLE IDENTIFICATION</th> <th style="width: 10%;">DATE</th> <th style="width: 10%;">TIME</th> <th style="width: 10%;">SAMPLE TYPE</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>	SAMPLE IDENTIFICATION	DATE	TIME		SAMPLE TYPE																																																		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">DATE</th> <th style="width: 10%;">TIME</th> <th style="width: 15%;">RECEIVED BY: <i>(Signature)</i></th> <th style="width: 10%;">DATE</th> <th style="width: 10%;">TIME</th> <th style="width: 40%;">COMMENTS:</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>	DATE	TIME	RECEIVED BY: <i>(Signature)</i>	DATE	TIME	COMMENTS:												
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METHOD OF SHIPMENT: FED X <input type="checkbox"/> UPS <input type="checkbox"/> BUS <input type="checkbox"/> HAND-DELIVERY <input type="checkbox"/> OTHER <input type="checkbox"/>																																																																													

Chain of Custody Record - Figure 5-1

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Custody Seal and Example of Sample Label - Figure 5-2

ACZ Laboratories, Inc.	_____
CUSTODY SEAL	Signature
No. _____	Date _____

ACZ Laboratories, Inc.	
30400 Downhill Drive	Steamboat Springs, CO 80487
(800) 334-5493	Fax (303) 875-2216
Company: _____	
Sample ID: _____	
Sample Date: _____	Time: _____
Inorganic Preservative:	
HNO ₃ <input type="checkbox"/>	HCL <input type="checkbox"/> NaOH <input type="checkbox"/> H ₂ SO ₄ <input type="checkbox"/> Zn Acetate <input type="checkbox"/>
Organic Analysis:	
BTX <input type="checkbox"/> TPH <input type="checkbox"/> Pests <input type="checkbox"/> PCB <input type="checkbox"/> Herbs <input type="checkbox"/>	VOA <input type="checkbox"/> BNA <input type="checkbox"/>
Sample Type: _____	Raw <input type="checkbox"/> Filtered <input type="checkbox"/> Solid <input type="checkbox"/>

5.3 Sample Storage

After the samples are logged into LABSAM and have been assigned a unique sequential laboratory number, they are separated into plastic bins based on the preservation used and whether or not filtration was performed. The bins are then labeled, indicating the sample numbers and preservation technique used. The sample bins are then moved to the appropriate sample storage area. We have four main sample storage areas: A walk-in cooler for all organic samples; a walk-in cooler for all inorganic samples requiring refrigeration; an unrefrigerated area for water samples requiring metals analysis; and an unrefrigerated area for soil samples that do not require organic analysis.

Sample extracts are stored in various refrigerators depending on required analyses. All walk-in coolers and refrigerators are maintained at 4 C +/- 2 C. The temperature of each refrigerator or walk-in and the initials of the person recording the temperature are recorded daily on a "Daily Temperature Log" kept with the refrigerator as shown in Figure 5.3.

Those samples involved in litigation will be placed immediately into a secured storage area after log-in. Samples can be removed from these areas only by the Laboratory Director, Data Manager, or a designated substitute. Log books are kept with these samples and extracts at all times, and full documentation of sample travel is recorded. The sample storage area is kept locked during non-working hours.

Daily Temperature Log - Figure 5-3

ACZ Laboratories, Inc. Daily Temperature Log													
Room: _____ Unit: _____													
Acceptable Temperature Range: _____ to _____ °C													
Date	Jan.	Inc.	Feb.	Inc.	Mar.	Inc.	Apr.	Inc.	May	Inc.	Jun.	Inc.	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
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20													
21													
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25													
26													
27													
28													
29													
30													
31													
Remarks:													

5.4 Internal Transfer Logs

Some clients may specify additional custody tracking of the samples once they have been properly labeled and stored for analysis. This is particularly true for CLP projects. If so required, a log book shall accompany the set of samples from log-in through completed analysis. The following information shall be contained in this logbook:

- 1) Time and date the samples were removed and replaced from their respective storage area.
- 2) Name of analyst who received custody.
- 3) Detailed information which will explain the handling of the samples during the time they were removed from storage.

The person responsible for the work shall sign and date each entry and/or page in the logbook. When all data from a sample set is compiled, copies of all logbook entries shall be included in the documented report package provided to the client. For specific CLP projects, the chain of custody procedures outlined in Exhibit F of the EPA's CLP Statement of Work shall be adhered to. It is the responsibility of every analyst to become familiar with these policies.

5.5 Sample Tracking

Each Section Supervisor accesses LABSAM data to prioritize and schedule sample analyses. LABSAM contains several data management programs which inform the supervisor as to sample holding times, client deadlines, and other factors influencing turnaround times. Using this information, our Lab Department Supervisors schedule all analytical activities to be performed weekly. The schedule serves as a guideline for the analysts, but can be altered if conditions warrant.

The analysts use LABSAM to generate sample worklists consistent with the weekly schedule. Worklists contain a sample analysis protocol which provides for calibration standards and quality-control samples at regular intervals. Each chemist/technician, after successfully completing the analytical process, initials and dates his/her completed worklist and submits it to the QA Officer for review. Approved worklists are then submitted to a Data-Entry Clerk for computer input. The worklists are also initialed and dated by the data entry personnel.

5.6 Sample Control of Subcontracted Work

When it becomes necessary to subcontract analytical work, we exercise the following control procedures.

- o Clients are notified prior to sample delivery if parameters are requested which are not part of ACZ Laboratories, Inc. capabilities. We inform the client of our intention to subcontract and discuss our preference of subcontractors.
- o If equipment failure or scheduling problems dictate the need to subcontract samples, client is notified prior to shipment of samples to subcontractor.
- o We verify all chain-of-custody records and sample information noting any discrepancies. All samples are logged into our computerized LIMS in accordance with the log-in procedures mentioned previously in this section.
- o The Log-in Clerk prepares samples for shipping, attaching a copy of our computer generated information to the Chain-of-Custody.
- o We maintain copies of subcontracted sample information in a file labelled " Subcontracted Analyses in Progress". Our subcontracted laboratory immediately notifies us by telephone of any problems which arise.
- o ACZ Laboratories, Inc. receives an analytical report from the subcontracting laboratory. Data is entered into our LIMS for final report preparation and/or downloading onto computer diskettes.
- o A comment is added to the final report of all subcontracted work stating the laboratory that performed the analyses.

6 INSTRUMENT CALIBRATION

All laboratory instruments are calibrated in accordance with manufacturer's guidelines and analytical method requirements so as to eliminate or minimize bias. Calibration frequency and acceptance criteria are established by analytical method and/or by specific client contract stipulations. In all cases, instruments are calibrated with NBS traceable standards so as to provide accurate and valid data. Instrument operators are responsible for documenting instrument operation, maintenance, and repairs. All major instrumentation is under service contract with the manufacturer. Most contracts include clauses requiring the manufacturer to respond in under forty-eight hours to any service call and one or two preventative maintenance visits during the year. We stock many spare parts and have an electronic technician on staff to quickly address minor instrument problems. This section provides an overview of the calibration schedules utilized for major laboratory instruments.

6.1 Traceability of Standards and Reagents

ACZ prepares calibration standards from stock standards purchased from chemical vendors such as Fisher, Baker, EM Science and VWR. Stock standards are of an analyzed grade and are traceable to NBS standards. All standards and reagents are tracked by a system of control numbers. First, upon receipt of the standard or reagent at our laboratory, each is assigned a Primary Control Number (PCN). This PCN is written into the Logbook of Primary and Secondary Control Numbers which is kept in the chemical storage room. Date of receipt, date opened and expiration date are entered into the Logbook. When a working standard is made from more than one reagent, PCNs of the reagents used are noted in the logbook and the new standard is assigned a Secondary Control Number (SCN). Stock standards are used for one year or until expiration date is reached.

This system allows our analysts to trace any suspect standards back to the original reagents. Any lot number of chemicals or reagents that are found to be contaminated are disposed of according to proper disposal practices and the manufacturer is notified.

Intermediate and instrument calibration standards are prepared using properly cleaned class "A" volumetric glassware. The maximum storage times are as follows unless specified otherwise by method:

- o Intermediate Metal Standards - six months
- o Intermediate Anion Standards - one month
- o Instrument Calibration Standards - ICP - one month

- o Instrument Calibration Standards - AA - daily
- o Instrument Calibration Standards - Auto-Analyzer - daily

Standard Reference Samples (SRS) are purchased from supply houses such as ERA, Supelco, RT Corp, and APG. Most SRS purchases are from CRADA certified organizations. These samples are supplied with certified paperwork tracing standards to NBS and/or EPA. All SRS records are maintained by our Quality Assurance Officer.

6.2 INSTRUMENT CALIBRATION - ORGANICS

6.2.1 Gas Chromatography (ECD, ELCD, FID, NPD, PID Detectors)

The GC section of the organic laboratory has the capacity to dedicate GCs for the specific analysis. Analyses frequently requested by clients are performed on a routine production basis. Each analysis follows a specified protocol, which includes the appropriate method with calibration, quality control, and reporting that has been stipulated by the method. The GC laboratory has the ability to modify methods at the request of the client for specific projects. This allows for the flexibility in both the analytical technique and in reporting. The clients are able to receive the requested results without the problems of either insufficient or excessive data.

The specific calibration of the instruments is dependant upon the type of detector associated with the GC. Though there are differences, the principals for each are similar. An initial calibration is performed to establish the detection limits, retention times, and dynamic range of calibration curve. A daily continuing calibration is performed. If the continuing calibration does not pass the method criteria, this would indicate that the analytical system is out of control and corrective action must occur before any samples are analyzed. Corrective action begins with notifying supervisor. Upon investigation, the supervisor will decide which of these corrective actions are necessary: Maintenance, Re-calibration of instruments, Re-analysis of samples.

6.2.2 Gas Chromatography/ Mass Spectrometry

The GC/MSs are tuned with a performance standard of either bromofluorobenzene (BFB) for volatile analysis, or decafluorotriphenylphosphine (DFTPP) for semivolatile analysis. A specific tuning criteria must be met for each compound before analysis is begun.

An initial calibration is performed to establish the detection limits, retention times, and dynamic range. A continuing calibration is performed every twelve hours to ensure that the GC/MS is still in calibration. If calibration does not meet criteria, re-calibration is performed.

6.3 INSTRUMENT CALIBRATION - INORGANICS

6.3.1 Inductively Coupled Plasma Mass Spectrometer (ICP-MS)

At the beginning of each shift, the tuning solution¹ is aspirated and tuning parameters are checked. A mass calibration, response calibration and detector calibration are performed using a minimum of six masses in the calculations. The system is checked for short term stability by acquiring a minimum of five replicates of the tuning solution.

6.3.2 Inductively Coupled Plasma (ICP)

The ICP is calibrated using one standard and one blank with each sample "run" (i.e. a separate calibration for dissolved, total recoverable, total, and soil samples. A "run" may consist of up to 300 samples. After calibration, an Initial Calibration Verification (ICV) standard and Initial Calibration Blank (ICB) are analyzed followed by the Interferant Check Samples (ICS). A wash sample is then introduced as part of the protocol. A Continuing Calibration Verification (CCV) standard and a Continuing Calibration Blank (CCB) are analyzed after every ten samples. Matrix Spikes (MS) and Matrix Spike Duplicates (MSD) are run after every ten samples. The CCV and CCB are also analyzed at the end of each sample run.

The ICV and CCV must fall within ten percent of the true value to be acceptable. The MS and MSD must fall between seventy-five and one-hundred twenty five percent to be acceptable.

For Total and Total Recoverable metal analyses, a digested blank and digested Standard Reference Sample (SRS) are incorporated at a frequency of every twenty samples. The blank must have all elements below the detection limits to be acceptable. The SRS must be within ten percent of the true value.

Analyst logbooks are updated daily with information on samples analyzed, method

¹ The normal tuning solution is 100 ppb of each of the following elements: Be, Mg, Co, In, Ba, Pb, Bi and U.

utilized and problems encountered. Analysts must initial all entries. A hard copy of all data is filed according to sample date and type of run.

6.3.3 Atomic Absorption/Graphite Furnace Atomic Absorption

The furnaces are calibrated using a blank and three standards. The linearity of the curve must be 0.995 or better to be acceptable. An ICV is analyzed after the curve and must be within ten percent of the true value to be acceptable. CCVs are run after every ten samples and must be within ten percent of the true value. An MS and MSD are run after every ten samples and must be between seventy-five and one hundred twenty five percent to be acceptable.

All raw data is attached to the worklist and filed by element. A logbook entry is made for each element that is run with date, what was run, and analyst's initials. If the QC is not within acceptance criteria as listed above, the run is stopped and problem corrected. The run is restarted at the last acceptable QC value.

The only exceptions to the above acceptance limits are antimony, selenium, and thallium. The acceptance range for ICV and CCV is fifteen percent for these elements due to interferences.

6.3.4 Auto-Analyzers

The Rapid Flow Analyzers (RFA) are calibrated using a blank and four standards. The curve must be 0.995 or better to be acceptable. An ICV and ICB are analyzed after the curve is run. CCVs and CCBs are analyzed after every ten samples. The ICV and CCVs must be within ten percent of the true value to be acceptable. A duplicate and spike are run after every ten samples. The spike value must fall between seventy-five and one hundred twenty-five percent to be acceptable.

All raw data, including recorder output, is attached to the work-list and filed according to parameter. The analyst records and initials parameter, date and problems encountered in the logbook.

6.4 INSTRUMENT CALIBRATION - WET CHEMISTRY

6.4.1 pH Meter

The pH meter is calibrated before each use or at least once a day. The calibration is performed with two pH buffers, usually a 4.0 pH buffer and 7.0 pH buffer. The

efficiency of the probe must be between 95% and 105% to be acceptable. The efficiency is recorded on the worklist, in the logbook, and initialed by the analyst. If the probe does not pass the acceptance criteria, it is removed from the instrument and cleaned. The probe is then reinstalled and the efficiency is determined. If the probe still does not pass, a new probe is used and the old probe disposed of according to proper disposal procedures.

6.4.2 Conductivity Meter

The Conductivity meter is checked before each use. A 1410 umhos standard is used to check the accuracy of the probe. If the value for the standard is not within ten percent of the true value, the probe is cleaned and the standard is rechecked. If the probe still fails, the old probe is replaced. The constant (the distance between the plates in the probe) is checked weekly. The value of the standard and the constant value are entered in the logbook along with the analyst's initials. The values are also transcribed onto the worklist.

6.4.3 Autotitrator

The autotitrator is used for alkalinity titrations. The probe on the titrator is calibrated using a 4.0 pH buffer and a 7.0 pH buffer. The efficiency of the probe must fall between 95% and 105%. If the probe does not fall between these limits, it is cleaned and the efficiency is rechecked. If the probe still fails, it is replaced with a new probe. The 4.0, 7.0, and 10.0 pH buffers are then read and the buffer values are listed in the logbook along with information about the run and the entry is initialed by the analyst. All print-outs are attached to the worklist and kept on file.

6.4.4 Balances

All balances are checked daily with calibrated weights. The values of the weights are entered into the logbook along with the analyst's initials. The balances are checked yearly by a certified balance company. The weights are also checked yearly.

6.4.5 Refrigerators/Walk-In Coolers/Drying Ovens/Incubators

All appliances are equipped with a thermometer. The thermometers are checked daily or before each use. The temperature is recorded on the daily log sheet with the analyst's initials. The thermometers are checked monthly against a certified thermometer and the results are recorded in the thermometer logbook. If the thermometers do not agree within two degrees of the certified thermometer, it is replaced with a thermometer that meets the QC criteria.

7 ANALYTICAL PROCEDURES

7.1 Glassware and Laboratory Supplies

ACZ Laboratories, Inc. uses only laboratory grade glassware and supplies purchased from nationally known supply houses. Prior to use, our technicians wash all laboratory glassware using Alconox® and rinse in deionized water. Glassware used for trace metals analysis is rinsed in a 1:1 Nitric Acid solution before being rinsed in deionized water. Nutrient analysis glassware is rinsed in 1:1 Hydrochloric Acid followed by a deionized water rinse. All organic analyses glassware is washed with Alconox®, rinsed with deionized water, and baked in a potters kiln overnight at 400°C. Glassware not immediately used is stored in an enclosed, dust-free environment.

7.2 Reagents, Solvents, and Water

ACZ Laboratories, Inc. uses only high-quality reagent grade chemicals. Chemical containers are dated when received and when opened. Chemicals or reagents are never used after the expiration date. All chemicals are stored according to the manufacturer's guidelines including the use of isolated cabinets to avoid contamination.

Reagent water is prepared in a two-stage purification system. Initially, the water is distilled in an all-glass still then passed through mixed-bed ion exchange cartridges. Distilled/deionized water from this system has a conductivity of less than 2 umhos/cm. Weekly conductivity and pH readings are recorded to track this system's efficiency. Water used for organic analyses is charcoal filtered prior to use. Quality assurance protocol requires reagent blanks to be analyzed every ten samples to detect possible failures in the reagent water system.

7.3 Methodology

ACZ Laboratories, Inc. is predominantly an environmental testing laboratory which provides data to clients for regulatory purposes. Consequently, we are required to utilize methods prescribed by the US EPA, USGS, USDOE and other state/federal agencies. Samples are generally analyzed for compliance with RCRA, SDWA, SMCRA, TSCA, CWA and CERCLA. These federal regulations state that we must adhere to methods published specifically for their application. And that we develop Standard Operating Procedures (SOPs) from these methods. The SOPs are written in conformance with EPA outline requirements stated in the EPA method of reference. We consider our SOPs proprietary documents and prefer to not distribute them freely. All SOPs can be reviewed at our facility as part of a site visit or lab audit. All SOPs have been developed from the following sources:

"Standard Methods for the Examination of Water and Wastewater," APHA, Fifteenth Edition, 1980.

"Annual Book of Standards, Water Analysis," ASTM, 1989.

"Quality Assurance for Environmental Measurements," ASTM, Tech. Pub. 867, 1989.

"Methods of Soil Analysis," Black, C. A., American Society of Agronomy and American Society for Testing and Materials, Agronomy No. 9.

"Minimal Requirements for a Water Monitoring Quality Assurance Program," Colorado Dept. of Health, 1983.

"Quality Control in Analytical Chemistry," Kateman, G., Vol. 60, 1985.

"Principles of Environmental Analysis, Analytical Chemistry," Keith, L.H., et al., Vol. 55, 1983.

"Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," NRC, 10 CFR Part 50, Appendix B., 1986.

"Soil Testing Methods used at Colorado State University Soil Testing Laboratory for the Evaluation of Fertility, Salinity, Sodicity and Trace Element Toxicity," Soltanpour, P.N., Workman, S.M., 1981.

"Mine Spoil Potentials for Soil and Water Quality," Smith, R.M., EPA-600/2-78-054, 1974.

"Diagnosis and Improvement of Saline and Alkali Soils," USDA, Agri. Hdbk. No. 60., 1983.

"Recommended Methods for Water Data Acquisition," USDOJ, 1984.

"Field and Laboratory Methods Applicable to Overburden and Mine Soils," USEPA, 1978.

"Methods for the Evaluation of Water and Wastewater," USEPA, EPA-600/4-79-020, 1979.

"Handbook for Analytical Quality Control in Water and Wastewater Laboratories," USEPA, 1979.

"Manual for the Certification of Laboratories Analyzing Drinking Water," USEPA, 1982.

"Test Methods for Evaluating Solid Waste," USEPA, SW-846, 1982.

"Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," USEPA, EPA-600/4-82-057, 1982.

"Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," USEPA, Federal Register Vol. 49, No. 209, Oct. 26, 1984.

"Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," USGS, 1979.

"Methods for Determination of Organic Substances in Water and Fluvial Sediments," USGS, Open File Rep. 82-1004, 1983.

"Prescribed Procedures for Measurement of Radioactivity in Drinking Water," USEPA 600/4-80-032.

8 DATA REDUCTION, VALIDATION AND REPORTING

ACZ Laboratories incorporates a multi-level data validation process to assure that the reported analytical data meets the client's data quality objectives. As the data quality objectives change from project to project, so does the intensity of the data validation process. At a minimum, the data validation process consists of the following steps:

- o Prior to performing an analysis, the analyst checks samples to be analyzed to insure that they are properly preserved and that holding times have not been exceeded.
- o Prior to analyzing the samples, the analyst checks the set-up and operation of the instrument. Set-up and operation procedures follow those established in the Standard Operating Procedures for the analysis being performed.
- o All raw data is thoroughly reviewed by the analyst performing the analysis. The review process includes: checking the calibration of the instrument (linearity of the calibration curve, calibration verification, and calibration blanks), preparation blank values, recoveries of the laboratory control samples, duplicate and matrix spike recoveries, and other calibration and/or quality control data specific to the analysis being performed. Part of the review process at this point includes performing calculations of all QC data and verifying that the data is within statistical control based on the use of control charts. Sample data is also reviewed to insure that all values are within the working range of the method and that no apparent anomalies exist. All required paperwork, including LIMS data entry forms and raw data sheets, is compiled by the analyst, signed, and submitted for the next level of data review.
- o The second level of data review is performed by the Laboratory Supervisor and Quality Control Officer. Completed analytical protocols are reviewed and validated by signatures of both the Laboratory Supervisor and the Quality Control Officer. Both reviewers will check approximately 20% of all the raw data including the performing of QC and sample calculations. Data which is deemed acceptable is then submitted to data entry.
- o Data is entered into the LIMS data base. Each value entered into the computer is re-checked by the data entry clerk to prevent transcription or typographical errors.

- o After data entry is complete, the LIMS computer system will automatically perform several QC calculations on the data. These include cation/anion balance checks and calculated TDS versus actual TDS ratios. These calculations are only performed on samples with major cation and anion analyses. Computer reports are generated by the Laboratory Supervisor detailing this QC information.
- o Prior to printing completed analytical reports, the data entry clerk will compare the requested analyses on the chain-of-custody forms with the log-in worksheet which is generated for each sample during the log-in process. If all analyses are completed, the analytical report is generated and submitted for final review and validation by the Laboratory Supervisor and QC Officer.
- o Final review is then performed by the Project Manager, if one is assigned.

This data validation process is adequate for the majority of the work going through the laboratory. Some projects require specific or more detailed data review and reporting. Such is the case for work following EPA CLP protocols. Data validation for this type of work is much more detailed and includes the compilation and reporting of all QC data and raw data.

8.1 Software Validation

During the development of any software used in the lab it is tested thoroughly to determine the integrity of all data operations performed. When a user is confident that all operations are being performed satisfactorily they will reduce their inspection frequency to 10%. This software includes the LIMS and data acquisition, reduction, reporting, and transfer programs.

9 INTERNAL QUALITY CONTROL

The overall focus of our internal quality control plan involves monitoring measurement processes to determine matrix-effects and laboratory performance. Control samples are analyzed with every batch of samples for every analytical method. Data from these control samples is plotted on control charts to establish control limits. Performance control samples demonstrate the precision/accuracy of the analytical run and expose out-of-control events. Matrix-specific control samples document the effect of the matrix on method performance and also qualifies data as in or out-of-control. Method blanks are included with all analytical runs from sample preparation through analysis as a method of assessing lab contamination levels.

The EPA or other agencies generally specify acceptance criteria for all lab performance and matrix-specific Quality Control samples. Control limits are established at ACZ from historical data, but must be as stringent as any regulatory guideline. Data that is out-of-control dictates corrective action ranging from re-extraction/re-analysis to reporting with qualifiers.

Internal quality control consists of the following:

- Proper instrument calibration (see Section 6)
- Use of high-quality, NBS traceable standards (see Section 6)
- Analysis of laboratory control samples, method blanks and matrix-specific Quality Control samples

9.1 Laboratory Control Samples

The overall performance of the analytical methods used to generate data is monitored by laboratory control samples. These consist of laboratory prepared control samples or certified reference materials and method blanks. The analysis and review of these types of samples allows both chemists and management to determine whether a method is in a state of "statistical control". These results also help the analysts verify the precision and accuracy of the analytical process.

9.1.1 Certified Reference Materials

Certified Reference Materials (CRM) are purchased from a number of vendors, predominantly those with CRADA certification. CRM are included in all analytical runs to check accuracy and precision of the measurement process. Most CRM are supplied with acceptable, warning, and/or advisory ranges of acceptability. CRM data is plotted on control charts and assessed for acceptability. If CRM data falls outside the acceptance windows, corrective action may be necessary. Acceptability of data is generally determined by the analyst and corrective action is initiated if necessary. Corrective action could involve re-analysis or re-preparation followed by re-analysis.

9.1.2 Laboratory Prepared Control Samples

Laboratory prepared Control Samples (LCS) are analyzed with each batch of samples. These samples are prepared by spiking a control matrix (water, oil, soil) with a known amount of the analytes of interest. These sample results are compared to accepted limits of recovery and plotted on control charts. The sample data generated with an LCS is deemed acceptable only if the LCS falls within the control limits. If data falls outside the limits, corrective action may be applied as above.

9.2 Method Blanks

Method blanks are analyzed to evaluate effect of background interferences and/or laboratory contamination on sample results. A method blank is prepared with every analytical batch and is processed in the same manner as the analytical samples.

The level of analyte in the method blank should be less than the method detection limit for that matrix. However, in trace metal work and organic analysis this may not be the case. If the blank is determined to be greater than the detection limit a blank correction may need to be applied or data may be reported with a qualifier. Because of the variability of contamination sources, reference to the individual method SOP's should be made for treatment of blank corrections.

9.3 Matrix-Specific Quality Control Samples

The effect of different matrices on the performance of the analytical methods can be profound. ACZ analyzes matrix spikes, matrix duplicates, matrix spike duplicates, and surrogate compounds to evaluate matrix effects on data quality. The SOPs for the

analytical methods contain more specific information regarding the evaluation and usage of matrix-specific QC samples

9.3.1 Matrix Spike Samples

ACZ uses matrix spike samples to determine the level of bias (accuracy) associated with a samples matrix. The samples are prepared by adding a known quantity of the analyte of interest to a replicate sample. Matrix spike samples are run on a ten percent frequency and the results, expressed as a percent recovery, are checked against the historical control limits. If the data is deemed out of control, a dilution or the method of standard additions may be required.

9.3.2 Matrix Duplicates/Matrix Spike Duplicates

The matrix-specific precision associated with the analytical methods is determined and verified through the use of matrix duplicates and matrix spike duplicates. These are performed on a ten percent frequency and control charted to monitor the precision. The analysis dictates which type of duplicate is used.

Matrix spike duplicates are used when the analysis is trace level and typically yields data close to the limit of detection. These are prepared on environmental samples as above and analyzed in exactly the same manner. The results are compared by calculating the relative percent difference and percent recoveries. The matrix effect on precision and accuracy can then be determined.

Sample duplicates are used for analysis that yield results above the limit of quantitation (wet chemistry, majors, etc.) or analysis that does not lend itself to spiking. The results between replicate samples are compared using the relative percent difference.

9.3.3 Surrogate Recoveries

Prior to sample extraction, organic preparation personnel add surrogate compounds to each field sample, blank, spike and duplicate sample. The actual surrogate compounds utilized at ACZ Laboratories, Inc. are specified in the specific method requested or by special client request. Following sample analysis, the analyst calculates, records and compares the surrogate recoveries to established quality control guidelines. We currently use acceptable surrogate recovery criteria specified in the Contract Laboratory Program (CLP) document (3/90). If surrogate recoveries

are outside the acceptance windows, corrective action may be necessary. As specified in the CLP documentation, one surrogate compound per fraction can be outside the acceptance windows. Corrective action can involve re-analysis and/or re-extraction/re-analysis.

10 PERFORMANCE AND SYSTEM AUDITS

ACZ Laboratories believes that the use of a quality assurance audit program is necessary to monitor and review the QA program system and assure that it is continually being implemented. The purpose of the audits is to verify both the compliance and performance of accepted QA procedures and to identify discrepancies when they exist.

10.1 Internal Audits

The internal audit program encompasses both a system audit, used to qualitatively evaluate the operational details of the QA program, and a performance audit, used to quantitatively evaluate the accuracy of data generated by the lab. The following audit programs descriptions do not include the real-time review of laboratory raw data or final reports for normal QC sample verification.

The system audit is performed by the QA Officer on a semiannual schedule and is done on a partial randomly selected basis by laboratory section (ICP, sample receipt, GC, Wet Chemistry) and covers the entire QA program. A more frequent schedule may be adopted if deemed necessary. This audit is documented through the use of checklists and summary reports that are made to management and laboratory supervisors.

Performance audits are facilitated through the introduction of blind samples on a monthly basis. These samples are purchased from outside vendors and prepared and distributed through the lab by the QA Officer. The data is compiled and summary reports are made to management, laboratory supervisors and chemists. All sections of the laboratory have blind PE samples submitted at least semi-annually.

10.2 External Audits

ACZ participates in a number of federal, state and private QA programs. Submitting its operations to both performance and system audits. These audits are usually the enforcement behind their certification programs. Audit results are available for review at the laboratory.

ACZ is periodically audited by on-site inspections and/or performance evaluation sample submittal by the following organizations:

- o EPA Water Supply (SDWA) and Water Pollution (CWA) Performance Evaluation Programs
- o EPA DMR-QA NPDES Laboratory PE Plan
- o Various state certifications requiring both site audits and PE sample analysis.
- o Chemical Waste Managements - Laboratory Approval Program

11 PREVENTATIVE MAINTENANCE PROCEDURES

Analysts are required to perform routine maintenance on all instrumentation. We believe this measure improves overall lab productivity by minimizing instrument downtime. Other benefits include job knowledge enhancement, maintenance cost reduction, and less frequent "out of control" situations. All major instrumentation is under service contract with the manufacturers and in most cases involves preventative maintenance checks by their service technicians. Most service contracts are written with 24-48 hour response times to service calls. All maintenance is documented in a maintenance logbook to be used as a source of information in solving future instrument problems.

In addition to preventative maintenance, we stock many parts that are considered consumable. As an example, contact rings for graphite furnace and spare columns for gas chromatographic techniques are routinely stocked to minimize downtime. We also have excellent relations with our vendors to provide for overnight shipment of parts that do not require manufacturers installation.

12 DATA QUALITY ASSESSMENT

Our Internal Quality Control Program requires the analysis of performance and matrix-specific QC samples. Laboratory Control Samples (LCS), Certified Reference Materials (CRM) and Matrix Spike samples are analyzed to demonstrate accuracy (bias) associated with both the analytical method and sample matrix. Duplicate samples and Matrix Spike Duplicates (MSD) are analyzed to demonstrate precision. QC data is evaluated graphically by way of Control Charts. Currently, all inorganic QC data is entered into a Control Chart Program by the analyst as the initial step in our data validation process. The Control Chart Program resides on our Local Area Network (LAN) and can be accessed by analysts/management from most computers on the LAN. Control Limits are established from historical data. At least 20 sample measurement points must be entered into the program to initiate the Control Limits. After every 20 sample measurement points the Control Limits are recalculated and a hard copy is generated for our files. The hard copy Control Charts are organized in a Method File notebook located in each laboratory.

* *Accuracy* as defined by Taylor is "the degree of agreement of a measured value with the true or expected value of the quantity of concern". LCS, CRM, and Spiked samples are analyzed with every batch of samples and the Percent Recoveries (%R) calculated as follows:

$$\%R = \frac{\text{Observed Value} - \text{Background Value}}{\text{Spike Value}} \times 100$$

Accuracy Warning Limits and Control Limits are generated by the Control Chart Program. Accuracy Warning Limits are set at +/- 2 times the Standard Deviation from the mean percent recovery, which represents the 95% Confidence Limit. Accuracy Control Limits are set at +/- 3 times the standard deviation from the mean percent recovery, which represents the 99% Confidence Limit.

* *Precision* as defined by Taylor (1987) is "the degree of mutual agreement characteristic of independent measurements as the result of repeated application of the process under specified conditions." Sample Duplicates and Matrix Spike Duplicates are analyzed with every batch of samples and the Relative Percent

Difference (RPD) is calculated as follows:

$$RPD = \frac{|Sample Value (1) - Sample Value (2)|}{[Sample Value (1) + Sample Value (2)] / 2} \times 100$$

Precision Warning Limits and Control Limits are generated by the Control Chart Program. Precision Warning Limits are set at +/- 2 times the standard deviation above zero, which represents the 95% Confidence Limit. Precision Control Limits are set at +/- 3 times the standard deviation above zero which represents the 99% Confidence Limit.

If an analyst finds a sample measurement out-of-control, a comment is made on the control chart documenting the corrective action taken. Data is determined to be out-of-control if any QC measurement point is outside the Control Limits or when seven consecutive data points fall on the same side of the center line. If the analyst is unable to determine the cause of the problem, it is presented to the department Supervisor and/or the QA Officer. Our QA Officer also reviews and validates control charts on a periodic basis and if problems are discovered they are brought to the attention of the analyst, the department Supervisor, and the President.

QC Limits are established and published for most EPA methodology. State agencies will occasionally set limits that are different from the EPA published methods. We attempt to adhere to the most stringent of the QC limits as a method of meeting all agency and/or client requirements.

Other calculations utilized routinely in the Control Chart process are as follows:

The Mean of Percent Recoveries:

$$\bar{x} = \frac{\sum x_i}{N}$$

The Standard Deviation of Percent Recoveries:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

Where: \bar{x} = average percent recovery
 x_i = individual percent recoveries

• "Quality Assurance of Chemical Measurements," Taylor, J., 1987

13 CORRECTIVE ACTIONS

Our QA Program has been established to ensure that only accurate and valid data be reported to our clients. Analytical errors are discovered as the result of a good data quality assessment program. When "out of control" data is identified, corrective action is necessary. Problems can arise in various stages of the analytical testing process including:

- o Lab contamination found in blanks above acceptable levels
- o Spikes, surrogates, and lab control samples not within acceptance ranges
- o Client inquiries about unusual data
- o Review of Performance Evaluation samples
- o Result of internal or external audits
- o Discrepancies observed at the various data review levels including chemist, lab supervisor, QA Officer and Project Manager
- o Trends observed on control charts

Many problems are discovered by the analysts and corrected before raw data is submitted for review. Problems discovered by management, auditors, or clients are brought to the attention of lab management and analysts as soon as possible. Problems and solutions are discussed in weekly lab management meetings and in the individual lab department meetings. All corrective actions are documented in logbooks and worklists if applicable. Problems are also addressed in the case narratives of complete data packages.

14 QA REPORTS TO MANAGEMENT

Our QA Officer is responsible for all aspects of quality assurance in the laboratory. He reports directly to the President of ACZ Laboratories, Inc. One of his major job responsibilities is to keep the lab management team informed on quality issues. A lab managers' meeting is held weekly to discuss everything from client services to capital equipment acquisitions. Our QA Officer is required to provide a QA/QC update to management at the weekly meetings. The areas frequently discussed include:

- o Discussion of problems discovered in previous weeks and the corrective action taken
- o Handouts on performance of blind samples and various external audit samples
- o Review of recent lab audits performed by federal, state, and industrial clients
- o Informing lab managers of upcoming audits and/or PE samples
- o Updates on employee performance on check samples
- o Presentation of ideas to improve quality of service/data to clients
- o Review of current control charts, projects, and client feedback