

1506-00109

**WASHOE COUNTY
DEPARTMENT OF WATER RESOURCES
NORTH LEMMON VALLEY
ARTIFICIAL RECHARGE PROJECT
QUALITY ASSURANCE PROJECT PLAN**



environmental consultants, inc.

Corporate Office • Sandy, Utah Reno, Nevada Boise, Idaho Elko, Nevada

**WASHOE COUNTY
DEPARTMENT OF WATER RESOURCES
NORTH LEMMON VALLEY
ARTIFICIAL RECHARGE PROJECT
QUALITY ASSURANCE PROJECT PLAN**

Prepared for:

Washoe County Department of Water Resources
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Reno, Nevada 89502

Contact:

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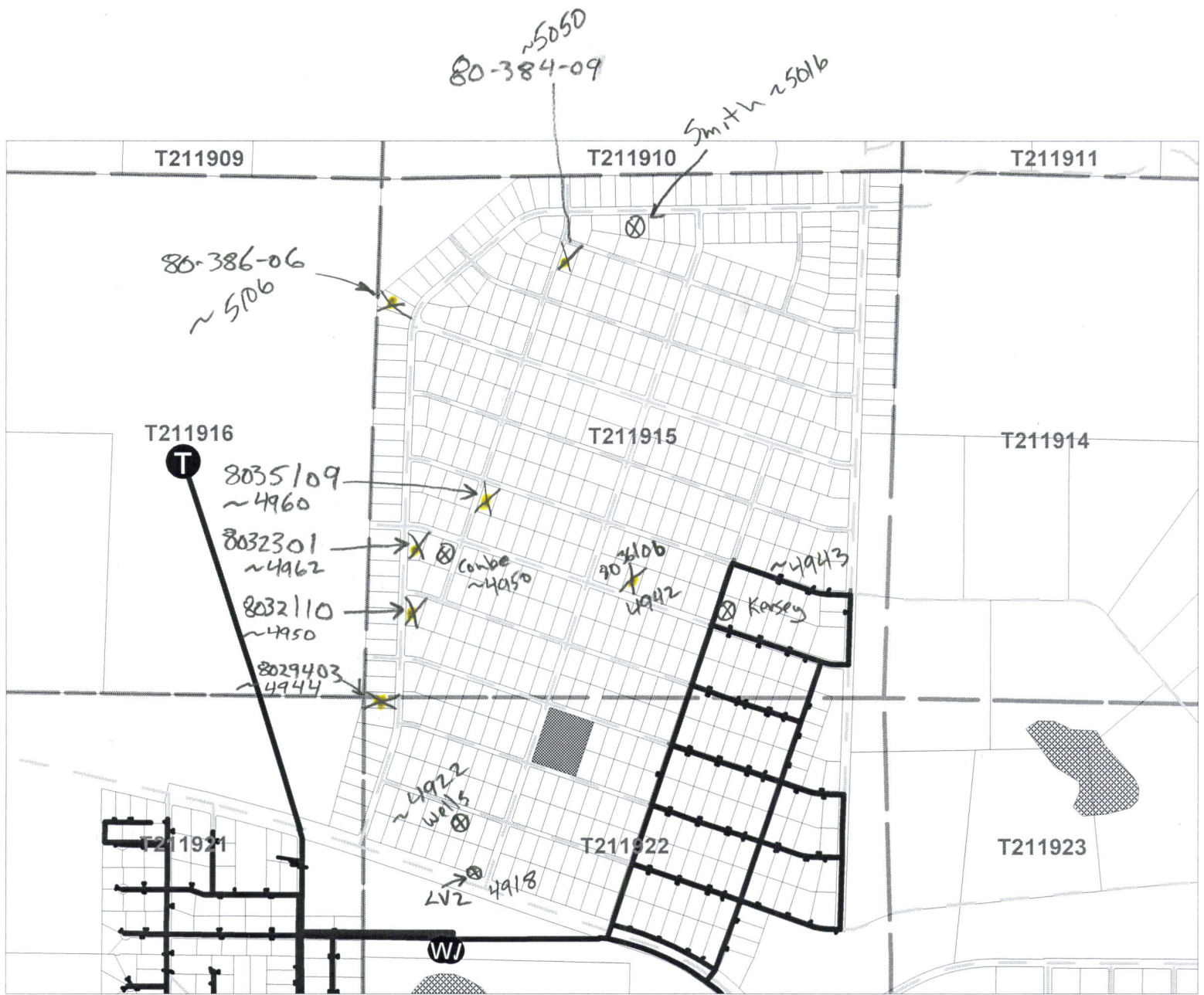
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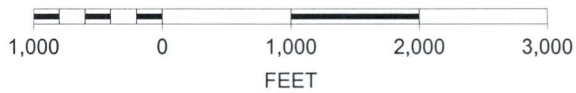
Contact:

Molly Reeves
(775) 747-5777

October 4, 2005



SCALE 1 : 18,028



Department of
Water Resources



Vanhoozer, Randy

From: Johnson, Mark
Sent: Thursday, January 19, 2006 9:56 AM
To: Vanhoozer, Randy
Subject: Heppner wells that have hooked up to expanded system

Here is the list of parcels that have hooked up to the expanded system that had an existing well.

080-384-09
080-294-03
080-292-11
080-321-10
080-323-01
080-351-09
080-361-06
080-386-06

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Vanhooser, Randy

From: Dragan, Dan
Sent: Wednesday, July 06, 2005 2:55 PM
To: Vanhooser, Randy
Subject: FW: QAPP

Randy,

Could you follow up on as many of these as you can? I think the first one we will use a Groundfos pump and be able to sample 3x borehole volumes.

Thanks
dan

-----Original Message-----

From: Molly Reeves [mailto:mreeves@jbr-env.com]
Sent: Tuesday, July 05, 2005 3:39 PM
To: Dragan, Dan
Cc: Hannah Visser
Subject: QAPP

Dan,

1. I'm assuming the wells you will be monitoring at Heppner will have large bore volumes due to large screened intervals. Can I assume that you will sample these wells by using the purge to stabilization method (as opposed to 3 bore volumes). And if so, can I assume you have the equipment to monitor selected water chemistry parameters (e.g., pH, dissolved oxygen, temperature and specific conductance). Or, is there a different method you typically use on such wells?

2. Also, we are still waiting to get maps from you. Specifically, it would be nice to have in electronic form, the locations of existing monitoring wells that the Co. checks water levels, and the locations of the municipal water supply wells.

3. Can you provide the general range of well screened interval depths that are common for the subdivision.

4. How/where will data be stored? Are your computer files be backed up?

5. What would you like to plan for reports? Quarterly technical memoranda? Annual reports or just a final report?

6. Can you list key personnel related to the project and their responsibilities - i.e. name and title and project job.

Thanks, Molly

Molly Reeves, CEM, CPESC
JBR Environmental Consultants, Inc.
5355 Kietzke Lane, Suite 100
Reno, Nevada 89511
(775) 747-5777 - Fax (775) 747-2177

Maybe on map - locate where we
would like monitoring well(s).

.shp

Production well
screens too.

**NORTH LEMMON VALLEY
ARTIFICIAL RECHARGE PROJECT**

QUALITY ASSURANCE PROJECT PLAN

APPROVAL SHEET

Date: _____
Name, Title
Organization

Date: _____
Name, Title
Organization

Date: _____
Name, Title
Organization

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**WASHOE COUNTY DEPARTMENT OF WATER RESOURCES
NORTH LEMMON VALLEY
ARTIFICIAL RECHARGE PROJECT**

1.0 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

This Quality Assurance Project Plan (QAPP) has been prepared to serve as the primary guide for the Quality Assurance (QA) and Quality Control (QC) functions during project monitoring activities for the North Lemmon Valley Artificial Recharge Project. Standards outlined in this QAPP will be implemented throughout the monitoring project to produce data that is scientifically valid and of known and acceptable quality needed to meet established objectives.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The following Washoe County Department of Water Resources (the County) staff will be responsible for all components of the project monitoring program:

Dan Dragan, Hydrogeology Manager - Project Manager

Randy Van Hoozer, Senior Hydrogeologist - Managing field work and work products for monitoring activities

Diana Hooper - Field staff

Harmony Farnsworth - Field staff

1.3 PROBLEM DEFINITION/BACKGROUND

The Heppner Subdivision is a rural development of approximately 525 homes on one-acre lots located approximately ten miles north of Reno, Nevada (Figure 1). Development of these homes began in the late 1950's. More than 500 homes utilize individual domestic wells for water supply and septic tanks for wastewater disposal. The combination of a low yield aquifer and increasing levels of nitrate in the groundwater has generated significant hardship on the homeowners. At least 160 individual domestic wells have been deepened or re-drilled, most due to declining water levels. A number of wells are being deepened or re-drilled for the second time.

In 1994, the Washoe County Department of Public Works, Utility Division received funding from the Nevada Division of Environmental Protection (NDEP), Bureau of Water Quality Planning and the U.S. Environmental Protection Agency (EPA) to conduct a water quality study of the Heppner area. Sampling and analysis showed levels of nitrates in groundwater that suggested septic system effluent was contaminating the aquifer (Washoe County, 1994). Because there are no requirements for water quality testing of domestic wells and any voluntary testing is confidential, there has been no follow-up investigation since the 1994 study. Water level monitoring conducted over the past 20 years indicates water table declines and well failures are likely to continue.

The County has investigated ways to address the water quality and quantity problems that exist in the Heppner Subdivision. One solution is to reduce the pumping of the aquifer by connecting

homeowners to another source of water as wells fail, rather than deepening or re-drilling. As more homes connect to the outside source, over pumping of the aquifer will be reduced. This approach is commonly known as in-lieu recharge.

The County has received a grant from the U.S. EPA to construct municipal water supply lines to a portion of the Heppner subdivision for homeowners to connect (Figure 2). Under the proposed action, municipal water will be supplied from three Washoe County municipal wells (well nos. 6, 7, and 8) that are located south of the subdivision. These municipal wells are drilled in the high yield sand and gravel aquifer just south of the subdivision. The County will initiate this in-lieu recharge project for the Heppner Subdivision in the summer of 2005. This program is anticipated to reduce hardships on homeowners by providing an alternative water source to homeowners whose wells are failing due to water table declines or who wish to connect to the municipal supply because of poor water quality. The program is also anticipated to reduce the number of individual wells that will need to be deepened or re-drilled. The overall goal of the in-lieu recharge project is to stabilize a declining aquifer and provide a drinking water source that meets all current drinking water standards. As part of this recharge project, the County will initiate a groundwater monitoring program.

The objective of the groundwater monitoring program outlined in this QAPP is to provide the County with data to determine the impact of the in-lieu recharge program on groundwater levels and groundwater quality. The data is also intended to provide agencies and homeowners with aquifer water quality and determine if there is an impact from individual septic systems on the local aquifer.

1.4 PROJECT DESCRIPTION

The two major components of this monitoring program include the measurement of groundwater levels and the collection and analysis of groundwater samples from converted domestic wells.

After the municipal water lines have been installed in Heppner and domestic well owners connect, the County will convert selected domestic wells to monitoring wells. The County expects many homeowners to allow conversion of their domestic wells to a monitoring well because it will save them significant well abandonment costs. The County anticipates approximately five wells per year will be converted over the project monitoring period (2006 to 2009), however the County anticipates it will not convert more than ten wells for monitoring associated with this project. ✓

The existing monitoring wells located in the vicinity of the Heppner subdivision are shown on Figure 3. These wells have been irregularly monitored for water levels on a monthly basis. Wells chosen for conversion in this monitoring program will be somewhat dependent on the location of domestic wells that are available for conversion. As wells become available, locations will be strategically selected so that the monitoring network provides a representative coverage of the study area. Well locations will be selected up-gradient and down-gradient of suspected contamination sources and at varying screened interval depths.

Existing domestic wells chosen for conversion to monitoring wells are six-inch wells that will have a two-inch galvanized steel pipe hung in the center of the top 20 feet of the well casing. The bottom end of the two-inch pipe will have a donut ring to fill the casing open space, and the top 20 feet of

the casing around the steel two-inch pipe will be backfilled with cement. After conversion the monitoring wells have two-inch casing at the surface, and remain six-inch casing from 20 feet below the top of casing to the bottom of the well.

The County will assume responsibility for future abandonment of the domestic wells converted to monitoring wells. Assurance of future abandonment is documented through the Nevada Division of Water Resources, State Engineer by an Affidavit of Intent to Abandon.

Water levels will be measured on a quarterly basis. At least one well will be instrumented with a pressure transducer and data logger to collect continuous water level measurements. Water quality parameters will be measured on a quarterly basis. Constituents of concern include total nitrogen (TN), nitrate and nitrite as nitrogen ($\text{NO}_3\text{-N}$, $\text{NO}_2\text{-N}$), total Kjeldahl nitrogen (TKN), chloride (Cl), total dissolved solids (TDS), and dissolved oxygen (DO). Collection and analysis of groundwater samples will follow standard procedures outlined in Section 2.0.

The County conducted a water quality study of the Heppner area in 1994 to evaluate groundwater contamination from septic tank effluent (Washoe County, 1994). Groundwater levels have been monitored irregularly in the project area since 1971. These data sets will provide a baseline for comparison with data collected for this monitoring program.

This monitoring program will begin as soon as homeowners begin connecting to the municipal supply (2006) and will continue through 2009. Monitoring data will be summarized in annual reports. The annual reports will present the data as described in Section 3.1. These monitoring reports will be used by the County to determine if the objectives of the in-lieu artificial recharge program are being achieved. The County does not have jurisdiction to make any regulatory decisions with the data collected. However, the annual reports will be provided to the Washoe County District Health Department for their review.

1.5 QUALITY OBJECTIVES AND CRITERIA

Sampling bias will be minimized by using standard procedures for sampling, preservation, transportation, and storage of the samples. The precision and bias routinely obtained by the analysis methods for all target parameters will be adequate for this project. The laboratory will be conducting the typical blanks, controls, and spikes, per lab quality control procedures. Table 1 displays the laboratory data quality objectives for each method.

1.6 SPECIAL TRAINING/CERTIFICATION

No special training or certification will be required. Project staff already have the training and qualifications necessary to carry out the activities in this QAPP.

Table 1. Laboratory Data Quality Objectives for each Method

Constituent	Analytical Method	Method Blank Max (mg/L)	Matrix Spike Recovery (%)	Duplicate RPD (max %)	Matrix Spike Duplicate RPD (max %)
Total Dissolved Solids (TDS)	SM2540C	10	N/A	N/A	N/A
Total Nitrogen (TN)	calculated	see NO ₂ , NO ₃ , TKN			
Nitrate Nitrogen (NO ₃)	EPA 300.0	0.010	80-120	20	20
Nitrite Nitrogen (NO ₂)	EPA 300.0	0.010	80-120	20	20
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.050	80-120	20	20
Dissolved Oxygen (DO)	EPA 360.1	N/A	N/A	N/A	N/A
Chloride (Cl)	EPA 300.0	10	80-120	20	20

1.7 DOCUMENTS AND RECORDS

The County field personnel will record the field data on field data sheets or in field notebooks. The data will be transferred to an Excel spreadsheet. The County's computer system is backed up on a weekly basis. The data recorded during each site visit is described in Section 2.4 Sampling Methods.

Annual reports will be produced from the data. Each annual report will show the findings of water quality and water level data for the year. Water quality for the year will be compared to State drinking water standards (maximum contaminant levels) for each constituent, and against historical data. Table 2 provides the State drinking water primary and secondary drinking water standards for the constituents that will be analyzed for this study. The historical data will be gathered from Washoe County (1994).

The County has been collecting water level data from monitoring wells in the vicinity of the Heppner Subdivision since the 1970s irregularly (Figure 3). Although this data is not published, the County's database of the water levels data will be accessed for the annual reports to provide historical water level trends for wells closest in proximity to newly converted monitoring wells measured for this program. The annual report will compare the water level trend for that year against the historical data collected from the County's database.

Table 2. Nevada Drinking Water Standards for Constituents of Interest

Constituent	Primary or Secondary Drinking Water Standard (mg/L)
TDS	1000
Cl	400
NO ₃ -N	10
NO ₂ -N	1
TKN	--
DO	--

2.0 DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

Monitoring well locations will be somewhat dependent on the location of available domestic wells. As wells become available for conversion, locations will be strategically selected based on site characteristics and well construction details (i.e., well depth and depth of screened interval) so that the monitoring network provides a representative coverage of the study area.

According to Washoe County's records, ground water levels beneath the Heppner Subdivision form a depression as a result of domestic pumping, such that flow directions in much of northern Lemmon Valley are towards the subdivision (Dragan, 2005). Domestic wells that represent up-gradient, down-gradient, and mid-gradient conditions will be selected in addition to wells that represent different depth intervals of the aquifer. In this way, there may be two wells located near each other that both represent up-gradient aquifer conditions, but one well may have a shallow screened interval to represent shallow aquifer water quality while the other has a deeper screened interval.

Sampling locations must begin at the monitoring well with the least contamination, generally up-gradient or furthest from the site or suspected source, then proceed systematically to the monitoring wells with the most potential to contain contaminated ground water.

Laboratory analysis of groundwater samples will include TN, TKN, NO₃-N, NO₂-N, Cl, DO, and TDS. Sampling bias will be minimized by using standard procedures for sampling, preservation, transportation, storage, and laboratory analysis of the samples. Sampling and analytical quality control procedures are discussed below.

Depending on the results of initial water quality monitoring, future monitoring may include analysis of nitrogen and oxygen isotopes to assist in the determination of the source of nitrate contamination, if present.

2.1.1 Schedule of Sampling

Water level measurements and water quality samples shall be collected on a quarterly basis (January, April, July, and October). Total well depth measurements shall be collected on an annual basis concurrent with the first water level measurement of the calendar year. At least one well will be instrumented with a pressure transducer to collect continuous daily water level measurements.

2.2 SAMPLING METHODS

Groundwater samples will be collected using methods outlined in the *Standard Operating Procedure for the Standard / Well-Volume Method for Collecting a Ground-Water Sample from Monitoring Wells for Site Characterization*. This document is provided in Appendix A and is available on the EPA Region 9 website at www.epa.gov/region09/qa/fieldsamp.html. Some project-specific modifications have been made to the standard operating procedure (SOP).

2.2.1 Water Level Measurements

Water level depth and total well depth at each monitoring well shall be measured from a permanently marked reference point at the top of the well casing using an electronic water-level indicator consisting of a probe, a cable with marked intervals of 0.01 foot, and a cable reel. If the well is too deep to accurately determine total well depth using an electronic water-level indicator, a steel tape marked at 0.01 foot intervals with a weight attached will be used. Water level measurement equipment will be decontaminated before and after use in each well, as discussed in Section 2.2.3.

The following method shall be used to measure water level depth:

- Measure water level depth prior to any other activities to avoid bias to the water level measurement.
- Slowly lower the water-level indicator into the well until it comes into contact with the top of the water column. Typically, the measuring device emits a constant tone when the probe is submerged in standing water and most electronic water level indicators have a visual indicator consisting of a small light bulb or diode that turns on when the probe encounters water.
- Measure water level depth from a permanently marked reference point at the top of the well casing using the graduated markings on the probe cable or tape. All readings are to be measured and recorded to the nearest 0.01 foot.
- Two successive water level measurements will be made at each well. Re-measure if the difference between measurements exceeds 0.01 foot.

The following method shall be used to measure total well depth:

- Check the available well log information or previous monitoring data for the total depth of the monitoring well prior to measurement.

- Slowly lower the weighted probe into the well until it is in contact with the bottom of the well.
- Measure the depth to the bottom of the well from a permanently marked reference point at the top of the well casing using the graduated markings on the probe cable or tape. All readings are to be measured and recorded to the nearest 0.01 foot.
- If the well is too deep to accurately determine total depth using an electronic water-level indicator, a chalked steel tape marked at 0.01 foot intervals with a weight attached may be used.

2.2.2 Calculation of Bore Volume

The volume of the water in the monitoring well (bore volume) will be calculated based on total well depth, standing water level, and casing diameter. One bore volume will be calculated as:

$$V = \pi d^2 h / 77.01$$

where:

V is the volume of one bore volume of water (cubic feet; 1 ft³ = 7.48 gallons);
d is the inner diameter of the well casing (inches); and
h is the total depth of water in the well (feet)

Record the bore volume and show calculations on the groundwater sampling data form.

2.2.3 Purging and Sampling Procedures

All wells shall be purged prior to sampling using a Grundfos Redi-Flo2 electrical submersible pump or equivalent device. Clean Teflon tubes will be used for groundwater extraction. All tubes will be decontaminated before use in each well. The pump intake will be placed well below the water level in case of drawdown.

The removal of at least three bore volumes is recommended to collect a representative sample. However, should the calculated gallons required for three bore volumes be excessive for purging, the samplers have the option of basing the actual number of bore volumes to be removed on the stabilization of water-quality indicator parameters of pH, specific electrical conductance (EC), DO, and turbidity. These measurements should be taken and recorded every ½ well volume after the removal of approximately 1 to 1 ½ well volume(s). Once three successive reading of the water-quality-indicator parameters provided in the Table 3 have stabilized, the sample collection may begin.

Table 3. Purging Stabilization Criteria

Parameter	Stabilization Criteria	Reference
pH	± 0.1 pH units	Puls and Barcelona, 1996; Wilde et al., 1998
specific electrical conductance (EC)	$\pm 3\%$ FS/cm	Puls and Barcelona, 1996
turbidity	$\pm 10\%$ NTUs (when turbidity is greater than 10 NTUs)	Puls and Barcelona, 1996 Wilde et al., 1998
DO	± 0.3 milligrams per liter	Wilde et al., 1998

The following SOP shall be followed for all purging and sampling activities:

- Record location, time, date and appropriate information on the groundwater sampling data form. Check and record the condition of the monitoring well for damage or evidence of tampering. Unlock well head.
- Lay out polyethylene sheeting around the well to minimize the likelihood of contamination of sampling/purging equipment from the soil. Place monitoring equipment on the sheeting.
- Prepare a complete set of sample containers for each well. All samples shall be collected in new, and certified clean (by manufacturer), sample containers provided by the analytical laboratory. Label each container submitted for analysis with the following information:
 - 1) Project name;
 - 2) Field sample identification (well number);
 - 3) Date and time sample was collected;
 - 4) Preservative (if applicable); and
 - 5) Sampler's initials.
- Remove inner casing cap. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark on the groundwater sampling data form.
- Measure the water level depth following the procedures outlined above and record information on groundwater sampling data form.
- Calculate the volume of water in the well and the volume to be purged using the formula provided above.
- Rinse outside of pump with distilled water and then, while lowering the pump, dry with disposable paper towels.

- Place the pump and support equipment at the wellhead and slowly lower the pump and tubing down into the monitoring well.
- Turn the pump on. The submersible pump should be operated in a continuous, low-flow manner so that it does not produce pulsating flows that cause aeration in the discharge tubing, aeration upon discharge, or resuspension of sediments at the bottom of the well.
- If there is room in the casing to fit the water level indicator along with the pump, water levels should be monitored during pumping to ensure that air does not enter the pump.
- Measure the discharge rate of the pump with a graduated container or graduated bucket and a stop watch. Also, measure the water level and record both flow rate and water level on the groundwater sampling log. Continue purging, monitor and record water level and pump rate every three to five minutes during purging. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well.
- Purged water will be dumped on the soil surface at least 50 feet away from the well.
- After approximately 1 to 1 ½ well volumes have been removed, a flow-through cell will be hooked up to the discharge tubing of the pump. If the well discharge water is not highly turbid, encounter separate liquid phases, or bacterial activity that may coat or clog the electrodes within the flow-through cell, then the cell can be immediately hooked-up to the discharge tubing.
- Measure temperature, pH, EC, turbidity, and DO at every ½ well volume after the removal of approximately 1 to 1 ½ well volumes. Record measurements on the groundwater sampling data form. Purging may cease when measurements for all four parameters have stabilized for three consecutive readings (see Table 3).
- If the water level is lowered to the pump level before 3 volumes have been removed, the water level will be allowed to recover for 15 minutes and the pumping can begin at a lower flow rate. If the pump again lowers the water level to below the pump intake, the pump will be turned off and the water level allowed to recover for a longer period of time. This will continue until a minimum of two well volumes are removed prior to taking the groundwater sample. This information should be noted on the groundwater sampling data form with a recommendation for a different purging and sampling procedure.
- Once the criteria have been successfully met indicating that the water quality indicator parameters have stabilized or three bore volumes have been purged, then sample collection can take place.
- Samples will be collected by lowering the flow rate to a rate that minimizes aeration of the sample while filling the bottles (approximately 300 ml/min). Then a final set of water-quality-indicator parameters is recorded. The pump discharge line shall be rapidly

disconnected from the flow-through cell to allow filling of bottles directly from the pump discharge line.

- The water should be transferred to the sample container in a way that will minimize agitation and aeration. One sample bottle will require a sulfuric acid preservative. The preservative may be provided by the laboratory in a preserved bottle, or may be added to the bottle immediately after sample collection. If sample contains preservative, avoid overfilling so that the preservative is not lost. The bottle with preservative should be properly labeled as having such preservative.
- Samples shall not be exposed to sunlight after collection. All samples are to be put into a cooler with ice immediately. Ensure that the samples that are to be cooled remain at 4° C, but do not allow any of the samples to freeze. Sample storage and holding time shall comply with the analytical requirements for each sample type, as provided in Section 2.4. The samples shall be delivered to the laboratory the same day the samples are collected.
- Remove the pump from the monitoring well. Decontaminate the pump and tubing.
- Close and lock the well.

2.2.4 Decontamination Procedures

To avoid cross-contamination between wells, all purging and sampling equipment will be decontaminated according to the following procedure:

- Pull pump out of previously-sampled well (or out of vehicle).
- Using three pressure sprayers (one filled with soapy [Alconox] water, one with tap water, and one with deionized water), spray outside of tubing and pump until water is flowing off the tubing after each rinse. Use bristle brush to remove any visible dirt, contaminants, etc.
- Fill three buckets filled with soapy water, tap water, and deionized water, respectively. Run pump in each until approximately 2 to 3 gallons of each decon solution is pumped through tubing and spray the outside of the pump and tubing with deionized water. Pump at a low rate to increase contact time between the decon solution and the tubing.
- Pump decon solutions out of tubing prior to use in next well.
- Use disposable paper towels and dry the pump and tubing.

2.3 Sample Handling and Custody

Chain-of-custody procedures will be followed throughout sample collection, handling, and transportation to Sierra Environmental Monitoring (SEM), a Nevada Certified Laboratory. The samples will remain in the custody of the sampler, or in a secure area. A chain-of-custody form will be completed and will accompany the samples to the laboratory. All persons relinquishing or accepting custody of the samples will be required to sign and date/time the chain-of-custody form. Upon delivery of the samples, the analytical laboratory will copy the form, so that a copy can be kept by the sampler as part of the field records. The chain-of-custody form shall also include a listing of the analyses to be requested for each sample. All sample containers will be clearly labeled with an adhesive label. Samples will be hand delivered to the laboratory. SEM's QA Manual is provided in Appendix B.

2.4 Analytical Methods

Table 4 displays the constituents of interest that would be analyzed by SEM.

Table 4. Methods and Limits for Sampling Constituents

Constituent	Units	Lab Reporting Limits	Holding Time	Preservative
TDS	mg/l	10	7 day	4° C
TN	mg/l	0.050	48 hour	--
NO ₃ -N	mg/l	0.010	48 hour	4° C
NO ₂ -N	mg/l	0.010	48 hour	4° C
TKN	mg/l	0.050	28 day	H ₂ SO ₄
DO	mg/l	N/A	ASAP	4° C
Cl	mg/l	1.0	28 day	4° C

2.5 Quality Control

Each quality control sample will be collected at a randomly selected location in the field and labeled similar to well identifications so they will be blind to the laboratory. Laboratory quality control tests will be taken from a randomly selected sample at the laboratory, following SEM's QA Manual (Appendix B).

2.5.1 Field Quality Control

The equipment used to measure groundwater levels (water level indicator) will be inspected prior to use to verify that it is working properly. Water levels will be measured to the nearest 0.01 foot,

with two successive measurements being made at each well. The difference between measurements should not exceed 0.01 feet.

All meters used to measure water quality field parameters (water temperature, electrical conductivity, pH and dissolved oxygen concentration) will be checked and calibrated as appropriate against known standards at the start of each sampling day. Meter calibration will be done in accordance with the manufacturer directions.

Field equipment blanks, trip blanks, and duplicate samples will be used to assess the overall sampling and analytical precision.

2.5.1.1 Field Equipment Blanks

To ensure quality assurance and quality control, a field equipment blank must be included in each sampling run, or at a minimum, one for every twenty samples collected (rate of five percent). These provide a cross check for imprecision that could arise due to handling, preservation, or improper cleaning procedures.

Equipment blanks should be taken for each sample bottle type that is filled. Deionized water is run through the pump tubing and placed in a sample bottle (the blank), and the contents are analyzed in the lab like any other sample. Following the collection of each set of twenty samples, a field equipment blank will be obtained. It is generally desirable to collect this field equipment blank after sampling a relatively highly contaminated well. These blanks may be obtained through the following procedure:

- Following the sampling event, decontaminate all sampling equipment according to the site decontamination procedures and before collecting the blank.
- Be sure that there is enough deionized water in the pump so that the field equipment blank can be collected for each analyses.

2.5.1.2 Duplicate Samples

Duplicate samples are collected by taking separate samples as close to each other in time and space as practical, and should be taken for every twenty samples collected. Duplicate results will be utilized by the project manager to give an indication of the precision of the sampling and analytical methods.

2.5.2 Laboratory Quality Control

Routine quality control procedures will be implemented according to the selected laboratory's standard operating procedures. Laboratory quality control tests consist of method blanks, matrix spikes, as well as duplicate and check standards (lab control standards). Analytical precision can be estimated from duplicate and check standards, duplicate sample analysis, and duplicate spiked sample analyses. Analytical bias will be estimated from matrix spikes, matrix spike duplicates, and check standards. Recoveries from check standards provide an estimate of bias due to calibration. Mean percent recoveries of spiked sample analyses provide an estimate of bias due to interference.

Laboratory staff will conduct quality assurance review of all analytical data generated prior to releasing the data to the project manager. These quality control measures are described in SEM's QA Manual, provided in Appendix B.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

2.6.1 Field Equipment

Field equipment testing, inspection, and maintenance shall be performed at the beginning and end of each monitoring day according to manufacturer's directions. Equipment found in disrepair will be repaired according to manufacturer's guidance or replaced.

2.6.2 Laboratory Equipment

Inspection and maintenance of laboratory equipment shall be performed according to the laboratory's standard operating procedures.

2.7 Instrument/Equipment Calibration and Frequency

2.7.1 Field Equipment

All meters used to measure water quality field parameters (water temperature, pH, EC, turbidity, and DO concentration) will be checked and calibrated as appropriate against known standards in accordance with the manufacturer directions. Meter calibration shall occur prior to use or at any time a meter drift is suspected. Calibration shall also occur during the middle of the day and at the end of the day. If proper calibration is not achieved, calibration will be repeated and equipment adjusted or replaced as necessary.

2.7.2 Laboratory Equipment

Laboratory instruments and equipment will be calibrated according to manufacturer's specifications, and will comply with the EPA's analytical method (Table 1) and SEM's QA Manual (Appendix B).

2.8 Non Direct Measurements

Annual reports will be produced from the data. Each annual report will show the findings of water level for the year, and compare this data against historical data. The County has been collecting water level data from monitoring wells (Figure 3) in the vicinity of the Heppner Subdivision since the 1970s irregularly. Although this data is not published, the County's database of the water levels data will be accessed for the annual reports to provide historical water level trends for wells closest in proximity to newly converted monitoring wells measured for this program. The annual report will compare the water level trend for that year against the historical data collected from the County's database. Because the water levels being compared will be from a different well, the annual report will describe the distance between the wells being compared.

2.9 Data Management

2.9.1 Data Storage

All data, reports, and related products generated during this project will be stored in project files maintained by the Washoe County Department of Water Resources (WCDWR) Hydrogeology Program Manager. The files will also include original laboratory reports and relevant historical

information that has contributed to project decision-making. Readily available public information used during the course of the project may not be included in the project files.

Data collected in the field will be written on data sheets or in a notebook. The following information should be recorded during each sampling event at each well site:

- project name
- samplers
- location (well name)
- time
- date
- weather
- water level depth (each visit) and total well depth (once annually)
- bore volume and calculations
- method used to purge
- pump discharge rate
- water level every 3-5 minutes during purging
- pH, DO, temperature every ½ well volume and a final set prior to sample collection
- sample bottles collected, names, preservative, and time
- notes on storage, handling, and delivery to the lab
- when field meter was last calibrated
- notes on decontamination procedure

Data from field notes and laboratory reports will be transferred to Excel spreadsheets. Data will be electronically managed with Excel spreadsheets and will be transferrable between WCDWR and other entities using hard copy, disks, CD-ROM, and/or e-mail. After project closure, all data files and other materials for long-term storage will be inventoried. The long term storage of project files will be maintained in accordance with Federal or State regulations by WCDWR.

The County has a system-wide weekly electronic backup of all files on their network. Additionally, annually the data will be stored on CDs and a copy will be kept in the hardcopy project files.

2.9.2 Data Reporting

Data will be reported using Excel spreadsheet files and will be presented in the annual reports. The data will be available in tables, indicating the date, location, type of test, and the results of all samples analyte values, given in standard units.

3.0 DATA VALIDATION AND USABILITY

3.1 Data Review, Verification, and Validation

At the completion of each sampling event all field data and laboratory analytical data will be compiled and evaluated against the project measurement quality objectives. Lab results will be checked for questionable or missing data. Analytical precision will be evaluated using standard

statistical techniques (relative percent difference (RPD), standard deviation (s), pooled standard deviation (sp), or percent relative standard deviation [%RSD]) as appropriate. The RPD for field duplicates will be used to assess data quality and reported in the annual report.

The data generated from this project will be reviewed for completeness and accuracy as described throughout this document. Any data found to be incomplete or inaccurate will be discarded or selected for provisional use only.

3.2 Data Use

An annual report will be prepared summarizing all monitoring efforts and results for each year. Annual reports will be generated by January of the following year. The quarterly technical memorandum will include the following information:

- Maps of the study area showing wells sampled.
- Brief descriptions of field and laboratory methods.
- Discussion of data quality and the significance of any problems encountered in the collection and analyses of samples.
- Summary tables of field and laboratory data, and State drinking water standards.
- Discussion of Quality Control results.
- Graphs displaying water level elevation over time for each well and displaying the water level from the historical County database (from each of the closest wells to the converted monitoring well), and the distance between the wells.
- Graphs displaying the concentration of each constituent from selected wells (i.e. upgradient and downgradient wells on the same graph) over time.
- Observations on significant or potentially significant findings.
- Recommendations based on project goals.

These reports will discuss the results of water quality relative only to drinking water standards and trends observed over time. Similarly, water elevations will be discussed in trends observed throughout each year and compared to previous years of monitoring data available. It is expected that water elevations will either rise, or stop declining, after residences begin hooking up to the municipal supply. This hypothesis will be tested by interpreting trends seen through each year and between multiple years and reported in the annual report. The information regarding the effectiveness of in-lieu recharge may assist the County in future decisions where in-lieu recharge is an option.

Based on water quality data from Washoe County (1994), and two known sources of $\text{NO}_3\text{-N}$ inputs to groundwater, septic system effluent and infiltration from horse properties, it is expected that analysis of water quality will find levels of $\text{NO}_3\text{-N}$ in the groundwater beneath the subdivision to near or above the State drinking water standard at the early stages of monitoring. This will be assessed in the reports. The reports will also address if a trend can be observed in increasing or decreasing level of $\text{NO}_3\text{-N}$ in the groundwater, whether yearly or between years. Additionally, since wells will be converted to monitoring wells with differing depths of screened intervals below the water table, the report will assess if $\text{NO}_3\text{-N}$ concentrations change with depth in the aquifer, thus

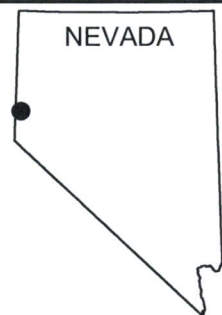
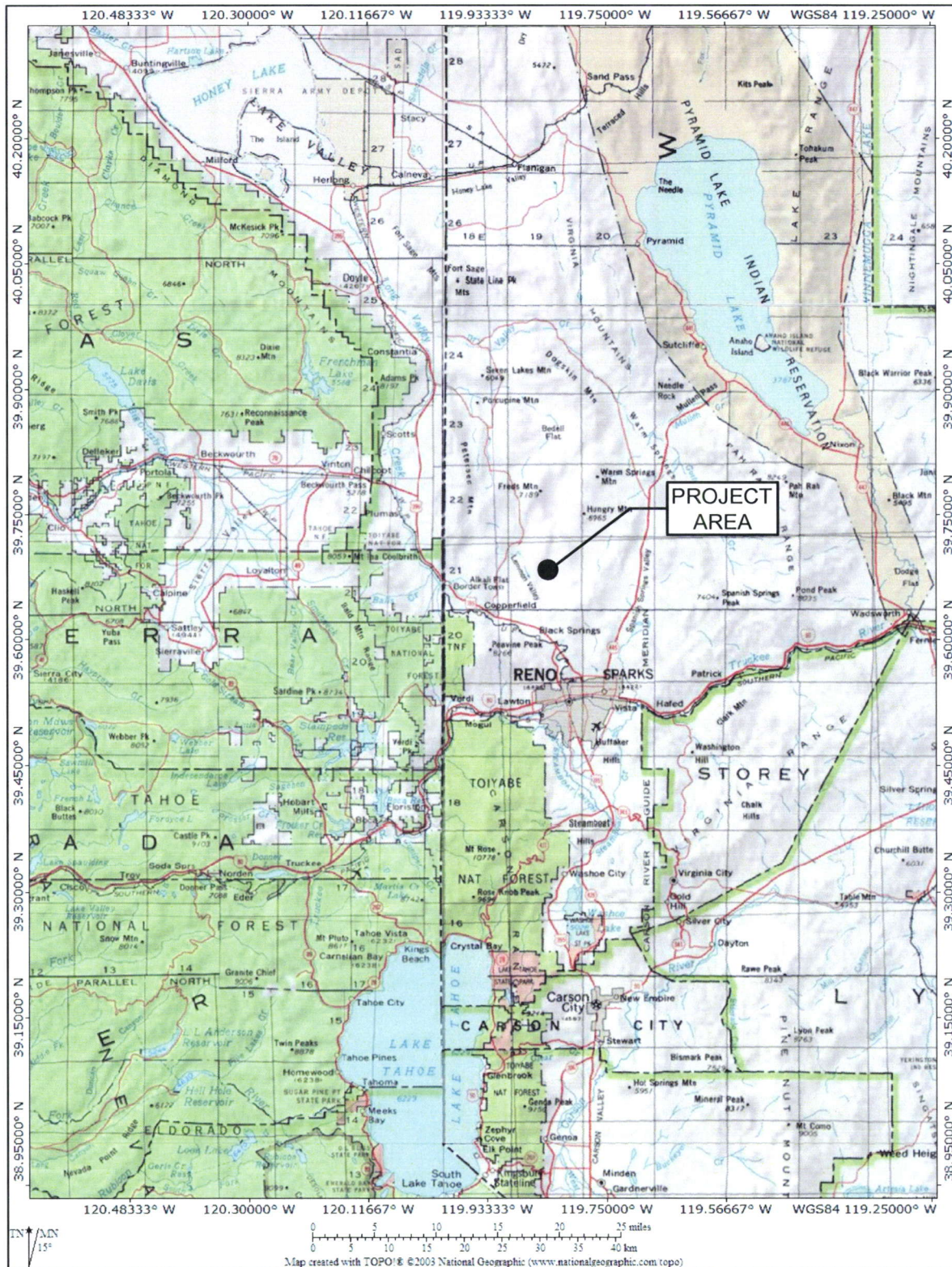
affecting each residence differently. The County has no authority to make regulatory decisions based upon the outcome of this monitoring.

Regardless of the findings, these annual reports will be provided to the Washoe County District Health Department for their review. It is unknown at this time if any regulatory decisions by the District Health Department may be based on the data provided in these annual reports.

4.0 REFERENCES

- Dragan, D. 2005. Hydrogeology Manager, Washoe County Department of Water Resources. Personal communication with Molly Reeves of JBR Environmental Consultants, Inc., Reno, Nevada. February 17, 2005.
- Puls, R. W. and M.J. Barcelona, 1996. Low-Flow (Minimal 14 Drawdown) Ground-Water Sampling Procedure, EPA/540/S-95/504, 12 pp.
- U.S. EPA, 2001. Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, at: <http://www.epa.gov/quality/qs-docs/g6-final.pdf>, March 2001.
- Washoe County Department of Public Works, 1994. Ground Water Contamination from Septic tank Effluent in a Closed Basin Washoe County, Nevada, Nevada Division of Environmental Protection, Bureau of Water Quality Planning.
- Wilde, F.D., D.B. Radtke, J.Gibs and R.T. Iwatsubo, eds., 1998. National Field Manual for the Collection of Water-Quality Data; U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources Investigations, variously paginated.

FIGURES



WASHOE COUNTY

LEMMON VALLEY ARTIFICIAL RECHARGE PROJECT

FIGURE 1
GENERAL LOCATION



DESIGN BY MR DRAWN BY AA CH'D BY SCALE --

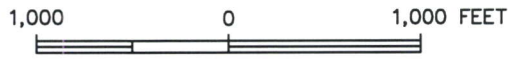
DATE DRAWN 07/21/05

REVISION

FILE NAME: Clients-2005\Washoe County-04 QAPP\AutoCAD\Project V1



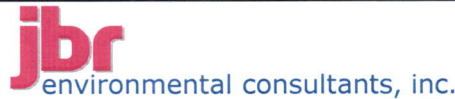
- BASE LAYERS ADAPTED FROM WASHOE COUNTY AUTOCAD FILE
- HEPPNER SUBDIVISION BOUNDARY
 - PROPOSED WATER LINES
 - EXISTING WATER LINES
 - PROPOSED FIRE HYDRANTS
 - LOTS OWNED BY WASHOE COUNTY

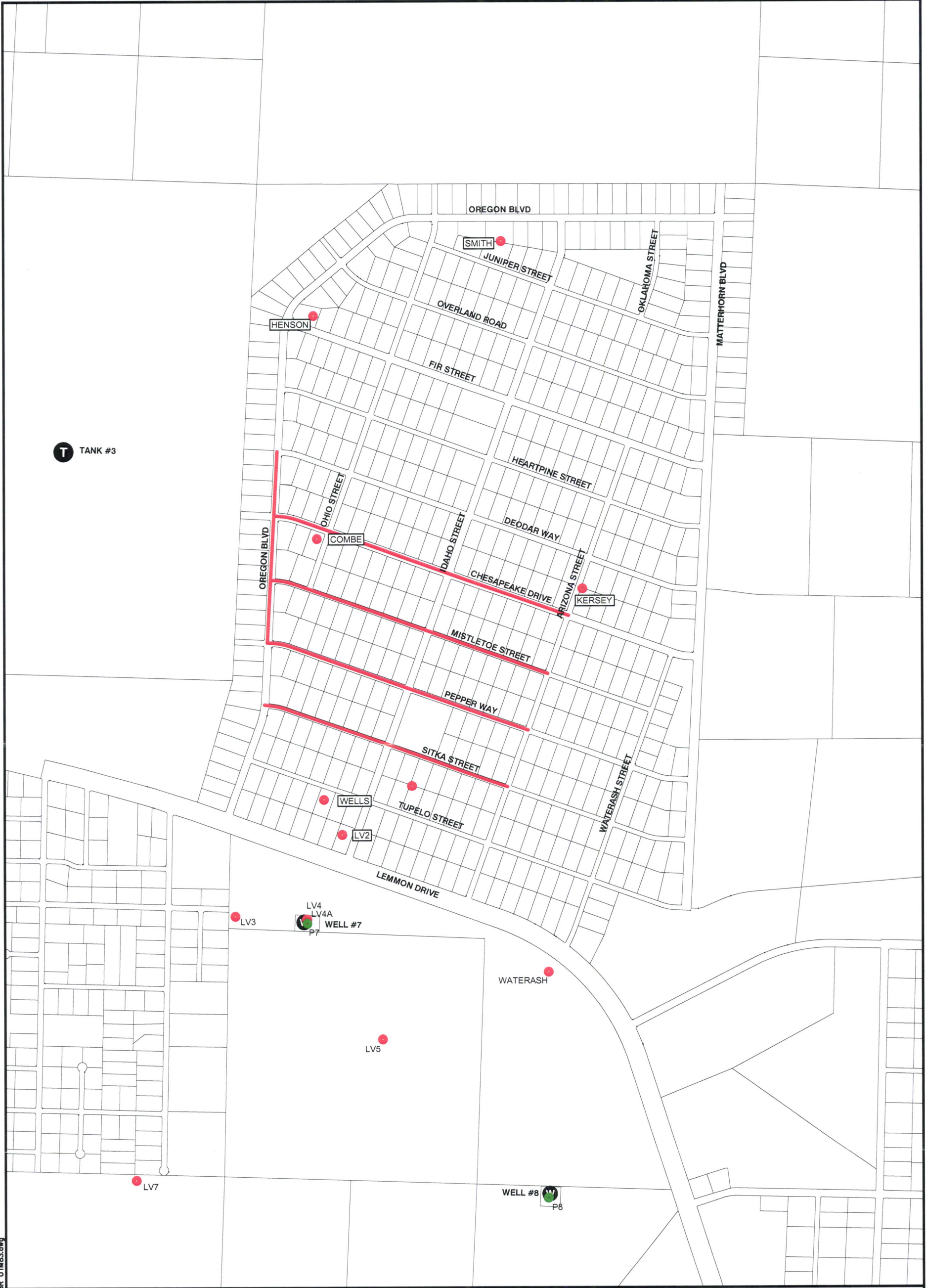


WASHOE COUNTY

LEMMON VALLEY ARTIFICIAL RECHARGE PROJECT

FIGURE 2
NORTH LEMMON VALLEY ARTIFICIAL
RECHARGE WATER LINES

		DATE DRAWN 07/21/05	
		REVISION	
DESIGN BY MR	DRAWN BY AA	CH'D BY	SCALE 1:9,600



FILE NAME: Clients-2005\Washoe County-02\AutoCAD\JBR UTM83.dwg

BASE LAYERS ADAPTED FROM WASHOE COUNTY AUTOCAD FILE
— PROPOSED WATER LINES
● MONITORING WELL
● PRODUCTION WELL

1,000 0 1,000 FEET



WASHOE COUNTY
LEMMON VALLEY ARTIFICIAL RECHARGE PROJECT

FIGURE 3
EXISTING MONITORING WELLS



DESIGN BY MR DRAWN BY AA CH'D BY SCALE 1:9,600

DATE DRAWN 07/21/05

REVISION

APPENDIX A

EPA Groundwater Sampling SOP

STANDARD OPERATING PROCEDURE FOR THE STANDARD/WELL-VOLUME METHOD FOR COLLECTING A GROUND-WATER SAMPLE FROM MONITORING WELLS FOR SITE CHARACTERIZATION

INTRODUCTION

The collection of "representative" water samples from wells is neither straightforward nor easily accomplished. Ground-water sample collection can be a source of variability through differences in sampling personnel and their individual sampling procedures, the equipment used, and ambient temporal variability in subsurface and environmental conditions. Many site inspections and remedial investigations require the sampling at ground-water monitoring wells within a defined criterion of data confidence or data quality, which necessitates that the personnel collecting the samples are trained and aware of proper sample-collection procedures.

The objectives of the sampling procedures described in this document are to minimize changes in ground-water chemistry during sample collection and transport to the laboratory and to maximize the probability of obtaining a representative, reproducible ground-water sample. Sampling personnel may benefit from a working knowledge of the chemical processes that can influence the concentration of dissolved chemical species.

The well-volume purging method described in this standard operating procedure (SOP) provides a reproducible sampling technique with the goal that the samples obtained will represent water quality over an entire open interval of a short-screened (ten feet or less) well. This technique is appropriate for long-term and detection monitoring of formation water quality. The resulting sample generally represents a composite of the well-screened interval, and thus integrates small-scale vertical heterogeneities of ground-water chemistry. This sampling technique also is useful for screening purposes for detection monitoring of contaminants in the subsurface. However, the detection of a low-concentration of contaminant in a thin contaminated zone, or with long well screens may be difficult, and should be determined using detailed vertical profiling techniques.

This method may not be applicable for all ground-water-sampling wells, such as wells with very low yields, fractured rock, and

some wells with turbidity problems. As always, site-specific conditions and objectives should be considered prior to the selection of this method for sampling.

SCOPE AND APPLICATION

The objective of a good sampling program should be the collection of a "representative" sample of the current ground-water conditions over a known or specified volume of aquifer. To meet this objective, the sampling equipment, the sampling method, the monitoring well construction, monitoring well operation and maintenance, and sample-handling procedures should not alter the chemistry of the sample.

An example of how a site's Data Quality Objectives (DQO's) for a characterization sampling effort might vary from those of a remediation monitoring sampling effort could be a difference of how much of the screened interval or aquifer should be sampled. A site characterization objective may be to collect a sample that represents a composite of the entire (or as close as is possible) screened interval of the monitoring well.

Additionally, the site characterization may require a large suite of contaminants to be sampled and analyzed, whereas, the remediation monitoring program may require fewer contaminants sampled and analyzed. These differences may dictate the type of sampling equipment used, the type of information collected, and the sampling protocol.

This sampling method described is for monitoring wells. However, this method should not be used for water-supply wells with a water-supply pump, with long-screened wells in complex hydrogeologic environments (such as fractured rock), or wells with separate phases of liquids (such as a Dense or Light Non-Aqueous Phase Liquids) present within the screened interval.

EQUIPMENT

- Depth-to-water measuring device - An electronic water-level indicator or steel tape and chalk, with marked intervals of 0.01 foot. Interface probe for measuring separate phase liquids, if needed. Pressure transducer and data logger optional for frequent depth-to-water measuring in same well.

- Steel tape and weight - Used for measuring total depth of well. Lead weights should not be used.
- Sampling pump - Submersible or bladder pumps with adjustable rate controls are preferred. Pumps are to be constructed of inert materials, such as stainless steel and teflon. Pump types that are acceptable include gear and helical driven, centrifugal (low-flow type) and air-activated piston. Adjustable rate, peristaltic pumps can be used when the depth to water is 20 feet or less.
- Tubing - Inert tubing should be chosen based on the types and concentrations of contaminants present, or expected to be present in the monitoring well. Generally, Teflon® based tubing are recommended when sampling for organic compounds. Polyethylene or Teflon® tubing can be used when sampling for inorganic constituents.
- Power source - If a combustion type (gasoline or diesel-driven) device is used, it must be located downwind of the point of sample collection. If possible, it should also be transported to the site and sampling location in a different vehicle from the sampling equipment.
- Flow-measurement equipment - Graduated cylinder or bucket and a stop watch, or a flow meter that can be disconnected prior to sampling.
- Multi-parameter meter with flow-through cell - This can be one instrument (such as a Hydrolab® or YSI® downhole sonde with a flow-through-cell) or multiple probes/instruments contained in a flow-through-cell. The water-quality-indicator parameters that are measured in the field are pH, oxidation/reduction potential (ORP, redox or Eh), dissolved oxygen (DO), turbidity, specific electrical conductance (SEC) and temperature. Calibration standards for all instruments should be NIST-traceable, within expiration dates of the solutions, and sufficient for daily calibration throughout the sampling collection.
- Decontamination supplies - A reliable and documented source of distilled water and any solvents (if used). Pressure sprayers, buckets or decontamination tubes for pumps, brushes and non-phosphate soap also will be needed.
- Sample bottles, sample preservation supplies and laboratory paperwork. Also, several coolers, sample packing supplies (absorbing packing material, baggies, etc.).
- Approved plans and background documents - Approved Field Sampling Plan, Quality Assurance Project Plan, well construction data, field and water-quality data from the previous sampling collection.

- Site Access/Permission documentation for site entry.
- Well keys and map showing locations of wells.
- Field notebook, field data sheets and calculator. A suggested field data sheet is provided as a figure.
- Filtration equipment - If needed, this equipment should be an in-line disposable filter used for the collection of samples for analysis of dissolved constituents.
- Polyethylene sheeting - Used for decontamination stations and during sampling to keep equipment clean.
- Site Health and Safety Plan and required equipment - The health and safety plan along with site sign-in sheet should be on site and be presented by the site health and safety officer. Personnel-protective and air-monitoring equipment specified in the Site Health and Safety Plan should be demonstrated, present and in good working order on site at all times.
- Tool box - All needed tools for all site equipment used.
- A 55-gallon drum or container to contain the purged water.

Materials of construction of the sampling equipment (bladders, pump, bailers, tubing, etc.) should be limited to stainless steel, Teflon®, glass and other inert materials when concentrations of the site contaminants are expected within the detection limit range. The sample tubing thickness and diameter should be maximized and the tubing length should be minimized so that the loss of contaminants absorbed to and through the tubing walls may be reduced and the rate of stabilization of ground-water parameters is maximized. The tendency of organics to sorb into and out of many materials makes the appropriate selection of sample tubing materials critical for these trace analyses (Pohlmann and Alduino, 1992; Parker and Ranney, 1998).

Generally, wells should be purged and sampled using the same positive-pressure pump and/or a low-flow submersible pump with variable controlled flow rates and constructed of chemically inert materials. If a pump cannot be used because the recovery rate to the well is so low (less than 100 to 200 ml/min) and the volume of the water to be removed is minimal (less than 5 feet of water in a small-diameter well), then a Teflon® bailer, with a double check valve and bottom-emptying device with a control-flow check valve may be used to obtain the samples. Otherwise, a bailer should not be used when sampling for volatile organics because of the potential bias introduced during sampling (Yeskis, et al., 1988; Pohlmann, et al., 1990; Tai, et al., 1991). Bailers also should be avoided when sampling for metals because

repeated bailer deployment has the potential to increase turbidity, which biases concentrations of inorganic constituents. Dedicated sampling pumps are recommended for metals sampling (Puls, et al., 1992).

In addition, for wells with long riser pipes above the well screen, the purge volumes may be reduced by using packers above the pumps. The packer materials should be compatible with the parameters to be analyzed. These packers should be used only on wells screened in highly permeable materials, because of the lack of ability to monitor water levels in the packed interval. Otherwise, if pumping rates exceed the natural aquifer recovery rates into the packed zone, a vacuum or negative pressure zone may develop. This may result in a failure of the seal by the packer and/or a gaseous phase may develop, that may bias any sample taken.

PURGING AND SAMPLING PROCEDURE

WATER-LEVEL MEASUREMENTS

The field measurements should include total well depth and depth to water from a permanently-marked reference point.

TOTAL WELL DEPTH

The depth of each well should be measured to the nearest one-tenth of a foot when using a steel tape with a weight attached and should be properly recorded. The steel tape should be decontaminated before use in another well according to the site specific protocols. A concern is that when the steel tape and weight hit the bottom of the well, sediment present on the bottom of a well is stirred up, thus increasing turbidity which will affect the sampling results. In these cases, as much time as possible should be allowed prior to sampling, such as a minimum of 24 hours. If possible, total well depth measurements can be completed after sampling (Puls and Barcelona, 1996). The weight of electric tapes is generally too light to determine accurate total well depth. If depth of well is greater than 200 feet, stretching of the tape must be taken into consideration.

DEPTH TO WATER

All water levels should be measured from the reference point by

use of a weighted steel tape and chalk or an electronic water-level indicator (a detailed discussion of the pros and cons of the different water level devices is provided in Thornhill, 1989). The steel tape is a more accurate method to take water levels, and is recommended where shallow flow gradients (less than 0.05 feet/foot) or deep wells are encountered. However, in those cases where large flow gradients or large fluctuations in water levels are expected, a calibrated electric tape is acceptable. The water level is calculated using the well's surveyed reference point minus the measured depth-to-water and should be measured to the nearest one-hundredth of a foot.

The depth-to-water measurement must be made in each well to be sampled prior to any other activities at the well (such as bailing, pumping, and hydraulic testing) to avoid bias to the depth-to-water measurement. All readings are to be recorded to the nearest one-hundredth of a foot. When possible, depth-to-water and total well depth measurements should be completed at the beginning of a ground-water sampling program, which will allow any turbidity to settle and allow a more synoptic water-level evaluation. However, if outside influences (such as: tidal cycles, nearby pumping effects, major barometric changes) that may result in significant water-level changes in the time between measurement and sampling, a water-level measurement should be completed immediately prior to sampling. In addition, the depth-to-water measurement during purging should be recorded, with the use of a pressure transducer and data logger sometimes more efficient (Barcelona et al., 1985, Wilde et al., 1998).

The time and date of the measurement, point of reference, measurement method, depth-to-water measurement, and any calculations should be properly recorded in field notebook or sampling sheet.

STATIC WATER VOLUME

From the information obtained for casing diameter, total well depth and depth-to-water measurements, the volume of water in the well is calculated. This value is one criteria that may be used to determine the volume of water to be purged from the well before the sample is collected.

The static water volume may be calculated using the following formula:

$$V = r^2h(0.163)$$

Where:

V = static volume of water in well (in gallons)
 r = inner radius of well casing (in inches)
 h = length of water column (in feet) which is equal to the total well depth minus depth to water.
 0.163 = a constant conversion factor that compensates for the conversion of the casing radius from inches to feet for 2-inch diameter wells and the conversion of cubic feet to gallons, and pi (π). This factor would change for different diameter wells.

Static water volumes also may be obtained from various sources, such as Appendix 11.L in Driscoll (1986).

WELL PURGING

PURGE VOLUMES

In most cases, the standing water in the well casing can be of a different chemical composition than that contained in the aquifer to be sampled. Solutes may be adsorbed or desorbed from the casing material, oxidation may occur, and biological activity is possible. Therefore, the stagnant water within the well must be purged so that water that is representative of the aquifer may enter the well.

The removal of at least 3 well volumes is suggested (USEPA, 1986; Wilde et al., 1998). The amount of water removed may be determined by collecting it in a graduated pail of known volume to determine pumping rate and time of pumping. A flow meter may also be used, as well as capturing all purged water in a container of known volume.

The actual number of well volumes to be removed is based on the stabilization of water-quality-indicator parameters of pH, oxidation-reduction potential (ORP), specific electrical conductance (SEC), dissolved oxygen (DO), and turbidity. The water initially pumped is commonly turbid. In order to keep the turbidity and other probes from being clogged with the sediment from the turbid water, the flow-through cell should be bypassed initially for the first well volume. These measurements should

be taken and recorded every 1/2 well volume after the removal of 1 to 1 1/2 well volume(s). Once three successive readings of the water-quality-indicator parameters provided in the table have stabilized, the sampling may begin. The water-quality-indicator parameters which are recommended include pH and temperature, but these are generally insensitive to indicate completion of purging since they tend to stabilize rapidly (Puls and Barcelona, 1996). Oxidation-reduction potential may not always be an appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidizing conditions, and for some fate and transport issues. When possible, especially when sampling for contaminants that may be biased by the presence of turbidity, the turbidity reading is desired to stabilize at a value below 10 Nephelometric Turbidity Units (NTU's). For final dissolved oxygen measurements, if the readings are less than 1 milligram per liter, they should be collected with the spectrophotometric method (Wilde et al., 1998, Wilkin et al., 2001), colorimetric or Winkler titration (Wilkin et al., 2001). All of these water-quality-indicator parameters should be evaluated against the specifications of the accuracy and resolution of the instruments used. No more than 6 well volumes should be purged, to minimize the over pumping effects described by Gibbs and Imbrigiotta (1990).

Table of Stabilization Criteria with References for Water-Quality-Indicator Parameters

Parameter	Stabilization Criteria	Reference
pH	+/- 0.1	Puls and Barcelona, 1996; Wilde et al., 1998
specific electrical conductance (SEC)	+/- 3%	Puls and Barcelona, 1996
oxidation-reduction potential (ORP)	+/- 10 millivolts	Puls and Barcelona, 1996
turbidity	+/- 10% (when turbidity is greater than 10 NTUs)	Puls and Barcelona, 1996; Wilde et al., 1998
dissolved oxygen (DO)	+/- 0.3 milligrams per liter	Wilde et al., 1998

Purging Methods

In a well that is not being pumped, there will be little or no

vertical mixing in the water column between sampling events, and stratification may occur. The water in the screened section may mix with the ground water due to normal flow patterns, but the water above the screened section will remain isolated and become stagnant. Persons sampling should realize that stagnant water may contain foreign material inadvertently or deliberately introduced from the surface, resulting in unrepresentative water quality. To safeguard against collecting nonrepresentative stagnant water in a sample, the following guidelines and techniques should be adhered to during sample collection:

1. As a general rule, monitoring wells should be pumped or bailed (bailed is to be strongly avoided) prior to collecting a sample. Evacuation of a minimum of three volumes of water in the well casing is recommended for a representative sample. In a high-yielding ground-water formation where there is no stagnant water in the well above the screened section (commonly referred to as a water-table well), evacuation prior to sample withdrawal is not as critical but serves to field rinse and condition sampling equipment. The purge criteria has been described previously and will be again in the SAMPLING PROCEDURES section. The rate of purging should be at a rate and by a method that does not cause aeration of the water column and should not exceed the rate at which well development was completed.

2. For wells that can be pumped or bailed to dryness with the sampling equipment being used, the well should be evacuated to just above the well screen interval and allowed to recover prior to sample withdrawal. (Note: it is important not to completely de-water the zone being sampled, as this may allow air into that zone which could result in negative bias in organic and metal constituents.) If the recovery rate is fairly rapid and time allows, evacuation of more than one volume of water is preferred.

3. A non-representative sample also can result from excessive prepumping of the monitoring well. Stratification of the contaminant concentrations in the ground-water formation may occur or heavier-than-water compounds may sink to the lower portions of the aquifer. Excessive pumping can decrease or increase the contaminant concentrations from what is representative of the sampling point of interest, as well as increase turbidity and create large quantities of waste water.

The method used to purge a well depends on the inner diameter, depth-to-water level, volume of water in the well, recovery rate

of the aquifer, and accessibility of the well to be sampled. The types of equipment available for well evacuation include hand-operated or motor-driven suction pumps, peristaltic pumps, submersible pumps, and bailers made of various materials, such as stainless steel and Teflon®. Whenever possible, the same device used for purging the well, should be left in the well and used for sampling, generally in a continual manner from purging directly to sampling without altering position of the sampling device or turning off the device.

When purging/sampling equipment must be reused in other wells, it should be decontaminated consistent with the Decontamination Procedures outlined in this document. Purged water should be collected and screened with air-monitoring equipment as outlined in the site health and safety plan, as well as water-quality field instruments. If these parameters and/or the facility background data suggest that the water is hazardous, it should be contained and disposed of properly as determined on a site-specific basis.

During purging, water-level measurements should be recorded regularly for shallow wells, typically at 15- to 30-second intervals. These data may be useful in computing aquifer transmissivity and other hydraulic characteristics, and for adjusting purging rates. In addition, these data will assure that the water level doesn't fall below the pump intake level

SAMPLING PROCEDURES

Ground-water sample collection should take place immediately following well purging. Preferably, the same device should be used for sample collection as was used for well purging, minimize further disturbance of the water column, and reduce volatilization and turbidity. In addition, this will save time and avoid possible contamination from the introduction of additional equipment into the well, as well as using equipment materials already equilibrated to the ground water. Sampling should occur in a progression from the least to most contaminated well, if known, when the same sampling device is used.

The sampling procedure is as follows:

- 1) Remove locking well cap, note location, time of day, and date in field notebook or on an appropriate log form.
- 2) Note wind direction. Stand up wind from the well to avoid

- contact with gases/vapors emanating from the well.
- 3) Remove well casing cap.
 - 4) If required by site-specific conditions, monitor headspace of well with appropriate air-monitoring equipment to determine presence of volatile organic compounds or other compounds of concern and record in field logbook.
 - 5) If not already completed, measure water level from reference measuring point on well casing or protective outer casing (if inner casing not installed or inaccessible) and record in field notebook. Alternatively, if no reference point, note that water level measurement is from top of outer protective casing, top of inside riser pipe, ground surface, or some other position on the well head. Have permanent reference point established as soon as possible after sampling. Measure at least twice to confirm measurement; measurement should agree within 0.01 feet or re-measure. Decontaminate water-level-measuring device.
 - 6) If not already completed, measure total depth of well (at least twice to confirm measurement; measurement should agree within 0.01 feet or re-measure) and record in field notebook or on log form. Decontaminate device used to measure total depth. If the total depth of well has been measured recently (in the past year), then measure at the conclusion of sampling.
 - 7) Calculate the volume of water in the well and the volume to be purged using the formula previously provided.
 - 8) Lay plastic sheeting around the well to minimize the likelihood of contamination of equipment from soil adjacent to the well.
 - 9) Rinse outside of sampling pump with distilled water and then, while lowering the pump, dry with disposable paper towels.
 - 10) Lower the pump (or bailer) and tubing down the well. The sampling equipment should never be dropped into the well, because this will cause degassing of the water upon impact. This may also increase turbidity, that may bias the metals analysis. The lowering of the equipment should be slowly and smoothly!
 - 11) The pump should be lowered to a point just below the water level. If the water level is above the screened interval, the pump should be above the screened interval for the reasons provided in the purging section.
 - 12) Turn the pump on. The submersible pumps should be operated in a continuous, low-flow manner so that they do not produce pulsating flows that cause aeration in the discharge tubing,

aeration upon discharge, or resuspension of sediments at the bottom of the well. The sampling pump flow rates should be lower than or the same as the purging rates. The purging and sampling rates should not be any greater than well development rates.

- 13) Water levels should be monitored during pumping to ensure that air does not enter the pump and to help in the determination of an appropriate purging rate.
- 14) After approximately one to two well volumes are removed, a flow-through cell will be hooked-up to the discharge tubing of the pump. If the well discharge water is not expected to be highly turbid, encounter separate liquid phases, or minimal bacterial activity that may coat or clog the electrodes within the flow-through cell, then the cell can be immediately hooked-up to the discharge tubing. This cell will allow measurements of water-quality-indicator parameters without allowing contact with the atmosphere prior to recording the readings for temperature, pH, ORP, SEC, DO and turbidity.
- 15) Measurements for temperature, pH, ORP, SEC, DO and turbidity will at each one-half well volume removed. Purging may cease when measurements for all five parameters have stabilized (provided in the earlier table) for three consecutive readings.
- 16) If the water level is lowered to the pump level before three volumes have been removed, the water level will be allowed to recovery for 15 minutes and then pumping can begin at a lower flow rate. If the pump again lowers the water level to below the pump intake, the pump will be turned off and the water level allowed to recover for a longer period of time. This will continue until a minimum of two well volumes are removed prior to taking the ground-water sample.
- 17) If the water-quality-indicator parameters have stabilized, sample the well. Samples will be collected by lowering the flow rate to a rate which minimizes aeration of the sample while filling the bottles (approximately 300 ml/min). Then a final set of water-quality-indicator parameters is recorded. The pump discharge line is rapidly disconnected from the flow-through cell to allow filling of bottles from the pump discharge line. The bottles should be filled in the order of volatile organic compounds bottles first, semi-volatile organic compound's/pesticides, the inorganics, and other unfiltered samples. Once the last set of samples are taken, if filtering is necessary, an in-line, appropriately chosen filter size, disposable filter will be added to the

discharge hose of the pump. Then the filtered samples will be taken. If a bailer is used for obtaining the samples, the filtering will occur at the sampling location, immediately after the sample is obtained from the bailer by using a suction filter. The first one-half to one liter of sample taken through the filter will not be collected, in order to assure the filter media is acclimated to the sample. If filtered samples are collected, WITHOUT EXCEPTION, filtering should be performed in the field as soon as possible after collection, and not later in a laboratory.

- 18) All appropriate samples that are to be cooled, are to be put into a cooler with ice immediately. All of the samples should not be exposed to sunlight after collection. Keep the samples from freezing in the winter when outside temperatures are below freezing. The samples, especially organics, cyanide, nutrients and other analytes with short holding times, are recommended be shipped or delivered to the laboratory daily. Ensure that the appropriate samples that are to be cooled remain at 4°C, but do not allow any of the samples to freeze.
- 19) If a pump cannot be used because the recovery rate is so slow and the volume of the water to be removed is minimal (less than 5 feet of water), then a Teflon® bailer, with a double check valve and bottom-emptying device with a control-flow check valve will be used to obtain the samples. The polypropylene rope used with the bailer will be disposed of following the completion of sampling at each well.
- 20) The pump is removed from the well and decontaminated for the next sampling location.

Additional precautions that can be made to ensure accurate and representative sample collection are as follows:

- Check valves on bailers (if used, which should be designed and inspected to ensure that fouling problems do not reduce delivery capabilities or result in aeration of the sample.
- The water should be transferred to a sample container in a way that will minimize agitation and aeration.
- If the sample bottle contains no preservatives, the bottle should be rinsed with sample water that is discarded before sampling. Bottles for sample analysis which require preservation should be prepared before they are taken to the well. Care should be taken to avoid overfilling bottles so that the preservative is not lost. The pH should be checked

and more preservatives added to inorganic sample bottles, if needed. VOA bottles would need to be discarded and new sample bottles immediately prepared.

- Clean sampling equipment should not be placed directly on the ground or other contaminated surfaces either prior to sampling or during storage and transport.

Special Consideration For Volatile Organic Compound Sampling

The proper collection of a sample for dissolved volatile organics requires minimal disturbance of the sample to limit volatilization and therefore a loss of volatiles from the samples. Sample retrieval systems preferred for the collection of un-biased volatile organic samples are: positive displacement pumps, low-flow centrifugal pumps and some in-situ sampling devices. Field conditions and other constraints will limit the choice of appropriate systems. The principal objective is to provide a valid sample for analysis, one that has been subjected to the least amount of turbulence possible.

- 1) Fill each vial to just overflowing. Do not rinse the vial, nor excessively overflow it, as this will effect the pH by diluting the acid preservative previously placed in the bottle. Another option is to add the acid at the well, after the sample has been collected. There should be a convex meniscus on the top of the vial.
- 2) Do not overtighten and break the cap.
- 3) Invert the vial and tap gently. Observe vial closely. If an air bubble appears, discard the sample and collect another. It is imperative that no entrapped air remains in the sample vial. Bottles with bubbles should be discarded, unless a new sample cannot be collected, and then the presence of the bubble should be noted in the field notes or field data sheet. If an open sample bottle is dropped, the bottle is to be discarded.
- 4) Place the volatile organic compound vial in the cooler, oriented so that it is lying on its side, not straight up.
- 5) The holding time for volatile organic compounds is 14 days. It is recommended that samples be shipped or delivered to the laboratory daily. Ensure that the samples remain at 4°C, but do not allow the samples to freeze.

Turbid Samples-Field Filtration

The USEPA recognizes that in some hydrogeologic environments, even with proper well design, installation and development, in combination with the low-flow rate purging and sampling techniques, sample turbidity cannot be reduced to ambient levels. The well construction, development and sampling information should be reviewed by the regional geologists or hydrologists to see if the source of the turbidity problems can be resolved or if alternative sampling methodologies should be employed. If the water sample is excessively turbid, the collection of both filtered and unfiltered samples, in combination with turbidity, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), pumping rate and drawdown data is recommended. The filter size used to determine TSS and TDS should be the same as used in the field filtration. An in-line filter should be used to minimize contact with air to avoid precipitation of metals. The typical filter media size used is 0.45 μm because this is commonly accepted as the demarcation between dissolved and non-dissolved species. Other filter sizes may be appropriate but their use should be determined based on site-specific criteria (examples include grain-size distribution, ground-water-flow velocities, mineralogy) and project DQO's. Filter sizes up to 10.0 μm may be warranted because larger size filters may allow particulates that are mobile in ground water to pass through (Puls and Powell, 1992). The changing of filter media size may limit the comparability of the data obtained with other data sets and may affect their use in some geochemical models. Filter media size used on previous data sets from a site, region or aquifer and the data quality objectives should be taken into consideration. The filter media used during the ground-water sampling program should be collected in a suitable container and archived because potential analysis of the media may be helpful for the determination of particulate size, mineralogy, etc.

The first 500 to 1000 milliliters of sample, depending on sample turbidity, taken through the filter will not be collected for a sample, in order to ensure that the filter media has equilibrated to the sample (manufacture's recommendations also should be consulted). Because bailers have been shown to increase turbidity while purging and sampling, bailers should be avoided when sampling for trace element, metal, PCB and pesticide constituents. If portable sampling pumps are used, the pumps should be gently lowered to the sampling depth desired, carefully avoiding being lowered to the bottom of the well, and allowed to sit in order to allow any particles mobilized by pump placement to settle. Dedicated sampling equipment installed in the well

prior to the commencement of the sampling activities is one of the recommended methods to reduce turbidity artifacts (Puls and Powell, 1992; Kearn, et al., 1992; Puls et al., 1992; Puls and Barcelona, 1996).

DECONTAMINATION PROCEDURES

Once removed from the well, the purging and sampling pumps should be decontaminated with a non-phosphate soapy-water wash and scrubbed with a brush, a water rinse, and a distilled-water rinse, to help ensure that there is no cross-contamination between wells. The step-by-step procedure is:

- 1) Pull pump out of previously-sampled well (or out of vehicle) and use three pressure sprayers filled with soapy water, tap water and distilled water. Spray outside of tubing and pump until water is flowing off of tubing after each rinse. Use bristle brush to help remove visible dirt, contaminants, etc.
- 2) Have three long-PVC tubes with caps or buckets filled with soapy water, tap water and distilled water. Run pump in each until approximately 2 to 3 gallons of each decon solution is pumped through tubing. Pump at low rate to increase contact time between the decon solutions and the tubing.
- 3) Try to pump decon solutions out of tubing prior to next well. If this cannot be done, compressed air may be used to purge lines. Another option is to install a check valve in the pump line (usually just above the pump head) so that the decon solutions do not run back down the well as the pump is lowered down the next well.
- 4) Prior to lowering the pump down the next well, spray the outside of the pump and tubing with distilled water. Use disposable paper towels and dry the pump and tubing.
- 5) If a hydrophobic contaminant is present (such as separate phase, high levels of PCB's, etc.) an additional decon step, or steps, may be added. For example, an organic solvent, such as reagent-grade isopropanol alcohol may be added as a first spraying/bucket prior to the soapy water rinse/bucket.

If the well has been sampled with a bailer and the bailer is not disposable, the bailer should be cleaned by washing with soapy water, rinsing with tap water, and finally rinsing with distilled water. Bailers are most easily cleaned using a long-handled

bottle brush.

It is especially important to clean thoroughly that portion of the equipment that will be in contact with sample water. In addition, a clean plastic sheet should be placed adjacent to or around the well to prevent surface soils from coming in contact with the purging equipment. The effects of cross-contamination also can be minimized by sampling the least contaminated well first and progressing to the more contaminated ones. The bailer cable/rope (if a bailer is used) and plastic sheet should be properly discarded, as provided in the site health and safety plan, and new materials provided for the next well.

FIELD QUALITY CONTROL

The quality assurance (QA) targets for precision and accuracy of sampling programs are based on average accuracy and precision guidelines established by the USEPA. When setting targets, keep in mind that all measurements must be made so that the results are representative of the sample water and site-specific conditions. Various types of blanks are used to check the cleanliness of the field-handling methods. These are known as field blanks, and include field equipment blanks and transport blanks. Other QA samples include spike samples and duplicates.

There are five primary areas of concern for QA in the collection of representative ground-water samples:

1. Obtaining a sample that is representative of water in the aquifer or targeted zone of the aquifer. Verify log documentation that the well was purged of the required volume or that the following parameters (temperature, pH, ORP, SEC, DO and turbidity) stabilized before samples were extracted.
2. Ensuring that the purging and sampling devices are made of materials and utilized in a manner that will not interact with or alter the analyses.
3. Results generated by these procedures are reproducible; therefore, the sampling scheme should incorporate co-located samples (duplicates).
4. Cross-contamination is prevented. Sampling should proceed from least to most contaminated wells, if known. Field-equipment blanks should be incorporated for all sampling and purging equipment, and decontamination of the equipment is

therefore required.

5. Samples are properly preserved, packaged, and shipped.

FIELD EQUIPMENT BLANKS

To ensure QA and quality control, a field equipment blank must be included in each sampling run, or for every twenty samples taken with the sampling device. These allow for a cross check and, in some cases, quantitative correction for imprecision that could arise due to handling, preservation, or improper cleaning procedures.

Equipment blanks should be taken for each sample bottle type that is filled. Distilled water is run through the sampling equipment and placed in a sample bottle (the blank), and the contents are analyzed in the lab like any other sample. Following the collection of each set of twenty samples, a field equipment blank will be obtained. It is generally desirable to collect this field equipment blank after sampling a relatively highly contaminated well. These blanks may be obtained through the following procedure:

- a) Following the sampling event, decontaminate all sampling equipment according to the site decontamination procedures and before collecting the blank.
- b) VOA field blanks should be collected first, prior to water collected for other TAL/TCL analyses. A field blank must be taken for all analyses.
- c) Be sure that there is enough distilled water in the pump so that the field equipment blank can be collected for each analyses.
- d) The water used for the field equipment blank should be from a reliable source, documented in the field notebooks, and analyzed as a separate water-quality sample.

TRIP BLANKS

A trip blank should be included in each sample shipment and at a minimum, one per 20 samples. Bottles, identical to those used in the field, are filled with reagent-grade water. The source of the reagent-grade water should be documented in the field notebooks, including lot number and manufacture. This sample is labeled and stored as though it is a sample. The sample is shipped back to the laboratory with the other samples and analysis is carried out for all the same constituents.

DUPLICATE SAMPLES

Duplicate samples are collected by taking separate samples as close to each other in time and space as practical, and should be taken for every 20 samples collected. Duplicate samples are used to develop criteria for acceptable variations in the physical and chemical composition of samples that could result from the sampling procedure. Duplicate results are utilized by the QA officer and the project manager to give an indication of the precision of the sampling and analytical methods.

HEALTH AND SAFETY CONSIDERATIONS

Depending on the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site health and safety plan should be reviewed with specific emphasis placed on the protection program planned for the sampling tasks. Standard safe operating practices should be followed, such as minimizing contact with potential contaminants in both the liquid and vapor phase through the use of appropriate personal protective equipment.

Depending on the type of contaminant expected or determined in previous sampling efforts, the following safe work practices will be employed:

Particulate or metals contaminants

1. Avoid skin contact with, and accidental ingestion of, purge water.
2. Wear protective gloves and splash protection.

Volatile organic contaminants

1. Avoid breathing constituents venting from well.
2. Pre-survey the well head space with an appropriate device as specified in the Site Health and Safety Plan.
3. If air-monitoring results indicate elevated organic constituents, sampling activities may be conducted in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing, such as Tyvek®.

General, common practices should include avoiding skin contact

with water from preserved sample bottles, as this water will have pH less than 2 or greater than 10. Also, when filling, pre-preserved VOA bottles, hydrochloric acid fumes may be released and should not be inhaled.

POST-SAMPLING ACTIVITIES

Several activities need to be completed and documented once ground-water sampling has been completed. These activities include, but are not limited to:

- Ensure that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
- All sample paperwork should be processed, including copies provided to Central Regional Laboratory, Sample Management Office, or other appropriate sample handling and tracking facility.
- All field data should be compiled for site records.
- All analytical data when processed by the analytical laboratory, should be verified against field sheets to ensure all data has been returned to sampler.

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Well ID:_____

Station #: _____

Facility Name: _____ Date: ____/____/____

Well Depth:_____ Depth to Water:_____ Well Diameter:_____

Casing Material.:_____ Volume Of Water per Well Volume:_____

Sampling Crew: _____

Type of Pump:_____ Tubing Material:_____ Pump set at _____ ft.

Weather Conditions: _____ NOTES: _____

[illegible]

Other Parameters: _____

Sampled at: _____ Parameters taken with : _____

Sample delivered to _____ by _____ at _____.

Sample CRL #: _____ OTR #: _____ ITR #: _____ SAS #: _____

Parameters Collected	Number of Bottles	Bottle Lot Number
----------------------	-------------------	-------------------

VOA's

THF/1,4-Dioxane

SVOC's/PCB's

Metals

APPENDIX B

Sierra Environmental Monitoring Quality Assurance Manual

SIERRA ENVIRONMENTAL MONITORING, INC.

QUALITY ASSURANCE MANUAL

for

**Analytical Procedures
Field Sampling Activities
General Laboratory Operations**

**Conducted at or from
1135 Financial Boulevard
Reno, Nevada 89502**

Prepared by:

**John Seher
Quality Assurance Manager
for
Sierra Environmental Monitoring, Inc.
1135 Financial Boulevard
Reno, NV 89502
775 - 857 - 2400**

Sierra Environmental Monitoring, Inc. Quality Assurance Manual

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Revision Date: January 3, 2003

1.0 Quality Assurance Manual Identification

1.1 Document Title: Sierra Environmental Monitoring, Inc Quality Assurance Manual

1.1.1 Applicable Entity: This Quality Assurance Manual describes the procedures necessary to maintain compliance with applicable standards and regulations for analytical procedures, field sampling, and general laboratory and administrative operations conducted at or from the facility located at 1135 Financial Boulevard, Reno, NV 89502.

1.1.2 Effective Date: This Quality Assurance Manual is effective from the date of acceptance of the responsible parties listed below in section 1.2.

1.2 Quality Assurance Manual Approvals:

Approved By:

Name: John Kobza¹

Signature: John Kobza

Title: President & Operations Manager Date: 2-17-03

Name: John Seher¹

Signature: John Seher

Title: Quality Assurance Manager Date: 2-17-03

Name: Lawrence Layman¹

Signature: Lawrence R. Layman

Title: Lead Technical Director Date: 2-17-03

¹ Available at: 1135 Financial Boulevard, Reno, NV 89502 Telephone: 775-857-2400

2.0 Introduction

2.1 Company Identification: Sierra Environmental Monitoring, Inc. (Also known as SEM or SEM, Inc.)

Corporate Offices, Analytical Laboratory, and Field Services:

1135 Financial Boulevard
Reno, NV 89502

Telephone: 775-857-2400
Facsimile: 775-857-2404
Web Site: sem-analytical.com
General E-Mail Address: sem@sem-analytical.com

2.2 Company Description

Sierra Environmental Monitoring, Inc. is an analytical laboratory providing water, wastewater, waste and air quality testing. Sierra Environmental Monitoring, Inc. provides a variety of analytical services to many different industries and individuals. The client list includes but is not limited to the following categories:

- Mining
- Governmental Agencies
- Domestic Water Supply
- Construction
- Utilities
- Manufacturing
- Water and Wastewater Treatment
- Food and Spice Industry

Sierra Environmental Monitoring, Inc. offers several hundred different types of analyses. Field sampling services are also available as required. Under Federal contracting rules Sierra Environmental Monitoring, Inc. is classified as a small business. The Standard Industrial Classification (SIC) code for our company is 8734.

2.3 Company Mission Statement

The mission of Sierra Environmental Monitoring, Inc. is to protect the environment by offering quality services that determine levels of hazardous contaminants, at fair prices, in a timely fashion that contribute to improved health and well being of the public.

2.4 Company History

Sierra Environmental Monitoring was established in 1974 as a DBA of William F. Pillsbury, Inc. Consulting Civil Engineers with one full time employee. Initially the laboratory emphasized water quality analysis for support of operations at the Tahoe Keys surface water treatment facility at South Lake Tahoe and for support of water and wastewater facilities plans being designed by the parent engineering company. A second full time employee was added in 1975. Gradually the laboratory acquired additional business, principally servicing NPDES discharge permits for industry and publicly owned treatment facilities. As more business developed from Nevada, the laboratory was moved to Reno, Nevada in 1979. Additional business was acquired through engineering and hydrological consultants with concomitant increases in staff and equipment. With the mining boom in Nevada in the late eighties business was developed with the environmental aspect of this industry. This increase in business necessitated a move to larger facilities in Sparks, Nevada. After five years residence in a leased building, the company moved to a facility in Reno, Nevada in 1994. In June of 2002 SEM was purchased from Mr. Pillsbury by an investment group, KVM Holdings, Inc., which includes the Operations Manager, John Kobza, as president of the corporation. The company currently employs sixteen full time personnel with twelve analysts and supervisory and four support personnel.

3.0 Quality Assurance Policy

Our Mission Statement says that it is the goal of our company "to protect the environment by offering quality services". The concept of "quality services" most certainly includes a rigorous quality assurance program.

3.1 Quality Assurance Policy Statement.

Sierra Environmental Monitoring, Inc. is dedicated to providing its clients with analytical data that are scientifically valid, legally defensible, and with precision and accuracy that are known and documented. Sierra Environmental Monitoring, Inc. employs only those who are qualified both educationally and attitudinally to strive for this end.

3.2 Purpose

The purpose of this manual is to describe the vehicles employed in our laboratory to maintain a high level of quality in our work, including the continually changing requirements in analytical methodology, precision, accuracy, detection levels and services. This manual is an evolving document, and is subject to review and modification as new methodologies gain approval and new regulations are implemented.

3.3 Scope

This document applies to the generation of analytical data and the associated support services at Sierra Environmental Monitoring, Inc. The majority of analytical services provided by SEM to its clients are for regulatory compliance monitoring as mandated by State and Federal programs. Consequently, our Quality Assurance Plan has been devised to meet the quality assurance requirements delineated in the following regulatory programs:

3.3.1 Safe Drinking Water Act (SDWA)

This program establishes quality standards for drinking water and describes how those standards will be achieved and maintained.

3.3.2 Clean Water Act

This program establishes regulations for surface water quality, including the National Pollution Discharge Elimination Service (NPDES).

3.3.3 Resource Conservation and Recovery Act (RCRA)

This program encompasses the safe handling and disposal of wastes and the remediation of polluted disposal sites.

3.3.4 The National Environmental Laboratory Accreditation Conference (NELAC)

3.3.5 Other Analytical Services

Analysis to fulfill client needs outside regulatory programs.

3.4 Confidentiality and Data Integrity Policy

Sierra Environmental Monitoring, Inc. has a responsibility to its clients to provide true data to the best of our ability. The data generated by the laboratory and reported to clients is impartial to outside influences and is in no way partial to any individual, entity or governmental agency.

The laboratory also provides analytical services to support various industrial and institutional clients in their endeavors. These analyses are held to the same strict quality assurance guidelines as those for regulatory compliance.

The affairs of every client are held in the strictest confidence. Requests for copies of analytical reports made by parties other than the client are fulfilled only upon obtaining the specific permission of the client. Client files and supporting data are kept secure on site at the SEM laboratory and are not accessible to anyone other than SEM staff. Archived information is held off site at a secure facility with controlled access. Similarly, electronic media is secure from tampering. Recorded backups of the electronic records are retained at secure locations on and off site, and can be accessed only by SEM personnel.

Each member of the SEM staff is dedicated to this policy. The Customer Service and Data Integrity Policy is presented as figure 3.1 below.

Revision Date: January 3, 2003

Figure 3.1 Sierra Environmental Customer Service and Data Integrity Policy

Sierra Environmental Monitoring, Inc.

Customer Service and Data Integrity Policy

Our business requires a team effort and each and every employee is important to the team. Providing analytical services of superior quality and absolute integrity depends upon:

1. The management of Sierra Environmental Monitoring, Inc. being committed to executing the Quality Assurance Plan and the company mission statement.
2. Each staff member's commitment to provide service of quality and integrity.
3. Each staff member's skill and knowledge relating to the task they are performing.

Sierra Environmental Monitoring, Inc. is committed to supporting the staff in their quest to provide the best possible analytical services to its clients. To promote this end, SEM offers the following policies:

1. The right of all laboratory personnel to stop an analytical procedure if a problem or error is discovered. There is only one way we do things, and that is to do it right.
2. Promotion of an in-house training program to augment your education and experience and to provide you with the opportunity to develop the skills necessary to perform your job well.
3. A management "open door" policy to hear any suggestions or complaints without fear of reprisal.

These policies ensure that each employee has the opportunity and the obligation to be an integral part of our mission to provide analytical services of the highest possible quality.

As an employee of Sierra Environmental Monitoring, Inc., integrity in your work must be the highest priority. Service or data quality problems must be brought to the attention of a manager or supervisor for review and solution, such that we may satisfy our clients' needs. Ignoring a problem or falsifying data to hide a problem can not be tolerated, as this would besmirch our reputation and could result in revocation of accreditation or other grave consequences for the company.

In our efforts to execute our mission, our company employs people of the highest character and personal integrity. Any staff member that knowingly deviates from this policy jeopardizes not only his own job and reputation, but also those of his coworkers and the company, and will be subject to immediate dismissal.

I have read and I understand the information presented above, and I agree to abide by this policy. I further understand that nothing contained in this policy alters my at-will employment relationship with Sierra Environmental Monitoring, Inc. as described in the Personnel Practices Manual.

Employee Name: _____
Signature: _____

Date: _____

4.0 Management and Organization

The objective of a quality assurance plan (QAP) is to describe the systems necessary to insure the generation of valid data. (See 3.2 above) It is the responsibility of the SEM ownership and management to insure that the systems described in the QAP are implemented, and that the staff has adequate resources to achieve this implementation.

All SEM employees, staff and management, have the universal responsibility to comply with the principles and practices delineated in the Quality Assurance Plan.

4.1 Management Responsibility

4.1.1 Corporation President

4.1.1.1. Responsibility

- Requires Operations Manager and Quality Assurance Manager to implement and maintain all aspects of the QAP.
- Ensures that the Operations Manager, Quality Assurance Manager and other key laboratory and support personnel have adequate resources to execute their responsibilities, both in the implementation of the QAP and in the other aspects of the operations.
- Establish policies and foster a working environment that insulates employees from undue pressures that might adversely affect the quality of the laboratory operation.
- Provide a safe, healthful, and comfortable working environment that promotes employee performance and provide adequate resources for execution of analytical procedures according to approved methodology and standard operating procedures.

4.1.1.2. Authority

- Ownership.

4.1.2. Laboratory Operations Manager

4.1.2.1. Responsibility

- Require all directors, managers, and staff to comply with the QAP.
- Make certain directors, managers, and staff have adequate resources to achieve compliance.
- Assign staff to tasks as required by workload and assign replacements in case of absence of managers or staff.
- Nominate replacements in case of the absence of managers.

4.1.2.2. Authority

Authority to council and terminate employees for dishonesty, unacceptable performance, non-compliance with the QAP, or unsafe work practices.

- Authority is granted from the President of Sierra Environmental Monitoring, Inc.

4.1.3. Quality Assurance Manager

4.1.3.1. Responsibility

- Responsible for devising the QAP and implementing its various aspects in the laboratory.
- Responsible for monitoring and assessing compliance of the laboratory with the requirements of the QAP.
- Carry out audits and inspections to assess compliance with the QAP and established laboratory SOP's.
- Maintain a document control system containing current SOP's utilized by SEM, Inc.
- Maintain the accreditation and certifications for the laboratory.
- Review performance evaluation studies submitted for maintenance of certifications or for client quality assurance requirements.
- Investigate all inquiries about data quality and implement corrective action when required.
- Nominate a replacement in case of the absence of the Quality Assurance Manager.

4.1.3.2. Authority

- The Quality Assurance Manager has the authority to stop or change any analytical procedure to insure that data quality is maintained.
- Authority to council employees for dishonesty, unacceptable performance, non-compliance with the QAP, or unsafe work practices.
- Authority is granted from the President of SEM.

4.1.4. Lead Technical Director and Department Supervisors

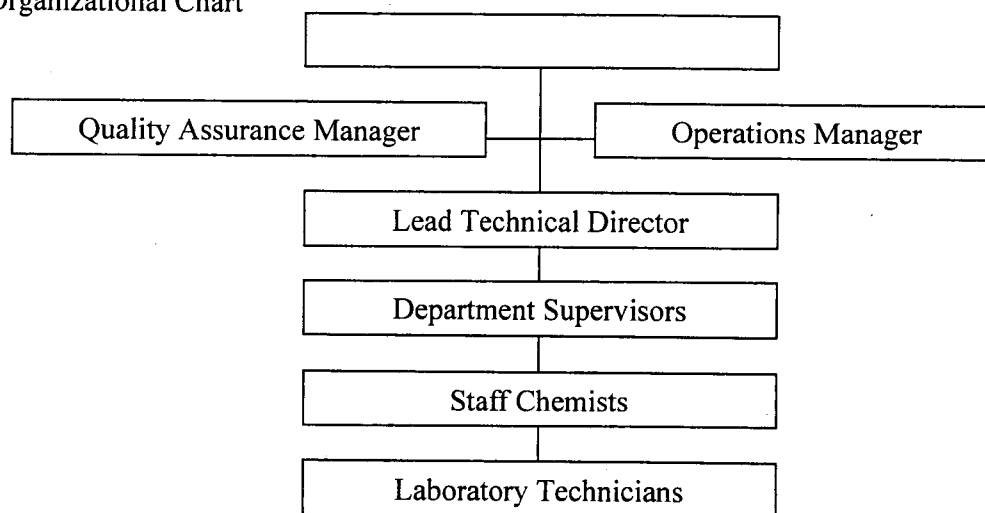
4.1.4.1. Responsibility

- Make certain that staff under supervision understand and utilize laboratory SOP's
- Prioritize work assignments.
- Conduct client contact concerning technical aspects of projects.
- Review analytical data and validate or assign staff for data validation

4.1.4.2. Authority

- Authority to conduct client contact and to remediate complaints.
- Authority to council employees for unacceptable performance, non-compliance with the QAP, or unsafe work practices.
- Authority is granted from the Operations Manager.

4.2 Organizational Chart



5.0 Personnel

5.1 General Requirements for Laboratory Staff

Every staff member must have attained a combination of experience and education commensurate with their posting in the SEM organization, and they must demonstrate an adequate knowledge of the tasks to which they are assigned. All personnel shall be responsible for complying with all aspects of the QAP for which pertain to their assignment.

5.2 Education, Experience, and Training.

5.2.1 Minimal levels of qualifications, including education and experience, are established for all positions in the laboratory to insure capability and competence, and to meet established standards.

5.2.1.1. The Operations Manager shall have a minimum of an advanced degree in a physical or life science and five years of supervisory experience in environmental analysis, or a Bachelor's degree in a physical or life science and ten years experience in environmental analysis and five years supervisory experience in environmental analysis.

5.2.1.2. The Quality Assurance Manager shall have a minimum of an advanced degree in a physical or life science, with a minimum of 20 semester hours of chemistry and 10 semester hours of mathematics. Additionally the Quality Assurance Manager shall have a minimum of five years analytical or supervisory experience in environmental analysis. Alternatively, he/she may have a Bachelor's degree in a physical or life science with a minimum of 20 semester hours in chemistry and 10 semester hours of mathematics and ten years experience in environmental analysis and five years supervisory experience in environmental analysis.

5.2.1.3. Chemists with responsibility as department supervisors or lead technical director shall have a minimum of a Bachelor's degree in a physical or life science and a minimum of five years experience in environmental analysis. Alternatively, they may have a minimum

of 90 semester hours at an accredited college or university and ten years experience in the analytical field.

5.2.1.4. Staff Chemists shall have a minimum of a Bachelor's degree in a physical or life science or a minimum of 90 semester hours at an accredited college or university and five years experience in the analytical field.

5.2.1.5. Laboratory technicians shall have a minimum of an Associate degree in a physical or life science or a minimum of one year of college level chemistry and adequate mathematical skills.

5.2.2. All technical staff receive training in the basic laboratory skills and are required to read and understand laboratory SOP's describing these tasks. Records of this training and an initialed chart of SOP's assigned and read are maintained in the employee's training file.

5.2.3. To insure initial proficiency in a particular analytical procedure, each analyst is required to perform an initial demonstration of capability (IDC). The IDC is conducted according to the written standard operating procedure for this process.

5.2.4. To insure that training is kept current the following documentation will be maintained in each employee's training file.

5.2.4.1. Evidence that the employee has read, understood, and agrees to abide by all aspects of the SEM Quality Assurance Plan.

5.2.4.2. Evidence of any training courses or workshops on instruments, analytical techniques, or laboratory procedures and concepts.

5.2.4.3. Evidence that each employee has read, understands and has agreed to perform the current revision of the standard operating procedure(s) (SOP's) for the tasks assigned.

5.2.4.4. Evidence of continuing technical proficiency as demonstrated by performing one of the following at least once per year:

- Method detection limit (MDL) study proving method detection limit.
- At least four consecutive laboratory control samples with acceptable performance.
- Successful analysis of four performance evaluation samples within the past year.

5.3 Personnel Training Records

Records which document qualifications, training, understanding SOP's, and performance on particular analyses will be maintained in a training file for each employee. The Metals Department Supervisor and Lead Technical Director have the responsibility of maintaining these records.

5.4 Current Personnel

A listing of the current SEM staff with brief personal *vitae* is presented in Appendix III

6.0 Facilities

6.1 Description of Laboratory Facilities

The facility consists of a reception and receiving area, offices for laboratory management and staff chemists, a main laboratory for wet chemistry, a metals analysis area, a separate microbiology laboratory, a sample storage room, a supplies storage room, and rooms for sample preparation. There are approximately 6,000 square feet of floor space in which to conduct business with approximately three quarters dedicated to production. The building was constructed to house an analytical laboratory with adequate HVAC, fume hoods, electrical, and plumbing capacity.

6.2 Working Environment

As delineated in section 4.1 above, the company president is responsible for ensuring an adequate working environment that includes the following aspects:

6.2.1 Laboratory working areas and associated electrical, HVAC, and plumbing are adequate to facilitate proper performance of analyses.

6.2.2. The environment in which these analyses are conducted shall not invalidate the results or otherwise adversely affect the outcome of the procedures.

6.2.3. The laboratory work areas will comply with relevant health and safety requirements, and in no way will the facility compromise an employee's health and safety. This topic is addressed in detail in the SEM Written Workplace Safety Program.

6.3 Work Areas

6.3.1 In the laboratory there are effective separations of work areas that may be incompatible.

6.3.2. The importance of good housekeeping is instilled in every staff member.

6.3.3. Work areas shall be available to conduct business in a safe and effective manner. Work areas include the following:

6.3.3.1. Access and entryways to the laboratory.

6.3.3.2. Sample receiving area.

6.3.3.3. Sample storage area.

6.3.3.4. Sample preparation areas.

6.3.3.5. Analysis areas.

6.3.3.6. Reagent storage areas.

6.3.3.7. Data handling and records storage areas.

6.3.3.8. Waste collection and storage areas.

6.3.3.9. Microbiological Analysis Area

Revision Date: January 3, 2003

6.4 Security

The laboratory building is secured with lock and key, and there is a continuously monitored security and fire detection system. Only SEM personnel and a bonded janitorial service have access to the facilities. All visitors to areas 6.3.3.3 through 6.3.3.9, as listed above, must sign in the visitor log.

6.5 Facility Site Map and Floor Plan

On the following pages are the Site Plan (figure 6.1) and the facility floor plan (figure 6.2).

Figure 6.1 Sierra Environmental Monitoring, Inc. Site Plan

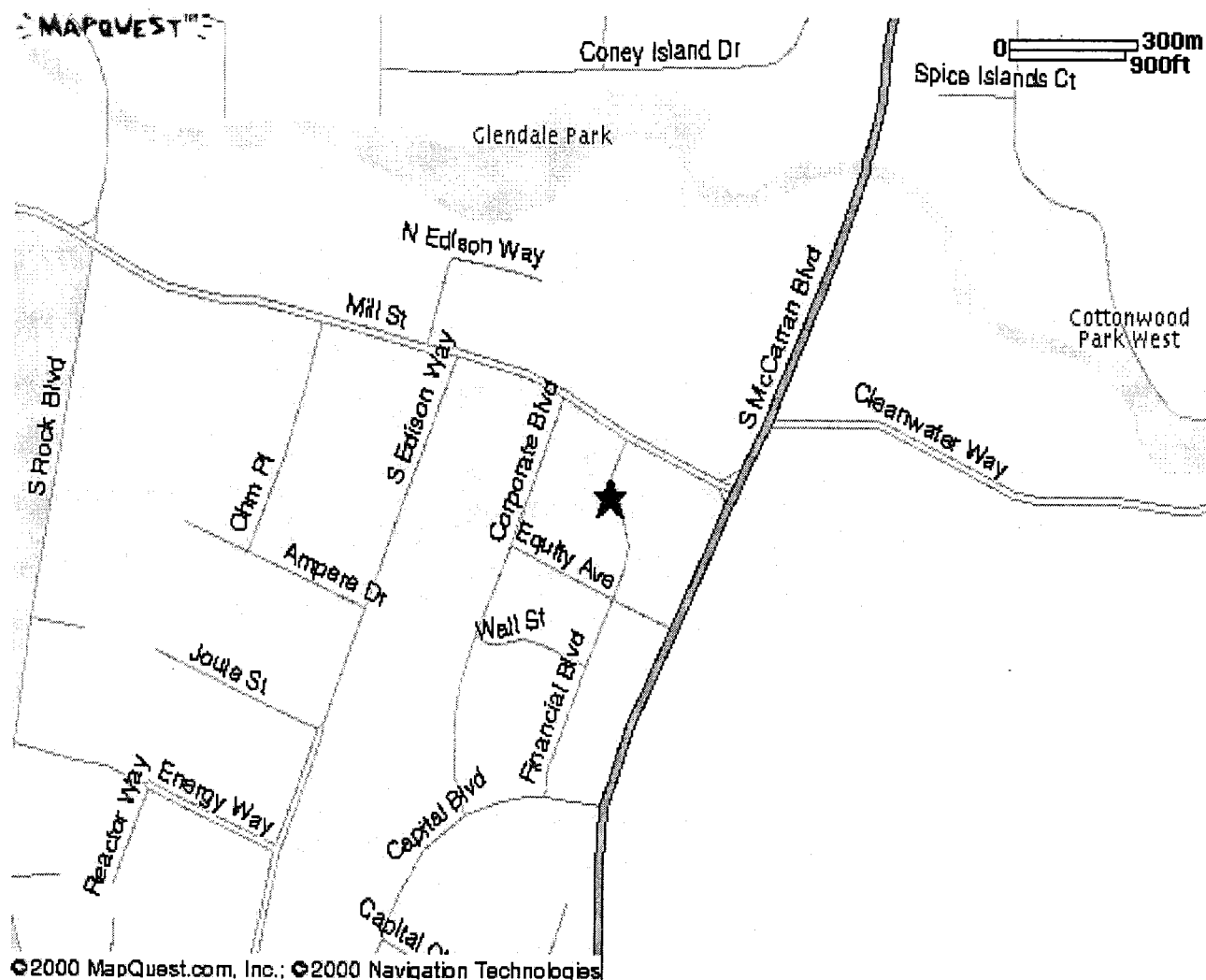
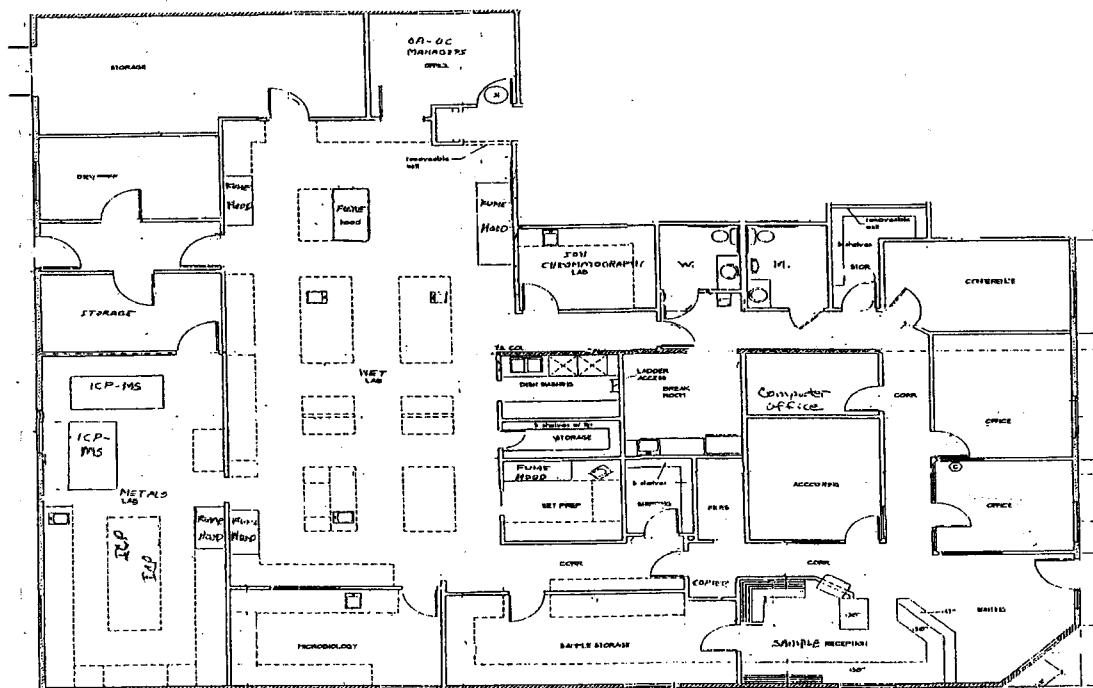


Figure 6.2 Sierra Environmental Monitoring, Inc. Facility Floor Plan



7.0 Quality Systems

7.1 Audits

7.1.1. Internal Audits

The quality assurance plan is effective only if staff and management are committed to executing every detail of the plan. In order to assess continued compliance with the plan and identify any areas where the plan may be inadequate, the Quality Assurance Manager shall perform annual internal audits as described in the Internal Audit SOP. These audits are conducted by the quality assurance manager or his designee(s). To the greatest extent possible, the auditor shall be independent of the section or activity being audited. If the audit discovers errors in the laboratory's calibrations or testing results, immediate corrective action will be taken, and affected client(s) will be notified.

7.1.2. External Audits

External audits are conducted, typically on a bi-annual basis by accrediting authorities, for example the California Department of Health Services, Environmental Laboratory Accreditation Program, and the Nevada Division of Environmental Protection, Bureau of Licensure and Certification. Clients also conduct audits in order to verify compliance with their own quality control requirements and contract specifications.

7.1.3. Performance Audits

SEM demonstrates its analytical performance by implementing several kinds of assessment. Examples of these performance audits are:

- 7.1.3.1. Internal quality control procedures, including, but not limited to the QC requirements mandated in particular analytical methods. When ever possible, statistical analyses are used by the laboratory personnel to evaluate data generated and the reliability of the analytical procedure. Control samples are routinely analyzed, and the results are captured and plotted on control charts by the SEM LIMS.
- 7.1.3.2. Participation in proficiency testing programs as mandated by State accreditation authorities. SEM participates in the following performance evaluation programs:
 - USEPA Water Supply (WS), semi-annual as supplied by a qualified vendor
 - USEPA Water Pollution (WP), semi-annual as supplied by a qualified vendor
 - California DHS ELAP Microbiology Study, semi-annual as supplied by a qualified vendor.
 - Nevada BLC Microbiology Study, semi-annual, as supplied by a qualified vendor
 - California DHS ELAP RCRA performance evaluation program as supplied by a qualified vendor.
 - AOAC proficiency testing program for bacteriological contaminants in food.

- 7.1.3.3. Replicate analysis using the same method or a confirmatory method.
- 7.1.3.4. When necessary, retesting of retained samples within allowed holding time.
- 7.1.3.5. Whenever possible, calculated checks of data accuracy are incorporated in to the audit process. An example of this is the ion balance calculation comparing the totals of anions and cations in samples where a complete analysis of anions and cations has been accomplished. An example of ion balance calculations is given in the appendix to this document. Other comparisons include relative values of different Nitrogen species, or the relationship among Biochemical Oxygen Demand (BOD), Carbonaceous BOD, and chemical oxygen demand (COD) or the relationship between total Phosphorous and ortho-phosphate.

7.2 Audit Review and Corrective Actions

All audit and review findings and any corrective actions that arise from them are documented according to the SEM SOP for Corrective Actions. The SEM LIMS is capable of recalling an audit trail to track any changes made to data that has been entered into the LIMS. The laboratory management is charged with the responsibility to discharge corrective actions in a timely manner.

7.3 Reports to Management

7.3.1 A monthly activity report prepared by the Quality Assurance Manager and his designee(s) is provided to the Operations Manager. The monthly activity report addresses the following topics:

- 7.3.1.1 Non-conformance with the QAP or SOP's.
- 7.3.1.2 Non-conformance with quality assurance goals and any corrective actions taken.
- 7.3.1.3 A summary on uncompleted projects.
- 7.3.1.4 A temperature monitoring summary noting any deviations from desired range.
- 7.3.1.5 A balance calibration summary noting any deviations from performance criteria.
- 7.3.1.6 A pipet calibration summary noting and deviations and adjustments.

7.3.2 An annual quality assurance report will be prepared by the Quality Assurance Manager and his designees to assess and verify the following functions.

- 7.3.2.1 Annual revision of the Quality Assurance Manual.
- 7.3.2.2 Status of SOP's and revisions to SOP's performed.
- 7.3.2.2 Internal quality assurance audit.
- 7.3.2.3 Summary of non-conformances and corrective actions.
- 7.3.2.4 Summary of instrument maintenance and calibration.
- 7.3.2.5 Summary of temperature monitoring, excursions, and refrigerator maintenance.
- 7.3.2.6 Reagent water quality checks.
- 7.3.2.7 Sample container contamination checks.
- 7.3.2.8 Performance evaluation results.
- 7.3.2.9 External Audits.

7.4 Quality Assurance Concepts.

Quality assurance is a collection of concepts and procedures which, when successfully implemented, insure that analytical data issued by the laboratory is reliable, defensible, and is valuable to the end user. There are five principle concepts of laboratory quality control, and they are identified as the following:

7.4.1 Accuracy

Accuracy is defined as the degree to which the analytical measurement reflects the true concentration of the constituent of interest in the sample. Accuracy is determined through two distinct methods.

7.4.1.1 Analysis of known standard materials with known values. These are obtained from commercial sources or from the NIST, and analyzed. The analytical result is compared to the known true value and the comparison expressed as a percent difference.

$$\text{Percent Difference} = \frac{\text{TV} - \text{MV} \times 100}{(\text{TV} + \text{MV})/2}$$

TV = True Value (from standards source)
MV = Measured Value (from Laboratory)

7.4.1.2 Accuracy is determined by analysis of matrix spike samples and calculation of the percent recovery of the known spike from the sample. The result is expressed as a percent of the spike recovered from the sample.

$$\text{Percent Recovery} = \frac{(\text{SSR} - \text{SR}) \times 100}{\text{SA}}$$

SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

7.4.2 Precision

Precision is defined as the measure of mutual agreement among individual measurements of the same sample by the same method. Precision can be expressed as the relative percent difference between duplicate measurements of the same sample.

$$\text{Relative Percent Difference} = \frac{(\text{M1} - \text{M2}) \times 100}{(\text{M1} + \text{M2})/2}$$

M1 = Measurement 1
M2 = Measurement 2.

Precision may also be expressed as the standard deviation of a data set when a sufficient number of replicate analyses on one sample have been accomplished.

7.4.3 Completeness

Completeness is the percentage of results that are supported by acceptable quality assurance data and are usable by the client. The performance of the laboratory is principally, but not exclusively, responsible for the degree of completeness achieved. Also important in achieving completeness is the performance of those involved in the sampling process and the transportation and handling of samples before they are received at the laboratory. This performance is assisted by instruction from SEM to field agents on proper sampling, preservation, and shipping protocols.

7.4.4 Representativeness

Representativeness is the degree to which the sample received at the laboratory represents the condition existing at the sampling site in the field. For most environmental analyses this quality is an objective to be achieved rather than a measurement which can be expressed in mathematical terms. SEM aids its clients in achieving representativeness through instruction on sampling techniques and pre-project conferences in which project goals are discussed.

7.4.5 Comparability

Comparability is the degree to which replicate analyses of the same sample carried out over time compare to one another. This quality is important to insure the success of long term monitoring projects and easy identification of trends in concentration. SEM strives to achieve comparability by utilizing approved analytical methods and by training the laboratory staff to follow written laboratory SOP's. Additionally, SEM advises clients on the importance of proper and consistent sampling and shipping procedures. SEM also insures comparability by utilizing a consistent policy in reported units of measure and by utilizing a standard report format.

7.5 Quality Control Procedures

The following general quality control principles are utilized, wherever applicable, for all analyses performed at SEM. The manner in which they are implemented depends upon the particular analysis. A listing of quality control procedures appears in table 7.1 below. Not all types of quality control procedures are applicable to all analyses. As an aid to understanding quality control procedures, we can separate them into two categories:

7.5.1 Essential Quality Control Procedures

Essential quality control procedures are those which are considered essential in data defensibility. These procedures prove analytical method performance and reveal method performance failure. They include calibration, calibration verification, analysis of blanks, and analysis of laboratory control standards. Essential quality control procedures also include adherence to all aspects of SOP's. If there is a failure in any of these processes, the analysis must be repeated. If a re-analysis is not possible, the client must be contacted and advised of the failure. Options for re-sampling and re-analysis or reporting of flawed data with appropriate caveats shall be discussed.

7.5.2 Non-Essential Quality Control Procedures.

These are quality control procedures that apply to particular samples, and do not reflect upon the method performance in general. These procedures include replicate analyses and spike recoveries. If these criteria are not met, and the analyst(s) showed due diligence in investigating and attempting to correct the discrepancy, the data may be reported to the client with appropriate data flag(s) and explanation. See Appendix I for the standard set of data flags utilized by SEM to qualify reported data.

7.6 Data Validation

Prior to release to clientele data are subject to a series of validation steps to assure that laboratory and administrative procedures have been conducted correctly. These validation procedures are carried out by someone other than the person who conducted the original task, and they include the following:

7.6.1 Validation that data entry is correct, including proper number of decimal places, significant figures, and units of measure.

7.6.2 Validation that information associated with the analysis is entered into the LIMS, including analyst name and analysis date.

7.6.3 Validating that all quality control information associated with the data entries is complete and meets quality control criteria.

7.6.4 After data validation as described in 7.6.1 through 7.6.3 above, and prior to reporting, reports are reviewed by a project manager, when one has been assigned, and by a signatory, to determine agreement with historic trends and to determine if the data are reasonable given our knowledge of the project.

7.6.5 Reports are reviewed by a signatory for comparative relationships among the various analytical parameters including the following:

7.6.5.1 Ion balance calculations have been accomplished and meet criteria per the SOP for Hardness and Ion Balance Calculations.

7.6.5.2 Relationship between TDS by evaporation and calculated TDS is reasonable.

7.6.5.3 Relationship among Nitrogen parameters is chemically feasible. Total Nitrogen calculated and rounded according to the SOP for Calculations and Data Expression

7.6.5.4 Relationship among BOD₅, CBOD, and COD is chemically feasible.

7.6.5.5 Relationship between suspended and volatile solids or dissolved and volatile solids is feasible.

7.6.5.6 Relationship between forms of alkalinity and pH are feasible as outlined in the SOP on Alkalinity.

7.6.5.7 Relationship between reported concentrations of metal(s) in different oxidation states is feasible. For instance Total Iron, Ferrous Iron.

7.6.5.8 Any other comparative relationship that can be identified in the data set.

7.6.5.9 Quality control information as calculated by the LIMS is reviewed and checked for compliance with control limits.

7.6.6 When these checks have been accomplished and the criteria have been met, the report of data is signed by one of the following personnel. Examples of their signatures are presented in section 1.0 of this document.

7.6.6.1 John Kobza, Operations Manager

7.6.6.2 John Seher, Quality Assurance Manager

7.6.6.3 Lawrence Layman, Lead Technical Director

Table 7.1 List of Quality Control Procedures Utilized by SEM, Inc.

Abbreviation	Full Name of Procedure	Purpose of Procedure
INS	Internal Standard	Reference standard internal to analysis of unknown.
CAL	Instrument Calibration	Calibrate instrument prior to analysis.
ICV	Initial Calibration Verification	Known sample analyzed to prove calibration before analysis of unknowns.
CCV	Continuing Calibration Verification	Known sample analyzed to prove calibration at set intervals during the analytical process.
CCB	Continuing Calibration Blank	Blank sample analyzed to prove calibration at zero analyte concentration during the analytical process. A sterility check can be considered to be a CCB.
ICB	Initial Calibration Blank	Blank sample analyzed to prove calibration at zero analyte concentration before analysis of unknowns. A start sterility check can be considered to be an ICB.
L C	Linearity Check	A standard above the calibration range that is analyzed to prove linearity of the calibration above the highest standard.
IDL	Instrument Detection Limit	Lowest level at which an instrument can detect an analyte at a statistically proven confidence level.
MDL	Method Detection Limit	Lowest level at which an entire analytical system can detect an analyte at a statistically proven confidence level.
RDL	Reporting Detection Limit	Established reporting limit for an analyte. May be set higher than MDL to allow for variance in performance of analytical system.
MS	Matrix Spike	Known amount of analyte added to a sample to prove performance of analytical system on that sample and to demonstrate the presence or absence of matrix effects.
MSD	Matrix Spike Duplicate	Known amount of analyte added to a sample to prove performance of analytical system on that sample and to demonstrate the presence or absence of matrix effects.
LCS	Laboratory Control Sample	Known sample derived from a source independent of that used for system calibration. LCS is used to assess the accuracy of the

		analytical system. A microbiological positive control is an LCS.
Abbreviation	Full Name of Procedure	Purpose of Procedure
LCSD	Laboratory Control Sample Duplicate	Known sample derived from a source independent of that used for system calibration. LCSD is used to assess the accuracy of the analytical system.
BS or LFB	Blank Spike or Laboratory Fortified Blank	Known amount of analyte added to a blank. Used to check calibration or assess system performance.
BSD or LFB	Blank Spike Duplicate or LFB Duplicate	Known amount of analyte added to a blank. Used to check calibration or assess system performance.
Dup	Duplicate	Duplicate sample analyzed to assess precision.
Spike	Spike	Used to determine recovery of known amount of analyte.
Unk	Unknown	Sample of unknown analyte concentration to be analyzed and reported to client.
Blank	Blank	Sample known to contain none of the analyte of interest. May be reagent water. A sterility check is in effect an analytical blank.
Dig Blank	Digestion Blank	Blank sample carried through a digestion process to determine if contamination is being introduced during that process.
Ex Blank	Extraction Blank	Blank sample carried through an extraction process to determine if contamination is being introduced during that process.
Ex Dup	Extraction Duplicate	Duplicate extraction carried out to determine variability introduced by the extraction process. May be a consequence on matrix non-homogeneity.
Dig Dup	Digestion Duplicate	Duplicate digestion carried out to determine variability introduced by the digestion process. High variability may be a consequence of matrix non-homogeneity.

8.0 Equipment and Reference Materials

8.1 General Requirements

8.1.1 The laboratory shall be furnished at all times with equipment and reference materials required for the correct performance of all procedures for which the laboratory is accredited. A comprehensive list of equipment utilized at Sierra Environmental Monitoring, Inc. is presented in Appendix II.

8.1.2 Records will be maintained for each major item of equipment concerning its performance.

8.2 Equipment Maintenance

8.2.1 All equipment is inspected, maintained, and serviced according to a schedule for each unit that is commensurate with the importance and ruggedness of that item. Specific routine maintenance procedures for equipment that is utilized directly in an analytical procedure is outlined in section 9 of each analysis SOP and in SOP's for use of specific pieces of equipment.

8.2.2 Corrective action for equipment malfunctions is outlined in the analysis SOP's or in the equipment SOP's

8.2.3 Records will be maintained for each routine and non-routine maintenance or repair performed on each major piece of equipment. Records shall include at a minimum:

8.2.3.1 The manufacturer, model, serial number and lab identification of the instrument.

8.2.3.2 The date of maintenance or repair and the identity of the analyst or service technician who performed the task.

8.2.3.3 The symptoms of malfunction and, if known, the cause of the malfunction.

8.2.3.4 The repair, replacement or adjustment performed to correct the malfunction.

8.3 Reference Equipment

SEM, Inc. maintains a set of equipment and standards that are used for calibration of measuring devices only, and are not to be utilized in routine analysis. Reference equipment or reference standards are obtained from, or are calibrated by, an entity that can provide NIST traceability.

9.0 Measurement Traceability and Calibration

9.1 General Requirements

SEM, Inc. shall maintain a program for calibration and verification of its analytical systems. Every measurement operation and each piece of test equipment utilized in analysis are calibrated or otherwise verified before being put into service.

9.2 Calibration Traceability

The program of calibration and verification is devised such that standards and calibrations are traceable to NIST or other recognized authority. This applies to calibrations conducted by SEM personnel, and to calibrations conducted by persons or entities external to the laboratory.

9.2.1 Documentation of Standards.

The laboratory maintains records for all purchased standards, including, if available, a manufacturers certificate of analysis, the date of receipt, and the expiration date for the standard.

9.2.2 Labeling of Standards and Reagents

Bottles containing standards and reagents are clearly labeled as to the contents, the concentration of analyte(s), the date of preparation, and the expiration date, and the identity of the person preparing the standard.

9.2.3 Records of Standard and Reagent Preparation

Records are maintained detailing the preparation of standards and reagents. These preparations may be dilution of a commercially prepared standard solution or preparation from reagent chemicals. The information captured includes the standard or reagent identity, the concentration of analyte(s), the preparation date and expiration date, the name of the preparer, the source(s) of materials used, including lot numbers, and reference to any procedures used to measure or verify the concentration of analyte(s). These records are maintained in a computerized database, and are backed up on CD-ROM. Section 10 of all SOP's, when applicable, contains prompts to remind analysts to record the preparation of standards and reagents.

9.3 Calibration

Calibration of all analytical systems is documented in such a manner as to be easily understood by the analyst and anyone auditing the system. Documentation is adequate to allow reconstruction of the calibration process. Detailed instructions for calibration associated with particular analyses are contained in sections 10, 11, and 12 in the SOP for that analysis.

9.3.1 Reference Standards

These are the standards that are utilized for calibration of measuring devices in the laboratory. Examples are sets of standard weights and certified thermometers. These items are reserved for calibration purposes, and not utilized for routine analytical procedures.

Revision Date: January 3, 2003

9.3.2 Support Equipment Calibration Verifications

This category of equipment includes such devices as the balances, mechanical pipettors and dispensing devices, ovens, refrigerators, and incubators. Logs of the performance of these items are maintained, and any adjustments or repairs are recorded.

9.3.2.1 Analytical balance is checked for calibration daily before use. This activity is described in an SOP for operation of this apparatus.

9.3.2.2 Refrigerators are monitored daily for correct temperature

9.3.2.2 Incubators and water baths for bacteriological use are monitored twice daily for correct temperature.

9.3.2.3 Mechanical pipettors are checked daily for calibration, with a comprehensive calibration check monthly. This activity is described in an SOP for calibration and maintenance of these items.

9.3.2.4 Autoclave sterilization temperatures are verified by chart recording of the temperature of every run. Spore strips are utilized monthly to confirm sterilization, and the timer is checked quarterly against an external standard.

9.3.3 Instrument Calibrations

Instruments are calibrated against known standards prior to conducting analyses as prescribed in the SOP for that particular analysis. Whenever possible standard materials are traceable to NIST standards. Records of calibration are maintained with the records of the analytical results.

9.3.3.1 Where the published method on which the SOP is based prescribes a calibration scheme, the calibration outlined in the SOP is at least as rigorous as that in the published method.

9.3.3.2 For published methods where no particular calibration scheme is dictated, the calibration scheme is adequate to prove linearity. A linear regression analysis is utilized to assess linearity, with a minimum correlation coefficient of 0.995.

9.3.4 Calibration Verification

9.3.4.1 Initial Calibration Verification.

After a calibration scheme is completed, it is verified against known standards and blanks before analysis of unknowns commences. The acceptance criterion for initial calibration verification (ICV) and initial calibration blank (ICB) is prescribed in the SOP for that analysis, and is at least as stringent as the criterion given in the published method.

9.3.4.2 Continuing Calibration Verification

Throughout the conduct of an analysis, the calibration scheme is verified against known standards and blanks. (CCV and CCB) These standards are analyzed at a frequency not greater than prescribed in the published method. If there is no published criterion for CCV and CCB frequency, these verification standards are included at a frequency of every ten samples. The acceptance criterion for CCV and CCB samples is prescribed in the SOP for that analysis, and is at least as stringent as the criterion given in the published method. Only those results bracketed by successful CCV and CCB analyses may be reported. An exception to this rule is that results may be reported if they are less than detection limit and the CCB samples are satisfactory, but the CCV sample(s) are high, indicating a high bias in the analytical scheme. If a CCV or CCB fails, and a second CCV or CCB also fails, a new calibration must be initiated and confirmed before analysis can proceed further.

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10.0 Test Methods

10.1 Test Method Documentation

SEM, Inc. maintains a library of test method manuals published by recognized authorities in the environmental analytical field. See section 16.0 of this document for a list of references utilized by SEM in preparation of this document and in preparation of our laboratory standard operating procedures (SOP's). Additionally, SEM maintains a set of SOP's detailing the essential operations in the laboratory that have a bearing on the validity of analytical results. This set of SOP's is devised and maintained according to the criteria set forth in the NELAC standards, section 5.10. A listing of the tests conducted at SEM and the published methods on which they are based is presented in Appendix VI.

10.1.1 Non-Standard Test Methods. The use of non-standard test methods is not encouraged, however they may be employed in special cases such as difficult sample matrix or a special request from the client. When data generated with non-standard analytical methods is reported, the data is flagged and a methodology description or citation is included with the analysis report to indicate clearly that a non-standard method was utilized and that the result would not be acceptable for compliance monitoring.

10.2 Initial Demonstration of Capability

Before conducting an analysis for reporting to clientele, SEM performs an initial demonstration of capability for that method. This process proves that the procedure is capable of producing accurate and reliable results that can be defended. The method verification process is as prescribed in the NELAC standards, Chapter 5, section 5.10 and Chapter 5, appendix C. This initial demonstration of capability is to be accomplished initially by the lead analyst for that method, and then by any other analysts who will be conducting the method.

10.3 Method Certification

When a method is proven viable, a blind performance evaluation sample is obtained from a qualified vendor, analyzed, and the results reported to the appropriate accrediting agencies. When SEM receives accreditation for the analyte and method from the accrediting agency, the method may be used to produce analytical results for reporting to clients.

10.3.1 Continuing Certification

SEM, Inc. obtains, analyzes, and submits results of performance evaluation samples on a semi-annual basis as required by accreditation authorities.

10.3.2 State Certificates

As a result of the activities described in 10.2 and 10.3 above, SEM, Inc. is granted accreditation from appropriate agencies in California, Nevada, and Hawaii states for reporting analytical data to satisfy requirements of their regulatory programs. These certificates and lists of accredited parameters are illustrated in Appendix V.

11.0 Sample Handling

11.1 Sample Tracking

The laboratory maintains a LIMS system that assigns a unique identification to each sample. The identification number is coded to include the year and month of receipt, and an assigned serial number beginning at 0001 for each month.

11.1.1 This laboratory identification code remains unequivocally linked with the SEM field identification code or client's identification for the sample.

11.1.2 The laboratory identification code is placed on the container as a durable label.

11.1.3 The laboratory identification code is maintained in the LIMS such that the sample can be linked with other activities recorded in the LIMS that relate to quality assurance for that sample.

11.1.4 The laboratory identification code is unequivocally linked with the list of analytical parameters requested by the client. This linkage is maintained in the LIMS.

11.1.5 A Standard Operating Procedure for Sample Acceptance and Log In details the process of capture and assignment of the sample identification.

11.2 Sample Acceptance

SEM, Inc. has set forth a written policy for acceptance of samples for analysis at the laboratory. This policy is presented in the SOP for Sample Acceptance and Log In. The sample acceptance policy encompasses applicable rules and regulations of accreditation authorities.

11.3 Sample Receipt Protocol

SEM, Inc. has in place a written protocol for sample receipt. The activities outlined in 11.1 above are executed. This protocol is presented in the SOP for Sample Acceptance and Log In. A chain of custody (COC) form is utilized to capture sample information and document transfers of sample custody. An example of the chain of custody form is presented in Appendix VII.

11.4 Sample Storage Conditions

SEM, Inc. maintains appropriate facilities for sample storage. These facilities are operated in such a fashion as to avoid deterioration of, contamination of, damage to, or tampering with samples during storage, preparation, and analysis. When samples are required to be stored under specified environmental conditions for the benefit of particular constituents, those conditions are maintained, monitored, and recorded.

11.4.1 Samples that require low temperature shall be stored under refrigeration at 4 °C. 2 °C.

11.4.2 Samples, extracts, digestates, leachates, and other sample derivatives, which may be used in an analysis, are stored away from any potential sources of contamination. Samples are stored in such a manner as to prevent cross contamination.

11.4.3 Samples for microbiological examination are stored in an area separate from the other areas of the laboratory.

11.5 Field Sampling

Sierra Environmental Monitoring, Inc. can provide field collection services when desired. The importance of representative sampling to the reliability of the final analytical result is well understood by the personnel. When the laboratory is requested to perform the sampling, site selection is based on reconnaissance of the general area to determine representativeness of the sample site and to ascertain other sources that may affect the site. A set of standard operating procedures has been devised to address the various types of field sampling.

11.6 Sample Containers and Preservatives

Sample containers appropriate to the requested analytical parameters and sample type can be supplied by the laboratory. SEM follows the guidelines listed in 40 CFR 136.3 and in "Standard Methods for the Examination of Water and Wastewater", 19th ed. for appropriate sample containers and preservation. Sample bottles used for bacteria evaluation are obtained from the supplier previously sterilized. Every sample container supplied by the laboratory has an SEM label attached. The label is to be completed by the party performing the sampling. A list of the recommended sample containers and preservatives, volume guidelines and holding times is presented in Appendix VI. It is the responsibility of the project manager to coordinate supply of appropriate sample bottles, preservation, shipping containers, and shipment of samples to the laboratory.

11.7 Sample Disposal

Samples are disposed in an environmentally responsible manner, and in compliance with applicable regulations.

11.7.1 Samples, extracts, and digestates that qualify as a RCRA waste either are returned to the client or are handled by a qualified waste disposal contractor.

11.7.2 Acid and base preserved samples that are not otherwise hazardous or toxic are neutralized on site and removed by a liquid waste hauler.

11.7.3 Samples that are not preserved and do not contain levels of regulated constituents that would disqualify them are discharged to the sanitary sewer and thence to the POTW.

11.7.4 Bacteriological materials that have been incubated are autoclaved prior to disposal, as are materials that are known to be highly contaminated with pathogenic organisms.

11.7.5 All SOP's for analyses in which waste is generated contain specific instructions concerning the disposal of waste and the disposition of recyclable materials.

11.8 Subcontracting

Under some circumstances samples are subcontracted to other qualified analytical laboratories in order to provide complete service to our clients. Typically subcontracting is necessary for

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analyses that SEM is not equipped or otherwise not qualified to perform.

11.8.1 SEM will always advise its client of the necessity to sub-contract any portion of a project to another party.

11.8.2 When analyses are subcontracted, the samples are transferred in such as manner as to maintain chain of custody. See COC form in Appendix VII.

11.8.3 When subcontracted analyses are reported to the client, the original report from the sub-contractor is included. SEM does not report results from other laboratories on its own laboratory analysis report form. The SEM report will reference the sub-contractor's report for those particular results.

11.8.4 Subcontractors are selected according to their capabilities, and are evaluated according to their Quality Assurance Plan, reporting format, turn around time, and reputation.

12.0 Records

A records keeping system is maintained to comply with all known regulations that apply to environmental analyses. The system can produce true records that can document the laboratory operations. The records include original measurements, associated calibrations, calculated data, and reports of analyses.

12.1 Records Keeping System

A records keeping system is maintained such that SEM will be able to review or reconstruct with adequate certainty any procedure that was conducted in the laboratory that affected the outcome of an analysis. The records include, but are not limited to the following topics:

12.1.1 Identity of the personnel conducting procedures

12.1.2 The types of laboratory facilities, equipment, reagents, standards, or test methods utilized in the analytical process.

12.1.3 Administrative or support activities such as sample receipt, data validation, and report approval that were involved.

12.2 Records Keeping Policy

In order to promote effective use of records and guarantee their usefulness, the following policies shall be executed:

12.2.1 The records keeping system shall facilitate the retrieval of archived records and working files.

12.2.2 Records entries are signed or initialed by the party responsible for the activity.

12.2.3 All data not collected or printed by automated systems is recorded on worksheets in a clear, legible, and concise manner in permanent ink.

12.2.4 Record entries are never to be obliterated or otherwise made illegible. Errors are to be corrected by drawing one line through the error and initialing. The corrected value is added

above or below according to available space.
12.3 Paper Records Management and Storage.

12.3.1 Records and reports are stored at a safe, secure location, and are held in confidence. No person or entity has access to the records without permission of the client or a court order.

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12.3.2 All records that may have an effect on the outcome of an analytical procedure are held for a minimum of five years. Records stored on electronic medium are supported by the hardware and software necessary for retrieval.

12.3.3 Access to archived information is recorded in an access log. Archived records are protected against loss due to fire, theft, vandalism, and environmental degradation in a secure off-site location.

12.4 Electronic Records Management and Storage

When computers or other electronic systems are used for data capture, processing, storage, or reporting, or for support activities, these electronic records are kept secure. To insure this security, SEM makes certain that:

12.4.1 Computer software is adequate for the task, is documented, and can be restored or replaced in case of loss.

12.4.2 Computers, or other electronic equipment, are capable of executing their role in retrieval of the electronic data.

12.4.3 Records that are stored on electronic medium have either hard copy or read only back up copies, and these back ups are held in safe, secure locations, just as for paper records as described in 12.3.3 above.

12.4.4 Electronic records are held in confidence, just as for paper records as described in 12.3.1 above.

12.4.5 Records will be maintained according to the SEM SOP for Maintenance of Electronic Data.

12.5 Sample Handling Records

Records of all procedures to which a sample is subjected while in the custody of SEM shall be maintained. These records shall describe:

12.5.1 Sample receipt, identification, receipt, and log in.

12.5.2 Sample preservation and compliance with required holding time.

12.5.3 Sample tracking records, including shipping receipts and bills of lading.

12.5.4 Sample preparations, digestions, or other derivations.

12.5.5 Sample analysis, including all original raw data

12.5.6 All supporting records that describe or document procedures that had a bearing on the outcome of the analysis.

12.5.7 Supporting quality control information.

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12.6 Support and Administrative Activities

Records shall be kept to document the following:

- 12.6.1 Copies of final reports and copies of any correspondence or explanatory material that accompanied the final reports.
- 12.6.2 Archived standard operating procedures
- 12.6.2 Corrective action reports, audits, and audit responses.
- 12.6.3 Performance evaluation test results.
- 12.6.4 Personnel qualifications and training records
- 12.6.5 Initial and continuing demonstration of proficiency for analysts
- 12.6.5 A record of names, signatures, and initials for all individuals who are responsible for signing or initialing any laboratory record or report.

13.0 Laboratory Report Format and Contents

Any effort expended on other aspects of a laboratory operation is wasted if the final report of results is not true and unambiguous. The results of each analysis or series of analyses conducted by Sierra Environmental Monitoring, Inc. are reported clearly, accurately, objectively, and unambiguously. Examples of the laboratory reports are presented in Appendix VIII.

13.1 Report Content

Each report shall include, at a minimum, the following information:

- 13.1.1 A document title "Laboratory Analysis Report" indicating the contents and purpose, a unique report number on each page of the report, the date of issuance, and page numbering indicating page number and total number of pages on each page.
- 13.1.2 The identity, location, and contact information for the issuing entity.
- 13.1.2 The identity of the client, including name, address, and if known, the contact person to whom the report is directed. Also included, if known is the client's purchase order or project number.
- 13.1.3 The client's identification for the sample(s) as listed on the chain of custody form that accompanied the sample(s) at time of submission.
- 13.1.4 The unique laboratory identification number assigned to each sample by SEM, Inc.
- 13.1.5 The date and time of sample collection and identity of the sample collector, as listed on the chain of custody form, and the date of sample receipt at SEM, Inc.
- 13.1.6 The method reference for the test method utilized in each analysis.
- 13.1.7 For each analysis the analytical result, the units of measure, the date the analysis was conducted, and the identity of the analyst.
- 13.1.8 Identification of any test results that did not meet holding time requirements or other sample requirements, such as container type or preservation.
- 13.1.9 Identification of any test results that did not meet quality assurance goals, or any non-standard conditions that may have affected the results.

13.1.10 Rigorous use of significant figures to avoid overstatement of the probable precision and accuracy of results.

13.1.11 Clear indication of any analyses that were subcontracted and the subcontractor's report. No subcontracted hard data will appear on the Laboratory Analysis Report issued by SEM, Inc.

13.1.12 Signatures line with the signature and title of the person accepting responsibility for the content of the report.

13.1.13 A disclaimer stating that the Laboratory Analysis Report relates only to the sample(s) as received at the laboratory, and that the client assumes all responsibility for further distribution of the report or its contents.

13.2 Special Reports

SEM, Inc. will issue reports of differing format for particular purposes, providing to clients information that facilitates interpretation of the analytical results. Examples of these are reports that contain information on drinking water maximum contamination limits or RCRA waste toxicity characteristic thresholds. Any report issued by SEM, Inc. will not lack any of the items detailed in section 13.1 above.

13.3 Amended Reports

An amended report may be issued after the issuance of the original Laboratory Analysis Report. In this instance, there shall be clear indication that the amended report is distinct from the original report, clear indication of which results(s) were modified, added or deleted, and the reason for the change(s). The original shall never be changed and reissued.

13.4 Electronic Transmission of Results

SEM, Inc. provides to clients electronic transfer of analytical data for reasons of speed and convenience. The format of electronic transmission will vary according to client requests, but will always indicate clearly the SEM report number, the SEM sample identification number, and the client's identification for each sample. Even though there has been an electronic transmission of data, the printed report will always remain the official report of record. If an amended electronic report is transmitted to a client, it is transmitted and identified in such a way that it can not be confused with the original report.

13.5 Confidentially

Laboratory Analysis Reports are held in strict confidence between laboratory and client. Copies of reports are not issued to other parties unless specific permission is given by the client. Whenever data is transferred by electronic means, effort is made to insure that confidentiality is maintained. Fax transmission of data is accomplished with a cover sheet indicating that this report is confidential and is intended only for the recipient indicated on the cover sheet. Client confidentiality and data integrity are addressed in depth in section 3 of this document.

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13.6 Correction of Errors

SEM, Inc. will immediately notify clients in the instance that a measuring system defect was discovered that would cast doubt on the validity of any reported analytical result. The problem will be discussed with the client by a signatory and SEM, and arrangements made for subsequent remediation.

14.0 Outside Support Services and Supplies

14.1 Subcontracted Analyses

To ensure that subcontractors utilized by SEM, Inc. maintain satisfactory quality assurance and conduct their affairs in a business like manner, each subcontractor is evaluated. An integral part of this evaluation is a review of the quality assurance plan and the completeness of the reports issued by the potential subcontractor. On-site audits of subcontractors are not conducted as a normal matter of course, but will be conducted at a client's request, or if SEM, Inc. has reason to question a subcontractor's capability. See section 11.8 of this document for additional information on the protocols for subcontracting.

14.2 Laboratory Supplies

Supplies necessary for the operation of the laboratory are purchased from numerous sources. Upon receipt at the laboratory, contents of shipments are checked against the packing list, and the list noted as to date of receipt. Items are distributed to the departments ordering them, and, where applicable, the supplies are marked as to date of receipt. If any supplies are deemed unacceptable for use in the laboratory, they are returned to the supplier, the ordering department is informed of the return. Arrangements are made with the supplier for replacement or an alternate source is utilized.

14.3 Reagent Chemicals

Those supplies that have a bearing on the outcome of analysis are purchased only from suppliers of established reputation providing materials from manufactures of established reputation. Reagent chemicals are acquired in a grade appropriate to their intended usage. At a minimum, all reagents purchased will be ACS Reagent Grade. Those materials utilized as standards shall be Primary Standard Grade or NIST traceable if possible.

14.4 Laboratory Equipment

Laboratory equipment will be inspected and tested to determine compliance with performance specifications. Whenever relevant, equipment will be tested for capability and calibrated before being put into service.

14.5 Laboratory Reagent Water

Reagent water is prepared in the laboratory by a multi-stage system consisting of a granular activated carbon bed for organics and chlorine removal and a primary mixed resin bed deionizer. This primary water meets the requirements for Type III water as described in "Standard Methods for the Examination of Water and Wastewater", 19th ed., 1080 C. This Type III water is distributed in an inert plastic distribution system in the laboratory to secondary deionizing and silica removal devices which produce reagent water that meets the standards for type II water as described in "Standard Methods for the Examination of Water and Wastewater", 19th ed., 1080 C. This type II reagent water is utilized for preparation of wet chemical testing reagents and for rinsing laboratory glassware. A high performance water purification system produces water that meets the standards of Type I reagent water as described in "Standard Methods for the Examination of Water and Wastewater", 19th ed., 1080 C. This type I water is utilized for preparation of standards for metals analysis and for preparation of eluent and standards for ion chromatography analysis. Water supply for bacteriological testing is tested for suitability on an annual basis.

14.6 Laboratory Building Maintenance

The importance of maintaining the laboratory building is emphasized to every employee at SEM, Inc., and is an official company policy written into the SEM Personnel Practices Manual. Keeping a neat, clean work place is an important aspect in producing quality work. The laboratory utilizes a professional janitorial service for general cleaning once per week. The janitorial service is instructed not to disturb any items on bench tops or any of the laboratory equipment. Personnel are instructed to bring any building maintenance problems to the attention of the Operations Manager.

15.0 Complaints

If a complaint is lodged concerning the operation of the laboratory or compliance with its quality Assurance Program, there shall be a rigorous investigation of the complaint and the areas of the laboratory which may have been the source of said complaint. This investigation will include an audit of the quality systems with a bearing on the results in question. Upon completion of the investigation, if a fault is found, remedial action will be taken to eliminate the problem. Record of the complaint and consequent corrective actions will be maintained according to the SOP for Corrective Actions. Any affected parties will be kept informed as to the audit and corrective action.

16.0 Listing of General References

In the preparation of this Quality Assurance Plan and the SEM, Inc. Standard Laboratory Operating Procedures the following sources were utilized:

- 16.1 "Methods for Chemical Analysis of Water and Wastes", EPA- 600/4-79-020, 1983.
- 16.2 "Test Methods for Evaluating Solid Waste", SW-846, 3rd ed. 1986.
- 16.3 "Standard Methods for Examination of Water and Wastewater", 18th ed., 1992. APHA/AWWA/WEF.
- 16.4 "Standard Methods for Examination of Water and Wastewater", 19th ed., 1995. APHA/AWWA/WEF.
- 16.5 "Official Methods of Analysis of the AOAC International", 17th ed., AOAC.
- 16.6 "Analytical Methods for Liberty ICP Spectrometer", Publication No. 85-100938-00. Varian Techtron Pty., Ltd, 1992.
- 16.7 "Operation Manual for UltraMass Spectrometer System", Publication No. 85-101202 00 Varian Australia Pty., Ltd, 1995.
- 16.8 "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, 1979.
- 16.9 "Microbiological Methods for Monitoring the Environment, Water and Wastes", EPA 600/8-78-017. 1978.
- 16.10 "Methods for the Determination of Metals in Environmental Samples, EPA-600/4-91-010, 1991, and subsequent revisions.
- 16.11 "Methods for the Determination of Inorganic Substances in Environmental Samples", EPA/600/R-93/100, 1993.
- 16.12 "Manual for the Certification of Laboratories Analyzing Drinking Water, Criteria and Procedures, Quality Assurance", 4th ed., EPA 815-B-97-001, 1997.
- 16.13 "Quality Systems", National Environmental Laboratory Accreditation Conference (NELAC), Chapter 5, July 1, 1999.

17.0 Definitions

The following list of definitions, with their source if available, is included to ensure that those persons utilizing this document have an accurate understanding of the technical terms as they apply in this document.

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: the process by which an agency or organization evaluates and recognizes a program of study or an institution as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Analytical Detection Limit (LD): the smallest amount of an analyte that can be distinguished in a sample by, a given measurement procedure throughout a given (e.g., 0.95) confidence interval. (Applicable only to radiochemistry)

Audit: a systematic evaluation to determine the conformance to quantitative specifications of some operational function or activity. (EPA-QAD)

Batch: environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples, extracts, digestates or concentrates which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (NELAC)

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC, Definitions of Environmental Quality Assurance Terms, 1996)

Blind Sample: a subsample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibrate: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration: the set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurand. (VIM- 6.13)

Calibration Curve (calibration plot): the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response. (NELAC)

Calibration Standard: a solution prepared from the primary dilution standard solution or stock standard solutions and the internal standards and surrogate analytes. The Calibration solutions are used to calibrate the instrument response with respect to analyte concentration. (EPA-QAD)

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30- 2.2)

Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples, data and records. (EPA-QAD)

Compromised Samples: those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions compromised samples are not analyzed. If emergency situations require analysis, the results must be appropriately qualified. (NELAC)

Confirmation: verification of the presence of a component through the use of an analytical technique based on a different scientific principle from the original test method. (NELAC)

Corrective Action: action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO8402)

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form. (EPA-QAD)

Detection Limit: the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated degree of confidence. See Method Detection Limit.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC, Definitions of Environmental Quality Assurance Terms, 1996)

Double Blind Sample: a sample submitted to evaluate performance with concentration and identity unknown to the analyst. (EPA-QAD)

Duplicate Analyses: the analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to

evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Federal Water Pollution Control Act (a.k.a. Clean Water Act, CWA): the enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat. 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

Holding Times (Maximum Allowable Holding Times): the maximum times that samples may be held prior to analysis and still be considered valid. (40 CFR Part 136)

Initial Demonstration of Analytical Capability: procedure to establish the ability of the laboratory to generate acceptable accuracy and precision which is included in many of the EPA's analytical test methods. In general the procedure includes the addition of a specified concentration of each analyte (using a QC check sample) in each of four separate aliquots of laboratory pure water. These are carried through the entire analytical procedure and the percentage recovery and the standard deviation are determined and compared to specified limits. (40 CFR Part 136)

Internal Standard: a known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Laboratory: a body that calibrates and/or tests. As used herein, the term "laboratory" refers to a body that carries out calibration or testing at or from a permanent location. (ISO 25)

Laboratory Control Sample (however named, such as LCS, laboratory fortified blank, or spiked blank): a-sample matrix free from the analytes of interest spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Laboratory Duplicate: aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Legal Chain of Custody (COC): an unbroken trail of accountability that ensures the physical security of samples, data and records. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Limit of Detection (LOD): the lowest concentration level that can be determined (by a single analysis and with a defined level of confidence) to be statistically different from a blank. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Manager (however named): the individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

Matrix: the component or substrate that contains the analyte of interest. For purposes of batch and QC requirements determination, the following matrix distinctions shall be used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater and effluents.

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source.

Non-aqueous liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Matrix Spike (MS, spiked sample, fortified sample): prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Matrix Spike Duplicate (MSD, spiked sample/fortified sample duplicate): a second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

May: permitted, but not required (TRADE)

Method Blank: a clean sample processed simultaneously with and under the same conditions as samples containing an analyte of interest through all steps of the analytical procedures. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Method Detection Limit (Analytical Detection Limit): the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B)

Must: denotes a requirement that must be met. (Random House College Dictionary)

National Laboratory Accreditation Conference (NELAC): a voluntary organization of State and federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP): the overall National Environmental Laboratory Accreditation Program of which NELAC is apart. (NELAC)

Negative Control: measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC Standards: the protocol and/or requirements established by the National Environmental Laboratory Accreditation Conference. (NELAC)

The plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards. (NELAC)

Performance Audit: the routine comparison of independently obtained quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Positive Control: measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: refrigeration and or reagents added at the time of sample collection to maintain the chemical and or biological integrity of the sample. (NELAC)

Proficiency Testing: determination of the laboratory calibration or testing performance by means of inter-laboratory comparisons. (ISO/IEC Guide 2 -12.6, amended)

Proficiency Testing Program: the aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results in comparison to peer laboratories and the collective demographics and results summary of all participating laboratories. (NELAC)

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance limits. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Protocol: a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (EPA-QAD)

Pure Reagent Water: shall be water in which no target analytes or interferences are present at a concentration which would impact the results when using a particular analytical test method.

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Quality Assurance (Project) Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA-QAD)

Quality Management Plan (QMP): a formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency, organization or laboratory to ensure the quality of its product and the utility of the product to its users. (EPA-QAD)

Quality Manual: a document stating the quality policy, quality system and quality practices of an organization. This may be also called a **Quality Assurance Plan** or a **Quality Plan**. NOTE - The quality manual may include by reference other documentation relating to the laboratory's quality arrangements. (NELAC)

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

Quantitation Limits: the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. Quantitation limit, for the purposes of NELAC, is defined as 3.18 times the MDL, by convention.

Range: the difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

Reagent Blank (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (Glossary of Quality Assurance Terms, QAMS, 8131192)

Record Retention: the systematic collection, indexing and storing of documented information under secure conditions. (EPA-QAD)

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.08)

Replicate Analyses: the measurements of the variable of interest performed identically on two or more subsamples of the same sample within a short time interval. (NELAC)

Requirement: a translation of a need into a set of individually quantifiable or descriptive specifications of the characteristics of an entity in order to enable its realization and assessment. (NELAC)

Resource Conservation and Recovery Act (RCRA): the enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the "cradle-to-grave," including its generation, transportation, treatment, storage, and disposal. (NELAC)

Resume: the summary (usually written) of an individual's relevant technical and management experience, including training, usually presented in chronological order with the most recent being first. (EPA-QAD)

Safe Drinking Water Act (SDWA): the enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitor, and enforce violations. (NELAC)

Selectivity: (Analytical chemistry) the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity: the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Shall: denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (*Style Manual for Preparation of Proposed American National Standards*, American National Standards Institute, eighth edition, March 1991)

Should: denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (*Style Manual for Preparation of Proposed American National Standards*, American National Standards Institute, eighth edition, March 1991)

Spike: a known mass of target analyte added to a blank sample or subsample; used to determine recovery efficiency or for other quality control purposes. (NELAC)

Standard: a protocol established by a recognized authority (such as the American society for Testing Materials, the American National Standards Institute, or the Institute of Electrical and Electronic Engineers). (ASQC Definitions of Environmental Quality Assurance Terms)

Standard Operating Procedure (SOP): a written document containing explicit instructions for performing a test method (*q.v.*). (NELAC)

Standard Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical test method. (EPA-QAD)

Supervisor (however named): the individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (EPA-QAD)

Technical Director: the individual(s) responsible for managing the technical aspects of an organization, and ultimately accountable for the quality of the organization's product(s). (NELAC)

Test: a technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. (NELAC) NOTE - The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method: defined technical procedure for performing a test or an adaptation of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Testing Laboratory: laboratory that performs tests. (ISO/IEC Guide 2 -12.4)

Test Sensitivity/Power: the minimum significant difference (MSD) between the control and test concentration that is statistically significant. It is dependent on the number of replicates per concentration, the selected significance level, and the type of statistical analysis (see Chapter 5, Appendix D, section 2.4.a). (NELAC)

Tolerance Chart (Control Chart): a chart in which the plotted quality control data is assessed via a tolerance level (e.g. +/- 10% of a mean) based on the precision level judged acceptable to meet overall quality/data use requirements instead of a statistical acceptance criteria (e.g. +1- 3 sigma). (ANSI N42.23-1995, Measurement and Associated Instrument Quality Assurance for Radioassay Laboratories)

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Verification: confirmation by examination and provision of evidence that specified requirements have been met. (NELAC) NOTE - In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

Validation: the process of substantiating specified performance criteria. (EPA-QAD)

Appendix I

Standard Set of Data Flags

This glossary serves to define and instruct in the proper use of data qualifier flags during the data generation and review process. Data qualifiers are not to be used in place of proper protocol and procedures. Data flags are to be used after all appropriate procedures have been followed and the data requires further explanation of possible bias in results. Data flags should be included in the "comments" text box available when entering analytical data into the LIMS. Be certain to indicate to which analyte the data qualifier belongs. Any use of data qualifiers should be accompanied by a case narrative that describes the situation leading to its use. Case narratives will be added by signatories at final report approval. Failure to add proper data qualifiers and case narratives may lead to the data being misunderstood or rejected by the client or end user.

Section 7.2 of the SEM Quality Assurance Plan describes the corrective action protocol to be followed whenever method quality objectives were not met. When appropriate corrective actions were taken, and did not correct the problem, or when insufficient sample is available for performance of quality control samples, data qualifier flags should be utilized.

The following explanations serve to detail when and where to use the data qualifiers.

- B - Element or compound also found in associated Method Blank.

This data qualifier is to be used when an element or compound is detected above the reporting limit in the associated method blank. The "B" data qualifier is only to be used when re-analysis of the samples is impossible. All samples in the QC batch must have the compound found in the method blank flagged with a "B". The method blank result for that compound does not need to be flagged with a "B".

- C - Sample concentration is at least 5 times greater than spike contribution. Spike recovery criteria do not apply.

The "C" data qualifier is used when the concentration of the sample that was spiked for the matrix spike sample is at least 5 times larger than the concentration of the spike added, thus the spike recovery value is not useful in assessing recovery of the unknown. The spike result is flagged with a "C". The sample result does not require a flag.

- D - Sample was run at dilution. Surrogate or internal standard was diluted outside the calibration range.

This data qualifier is used when a surrogate was diluted out of the calibration range. This data qualifier is most typically used in organics analysis where surrogates are added to the sample, but could apply to metals analysis where internal standards are utilized.

- Di - Results reported from analysis at a higher dilution.

The "Di" data qualifier is used to flag individual analytes in a list of analytes that had to be analyzed at a higher dilution than the dilution from which the surrogate results and other analytes in the list were reported. This may occur in a metals analysis when one or more of the analytes are present in much higher concentration than others on the requested profile.

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- E - Concentration exceeded calibration range. It should be considered an estimated value. The "E" data qualifier is used to flag individual analytes whose concentrations exceed the calibration range after at least two (2) analyses at different dilutions have been performed. It may also be used temporarily on rush analyses that cannot be reanalyzed within the rush TAT. Only results that were quantitated outside of the analysis calibration range need to be flagged with an "E".

- Ha - Sample was analyzed beyond holding time for this parameter per client's request.

The "Ha" data qualifier is used to flag any sample result acquired beyond the holding time for a parameter when the sample was received at the laboratory within the specified holding time. The client **MUST** be notified that the hold time was exceeded before analysis is conducted. If a holding time exceedance occurs, we must make an honest effort to obtain a replacement sample at no cost to the client.

- He - Sample was extracted beyond holding time for this parameter per client's request.

The "He" data qualifier is used to flag any sample result that was obtained from a sample which was extracted beyond the holding time for the parameter when the sample was received at the laboratory within the hold time. The client **MUST** be notified that the hold time was exceeded before analysis is conducted. This flag applies more usually to organics analysis, though it could apply to some inorganics analysis in our laboratory, for instance, hexavalent Chromium, or Mercury.

- Hr - Sample was received beyond holding time for this parameter and analyzed per client's request.

The "Hr" data qualifier is used to flag any sample result determined on a sample that was received beyond the holding time for the parameter. The client **MUST** be notified that the hold time was exceeded before analysis is performed.

- J - Estimated concentration due to laboratory control sample failure.

The "J" data qualifier is used to flag any sample result reported which is associated with an LCS which is outside the established control limits. This flag should only be used when there is insufficient sample for reanalysis. Both the LCS and sample results for the parameter, which exceeded the acceptance criteria, must be flagged with the "J" data qualifier. In cases where an analysis has an LCS and an LCSD, a failure in either LCS requires the data to be flagged with a "J" for samples analyzed under RCRA. For Clean Water Act and Safe Drinking Water Act analyses the data flag is only required to be on the failing LCS or LCSD.

- Jc - Estimated concentration. Continuing calibration check standard did not meet QC requirements for this analyte.

The "Jc" data qualifier is to be used when reporting a sample result acquired in an analytical batch that contained a CCV failure. All sample results as well as any QC results associated with this analytical batch should be flagged with the "Jc" data qualifier. Reporting a result not bracketed by successful ICV and/or CCV's is not normally allowed. We would use this data qualifier only when re-analysis is not possible.

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- Je - This concentration is below reporting limit, but above the method detection limit. It should be considered an estimated value.

The "Je" data qualifier is used when a client has requested that we report an analyte at a level below our reporting limit. The concentration of the analyte must be greater than the MDL. Only the sample results which are less than the reporting limit must be flagged with the "Je" data qualifier.

- Ji - Estimated concentration due to probable matrix interference. The internal standard was outside acceptance criteria.

The "Ji" data qualifier is applied to analytical results that were obtained for a sample in which the associated internal standard failed acceptance criteria. This flag is used only when the sample or digestate has been reanalyzed to prove the failure was not due to analyst or instrument error. Only the affected analytes need to be flagged with the "Ji" data qualifier.

- JI - The batch MS and/or MSD were outside acceptance limits. The batch LCS was acceptable.

The "JI" data qualifier is used when the batch MS/MSD recoveries or RPD criteria are exceeded. This data qualifier should be used only when the LCS has passed and the MS/MSD and sample that was spiked have been reanalyzed and shown to be unacceptable a second time. Both the result of the analyte for the sample that had the MS/MSD failure and the MS/MSD result that failed must be flagged with the "JI" data qualifier.

- Js - Estimated concentration due to probable matrix effects. Sample QC outside acceptance criteria in duplicate analyses.

The "Js" data qualifier is used to flag sample results that were analyzed in duplicate, whose RPD was outside acceptance limits. After reanalysis to confirm the RPD failure, the sample result is flagged with the "Js". This could be due to sample non-homogeneity. The client should be provided the results of the original run and the replicate analyses.

- M - Analyzed by Method of Standard Additions.

The "M" data qualifier is used to flag sample results that were acquired using the method of standard additions as opposed to an internal standard or external standard calibration model. All sample results and associated QC samples analyzed by the method of standard additions are flagged with the "M" data qualifier.

- Me - Method is known by USEPA to have low recoveries for this parameter.

The "Me" data qualifier should be used to flag sample results for an analyte that was acquired using a method known by the USEPA to give low recoveries for that analyte. Both sample and QC results must be flagged with the "Me" data qualifier. Examples would be hexavalent Chromium or organic Lead.

NC - Result is to be used for non-compliance purposes only, as SEM, Inc. is not accredited for this analysis. The sample was analyzed for this parameter at the request of client.

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The "NC" data qualifier is applied to any results reported to a client for which certification/licensing is required, but which is not held by SEM, Inc. at the time of analysis. These analyses **MUST only be performed at the request of the client** after the client has been made aware that the results can not be used for compliance reporting. This data qualifier is to be applied to all results, both samples and QC.

- NCs - Result was determined by an analytical method that may not be specifically approved in the client's or end user's regulatory entity.

The NCs qualifier is used to mark data that has been produced utilizing an analytical methodology that is not specifically approved for the state or EPA region where the project is located. Examples of this could be WAD Cyanide by F.I.L.E. or Oil & Grease by hexane extraction. We must obtain approval from the client before such methods are used.

- P - Sample was received improperly preserved and analyzed at the client's request.

The "P" data qualifier is used to flag any sample result that was acquired from a sample that was improperly preserved. Improper preservation is defined to be: 1) required preservation missing, 2) incorrect pH, 3) incorrect temperature upon receipt or 4) presence of compounds, which should have been neutralized upon sampling, but were not. Flag the sample result acquired on the improperly preserved sample only. The client **MUST** be contacted and given the opportunity to resample before the improperly preserved sample is analyzed.

- RL - Reporting limit raised due to sample matrix interference.

The "RL" data qualifier is used to flag an analyte for which an analysis reporting limit must be raised due to matrix interference. This data qualifier is not to be used when a compound is found in the associated method blank above the reporting limit. See data flag "B" above.

- Tb - No Trip Blank was returned with these samples. The results should be judged accordingly.

The "Tb" data qualifier is applied to positive sample results in volatiles analyses, when the samples were not accompanied by a trip blank. Only positive sample results must be flagged with the "Tb" data qualifier. The State of California requires this on all volatiles analyses. Though this data flag is used principally for organics analyses that are subcontracted, we would add this flag to our own report to note the lack of a trip blank when samples were received at SEM, Inc. laboratory.

- V - Result was verified by independent analysis.

The "V" data qualifier is used to flag analysis results that were also performed at another laboratory to verify our results, or by a different method in our laboratory. This data qualifier should only be used when the result from the verification laboratory has verified our result. Only the analyte result should be flagged with the "V" data qualifier. A client may desire a confirmatory analysis for an exceedingly important analysis, for instance an enforcement action.

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Appendix II

Sierra Environmental Monitoring, Inc. Equipment Inventory

Item	Manufacturer	Model or Type	Number
Autoclave	Market Forge	Sterilamatic	1
Autoclave	Amsco	General Purpose	1
Auto-Titration	Man-Tech	PC Titrate	1
Balance, Triple Beam	Ohaus	Triple beam	1
Balance, Top Loader	Mettler	PB-1592 Electronic	1
Balance, Analytical	Denver Instruments	A-160 Electronic	1
Balance, Analytical	Mettler	H31-AR (backup to DI A-160)	1
Block Digester	Environmental Express	Hot Block	2
BOD Incubator	VWR - Shell Lab	BOD Incubator	1
COD Reactor	Hach	COD Reactor	1
Colony Counter	Reichert - Jung	Quebec	1
Computers	Various	Pentium Class Win 95/98/NT/XP	22
Conductivity Meter	VWR	Model 1054	1
Dissolved Oxygen Probe	Orion	BOD Electrode	2
Flash Point Apparatus	Precision	Pensky-Martens Closed Cup	1
Flow Injection Analyzer	Alpkem	FS-3000 with F.I.L.E. CN module	1
Fume Hoods	Fisher, Hamilton, etc.	Various	6
Hot Plates	Thermoline & Corning	Various	4
Hot Plate / Stirrer	Corning, et. al.	Various	4
ICP – OES	Varian	Vista-MPX & SPS-5 Autosampler	1
ICP- MS	Varian	Ultramass & SPS-5 Autosampler	2
ICP- OES	Varian	Liberty Series II & SPS-5 Autosampler	1

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Item	Manufacturer	Model or Type	Number
Incubator, Bacteriological	Precision Scientific	Coliform water bath	1
Incubator, Bacteriological	Precision Scientific	Bacteriological, 30 cu. ft.	1
Incubator	Fisher	Block type for spore strip vials	1
Ion Chromatography System	Dionex	DX-500 with autosampler and PeakNet software.	2
Laboratory Information Management System	Accelerated Technology Laboratories	SampleMaster	1
Mercury Analyzer	Cetac	Model 6000 A	1
Microscope	American Optical	Binocular, Model "One-Fifty"	1
Microscope	Fisher Scientific	Binocular dissecting type	1
Oven	National Appliance	Model 620 - fan forced	1
Oven	Sheldon Laboratory	HAFO 1600 Programmable	1
Oven	Fischer Scientific	Iso-Temp, 4 ft ³	1
PH / ISE Meter	Orion	Model 720A	3
pH Meter	Corning	Model 7	1
Refrigerators	True, Frigidaire, Kitchen Aid	Various	5
Sulfur Analyzer	Leco	Model SC-132	1
Turbidimeter	Hach	Model 2100A	1
Vis-UV Spectrophotometer	Varian - Cary	Model 1-E with Varian software	1
Water Bath	VWR	Model 1230 thermostated	1
Water Purification System	Barnstead	Nano-Pure	1
Water Purification System	Barnstead	Ultra-Pure	2

Appendix III Current Personnel

John Seher, Quality Assurance Manager and Special Consultant

Mr. Seher has been with Sierra Environmental Monitoring, Inc. since April of 1975. He has been the principle Chemist, and from 1988 to 1996, Laboratory Manager at SEM. From 1996 to the present he has been the Quality Assurance Manager and consulted with clients on special projects. His training includes a Bachelor of Science in Chemistry, 1969, and Master of Science, Inorganic Chemistry, 1976 from the University of Nevada, Reno. Previous to his tenure at SEM, he worked in the mining industry conducting research in metallurgical separation and recovery. He has also worked in academic research conducting measurements in radio astronomy for the University of California, Berkeley Space Sciences Laboratory at the White Mountain Research Station near Bishop, CA.

John Kobza, Operations Manager; President, KVM Holdings, Inc.

Mr. Kobza joined the staff of Sierra Environmental Monitoring, Inc. in 1996 coming from ETICAM, a hazardous waste processing company in Fernley, Nevada. At ETICAM Mr. Kobza served as Analytical Manager for three years and Technical Director for three years. In these positions he was responsible for the technical operation of a complex waste treatment facility. Prior to his work in the waste processing industry he was an instructor in Biology at Truckee Meadows Community College and a Post Doctoral Fellow at the University of Nevada and the Washington State University. Mr. Kobza has earned a Bachelor of Science and a Master of Arts in Biology from the University of South Dakota, and a Doctor of Philosophy in Botany from the Washington State University.

Larry Layman, Chemist and Lead Technical Director

Mr. Layman became a member of the Sierra Environmental Monitoring, Inc. staff in early 2001. Mr. Layman has most recently instructed Chemistry at Lafayette College in Easton, Pennsylvania. Prior to his faculty position at Lafayette, he was a research scientist at the Los Alamos National Laboratory in Los Alamos, New Mexico. His work at Los Alamos was classified. He has also been a principal scientist at the U. S. Geological survey Laboratory in Denver, Colorado, where he worked to develop methods for analysis of water and geochemical samples utilizing atomic emission spectroscopy and inductively coupled plasma mass spectrometry. Mr. Layman has earned his Bachelor's degree in chemistry from Occidental College in Los Angeles, California and his Ph.D. in analytical Chemistry at the Indiana University at Bloomington, Indiana.

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Susan Kleinworth, Laboratory Technician

Ms. Kleinworth joined the SEM staff in March of 1993, after serving in a laboratory technician role at ETICAM, a hazardous waste processing and reclamation facility, in Fernley, Nevada. Prior to her position at ETICAM, Ms. Kleinworth was employed for six years with the Shipley Company in Los Angeles, California, where she did process and quality control testing on chemical products used in the semiconductor industry. Ms. Kleinworth has also worked for Smith Tool International, Carbide Tool Division as a metallurgical laboratory technician. She holds an Associate of Arts degree from Fullerton College in Fullerton California and has undertaken specialized training in the specialized chemical techniques employed in semiconductor manufacture.

Keith Catlin, Microbiologist

Before joining the SEM staff in 1995, Mr. Catlin has worked for the past nine years in microbiological testing of food commodities. His experience includes seven years as microbiology technician and quality control supervisor for Baltimore Spice and two years in a similar capacity with Specialty Brands, both in Reno. In his past employment Keith has participated in preparation of ISO 9000 documentation. At SEM Keith conducts microbiological assays and specialized chemical tests on food commodities, and is the quality control coordinator for Microbiology. Keith has earned a Bachelor of Science degree in Business Management from the University of Nevada, Reno, and has completed Biology major requirements at Seattle Pacific University.

Michael Henderson, Chemist

Prior to joining the SEM staff in 2001, Mr. Henderson Lowe has worked with Nevada Environmental Laboratory in Reno, Nevada where he conducted numerous analytical methods utilizing instrumental and wet chemical methods. Prior to this he worked as a laboratory and field assistant at the University of New Mexico conducting hydrogeological research. Mr. Henderson has earned his Bachelor of Arts degree in English with a minor in Earth and Planetary Sciences from the University of New Mexico in Albuquerque, New Mexico.

Dongmei Li, Chemist

Ms. Li joined the staff at SEM in April of 2001, coming from a chemist position with the City of Calgary, Alberta, Canada where she conducted analyses on waste water and environmental samples by instrumental and wet chemical methods. At the City of Calgary she also carried out research projects in support of environmental protection programs and trained analysts on new techniques. She has also been a research assistant at the University of Calgary and at the Institute for Marine Biology of Crete, Iroklion, Crete. She has earned a Bachelor of Science degree in chemistry at the Sichuan University, Chengdu, Sichuan, China, and a Master of Science degree in analytical chemistry at the University of Calgary, Calgary, Alberta,

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Canada.

Lance Hellman, Chemist

Mr. Hellman joined the staff of Sierra Environmental Monitoring, Inc. in 1999. Prior to arrival at SEM Mr. Hellman was employed at Midwest Testing in St. Louis, MO where he was involved in soil engineering and materials testing. Previous work history also includes working at Environmental Resources Mgmt. in Exton, PA where he was responsible for the daily monitoring of the biological treatment system for industrial wastewater. Mr. Hellman received his Bachelor of Arts from the University of Kansas in Lawrence, KS in 1995 in Environmental Policy and Land Use Analysis.

Jennifer Tretten, Chemist

Ms. Tretten joined the staff of Sierra Environmental Monitoring, Inc. in 2000, left for a time in early 2002 and rejoined the staff later that year. Prior to working at SEM she was a laboratory technician at McClelland Laboratories, Inc. in Sparks Nevada where she had the opportunity to learn about the inorganic analysis of samples derived from the mining industry. Ms. Tretten has earned her Bachelor's of Science degree from University of California, Davis in 1999 in biochemistry.

Jody Benesch, Laboratory Technician

Ms. Benesch joined the staff at Sierra Environmental Monitoring, Inc. in July 2002, having previously worked with Dr. Mae Gustin at the University of Nevada, Department of Environmental Studies, conducting environmental Mercury research projects. Ms. Benesch holds a Bachelor of Science degree in Chemistry and a Masters of Science degree in Environmental Studies from the University of Nevada, Reno.

Salina Eastwood, Laboratory Technician

Ms. Eastwood joined the staff at Sierra Environmental Monitoring, Inc. in July 2000, working part time while a student at the University of Nevada, Reno. After her graduation in December 2000 with a Bachelor of Science in Environmental Policy Analysis and Biology she has been a full time staff member.

Tom Ferrell, Laboratory Technician

Mr. Ferrell has been on the staff at Sierra Environmental Monitoring, Inc. since July 2000 working part time during the school year while pursuing his Bachelor of Science degree in environmental science with a minor in chemistry at the University of Nevada, Reno. Prior to employment at SEM he has worked at the Hilton Hotel in Reno in the building maintenance and engineering department

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where he gained experience in mechanical systems. Tom expects to graduate in May 2001.

Robin Proctor, Office Manager

Ms. Proctor has been employed at Sierra Environmental Monitoring, Inc. since June of 1988. Before joining our staff she had been employed with the Lyon County School District as an administrative assistant. Ms. Proctor is responsible for sample receipt and inventory and analysis report generation. She has studied English and Education at the University of Nevada, Reno.

Susan Osterreicher, Laboratory Technician

Ms. Osterreicher joined the staff at Sierra Environmental Monitoring, Inc. in March of 2001. She has worked as a laboratory technician and chemist at Clayton Environmental Services in Pleasanton, California, and PME Laboratories, in Santa Clara, California. Prior to these postings she has worked in a metallurgical testing laboratory and served in the U. S. Air Force as an aircraft electrical repairman. She has studied Chemistry, Biology, and general science at California State University, Hayward, Purdue University, Weber State College in Utah, and the Community College of the Air Force.

Tina Marie Martella, Full-Charge Bookkeeper

Ms. Martella joined Sierra Environmental Monitoring, Inc in February 1999. She holds a Bachelor of Science degree in Business Administration from the University of Nevada in Reno. She also attended University of Central Florida and Southwest Texas State University. She has held several financial and administrative positions, most recently as Supervisor, Accounting and Billing for Laxalt and Nomura Ltd., a law firm in Reno, Nevada.

Matthew Wroblewski, Chemist (1948 - 2002)

Matt had been battling cancer over the past four years, and had taken leaves of absence several times during this period to undergo chemotherapy and radiation treatment. He never complained about his obvious discomfort caused by the disease and the side effects of the treatments. We will miss him dearly, both as a scientist and as a human being.

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Appendix IV Current Analytical Methods Utilized and Reference Sources

Analysis Category	Analysis Name	Reference Source	Method Identity	Description of Method
General Physical	Acidity	Std Methods	2310 B	Titrimetric
	Alkalinity	Std Methods	2320 B	Titrimetric
	Color	Std Methods	2120 B	Color Comparison
	Conductivity	Std Methods	2510 B	Wheatstone Bridge
	Hydrogen Ion	Std Methods	4500-H+ B	Electrometric
	Redox Potential	Std Methods	2580	Potentiometric
	Turbidity	Std Methods	2130 B	Nephelometric
	Total Dissolved Solids	Std Methods	2540 C	Gravimetric
	Suspended Solids	Std Methods	2540 B	Gravimetric
	Volatile Solids	Std Methods	2540 E	Gravimetric
Nutrients	Nitrogen, Ammonia	Std Methods	4500-NH3	Distill / Potentiometric
	Nitrogen, Kjeldahl	Std Methods	4500-NH3	Digest / Distill
	Nitrogen, Nitrate,	EPA	300.0	Ion Chromatography
	Nitrogen, Nitrite	EPA	300.0	Ion Chromatography
	Nitrogen, total	Std Methods	4500-N	Calculation - sum of species
	Phosphorous, Total	EPA	365.3	Digest / Ascorbic Acid
	Phosphorous, Ortho	EPA	365.3	Ascorbic Acid Colorimetric
Demands	Biochemical Oxygen	Std Methods	5210 B	O2 Electrode/Incubation
	BOD, Inhibited	Std Methods	5210 B	O2 Electrode/Incubation
	Chemical Oxygen Demand	Std Methods	5220 D	Closed Reflux / Colorimetric

Analysis	Analysis Name	Reference	Method	Description of Method
Anions	Chloride	EPA	300.0	Ion Chromatography
	Cyanide, Total	Std Methods	4500-CN C,E	Digest / Colorimetric
	Cyanide, WAD	Std Methods	4500-CN I,E	Digest / Colorimetric
	Cyanide, WAD, F.I. L. E.	EPA	1677	F.I.L.E. / Electrochemical
	Cyanide, Free	EPA	1677	F.I. / Electrochemical Detection
	Cyanide, Free	Std Methods	4500-CN D	Titrimetric
	Cyanide, Amenable	Std Methods	4500-CN G,E	Treat/Digest/Colorimetric
	Cyanate	EPA	300.0	Ion Chromatography
	Thiocyanate	Std Methods	4500-CN M	Colorimetric
	Fluoride	EPA	300.0	Ion Chromatography
	Sulfide	Std Methods	4500-S ²⁻ F	Iodometric Titration
	Bromide	EPA	300.0	Ion Chromatography
Inorganics & Miscellaneous	Chlorine, Residual	Std Methods	4500-Cl B	Iodometric Titration
	Chlorine, Residual	Std Methods	4500-Cl F	DPD / FAS Titration
	Oxygen, Dissolved	Std Methods	4500-O G	O2 Electrode
	Oxygen, Dissolved	Std Methods	4500-O C	Winkler Titration
	Silica	Std Methods	4500-Si C	Molybdosilicate Colorimetric
	Silica	EPA	200.7	ICP - OES
	Surfactants	Std Methods	5540 C	MBAS Colorimetric
	Tannins & Lignins	Std Methods	5550	Colorimetric
	Hardness	Std Methods	2340 C	EDTA Titrimetric
	Hardness	Std Methods	2340 B	ICP - OES + Calculation
	Corrosivity Index	Std Methods	2330	CaCO3 Saturation Index
	Corrosivity	Fed. Regs.	40 CFR 261	Aging Metal Coupon / Gravimetric
	Grease & Oil, Liquids	Std Methods	5250 B	Freon Extraction / Gravimetric
	Grease & Oil, Soil	Std Methods	5520 E	Freon Extraction / Gravimetric
	Grease & Oil - Hexane	EPA	1664	Hexane Extraction /

Revision Date: January 3, 2003

Analysis Category	Analysis Name	Reference Source	Method Identity	Description of Method
Digestions, Extractions, & Preparations	STLC	California	Title 22	Agitation / Extraction
	TTLIC	California	Title 22	Acid Digestion
	TCLP	SW-846 – EPA	1311	Agitation / Extraction
	SPLP	SW-846 – EPA	1312	Agitation / Extraction
	Acid Digestion, RCRA	SW-846 – EPA	3020	Acid Digestion
	Acid Digestion, RCRA	SW-846 – EPA	3050	Acid Digestion
	MWMP	NDEP	1997	Column Extraction
	Digest, total metals, CWA	EPA	200.2	Acid Digestion
Metals	Aluminum	EPA	200.7	ICP - OES
	Aluminum	EPA	200.8	ICP - MS
	Antimony	EPA	200.8	ICP - MS
	Arsenic	EPA	200.8	ICP - MS
	Barium	EPA	200.7	ICP - OES
	Beryllium	EPA	200.8	ICP - MS
	Boron	EPA	200.7	ICP - OES
	Cadmium	EPA	200.8	ICP - MS
	Calcium	EPA	200.7	ICP - OES
	Chromium	EPA	200.8	ICP - MS
	Chromium, Hexavalent	Std Methods	3500-Cr B	Diphenylcarbizide
	Cobalt	EPA	200.8	ICP - MS
	Copper	EPA	200.8	ICP - MS
	Gold	EPA	200.8	ICP - MS
	Iron	EPA	200.7	ICP - OES
	Iron, Divalent	Std Methods	3500-Fe B	Phenanthroline Colorimetric
	Lead	EPA	200.8	ICP - MS
	Lithium	EPA	200.7	ICP - OES
	Magnesium	EPA	200.7	ICP - OES
	Manganese	EPA	200.8	ICP - MS
	Mercury	EPA	245.2	Cold Vapor AA
	Molybdenum	EPA	200.8	ICP - MS

	Nickel	EPA	200.8	ICP - MS
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Analysis Category	Analysis Name	Reference Source	Method Identity	Description of Method
Metals, Cont.	Platinum	EPA	200.8	ICP - MS
	Potassium	EPA	200.7	ICP - OES
	Selenium	EPA	200.8	ICP - MS
	Silver	EPA	200.8	ICP - MS
	Sodium	EPA	200.7	ICP - OES
	Strontium	EPA	200.7	ICP - OES
	Thallium	EPA	200.8	ICP - MS
	Tin	EPA	200.7	ICP - OES
	Vanadium	EPA	200.8	ICP - MS
	Zinc	EPA	200.8	ICP - MS

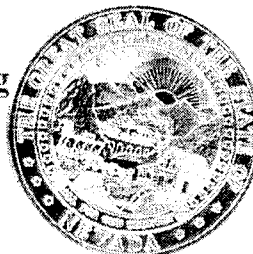
Appendix V
Laboratory Accreditation

STATE OF NEVADA
DIVISION OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER QUALITY PLANNING
ENVIRONMENTAL LABORATORY SERVICES
LABORATORY CERTIFICATION PROGRAM

The environmental laboratory listed on this Certificate has met the quality requirements as specified by the Nevada Administrative Code 445A and is hereby certified to conduct the analyses of water for the contaminants listed on their accepted parameter list(s) effective dates:

August 1, 2003 through July 31, 2004

Sierra Environmental Monitoring
1135 Financial Blvd.
Reno, Nevada 89502




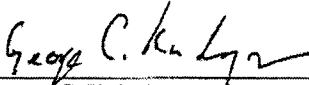
CERTIFICATE No. NV13-2004-69

Jack Ruckman Ph.D.
Laboratory Certification Officer

7-26-03
Date

Donald E. LaFara
Laboratory Certification Officer

8-26-03
Date

	
<p>STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM</p>	
<p>ENVIRONMENTAL LABORATORY CERTIFICATION</p>	
<p>Is hereby granted to</p>	
<p>SIERRA ENVIRONMENTAL MONITORING, INC.</p>	
<p>1135 FINANCIAL BOULEVARD</p>	
<p>RENO, NV 89502</p>	
<p>Scope of certification is limited to the "Accredited Fields of Testing" which accompanies this Certificate.</p>	
<p>Continued certification status depends on successful completion of site visit, proficiency testing studies, and payment of applicable fees.</p>	
<p>This Certificate is granted in accordance with provisions of Section 100825, et seq. of the Health and Safety Code.</p>	
<p>Certificate No: 2526 Expiration Date: 11/30/2004 Effective Date: 07/17/2003</p>	<p> George C. Kulasingam, Ph.D. Program Chief Environmental Laboratory Accreditation Program</p>
<p>Berkeley, California subject to forfeiture or revocation.</p>	



DIANA M. BONTÁ, R.N., Dr. P.H.
Director

State of California—Health and Human Services Agency
Department of Health Services
Sierra Environmental Monitoring



GRAY DAVIS
Governor

AUG 25 2003

July 23, 2003

Certificate No.: 2526

JOHN KOBZA, Ph.D.
SIERRA ENVIRONMENTAL MONITORING, INC.
1135 FINANCIAL BOULEVARD
RENO, NV 89502

Dear JOHN KOBZA, Ph.D.:

This is to advise you that the laboratory named above has been certified as an environmental testing laboratory pursuant to the provisions of the California Environmental Laboratory Improvement Act (Health and Safety Code (HSC), Division 101, Part 1, Chapter 4, Section 100825, et seq.).

The Fields of Testing for which this laboratory has been certified under this Act are indicated on the enclosed "Accredited Fields of Testing." Certification shall remain in effect until **November 30, 2004** unless revoked. This certificate is subject to an annual fee as prescribed by Section 100860(a), HSC, due on November 30, 2003.

Your application for renewal must be received 90 days before the expiration of your certificate to remain in force according to the California Code of Regulations, Title 22, Division 4, Chapter 19, Section 64801 through 64827.

Any changes in laboratory location or structural alterations, which may affect adversely the quality of analysis in the fields of testing for which the laboratory has been granted certification, require prior notification. Notification is also required for changes in ownership or laboratory director within 30 days after the change (HSC, Section 100845(b) and (d)).

Your continued cooperation is essential to maintain high quality of the data produced by environmental laboratories certified by the State of California.

If you have any questions, please contact Aida Dente at (510) 540-2800.

Sincerely,

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Enclosure



Do your part to help California save energy. To learn more about saving energy, visit the following web site:
www.consumerenergycenter.org/flex/index.html

Environmental Laboratory Accreditation Program
1625 Shattuck Avenue, Room 101, Berkeley, CA, 94709-1611
510/ 540-2800, fax 510/849-5106
Internet Address: www.dhs.ca.gov/elap

CALIFORNIA DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

SIERRA ENVIRONMENTAL MONITORING, INC.
1135 FINANCIAL BOULEVARD
RENO, NV 89502

Lab Phone (775) 857-2400

Certificate No: 2526 Renew Date: 11/30/2004

Field of Testing: 101 - Microbiology of Drinking Water

101.010	001	Heterotrophic Bacteria	SM9215B
101.020	001	Total Coliform	SM9221A,B
101.021	001	Fecal Coliform	SM9221E (MTF/EC)
101.022	001	E. coli	CFR 141.21(f)(6)(i) (MTF/EC+MUG)
101.050	001	Total Coliform	SM9222A,B,C
101.051	001	Fecal Coliform	SM9221E (MF/EC)
101.052	001	E. coli	CFR 141.21(f)(6)(i) (MF/EC+MUG)
101.050	002	Total Coliform	SM9223
101.050	003	E. coli	SM9223
101.120	001	Total Coliform (Enumeration)	SM9221A,B,C
101.130	001	Fecal Coliform (Enumeration)	SM9221E (MTF/EC)
101.140	001	Total Coliform (Enumeration)	SM9222A,B,C
101.150	001	Fecal Coliform (Enumeration)	SM9222D
101.150	001	Total Coliform (Enumeration)	SM9223

Field of Testing: 102 - Inorganic Chemistry of Drinking Water

102.030	001	Bromide	EPA 300.0
102.030	002	Chlorate	EPA 300.0
102.030	003	Chloride	EPA 300.0
102.030	005	Fluoride	EPA 300.0
102.030	006	Nitrate	EPA 300.0
102.030	007	Nitrite	EPA 300.0
102.030	010	Sulfate	EPA 300.0
102.070	001	Phosphate, Ortho	EPA 355.1
102.100	001	Alkalinity	SM2320B
102.121	001	Hardness	SM2340C
102.130	001	Conductivity	SM2510B
102.140	001	Total Dissolved Solids	SM2540C
102.150	001	Cyanide, Total	SM4500-CN E
102.152	001	Cyanide, amenable	SM4500-CN G
102.270	001	Surfactants	SM5540C
102.520	001	Calcium	EPA 200.7
102.520	002	Magnesium	EPA 200.7
102.520	003	Potassium	EPA 200.7
102.520	004	Silica	EPA 200.7
102.520	005	Sodium	EPA 200.7
102.520	006	Hardness (calc.)	EPA 200.7

Field of Testing: 103 - Toxic Chemical Elements of Drinking Water

103.130	001	Aluminum	EPA 200.7
103.130	009	Iron	EPA 200.7
103.130	018	Boron	EPA 200.7
103.140	002	Antimony	EPA 200.8
103.140	003	Arsenic	EPA 200.8
103.140	004	Barium	EPA 200.8
103.140	005	Beryllium	EPA 200.8
103.140	006	Cadmium	EPA 200.8

As of 07/23/2003, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Revision Date: January 3, 2003

SIERRA ENVIRONMENTAL MONITORING, INC.

Certificate No: 2526
Renew Date: 11/30/2004

103.140	007	Chromium	EPA 200.8
103.140	006	Copper	EPA 200.8
103.140	009	Lead	EPA 200.8
103.140	010	Manganese	EPA 200.8
103.140	011	Mercury	EPA 200.8
103.140	012	Nickel	EPA 200.8
103.140	013	Selenium	EPA 200.8
103.140	014	Silver	EPA 200.8
103.140	015	Thallium	EPA 200.8
103.140	016	Zinc	EPA 200.8
103.140	018	Vanadium	EPA 200.8
103.160	001	Mercury	EPA 245.1
Field of Testing: 107 - Microbiology of Wastewater			
107.010	001	Heterotrophic Bacteria	SM9215B
107.020	001	Total Coliform	SM9221B
107.040	001	Fecal Coliform	SM9221C.E (MTP/EG)
107.090	001	Total Coliform	SM9222B
107.090	001	Fecal Coliform	SM9222D
107.100	001	Fecal Streptococci	SM9230B
107.100	002	Enterococci	SM9230B
107.110	002	Enterococci	SM9230C (MF/ME)
107.111	001	Fecal Streptococci	SM9230C (MF/m-Enterococcus)
107.111	002	Enterococci	SM9230C (MF/m-Enterococcus)
Field of Testing: 108 - Inorganic Chemistry of Wastewater			
108.112	001	Boron	EPA 200.7
108.112	002	Calcium	EPA 200.7
108.112	003	Hardness (calc.)	EPA 200.7
108.112	004	Magnesium	EPA 200.7
108.112	005	Potassium	EPA 200.7
108.112	006	Silica	EPA 200.7
108.112	007	Sodium	EPA 200.7
108.120	001	Bromide	EPA 300.0
108.120	002	Chloride	EPA 300.0
108.120	003	Fluoride	EPA 300.0
108.120	004	Nitrate	EPA 300.0
108.120	005	Nitrite	EPA 300.0
108.120	006	Nitrate-nitrite, Total	EPA 300.0
108.120	008	Sulfate	EPA 300.0
108.172	001	Chlorine Residual, Total	EPA 330.3
108.202	001	Ammonia	EPA 360.3
108.264	001	Phosphate, Ortho	EPA 365.3
108.265	001	Phosphorus, Total	EPA 365.3
108.270	001	Dissolved Silica	EPA 370.1
108.290	001	Sulfide	EPA 376.1
108.310	001	Biochemical Oxygen Demand	EPA 405.1
108.323	001	Chemical Oxygen Demand	EPA 410.4
108.330	001	Oil and Grease	EPA 413.1
108.380	001	Oil and Grease	EPA 1664
108.390	001	Turbidity	SM2130B
108.400	001	Acidity	SM2310B
108.410	001	Alkalinity	SM2320B
108.421	001	Hardness	SM2340C
108.430	001	Conductivity	SM2510B
108.440	001	Residue, Total	SM2540B

As of 07/23/2003, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Page 2 of 4

SIERRA ENVIRONMENTAL MONITORING, INC.

Certificate No: 2526

Renew Date: 11/30/2004

108.441	001	Residue, Filterable	SM2540C
108.442	001	Residue, Non-filterable	SM2540D
108.443	001	Residue, Settleable	SM2540F
108.470	001	Cyanide, Manual Distillation	SM4500-CN C
108.473	001	Cyanide, amenable	SM4500-CN G
108.490	001	pH	SM4500-H+ 8
108.501	001	Kjeldahl Nitrogen	SM4500-NH3 C
108.590	001	Biochemical Oxygen Demand	SM5210B
108.591	001	Carbonaceous BOD	SM5210B
108.640	001	Surfactants	SM5540C
108.650	001	Tannin and Lignin	SM5550B

Field of Testing: 109 - Toxic Chemical Elements of Wastewater

109.010	001	Aluminum	EPA 200.7
109.010	012	Iron	EPA 200.7
109.010	024	Tin	EPA 200.7
109.020	002	Antimony	EPA 200.8
109.020	003	Arsenic	EPA 200.8
109.020	004	Barium	EPA 200.8
109.020	005	Beryllium	EPA 200.8
109.020	006	Cadmium	EPA 200.8
109.020	007	Chromium	EPA 200.8
109.020	008	Cobalt	EPA 200.8
109.020	009	Copper	EPA 200.8
109.020	010	Lead	EPA 200.8
109.020	011	Manganese	EPA 200.8
109.020	012	Molybdenum	EPA 200.8
109.020	013	Nickel	EPA 200.8
109.020	014	Selenium	EPA 200.8
109.020	015	Silver	EPA 200.8
109.020	016	Thallium	EPA 200.8
109.020	017	Vanadium	EPA 200.8
109.020	018	Zinc	EPA 200.8
109.190	001	Mercury	EPA 245.1
109.811	001	Chromium (VI)	SM3500-Cr D

Field of Testing: 114 - Inorganic Chemistry of Hazardous Waste

114.020	001	Antimony	EPA 6020
114.020	002	Arsenic	EPA 6020
114.020	003	Barium	EPA 6020
114.020	004	Beryllium	EPA 6020
114.020	005	Cadmium	EPA 6020
114.020	006	Chromium	EPA 6020
114.020	007	Cobalt	EPA 6020
114.020	008	Copper	EPA 6020
114.020	009	Lead	EPA 6020
114.020	010	Molybdenum	EPA 6020
114.020	011	Nickel	EPA 6020
114.020	012	Selenium	EPA 6020
114.020	013	Silver	EPA 6020
114.020	014	Thallium	EPA 6020
114.020	015	Vanadium	EPA 6020
114.020	016	Zinc	EPA 6020
114.103	001	Chromium (VI)	EPA 7186A
114.140	001	Mercury	EPA 7470A
114.141	001	Mercury	EPA 7471A

As of 07/23/2003, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Page 3 of 4

SIERRA ENVIRONMENTAL MONITORING, INC.

Certificate No: 2526
Renew Date: 11/30/2004

114.221	001	Cyanide, Total	EPA 9012A
114.240	001	pH	EPA 9040
114.241	001	pH	EPA 9045
Field of Testing: 115 - Extraction Test of Hazardous Waste			
115.021	001	TCLP Inorganics	EPA 1311
115.030	001	Waste Extraction Test (WET)	CCR Chapter 11, Article 5, Appendix II
115.040	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312
Field of Testing: 120 - Physical Properties of Hazardous Waste			
120.010	001	Ignitability	EPA 1010
120.040	001	Reactive Cyanide	Section 7.3 SW-846
120.050	001	Reactive Sulfide	Section 7.3 SW-846
120.070	001	Corrosivity - pH Determination	EPA 9040B
120.080	001	Corrosivity - pH Determination	EPA 9045C
Field of Testing: 126 - Microbiology of Recreational Water			
126.010	001	Total Coliform (Enumeration)	SM9221A,B,C
126.020	001	Total Coliform (Enumeration)	SM9222A,B
126.030	001	Fecal Coliform (Enumeration)	SM9221E
126.040	001	Fecal Coliform (Enumeration)	SM9222D

ALLEN BIACCI, *Administrator*

(775) 687-4670

Administration
Facsimile 687-5856Water Pollution Control
Facsimile 687-4684Mining Regulation and
Reclamation
Facsimile 684-5239STATE OF NEVADA
KENNY C. GUINN
Governor

Sierra Environmental Monitoring

R. MICHAEL TURNIPSEED, *Director*

OCT 3 2003

Waste Management
Corrective Actions
Federal FacilitiesAir Pollution Control
Air Quality Planning
Water Quality Planning

Facsimile 687-6396

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTIONJohn Seher
Sierra Env Monitoring NV15
1135 Financial Blvd
Reno, NV 89502333 W. Nye Lane, Room 138
Carson City, Nevada 89706

September 30, 2003

STATE OF NEVADA
CERTIFIED PARAMETER LIST

Pursuant to regulations adopted by the Board of Health and the Environmental Commission, the State of Nevada will accept data from this laboratory for the following contaminants under the Safe Drinking Water and Clean Water Acts.

Please be advised that it is the responsibility of the laboratory to make your clientele aware of changes. In particular it is important that the clients are aware of the loss of any previously certified parameters. If the laboratory subcontracts samples to other laboratories, it is the responsibility of the laboratory to ensure that the contracting laboratory is Nevada certified for all contracted parameters. The clients must be made aware of any subcontracted work.

Proficiency testing results should be submitted prior to the expiration date.

This parameter list supercedes any previously issued parameter lists.

EXPIRATION DATE: March 31, 2004

Drinking Water Metals

	METHODS
Aluminum	200.7
Antimony	200.8
Arsenic	200.8
Barium	200.8
Beryllium	200.8
Boron	200.7
Cadmium	200.8
Chromium	200.8
Chromium VI	3500-Cr D
Copper	200.8
Iron	200.7
Lead	200.8
Manganese	200.8
Molybdenum	200.8
Nickel	200.8
Selenium	200.8
Silica	370.1
Silver	200.8
Thallium	200.8
Vanadium	200.8
Zinc	200.8
Mercury	245.2
<u>Drinking Water Microbiology</u>	METHODS
Total Coliforms	9222 B
Fecal Coliforms	9222 D
Total Coliforms	9221 B
Fecal Coliforms, E. Coli	9221 E, F
Total Coliforms	9223 B
E. Coli	9223 B

Drinking Water Inorganics

	METHODS
pH	4500-H B
Chloride	300
Conductivity	2510B
Fluoride	300
Nitrate as N	300
Nitrate + Nitrite as N	300
Potassium	200.7
Sulfate	300
Total Dissolved Solids 180 C	2540C
Alkalinity	2320B
Sodium	200.7
Turbidity	2130B
Total Residual Chlorine	350.3
Nitrite as N	300
Ortho-Phosphate as P	365.3
Cyanide	4500-CN C
Bromide	300
Total Hardness as CaCO ₃	2340C
Calcium	200.7
Magnesium	200.7
Surfactants (MBAS)	5540C
Corrosivity	2330 B

John Seher
Sierra Env Monitoring NV15
1135 Financial Blvd
Reno, NV 89502

September 30, 2003

STATE OF NEVADA

This parameter list supercedes any previously issued parameter lists.

EXPIRATION DATE: December 31, 2003

Waste Water Metals

Aluminum	Method 200.7
Antimony	Method 200.8
Arsenic	Method 200.8
Barium	Method 200.8
Beryllium	Method 200.8
Boron	Method 200.7
Cadmium	Method 200.8
Chromium	Method 200.8
Cobalt	Method 200.8
Copper	Method 200.8
Iron	Method 200.7
Lead	Method 200.8
Manganese	Method 200.8
Molybdenum	Method 200.8
Nickel	Method 200.8
Selenium	Method 200.8
Silver	Method 200.8
Strontium	Method 200.7
Thallium	Method 200.8
Vanadium	Method 200.8
Zinc	Method 200.8
Mercury	Method 245.1
Tin	Method 200.7
Titanium	Method 200.7
Chromium VI	Method 3500 Cr D
Bromide	Method 300.0
Silica	Method 370.1

Waste Water Microbiology

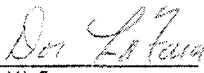
Heterotrophic Plate Count	Method 9215 B
Fecal Streptococcus	Method 9230 C
Total Coliforms	Method 9222 B
Fecal Coliforms	Method 9222 D
Total Coliforms	Method 9221 B
Fecal Coliforms, E. Coli	Method 9221 E, F

Waste Water Inorganics

Acidity	Method 2310 B
Alkalinity	Method 2320 B
Chloride	Method 300.0
Conductivity	Method 2510 B
Fluoride	Method 300.0
Potassium	Method 200.7
Sodium	Method 200.7
Sulfate	Method 300.0
Total Dissolved Solids	Method 2540 C
Total Solids	Method 2540 B
pH	Method 4500 H+ B
Total Suspended Solids	Method 2540 D
Settleable Solids	Method 2540 F
Volatle Solids	Method 2540 E
Calcium	Method 200.7
Magnesium	Method 200.7
Total Hardness	Method 2340 C
BOD	Method 5210 B
CBOD	Method 5210 B
COD	Method 410.4
Ammonia	Method 350.3
Nitrate	Method 300.0
ortho-Phosphate	Method 385.3
TKN	Method 351.4
Total Phosphorus	Method 385.3
Cyanide	Method 335.2
Oil & Grease	Method 413.1
Total Residual Chlorine	Method 330.3
Sulfide	Method 376.1
Surfactants	Method 5540 C
Turbidity	Method 2130 B

END OF REPORT

Summary of Changes: None


Donald LaFara
Laboratory Certification Officer
Nevada Division of Environmental Protection

9-30-03
Date


Tom Porta P.E., Bureau Chief
Water Quality Planning
Nevada Division of Environmental Protection

9-30-03
Date

Sierra Environmental Monitoring, Inc.

Revision Date: January 3, 2003

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BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII



BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

Sierra Environmental Monitoring

APR 8 2002

STATE OF HAWAII
DEPARTMENT OF HEALTH
STATE LABORATORIES DIVISION
2725 WAIMANO HOME ROAD
PEARL CITY, HAWAII 96782-1496

In reply, please refer to:
File: SLD

April 1, 2002

John Seher
Quality Assurance Manager
Sierra Environmental Monitoring, Inc.
1135 Financial Blvd.
Reno, NV 89502-2348

Dear Mr. Seher:

After a review of the required documents we are pleased to recommend that data for drinking water analyses be "accepted" for regulatory purposes by the State of Hawaii, Department of Health, Safe Drinking Water Program until March 31, 2003 for the parameters listed on the following page. **All testing for regulatory drinking water purposes must be done with approved EPA methods and PE studies should be passed using these methodologies. Failure to do so, could result in the loss of approval status with this state.**

It is the laboratory's responsibility to keep the file current by continuing to submit results of WS PE studies, copies of home state on-site evaluation reports, as they occur, responses to "not acceptable" results on PE studies and immediate notification of any significant changes.

The State of Hawaii, Safe Drinking Water Program, requires that a laboratory pass one Performance Evaluation sample, each year, for each analyte, for which they want "Approval". The laboratory should complete a WS PE study within the first quarter of 2002.

All samples that are contracted out by your laboratory for Hawaii regulatory drinking water monitoring must be analyzed by laboratories that have been approved by the Hawaii Safe Drinking Water Program.

Sierra Environmental Monitoring, Inc.

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To avoid interruption of your approval, you must submit a written request for renewal at least two months prior to the expiration date indicated above.

If you have any questions, please call Richard Kiyokane, Laboratory Certification Officer, at (808) 453-6679. Thank you for your time and efforts.

Sincerely,



Vernon K. Miyamoto, Ph.D.
Chief, State Laboratories Division

VKM:rk
Enclosure
c: William Wong, Chief, Safe Drinking Water Branch

It is recommended that data from the following laboratory be accepted for drinking water analyses for regulatory purposes by the State of Hawaii, Department of Health, Safe Drinking Water Program for the contaminants listed until March 31, 2003.

Sierra Environmental Monitoring, Inc.
1135 Financial Blvd.
Reno, NV 89502-2348
John Seher, Quality Assurance Manager
(775) 857-2400

Primary Inorganic Contaminants

Antimony	200.8
Arsenic	200.8
Barium	200.8
Beryllium	200.8
Cadmium	200.8
Chromium	200.8
Mercury	245.2
Nickel	200.8
Lead	200.8
Copper	200.8
Selenium	200.8
Thallium	200.8
Nitrate	300.0
Nitrite	300.0
Fluoride	300.0
Cyanide	4500CN C
Alkalinity	310.1
Turbidity	180.1
PH	150.1

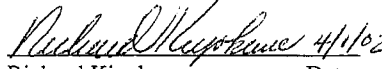
Secondary Inorganic Contaminants

Chloride	300.0
Sulfate	300.0
Total Dissolved Solids	160.1
Aluminum	200.7
Calcium	200.7
Magnesium	200.7
Conductivity	120.1

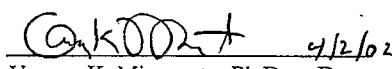
Secondary Inorganic Contaminants

Orthophosphate	365.3
Manganese	200.8
Potassium	200.7
Silver	200.8
Sodium	200.7
Hardness	130.2
Zinc	200.8
Molybdenum	200.8
Vanadium	200.8
Residual Chlorine, Total	4500CL F
Bromide	300.0

RECOMMENDED:


Richard Kiyokane Date
Laboratory Certification Officer

APPROVED:


Vernon K. Miyamoto, Ph.D. Date
State Laboratory Administrator

Appendix VI

Sample Containers, Preservation, Holding Times, and Recommended Volumes

Group	Parameter	Container	Preservation ₂	Holding Time	Volume
Bacteriological	Coliform, total/fecal	P or G ₁	Cool 4 °C, 0.008% Na ₂ S ₂ O ₃	6 hours	125 ml
	Fecal Streptococci	P or G ₁	Cool 4 °C, 0.008% Na ₂ S ₂ O ₃	6 hours	125 ml
	Coliform, total, P/A	P or G ₁	Cool 4 °C, 0.008% Na ₂ S ₂ O ₃	24 hours	125 ml
General Physical	Acidity	P or G	Cool 4 °C	14 days	250 ml
	Alkalinity	P or G	Cool 4 °C	14 days	250 ml
	Color	P or G	Cool 4 °C	48 hours	250 ml
	Hydrogen Ion (pH)	P or G	None	Immediately	250 ml
	Redox Potential	P or G	None	Immediately	250 ml
	Turbidity	P or G	Cool 4 °C	48 hours	250 ml
	Total Diss. Solids	P or G	Cool 4 °C	7 days	500 ml
	Suspended Solids	P or G	Cool 4 °C	7 days	1 liter
	Volatile Solids	P or G	Cool 4 °C	7 days	1 liter
Nutrients	Nitrogen, Ammonia	P or G	Cool 4 °C, H ₂ SO ₄ pH <2	28 days	500 ml
	Nitrogen, Kjeldahl	P or G	Cool 4 °C, H ₂ SO ₄ pH <2	28 days	500 ml
	Nitrogen, Nitrate	P or G	Cool 4 °C ₃	48 hours	250 ml
	Nitrogen, Nitrite	P or G	Cool 4 °C ₄	48 hours	250 ml
	Phosphorous, total	P or G	Cool 4 °C, H ₂ SO ₄ pH <2	28 days	250 ml
	Phosphorous, ortho	P or G	Cool 4 °C	48 hours	250 ml
O ₂ Demands	BOD, CBOD	P or G	Cool 4 °C	48 hours	1 liter
	COD	P or G	Cool 4 °C, H ₂ SO ₄ pH <2	28 days	250 ml
Anions	Chloride	P or G	None	28 days	250 ml
	Cyanide, all forms	P or G	Cool 4 °C, NaOH pH >12 ₅	14 days ₆	1 liter
	Cyanate	P or G	Cool 4 °C	7 days	250 ml
	Thiocyanate	P or G	Cool 4 °C	14 days	250 ml
	Fluoride	P or G	None	28 days	250 ml
	Sulfide	P or G	Cool 4 °C, ZnOAc, NaOH	7 days	1 liter
	Bromide	P or G	None	28 days	250 ml
Inorganics & Miscellaneous	Chlorine, residual	P or G	Cool 4 °C	Immediately	1 liter
	Oxygen, dissolved	P or G	Cool 4 °C	Immediately	1 liter
	Silica	P only	None	28 days	250 ml
	Surfactants	P or G	Cool 4 °C	48 hours	500 ml
	Tannins & Lignins	P or G	Cool 4 °C	7 days	500 ml
	Hardness	P or G	HNO ₃ to pH < 2	6 months	500 ml
	Corrosivity	P or G	Cool 4 °C	7 days	500 ml
	Grease & Oil, liquid	G only	Cool 4 °C, H ₂ SO ₄ , HCl pH <2	28 days	1 liter
	Grease & Oil, soil	G only	Cool 4 °C	28 days	100 g.
Waste Characterization	TCLP, STLC	P or G	None	28 days	200 g.
	Flash Point	G only	Cool 4 °C	28 days	40 ml
	Ignitability	P or G	None	28 days	200 cm

Group	Parameter	Container	Preservation ₂	Holding Time	Volume
Metals	Metals	P or G	HNO ₃ to pH < 2	6 months	250 ml
	Mercury	P or G	HNO ₃ to pH < 2	28 days	250 ml
	Chromium VI	P or G	Cool 4 °C	24 hours	500 ml
	Iron II	P or G	Cool 4 °C, HCl pH < 2	7 days	250 ml
	Arsenic III, V	P or G	Cool 4 °C	7 days	250 ml

Footnotes:

1. Containers for bacteriological analyses must be sterilizable.
2. Preservation should be accomplished immediately after sample collection.
3. Nitrate Nitrogen may be preserved with H₂SO₄ to pH <2 with holding time extended to 28 days. Reporting limit will be raised by at least a factor of 10. This preservation will convert any nitrite present into nitrate.
4. Nitrite may be preserved with H₂SO₄ with holding time extended to 28 days, however nitrite will be converted to nitrate, and the analytical result will be nitrate + nitrite.
5. Samples for cyanide analysis should be checked for presence of oxidants before preservation. If oxidants are present, add 0.5 gram of ascorbic acid, agitate, and retest. Repeat until negative test for oxidants is achieved. Samples containing sulfides should be analyzed within 24 hours.

Sierra Environmental Monitoring, Inc.

Revision Date: January 3, 2003

Document ID: SEM QAP 11-03-

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Appendix VII

Chain of Custody Form

Appendix VIII

Example Laboratory Analysis Reports

**Laboratory
Analysis Report**Sierra
Environmental
Monitoring, Inc.Sierra Environmental Monitoring
1135 Financial Boulevard
Reno, NV 89502-2348
Attn: Lance HellmannDate: 12/16/2002
Client: SEM-965
Taken by: R. Kobza
Report: 50254
PO #:

Sample ID:	Customer Sample ID	Date Sampled	Time Sampled	Date Received		
S200211-1062	Acid Waste Drum A Start 10/18-02	11/21/2002	9:20 AM	11/21/2002		
Parameter	Method	Result	Units Of Measure	MCL	Analyst	Date Analyzed
Total Recoverable Metals - Acid	SW-846 3020A	Completed			Kleinworth	11/22/2002
Arsenic - ICP-MS	SW-846 6020	<0.4	mg/L	0.01 mg/L	Li	11/27/2002
Barium - ICP-MS	SW-846 6020	0.5	mg/L	2.0 mg/L	Li	11/27/2002
Cadmium - ICP-MS	SW-846 6020	<0.2	mg/L	0.005 mg/L	Li	12/12/2002
Chromium - ICP-MS	SW-846 6020	<0.4	mg/L	0.1 mg/L	Li	11/27/2002
Silver - ICP-MS	SW-846 6020	<0.4	mg/L	0.1 mg/L	Li	11/27/2002
Lead - ICP-MS	SW-846 6020	0.7	mg/L	0.015 mg/L	Li	11/27/2002
Mercury - AA Cold Vapor	SW-846 7470	<0.004	mg/L	0.002 mg/L	Layman	11/26/2002
Selenium - ICP-MS	SW-846 6020	<0.4	mg/L	0.05 mg/L	Li	11/27/2002

SAMPLE WATER AS TESTED DID DID NOT MEET DRINKING WATER STANDARDS.Approved By: John Kobza

Sierra Environmental Monitoring, Inc.

Date: 12/16/02

This report is applicable only to the sample received by the laboratory. The liability of the laboratory is limited to the amount paid for this report. This report is for the exclusive use of the client to whom it is addressed and upon the condition that the client assumes all liability for the further distribution of the report or its contents.



Sierra
Environmental
Monitoring, Inc.

Quality Control Report

An Addendum to SEM Report Number: 50254

Project ID: Acid Waste

Parameter	LCS, % Recovery	MS, % Recovery	MSD, % Recovery	RPD, %	Method Blank
Arsenic - ICP-MS	103	90	93	3.00	<0.4 mg/L
Barium - ICP-MS	101	89	92	3.00	<0.4 mg/L
Cadmium - ICP-MS	103	88	90	3.00	<0.4 mg/L
Chromium - ICP-MS	104	88	90	2.00	<0.4 mg/L
Lead - ICP-MS	102	90	91	2.00	<0.4 mg/L
Mercury - AA Cold Vapor	104	104	100	4.00	<0.004 mg/L
Selenium - ICP-MS	101	88	90	3.00	<0.4 mg/L
Silver - ICP-MS	102	85	84	1.00	<0.4 mg/L

Legend: LCS, Laboratory Control Standard; MS, Matrix Spike; MSD, Matrix Spike Duplicate;
RPD, Relative Percent Difference

Monday, December 16, 2002

John Kobza, Ph.D.
Laboratory Director

1135 Financial Blvd.
Reno, NV 89502-2348
Phone (775) 857-2400
FAX (775) 857-2404
sem@sem-analytical.com

John C. Seher
Special Consultant
Quality Assurance Manager

Page 1 of 1

**Laboratory
Analysis Report**Sierra
Environmental
Monitoring, Inc.Sierra Environmental Monitorin
Attn: Lance Hellmann
1135 Financial Boulevard
Reno, NV 89502-2348Date: 12/16/2002
Client: SEM-965
Taken by: R. Kobza
Report: 50254
PO #:Sample ID: Customer Sample ID
S200211-1062 Acid Waste Drum A Start 10/18-02

Date Sampled 11/21/2002 Time Sampled 9:20 AM Date Received 11/21/2002

Parameter	Method	Result	Units Of Measure	Reporting Limit	Analyst	Date Analyzed
Total Recoverable Metals - Acid	SW-846 3020A	Completed			Kleinworth	11/22/2002
Arsenic - ICP-MS	SW-846 6020	<0.4	mg/L	0.4	Li	11/27/2002
Barium - ICP-MS	SW-846 6020	0.5	mg/L	0.4	Li	11/27/2002
Cadmium - ICP-MS	SW-846 6020	<0.2	mg/L	0.2	Li	12/12/2002
Chromium - ICP-MS	SW-846 6020	<0.4	mg/L	0.4	Li	11/27/2002
Silver - ICP-MS	SW-846 6020	<0.4	mg/L	0.4	Li	11/27/2002
Lead - ICP-MS	SW-846 6020	0.7	mg/L	0.4	Li	11/27/2002
Mercury - AA Cold Vapor	SW-846 7470	<0.004	mg/L	0.004	Layman	11/26/2002
Selenium - ICP-MS	SW-846 6020	<0.4	mg/L	0.4	Li	11/27/2002

Approved By:

Sierra Environmental Monitoring, Inc.

Date:

12/16/02

This report is applicable only to the sample received by the laboratory. The liability of the laboratory is limited to the amount paid for this report. This report is for the exclusive use of the client to whom it is addressed and upon the condition that the client assumes all liability for the further distribution of the report or its contents.

Appendix IX

Example Cation/Anion Balance Calculation

Sierra Environmental Monitoring, Inc
Cation/Anion Balance Worksheet

OrderID: 49070

S200209-1171 MW-19

Alkal.	Cl	CN	F	NO3	SO4	Anions	Silica	Al	Ca	Cu	Fe	Mg	Mn	K	Na	Cations	Hardness
48	46	0	0.33	0	290	365.13	0	mg/l	94	0.01	0	16	0	2.6	48	160.61	300.606
0.96	1.30	0.00	0.02	0.00	6.04	8.317	meq/l	0.00	4.69	0.00	0.00	1.32	0.00	0.07	2.09	8.161	meq/l
TDS Measured: 560 mg/l TDS Calculated: 525.74 mg/l TDS % Diff: 6.31 % Ion % Diff: 1.88 % Conductivity/TDS: 0.00																	

S200209-1172 MW-17

Alkal.	Cl	CN	F	NO3	SO4	Anions	Silica	Al	Ca	Cu	Fe	Mg	Mn	K	Na	Cations	Hardness
82	80	0	0.24	2.1	290	428.74	0	mg/l	110	0.003	0	19	0	3.7	48	180.70	352.912
1.64	2.26	0.00	0.01	0.15	6.04	10.101	meq/l	0.00	5.49	0.00	0.00	1.56	0.00	0.09	2.09	9.235	meq/l
TDS Measured: 610 mg/l TDS Calculated: 609.446 mg/l TDS % Diff: 0.09 % Ion % Diff: 8.96 % Conductivity/TDS: 0.00																	

S200209-1173 DM-3

Alkal.	Cl	CN	F	NO3	SO4	Anions	Silica	Al	Ca	Cu	Fe	Mg	Mn	K	Na	Cations	Hardness
120	19	0	0.55	0	21	112.55	0	mg/l	30	0	0	5.5	0	2	33	70.5	97.559
2.40	0.54	0.00	0.03	0.00	0.44	3.402	meq/l	0.00	1.50	0.00	0.00	0.45	0.00	0.05	1.43	3.436	meq/l
TDS Measured: 220 mg/l TDS Calculated: 183.05 mg/l TDS % Diff: 18.34 % Ion % Diff: 0.98 % Conductivity/TDS: 0.00																	