

APPENDIX D

Field Monitoring and Sample Collection Standard Operating Procedures Manual for Groundwater Discharge Permit Monitoring GW1810161

**Field Monitoring and Sample Collection
Standard Operating Procedures Manual**

For

Groundwater Discharge Permit Monitoring

GW1810161

**KENNECOTT EAGLE PROJECT
MARQUETTE COUNTY, MICHIGAN**

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DC-1: Field Records

Record appropriate information associated with each monitoring event and sample. Field record entries shall be made in pencil or indelible ink on field data sheets pre-printed on water resistant paper. Record the following information:

1. Sample, client, project and sampler identities;
2. Date and time of sample collection and weather;
3. Comments such as site visitors, well condition, QC samples or photographs;
4. Evacuation method;
5. Stabilization record including initial water level, start time, purge rate and temperature followed by sequential field readings of time, water level, specific conductivity, ORP, pH, and dissolved oxygen;
6. After stabilization is achieved, record odor, appearance, turbidity, specific conductance, conductance, pH, dissolved oxygen, and ORP; and
7. Sample containers collected.

Hard copy field data sheets will be scanned and filed in the appropriate project field record three ring binder.

DC-2: Monitoring Point and Sample Identification

A descriptive alphanumeric coding system will be used to provide a unique identification to each monitoring location and sample. All samples collected from a monitoring location will be identified by this monitoring location code and a unique sample identification (KEX ID).

The monitoring location code will consist of the following fields:

<u> </u> Feature Designation	<u> </u> Sub-feature* * (if applicable)	<u> </u> <u> </u> <u> </u> Location ID*	<u> </u> Depth*
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Feature designations will be a three letter acronym such as “QAL” for quaternary aquifer. Sub-feature identification will be an identifier indicating that the monitoring point is either a well (M) or a piezometer (P). The location ID will be a numeric identification for the feature (such as 008) The depth code is an alphabetical identifier of the screened zone of the saturated Quaternary aquifer (A through E) with “A” representing the upper most

saturated zone and “E” representing the lower most saturated zone. The monitoring location code is assigned by the hydrology task leader.

The date and time of sample collection in combination with the unique monitoring location code will create a unique point-in-time identification for a sample collected from a particular monitoring point.

Each environmental sample, field blank and duplicate will also be assigned a “KEX ID”. This ID is an alphanumeric designation unique to each sample. The identification links the resulting data to the monitoring point and date of monitoring. The identifier consists of “EAG” identifying the sample as part of the Eagle project, followed by a hyphen and 7 numbers generating an ID such as EAG-1001724. The numbers are sequentially assigned to the environmental and quality control samples prior to collection.

DC-3: Sample Container Preparation

Sample containers will be prepared by the analytical laboratory and shall include labels and preservatives (as required by the analytical method). The container and preservative for each analytical parameter is shown in Table DC-1.

DC-4: Sample Labeling

Sample labels will be provided by the analytical laboratory and will include the client name, project name, sample and KEX ID, preservative and have spaces for field samplers to record the date and time of collection and the samplers initials. All labels shall be water resistant. Information recorded by the samplers on the label shall be completed using indelible ink. Labeling may also be done directly on the sample containers with indelible ink, or using stick-on labels, or tags with wire or string ties. .

DC-5: Sample Custody

Sample chain of custody documentation will be completed using a laboratory supplied Chain of Custody Record (COC). The COC will be completed and checked prior to shipping and will generally include the following information:

1. Client name, project name and contact, reporting and invoicing information;
2. Laboratory shipping address and contact information;

3. Sample ID and KEX IDs, sampling date and time, and sample matrix;
4. Sample analytical requests, preservatives, and number of containers;
5. Sampler's name and signature and relinquish date and time;
6. Laboratory receiving information (completed by laboratory);
7. Additional comments or instructions; and,
8. Shipping method and tracking numbers.

After collection, the samples will be stored in a secure manner and packaged as required by the analytical protocol (e.g., packed on ice) until shipped to the laboratory.

Laboratory personnel will note any damage to the sample containers or discrepancies between the sample label and information on the COC. The task leader or quality assurance manager will be contacted to resolve any problems.

DC-6: Sample Preservation and Packaging

Sample containers from each monitoring point shall be grouped in a Ziploc bag (or equivalent) and placed in a cooler with sufficient ice to cool the samples to about 4 degrees Celsius and keep the samples at that temperature until delivered to the laboratory. The COC will also be placed in a water tight bag and in one of the sample shipment coolers. Glass sample containers will be protected from breakage with bubble wrap. Coolers shall be secured with packaging tape and a signed and dated COC seal. Table DC-1 contains the required sample containers, preservatives, and holding times for analytical parameters.

TABLE DC-1
CONTAINERS, PRESERVATION, AND HOLDING TIMES

ANALYTE	CONTAINER*	PRESERVATIVE	HOLDING TIME
Alkalinity	P,G	Cool, 4°C	14 Days
BOD	P	Cool, 4°C	48 Hours
Chloride	P,G	None	28 Days
Fluoride	P	None	28 Days
Mercury	P,G	No Headspace - None	28 Days
Metals, except Mercury	P	HNO ₃ to pH<2, Cool, 4°C	6 Months
Nitrate	P,G	Cool, 4°C	48 Hours
Nitrite	P,G	Cool, 4°C	48 Hours
Nitrogen,	P,G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 Days
Sulfate	P,G	Cool, 4°C, if pH is < 4.5, use HCL	28 Days

*Polyethylene (P), Glass (G)

DC-7: Electronic Data

Hand generated field data sheets shall be scanned and converted to electronic files upon return to the office. The scanned images shall be stored in the appropriate project file directory. Laptop or handheld (field) computers may be used as an alternative to handwritten field data sheets for documentation. The specified information is entered into the computer at each site and regenerated to a hard copy upon return to the office. All electronic records should be stored in the appropriate project file directories.

MD-1: Equipment Maintenance

Equipment and instrument maintenance is required to ensure that accurate data are collected during field investigations with minimal equipment problems. This procedure discusses the required field maintenance. Procedure GF-01 includes equipment calibration steps. In addition to these procedures, the appropriate manual will be consulted for the proper preventative maintenance and calibration details for each instrument.

Routine daily maintenance procedures will be conducted in the field to ensure that equipment is operable, including the following:

1. Remove surface dirt and debris;
2. Replace disposable parts (e.g., probe membranes) as required by equipment manual;
3. Store equipment in a secure, dry place, protected from dust, wind, and precipitation;
4. Large equipment stored outside will be protected by covering sensitive parts to protect from dust, wind, and precipitation;
5. Inspect equipment and instruments for possible problems (e.g., cracked or clogged lines or tubing, weak batteries); and,
6. Charge battery packs for equipment.

MD-2: Equipment Decontamination

Decontaminate all non-dedicated and non-disposable equipment that contact water destined for sample containers prior to use and after each field event. The materials needed for decontamination are dependent upon the equipment to be cleaned and the nature of potential contaminants encountered while sampling. The following is a list of equipment to be considered during decontamination:

1. Cleaning solutions, tap water, and de-ionized/distilled water for the final rinse;
2. Storage vessels to transport large volumes of distilled water;
3. Buckets and wash basins for use in the washing and rinsing of equipment;
4. A drying rack;
5. Paper towels or Chemwipes for use in cleaning all outside surfaces or surfaces that do not come into contact with the sample; and,
6. Plastic garbage bags to contain all disposable items.

Decontaminate non-dedicated and non-disposable equipment that contacts sample media as described below:

1. Manually scrub with a non-phosphate detergent;
2. Rinse with tap water, and then with de-ionized/distilled water;
3. Rinse three times with de-ionized/distilled water;
4. If sampling for organic compounds, rinse with pesticide-grade acetone or pesticide-grade methanol;

5. Air dry equipment; and,
6. Place all disposal items into plastic garbage bags and transport to an appropriate garbage receptacle.

MD-3: Maintenance and Calibration of Field Meters

All water level meters will be calibrated annually or after any repairs to ensure the marks on the tape used for measurement of the water levels are in the correct position, and that the tape has not slipped. The calibration shall be made to a steel tape. If these measurements show the marking to be incorrect or that the tape has stretched more than 0.1 percent of its length, the meter will be repaired or replaced.

The water level probe will be checked, cleaned, and or replaced whenever a clear and distinct signal is not obtained when making water level measurements. If probe wire repair results in the cutting of the water level meters measurement line, the wire beneath the cut will be replaced with wire containing the proper measuring marks and factory made splice joints.

All field analytical meters will be checked for proper function, calibration and maintenance needs monthly and/or prior to field monitoring events. The meters will also be maintained and/or calibrated if field readings are observed to be inconsistent with historical site data or if meter drift is observed.

Calibration checks shall be made by comparing instrument readings to calibration solution concentrations. If the calibration check results are unacceptable (>20% difference) the meter will be calibrated according to the manufacturer's directions. If calibration cannot be achieved, the meter will be repaired or replaced. Routine maintenance will be completed as specified by the manufacture. Manuals shall be available for each field instruments.

GF-1: Equipment Calibration

This procedure presents procedure and schedule for the calibration of field monitoring equipment used for measurement of water quality index parameters including those used to measure temperature, pH, conductivity, turbidity, ORP, and dissolved oxygen. In general, the accuracy of data generated from each sensor of field monitoring instruments

shall be verified prior to a monitoring event and during a monitoring event when sensor readings suggest that a data accuracy issue is developing. The verification process shall begin with a comparison of sensor data generated from immersion of the sensor in a calibration solution with the published concentration of the calibration solution. If this process identifies a discrepancy of greater than 10 percent, the sensor shall be inspected, maintenance shall be preformed (such as cleaning or membrane replacement) and verification of performance to a standard solution shall be rechecked. If sensor maintenance does not resolve the calibration discrepancy, the sensor shall be calibrated according to manufacture specifications. If calibration does not resolve the calibration discrepancy, the sensor and or meter shall be shipped to an authorized service representative for repair or replacement.

Calibration solutions shall be new and within the manufacture's specified period of use (most solutions have an expiration date). A detailed record of each instrument's calibration check results, maintenance and sensor calibration shall be made and retained with reference to the associated field activity (inspector, project, date and task).

GF-2: Water Quality Index Parameters

The following list outlines the steps to be used for the collection of water quality index parameters:

1. Install a flow through cell in the discharge line of the well's pump downstream of the point that is used to collect water samples.
2. Start flow through the flow through cell and start the multi-parameter field water quality meter. Allow adequate time for the instrument electronics to warm up and for the instrument sensors (potentially including pH, conductance, temperature, ORP, dissolved oxygen and turbidity) to stabilize in the well's purge water.
3. Record temperature as soon as it is stable.
4. Read and record the desired field parameters and record the values on the field data sheet along with the time of measurement.
5. Repeat steps 1 through 4 as required or if the results appear to be questionable.
6. Review the resulting data and if dissolved oxygen values are less than 1 mg/L verify the result with a CHEMet ampoule as described in Procedure GF-03.
7. If purge water flow rates are low enough that ambient conditions influence field parameter results such as temperature or dissolved oxygen, note issue on the field data sheet.

GF-3: Dissolved Oxygen Measurement

1. Use CHEMets ampoules to measure dissolved oxygen if the results from measurement using a sensor on the multi-parameter field water quality meter is less than 1 mg/L or if the multi-parameter field water quality meter does not have a dissolved oxygen sensor.
2. Observe the discharge line for the presence of air bubbles and verify that the water level in the well is above the top of the well screen. If an air leak is observed, inspect the discharge line connections and make the necessary repairs. If the water level is below the top of the screen reduce flow until the water level recovers enough to rise above the top of the screen. If this can not be achieved, note condition in the field data sheet.
3. Maximize the purge water flow rate relative to low flow sampling protocols and water levels with respect to the elevation of the well screen. Verify that the flow rate is high enough to prevent the dewatering of the tube and introduction of air into the CHEMets by snapping a tube in the discharge line. Adjust the flow as required and as is feasible within the constraints of the low flow sampling method and aquifer conditions at the monitoring point.
4. If flow rates are inadequate to prevent drawing of some air into the discharge line and CHEMets ampoule, attempt to correct the problem by adding a short piece of larger diameter hose to the discharge line. If this does not solve the problem, note that accurate measurement of dissolved oxygen below 1 mg/L is not possible on the field data sheet along with a dissolved oxygen value of <1.0.
5. If monitoring conditions are acceptable, position the ampoule directly and deeply in the discharge tubing (downstream of a sampling point) from the well's pump and break the ampoule at the neck.
6. Mix the ampoule by slowly turning the tube to drive the residual bubble through the fluid in the vial and wait for the specified amount of time prior to comparing the resulting color with the color in the standard ampoules.
7. If the resulting color is within the range of the standard ampoules, establish the dissolved oxygen concentration by extrapolating between the colors of the standard ampoules to $\pm 50\%$ of the standard ampoule units and record on the field data sheets. If the resulting color is at or above/below the range of the standard ampoules, repeat the analysis with a CHEMets with a higher/lower measurement range.
8. If no color is observed using the CHEMets with the lowest available measurement range record the lowest value on the standard ampoules as a <0.005 mg/L value rather than reporting 0 mg/L.
9. For additional information, review the instructions provided in the CHEMetric test kit, contact CHEMetrics, Inc. (Phone 1-800-356-3072) or look up the method in APHA Standard Methods, 17, ed., p.4-192, 1989.

GF-4: Measurement of Depth to Water and Total Depth of a Well

The depth to water and depth to bottom of a monitoring well casing are required to calculate purge volumes for evacuation prior to sampling, verification of well location and well integrity, development of new wells, and in preparation for well abandonment. See Procedure GW-09 for site-wide water-level measurements to determine the potentiometric surface. If water levels are taken independent of a sampling event use the field data sheet shown in Figure GF-1.

Depth to Water

Measure the depth to water prior to well evacuation and at other times, as needed, as follows:

1. Lower the meter probe into the casing and measure to the nearest one-hundredth of a foot below the measuring point elevation (top of PVC casing marked with an indelible ink marker or another method to standardize its location).
3. If contaminants are known or suspected, decontaminate the meter prior to each use with three rinses of de-ionized water.

Total Well Depth

Measure depth to the bottom of the casing in wells without dedicated pumps at least once per year; every two years in wells with small, removable pumps; and, for larger pumps when serviced, as follows:

1. Remove dedicated pump if it will obstruct the measurement.
2. Insert weighted depth-to-water meter or steel tape into the casing until the bottom is reached.
3. Measure to the nearest one-tenth of a foot below the measuring point evaluation (top of the protective casing previously marked with an indelible ink marker or another method to standardize its location).
4. Record the depth on the Groundwater Sampling Field Data Sheet.

GF-5: Procedure for Requesting New Sample Location Number

Each time a new monitoring point is added to the monitoring system, a new sample location number should be requested using the form shown in Figure GF- 2. The request for a new sample location number will be made to the hydrology task leader.

Included in this request will be the proposed site location and horizontal coordinates in

UTM, NAD datum. If the sampling point is a newly constructed well, a summary of the well documentation shall be provided to the sampling team within 90 days of the well's construction.

GF-6: Purge and Rinseate Water Handling

Contaminant sources and contaminated purge waters for are not known or suspected to exist within the formations being sampled, therefore small purge volumes for sampling may be discharged to the ground surface.

If field observations indicate the potential for contamination (e.g., observation of immiscible liquids, low or high pH, or high conductivity), stop purging and contact the hydrology task leader for further instructions. Analytical data will be used to determine if purge water exceeds any regulatory criteria and consequentially require special handling.

GW-1: Piezometer and Well Identification

All groundwater sampling locations are identified utilizing procedure DC-02. Special identification numbers for QC samples are described in the QAPP. Names for new wells will be established by the hydrology task leader.

GW-2: Well Inspection

This procedure describes a general well inspection to be conducted each time a well is sampled and a comprehensive well inspection to be completed once for each well and after any major modification or problem with the well.

General Well Inspection

Each time the well is sampled a general well inspection is to be completed. As a minimum, the following items should be checked to determine if a problem exists:

- General condition of the well and well pad;
- Recent damage to the well;
- Well locked on arrival; and,
- Broken or missing well caps.

If this inspection indicates a problem, the problem should be noted and recorded in the

Field Data Sheet. Any serious problems should be reported to the hydrology task leader.

Comprehensive

The comprehensive well inspection is to be completed at least once for each well. This inspection should be completed following installation and following major modifications or the identification of significant problems with a well.

Unless previously surveyed, prepare a well location map and photograph the well to document the location and elevation marker point. Include the drilling contractors well completion diagram as part of the inspection report.

Map and Photograph

1. Attach a copy of an existing map with notations field-measured distances to permanent or semi-permanent landmarks (natural features and/or man-made structures);
2. Photograph each well. One photograph should have the well in the foreground, and landmarks (shown on the well location map) in the background. A second photograph should show the location of the marker point (used to measure depth to water and depth to bottom in the well).
3. File all well inspection information in the project filing system.

Well Inspection

1. Inspect the locking cap on the protective external casing. Check that the locking hasp is not broken and that the shackle of the lock will not fall out of the hasp. Check the lock for smooth operation. Lubricate if necessary.
2. Examine the external casing, if present. Note outside diameter and construction material. Check the condition of the paint. Make sure the Well I.D. # is marked on the external casing. Note corrosion or weathering.
3. Examine the well pad, if present. Note construction material, thickness and Well I.D.# markings.
4. Inspect the inner casing. Note outside and inside diameters, construction material and type of adapter, if present. If no adapter, inspect condition of top of casing for smoothness. Check to see if marker point is present and labeled. Inspect the annular seal for fill height and condition of material.
5. Measure the depth to the bottom of the well.
6. Note the presence or absence of a pump and data recorders and type.
7. Note any other pertinent items about the condition of the well, special sampling considerations, or its surroundings not included in the above information.

GW-3: Purging

Wells will be purged and sampled using “low flow” (low stress) procedures (USEPA 1995, Barcelona et al. 2005) and physical and chemical parameters will be monitored during purging to document that representative formation water is being collected for analysis. Dedicated submersible pumps shall be installed in each monitoring well prior to initiation of sample collection activities. Dedicated pumps prevent cross-contamination and minimize disturbance to the sampling interval within the well.

- Prior to starting the pump, measure the static water level and verify the pumping rate that has historically met the requirements of the low-stress purging and sampling method.
- Start the well pump at the specified pumping rate and record the initial water level, starting time of pumping, pumping rate, pump setting (if appropriate) and initial temperature on the field data sheet.
- Drawdown of the water elevation in the well while purging should be stable and at an elevation that is above the top of the well screen (or the minimum stable drawdown reasonably possible if the water elevation is within the well screen).
- Monitor index parameters of stabilization (water level, turbidity, pH, ORP, dissolved oxygen and specific conductance) no less than every 5 minutes or for very low purge rates during a time interval that is no less than is required to pass at least two times the volume of the flow through cell through the cell (Procedure GF-2 through GF-4).
- The well is considered stable and ready to sample when three consecutive field parameters readings are within 0.1 units for pH, 3% for specific conductance, 10 mv units for ORP and 10% for dissolved oxygen and turbidity.
- If an index parameter probe fails (or becomes unstable or is producing questionable readings) during stabilization, stabilization may continue to completion if at least three of the following index parameter probes continue to function properly (pH, specific conductivity, turbidity or dissolved oxygen).
- If well yield is lower than 100 ml/min without a stable water level, evacuate the well until the water elevation is just above the pump inlet. Collect samples after the water elevation in the well has recovered to within 10 percent of the original depth to water measurement.

Submersible Pump Operation

In high-yielding wells (stable drawdown while pumping at a rate exceeding 1,000 ml/min) set the dedicated pump near the middle of the screened interval. If well yield is low (stable drawdown while pumping at a rate between 100 and 1,000 ml/min), and the

water level is lower than the top of the screened interval, place the pump at the bottom of the screened interval. If well yield is very low (stable to unstable drawdown while pumping at a rate less than 100 ml/min), set a dedicated 1/2 –length bladder pump near the bottom of the screened interval. The following procedures describe pump operation:

Dedicated Submersible Pumps

1. Remove the power supply (electric cord or air compressor line) and discharge tubing coiled within the well casing and connect the pump to the power supply.
2. .Using the well development record or past sampling records set the flow rate appropriate for low stress sampling at that well and turn the pump on. When pumping commences, note the time and flow rate on the Groundwater Sampling Log. Measure the stabilization parameters as described above.
3. After purging and sampling, turn off the pump. Recoil the power cord and discharge tubing and place inside the protective casing. Replace the locking cap and lock the well.

GW-4: Groundwater Quality Field Data Sheets

A sample Groundwater Sampling Log shown on the following page. Complete each applicable item of the log form. Place a copy of the log in the project filing system.

Figure GW-2

North Jackson Company Groundwater Sampling Log

Proj. Name: GW Discharge Permit Operational
Weather: Cloudy, ~50°s F
Location: QAL008A
Sample ID: QALM008A
KEX ID: EAG-1001729

Date: 6/11/08
Sampler(s): CLS/CEC
Sampling time: 1033

Odor: None
Appearance: Clear

Temperature (°C): 8.1
Spec. Cond. (µmhos/cm @ 25°C): 56
Conductivity (µmhos): 38
pH (SU): 9.3
D.O. (ppm): 11.2
ORP(mV): 53
Turbidity (NTU): <1

Description of measuring point

Mark on riser

Total depth: 93 ft
Approx. Depth to water: 79 ft
Water column in well: 14 ft
Volume/foot: 0.16 gal/ft
Well volume: 2 gal

Well diameter (in): 2
Gallons purged prior to sampling: ~31

Evacuation method: Dedicated submersible pump with dedicated tubing

Tag	# Collected	Bottle	Preservative	Parameter	Comment
None	1	500 ml plastic	None	Various	
None	1	500 ml plastic	HNO3	Metals	Unfiltered
None	1	500 ml plastic	H2SO4	Ammonia	
None	2	150 ml glass	HCl	Mercury	Unfiltered

Photographs: None

Remarks: Well condition excellent. Pump rate ~1 gpm.

Time	Spec. Cond. (µmhos/cm @ 25°C)	pH (SU)	D.O. (ppm)	ORP (mV)	Turbidity (NTU)	Volume Removed (gal)	Depth to Water (ft)
1002							79.37
1012	57	9.2	11.2	-10	<1	10	81.65
1017	56	9.3	11.2	16	<1	15	81.62
1022	56	9.3	11.2	34	<1	20	81.61
1027	56	9.3	11.2	45	<1	25	81.63
1030	56	9.3	11.2	50	<1	28	81.63
1033	56	9.3	11.2	53	<1	31	81.63

GW-5: Sample Collection General Ions and Metals

General Protocol

Collect samples from monitoring wells, as described below, also following the general procedures for documentation, sample handling, and quality control (DC, MD, and QC series procedures).

Complete well documentation and inspection as required by Procedure GW-02.

Sample Collection From Monitoring Wells

1. Measure the water level in accordance with Procedure GF-04.
2. Purge the well in accordance with Procedure GW-03.
3. Disconnect the flow through cell and collect samples in laboratory supplied containers with the proper preservatives.
4. Attach the in-line filtering device (0.45 micron) to collect samples which require filtering (field turbidity values exceeding 1 NTU). Follow the manufacturer's instructions for filter use.
5. If any preservative is lost prior to or during the filling of a sample container (i.e., spilling or overflow), use another laboratory supplied container.
6. Thoroughly decontaminate any equipment and instruments that could contact the sample stream.

GW-6: Water Level Measurements

In order to collect the data necessary to determine the potentiometric surface for a given aquifer or to determine the gradient between aquifers, water-levels shall be measured during as short a period of time as is practical given well locations and site logistics. Measure the depth to water using Procedure GF-04. Water level data shall be recorded on a water level summary form similar to the example form on the following page.

North Jackson Company Water Level Summary

Project Name: Eagle Groundwater Discharge Monitoring

Location	Date	Measuring Point Elevation (ft MSL)	Depth to Water	Total Depth (ft)	Water Elevation (ft MSL)
QAL008A	5/29/08	1468.19	79.50	93	1388.69
QAL008D	5/29/08	1467.92	114.52	123	1353.40
QAL026A	5/29/08	1460.84	42.65	48	1418.19
QAL026D	5/29/08	1461.29	49.58	83	1411.71
QAL026E	5/29/08	1460.47	48.86	119	1411.61
QAL029A	5/29/08	1460.10	41.11	50	1418.99
QAL029D	5/29/08	1460.35	51.78	77	1408.57
QAL050A	5/29/08	1468.93	106.90	120	1362.03
QAL051A	5/29/08	1467.30	103.76	107	1363.54
QAL051D	5/29/08	1467.44	103.83	120	1363.61
QAL052A	5/29/08	1468.53	117.25	125	1351.28
QAL053A	5/29/08	1465.22	78.59	93	1386.63
QAL055A	5/29/08	1465.52	102.25	115	1363.27
QAL056A	5/29/08	1467.25	76.89	92	1390.36
QAL057A	5/29/08	1467.22	106.31	118	1360.91
QAL057D	5/29/08	1467.09	106.09	130	1361.00

QC-1: Quality Control Sampling

Quality control (QC) samples will be collected to measure accuracy and precision of analyses as affected by field methodologies. Field QC samples appropriate to water sampling includes field blanks, equipment blanks, duplicates, and external laboratory duplicates. Rates of QC sample collection are specified in the QAPP. QC samples will be documented and handled in the same manner as other samples prior to submittal to the laboratory.

QC-2: Masked Duplicates

Duplicates will be collected at a rate specified in the QAPP. The sites selected for the collection of duplicate samples will represent the general quality of water recently sampled. Duplicates should represent the range of water quality sampled throughout the year. Additional duplicates will be collected, if there is a concern that special problems may be encountered in particular samples that are not represented by other duplicate samples.

Duplicates will be collected by alternately filling the primary and duplicate sampling containers to ensure that representative samples are collected. The first three letters of the sample name will be "DUP", and the next three numbers will indicate the sequence number for the duplicate sample. For example DUP003, where the number indicates the third duplicate sample collected during that monitoring event. A fourth letter may be added after the P to denote that the sample is associated with monitoring wells (M) or piezometers (P).

The actual name of the sample location of the duplicate will be recorded in the field logbook or field data sheet.

QC-3: External Laboratory Duplicates

External laboratory duplicates may be collected by alternately filling the primary and duplicate sample containers to ensure that representative samples are collected. The first three letters of the sample name will be EXL, and the next three numbers will indicate the sequence number for the duplicate sample. For example EXL002, where the number 002 indicates the second external laboratory duplicate collected of the sampling event.

The QAPP specifies the number of external laboratory duplicates required during a given sampling event. When multiple external laboratory duplicates are required in a monitoring event at a single monitoring location, the duplicate sample containers should be alternately filled to ensure representative samples. A letter will be appended to the sample identification number to uniquely identify each sample. For example, EXL002c would represent the third external duplicate.

The actual name of the sample duplicated and its location will be recorded in the field logbook or field data sheet.

QC-4: Matrix Spike Samples

Matrix spiking will be done at the frequency identified in the laboratory's quality assurance project program. Laboratory personnel will select samples for matrix spiking. Additional samples may be submitted by field personnel for laboratory spiking. Samples collected in the field for laboratory spiking will be assigned a sample identification number starting with the letters QC followed by the sample point identification number and any trailing letters followed by the letters SK for the spike sample and SD for the spike duplicate. For example, a sample collected from well QAL002D for spiking would be labeled QCQAL002DSK and the spike duplicate would be QCQAL002DSD. Any spiking instructions must be clearly identified on the analytical request form. Laboratory personnel will assign control numbers to all spiked samples.

Samples selected for spiking by field personnel will be collected by alternately filling the primary and spike sample containers to ensure that the samples collected are representative of each other.

QC-5: Field Blanks

Field blanks will be collected at the rate specified in the QAPP. Field blank samples will be submitted and labeled with a special identification number. The first three letters of the sample name will be FBK, and the next two or three numbers will indicate the sequence number for the field blank. For example FBK003, where the number 3 indicates the third field blank collected of the monitoring event. A fourth letter may be added after the K to denote that the sample is associated with monitoring wells (M) or

piezometers (P). The sample containers will be prepared using the proper preservatives and filled with laboratory supplied blank water. The containers will accompany the sampling crew that day and will be delivered to the laboratory along with the other samples.

QC-5: Equipment Blanks

For inorganic samples, the rate of equipment blank sampling will be specified in the QAPP. The sample containers will be prepared using the proper preservatives and filled with the laboratory supplied blank water pumped through the sampling device. The first three letters of the sample name will be EQB, and the next three numbers will indicate the sequence number for the trip blank. For example EQB001, where the number 001 indicates the first equipment blank collected during the monitoring event. A fourth letter may be added after the B to denote that the sample is associated with equipment used to sample monitoring wells (M) or piezometers (P).

A description of the equipment blank and the name of the location sampled will be recorded on the field sampling form or field logbook.