APPENDIX E

Quality Assurance Project Plan for Groundwater Discharge Permit Monitoring GW1810161

QUALITY ASSURANCE PROJECT PLAN

FOR

GROUNDWATER DISCHARGE PERMIT MONITORING

GW1810161

KENNECOTT EAGLE PROJECT
MARQUETTE COUNTY, MICHIGAN

Version 1.0 – June 2008

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SECTION 1 INTRODUCTION

This surface and groundwater monitoring program Quality Assurance Project Plan (QAPP) is for the Eagle Project. It sets out the protocols necessary to achieve data quality objectives (DQOs) dictated by the intended use of the data. Work scopes are described in the Sampling and Analysis Plan (SAP) and field procedures in the Standard Operating Procedures Manual for Groundwater Discharge (SOP Manual).

This document includes discussions of:

- Project organization and responsibilities;
- Quality assurance objectives for data precision, accuracy, representativeness, comparability, and completeness;
- Sampling and analytical procedures; and,
- Guidelines for data verification and reporting, quality control checks, performance and systems audits, corrective actions, and quality assurance reporting.

SECTION 2 PROJECT ORGANIZATION AND RESPONSIBILITIES

All personnel involved in the generation of data are part of the overall project and quality assurance program. Individuals with specific responsibilities are described below.

2.1 PROJECT LEADER

The project leader, Victoria Peacey (Kennecott Eagle Minerals Company), is responsible for oversight of all environmental aspects of the Eagle Mine and associated coordination of communication with the project team, governmental agencies and the public.

2.2 PROJECT MANAGER

The project manager, Dan Wiitala (North Jackson Company), is responsible for development and update of the groundwater discharge monitoring work plans and schedules and ensuring that all work is conducted in accordance with SOPs. In cooperation with the quality assurance manager, the project manager will review data, evaluate project objectives, and based on audit findings and quality control (QC) checks, determine the need for corrective actions. A project file is maintained by the project manager containing or indicating the location of all documents.

2.3 QUALITY ASSURANCE MANAGER

The quality assurance manager, Peter Sabee (North Jackson Company), is responsible for the evaluation and update of this Quality Assurance Project Plan (QAPP). The quality assurance manager will also review all final project analytical reports and assure that data verification has been performed and that a minimum of ten percent of field data entries to the project database system have been verified. The quality assurance manager will prepare and maintain the audit schedule and plan and will evaluate the need for corrective actions and make recommendations to the project manager.

2.4 LABORATORY PROJECT MANAGERS

Laboratory project managers will ensure that all samples are analyzed according to laboratory SOPs in a timely manner. Laboratory project managers are responsible for ensuring all laboratory quality assurance procedures are followed and management of all laboratory data reduction and verification. Laboratory project managers will sign the analytical reports verifying that laboratory analytical and QC procedures have been followed.

2.5 FIELD PERSONNEL

The sampling crew is responsible for the collection of field measurements and water quality samples according to the schedule and will ensure that all work is done according to SOPs. These personnel, as well as all staff members involved with the project, are responsible for ensuring the quality of their own work.

SECTION 3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

Quality Assurance (QA) can briefly be defined as the process for ensuring that all data that provide the basis for project decisions are technically sound, statistically valid and properly documented. QC procedures are the tools employed to measure the degree to which the QA objectives are met. This section discusses the objectives for the measurement of data in terms of precision, accuracy, representativeness, comparability, and completeness. These objectives are based on the intended use of the data, available laboratory procedures, and available resources. Specific QC samples to be collected to evaluate field activities are described in Section 6.

3.1 OVERALL QUALITY ASSURANCE OBJECTIVE

The overall quality assurance objective is to keep the total uncertainty within an acceptable level that will not hinder the intended use of the data. Therefore, specific data quality requirements such as target detection limits, criteria for accuracy and precision, sample representativeness, data compatibility and data completeness are specified in this document.

Data quality objectives are quantitative and qualitative statements specifying the required quality of the collected data. The data quality objectives define the acceptable level of uncertainty. This uncertainty includes random sampling and analytical error.

3.2 FIELD INVESTIGATION QUALITY OBJECTIVE

The field investigation quality objective is to maximize confidence in the data in terms of precision, accuracy, representativeness, comparability, and completeness. Section 6 presents the frequency with which blank and duplicate samples will be collected and analyzed such that a specific degree of precision and accuracy may be calculated. Quantitative objectives are summarized in Table 1.

Precision will be calculated as Relative Percent Difference (RPD) if there are only two analytical points or as Relative Standard Deviation (RSD) if there are more than two analytical points. The RPD is calculated as the difference between two results, relative to their arithmetic mean,

$$RPD = 100\frac{(X1 - X2)}{\frac{(X1 + X2)}{2}}$$

expressed as a percent:

X1 = Concentration of the first sample

X2 = Concentration of the second sample

The RSD is calculated as the standard deviations of results relative to their arithmetic mean, expressed as a percent (also referred to as coefficient of variation) (USEPA 1990):

$$RSD = 100\frac{LC}{\bar{x}}$$

$$where: \bar{x} = the\ arithmetic\ mean\ of\ the\ x_i\ measurements;$$
$$LC = s = Standard\ Deviation;\ and$$
$$s^2 = \sum^{n} \frac{(x_i - \bar{x})^2}{n-1}$$

Submission of field blanks will provide a check with respect to accuracy. Accuracy can be assessed by evaluating the results of blanks to monitor contaminants that may be introduced during sampling, preservation, handling, shipping, and analysis. The data quality objective for field blanks is to have no quantifiable amounts of target analytes above quantitation limits.

To assure sample representativeness, all sample collection and measurements will be performed in accordance with the protocol outlined in this QAPP and SOPs.

In order to establish comparability, such that observations and conclusions can be directly compared with previous data, standardized methods of field analysis, sample collection, and preservation will be used. These methods are documented in the SOPs.

3.3 LABORATORY QUALITY OBJECTIVE

The laboratory quality objective is to ensure precision, accuracy, representativeness, comparability, and completeness with respect to analytical results. The laboratory will demonstrate analytical precision and accuracy through procedures established in each laboratory's QAPP. Laboratory DQOs are consistent with guidelines specified in EPA analytical methodology.

3.4 DATA MANAGEMENT OBJECTIVE

The data management objective is to accurately and completely document all field and laboratory activities and results. All aspects of sample collection, shipment and analysis will be performed in conjunction with rigorous QA/QC documentation as specified by the QAPP and SOPs. This includes the use of field logbooks, field data sheets, sample container labeling, and chain-of-custody forms. Field data are entered into the project information management system database. The laboratory project managers will verify laboratory results (see Section 5) and submit signed report of analysis to the project manager. All accountable project field documents will be filed and/or inventoried in a project filing system maintained by the project manager.

The flow of data from the field and laboratory, through the project information management system and to project reports is shown in Figure 1.

SECTION 4 SAMPLING AND ANALYTICAL PROCEDURES

This section summarizes sampling and analytical procedures to be used in monitoring activities.

4.1 SAMPLING PROCEDURES

The purpose of sampling is to obtain specimens that accurately represent site conditions. SOPs have been developed for all field activities of the monitoring program to ensure that representative samples are collected.

4.2 ANALYTICAL PROCEDURES

Samples will be analyzed for the parameters specified in tables included in the project work plan. These tables also identify the analytical method and target detection limits for each parameter. Analytical methods are selected to meet the target detection limits where possible. Measurements to be conducted in the field are listed in the work plan, and measurement protocols are contained in the field measurement SOP. Sample containers, preservation and holding times for each parameter are also presented in SOPs. All analyses will be conducted according to test procedures specified for use in Michigan.

SECTION 5 DATA VERIFICATION, REDUCTION AND REPORTING

Data verification will be conducted to ensure that integrity is maintained and an audit trail developed for those data that require reduction. All field data will be written in a bound field logbook or on a field data sheet, as appropriate. Field personnel will be responsible for proof reading all field data transfers. The quality assurance manager will document that a minimum of ten percent of all data transfers are reviewed.

The quality assurance manager will conduct data verification activities to assess performance in meeting quality assurance requirements. Such reviews include a verification that: 1) the samples were analyzed and reported in the appropriate units; 2) the samples were properly preserved and met holding times and temperature restrictions; 3) quantitation limits were achieved; and, 4) field and equipment blanks contained acceptable levels of contamination.

Data reduction for laboratory analyses is conducted by laboratory personnel in accordance with EPA procedures for each method. Analytical results and field measurements will be entered into the laboratory's data management system (DMS). Results will be printed out from the DMS in the form of a report and signed by the project laboratory manager. The signed report will be submitted to the project manager and filed in the project filing system. Once a data report has been issued, changes to results in the laboratory information management system will be documented and a revised report will be submitted to the project manager.

A data control program will be followed to ensure that all documents generated during the project are accounted for upon their completion. Accountable documents include: field log books, field data sheets, analytical request sheet/sample chain of custody, correspondence, analytical reports, quality assurance reports, and audit reports. The project manager is responsible for maintaining the hydrology project filing system.

Periodically, program data will be reviewed by the quality assurance manager. The evaluation will be documented in a report. This report will also present a summary of quality assurance

activities, as well as recommendations for program changes.

SECTION 6 QUALITY CONTROL

6.1 QUALITY CONTROL CHECKS FOR FIELD ACTIVITIES

The QC samples used to measure accuracy and precision affected by field activities are summarized in this section.

Field Blanks

Field blanks consist of laboratory supplied blank water in each sample container along with any preservatives required for that analysis. These blanks will be prepared by field samplers and accompany the sampling crew during the sampling process. The blanks will serve as a quality check on container cleanliness, reagent, external contamination, and the analytical method. One (1) field blank will be collected for every ten (10) samples collected.

Equipment Blanks

Equipment blanks will be collected to ensure that sampling equipment is clean and that the potential for cross-contamination has been minimized by the equipment decontamination procedures. These blanks will consist of laboratory supplied blank water passed through any non-dedicated sampling devices that contact the samples. One (1) equipment blank will be collected for every ten (10) samples. Equipment blanks will be analyzed only for those parameters contacting non-dedicated sampling equipment.

Masked Duplicates

Masked duplicate samples will be collected and submitted for analysis to allow a determination of overall analytical precision. One (1) masked duplicate sample will be collected for every ten (10) samples collected.

Procedures

The QC sample SOP (Exhibit 1) specifies the procedure for the collection and submittal of the QC samples described above. The analytical results for the field QC samples will be entered into the project information management system and reviewed by the quality assurance manager (see Section 8).

6.2 INTERNAL QUALITY CONTROL CHECKS FOR ANALYSES

Matrix spiking may be used to measure recovery of analytes in order to monitor matrix effects and for comparison to the established accuracy objective and precision. Except as noted below, all matrix spiking will be done by the laboratory as required by the laboratory's QAPP.

Matrix Spike Samples

Matrix spike samples may be selected in the laboratory and spiked by the laboratory analyst. At least one water sample will be spiked in each instrument batch. Field matrix spikes will be submitted only in cases where matrix problems that may be associated with particular samples (such as high TDS samples) are being evaluated by the field program. The sample will be spiked in the laboratory and treated the same as other spiked samples. Analytical results will be recorded within the laboratory DMS.

6.3 PERFORMANCE AND SYSTEMS AUDITS

Audits are conducted periodically to determine the accuracy of the total measurement system or its component parts. System audits will be conducted to evaluate QC procedures. Performance audits will be conducted for field methodologies established in the SOPs as well as data management activities. Field activities include, but are not limited to, equipment calibration and maintenance, well evacuation, sample collection and equipment decontamination.

The quality assurance manager will prepare and maintain the audit schedule that specifies a minimum of one unannounced audit per year of the field data and field sampling. Additional audits will be conducted as deemed necessary when quality assurance objectives are not met. An initial baseline systems audit will be based on requirements set forth in this QAPP and the SOPs. Follow-up audits will be based on a review and evaluation of findings from and responses or corrective actions to previous audits. Periodic audits will emphasize critical areas or areas believed to be weak.

Audits will be coordinated by the project manager. Example checklists for performance audits of sample collection, field measurements, equipment decontamination and sample handling, and documentation are included in Exhibits 2, 3, 4 and 5, respectively. All audit plans, completed checklists, and reports will be kept in the project filing system.

Audit results will be reviewed and consolidated into an audit report that is submitted to the project manager, sampling team and the project manager. A post-audit meeting will be held with the audited personnel. The meeting will allow a discussion of findings and resolution of any misunderstandings. A plan and schedule for corrective actions will be established during the meeting, as well as a follow-up audit if deemed necessary by the quality assurance manager. The audit report will be revised to reflect meeting discussions and submitted to the project manager.

SECTION 7 CORRECTIVE ACTION

If audit findings or QC checks indicate that DQOs are not being met, corrective actions will be taken as deemed necessary by the quality assurance manager or the project manager. Such actions may include re-sampling, re-analysis, and procedure changes. The appropriate manager or supervisor will be notified of the problem (if not already discussed in a post-audit meeting) to discuss possible solutions.

The quality assurance manager will document all necessary corrective actions taken, verify the outcome of these actions and document the effect on data produced. These reports will be submitted to the project manager and filed in the project filing system.

Laboratory personnel will take immediate corrective actions regarding sample analyses as prescribed by EPA methods and the laboratory's quality assurance program plan.

SECTION 8 QUALITY ASSURANCE REPORTING

The quality assurance manager will periodically report the results from quality assurance reviews. These reports will present the results from assessments of precision, accuracy, completeness, representativeness, and comparability using the results of QC sample analyses and monitoring results. These reports, along with any reports of audits and corrective actions will be filed in the project filing system.

SECTION 9 REFERENCES

American Public Health Association (APHA). 1995. Standard Methods for the Examination of Water and Wastewater. Nineteenth Edition. Prepared and published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 1986. Test Methods for Evaluating Solid Waste. Third Edition. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

TABLE 1
Precision and Accuracy Objectives

DUPLICATE SAMPLES

Indicator Parameters, Major Anions, Major Cations, Metals:
Within 25% RPD or 4 times the RL, whichever is greater

Organics:
Within 30% RPD or 4 times the RL, whichever is greater

SPIKED SAMPLES

Major Anions and Cations, Metals:
75% to 125% of the spiked analyte

Organics:
70% to 130% of the spiked analyte

The spike objectives are generally for clean waters with less than 2,000 mg/L TDS

BLANK SAMPLES

Less than the RL

MASS BALANCES

TDS: Measured and observed TDS within 15%

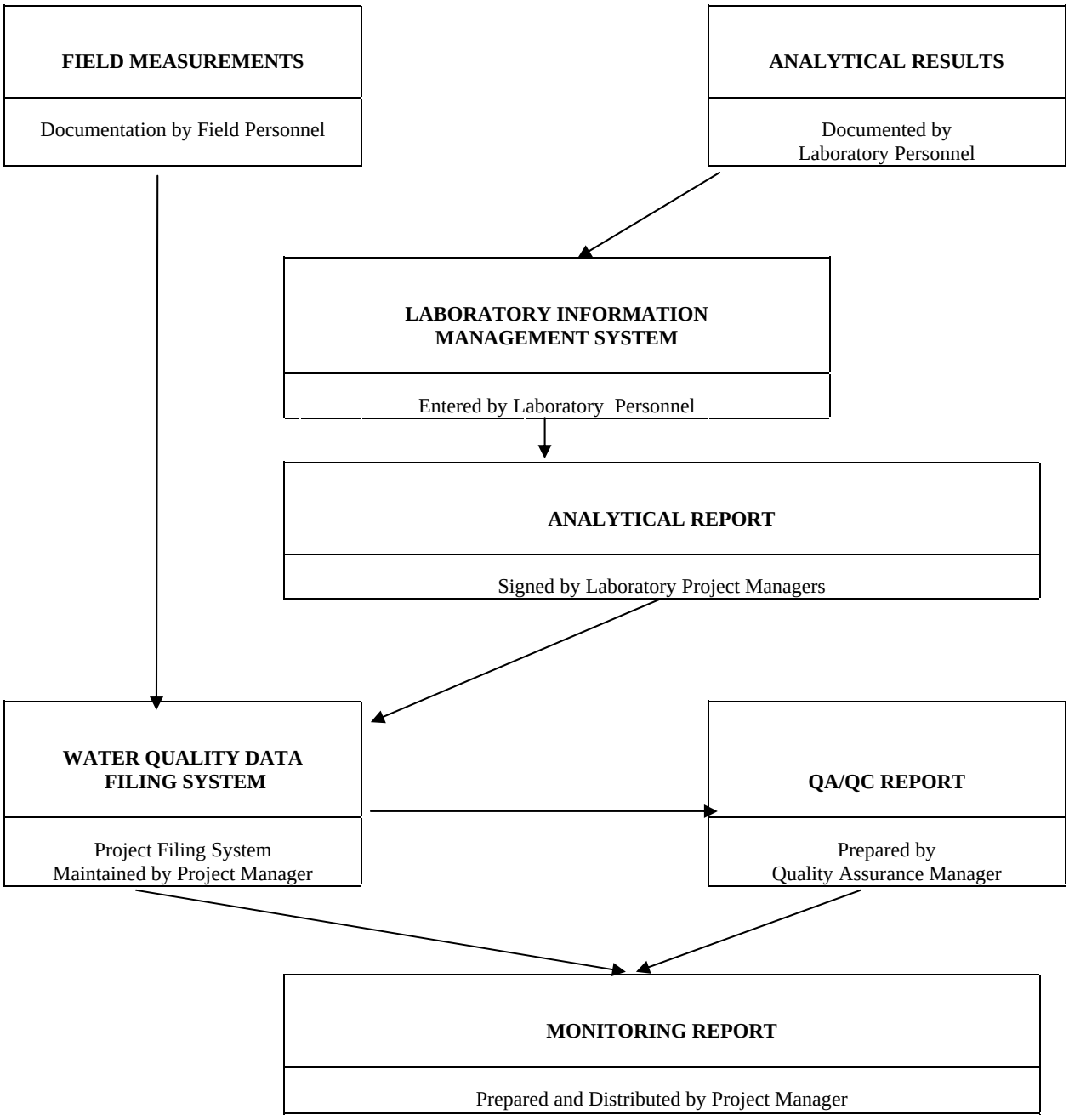
DETECTION LIMITS

Target Detection for Metals and Organics:
Located in tables in project work plan

NOTES:

RPD = Relative Percent Difference
RL = Reporting Limit

FIGURE 1
Data Movement from the Field and Laboratory to the Report



EAGLE PROJECT
PERFORMANCE AUDIT
SAMPLE COLLECTION

Audit Team Leader:_____ Audited Organization: _____

Audit Team Members:_____ Reported By:_____ Date: _____

Check One: S = Satisfactory; D = Deficiency; O = Observation. Provide comments (and reference to specific Procedure No. And Step No.) for deficiencies and observations.

Item		S	D	O	Comments (Procedure/Step #)
1.	Low stress purging procedures used.				
2.	Drawdown stable and above screened interval.				
3.	Field parameters (minimum of pH, sp cond,, turbidity or DO) stable prior to sample collection.				
4.	A sufficient quantity of proper sample containers with proper preservatives is available at the sample site.				
5.	Sample collected upstream of non-dedicated equipment.				
6.	Field and equipment blank collected				
7.	Duplicate/other split samples collected in composite 1/4ers by volume.				
8.	Clean hands/dirty hands procedures and no headspace used for mercury samples.				
9.	Data recorded on field log and COC.				
10.	Samples filtered if turbidity exceeds 1 NTU.				

EAGLE PROJECT
PERFORMANCE AUDIT

FIELD MEASURMENTS

Audit Team Leader:_____ Audited Organization:_____

Audit Team Members:_____ Reported By:_____ Date: _____

Check One: S = Satisfactory; D = Deficiency; O = Observation. Provide comments (and reference to specific Procedure No. And Step No.) for deficiencies and observations.

Item	S	D	O	Comments (Procedure/Step #)
1. Flow through cell is downstream of sample collection point.				
2. CHEMet ampoules available for 0.005 to 1.0 ppm range and used when D.O. is <1.0.				
3. Water level measurement technique adequate to provide data accurate to 0.01 foot.				
3. D.O. measurements completed without influence of introduced atmospheric oxygent.				

EQUIPMENT CALIBRATION, MAINTENANCE AND DECONTAMINATION

Audit Team Leader:_____ Audited Organization:_____

Audit Team Members:_____ Reported By:_____ Date: _____

Check One: S = Satisfactory; D = Deficiency; O = Observation. Provide comments (and reference to specific Procedure No. And Step No.) for deficiencies and observations.

Item	S	D	O	Comments (Procedure/Step #)
1. Equipment that contacts sample is decontaminated between monitoring points according to SOP.				
2. Water markers are calibrated in past year and in good working condition.				
3. Field monitoring equipment was calibrated prior to the field monitoring event.				
4. Field monitoring equipment appears to be in good working condition and providing reliable data.				
5. Calibration and maintenance records properly recorded and filed.				
6. Calibration solutions available, pristine and within use-by dates.				

EAGLE PROJECT
PERFORMANCE AUDIT

SAMPLE DOCUMENTATION

Audit Team Leader:_____ Audited Organization:_____

Audit Team Members:_____ Reported By:_____ Date: _____

Check One: S = Satisfactory; D = Deficiency; O = Observation. Provide comments (and reference to specific Procedure No. And Step No.) for deficiencies and observations.

Item	S	D	O	Comments (Procedure/Step #)
1. Sample collection is documented on field data sheets as specified in the SOP.				
2. Field data sheets scanned and filed in electronic and hard copy file folders.				
3. Monitoring point, KEK and sample identifications correctly used.				
4. All information entered is recorded on waterproof paper using either indelible ink or pencil.				
5. Errors are struck through with a single line.				
6. Sample container labels completed correctly with Ids, sampler initials, date, time project name and preservatives.				
7. KEK ID used on container, field data sheet and COC:				
8. COC and custody seals used.				
9. KEK ID, sample ID, sampler signature, custody release signature, date, time and container numbers, preservatives and required analysis on COC correctly.				
10. COC and field sheets scanned at end of field day.				