APPENDIX B

Magna Reservoir
Leak Detection & Water Quality Sampling Plan
(Revised June 2011)

1.0 Introduction

The Magna Reservoir System, located in the North Concentrator facilities area, acts as a central hub for industrial process waters. Flows from the No. 1 and No. 4 Pump Stations are discharged into the reservoir (approximately 35,000 gpm) where the combined flows are routed to the Copperton Concentrator via Pump Station 3A and 3B, and to the Kennecott Utah Copper LLC (KUC) Utah Power Plant via Pump Station 3.

This plan presents the sampling, analysis and quality assurance guidelines to be performed by KUC for water quality sampling of the groundwater protection features of the Magna Reservoir System.

1.1 System Description

The Magna Reservoir system consists of two reservoirs located adjacent to each other. The reservoirs were designed to be operated primarily in series with flow typically first entering Reservoir No. 1, flowing to Reservoir No. 2, and then to Pump Stations 3, 3A, and 3B. However, each reservoir has an inlet, outlet, and overflow that can be isolated from the other reservoir so that the reservoirs can be operated independently during periods of maintenance or modification. A common overflow system, linked to both reservoirs, allows excess flows to passively flow over a weir and into a pipeline conveying excess flows to the Clarification Canal located up-gradient from KUC Pump Station 1 within the Tailings Impoundment.

With regards to the leak detection systems and seepage barrier construction, the reservoirs are identical.

1.1.1 Construction

The reservoirs include an identical, double containment liner system as the seepage barrier:

- A primary liner consisting of an 80-mil HDPE geomembrane with micro spikes for surface traction is located on top.
- A secondary liner consisting of a 60-mil HDPE geomembrane with drainage nubs is located beneath the primary liner.

The drainage nubs provide separation between the two liners and allow for leakage through the primary liner to be collected in the leak detection system.

Reservoir No. 1 is constructed with engineered fill at 2:1 side slopes. Under normal operating conditions, water is first conveyed to Reservoir No. 1which includes a concrete floor at the bottom of the reservoir to facilitate removal of any sediment that may accumulate. This concrete floor is located above and is independent of the HDPE liner system. Reservoir No. 2 is also constructed with engineered fill at 2:1 side slopes but does not include a concrete floor.

Leakage, if it occurs through the primary liner, is collected at a single point for each reservoir – at the east end of Reservoir No. 1 and in the northwest corner for Reservoir No. 2. See Figure 1.

Leakage flow from each reservoir is conveyed by gravity through a 6-inch diameter HDPE pipeline to independent meter vaults where the continuous flow is measured using an area velocity type flow metering system. Tail water from the individual reservoir meter vaults is conveyed to the Clarification Canal located up-gradient from KUC Pump Station 1 through the existing area drainage system to be circulated back to the Magna Reservoir System for use.

The continuous quantity of leakage flow rate (GPM) from each reservoir is measured in the meter stations and, via electronic 4 to 20 ma and fiber optics signals, remotely monitored and recorded in the KUC plant SCADA system at the Tailings Control room.

In addition to the continuous flow being recorded, the volume of leakage (in total gallons) is determined each day by logic programmed into the dedicated PLC. If the total daily volume exceeds the allowable leakage rate an alarm will be activated and Tailings Operations will conduct a site investigation to determine the source of the increased leakage rate. The initial response will be to confirm leakage flow rates and initiate inspections and repairs as required. In addition to the total daily volume alarm being activated for excess leakage, the SCADA logic system shall be programmed for early warning alert. During a variable time period (typically shorter than 24 hours) flows can be monitored and a projected 24 hour total volume determined. On this occurrence an alert can be monitored at the control room.

KUC maintains an Operations and Maintenance Manual for Magna Reservoir that includes specifications for equipment, recommended inspections, and operations and maintenance recommendations.

1.1.2 Allowable Leakage Rate

Liner leakage flow from reservoir No. 1 or No. 2, if present, will report to a respective flow meter station where it can be read remotely or in the field by Tailings personnel.
KUC has adopted a two tier approach with respect to allowable leakage rate for the Magna Reservoir System. Tier I leaks are based upon liner manufacturer specifications and are designed to alert KUC personnel to an escalation in leakage rate, possible minor liner separation or flow meter station malfunction. Tier II leaks are based upon EPA guidance for allowable leakage rates for double lined surface impoundments (Bonaparte & Gross, 1993) and are designed to trigger UDWQ notification that the allowable leakage rate for the respective reservoir has been exceeded. The Tier I and II leakage rates were further developed using total liner surface area for each respective reservoir and are consistent with US EPA methodology. Allowable leakage rates are summarized in Table 1.

Table 1: Tier I and Tier II Allowable Leakage Rates (ALR)

Reservoir	Liner surface area (acres)	Tier I[1] (gallons/day)	Tier II[2] (gallons/day)
No. 1	1.38	69	1380
No. 2	1.49	75	1490

[1] Based upon guarantee by installer and manufacturer stating maximum leakage through primary geomembrane liner not to exceed 50 gallons per acre, per day (gpd/ac).

[2] Based upon US EPA recommended ALR requirements for surface impoundments of 10,000 liters per acre, per day or approximately 1000 gallons per acres, per day.

Repair and or reporting requirements are triggered if the allowable leakage rate for either respective reservoir exceeds Tier I or Tier II limits over a twenty-four hour period (12:00 PM to 12:00 AM)

2.0 Facility Organization and Responsibilities

The KUC Manager – Environment or designee will serve as the Compliance Project Manager and will have overall responsibility for direction of the sampling and compliance program, quality control, notifications and reporting. The KUC Sampling Supervisor will serve as technical director and will be responsible for execution of all activities in accordance with this sampling plan.

The KUC Tailings Superintendent - Operations or designee is responsible for monitoring and recording daily flows reporting to the Magna Reservoir leak detection sump. The same personnel will also be responsible for maintaining the leak detection monitoring equipment and ensuring it is fully functional on a daily basis. In the event a leak detection sump exceeds compliance limits as outlined in Section 4.2. The same personnel are responsible for notification to the Manager, Environment or designee and coordinating efforts to maintain compliance and subsequent repairs as necessary.

The KUC Sampling Technicians have the responsibility of collecting all water quality samples required by the permit in accordance with this sampling plan and the GCMP.

The KUC Manager – Tailings and Water Services will report results of water quality sampling and volume pumped from leak detection sumps in the event compliance limits are exceeded to the Executive Secretary of the Utah Water Quality Board. Maintenance, repair and monthly inspections will be the responsibility of the KUC Tailings staff.

KUC Laboratory Manager will ensure all water quality samples are analyzed using the appropriate methods and within the specified holding times in accordance with this sampling plan and GCMP.

3.0 Analytical Parameters

All water quality samples from the monitoring sump and reservoir will be analysed for the field measurements (pH, specific conductance, and temperature), major ions (alkalinity, boron, chloride, sulfate, potassium, sodium, magnesium, and calcium), dissolved metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, and zinc) and TDS. All samples will be analysed using EPA approved methods as specified in Utah Regulation R317-6-6.3.

4.0 Schedule for Water Quality Monitoring and Reporting

4.1 Reservoirs

Water quality samples representing both zones of the Magna Reservoir System are collected on a monthly basis. The sample ID is MCP1416 and is collected from pump station 3A which is the Magna Reservoir System discharge point under normal operation. Water quality sampling results will be submitted to the Executive Secretary of the Utah Water Quality Board in the form of semi-annual reports of the corresponding half year in which the sampling was conducted.

4.2 Leak Detection Sumps

Piping from respective Reservoirs No.1 and No.2 of the Magna Reservoir System report to respective flow meter stations. The flow meter stations are monitored through a control room on a continuous basis and alarms are programmed to sound in the event threshold allowable leakage rates are exceeded

- The control room will receive an alarm if allowable leakage rates outlined in Table 1 are exceeded.
- Reporting requirements are triggered as outlined in Section I Part F of the permit if the Tier II allowable leakage rate for a respective reservoir is exceeded.

4.3 Monitoring Wells

A series of groundwater monitoring wells listed in Table 1 of the permit are located adjacent to the Magna Reservoir System. These wells monitor groundwater quality and will aid in detection of reservoir failure should in the unlikely occurrence the early detection system fail in detection. All sampling will be in compliance with the current Kennecott Utah Copper Ground Water Characterization and Monitoring Plan (GCMP).

5.0 Water Quality Sampling Procedures

5.1 Reservoirs

Water quality representing both Reservoir No. 1 and Reservoir No. 2 of the Magna Reservoir System is collected from a sample port from within pump station 3A (MCP1416). Water quality sampling results will be submitted to the Executive Secretary of the Utah Water Quality Board in the form of semi-annual reports of the corresponding month in which the sampling was conducted.

5.2 Leak Detection Sumps

KUC will collect a sample from the corresponding leak detection sump in the event the allowable leakage rate is exceeded.

- Magna Reservoir No.1 flow meter station – MCP2817
- Magna Reservoir No.2 flow meter station – MCP2818

All field measurements and water quality sampling will be collected in accordance with the GWCMP. Results will be reported in the corresponding semi-annual report.

5.3 Monitoring Wells

All sampling will be compliant with the current Kennecott Utah Copper Ground Water Characterization and Monitoring Plan (GCMP).

6.0 Sample Custody

6.1 Field Operations

The following records and actions will be taken as part of the water quality sampling of the Magna Reservoir System.

- Field Logs: A complete record of all field sampling activities will be kept by the sampler. The field logs will document the date, time, and location of sampling and the name of the person(s) performing the sampling, as well as any other pertinent information.
- Sample Labels- Sample containers will be labelled with the information necessary to prevent misidentification of samples. Each sample container will be clearly labelled with the sample location, date and time of collection, preservative(s), filtered or unfiltered, and the name of the person(s) performing the sampling.
- Chain-of-Custody Record: In order to establish the documentation necessary to trace sample possession, a chain-of-custody record will be filled out to accompany every sample shipment from the time of collection through receipt by the analytical laboratory. The samples will be delivered to the laboratory for analysis as soon as possible.
- All sampling will be noted and recorded as required in the GCMP.

6.2 Laboratory Operations

The primary laboratory to be used for analysis of the water quality samples will be the Kennecott Environmental Laboratory (KEL). KEL is certified by the State of Utah (certification No. E-21). Any other laboratories used, if necessary, will be certified by the State of Utah. The laboratories will maintain internal chain-of-custody control in accordance with their own standard quality assurance program.

The date and time of analysis, name of person(s) performing the analysis, and methods used, will be documented by the laboratory.

7.0 Internal Quality Control Checks

7.1 Overview

All internal quality control checks will be conducted in accordance with the current GCMP.

7.2 Field Operations

The following description refers to all sampling incorporated into the GCMP and may or may not include a sample specific to this permit or Appendices based upon the random nature of the sampling. Blind field duplicates will be prepared and submitted to the laboratory by the sampler. One out of every 20 samples or at least one sample per year will be a blind field duplicate. Sample splitting for duplications will be conducted as specified in the GCMP. The results of these duplicate analyses will be reported as required by the GCMP.

7.3 Laboratory Operations

The certified laboratory will conduct its own internal quality control checks in accordance with its own quality assurance program as part of State of Utah certification. This will include running at least 5 percent duplicate, spike, and control samples for all samples collected within the GCMP.

Laboratory equipment maintenance will be in accordance with the Laboratory QA Plan.

8.0 References

Bonaparte, R. and Gross, B.A. 1993. US EPA Project Summary, LDCRS Flow from Double-Lined Landfills and Surface Impoundments.

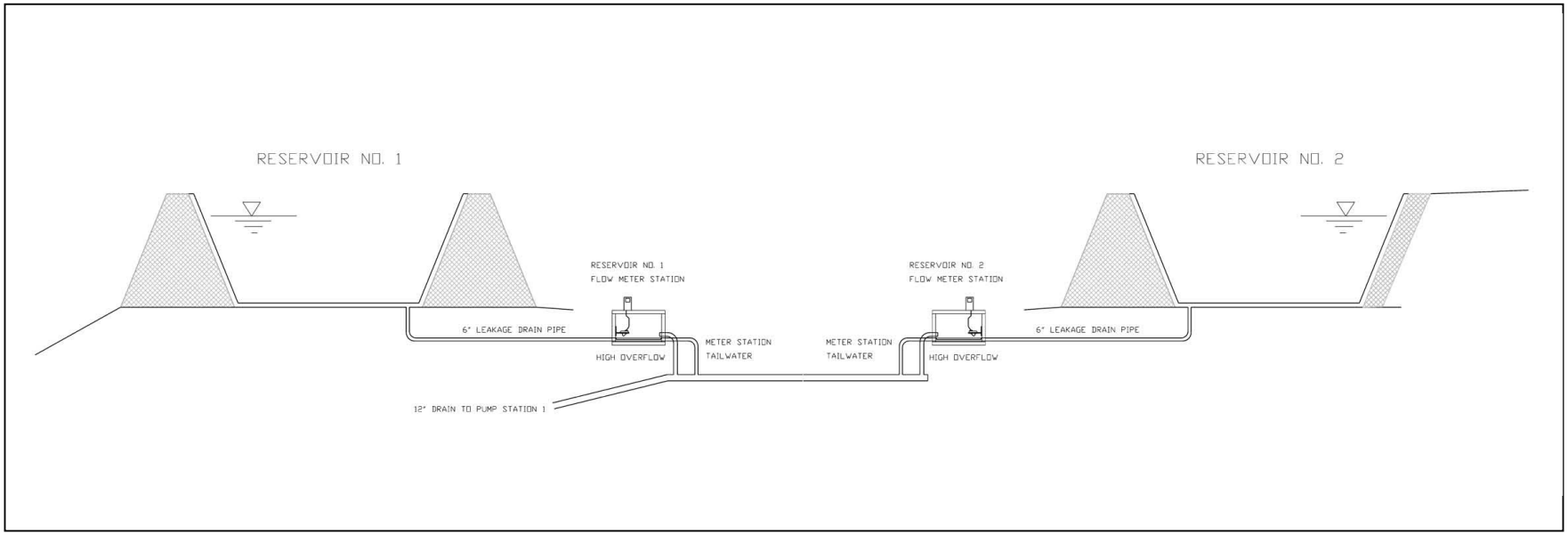

Figure 1

Schematic of Magna Reservoir Leak Detection System