*Draft Public Notice Version, June 5, 2013*
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**GROUND WATER QUALITY DISCHARGE PERMIT UGW350011**
**STATEMENT OF BASIS**

Kennecott Utah Copper LLC
Tailings Impoundment
Magna, Utah

Date 2013

## Introduction

Kennecott Utah Copper LLC (Kennecott) has proposed to expand its tailings storage facilities to prolong the life of the Bingham Canyon Mine approximately 30 years. The tailings impoundment footprint will expand by approximately 1,300 acres adjacent to and east of the North Impoundment, the North Impoundment will be raised above its current design height, and portions of the South Impoundment will be raised.

## Proposed Expansion

The project will be completed in two phases and will increase the available tailings storage by an additional 1.2 billion tons for a total of 2.2 billion tons. It includes the construction of a tailings impoundment to the northeast (Northeast Impoundment) to a height of approximately 4,462 feet above mean sea level (amsl) and increasing the height of the existing North and South Impoundments to approximately 4,500 feet amsl. The Northeast Impoundment will add an approximate 1,300 acres that will extend the overall Tailings Impoundment facility into Sections 4, 5, and 9 of Township 1 South, Range 2 West. The total area of the proposed Tailings Impoundment facility, after the expansion, will be approximately 10,000 acres.

Phase I will consist of constructing the Northeast Impoundment, relocating infrastructure, and raising the North Impoundment. The Northeast Impoundment will be adjacent to the northeast corner of the existing impoundments. The northeast area is underlain by Bonneville Clay, a thick, laterally extensive, low-permeability lacustrine deposit that also underlies the existing North and South Impoundments. In addition to this low-permeability layer, a drainage blanket will be constructed underneath the northeast embankment. A 25,000 linear foot toe ditch around the proposed expansion will also be added. The estimated maximum potential discharge rate from the Northeast Impoundment to the Shallow Aquifer is 240 gallons per minute.

Other Phase I ancillary work includes: upgrading and expanding the tailings delivery system; adding a new tailings and underflow delivery system; installing a dust control system; re-routing existing electrical and fiber optic utilities; realigning four miles of the Union Pacific Railroad; and constructing an overpass bridge along 7200 West. Initial

tailings deposition in the Northeast Impoundment is scheduled for 2015.

Phase II will consist of continuing to raise the North Impoundment and raising portions of the South Impoundment. The Northeast Impoundment will continue to be raised until transition of deposition to the North and South Impoundments is complete. Engineered structures will be constructed along the east, west, and south slopes of the South Impoundment. The tailings delivery system for the North and South Impoundments will be upgraded and expanded to accommodate deposition on the South Impoundment. Two additional pumps will be added to provide extra pump head for the existing North Impoundment.

**Facility Description and Background**

The current Tailings Impoundment complex and the proposed tailings expansion area is located in, or in portions of, Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 of Township 1 South, Range 3 West; Sections 4, 5, 6, 7, 8, 9, 17, 18, 19, and 20 of Township 1 South, Range 2 West; Sections 31, 32 and 33 of Township 1 North, Range 2 West; and Sections 35 and 36 of Township 1 North, Range 3 West. The Tailings Impoundment has operated since 1906 for the storage of tailings from concentrators processing ore from the Bingham Canyon mine, and has undergone numerous changes and expansions to accommodate the volume of materials. The original 1,350-acre impoundment was located in the western portion of the Magna impoundment area. Around 1914, the original impoundment was enlarged to the east by approximately 1,466 acres. By the early 1990's, the footprint of the South Impoundment had reached approximately 5,700 acres with a height of over 220 feet, storing 1.5 billion tons of tailings. The South Impoundment currently does not receive tailings materials. In 1995, Kennecott added approximately 3,300 acres adjacent to and north of the existing impoundment to enable operations of the Bingham Canyon Mine to continue for approximately another 20 years. This expansion also allowed for the seismic upgrade of the impoundment. Beginning in 1999, tailings deposition began transitioning from the South Impoundment to the North Impoundment. The current discharge into the North Impoundment is approximately 170,000 tons per day of tailings from the Copperton Concentrator.

**Site Hydrogeology**

Three aquifer systems exist in the vicinity of the Tailings Impoundment: the Bedrock Aquifer system associated with the Oquirrh Mountains, the confined Principal Aquifer, and the unconfined Shallow Aquifer. The bedrock aquifer is comprised of highly fractured Paleozoic carbonate rocks. Recharge to this system is principally from precipitation on the mountains to the south. The flowpath through this aquifer moves from the fractured bedrock into the Principal and Shallow Aquifers or is discharged as spring water along bedrock contacts at the base of the mountains. Water quality of the bedrock aquifer is generally Class II ground water with total dissolved solids (TDS) less than 3,000 mg/l.

The Principal Aquifer is a confined system which includes a gravel zone and lacustrine deposits. The gravel zone was most likely derived from the local mountains during an extensive low lake cycle. Many high-yield water supply wells near the Oquirrh Mountains are completed in the gravel zone of the Principal Aquifer. The lacustrine zone consists of clay, silt and interbedded fine sand. Ground water flow direction for the Principal Aquifer is north toward the Great Salt Lake. Measured water levels in the Principal Aquifer wells located around the perimeter of the tailings impoundment are above the water levels in adjacent nested Shallow Aquifer wells, indicating an upward hydraulic gradient throughout the vicinity of both impoundments. The majority of Principal Aquifer wells located along the perimeter of the North and South Impoundments are under flowing artesian conditions. Ground water quality in the Principal Aquifer is generally better than the Shallow Aquifer, with TDS values ranging from approximately 700 to 30,000 mg/l (from 2006 through 2011). The higher TDS values correlate with proximity to the Great Salt Lake. Background concentrations of arsenic in excess of Utah Ground Water Quality Standards have been observed in the Principal Aquifer in the Tailing Impoundment area.

The Shallow Aquifer system consists of interbedded lacustrine Bonneville Clay, silt, and fine sand. The exact depth of this system varies but is approximately the upper 35 to 50 feet of saturated sediments. The potentiometric surface for the Shallow Aquifer system depicts lateral flow in a northerly direction toward the Great Salt Lake. An upward hydraulic gradient from the underlying Principal Aquifer exists for the majority of well nests completed in both the Shallow and Principal Aquifers. Localized confining conditions exist in the Shallow Aquifer within the Tailings Impoundment area. The majority of Shallow Aquifer wells located along the northern perimeter of the North Impoundment are under flowing artesian conditions. The hydraulic head in the Tailings Impoundment is higher than the hydraulic head in the Shallow Aquifer, resulting in downward vertical gradients with a potential for discharge of tailings water into the shallow aquifer system. Ground water quality in the shallow lacustrine unit is Class III Limited Use and Class IV Saline Ground Water, with TDS values up to approximately 70,000 mg/l in the vicinity of the Great Salt Lake (from 2006 through 2011). Background concentrations of arsenic in excess of Utah Ground Water Quality Standards have been observed in the Shallow Aquifer in the Tailing Impoundment area.

**Facility Operations**

South Impoundment - Tailings deposition into the South Impoundment ceased in October 2002. Draindown water from the South Impoundment is collected in the clarification canal and horizontal PVC drain pipes that have been constructed around the perimeter of the impoundment. When necessary, the water in the clarification canal can be discharged through UPDES permitted discharge points. Some seepage from the impoundment enters the Shallow Aquifer system. Kennecott estimates the maximum potential discharge rate of tailings water to be 700 gallons per minute. The seepage rate may gradually decrease over time due to the establishment of a vegetative evapotranspiration cover. The South

Impoundment is underlain by the Bonneville Clay, a thick, laterally extensive, low-permeability lacustrine deposit.

A sedimentation pond is located east of the northeast corner of the South Impoundment to settle out suspended sediments in the water prior to entering the Clarification Canal. The Sedimentation Pond is also underlain by the low permeability Bonneville Clay.

Diving Board - The Diving Board area is located immediately south of State Road 201 and west of 9180 West. This area is a small earthen impoundment originally designed to retain tailings discharges resulting from emergency shutdowns. Due to the relocation of the tailings pipeline, the Diving Board is no longer used for this purpose. It is currently designated as the capture area for the Magna Reservoir in the unlikely event of a catastrophic failure. Dissolved arsenic levels in the shallow ground water have exceeded the Utah Ground Water Quality Standard, likely due to historical operations in this area. The upward hydraulic gradient has protected the Principal aquifer from arsenic degradation.

North Impoundment - The North Impoundment is underlain by the Bonneville Clay, a thick laterally extensive low-permeability lacustrine deposit. This contiguous stratum represents the top layer of a several hundred foot thick sequence of fine-grained lacustrine sediments.

Tailings are deposited into the North Impoundment as a slurry from a single point discharge system that deposits tailings into the interior as well as through two main discharge facilities (cyclones). Cyclones direct overflow (fine-grained material) to the interior and the underflow (coarse material) to the embankment. An underdrain consisting of a blanket drain and finger drains composed of crushed slag were constructed in the base of the embankment to promote horizontal seepage of tailings water under the embankment and into the perimeter toe drain collection ditch. Water is also removed from a decant pond and recycled back to the Copperton Concentrator. When necessary, the water can be discharged through a UPDES permitted discharge point. The estimated maximum potential discharge rate of tailings water from the North Impoundment to the Shallow Aquifer is 560 gallons per minute.

Bevill-Excluded Wastes - Congress granted an exclusion from the requirements of the hazardous waste program for certain mining wastes. This exclusion, known as the Bevill Amendment, identifies solid wastes from the extraction, beneficiation, and processing of ores and minerals and excludes them from the requirements of the EPA Hazardous Waste Program. The basis of this exclusion was that these wastes are characterized by high volume, low hazard, and that management as hazardous waste may be inappropriate. On June 23, 1990, EPA issued a final rule that listed 20 mineral processing wastes that are excluded. Several inflows to the Tailings Impoundment are included under this Bevill exclusion and therefore are not subject to the requirements of the Hazardous Waste Program.

Waste Stream Inflows - Waste stream inflows authorized under this permit for placement in the Tailings Impoundment are:

1. Copper tailings from the Copperton Concentrator;
2. Slag tailings from the slag concentrator at the Smelter;
3. Power plant ash slurry;
4. MAP (molybdenum autoclave plant) effluent and autoclave waste (start-up anticipated in 2014);
5. Smelter process waters;
6. Wastewater effluent slurry from the Hydrometallurgical Plant at the Smelter;
7. Mine leach water and meteoric contact water that have been treated in the tailings pipeline;
8. Wastewater effluent from the Reverse Osmosis treatment of sulfate-contaminated waters;
9. Neutralization of acid-mine contaminated waters;
10. Barneys Canyon mine pit dewatering and heap leach pad draindown waters;
11. Construction, maintenance and other non-hazardous trash (Salt Lake Valley Health Department Permit: 35-0011805 covering footprint of Tailings Impoundment);
12. Treated effluent from the sewage treatment plant;
13. Other inflows that are approved by the Director for this permit or UPDES permit UT0000051.

The first four waste streams listed above are included under the regulatory exclusion from RCRA as Bevill waste. The majority of materials placed in the Tailings Impoundment are copper tailings. Following settlement of a Natural Resources Damage Claim, the State of Utah has approved a plan to clean up contaminated ground water in the Southwest Jordan Valley area of Salt Lake County. Over the next 40 years, extraction and treatment of ground water from contaminated zones will remove contaminants and provide municipal-quality drinking water to the public. By removing contaminated water from the underlying aquifer, the project will also improve ground water quality and prevent further migration of the contamination in the valley. In the absence of a better disposal option for contaminants removed from the treated water, the treatment concentrates will be introduced into the tailings pipeline for disposal in the Tailings Impoundment.

These sources enter the Tailings Impoundment at the following discharge points:

1) West Cyclone Station
2) East Cyclone station
3) North Impoundment Single Point Discharge (East and West)
4) North Impoundment Peripheral Discharge

**Corrective Actions**

The Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6) require applicants to submit a Corrective Action Plan or other response measures to remedy any violation of ground water quality standards resulting from discharges. The permit has a compliance condition that allows the Director to call for a Contamination Investigation and Corrective Action Plan to be submitted and made a part of this permit should future data indicate that clean-up of contamination at the Tailings Impoundment site is needed.

**Background Ground Water Quality**

Assessing background ground water quality is a complicated task for the area around the Tailings Impoundment because several complicating factors impede measurement or estimation of true background. There are two previously existing facilities that may have impacted ground water quality. The abandoned Morton Salt operation and the Chevron Phosphate operation are within the footprint of the North Impoundment. These operations have likely complicated the ability to observe any impacts from tailings. In addition, given the nearly century-long history of operations, impacts from the Tailings Impoundment have probably already occurred.

In light of the aforementioned complicating factors, Ground Water Protection Levels for this permit are established using existing ground water quality on a well-by-well basis. This approach ensures that the existing ground water quality will be protected by not allowing significant degradation from existing protection levels. There are several compliance monitoring wells that are relatively close to the bedrock contact and that indicate Class II ground water quality. These wells are assigned protection levels consistent with Class II ground water. The majority of the compliance monitoring wells are classified as Class III ground water, and are assigned protection levels consistent with Class III ground water. Additionally, the method given in R317-6-4.6.A.3, which allows for a no net increase standard for Class III waters when the background concentration already exceeds the ground water quality standard, is used where indicated. Compliance wells completed in Class IV ground water are assigned protection levels equal to the greater of the Utah Ground Water Quality Standards or the background value plus two standard deviations, with the exception that TDS limits are not imposed for Class IV Saline ground water. Due to influences of the Great Salt Lake, TDS values in the Class IV wells range from 9,000 to over 70,000 mg/l (2006 through 2011). The basis for assigning protection levels (except TDS) to Class IV waters that are in close proximity to the Great Salt Lake is to protect wetland systems that exist in proximity to the lake and serve as habitat for shore birds and other aquatic species.

In most of the Class III wells, the background value for arsenic exceeds the Ground Water Quality Standard of 0.05 mg/l. Sample results from these wells routinely exceed the background value due to normal variation around the mean; probable out of compliance is defined by concentrations which exceed the ground water protection levels

listed in Permit UGW350011 Table 1.

Kennecott conducts Toxic Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) analyses of tailings material to describe the toxicity of the tailings even though this material is not subject to RCRA requirements. Both TCLP and SPLP analysis have not revealed any toxicity concerns. The interstitial waters in the tailings have been characterized and do not appear problematic. To assure that the waste streams deposited into the Tailings Impoundment do not contain materials that differ markedly from those waste streams that have been characterized, the permit requires only materials of Bingham Pit origin and related processing wastes be disposed of in the Tailings Impoundment. There is a provision that allows Kennecott to request a variance from this standard for incidental situations that would not impact overall water quality of aquifers underlying the impoundment.

Kennecott utilizes a discharge minimization approach with ground water monitoring to assess if any impacts occur. Discharge minimization is achieved by utilizing a natural clay liner beneath the impoundment to impede downward flow of tailings waters. The clay liner consists of the upper portion of the Bonneville Clay, which has been mapped at an average thickness of 8 feet and is continuous throughout the approximate 10,000 acre area of the South Impoundment, North Impoundment, and proposed Northeast Impoundment. Measured vertical hydraulic conductivities for this segment of the Bonneville Clay range from $3 \times 10^{-7}$ cm/sec to $4 \times 10^{-8}$ cm/sec, which meets the liner requirements of R317-6-6.4.A3 and C3. Best Available Technology is defined in R317-6-1.3 as "... the application of design, equipment, work practice, operation standard or combination thereof at a facility to effect the maximum reduction of a pollutant achievable by available processes and methods taking into account energy, public health, environmental and economic impacts and other costs."

The compliance monitoring well network is comprised of 29 wells in 14 locations. Most locations contain nested or paired wells: one screen interval in the upper shallow aquifer and one screen interval completed in the lower confined aquifer. The perimeter of the South and North Impoundment is approximately 14 miles long. The 14 locations comprise a well frequency of about one well location per mile of embankment. Additional compliance monitoring wells will be located around the perimeter of the proposed Northeast Impoundment at a depth and frequency consistent with the existing facility.

**Potential Impacts to Water Quality**

With the height of Tailings Impoundment reaching over 290 feet, it is likely that downward hydraulic gradients will develop and allow some movement of tailings interstitial waters through the Bonneville Clay and into the underlying aquifer systems. The average concentrations of constituents in the interstitial waters of the tailings, when compared to the concentrations in the shallow and principal aquifers, are summarized in Table S-1 of this Statement of Basis.

While the concentrations in Table S-1 are average values and some individual values may vary significantly, it is anticipated that the overall water quality of the Shallow and Principal Aquifers will not be degraded by water from the impoundment. Interstitial waters and toe drain (recycled) waters from the impoundment will continue to be sampled semi-annually throughout the term of this permit to provide a check on the quality of these waters.

One of the most important technical issues associated with the Tailings Impoundment is the long term potential for acidification of the tailings materials. The chemical reactions associated with oxidation of sulfides results in production of acid, which if not neutralized could, over time, acidify the tailings materials. Should this happen, leaching of metals and other constituents that are not mobile in neutral pH conditions may occur. Kennecott conducts static and kinetic testing of tailings materials to predict the potential for the tailings to acidify over time. Results to date indicate a low potential for the fine fraction tailings (overflow) to become acidic. The coarse fraction (underflow) can acidify under conditions mentioned above. To assure that signs of acidification are not occurring through the life of the impoundment, Kennecott is required to monitor the interstitial water within the tailings and to perform analysis of the copper tails inflow to the impoundment on a semi-annual basis. Surface sites on the impoundment exterior are also sampled and analyzed for acidification potential.

The North Impoundment covers a phosphogypsum tailings pile (gypstack) in the northwestern corner of the expanded impoundment. This tailings pile was part of a phosphate fertilizer production facility that was not affiliated with Kennecott. Downward hydraulic gradients could move gypstack pore fluids into the Shallow Aquifer and toward the toe drain. Hydraulic conductivity modeling has estimated a very slow rate of travel in the mine tailings and aquifer. Two monitoring well pairs were installed to detect effects, if any, from burial of the phosphogypsum tailings. These wells have 14 years of background monitoring to establish background levels of radionuclides. Monitoring frequency has been changed to once every five years, until such time that detections of radionuclides and uranium may exceed Utah Ground Water Quality Standards.

**Basis for Permit Issuance**

As a basis for issuance, modification, and renewal of the ground water discharge permit as required under UAC R317-6-6.4, and to assure adequate ground water quality protection, the facility has been designed to employ discharge minimization and control technology with ground water monitoring to prevent any impairment of present and future beneficial uses of the ground water. This permit modification authorizes expansion of the ground water operational monitoring network for a slightly larger tailings impoundment footprint. There is no change in authorized waste stream inflow materials.

Ground water monitoring is the primary compliance monitoring method for the Tailings

Impoundment. General monitoring of the Kennecott well network is performed to develop a data base and identify ground water quality trends. Compliance monitoring is performed at selected wells located outside the impoundment footprint. Most sites are situated to characterize the influence of the tailings disposal on ground water. Compliance monitoring wells are listed in Table 1 of the Permit. The compliance monitoring parameters are listed in Permit Part I, Section F.

**Major Permit Changes**

1. A construction permit will be obtained from DWQ prior to starting construction on the Northeast Impoundment footprint.

2. Prior to construction of the northeast impoundment, Kennecott shall provide documentation of the proper abandonment of any wells or features that exist in the expansion footprint that could compromise the integrity of the Bonneville Clay liner. Wells must be abandoned according to Utah Administrative Code R655-4-14.

3. Construction of the Northeast Impoundment will necessitate a revised ground water monitoring network. Within 60 days of installation and completion of any new or replacement monitoring well, Kennecott shall submit documentation on the wells that describes its location and aquifer to be monitored. An accelerated ground water sampling program shall be started to establish ground water protection levels for each new or replacement compliance monitoring well. The accelerated sampling program will consist of 12 consecutive quarters of ground water sampling to establish background levels. Kennecott shall submit the background sampling results in an Accelerated Background Monitoring Report. After completing the accelerated sampling, the new wells will be sampled on a semi-annual basis.

4. Operational Monitoring Plan - A water quality summary and analysis is required to assess long term changes to water quality over the life of this structure. The water quality of interstitial waters within the tailings, waters that are decanted from the top of the impoundment and other outflows such as seeps, and characterization of inflows will provide information that will assist in predicting potential impacts from the impoundment as well as track changes over time. This condition requires Kennecott to provide an annual report that compiles the results of sampling and analysis.

5. Closure Plan - Closure of the South Impoundment is complete; however, portions of the South Impoundment will be raised during Phase II of the proposed expansion. Any proposed changes to the current closure plan based on ongoing characterization of tailings mineralogy, impoundment surface oxidation, internal pore water chemistry, or other data, shall be submitted to the Director for review and approval.

**Table S-1**
**Tailings Impoundment Water Chemistry Summary**

| Constituent | Mean Concentrations in Shallow Aquifer[1] | Mean Concentrations in Principal Aquifer[1] | Mean Concentrations in Tailings Pore Waters [1, 2] | Mean Concentrations in Clarification Canal [1, 3] |
|---|---|---|---|---|
| pH | 7.49 | 7.73 | 6.86 | 7.31 |
| TDS | 15,417 | 8,847 | 5,604 | 8,448 |
| Sulfate | 987 | 373 | 1,603 | 3,087 |
| Arsenic | 0.068 | 0.156 | 0.123 | 0.029 |
| Barium | 0.248 | 0.191 | 0.015 | 0.101 |
| Cadmium | 0.0015 | 0.0013 | 0.0036 | 0.0066 |
| Chromium | 0.015 | 0.013 | 0.011 | 0.010 |
| Copper | 0.033 | 0.030 | 0.658 | 0.026 |
| Lead | 0.005 | 0.005 | 0.005 | 0.005 |
| Selenium | 0.008 | 0.005 | 0.003 | 0.021 |
| Zinc | 0.014 | 0.013 | 0.226 | 0.041 |

All concentrations in mg/l
[1] Arithmetic mean concentrations are based on available analyses from 1995 through 2011. The mean incorporates non-detections, assuming that the reporting limit is the concentration.
[2] Tailings pore water is represented by 5 tailings wells.
[3] The clarification canal is represented by sample location CLC452.