GROUNDWATER QUALITY DISCHARGE PERMIT

STATEMENT OF BASIS

Kennecott Bingham Canyon Mine and Water Collection System

Purpose

Groundwater Discharge Permit No. UGW350010 for the Bingham Canyon Mine and Water Collection System is undergoing the renewal process which occurs every five years, last renewed in 2010. As part of the renewal process, the permit will also incorporate modifications associated with new waste rock placement within the south dump drainages and relocation of associated cut-off walls for the proposed activity.

The permit was originally issued in 1999 and included a number of source control measures such as the cessation of active waste rock leaching and the installation of an engineered water collection system along the toe of the valley-facing waste rock dumps. This renewal will comprise changes to the original permit and, if needed, include adoption of permit limits determined in accordance with Part II.F.3 for all wells covered by the permit. Prior to this renewal/modification, the permit was last modified in 2013 to incorporate the East Waste Rock Extension project.

Description of Facility

Bingham Canyon Mine - The Kennecott Utah Copper Bingham Canyon Mine operations are located in the Oquirrh Mountains approximately 18 miles southwest of Salt Lake City, Utah. This mine produces copper and other metals that are currently extracted using an open pit method of mining. Open pit operations have been conducted at this site for over 110 years. Facilities included in the mine operations include the truck maintenance shops, warehouses, and mine support activities.

Waste Rock Dumps - The waste rock associated with this mining operation has been placed adjacent to the open pit on the slopes of the Oquirrh Mountains. The waste rock disposal areas consist of over 5 billion tons of waste rock located in three principal areas. These three areas are referred to as the East Side, South Side and West Side waste rock dumps. The waste rock consists of low concentrations of sulfide mineralization and trace metals in an intrusive host rock, limestone, and quartzite.

Active leaching of the waste rock dumps ended in October 2000. Previously, parts of the dumps were leached by recycling water collected at the base of the dumps and placing it back on top of the waste rock. Although active leaching, i.e. recycling the collected water, has stopped, poor quality mine impacted water is still collected in the water collection system at the base of the dumps. Other portions of the dumps were not actively leached but do generate acidic drainage by virtue of contact of meteoric precipitation with waste rock. This water is collected and used as process water or discharged, as permitted under the UPDES permit (#0000051).

The current collection system for the East Side dumps was constructed between 1993 and 1996 and consists of a series of 26 cut-off walls (Figure 1) constructed in each drainage down gradient of the

waste rock dumps. To augment the effectiveness of the cut-off walls in the formerly leached area from Bluewater 1 to the Copper drainage, toe and French drains were installed.

The collection system down gradient of the east waste rock dumps is planned to be modified starting in 2015 to accommodate the continuation of mining, which includes placing waste rock to the east of the existing East Side dumps (see drawing 454-T-0119). This project is generally referred to as East Waste Rock Extension (EWRE) and it was approved by Utah Division of Water Quality (UDWQ) in 2013. In this effort, 9 cut-off walls will be impacted between Copper drainage and Congor drainage. These 9 walls will be replaced by 12 new walls of similar design to those originally constructed (Dwg. 454-T-0119). Where modifications take place, the modified collection system employs a toe drain beginning at Copper drainage and ending at Midas drainage where it overlaps the existing toe drain collection system in Midas drainage. The newly installed collection system runs continuously along the entire eastern toe of the new waste rock dump between Copper and Midas drainages and acts as the primary means of collecting waste rock contact water (WRCW). The new cut-off walls act as a secondary collection point for WRCW and the point of compliance.

In addition to the EWRE, a reclamation project referred to as the South Waste Rock Reclamation (SWRR) project began in 2014 and will modify portions of the water collection system associated with the South Dumps, primarily in Butterfield Canyon (see Figure 1-2). The SWRR project includes the placement of waste rock adjacent to the existing south dumps and eventual reclamation of the dumps associated with the drainages from Yosemite to Olsen. Three existing cut-off walls will be relocated and replaced with four newly constructed cut-off walls to better accommodate a relaxed and reclaimed waste rock slope. The drainages affected by reclamation activities and cut-off wall relocations include Yosemite, Butterfield 1 and Olsen. Modifications to the south dump drainages also include enhanced storm water detention basins which were granted a construction permit through the DWQ. More detail regarding the cut-off wall relocation and basin enhancements are included in the permit application (Appendix J).

The collected water is conveyed by HDPE pipelines to South Area Water Services (SAWS) Advanced Copper Cementation Plant (ACC) and/or Precipitation Plant for metal extraction or to the Large Reservoir system. Following the extraction of copper, the collected water is stored in the lined Bingham Reservoirs (permit #UGW350006) or pumped to the tailings pipelines and then gravity fed to the Tailings Impoundment (permit #UGW350011).

Leach water was applied to the Dry Fork waste rock dump until 1999. The Dry Fork plume is located under the historic Dry Fork leaching operation and is the result of historic mining activities. Controls related to the plume and WRCW include the cut-off wall in lower Bingham Canyon and groundwater extraction wells located in Bingham Canyon and Dry Fork. These wells are designed to either intercept groundwater impacted by the historic leach water applications or to capture clean water before it comes in contact with waste rock.

SXEW Operations - Kennecott has conducted a pilot scale Solvent

Extraction/Electrowinning (SXEW) project on a lined and monitored area on the Dry Fork dump. The original pilot plant was decommissioned in 1999. The pads associated with the project are being used for heap leach test work. However the pads are currently not in operation and are maintained under a care and maintenance program for up to three years. After three years this system will be evaluated to decide if the operations should be decommissioned. Pregnant leach solution from this test facility is either used in pilot SXEW operations adjacent to the heap leach or can be piped to the Precipitation Plant area at the mouth of Bingham Canyon. The extent of SXEW operations is dependent on a variety of future market conditions.

Bluewater Repository - The Bingham Canyon Mine and Water Collection System groundwater quality discharge includes pertinent portions of the prior groundwater permit issued for the Bluewater Repository. Each segment of the repository includes a leachate collection system that routes flows to the leach collection pipeline.

Site Hydrogeology

Tertiary volcanic bedrock is the primary stratigraphic unit that underlies the majority of the East Side waste rock dumps. The South Side waste rock has both Teritiary volcanic and Paleozoic bedrock beneath. There is a thin layer of unsaturated alluvial and colluvial material under parts of the waste rock dumps. Beneath the Tertiary volcanics are quartzites and limestones of Paleozoic age. The Paleozoic bedrock beneath the Dry Fork waste rock dump area is highly fractured and is more permeable than the bedrock beneath the other waste rock dumps. Beneath most of the dumps, water tends to perch at the waste rock/bedrock contact. To the east of the waste rock disposal areas, the Tertiary volcanics and Paleozoic bedrock are covered by Plio-Pleistocene alluvial deposits. These deposits thicken to the east to form the principal aquifer in the Southwest Salt Lake Valley[1].

The central portion of Salt Lake Valley is generally characterized as having a shallow unconfined and a principal confined aquifer system. Confining layers are generally not present or discontinuous near the base of the mountains and are more pronounced towards the center of the valley[2]. Except for a thin veneer of alluvial material in the area from the Copper drainage northward to the Bluewater drainage, Kennecott's East Side waste rock dumps and water collection system are located on top of Tertiary volcanic rocks that transition to the alluvial aquifer system to the east of and down gradient from the collection system. Based on mapping of recharge areas completed by the U.S. Geological Survey, Kennecott's former East Side leaching operations are immediately adjacent to the primary recharge area for the west side of the Salt Lake Valley[2].

Background Water Quality

Water quality in the principal aquifer adjacent to the East Side and South Side waste rock dumps is somewhat variable. Effects of historic mining practices are evident in some areas. Generally the water quality down gradient of the non-leached waste rock dumps has a total dissolved solids (TDS) value between 500 mg/l and 3,000 mg/l making it Class II water. There are a few areas that exhibit Class I water with TDS values less than 500 mg/l. In areas impacted by acidic waters, a typical water

quality signature includes Class III water with elevated values of TDS, sulfate, magnesium, copper, cadmium and zinc.

Basis for Permit Issuance

Kennecott has proposed a discharge minimization approach coupled with source control for this groundwater discharge permit. Discharge minimization will be achieved through the use of cut-off wall/collection system which Kennecott has plans to enhance in part under the EWRE and SWRR projects.

Control Technology - A typical cut-off wall configuration for the East Side waste rock dumps is depicted on drawing 451-T-9080 in the permit. Cut-off wall design modifications applicable to the drainages from Copper to Congor are depicted in Figure 1-2 of Appendix J. Cut-off walls have been placed in all principal drainages along the perimeter of the East Side and South Side waste rock dumps. The site for each wall was excavated to bedrock to allow the wall to be keyed into bedrock. Along with the concrete cut-off wall, a collection pond immediately upstream of the wall is installed. In the Bluewater 1 to the Midas drainages the collection basins upstream of the walls are lined and seepage collection trenches extend from each side of the wall to the top of the local drainage catchment. These trenches are excavated to bedrock, clay lined and has a perforated collector pipe lain in a filter-cloth enclosed gravel drain on top of the clay liner. The trenches augment interception of subsurface flow in the thin veneer of alluvial material and direct the water to the collection pond upgradient of the cut-off wall.

In the modified collection system from Midas to Copper drainages, seepage is captured along the toe of the dump using a trench system which employs dual 12" perforated pipe excavated into bedrock and lined with clay which directs water via piping to drainage bottoms and the cut-off walls. The wall acts as a secondary collection system and employs a 6" perforated pipe along the base of the wall to capture water seepage not collected by the trench. The modified system also employs storm water detention basins which manage surface water separately from sub-surface water (Figure 2-1, Attachment 2 of Appendix J). The intent of these basins will help reduce maintenance requirements that are associated with scale which forms when two sources of water of varying quality comingle and generate precipitates. The storm water will be transported separately by HDPE to the Bingham Canyon Reservoir. Waters collected at a cut-off wall are directed via HDPE pipeline to the primary collection pipe.

Two concrete lined canals, with an upper canal from Congor to the Eastside Reservoir and a lower canal from Copper to the Bingham Reservoir function as a secondary means of conveyance of the collected water. The upper canal is designed primarily to convey mine impacted water under upset conditions or pipeline cleanout and the lower canal is principally used for storm water conveyance. The lower canal also can be used as a secondary containment structure for water piped from Bingham Tunnel and/or Lark Shaft to the Large Reservoir and/or to the Waste Water Disposal Pump Station. The lower canal can also be used to capture water generated from upset conditions such as a pipeline break. The concrete ditch is not used for routine conveyance of mine impacted water.

Flows from the South Side are collected by gravity flow and commingled with flows from the East Side. Cut-off walls are excavated into bedrock. Sedimentation basins are located upstream of each cut-off wall and in some cases additional basin capacity will be established downstream of the cut-off walls but will continue to report to the primary collection pipe under gravity flow.

Flows from the Dry Fork waste rock dump and other West Side dumps that drain into the Bingham Canyon are contained and collected as follows with specific permit conditions outlined in Table 2 and discussed in detail in Appendix G; well locations can be identified in Figure 2 of the Permit:

1. Two clean water extraction wells (Mid Valley and Picnic Flats) are maintained in upper Dry Fork Canyon to capture water before it contacts the waste rock dumps and underlying contaminated groundwater. Water is collected by the Mid Valley well (COP2701) and the Picnic Flats well (COG1172) and routed to the Copperton Concentrator for use as process water.

2. The Bingham Creek cut-off wall was constructed upstream of the Bingham Reservoir System in 1994-95 to collect surface and subsurface alluvial flow in the Bingham Creek drainage. The scale of this wall is considerably larger than other cut-off walls constructed for the East Side dumps. The depth of the excavation to bedrock was in excess of 100 feet. The wall is over 300 feet across at the top with a maximum thickness of 20 feet at its base. Alluvial flows are collected by the wall through pumping and are ultimately sent to the tailings pipeline.

3. An alluvial extraction well identified as the Copperton Channel well (ECG1185) is located in the Copperton channel, a small alluvial channel which trends eastward. The well was commissioned for alluvial extraction in 1996. The well is screened between 130 and 200 feet below ground surface to capture subsurface alluvial flows. Flows captured in this channel are ultimately sent to the tailings pipeline.

4. An alluvial extraction well in Bingham Creek identified as ECG2787 was installed in Bingham Canyon in 2009. The well is screened in alluvium between 75 and 129 feet below ground surface and extracts mine impacted water from the surrounding alluvium. This well is located down-gradient of the Bingham Canyon waste rock dump. Under normal operating conditions, water from this well is sent to the ACC Plant to recover copper.

5. An alluvial extraction well identified as Curtis Springs (K83) has operated in Bingham Canyon since the 1960s. The well is located down-gradient of ECG2787 and is screened in alluvium between the depths of 46.5 and 96.5 feet below ground surface. Flows reporting to and captured by this well are contingent upon alluvial water levels. Water levels for K83 respond to pumping conducted at the upgradient ECG2787.

The Bingham Canyon Mine pit acts as a large groundwater collection basin in this portion of the

Oquirrhs. On average, Kennecott removes water from the pit, on a continuous basis, at a rate of approximately 1,000 to 1,500 gallons per minute. There is several water quality issues related to mine closure which are addressed in the closure plan (Appendix D). The majority of these issues are related to pit water accumulation and quality as well as flows from a variety of tunnels associated with mine operations.

Monitoring Approach

A monitoring well network of 43 wells, 36 on the east side and 7 in the Dry Fork area (DWG 454-T-0118 and Table 1), is utilized for compliance monitoring of the Bingham Canyon Mine and Water Collection System. In addition, wells listed in Table 3 will be used for additional informational monitoring on the east side and within Dry Fork/Bingham Canyon area. Prior to 2004, only 15 wells were used for compliance monitoring. In 2004, 28 wells were added to the existing network of compliance monitoring wells. The primary objective of compliance wells is to monitor the valley principal aquifer system. Permit limits are based on groundwater class protection levels, and monitor the effectiveness of the upgraded cut-off walls, source controls and the collection system.

Where possible, East side well locations were selected to provide completions in the saturated alluvial aquifer system to the east of the waste rock disposal areas where at least 50 to 100 feet of saturation exists adjacent and above bedrock. In the southern portion of the East Side and the South Side waste rock disposal areas and areas immediately down-gradient of the cut off walls; compliance monitor wells are completed in bedrock because no saturated alluvial deposits exist.

The seven compliance wells located in the Dry Fork/Bingham Canyon area (Table 1) are screened in bedrock and are sited to confirm that contamination is not migrating out of the Dry Fork/Bingham Canyon area via bedrock flow paths. These compliance monitoring wells are all located upgradient of the Bingham Canyon cut-off wall.

Permit limits for pH, total dissolved solids, sulfate, dissolved metals of cadmium, copper and zinc (Table 1) were established in 1999 for the original 15 compliance wells; in 2004 for the additional compliance wells; and adjusted in 2010 to account for the full history and data available for each compliance well. These parameters were selected as good indicators of mine impacted water. The permit limits established in 1999 were based on monitoring data collected over a period of 4 to 5 years, while limits established in 2004, 2010 and 2015 are based on monitoring data collected over ten and 15 years, respectively.

Operational monitoring for this permit includes flow and quality sampling of mine impacted waters from the collection system, tunnel flows, leachate from repository sumps, seeps (if present), informational wells and extraction wells.

One of the technical issues associated with the monitoring well system is the ability to distinguish contamination that is historical in nature from contamination that has a recent origin. Prior to the

installation of the upgraded cutoff wall system in 1994-1996, the old cutoff wall system was in operation. The old cutoff wall system was not as effective and loss of leach water was significant. In addition, the velocity of groundwater in the bedrock material is quite low based on numerous hydraulic conductivity tests conducted by Kennecott. It is very likely that the contaminated groundwater present in the vicinity of some monitoring wells is from a time frame that precedes the installation of the upgraded cut-off wall system. The monitoring well data will need to distinguish between historic contamination and any recent contamination. If recent contamination is detected, it may indicate the upgraded cut-off wall system is not performing properly. Kennecott completed several studies to age date and identify the source of groundwater and contamination in the area to provide clarification on this issue (DWQ-2001-001082, DWQ-2002-001141 and DWQ-2002-001101).

Basis for Specific Permit Conditions

1. *Bluewater Repository* – The Bingham Canyon Mine and Water Collection System permit incorporates the previous groundwater discharge permit for the Bluewater Repository. Two standing conditions from that permit are needed to address future construction of the clay liner or clay cap. The first item requires Kennecott to comply with the Quality Assurance/Quality Control (QA/QC) plan approved for the Bluewater Repository groundwater discharge permit. The second item requires an "As Built" report that documents how construction conformed to the approved design and QA/QC requirements be submitted within 60 days of final completion of new segments of the cap or liner.

2. *Permit Renewal Application Items* - To assist in permit renewals every five years, this condition requires Kennecott to submit a water quality summary of the previous data collected for operational sites and compliance monitoring wells and surface water sites. The annual groundwater report submitted on an annual basis fulfills this requirement. The report will include an analysis of trends and changes in water quality over the life of the permit (five years).

3. *Closure Plan* - Acidic drainage from the waste rock dumps will continue to be generated from meteoric water long after the Bingham Canyon Mine ceases operations. In addition, groundwater will inundate a portion of the pit and may flow out of the pit via tunnels etc. A conceptual closure plan has been submitted to the DWQ to address the water quality related closure issues associated with the mine and waste rock disposal areas (Bingham Canyon Mine 2003 Reclamation and Water Management Plan). The conceptual closure plan will be updated and submitted for review in conjunction with major changes and revisions to both the permit and the plant that directly affect closure strategy. A final closure plan is due one year prior to final closure. Included in the closure plan will be preliminary designs and a schedule to minimize infiltration of meteoric water through the waste rock and low-grade ore stockpiles.

4. *SXEW Plans and Specifications* - Kennecott is currently conducting a pilot scale leaching program on a lined portion of the Dry Fork Waste Rock Dump as well as pilot scale solvent extraction/electrowinning. The original pilot scale Solvent Extraction/Electrowinning plant associated with the heap leach piles was discontinued in the late 1990's and planned for demolition. However, this condition is included in the Bingham Canyon Mine and Leach Collection System Groundwater Quality Discharge Permit to require Kennecott to provide detailed plan modifications and specifications for any future SXEW operations. Plans and specifications should be submitted 180 days prior to the planned start of construction of these facilities. The plans and specifications must be approved by the Director.

5. *Contingency for Installation of a Bedrock Extraction Well in Bingham Canyon* – If bedrock compliance monitor wells K93 and ECG2789A&B at the mouth of Bingham Canyon begin to show signs of contaminant plume migration, Kennecott will refer to Section 4 of Appendix G of Permit UGW350010 for guidance on how to proceed. A remedial strategy will be developed by Kennecott and approved by the DWQ to address the migration of possible bedrock contamination by previous up-gradient Dry Fork leaching activities. Following approval of the remedial strategy, Kennecott will implement a remedial program to address contamination. Kennecott and DWQ will refer to Section 4 of Appendix G of this permit for guidance regarding pumping well installation and Part II.F.3.(a) of the permit to establish compliance limits for the wells as per the accelerated sampling program.

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1. Bingham Canyon Mine East Side Collection Monitoring Network Ground Water Discharge Permit Application. Kennecott Utah Copper, April 1996.

2. Hydrogeology of recharge areas and water quality of the principal aquifers along the Wasatch Front and adjacent areas, Utah. U.S. Geological Survey Water Resources Investigations Report 93-4221. P.B. Anderson, D.D. Susong, S.R. Wold, V.M. Heilweil, and R.L. Baskin, 1994.