Kennecott Utah Copper Corporation

North Facilities Soils and Wastewater Treatment Plant Ponds Site Removal Action SSID #4B

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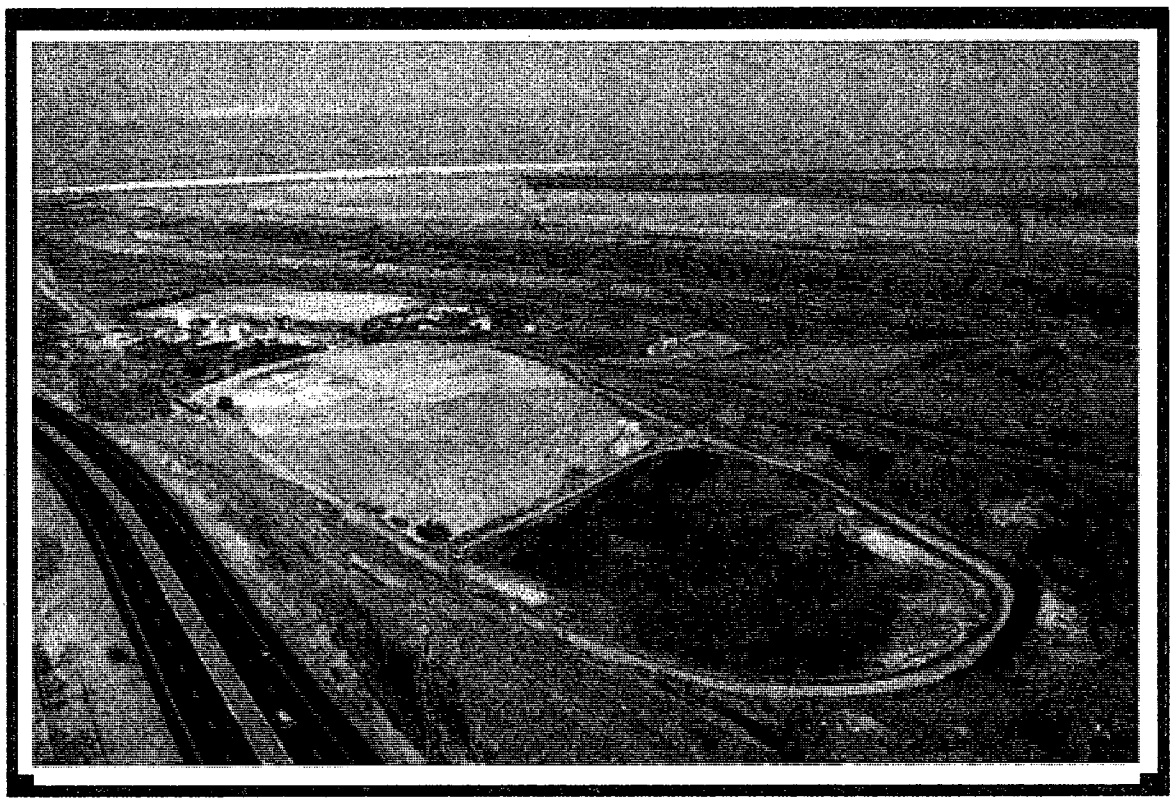

Work Plan
with Appendices

Prepared and Submitted by:
Kennecott Environmental Engineering Projects Group
Bingham Canyon, Utah

September 1996

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KENNECOTT UTAH COPPER CORPORATION

NORTH FACILITIES SOILS AND WASTEWATER TREATMENT PLANT PONDS SITE REMOVAL ACTION

WORK PLAN

SSID #4B

Prepared and Submitted by:

Kennecott Environmental Engineering Projects Group
Bingham Canyon, Utah

September 1996

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1.0 INTRODUCTION

Kennecott Utah Copper Corporation (Kennecott), as part of the continuing property-wide clean up efforts, will conduct removal of contaminated soils and sludge and demolition of selected structures at their North Facilities near Magna, Utah. Kennecott will conduct the characterization activities, removal actions, demolition, and reclamation with the Utah Department of Environmental Quality (UDEQ) and the United States Environmental Protection Agency (EPA) oversight and governed by an Administrative Order on Consent (AOC). The action is titled the Kennecott North Facilities Soils and Wastewater Treatment Plant Ponds Site Removal Action (NFS/WWTP Removal Action - SSID# 4B). This Work Plan, appendices and schedule will become part of the negotiated AOC and are also intended to satisfy the commitments of the September 29, 1995 Memorandum of Understanding (MOU) among EPA, UDEQ and Kennecott.

The Kennecott North Facilities include the areas and certain structures associated with the Noranda Smelter, Refinery, Arthur Concentrator Footprint Site (facility was demolished in 1992), Magna Concentrator footprint, and the Bonneville Crusher footprint at the north end of the Oquirrh Mountains (Dwg. No. 500-T-0006). The North Concentrator is located at 9600 West 2100 South; the Refinery is located at 11500 West 2100 South; and the Smelter is located at 12000 West 2100 South. This property has been used for industrial purposes, specifically minerals beneficiation and extraction, mineral processing and smelting, for approximately 100 years. Soil and debris characterization activities have been and will continue to be implemented to assess existing site conditions. Potential hazards to human health and the environment will be evaluated to support removal action decision making. This Work Plan pertains only to soil and other solid waste potentially contaminated with inorganic substances (primarily metals). Ground water studies and remediation will be addressed under a separate plan as appropriate. Findings of soil and debris characterization investigations will be compiled by Kennecott and submitted to the EPA and UDEQ. Kennecott and/or agency personnel may require additional information be collected subsequent to the initial characterization event and before removal actions are implemented. To date, Kennecott has characterized the Site to the extent practicable (not all sites identified in this Work Plan have been fully characterized), but due to existing decommissioned and operational structures, additional sites may be added to the work scope, if appropriate.

1.1 Purpose

The Work Plan is submitted pursuant to a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA-VIII-95-04) Administrative Order on Consent with the EPA. The purpose of the North Facilities Removal Action is to define the nature and extent of contaminated demolition debris and soils (including Wastewater Treatment Plant (WWTP) sludge) and implement the appropriate response measures to protect human health and the environment. All valid data have been evaluated and based on similar programs successfully initiated on other Kennecott property (with State and EPA oversight and approval), it has been determined that on-site disposal is the most feasible, efficient, protective, and cost-effective response alternative for the majority of inorganic mining related waste. To facilitate this removal alternative, Corrective Action Management Units

(CAMUs) have been designated for the purpose of managing hazardous remediation wastes (fully described in Section 8.0). A CAMU is a management tool that allows an owner/operator flexibility to conduct remedial activities in a manner that is qualitatively different from normal waste storage, treatment and disposal activities. Under the CAMU rule, one or more areas at a facility may be designated as a CAMU in accordance with the criteria at subsections 264.55(c) and (e) of 40 CFR. Movement and consolidation of hazardous remediation wastes into or within a CAMU does not constitute land disposal of hazardous wastes. Reprocessing of materials will be evaluated on a site-by-site basis and conducted if appropriate and economically justified. Off-site disposal may be necessary for specific wastes.

Kennecott and its contractors will perform the Site characterization, demolition, excavation, transport, and placement of contaminated soils. Material handling, soil sampling protocols, health and safety requirements, and air monitoring methodologies specified are consistent with those used during other actions conducted by Kennecott and at similar sites. The following Work Plan details the project scope that will be initiated during the Removal Action. Due to the schedule and magnitude of this project, this Work Plan and associated plans should be considered "iterative documents". The Work Plan will be amended as required in writing and with mutual agreement between Kennecott and agency personnel.

In summary, Kennecott will decontaminate materials and equipment from decommissioning and demolition activities, excavate contaminated soils (some of which may be contaminated with hazardous wastes), temporarily store removal wastes in existing WWTP ponds if necessary, excavate WWTP sludges, mix and dry the sludges and soils in a staging area, and consolidate the solid mixture in a secure on-site repository.

2.0 PHYSIOGRAPHIC SETTING

2.1 Topography

The Kennecott North Facilities are located between the southern shore of the Great Salt Lake and the northern end of the Oquirrh Mountains. The approximate elevation of the Facilities range from 4225 to 4450 feet National Geodetic Vertical Datum of 1929 (NGVD) and generally slope north. The Great Salt Lake is at an elevation averaging 4200 feet NGVD.

2.2 Meteorology

Precipitation data recorded at the Saltair Station at the southern shore of the Great Salt Lake indicate the average precipitation for the North Facilities region is 13.6 inches per year. The average monthly precipitation ranges from a high of 1.8 inches in April to an average low of 0.7 inches in July. Based on aerial precipitation maps compiled by Hely et al. (1971), the average annual precipitation at Kessler Peak, southeast of the Smelter and 4500 feet higher, is about 20 inches per year.

Ambient temperature in the North Facilities region is largely influenced by altitude and land features. During the summer months average temperatures near the Great Salt Lake are considerably higher than in the Oquirrh Mountains. The recorded temperatures at Salt Lake City International Airport range from average highs greater than 90 degrees Fahrenheit (F) in July and August to average lows near 40 degrees F in December and February (Hely, et al., 1971).

Evaporation rates have been recorded at Saltair using a Class A pan. For the period 1956 to 1986, the average annual pan evaporation rate was 74.6 inches (ETA, 1992). Monthly evaporation rates range from an average high of 14.4 inches in July to near zero for the months of December through February.

Wind direction in the North Facilities region is predominantly out of two directions; east-southeast and west-southwest with an average wind speed of six miles per hour.

2.3 Geology and Soils

The Kennecott North Facilities are situated on sediments eroded from the northern end of the Oquirrh Mountains. The Northern Oquirrh Mountains are composed of thick sequences of folded and faulted Pennsylvanian and Permian sedimentary rocks of the Erda and Kessler Canyon Formations, respectively (Tooker and Roberts, 1971). The bedrock is composed of alternating sequences of limestone, dolomite, sandstone, quartzite, and shale. The Erda Formation outcrops in several areas south of the Facilities.

Overlying the bedrock are Quaternary alluvial and colluvial deposits derived from the local bedrock and consist of clayey to sandy gravels. These deposits merge and interfinger with the Quaternary lacustrine and deltaic valley-fill sediments along the base of the Oquirrh Mountains. Heterogeneous mudflow sequences influenced by historic torrential rains occur throughout the area. The mudflow units and interlayered gravelly sequences are interpreted to dip to the north based on lithologic correlation. The surface of the Quaternary alluvium has been shaped by inundations of historic Lake Bonneville, which created wavecut benches and shoreline erosion features.

2.4 Surface Water

There is no perennial surface water in the North Facilities area, but seasonal and storm water runoff does occur in the watershed. Due to lack of vegetation throughout the watershed, peak flow during runoff events can be high and erosional features are present. Surface runoff in most locations is diverted into a network of ditches and collection ponds, and some is directed to the water recycle system. Several water bodies are located north of the Facilities including the Great Salt Lake, several springs, and wetland areas.

2.5 Land Use

Land use in the vicinity of the North Facilities is industrial, associated with Kennecott mineral processing activities and tailings disposal. Transportation corridors located north of the Facilities include State Highway 201, Union Pacific Railroad, and federal Interstate Route 80. Other facilities in the area not operated by Kennecott are Union Pacific Resources north of the Smelter and Praxair (oxygen plant) near the Refinery. The Chevron Chemical Property has recently been acquired by Kennecott to facilitate the Tailings Impoundment Expansion and Modernization Project.

Great Salt Lake beaches and the Great Salt Lake State Park and Marina are north of the Facilities. The nearest areas of human habitation include the cities of Magna and Lake Point, about four miles east and west of the Smelter, respectively.

3.0 NORTH FACILITIES HISTORY

The Kennecott Smelter/Refinery Modernization will replace several process units at the North Facilities adjacent to State Highway 201 (along with other ancillary facilities at Arthur, Bonneville, and Magna Concentrators). It was determined from sampling activities that soil and associated debris affiliated with the North Facilities contain elevated levels of heavy metals. This Work Plan is based on previously collected and current data, operational history of the facilities, and previous removal actions conducted by Kennecott. The following provides an operational history of the major facilities and a description of the soil and demolition sites identified to date. Detailed characterization reports will be submitted as addenda to the Soil and Demolition Debris Quality Assurance Project Plan and Sampling and Analysis Plan as studies are completed.

3.1 North Concentrator Area

The North Concentrator Area includes four main facilities at the north end of the Oquirrh Mountains east of the refinery; the Arthur Concentrator Area, the Magna Concentrator Area, the Utah Power Plant, and the Bonneville Crusher Area (Dwg. No. 507-T-0173).

3.1.1 Arthur Concentrator Area

The Arthur Concentrator, built in 1909 by Boston Consolidated (acquired by Utah Copper in 1910), included crushing, grinding, flotation, and filter plant processing facilities. Ancillary facilities included a steel and brass foundry, boiler shop, machine shop, paint shop, and a reagent circuit (Arthur Stills). In 1975, a tailings re-treatment plant was added.

Operations at the facilities were halted in 1985 and 1986 during the Kennecott shutdown. The processing area (excluding the maintenance shops and administration building currently in use) was demolished in 1988 and 1989. The tailings re-treatment plant was demolished in 1992. Currently,

no additional demolition sites have been identified at Arthur. The Arthur Area consists of five soil sites. All five sites have been characterized and demonstrate elevated concentrations of metals.

The West Debris Site (A01) consists of irregularly shaped piles containing predominately soil, wood, slag, laboratory glassware, crucibles, metal shavings, concrete, bricks and other building material. Characterization sampling indicates four of the eleven samples to be elevated in total arsenic (320 parts per million (ppm), 360 ppm and 260 ppm) and(or) total lead (65000 ppm, 38000 ppm and 4100 ppm). Toxicity Characteristic Leaching Procedure (TCLP) performed on a composite of elevated total metal samples was below the Maximum Concentration of Contaminants (MCC). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	40	0.5	120	< 14
MAXIMUM	360	4	65000	< 14
AVERAGE*	146	3	10032	7

Further investigation of the Site indicated the presence of friable asbestos (chrysotile). The metal and asbestos contaminated soil will be placed in the Arthur Step-Back Repository.

The Crucible Site (A04) consists of predominately fire assay debris and other waste from the old Arthur Assay Laboratory. Characterization sampling indicates six of the sixteen samples to be elevated in total arsenic (210 ppm) and(or) total lead (35000 ppm, 37000 ppm, 6100 ppm, 4300 ppm, 15000 ppm and 3400 ppm). Toxicity Characteristic Leaching Procedure performed on a composite of elevated total metal samples was below the MCC. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 30	< 0.5	70	< 30
MAXIMUM	210	4.1	37000	< 30
AVERAGE*	63	1.6	6484	15

The Foundry Slag Site (A10) consists of predominately slag and metal debris from the now demolished Arthur Foundry that produced brass and iron products. Characterization sampling indicates six of the thirty samples collected to be elevated in total arsenic (390 ppm and 393 ppm) and(or) total lead (8100 ppm, 3050 ppm, 3000 ppm, 2140 ppm and 2950 ppm). Toxicity Characteristic Leaching Procedure performed on a composite of elevated total metal samples failed for the lead MCC. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 14	< 0.5	< 10	< 13
MAXIMUM	393	13	8100	130
AVERAGE*	63	3	885	19

The Railroad Debris Site (A11) is a pile that was used as an end-of-line barrier for the railroad. The pile consists of oxidized metallic debris, soil and concrete debris. A characterization sample collected by Kennecott personnel indicates elevated total metal lead (876.8 ppm).

The Stills Site (A12) is the former location of a RECO plant which produced chemicals for the Arthur Mill floatation process. Characterization sampling indicates three of the eighteen samples are elevated in total arsenic (503 ppm, 817 ppm) and(or) total lead (2700 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	11	< 0.2	3.6	< 0.5
MAXIMUM	817	5.78	2700	89.4
AVERAGE*	127	0.9	269	12

3.1.2 Magna Concentrator Area

The Magna Concentrator, built in 1906 and 1907, consisted of crushing, grinding, flotation, and filter plant processing facilities and a molybdenite circuit. The flotation portion was upgraded in 1975 with the old structures demolished in 1991 and 1992. The crushing and grinding sections were closed in 1988 when the Copperton Concentrator came on-line. The facility is currently operating with the original filter plant.

The Magna Concentrator Area consists of three sites. Only two of the three soil sites have been characterized and both demonstrated elevated concentrations of metals. No demolition sites have been identified to date at Magna.

The Railroad Slope Site (M01) is an area consisting of steep slag and metal debris slopes. Characterization sampling indicates six of the fourteen samples collected are elevated in total arsenic (200 ppm, 220 ppm 270 ppm and 240 ppm) and(or) total lead (2300 ppm, 5000 ppm, 3010 ppm, 11000 ppm and 2800 ppm). Toxicity Characteristic Leaching Procedure performed on a composite of elevated total metal samples failed for the lead MCC. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 5	< 1	< 2	< 4
MAXIMUM	270	6.3	11000	30
AVERAGE*	100	2.5	1971	4.9

The Concentrate Loading Site (M06) is an active operations area consisting of a rail line and a overhead concentrate chute that loads the rail cars. This Site has not been characterized to date.

The East Debris Site (M09) consists of predominately waste ore and metal debris. Characterization sampling indicates six of the eighteen samples are elevated in total arsenic (215 ppm, 390 ppm, 210 ppm, 990 ppm and 360 ppm) and(or) total lead (4940 ppm, 4900 ppm, 4800 ppm and 9900 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 5	0.59	12.2	< 4
MAXIMUM	990	14	9900	41
AVERAGE*	163	4.7	1506	7.4

3.1.3 Utah Power Plant Area

Above the Magna Concentrator is the Utah Power Plant with 175-megawatt generating capacity for the North Facilities operations. The plant has the capability of burning coal and/or natural gas as fuel sources. To date, no inorganic concerns have been identified at the Power Plant. Confirmation samples will be collected to confirm this, and if necessary, corrective action will be taken.

3.1.4 Bonneville Crusher Area

The Bonneville Crushing and Grinding facility was constructed in 1966 and receives ore by rail from the Bingham Canyon Mine. The Bonneville facility is currently operational with crushed ore being supplied to and processed at the Magna Concentrator. After processing, concentrate is sent from the North Concentrator area to the Smelter or shipped by rail to customers. The Bonneville Area consists of four sites. All four soil sites have been characterized and are below all total metals action levels (see Section 4.2). No demolition sites have been identified to date at Bonneville.

The Scrap Yard Site (B01) was used as a coal storage and concentrate stockpile area. The concentrate was removed and the Site was sampled by Kennecott personnel in 1994. Recently the Site has been used as a railroad laydown yard and has been partially reclaimed. In 1995 the Site was further characterized. A total of four samples were collected and analyzed for arsenic, cadmium,

lead and selenium which indicated all values below the action levels. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	2.95	> 0.5	6.5	< 1
MAXIMUM	13.6	0.74	17.8	1.15
AVERAGE*	7.97	0.46	11.67	0.66

The Bonneville Gate Hillside Site (B02) is the former location of a precious metals recovery operation that stockpiled ore on the hillside. Characterization sampling indicates all six samples collected were below the total metals action levels. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	12	0.45	15	0.68
MAXIMUM	35	1.3	47	2.9
AVERAGE*	25	0.69	33	1.61

The Little Valley Settlement Ponds Site (B04) consists of a series of ponds that collect sediment from the upgradient Bonneville Crushing and Grinding facility's ore stockpiles. Characterization sampling indicates all four samples collected were below the total metals action levels. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	34.7	> 0.41	13.1	> 13
MAXIMUM	124	1.08	97	> 13
AVERAGE*	78.8	0.50	42.3	6.5

The North Slope Site (B10) consists of a series of ore and metal debris piles from the routine cleaning of the Bonneville Crusher and Grinder. Characterization sampling indicates all five samples collected were below the total metals action levels. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	14	0.455	11.1	> 5
MAXIMUM	44.3	1.09	65.5	> 13
AVERAGE*	27.52	0.77	34.58	4.9

3.2 Noranda Smelter Area

The Kennecott Smelter Plant is a 160 acre industrial facility located at 12000 West immediately south of Utah State Highway 201. Kennecott is constructing a modernized smelter on approximately 22 acres within the existing smelter boundary. The work to be conducted and governed by this Plan is associated with the existing Noranda Smelter (decommissioned June 1995) and related soils.

The first smelter located at this site (the Garfield Smelter) was constructed in 1905 and 1906 by the American Smelting and Refining Company (ASARCO). Ore from many early mining companies such as Utah Copper and the Boston Consolidated Mining Company was processed at the ASARCO Smelter. Kennecott purchased the smelter in 1959 and converted it to a green feed Smelter using a reverberatory process for handling Bingham Canyon Mine ore concentrate, exclusively.

The Noranda Smelter Plant construction began in 1975 and operated since 1978 using the Noranda continuous feed process. The modernized Kennecott Smelter uses state-of-the-art "flash smelting" technology, and was commissioned mid-1995. The Noranda Smelter processed copper concentrate generated at the Copperton and Magna concentrating plants. The concentrate was delivered to the Smelter by both rail and slurry pipeline. After smelter processing, the cooled anodes were transported by rail in open flat-bed cars to the Refinery where an electrolytic process was used to refine the copper.

3.2.1 Noranda Smelter Area Soils

The Noranda Smelter Area (Dwg. No. 503-T-0172) consists of ten soil sites. To date only three of the ten sites have been characterized and demonstrated elevated concentrations of metals.

The East Yard Site (S02) consists of strongly discolored slopes, terraces and stockpiles. Characterization sampling indicates two samples are elevated in total arsenic (738 ppm and 542 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	542	10.2	1000	57.7
MAXIMUM	738	13.1	1810	79.1
AVERAGE*	640	11.7	1405	68

The Noranda Smelter Soils Site (S08 which includes #8 Acid Plant) is the footprint of the buildings and structures that were incorporated in the old Smelter facility. The Noranda Smelter demolition is scheduled to begin during the summer of 1996, and be complete in the fall of 1999 with soils characterization sampling to follow.

The Kessler Canyon Site (S09) consists of several flue dust and copper concentrate contaminated stockpiles and ground surface along with other debris such as bricks and concrete. Characterization sampling indicates 196 of the 481 samples are elevated in total arsenic and(or) total lead and(or) total selenium. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	0.6	0.1	1	0.2
MAXIMUM	50000	1703	68578	492
AVERAGE*	1112	45.2	1322	14.8

The Return Canal Site (S11) is an old canal that was used as the storm water and surface runoff discharge point. The Site has not been characterized to date.

The Weak Acid Corridor Site (S12) consists of a pipeline that transported weak acid and process water from the Weak Acid Lift Station to the WWTP. The Site has not been characterized to date.

The Weak Acid Lift Station Site (S13) is the main pump station that pumped weak acid and process water to the WWTP via the Weak Acid pipeline. This facility is still in operation and will be demolished after the demolition of the Noranda Smelter. Characterization sampling of the footprint will follow the demolition.

The Slag Tailings Pipeline Corridor Site (S15) is the old pipeline that transported slag tailings from the Smelter to the Tailings Impoundment. This Site has not been characterized to date.

The Slag Pile Soils and Lagoon Site Footprint (S16) is the footprint of the currently owned by Union Pacific slag pile which will be used as drain rock for the Tailings Modernization Project. This Site will be characterized following the removal of the slag.

The Railroad Yard Soils Site (S17) is a loading and off-loading, sampling and weighing facility for the concentrate that is being transported off-site. The Site will be characterized following the cessation of concentrate shipping activities.

The Acid Plant #7 Soils Site (S100) consists of the footprint of Acid Plant #7 that was demolished in the spring of 1996. The Site covers an area of approximately 3 acres and consists of a variety of fill soil, slag, and asphalt mixed with metal, concrete, and wood debris. Forty-five characterization samples were collected from the Site. Twenty-seven of the forty-five samples collected contained

arsenic in concentrations above the action level of 200 ppm. Eleven samples contained lead in concentrations above the action level of 2000 ppm. One sample contained selenium above the action level of 1000 ppm.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	3	0.25	4	4
MAXIMUM	8680	262	31600	1380
AVERAGE*	894	24	2395	92

3.2.2 Noranda Smelter Area Demolition

Kennecott has recently completed construction of a new copper smelter near Salt Lake City, Utah. Due to this new construction, the 1977 vintage Noranda Smelter has been decommissioned and related structures will be demolished. The demolition area can be divided into five main areas of interest which are the Hot Metals Building, Material Handling, Powerhouse, Gas Handling, and Acid Plant #8 (Dwg. No. 503-T-0215).

The Hot Metals Building, where the copper smelting took place, was constructed in 1977. The major pieces of equipment associated with this building are three Noranda reactors, four Pierce-Smith type converters, two pelletizers, and the anode casting system. Contaminants associated with this building could be heavy metals related to concentrate and fugitive dusts.

The Material Handling Area dried and conveyed copper concentrates from the storage area to the Noranda reactors in the Hot Metals Building. Material Handling is made up of several thousand feet of conveyors and belt feeders ranging from 24 inches to 48 inches wide. In addition, two stainless steel rotary dryers, that were used for drying the concentrates, are present. Contaminants associated with this building and structures could be heavy metals related with concentrate.

The Smelter Powerhouse was constructed in the early 1900's but has been through numerous modifications since that time. Operating at full capacity it could supply the 15 megawatts of electricity needed to power the Noranda Smelter. The primary equipment in the powerhouse is three generators, two electric turbines, four steam turbines, and five screw compressors. This structure is not expected to be contaminated with metals other than fugitive tracking and dust.

The Gas Handling Area collected the fugitive gases from the Hot Metals Building and conveyed them to the acid plant and subsequently to the stack. The large fans in Gas Handling are the primary pieces of usable equipment. Some gas handling flues are known to be contaminated with flue dust.

Acid Plant #8 scavenged the sulfur from the fugitive gases and produced sulfuric acid. The contaminants associated with the Acid Plant are sulfuric acid and heavy metals related to dusts and sludge. The dusts and sludge are accumulations in various places throughout the process equipment

and are elevated with arsenic, cadmium, and some lesser amounts of other metals. This Acid Plant, as a whole, is in good condition.

In addition to the large pieces of equipment listed above, Kennecott has an inventory of the equipment associated with the five main demolition areas. Kennecott will sell equipment and salvageable materials from the facilities before and(or) during demolition.

3.3 Refinery Area

The Kennecott Refinery is a 45 acre industrial facility located on the north end of the Oquirrh Mountains between the Smelter and the Arthur Site (the areas to be demolished are discussed below). The existing facility was built by Kennecott in 1950 to refine copper anodes from the smelter and produce electrochemically pure copper, gold, and silver. The Refinery has been modernized to match the capacity of the modernized Smelter.

The Refinery facility is comprised of the Tankhouse, MPC Building, Silver Building, Lead Shop, Electrolyte Purification (EP) Building, Boiler Plant, Chemical Laboratory, and other maintenance and administrative structures (the structures to be demolished are discussed in section 3.3.2). The Refinery produces copper cathodes, gold bars, silver bars, platinum sponge, palladium sponge and commercial grade selenium. Most of the structures were built in the early 1950's and have remained virtually unchanged. The Tankhouse accommodated the cells where the anode is electrically plated to a starter sheet to become the commercial cathode and covers approximately 224,000 square feet. Slimes washed from the cell bottom are delivered to the Silver Building. A new Precious Metals Building has been constructed west of the Tankhouse. Electrolyte used in the process was mixed and cleaned in the now obsolete EP Building.

3.3.1 Refinery Area Soils

The Refinery Area (Dwg. No. 503-T-0173) consists of seven soil sites. Only three of the seven sites have been characterized to date. Characterization sampling indicates two of the three sites are elevated in metals.

The Precious Metals Site (R01) is the original Silver Building footprint. The building is scheduled for demolition in the summer of 1996 with soils characterization sampling to follow.

The Old Spent Electrolyte Pond Site (R02) is a capped and vegetated pond which received spent electrolyte solutions. Characterization sampling indicates five of the twenty-three samples are elevated in total arsenic (360 ppm, 450 ppm, 513 ppm, 241 ppm and 394 ppm) and(or) total lead (9935 ppm) and(or) total selenium (1800 ppm, 7332 ppm, 2215 ppm and 1844 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	15.8	< 1	35.6	< 5
MAXIMUM	513	2.4	9935	7332
AVERAGE*	126	0.7	659	700

The East Rail Yard Site (R05) is a benched area consisting of predominately slag and fly ash with other metal debris. Characterization sampling indicates one of the twenty-three samples to be elevated in total arsenic (211 ppm). This sample was collected from an operational area (railroad) and removal will occur once all operations on this rail line are complete. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 14	< 0.4	< 2.6	< 15
MAXIMUM	211	5	427	17.8
AVERAGE*	23.5	0.75	76	9

The Electrolyte Purification Site (R08) is the Electrolyte Purification Building footprint. The building is scheduled for demolition in the spring of 1996 with soils characterization sampling to follow.

The Lead Shop Site (R09) is the Lead Shop Building footprint. The building is scheduled for demolition in the fall of 1996 with soils characterization sampling to follow.

The Electrolyte Pipeline Corridor Site (R12) is the location of the old electrolyte pipeline that transported spent electrolyte solution from the Refinery Electrolyte Purification Building to the WWTP. The Site has not been characterized to date.

The Garfield Town Site (R13) is the footprint of the old town of Garfield. Characterization sampling indicates none of the twenty-five samples collected were elevated in total metals. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	> 30	0.6	50	> 30
MAXIMUM	190	5.6	1000	70
AVERAGE*	55.8	2.2	388	19.6

3.3.2 Refinery Area Demolition

Kennecott has recently completed construction of new copper refining facilities on Refinery Property. Due to this new construction, many of the 1950 vintage buildings have been decommissioned. The demolition areas can be divided into four main areas of interest which are the Silver Building (the old Precious Metals Building), Electrolyte Purification Building, Physical and Chemical Laboratory, and the Lead Shop (Dwg. No. 503-T-0216).

The Silver Building processed anode slimes from the Tankhouse by thickening them with a filtered decant solution. The thickened slimes were pressure leached with sulfuric acid and oxygen. This removed over 99% of the copper content. The residue was filtered, washed, and air dried in a filter press. Elemental selenium, silver, and gold were produced at the Refinery. Refinery waste effluent solutions were pumped to the WWTP for neutralization and heavy metals removal.

The Electrolyte Purification Building was used to maintain the electrolyte solution, control copper content and soluble impurities such as arsenic, antimony, and bismuth, and control organics by electrowinning in cells containing insoluble lead anodes.

The Chemical and Physical Laboratory was used as an assay laboratory to support Kennecott operations and quality control. The building was approximately 50 feet by 100 feet with a main floor and partial basement. The contaminants associated with the Lab were found in the table hoods and dust.

The Lead Shop was used to construct and mold the liners for electrowinning cells used at the Electrolyte Purification Building. The building is a small structure that has been cleaned and is currently being used as a shop with an adjoining lunch room. This building will be demolished following all other areas.

3.4 Wastewater Treatment Plant Area

The Kennecott Wastewater Treatment Plant is located adjacent to the intersection of State Highways 201 (2100 South) and 202, north of the Refinery. The primary function of the WWTP was to neutralize acid plant blowdown from the Smelter and bleed electrolyte from refinery operations. The WWTP also received and treated in-plant sewage and clarified other process waters from the Smelter, Refinery, Power Plant, and the North Concentrator facilities. The sludge and wastewater

have been sequentially discharged into five ponds, designated Ponds A, B, C, C-Extension, and D, all located within 1-1/2 miles of the WWTP.

Treatment processes at the WWTP have been modified several times during past operations through the addition of lime, ferric chloride, or both. These modifications resulted in concentration variations of both total and leachable metals in the sludge. From start-up in 1974 through 1978, ferric chloride was added to the wastewater influent to stabilize some of the heavy metals. The

addition of ferric chloride was discontinued in 1982 due to operational difficulties, but was resumed in August 1991 to reduce the concentration and leachability of arsenic in the effluent. During the period 1983 to 1989, the WWTP was modified to use a high concentration lime process. The WWTP was completely shut down between 1985 and 1987. In mid 1989, the neutralization process was changed by reducing the pH from 12 to 10 to provide better control of the pH of the final effluent at the discharge location. The addition of ferric chloride resumed in August 1991 to reduce the concentration of arsenic in the effluent and to reduce the leachability of arsenic from the sludge. Most of this low-lime sludge was stored in Pond D, but some ferric chloride-treated, low-lime sludge was placed in Ponds B and C.

The WWTP treated approximately 3000 gallons per minute (gpm) of which approximately 1250 gpm came from the Smelter, 1300 gpm from the Power Plant, 300 gpm from the Refinery, and 150 gpm from the North Concentrator. The WWTP clarified effluent stream was approximately 4000 gpm due to the addition of lime slurry and water as part of the neutralization process. The treated effluent produced a sludge residue at a rate of approximately 250 wet tons per day. The calcium sulfate sludge from the WWTP is exempt from classification and regulation as a hazardous waste pursuant to 40 CFR § 261.4 (7). Due to modernization of the Smelter and Refinery, the WWTP may no longer be needed (as of this writing, the flows have been significantly reduced or stopped from all sources). The Plant will remain operational for treatment of decontamination waters generated from soil removal and demolition activities. Investigation derived wastes, such as waters associated with ground water sampling, will also be treated at the WWTP during this Action (this is consistent with the substantive requirements of CAMUs).

A summary of results from previous sludge characterization studies (Phase I) and a discussion of Kennecott's most recent (Phase II) sampling investigation have been submitted to the agencies as the *Wastewater Treatment Plant Site Characterization and Sludge Stabilization Study, Kennecott Plant Projects Group, November, 1994.* The Phase II investigation was conducted on the WWTP sludge to verify Phase I data, fill gaps in the previously obtained data, and insure proper quality assurance and quality control (QA/QC) measures. Data were collected on physical and chemical properties of the sludge in the ponds, native soils underlying each pond, and dike material surrounding each pond. Characterization activities were implemented to assess accumulated sludge for design and evaluation of potential remedial actions.

The WWTP area (Dwg. No. 503-T-0173) consists of two overall soil sites. To date only one site has been characterized and demonstrated elevated concentrations of metals.

The WWTP Ponds Site (W01 which includes pond A, B, C, C-extension and D) is a series of five ponds that received sludge from the WWTP. The sludge has been characterized and will be mixed with north facility soils and disposed of in the Arthur Step-Back Repository, Ponds C, C-Ext and D have been designated CAMUs. These ponds will be used to temporarily store soils removed from soil sites. The sludges have a very low in place permeability, thus reducing the possibility of releases to the atmosphere or ground water. The ponds will be closed to the criteria outlined in Section 4.2. Further characterization of the ponds footprint will follow the removal of the sludge.

The WWTP Soils Site (W02) is the footprint soils of the WWTP facility. This facility is operational and once it is determined by Kennecott that the WWTP is of no further use it will be demolished. Characterization sampling will follow the demolition of the facility.

4.0 SCOPE OF ACTION

The work to be completed, governed by this Work Plan, includes; 1) the excavation, removal, and placement of WWTP sludge from the five ponds into the Arthur Step-Back Repository; 2) the excavation, removal, and placement of mine waste containing elevated levels of indicator constituents (Section 4.2) on Kennecott property into the Arthur Step-Back Repository; 3) demolition of selected decommissioned structures and disposal of associated debris; 4) reprocessing of economical materials including contaminated soils, as appropriate; 5) the reclamation and revegetation of removal sites; and 6) capping (closure) of the Arthur Step-Back Repository. This Action will reduce potential contaminant exposure to the public, reduce both wind and water erosion (migration) of affected soils, revegetate previously barren areas, and reduce the area of Kennecott property affected by various mine waste deposits. While the scope of this Removal Action does address potential sources of ground water contamination, it does not address ground water remediation.

This Work Plan is sufficiently detailed to allow the lead agency to review and evaluate the Kennecott North Facilities removal procedures. The Work Plan also provides essential field discretion for the on-site coordinators to adjust operations for site-specific circumstances, within the scope as defined above and other AOC documents.

4.1 Removal Action Objectives

The objective of the North Facilities Removal Action is to incorporate the WWTP ponds sludge and other inorganic mine waste into the Arthur Step-Back Repository (more than one repository may be required, see Section 5.1) and demolish decommissioned structures. This action will mitigate potential health risks to humans and increase the overall environmental quality of Kennecott property near the north operational facilities. The site-specific objectives of the Removal Action, based on existing characterization data, are as follows:

- Reduce the availability of potentially hazardous substances by implementing this Removal Action which is a technically feasible, permanent, and cost-effective remedy;
- Remove WWTP sludge and surface soils with elevated levels of the indicator metals (lead, arsenic, cadmium, and selenium) to an approved repository;
- Improve protection of human and ecological receptors from unacceptable risks due to ingestion of, or contact with potential chemicals of concern in WWTP sludge and surface soils;
- Demolish decommissioned structures that may contain hazardous substances and may be safety hazards;

- Improve protection of surface water, ground water, and air quality as a result of this Removal Action;
- Maximize long-term use of Kennecott property for industrial purposes and reduce the surface acreage affected by past mineral processing activities, both during and after this Action; and
- Minimize the effects of the Removal Action on the public (human health and safety) and the environment.

The Removal Action objectives will be met by following the removal criteria set forth in this Plan and other related documents.

4.2 Removal Criteria

Removal criteria for sludge, soils, and debris from Kennecott North Facilities will be based on elevated concentrations of lead, arsenic, cadmium, and selenium using total metal analysis.

Lead, arsenic, cadmium, and selenium were chosen as the indicator metals for the following reasons:

- To remain consistent with removal actions for similar waste materials;
- These metals were the most common elevated metals found during site characterization; and
- When soils with elevated levels of these constituents are removed, past experience and current studies have demonstrated other metal values have been reduced to acceptable levels.

The total metal action levels (AL) for this Removal Action as provided in Section L of the Statement of Work are as follows:

- 200 ppm Arsenic
- 1,000 ppm Cadmium
- 2,000 ppm Lead
- 1,000 ppm Selenium

These ALs are based on standard default values for soil ingestion and soil with concentrations above the AL will be considered elevated for this industrial site. However, these ALs are not based upon a base-line risk assessment. Removal depths for the Kennecott North Facilities industrial site will generally not exceed 18 inches from existing grade. It will be at Kennecott's discretion to remove soils at depths greater than 18 inches. If elevated total metal levels of the indicator metals are present at depths greater than 18 inches following removal (and the decision has been made to leave them in place), site conditions will be documented and an appropriate soil cover will be placed to prevent exposure. If site conditions prohibit removal of contaminated soil to 18 inches (because of piping, concrete, building foundations, etc.) an approach such as capping or stabilizing may be evaluated and will be implemented as appropriate to achieve the Removal Action objectives. The quantity of soils to be removed from the Kennecott North Facilities is estimated at approximately 1.0 million cubic yards. As characterization activities are completed for individual sites, quantities will be revised.

In addition, soils left in place below 18 inches that demonstrate leachability using the synthetic precipitation leaching procedure (SPLP - EPA Method 1312) will be evaluated for the potential to release hazardous substances to ground water at levels of concern. If results of sampling analysis indicate a potential threat to ground water exists, then to the extent practicable, additional soils will be removed or other actions will be implemented to mitigate release of hazardous substances to ground water (Section 6.0). Kennecott may address potential threats to ground water under the terms of another enforceable agreement, if required. As stated in Section 1.0, this Action does not address ground water contamination.

The WWTP sludge contains elevated levels of total metals and is physically unstable. The removal of WWTP sludge includes approximately 1.1 million cubic yards of wet sludge and associated soil from the five ponds. Kennecott will remove the WWTP sludge from Ponds A, B, C, C-Extension, and D based on results from the *Wastewater Treatment Plant Site Characterization and Sludge Stabilization Study, Kennecott Plant Projects Group, November, 1994*. Characterization data from Pond A indicates that approximately 60,000 cubic yards of material is present and demonstrate this material has economic value (if Pond A material is not reprocessed, it will be placed in the Repository).

4.3 Removal Procedures

Based on results from field investigations and similar removal actions, the pond sludges and other soils will be removed on a visually guided basis and placed in the Repository. The contaminated soils transported to the Arthur Step-Back Repository will be mixed with WWTP sludge, air dried and tilled if necessary. Kennecott will conduct post-removal sampling in the areas of excavation once an area is designated visually "clean" (based on field observations, removal depth, or other information). Post-removal samples will be analyzed for total lead, arsenic, cadmium, and selenium and leachability analysis will be conducted as appropriate. Removal criteria outlined in Section 4.2 will assist in determining removal depths and post-removal site conditions.

Samples will be collected from the Repository as material is placed therein for documentation purposes only. One composite sample will be collected for every 20,000 cubic yards placed and will be analyzed for the constituents of concern as totals and SPLP. Sampling procedures and protocols are fully described in Appendix C and will be followed for characterization and removal activities.

The WWTP sludge and other soils will be handled using appropriate excavation and transport equipment depending on the characteristics of the individual sites and material deposition. Pilot scale trials on similar materials have demonstrated that pond sludge and sediments require a sandy, gravely matrix fill for preparation prior to final placement. The majority of the North Facility soils are appropriate for using as the matrix fill. The percent of mixing material required for the sludge depends on the moisture content and subsequent drying time before placement. Based on previous Kennecott projects, the range of mixing soils required can be 0 to 50 percent. The physical quality and suitability of North Facility soils as preparation material will continually be evaluated throughout the project. Should additional material be needed, alternate borrow sources have been

identified on Kennecott property. Following preparation, roughly 1.8 million cubic yards of dried pond sludge and soils will be placed in the Arthur Step-Back Repository.

The removal areas will be regraded and, if necessary, covered with a minimum of 18 inches of clean borrow material. Borrow material will be sampled for the constituents of concern at a rate of one sample for every 5000 cubic yards to ensure clean material is being placed. Borrow sources have been identified near the North Facilities on Kennecott property for reclamation soil and fill materials.

4.3.1 Types of Equipment

Based on results from field investigations and execution of soil and sludge pilot programs, dozers, front-end loaders, excavators, and scrapers will all be appropriate for removing material. Characteristics of sludges vary for each pond and equipment that is effective in one pond may not be the most appropriate in the next. Smaller excavation equipment may be used in difficult access areas, if suitable. There are many different excavation methods that are anticipated and those ultimately employed will be the most practical and cost-effective as determined in pilot excavation activities and continued experience.

Demolition equipment used will be appropriately sized to the specific structure being removed. Shears, grapples, cranes, and excavators will be utilized as outlined in Appendix B and the Demolition Pre-Planning Safety Manual. High pressure low volume water spray will be used to decontaminate structures prior to demolition and assist in controlling airborne particulates. Water will be collected and handled properly. Demolition procedures will vary from structure to structure, but a typical demolition sequence would be implemented as follows:

- Collect characterization samples for industrial hygiene, personal protective equipment selection, and waste characterization purposes;
- Remove and properly dispose of non-structural materials and equipment (disposal will be based on characterization samples collected as described in Appendix C);
- Conduct demolition of the structure and segregation of waste, debris, and recyclable materials;
- Sample the footprint and adjacent soils for potential contaminants of concern and conduct soils removal if necessary; and
- Backfill excavation with appropriate fill material and place surface water controls as necessary.

Other standard construction equipment will be employed to build and maintain haul roads and maintain a safe site, as appropriate. Site-specific conditions will likely allow more than one area of excavation to be managed concurrently. This opportunity will be evaluated and implemented if appropriate, once project activities commence.

4.3.2 Engineering Controls - Excavation and Loading Area

Engineering controls, such as water application before and during excavation and loading will ensure that both occupational exposures and airborne emissions from the work zone are below accepted levels for total suspended particulate (TSP), lead, arsenic, cadmium, and selenium (other metals will be monitored for as necessary). Increased or additional engineering controls will be initiated if air monitoring results exceed the action levels for airborne emissions as described in the Personnel and Work Zone Air Sampling and Analysis Plan (Appendix A).

Three decontamination areas have been identified at the Noranda Smelter to assist in safely and efficiently decontaminating debris, equipment, or any other appropriate material. The decontamination pads (Dwg. No's. 505-T-0815 and 503-T-0212), are identified as CAMUs and will allow for efficient handling of the referenced materials without the delay and expense of constructing new facilities. The pads are currently set up to minimize, if not eliminate, releases to the atmosphere and surface and ground water. The decontamination pads are concrete tanks or sumps that were used to contain water. Therefore, decontamination is an ideal usage for the pads and they are still connected to the WWTP with piping and pump systems. Material will be physically placed on the pads, washed, inspected for contaminant removal, and then physically removed and transported for final disposition. The decontamination pads will be closed to the criteria outlined in Section 4.2.

4.4 Transport Procedures

Sludge from four of the WWTP ponds (all but Pond D) and soils from the other sites will be hauled from loading areas to the Arthur Step-Back staging area or directly to the Repository. This activity will be conducted using appropriate haulage trucks. The size of equipment may vary due to space limitations and other site access requirements. Sludge from Pond D may be pumped or moved in a manner that addresses concerns over traffic patterns on Highway 202.

4.4.1 Types of Equipment

A broad, flat depositional environment, such as the WWTP Ponds, is one in which large transports (capacities of 15 to 20 cubic yards) can maneuver and be directly loaded. Other North Facility soils will be hauled using large (15 to 20 cubic yards) transports and smaller (8 to 12 cubic yards) units. Direct loading will increase efficiency and eliminate multiple material handling. Where access and feasibility are restricted, transports will be loaded at a designated loading zone for the haul to the Repository. Due to the short haul distance on public roads and because of the physical nature of the material, it may not be necessary to tarp haul trucks. If visible release of contaminated airborne emissions is evident, haul trucks will be covered or tarped from the loading zone to the Repository.

4.4.2 Staging Areas

A material handling staging area for drying and mixing sludge will be constructed north of the Arthur Step-Back Repository. This temporary staging area (a portion of the Arthur Step-Back

Repository CAMU) will allow for the safe and efficient preparation of materials to be placed in the Repository. This area on the south edge of the tailings impoundment will be constructed using tailings and will not require decontamination other than thorough removal of staged material. Once the staging area is no longer needed and all staged materials have been removed, sampling will be conducted to ensure the criteria in Section 4.2 have been met.

The contractor staging area for site operations will be located immediately northeast of the WWTP off of Highway 202. The staging area will serve as a controlled zone for decontamination facilities, a general maintenance area, personnel parking, contractor office space, and fuel storage. The Arthur Step-Back Repository will be accessed from this point by all employees and site visitors. Staging areas for removal of material south of Highway 201 will be constructed as necessary throughout the North Facilities. The staging areas will be decontaminated, if necessary, after operations are completed by removing the top 2 to 4 inches of soil. This soil will be hauled to and placed in the Repository.

4.4.3 Haul Routes

Ponds A and D are north of a bridge on Highway 202 over two railroad lines; the Union Pacific and Western Pacific. The bridge has load limits that would be exceeded using haul units with any practical size. An alternate trucking route is available around the north side of the tailings impoundment or to the west through the slag area, if needed. If it is necessary for haul units to enter public roads, the appropriate notifications and traffic control measures will be made.

North Facility soils south of Highway 201 will be transported on Kennecott property haul roads to several of the Highway 201 access points (haul routes are shown on the soil site drawings). Highway 201 will be flagged, signed, and controlled, if required, depending on haul unit numbers and size. Haul units will proceed directly through Gate 10 to the staging area or Repository. Haul routes may require adjustment to address site-specific conditions.

4.4.4 Decontamination Procedures

Haul trucks leaving the work zones will be inspected prior to entry on haul roads. Work crews will be responsible for physically removing visible soil deposits or spillage collected on the vehicle. Other machinery will be decontaminated upon completion of project specific activities. Decontamination equipment will be maintained in the staging area or at the decontamination pads, as needed. Contaminated soils from decontamination procedures will be placed in the Repository. Haul roads will be decontaminated as needed. A visual inspection of the haul roads will be conducted prior to cessation of the work activities. Decontamination will consist of removing any material that may have spilled enroute. This material will be disposed in the Repository.

4.4.5 Engineering Controls - Haul Roads

During transportation and dumping operations, engineering controls such as water application will be implemented as appropriate. Dust abatement materials may be applied to major dirt haul roads. These controls will ensure that occupational exposures and airborne emissions are below acceptable levels for the contaminants of concern and total airborne dust.

4.4.6 Emergency Spill Plan

Any accidental spills of mine waste or sludge that might occur during transportation will be responded to by Kennecott and reported as required by the AOC. The following measures will be implemented:

- All truck transports will be equipped with radios to notify the Project Coordinators in the event of an accidental spill;
- All truck transports carrying waste will be equipped with secured gates to reduce the possibility of an accidental spill; and
- Appropriate equipment will be available from the various project activities to respond to any emergency spill situations.

5.0 ARTHUR STEP-BACK REPOSITORY

The Arthur Step-Back Repository is located northeast of Magna, Utah, in the NE1/4 and SE1/4 of Section 23 and the SW1/4 of Section 24, T.1S, R.3W (Dwg. No. 555-T-0152). The Step-Back was formed when the tailings discharge header was moved north, toward the center of the tailings impoundment. The Repository is on the southwest corner of the Kennecott Magna Tailings Impoundment and occupies an area of approximately 32 acres, all contained within the controlled area around the tailings impoundment. A dirt haul road off of Utah Highway 202 north of the WWTP provides access to the Repository.

Materials underlying the Repository are hydraulically placed tailings. Ground water has been observed at depths of 100 feet below existing grade (ETA, 1992 and Montgomery, 1992). Permeabilities reported for 6 feet and 12 feet below the surface were 7.875×10^{-4} and 4.478×10^{-6} cm/sec, respectively. The Site is located above the 100 year floodplain. A review of the background geotechnical data and new data was generated by AGRA E&E, Inc., January 1995.

The Repository, which meets Resource Conservation Recovery Act (RCRA) landfill cell design standards, utilizes proven technology to safely dispose of contaminated soils and sludges. The Repository is adjacent to the Kennecott Tailings Impoundment and will allow for the long term storage of wastes which will not impact residential areas or use off-site RCRA storage space. To date, the Arthur Step-Back Repository will be the only permanent CAMU designated for this site.

5.1 Description

The Repository will receive WWTP pond sludge with associated over excavation and other contaminated soils from the North Facilities. Approximately 1.8 million cubic yards of sludge and contaminated soils have been estimated for placement into the Repository. The sludge will be mixed with soils prior to and during placement in the Repository. Mixing will improve handling through a combination of evaporation and absorption with other materials. Evaporation will be optimized by placing the sludge in lifts and pre-drying when possible. At current design, the Arthur Step-Back has a holding capacity of 1.6 million cubic yards struck level (with potential of up to 2.0 million cubic yards depending on final cap configurations). Kennecott anticipates the need for a second repository depending on property availability, appropriateness, and contaminated material quantity. Additional repository siting studies are being conducted at present and this Work Plan will be amended as data from those studies become available.

Based on moisture content and chemical characterization data, the WWTP sludge is the "worst case" material identified to date to be placed in the Repository. Therefore, Kennecott has based the Repository designs on protecting ground water and preventing migration of the sludge. The following discussion provides a general description of the design components and some of the design related operational criteria of the Repository. Detailed technical design and operation information, calculations, data and plans are provided in the Arthur Step-Back Repository Development and Construction Plan (Appendix D).

5.2 Design

The Arthur Step-Back Repository has been designed with a surface area of approximately 30 acres and a depth of approximately 93 feet at the lowest sump. The length of the Repository will be about 3060 feet with an average width of about 420 feet. There will be five sumps (numbered Sump No. 1 through Sump No. 5) designed to collect leachate from each of five different drainage areas. The minimum floor slope will be 3 percent and the interior and exterior embankment slopes will be 3H:1V (horizontal to vertical).

Although the Repository is not subject to minimum technology requirements (MTRs) as a CAMU, it nevertheless has been designed to meet RCRA landfill cell design standards. The Repository has been designed with a double liner system with drainage systems between the liner systems and above the top liner system. The liner and drainage systems (from the lowermost to the uppermost layer) consist of the following: (1) a bottom (secondary) composite liner system; (2) a leak detection, collection and removal system; (3) a top (primary) liner system; and (4) a leachate collection and removal system. Other areas of design consideration are the soil protective cover, access ramps and runoff control system within the Repository prior to closure.

5.2.1 Secondary Composite Liner System

The secondary composite liner system consists of a 60-mil conductive HDPE geomembrane liner which lies directly above a 3 foot (minimum) thick compacted clay layer meeting a maximum permeability of 1×10^{-7} cm/sec. The 60-mil geomembrane liner is textured on both the upper and lower sides at the locations of the east and west interior access ramps. A textured liner was necessary to provide resistance to slippage during construction and operation of the Repository.

Leak Detection, Collection and Removal System. The Leak Detection, Collection and Removal System (LDCRS) consists of two main components: (1) the secondary collection and conveyance system, and (2) the secondary sump and leachate withdrawal system.

Secondary Collection and Conveyance System. The secondary collection and conveyance system consists of a drainage layer above the secondary composite liner system which is designed to collect leachate, if any, that penetrates the primary liner system and convey that leachate to one of the five secondary sumps. The drainage layer is comprised of a geonet (drainage net) across the floor and interior side slope area of the Repository. The drainage net in the areas of the east and west interior access ramps consists of double bonded fabrinet. Double bonded fabrinet has geotextile fabric bonded to both sides of the drainage net which increases the friction resistance between the textured HDPE liners placed on the ramp areas and the secondary drainage net.

Secondary Sump and Leachate Withdrawal System. The secondary sumps and leachate withdrawal systems consist of gravel sumps, which also contain perforated polyethylene drain pipe, that slope to stainless steel sumps. Attached to the stainless steel sumps are 10 inch diameter leachate withdrawal pipes in which pumps are inserted for pumping of leachate from the sumps. In addition to the composite compacted clay/60-mil HDPE secondary liner system, the gravel sumps are lined with a geosynthetic clay liner to provide additional security against leachate penetrating the secondary liner system in the sump areas. The sumps are also lined with an additional 60-mil HDPE geomembrane rubsheet to provide added protection against damage to the secondary liner system in the sump areas.

5.2.2 Primary Liner System

The primary liner system consists of an 80-mil conductive HDPE geomembrane liner. The 80-mil HDPE geomembrane liner is textured on both the upper and lower sides at the locations of the east and west interior access ramps. A textured liner was necessary to provide resistance to slippage during construction and operation of the Repository.

Leachate Collection and Removal System. The Leachate Collection and Removal System (LCRS) consists of two main components: (1) the primary collection and conveyance system, and (2) the primary sump and leachate withdrawal system.

Primary Collection and Conveyance System. The primary collection and conveyance system consists of a drainage layer above the primary liner system which is designed to collect leachate generated within the Repository and convey the leachate to one of the five primary sumps. The drainage layer is comprised of a geonet (drainage net) across the floor area of the Repository. The primary drainage layer at the toe of the north interior slope consists of multiple layers of high capacity geonet separated by 60-mil HDPE geomembrane sheeting to provide a toe of slope drain for conveyance of leachate to the sumps.

Primary Sump and Leachate Withdrawal System. The primary sumps and leachate withdrawal systems consist of gravel sumps, which contain perforated polyethylene drain pipe, that slope to stainless steel sumps. Attached to the stainless steel sumps are 12 inch diameter leachate withdrawal pipes in which pumps are inserted for pumping of leachate from the sumps. In addition to the 80-mil HDPE primary liner system, the gravel sumps are lined with a geosynthetic clay liner to provide additional security against leachate penetrating the primary liner system in the sump areas. The sumps are also lined with an additional 80-mil HDPE geomembrane rubsheet to provide added protection against damage to the primary liner system in the sump areas.

The material being placed in the Repository is not expected to produce leachate once the cell is closed. During construction, it is likely that meteoric water will report to the primary collection system. The reporting of this water will be conducted through the weekly reports submitted to the EPA and State during the Removal Action. The water will be sampled and disposed of appropriately. Following closure of the Repository and this Action, reporting will be submitted to the State only as part of the Kennecott Tailings Impoundment, State of Utah, Ground Water Discharge Permit (UGW350011). Monitoring wells adjacent to the Repository that have been selected as up and down gradient wells will be sampled as part of this plan. The permit will be amended at the renewal period and a detailed outline and plan will be submitted following closure of the Arthur Step-Back Repository.

5.2.3 Soil Protective Cover

The drainage layer and liner systems will be protected with a soil protective cover during construction and operation of the Repository. During construction, the soil protective cover material will be placed 2 feet thick (minimum) across the floor and for a vertical distance of 5 feet up the interior side slopes of the Repository. Soil protective cover material placed on the east and west interior access ramps will be placed at a minimum thickness of 3 feet.

As the Repository fills, the soil protective cover will be placed on the interior side slopes in 5 foot vertical lifts. Therefore, as material placed in the Repository approaches the top of soil cover previously placed on the side slopes, an additional lift will be placed to allow additional filling of the Repository. Placement of the soil protective cover will continue following these procedures until the soil protective cover is within 2 feet of the top of the Repository.

5.2.4 Access Ramps

Access ramps are provided at the east and west ends of the Repository. The minimum slope provided for the access ramps is 6H:1V in order to provide for adequate stability for the liner and drainage systems. A safety berm meeting OSHA requirements will be provided on the south side of the west ramp for the vehicles anticipated for operation within the Repository. Soil protective cover material will be maintained on the side slopes adjacent to the ramps for a vertical height of 5 feet in order to protect the liner and drainage systems from vehicular traffic on the ramps.

5.2.5 Runoff Control System

A V-shaped ditch, consisting of a 2 foot depth and 3H:1V lined interior Repository slopes on each side, will be maintained at the top perimeter of the Repository to control precipitation runoff within the Repository prior to closure. The ditch will follow the same one percent slope toward the west end of the Repository that exists at the top of the Repository embankments. Sufficient ponding capacity will be maintained at the west end of the Repository to provide for a minimum of 5.4 acre-feet of runoff storage from precipitation events.

5.3 Air Monitoring

Air monitoring at the Repository will be conducted by Kennecott to assess levels of TSP, airborne arsenic, lead, cadmium, selenium, and other metals as necessary. Quantitative air monitoring will be conducted to document repository personnel exposure levels using appropriate monitoring equipment. Samples of ambient air at the perimeter of work zones will occasionally be collected during Repository work activities.

Personal protective equipment required for personnel working in the Repository and Staging Area will be selected based on results of monitoring. Initially, level D personal protective equipment will be required for Repository activities.

5.4 Engineering Controls

Haul trucks leaving the Repository will be inspected prior to entry on haul roads. Work crews will be responsible for physically removing visible soil deposits or spillage collected on the vehicle. Other machinery will be decontaminated upon completion of project specific activities. Decontamination equipment will be maintained in the staging area, as needed. Soils from decontamination procedures will remain or be placed in the Repository. Decontamination of Repository roads will consist of removing any material that may have spilled enroute and it will be disposed in the Repository.

During transportation, dumping, grading and compacting operations, engineering controls such as water application will be implemented as appropriate. Dust abatement materials may be applied to major dirt haul and Repository roads. These controls will ensure that occupational exposures and

airborne emissions are below acceptable levels for the contaminants of concern and total airborne dust.

Any accidental spills of mine waste or sludge that might occur near the Repository and staging area will be responded to by Kennecott and their contractors and will be reported as required by the AOC. The following measures will be implemented:

- All truck transports will be equipped with radios to notify the Project Coordinators in the event of an accidental spill;
- All truck transports carrying mine waste will be equipped with secured gates to reduce the possibility of an accidental spill; and
- Appropriate equipment will be available from the various project activities to respond to any emergency spill situations.

5.5 Operations and Maintenance

After the contaminated sludge and soils have been placed and the Repository has been capped, the Repository will be monitored as described below.

The leachate collection system, leak detection system and surface water diversion system will be inspected each quarter for the first year and annually thereafter. The systems will be cleaned and maintained to ensure their integrity. If liquid is detected in the seepage collection sump during quarterly inspection, it will be sampled and analyzed for total lead, arsenic, cadmium, and selenium. Sampling and analytical procedures will follow EPA guidelines. If contaminated water from the collection system is confirmed, inspection will be increased to a once per month frequency. If flow subsides, the inspection frequency will correspondingly be reduced to quarterly then annually.

The Repository cap will be inspected for structural defects as part of the Kennecott Tailings Impoundment Transition Plan. This long term plan is the revegetation plan for the annual closure for specific areas on the impoundment. Vegetation and cap soils will be observed at each inspection and repaired or maintained as necessary. Reporting for these inspections will be submitted to the State only.

6.0 RECONTOURING AND REVEGETATION

Prior to project activities, photos will be taken to document existing conditions and critical elevations will be surveyed if necessary. These data will be used to establish final contouring throughout the property, where pertinent.

As stated before, soils that demonstrate leachability using the synthetic precipitation leaching procedure (SPLP - EPA Method 1312) will be evaluated for the potential to release hazardous substances to ground water at levels of concern. If Kennecott determines that a threat to ground

water exists, then to the extent practicable, additional soils will be removed or other actions to mitigate release of hazardous substances to ground water will be implemented.

One tool Kennecott will use, as appropriate, is the Hydrogeologic Evaluation of Landfill Performance (HELP) program. This program will be used to evaluate interim and potentially final drainage remedies for sites with leachable soils after all removal activities are complete. The program will be used to estimate the amount of surface runoff, surface drainage, and potential leaching that may be expected to result from surface cap and drainage designs. The HELP program simulates the hydrogeologic processes including precipitation, surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage using a quasi-two-dimensional approach. The approach incorporates climatological, soil, and design data and utilizes a solution technique that accounts for the hydrological processes described above. The model results will be used to determine the appropriate design for post-removal site conditions once the extent of soil contamination is determined. Other factors that will be investigated may include mass of contaminant left in place, depth to ground water, speciation of contaminant, buffering capacity of subsoil, and other contaminant specific information.

6.1 Local Borrow Fill

Local borrow sources have been identified throughout Kennecott property on the north end of the Oquirrh Mountains. Local borrow fill will be used when needed for both recontouring the removal areas and to supply material for physically stabilizing and covering the Repository. Borrow material will be placed to blend into existing areas that were not affected. New slopes will be constructed with swales and undulations to obtain a more natural appearance.

6.2 Erosion Control Methods

A variety of techniques will be employed to minimize erosion of the removal area footprints and borrow areas to reduce down gradient transport of soils. Temporary controls used for stabilization until the establishment of vegetation may include:

- Construction of shallow basins to intercept and store runoff inflow to the particular site. These basins will also function as desilting basins. The basins will contain runoff from most light precipitation events and overflow from a basin will be conveyed through gradual swales to the controlling drainage;
- Contouring and shaping will be conducted at the top of new and undisturbed slopes to limit inflow of runoff. Runoff will be conveyed to basins, as described above, or directly into swales and drainages, if necessary;
- Shallow swales will be constructed in drainage bottoms to function as silt traps. These swales will retard soil transport down gradient until the establishment of vegetation. The swales will eventually fill with sediment; or
- Scarifying of all new slopes, modified slopes where possible, and all borrow areas will be conducted to depths of 6 to 16 inches, perpendicular to the slope. This will reduce runoff down the slopes and will improve infiltration, thus minimizing erosion.

6.3 Topsoil and Subsoil

Suitable topsoil and subsoil will be salvaged from sites prior to reclamation. As reclamation is completed, subsoil and/or topsoil (equivalent to native conditions) will be replaced on borrow areas and removal zones. All areas will be scarified to depths of 6 to 16 inches, followed by discing to a depth of 6 to 8 inches to prepare the ground for seeding.

6.4 Fertilizing and Seeding

All areas disturbed as a result of project activities will be fertilized and seeded (except for those areas to be returned to farming). All areas to be seeded by Kennecott will be fertilized at a rate to provide 40 pounds of available nitrogen per acre with a 28N: 13P: 13K blend of commercial, granular fertilizer. Seed will be applied by drill or pit seeding at a rate of 30 pounds of pure live seed (PLS) per acre and in areas of difficult access, hydro mulch may be applied (this mix would vary from that outlined below).

Drill or pit seeding techniques will mainly be used because they provide improved germination and vegetation success compared to other seeding methods. Pit seeding provides effective soil erosion mitigation and conserves water. Miscellaneous areas inaccessible to equipment will be broadcast-seeded (hand application or blown on by machinery) and hand-raked, if required to lightly cover the seed with soil.

The following seed mixture (or similar) will be used for areas to be revegetated by Kennecott EEPG:

Species	Lbs. PLS/Acre
Western Wheatgrass	6.0
Thickspike Wheatgrass	6.0
Slender Wheatgrass	6.0
Streambank Wheatgrass	6.0
Palmer Penstemon	0.3
Rocky Mtn. Penstemon	0.5
California Poppy	2.2
Blanket Flower	0.5
Lewis Blue Flax	2.2
Munro Globe Mallow	0.3
TOTAL	**30.0**

7.0 DATA COLLECTION AND EVALUATION

Existing analytical data will be compiled, reviewed, and evaluated in relation to the project objectives stated above. The Personnel and Work Zone Air Monitoring Plan, Site-specific Health and Safety Plan (HASP), and Soil and Demolition Debris Quality Assurance Project Plan and Sampling and Analysis Plan (Sampling Plan) for this project are described in the Appendices. The Sampling Plan includes Standard Operating Procedures (SOP), QA/QC objectives and procedures, and laboratory Quality Assurance Project Plans (QAPP). Addenda will be included with the appendices as required by project specific circumstances. The soils data to be collected will be Analytical Level III. Chemical methods will be those of SW-846 (US EPA, 1986, 1989), US EPA Methods for Chemical Analysis of Water and Wastes (US EPA, 1983), and 1992 Region VIII EPA QA/R5 protocols. Field parameters for soils to be determined at each site will include basic soil characterization and observations: morphology, soil texture, grain size, induration, cementation, and moisture content.

7.1 Quality Control Parameters

Precision, accuracy, completeness, and comparability requirements for this project will be consistent with previous Kennecott projects conducted under an AOC. The completeness goal for this project is 90 percent. The goals for relative percent difference (RPD) will be ±25 percent; if data fall outside of these goals after corrective measures outlined in the Sampling Plan are followed, the relevant data will be qualified in all data presentations.

8.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Paragraph 51 of the AOC requires Kennecott to perform all actions required pursuant to the AOC in accordance with local, state and federal applicable or relevant and appropriate requirements (ARARs) except as provided in section 121(e) of CERCLA, 42 U.S.C.U. 9621(e), and 40 C.F.R. section 300.415(j). CERCLA section 121(e) provides that on-site removal actions do not require any federal, state or local permits. Section 300.415(j), part of the National Contingency Plan (NCP), provides that removal actions shall attain ARARs under federal environmental or state environmental or facility siting laws to the extent practicable considering the exigencies of the situation.

The scope of the Removal Action is a relevant factor in determining whether compliance with ARARs is practicable (40 C.F.R. U300.415(j)(2) (1995)). Due to the limited scope of this removal action, compliance with some potentially applicable ARARs would not be "practicable." For example, as indicated in Section 1.0 of the Work Plan, this removal action will not address ground water remediation from contamination caused by existing contaminant sources; compliance with state ground water regulations would therefore not be practicable for this removal action. Following is a list of the Federal and State ARARs for which compliance would be practicable.

8.1 Federal ARARs

Resource Conservation and Recovery Act, Subtitle C (42 USC 6901 *et seq.*):

- Corrective Action Management Unit Rule (40 CFR 264.552) is applicable;
- Hazardous waste landfill standards (40 CFR Part 264 Subpart N) are relevant and appropriate; and Subtitle D solid waste disposal requirements are applicable for Bevill waste (currently, no treatment standards apply to mineral processing waste under Land Disposal Restrictions);
- Clean Water Act (33 USC Sections 1341 and 1344);
- Clean Water Act (40 CFR Part 230);
- Executive Order 11988 (Floodplain Management, 1977), (40 CFR Subpart C, Section 6.302(b));
- Executive Order 11990 (Wetlands Protection), (40 CFR Subpart C, Section 6.302(a));
- Surface Mining Control and Reclamation Act (30 USCs 1201-1328, 30 CFR 816.111);
- DOT Hazardous Material Transportation Regulations (49 CFR Parts 107, 171-177); and
- With respect to hazardous wastes that are sent off-site, the following hazardous waste generator requirements are relevant and appropriate: manifests (40 CFR 262.20 through 262.23); packaging, labeling, marking and placarding (40 CFR 262.30 through 262.33); recordkeeping (40 CFR 262.40); and reporting (40 CFR 262.41 through 262.44).

The federal RCRA program, 42 U.S.C. Sections 6901 et seq., has been delegated to, and is administered by the Utah Department of Environmental Quality. Relevant and appropriate state hazardous waste management rules are discussed below.

Corrective Action Management Units are areas designated for the purpose of managing hazardous "remediation wastes"[1] generated by corrective actions. The CAMU rule is an "applicable" requirement for this Removal Action because the action will involve management of remediation wastes, some of which may be hazardous wastes.

A CAMU is a management tool that allows an owner/operator flexibility to conduct remedial activities in a manner that is qualitatively different from normal waste storage, treatment and disposal activities. Under the CAMU rule, one or more areas at a facility may be designated as a CAMU in accordance with the criteria at subsections 264.55(c) and (e). Movement and consolidation of hazardous remediation wastes into or within a CAMU does not constitute land disposal of hazardous wastes. Thus, the wastes are not subject to pretreatment land disposal restrictions (LDRs) found at 40 CFR part 268. Consolidation or placement of hazardous removal wastes into or within a CAMU also does not constitute creation of a unit subject to MTRs of RCRA § 3004(o), or the unit expansion restrictions of RCRA § 3015. The criteria at subsections 264.552(c) and (e) are applied on a case-by-case basis to ensure that areas designated as CAMUs will be protective of human health and the environment.

In summary, CAMUs are appropriate for the NFS/WWTP Removal Action because:

- Corrective Action Management Units will assist in the implementation of treating[1] removal wastes and consolidating them in a repository, reducing the mobility of the contaminated materials in a reliable and cost-effective manner that is protective of human health and the environment;

- The consolidation of materials elevated in total metals in the lined, capped, and covered repository, which will meet minimum technology requirements for land disposal units and provide redundancy in its safety features, will ensure protection of human health and the environment;

- Containment of treated removal mine wastes in the lined, capped, and covered repository will effectively eliminate potential human health exposure pathways thereby reducing risks from residual materials to essentially zero;

- Temporary storage of certain removal wastes in existing WWTP ponds and in the staging area adjacent to the repository will facilitate the implementation of a reliable, effective, protective and cost-effective remedy;

- Cleaning of demolition and decommissioning materials and equipment in the decontamination areas will facilitate the implementation of a reliable, effective, protective and cost-effective remedy;

- The proposed approach is cost-effective. It is estimated that the cost of alternative technologies and/or off-site disposal would be approximately four times more costly than implementing the removal action, without a proportionate benefit to protection of human health and the environment; and

- The proposed approach minimizes regulatory impediments that unnecessarily inhibit accelerated progression of removal activities. The CAMU designations will help ensure that implementation of this removal action is not unnecessarily delayed.

Kennecott requested the EPA Region VIII Administrator approve the CAMUs as proposed in the *Request for Identification and/or Designation of Corrective Action Management Units for Implementing the CERCLA Removal Action for the North Facilities Soils and Wastewater Treatment Plant Ponds Site Removal Action SSID #4B* document and include such designation in the AOC prepared by the EPA for the NFS/WWTP Removal Action. The proposed CAMUs meet the criteria prescribed in 40 CFR § 264.552(c) for establishing a CAMU. The CAMUs that will be utilized by Kennecott during the NFS/WWTP Removal Action are shown on drawings 503-T-0212 and 505-T-0185. The only permanent CAMU is the Arthur Step-Back Repository.

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[1]As used in this context, the term treatment refers to the process of mixing the sludges and soils together to reduce the mobility of heavy metals; and drying removal wastes to significantly reduce their volume and obtain greater compaction, thereby reducing the mobility of heavy metals in the removal wastes.

8.2 State ARARs

Utah Solid and Hazardous Waste Management Act (Utah Code Ann. (UCA) Title 19, Chapter 6, Part 1) and Rules (Utah Administration Code (UAC) R315):

- Corrective Action Management Unit Rule (40 CFR 264.552), incorporated by reference by UAC R315-8-21, is applicable;
- Hazardous waste landfill standards (UAC R315-8-14) are relevant and appropriate; and
- With respect to hazardous wastes that are sent off-site, requirements concerning hazardous waste manifests (UAC R315-5-4); recordkeeping (UAC R315-5-5); reporting (UAC R315-5-6, R315-5-7); and packaging, labeling, marking and placarding (UAC R315-5-9) are applicable.

Utah Water Pollution Control Act (UCA Title 19, Chapter 5) and Rules (UAC R317):

- Groundwater protection rules (R317-6) may be "considered" in formulating the removal action.

Utah Air Conservation Act (UCA Title 19, Chapter 2) and Rules (UAC R307):

- Fugitive Emissions and Fugitive Dust Rule (UAC R307-12) is applicable;
- Asbestos Certification, Asbestos Work Practices, and AHERA Implementation Rule (UAC R307-1-8) is applicable; and
- National Emissions Standard for Asbestos, Standard for Demolition and Renovation (40 CFR 61.145), incorporated by reference by UAC R307-10-1, is applicable.

Utah Reclamation of Land Mined for Minerals Act (UCA Title 35, Chapter 9) and Rules (UAC R618-875):

- Noncoal Reclamation Rule (UAC R643-875) is applicable.

Utah Occupational Safety and Health Act (UCA Title 35, Chapter 9) and Rules (UAC R574):

- Hazardous Waste Operations and Emergency Response Rule (29 CFR 1910.120), incorporated by reference by UAC R574-104, is applicable;
- Safety and Health Regulations for Construction (29 CFR 1926), incorporated by reference by UAC 574-200, are applicable; and
- Occupational Exposure to Asbestos Rule (59 Fed. Reg. 40964 (August 10, 1994)), incorporated by reference by UAC 574-200, is applicable.

Utah Aquatic Wildlife Act (UCA Title 23, Chapter 15):

- Rule prohibiting pollution of waters (UCA 23-15-6) is applicable.

Utah Water Appropriations Act (UCA title 73, Chapter 3) may be applicable.

8.3 Local ARARs

To date, no local ARARs have been identified, though some County permits and State demolition permits have been attained and courtesy notifications made.

9.0 PERSONAL PROTECTION

Level D personal protective equipment (basic OSHA construction safety equipment) will be appropriate for all workers engaged in excavation, transportation, placement and recontouring activities. Personal protective equipment will be upgraded from Level D if necessary, based on results from air monitoring and site conditions. A site-specific Health and Safety Plan (Appendix B) is included with this Work Plan and is based on available information from all investigations completed to date.

10.0 DOCUMENT ORGANIZATION

This North Facilities Soils Removal Work Plan is composed of the previous text and following appendices:

- Personnel and Work Zone Air Monitoring Plan (Appendix A);
- Site-specific Health and Safety Plan (Appendix B);
- Soil and Demolition Debris Quality Assurance Project Plan and Sampling and Analysis Plan (Appendix C); and
- Arthur Step-Back Repository Development and Construction Plan (Appendix D attached as an individual binder).

11.0 PROJECT SCHEDULE

The following outlines the schedule for major tasks and deliverables meeting the requirement set forth in Paragraph 36 of the AOC and SOW.

ACTIVITY OR MILESTONE	DATE COMPLETE
Wastewater Treatment Plant Site Characterization and Sludge Stabilization Study, Kennecott, 1994	Submitted to EPA March 1995
North Facility Soils/Debris Characterization	February 8, 1995 through project completion
North Facilities Soils and Wastewater Treatment Plant Ponds Site Removal Action Work Plan (including the Arthur Step-Back Repository Development and Construction Plan, Appendix D)	July 1996
Construction of the Arthur Step-Back Repository Complete	1996 Construction Season
Refinery Area Demolition	1996 Construction Season through 1997 Construction Season
Smelter Area Demolition	1996 Construction Season through 1998 Construction Season
Placement of WWTP Sludge and Soils in Repository	1997 Construction Season through 2000 Construction Season
Complete Cover and Revegetation	2000 Construction Season
Final Reclamation and Project Completion	2001 Construction Season
Final Report	120 Days After Project Completion

12.0 REFERENCES

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KENNECOTT UTAH COPPER CORPORATION

NORTH FACILITIES SOILS AND WASTEWATER TREATMENT PLANT PONDS SITE REMOVAL ACTION

APPENDIX A

PERSONNEL AND WORK ZONE AIR MONITORING PLAN

SSID #4B

Prepared and Submitted by:

Kennecott Environmental Engineering Projects Group
Bingham Canyon, Utah

July 1996

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Table 1 LIMITS FOR AIR CONTAMINANTS

APPENDIX A

PERSONNEL AND WORK ZONE AIR MONITORING AND ANALYSIS PLAN

A.1.0 INTRODUCTION

Kennecott Utah Copper Corporation (Kennecott) will be conducting soil removal and reclamation projects at their North Facilities near Magna, Utah. Demolition projects governed by the Work Plan will be taking place concurrently with soils work. This Air Monitoring Plan will be part of all project plans and presents the methodology to be used by Kennecott for conducting air sampling. If additional site-specific air monitoring information is required for a particular project, an addendum will be included with this Plan.

All areas referenced in the North Facilities Work Plan will be monitored. Air monitoring samples will be collected at excavation zones, along haul roads, at the repository, at demolition sites, and from selected personnel to monitor for airborne emissions during project activities. Quantitative air sampling will be conducted using battery powered personal sampling pumps and high-volume area pumps. Both of these pumps draw air through sampling media that is analyzed for the constituents of concern. This air sampling will be used to monitor employee exposures and work zone boundaries. Qualitative air monitoring will be conducted when immediate results are needed. Miniature real-time aerosol monitors (Minirams) will be used for respirable dust; detector tubes will be used for gases and vapors.

A.1.1 Purpose

The purpose of air monitoring is to:

- Document employee exposure, if any;
- Assist in the selection of personal protective equipment;
- Document work-zone emissions; and
- Evaluate the effectiveness of engineering controls.

A.1.2 Objectives

The Air Monitoring Plan is designed to identify, evaluate, and control the generation of harmful airborne contaminants. Engineering controls and work practices will be adjusted as necessary according to the results of the air monitoring.

A.2.0 AIR SAMPLING

Air sampling will be governed by the National Institute for Occupational Safety and Health (NIOSH) methods and Occupational Safety and Health Administration (OSHA) standards (29CFR, Part 1910). Quantitative air samples will generally be analyzed for total suspended particulates (TSP or airborne dust), arsenic, lead, cadmium, chromium, and selenium. Sampling

will also be conducted on a regular basis for silica and asbestos. Table A-1 lists some general information for these air contaminants.

Table A-1
Limits for Air Contaminants

Air Contaminant	Action Level (AL) [$\mu g/m^3$]	Permissible Exposure Level (PEL) [$\mu g/m^3$]	Standard 29CFR1910
Total Dust (TSP)	7,500	15,000	Table Z-3
Arsenic (As)	5	10	1018
Lead (Pb)	30	50	1025
Cadmium (Cd)	2.5	5	1027
Chromium (Cr)	500	1000	Table Z-1
Selenium (Se)	100	200	Table Z-1
Silica (SiO_2)	one-half the PEL	(10 $\mu g/m^3$) / (%SiO_2+2)	Table Z-3
Asbestos	0.05 fibers/cc	0.10 fibers/cc	1001
Sulfuric Acid (H_2SO_4)	500	1000	Table Z-1

Units: $\mu g/m^3$ unless otherwise indicated
Standards are listed as an 8-hour time weighted average

The action level has been set at one-half the permissible exposure level (PEL) unless otherwise specified in the standard. The detection of AL or above concentrations will result in the institution of engineering controls or other measures to reduce the risk of employee exposure (Section A.5.0). Other site-specific airborne contaminants to be monitored may include additional metals, organics, solvents, acids, or any others of concern. All quantitative samples will be handled under chain-of-custody procedures and delivered to an accredited laboratory to be analyzed according to the appropriate NIOSH and OSHA methods. Spontaneous, real-time data will also be collected. Quantitative (personnel and work zone) sampling, and qualitative (real-time) sampling methods are described in sections A.2.3 and A.2.4, respectively.

A.2.1 Standard Operating Procedures

The following standard operating procedure (SOP) will be followed for all quantitative sampling conducted:

1. Fill out logbook header at the beginning of the day;
2. Calibrate sampling pumps and record information on a calibration documentation form;
3. Connect filter cassette to pump, remove the inlet plug from filter cassette, turn pump on, and place pump on person or in area to be monitored;
4. Document initial information about the individual samples and conditions in a field logbook, including pump number, start times, locations and/or personnel, maps or diagrams (when necessary), and any field conditions relevant to air sampling;
5. Ensure required quality assurance field blank (1 per 10 samples) is opened and placed near a sampling pump (field blank) or a trip blank is carried during sampling routine;
6. At days end, turn off pumps, record stop time in field log, and plug cassettes;
7. Re-calibrate pumps and record information on the calibration documentation form;
8. Place the pumps on charge overnight;
9. Prepare chain-of-custody forms for all samples; and
10. Either securely store or package and ship samples, including chain-of-custody forms.

A.2.2 Background Air Sampling

Background air samples will be collected prior to any demolition or soils/sludge removal activities. Previously collected data may serve as background data. The availability and useability of historical background data will be evaluated on a case-by-case basis. Lo-flow (0.01 to .75 L/min), hi-flow (1.0 to 2.0 L/min) and/or hi-volume (up to 20.0 L/min) samples will be collected at work sites prior to start of work activities. Historical and site assessment data will be used to determine what parameters will be sampled. The background samples will be used to determine a suitable reference data base for comparison with airborne particulates, metals, and gaseous concentrations measured during the project.

A.2.2.1 Special Case: Abandoned Structures

In order to accurately determine contaminants present at abandoned structures and their potential to become airborne by work activities, air monitoring personnel will conduct aggressive background air sampling at selected sites under "worst case" conditions. Air sampling pumps, fitted with filter cassettes, will be placed inside a building or structure near a location deemed by air monitoring personnel to have the greatest potential for airborne particulates. Air sampling personnel, properly outfitted with personal protective equipment (PPE), will use a leaf blower during sample collection to disturb settled particulate matter. Sample periods will be of a suitable duration to obtain a reasonable volume of air; care will be taken not to exceed two milligrams of total loading per filter. During sampling, appropriate measures will be taken to prohibit unauthorized personnel from entering the structure.

The following list of air monitoring pumps and filter cassettes will typically be used (analytes in parenthesis):

- Two hi-volume air sampling pumps fitted with 37mm cassettes containing 0.8 micron copoly PVC filters (metals);
- One hi-flow air sampling pump fitted with a cyclone and 5.0 micron low ash PVC filter in a 37mm cassette (silica);
- One hi-flow air sampling pump fitted with a 37mm cassette containing a 0.8 micron MCE filter (low level sulfates); and
- One hi-flow air sampling pump fitted with a 25mm cassette containing a 0.8 micron MCE filter (asbestos count).

Information gained from sample results will enable monitoring personnel to focus on air contaminants of concern and institute appropriate measures to insure proper worker protection during demolition activities.

Samples collected for metals analysis will be analyzed by Inductively Coupled Plasma (ICP) which can identify (if present) up to 30 constituents that may be harmful to demolition workers.

A.2.3 Quantitative Air Sampling

All quantitative air monitoring will be conducted following NIOSH methodologies. Personal monitoring will be performed with battery powered lo-flow and hi-flow sampling pumps that draw air through sampling media. Most samples will be collected using 37 millimeter cassettes containing pre-weighed filters. Asbestos samples will be collected with 25 millimeter filter cassettes and sorbent tubes may be used as needed. The number of personal samples collected will be based on NIOSH recommendations and good industrial hygiene practice. The sampling results will document the air quality of immediate work areas and potential worker exposures.

Work zone air samples will be collected at demolition, soil removal, and repository work zones to determine emission concentrations. The sampling results will document work zone air quality and potential off-site migration of air contaminants. The samples will be collected with both hi-flow and hi-volume sampling pumps that draw air through 37 millimeter cassettes containing pre-weighed filters.

A.2.4 Qualitative Air Sampling

Miniram monitors and detector tubes may be used to qualitatively measure personnel exposures, and work zone and perimeter emissions. The Miniram is a nephelometer which measures the light-scattering effect of particulates and gives an estimated, digital representation of the respirable dust concentration (PM10) of an area. This instrument will be placed in the field with a personal pump (as a reference), and in locations determined to have the greatest potential for air emissions.

Detector tubes are used to detect various gases in the atmosphere, and are generally species specific. They are used with a bellows pump or a syringe that will draw a specified volume of gas through the tube. Each tube contains a specific detector chemical that will react with the gas being sampled. Once the proper volume of gas has been drawn, the tube can be visually examined. A chemical reaction between the sample gas and the detector chemical is represented by a color change. Detector tubes will be employed as needed in areas suspected of containing harmful gases or vapors.

A.3.0 QUALITY ASSURANCE AND QUALITY CONTROL

The purpose of the Air Sampling Quality Assurance and Quality Control (QA/QC) Program is to assure that data generated during the air monitoring program is accurate and consistent with QA/QC objectives. The quality of the data will be assessed based on accuracy and completeness. Accuracy is a determination of how close the measurement is to the true value and will be assessed by calibration of sampling pumps, cleanliness of field blanks, and laboratory quality control (Sections A.3.1, A.3.4, and A.3.5). Completeness is a measure of the amount of valid data that will be obtained, compared to the amount that is expected under normal conditions. Ninety percent (90%) accuracy and completeness is expected for this Air Monitoring Plan. The project data objectives for accuracy and completeness meet or exceed guidelines established by NIOSH and OSHA.

Quality assurance and quality control procedures for air sampling require the calibration of instruments, the completion of a sampling log, following chain-of-custody procedures, and the use of quality control blanks. Additionally, internal QA/QC audits and laboratory audits will be conducted. The following sections describe each of these QA/QC procedures.

A.3.1 Instrument Calibration

Air sampling pump flow will be calibrated following NIOSH protocol. The pumps will be calibrated on a quarterly basis using a BIOS International DryCal calibrator or other commercially accepted primary standard calibration device. With the DryCal, a filter cassette is connected between the air pump and calibrator, and the pump is activated. Air flow through a piston/cylinder cell in the DryCal is displayed on a real-time digital readout so that adjustments can be made to achieve the necessary flow rate. At least three ten-cycle average readings will be recorded on a calibration form to insure consistent flow and to document the calibration. If a primary calibration device other than the DryCal is used, the pumps will be calibrated according to the manufacturers protocol.

Air sampling pumps will also be calibrated at the beginning and end of each sampling day. Daily pump calibrations will be conducted using either the DryCal or a secondary device such as a rotameter. If a rotameter is used, it must be calibrated against a primary standard and a calibration curve developed between the two standards. The cassette used for pre-calibration will also be used for post-calibration. The post-calibration must be within ±5% of the pre-calibration or that particular sample will be voided.

A.3.2 Air Sampling Logbooks

Quality assurance and quality control procedures for air sampling require that relevant information be recorded in a field log and certain entries be made in a sampling log.

A.3.2.1 Field Logbook

An up-to-date sampling field notebook will be maintained by project personnel during all sampling activities. The general information recorded for each day's sampling includes:

- Header (date, job name, sampling personnel, and weather conditions);
- Pump number, location of sample or name of person wearing pump, start/stop and total time of sample; and
- Any field observations/work activities relevant to air sampling and maps or diagrams as necessary.

Significant deviations from sampling protocol shall be formally noted in the sample log, along with visiting personnel and any unusual circumstances which might affect the sampling.

A.3.2.2 Sample Logbook

A sample logbook will be maintained to document information on each sample collected. For each sample collected (including blanks), the sample log must contain:

- Sample date;
- Name and location of collected sample;
- Sample chain-of-custody number;
- Cassette number;
- Pump number;
- Pump flow rate (lowest of two calibrations);
- Start and stop time, total time of sample;
- Constituents selected for analysis; and
- Site engineering controls, PPE worn by workers, and field observations.

Significant deviations from sampling protocol shall be formally noted in the sample log, along with any unusual circumstances which might affect the sampling.

A.3.3 Chain-of-Custody

To establish the documentation necessary to trace sample possession from the time of collection through analysis, a chain-of-custody record will be filled out for each sample and accompany every set of samples to the laboratory. The record will include the following:

- Name of sampler;
- The project name and number;

- Sample collection date;
- Sample number;
- Pump number;
- Filter cassette number;
- Air sample analysis request;
- Pump flow rate (lowest of two calibrations);
- Length of sampling time;
- Signature of the collector;
- Signature of person(s) involved in the chain of possession; and
- Time and date of change of possession.

To prevent sample misidentification, each sample cassette is affixed with a label. The following information will be recorded on the sample cassette:

- Date sample collected;
- Sampling pump identification number;
- Sample cassette number; and
- Chain-of-custody number.

Samples will be packaged in clean areas that are remote from potential contaminant sources. Packing material will be used to stabilize the cassettes during shipment, if necessary. Samples will be picked up, delivered or shipped for analysis once a sufficient amount of cassettes have been collected.

A.3.4 Quality Control Blanks

Internal quality control checks will be conducted to evaluate the quality of data based on field conditions and constraints. The field QA/QC program will be conducted in addition to laboratory QA/QC. One QC blank should be submitted for every 10 samples (10%). Blanks are unsampled cassettes that are returned to the lab with the other samples as a test for contamination during sample handling, transport, and/or analysis. The following quality control blanks will be submitted for analysis:

- Field Blank - Opened but unsampled filter cassette placed near an active sample. The cassette is closed and returned to the lab with the other samples as a test for contamination during sampling and/or transport.
- Trip Blank - Unopened cassette that is subject to the same handling as sampled cassettes. The trip blank is returned to the lab as a test for contamination of the filter prior to receiving the cassette from the lab and/or during analysis.

The above internal QC samples will be evaluated to determine if sampling and analysis procedures are adequate to provide valid analytical data. The presence of contamination in blanks would indicate the need for review of field and/or laboratory procedures.

A.3.5 Quality Control Audits

Quality control system audits will be conducted once a month by the QA/QC coordinator as an internal check on all components of the monitoring procedures including field and laboratory methods. The purpose of the QA/QC audit is to:

- Identify and correct reporting errors;
- Ensure that quality data will be reported; and
- Determine if a sufficient amount of air sampling is being performed in accordance with Federal regulations.

If QC system or performance audits detect conditions or data that do not meet QC requirements, corrective action will be initiated. The nature of the action will depend on the circumstances of each situation and may include:

- Evaluating and amending sampling and analytical procedures; and
- Accepting data, acknowledging level of uncertainty.

Any corrective measures taken during the monitoring program will be described in the monthly and final reports.

A.3.6 Data Reduction, Validation and Reporting

All data will be reported in appropriate units. All raw data will be reviewed and validated against calibration records to ensure its reliability and compliance with QA/QC objectives. Upon completion, a copy of the signed laboratory report will be retained for future reference. Raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified.

Quality control records, showing accumulated precision and accuracy data, will be maintained in the laboratory and reported along with analytical results. Poor quality results require that the problem be determined and corrected in a timely manner.

A.3.7 Quality Assurance Reports to Management

Final field and laboratory reports will be submitted to the QA/QC Officer for review; issues requiring clarification will then be addressed. Following review by the QA/QC Officer, final field and laboratory reports will be submitted to the Project Manager at the completion of individual projects. The reports will include the following:

- Total number of samples collected for the month/project;
- Total number of samples voided for the month/project;
- Total number of blanks for the month/project;

- Percent blanks and percent completion for the month/project;
- Number of days lost due to weather or other unforeseen circumstances; and
- Text description of project activities.

A.4.0 ANALYTICAL METHODS

The air samples collected using NIOSH methods will generally be analyzed for total suspended particulates (TSP or airborne dust), lead, arsenic, cadmium, chromium, and selenium. Additional samples will be analyzed for silica, asbestos and sulphates. All quantitative samples will be analyzed using NIOSH standard methods at a certified laboratory. Return time for the sample analysis results will be approximately ten days to two weeks unless otherwise specified.

Analysis will consist of a gravimetric method for determination of total suspended particulate with a detection limit of 100 micrograms (μg) for personal samples. Arsenic analysis will be conducted using a Zeeman Furnace Atomic Absorption Spectrophotometer with a detection limit of 1.0 μg. Lead analysis will be conducted by flame atomic absorption spectrophotometry with a detection limit of 2.0 μg. Cadmium, chromium, and selenium samples will be analyzed by Zeeman Background Corrected Graphite Furnace Atomic Absorption Spectrophotometer with a detection limit of 1.0 μg for cadmium and 2.0 μg for chromium and selenium for personal samples. X-Ray diffraction will be the method of analysis for detection of silica (crystalline quartz, respirable dust) with a detection limit of 10.0 $\mu g/m^3$ for personal samples. Airborne asbestos fiber samples will be analyzed by phase contrast microscopy (PCM) or the transmission electron microscopy (TEM) method. Gaseous and vapor type samples will be analyzed by the appropriate NIOSH or OSHA methodology.

Other site-specific air contaminants that may be monitored will be analyzed by the appropriate methods. The results of all air sampling will be shown to employees involved in work activities at each site within five days of receiving them, which meets or exceeds OSHA regulations.

A.5.0 ENGINEERING CONTROLS AND WORK PRACTICES

Site-specific air monitoring programs will be implemented to monitor the effectiveness of engineering controls and work practices used to suppress particulate emissions, and to document worker exposure to airborne physical and chemical hazards. Results from air monitoring will be used to adjust site activities to reduce particulate generation. Engineering controls previously implemented during Kennecott projects include the following:

- Application of water or commercial road treatment on haul roads and excavation areas;
- Application of water or dust surfactant on stockpiles and soil reclamation areas;
- Washing down of contaminated surfaces; and
- Lead paint and asbestos abatement.

Any additional controls will be initiated as necessary to insure that worker protection will be adequate and to reduce the chance of employee exposure to potentially harmful physical or chemical hazards.

Work practices will vary from site to site, but can include practices such as keeping doors and windows of equipment closed during dusty conditions. Proper usage of personal protective equipment and good personal hygiene will be required during all remediation and reclamation activities.

3

KENNECOTT UTAH COPPER CORPORATION

NORTH FACILITIES SOILS WASTEWATER TREATMENT PLANT PONDS SITE REMOVAL ACTION

APPENDIX B

SITE-SPECIFIC HEALTH AND SAFETY PLAN

SSID #4B

Prepared and Submitted by:

Kennecott Environmental Engineering Projects Group
Bingham Canyon, Utah

July 1996

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APPENDIX B

SITE SPECIFIC HEALTH AND SAFETY PLAN

B.1.0 INTRODUCTION

This Health and Safety Plan (HASP) applies to activities related to the North Facilities Soils Wastewater Treatment Plant Ponds Site Removal Action. Project activities will include site characterization, construction of a repository, demolition of certain obsolete buildings, removal and disposal of contaminated soils, and removal and disposal of sludge. The work will be conducted by employees, contractors, and subcontractors of Kennecott Utah Copper Corporation (Kennecott). This HASP will be available at all times for review by employees, contractors, subcontractors, regulatory agencies, or representatives thereof. All visitors are expected to be familiar with and comply with all aspects of this HASP.

This HASP is designed to identify, evaluate, and control health and safety hazards associated with Kennecott Plant Projects Group (PPG) demolition and soils remediation projects. This HASP is based on existing information regarding the entire site and similar work conducted to date on Kennecott property. Addressed are specific safety and health hazards and procedures necessary to protect the employees conducting the various projects from these hazards. If additional site-specific health and safety issues arise that are not addressed in this HASP, an addendum will be included prior to the start of work activities. Each contractor will also provide a Safety, Health, and Environmental Action Plan (SHEAP) before their particular projects begin.

It is anticipated that field conditions will vary during specific projects. As actual site conditions change, sections of the HASP may change and will be subject to approval by the Health and Safety Officer (HSO). Such changes will be communicated to all employees.

B.2.0 COMPREHENSIVE WORK PLAN

A comprehensive Work Plan for the operations to be conducted precedes this HASP. The Work Plan describes work tasks, objectives, and personnel requirements. The excavation, haulage, and placement of materials in the designated repository is outlined in the Work Plan.

B.3.0 SAFETY AND HEALTH HAZARD ANALYSIS

The potential hazards associated with site activities include both chemical and physical hazards. Equipment operators and laborers directly involved in day-to-day project activities have the greatest potential for exposure to these hazards. Haulage truck operators and site supervisors generally have a lower potential of exposure to these hazards. The levels of exposure will be addressed appropriately.

B.3.1 Physical Hazards

This section describes normal physical construction and demolition site hazards.

B.3.1.1 Heat Exhaustion

Heat exhaustion occurs when the body loses so much water and electrolytes through heavy sweating that fluid depletion (hypovolemia) occurs. For sweating to be an effective cooling mechanism, the sweat must be able to evaporate from the body surface. If evaporation does not take place, cooling will not occur. Heat exhaustion is a potential hazard associated with elevated body temperatures caused by high ambient air temperatures and high humidity, heavy physical labor, wearing personal protective equipment, and/or any combination thereof. This hazard will be evaluated on a day-to-day basis by the Kennecott Project Coordinator and HSO.

B.3.1.2 Cold Exposure

Cold injury (frostbite and hypothermia) and impaired work ability are potential hazards at low ambient air temperatures and/or when the wind chill factor is low. The symptoms associated with cold exposure are excessive shivering, loss of control of muscle activity, becoming lethargic and losing interest in combating cold, and finally decreased vital signs. This hazard will be evaluated on a day-to-day basis by the Kennecott Project Coordinator and HSO.

B.3.1.3 Inclement Weather

Rain, snow, extreme low or high temperatures, or high winds may occur during scheduled work activities. All employees will be trained in the hazards of exposure to cold and/or wet conditions. Protective clothing for cold and/or wet, slippery conditions will be used when needed. Severe weather conditions may result in cessation of work activities at the discretion of the Project Manager, Kennecott Project Coordinator or HSO.

B.3.1.4 Utility Lines

Overhead and buried utility lines may be present near work areas. All operators and ground personnel should always be aware of all overhead hazards and warn each other of potential danger. All underground utilities will be located and clearly marked prior to demolition or excavation. Any valve or electrical switch going into an area under demolition must be locked and tagged or physically disconnected. Metering electrical lines and opening valves on utility lines will be performed to verify each service has been disconnected prior to demolition. Appropriate precautions will be taken when working around overhead and underground utilities.

B.3.1.5 Noise

Exposure to elevated noise is expected for heavy equipment operators and potentially to ground personnel. Engineering controls will be used to manage this hazard and supplemented

by wearing the appropriate level of hearing protection when necessary. Either ear plugs or muffs will be encouraged for heavy equipment operators, laborers, and any other personnel working near the equipment. The HSO will assist in determining the engineering controls and proper level of hearing protection to be worn by site personnel.

B.3.1.6 Construction

As on all construction sites, there is potential for personal injury. American National Standards Institute (ANSI) approved safety equipment will be required at all times. Hard hats, steel-toed boots, and safety glasses will be required to guard against head, foot, and eye injuries. All required construction equipment will have appropriate audible or visual warning alarms. Applicable Mine Safety and Health Administration (MSHA) and Occupational Safety and Health Administration (OSHA) regulations will be followed and enforced.

The excavation standard outlined in 29 Code of Federal Regulations (CFR) 1926.650 will be adhered to at all times. An excavation permit will be issued by the HSO before excavating begins. Upon completion of the excavation, a competent person will inspect excavations that personnel must enter to ensure proper sloping or shoring has been achieved. This inspection must take place before any person enters the excavation.

B.3.1.7 Demolition

The demolition standard outlined in 29 CFR 1926.850 (refer to the National Association of Demolition Contractors [NADC] manual and the Kennecott Safety Reference Material for Demolition Pre-Planning) will be adhered to at all times. All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped or otherwise controlled outside the building before demolition work is initiated. Where a hazard exists from fragmentation of glass, such hazards shall be removed. Where a hazard exists to employees falling through wall openings, the opening shall be protected to a height of approximately 42 inches. Only those stairways, passageways, and ladders designated as means of access to the structure of a building shall be used. Other access ways shall be entirely closed at all times.

During demolition, continuing inspections by a competent person shall be made as the work progresses to detect hazards resulting from weakened or deteriorated floors, walls, or loosened material. No employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing, or other effective means.

B.3.1.8 Confined Space Entry Procedures

A confined space is defined as being of adequate size and configuration with limited means of entering and exiting. A confined space is not designed for continuous employee occupancy. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels. Entry into a confined space means the person has passed through an opening into a confined

space. Entry occurs when any part of the Entrant's body has gone through the opening into the space.

The procedures outlined in the attached addenda will be adhered to at all times.

B.3.1.9 Dust Suppression

Dust may be generated during demolition of buildings, excavation, transportation, and placement of material. Vacuuming, pre-soaking, water spray, tarping of transport vehicles, or other controls will be used as necessary to control dust levels. Air monitoring will be conducted to ensure occupational exposures to emissions from work areas are below accepted safe levels. (Refer to the Kennecott Dust Abatement Procedures for Demolition and Reclamation)

The OSHA Action Level (AL) for Total Suspended Particulates (TSP) based on an 8-hour time-weighted average is 7500 micrograms per cubic meter. The OSHA Permissible Exposure Limit (PEL) for TSP based on an 8-hour time-weighted average is 15,000 micrograms per cubic meter.

B.3.1.10 Other Physical Hazards

Other physical hazards such as insect bites, bee stings, etc., may occur during construction/demolition, and placement operations. The hazard will be evaluated on a case-by-case basis.

B.3.2 Chemical Hazards

Based on available information regarding the sites, metals of concern identified in the buildings and soils are arsenic, lead, cadmium, selenium, and chromium. Asbestos, cresol and silica have also been identified. If these and/or other chemical hazards such as hydrocarbons become evident, engineering controls and appropriate levels of personnel protective equipment (PPE) will be used to protect the health and safety of personnel on the site and prevent off-site migration. All employees will be notified of any new hazards as they become known.

B.3.2.1 Arsenic

Arsenic is a solid material with no odor. Potential exposure routes are through inhalation or ingestion. Skin contact can also result in adverse effects. Some arsenic compounds may cause irritation of the eyes, mucous membranes, respiratory system, and skin. Dermatitis can also result from poor personal hygiene when working around these materials. Excessive inhalation of arsenic may result in respiratory problems such as coughing and chest pain. Other symptoms include giddiness, headache, and extreme weakness preceding gastrointestinal irregularities. Prolonged exposure can result in weight loss, nausea, diarrhea, pigmentation of skin, and loss of hair. Arsenic is considered a carcinogen; a cancer-causing substance. Arsenic may be present in soils, demolition and flue dust.

The OSHA AL for arsenic is 5.0 micrograms per cubic meter based on an 8-hour time-weighted average. The OSHA PEL based on an 8-hour time-weighted average is 10 micrograms per cubic meter.

B.3.2.2 Lead

Lead is a solid material with no odor. Potential exposure routes are through inhalation or ingestion. The early effects of overexposure to lead are nonspecific and are difficult to distinguish from the symptoms of minor seasonal illnesses, except by laboratory testing. The symptoms are decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, abdominal pains, and decreased appetite. More advanced effects include anemia, pallor, a "lead line" on the gums, and decreased hand grip strength. Lead is not considered a carcinogen but it is classified as a reproductive toxin and a teratogen (causes fetal malformation). Lead present in the tailings is bound in a mineral matrix and is not present as a pure substance. Therefore, the possibility of acute exposure to lead is unlikely. Lead may be present in paints, soils, demolition and flue dust. In the event that cutting on lead based paint becomes a necessity, abatement of the lead will be performed when feasible. Personal protective equipment will be used when appropriate.

The OSHA Al for lead is 30 micrograms per cubic meter. The OSHA PEL for lead is 50 micrograms per cubic meter.

B.3.2.3 Cadmium

Cadmium is a blue-white, malleable, lustrous metal or a grayish-white powder. Some cadmium compounds may also appear as a brown, yellow, or red powdery substance. Potential exposure routes for cadmium are through ingestion or inhalation. The main adverse health effects associated with cadmium are lung cancer and kidney dysfunction. Early symptoms may include mild irritation of the upper respiratory tract, a sensation of constriction of the throat, a metallic taste and/or a cough. Indications of prolonged exposure to cadmium would include shortness of breath, chest pain, and flu-like symptoms. Cadmium is a naturally-occurring environmental contaminant to which humans are continually exposed to in food, water, and air. A non-occupational source of cadmium is smoking tobacco. Cadmium may be present in soils, demolition and flue dust.

The OSHA AL for cadmium is 2.5 micrograms per cubic meter. The OSHA PEL for cadmium is 5 micrograms per cubic meter.

B.3.2.4 Chromium

Chromium is a blue-white to steel-gray, brittle, hard solid. Potential exposure routes are inhalation or ingestion. Prolonged exposure to chromium may cause histologic fibrosis of the lungs. Chromium is a potential occupational carcinogen. Chromium may be present in paints, soils, demolition and flue dust.

The OSHA AL for chromium is 500 micrograms per cubic meter. The OSHA PEL for chromium is 1000 micrograms per cubic meter.

B.3.2.5 Selenium

Selenium is a red to gray solid. Selenium may enter the body by inhalation, absorption, or ingestion. Some of the symptoms of exposure to selenium are irritated eyes, nose, and throat, visual disturbance, dermatitis, gastrointestinal disturbance, headaches, chills, and fever. Other symptoms of exposure are garlic breath and a metallic taste in the mouth. Selenium may be present in soils, demolition and flue dust.

The OSHA AL for selenium is 100 micrograms per cubic meter. The OSHA PEL for selenium is 200 micrograms per cubic meter.

B.3.2.6 Asbestos

Asbestos is the name of a class of magnesium-silicate minerals that occur in fibrous form. Minerals that are included in this group are chrysolite, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos. Asbestos may be found in a variety of building materials including floor tiles, roofing felts, ceiling tiles, asbestos-cement pipe and sheet and fire-resistant drywall. Asbestos may also be present in pipe and boiler insulation materials, and in sprayed-on materials located on beams, in crawlspaces, and between walls. The potential for an asbestos-containing product to release breathable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felts are considered nonfriable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are crushed during demolition operations. Asbestos may cause disabling respiratory disease and various types of cancer if the fibers are inhaled. Inhaling or ingesting fibers from contaminated clothing or skin can also result in these diseases. The symptoms of these diseases generally do not appear for 20 or more years after initial exposure. Exposure to asbestos has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rare cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

The OSHA AL for asbestos is .05 fibers per cubic centimeter. The OSHA PEL for asbestos is .1 fibers per cubic centimeter.

B.3.2.7 Cresol

Cresol is a dark amber to black liquid with a tarry creosote odor. Cresol is corrosive to all tissues, therefore, the liquid may cause severe eye or skin irritation. Prolonged or repeated

dermal contact to low concentrations of cresol may produce a skin rash. Ingestion or skin absorption may cause headache, dizziness, blurred vision, ringing of ears, rapid breathing, mental confusion, muscular weakness, loss of consciousness, and liver and kidney damage. Prolonged or repeated contact by any route may produce the following signs: vomiting, difficulty in swallowing salivation, diarrhea, loss of appetite, headache, faintness, dizziness, mental disturbances, skin rash, and liver and kidney damage. Water contact with this product may cause liberation of hydrogen sulfide. Hydrogen sulfide has a rotten-egg odor, however, some people are unable to smell the gas and exposure will deaden the sense of smell. Therefore, odor is an unreliable indicator of exposure. Overexposure to hydrogen sulfide gas may cause severe eye or respiratory tract irritation, rapid development of coma and respiratory failure. Low levels of hydrogen sulfide may cause headache, dizziness, staggering gait, neurological damage and gastritis. An adequate enclosure and local exhaust ventilation will be provided to minimize exposure. Cresol may be present in soils at Arthur Stills and in other areas.

The OSHA AL for cresol is 11000 micrograms per cubic meter. The OSHA PEL for cresol is 22000 micrograms per cubic meter.

The OSHA AL for hydrogen sulfide is 7 milligrams per cubic meter. The OSHA PEL for hydrogen sulfide is 14 milligrams per cubic meter.

B.3.2.8 Silica

Silica is a colorless, odorless solid. Silica is a component of many mineral dusts. Silica may enter the body by inhalation only. Some of the symptoms of overexposure to silica are coughing, wheezing, impaired pulmonary functioning, and dyspnea. Silica is also considered to be a carcinogen. Silica may be present at the site of the repository and in some demolition debris.

The OSHA AL for silica is .025 milligrams per cubic meter. The OSHA PEL for silica is .05 milligrams per cubic meter.

B.3.3 Hazard Mitigation

The hazards identified in the above sections, and any additional hazards which arise or are identified during work activities will be mitigated by engineering controls, PPE and other safety procedures. Physical hazards will be mitigated by the implementation and enforcement of standard operating procedures described in Section 10.0. Chemical hazards will be identified through site characterization, soil sampling and the air monitoring program described in Section 8.0 and mitigated by the use of PPE, engineering and site controls.

B.4.0 PERSONAL PROTECTIVE EQUIPMENT

Occupational exposures to arsenic, lead, cadmium, chromium, selenium, and TSP are expected

to be below action levels specified in the CFR 1910.1000. Therefore, the level of personal protection to be utilized for all initial site activities is modified Level D which includes use of a respirator when necessary as determined by the Kennecott Project Coordinator or the HSO. Level D PPE shall consist of a hard hat (ANSI Z89), safety glasses (ANSI Z87), steel-toed boots (ANSI Z41 with substantial leather 6 inch uppers and cut heels) and cotton coveralls. Gloves and hearing protection may be required for task specific work. Work zone visitors will be required to wear applicable safety equipment depending on site specific conditions. The level of protection will be adjusted according to results of employee exposure monitoring, specific job functions, or as site conditions change.

B.5.0 TRAINING REQUIREMENTS

The Kennecott HSO will be responsible for identifying which oversight agency , MSHA or OSHA, has jurisdiction for each project. Kennecott will adhere to the more stringent of the two agencies' regulations.

Project employees will receive a minimum of 40 hours of initial health and safety training for Hazardous Waste Site Operations. These employees will also receive a minimum of 24 hours of on-the-job training. Copies of training certificates and other training documentation will be kept on file near the job site by the individual contractors.

Mine Safety and Health Administration related project employees will receive the 8-Hour Newly Employed Experienced Miner training required by MSHA regulations. These employees will be required to demonstrate that they have job related experience. If employees do not have job related experience, they will be required to receive 24 hours of the MSHA Newly Employed Inexperienced Miner training. Certificates and training documentation should be kept by the contractor near the job site.

Employees will be trained to a level required by their job function and responsibility before being permitted to engage in field activities. Pre-project safety information will include:

- Names of personnel and alternates responsible for site safety and health;
- Chemical and physical hazards present on the site;
- Work practices by which risks from hazards can be minimized;
- Detailed review of this HASP and Kennecott Emergency Protocols;
- Safe use of engineering controls and equipment on the site;
- Use of personal protective equipment; and
- Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards.

Site safety meetings (tailgate meetings) will be held at least weekly to notify personnel of specific hazards, air monitoring results, changes in the HASP, or other topics determined by the HSO and Construction Superintendent. Specific meetings will be held at the initiation of new or different field activities and at the time of any crew changes. Kennecott will conduct

weekly supervisor planning/safety meetings.

B.6.0 DECONTAMINATION PROCEDURES

Equipment decontamination will be conducted on-site as appropriate. Equipment decontamination will consist of physically removing visible contamination from contact points of the equipment at completion of work tasks and before leaving the work area. The removed material will be transported to the designated repository. Equipment can be decontaminated at the Kennecott decontamination station if it is close enough to work activities or can be transported to the station without contaminating roads.

Personal decontamination, where required, will consist of removing and leaving outer PPE at the safety trailer or temporary staging area and good personal hygiene. The safety trailer or staging area will have facilities for washing exposed skin. Employees will be required to wash with soap and water at each break, lunch period and at the end of the work shift. Decontamination trailers may be on-site for particular jobs. Workers and visitors will be required to pass through and use the staging area when exiting the work zone.

Decontamination procedures will be monitored by the HSO to determine their effectiveness. If such procedures are found to be ineffective, they will be altered to correct any deficiencies.

B.7.0 SITE CONTROL

All areas, if necessary, will adhere to the Kennecott Safety and Facility Standard 16.3 regarding off limit areas and will have perimeter fencing or be otherwise barricaded as the situation requires. "No Entry" signs will be posted at regular intervals around the perimeter and at each entrance to a site. Plant Managers will be notified of each project and a Safety Bulletin will be disseminated to the respective plant personnel.

B.8.0 AIR MONITORING

Air monitoring will be conducted by Kennecott to evaluate the potential for employee exposure to airborne contaminants and to determine the overall contribution of work activities to ambient air quality. Prior to any activities on site, background air samples will be collected to establish a datum for site activities. During demolition, excavation and placement activities, quantitative and qualitative air sampling will be conducted to determine employee exposures.

All air samples will be collected and analyzed according to the appropriate National Institute of Occupational Safety and Health (NIOSH) or Occupational Safety and Health Administration (OSHA) methods (see Appendix A to the Work Plan).

Quantitative personal samples will be collected using constant-flow pumps that draw air through filter media. The samples will be handled under chain-of-custody procedures and delivered to a qualified laboratory for analysis.

Employees out of each job classification, for each shift, and in each work area will be selected for personal monitoring. At the start of field activities and periodically thereafter, occupational air samples will be collected and analyzed for arsenic, lead, cadmium, chromium, selenium, TSP, asbestos, silica, sulphates, cresol and any gases or vapors suspected to be present. Additional air monitoring will be conducted whenever there is a change in work conditions which can be expected to result in new or additional exposure levels or whenever an employee complains of symptoms which may be attributable to exposure from contaminants in his/her work area.

Qualitative work zone air monitoring will be conducted as needed using real-time instruments.

B.9.0 MEDICAL SURVEILLANCE PROGRAM

A medical surveillance program provides a means of selection of employees who are physically able to safely perform the work assigned and monitor their health on a regular basis. The medical surveillance program to be implemented for this project will comply with 29 CFR 1910.120(f).

The program consists of a pre-employment medical evaluation to determine fitness for the job assignment, an annual evaluation based on length of assignment or attending physicians opinion (no greater than biennially), and an end-of-employment evaluation. In addition, a special evaluation is warranted when an employee indicates that they may have developed symptoms resulting from a possible exposure to hazardous substances.

Medical surveillance will be conducted for all site personnel who may be exposed to arsenic, lead, cadmium, chromium, and selenium in excess of ALs, without regard to the use of respirators, for 30 days or more per year. All personnel participating in the medical surveillance program will have an examination which equals or exceeds the following:

- Medical and Occupational History;
- Physical Examination;
- Pulmonary Function Test;
- Six Frequency Audiogram;
- Urinalysis, with microscopic morphology and dipstick;
- Complete Blood Count;
- CHEM 20 Chemistry Screen;
- SAM 9a Drug Screen;
- Chest X-Ray (scanned by a "B" reader); and

- Blood lead and urine arsenic, cadmium, chromium, and selenium levels. (Urine arsenic samples will be speciated if levels are higher than 45ug/gm of creatinine)

Exit medicals will consist of the following:

- Blood lead levels; and
- Urine arsenic, cadmium, chromium, and selenium levels.
  (Urine arsenic will be speciated if levels are higher than 45ug/gm of creatinine)

All contractor personnel with the potential for chemical exposure are required to have medical monitoring which equals or exceeds this program. Visitors who will enter the work area may be required to demonstrate participation in a medical program which is equivalent to or exceeds this program. The HSO will determine which personnel must meet training and medical monitoring requirements.

Prior to the start of project activities, all employees with potential for airborne contaminant exposure will have a baseline evaluation conducted for lead levels in blood and urine arsenic, cadmium, selenium, and chromium levels. These evaluations are to be repeated at the completion of work activities or at the end of employment. If an employee is removed from a project to conduct work at another site off Kennecott property, that employee shall receive an additional bio-metals exam before leaving and upon return to the Kennecott project, regardless of the off-site duration.

Copies of the physician's written opinion for the capability of the individual to work in areas with a potential for arsenic, lead, cadmium, chromium, and selenium exposure and the ability to wear a respirator will be maintained by the HSO for all workers on-site. The completed and signed respirator fit test form will be kept in the same file.

B.10.0 STANDARD OPERATING PROCEDURES/SAFE WORK PRACTICES

Standard operating procedures and safe work practices for this project consist of Kennecott General Safety for Contractors, Kennecott Emergency Protocols, and the following:

- No alcohol, firearms, or illegal drugs will be allowed on-site;
- Any employee under a physician's care and/or taking prescribed medication must notify the Site Health and Safety Officer;
- Eating, drinking, smoking and chewing tobacco or gum are allowed only in designated areas and never in the removal work zone or at the dump site;
- All personnel shall listen for warning signals on construction equipment and shall yield to equipment;
- All equipment operators shall pay careful attention to workers on the ground who may be in their path and provide warning to these people before moving. All employees working regularly on the ground near heavy equipment will wear

orange vests with reflective tape. Operators shall also pay deliberate attention to all types of utility lines and sources;

- All personnel are required to be familiar with and abide by the security rules, and emergency procedures;
- All personnel must immediately report any injuries, vehicle accidents, and/or illnesses to their supervisor. This includes minor or slight injuries;
- All newly hired employees must pass a pre-work assignment physical, drug test and subsequent exams as required by this HASP;
- All personnel must participate in the air-quality exposure monitoring program by wearing personal monitors or sampling devices designated by the Site Health and Safety Officer;
- All personnel must abide by all safety rules and procedures as described in the work rules and/or throughout the project; and
- Remember, safety starts with you.

B.11.0 EMERGENCY COMMUNICATION PROCEDURE

In the event of a medical, fire, or any other type of emergency, notify Kennecott at the following gates:

Smelter	569-6499;
Refinery	569-6722; or
North Concentrator	569-6622.

An emergency may also be communicated by transmitting on Radio Channel 6. The Emergency Medical Technician (EMT) at the respective guard shack will obtain the necessary information and notify the proper authorities. If an injury is reported by radio, the name will not be revealed. The EMT will respond to the scene and assess the situation. **Do Not Call 911.**

If an accident is a minor injury or illness, the EMT will administer to the patient following protocol. The Contractor Clinic (Kennecott Wellness Center) must always be notified of any injury or illness before response by the Security EMT. The injured will be transported to the Contractor Clinic for treatment, as required, by a Foreman or a Safety Officer. The Wellness Center phone number is 252-3301.

B.12.0 NAMES AND NUMBERS OF KEY PERSONNEL

The following persons have been identified to oversee the safety and health of employees involved with Kennecott work activities:

	PHONE	MOBILE	PAGER
Dan Self	569-6603	599-7791	481-0572
Keith W. Smith	569-6536	599-7991	
Charlie Masson	569-6472	460-4617	
Bill Williams	252-3110	597-2410	

Signature Form

By signing below, I have read and understand the Health and Safety Plan above and I will abide by all safety guidelines established herein at all times..

Date	Name	Signature

ADDENDA: Confined Space Entry Procedures

Addenda: Confined Space Entry Procedures

Purpose

The Kennecott Utah Copper Corporation (Kennecott) Safety Department is responsible for developing and maintaining this safety procedure. This safety procedure establishes the requirements for a confined space entry control program. The objective is to provide protection to personnel during entry and while working within confined spaces.

Definitions

Accepted entry conditions: The conditions that must exist in a confined space to allow entry and to ensure that personnel involved in a confined space entry can safely enter and work in the space.

Attendant: A person who is assigned as a standby to monitor a confined space process or operation and to provide required support. This person is trained as specified in this procedure.

Authorized entrant: An employee who is authorized by the entry supervisor to enter a confined space and, thereby, becomes a member of the entry team.

Confined space: A space that is: (a) large enough and so configured that an employee can bodily enter and perform assigned work, (b) has limited or restricted means for entry or exist and, (c) is not designed for continuous employee occupancy. Confined spaces include, but are not limited to, storage tanks, cement bins, lime bins, tank trucks, manholes, transformer vaults, ventilation or exhaust ducts and pipelines.

Non-permit required confined space: A confined space that does not contain any hazardous atmosphere or contain the potential for engulfing an entrant. A non-permit space does not have an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section or does not contain any other recognized serious safety or health hazard.

Confined space entry permit: The document used by the entry supervisor to authorize and control entry into a permit required confined space.

Permit required confined space: A confined space that contains any hazardous atmosphere or the potential for engulfing an entrant. A permit required space does have an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section or a space that contains any other recognized serious safety or health hazard.

Emergency response: A response to any occurrence, either inside or outside the confined space, when that occurrence could endanger the entry team(s).

Engulfment: The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspired to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction or crushing.

Entry: The action by which a person passes through an opening into a confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into that space.

Entry supervisor: The supervisor responsible for: (a) determining if acceptable entry conditions are present at a confined space where entry is planned, (b) authorizing entry and overseeing entry operations and © terminating entry as required by this procedure.

Entry team: A group of employees authorized to enter the confined space.

Hazardous atmosphere: An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury or acute illness from one or more of the following causes:

- Flammable gas, vapor or mist in excess of 10% of its lower explosive limit (LEL);
- Airborne combustible dust at a concentration that meets or exceeds its LEL. Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet or less;
- Atmospheric oxygen concentrations below 19.5% or above 23.5%; and
- Any other atmospheric condition that is immediately dangerous to life or health.

Immediate danger: Any condition that poses an immediate or delayed threat to life, that would cause irreversible adverse health effects or would interfere with an individual's ability to escape unaided from a confined space.

<u>Responsibilities</u>

Manager

- Ensure proper execution of this safety procedure in their respective areas of responsibility; and
- Designate the entry supervisor.

Entry Supervisor

- Ensure that unsafe conditions that would not allow removal of the entrance cover are eliminated;
- Ensure that when entrance covers are removed, the opening is promptly guarded by railing and/or temporary barrier(s);

- Retain the original permit at the entry site until the work is complete or the permit is canceled;
- Document any problems encountered during the entry operations in the "Remarks" section of the permit;
- Terminate entry and cancel the permit when entry operations have been completed or when a condition that is not allowed under the permit arises in or near the confined space; and
- Ensure compliance with all sections of this procedure.

The entry supervisor may disregard the remainder of this procedure and continue operations if satisfied that entry into the space does not require a permit.

The safety supervisor shall analyze the confined space before entry is allowed. The entry supervisor shall determine the specific entry requirements.

Safety Department

- Monitor air quality in the confined space before and during entries;
- Work with the entry supervisor to ensure that the necessary engineering controls, respiratory protection and personal protective equipment (PPE) are used;
- Monitor personnel for heat stress when required;
- Provide rescue teams when necessary;
- Develop the confined space entry program and ensure its administration; and
- Before entry, test and document the internal atmosphere with a calibrated direct reading instrument for the following conditions, in the order given, to ensure that the atmosphere is not hazardous:
    - Oxygen content
    - Flammable gases and vapors
    - Potential toxic air contaminants

If a confined space is not currently under a permit and work is planned within the space, it shall be inspected to determine the following:

- The potential for a hazardous atmosphere;
- If the space contains a material that has the potential for engulfing an entrant;
- If the internal configuration could trap or asphyxiate an entrant because of inwardly converging walls or downward sloping floors that taper to a smaller cross section; and
- Any recognized serious safety or health hazards within the space.

Attendant

- Must know the hazards that may be faced during entry;
- Must remain outside the confined space unless relieved by another attendant. The attendant shall not enter the confined space in an attempt to rescue those inside;

- Maintain an accurate written list of all entry team members in the confined space by continuously updating the list as personnel enter and exit;
- Remain in constant voice or visual contact with the entrant(s) or entry team.;
- Monitor conditions inside and outside the confined space that could adversely affect the entry team;
- Provide assistance to those entering the confined space;
- Order occupants to exit the confined space when any irregularities are observed; and
- Summon rescue and other emergency services if the entrant(s) need(s) assistance in escaping the confined space.

Entry Team Members

- Comply with the requirements in this safety procedure and the precautions specified on the permit;
- Know the hazards that may be faced during entry;
- Properly use all required equipment;
- Communicate with the attendant;
- Be first aid/CPR trained; and
- Alert the attendant whenever any warning sign or symptom of exposure to a dangerous situation or a prohibited condition is detected.

Exit from the confined space as quickly as possible for any of the following reasons:

- The attendant or the entry supervisor gives an order to evacuate;
- An attendant recognizes any warning symptoms of exposure to a dangerous situation;
- An entrant detects a prohibited condition; or
- An evacuation alarm (predetermined method of alarm) is activated.

All Personnel

- Comply with the requirements of this safety procedure and shall not attempt to enter any confined space unless specifically authorized to do so as an entry team member.

Planning Procedures for Confined Space Entry

- The manager, superintendent and Safety Department shall conduct a preliminary survey and identify in writing all permit required confined spaces;
- Warning signs (DANGER- CONFINED SPACE - ENTRY BY PERMIT ONLY) must be posted on all permit required confined spaces; and
- At least annually, the list of existing confined space permits must be reviewed to ensure that information is current and complete.

Job Safety Analysis

The purpose of the job safety analysis (JSA) is to identify existing or potential hazards and necessary precautions to be taken. The entry supervisor, safety representative, entry team and rescue team shall review the JSA at the job-site before anyone enters the confined space. The entry supervisor shall brief the entry team to ensure that they understand the potential hazards of the confined space before entering. The briefing shall include, but is not limited to, the following:

- The contents of the permit and analysis, where applicable;
- The contents of applicable Material Safety Data Sheets (MSDS); and
- Any other information that may be relevant to the job.

Stop Work Authority

All personnel responsible for supervising or entering a confined space or personnel who participate in a confined space rescue shall be given the authority to stop work and may halt the project if they believe unresolved hazards exist.

Air Quality Monitoring in a Confined Space

The safety representative shall:

- Verify that the air quality is within the following permissible limits before entry into the confined space is permitted:
  - oxygen - 19.5% to 23.5%;
  - explosivity - less than 10% of LEL; and
  - toxicity - less than recognized exposure limits per Subpart Z of Title 29 Part 1910
- Document the results of the air quality check on the survey and attach to the confined space entry permit;
- In cooperation with the entry supervisor, require the use of engineering controls and respiratory protection before entry into confined space is permitted if the air quality in the confined space does not meet the recognized standards;
- Check the air quality in the confined space to verify that the containments and engineering controls are not causing a hazardous condition;
- Air quality **must always be checked** before entry into a confined space;
- Ensure that the testing of the confined space is conducted throughout the entire area surrounding the space to be occupied; and
- Determine the appropriate procedures and equipment to use that will allow entrants to exit safely if the air quality becomes unsafe while work is in progress.

Lockout/Tagout and Isolation of Electrical/Mechanical Systems

The entry supervisor shall:

- When lockout/tagout is required, ensure that the authorized employee locks and tags out the hazards in the confined space before entrants are permitted to enter the confined space; and
- Ensure the most rigorous isolation possible in the confined space when complete isolation is not possible. The reason why complete isolation is not possible and the compensating control measures taken must be documented on the permit.

Ventilation

- The space shall be ventilated until the air quality is within the acceptable ranges previously stated when mechanical ventilation is used to remove contaminants from the air in the confined space;
- The entry supervisor shall select and have employees use methods and means to prevent flammable, toxic, irritating or oxygen-displacing gases and vapors from entering the confined space;
- Air movers shall meet the requirements set forth and outlined in ANSI/NFPA 91 and ANSI Z9.2. They shall be bonded, grounded and intrinsically safe when used to move flammable atmospheres; and
- When ventilation is not possible, the Safety Department shall determine alternate methods to remove air contaminants before authorizing entry.

Personal Protective Equipment

The Safety Department shall determine and specify the personal protective equipment needed by all personnel, including rescue teams, entering the permitted space.

Tools and Equipment

- The entry supervisor shall ensure that all required tools, equipment and materials are approved for the work being performed and is in proper working condition;
- Ensure that electrical equipment, tools, extension cords and lighting used in hazardous locations are the approved type and meet the appropriate requirement of Article 500 of the National Electrical Code (NEC); and
- Ensure the use of appropriate electrical equipment (e.g., ground fault circuit interrupters, double insulated tools, etc.) or systems where there is a potential for electrical shock.

Rescue and Emergency Response

- The entry supervisor shall ensure that the appropriate equipment or methods for retrieving personnel are used whenever a person enters a confined space;

- If use of retrieval equipment increases the overall risk of the entry or does not contribute to the rescue, the Safety Department may waive its use by noting in the "Remarks" section of the permit;
- A mechanical device shall be available to retrieve personnel from vertical-type permit spaces greater than 5 feet in depth;
- Anyone who enters a confined space shall wear a chest or full body harness with a retrieval line attached at the center of the entrant's back near shoulder level or above the entrant's head. Wristlets may be used instead of the chest or full body harness if the harness is infeasible or creates a greater hazard. The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the confined space; and
- Rescue team members shall:
  - Consist of at least two members
  - Attend the confined space training
  - Be current in first aid/CPR training

Contractors

The entry supervisor shall:

- Ensure that all Contractors follow Kennecott permitted confined space entry requirements;
- Discuss with subcontractors their respective confined space entry procedures;
- Inform subcontractors of all known hazards or potential hazards associated with the entry; and
- Debrief Contractors at the conclusion of the entry operations regarding any hazards found or created in the confined space.

Training

Entry supervisors, attendants, entry team members and rescue team members shall attend a confined space training class:

- Before employees are first assigned duties covered by this procedure;
- Before there is a change in the employee's assigned duties involving confined space entry;
- Whenever there is a change in the confined space operations that presents a hazard which an employee has not been previously trained to handle;
- Whenever there is a reason to believe that an employee's knowledge of a procedure is inadequate;
- Training shall consist of:
  - The provisions contained in this procedure;
  - Proper use of PPE and rescue equipment necessary for making rescues from confined spaces; and

- Practice rescue from confined spaces at least once every 12 months in which dummies or real persons will be used in confined spaces.

Emergency or Unscheduled Confined Space Entry Training

In case of emergency or unscheduled confined space entry, a properly trained and qualified entry supervisor may conduct a needed training session on a one-time basis. Training shall include the following:

- Explanation of the general hazards associated with confined spaces;
- Discussion of specific confined space hazards associated with a facility, location or operation;
- Reasons for using PPE and other safety equipment required for entry into confined spaces;
- Explanation of the confined space entry system and other procedural requirements for conducting a confined space entry;
- Duties and responsibilities for each team member of the confined space entry team; and
- Description of how to recognize symptoms of overexposure to air contaminants in themselves and co-workers and methods for alerting attendants.

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NORTH FACILITIES SOILS AND WASTEWATER TREATMENT PLANT PONDS SITE REMOVAL ACTION

APPENDIX C

SOIL AND DEMOLITION DEBRIS QUALITY ASSURANCE PROJECT PLAN AND SAMPLING AND ANALYSIS PLAN

SSID #4B

Prepared and Submitted by:

Kennecott Environmental Engineering Projects Group
Bingham Canyon, Utah

July 1996

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APPENDIX C

SOIL AND DEMOLITION DEBRIS QUALITY ASSURANCE AND SAMPLING AND ANALYSIS PLAN

C.1.0 INTRODUCTION

This Soil and Demolition Debris Quality Assurance Project Plan and Sampling and Analysis Plan (Sampling Plan) establishes the guidelines for collecting representative soil and demolition debris samples at Kennecott North Facilities soils removal, demolition, and reclamation projects. The North Facilities include a variety of sites that may be contaminated from past operational facilities. The following sections include site descriptions and available history, sampling and analytical protocols, and quality assurance and quality control (QA/QC) procedures. Each site may have unique characteristics requiring different approaches to sampling and analysis, therefore, addenda to this Sampling Plan will be included for site-specific sampling and analytical requirements. For the purposes of this Sampling Plan all soil-like material will be referred to as soil, although other materials (such as tailings, slag, or dust) and demolition debris may be sampled at some sites.

C.1.1 Objectives

The sampling program is designed to fulfill data objectives that include:

- The samples collected are representative of the materials sampled;
- Sample integrity is maintained and documented;
- Proper measurements and information are recorded;
- Sample volumes are sufficient for the required analytical procedures;
- Analytical results adequately characterize soil; and
- The sampling protocol is efficient and relatively uncomplicated.

C.1.2 Project Task and Description

Kennecott Utah Copper Corporation (Kennecott), as part of the continuing property-wide clean up efforts, will conduct removal of contaminated soils and sludge and demolition of selected structures at their North Facilities near Magna, Utah. The Kennecott North Facilities include the Noranda Smelter, Refinery, Arthur Concentrator Site (facility was demolished in 1992), Magna Concentrator, and the Bonneville Crusher at the north end of the Oquirrh Mountains (Dwg. No. 500-T-0006). This property has been used for industrial purposes, specifically mineral processing and smelting, for approximately 100 years. Soil and debris characterization activities have been and will continue to be implemented to assess existing site conditions. Potential hazards to human health and the environment will be evaluated to support removal action decision making. This Sampling Plan pertains only to soil and other solid waste potentially contaminated with inorganic substances (primarily metals). Ground water

will be addressed under a separate plan. Findings of soil and debris characterization investigations will be compiled by Kennecott and submitted to the United States Environmental Protection Agency (EPA) and Utah Department of Environmental Quality (UDEQ). Kennecott and(or) agency personnel may require additional information be collected subsequent to the initial characterization event and before removal actions are implemented. To date, Kennecott has characterized the Site to the extent practicable (not all sites identified in this Work Plan have been fully characterized), but due to existing decommissioned and operational structures, additional sites may be added to the work scope, if appropriate.

Kennecott will conduct the characterization activities, removal actions, demolition, and reclamation with UDEQ and EPA oversight and governed by an Administrative Order on Consent (AOC-CERCLA-VIII-95-04). The action is titled the Kennecott North Facilities Soils and Wastewater Treatment Plant Ponds Site Removal Action (NFS/WWTP Removal Action - SSID# 4B).

Sampling will progress at each site from characterization sampling (if not previously completed) designed to determine the nature and extent of contamination to post removal sampling, if removal is required. A sufficient number of samples will be collected from a site to adequately characterize and determine the limits of contamination. Samples will be collected using hand tools and if necessary a backhoe to expose sample material. If removal is required, post removal samples will be collected to document the existing soil conditions. Any fill materials associated with a site will be sampled prior to and during placement (one sample per 5000 cubic yards of fill) to ensure that the fill is not contaminated.

The samples will be analyzed for the constituents of concern (Section C.4.0) according to EPA methods. All analytical procedures will be consistent with Federal Guidance Solid Waste (SW) - 846 (Test Methods For Evaluating Solid Waste).

C.2.0 SITE BACKGROUND AND DESCRIPTION

C.2.1 Topography

The Kennecott North Facilities are located between the southern shore of the Great Salt Lake and the northern end of the Oquirrh Mountains. The approximate elevation of the Facilities range from 4225 to 4450 feet National Geodetic Vertical Datum of 1929 (NGVD) and generally slope north. The Great Salt Lake is at an elevation averaging 4200 feet NGVD.

C.2.2 Meteorology

Precipitation data recorded at the Saltair Station at the southern shore of the Great Salt Lake indicate the average precipitation for the North Facilities region is 13.6 inches per year. The average monthly precipitation ranges from a high of 1.8 inches in April to an average low of 0.7 inches in July. Based

on aerial precipitation maps compiled by Hely et al. (1971), the average annual precipitation at Kessler Peak, southeast of the Smelter and 4500 feet higher, is about 20 inches per year.

Ambient temperature in the North Facilities region is largely influenced by altitude and land features. During the summer months average temperatures near the Great Salt Lake are considerably higher than in the Oquirrh Mountains. The recorded temperatures at Salt Lake City International Airport range from average highs greater than 90 degrees Fahrenheit (F) in July and August to average lows near 40 degrees F in December and February (Hely, et al., 1971).

Evaporation rates have been recorded at Saltair using a Class A pan. For the period 1956 to 1986, the average annual pan evaporation rate was 74.6 inches (ETA, 1992). Monthly evaporation rates range from an average high of 14.4 inches in July to near zero for the months of December through February.

Wind direction in the North Facilities region is predominantly out of two directions; east-southeast and west-southwest with an average wind speed of six miles per hour.

C.2.3 Geology and Soils

The Kennecott North Facilities are situated on sediments eroded from the northern end of the Oquirrh Mountains. The Northern Oquirrh Mountains are composed of thick sequences of folded and faulted Pennsylvanian and Permian sedimentary rocks of the Erda and Kessler Canyon Formations, respectively (Tooker and Roberts, 1971). The bedrock is composed of alternating sequences of limestone, dolomite, sandstone, quartzite, and shale. The Erda Formation outcrops in several areas south of the Facilities.

Overlying the bedrock are Quaternary alluvial and colluvial deposits derived from the local bedrock and consist of clayey to sandy gravels. These deposits merge and interfinger with the Quaternary lacustrine and deltaic valley-fill sediments along the base of the Oquirrh Mountains. Heterogeneous mudflow sequences influenced by historic torrential rains occur throughout the area. The mudflow units and interlayered gravelly sequences are interpreted to dip to the north based on lithologic correlation. The surface of the Quaternary alluvium has been shaped by inundations of historic Lake Bonneville, which created wavecut benches and shoreline erosion features.

C.2.4 Surface Water

There is no perennial surface water in the North Facilities area, but seasonal and storm water runoff does occur in the watershed. Due to lack of vegetation throughout the watershed, peak flow during runoff events can be high and erosional features are present. Surface runoff in most locations is diverted into a network of ditches and collection ponds, and some is directed to the water recycle system. Several water bodies are located north of the Facilities including the Great Salt Lake, several springs, and wetland areas.

C.2.5 Land Use

Land use in the vicinity of the North Facilities is industrial, associated with Kennecott mineral processing. Transportation corridors located north of the Facilities include State Highway 201, Union Pacific Railroad, and federal Interstate Route 80. Other facilities in the area not operated by Kennecott are Union Pacific Resources north of the Smelter and Praxair (oxygen plant) near the Refinery. The Chevron Chemical Property has recently been acquired by Kennecott to facilitate the Tailings Impoundment Expansion and Modernization Project.

Great Salt Lake beaches and the Great Salt Lake State Park and Marina are north of the Facilities. The nearest areas of human habitation include the cities of Magna and Lake Point, about four miles east and west of the Smelter, respectively.

C.3.0 NORTH FACILITIES HISTORY

The Kennecott Smelter/Refinery Modernization will replace several process units at the Smelter, Refinery, and Wastewater Treatment Plant (WWTP) adjacent to State Highway 201 (along with other ancillary facilities at Arthur, Bonneville, and Magna Concentrators). It was determined from sampling activities that soil and associated debris affiliated with the North Facilities contain elevated levels of heavy metals. This Sampling Plan is based on previously collected and current data, operational history of the facilities, and previous removal actions conducted by Kennecott. The following provides an operational history of the major facilities and a description of the soil and demolition sites identified to date. Detailed characterization reports will be submitted as addenda to the Soil and Demolition Debris Quality Assurance Project Plan and Sampling and Analysis Plan as studies are completed.

C.3.1 North Concentrator Area

The North Concentrator Area includes four main facilities at the north end of the Oquirrh Mountains east of the refinery; the Arthur Concentrator, the Magna Concentrator, the Utah Power Plant, and the Bonneville Crusher (Dwg. No. 507-T-0173).

C.3.1.1 Arthur Concentrator

The Arthur Concentrator, built in 1909 by Boston Consolidated (acquired by Utah Copper in 1910), included crushing, grinding, flotation, and filter plant processing facilities. Ancillary facilities included a steel and brass foundry, boiler shop, machine shop, paint shop, and a reagent circuit (Arthur Stills). In 1975, a tailings re-treatment plant was added.

Operations at the facilities were halted in 1985 and 1986 during the Kennecott shutdown. The processing area (excluding the maintenance shops and administration building currently in use) was demolished in 1988 and 1989. The tailings re-treatment plant was demolished in 1992. Currently, no

additional demolition sites have been identified at Arthur. The Arthur Area consists of five soil sites. All five sites have been characterized and demonstrate elevated concentrations of metals.

The West Debris Site (A01) consists of irregularly shaped piles containing predominately soil, wood, slag, laboratory glassware, crucibles, metal shavings, concrete, bricks and other building material. Characterization sampling indicates four of the eleven samples to be elevated in total arsenic (320 parts per million (ppm), 360 ppm and 260 ppm) and(or) total lead (65000 ppm, 38000 ppm and 4100 ppm). Toxicity Characteristic Leaching Procedure (TCLP) performed on a composite of elevated total metal samples was below the Maximum Concentration of Contaminants (MCC). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	40	0.5	120	< 14
MAXIMUM	360	4	65000	< 14
AVERAGE*	146	3	10032	7

The Crucible Site (A04) consists of predominately fire assay debris and other waste from the old Arthur Assay Laboratory. Characterization sampling indicates six of the sixteen samples to be elevated in total arsenic (210 ppm) and(or) total lead (35000 ppm, 37000 ppm, 6100 ppm, 4300 ppm, 15000 ppm and 3400 ppm). Toxicity Characteristic Leaching Procedure performed on a composite of elevated total metal samples was below the MCC. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 30	< 0.5	70	< 30
MAXIMUM	210	4.1	37000	< 30
AVERAGE*	63	1.6	6484	15

The Foundry Slag Site (A10) consists of predominately slag and metal debris from the now demolished Arthur Foundry that produced brass and iron products. Characterization sampling indicates six of the thirty samples collected to be elevated in total arsenic (390 ppm and 393 ppm) and(or) total lead (8100 ppm, 3050 ppm, 3000 ppm, 2140 ppm and 2950 ppm). Toxicity Characteristic Leaching Procedure performed on a composite of elevated total metal samples failed for the lead MCC. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 14	< 0.5	< 10	< 13
MAXIMUM	393	13	8100	130
AVERAGE*	63	3	885	19

The Railroad Debris Site (A11) is a pile that was used as an end-of-line barrier for the railroad. The pile consists of oxidized metallic debris, soil and concrete debris. A characterization sample collected by Kennecott personnel indicates elevated total metal lead (876.8 ppm).

The Stills Site (A12) is the former location of a RECO plant which produced chemicals for the Arthur Mill floatation process. Characterization sampling indicates three of the eighteen samples are elevated in total arsenic (503 ppm, 817 ppm) and(or) total lead (2700 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	11	< 0.2	3.6	< 0.5
MAXIMUM	817	5.78	2700	89.4
AVERAGE*	127	0.9	269	12

C.3.1.2 Magna Concentrator

The Magna Concentrator, built in 1906 and 1907, consisted of crushing, grinding, flotation, and filter plant processing facilities and a molybdenite circuit. The flotation portion was upgraded in 1975 with the old structures demolished in 1991 and 1992. The crushing and grinding sections were closed in 1988 when the Copperton Concentrator came on-line. The facility is currently operating with the original filter plant.

The Magna Area consists of three sites. Only two of the three soil sites have been characterized and both demonstrated elevated concentrations of metals. No demolition sites have been identified to date at Magna.

The Railroad Slope Site (M01) is an area consisting of steep slag and metal debris slopes. Characterization sampling indicates six of the fourteen samples collected are elevated in total arsenic (200 ppm, 220 ppm 270 ppm and 240 ppm) and(or) total lead (2300 ppm, 5000 ppm, 3010 ppm, 11000 ppm and 2800 ppm). Toxicity Characteristic Leaching Procedure performed on a composite of elevated total metal samples failed for the lead MCC. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 5	< 1	< 2	< 4
MAXIMUM	270	6.3	11000	30
AVERAGE*	100	2.5	1971	4.9

The Concentrate Loading Site (M06) is an active operations area consisting of a rail line and a overhead concentrate chute that loads the rail cars. This site has not been characterized to date.

The East Debris Site (M09) consists of predominately waste ore and metal debris. Characterization sampling indicates six of the eighteen samples are elevated in total arsenic (215 ppm, 390 ppm, 210 ppm, 990 ppm and 360 ppm) and(or) total lead (4940 ppm, 4900 ppm, 4800 ppm and 9900 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 5	0.59	12.2	< 4
MAXIMUM	990	14	9900	41
AVERAGE*	163	4.7	1506	7.4

C.3.1.3 Utah Power Plant

Above the Magna Concentrator is the Utah Power Plant with 175-megawatt generating capacity for the North Facilities operations. The plant has the capability of burning coal and(or) natural gas as fuel sources.

The Power Plant was inspected on November 24, 1987, by representatives of the Utah Bureau of Solid and Hazardous Waste and the Salt Lake City-County Health Department to investigate allegations of improper disposal of materials. Improper disposal was never substantiated and it was determined that "no substantial threat to human health or the environment exists" due to operations. It was recommended that no further action be taken (EPA No. UTD980959282). Subsequent to that investigation, Kennecott has not found any inorganic concerns at the Power Plant.

C.3.1.4 Bonneville Crusher

The Bonneville Crushing and Grinding facility was constructed in 1966 and receives ore by rail from the Bingham Canyon Mine. The Bonneville facility is currently operational with crushed ore being supplied to and processed at the Magna Concentrator. After processing, concentrate is sent from the North Concentrator area to the Smelter or shipped by rail to customers. The Bonneville Area consists of four sites. All four soil sites have been characterized and are below all total metals action levels (AL). No demolition sites have been identified to date at Bonneville.

The Scrap Yard Site (B01) was used as a coal storage and concentrate stockpile area. The concentrate was removed and the Site was sampled by Kennecott personnel in 1994. Recently the Site has been used as a railroad laydown yard and has been partially reclaimed. In 1995 the Site was further characterized. A total of four samples were collected and analyzed for arsenic, cadmium, lead and selenium which indicated all values below the AL. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	2.95	> 0.5	6.5	< 1
MAXIMUM	13.6	0.74	17.8	1.15
AVERAGE*	7.97	0.46	11.67	0.66

The Bonneville Gate Hillside Site (B02) is the former location of a precious metals recovery operation that stockpiled ore on the hillside. Characterization sampling indicates all six samples collected were below the total metals AL. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	12	0.45	15	0.68
MAXIMUM	35	1.3	47	2.9
AVERAGE*	25	0.69	33	1.61

The Little Valley Settlement Ponds Site (B04) consists of a series of ponds that collect sediment from the upgradient Bonneville Crushing and Grinding facility's ore stockpiles. Characterization sampling indicates all four samples collected were below the total metals AL. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	34.7	> 0.41	13.1	> 13
MAXIMUM	124	1.08	97	> 13
AVERAGE*	78.8	0.50	42.3	6.5

The North Slope Site (B10) consists of a series of ore and metal debris piles from the routine cleaning of the Bonneville Crusher and Grinder. Characterization sampling indicates all five samples collected were below the total metals ALs. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	14	0.455	11.1	> 5
MAXIMUM	44.3	1.09	65.5	> 13
AVERAGE*	27.52	0.77	34.58	4.9

C.3.2 Smelter Area

The Kennecott Smelter Plant is a 160 acre industrial facility located at 12000 West immediately south of Utah State Highway 201. Kennecott is constructing a modernized smelter on approximately 22 acres within the existing smelter boundary. The work to be conducted and governed by this Plan is associated with the existing Noranda Smelter (decommissioned June 1995) and related soils.

The first smelter located at this site (the Garfield Smelter) was constructed in 1905 and 1906 by the American Smelting and Refining Company (ASARCO). Ore from many early mining companies such as Utah Copper and the Boston Consolidated Mining Company was processed at the ASARCO Smelter. Kennecott purchased the smelter in 1959 and converted it to a green feed Smelter using a reverberatory process for handling Bingham Canyon Mine ore concentrate, exclusively.

The Noranda Smelter Plant construction began in 1975 and operated since 1978 using the Noranda continuous feed process. The modernized Kennecott Smelter uses state-of-the-art "flash smelting" technology, and was commissioned mid-1995. The Noranda Smelter processed copper concentrate generated at the Copperton and Magna concentrating plants. The concentrate was delivered to the Smelter by both rail and slurry pipeline. After smelter processing, the cooled anodes were transported by rail in open flat-bed cars to the Refinery where an electrolytic process was used to refine the copper.

C.3.2.1 Smelter Area Soils

The Smelter Area (Dwg. No. 503-T-0172) consists of ten soil sites. To date only three of the ten sites have been characterized and demonstrated elevated concentrations of metals.

The East Yard Site (S02) consists of strongly discolored slopes, terraces and stockpiles. Characterization sampling indicates two samples are elevated in total arsenic (738 ppm and 542 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	542	10.2	1000	57.7
MAXIMUM	738	13.1	1810	79.1
AVERAGE*	640	11.7	1405	68

The Old Smelter Soils Site (S08 which includes #8 Acid Plant) is the footprint of the buildings and structures that were incorporated in the old Smelter facility. The old Smelter is scheduled for demolition in the summer of 1996 (three years total) with soils characterization sampling to follow.

The Kessler Canyon Site (S09) consists of several flue dust and copper concentrate contaminated stockpiles and ground surface along with other debris such as bricks and concrete. Characterization sampling indicates 196 of the 481 samples are elevated in total arsenic and(or) total lead and(or) total selenium. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	0.6	0.1	1	0.2
MAXIMUM	50000	1703	68578	492
AVERAGE*	1112	45.2	1322	14.8

The Return Canal Site (S11) is an old canal that was used as the storm water and surface runoff discharge point. The Site has not been characterized to date.

The Weak Acid Corridor Site (S12) consists of a pipeline that transported weak acid and process water from the Weak Acid Lift Station to the WWTP. The Site has not been characterized to date.

The Weak Acid Lift Station Site (S13) is the main pump station that pumped weak acid and process water to the WWTP via the Weak Acid pipeline. This facility is still in operation and will be demolished after the old Smelter. Characterization sampling will follow the demolition.

The Slag Tailings Pipeline Corridor Site (S15) is the old pipeline that transported slag tailings from the Smelter to the Tailings Impoundment. This Site has not been characterized to date.

The Slag Pile Soils and Lagoon Site (S16) is the footprint of the Union Pacific slag pile which will be used as drain rock for the Tailings Modernization Project. This Site will be characterized following the removal of the slag.

The Railroad Yard Soils Site (S17) is a loading and off-loading, sampling and weighing facility for the concentrate that is being transported off-site. The Site will be characterized as soon as the shipping of concentrate ceases.

The Acid Plant #7 Soils Site (S100) consists of the footprint of Acid Plant #7 that was demolished in the spring of 1996. The Site covers an area of approximately 3 acres and consists of a variety of fill soil, slag, and asphalt mixed with metal, concrete, and wood debris. Forty-five characterization samples were collected from the Site. Twenty-seven of the forty-five samples collected contained arsenic in concentrations above the AL of 200 ppm. Eleven samples contained lead in

concentrations above the AL of 2000 ppm. One sample contained selenium above the AL of 1000 ppm.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	3	0.25	4	4
MAXIMUM	8680	262	31600	1380
AVERAGE*	894	24	2395	92

C.3.2.2 Smelter Area Demolition

Kennecott has recently completed construction of a new copper smelter near Salt Lake City, Utah. Due to this new construction, the 1977 vintage Noranda Smelter has been decommissioned. The demolition area can be divided into five main areas of interest which are the Hot Metals Building, Material Handling, Powerhouse, Gas Handling, and Acid Plant #8 (Dwg. No. 503-T-0215).

The Hot Metals Building, where the copper smelting took place, was constructed in 1977. The major pieces of equipment associated with this building are three Noranda reactors, four Pierce-Smith type converters, two pelletizers, and the anode casting system. Contaminants associated with this building could be heavy metals related with concentrate and fugitive dusts.

The Material Handling Area dried and conveyed copper concentrates from the storage area to the Noranda reactors in the Hot Metals Building. Material Handling is made up of several thousand feet of conveyors and belt feeders ranging from 24 inches to 48 inches wide. In addition, two stainless steel rotary dryers, that were used for drying the concentrates, are present. Contaminants associated with this building and structures could be heavy metals related with concentrate.

The Smelter Powerhouse was constructed in the early 1900's but has been through numerous modifications since that time. Operating at full capacity it could supply the 15 megawatts of electricity needed to power the Noranda Smelter. The primary equipment in the powerhouse is three generators, two electric turbines, four steam turbines, and five screw compressors. This structure is not expected to be contaminated with metals other than fugitive tracking and dust.

The Gas Handling Area collected the fugitive gases from the Hot Metals Building and conveyed them to the acid plant and subsequently to the stack. The large fans in Gas Handling are the primary pieces of usable equipment. Some gas handling flues are known to be contaminated with dust.

Acid Plant #8 scavenged the sulfur from the fugitive gases and produced sulfuric acid. This Acid Plant, as a whole, is in good condition. The contaminants associated with the Acid Plant are sulfuric acid and heavy metals related to dusts and sludge.

In addition to the large pieces of equipment listed above, Kennecott has an inventory of the equipment associated with the entire facility. Kennecott will sell equipment and salvageable materials from the facilities before and(or) during demolition.

C.3.3 Refinery Area

The Kennecott Refinery is a 45-acre industrial facility located on the north end of the Oquirrh Mountains between the Smelter and the Arthur Site. The existing facility was built by Kennecott in 1950 to refine copper anodes from the smelter and produce electrochemically pure copper, gold, and silver. The copper refining process is housed in the Tankhouse, which covers approximately 224,000 square feet. The Refinery has been modernized to match the capacity of the modernized Smelter. The footprint of the Tankhouse was not increased. Processes associated with precious metals recovery are housed in a new building to the west of the Tankhouse.

The Refinery is comprised of the Tankhouse, MPC Building, Silver Building, Lead Shop, Electrolyte Purification (EP) Building, Boiler Plant, Chemical Laboratory, and other maintenance and administrative structures. The Refinery produces copper cathodes, gold bars, silver bars, platinum sponge, palladium sponge and commercial grade selenium. Most of the structures were built in the early 1950's and have remained virtually unchanged. The Tankhouse accommodated the cells where the anode is electrically plated to a starter sheet to become the commercial cathode. Slimes washed from the cell bottom are delivered to the Silver Building. Electrolyte used in the process was mixed and cleaned in the now obsolete EP Building.

C.3.3.1 Refinery Area Soils

The Refinery Area (Dwg. No. 503-T-0173) consists of seven soil sites. Only three of the seven sites have been characterized to date. Characterization sampling indicates two of the three sites are elevated in metals.

The Precious Metals Site (R01) is the original Silver Building footprint. The building is scheduled for demolition in the summer of 1996 with soils characterization sampling to follow.

The Old Spent Electrolyte Pond Site (R02) is a capped and vegetated pond which received spent electrolyte solutions. Characterization sampling indicates five of the twenty-three samples are elevated in total arsenic (360 ppm, 450 ppm, 513 ppm, 241 ppm and 394 ppm) and(or) total lead (9935 ppm) and(or) total selenium (1800 ppm, 7332 ppm, 2215 ppm and 1844 ppm). The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	15.8	< 1	35.6	< 5
MAXIMUM	513	2.4	9935	7332
AVERAGE*	126	0.7	659	700

The East Rail Yard Site (R05) is a benched area consisting of predominately slag and fly ash with other metal debris. Characterization sampling indicates one of the twenty-three samples to be elevated in total arsenic (211 ppm). This sample was collected from an operational area (railroad) and removal will occur once all operations on this rail line are complete. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	< 14	< 0.4	< 2.6	< 15
MAXIMUM	211	5	427	17.8
AVERAGE*	23.5	0.75	76	9

The Electrolyte Purification Site (R08) is the Electrolyte Purification Building footprint. The Building is scheduled for demolition in the spring of 1996 with soils characterization sampling to follow.

The Lead Shop Site (R09) is the Lead Shop Building footprint. The building is scheduled for demolition in the fall of 1996 with soils characterization sampling to follow.

The Electrolyte Pipeline Corridor Site (R12) is the location of the old electrolyte pipeline that transported spent electrolyte solution from the Refinery Electrolyte Purification Building to the WWTP. The Site has not been characterized to date.

The Garfield Town Site (R13) is the footprint of the old town of Garfield. Characterization sampling indicates none of the twenty-five samples collected were elevated in total metals. The Sites' overall average, maximum and minimum are listed below.

	ARSENIC (ppm)	CADMIUM (ppm)	LEAD (ppm)	SELENIUM (ppm)
MINIMUM	> 30	0.6	50	> 30
MAXIMUM	190	5.6	1000	70
AVERAGE*	55.8	2.2	388	19.6

C.3.3.2 Refinery Area Demolition

Kennecott has recently completed construction of new copper refining facilities on Refinery Property. Due to this new construction, many of the 1950 vintage buildings have been decommissioned. The demolition areas can be divided into four main areas of interest which are the Silver Building (the old Precious Metals Building), Electrolyte Purification Building, Physical and Chemical Laboratory, and the Lead Shop (Dwg. No. 503-T-0216).

The Silver Building processed anode slimes from the Tankhouse by thickening them with a filtered decant solution. The thickened slimes were pressure leached with sulfuric acid and oxygen. This removed over 99% of the copper content. The residue was filtered, washed, and air dried in a filter press. Elemental selenium, silver, and gold were produced at the Refinery. Refinery waste effluent solutions were pumped to the WWTP for neutralization and heavy metals removal.

The Electrolyte Purification Building was used to maintain the electrolyte solution, control copper content and soluble impurities such as arsenic, antimony, and bismuth, and control organics by electrowinning in cells containing insoluble lead anodes.

The Chemical and Physical Laboratory was used as an assay laboratory to support Kennecott operations and quality control. The building was approximately 50 feet by 100 feet with a main floor and partial basement. The contaminants associated with the Lab were found in the table hoods and dust.

The Lead Shop was used to construct and mold the liners for electrowinning cells used at the Electrolyte Purification Building. The building is a small structure that has been cleaned and is currently being used as a shop with an adjoining lunch room.

C.3.4 Wastewater Treatment Plant Area

The Kennecott WWTP is located adjacent to the intersection of State Highways 201 (2100 South) and 202, north of the Refinery. The primary function of the WWTP was to neutralize acid plant blowdown from the Smelter and bleed electrolyte from refinery operations. The WWTP also received and treated in-plant sewage and clarified other process waters from the Smelter, Refinery, Power Plant, and the North Concentrator facilities. The sludge and wastewater have been sequentially discharged into five ponds, designated Ponds A, B, C, C-Extension, and D, all located within 1-1/2 miles of the WWTP.

Treatment processes at the WWTP have been modified several times during past operations through the addition of lime, ferric chloride, or both. These modifications resulted in concentration variations of both total and leachable metals in the sludge. From start-up in 1974 through 1978, ferric chloride was added to the wastewater influent to stabilize some of the heavy metals. The addition of ferric chloride was discontinued in 1982 due to operational difficulties, but was resumed in August 1991 to reduce the concentration and leachability of arsenic in the effluent. During the period 1983 to 1989, the WWTP was modified to use a high concentration lime process. The WWTP was completely shut

down between 1985 and 1987. In mid 1989, the neutralization process was changed by reducing the pH from 12 to 10 to provide better control of the pH of the final effluent at the discharge location. The addition of ferric chloride resumed in August 1991 to reduce the concentration of arsenic in the effluent and to reduce the leachability of arsenic from the sludge. Most of this low-lime sludge was stored in Pond D, but some ferric chloride-treated, low-lime sludge was placed in Ponds B and C.

The WWTP treated approximately 3000 gallons per minute (gpm) of which approximately 1250 gpm came from the Smelter, 1300 gpm from the Power Plant, 300 gpm from the Refinery, and 150 gpm from the North Concentrator. The WWTP clarified effluent stream was approximately 4000 gpm due to the addition of lime slurry and water as part of the neutralization process. The treated effluent produced a sludge residue at a rate of approximately 250 wet tons per day. Due to modernization of the Smelter and Refinery, the WWTP will no longer be needed (as of this writing, the flows have been significantly reduced or stopped from all sources). The Plant may remain operational for treatment of decontamination waters generated from soil removal and demolition activities.

A summary of results from previous sludge characterization studies (Phase I) and a discussion of Kennecott's most recent (Phase II) sampling investigation have been submitted to the agencies as the *Wastewater Treatment Plant Site Characterization and Sludge Stabilization Study, Kennecott Plant Projects Group, November, 1994*. The Phase II investigation was conducted on the WWTP sludge to verify Phase I data, fill gaps in the previously obtained data, and insure proper QA/QC measures. Data were collected on physical and chemical properties of the sludge in the ponds, native soils underlying each pond, and dike material surrounding each pond. Characterization activities were implemented to assess accumulated sludge for design and evaluation of potential remedial actions.

The WWTP area (Dwg. No. 503-T-0173) consists of two overall soil sites. To date only one site has been characterized and demonstrated elevated concentrations of metals.

The Wastewater Treatment Plant Ponds Site (W01 which includes pond A, B, C, C-extension and D) is a series of five ponds that received sludge from the WWTP. The sludge has been characterized and will be mixed with north facility soils and disposed of in the Arthur Step-Back Repository. Ponds C, C-Ext and D have been designated CAMUs. These ponds will be used to temporarily store soils removed from soil sites. The sludges have a very low in place permeability, thus reducing the possibility of releases to the atmosphere or ground water. The ponds will be closed to the criteria outlined in Section 4.2. Further characterization of the ponds footprint will follow the removal of the sludge.

The Wastewater Treatment Plant Soils Site (W02) is the footprint soils of the WWTP facility. This facility is operational and once it is determined by Kennecott that the WWTP is of no further use it will be demolished. Characterization sampling will follow the demolition of the facility.

C.4.0 DATA QUALITY OBJECTIVES

The purpose of data quality assessment is to assure that data generated under the QA/QC program is accurate and consistent with program objectives. The quality of the data will be assessed based on precision, accuracy, and completeness. Percent precision is the degree to which a measurement is reproducible and will be assessed by a comparison of split sample results. A relative percent difference (RPD) of 25% for the split samples is the precision goal. One split sample will be created for every 15 samples collected. Percent accuracy is a determination of how close the measurement is to the true value and will be assessed via spike recovery in sample matrices and blanks. This will be performed by the laboratory as part of their QA/QC procedures. Spike recoveries reported by the laboratories need to be within 20% of the spiked amount. Completeness is a measure of the amount of valid data obtained, compared to the amount that was expected under normal conditions. Ninety (90%) percent completeness is the goal of this Sampling Plan.

Sludge and soils sampled from Kennecott North Facilities will be analyzed for concentrations of total lead, arsenic, cadmium, and selenium. Environmental Protection Agency Methods 6010/ICP will be used for the analysis and EPA Method 3050 for the preparation. Debris will be characterized by both total (EPA Methods 3050/6010) concentrations of lead, arsenic, cadmium, and selenium and leachable (TCLP, EPA Method 1311) concentrations of the Resource Conservation Recovery Act (RCRA) eight metals. Results of the analysis will assist in determining disposal options. Soil left in place (following removal action procedures and criteria outlined in the Work Plan) will be characterized for leachability using the Synthetic Precipitation Leaching Procedure (SPLP/ EPA Method 1312) for the RCRA 8 metals. The results of the SPLP will aid in determining if the soil will affect groundwater quality. Borrow material will be analyzed for total (EPA Methods 3050/6010) arsenic, cadmium, lead, and selenium concentrations prior to placement. Table 1 lists the analytical methods to be used.

Lead, arsenic, cadmium, and selenium were chosen as the indicator metals for the following reasons:

- To remain consistent with removal actions for similar waste materials;
- These metals were the most common elevated metals found during site characterization; and
- When soils with elevated levels of these constituents are removed, past experience and current studies have demonstrated other metal values have been reduced to acceptable levels.

The total metal ALs for this Removal Action are as follows:

- 200 ppm Arsenic
- 1,000 ppm Cadmium
- 2,000 ppm Lead
- 1,000 ppm Selenium

Concentrations of leachable (TCLP) metals from debris samples will be considered elevated if the RCRA Toxicity Characteristics (TC) limits are exceeded. Toxicity Characteristic limits for the RCRA eight metals are as follows:

- 5 ppm arsenic
- 100 ppm barium
- 1 ppm cadmium
- 5 ppm chromium
- 5 ppm lead
- 0.2 ppm mercury
- 1 ppm selenium
- 5 ppm silver

C.5.0 SAMPLING DESIGN

The following sections outline standard operating procedures (SOP) to be followed for conducting sampling for quantitative analysis. Samples may be collected from the shallow subsurface (0-2 feet) by hand methods or from greater depths using a backhoe. The depth to which a site will be characterized will generally be based on the limit of a backhoe. Materials to be sampled will include soil, slag, tailings, dust, and demolition debris. Demolition debris may include concrete, steel, wood, plastic, dust, and precipitate from solutions. The following sections describe specific sampling procedures to be used for soil and demolition debris.

Sample types may consist of grab, composite, and(or) vertical or horizontal channel samples. A grab sample is a sample collected from a discrete location. This type will be collected during site characterization or when the distribution of contaminated material is unknown. A composite sample consists of material sampled from two or more sub-locations combined together to form one sample. This type will be collected from sites that are believed to be homogenous in nature. A vertical or horizontal channel sample is a sample collected from a specific or identifiable vertical or horizontal interval and is considered representative of the entire interval. These samples will not be biased by collecting more sample material from one part of the interval. These samples may also be composited with other similar intervals.

Due to the number and variety of sites to be characterized, sample density and sampling strategy may vary from site to site. Characterization sampling of a site with no sampling history may initially rely on a biased sample approach based on observation or other information. Grab samples or composites from visually similar material would be more common than a systematic approach in this situation. Analysis of the initial samples will dictate if additional characterization sampling is necessary and if so, what type and density. If a site is considered to be homogenous in nature based on previous sampling or visual observation, then a systematic approach using composite samples would likely be used. In general, post removal samples will be composite samples arranged on a non-biased grid.

The following sections describe specific sampling procedures to be used in the collection process.

C.5.1 Surface and Shallow Subsurface Sampling (<2 feet)

Soil will be sampled from the shallow surface (< 2 feet below surface) using hand tools. The following procedures will be used to collect a soil sample from the 0 to 2 feet below surface interval:

- Excavate a hole to 3 inches greater than the desired sample depth using a trowel, hand shovel, or pickhoe;
- Using a clean hand tool, scrape the side of the hole until undisturbed sample material is exposed;
- Using a clean hand tool scrape sample material from the side of the hole allowing it to fall into the cup. If a composite sample is required, insure that an equal amount of sample material is collected from each subsite;
- Pour the contents of the cup into the appropriate sample container and seal; and
- Label the sample container with the following information:
    - Sample identification number;
    - Initials of sampling personnel;
    - Date and time of collection;
    - Location and other pertinent comments; and
    - Replace excavated soil into the hole and place survey stake.

C.5.2 Deep Subsurface Sampling (>2 feet)

If samples of soil deeper than what can be reasonably accessed with hand tools are required, a backhoe may be used to excavate the hole. If the hole is too deep to safely enter, sample material may be collected from the backhoe bucket. Sample depth will be determined by lowering a tape measurer into the excavation. When sampling from the backhoe bucket, care will be taken to sample material from the desired interval only. The sampled material will be placed in an appropriate container and labeled as described in Section C.5.1. Excavated material will generally be replaced in the order in which it was removed.

In some situations it may be necessary to enter the excavation in order to collect the sample. If this is required, the excavation will be made safe prior to entry according to the Code of Federal Regulations (CFR) 1926 Subpart P: Excavation, Trenching, and Shoring. Sampling procedures outlined in Section C.5.1 will be followed.

C.5.3 Demolition Debris Sampling

Some facilities to be demolished may contain materials contaminated with heavy metals. The contaminants are thought to be primarily from concentrate spillage, concentrate dust, flue dust, and precipitate from leaking pipes or operational procedures. Loose contaminants will be removed from the buildings before demolition by vacuuming and pressure washing when practicable. Concentrate

and other copper containing materials will be recycled when economically feasible. The wash water will report to the WWTP.

After washing, residual contaminants may still be present on or in the building materials. Differing physical and chemical characteristics of various building materials (i.e., steel, concrete, brick, wood, etc.) will require that separate samples of each building material type be collected and sampling protocols for each type may vary. For example, due to the permeability of concrete and brick, these materials will be cored. Building material such as metals are considered impermeable to contaminants (as opposed to concrete, wood, plastic, and brick), and an appropriate sampling strategy has been developed. Demolition debris will be screened by using total metal analysis and characterization samples will be analyzed for leachable concentrations of arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver (RCRA 8 metals) when required. These sampling protocols are discussed below.

C.5.3.1 Permeable Building Materials

Permeable building materials such as concrete and brick will be sampled by coring or breaking off representative pieces. The sampled material will be logged and photographed. Samples from similar areas within a building will be crushed and ground to <1/8 inch and homogenized to form one sample. The number of samples collected will depend on the variability of visible contaminants or discoloration observed, and the number of areas within a building where processes producing contaminants were performed.

Other permeable materials such as wood and plastic will be collected by cutting cross-sections of the material. The cross-sections may be cut into smaller pieces (<9.5mm) as required for the appropriate analysis. Hand saws or other suitable hand tools will be used to cut the material.

C.5.3.2 Impermeable Building Materials

Impermeable materials include metals such as steel, stainless steel, cast iron, and copper. Based on observation and previous sampling experience, the contaminants associated with metal debris are physically on the material and not "in" them. Sampling of these materials will be performed by removing the suspected contaminants from a cross-sectional surface. The surface area the sample was collected from, will be measured at the time of sample collection and the weight of the sampled material will be recorded before analysis. Leachability of the "whole sample" will be determined by calculating the percent by weight the sample material represents, compared with the weight of the sample material plus the metal (for the measured cross-section). For example, contaminated material is removed from the surface area of one lineal foot of an I-beam. The I-beam, by itself, weighs 100 pounds per lineal foot and the sample material from one lineal foot weighs 5 pounds. The "whole sample" weighs 105 pounds and the sampled material represents 4.76% of the "whole."

$5/105 = x/100$
$x = 500/105$
$x = 4.76\%$

The sampled material is analyzed for arsenic leachability and the result is 10 ppm. Leachability of the "whole sample" would be 0.476 ppm.

$4.76/100 = x/10$
$47.6/100 = x$
$x = 0.476$ ppm

The weight of the metal per lineal foot will be determined from reference tables and(or) building construction drawings if available.

The number of samples collected will depend on the variability of the material being characterized. Variability will be assessed from the analytical results of the initial samples collected from a particular area or the building material type being characterized.

If metal is found with a contaminant on it, but not in quantities great enough to sample (100 grams for TCLP or approximately 1 liter), the material will be considered "clean" based on the relative weight percentages of the contaminant compared to the metal.

C.6.0 SAMPLING METHODS

The following sections describe protocol designed to insure that sample quality is maintained. The procedures are designed such that sufficient documentation is associated with a sampling event.

C.6.1 Sampling Sequence

The following sequence of events will be followed for all collected soil samples:

1. Fill out logbook header at the beginning of the day;
2. Document initial information about the individual samples and conditions in a field logbook, including a map or diagram;
3. Label container with sample number, date, time, and samplers' name;
4. Record sample description in the field logbook; and
5. Photograph site.

At day end:

6. Prepare chain-of-custody forms; and
7. Package and deliver or ship samples, including chain-of-custody forms.

Each sequence event is described in detail in the following sections.

C.6.2 Logbook Header

An up-to-date sampling field notebook will be maintained by on-site personnel during all sampling activities. The general information recorded for each days' sampling event includes:

- Date;
- Name of overall sampling event and project number;
- Sampling personnel; and
- Climatic conditions.

C.6.3 Logbook Sample Entries

Quality assurance and quality control procedures for soil sampling require completion of a field sampling log. For each sample collected, the logbook must contain:

- Sample number;
- Location with measurements if necessary;
- Time;
- Sampling method (grab, composite, etc.);
- Field observations;
- Map or diagram;
- Sample type (soil, slag, etc.);
- QA (split, rinsate, etc.); and
- Analyses to be performed.

Significant deviations from sampling protocol will be formally noted in the field log, along with visiting personnel and unusual circumstances pertinent to the sampling effort.

C.6.4 Sampling Tools

Soil samples will be collected using disposable plastic or decontaminated stainless steel hand tools. These tools may include one or more of the following:

- Disposable plastic spoon, trowel, or cup;
- Stainless steel spoon, trowel, or cup;
- Hand shovel and pickhoe;
- Stainless steel bowl; and
- Gloves.

Only disposable plastic or decontaminated stainless steel tools will contact sampled material. Hand shovels or pickhoes will be used only to gain access to sample material. Disposable plastic or stainless steel tools may be used for material sampled for metals. Reusable sampling tools will be decontaminated prior to use following the procedures described in Section C.6.5.

C.6.5 Decontamination

All non-disposable sampling equipment will be cleaned prior to reuse. The equipment decontamination procedures are as follows:

- Remove gross contaminants;
- Wash with Alconox soap;
- Rinse with tap water;
- Triple-rinse with deionized water; and
- Repeat all or part of the procedure, if necessary.

Field personnel conducting the equipment decontamination and sampling will be required to wear protective gloves and the personal protective equipment required under the Health and Safety Plan (HASP). The decontamination procedures used will be recorded in the field logbook.

C.6.6 Photographs

A photograph will be taken of the sample site and(or) sample material. A photo log will be maintained in the field logbook and will contain the following information:

- Orientation of photo;
- Identification of site;
- Date of photo; and
- Name of photographer.

C.6.7 Surveying

All sample sites will be surveyed using either a total station instrument, global positioning satellite system, or a hand held compass. Locations will be reported in State Plane Coordinates or referenced to known landmarks. Sample sites will be marked in the field with a wooden stake affixed with an aluminum tag inscribed with the sample identification number.

C.6.8 Sample Homogenization

Material sampled for metals characterization will be homogenized prior to analysis. This may be done in the field or at the laboratory. Homogenization techniques will vary depending on sample texture and moisture content. Drying may be necessary to facilitate thorough homogenization. If drying is necessary, temperatures will be low enough to prevent loss of analytes of concerns. Homogenization will be accomplished by shaking or stirring the sample either in the sample container or if necessary, by transferring to a stainless steel bowl. All reusable tools used in the homogenization process will be decontaminated following the procedure described in Section C.6.5.

C.7.0 SAMPLE HANDLING AND CUSTODY

The following sections describe sample handling procedures and custody requirements from the time of sample collection until delivery to the laboratory.

C.7.1 Sample Containers, Preservation Techniques, and Holding Times

Sample containers, preservation techniques, and holding times will be consistent with the EPA SW-846 guidelines. Soil samples to be analyzed for metals will be placed in plastic ziplock bags or plastic or glass jars. No preservation is necessary for metals analysis and holding time is six months.

C.7.2 Container Labels

To prevent misidentification of samples, each sample container will be labeled and written with indelible ink. The following information will be recorded on the sample container:

- Sample identification number;
- Initials of sampling personnel;
- Date and time of collection; and
- Location and other pertinent comments.

C.7.3 Chain-of-Custody

Chain-of-custody will be maintained for all samples collected. To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody record will be filled out and accompany every set of samples. The record will include the following:

- List of sample numbers;
- Signature of collector;
- Date and time of collection;
- Sample types;
- Number of containers;
- Parameters requested for analysis for each sample;
- Signature of person(s) involved in the chain of possession; and
- Inclusive dates of possession.

A copy of a Chain-of-Custody form is included as Attachment 2.

C.8.0 QUALITY ASSURANCE AND QUALITY CONTROL SAMPLES

Quality assurance and quality control samples will include laboratory confirmation samples (field split samples) and equipment rinsate samples. One out of every 15 samples collected will be split. Split samples will be submitted to a second laboratory for analysis. The analysis of split samples will be compared to ensure accurate and reproducible results are ascertained by the primary laboratory. One other type of QA/QC sample that will be submitted periodically over the duration of this project is the Performance Evaluation Sample. These samples will be submitted by the EPA to the Kennecott Analytical Laboratories.

One equipment rinsate sample will be collected for every 20 soil samples while using non-disposable sampling implements. This sample will consist of deionized water poured over decontaminated sample collection devices and collected in a sample container. This sample will serve as a check on the quality of the decontamination process.

The primary analytical laboratory is Kennecott Environmental (Magna) and the secondary laboratory is Chemtech (Salt Lake City). Both laboratories are State certified and as such follow QA/QC procedures consistent with EPA standards. Laboratory QA/QC samples include method blanks, matrix spikes, duplicates and matrix duplicates, and calibration and calibration check samples. Copies of the laboratory quality control reports will be required from the laboratories and will be reviewed on a regular basis. Included as Attachment 1 is a summary of the Laboratory Quality Assurance Plans.

C.9.0 ASSESSMENTS AND RESPONSE ACTIONS

As the work defined under the AOC progresses, findings of soil and debris characterization investigations will be compiled by Kennecott and submitted to the EPA and UDEQ. Kennecott and(or) agency personnel may require additional information be collected subsequent to the initial characterization event and before removal actions are implemented. The EPA and UDEQ oversite personnel will be notified before a planned sampling event occurs and will receive split samples if desired for independent analysis. During times of sample collection and(or) removal activities weekly reports will be prepared summarizing the work performed. Included in the reports will be the following:

- Actions performed;
- Problems encountered;

- Data received;
- Anticipated developments; and
- Schedule of actions, anticipated problems and planned resolutions.

During this time problems encountered with sampling and(or) analysis will be discussed between Kennecott, EPA, and UDEQ. If changes to the Sampling Plan are required due to new conditions encountered these changes will be agreed upon and instigated as needed.

C.10.0 DATA REVIEW, VALIDATION, VERIFICATION, AND USABILITY

Data from previous sampling efforts at sites included in this AOC will be reviewed and evaluated based on the available associated documentation and QA/QC data. In general there are limited or no data available for most sites. The data that are available are generally at the preliminary characterization level and additional characterization/confirmation will be required.

Data generated from the sampling associated with this AOC will be reviewed and evaluated for usability. Review of data includes the following:

- Comparison of laboratory confirmation analysis;
- Check of laboratory quality control reports;
- Comparison of sample descriptions from field notes and associated analytical results to determine and verify trends;
- Reanalysis of samples in question; and
- Collection of additional samples for confirmation purposes.

The analytical results of confirmation samples will be compared by calculating the RPD. The RPD is defined as :

$$RPD=(A1-A2)/((A1+A2)/2)*100$$

A1=Analytical results from primary lab
A2=Analytical results from secondary lab

The data quality objectives for this comparison is $\pm$ 25%. Data that exceeds RPD's in excess of 25% may still however be considered usable if the analyte is detected in quantities less than 10 times the detection limit. For example, if cadmium is detected at 1.5 ppm by one lab and 3.0 ppm by the other,

with a detection limit of 0.5 ppm, the RPD would be -66%. However the actual difference is only 1.5 ppm and could easily be attributed to the nonhomogeneous nature of the sample material. In this situation the data would be considered valid and usable. If a split sample was found to contain 23 ppm lead by one lab and 450 ppm by the other, there is most likely a problem at one or both the laboratories. The data is not valid without additional checks, however, it may still be usable because neither of the samples are close to the AL of 2000 ppm for lead. If adjacent or similar samples confirm lead values near or below 450 ppm the data would be accepted as usable. Additional analysis would still be required from one or both laboratories to determine if the difference is due to the analysis or the nonhomogeneous nature of the splits.

Laboratory quality control reports will be reviewed for every sample. The reports include matrix spike samples, blank samples, and spiked blank samples. The percent recovery must be within ±20% of the spiked amount.

Sample descriptions will be checked regularly to insure that they are consistent with previous analytical data that have been used to identify contaminated or clean material. Analytical results that are inconsistent with field observations will be considered for reanalysis.

As analytical is data is collected the degree of homogeneity of the sampled material will be evaluated. If the sampled material consistently produces erratic results, this will be taken in account in evaluating the validity and usability of the data. If QC results detect conditions or data that do not meet QC requirements, corrective action will be initiated. The nature of the action will depend on the circumstances unique to each situation and may include:

- Reanalyzing the samples, if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures;
- Accepting data, acknowledging level of uncertainty; and
- Conducting a laboratory audit.

Table 1 lists the QC procedures and requirements.

C.11.0 HEALTH AND SAFETY PLAN

All work performed under the AOC will follow health and safety protocols described in the Health and Safety Plan (HASP). The HASP is included as Appendix B of the Work Plan.

TABLE 1: ANALYTICAL METHODS AND QUALITY CONTROL PROCEDURES AND REQUIREMENTS.

PARAMETER	MINIMUM FREQUENCY	PREPARATION METHOD	*ANALYTICAL METHOD	QC CHECK	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
RCRA 8 METALS						REPEAT ANALYSIS, RE-SPLIT SAMPLE AND RE-ANALYZE, COLLECT NEW SAMPLE AND ANALYZE, AND/OR CONDUCT LABORATORY AUDIT.
TOTALS	1 PER 15 SAMPLES	SW-846/3050	SW-846/6010	FIELD SPLIT	RPD<25%	REPEAT ANALYSIS, RE-SPLIT SAMPLE AND RE-ANALYZE, COLLECT NEW SAMPLE AND ANALYZE, AND/OR CONDUCT LABORATORY AUDIT.
SPLP	1 PER 15 SAMPLES	SW-846/1312	SW-846/6010	FIELD SPLIT	RPD<25%	REPEAT ANALYSIS, RE-SPLIT SAMPLE AND RE-ANALYZE, COLLECT NEW SAMPLE AND ANALYZE, AND/OR CONDUCT LABORATORY AUDIT.
TCLP	1 PER 15 SAMPLES	SW-846/1311	SW-846/6010	FIELD SPLIT	RPD<25%	REPEAT ANALYSIS, RE-SPLIT SAMPLE AND RE-ANALYZE, COLLECT NEW SAMPLE AND ANALYZE, AND/OR CONDUCT LABORATORY AUDIT.

*SW-846/7470 (LIQUID) AND 7471 (SOLID) FOR MERCURY.

ATTACHMENT 1

Quality Assurance Program Plan

Kennecott Environmental Laboratory
Kennecott Utah Copper

January 30, 1995

APPROVAL:

Technical Services Manager	2-2-95 Date
Laboratory Director	2-7-95 Date
Quality Assurance Manager	02-07-95 Date

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1.0 INTRODUCTION

This Quality Assurance Program Plan (QAPP) describes the Kennecott Utah Copper Environmental Laboratory (KEL) quality assurance (QA) policies and procedures for environmental analytical services. The objective of this QAPP is to ensure that data generated is scientifically valid, defensible, of known and documented quality and is usable for the intended purpose of supporting the various Data Quality Objectives (DQOs) and monitoring programs of Kennecott Utah Copper. The management team is dedicated to the production of high quality data for all programs in which the data will be used. The effectiveness of the quality assurance program is dependent upon laboratory operations that function in concert with the QAPP. Assuring precision, accuracy, representativeness, completeness and comparability of analytical procedures and subsequent data distribution is the overall objective. Using the QAPP in harmony with the laboratory program will detect errors, prevent errors recurring and quantify the errors inherent to the system.

This QAPP was developed on the basis of U.S. Environmental Protection Agency (EPA) guidelines as outlined in "Interim Guidelines and Specifications for Preparing Assurance Program Plans," QAMS-004/80, December 29, 1980, and "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, February 1983. Both of these guidance documents were issued by the Office of Monitoring Systems and Quality Assurance, Office of Research and Development. Following these guidelines, the QA policy is stated in Section 2.0.

The following paragraphs describe laboratory operations and address the specific purpose and scope of this document.

1.1 Laboratory Description

KEL is a component of the Kennecott Utah Copper Corporation and has provided laboratory services to Kennecott Corporation for 36 years. The organization is structured under the Manager of Technical Services, as shown in Figure 1.1. Safety guidelines for the laboratory are given in the Chemical Hygiene Plan (KEL 1995) and by using the corporate Kennecott Utah Copper Safety Policies and Procedures Manual as a major resource.

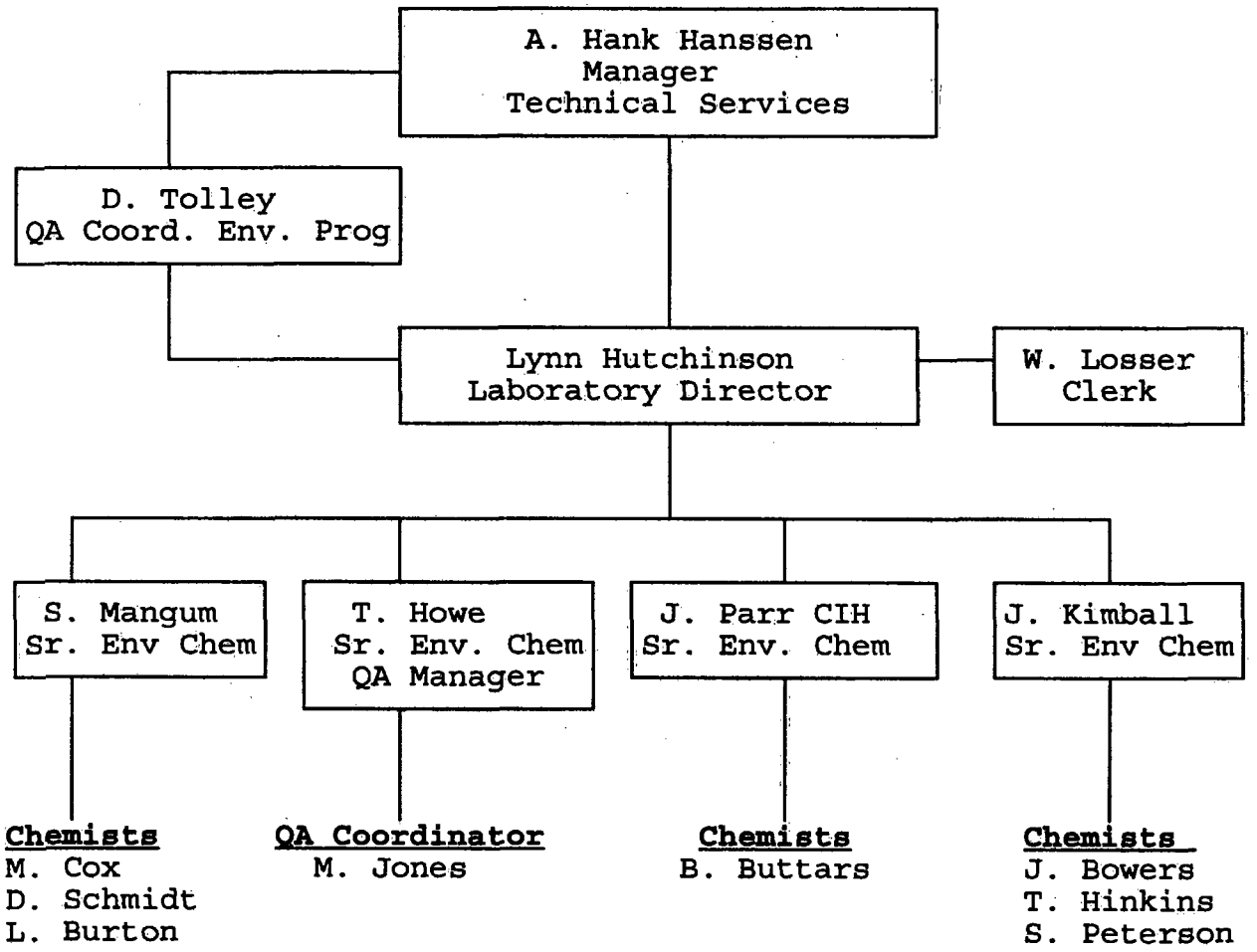

Figure 1.1: KEL Organization Chart.

rev 01-30-95

The laboratory is located in the Analytical Services Center at 9600 West 2100 South, Magna, Utah. Access is limited to Kennecott Environmental Affairs employees and authorized visitors using a card key system. The laboratory area where environmental samples are stored and analyzed is considered a RCRA secure area.

1.2 Laboratory Operations

The laboratory provides analytical services for environmental, industrial hygiene, biological and process monitoring programs within Kennecott Corporation only; the laboratory does not provide analytical services to outside clients. The full range of analytical services is described in the KEL Methods/SOP Manual (1995). Each member of the laboratory staff is trained in the usage of the QAPP and the Methods/SOP manual. This training is documented by the QA Manager. KEL monitoring programs are strengthened by a variety of certification, accreditation or licensing programs. A brief synopsis of current accreditation and staff experience certifications is provided in Table 1.2.

1.3 Purpose

The purpose of this QAPP is to present an overview of the essential elements of KEL's QA program. Elements not specified in the EPA guidance documents are included in this QAPP to provide additional QA program elements required to meet the objectives of the QA policy. The elements presented in this QAPP must be included in all QA project plans written for environmental projects supported by the laboratory's analytical services.

The QA policies and procedures described herein are designed to eliminate systematic errors and minimize the occurrence of other errors. However, no QA program can eliminate all errors that may occur during analysis. The QA program forms the framework for minimizing errors and identifying and correcting those errors that may occur. These QA policies and procedures must be coupled with the professional judgment of the technical staff to ensure that quality data are consistently produced.

1.4 Scope

The scope of this QAPP is to document all of the essential elements of the KEL QA program for environmental analyses. The QA program includes the Kennecott Methods/SOPs Manual and all laboratory policies and procedures. Therefore, the scope of this QAPP is limited to defining the program that incorporates the documentation required to accomplish the following:

- Demonstrate the laboratory's environmental capabilities by describing its:
  - Facilities
  - Equipment
  - Personnel
  - Accreditation
  - SOPs
  - Methods
- Control laboratory operations through the analysis of:
  - Check standards
  - Blanks
  - Calibration standards
  - Performance evaluation samples
- Measure matrix effects in environmental samples through the analysis of:
  - Duplicate samples
  - Matrix spike and matrix spike duplicate sample sets
  - Post-digest spike samples
- Appropriately report analytical and related QC results for environmental samples by describing the procedures followed for performing:
  - Data reduction, validation and reporting

- Corrective action
- Performance audits
- System audits
- Preventive maintenance
- Sample receiving and custody transfers
- Sample preparation, analysis and calibration

The specific aspects of each of these key elements are described in this document.

1.4 Environmental Analytical Services

The analytical services include routine analysis of samples of groundwater, drinking water, surface water, soil, sludge, waste and air (gas and particulate). KEL standard operating procedures (SOPs) are dynamic and follow approved EPA methodology for analysis of the following:

- Metals by atomic absorption spectroscopy (AA, GFAA, Hydride, CVAA), inductively coupled plasma/atomic emission spectroscopy (ICP/AES), ICP/mass spectrometry (ICP/MS) methods and classical wet chemistry procedures.
- Anions by rapid flow analysis (RFA) methods.
- Phenols and cyanide by colorimetric methods.
- Physical parameters by conventional techniques.

The methods used in the analysis of environmental samples are documented in SOP format. Major laboratory instrumentation follows in Table 1.4.

1.5 Laboratory Information Management System (LIMS)

The Laboratory Information Management System (LIMS) is **LABWORKS** version 3.4 distributed by Analytical Automation Specialists, Baton Rouge, La. The LIMS software is operating on a P.C. based Novell 3.11 Network which affords interfacing to analytical instrumentation. The **LABWORKS** programs provide the means for sample login, scheduling, backlog queries, accounting, sample tracking, status, quality assurance, audit trail, reporting, archival storage, data search, and retrieval. Following analyst review, analytical data is

entered into LIMS either manually or imported directly from instrumentation. Validation is required prior to final reporting, performance limits are included for real time data monitoring. Completed and validated data are transferred via direct computer interface to Kennecott's Utah Copper main frame IBM computer for access and use by Kennecott environmental personnel. The LIMS is maintained by a designated in-house specialist or by contract help. Additional validation is provided in the transfer of data to the mainframe. When possible, data is reviewed and compared against historical data to identify trends and outlying data points.

Table 1.2: KEL: Accreditation, Certification and Professional Experience

Laboratory Accreditation and Certifications

- Certified by the State of Utah, Environmental Testing Performed under the Safe Drinking Water (SDWA) the Clean Water Act (CWA) and the Resource Conservation and Recovery Act (RCRA). Initial certification July 10, 1984, #E24.
- Accredited by the American Industrial Hygiene Association (AIHA) for all aspects of industrial hygiene analysis including: heavy metals, organics, free silica and asbestos. Initial certification September 1, 1978.
- Licensed under the Clinical Laboratory Improvement Act under the Medicare program for receiving and analyzing samples for blood lead. License number, 43-1027.
- Approval by the Occupational Safety and Health Administration (OSHA) under the Ambient Lead Standard to conduct blood lead analyses. Program requires quarterly proficiency testing. June 20, 1991.
- Application submitted for laboratory certification by the State of Nevada to conduct environmental analyses under, SDWA, CWA and RCRA.
- Application submitted for accreditation by National Institute for Occupational Safety and Health (NIOSH) for Environmental Lead Proficiency Analytical Testing (ELPAT).

Professional Experience and Certifications

Professional Experience

- The professional staff of environmental scientists have earned college degrees in chemistry or a related discipline. Two members have obtained their masters of science, one in Soil Chemistry and one in Industrial Hygiene. Average years experience in the industry is approximately 17 years.

Professional Certifications

- Lynn A. Hutchinson, Certified Industrial Hygienist (CIH), American Board of Industrial Hygiene (ABIH), certificate number 1316.
- John C. Parr, CIH, ABIH certificate 1432.
- David L. Adamson, Consultant CIH, ABIH certificate 4583.

Table 1.4: KEL Analytical Instrumentation[1]

ICP/MS	Perkin-Elmer	Elan 5000
ICP/AES	Perkin-Elmer	Optima 3000
ICP/AES/AA	Perkin-Elmer	6500
GFAA/Zeeman/AA	Perkin-Elmer	5100 PC
GFAA/Zeeman/AA	Perkin-Elmer	5000 PE
GFAA/Zeeman/AA	Perkin-Elmer	5100 PE
X-ray Diffraction	Siemens	5000
X-ray Fluorescence	Philips	3000
Rapid Flow Analyzer	AlpKem	RFA (3)
Autoanalyzer	Technicon	AAII
Mercury Analyzer	Leeman	PS200
GC	Hewlett-Packard	5840
GC	Hewlett-Packard	5880
GC	Hewlett-Packard	5890
GC	Perkin-Elmer	8320
GC/MS	Hewlett-Packard	5790
Spectrophotometer	Perkin-Elmer	UV-Vis 323
Spectrophotometer	Perkin-Elmer	IR-467 (2)
Spectrophotometer	Perkin-Elmer	Fluorescence
Microscopy	Zeiss	Phase-Contrast
Microscopy	Fisher	Stereo
Microscopy	Wilde	Stereo
Autotitrator	Mettler	DL20
Balance	Mettler	ME 30 Micro
Balance	Mettler	Analytical 163
Balance	Sartorius	1712
Balance	Mettler	AE 50
Balance	Mettler	AB104

[1] Number in parentheses indicates the number of instruments in the laboratory.

ICP/MS: Inductively Coupled Plasma Emission Mass Spectrometer
ICP/AES: Inductively Coupled Plasma Atomic Emission Spectroscopy
GFAA: Graphite Furnace Atomic Absorption Spectroscopy
GC: Gas Chromatograph
GC/MS: Gas Chromatography Mass Spectrometry
AA: Atomic Absorption Spectroscopy

2.0 QUALITY ASSURANCE POLICY

The objective of KEL is to provide high quality analytical data that are accurate, reliable and adequate for the intended purpose. The QA program has been implemented to ensure the production of legally and scientifically defensible data of documentable quality. Therefore, the primary objective of the QA program is to ensure that all results generated by the laboratory are valid representations of the amount of environmental material in the samples at the time of sampling. To meet this objective, it is essential that a series of secondary goals be met. These goals are:

1. Maintain the integrity of all samples submitted.
2. Check the accuracy and precision of all methods used by analyzing blanks, matrix spikes and matrix spike duplicates.
3. Define the accuracy and precision of the methods used.
4. Document all methodology and quality control activities.
6. Adhere to good laboratory practices.
7. Investigate and correct errors in methodology, practices and data. Utilize LIMS for data validation and corrective action reporting.
8. Train and document the training of personnel to meet quality control objectives.
9. Provide SOPs for new instrumentation and methodology.

While this listing is not all-inclusive, meeting these goals will enable the overall objective of the QA program to be met. Results generated by the laboratory will be valid representations of the amount of analyte present in an environmental sample as received at the laboratory.

3.0 PROGRAM ORGANIZATION AND RESPONSIBILITY

Implementing an effective QA program in a laboratory that performs a broad scope of analytical services requires the commitment and attention of both management and staff. The QA Manager coordinates the QA program. The Laboratory Director is responsible for the quality of data produced by the laboratory. Both the QA Manager and the Laboratory Director are assisted in daily operation of the QA program by the designated QA Chemist and the laboratory analysts. Specific QA responsibilities of laboratory personnel are described in this section.

Laboratory Director

The Laboratory Director is ultimately responsible for the quality of data produced by the laboratory. Accordingly, only the Laboratory Director has the authority to approve the release of analytical results and give final approval of analytical methods and SOPs. In addition, the Laboratory Director is responsible to perform the following activities:

- Administer the use of accurate and current analytical methods and SOPs in the laboratory.
- Maintain a work environment that emphasizes the importance of data quality.
- Provide management support to the QA Manager.
- Ensure all analysts are trained to perform analytical methods with proper QA procedures.
- Pursue and maintain external accreditation, licensing and certification programs.
- Participate in internal and external system audits.
- Participate in performance evaluation audits.
- Review and approve all data reports before release.

QA Manager

The QA Manager is directly responsible for the ongoing implementation of the QA program. Accordingly, the QA Manager has the authority to discontinue the use of analytical methods and SOPs and can delay the release of sample data until QA requirements are achieved and corrective action has taken place, if required. Additionally, the QA Manager is responsible to perform the following activities:

- Ensure laboratory participation in external system audits.
- Ensure that internal performance and system audits are conducted and documented.
- Provide QA reports and internal and external systems audit reports to the Manager of Technical Services and the Laboratory Director.
- Identify corrective action procedures and monitor their implementation.
- Ensure that all analysts are trained to perform their QA procedures at the bench level.
- Secure laboratory participation in accreditation, licensing, and certification programs.
- Maintain an archive of all QC data, analytical methods, QA reports, and SOPs.
- Implement the QA program on a day-to-day basis.
- Conduct and document internal performance audits.
- Maintain stocks of certified reference materials for use as check standards.
- Review all data produced for adherence to QA program requirements.
- Maintain QC databases.
- Report results of statistical analyses of QC data to the Manager of Technical Services, Laboratory Director, QA Manager and laboratory analysts.
- Prepare blind duplicate and spike samples for submission to laboratory.

Laboratory Analysts

Each laboratory analyst is responsible to ensure that QC criteria are met for the type of analysis they may perform. The analyst is responsible for participating and collaborating with the QA program to achieve a productive, compliant and cohesive working environment. Accordingly, the laboratory analysts are required to perform the following activities:

- Ensure compliance with analytical methods and SOPs.
- Maintain sample custody procedures during preparation and analysis when required.
- Review all QC and sample data to ensure that QA criteria are achieved.
- Evaluate and perform corrective actions as needed.
- Archive log book maintenance and instrument specific electronic data.
- Report and document corrective action via the QA manager.
- Prepare and document traceable standards and certificates of analysis.

4.0 SAMPLE CUSTODY

Upon receipt, samples are maintained and processed in an orderly sequence designed to ensure continuous integrity of both the sample and intrinsic documentation.

A Kennecott Environmental Laboratory Analysis Request Sheet (Figure 4.1) is initiated prior to sample delivery. This standard form is used to record sample description, field analytical and requested analyses. The sample request sheet serves to initiate sample chain of custody. Samples, together with the related Analysis Request Sheets, are placed in coolers or other appropriate sample containers designated by the sampling protocol, secured and shipped or delivered to the laboratory.

When the samples are received and before signature is given by the sample clerk, the Analysis Request Sheet is inspected for the following:

- Proper chain-of-custody documentation.
- Condition of the samples and sample containers.
- Proper sample preservation.
- Agreement between the Analytical Request Sheet and sample labels.

If information is missing or discrepancies are noted, the shipment is unacceptable and the sample receipt clerk is responsible to initiate corrective action by contacting either the person who sent the samples, the Laboratory Director or the QA Manager.

If the Analysis Request Sheet appears to be complete and correct, the sample receipt clerk is responsible to perform the following activities:

- Assign each Analytical Request Sheet a unique report number and record this number on the Analytical Request Sheet.
- Assign each sample, including duplicates and matrix spikes, a unique laboratory number and record these numbers on the original Analytical Request Sheet.

KENNECOTT ENVIRONMENTAL LABORATORY
9600 West 2100 South Magna, Utah 84044

ANALYTICAL REQUEST SHEET
Sample Chain of Custody

_____ - _____ - _____
Sheet Request No.
Lab Use Only

#	Lab I.D. # (Lab Use Only)	Sample Description	Date Collected	Time Collected	Total # of Containers	Field Data						Analyses Requested
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Sample Submitted by: _____ **Telephone #** _____ **Fax #** _____
Report Results to : _____ **Telephone #** _____ **Fax #** _____

Sampler: _____ **Sampling Site:** _____ **Sampling Date:** _____ **Time:** _____

Surrendered By: _____ **Received By:** _____ **Date/Time:** _____
Surrendered By: _____ **Received By:** _____ **Date/Time:** _____
Surrendered By: _____ **Received By:** _____ **Date/Time:** _____

Comments / Special Instructions: _____

Figure 4.1: Chain of Custody, Analytical Request Sheet.

- Produce bar code labels containing the laboratory sample number for sample containers, including any containers that will be needed for sample splits or prepared samples created by laboratory personnel.
- Deliver all sample containers to the designated sample storage locations that are designed to ensure proper preservation and handling for each sample type.
- Log all sample shipment information into the Laboratory Information Management System (LIMS), including the Analytical Request Sheet number, all sample numbers and identifications, requested analyses, sample dates and field data. A comments field can be used for additional information or sample anomalies.

Upon completion of analyses, the samples are returned to the sample receipt clerk (or their designee) and are archived for a designated time period after the analytical results are released. After the archive time elapses, the sample receipt clerk arranges for proper disposal of the samples. Nonhazardous samples are appropriately disposed by laboratory personnel. Samples considered to contain hazardous materials are returned to the sample generator for proper storage and/or disposal.

5.0 ANALYTICAL PROCEDURES

Analyses performed by KEL are designed to comply with regulatory guidelines and standards. Therefore, the analytical methods are predominantly published by regulatory agencies. The methods used are those specified by federal agencies, state agencies, and professional organizations, as provided in the following references:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act.", 40 CFR Part 136
- Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (revised March 1994).
- Methods for the Determination of Metals in Environmental Samples, EPA-600/4-91/010 (June) EPA 1989
- Test Methods for Evaluating Solid Waste (SW-846), 2nd Edition (revised), Update I (1984), Update II (1985), 3rd Edition (1986), Update II (1989), Office of Solid Waste and Emergency Response. Office of Solid Waste and Emergency Response, EPA
- Standard Methods for the Examination of Water and Wastewater, 18th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation Washington, D.C. (1985)
- Official Methods of Analysis, 15th Edition, Association of Official Analytical Chemists Arlington, Virginia (1984)
- Annual Book of ASTM Standards, Volumes 11.01 and 11.02, 11.03 American Society for Testing and Materials (ASTM), Philadelphia Pennsylvania (1992)
- Techniques of Water Resources Investigations of the USGS, Book 5, Laboratory Analysis, United States Geological Survey (USGS), Washington D.C. (1979)
- NIOSH Manual of Analytical Methods, Third Edition, Supplement 1 (1985), Supplement 2 (1987), and Supplement 3 (1988), National Institute for Occupational Safety and Health Division of Physical Sciences and Engineering, Cincinnati, Ohio (1984)
- OSHA Analytical Methods Manual, Second Edition August 1991, Occupational Safety and Health Administration (1991)
- Methods of Soil Analysis, Parts I and II. American Society of Agronomy, No. 9.

KEL analytical methods are given in Table 5.1. RCRA methodology is given in Table 5.2. Additional method summaries are given in the Kennecott Methods/SOP Manual (1995).

Table 5.1: Kennecott Utah Copper Environmental Laboratory
Analytical Methods

5.1.1 Anions and Miscellaneous Tests

Parameter	Methods[1,2]	IDL (mg/l)
Alkalinity	310.2	10
Chloride	325.2	5
Fluoride	340.2	0.2
Nitrate	353.2	0.2
Nitrite	353.2	0.05
Sulfate	375.2	5
Sulfate	375.3	5
Sulfate	375.4	10
Ammonia	350.1	0.01
Acidity	305.1	10
BOD_5	405.1	1
Coliform	9221B	
Coliform	9222B	
Conductivity	120.1	
Cyanide	335.2	0.005
Cyanide	335.3	0.005
Dissolved Oxygen	360.1	0.2
Fecal Coliform	9221C	
Fecal Coliform	9222D	
Hardness	130.1	10
pH	150.1	
Kjeldahl Nitrogen	351.2	0.2
Oil & Grease	413.1	1
Organic Carbon	415.2	0.1
Phenolics	420.2	0.01
Residual Chlorine	330.2	0.2
Silica	370.1	5
Sulfide	376.2	1
TDS	160.1	1
TSS	160.2	1
TS	160.3	1
Turbidity	180.1	1 NTU

1. Methods for the Chemical Analysis of Water and Wastewater U.S. Environmental Protection Agency (EPA), EPA-600/4-79-020, March.

2. Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992.

mg/l= milligrams per liter
NTU= nephelometric turbidity units

Table 5.1: Kennecott Utah Copper Environmental Laboratory Analytical Methods

5.1.2 Metals

Parameter	Methods[1,2,3,4]	IDL (mg/l)
Aluminum	200.7	0.01
Aluminum	200.8	0.001
Aluminum	202.1	0.1
Antimony	200.8	0.001
Antimony	200.9	0.003
Antimony	204.1	0.2
Antimony	204.2	0.003
Arsenic	200.7	0.1
Arsenic	200.8	0.001
Arsenic	200.9	0.004
Arsenic	206.2	0.004
Barium	200.7	0.01
Barium	200.8	0.002
Barium	208.1	0.1
Beryllium	200.8	0.0001
Beryllium	210.1	0.005
Beryllium	210.2	0.001
Bismuth	200.7	0.1
Bismuth	200.8	0.0005
Boron	200.7	0.05
Boron	200.8	0.005
Cadmium	200.7	0.01
Cadmium	200.8	0.0002
Cadmium	200.9	0.0005
Cadmium	213.1	0.005
Cadmium	213.2	0.001
Calcium	200.7	0.1
Calcium	215.1	0.1
Chromium	200.7	0.01
Chromium	200.8	0.001
Chromium	200.9	0.002
Chromium	218.1	0.05
Chromium	218.2	0.002
Cobalt	200.7	0.01
Cobalt	200.8	0.001
Cobalt	200.9	0.001
Cobalt	219.1	0.05
Cobalt	219.2	0.002
Copper	200.7	0.01
Copper	200.8	0.001
Copper	200.9	0.001
Copper	220.1	0.01

Table 5.1: Kennecott Utah Copper Environmental Laboratory
Analytical Methods

5.1.2 Continued

Parameter	Methods[1,2,3,4]	IDL (mg/l)
Copper	220.2	0.001
Gold	200.8	0.0001
Gold	231.1	0.1
Gold	231.2	0.001
Hafnium	200.8	0.001
Iron	200.7	0.01
Iron	200.9	0.001
Iron	236.1	0.03
Iron	236.2	0.001
Lead	200.7	0.1
Lead	200.8	0.0001
Lead	200.9	0.001
Lead	239.1	0.1
Lead	239.2	0.005
Magnesium	200.7	0.01
Magnesium	200.8	0.001
Magnesium	242.1	0.001
Manganese	200.7	0.01
Manganese	200.8	0.001
Manganese	200.9	0.001
Manganese	243.1	0.01
Manganese	243.2	0.001
Mercury	200.8	0.001
Mercury	245.1	0.0002
Molybdenum	200.7	0.01
Molybdenum	200.8	0.001
Molybdenum	246.1	0.1
Nickel	200.7	0.1
Nickel	200.8	0.001
Nickel	200.9	0.001
Nickel	249.1	0.04
Nickel	249.2	0.002
Phosphorus	200.7	0.1
Phosphorus	200.8	0.001
Potassium	258.1	0.01
Rhenium	200.7	0.1
Rhenium	200.8	0.001
Rhenium	264.1	0.4
Rhodium	200.8	0.0001
Selenium	200.7	0.1
Selenium	200.8	0.001
Selenium	270.2	0.004
Silicon	200.7	0.1
Silicon	200.8	0.005
Silver	200.7	0.01

Table 5.1: Kennecott Utah Copper Environmental Laboratory Analytical Methods

5.1.2 Continued

Parameter	Methods[1,2,3,4]	IDL (mg/l)
Silver	200.8	0.0001
Silver	200.9	0.0001
Silver	272.1	0.005
Silver	272.2	0.0001
Sodium	273.1	0.01
Strontium	200.7	0.01
Strontium	200.8	0.001
Tellurium	200.7	0.1
Tellurium	200.8	0.002
Tellurium	200.9	0.004
Thallium	200.8	0.001
Thallium	279.2	0.01
Tin	200.7	0.1
Tin	200.8	0.001
Tin	282.1	1
Tin	282.2	0.005
Titanium	200.7	0.01
Titanium	200.8	0.001
Tungsten	200.8	0.001
Uranium	200.8	0.001
Vanadium	200.7	0.01
Vanadium	200.8	0.001
Yttrium	200.8	0.0001
Zinc	200.7	0.005
Zinc	200.8	0.001
Zinc	200.9	0.001
Zinc	289.1	0.01
Zinc	289.2	0.001

1. Methods of Chemical Analysis of Water and Wastewater U.S. Environmental Protection Agency (EPA), EPA-600/4-79-020 March.

2. Methods for the Determination of Metals in Environmental Samples U.S. Environmental Protection Agency (EPA), EPA-600/4-91-010.

3. Standard Methods for the Examination of Water and Wastewater 18th Edition 1992

4. 40 CFR 136

Table 5.2: RCRA Methodology

Table 5.2.1: Anions and Wet Chemistry

Parameter	Methods[1]	IDL (mg/l)
Chloride	9250	5
Sulfate	9036	5
Sulfate	9038	5
Cyanide	9010	0.005
pH	9040	
pH	9041	
pH	9045	
Organic Carbon	9060	0.1
Phenolics	9066	0.01
Sulfide	9030	1
Ignitability	1010	
Paint Filter Test	9095	
Oil and Grease	9070	
Oil and Grease	9071	
Nitrate	9200	1
TCLP Metals	1311	
SPLP Metals	1312	
Total Coliform	MF	

1. Test Methods for Evaluating Solid Waste U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. SW-846 November 1986 Third Edition.

Table 5.2: RCRA Methodology.

Table 5.2.2: Metals

Parameter	Methods[1]	IDL (mg/l)
Aluminum	6010	0.01
Antimony	6010	0.001
Antimony	7040	0.003
Arsenic	6010	0.1
Arsenic	7060	0.004
Arsenic	7061	0.001
Barium	6010	0.01
Barium	7080	0.002
Beryllium	6010	0.005
Beryllium	7090	0.001
Cadmium	6010	0.01
Cadmium	7130	0.0002
Calcium	6010	0.1
Chromium	6010	0.01
Chromium	7191	0.001
Chromium	7190	0.002
Chromium VI	7197	0.05
Cobalt	6010	0.001
Cobalt	7200	0.05
Copper	6010	0.01
Iron	6010	0.001
Iron	7380	0.03
Lead	6010	0.001
Lead	7420	0.1
Lead	7421	0.005
Magnesium	6010	0.001
Manganese	6010	0.01
Manganese	7460	0.001
Mercury	7470	0.0002
Mercury	7471	0.001
Molybdenum	6010	0.01
Molybdenum	7480	0.001
Nickel	6010	0.001
Nickel	7520	0.04
Phosphorus	6010	0.001
Potassium	6010	0.01
Selenium	6010	0.1
Selenium	7740	0.004
Selenium	7741	0.001

1. Test Methods for Evaluating Solid Waste U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. SW-846 November 1986 Third Edition.

Table 5.2: RCRA Methodology.

Table 5.2.2: Continued

Parameter	Methods[1]	IDL (mg/l)
Silicon	6010	0.1
Silver	6010	0.01
Silver	7760	0.001
Silver	7761	0.0004
Sodium	6010	0.01
Thallium	6010	0.01
Tin	7870	0.005
Vanadium	6010	0.001
Zinc	6010	0.001

1. Test Methods for Evaluating Solid Waste U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. SW-846 November 1986 Third Edition.

6.0 CALIBRATION PROCEDURES

Instrument calibration procedures are intended to ensure that analytical systems are operating correctly and have adequate sensitivity to meet method requirements. General instrument calibration procedures are specified by the manufacturer, method specific procedures are given in the appropriate analytical method. Instruments are calibrated daily and/or each time they are prepared to run samples. The calibration procedures are determined by the manufacturers specifications and the analytical method. Each instrument is calibrated with standards (independent source standards) appropriate to the designated function of the instrument, type of analysis and the established operating range of the analytical method as indicated in the following paragraphs.

6.1 Inductively Coupled Plasma Instruments

The inductively coupled plasma instruments (ICP, ICP/MS) are calibrated with a minimum of four (4) working standards (3 standards and an instrument calibration blank). The linear range is determined by the most concentrated standard used to calibrate the instrument. No values are reported above this upper concentration without dilution. The calibration is verified initially and then monitored by the analysis of a calibration verification standard (CVS) minimally every 20 samples or less. The calibration verification standard is prepared from an independent source. An interelement correction standard (ICS) is analyzed as part of the initial daily calibration on the simultaneous ICP instrument to verify background correction and interelement correction factors, if they are being used. Standards and blanks must meet historical and method specific criteria for acceptance or analysis is terminated, the problem is isolated and resolved; the instrument is recalibrated. All samples analyzed after the last acceptable calibration are re-analyzed.

6.2 Atomic Absorption Instruments

Atomic absorption (AA) instruments are calibrated prior to sample analyses using at least two standard concentrations and a blank. The reporting range of the instrument is determined by the highest concentration standard used in the calibration. No values are reported above this concentration without dilution. The calibration is verified initially and then monitored with a calibration check standard every 20 samples or less. All standards and blanks analyzed must meet historical or method-specific criteria, or the analysis is terminated,

the problem is identified, corrected and the system is recalibrated. Samples analyzed after the last acceptable calibration check are re-analyzed.

6.3 Rapid Flow Analysis Instruments

All rapid flow analysis (RFA) instruments are calibrated each time the instrument is used and before any samples are analyzed. Multiple calibration standards and an instrument blank are analyzed to develop the calibration curve. Samples with results higher than the valid calibration range are diluted and reanalyzed. The calibration is verified with a blank and a check standard initially and after every 20 samples. Standards and blanks must meet historical or method-specified criteria or the analysis is terminated, the problem is identified, corrected and the system is recalibrated. Samples analyzed after the last acceptable calibration check are re-analyzed.

6.4 Conventional Analysis/Wet Chemsitry

Conventional or traditional analyses conducted at KEL involve a variety of instrumental and wet chemical techniques. Although calibration procedures vary depending on the type of system and analytical objective, the following general calibration procedures apply. Each system is calibrated before analyses are conducted. The method reporting range is defined by using a series of calibration standards. The calibration is checked using a continuing calibration verification standard. When a continuing calibration check fails, the problem is isolated, solved and the system is recalibrated. Samples analyzed after the last acceptable calibration check are re-analyzed.

7.0 QUALITY CONTROL

The quality control program is designed to provide an accurate estimate of the precision, accuracy, comparability, completeness and representativeness of environmental data generated at KEL. Information regarding the magnitude of the random error and bias within the analytical process is monitored through the analysis of QC samples. Post-analysis corrective action is addressed by the analyst at the bench level. If the problem(s) cannot be resolved at this level, further action is taken by the QA Manager or the Laboratory Director. All QC information used by the QAPP to determine the need for corrective action as discussed in Section 12.0. Random errors and bias can be the result of laboratory operations or matrix effects as discussed in following sections.

7.1 Standard/Reagent Preparation

A critical element of producing quality data is the purity, quality and traceability of the standard solutions and reagents used in the QC program. To ensure the highest purity possible, all primary reference standards and standard solutions are obtained from the National Institute of Standards and Technology (NIST), approved vendors and other reliable sources. Standards are logged into the Standards and Reagent Log upon arrival at KEL, a log book for this purpose is dedicated to each lab group. The analyst preparing the standard documents the vendor, lot number, concentration, receipt/preparation date, preparer's initials, preparation method and expiration date. The certificate of analysis is kept on file with the associated standard number assigned when the sample was checked in. The certificate of analysis file is maintained by the QA Unit. These log books and certificates of analysis provide for the traceability of the standard from the time it arrives to the time it is used for an analytical purpose.

Standard solutions are verified before use by analyzing a separate standard prepared at a different time or obtained from a different source. This verification is used to evaluate any bias resulting from standard solution preparation and can be used to determine the quality of a vendors product. Stock standards and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates or change in concentration. Care is exercised in the proper storage and handling of standard solutions. Standards are not stored with samples. Working standard reagent containers shall be clearly labeled with the following

information: Standard number, description, preparation date, concentration, expiration date, preparer's initials and special safety precautions or MSDS information.

7.2 Laboratory Operations: Quality Control

Laboratory operations are monitored by analyzing laboratory check samples and blanks. These samples are used to identify random errors and bias from laboratory operations. Specific methodology and SOPs describe the frequency at which these samples are analyzed. In certain cases, a specific project may require unique QC direction. All Laboratory results are compared to method QC samples, reference materials, customized standards or when possible, to historical limits to determine the accuracy and precision of the preparation procedure. A Certified Reference Material (CRM) will be obtained (if available) that contains the analyte(s) of interest near levels expected in the samples and with matrices matched as closely as possible.

Blanks are analyzed to evaluate the bias introduced into the analytical system through contamination and sample handling. Routinely analyzed blank samples include field, equipment, trip, instrument and method blanks. Field, equipment and trip blanks are analyzed as part of the field QC program as set forth in the GCMP or other appropriate document. Instrument blanks are included in calibration curves and evaluated before beginning sample analysis. Method blanks are analyzed as specified in the methodology or SOP. Method blanks are carried through the entire analytical process. Collectively, data from method blanks offer the most utility for determining bias in the sample preparation process.

7.3 Matrix Effects: Quality Control

Matrix effects on the quality of the data produced are measured through the analysis of duplicate, matrix spike, matrix spike duplicate and post-digest spike samples. Results from these QC samples are compared to instrumental, method and historical control limits to provide an accurate estimate of the precision, accuracy and representativeness of the data produced for each matrix analyzed. These matrix effects QC samples are described in this section.

Duplicate samples are analyzed at a frequency of one duplicate sample for every 20 samples. Duplicate samples are created in the laboratory by collecting two aliquots of a homogenized sample, then processing them

through the entire analytical sequence. Field personnel submit blind field duplicate samples as part of the field QA program and the QA Manager submits blind duplicate samples as part of the internal performance audit system described in Section 9.1. Duplicate sample analysis results are reported by computing the relative percent difference (RPD) using Equation (1).

$$\%RPD = \frac{|A-B|}{A+B} X200 \qquad (1)$$

Where, A = Sample Result
B = Duplicate Sample Result

RPDs are evaluated and compared to method specific acceptance criteria for a given matrix. RPD results provide an estimation of the accuracy and representativeness for a given sample matrix.

Matrix spike and matrix spike duplicate samples are analyzed at a frequency of one matrix spike sample set per twenty samples of a given matrix. A matrix spike sample set is created in the laboratory by collecting three aliquots from a homogenized sample. One aliquot is unspiked and the remaining two aliquots are spiked with a known concentration of standard reference material. All three aliquots are then processed through the entire analytical system, including sample preparation. Blind matrix spikes are submitted by the QA Manager on a quarterly basis as part of the internal performance audit system described in Section 9.1. Matrix spike results are reported by computing the percent recovery using Equation (2).

$$\%R = \frac{A-B}{C} X100 \qquad (2)$$

Where, A = Spiked Sample Result
B = Sample Result
C = Spike Value

The RPD and percent recovery for spike duplicates is computed using the percent recovery and RPD calculation using Equations (1) and (2). Percent recoveries and RPDs are compared to method acceptance criteria and

historical control limits for each matrix to provide an accurate estimation of precision, accuracy and representativeness for a given matrix.

Post-digest spikes are analyzed for methods that require them or for corrective action purposes when verifying a standard reference material. The sample and the post-digest spike are analyzed separately during the same analytical run. Post-digest spike results are also reported as percent recovery and compared to method and historical control limits for a given matrix to provide an accurate estimate of the precision and representativeness for a given matrix.

8.0 DATA REDUCTION, VERIFICATION, AND REPORTING

All data are processed to ensure that the precision, accuracy, representativeness, completeness and comparability of the data are of known and documented quality. The data validation includes data reduction, verification and reporting procedures completed independently by the analyst, QA Manager and Laboratory Director, as described in the following sections.

8.1 Analyst Data Reduction, Validation and Reporting

The analyst has primary responsibility for reporting data of acceptable, known and documented quality. The process involves reducing instrumental output to concentration values, verifying that all QC results are acceptable when compared to method specific criteria and historical control limits. The LIMS is used to report individual data sets either by manual data entry or electronic data transfer. Peer review of sample data is completed after each analytical batch. Typically, a minimum of 10% of the data generated by a Laboratory Group is reviewed by the Group Supervisor. Corrective action takes place at the bench level with documentation through the use of the Corrective Action Report Summary. Section 13.0 describes the corrective action sequence and reporting mechanism in detail.

The analyst inspects standard, blank, sample, duplicate and matrix spike results during an analytical batch run and compares results against known control limits. Results found to be suspect and those that are outside acceptance limits are investigated. The analyst will troubleshoot the problem(s) and restart the batch beginning with calibration, if necessary. A Supervisor or the QA Manager will be summoned if the problem(s) cannot be resolved at the analyst level. The QA manager will be notified to determine whether further corrective action is required and conclusions will be documented by the QA Manager. The limits used to determine acceptable results include control charts for QC and check standard results and historical data for sample results. When the analyst determines that data quality is acceptable and the other aspects affecting the data quality are known and documented, the analyst enters the data into the LIMS, via data entry or electronic transfer.

8.2 QA Manager Data Reduction, Validation and Reporting

The QA Manager is responsible to ensure that the precision, accuracy, representativeness, completeness and comparability of the data are of known and documentable quality. The QA Manager reviews the data only after all requested analyses for an Analytical Request Sheet (Figure 4.1) have been completed. The process followed by the QA Manager includes reviewing the data reduction, verification and reporting processes conducted by the analysts. Data reduction is performed using the QA database programs. Verification includes an assessment of QC results and a review of each sample result against historical means and standard deviations; confirming ion balances and total dissolved solids measurement for each water sample. After verification, the data determined to be acceptable are reported to the Laboratory Director. The QA programs used by the QA Manager are the ion balance, total dissolved solids and historical limit check programs. The ion balance check program compares the major cation and with major anion results for each water sample along with the electrical conductivity. The limit check program compares the reported results to the historical results on a unique location-by-location basis. A statistical reduction is used to produce historical limits unique to each sample. The program identifies and reports results that are outside the historical limits. These data reports are reviewed using the professional judgment of the QA Manager and corrective action is initiated as needed.

The QA Coordinator transfers completed data sets to the QA database, reviews the data and determines whether corrective action is required. The QA Coordinator then completes a re-run sheet and gives that to the Group to re-analyze sets of data. Corrective actions are implemented as needed on the basis of this additional review of these statistics and control chart data.

The QA Manager verifies that all required corrective actions have been implemented and documented, the data reported is then considered to be of known and documentable quality. The QA Manager then provides the Laboratory Director with the current printouts of the balance and limit check programs followed by the final data report. The data are not reported to the Laboratory Director until the QA Manager is satisfied that the data are acceptable for inclusion in the KUC Mainframe.

8.3 Laboratory Director Data Reduction, Validation and Reporting

The Laboratory Director has the definitive responsibility to ensure that the precision, accuracy, representativeness, completeness and comparability of the data are known and documented. The Laboratory Director validates all corrective action requirements, reviews sample results that are outside historical limits or have ion balances that are not comparable. The Director then approves the data for inclusion in the Mainframe. Any additional corrective actions identified by the Laboratory Director are investigated, documented and reviewed before the Laboratory Director approves the final data report.

9.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits are an important component of the QA program. Performance audits include the analysis of standard QC samples including: duplicates, matrix spikes, matrix spike duplicates, blanks and certified reference materials. The performance audits are designed to verify the ability to correctly identify and quantify sample concentrations in blind QC samples. System audits include review of documentation, record checks, log book inspections and laboratory inspections conducted by the Laboratory Director, QA Manager and external auditors. These audits are conducted to verify that the staff has the equipment, facilities, engineering controls and procedures needed to generate data of acceptable, known and documented quality. The types of performance and system audits are detailed in the following sections.

9.1 Internal Performance Audits

Internal performance audits are conducted quarterly by the QA Manager. The laboratory participates in a performance evaluation program administered by an independent vendor. These PET (Performance Evaluation Testing) samples are submitted to each Group. Results are mailed to the vendor and a complete report, including statistical analysis is mailed to the QA Manager within one week. Results are submitted blind and the QA Manager is responsible for reporting and identifying deficiencies as an integral part of the quarterly PE audit. The QA Manager compares internal audit sample results to the true values and reports the findings to the analyst(s), Laboratory Director and Technical Services Manager. Conclusions are used to assess data quality and to determine the need for corrective actions within a given analytical system. The quarterly internal audit report serves as the documentation and the analyst is required to report corrective actions (if required) for any deficiencies to the QA Manager, in an expedient manner. A formal internal audit schedule is maintained by the QA Manager including the Directors response and corrective action documentation.

9.2 External Performance Audits

In addition to internal performance audits, the Laboratory participates in several external performance audit programs. These programs include the following:

- Environmental Monitoring under RCRA and the Clean Water Act laboratory certification program administered by the State of Utah Department of Health, Bureau of Laboratory Services.
- The drinking water analysis program administered by EPA
- The National Pollution Discharge Elimination System (NPDES) program administered by EPA
- The Proficiency of Analytical Testing (PAT) program jointly administered by AIHA and NIOSH
- The blood lead program administered by the College of American Pathologists (CAP) and Center for Disease Control (CDC)
- The blood lead, blood mercury, urinary arsenic, urinary mercury, and urinary fluoride programs administered by the Centre de Toxicologie du Quebec
- The Environmental Lead Proficiency Analytical Testing Program (ELPAT) administered by the National Institute for Occupational Safety and Health
- Inter-laboratory Asbestos Program, administered through local professional society.

The information provided through participation in these programs is used to evaluate laboratory performance in each area and to assist the QA Manager, Laboratory Director and external audit teams in assessing areas that require increased attention to correct any deficiencies. Sample information for external performance evaluation samples is recorded and tracked in the LIMS database, including sample identity and reported results. Audit samples are treated as samples that are processed through the laboratory in a manner analogous to routine environmental samples, from sample receipt to final reporting. The results of external performance audits will be distributed to the Laboratory Director and Technical Services Manager each quarter.

9.3 Internal System Audits

System audits are conducted annually by the QA Manager. System audits are conducted by the Laboratory Director as needed in response to problems identified through the QA program or performance audits (both internal and external). Any deficiencies identified in the audit are documented and addressed as part of the audit process. Corrective actions resulting from an system audit can include revising SOPs,

reanalyzing affected samples, or repairing imperfect instrumentation. A well administered system audit may isolate deficiencies with regard to adequate engineering controls within the laboratory, such as an inoperable fume hood. Safety and compliance problems are addressed by the Laboratory Director. The analyst must have proper controls in place to properly execute their job function. A formal system audit schedule is maintained by the QA Manager.

9.4 External System Audits

External system audits are conducted by auditors from federal, state and county agencies. These audits are conducted as part of the accreditation, licensing and certification programs identified in Table 1.1 and as oversight by governmental agencies. The QA Manager and Laboratory Director actively participate in the audit. KEL responds to all external system audits through corrective action deficiency reporting as required by the agency and by documenting and correcting problems identified during the audit.

10.0 PREVENTIVE MAINTENANCE

Preventive maintenance of analytical instrumentation and other traditional equipment is routinely performed on a daily basis and documented in maintenance logbooks. One important part of the instrument maintenance program is service contracts that cover major pieces of analytical instrumentation. Preventive maintenance procedures required by the instrument manufacturer or the QA program are included in the Methods/SOPs relating to the instrument. Instruments requiring service from an authorized service engineer are removed from service until the repair or maintenance is completed. Other pieces of equipment such as the balances, are maintained on an annual basis by authorized maintenance personnel. Documentation of service call maintenance is achieved by maintaining a file for each type of analytical instrumentation in the group. Internal system audits are used to monitor preventive maintenance. Annual systems audits are designed to address any longstanding or recurring problems with the instrumentation and engineering controls.

11.0 DATA QUALITY ASSESSMENT

This section of the QAPP provides a description of the techniques that are used to assess the completeness, accuracy, precision, representativeness and comparability of data generated under the Quality Assurance Program.

11.1 Completeness

Completeness is defined as a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal operating conditions. It is evaluated in terms of the amount of valid data obtained compared to the amount that is needed to complete the QA goals. The amount of data actually generated in an analytical sequence can vary due to a number of causes: laboratory sample handling or preparation errors resulting in the loss or destruction of an analyte, instrumental errors resulting in data rejection and insufficient QC data (e.g., lack of spike recovery data). If data acquisition targets are not met, the data may be determined to be incomplete by the QA manager and further analysis or repeated sampling may be required. The QA manager may then submit samples for re-analysis due to the deficiencies in the completeness goal. A completeness goal of 90% has been established.

11.2 Accuracy

Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property) with the accepted reference value or true value. It is a measure of the bias in a system and will be expressed as the percent recovery in a fortified sample. It can also be assessed by the use of a certified reference material (CRM) with certified values. The accuracy of data will be determined as follows:

- Compute percent recoveries for spiked or fortified samples and for performance evaluation samples.
- Calculate the standard deviation for the overall average recovery value.
- Determine the range of uncertainty at a given level of confidence. Using method specified criteria or use guidelines published in Chapter 1 SW 846 revision 2, July 1994.

- Inspect all blank analysis data for field or laboratory contamination problems. Proper use of these results will offer insight into instrument performance and general data quality.
- Check for inclusion of and frequency of the required QC supporting information, generally: method detection limit verification, instrument inherent response factors, calibration validation, interference check samples, continuing calibration verification standards and overall data quality based on historical data (e.g., well data).

Accuracy data will be used to determine any bias in the analytical methods. The methods provide control limits for matrix spikes and the appropriate qualifications for the use of the data if specified control limits are not attained.

11.3 Precision

Defined as the measure of mutual agreement among individual measurements of the same property, usually under similar prescribed conditions, e.g. identical matrices. Precision is best expressed in terms of relative percent difference. Various measures of precision exist dependent upon method specified similar conditions. The determination of precision for data will be performed by the following:

- Determine if sample preparation or instrumental errors have occurred through proper application of sample duplicates and instrumental replicates.
- Perform duplicate analysis of certified reference materials, performance evaluation samples and inspect duplicate results for every QC set analyzed in the analytical process.
- Validate all data by using duplicate and replicate analysis with control limits set based upon the analytical method or other specified criteria.

11.3 Representativeness

This parameter expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition. The determination of the representativeness of the data will be assessed as follows:

- Compare actual bench level procedures to those delineated in SOPs and analytical methods.
- Inspect blanks for external, internal or cross contamination. Poor blank results can be used to invalidate sample results.
- Invalidate nonrepresentative data or classify the data as questionable (qualitative). Only representative data will be used in subsequent data reduction and validation activities.
- Assure that representativeness is achieved through the mindful selection of methods and procedures used in the generation of data.

11.4 Comparability

Defined as the confidence with which one data set can be compared to another. Comparability is assessed by identifying pertinent data characteristics that may limit comparability to other sets. The determination of comparability will be done as follows:

- Assure measurements obtained during a pre-determined time frame are comparable through the use of SOPs and standard analytical procedures.
- Through the proper application of quarterly performance audits and annual system audits by the QA manager, comparability can be assessed. One data set generated by one analyst or instrument can be compared to another.
- Comparison with historic data from the sampling site.

Interpretative data will be assessed by cross-checking of data bases, data correlation and by independent review from an external source.

12.0 QUALITY ASSURANCE REPORTS

Laboratory QA reports will be submitted to the Manager of Technical Services on both an informal and a formal basis. Informal QA reports will be submitted in response to internal and external system audits as well as for any corrective actions that require rejecting data or resampling. These informal QA reports will address all topics required to inform the Manager of Technical Services of the problems identified and their resolution.

Formal laboratory QA reports will be submitted to the Manager of Technical Services on a yearly basis. These QA reports will include an assessment of the data produced by the laboratory during the preceding quarter and year. The data quality will be judged in terms of its precision, accuracy, representativeness, completeness, and comparability.

Laboratory precision will be assessed as the RPD between duplicate sample and matrix spike sample set results as described in Section 7.0. Precision and instrument stability will also be demonstrated through the comparison of check standards. All precision data will be summarized in the report, including a discussion that indicates, for each analyte, the overall laboratory performance on precision for the year.

Laboratory accuracy will be assessed as percent recovery for matrix spike sample sets as described in Section 7.0. Additonally, laboratory accuracy will be assessed by an evaluation of all external performance audit results. All accuracy data will be summarized in the report, including a discussion that indicates the overall laboratory performance on precision for the year.

Laboratory representativeness will be assessed using the results of external system audits and internal QC samples. External system audits will be used to compare laboratory operations at KEL to other laboratories. QC samples will be assessed to determine how accurately the KEL data represent actual sample concentrations.

An assessment of laboratory completeness will be assessed by reporting the number of samples received for each analysis and the number of valid results reported for each analysis. Any problems identified in this completeness check will be addressed in the formal QA reports.

An assessment of the comparability of data produced at KEL will also be included in the QA reports. This assessment will summarize all data provided in the preceding year and will report any data that are not

comparable to the historical data. In addition, external audit sample results will be compared to results obtained for these audit samples at other laboratories.

13.0 CORRECTIVE ACTION

Corrective action procedures that might be implemented as a result of unacceptable quality control criteria or audit results will be developed on a case by case basis. The essential steps in corrective action system include:

- Identify and define the problem.
- Assign responsibility for investigating the problem.
- Investigate and determine the cause of the problem.
- Determine some type of corrective action to solve the problem.
- Assign and accept responsibility for implementing the corrective action.
- Identify person accepting responsibility for implementation.
- Verify that corrective action has eliminated the problem.

The need for corrective action is identified through standard quality control procedures, control charting and audits. The experienced analyst will often perform corrective action at the bench level because the common problems are often simplistic and involve the regular maintenance of instrumentation. Corrective action may include:

- Reanalyzing samples if holding times have not been exceeded or requesting resampling if holding times have been exceeded.
- Repairing or performing maintenance on equipment and instrumentation.
- Data rejection and reanalysis.
- Recalculation of results and/or change in formulas, etc.
- Preparing fresh calibration standards or QC check standards.

Corrective action is documented at the bench level by completing a Corrective Action Report Summary Form (included as Figure 13.1) and submitting it to the QA Manager for review and storage. Further, corrective action that is completed and is deemed to be related to data quality and production will be noted by the individual analyst in the appropriate logbook.

CA Report No._____

CORRECTIVE ACTION REPORT SUMMARY

Laboratory Group (circle one):

Inorganics **Wet Chemistry** **Sample Prep** **Other**

Description of Problem: _____

_____

_____

Corrective Action: _____

_____

Resolved (circle one): Yes No

Data Review Required: Yes No

_____ _____
Initiated By Date

_____ _____ Logged_____
QA Manager Date

Figure 13.1: Corrective Action Report Summary.

14.0 REFERENCES

1. U.S. Environmental Protection Agency, 1980, Interim Guidelines and Specifications for Preparing Quality Assurance Program Plans: QAMS-005/80, December.

2. U.S. Environmental Protection Agency, 1983, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80, February.

3. Kennecott Utah Copper Environmental Laboratory, 1995, Methods/SOPs Manual.

DISTRIBUTION

CHEMTECH · FORD
Quality Assurance Plan

Revision: 1/95

Chemtech Analytical Laboratory
Murray, Utah

Ford Analytical Laboratory
Salt Lake City, Utah

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APPENDIX I - TABLES AND FIGURES

MANAGEMENT SUMMARY

Chemtech Analytical Laboratory's primary mission is to provide for our customers accurate and precise data in a timely manner. This can only be achieved when every member of our staff has been trained in the principles of quality assurance, integrates this training into their professional attitudes and performance, and a program is in place to monitor the quality program.

The Quality Assurance program described in this manual has been designed to monitor the performance of every phase of our analytical services. It reflects our commitment to quality from the receipt of samples to the preparation of the final report.

Every laboratory report bears the signature of management and the assurance that the data presented meets our standards of quality and accuracy and that is supported by complete quality assurance documentation.

Sincerely,

Joel Workman
Laboratory Director

1.0 TITLE PAGE

CHEMTECH ANALYTICAL LABORATORY

QUALITY ASSURANCE PLAN

Approved by:

Joel Workman 5/5/95

Joel Workman Date

Lab Director

Russell Ruckman 5/5/95

Russell Ruckman Date

Quality Assurance Manager

2.0 QUALITY ASSURANCE PLAN DESCRIPTION

2.1 STATEMENT OF POLICY

The objective of the Chemtech Analytical Laboratory QUALITY ASSURANCE PLAN is to ensure that data generated at the laboratory are scientifically valid, defensible, are of known and documentable quality, and are usable for the intended purpose. The management of Chemtech Analytical Laboratory is dedicated to the production of high quality data for all programs in which the data will be used.

The overall effectiveness of the quality control program is dependent upon laboratory operations in accordance with a program which systematically assures the precision and accuracy of analyses. This system must detect errors, prevent the reoccurrence of error, and measure the degree of error inherent in the system. The administrative staff is committed to the generation of data of the highest quality possible, using standardized methodologies and a well-defined quality assurance program.

The validity of analytical data is dependent upon the use of currently recognized analytical methods and substantiated by the recording and reporting of laboratory results in a systematic, uniform, and permanent fashion. The standardization Standard Operating Procedures (SOP's) to EPA, ASTM, AOAC, or other standard methods of analysis allows our laboratory data to be consistent with other laboratories with comparable methodologies in place. Data evaluation is a joint effort between the analyst, supervisor, and Quality Assurance personnel. The analysts are responsible for reviewing personally generated data against historical and established reporting criteria. Supervisors evaluate and review data generated to determine if data meets requirements as established by historical QA/QC data.

The Laboratory Director manages the laboratory operations placing emphasis on implementation of systems that increase productivity while maintaining all QA/QC requirements. At his discretion, the Laboratory Director evaluates technical data and documentation within the laboratory in order to assess production and quality so that quality improvements can be made. The Laboratory Director also oversees laboratory operations. Data is reviewed and approved by a supervisor. The Laboratory Director, at his discretion, may also choose to exercise the right to review and approve any or all analytical data either on a spot check basis or as a permanent additional signature to be added to the required analytical review process.

The internal quality control checks in place help ensure the accuracy of data generated. Where applicable by approved methodology, standard calibration of analytical procedures is developed by preparing known concentrations of standards. Initial and continuing calibration factors can be checked against historical calibration factors. Instrument calibration is verified both initially and during sample analysis as the method allows. Internal standards and surrogates are used during analysis when appropriate for particular analytical procedures. Also, samples are spiked with standard reference materials and analyzed at a rate determined by the appropriate method. The calibration of all analytical equipment is performed by qualified staff according to published analytical methodology or manufacture's specifications on a scheduled, periodic basis. All materials used for instrument and equipment calibration are traceable to certified reference materials. Calibration routines are documented in equipment log books or on the associated printouts. Documentation includes, at a minimum, the date, time of analysis, calibration routine, and reference materials used. Equipment maintenance is performed on a scheduled basis according to specific manufacturer's requirements.

In addition to the internal quality control procedures, the laboratory will be participating in several programs externally. Analysis of EPA Round Robin Water Pollution and/or Water Supply studies are performed on a semi-annual basis, upon availability. The laboratory participates in the Utah State certification program, with performance evaluation samples analyzed periodically. Successful participation in these programs demonstrates that the internal quality-control measures in place allows analysts to generate accurate and reproducible data.

3.0 ORGANIZATION AND RESPONSIBILITY

3.1 THE CHEMTECH ORGANIZATION

Chemtech Analytical Laboratory specializes in chemical and bacteriological analyses. Chemtech offers a variety of analytical services, ranging from classical wet chemistry techniques to GC/MS and ICP analyses. This wide range of services can be applied to most environmental matrices including water, soil, sludge, non-aqueous liquids, and solids.

The laboratory's well-trained and dedicated staff, using current instrumentation, perform analysis in the support of the needs of it's clients. The Organizational Chart is located in Appendix I

3.2 KEY PERSONNEL AND RESPONSIBILITIES

The Laboratory management is responsible for the development, implementation, periodic review, and revision of the quality assurance program plan. The laboratory management and employee responsibilities include the following:

3.2.1 LABORATORY DIRECTOR

The Laboratory Director reports directly to the Company President and is a senior member of the management staff at the facility. In this capacity he:

- Oversees the overall operation of the laboratory
- Oversees Group Leaders and technical staff
- Reviews and approves all quality assurance and quality control policies
- Reviews and approves all new and existing analytical procedures
- Reviews quality assurance audits
- Reviews quality control audits
- Performs final review and approval of new laboratory projects including reports and documents

3.2.2 QUALITY ASSURANCE COORDINATOR

The Chemtech Analytical Laboratory Quality Assurance Coordinator reports directly to the Laboratory Director. The Quality Assurance Coordinator:

- Performs final QA review of analytical data.
- Independently audits the adherence of laboratory staff to laboratory QA policies
- Periodically introduces internal and external performance standards and system audits
- Evaluates quality control data to assure that established procedures and criteria are being followed
- Recommends policies and methods to improve QA/QC program
- Initiates and maintains certification programs
- Supervises quality control performance evaluations
- Compiles and submits Quality Assurance Plan

3.2.3 LABORATORY SUPERVISORS

Supervisors of the Metals, Organics, and Inorganics areas report directly to the Laboratory Director. Laboratory Supervisors:

- Review and approve analytical data generated within the area
- Develop and/or approve new methods and operating procedures
- Evaluate instrument and personnel needs
- Ensure the overall data quality within the area

3.2.4 TECHNICAL STAFF

- Report directly to assigned supervisor
- Perform duties in accordance with the Chemtech Analytical Laboratory QA Manual and appropriate methods

3.3 FACILITY DESCRIPTION

The Chemtech Facility (see appendix I) has been designed to optimize quality and productivity throughout the laboratory. Many features make this facility ideal for analytical testing. An open laboratory design allows for a smooth sample flow from receiving to controlled refrigerators and then to the bench for analysis. The placement of testing equipment and reagents is such that cross contamination is minimized. Deionized water and ultra-pure deionized water is supplied to several areas of the laboratory where necessary.

3.3.1 SAMPLE RECEIVING

The sample receiving area is designed to be an independent of other laboratory areas. The sample receiving area is designed with a convenient access from the out-of-doors. This access is controlled allowing security of the laboratory and sample storage. The sample receiving area is also used for preparing and shipping of containers to clients.

3.3.2 VOLATILES LABORATORY

The volatiles laboratory is located across the street from the main laboratory to eliminate solvent contamination from other areas of the laboratory. As with the main laboratory, access to this building is limited to authorized personnel. All GC/MS volatile work is performed in this area.

3.3.3 WET CHEMISTRY LABORATORY

The wet chemistry laboratory is the largest of the lab area within the building. The wet chemistry area is a single spacious open room equipped with several large benches for analytical work. Here, most inorganic analyses are performed. Conventional wet techniques such as are gravimetric, colorimetric, titrimetric are performed here.

3.3.4 AUTOMATED WET CHEMISTRY LABORATORY

The automated wet chemistry laboratory is dedicated to the methods of wet chemistry that lend

themselves to automation. This area is equipped with several feet of bench space and two segmented-flow analyzers and related equipment.

3.3.5 METALS ANALYSIS LABORATORY

The metals analysis laboratory contains all of the metals analysis equipment. Samples are prepared for metals analysis in the Wet Chem area thus reducing the possibility of instrument contamination. The metals laboratory has two large benches. The laboratory is designed for both ICP and GFAA instrumentation and supplies.

3.3.6 GC AND SEMI-VOLATILE GC/MS LABORATORY

The semi-volatile preparation laboratory is located adjacent to the Automated Wet Chemistry Area. The preparation lab contains one six foot standard fume hood and ample bench space for sample extraction.

The GC and Semivolatile GC/MS instrument laboratory has several benches with GC and GC/MS instrumentation and supplies. This lab has one four foot hood for sample preparation.

4.0 DOCUMENTATION AND RECORDS CONTROL

This section describes how the laboratory will control the issue and retrieval of all documents relating to the analytical and testing activities of the laboratory, to the control of quality of these activities and to the storage and security of the technical documentation generated by these activities.

The controls described in this section are limited to the documents and reports listed below, and do not affect documentation related to other laboratory management activities. Such document control procedures are described in other laboratory standard operating procedures.

The most important elements of the quality assurance program to which document control is applied include:

- -Sampling procedures
- -Calibration procedures
- -Analytical and test procedures
- -Data collection and reporting procedures
- -Auditing procedures
- -Computational and data validation procedures
- -The Quality Assurance Manual
- -Analytical and testing reports
- -Laboratory notebooks
- -Validation reports
- -Vendor and internal audit reports
- -Calibration and preventive maintenance records
- -Chain-of-custody documentation
- -Corrective Action Requests

The quality records listed above which are originated and maintained as hard copies will be retained for a period of five years in laboratory files. After a period of five years, they will be reviewed for disposition. Records generated by computer will be retained on electronic media for a period of five years.

The Quality Control Coordinator will maintain full control over the distribution of documents listed above. The Quality Control Coordinator is responsible for seeing that copies of obsolete documents are removed from points of use and are appropriately dealt with. He/she is also responsible for monitoring activity to ensure that approved changes are incorporated into the laboratory's routine work activity.

4.1 DOCUMENT CHANGES

A Request for changes to methods, sampling data sheets, or calibration instructions may be made by anyone, the request should be made in writing and submitted to the Laboratory Director. It must be approved by the Laboratory Director before the change is published and distributed.

Changes may be promulgated by the issue of entire new documents, of replacement pages thereto, or, in the case of corrections of errata, etc., by pen and ink posting on the original document.

The Quality Control Coordinator is responsible for distribution and retrieval of documents and for obtaining all required signatures.

All files, when not in use will be kept in secure area. Any changes to raw data, will be made with a single line drawn through the original entry. The new data is written in and initialed and dated by the person changing the data. Data corrected after a final report has been generated requires the generation of a new report which is marked "Corrected Copy" and submitted to the client.

4.2 MANAGEMENT OF THE QUALITY MANUAL

The purpose of this section is to define the tasks and responsibilities relating to the preparation, distribution, review, and maintenance of this Quality Manual.

The Quality Control Coordinator bears the primary responsibility for the preparation, issue, review, and upkeep of the Laboratory Quality Manual. He is assisted in this task by the Laboratory Director.

After the preparation of the manual, the Quality Control Coordinator is responsible for the initial distribution of

controlled copies of the manual. Controlled copies are serially numbered, and a distribution list is kept showing to whom each copy has been issued. The purpose of this control is to make sure that changes are distributed to recipients of the manual when necessary.

Uncontrolled copies of the manual may be distributed, from time-to-time to individuals or organizations outside the laboratory. These copies will not be numbered or logged and will not receive changes as they occur. Uncontrolled copies will be so marked.

5.0 QUALITY CONTROL CHECKS AND ROUTINES

The overall quality assurance objective is to provide defensible analytical data that is accurate, precise, comparable between laboratories. This data must also be statistically valid and properly documented. Quality analytical data is defined as data that accurately, precisely, and with the required sensitivity reflects the composition of the sample material received in the laboratory. The internal quality control proceeders described in this section are used to evaluate overall data quality

The quality control practices and frequencies described in this section will be used when not specifically described in the standard analytical method. As appropriate, all instrumentation and equipment will be calibrated prior to each use with certified standards. Type II ASTM grade water will be monitored to assure its quality for use in analytical procedures. Laboratory consumables such as reagents, glassware, and standards must meet method specification. Reagents and solutions will be labeled to indicate the contents, hazards, date of preparation, analyst, and expiration date. Preparation of primary standards, working standards, and solutions will be documented in appropriate log books noting stock solutions from which they were prepared. Glassware will be cleaned according to established procedures appropriate to the analysis being performed.

5.1 INSTRUMENT PERFORMANCE EVALUATION

All instrumentation must be evaluated through the use of an instrument performance evaluation standard and blanks before analysis can be initiated. Divergence from acceptable benchmark criteria requires correction before analyses can be performed. The instrument performance evaluation material may be a standard spiked into the solvent used for analysis. It is not extracted as if it were a sample.

5.2 METHOD BLANKS

Method blanks must be prepared with each batch of samples and analyzed to insure that sample contamination has not occurred. If blank analyses do not fall within acceptable limits, as noted in the method specific SOP, modification of reagents, or cleaning of glassware may need to be implemented. In addition to method blanks, reagent blanks shall be prepared whenever the lot number of a reagent used in the analysis has changed.

5.3 RECOVERY OF KNOWN ADDITIONS (MATRIX SPIKES)

Matrix spikes are employed to monitor recoveries and maintain extraction and/or concentration techniques at acceptable levels. This procedure provides information about the effect of the sample matrix on the analyte in question. A ratio of one spike sample for each ten samples analyzed must be maintained. (In the event that an analysis will have less than ten samples one spike shall accompany the batch.) Consult the supervisor and/or the method SOP to determine the proper frequency. Solutions used to fortify samples should, when possible, be made from a source other than that from which the calibration standards are made. Percent recovery of matrix spikes is determined using the following:

$$\text{Percent Recovery} = (SSR-SR)/SA \times 100$$

Where:

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

5.4 DUPLICATE AND MATRIX SPIKE DUPLICATE ANALYSES

Laboratory fortified blanks and duplicate fortified blanks must be prepared and analyzed for each ten samples. This procedure provides information regarding the precision of an analysis. (These sample types are not always possible due to the type of analysis, for example pH.) The relative difference between duplicate measurements is assessed using the following equation:

$$\text{Relative Percent Difference (RPD)} = |D_1-D_2|/ ((D_1 + D_2)/2) \times 100$$

Where:

D_1 = Sample Value

D_2 = Duplicate Sample Value

5.5 CALIBRATION

A calibration curve will established for each parameter using known concentrations of standards. Reportable analytical results are those within the range of the standard dilutions used. In general, values above the highest standard are not reported. The lowest reportable value is the MDL, provided that the lowest calibration standard is less than 10 times the MDL.

Instrumental calibration will be verified both initially and during sample analysis or at a rate that the established method requires. The continuing calibration (may be substituted by the check standard) is made with standards independent from that used for instrumental calibration. The calibration check must agree within established limits with the calibration or the instrument is recelebrated. Continuing calibration standards must agree within established limits of calibration. If not, the cause of the discrepancy is identified, corrected and documented.

5.6 CALIBRATION CHECK SAMPLE

A calibration check sample is a well-characterized material that is run with each batch of samples, at a minimum. The material may be a standard spiked into reagent water, a material obtained from an outside source e.g. EPA. This sample is used by the laboratory to assess the performance of the method, the check sample is run as if it were a sample. If the results of the analysis are not within acceptable limits, the batch is rejected. A calibration check solution or sample material should be analyzed at least every day of analysis to show that calibration and standardization of instrumentation is within acceptable limits. This procedure informs the laboratory that prescribed precision and accuracy are being maintained.

6.0 DATA REDUCTION, VALIDATION, AND REPORTING

Data validation is the process in which data are checked and accepted or rejected based on a set of criteria. Validation is performed to isolate spurious values since such values are not automatically rejected. Records of invalid data found will be retained in accordance with established records retention policies.

The validation process can be manual or computerized. Validation methods will include review by supervisors as well as comparison with criteria by computer. Criteria will depend on the types of data and on the purpose of the measurement. Various statistical techniques are useful. Periodic checking of manually reduced data is imperative.

6.1 DATA REDUCTION

The amount and scheme of data reduction is dependent on the specific method of analysis. Analytical procedures specify the means by which raw data obtained during analysis is reduced to produce the final analytical result.

6.2 DATA VALIDATION

Data integrity generated during sample collection, laboratory analysis and reporting will be validated using the following systematic approach.

6.2.1 Field and sample information will be audited for completeness and accuracy including specific evaluation of the chain-of-custody procedures, documentation, and the sample log-in procedure.

6.2.2 All data and supporting documentation generated for reporting purposes will be examined for accuracy, precision and comparability according to the criteria (spike, duplicate spike, control standards, etc.) described in this manual.

6.2.3 Data validation will be a joint effort of the analyst, the supervisor, and the Quality Assurance Unit under the review of the Laboratory Director with the following established responsibilities:

6.2.3.1 The analyst will be responsible to review personally generated data against historical and established reporting criteria. Any data not meeting requirements will either be reanalyzed or will be explained (in the event of a legitimate excursion from acceptance criterion).

6.2.3.2 The supervisor will be responsible for all data generated in their group to assure that all operational criteria for data reporting have been met prior reporting.

6.2.3.3 The Quality Assurance Unit will be responsible for an spot check audit review of reported data, and for a ongoing review of all operational QA procedures to assure that they are current, appropriate, and meet regulatory and laboratory needs.

7.0 CONTROL CHARTS

Control Charts will be maintained to monitor the analysis of duplicates, laboratory control sample results and spike recoveries for a given method and parameter. Acceptance limits for these quality control parameters are set by program limits or, in their absence, the standard deviation (SD) is used to calculate and set the control limit. In cases where the acceptance limits are set by the monitoring program, control charts will be used to monitor the analytical system and take necessary corrective action.

When generating control charts, limits will be set using the previous 100 data points, if available. Where possible, control charts and the associated acceptance criteria will be available to the analyst at the time of data reduction. This will enable the analyst to make immediate corrective action when QC data falls outside established control limits.

7.1 DUPLICATES AND SPIKE DUPLICATES

The relative percent difference between duplicate sample analysis or duplicate spike analysis must range between ± 2 standard deviations (SD) of historical relative percent difference (RPD) when method specified criterion are not available. It is recognized that this will not always be achievable due to matrix effects. If a matrix effect if conformed, the data will be reported and an explanation concerning the problem will be noted on the final report.

7.2 SPIKE RECOVERIES

Percent spike recoveries range between ± 3 standard deviations (SD) of the historical percent recoveries when method specified criterion are not available. It is recognized that this will not always be achievable due to matrix effects. In that case, the data will be reported and an explanation concerning the problem made.

7.3 CONTROL STANDARDS

Laboratory control standards must agree within ± 2 standard deviations of the historical data base or no greater than ± 20 percent of the true value. Where method specific ranges exist, they may be used.

8.0 CORRECTIVE ACTION

All data is evaluated, as described above, to determine precision and accuracy. This information, as well as the method blank and other information, is to be used to validate the quality of the data that is reported. Each laboratory analyst is responsible for tracking data performance and reporting criteria. When data falls outside of the established control limits or acceptance limits for a given method, that information is evaluated and corrective action taken.

8.1 ACTION LIMIT DEFINITION

Action limits are associated the analysis of blanks, duplicate samples, spikes, duplicate spikes, and/or control samples, as described elsewhere in this document.

8.2 SYSTEMATIC CORRECTIVE ACTION

To establish corrective action criteria the following action system will be used:

1. Establish the need for corrective action based on action criteria
2. Define the problem
3. Define the responsible party for action
4. Follow corrective action procedures
5. Verify with laboratory control samples that the method is in control
6. Reanalyze samples analyzed during out of control period
7. Document the problem, the samples affected, and the corrective action taken

Specific protocols to reestablish control are outlined in the method SOP documentation. Each analytical section dependent on the type of method, type of instrumentation and sample type received will have different operational methods to reestablish control.

9.0 SAMPLE HANDLING, STORAGE AND SHIPPING

The purpose of this section is to describe the duties and responsibilities of the Quality Control Coordinator and Sample Receiving Clerk with respect to shipping, packaging, handling and storage of samples. It also provides guidance in making decisions pertinent to the validity and acceptability of samples submitted for testing or analysis. While it is particularly pertinent to samples submitted to the laboratory for chemical analysis, its principles apply broadly to all types of samples, the goal being the preservation of the integrity of the sample. It is applicable to all in-house and contract laboratory activities dealing with the handling of samples.

9.1 PHYSICAL CONDITION OF SAMPLE CONTAINER

Physical damage to the sample container may be the fault of the carrier due to abusive handling or may be the fault of the sender because of faulty packaging. If damage to the container is evident, the package will be carefully opened and its contents inspected. In the event of damage to the sample because of damage to the shipping container, the sender will be notified and the invalid sample discarded. Where contract laboratory samples are involved, it will be the responsibility of the contractor to notify the Quality Control Coordinator concerning any suspect samples. He will then contact the sender and make any necessary decision regarding sample disposition.

9.2 SAMPLE INTEGRITY

Sample integrity refers to the cumulative end result of those factors which contribute to the overall validity of a sample. Sample integrity is promoted and preserved by adhering to adequate custodial, handling, and identification procedures by those individuals collecting the samples, up to the point of receipt of samples by the laboratory. When the samples are received for testing or analysis they are checked for:

1. Physical damage to samples because of inadequate packing and protection
2. Loss of samples because of inadequate or improper sealing. This includes leakage of liquids from vials, loss of particulate material from filters or containers, inadequate sealing of solid sorbent sampling tubes, etc.
3. Contamination of samples due to inadequate separation of sample types or bulk sampling materials.

An example is collected airborne vapor samples shipped in the same container with bulk liquid organics

4. Improper use of special shipping procedures designed to preserve the samples at temperatures other than ambient. This applies to those samples such as drinking water, food, samples for the analysis of organic compounds, pesticides, which must be shipped cold and by express carrier. Most violations will result in the need to determine the loss of integrity and a decision regarding the disposition of the sample.

9.3 SHIPMENT OF SAMPLES

When shipping samples:

1. Check the method to determine if Packing and Shipping Instructions are included. If so, follow the instructions given.
2. Divide samples into appropriate and compatible shipping groups. Liquids will be kept separate from other materials.
3. Select appropriate shipping container and packing material.
4. Make sure that the sample is properly and accurately identified and that all necessary paperwork accompanies the shipment.

9.4 SAMPLE IDENTIFICATION

A basic requirement of sample integrity is accurate sample identification. Samples that cannot be related to an associated Analysis Request Form because of inadequate, ambiguous, or non-existent labeling, will be discarded unless the requestor is able to provide immediate identification. Only under those circumstances where sample identification is fairly obvious, will laboratory personnel make a special effort to identify and correlate unidentified samples.

9.5 SAMPLE HOLDING TIME

Official methods (EPA or State) prescribe maximum holding times for many parameters. An example of the holding times prescribed is found in Appendix I. For more recent information see the appropriate method or

federal register citation. Samples received outside those holding times are so marked and the client is contacted as to disposition.

10.0 SAMPLE CUSTODY

Sample custody and document control encompasses the means by which Chemtech Analytical Laboratory track work performed on a sample from sample receipt, through analysis, to sample disposal. In general, Chemtech Analytical Laboratory will track and manage operations as follows:

10.1 SAMPLE RECEIPT AND LOG IN

The laboratory's sample custodian is responsible for sample receipt, log-in procedures, and documentation.

1. Upon receipt of samples in the laboratory, the sample custodian will complete sample log-in and assure completeness and accuracy of all associated documentation.
2. Sample numbers will be assigned as described by the standard operating procedure for sample receipt.

10.2 LABORATORY CUSTODY/RECEIVING

The following steps are taken when samples are received.

1. Examination of shipping container. Note the presence or absence of labels and other required information as set forth in the SOP for sample receiving.
2. Unpackage samples, noting any damage on the sample receiving paperwork. Make sure that the number of samples match any shipping documents such as chain-of-custodies or other documentation.
3. Login the sample as appropriate and assign the laboratory number according to the SOP for sample receiving.
4. Determine the storage unit, into which the sample will be placed, and log it into that area.
5. Give any accompanying paperwork to the data management group so that entry into the tracking system may occur.

10.3 CHAIN OF CUSTODY AND SAMPLE STORAGE

The sample custodian will be responsible for initial transfer of custody from receipt into the laboratory on

all samples. Sample storage will be assigned. The laboratory does not normally follow internal chain-of-custody procedures in handling routine samples received for testing or analysis. The submitter is responsible for determining the necessity for chain-of-custody procedures for a particular sample or sample set.

The Internal Chain-Of-Custody Documentation Form (Appendix I) will be used as the chain of custody record unless the client has a form they wish to use, when a chain of custody is required.

10.4 SAMPLE DISPOSITION

When the laboratory groups have completed the work on a sample, the sample custodian is responsible for appropriate archiving and sample disposition. Sample disposition will follow the SOP for sample receiving.

11.0 CONTROL OF MEASURING AND TEST EQUIPMENT

This section is written to assure that only gages and instruments which are properly and currently calibrated are used in making determinations, the results of which are recorded and reported.

The calibration of laboratory instruments falls into two categories: calibration which is conducted on a routine basis as part of the analytical procedure prior to each use; and periodic, scheduled calibration of instruments and gages against known standards to ensure the continuing precision and accuracy of such instruments.

11.1 Calibration. At least three different concentrations in non-interfering matrices, that span the range of expected sample values are analyzed and plotted. The lowest concentration must be within 2 to 10 times the minimum detection limit for the procedure. A linear regression calculation defines the calibration curve. A correlation coefficient of better than 0.995 constitutes an acceptable calibration. Specific calibration requirements are included in SOP's and Official Method documentation which may augment this definition. (In some cases, the method may allow for significantly different calibration schemes, such as in the case of ICP work. In these cases, the analytical method will take precedence.)

11.2 Calibration Policy. The calibration policies and procedures set forth in this section apply to all instruments requiring scheduled calibrations against traceable standards, including:
Analytical and test equipment in the laboratory, Flow rate (e.g., rotameters), volume (e.g., dry gas meters), pressure, vacuum and temperature measurement equipment, balances, pH meters, meters, etc.

Transfer standards will have greater accuracy then that of field and laboratory instruments and gages. For example, a thermometer used in the field to determine air temperature, having a specified accuracy of + or - 2 degrees F, will be calibrated against a laboratory thermometer with an accuracy of + or - 0.5 ° F.

The Standards used in the laboratory measurement system will be calibrated against higher-level, primary standards having unquestionable accuracy. These higher-level standards will be certified by NIST or other recognized standardization bodies.

Calibration standard reagents purchased from commercial vendors will be required to have a certificate of analysis. Whenever a certified, calibration standard is available from NIST, commercial vendors will be required to establish traceability of the certificate of analysis to the certified standard.

11.3 ENVIRONMENTAL CONDITIONS

Measuring and test equipment and calibration standards will be calibrated in an area that provides control of environmental conditions to the extent necessary to assure required accuracy and precision. The calibration area will be kept reasonably free of dust, vapor, and vibration; and it will be remote from or shielded from equipment producing noise, vibration, chemical or micro-wave emissions, etc.

11.4 ELECTRIC POWER

The quality of the electric power furnished by the local utility company has been found to be satisfactory except that some computer equipment may be protected with surge protectors and some data storage equipment may be protected with battery back-up.

11.5 LIGHTING

Adequate lighting will be maintained at work bench areas.

11.6 CALIBRATION INTERVALS

All calibration standards and instruments and gages will be assigned an established calibration interval. In the absence of an established interval based on the equipment manufacturer's recommendations, an initial calibration period will be assigned by the Quality Control Coordinator. The calibration intervals will be adjusted from time-to-time, based on experience gained through use over a period of time, as evidenced by data from gage calibration records. The calibration intervals will be specified in terms of time or, in the case of certain types of measuring and test equipment, usage cycles, or usage periods.

11.7 TEMPERATURE

The effect temperature may have on most analytical results mandates that all thermometers used in the laboratory used in the laboratory are calibrated against NIST traceable standards at least semi-annually.

11.8 LABELING

Some equipment to be calibrated will have affixed to it in plain sight, on the instrument itself, or its container, a tag or label. This label is to be filled out in the following manner: (1) enter the name of the person performing the calibration service. (2) Enter the date the calibration was performed. (3) enter the date that the next calibration service is due, based on information from the Calibration Record and the Calibration Frequency schedule below.

EQUIPMENT CALIBRATION SCHEDULES

EQUIPMENT TYPE	CALIBRATION ACTION	FREQUENCY	RECORDS LOCATION
Balances	Check Calibration	Monthly	Balance Log
	Service & Clean	Yearly	Balance Log
Thermometers	Check Calibration	Six Month	Thermometer Log
pH Meters	Check Calibration	Monthly	pH Meter Log
Reagent Water	Complete Analysis	Monthly	Water Quality Log

12.0 REAGENT AND WATER QUALITY

This section describes the procedures for including technical and quality requirements in purchase orders and for marking, receiving, and storing reagents, chemicals, and testing supplies and materials. This section deals only with supplies and materials used in testing and analytical work. It is not concerned with test or analytical samples or testing equipment.

12.1 LABORATORY WATER

In any laboratory, an adequate supply of purified water is an absolute necessity. Water containing even traces of metals or organic matter may cause inaccurate analyses. The accuracy of the results obtained at Chemtech Analytical Laboratory depends on the quality of water being used. A central deionizing system is located in the laboratory. Point of use double deionizing systems capable of removing trace level organics are found in areas requiring higher quality water than the central system. The laboratory is dedicated to using only water of high quality for all analytical testing. The water is tested on a monthly basis and these records are kept on file.

12.2 VENDOR QUALITY

A vendor of testing or analytical supplies and materials is regarded as a resource to and an extension of the laboratory organization. The standards for quality, therefore, imposed on vendors are the same as those self-imposed on the laboratory.

Analysts must ensure that the material received is properly identified and that the reagent meets or exceeds method requirements.

12.3 CONTROL OF INCOMING MATERIALS

The Laboratory Receiving Clerk segregates incoming reagents, analytical and testing materials, and verifies that the material description and quantity received matches the receiving document (packing list). He/she then signs and dates the document and returns it to the purchasing department where it is compared with the

original purchase order. Reagents are marked with date received and date opened. Materials having a finite shelf-life are plainly marked with an expiration date. Before use, containers are checked to make sure that expiration dates are not exceeded.

13.0 ANALYTICAL PROCEDURES

The validity of controlled analytical performance is dependent upon the use of currently recognized analytical methods and substantiated by the recording and reporting of laboratory results in a systematic, uniform, and permanent fashion.

Analytical procedures used by the laboratory are referenced to accepted methods and/or standard operating procedures whenever possible.

Due to the continuing changing nature of the work at Chemtech Analytical Laboratory, a comprehensive listing of all method performed is not possible. The laboratory will have available copies of all methods cited for an analysis. Along with these methods will be any associated SOP's and detection limit procedures where applicable.

14.0 PERFORMANCE AND SYSTEM AUDITS

14.1 PERFORMANCE AUDITS

An extensive quality assurance program, being developed at Chemtech Analytical Laboratory, requires that an internal quality control sample, a blank, a duplicate sample, and a fortified sample be analyzed according to specified frequency. Results of these analyses are documented on control charts on a daily basis.

Quality control charts are reviewed by the analyst, supervisor, Quality Assurance Coordinator, and Laboratory Director as necessary. In this way, trends in the quality control data are examined and addressed. This continual examination and evaluation of quality control data ensures sample data of high quality.

External reference materials (usually WS or WP audit samples) for each method are analyzed several times each year. Reference materials can also be purchased from vendors such as NIST, ERA, or EPA. Results of these analyses are documented comparing certified values and target ranges to actual results.

15.0 PREVENTIVE MAINTENANCE

Chemtech Analytical Laboratory recognizes that the best analytical can only be obtained from instruments that are well calibrated and maintained properly. Chemtech Analytical Laboratory maintains service contracts on many critical instruments. Manufacturers' instrument maintenance manuals are kept on file for quick reference. The service agreements provide for regular checks by qualified service personnel on a "real time" basis. This helps minimize down time and helps assure that scheduled completion dates are met.

All instruments and equipment will be maintained according to specific manufacturer's requirements. Regularly scheduled maintenance will be performed by trained analysts or manufacturer service representatives. Instrumental maintenance shall include, as needed, repairs, parts, replacements, and cleaning. To minimize instrument downtime, laboratories will maintain a wide inventory of parts and supplies for all instrumentation.

Instrument and equipment maintenance log books will accompany all instruments and equipment. Each log book will contain the following information:

- Preventive Maintenance - scheduled and unscheduled
- Repairs - scheduled and unscheduled
- Operator comments
- Date
- Analyst

One invaluable tool in the early diagnosis of instrument problems is the use of the instrument performance evaluation sample. By tracking this closely, an experienced analyst develops the ability to determine deterioration in the system on a timely basis.

16.0 GLOSSARY

ACCURACY

Accuracy means the nearness of a result or the mean (x) of a set of results to the true value. Accuracy is assessed by means of reference samples and percent recoveries.

AUDIT

A systematic check to determine the quality of operation of some function or activity. Audits may be of two basic types: (1) performance audits in which quantitative data are independently obtained for comparison with routinely obtained data in a measurement system, or (2) system audits of a qualitative nature that consist of an on-site review of a laboratory's quality assurance system and physical facilities for sampling, calibration, and measurement.

COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another.

COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

DATA QUALITY

The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.

DATA VALIDATION

A systematic process for reviewing a body of data against a set of criteria to provide assurance that the data is adequate for its intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification, and review.

PERFORMANCE AUDITS

Procedures used to determine the accuracy of the total measurement system or its component parts.

PRECISION

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the prescribed similar conditions.

QUALITY ASSURANCE

The total integrated program for assuring the reliability of monitoring and measurement data. A system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.

QUALITY ASSURANCE PLAN

An orderly assemblage of management policies, objectives, principles, and general procedures by which an agency or laboratory outlines how it intends to produce data of known and accepted quality.

QUALITY CONTROL

The routine application of procedures for obtaining prescribed standards of performances in the monitoring and measurement process.

REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

STANDARD OPERATING PROCEDURES (SOP)

A written document which details an operation, analysis or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks.

17.0 REFERENCES

1. USEPA SW 846 Methods for Evaluating Solid Waste, Third Edition

2. American Society for Testing and Materials, 1984

3. QAMS - 005/80, Interim Guidelines and Specifications for preparing Quality Assurance Project Plans, USEPA Office of Monitoring Systems and Quality Assurance, December 1980

4. Quality Assurance Plan - Critical Items, State of Utah Department of Health

5. RCRA Quality Assurance Workshop - Outline of Mandatory and Recommended QA Practices - Chapter ONE of SW - 846, July 1990

6. Standard Methods for the Examination of Water and Wastewater, 18th Edition

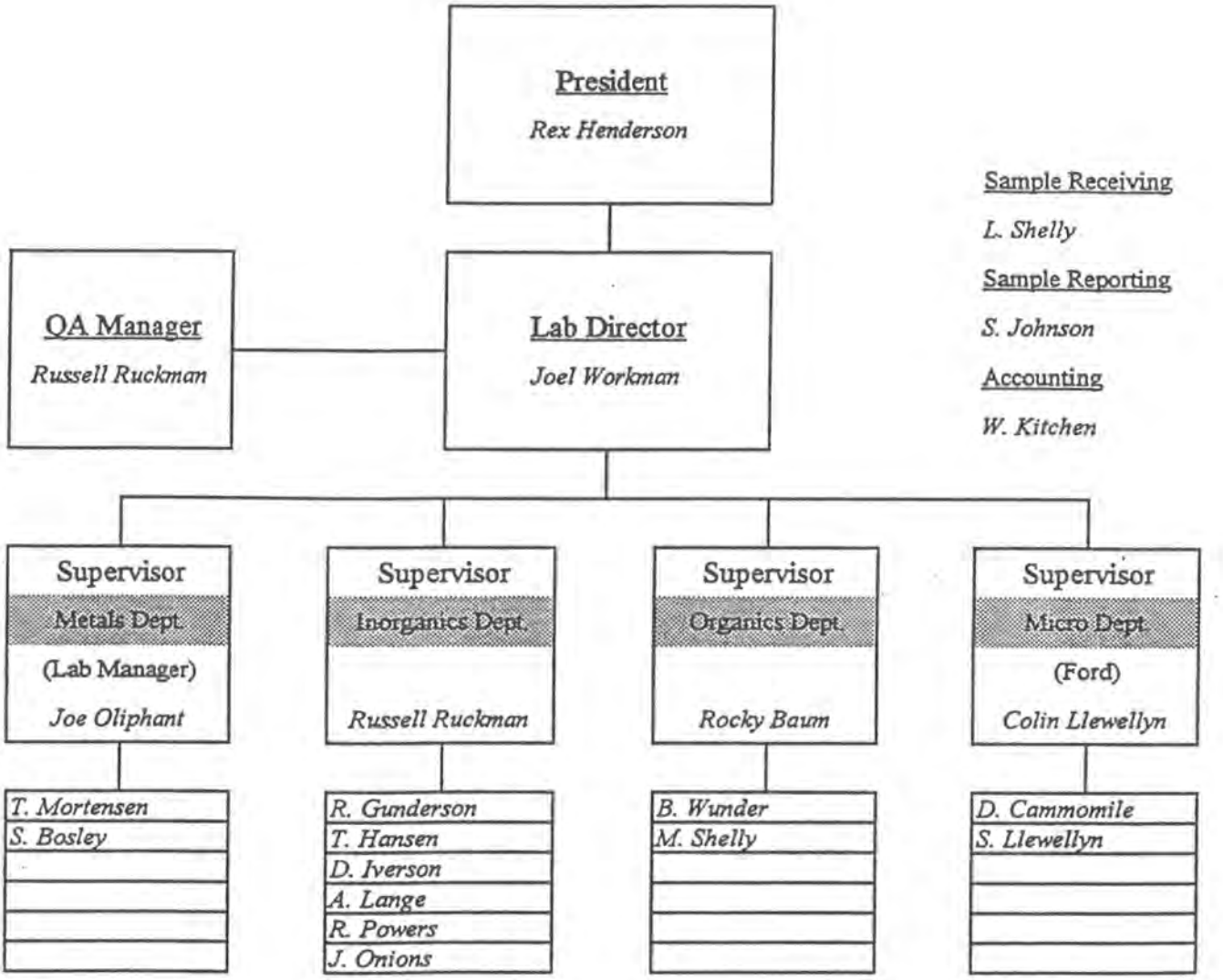
APPENDIX 1

APPENDIX I - TABLES AND FIGURES

1. Chemtech Organizational Chart
2. The Chemtech Facility Map
3. Analysis Request Form
4. Sample Holding Times
5. Internal Chain-of-Custody Form

ORGANIZATIONAL CHART

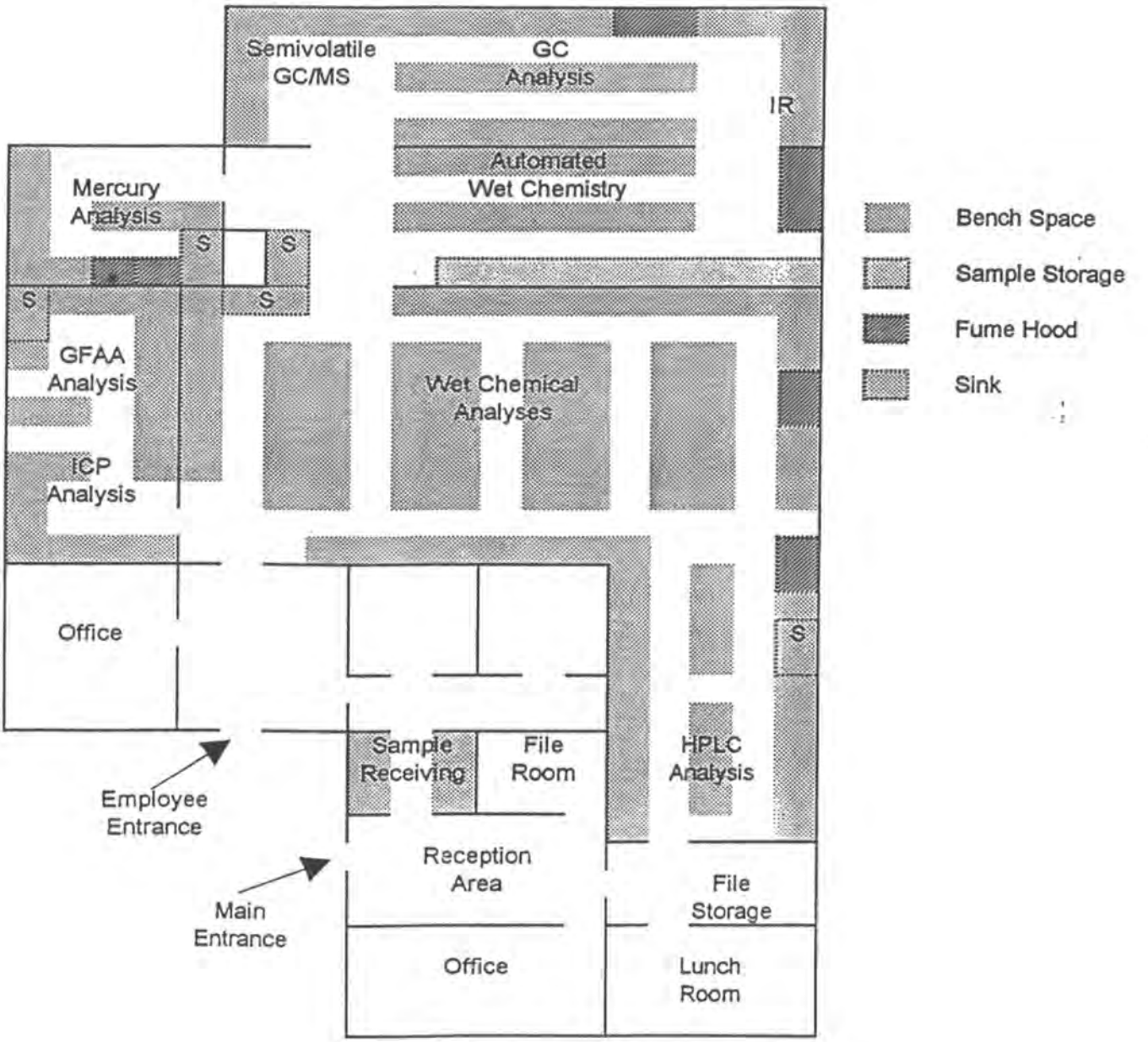
CHEMTECH ANALYTICAL LABORATORY, 1/95



ANALYTICAL FACILITIES

CHEMTECH ANALYTICAL LABORATORY, 1/95

Main Laboratory

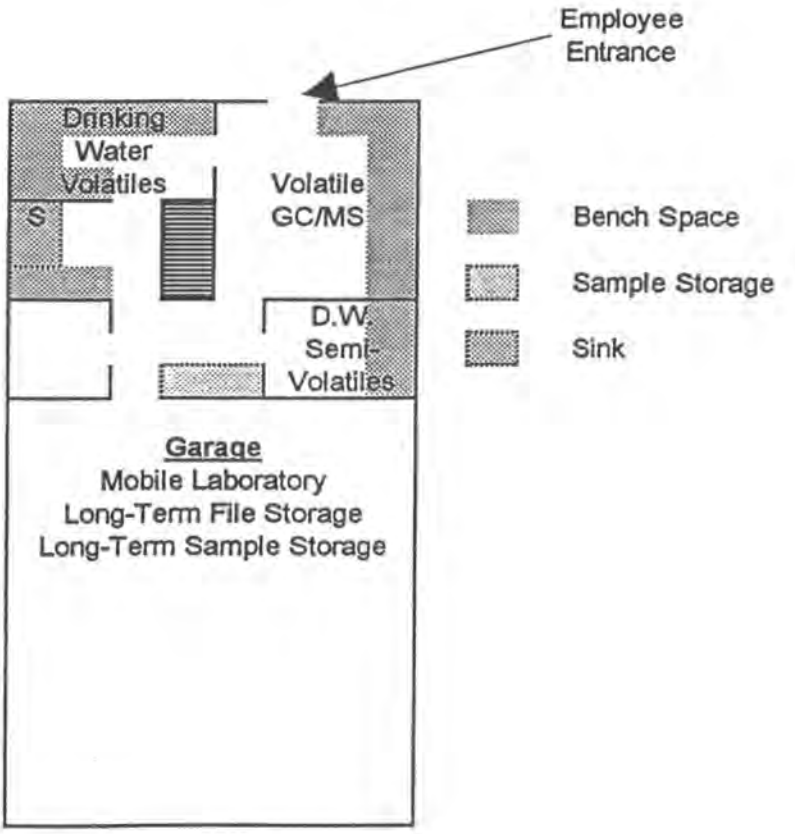


ANALYTICAL FACILITIES

CHEMTECH ANALYTICAL LABORATORY, 1/95

Volatiles Laboratory

Main Floor



ANALYSIS REQUEST FORM

COMPANY: _____ COMPANY CONTACT: _____

ADDRESS: _____ PROJECT ID: _____

CITY/STATE/ZIP: _____ P.O. #: _____

PHONE #: _____ FAX #: _____ TURNAROUND REQUIRED* _____

*expedited turnaround subject to additional charge

SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	Number of Containers	MATRIX: Drinking Water	Water	Soil / Solid (circle)	Sludge	Oil	Other (specify)	ANALYTES REQUESTED																					
1.																															
2.																															
3.																															
4.																															
5.																															
6.																															
7.																															
8.																															
9.																															
10.																															

Sampled by: (print)	Sampled by: (signature)	Comments

Special Instructions: _____

Relinquished by: (signature)	Received by: (signature)	Date/Time	Comments
Relinquished by: (signature)	Received by: (signature)	Date/Time	Comments
Relinquished by: (signature)	Received by: (signature)	Date/Time	Comments

TABLE 1060:I. SUMMARY OF SPECIAL SAMPLING OR HANDLING REQUIREMENTS*

Determination	Container	Minimum Sample Size *mL*	Preservation	Maximum Storage Recommended/ Regulatory†
Acidity	P, G(B)	100	Refrigerate	24 h/14 d
Alkalinity	P, G	200	Refrigerate	24 h/14 d
BOD	P, G	1000	Refrigerate	6 h/48 h
Boron	P	100	None required	28 d/6 months
Bromide	P, G	—	None required	28 d/28 d
Carbon, organic, total	G	100	Analyze immediately; or refrigerate and add HCl to pH<2	7 d/28 d
Carbon dioxide	P, G	100	Analyze immediately	stat/N.S.
COD	P, G	100	Analyze as soon as possible, or add H_2SO_4 to pH<2; refrigerate	7 d/28 d
Chlorine, residual	P, G	500	Analyze immediately	0.5 h/stat
Chlorine dioxide	P, G	500	Analyze immediately	0.5 h/N.S.
Chlorophyll	P, G	500	30 d in dark	30 d/N.S.
Color	P, G	500	Refrigerate	48 h/48 h
Conductivity	P, G	500	Refrigerate	28 d/28 d
Cyanide:				
Total	P, G	500	Add NaOH to pH>12, refrigerate in dark	24 h/14 d; 24 h if sulfide present
Amenable to chlorination	P, G	500	Add 100 mg $Na_2S_2O_3$/L	stat/14 d; 24 h if sulfide present
Fluoride	P	300	None required	28 d/28 d
Hardness	P, G	100	Add HNO_3 to pH<2	6 months/6 months
Iodine	P, G	500	Analyze immediately	0.5 h/N.S.
Metals, general	P(A), G(A)	—	For dissolved metals filter immediately, add HNO_3 to pH<2	6 months/6 months
Chromium VI	P(A), G(A)	300	Refrigerate	24 h/24 h
Copper by colorimetry*				
Mercury	P(A), G(A)	500	Add HNO_3 to pH<2, 4°C, refrigerate	28 d/28 d
Nitrogen:				
Ammonia	P, G	500	Analyze as soon as possible or add H_2SO_4 to pH<2, refrigerate	7 d/28 d
Nitrate	P, G	100	Analyze as soon as possible or refrigerate	48 h/48 h (28 d for chlorinated samples)
Nitrate + nitrite	P, G	200	Add H_2SO_4 to pH<2, refrigerate	none/28 d
Nitrite	P, G	100	Analyze as soon as possible or refrigerate	none/48 h
Organic, Kjeldahl	P, G	500	Refrigerate; add H_2SO_4 to pH<2	7 d/28 d
Odor	G	500	Analyze as soon as possible; refrigerate	6 h/N.S.
Oil and grease	G, wide-mouth calibrated	1000	Add H_2SO_4 to pH<2, refrigerate	28 d/28 d
Organic compounds:				
Pesticides	G(S), TFE-lined cap	—	Refrigerate; add 1000 mg ascorbic acid/L if residual chlorine present	7 d/7 d until extraction; 40 d after extraction
Phenols	P, G	500	Refrigerate, add H_2SO_4 to pH<2	*/28 d
Purgeables by purge and trap	G, TFE-lined cap	50	Refrigerate; add HCl to pH < 2; add 1000 mg ascorbic acid/L if residual chlorine present	7 d/14 d
Oxygen, dissolved:	G, BOD bottle	300		
Electrode			Analyze immediately	0.5 h/stat
Winkler			Titration may be delayed after acidification	8 h/8 h
Ozone	G	1000	Analyze immediately	0.5 h/N.S.
pH	P, G	—	Analyze immediately	2 h/stat
Phosphate	G(A)	100	For dissolved phosphate filter immediately; refrigerate	48 h/N.S.
Salinity	G, wax seal	240	Analyze immediately or use wax seal	6 months/N.S.
Silica	P	—	Refrigerate, do not freeze	28 d/28 d
Sludge digester gas	G, gas bottle	—	—	N.S.
Solids	P, G	—	Refrigerate	7 d/2–7 d; see cited reference
Sulfate	P, G	—	Refrigerate	28 d/28 d
Sulfide	P, G	100	Refrigerate; add 4 drops 2N zinc acetate/100 mL; add NaOH to pH>9	28 d/7 d
Taste	G	500	Analyze as soon as possible; refrigerate	24 h/N.S.
Temperature	P, G	—	Analyze immediately	stat/stat
Turbidity	P, G	—	Analyze same day; store in dark up to 24 h, refrigerate	24 h/48 h

* See text for additional details. For determinations not listed, use glass or plastic containers; preferably refrigerate during storage and analyze as soon as possible. Refrigerate = storage at 4°C, in the dark. P = plastic (polyethylene or equivalent); G = glass; G(A) or P(A) = rinsed with 1 + 1 HNO_3; G(B) = glass, borosilicate; G(S) = glass, rinsed with organic solvents; N.S. = not stated in cited reference; stat = no storage allowed; analyze immediately.

† Environmental Protection Agency, Rules and Regulations, *Federal Register* 49; No. 209, October 26, 1984. See this citation for possible differences regarding container and preservation requirements.

★ CHEMTECH ★
Analytical Laboratory

6100 S. Stratler, Murray, UT 84107
Ph: (801)262-7299, Fax: (801)262-7378

INTERNAL CHAIN OF CUSTODY

Date Received:		Lab Numbers:
Storage Date/Time:		
Placed in Storage By:		

Sample Identification	Date	Analyst	Parameters	Time Out	Time In	Remarks
			Disposal Date:			
			Disposed By:			

ATTACHMENT 2

KENNECOTT UTAH COPPER CORPORATION **CHAIN OF CUSTODY** **ENGINEERING SERVICES/PLANT PROJECTS GROUP**

PROJECT CODE/NAME	PO #	PPG1144

LAB ID (lab use only)	SAMPLE ID	CONTROL #	DATE COLLECTED	TIME	SAMPLE TYPE / # OF CONTAINERS			FIELD PARAMETERS					ANALYSIS REQUESTED
					Soil	Water	Other	pH	Cond.	Temp.	Eh		

SAMPLER'S SIGNATURE:_____ LAB SUBMITTED TO:_____

REPORT RESULTS TO:_____ PHONE #:_____ FAX #:_____

SURRENDERED BY:_____ RECEIVED BY:_____ DATE/TIME:_____

SURRENDERED BY:_____ RECEIVED BY:_____ DATE/TIME:_____

SURRENDERED BY:_____ RECEIVED BY:_____ DATE/TIME:_____

COMMENTS:_____

WHITE COPY: LAB/SAMPLES YELLOW COPY: PPG PINK COPY: SAMPLER

5

Cardinal.

APPENDIX D
(Attached as Individual Binder)

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 399181

SITE NAME: KENNECOTT NORTH

DOCUMENT DATE: 09/30/1996

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☑ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☐ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

MAP - REFINERY AREA DEMOLITION SITES 503-T-0216
MAP - ARTHUR STEP-BACK REPOSITORY SITE PLAN 505-T-0152
MAP - CORRECTIVE ACTION MANAGEMENT UNITS 505-T-0185
MAP - CORRECTIVE ACTION MANAGEMENT UNITS 503-T-0212

Contact the Superfund Records Center to view available document.
(303) 312-6473