# FIVE-YEAR REVIEW REPORT

# KENNECOTT NORTH ZONE SUPERFUND SITE

# APPENDIX B: SITE INSPECTION PHOTOGRAPHS

Photo No. 1- OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is the reclaimed footprint of Waste Water Treatment Plant, which is used in part as a vehicle staging area. Other portions are left as open space. Footprint is partially vegetated on eastern portion (green and brown surface vegetation in the distance).

Photo No. 2 – OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is the reclaimed footprint of Waste Water Treatment Plant. Recent development activity includes the construction of two pipelines for Kennecott's MAP facility along the northern boundary of the WWTP footprint (black arrow denotes plastic marker placed along the pipeline alignment). Excavated soils were managed pursuant to the Moly Autoclave Process Pipelines Soil Management Work Plan, dated June 2011.

Photo No. 3 – OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is the reclaimed footprint of Former Sludge Pond B. The reclaimed footprint has been used as an egress/ingress corridor for the Magna Tailings Impoundment facility (located east of Former Sludge Pond B). The footprint is fairly well vegetated with grasses and phragmites on its western portion. Recent development activity included the construction of a pipeline from Kennecott's MAP facility along the central eastern portion of the former sludge pond (just to the west of the vehicular corridor from where the photo was taken). Soils excavated during the project were managed under the Former Sludge Pond B Site Soil Removal Work Plan, Kennecott North Zone Site, dated June 2011. The pipeline corridor is currently being revegetated. The subjects encircled in red are addressed in the caption for Photo No. 4.

Photo No. 4 – OU8, Waste Water Treatment Plant and Sludge Ponds. As noted in photo No. 3 (red circle) two Canadian Geese were observed near the eastern boundary of the pipeline corridor project. The red circle area is enlarged in this photo. Former Sludge Pond B is bounded along its eastern and northern boundary by the Smelter Return Canal. The footprint's topography is generally lower than the land immediately south and west. The area can support wetland vegetation in the spring, as evidenced by the phragmites (brown vegetation). With wetlands and canals nearby, waterfowl and other wetland avian species can at times be spotted in less frequently used portions of the Kennecott North Zone.

Photo No. 5 – OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is the eastern portion of the reclaimed footprint of Former Sludge Ponds C and C+ (or C – Extension). The footprint is well vegetated with grasses and other forbs. Former Sludge Ponds C and C+ are located in a natural bowl formed by the surrounding rising topography of the northern foothills of the Oquirrh Mountains. Soils are unconsolidated fill and lacustrine sediments which are able to trap surface water in the spring. The stands of phragmites (brown vegetation, black arrows) are the result of aerial deposition of seeds and are a sign of ponded or near surface water. Seeds are potentially sourced to phragmites in the Garfield Wetlands, located immediately west of OU8. Pond C+ begins to the east (view direction of the photo) of the larger stand of phragmites. The sediments of the upper slopes are unconsolidated, gravelly fill which could explain the lack of vegetative growth.

Photo No. 6 – OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is the western portion of the reclaimed footprint of Former Sludge Pond C. Similar to Photo No. 5, the surface of Former Sludge Pond C's western end is well vegetated. The soil has some gravel and cobbles mixed in, which could explain some of the bare patches. In the distance (to the southwest) are the Kennecott Refinery (OU14, black arrow) and new MAP facility (under construction, red arrow) at the Garfield Townsite.

Photo No. 7 – OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is a portion of the surface of the reclaimed Former Sludge Pond C. Though the individual was not observed during the site inspection, the track(s) of a mule deer or elk were observed in the soft topsoil of the sludge pond footprint. More likely these are the tracks of mule deer which are often seen frequenting the open space around Kennecott's north end operations. The resident elk herd tends to spend most of the year in the upper canyons of the Oquirrh Mountains, located behind the north end facilities (OU19).

Photo No. 8 – OU8, Waste Water Treatment Plant and Sludge Ponds. Pictured is the northwestern boundary of Former Sludge Pond C. Pictured is a remnant of the dike used to create the sludge pond (black arrow).

Photo No. 9 – OU9, Magna Soils. The Community of Magna, Utah is located immediately east of Kennecott's property boundary located along 9200 West, down gradient of the Bonneville Hillside (foreground) and Little Valley Canyon (black arrow, right side of the panorama). The panorama is aligned to show the community (foreground and background features may not line up). The Community of Magna is similar to other unincorporated areas within Salt Lake County, a mixture of residential, commercial and agricultural land use. The northern portion of the community (adjacent to Hwy-201, yellow arrow) still supports agricultural land use including livestock grazing. Kennecott's South Tailings Impoundment (red arrow) is located immediately north of the community on the north side of Hwy-201. The Bonneville Hillside supports the rail corridors of Kennecott's North End Rail Operations (OU24, not a part of this five year review).

Photo No. 10 – OU9, Magna Soils. An example of typical residential land use.

Photo No. 11 – OU9, Magna Soils. Foreground includes a school (background, right) and an apartment complex (foreground, left)

Photo No. 12 – OU9, Magna Soils. An example of typical pasture land used to support grazing horses and sheep.

Photo No. 13 – OU13, Smelter and Associated facilities. The current smelter (Outokumpu Smelter) is located at the mouth of Kessler Canyon on the range front of the Northern Oquirrh Mountains. Due to the current smelter (and its support facilities) having been constructed on the footprint of the two historic smelters there continues to be a need to manage soils (to manage exposure risk) during excavation projects. As shown here, the Outokumpu Smelter is located immediately south of Hwy-201 beyond which are the Garfield Wetlands (OU22), which in part includes the Hansen Springs area (red arrows) and Pond 8 (black arrow). I-80 (yellow arrow) is located immediately north of Pond 8, beyond which is the south shoreline of the Great Salt Lake (background). The topography gently slopes towards the Great Salt Lake. The footprint of the Smelter supports operations associated with the smelting of copper ores, with most of the surfaces covered in asphalt or concrete. There are some limited areas that are either vegetated or have surfaces of barren soil. Copper concentrate can be found along the edges of the roads, along rail sidings and in the rail yard pictured in the left side of the panorama. Slag from the furnaces is stockpiled and crushed prior to re-introduction to the smelting operation (see Photo No. 16).

Photo No. 14 – OU13, Smelter and Associated facilities. This panorama provides a view of the Smelter facilities from western bench above the smelter (near and far features may not line up). Noted facilities include the Slag Pot Cooling Area and Slag Mill (red arrows), Noranda Smelter Footprint (yellow arrows), Outokumpu Smelter(green arrow), Acid Tank Farm and Loading Station(orange arrow), and Praxair O2 Plant (blue arrow). Kessler Canyon (OU19), located south of the 1200 foot smokestack, curves south and east up into the Oquirrh Mountain range front (background, right); refer to Photos No. 54 – 60.

This panorama provides a great aerial photo of the Garfield Wetlands located between Hwy-201 and I-80 (refer to Photo No. 66), the south shoreline of the Great Salt Lake (background, left) and the nearby Salt Lake Marina (black arrow). Until operations cease, the footprint of the Smelter complex will continue to contain soils with the potential to exceed the Sites' industrial and unrestricted land use standards. Kennecott is managing excavated soils under the oversight of UDEQ when excavation projects take place at the facility.

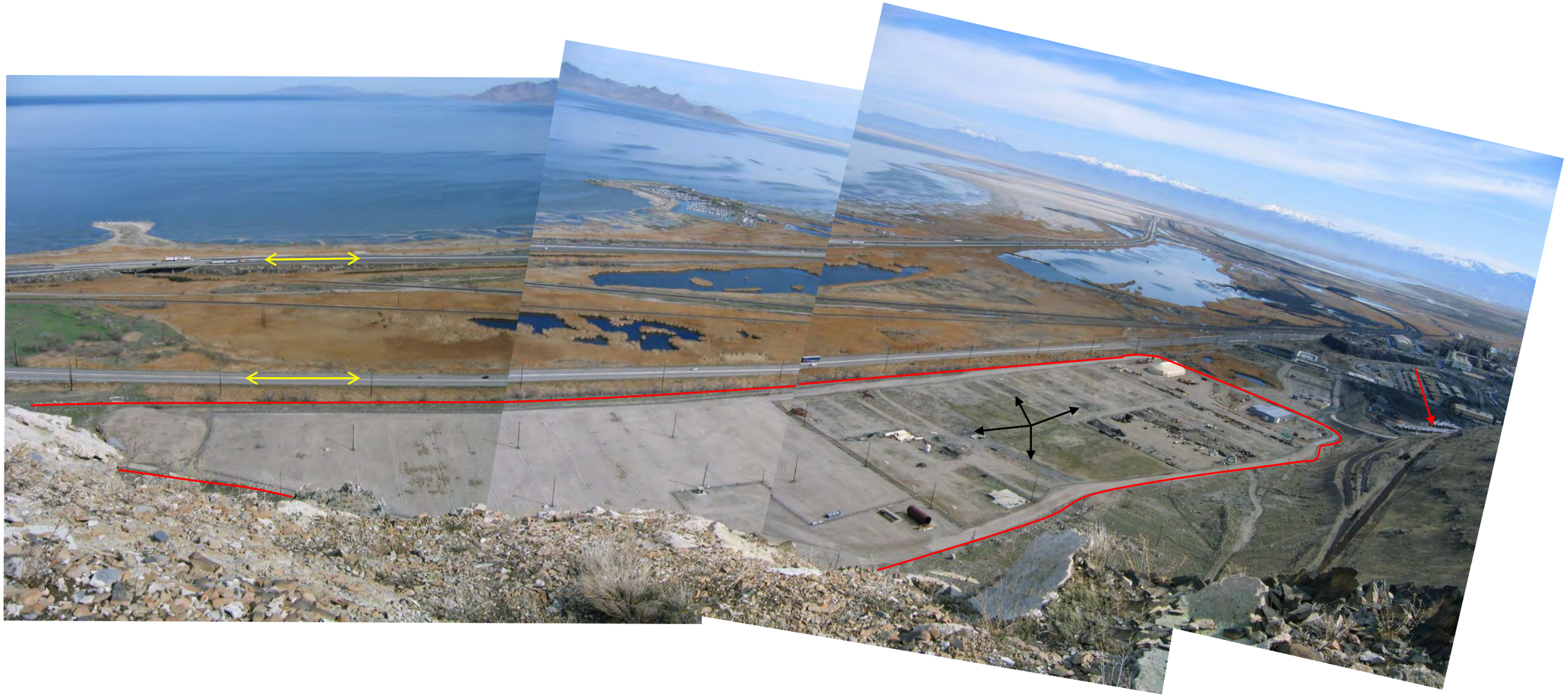

Photo No. 15 - OU13, Smelter and Associated facilities. Pictured is what is suspected to be the footprint of the Black Rock Tailings Pond (red outline). Pursuant to a reference, located 1 mile west of the Smelter is the Black Rock Tailings Pond. Approximately 400,000 cubic yards of slag tailings were deposited in the Black Rock Tailings Pond. Photo is aligned to show the suspected slag tailings pond, background images may not be aligned.

The surface of the slag tailings pond can be segregated into three cover types. The western third (left) has historically been used as an employee parking lot with a gravel cover and a chain-link security fence. The central third's surface is partially vegetated and partially left as barren soil. The central third of the slag tailings pond was used historical as a lay down yard. The eastern third (right) continues to be used for lay-down yards and supports two temporary structures (one an oval tent). The central and eastern thirds of the tailings ponds have locations where a greyish-black colored material (black arrow) is visible on the surface. The greyish-black material is consistent with slag. The outer perimeter of the slag tailings pond is encircled with a dirt access road.

The slag tailings pond is located approximately 100 feet south of Hwy-201, immediately northwest of the Slag Pot Cooling Area and Slag Mill (red arrow). The western extant of the Garfield Wetlands can be seen just north of Hwy-201 (yellow arrow) and the Great Salt Lake Shoreline can be seen just north of I-80 (yellow arrow).

Photo No. 16 – OU13 Smelter and Associated facilities. Pictured is the Slag Pot Cooling Area and Slag Mill. The Slag Pot Cooling Area (red arrows) surface is covered in asphalt. Slag, once cooled is tapped out of the furnace casting pots and stockpiled in the pictured slag pile (black mound). From the stockpile, slag is fed into the Slag Mill (blue arrow) where it is ground and fed back into the Smelter's furnaces. To the east and south of the Slag Mill are smaller stockpiles of slag.

The HDPE lined West Process Water Pond is located just north of the Slag Mill (orange arrow). The process water containment pond is comprised of four cells.

The historic slag bluff (yellow arrow) is located just to the east of the West Process Water Ponds. The slag bluff demonstrates that the current Smelter is underlain by various thicknesses of slag and soil with various concentrations of the COCs.

North of the Slag Mill and employee parking area (red outline), surface cover transitions from asphalt to unconsolidated soils of the northern Oquirrh Mountain range front. The soils generally support grasses and other forbs. Surface water ponds north of Hwy-201 and northwest of the slag stockpile support phragmites and other wetland plant species (though the phragmites tend to overcrowd the shoreline of these spring fed ponds).

Photo No. 17 – OU13 Smelter and Associated facilities. Similar to the Slag Pot Cooling Area and Slag Mill, the surfaces around the Smelter are predominantly covered in asphalt. Some surfaces are not covered by impervious material, the sparsely vegetated surface consist of unconsolidated fill. There are discrete locations where either slag or potentially concentrate can be found along the gutters and sides of access roads.

The Outokumpu Smelter furnace and roaster building is denoted by the black arrow. The Outokumpu Smelter was constructed on the footprint of the Reverberatory Smelter. Remnants of the tunnels associated with the Reverberatory Smelter are located immediately behind the current furnace building (tall building at the tip of the black arrow).

The copper concentrate storage yard (with sheds) is delineated by the blue arrow.

The Acid Tank Farm and loading station (immediately to the north of the tank farm) is delineated by the red arrow. The Praxair Plant is delineated by the green arrow. In the immediate background are the ponds which comprise the Garfield Wetlands and in the distance are the North Tailings Impoundment (orange arrows) and the northern extent of the South Tailings Impoundment (yellow arrow).

Often it is the arsenic concentration in the soils around the Smelter complex which drive soil management activities as Kennecott constructs infrastructure or decommissions facilities. However, until operations cease the extent of contamination across the whole complex remains to be characterized.

Photo No. 18 – OU13 Smelter and Associated. Approximately 1,700 feet south of the Smelter furnace building (along the east side of Kessler Canyon) are the two concrete foundations for the historic smelter smokestacks. Soils are generally unconsolidated, gravelly fill and surfaces are partially vegetated around the smokestack footprints.

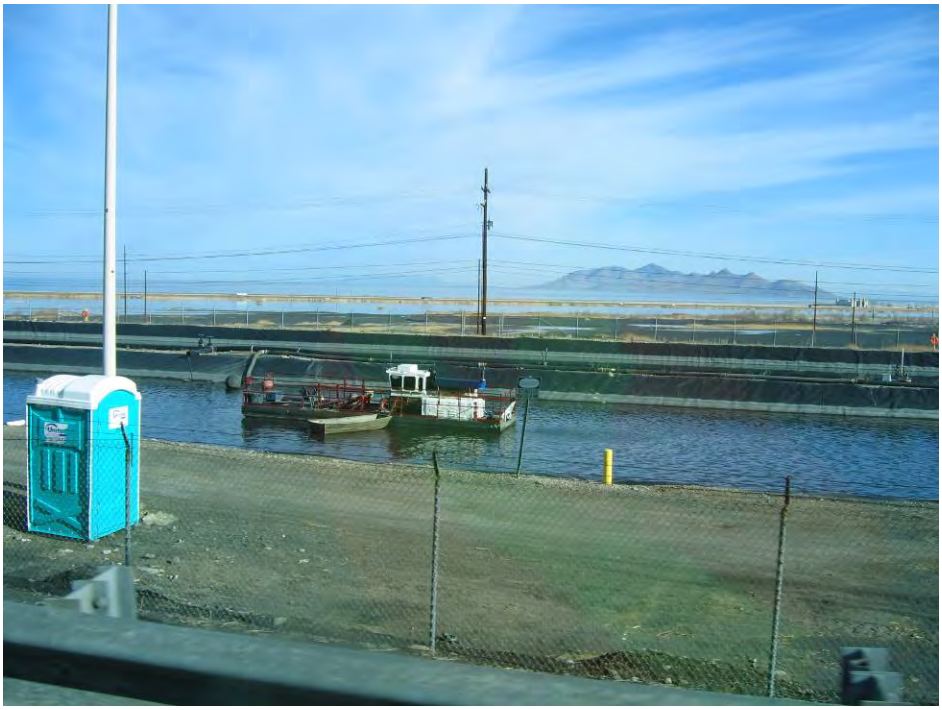

Photo No. 19 – OU13 Smelter and Associated facilities. Located approximately 1,000 feet northeast of the Smelter's furnace building is the East Smelter Process Water Ponds. The reservoir is lined with HDPE liners and incorporates leak detection. Kennecott operates both noted process water reservoirs in compliance with their Utah Groundwater Protection Program permit limitations. Pictured is the barge Kennecott uses for interior maintenance of the ponds.

Photo No. 20 – OU13 Smelter and Associated facilities. Pictured is the Smelter access road located just northeast of the Smelter's furnace building (out of frame to the left). Along the south side of the road Kennecott recently constructed a sidewalk for employees traversing the area on foot (yellow guard rail). The side walk is situated above a storm water canal located below the height of the access road. Soils with elevated arsenic were managed by Kennecott as a small project and a report is pending on the work performed. Photo No. 20 also depicts the general condition of the asphalt roadways around the Smelter where, as noted before, material (generally soil and sediment, but also potentially copper concentrate) can be found along the sides of the roadway.

Photo No. 21 – OU13 Smelter and Associated facilities. Pictured is the Smelter Acid Tank Farm and Loading Station, which is located directly in front of the tank farm. Sulfuric acid produced at the Smelter is piped to the four depicted storage tanks. At the Loading Station, both rail and truck tanker cars can be loaded with the sulfuric acid for shipment to Kennecott's customers. In 2009, a sump located at the Loading Station was determined to have had a slow leak, releasing an acidic solution which entered the underlying shallow aquifer. The length of time of this release took place was not determined. Groundwater sample results determined that low pH water had migrated into the shallow aquifer which showed evidence (groundwater monitoring data) of elevated arsenic and selenium concentrations. The initial investigation determined the low pH plume was located on Kennecott property extending north from this depicted facility, under the depicted roadway and was underlying the Praxair Facility (which is Kennecott leased property).

In 1991 a similar spill from a historic tank farm was reported and Kennecott performed corrective action under stipulated consent order #9212006 (SCO), issued by the Utah Division of Solid and Hazardous Waste in 1994. Under the SCO, Kennecott constructed an extraction trench below the surface (under the current Praxair Facility), actively collected low pH water, and placed the water into their process water circuit.

After characterizing the 2009 release, Kennecott entered into a corrective action plan with the Division of Water Quality (under the Groundwater Protection Program permit for the Smelter, #UGW350008). As part of the corrective action plan, Kennecott revitalized the buried extraction trench (see photo No. 22) and increased the frequency of monitoring the groundwater well network down gradient of the Acid Tank Farm and Loading Station. Two of the wells of the overall monitoring network are visible in this photo, NES2803 A&B (red arrow) and NES2804 A, B&C (black arrow). The above ground well heads appeared to be in good condition. The corrective action being implemented by Kennecott is intended to prevent the low pH fluid (with elevated metals) from migrating further north, under Hwy-201 and into the aquifer underlying the Garfield Wetland where upward gradients could cause the low pH fluids to express at the surface. EPA and UDEQ-DERR are (for their part) monitoring the progress of the corrective action and monitoring the springs and ponds of the Garfield Wetlands to assess the water quality of the spring water and surface water in the ponds of the Garfield Wetlands.

Photo No. 22 – OU13 Smelter and Associated facilities. Pictured is the Praxair O2 Plant located immediately north of the Acid Tank Farm, Acid Tank Farm Loading Station, and the Smelter access road (depicted in Photo No. 21). Under the caption for Photo No. 21 reference is made to the extraction trench Kennecott revitalized to address their corrective action (under oversight by DWQ) in response to the 2009 release of low pH fluid from the Loading Station.

Though buried under the asphalt at the Praxair O2 Plant, the approximate location of the extraction trench is depicted by the yellow line in this photo. The monitoring wells up-gradient (#NES1366, #NES1376, and #NES691) and down gradient (#NES1365, #NES1364, #NES1363, #NES672, and #NES675) of the extraction trench are flush with the asphalt parking lot. The flush completed monitoring well #NES1376 can be seen in this photo (red arrow). The low pH fluid extracted by the underground trench is piped to Kennecott's process water circuit.

Photo No. 23 – OU14 Refinery and Associated facilities. Pictured are the Refinery Tank House (red arrow) and a portion of the current Precious Metals Plant (yellow arrow) from the western portion of the capped Electrolytic Pond. The Refinery complex is secured with chain link fencing topped by barbed wire. The majority of the enclosed surfaces are covered in impervious materials (asphalt, concrete). There are two historic facilities at the Refinery which have an engineered cap, the Old Precious Metals Plant (refer to Photo No. 24) and the Electrolytic Pond (vegetated surface seen in the foreground of this photo, refer to Photo No. 25). In the distance on the hillside to the south of the tank house is a large white water tank (black arrow) which is part of the subject in the caption for Photo No. 26.

Photo No. 24 – OU14 Refinery and Associated facilities. Pictured is the capped surface (red outline) of the Old Precious Metals Plant (the current Precious Metals Plant is the large tan building in the background with the green stripe). The Refinery's Tank House is out of frame to the right. A main line of the Kennecott North End Operational Rail Service (OU24) traverses the south boundary of the Refinery complex (outside of the perimeter fencing). This line serves the Smelter and Refinery. The impacted soils of the capped Old Precious Metals Building footprint where one of two sources of selenium comprising the selenium plume emanating from the Refinery (that is addressed as part of OU23). The cap is otherwise in good condition and well vegetated.

Kennecott recently constructed a drilling pad (non-vegetated soils located on the cap of the Old Precious Metals Building footprint) as part of its remedial investigation update for OU23. The drill pad supported the installation of lysimeters into the underlying contaminated soils. The lysimeters are being used to quantify the groundwater flowing through this footprint. No capped soils were disturbed during construction of the drill pad as the drill pad was constructed on-top of the cap.

Photo No. 25 – OU14 Refinery and Associated facilities. Pictured is the capped footprint (red outline) of the historic Electrolytic Pond (EP), located approximately 360 feet southwest of the Refinery Tank House and 233 feet south of the current Precious Metals Plant. The historic EP was the disposal location for spent electrolytic fluid from the Refinery Tank House. The fluid historical disposed in the EP and the underlying soils of the capped footprint where one of two sources of selenium comprising the selenium plume emanating from the Refinery (that is addressed as part of OU23).

Kennecott recently installed four lysimeters to measure the flow of groundwater through the EP. The drilling pad (constructed on-top of the cap) is visible in the center. Near the drilling pad, some of the cap soil was disturbed during its construction. (See Photo No. 28). Otherwise, the surface of the cap is in good condition and well vegetated.

Photo No. 26 – OU14 Refinery and Associated facilities. Along the southern boundary of the EP is a drainage channel that is rip-rapped. The drainage channel is partially underlain by the liner placed over the impacted soils of the EP. Under normal conditions, water does not flow down the channel except for during storm events.

During the inspection the channel was found to be intact and the rip-rap cover was stable. A steady flow of water was observed in the channel and found to flow to a topographic low spot located south of the EP footprint. The water was determined to be sourced to a large 2 million gallon storage tank (white tank, photo No. 23) located behind the Refinery Tank House. The storage tank stores Section 21 water (culinary water) which is used at the Refinery. Kennecott was requested to cease the release of water from the tank and its routing into the channel. The channel is only partially underlain by the EP liner and thus water can still infiltrate into the underlying soils. A resulting investigation by Kennecott determined the release of water from the tank resulted from an internal miss-communication. A total of 200,000 gallons of Section 21 Pipeline water was released from the tank prior to its shut down.

Photo No. 27 – OU14 Refinery and Associated facilities. Pictured are the drilling pad and four lysimeters installed into the cap of the EP footprint. The drilling pad was constructed on top of the vegetated cap of the EP. The drilling pad consists of localized borrow material (mostly unconsolidated gravelly fill). The lysimeters were left in place and continue to be monitored.

Photo No. 28 – OU14 Refinery and Associated facilities. During construction of the drilling pad a vehicle backed over the vegetated cover of the EP. The tires appeared to have compressed the capping soils, rather than intrude into them. Kennecott was requested to repair the surface.

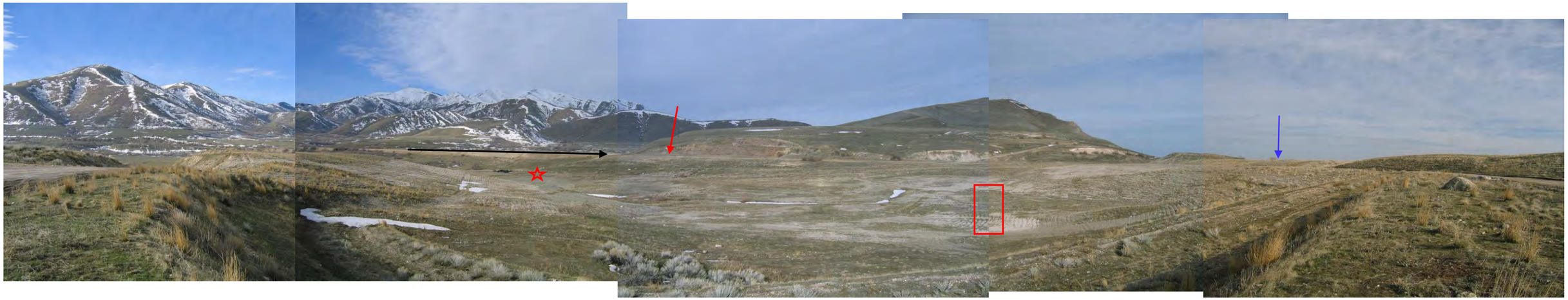

Photo No. 29 – OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is the remediated and reclaimed footprint of the Bonneville Crusher Facility. Historically situated along the top surface and in a shallow bowl (depicted here) of the third bench of the Oquirrh Mountain range were the crushing, grinding, conveyance and storage facilities of the Bonneville Crusher. Ore from the Bingham Canyon Mine was delivered by rail car via the Copperton High Line (black arrow, which is currently being removed by Kennecott) to a pit crusher located below the surface of the bench (red arrow denotes the approximate location). From the crusher the ore was conveyed out of a tunnel into the lower portion of the bowl (red star, approximately) and then conveyed (though a series of conveyors) to a building which housed a secondary and tertiary crusher (red rectangle denotes the approximate location), called Symons Building. From Symons Building ore was conveyed to the hillside to the north (blue arrow) and stored in a free standing A-frame structure. From there ore was conveyed from the floor of the ore shed to a building that sat further north (just below the top of this bench area, on its north slope) which housed the grinding mills.

From 2007 to 2009 the Bonneville Crusher was demolished and the footprint was characterized. The post demolition and post reclamation sampling report is pending submission. Generally the surface of the footprint consists of unconsolidated gravelly fill. The hillsides of the bowl were broadcast seeded and vegetative success varies based predominantly on the amount of gravels in the current surface soils. Little Valley Canyon (OU19) is in the distant background (left and left central) extending east from the base of the snowcapped Oquirrh Mountain peaks.

Photo No 30 – OU15 Mills, Milling Waste, Power Plants and Associated facilities. A close up of the reclaimed surface in the lower bowl of the Bonneville Crusher footprint (in the vicinity of the footprint for the Symons Building that housed the secondary and tertiary crushers). Vegetative cover is sparse.

Photo No. 31 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is the hillside situated just south of the bowl where the Bonneville Crusher Facility (black arrows) was located. The photo was taken from the raised rail bed of the Kennecott Copper Company's Copperton High Line (which is currently undergoing removal and reclamation). The red arrows in the photo denote the alignment of the Copperton High Line rail corridor which is located along the third bench, or the Bonneville Lake Bench, of the Oquirrh Mountains. The Copperton High Line was used to deliver ore to the Bonneville Crusher Facility. The surface of the bench floor (which gently slopes to the east/southeast from the rail corridor) is well vegetated with various grasses and forbs and scrub oak. Along the base of the Copperton High Line Kennecott has been actively removing material with elevated arsenic and lead that has migrated down from the rail bed.

Though hardly distinguishable from the Bonneville Bench terrain, Little Valley Canyon (OU19) is a west to east aligned canyon of the Oquirrh Mountain Range running perpendicular to the bench floor depicted here. The yellow arrow approximates the alignment of Little Valley.

Photo No. 32 - OU15 Mills, Milling Waste, Power Plants and Associated facilities & OU19 Smelter Fallout. Pictured is the floor in lower Little Valley Canyon (as taken from the Copperton High Line grade). Lower Little Valley Canyon supports the Kennecott Tailings Slurry Pipeline (red arrows) which transports general mill tailings and other managed waters including the acidic water extracted from the core of the Zone A plume (OU2), and the reverse osmosis concentrate from the Bingham Canyon Water Treatment Plant (OU2). The Tailings Slurry Pipeline is located in the historic corridor of the Bingham & Garfield Rail line (OU24).

Besides rail and pipeline corridors, lower Little Valley Canyon has been used as a source of unconsolidated fill consisting of sands, silt and gravel (yellow outline polygon). This area is currently being characterized because approximately 5.26 million cubic yards is proposed to be extracted and used by Kennecott for the pending expansion of the Tailings Impoundment complex located north of Magna, Utah (black arrow). Due to potential deposition of historic sulfur dioxide emissions from the historic smelters, Kennecott implemented a characterization of the unconsolidated fill in the area of the yellow outline to assess the concentrations of arsenic, cadmium, lead and selenium (the listed contaminants of concern for the Kennecott North Zone).

The lower portion of Little Valley Canyon is also a part of OU19 Smelter Fallout (as is the upper portion of the Little Valley Canyon), due to its proximity to the historic smelting operations that took place just over the ridge line forming the upper boundary on the overall Canyon. Refer to Photos No. 52 & 53).

Photo No. 33 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured from its eastern boundary, the footprint of the historic Magna Leaching Facility is due east of Kennecott's active Power Plant. The footprint of the Magna Leaching Facility's Lime Kilns and Lime Slacking Plant is located closer to Kennecott's Power Plant depicted in the left frames of this panorama (refer to photo No. 34). Since its decommissioning, the Magna Leaching Facility's concrete leaching tanks (seen here undergoing demolition) have and are being used to store cooling water for the Power Plant. The demolition activity is intended to make room for an approximate 1.0 million gallon storage tank. Currently six of the twelve leaching tanks have been demolished and the soils of the footprint have been sampled (pursuant to the work plan referenced in the next paragraph) to assess the concentration of arsenic, cadmium, lead and selenium (the listed contaminants of concern for the Kennecott North Zone).

During its operational history, the concrete leaching tanks of the Magna Leaching Facility required maintenance to remove accumulated sediment. The sediment would be extracted and placed on the hillside immediately south of the leaching tanks (foreground of the panorama). The soils along the hillside were characterized and one small section was determined to contain a small volume of soil with lead above the Sites' industrial land use standard. The soils were removed under the work plan submitted by Kennecott (and approved by the Agencies) entitled UPP Repower Plant Soil Management Work Plan, dated June 2012. Prior to demolition activities, the soil surfaces surrounding the leaching tanks were characterized. No elevated concentrations of the contaminants of concern (arsenic, cadmium, lead, selenium) were detected above the Sites' industrial land use standards. As noted above, the area depicted in this photo where six tanks once stood was characterized. No elevated concentrations of the contaminants of concern were detected.

Kennecott access roads (paved and unpaved) border the Magna Leach Facility's footprint, as does a spur of Kennecott's active operational rail (white sulfuric acid tanker cars). The Power Plant is located along the western boundary of the Magna Leaching Facility footprint. In the distance is the vegetated embankment of the South Tailings Impoundment (black arrow) and to the east (red arrow) is Magna, Utah.

Photo No. 34 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. The disturbed soil surface was the location of the Magna Leaching Facility's Lime Kilns and Lime Slacking Plant. This hillside was characterized by Kennecott and no contaminants of concern were detected above the Sites' industrial land use standards. With the reconfiguration of the Power Plant, this area is intended to become part of the footprint of the Power Plant. Soil management activities have and continue to be performed under Kennecott's soils management work plan referenced in the caption for Photo No. 33.

Photo No. 35 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Depicted from the east is Kennecott's Power The caption for Photo No. 33. The surfaces around the Power Plant support the storage of coal and other materials needed for the Plant.

Photo No. 36 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. North of Kennecott's Power Plant and the Magna Leaching Facility's concrete tanks is the reconstructed Magna Process Water Reservoir (red arrow). The Reservoir stores process water and spring water (collected down gradient of the Refinery and Smelter facilities). From the Reservoir water is sent south to the Copperton Mill (OU24, not an operable unit covered under this five year review).

Photo No. 37 – OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is a closer view of the western pond of the Magna Process Water Reservoir. The reservoir is comprised of two lined impoundments. The liner is made of HDPE fabric and is intended to prevent infiltration. Demolition of the original reservoir and reconstruction of the two new lined impoundments of the reservoir was coordinated by Kennecott with UDEQ oversight (provided by DERR and DWQ) as part of the larger UPP project (under the work plan referenced in the caption for Photo No. 33). The Reservoir is operated in compliance with a groundwater protection program (GWPP) permit (for the North Concentrator facility). No evidence of releases was observed. Access to the Reservoir is restricted through the use of a permanent six foot chain link fence.

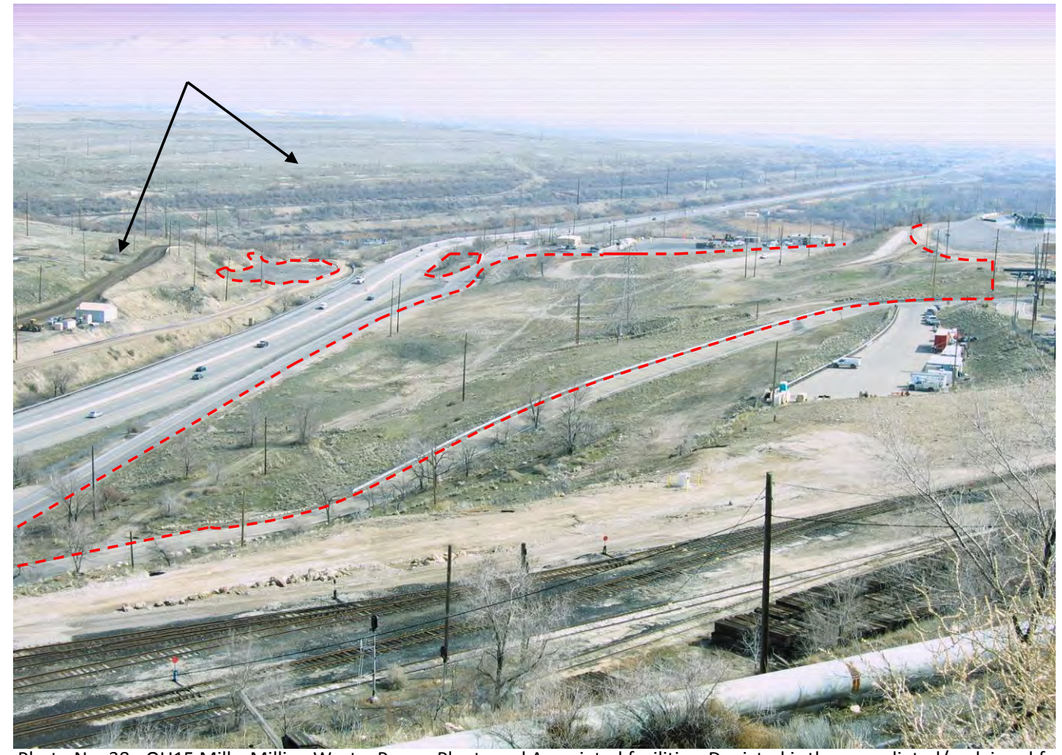

Photo No. 38 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Depicted is the remediated/reclaimed footprint of the Magna Concentrator (a.k.a. Magna Mill or North Concentrator). The red-dashed lines depicted the area which received removal response action by Kennecott under an accepted work plan for the Magna Mill footprint, from 2007 to 2009. The large red-dashed line delineates the mill footprint proper, while the smaller dashed-red lines delineate the tailings dispersal structures which gravity directed tailings from the mill to the South Tailings Impoundment. The revegetated slopes of the South Tailings Impoundment are denoted by the black arrows. Establishment of a vegetative cover is still on-going as the surface soils (comprised of local unconsolidated fill with a lot of gravel) were broadcast seeded. A report is pending on this response work.

Located due north of the Power Plant and south of Hwy-201, the Magna Concentrator was a facility that concentrated copper ores processed by the Bonneville Crusher. Currently the footprint is left as open space by Kennecott.

A portion of the original mill constructed circa 1905 (and used for gravitational separation) was demolished and was remediated in the 1990's (southern and western portion of the footprint, photo is looking east). This work was performed under the June 1997 AOC work plan; a report was filed and accepted by EPA and UDEQ.

Also depicted, is a segment of Kennecott's operational rail corridor (OU24, not a part of this five year review). Slag (dark colored material between the tracks) was used as rail bedding when the sidings and spurs were first constructed and represents the predominant issue along the active north rail operational corridors of the Kennecott North Zone. Fine grain slag can contain arsenic and lead above the Site's unrestricted use standard.

Photo No. 39 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured in the foreground is the lower portion of the Magna Concentrator footprint. The Magna Mill used both gravitational and chemical floatation separation technology during its operational life. As noted in the caption for Photo No. 38, the establishment of the post removal vegetative cover is still ongoing (notice the barren soil surfaces). The footprint is managed currently by Kennecott as open space. Two recent construction projects were completed in 2012-2013. The rip-rapped drainage channel depicted in the foreground was constructed recently to facilitate storm water management. The drainage channel crosses the footprint behind the approximate location of the demolished chemical flotation building, directing surface water to locations less prone to erosion. The yellow marker (red arrow) denotes the location of a gas pipeline recently constructed through the footprint to an old locomotive maintenance warehouse located between the Magna Concentrator footprint and the Magna Process Water Reservoir. Soils were managed by Kennecott during the excavation for the gas pipeline under the UPP Repower Plant Soil Management Work Plan, dated June 2012. The gas pipeline was installed as part of the Power Plant reconstruction project. Though the footprint is devoid of vegetation in a number of locations, no tell-tale signs of erosion were visible. During the 2007-2009 response work, demolition debris was buried under the surface depicted here, which may account for the debris piles visible in the left frame of this panorama.

Photo No. 40 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured in the foreground is a portion of the southern slope of the Magna Mill Facility footprint, which was (in part) the location of chemical storage units and portions of the gravitational separation processing units of the historic mill constructed in 1905 (approximately the area enclosed by the red-dashed line). The surface is partially vegetated likely due to the broadcast seeding performed by Kennecott on the unconsolidated rocky fill. The yellow marker (red arrow) denotes the alignment of the gas pipeline discussed in the caption for Photo No. 39.

The slope rises to the south and levels off to form the first bench located along the northern front of the Oquirrh Mountains. On the first bench is located the Magna Process Water Reservoir (black arrow) and the historical locomotive maintenance warehouse (blue arrow). Further south and located on the second bench is Kennecott's Power Plant (yellow arrow).

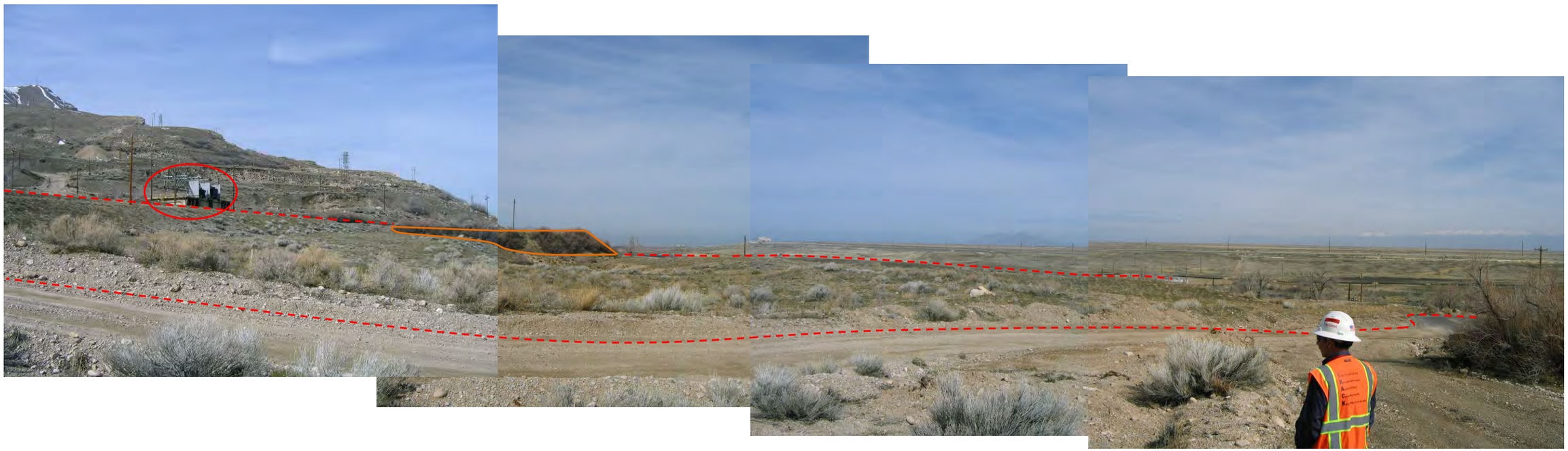

Photo No. 41 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is the upper portion of the footprint where the Arthur Mill (constructed circa 1905 – 07) once stood (approximately the area enclosed by the red-dashed line). The Arthur Mill (which used gravitational and chemical floatation separation techniques to segregate copper ores) was located approximately 1.0 mile west/northwest of the Magna Mill and connected to surrounding processing facilities by rail corridors. The Arthur Mill footprint was remediated by Kennecott in the late 1980's.

The foundation of one of the Arthur Mill's tailings thickeners is denoted by the solid copper colored line. The Mill's footprint extends from the decommissioned power substation (red circle) approximately 769 feet north to the first of four lower rail sidings (which are out of view). The footprint is currently well vegetated with predominantly grasses, some rabbit brush and Mormon Tea. The footprint has been left as open space by Kennecott, with pipeline corridors (for process fluids, and utilities such as gas) crossing the footprint along its southern and northern boundaries. The footprint of the tailings thickener appeared stable and well vegetated. Mr. Larry Elkin (Kennecott Utah Copper LLC) joined me during the inspections and noted that after the removal work performed in the late 1980's the data characterizing the post removal surface was potentially incomplete. Support infrastructure (i.e., warehouses, rail maintenance buildings, Kennecott's environmental lab) are located due east of this vantage point of the Arthur Mill footprint (view is to the west).

Photo No. 42 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is a portion of the eastern half for the Arthur Mill footprint (the extent of the footprint is difficult to represent). East of the Arthur Mill footprint proper, ancillary facilities were located which performed different functionalities. These facilities included an administrative building, carpenter shop, rail maintenance shops, lumber shop, material warehouse, and an iron foundry. In the left frame, the rail maintenance structures can be seen through the trees (black arrow). A stonewall foundation (blue arrow) denotes the area where the iron foundry was historically located. Out of frame to the left (approximately 686 feet to the east) is Kennecott's environmental laboratory. The red lines (both solid and dashed) in the background denote the approximate location of two historic (and partially abandoned) rail sidings that have yet to be addressed (as part of rail removal work under OU24, not an operable unit part of this five year review). Access roads are maintained by Kennecott and near active facilities are paved; otherwise they are dirt (as depicted here).

As noted by Mr. Larry Elkin a tunnel underlying the southern portion of the footprint remains to be characterized. Recent demolition of the carpenter, lumber shops, and the administration building, determined that there were no underlying soils with elevated concentrations of the contaminants of concern in these locations (post demolition reports are pending). All together the Arthur Mill footprint is stable and supports ongoing active rail operations, pipeline operations (as exemplified by the black HDPE pipe at the base of the rail siding embankment, yellow arrow), and the operations at Kennecott's Environmental Laboratory.

Photo No. 43 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. This panorama depicts portions of the North Tailings Impoundment (delineated by the red-dashed line) and the South Tailings Impoundment (delineated by the copper colored dotted line). As noted from the FYR report, both impoundments of the Magna Tailings Facility cover large areas. The North Tailings Impoundment is Kennecott's active impoundment, while the South Tailings Impoundment is undergoing reclamation (which includes de-watering). Kennecott actively manages the suppression of dust at the North Tailings Impoundment by keeping the center (where fine grain tailings are deposited) wet with tailings slurry, and watering the outer embankments with recirculated water and water drawn from their UPDES Outfall #008 (yellow arrows). During the inspection, no dust nor evidence of uncontrolled releases from the North Tailings Impoundment was observed. As noted from the FYR report, Kennecott has maintained compliance with the requirements of their UPDES and GWPP permits and the fugitive dust permit. The South Tailings Impoundment (which extends out of frame to the right) is well vegetated (refer to Photo No. 45). No dust or evidence of uncontrolled releases from the South Impoundment was observed during the inspection. Please note, along with their large horizontal dimensions, both impoundments have significant height compared to the surrounding floor of the Salt Lake Valley. For example, the South Tailings Impoundment is approximately 200 feet vertically higher than the surrounding valley floor.

Photo No. 44 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. This panorama depicts the western portion of the North Tailings Impoundment (from the northern slope of the South Tailings Impoundment's dam, vegetative surface in the foreground). As the South Tailings Impoundment's (STI) dam slopes north, the beach of the North Tailings Impoundment (NTI) extends west, north and east to the NTI's exterior embankment (i.e. dam, black arrows). Fine grain tailings are segregated and deposited in the interior of the NTI for permanent disposal, coarse grain tailings are used to build-up the exterior embankment (black arrows). Water associated with the slurry keeps the active disposal area and the beach wet during normal operations. Kennecott also uses large sprinklers to keep the embankments and beach area of the NTI wet to suppress dust (a sprinkler wetting the beach can be seen in the left frame of the panorama). On April 10, 2013, Kennecott experienced a large slide at the Bingham Canyon Mine, which in part reduced the available stock of copper ore being processed and reduced the volume of tailings being produced. In a coordinated effort the Agencies (EPA and UDEQ) agreed to the use of rail bedding material (removed from the Copperton High Line and being disposed in the Tailings Landfill) as road base along the beach of the NTI to facilitate dust management. Kennecott implemented measures to apply a soil encrusting compound to reduce the ability for tailings to become entrained in the air. Under the terms of the Salt Lake County Landfill permit, the Tailings Landfill was assessed to represent the entire Manga Tailings Impoundment (both the STI and NTI). Since the Agencies previously agreed to the disposal of the rail bedding material in the Tailings Landfill, the use of the rail bedding along the beach was assessed to be acceptable. No dust was observed, and no evidence of spills was observed during the inspection.

Photo No. 45 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. This panorama depicts the central and (in the distance) the eastern top surface of the South Tailings Impoundment (STI). The panorama demonstrates how the top surface of the STI has been reclaimed across its full extent. The vegetative cover is predominantly comprised of grasses and other low lying forbs. Some scrub oak has been planted along the surface. One of the goals of the reclamation efforts is to eliminate the generation of dust from winds blowing across the surface. The flat surface and relatively large expanse of the top surface of the STI was often prone to the generation of dust (prior to the establishment of the vegetated reclamation cover), which led to dust migrating into the community of Magna, Utah located further to the south (out of site in the background). The dark piles of dirt in the left frames of the panorama (black arrows) are reclamation soils scraped from the surface as part of opening up a portion of the Tailings Landfill (which is considered to be any location within the confines of the STI and/or NTI). This particular portion of the tailings landfill is receiving the rail bedding material being removed from the Copperton High Line. Once the Copperton High Line removal project is completed, the reclamation cover will be re-established by Kennecott. No dust was observed during the inspection.

Photo No. 46 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. This panorama depicts the Arthur Step-back Repository (ASR), a CERCLA CAMU constructed by Kennecott on the southwest bench of the STI (red arrow). The ASR was designed to receive soils removed by Kennecott pursuant to the 1996 North Zone AOC work plan (and subsequent work plans since). The eastern half (black arrow) of the repository (approximately 2000 feet east from the western boundary of the ASR) is permanently capped with HDPE liners, topsoil and a vegetated cover. The western half of the repository is temporarily capped with the depicted black HDPE liner. Prior to the placement of material for disposal the depicted liner is cut to allow for the flow of leachate to the leachate control system. New temporary HDPE liners are then placed over the disposed material. The repository was constructed with a clay liner and a double HDPE liner with leak detection, and sumps. There are three groundwater monitoring wells down-gradient of the repository, which are used to monitor for potential releases of leachate. Both halves of the repository looked to be in good condition. The permanent cap looked stable and well vegetated; the temporary liner did not have any apparent rips. An email (Appendix D) dated April 5, 2013, from Mr. Tom Nannini (Kennecott Utah Copper LLC), noted the water collected on the liner is winter melt and was scheduled to be pumped into the leachate collection system. Leachate is directed to Kennecott's Pump Station #4, where it can be directed into Kennecott's process water circuit.

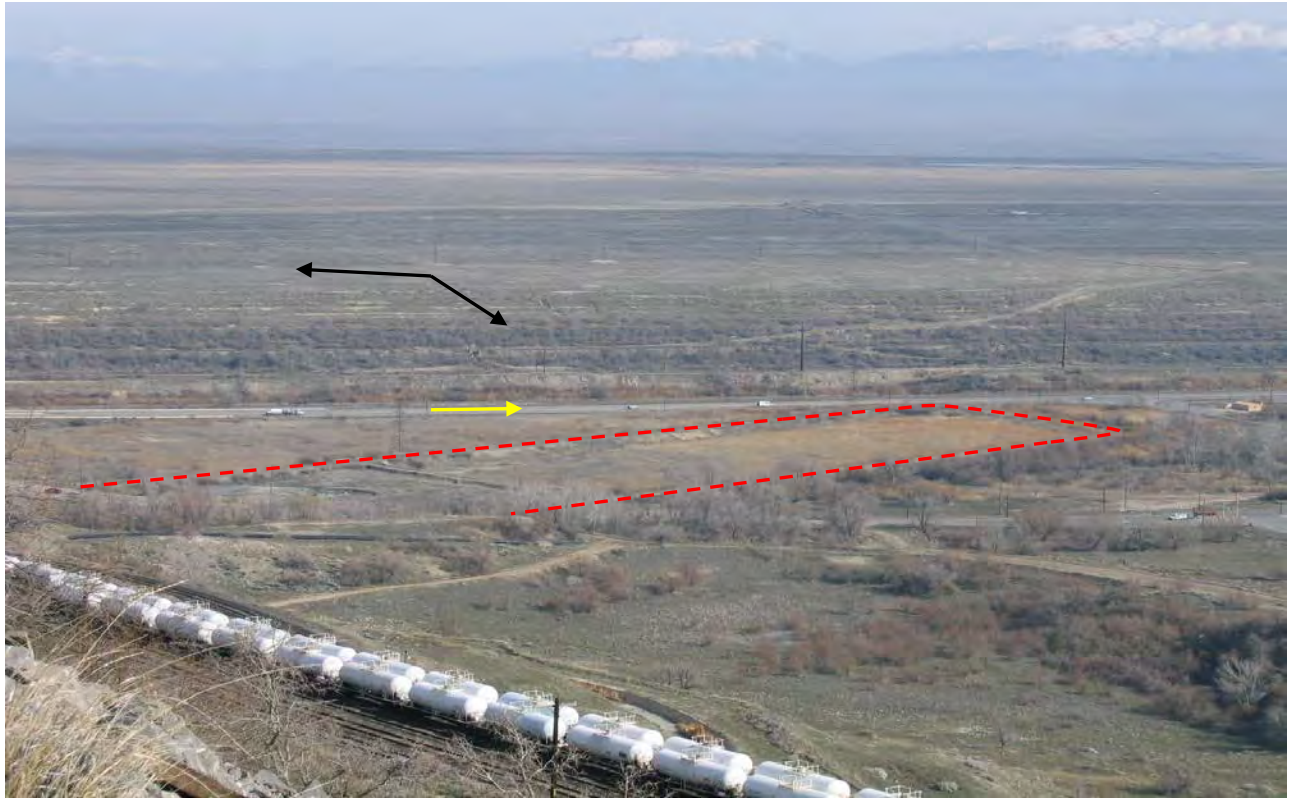

Photo No. 47 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Depicted is the Diving Board Tailings Impoundment (red-dashed line) located on Kennecott's property, approximately 100 feet south of Hwy-201 (yellow arrow). The impoundment is approximately 550 feet north/northwest of Kennecott's Magna entrance gate. The impoundment was designed to receive process water from the Magna Process Water Reservoir and other sources when (historically) upset conditions arose. Currently the impoundment can receive water from the Magna Process Water Reservoir during upset conditions and from various storm water collection basins up-gradient of the impoundment's location. Generally the impoundment is not used, but it is a facility that is permitted under Kennecott's GWPP permit for the North Concentrator area (and subsequently subject to the permit restrictions listed). Compliance with the permit is discussed in a memo (Appendix D) from Edward Hickey (DWQ) dated Feb. 19, 2013.

The embankments and interior space of the Diving Board Tailings Impoundment are well vegetated with various wetland plants, grasses and scrub oak. No evidence of spills was observed, nor was there evidence of recent use. A minimal amount of water is directed into the impoundment from nearby springs, hence the species of wetland plants (i.e. phragmites) observed in the eastern interior. In the distance, north of Hwy-201, is the rising embankment of the STI (black arrows). Note the successful vegetative cover along the embankment (consisting of grasses, forbs and trees).

Photo No. 48 – OU15 Mills, Milling Waste, Power Plants and Associated facilities. The following photos (48-51) are of different segments of the Tailings Slurry Pipeline. In general, no spills or releases were observed during the inspection. The pipeline was functioning as normal. The pipeline consists of two concrete pipes, one with a 60-inch and one with a 48-inch diameter. The pipeline conveys general mill tailings from the Copperton Concentrator ) to the North Tailings Impoundment (NTI). In addition the pipeline manages the acidic core water extracted from the Zone A Plume and the RO concentrate from the treatment of sulfate impacted water extracted from the leading edge of the Zone A Plume, a portion of OU2 (not a subject of this five year review). This segment is located just below the Bonneville Crusher Facility footprint adjacent to the partially remediated KCC Copperton High Line (refer to Photo No. 32; this location is at the end of the red arrow). Both pipes were constructed with "vents', vertical pipe access portals to allow for inspections and for cleaning (black arrow). The "vents" have at times been the locations were spills or releases of tailings have taken place.

Photo No. 49- OU15 Mills, Milling Waste, Power Plants and Associated facilities. When releases from the Tailings Slurry Pipeline happen Kennecott responds quickly. On-top of the vegetated embankment (black arrow) are located the two pipes of the Tailings Slurry Pipeline. On February 4, 2013, the pipeline had a release approximately 4.9 miles north of the Copperton Concentrator (OU24, not a subject of this five year review). Approximately 696,000 gallons (4,000 tons of solids) tailings slurry was released out of vent stack #335and flowed north between the two pipes for approximately 2700 feet where it flowed down an un-used road into the basin area depicted here (where recent storm water had pooled). The tailings then flowed approximately 1400 feet east onto ATK property. The flow stopped approximately 150 feet west of Hwy-111. Released tailings will typically have a low metals concentration. The Feb 4, 2013 release was assessed to have a lead concentration of 6 mg/kg, but because of the volume released exceeded the reportable quantity for lead it was reported to the Utah's spills response center and the NRC. In response to the Feb. 4th spill Kennecott initiated the removal of the tailings solid between the pipes and in the drainage. At the time of this inspection, Kennecott had reconstructed the culvert underlying the Tailings Slurry Pipeline access road (vegetated embankment, black arrow) and basin located on the east side of the Tailings Slurry Pipeline road (as depicted here). Part of the response action also included placing straw/hay bales around the culvert underlying Hwy-111 (further east) to prevent migration of soils and tailing solids while removal actions were on going.

Photo No. 50 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is the Tailings Slurry Pipeline at the location of vent stack #280. During the inspection no releases were observed or reported by Kennecott. No tailings solids were visually observed along the pipeline corridor. In this image one can observed the space which is located between the two pipelines. The two pipes are approximately 24 feet apart. Each pipe (when on the surface) is partially buried. Some segments have short vertical berms along the outer edges, but the berms have no practical containment properties (based upon their height and proximity to the pipes).

Photo No. 51 - OU15 Mills, Milling Waste, Power Plants and Associated facilities. Pictured is the Tailings Slurry Pipeline approximately 3 miles north of the Copperton Concentrator and approximately 0.5 miles north of Clay Hollow. Of interest, just north of Clay Hollow the pipeline enters and follows the footprint of the historic Bingham & Garfield Rail corridor (which includes the two pipelines and the access road depicted here). No tailings slurry or solids were observed along the length of the pipeline from this point to approximately 1.7 miles north of the Copperton Concentrator. In the distance one can see the two eastern heap-leach piles (black arrows) of the Barney's Canyon Gold Mine (which is a facility currently in the process of closure pursuant to regulations under a DOGM and DWQ permits). The heap leach piles (total of five) were operated by the Barneys Canyon Mining Company in compliance with a state of Utah Groundwater Protection Program permit.

Photo No. 52 - OU19 Smelter Fallout. Pictured is the upper Little Valley Canyon (viewed from the Copperton High Line grade, refer to Photo No. 29, black arrow). Upper Little Valley stretches into a wide canyon and ends with the snow covered ridge line and peaks of the Oquirrh Mountains. The canyon floor is well vegetated with grasses, forbs and some healthy stands of scrub oak. The floor is stepped, with topography rising toward the west (photo view). Kennecott periodically leases the upper portion of Little Valley for grazing. The upper portion of Little Valley also supports a healthy herd of elk, though none were observed during the inspection. Vegetation decreases as you increase in elevation along the peaks. Please refer to photo No. 32 for a view of the lower portion of Little Valley Canyon.

Photo No. 53 – OU19 Smelter Fallout. Pictured is a section of the canyon floor in upper Little Valley Canyon as taken from the Copperton High Line grade. The southern portion of the upper canyon has uneven topography with various hills and gullies leading west to the snow covered peaks forming the western boundary of Little Valley. Because of sloping terrain and the lack of vegetation in the past, three sedimentation basins were constructed in Little Valley to prevent mud-flows from entering the community of Magna, Utah. Pictured is the upper basin (located immediately adjacent and up-gradient of the Copperton High Line embankment) which appears to have a well vegetated interior. The culverts leading to and away from the basin were in good condition.

Photo No. 54 – OU19 Smelter Fallout. Depicted is the lower portion of Kessler Canyon from Kennecott's Smelter viewing platform. Sulfur dioxide emissions from the historical smelters led to the de-vegetation of the canyon floor and side slopes in Kessler Canyon, and the deposition of metals (predominantly arsenic and some lead). Kessler canyon has historically and to date supported smelter operations including the location of two historic smelter emissions stacks (see photo No. 18), the location of the Smelter's process water reservoirs (see photo No. 55), the location of a Salt Lake County permitted mono-fill which receives concrete demolition debris and other permitted smelter waste (i.e. trash), and a source of borrow material. The canyon also has a series of stone-masonry check dams which were built in the early 1900's as a means to control the flow of storm water and mud flows.

Where there is no operational activity and with Kennecott's conversion to a taller emission stack (right frame of the panorama), vegetation in lower Kessler Canyon (as well as upper) is progressively spreading voluntarily. Most of the vegetation consists of grasses and alpine forbs, very little tree growth was observed. Due to the slope angles of the upper snow covered peaks, sparse vegetation has recovered the slopes.

Photo No. 55 – OU19 Smelter Fallout. This panorama covers the middle portion of Kessler Canyon, as taken from the upper dam in Kessler looking north towards the Smelter complex.

Similar to Lower Kessler Canyon, the middle portion has begun to recover from years of sulfur dioxide emissions from the historical smelters. Predominantly, the canyon floor is vegetated with grasses and other low alpine forbs. One Kennecott access road traverses the canyon floor to the upper dam as depicted in the left and left central frames of the panorama. A few roads are located along the side slopes. Closer to the dam, junipers and a few scrub oak have begun to take hold voluntarily, but with increasing slope angles sparse vegetative cover exists. Located on the canyon floor, approximately 2300 feet southeast of the current smelter smokestack is a lined, three-cell reservoir (red arrow). The reservoir holds water delivered by Kennecott's Section 17 Pipeline. The water is derived in part from underground springs located in northern Tooele Valley. Recently the Section 17 Pipeline was reconstructed, during the work Kennecott followed the Section 17 Pipeline soils management work plan to ensure soils excavated along the pipeline corridor were appropriately managed. The post response work report is pending.

As noted, with increasing slope angles and altitude vegetative covers begin to decrease both in respect to the species of colonizing plants and range of cover. Some riling along the western side slopes (left frame) was visible. It is possible for some of the soils in the canyon to have elevated concentrations of metals due to historical aerial deposition from the smelting operations. Hence, prior to construction projects Kennecott characterizes soils to assess the concentration of the contaminants of concern (arsenic, cadmium, lead and selenium). Some colonizing plants, such as White Top, have the capacity to uptake selenium that may be in the soils located in Kessler Canyon. White Top was not observed in the canyon during the inspection, but it was early spring when the inspections were performed and the plant may not have been readily observable. Kennecott has reported that they do not use White Top or other plant species with the capacity to uptake selenium when re-seeding areas (refer to email from Ann Neville, Kennecott, dated March 27, 2013 in Appendix D).

The ridgeline and saddle in the distance along the western boundary of Kessler Canyon (yellow arrow), separates Kessler Canyon from Black Rock Canyon. During the five year review inspection, elk from Black Rock Canyon were observed in the area of this saddle. The saddle provides a migration corridor for large mammals like the elk, which are part of a large herd located in the Northern Oquirrh Mountains. Kessler Canyon currently does not provide significant bedding habitat for large mammals such as elk, thus it may be frequented only during the time the large mammals are traversing from Black Rock Canyon to areas they forage within. During the inspection approximately two or three song birds were heard, thus lending evidence that avian species are potentially making use of Kessler Canyon (and others of OU19) once devoid of wildlife.

There are three water flow control structures located down gradient from the upper dam. The structures, originally constructed by the conservation corps in the early to mid-1900s, were constructed to control run-off in Kessler Canyon during storms and during the spring melt. During the inspection, the dams were found to be in good condition and did not show signs of sediment buildup. No evidence was apparent of significant erosional activity in Kessler Canyon, other than the gullies or rills along the slopes of the rising peaks and ridge line.

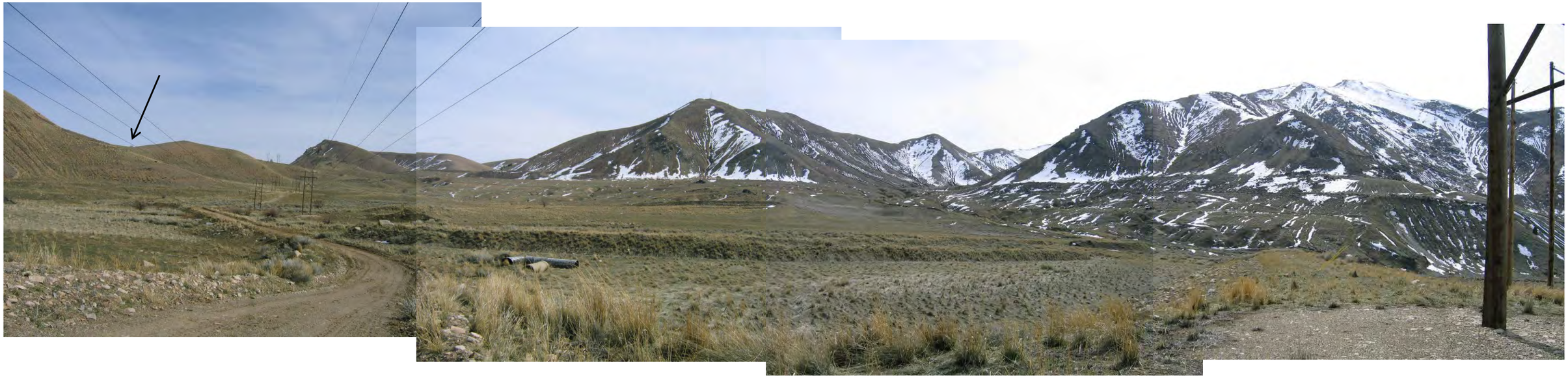

Photo No. 56 - OU19 Smelter Fallout. This panorama covers the upper portion of Kessler Canyon, as taken from the upper dam in Kessler (view is south/southeast). Similar to the observances noted in the caption for Photo No. 55, the canyon floor, side slopes of the upper dam's embankments and the lower slopes of the surrounding peaks are all well vegetated with grasses and other low-lying alpine forbs. Kennecott's access road continues south/southeast to the saddle along the ridgeline (black arrow) that is shared with the drainages leading into the ridgeline above the Arthur Mill and Little Valley Canyon.

The snow covered southern peaks are higher and have steeper slope angles than the vegetated peaks to the east (left frame). Because of the slope angles vegetation success is less along the steeper slopes than along the shallower slopes. Gullies and rills were observed along the steeper slopes suggesting in part that some soils from the peaks may have mobilized over time. No significant sediment buildup was observed along the up-gradient side of the upper control dam, suggesting that soils and sediment may settle out quickly in the upper portion of Kessler Canyon. The upper Kessler Canyon has a broad, flat floor which likely facilitates the deposition of sediment and soil prior to its accumulation behind the upper control dam. The dam itself appeared to be in great condition, no erosional gullies or rills were observed along its embankments. As far as could be seen, no White Top appeared to be located in upper Kessler Canyon but it was early spring and the vegetative community was come out of its winter conditions

As noted in the caption for Photo No. 55, songs birds were heard (not seen) in Kessler Canyon.  Though the predominant plant species in Kessler are grasses and low alpine forbs, some small stands of scrub oak might provide habitat for the avian community frequenting the canyon.  .

Photo No. 57 – OU19 Smelter Fallout. Depicted are the two lower water flow control dams located in middle Kessler Canyon. In non-operational areas of the lower Kessler Canyon, the floor and the creek bed are well vegetated suggesting that sediment and soils are not mobilizing from up-gradient locations, nor is the ephemeral creek eroding the canyon floor.

Photo No. 58 – OU19 Smelter Fallout. This photo depicts the spillway for the upper dam in Kessler Canyon. Water released from the dam is directed down a stonemasonry spillway into the Kessler Creek drainage. The structure appeared to be in great condition, considering its age (dates to the 1930s) and use in the past. The slopes of the eastern peaks (background) were eroded (gullies and rills), evidence of erosional activity prior to recent voluntary colonization by grass and low alpine forb plant species.

Photo No. 59 – OU19 Smelter Fallout. Depicted is an example of the western slope of Kessler Canyon (near the saddle between Kessler and Black Rock Canyon, refer to the yellow arrow in Photo No. 55). Note that the peaks and steeper slopes are devoid of vegetation, whereas the shallower slopes begin to show signs of vegetative success. Rills or gullies (as seen here) will continue to happen while the soils stabilize and vegetation with deeper and broader root structures, begin to take hold.

Photo No. 60 – OU19 Smelter Fallout. During the inspection of Kessler Canyon a few Chukars were observed calling out from the vegetation and rock outcrops located along the western boundary of the canyon. The individuals appeared to be healthy. The extent of the populations could not be ascertained, but numerous individuals were heard. With the increasing success of revegetation efforts (voluntary and implemented) and increase forage available in the canyon, habitat for wildlife (avian and mammalian species) will increase leading to the voluntary re-use of the canyon by the avian and mammalian species.

Photo No. 61 – OU19 Smelter Fallout. With time it is anticipated that the vegetation in the canyons located down-wind of the smelter will become more diverse. Near a lower saddle along the eastern ridgeline separating Black Rock Canyon from Kessler Canyon, some aspen trees have begun to grow. Such trees can (over time) help to stablize the surrounding soil, which in part will facilitate other plant species prospering and providing habitat for surrounding upland wildlife.

Albeit, soils may/do still contain elevated metals (i.e. arsenic, selenium) from the historic deposition of smelter emissions and thus will require ongoing management by Kennecott, as noted in this report. But the voluntary establishment of vegetation is helpful to stabilize the soils.

Photo No. 62 – OU19 Smelter Fallout. From another view of the saddle noted in Photo No. 61, predominantly the slopes and floors of the down-wind canyons are vegetated with sage and rabbit brush, and various species of grass. The plant life in the canyons is potentially sustaining the large herbivorous mammals such as elk, located in the northern Oquirrh Mountains (refer to Photo No. 64).

Photo No. 63 – Like the aspen (refer to Photo No. 61), other plants have begun to appear within the plant communities of the canyons down-wind of the Smelter. Near the saddle into Black Rock Canyon, this Mountain Rose was observed amongst the rabbit brush. These shrubs are helpful because they provide habitat and forage for the herbivorous and insectivorous birds and mammal communities in the canyons, at the same time help to stabilize the soils.

Photo No. 64 – OU19 Smelter Fallout. As noted, with the revegetation of the canyons the wildlife community in the downwind canyons is recovering. Just upon entering Black Rock Canyon these two individual elk were observed. They eventually moved through the saddle located along the ridgeline forming the boundary between Black Rock and Kessler Canyons (refer to the yellow arrow in Photo No. 55).

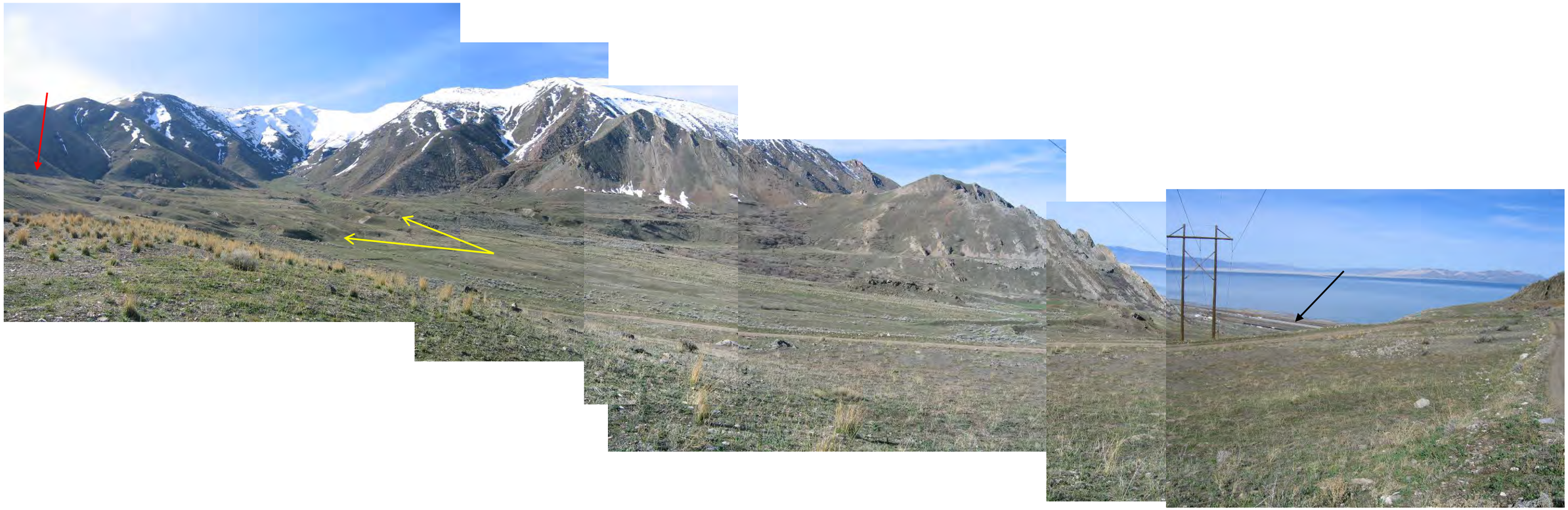

Photo No. 65 - OU19 Smelter Fallout. Pictured is Black Rock Canyon from the northern saddle along the eastern ridgeline. The canyon floor is predominantly vegetated with grasses and other low alpine forbs, including some stands of rabbit brush or sage. Near the bases of the snow covered peaks, some stands of scrub oak have begun to populate the canyon slopes and floor. The scrub oak can provide bedding cover for herbivorous mammals (such as elk). The surrounding peaks have vegetative covers where the slope angles are less steep, weather conditions permit plant growth and there is soil rather than bedrock available for roots to take hold. The vegetative cover is generally more successful below the Bonneville Bench (red arrow, left frame) which is located at approximately 5200 feet above sea level.

Some evidence of historical erosional activity is still evident to this day in the southern and western portions of Black Rock Canyon. Deep entrenched gullies (yellow arrows) were observed along the canyon floor extending north from the upper ridgelines. The fill along the canyon floor is mostly Bonneville Lake sediments, which consist of unconsolidated sands and gravels deposited by the prehistoric Lake Bonneville. The vegetation along the canyon floor appears to be stabilizing the gullies, as they were observed to have surface vegetation on them.

In the distance (as displayed in the right frame) one can see a segment of I-80 (black arrow), which is approximately 1500 feet north of the mouth of Black Rock Canyon. Correspondence with Ann Neville (Kennecott), suggests that Black Rock Canyon is a location where the general public has been observed trespassing onto Kennecott's property. Kennecott does its best to prevent trespassing, but as can be observed in this photo some areas of Kennecott's land holdings are remote. Currently the risks of exposure present in Black Rock Canyon are related to the localized biota consuming plants with the capacity to uptake selenium from the soils (for example: white-top). Kennecott has provided evidence (refer to Appendix D) that they do not use the seeds of plants capable of accumulating selenium from soil during their revegetation efforts. Access by the general public is restricted, but as noted is not always successful. A standing requirement placed on Kennecott is the need to manage soils excavated from Black Rock Canyon and shipped to off-site locations. Such operations do not currently take place, but if proposed in the future soils have to be in compliance with the unrestricted land use standards established for the Sites.

Photo No. 66 – OU22 Great Salt Lake, Shoreline and Wetlands. Depicted in the panorama are the ponds and springs that comprise the Garfield Wetlands and are monitored on annual basis pursuant to the remedy selected for OU22. The Garfield Wetlands are down gradient (north) of the Kennecott Smelter and Refinery complexes. North of the wetlands is the I-80 corridor (yellow dotted line) and the Great Salt Lake (immediate background). The Garfield Wetlands are bounded by I-80 (north boundary) and Hwy-201 (south boundary and by Hwy-202 (eastern boundary, immediately adjacent to the Magna Tailings Facility). The two highways, I-80 and Hwy-201, are depicted by the yellow dotted lines. The Garfield Wetlands are traversed by two partially active Union Pacific rail corridors (black lines), in part bisecting Ponds 5 and 4 and Ponds 6 and 7 on the eastern end. Two other monitored ponds (2 and 11, which are springs), other springs in the area, and the monitored Smelter Return Canal are not highlighted or labeled above because there footprints are too small to observe in the photo. The black colored ground near Ponds 6 and 7 (respectively) is an area where smelter slag used to be stockpiled. When the slag was removed, springs began expressing on the surface. The area is collectively called Hansen Springs, and is monitored by Kennecott.

Groundwater (alluvial and bedrock) flowing off the northern Oquirrh Mountains and under the Smelter and Refinery complexes, reports to the Garfield Wetlands. The principal and shallow aquifers have an upward gradient which causes Pond 8, 9B and various springs (for example, Japanese Spring – Pond 10, No-Name Springs – Pond 11, and Spitz Springs) to have water most of the year. The groundwater system underlying the Garfield Wetlands, and the Refinery, is currently the subject of an update to the original site remedial investigation completed in 2000. The purpose for the RI update is to determine the extent of the Refinery selenium. to assess source control measures previously implemented, and to assess locations where the plume may be expressing in the Garfield Wetlands that were not originally detected. Surface water in the Garfield Wetlands eventually flows into Pond 8 (or evaporates), surface water from Pond 8 can be discharged by Kennecott through their UPDES permitted outfall No. 004.

The Garfield Wetlands is currently the principal site of interest in OU22. The reason is that the ponds provide habitat for numerous waterfowl and shoreline birds, for nesting and foraging. During the nesting and brooding season (May to July) the shorelines and open water of the ponds play host to a number of different species. The most abundant species which use this area include: American Coots, Mallards, Grebes, Black-necked Stilts, Avocets, California Gulls, Yellow-headed and Red-winged Blackbirds. None of these birds were observed during the inspection since the inspections were performed from March to April. Even though the wetlands are surrounded by vehicle transportation corridors, traversed by active rail transport corridors, and located adjacent to the active smelting and refining operations of Kennecott, waterfowl and shoreline birds continue to use the Garfield Wetlands.

The ponds and springs are monitored by Kennecott to assess the concentration of the contaminant of concern (pursuant to the currently selected remedy, selenium) in co-located samples of sediment/soil, water and macroinvertebrate tissues. Since remedy selection, some ponds demonstrated compliance with the selected performance standard under the remedy (<5 mg/kg dry weight macroinvertebrate tissue selenium concentration) and hence are not monitored currently. The ponds highlighted in the figure continue to be monitored because selenium concentrations continue to remain elevated above the remedy benchmark for macroinvertebrate tissue of 5 mg/kg dry weight. In 2011 – 2012, the Agencies initiated a number of studies to clarify and refocus the remedy to better assess protection of the avian community. Part of this effort has recognized that arsenic is also a contaminant of concern and requires a performance standard.

As noted during the inspection, the shorelines of the ponds are predominantly vegetated by Phragmites (a non-native, intrusive wetland plant). The upland areas are vegetated with various grasses and salt tolerant species of plants. Soils in the vicinity can have an elevated salt concentration which acts indirectly to cause for selective vegetative success. Some of the ponds contained water (10, 9, 8, 7, 6 and 4) while Pond 5 was predominantly dry. Surface areas in the Garfield wetlands without water can at times be similar to salt playa type habitat, where not inundated by Phragmites. Ponds 4 and 5 were taken out of service by Kennecott from 2009 to 2010, and converted to upland habitat (though Pond 4 does maintain a small body of open water). Surface water in Pond 4 is actively pumped by Kennecott and directed to Kennecott's UPDES permitted outfall No. 008 (via a collection sump).

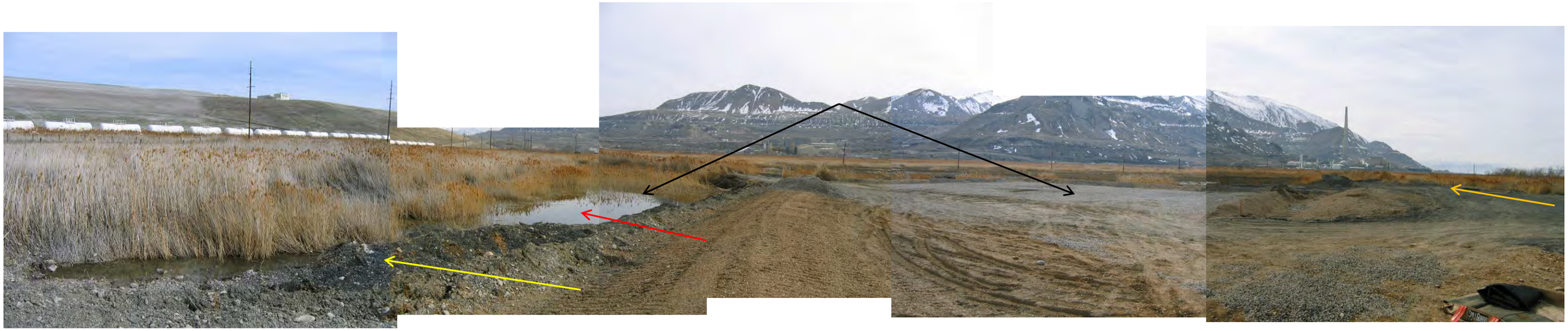

Photo No. 67 - OU22 Great Salt Lake, Shoreline and Wetlands. Depicted is the footprint of Pond 4A (black arrows). Pond 4A was the largest surface water body of the three ponds forming the Pond 4 complex (i.e. 4A, 4B and 4C). Pond 4A still has surface water (red arrow) which is pumped out and delivered to a collection sump located north of this vantage point (view is to the south). The gravel covered area (right black arrow) was in part the historic location of Garfield Well No. 5 which was abandoned by Kennecott as a result of the 2013 RI update performed on the underlying groundwater system (OU23). No birds or fish were observed during the inspection, though mosquito fish have been observed in the past in the surface water of Pond 4A. Slag (yellow arrow) in part was used to take Pond 4A out of service because of its low leachability and coarse grains which facilitate drainage. Kennecott response work to drain Pond 4 and 5 and convert them to upland habitat has yet to be reported to the Agencies. Phragmites were observed to be the predominant plant species, voluntarily re-vegetating the area of Pond 4A, 4B and 4C. The orange arrow in this panorama and Photo No. 68 delineates the southern abandoned rail corridor bisecting the Garfield Wetlands. Pond 4C (out of frame, discretely called out as 4C1, 4C2 and 4C3) are ditches located to the west of this vantage point, adjacent or between the two abandoned rail corridors.

Photo No. 68- OU22 Great Salt Lake, Shoreline and Wetlands. Depicted is the surrounding landscape near the abandoned Garfield Well No. 5 footprint (black arrow). The well was abandoned by Kennecott pursuant to State regulations vested with the Division of Water Resources. Extending south (view direction in the left frames) from the footprint of Garfield Well No. 5 is the southern portion of Pond 4A extending into Pond 4B. Water still was visible along the surface but the area was graded to drain towards the low point created in the northeast corner of Pond 4A (refer to Photo No. 67). The abandoned well looked stable with no evidence of underlying artesian flow. The surfaces of Pond 4A extending to the south appeared to be stable, with some smaller surface water bodies. As noted in Photo No. 67, phragmites are colonizing the converted pond area (red arrow).

Photo No. 69 – OU22 Great Salt Lake, Shoreline, Wetlands. Depicted in this panorama is the regarded/reclaimed footprint of Pond 5 of the Garfield Wetlands. The immediate foreground (outlined in black) is the southeast corner of the embankment which formed the southern and eastern boundary of Pond 5. The surface regarding work Kennecott completed in 2009-2010 included the lowering of the elevation of the embankment, thus raising the overall elevation of the center of Pond 5 to reduce the potential for ponding along the surface. In the center of Pond 5 the topography rises slightly to form an island (when the pond held water), the red line approximates the southern and eastern toe of the island. Meteoric water from time to time still collects along the toe near the northeast end of the island.

The regarding work by Kennecott generally causes the topography to slope towards the north, thus facilitating drainage toward Pond 6. The Pond 6 area is near the large pile of slag (black arrow) located adjacent to the active Union Pacific rail corridor bisecting the Garfield Wetlands (not visible). After the regarding effort by Kennecott, phragmites began to colonize the footprint of Pond 5. However, the area between the island and the embankment generally was free of vegetation as observed during the inspection. Some salt tolerant (playa type) grasses have begun to colonize the bottom of Pond 5. Kennecott's goal for Pond 5 has been to remove its value to the avian community as nesting habitat. It is anticipated that the phragmites will take over as the predominant vegetative cover over time. Approximately 3 years after response work the phragmites have yet to fill in the footprint completely. What is clear is that Pond 5 generally does not retain water on the surface, as Pond 4 does.