6.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

6.1 IDENTIFICATION AND PRELIMINARY SCREENING OF REMOVAL ACTION OPTIONS FOR AOIs

6.1.1 RT/DSS AOI

This AOI consists of the retort tailings (RT) deposit and streambed sediments downstream (DSS) of the retort tailings deposit. Analytical results indicate these two AOIs have similar characteristics and should be managed as a single AOI. Four removal action options for this AOI were identified as follows:

1. No action
2. In-place closure for RT AOI and removal and on-site consolidation for DSS AOI
3. Removal and on-site consolidation for RT and DSS AOI's
4. Removal and off-site disposal for RT and DSS AOI's

In-place closure for the DSS AOI was not considered due to long-term maintenance considerations. The streambed has a potential for flash floods, which is an uncontrollable setting. Therefore, management of these materials within a high-energy, dynamic occurrence such as a streambed prone to periodic floods would be ineffective and infeasible.

The analytical results and risk assessment for the RT/DSS AOI indicate the following:

1. The retort tailings and downstream sediments do not contain concentrations of elemental mercury, mercuric chloride, or methyl mercury in excess of either applicable soil remediation levels (SRLs) or risk-based soil remediation levels for a recreational site user.
2. The EE/CA sampling and analysis program (see Section 2.4.5) indicates that the potential for the retort tailings and downstream sediments to impact groundwater and surface water above applicable water quality standards is minimal, and it is not expected that water quality standards will be exceeded.

Based on the above, Options 1-4 above will meet the RAO for the RT/DSS AOI. Option 2 would lessen future downstream erosion and migration of the retort tailings, while Options 3 and 4 would eliminate future downstream erosion and migration of the retort tailings. Each Option is described in the following subsections. Cost estimate details for each Option are provided in Table J-1 attached as Appendix J.

6.1.1.1 No Action (Option 1)

The no action alternative is mandated by the NCP. For the RT/DSS AOI, it would leave the retort tailings deposit and downstream sediments in-place without modification. The retort tailings meet the ARAR and risk-based cleanup goals. There are no other ARARs that require management of the retort tailings and downstream sediments. The retort tailings deposit is undergoing natural reclamation through re-vegetation and natural slope stability (see Photographs 1, 8, & 13-15 in Appendix A). This is a gradual process. Over time the retort tailings deposit will reach an equilibrium condition. The no action alternative would meet the RAOs. No additional work is required. Therefore, the capital cost for Option 1 is zero.

6.1.1.2 In-Place Closure of RT AOI and Removal/On-Site Consolidation of DSS AOI (Option 2)

Option 2 would minimize further migration of the retort tailings downstream of the Site. Option 2 would include the following components:

1. Improvements to the access road to allow for mobilization of necessary earth moving equipment.

2. Construction of a temporary haul road to the streambed below the retort tailings pile to allow access to downstream sediment deposits. The haul road is assumed to be 0.5 miles long.

3. Moving an assumed 2,000 cubic yards (cy) of downstream sediments to the main retort tailings deposit.

4. Re-grading the retort tailings pile from the existing 1.5:1 slope on a 1.5-acre footprint to an approximate 3:1 slope on a three-acre footprint. The Labor Day 1970 Storm created a natural channel capable of conveying greater than a 100-year runoff event around the existing retort tailings deposit. The design assumes the retort tailings are re-graded along the eastern bank of the channel and the existing channel is not filled.

5. Cover the re-graded retort tailings deposit with approximately 12 inches of soil obtained from nearby borrow areas. For cost estimation purposes, approximately 5,000 cy of material are assumed.

6. Riprap erosion protection would be installed along the base of the covered retort tailings deposit. For cost estimation purposes, the riprap protection would extend for a distance of 0.25 miles and would be designed to protect against a minimum 100-year runoff event.

7. Confirmatory sediment sampling would be performed along portions of the streambed where sediments were removed.

8. The borrow area and covered retort tailings would be re-vegetated with native vegetation.

9. The cost estimate assumes a 30-year inspection and monitoring program at an assumed cost of $5,000 per year.

The following action-specific ARARs will be attained to the extent practicable considering the exigencies of the situation: substantive stormwater discharge requirements of the Clean Water Act – National Pollutant Discharge Elimination System (CWA – NPDES); fugitive dust emissions (dust control); and, the substantive requirements of the Arizona Mined Land Reclamation Rules, particularly those pertaining to soil conservation, erosion control and topographic contouring, roads, re-vegetation, and redistribution of soils. Permits are not required for the portion of a response action that is conducted entirely on-site pursuant to CERCLA §121(e)(1) of CERCLA.

Option 2 would be designed to avoid the covered retort tailings filling the existing drainage, which would remove the retort tailings from the drainage and meet the short-term effectiveness criteria. Long-term effectiveness may be considered moderate because catastrophic events such as range fires and runoff events greater than a 100-year event are difficult to predict and measures to protect against these events are difficult to design against and are costly to implement. Material and equipment required to implement Option 2 are readily available. However, road improvement/construction is required and construction activities would disturb the local ecology. Therefore, technical feasibility is considered moderate to high. Assuming a 30 percent contingency, the cost for Option 2 could range from $1,192,394 - $1,550,112.

6.1.1.3 Removal and On-Site Consolidation of RT/DSS AOI (Option 3)

Option 3 would involve the removal of the retort tailings from the drainage. Therefore, Option 3 would prevent further migration of the retort tailings downstream of the Site. Option 3 would include the following components:

1. Improvements to the access road to allow for mobilization of necessary earth moving equipment.
2. Construction of a temporary haul road to the streambed below the retort tailings pile to allow access to downstream sediment deposits. The haul road is assumed to be 0.5 miles long.
3. Moving an assumed 9,000 cubic yards (cy) of retort tailings to the on-site consolidation cell. The retort tailings would initially be placed in the vertical shaft pit. Excess retort tailings would be placed in the open pit.
4. Cover the consolidation cell with approximately 12 inches of soil obtained from a nearby borrow area.
5. Confirmatory sediment sampling would be performed along the areas where the retort tailings were removed.
6. The borrow area, covered retort tailings, and haul road would be re-vegetated with native vegetation.
7. Long-term inspection and monitoring is not anticipated and is not included in the cost estimate.

The following action-specific ARARs will be attained to the extent practicable considering the exigencies of the situation: substantive stormwater discharge requirements of the Clean Water Act – National Pollutant Discharge Elimination System (CWA – NPDES); fugitive dust emissions (dust control); and, the substantive requirements of the Arizona Mined Land Reclamation Rules, particularly those pertaining to soil conservation, erosion control and topographic contouring, roads, re-vegetation, and redistribution of soils. Permits are not required for the portion of a response action that is conducted entirely on-site pursuant to CERCLA §121(e)(1) of CERCLA.

Option 3 would be effective in both the short-term and long-term. Material and equipment required to implement Option 3 are readily available. However, road improvement/construction is required and construction activities would disturb the local ecology. Therefore, technical

feasibility is considered moderate to high. Assuming a 30 percent contingency, the cost for Option 3 could range from $436,700 - $567,710.

6.1.1.4 Removal and Off-Site Disposal of RT/DSS AOI (Option 4)

Option 4 is essentially the same as Option 3, with the addition that the removed materials would be transported and disposed off-site. Based on the results of the site investigation, the retort tailings would not be characterized as hazardous waste. Therefore, the cost estimate assumes disposal in a Subtitle D landfill as solid waste or daily cover. Assuming a 30 percent contingency, the cost for Option 4 could range from $1,314,700 - $1,708,850.

6.1.2 RB AOI

This AOI consists of the area of the retort building (RB). The data evaluation and risk assessment indicate that the soils around the retort building do not contain mercury concentrations in excess of risk-based levels for a recreational user. The analytical results do indicate a potential for leaching of mercury to groundwater from soils located near the base of the fallen retort stack. This area is limited and minimal in extent and the absence of groundwater in this area makes this exposure pathway incomplete. The secondary concern for this area is the dilapidated state of the retort building, which represents a potential physical safety hazard to visitors. Physical safety hazards constitute a non-environmental situation that may pose a threat to public health and welfare, but not one that is expected to result in CERCLA-regulated release. There are five options for this AOI as follows:

1. No action
2. Limit access
3. Remove soils around the retort building and limit access
4. Limited soil removal and demolish retort building to concrete slab
5. Demolish retort building and remove soils

Options 1-5 above would meet the RAO for the RB AOI. Options 2 and 3 will minimize site visits, while retaining the retort building. Option 3 would have the effect of removing impacted soils around the fallen retort stack. Options 4 and 5 would be the most aggressive options and would involve removing the retort building and impacted soils around the retort building. Each

Option is described in the following subsections. Cost estimate details for each Option are provided in Table J-2 attached as Appendix J.

6.1.2.1 No Action (Option 1)

The no action option for the RB AOI would leave the soil around the retort building in-place and leave the retort building standing, with no access limitations. Option 1 would be the easiest to implement, would have the lowest cost, and would result in the least amount of disturbance to the local ecology. Chemical-specific ARARs and/or risk-based concentration levels associated with the RB AOI currently are attained. The no-action alternative meets the RAOs. Option 1 would preserve the historic significance of the retort building. However, Option 1 would not eliminate the physical safety hazards associated with the dilapidated condition of the retort building. No additional work would be required. Therefore, the capital cost for Option 1 would be $0.

6.1.2.2 Limited Access (Option 2)

Access limitations would initially consist of locked gates and fences, which would require long-term maintenance on public lands. Therefore, the gates and fences should be considered temporary measures to minimize vehicular traffic to allow natural reclamation of the access road. Due to the remote and rugged nature of the site and vicinity, if the access road were to be eliminated, persons would be less likely to visit the site. Therefore, Option 2 would mitigate site access and the physical safety hazard risks associated with retort building, which is not a CERCLA concern. The estimated cost to install temporary fences and gates and re-vegetate portions of the access road is estimated to range from $30,000.00 to $50,000.00.

6.1.2.3 Remove Soils Around Retort Building and Limit Access (Option 3)

Option 3 would be similar to Option 2, with the addition of removing soils around the fallen retort stack. Access limitation would be employed as described as Option 2. The minimum area of soil removal starts at the base of the stack to the end of the stack, which is a length of approximately 30 feet, and a distance of three feet on either side of the stack. Soil removal depth is assumed to be one foot. This is approximately 180 cubic feet of soil. Though the exposure pathway for groundwater is indicated to be incomplete, Option 3 would eliminate concerns associated with leaving potentially leachable soils, in-place and uncovered, at the site.

The soil removal would be performed before eliminating the access road. The SPLP analytical results for samples RB-6-S and RB-7-S indicated the leachate for these samples contained

mercury in excess of 0.2 mg/L. TCLP analysis on the same sample may or may not result in the TCLP standard being exceeded. The TCLP standard for mercury is 0.2 mg/L. For cost estimation purposes only, and without determining or implying that the soils are hazardous waste subject to regulation as hazardous waste under Subtitle C of RCRA or the Arizona hazardous waste program, or that RCRA Subtitle C requirements are applicable or relevant and appropriate to this removal action, MACTEC assumes a worst-case scenario that the excavated soils will require management as hazardous waste. This would require disposal in a landfill permitted to accept hazardous wastes. The closest Sub-Title C facility to the Site is located in Beatty, Nevada. The area behind the retort building (east side) is inaccessible to equipment. Therefore, the soils around the fallen retort stack will be removed using hand methods. The removed soils would be placed in 55-gallon drums and transported via pickup truck to a designated area that is accessible to a larger transport vehicle.

Option 3 takes into account the RCRA requirements for characterization, transportation, and disposal of hazardous waste. Less than 0.1 acres of land would be disturbed so that Clean Water Act stormwater requirements are not applicable. The retort building would not be demolished. Therefore, the action-specific ARARs associated with archeological and historic resources are not necessary.

Option 3 would be effective in the short-term and long-term and would retain the retort building. Equipment and materials are readily available to implement Option 3. Therefore, technical feasibility is considered 'high'. Assuming a 50 percent contingency to account for the unknown extent of impacted soil, the cost for Option 3 could range from $56,600 - $89,900. In the event the removed soils are characterized as non-hazardous and are suitable for on-site consolidation or off-disposal as solid waste, the costs could be approximately 30 to 40 percent lower.

6.1.2.4 Demolish Retort Building to Concrete Slab and Limited Soil Removal (Option 4)

Option 4 does not involve access limitations. It includes demolition of the retort building to the concrete slab. Some heavy equipment would be required; therefore, improvements to the access road would also be required. Non-hazardous demolition debris such as wood and metal roofing would be buried on-site. For worst-case cost estimation purposes, the retort equipment, including the rotary kiln, would be dismantled on-site and disposed off-site as hazardous waste. Asbestos containing materials (ACM) will be removed in accordance with NESHAP regulations and

disposed off-site in a proper landfill. The removal of the retort building could necessitate the removal of a larger quantity of soil. Soils beneath the building are not currently accessible and have not been characterized. This was agreed upon by the Forest Service by approval of the SAP, which did not include sampling of soils beneath and in the vicinity of the retort building. By leaving the slab in-place as a cover, the amount of soil to be removed would be less than if the foundation was also removed.

Assuming the area of impacted soil extends to the soil sample collected by Dynamac near the dump chute, the area is approximately 80 feet by 80 feet in dimension or 6,400 square feet. Subtracting the approximate area of the concrete slab, the area of soil removal is reduced to approximately 5,000 square feet. Assuming a minimum of two feet of soil removal, approximately 600 tons of soil would be removed. Option 4 would encompass the following action-specific ARARs: archeological and historic site preservation; NESHAP; CWA – stormwater; and, fugitive dust control.

Though the exposure pathway for groundwater is indicated to be incomplete, Option 4 would eliminate concerns associated with leaving potentially leachable soils at the site in-place. Additionally, the physical safety hazards associated with the retort tailings building would be eliminated and access to the area is retained. Therefore, Option 4 would be effective in the short-term and long-term and would be technically feasible. Assuming a 50 percent contingency to account for the unknown extent of soil impact, the estimated cost could range from $550,000 to $825,000. As indicated in Option 3, in the event the removed soils are characterized as non-hazardous and are suitable for on-site consolidation or off-disposal as solid waste, the costs would be approximately 30 to 40 percent lower.

6.1.2.5 Demolition of Retort Building and Concrete Slab and Limited Soil Removal (Option 5)

Option 5 is identical to Option 4, with the addition of removing the concrete slab and possibly soil underlying the concrete slab, if impacted. Assuming the area of impacted soil extends to the soil sample collected by Dynamac near the dump chute, the area is approximately 80 feet by 80 feet in dimension or 6,400 square feet. Assuming a minimum of two feet of soil removal, approximately 900 tons of soil would be removed. Assuming a 50 percent contingency to account for the unknown extent of soil impact, the estimated cost could range from $665,500 to $998,250. As indicated in Option 3, in the event the removed soils are characterized as non-

hazardous and are suitable for on-site consolidation or off-disposal as solid waste, the costs would be approximately 30 to 40 percent lower.

6.2 REMOVAL ACTION ALTERNATIVES

6.2.1 Analysis of Alternative 1 – No Action

Alternative No. 1 would not include site removal actions for the RT/DSS and RB AOIs. Comparison of soil and vapor analytical data to ARAR-based and risk-based cleanup goals indicate that the overall protection of human health and the environment from mercury species considered to be mobile and toxic would be achieved by this alternative, as would the short-term effectiveness, long-term effectiveness, reduction of toxicity, mobility and volume and compliance with ARARs. The retort tailings would be allowed to continue the current process of natural reclamation, which has been occurring for more than 30 years. Alternative No. 1 would not mitigate the physical safety hazard risks associated with the retort building; however, neither CERCLA nor the NCP authorize removal actions for the sole purpose of mitigating physical safety hazards in the absence of a release or threatened release of hazardous substances that presents an unacceptable risk. The technical feasibility and availability of services and materials for implementability are rated high because essentially no construction would be required. The capital and O&M costs would be $0.

6.2.2 Analysis of Alternative 2 – No Action for RT/DSS AOI and Limit Access

Alternative 2 is identical to overall Alternative 1, with the addition of access limitations. The access limitations are primarily intended to minimize the physical safety hazard risks associated with the retort building. Neither CERCLA nor the NCP authorize removal actions for the sole purpose of mitigating physical safety hazards in the absence of a release or threatened release of hazardous substances that presents an unacceptable. However, the access limitations also minimize access to the RT/DSS AOI. Elimination of the access road to the Site is a critical component to this alternative. If the access road is eliminated, recreational users in the area would be less likely to visit the Site. Alternative 2 has the benefit of retaining the historical value of the retort building and would eliminate the implementation of the action-specific ARARs associated with historical resources.

Alternative 2 would initially involve the use of temporary fences and locked gates to limit access to the access road. This would minimize or eliminate vehicular traffic and would enhance natural reclamation of the road. This process is already occurring along several stretches of the road. Eventually, the fences and gates could be removed. The criteria of effectiveness and implementability of overall Alternative 2 are the same as overall Alternative 1. However, while possible, it is difficult to maintain access limitations on public lands. This is the reason for allowing natural reclamation of the access road. The cost for overall Alternative 2 could range from $30,000 to $50,000.

6.2.3 Analysis of Alternative 3 – No Action for RT/DSS AOI and Limited Soil Removal around Retort Building

Alternative 3 is identical to overall Alternative 2, with the addition that limited soil removal is performed around the fallen retort stack. Access limitations will be implemented as described in overall Alternative 2. As with overall Alternative 2, this alternative will also meet the evaluation criteria of effectiveness and implementability. The limited soil removal would be performed by hand, which would minimize disturbance to the local ecology and the need for extensive access road improvements. As described in Section 6.1.2.3, the quantity of soil to be removed has not been evaluated. Therefore, additional investigation is required. As discussed in Section 6.1.2.3, Alternative 3 assumes that the minimum area of soil removal would be 180 square feet and that the soil would be characterized as hazardous waste. Assuming a 50 percent contingency to allow for the unknown extent of soil impact, the cost for Option 3 could range from $56,600 - $89,900. In the event the removed soils are characterized as non-hazardous and are suitable for on-site consolidation or off-disposal as solid waste, the costs could be approximately 30 to 40 percent lower.

6.2.4 Analysis of Alternative 4 – No Action for RT/DSS AOI, Demolish Retort Building to Concrete Slab, and Limited Soil Removal around Retort Building

Alternative 4 includes removal of the retort building to the concrete slab. The overall benefit of leaving the concrete slab in-place is the reduction of the quantity of soil that requires off-site disposal and the historic value of the retort building. The retort building would be removed; therefore, access limitations would only be required during demolition activities. Heavy equipment would be required, which would require access road improvements. Mobilization and use of heavy equipment would increase disturbance to the local ecology. As with Alternatives 1 through 3, Alternative 4 would meet the effectiveness criteria. Though the historical value of the

retort building would be removed, the removal of the retort building would eliminate the physical safety hazard risks associated with the retort building. However, neither CERCLA nor the NCP authorize removal actions for the sole purpose of mitigating physical safety hazards in the absence of a release or threatened release of hazardous substances that presents an unacceptable risk. The technical feasibility of Alternative 4 is 'moderate to high' and the availability of services and equipment required to implement the actions would be 'moderate to high', with access road improvements being a limiting factor. Assuming a 50 percent contingency to allow for the unknown extent of soil impact, the cost for Option 4 could range from $550,000 to $825,000. In the event the removed soils are characterized as non-hazardous and are suitable for on-site consolidation or off-disposal as solid waste, the costs could be approximately 30 to 40 percent lower.

6.2.5 Analysis of Alternative 5 – No Action for RT/DSS AOI, Complete Removal of Retort Building, and Limited Soil Removal around Retort Building

Alternative 5 is identical to Alternative 4, with the addition that the retort building is completely removed. Technical feasibility would be 'moderate to high' and the availability of services and equipment required to implement the actions is moderate to high, with access road improvements being a limiting factor. The difference between Alternatives 4 and 5 is the cost for removal of the concrete slab and impacted soils underlying the concrete slab, if present. Therefore, assuming a 50 percent contingency to account for the unknown extent of soil impact, the cost for Alternative 5 could range from $665,500 to $998,250. In the event the removed soils are characterized as non-hazardous and are suitable for on-site consolidation or off-disposal as solid waste, the costs could be approximately 30 to 40 percent lower.

6.2.6 Analysis of Alternative 6 – In-Place Closure for RT AOI, On-Site Consolidation of DSS AOI, Complete Removal of Retort Building, and Limited Soil Removal around Retort Building

Extensive earthwork is required for Alternative 6, which would likely result in worsening the condition of the retort building. Therefore, Alternative 6 is a combination of RB/DSS AOI Option 2 and RB AOI Option 5. Alternative 6 would be effective in the short-term and long-term. However, Alternative 6 would require long-term inspection and monitoring of the consolidated and covered retort tailings. Though equipment and services are readily available, technical feasibility of Alternative 6 is considered 'moderate to high' due to the requirement to improve and construct access roads and disturbance of the local ecology during removal action

activities. Assuming contingencies, the cost for Alternative 6 could range from $1,791,894 to $2,449,362.

6.2.7 Analysis of Alternative 7 – On-Site Consolidation of RT/DSS AOI, Complete Removal of Retort Building, and Limited Soil Removal around Retort Building

The materials removed from the RT/DSS AOI will be placed in the existing mine working. Extensive earthwork is required for Alternative 7, which would likely result in worsening the condition of the retort building. Therefore, Alternative 7 is a combination of RT/DSS AOI Option 3 and RB Option 5. Debris generated by demolition of the retort building will also be placed in the mine workings. Short-term and long-term effectiveness are considered high because the retort tailings would be removed from the drainage. If properly constructed, the cover for the consolidation cell should require minimal monitoring and maintenance, particularly considering that the groundwater exposure pathway is incomplete. Though equipment and services would be readily available, technical feasibility of Alternative 7 is considered 'moderate to high' due to the requirement to improve and construct access roads and disturbance of the local ecology during removal action activities. Assuming contingencies, the cost for Alternative 7 could range from $1,036,200 to $1,466,960.

6.2.8 Analysis of Alternative 8 – Off-Site Disposal of RT/DSS AOI, Complete Removal of Retort Building, and Limited Soil Removal around Retort Building

Alternative 8 is identical to overall Alternative 7, with the exception that the retort tailings and downstream sediments are disposed off-site as solid waste. Assuming contingencies, the cost for Alternative 8 could range from $1,914,200 to $2,608,100.