Umetco Minerals Corporation

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May 10, 2011

Mr. Dominic Orlando, Senior Project Manager
U.S. Nuclear Regulatory Commission
Special Projects Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
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Office of Federal and State Materials
and Environmental Management Programs
US Nuclear Regulatory Commission
Mail Stop T-8F5
11545 Rockville Pike
Rockville, Maryland 20852

Reference: **Radioactive Materials License SUA-648; Docket No. 040-0299**

Subject: **Response to U.S. Nuclear Regulatory Commission Staff Review of Umetco Minerals Corporation's Gas Hills Reclamation Project – Above Grade Tailings Impoundment and A-9 Repository Erosion Protection Enhancement Design Report (License SUA-648, Docket 040-0299)**

Dear Mr. Orlando,

Enclosed please find two copies of the report titled Request for Additional Information, Gas Hills Reclamation Project, Above Grade Tailings Impoundment and A-9 Repository, Erosion Protection Enhancement Design Report, dated May 9, 2011.

This submittal documents Umetco Minerals Corporation's (Umetco) design modifications and provides response to U.S. Nuclear Regulatory Commission's (NRC) request for additional information provided by NRC letter dated April 20, 2011.

FSME21

The document includes the following:

- Umetco's specific response to NRC's request for additional information.
- Revised design report text
- Two replacement drawings – sheet 5 of 8 and sheet 6 of 8.

If you, or the staff, have any questions, please contact me at 970-256-8889 or by e-mail at gieckte@dow.com.

Regards,

Thomas E. Gieck
Remediation Leader

TEG/jfc
Enclosures: As stated

cc: Mark Moxley, WDEQ

REQUEST FOR ADDITIONAL INFORMATION

GAS HILLS RECLAMATION PROJECT

ABOVE GRADE TAILINGS IMPOUNDMENT AND A-9 REPOSITORY EROSION PROTECTION ENHANCEMENT DESIGN REPORT

UMETCO MINERALS CORPORATION
GAS HILLS URANIUM TAILINGS SITE SUA-648
GAS HILLS, WYOMING
MAY 9, 2011

REQUEST FOR ADDITIONAL INFORMATION

GAS HILLS RECLAMATION PROJECT
ABOVE GRADE TAILINGS IMPOUNDMENT
AND A-9 REPOSITORY
EROSION PROTECTION ENHANCEMENT
DESIGN REPORT

Contents:

RESPONSE TO U.S. NUCLEAR REGULATORY COMMISSION STAFF'S REQUEST FOR ADDITIONAL INFORMATION (RAI) OF UMETCO MINERALS CORPORATION'S GAS HILLS RECLAMATION PROJECT – ABOVE GRADE TAILINGS IMPOUNDMENT AND A-9 REPOSITORY EROSION PROTECTION DESIGN REPORT
(LICENSE SUA-648, DOCKET 040-0299)

REQUEST FOR ADDITIONAL INFORMATION

Rill Formation and Proposed Enhancements:

1. Staff review of the proposed erosion protection enhancement indicates that Umetco intends to provide additional filter material under the 6-inch (Type C) rock layers to reduce interstitial flow velocities to acceptable levels. The staff concludes that this design is acceptable for the Type C rock layers, but may not be adequate to prevent future gully formation where no additional filter material is proposed to be added. Based on review information provided by Umetco and independent staff evaluations, the staff considers that the gullying observed in the Type C rock layers could occur in some steeper areas of the Type B rock layers. Although no gulling has yet been observed in the Type B riprap layers, the staff believes that additional measures need to be taken to assure stability of the layers. The staff's rationale for this conclusion is summarized below.

a. The gullies observed in the Type C rock layers may have been produced by freezing of the rock layers above the soil layer, causing a "bridging" effect where "tunnels" occurred under the rock – and above the soil layer – providing a low-resistance pathway for snowmelt runoff to produce sufficiently high velocities to erode the soil cover. After the snow had melted and the rock ridges had thawed, the rock collapsed into its current configuration.

b. The staff believes that interstitial velocities alone (in the Type C, 6-inch riprap) are not great enough to cause the significant erosion that occurred at the Umetco site. The interstitial flow velocities estimated by Umetco using NUREG-4620, of 0.5 to 1.0 ft/sec are usually not great enough to cause such erosion. The staff also examined methods other than those found in NUREG-4620 for computing interstitial flow velocities, including "Estimated of Flow Through and Over Armoured Slopes," (R. Codell, S.Abt, T. Johnson, J. Ruff, , American Society of Civil Engineers, Journal of the Hydraulics Division, Volume 116, October, 1990). Using information in this article, the computed interstitial velocities for 6-inch rock on a 10 percent slope were about 0.5 ft/sec, less than normally required for significant erosion.

c. If a larger flow area than the area of the rock voids is assumed to occur, caused by freezing and "bridging" of the rock layers, a gully on a 5 – 10 percent slope could cause extensive erosion of the underlying soil. As shown on photos provided by Umetco, the gullies appear to be about 1 – 2 feet wide and 1 – 2 feet deep, indicating that freezing and bridging of the Type C rock layers may have produced openings on such steep slopes

could produce flow velocities in excess of the 2 – 3 feet per second, which would be sufficient to cause the observed significant erosion.

d. The staff considers that some soils that become saturated, freeze, and then thaw may have a significantly reduced resistance to erosion and movement in the recently – thawed condition. The staff examined information provided in references such as "Effects of Freeze – Thaw Cycling on Soil Erosion," (L. W. Gatto, et al), indicating that recently – thawed soils may have significantly reduced resistance to erosion.

e. Particularly large shear stresses can be produced in those areas where the Type B layer ends and the Type C layer begins. These excessive shear stresses can be produced where there is a slope change and the flow passes through critical depth.

f. Based on the 2/22/11 aerial photographs of the snow cover that were provided by Umetco, and Umetco's interpretation of the snow cover, it appears that snow drifts tend to concentrate in certain areas where the slope changes or in areas where the rock size transitions from one size to the other. Such concentrations of snow could result in concentration of runoff due to rapid melting. Coupled with decrease in shear strength discussed in (d) above and the increase in shear stresses discussed in (e) above, this could lead to erosion problems.

Rill Formation and Proposed Enhancements, Comment No. 1:

Please provide additional information to resolve the concerns discussed above and provide further justification that the Type B rock layers would not be subject to the gullying that occurred on the Type C rock layers.

Alternately, Umetco could provide an alternate bedding/filter design for the Type B rock layers. Such designs could include:

a. Placement of additional material under the Type B rock layers

b. Partial placement of filter material under the Type B rock layers, such as x-wide strips of filter material spaced at specific intervals.

c. Placement of filter layers in those areas where flows transition from the Type B layers to the Type C layers.

Response to Rill Formation and Proposed Enhancements Comment No. 1:

Umetco will place a minimum 3-inch layer of the 30/70 bedding material extending 25-feet upslope from the transition between the Type B and Type C erosion protection materials on the AGTI (a similar treatment for the crest of the A-9 Repository is provided for in the original design proposal). The existing Type B riprap will be removed and subsequently replaced after the bedding layer is placed. This will essentially provide a 50-foot bedding zone at the transition (25-feet under the Type B riprap and 25-feet under

the Type C riprap). This transition/buffer zone will be provided to add conservatism to the proposed erosion repair design.

Umetco has evaluated the freezing/bridging/tunneling hypothesis proposed by staff and concluded that the erosion rills which have developed on the AGTI and A-9 Repository are a result of the lack of an adequate bedding layer beneath the Type C riprap layer placed on these structures. Umetco cannot support a conclusion that freezing/bridging/tunneling has contributed to the rilling phenomenon, this conclusion is based on the information provided below:

a. In order for the rock layer to freeze it would have to be saturated. As both the Type B and Type C erosion protection layers are comprised of coarse grained free draining materials and the erosion protection material is placed on a fairly steep uniform slope ($\geq$ 10-percent), it is difficult to envision a condition in which the rock layer would become completely saturated, freeze and subsequently develop the proposed bridging effect. While the presence of drifting snow is apparent and snow could be driven into the voids in the rock covers, there is not enough water content in a snow pack/drift to completely saturate the layer and provide for freezing/bridging conditions to occur. Typically fresh snow exhibits a water content of 7- to 12-percent and a deep, high altitude, compacted snowpack exhibits a water content of 30- to 50-percent, with the 50-percent value occurring during spring melt conditions.

The physics of snow melt are such that a snow pack/drift begins to melt when its temperature from top to bottom equalizes at 32-degrees F. Before reaching this isothermal state, the snowpack has different temperatures at different depths and some edge effect melting/runoff can occur. Due to the free draining characteristics of the rock layers and steepness of the slope it seems reasonable that melt water would runoff of the slope and not have the residence time required to freeze or re-freeze the rock layer.

Snow pack/drift water content and snow melt references include *Martin A. Baxter, Charles E. Graves, and James T. Moore, "A Climatology of Snow-to-Liquid Ratio for the Contiguous United States", Weather and Forecasting, Vol. 20, Issue (5), pgs. 729 – 744(October 2005); California Data Exchange Center, snow "Depth and Density", Department of Water Resources California (2007); and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and U.S Department of the Interior-U. S. Geological Society web sources.*

b. In addition to the lack of adequate water content/saturated conditions, the subnivean conditions which exist in and underneath a snow pack/drift would inhibit freezing of the rock layers.

c. The erosion rills which have formed on the AGTI (under the Type C riprap cover) exhibit dimensional and depositional characteristics which are identical to those found on the southern slope of the A-9 Repository. Due to the prevailing wind, little, if any, snow accumulates on the southern slope and the possibility of conditions which would contribute to a frozen rock layer on the A-9 Repository are nonexistent as the rock layer

is free draining, a steep/well drained slope is present and unsaturated moisture conditions exist within the rock layer.

d. Umetco agrees that interstitial flow velocities less than 0.5-feet per second are not great enough to cause significant erosion on the structure slopes in question. No erosion has been detected on slopes covered with Type A, Type B and/or Type C riprap where the interstitial velocity is 0.5-feet per second or less. Erosion rills have only formed or been detected on slopes where the interstitial velocity exceeds the 0.5-feet per second threshold velocity cited in NUREG-1623.

e. Umetco reviewed a reference published subsequent to the reference cited in comment 1.d., *Quantifying the Effect of a Freeze-Thaw Cycle on Soil Erosion, M.G. Ferrick and L.W. Gatto, July 2004.* The focus of this study was to quantitatively test the hypothesis that soil freeze-thaw processes significantly increase the potential for upland slope erosion during runoff events that follow thaw. According to this study, three conditions must exist for ground ice to become a substantial component of a soil mass:

1. Adequate supply of soil moisture,
2. Sufficiently cold air temperatures to cause heat loss and freezing, and
3. A frost-susceptible soil with a significant silt component (Anderson, et.al., 1978).

While the first two conditions may exist at the Gas Hills site the third does not, i.e., silts with available soil water are most susceptible to changes in strength and erodibility caused by the Freeze-Thaw Cycle. The results of this study were based on a soil composed of 82-percent silt- and clay- sized particles and a liquid limit of 28-percent. Frost protection soils at the Gas Hills site classify as a SC with only an average 36-percent silt- and clay- sized particles with an average Plasticity Index of 18 (very low silt content), and significant portions of medium and coarse grained sand. Accordingly, the cover soils at the Gas Hills site would be not be considered as susceptible to reduced resistance to erosion as those soils identified by the referenced study.

After reexamining the design calculations, performing additional field observations this spring, which focused on an examination of the condition of the existing Type B erosion protection material/placement on the slopes of the AGTI (May 5, 2011), and evaluating NRC staff's freezing/bridging hypothesis, Umetco must conclude that the sub-grade beneath the Type B riprap has not been adversely affected by erosion as interstitial velocities are less than or equal to 0.5-feet per second in these areas and any collapse or rill formation beneath the Type B erosion protection materials would be readily evident due to the smaller size (6-inch minus gradation) and depth (6-inches) of this rock layer. However, in addition to providing a 25-foot bedding layer under the Type B riprap at the transition between the Type B and Type C materials (as noted above), the existing Type B riprap cover on the AGTI will be thoroughly reexamined again for signs of rilling or collapse when construction activities are initiated at the Gas Hills site during the summer of 2011. If additional rilling (under the Type B material) is discovered, a repair plan will be prepared for NRC review.

REQUEST FOR ADDITIONAL INFORMATION

GAS HILLS RECLAMATION PROJECT

ABOVE GRADE TAILINGS IMPOUNDMENT AND A-9 REPOSITORY EROSION PROTECTION ENHANCEMENT DESIGN REPORT

UMETCO MINERALS CORPORATION
GAS HILLS URANIUM TAILINGS SITE SUA-648
GAS HILLS, WYOMING
MAY 9, 2011

Geotechnical Issues:

Umetco discusses two proposed repair methods for the Type C erosion protection. However, it is not clear how material will be managed and staged on a daily basis (i.e., will the bedding material be stockpiled at the site or will it be transported from the quarry on an as needed basis). It is also not clear where the rock from the upstream side of the launch rock structure would be placed during repair.

Geotechnical Issues Comment No. 1:

Please provide a description of the manner in which rock and bedding material will be managed at the site.

Response to Geotechnical Issues Comment No. 1:

In general, erosion protection materials will be transported from the Quarry and placed in their point of final use on an as needed load by load basis. No on-site stockpiling or re-handling of erosion protection materials is anticipated other than the re-handling of the 30/70 blended bedding material which will have to be transferred from delivery/haul trucks to front end loader type spreading equipment. While some stockpiling may be necessary, it will be conducted in a manner previously evaluated and assessed by the NRC during the execution of previous site reclamation activities.

With respect to repair method 1 (Type C riprap removal, Type A bedding placement and riprap replacement), the existing Type C rock will be removed or windrowed in manageable panel widths (not to exceed 50-feet) running perpendicular to the side slope. Once the existing riprap material has been removed, the Type A bedding material will be placed, graded and proof rolled. The Type A bedding will be placed on the slope on an as needed load by load basis and little if any on-site stockpiling is anticipated.

With respect to repair method 2 (contour bedding bands and 30/70 bedding material vibrated into the existing Type C riprap), the bedding bands will be prepared by removing the existing riprap and stockpiling it on the upslope side of the 25-foot wide band. Type A bedding (3-inches thick) will be placed (again, on a load by load basis) on the exposed frost barrier surface to act as a plated wear/staging surface and subsequently the bedding layer. The 30/70 blended bedding material will be delivered to the prepared bedding band and dumped/temporarily stockpiled for pickup and placement on the slope between bedding bands (on 10-foot elevation centers) with front end loader type equipment. Again, due to the limited space available on the bedding bands, no long term stockpiling of bedding material is anticipated or feasible.

The existing Type C riprap located upstream or above the Launch Rock Filter Zone will be removed and stockpiled above the filter zone area at a distance to be determined in the field. The minimum distance will provide for the width of the filter trench excavation (30- to 40-feet), an access/staging road (25- to 30-feet wide), and a frost barrier temporary stockpile area (25- to 35-feet wide). The placement of the Type A side slope

bedding material and installation of the Launch Rock Filter Zone will be coordinated such that the two activities are performed in conjunction with each other, beginning at the south end of the east side slope and progressing to the north end of the Launch Rock structure.

Financial Assurance:

1. Source Materials License SUA-648, License Condition (LC) 55, in part, states the financial surety arrangement must be adequate to cover the costs, based on a third party contractor, associated with site closure. LC 55 also states that each revision to the surety amount must contain a basis for the cost estimates. In this regard, it is unclear whether the cost estimates are based on the costs of a third party, and the basis for the "Reclamation Construction Task(s)" is unclear. Specifically, the scope of activities associated with each task is unclear.

It appears that Umetco might be relying on first party costs. It is also unclear whether all pertinent costs related to the cover improvements are included. For example, it appears that the costs of Type-A and 30/70bedding material and Type-C riprap are not included in the estimate:

- Section 3.1.2.1 states "an adequate quantity of Type A bedding material is stockpiled at the Rattlesnake Quarry to complete the repairs on the AGTI."

- Section 4.4.1 states "[r]andom fill and the frost protection layer of the cover shall be constructed with soils obtained from local mine spoil borrow sources, required excavations or the Rattlesnake Quarry."

- Section 4.5 states "Type C riprap stockpiled in the [Rattlesnake] quarry, to be used in the construction of the apron channel and launch rock filters..."

While this material may already be available to Umetco at no cost, the license and 10 C.F.R. Part 40, Appendix A, Criterion 9, requires that cost estimates be based on the costs of a third party. Therefore, the third party costs of such material, as well as all other aspects of the cost estimates, should be based on third party costs.

Additionally, a description of the activities and costs associated with each "Reclamation Construction Task" should be provided. Such a description may clarify the scope of activities associated with the cover design improvements, and may clarify whether third party costs are included. For example, it is unclear whether the following activities/costs are included: (1) the costs of type-A rock, 30/70 material, and type-C riprap; (2) the costs of soil for the repair rills/gullies; (3) the costs of equipment and machinery rental/purchase; (4) labor and equipment costs for surveying, grading, tracking, rolling, compacting, etc., of the Type –A rock bedding layer and/or Type-C riprap; (5) supervision, oversight and project management; (6) costs of materials, equipment, and labor for the construction of access bands.

Financial Assurance Comment No. 1:

Please provide additional clarification regarding the scope of activities and costs associated with each "Reclamation Construction Tack" and clarify whether all costs are based on the costs of a third party. If needed, please provide a revision to the cost estimates such that all third party costs are included.

Response to Financial Assurance Comment No. 1:

A revised cost estimate (Appendix C) is provided with the revised Design Report. The revised cost estimate is based on the actual Construction Bid Schedule issued on Umetco's behalf by URS Corp. to Contractors for third party unit price quotes and combines the similar construction activities for the AGTI and A-9 Repository into one comprehensive schedule.

All Lump Sum and Unit Price costs provided in the revised cost estimate are based on the cost of contracting (including profit and overhead) with a third party to complete the reclamation work.

Reclamation Construction Task No. 12 - New Quarry Operations has been added to the Bid Schedule which addresses the need for a new quarry to be developed and the processing of required rock products in the event that the existing Rattlesnake Quarry and rock products stockpiled there are no longer available as first party materials to Umetco.

The scope of work consists of the following activities:

Reclamation Construction Task No. 1 - Mobilization/Demobilization

- Transport Contractor equipment to and from the site.
- Transport and stockpile supplies at the site.
- Establish temporary offices (including a separate office facility for URS' use) and staging area.
- Prepare a Storm Water Pollution Prevention Plan submittal. Construct/install temporary erosion control devices to control storm water from the reclamation site surfaces/out-slopes and Rattlesnake Quarry during all reclamation construction activities in compliance with Umetco's WPDES permits and SWPPPs.
- Install and (subsequently) remove fuel storage facilities and provide and implement an SPCC Plan.
- Identify, locate and protect all utilities in work areas.
- Payment: The Lump Sum bid price for Mobilization/Demobilization shall include all costs associated with mobilization and demobilization of equipment, personnel, fuel, supplies, establishment of temporary offices and other facilities, storm water management, dewatering and incidental items, including acquisition of necessary permits, adherence to all regulations described in this section, profit, overhead and any and all related costs required to make the Work complete.

In addition, demobilization shall include costs associated with radiological scanning, and removal of all Contractor's facilities and equipment as well as cleaning areas used/disturbed by the Contractor to the satisfaction of Umetco/URS.

Reclamation Construction Task No. 2 - Construction Water

- Inspect existing appurtenances (Process Water Well 6, aka "Deep Well" and existing HDPE/thin metal 6-inch diameter pipeline) and prepare a refurbishment/water delivery plan submittal. The Contractor may elect to refurbish the existing well (bypass the pipeline) and haul construction water approximately 3 miles from the Process Water Well 6 site to the East Gas Hills site, as long as an adequate quantity of water is readily available and can be reliably supplied when required.
- At a minimum the Contractor will be required to reestablish three-phase electrical service and provide switch gear to the existing 40-hp submersible well pump or provide a three-phase generator set and switch gear.
- Should the pipeline be utilized, an in-line booster pump may be required. If so elected by the Contractor, the Contractor shall provide, install/plumb, energize and maintain the booster pump in the existing pipeline.
- If utilized, the Contractor shall connect existing pump/well to existing pipeline and establish water distribution methods, i.e., storage tanks, water load out chutes, water trucks, etc.
- Measurement and Payment: Measurement and payment for construction water and dust control during construction will be made on a Lump Sum basis and shall include all costs associated with: inspection and preparing a plan; refurbishing existing appurtenances; furnishing electricity and electrical service; pumps, products and materials; labor; tools; equipment; accessories; backup equipment, maintenance, repairs; profit, overhead and any and all other associated costs required to comply with the Specifications and make the Work complete.

Reclamation Construction Task No. 3 - Establish Access and Haul Routes

- Prepare an access/haul route plan submittal.
- Apply uncontaminated water to maintain access/haul routes and control fugitive dist emissions from the designated/refurbished construction water source (Process Water Well 6).
- Obliterate and reclaim access and haul routes when no longer required.
- Measurement and Payment: Measurement and payment for construction, maintenance and traffic control will be made on a Lump Sum basis and will include all costs associated with: inspection of site conditions, devising/construction of access/haul routes and Traffic Control Plan(s) preparation; storm water erosion control provisions; safety berms; traffic control and signage; products and materials; labor; tools; equipment; accessories; maintenance; repairs; profit, overhead and any and all other associated costs required to comply with the Specifications and make the Work complete.

Reclamation Construction Task No. 4 - Radon Barrier Test Trenches

- Excavate a minimum of two test trenches in rill locations (as directed by Umetco/URS in the field), one each on the AGTI and A-9 Repository. Excavated materials shall be stockpiled for replacement.
- Backfill and replace excavated materials in accordance with the Specifications.
- Measurement and Payment: Measurement for payment for the excavation of test trenches will be in cubic yards for material actually removed. The quantity for payment will be computed by the average end area method from surveys conducted by the Contractor before and after excavation operations and prior to backfilling. No separate measurement for payment will be made for stockpiling excavated materials for reuse or backfill placement of radon and/or frost barrier materials, these items shall be considered incidental to the test trench excavation. Placement of bedding and erosion protection materials shall be measured for payment under Reclamation Construction Task No. 5 – Erosion Protection Enhancement.

  Payment for test trench excavation will be made at the unit price quoted in the Bid Schedule. The price quoted shall include the associated cost of all labor, equipment, scheduling, de-watering excavation, temporary material stockpiling, any loading or transportation, hand excavation/probing, backfill placement and compaction activities required to comply with this Specification, profit, overhead and any and all incidental costs required to make the Work complete.

  Due to uncertainties associated with the final number, size and characteristics of materials removed from the required excavations, URS makes no warranty as to the final quantities of Work. The combined estimated quantities provided in the Bid Schedule provide an estimated representation of the total magnitude of Work to be performed.

Reclamation Construction Task No. 5 - Erosion Protection Enhancement

- Process 30/70 Blended Bedding material in the Rattlesnake Quarry
- Affect erosion protection enhancements - haul and place bedding materials under/within the existing riprap on the AGTI and A-9 Repository according to two placement methods. Method No. 1 - remove/stockpile existing erosion protection materials in designated areas, place 3-inch minimum layer of Type A bedding and replace stockpiled erosion protection material. Method No. 2 - spread 30/70 bedding material over designated areas and work into the existing riprap layer by Dozer Tractor track walking and smooth drum vibration to form a minimum 4-inch layer of bedding material in the bottom portion of the existing riprap layer.
- Repair rills (associated with placement Method One) in the surface of the Frost Barrier layer (in designated areas), haul and place Type A bedding material to reestablish/match existing Frost Barrier sub-grade.
- Measurement and Payment: Measurement for payment for the following Bid Schedule items will be made for the number of cubic yards of erosion protection materials (bedding material and riprap) processed and/or delivered and placed in the completed Work in accordance with the Specifications. The quantities for payment

will be computed by the average end area method and/or areal surveys conducted by the Contractor multiplied by the neat line depths Specified and/or shown on the Construction Drawings, as determined by the URS Representative.

In addition, measurement for payment for processed 30/70 bedding material will also be made for the number of cubic yards of bedding material processed at the Quarry site in compliance with the Specifications. The processed quantity will be computed from the load factor determined by the Contractor, and agreed upon by URS, and weight tickets. Load factor determinations and/or quantity surveys conducted by the Contractor to verify URS' field measurements will be performed at the Contractor's expense.

The quantity of erosion protection materials delivered to the site and incorporated in the Work will be compared to weight delivery tickets/records to verify accuracy.

The following items will be measured for payment:

Bid Schedule Item No. 5.1 - Process 30/70 Blended Bedding Material;

Bid Schedule Item No. 5.2 – Transportation and Placement of 30/70 Blended Bedding Material on the AGTI and A-9 Repository;

Bid Schedule Item No. 5.3 – Transportation and Placement of Type A Bedding Material on the AGTI and A-9 Repository;

Bid Schedule Item No. 5.4 – Remove and Replace Existing Type C Erosion Protection Riprap on the AGTI and A-9 Repository;

Bid Schedule Item No. 5.5 – Transportation and Placement of 30/70 Blended Bedding Material in the Launch Rock Filter;

Bid Schedule Item No. 5.6 – Transportation and Placement of Type A Bedding Material in the Launch Rock Filter;

Bid Schedule Item No. 5.7 – Transportation and Placement of Type C Erosion Protection Riprap in the Launch Rock Filter;

Bid Schedule Item No. 5.8 – Transportation and Placement of Type A Bedding Material on the Apron Channel;

Bid Schedule Item No. 5.9 – Transportation and Placement of Type C Erosion Protection Riprap on the Apron Channel; and

Bid Schedule Item No. 5.10 – Transportation and Placement of Type C Erosion Protection Riprap to Stabilize Off-Site Erosion Features.

Payment for the Bid Schedule Items cited in Measurement, above, will be made at the unit price quoted in the Bid Schedule for the respective Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, placement and compaction, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 6 - Launch Rock Structure Enhancement

- Excavate U/S and D/S filter trenches and stockpile excavated materials for reuse.
- Haul and place multi-layer filter materials (U/S and D/s of Launch Rock structure).
- Backfill U/S filter and restore slope leading to the Launch Rock Structure and repair sinkholes as required. All backfill to be placed in accordance with these Specifications.
- Measurement and Payment: Measurement for payment of Launch Rock filter materials will be made for the number of cubic yards of filter materials placed in accordance with the Specifications. Measurements will be made to neat line widths and finish grades shown on the Construction Drawings or as modified by URS during execution of the work to include the actual depth of filter materials placed in accordance with the Specifications. The payment quantity will be calculated by the average end area method from URS accepted surveys provided by the Contractor. Measurement and payment for erosion protection material processing, transportation and placement shall be made in accordance with Reclamation Construction Task No. 5 – Erosion Protection Enhancement.

  Payment for the installation of the U/S and D/S Launch Rock filter zones will be made at the unit price quoted in the Bid Schedule for Launch Rock filter trench excavation. The price quoted shall include the associated cost of all labor, equipment, materials, incidental excavation, sub-grade preparation, furnish and install non-woven filter fabric, over burden/excess material relocation/disposal, Earthwork backfill (excluding the Type C riprap (re)placement), hand work, compaction, profit, overhead and any and all associated costs required to comply with the Specifications and make the Work complete.

  Payment for the Bid Schedule Items cited in Reclamation Construction Task No. 5 – Erosion Protection Enhancement - Measurement will be made at the unit price quoted in the Bid Schedule for the respective Launch Rock Filter material Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, special handling placement and compaction, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 7 - Apron Channel Construction

- Establish and maintain access/haul routes to the Apron Channel area located on the southwest edge of the AGTI.
- Prepare Apron Channel sub-grade with compacted on-site random soil fill material.
- Haul and place Erosion protection materials (18 inches of Type C riprap on a 6-inch layer of Type A bedding material).
- Measurement for payment for apron channel construction will be made by the linear foot measured along the length of the centerline alignment of the apron channel completed in accordance with the Specifications. The quantity will be calculated

from centerline length surveys, accepted by URS, and performed by the Contractor, irrespective of the amount of backfill required to complete the sub-grade shaping.

Payment will be made at the unit price quoted in the Bid Schedule for apron channel construction. The price quoted shall include the cost of all labor, equipment, clearing and grubbing, sub-grade preparation and backfill, profit, overhead and any and all incidental costs required to make the Work complete in accordance with the Specifications.

Measurement for payment for the transportation and placement of erosion protection materials will be made by the cubic yard for erosion protection materials placed in the completed apron channel in accordance with the Specifications. The quantity will be calculated from cross-sectional and/or areal surveys, accepted by URS, and performed by the Contractor. The respective material quantities will be calculated by average end area method and/or by applying the neat line depth shown on the Construction Drawings and/or Specified herein to the accepted areal survey area(s).

No allowance will be made for over built erosion protection layers.

Payment for the Bid Schedule Items cited in Reclamation Construction Task No. 5 – Erosion Protection Enhancement– Measurement for apron channel erosion protection materials will be made at the unit price quoted in the Bid Schedule for the respective Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, placement and compaction, profit, overhead and any and all incidental costs required comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 8 - Stabilization of Off-Site Erosion Features

- Erosion features are located in the Rim Pit area (north of the reclamation site), along the groin area between the reclamation cover and natural ground on the southeast side of the Heap Leach structure and near the toe of the northern slope of the AGTI.
- Re-grade/shape/compact erosion feature sub-grade with on-site/existing random soil material.
- Haul and place Erosion Protection materials.
- Measurement for stabilization of off-site erosion features shall be made on a Lump Sum basis for Work completed in accordance with the Specifications, irrespective of the number and location of individual erosion features to be stabilized.

  Payment will be made at the lump sum price quoted in the Bid Schedule for stabilization of off-site erosion features. The lump sum price quoted shall include all labor, equipment, filter fabric products and materials, access/haul routes, sub-grade preparation, proof rolling, profit, overhead and any and all other associated costs required to comply with this Specification and make the Work complete.

  Measurement for payment for the transportation and placement of Type C erosion protection riprap materials used to stabilize off-site erosion features will be made for the number of cubic yards of erosion protection materials placed in accordance with

the Specifications. Measurements will be made to neat line widths, depths and finish grades shown on the Construction Drawings or as modified by URS during execution of the work to include the actual depth of erosion protection materials placed. The payment quantity will be calculated by the average end area method from URS accepted surveys provided by the Contractor. Measurement and payment for erosion protection material processing, transportation and placement will be made in accordance with Reclamation Construction Task No. 5 – Erosion Protection Enhancement, of these Specifications.

Payment for the Bid Schedule Item cited in Reclamation Construction Task No. 5 – Erosion Protection Enhancement – Measurement will be made at the unit price quoted in the Bid Schedule for the material Item associated with the stabilization of off-site erosion features. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, special handling placement and compaction, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 9 - Well Abandonment

- Abandonment of three existing (permitted) wells within the site boundary by a Wyoming licensed Well Driller. The wells are shown on the Construction Drawings and are designated as the A-8 Pit Well, the Aljob 2 Well (aka the Domestic Well) and the PW4 monitoring well.
- Abandon two existing line marker/leak detection wells along the County Road on the north side of the site utilizing simple Bentonite/sand/cement backfill materials.
- Measurement and Payment: Measurement for payment for abandoning ground water wells will be made in linear feet for every foot of well depth abandoned in accordance with the Specifications. Depth measurements shall be made by the Contractor and accepted by URS.

  Payment for abandoning ground water wells will be made by the unit price per foot quoted in the Bid Schedule. The price quoted shall include the cost all equipment, labor, materials, drill rig set up and tear down, grout mixture preparation, pressure grouting, individual well site cleanup and disposal of debris and any and all incidental costs required to comply with the Specifications and to make the Work complete.

  Measurement for payment for abandoning line marker wells will be made for each well installation abandoned in accordance with the Specifications. The Contractor and URS will agree upon the number of line marker wells.

  Payment for abandoning ground water wells will be made by the unit price each quoted in the Bid Schedule. The price quoted shall include the cost all equipment, labor, materials, introduction of bentonite chips, water mixture preparation, individual well site cleanup and disposal of debris, profit, overhead and any and all incidental costs required to comply with the Specifications and to make the Work complete.

Reclamation Construction Task No. 10 - Fencing

- Remove/realign/replace existing site security fencing as determined necessary by field operations to accommodate new Work (Apron Channel) and facilitate access to the various Work areas.
- Furnish and install temporary fencing as may be required to maintain site security and to prevent livestock from entering the site.
- Extend to include the wetland area located on the east side of the AGTI.
- Measurement and Payment: No separate measurement for payment for removing, disposing, and/or reestablishing security fencing during construction will be made. The cost for removing and reestablishing existing fencing systems during execution of the Work, including dismantling, disposal, salvage of reusable materials, establishing temporary fencing, daily inspection and maintenance and repairs shall be considered incidental to applicable items of the Work.

  Measurement to furnish new materials or obtain materials from salvage stockpiles and install permanent barbed wire fencing will be made by the linear foot of fence installed in accordance with the Specifications. Measurements will be made, by the Contractor, along the top of the completed and accepted fence to the nearest foot and shall include the installation of salvaged gates. No allowance will be made for the installation of gates by and for the Contractor's convenience and left in the completed Work.

  Payment to furnish and install permanent barbed wire fencing will be made at the unit price quoted in the Bid Schedule. The unit price shall include cost for furnishing all labor, materials, tools, equipment, and accessories including preparation of the ground surface along the alignment of new fence lines, maintenance, profit, overhead and any and all incidental activities required to make the Work complete.

Reclamation Construction Task No. 11 - Site Reclamation

- Obliterate haul/access roads and provide re-grading/shaping as required to restore the site to previous/existing contours.
- Prepare the seedbed, fertilize/amend, seed and mulch all disturbed areas.
- Stabilize/re-grade/shape the Rattlesnake Quarry to provide stable contours and prevent/reduce erosion.
- Measurement for payment for site reclamation shall be made by surface acres of disturbed areas actually seeded and accepted. Quantities shall be computed from areal surveys conducted by the Contractor and accepted by URS of disturbed areas reclaimed in accordance with the Specifications. No measurement for payment will be made for reseeding and/or fertilizer replacement due to wash-outs, erosion or storm damage occurring prior to final acceptance.

  Payment will be made at the unit price quoted in the Bid Schedule for site reclamation. The price quoted shall include full compensation for furnishing all materials, labor, tools, equipment, grading and shaping, seedbed preparation, soil amendment application/incorporation, ALM and fertilizer materials and application,

furnishing seed and seeding, product certifications, reseeding and/or replacement of lost or eroded fertilizer materials, maintenance, profit, overhead and any and all incidental costs required to make the Work complete.

Reclamation Construction Task No. 12 - New Quarry Operations

- Control storm water runoff and erosion from the Quarry site surface and out-slopes during all quarry construction and reclamation activities in compliance with applicable Wyoming Department of Environmental Quality mining permits and storm water plans.
- Prepare a Quarry Operation Plan submittal to site, permit and develop a new Quarry, conduct quarry operations as may be required (blast/crush/screen/stockpile) to produce the quantity of Type A, Type B and Type C rock materials cited in the Bid Schedule. The Quarry Operation Plan shall also address the load-out, measurement (weighting) and delivery of all required rock products.
- Implement the acceptable Quarry Operation Plan.
- Establish and maintain access/haul routes within and exiting the Quarry, to include fugitive dust suppression.
- Re-grade/shape disturbed Quarry surfaces/topography to prevent/reduce erosion.
- Measurement for payment for the following Bid Schedule items will be made for the number of cubic yards of erosion protection materials (bedding material and riprap) processed and stockpiled at the newly developed quarry in accordance with the Specifications. The quantities for payment will be computed by load factor weight determinations and/or quantity surveys conducted by the Contractor of stockpiled material.

  The following items will be measured for payment:

  - Bid Schedule Item No. 12.1 – Process and stockpile Type A Bedding Material;
  - Bid Schedule Item No. 12.2 – Process and stockpile Type B Bedding Material; and
  - Bid Schedule Item No. 12.3 – Process and stockpile Type C Bedding Material.

  Payment for the Bid Schedule Items cited in Measurement, above, will be made at the unit price quoted in the Bid Schedule for the respective Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations (including site location and permitting), quality control testing, load factor weight determinations, blasting, crushing, screening, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

2. Source Materials License SUA-648, License Condition 55, in part states that "[a]long with each proposed revision or annual update, the licensee shall submit supporting documentation showing a breakdown of the costs and the basis for the cost estimates..." In this regard, both the AGTI and A-9 Repository tables provide various costs, however, a clear basis is not provided (e.g., the source of the costs, such as a quote/contract).

With respect to units, additional clarification is requested. For example, for the task titled "R&R Existing Type C Riprap" in the A-9 Repository table, units are listed as "cubic yards." However, the table lists the unit cost at "$10." this suggests that "$10" refers to "$10 per cubic yard," however the cost estimate should clearly state the units (e.g., U.S. Dollars per hour, U.S. Dollars per cubic yard, etc.).

Financial Assurance Comment No. 2:

For all tasks listed in both the AGTI and A-9 Repository tables please clarify the units (i.e. $/cubic yard) and provide for all unit costs relied on for the purposes of calculating the construction cost estimates.

In every case the estimated unit price shall be applied to the applicable unit cited in the preceding column of the cost estimate schedule and all costs and reimbursements are understood to be made in U. S. dollars.

The estimated unit costs provided in the revised cost estimate are based on historic costs obtained from Bid Abstracts for third party performance of the same or similar work at the Gas Hills site. The historic costs were increased by 1.5-percent per year to arrive at the costs presented in the estimate and include third party profit and overhead.

Third party Bids for the Erosion Protection Enhancement Project at the Gas Hills Reclamation site are scheduled to be opened on May 27, 2011 and construction activities are scheduled to commence during June of 2011. Therefore, actual real time unit price quotes will be available and will be included in the June 13, 2011 annual update to the surety amount submittal.

Response to Financial Assurance Comment No. 2:

3. 10 C.F.R. Part 40, Appendix A, Criterion 9, in part, states that "[i]n establishing specific surety arrangements, the licensee's cost estimates must take into account total costs that would be incurred if an independent contractor were hired to perform the decommissioning and reclamation work." The Branch Technical Position (BTP) titled "Technical Position on Financial Assurances for Reclamation, Decommissioning and Long Term Surveillance and Control of Uranium Recovery Facilities (October 1988)" (ML020300533) States that [a]ll costs (unit and total) are to be estimated on the basis of independent contractor costs (include overhead and profit in unit costs or as a percentage of the total)."

The cost estimates do not appear to include a sufficient basis or justification with respect to the overhead and contractor profit rates. It is also unclear which costs the overhead rate is intended to cover (i.e., vacation, sick leave, taxes).

Financial Assurance Comment No. 3:

Please provide a basis of the overhead and profit rates of 10%. If needed, please provide a revision to the cost estimates to include the full cost of overhead and profit.

Response to Financial Assurance Comment No. 3:

All Lump Sum and Unit Costs are based on the cost of contracting (including profit and overhead) with a third party to complete the reclamation work. However, in the revised cost estimate a 12-percent oversight rate has been added to provide for construction management and oversight. The 12-perecnt rate is based on URS Corp. personnel and service rates to provide construction management, oversight, quality assurance/quality control, civil surveying and radiological surveying.

4. Source materials License SUA-648, License Condition 55, in part, states that "[a]long with each proposed revision or annual update, the licensee shall submit supporting documentation showing a breakdown of the costs and the basis for the cost estimates..."

Relying upon Umetco's submittal and the submitted site maps, the staff is unable to verify all of the quantities listed in the "Quantity" columns of the cost estimates. Specifically, it is unclear how these figures were calculated and whether a void space factor is included.

Financial Assurance Comment No. 4:

For all the figures listed in the "Quantity" column whose value is different from 1, please describe how each is calculated.

Response to Financial Assurance Comment No. 4:

A revised cost estimate (Appendix C) is provided with the revised Design Report. The revised cost estimate contains quantity calculation details verified by an independent third party review/check (URS, Corp.).

Miscellaneous Issues:

1. The Report states that activities done outside the site boundary will only be done with the property owner's permission. It is unclear what activities are contemplated outside of the Umetco property boundary.

Miscellaneous Issues Comment No. 1:

Please clarify what activities Umetco contemplates occurring outside of the site boundary.

Response to Miscellaneous Issues Comment No. 1:

Reclamation activities conducted within the established Gas Hills site boundary shall be conducted in accordance with the evaluations and assessments contained in existing or previous Environmental Site Assessments conducted/approved by the NRC. All proposed construction activities are consistent with previous activities evaluated and assessed by the NRC.

However, it is Umetco's desire to address/repair some erosion features located in the Rim Pit area, which falls outside of the site boundary, while a prime contractor is mobilized at the Gas Hills site. The Rim Pit area is located north of the reclamation site and falls within Umetco's Wyoming Department of Environmental Quality – Land Quality Division Mine/Drilling Notification Permit No. DN60. Permission to access the erosion features located in the Rim Pit area will be required by Umetco, as the area has been reclaimed and only the minimum amount of disturbance will be allowed to access and affect erosion repairs.

2. The Report states that fill material and the frost protection layer will be constructed with soils from mine spoils. As mine spoils may contain residual radioactive material, it is not clear why Umetco does not contemplate re-use of the frost protection cover material for the test excavations.

Miscellaneous Issues Comment No. 2:

Please provide the rationale for using mine spoils for the frost protection layer.

Response to Miscellaneous Issues Comment No. 2:

All frost barrier material removed from required excavations, i.e., the radon barrier test trenches (one each on the AGTI and A-9 Repository) and Launch Rock Filter Zone trench will be stockpiled for re-use. The hierarchy or ranking of sources for frost barrier material will be re-use from required excavations, the Rattlesnake Quarry and frost barrier material deposited as sediment downstream of the Launch Rock Structure. The need for frost barrier material obtained from the mine spoil source is remote, however this source was approved for use in the past and has been included in the Specifications as a last resort source should the other material sources prove inadequate or un-usable.

3. The staff raised several issues concerning the management and monitoring of equipment at the site, specifically:

- it is not clear why Umetco would wash a vehicle before doing a survey for residual radioactive material;

- the basis for the statement that only 10 percent of the heavy equipment leaving the site will be surveyed; and,

- the procedure whereby equipment delivered to the site in a contaminated condition is reported to the equipment owner and not the NRC.

Miscellaneous Issues Comment No. 3:

Please provide a justification for these procedures or clarify how they will ensure that equipment entering and leaving the site will be managed appropriately.

Response to Miscellaneous Issues Comment No. 3:

The Specification Section describing equipment/vehicle washing and the survey of 10-percent of the equipment was an artifact from the operational procedures where heavy equipment routinely cycled between the (off-site) borrow areas and returned to the restricted boundary or Contamination Reduction Zone (CRZ). This Section has been deleted from the report.

Equipment and vehicles entering the site for the first time will be surveyed for contamination. Any equipment delivered to the site in a contaminated condition will be reported immediately to the NRC.

REVIEW MEETING REPORT

A review meeting (teleconference) was conducted on March 30, 2011. Issues not addressed in the RAI will be addressed/clarified and presented as highlighted text in the body of a revised Design Report.

In addition to revising the Design Report, a revised cost estimate (Appendix C) and revised drawings 5 of 8 and 6 of 8 will be provided with the RAI submittal.

Umetco noted the following two items during the review meeting:

- In Section 4.5 – Erosion Protection and Bedding Materials of the report, the frequency of quality control depth check and bedding gradation testing will be changed from "[o]ne set of tests (depth and gradation) for every 500 square feet" to "[o]ne set of tests (depth and bedding gradation) for every square acre".

- The U. S. Department of Energy (DOE) has proposed that groundwater monitoring well PW4 be removed from the long-term groundwater monitoring network. This well is included in Umetco's Ground Water Monitoring Plan (ACL application, Appendix M) submittal of January 5, 2004. Abandonment of monitoring well PW4 may require a revision to License Condition 35 of Umetco's Materials License (SUA-648). During the review meeting it was Umetco's understanding that the NRC and DOE would coordinate a review of the DOE (draft) Long Term Surveillance Plan (LTSP) and render a decision. If groundwater monitoring well PW4 is not required by the LTSP, it is Umetco's

desire to abandon the well during the summer of 2011, while a contractor is mobilized to the Gas Hills site.

GAS HILLS RECLAMATION PROJECT

ABOVE GRADE TAILINGS IMPOUNDMENT AND A-9 REPOSITORY EROSION PROTECTION ENHANCEMENT DESIGN REPORT

UMETCO MINERALS CORPORATION
GAS HILLS URANIUM TAILINGS SITE SUA-648
GAS HILLS, WYOMING
DECEMBER 20, 2010, REVISED MAY 9, 2011

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2 OF 8	EVALUATION OF HYDROLOGY AND EROSION PROTECTION DESIGN, CRITICAL HYDRAULIC PROFILES
3 OF 8	ABOVE-GRADE TAILINGS IMPOUNDMENT, EVALUATION OF SETTLEMENT SURVEY
4 OF 8	A-9 REPOSITORY, EVALUATION OF SETTLEMENT SURVEY
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8 OF 8	EROSION CONTROL APRON CHANNEL, PLAN AND DETAILS

1.0 Introduction

Monitoring and inspection activities performed by Umetco Minerals Corporation (Umetco) on the Above-Grade Tailings Impoundment (AGTI) and A-9 Repository (A-9) Reclamation Covers have identified isolated areas of concern associated with the erosion protection layer resulting from a design error. This issue has been previously communicated to the NRC and observed with NRC staff in the field.

While this issue has resulted in shallow incision of the underlying cover soils in isolated locations, there has been no release of tailings or degradation of the radon attenuation capacities of the completed reclamation covers.

Accordingly, this submittal provides an evaluation of the erosion protection design which identifies the design deficiency and provides an enhanced design to correct this deficiency.

1.1 History of Above-Grade Tailings Impoundment Plan Approval

Umetco submitted a reclamation plan for the AGTI area of the site in 1980 (D'Appolonia, 1980). During the mid-1990s, the existing reclamation plan was reevaluated to address potential erosion of the cover design, NRC's position on previously approved reclamation designs, as well as additional contamination identified adjacent to the existing cover in the area. Umetco submitted an enhanced reclamation plan for the AGTI area on October 6, 1997 that involved: (1) extending the existing radon barrier to address the additional contamination; (2) regrading areas of the impoundment; (3) installing a 137.16-cm (54-inch) frost protection layer; and (4) installing riprap erosion protection (Shepherd Miller, 1997). The NRC approved this enhanced plan in 1999. In 2000, Umetco submitted a request for approval for modification of the erosion protection design to prevent potential disturbance of cultural resources discovered during reclamation activities. The enhanced design modification was approved by NRC in April 2001. Work in this area was completed in 2002.

1.2 History of A-9 Repository Plan Approval

The A-9 is a former open pit uranium mine that was used for tailings disposal. The original reclamation plan was previously approved by the NRC, but the cover was never constructed. Umetco submitted a revised reclamation plan in 1998 to implement modifications to the A-9 (Shepherd Miller, 1998). The NRC approved the revised reclamation plan in 1999. This approval allowed for the North and South Evaporation Pond liners to be placed in the A-9 and for the slopes of the North and South Evaporation Ponds to be regraded. The A-9 reclamation cover includes a 45.72-cm (18-inch) thick radon barrier, 137.16-cm (54-inch) thick frost protection layer and an erosion protection layer. Work in this area was completed in 2006.

1.3 Construction Completion Approval

On June 29, 2007, Umetco submitted the Construction Completion Report documenting the completed construction activities at the site inclusive of the AGTI and A-9 reclamation covers. The Construction Completion Report was subsequently approved by License Amendment 60, dated September 8, 2008.

2.0 Erosion Protection – Areas of Concern

The areas of concern, discussed herein, were first identified by Umetco during routine field inspections. Subsequent field investigations and review of approved design documents have identified the associated cause of the sub-grade erosion as a design error. The design error is associated with utilization of inappropriate interstitial velocity for inclusion of a filter or bedding layer in the erosion protection design.

Umetco has completed a review of approved designs associated with all reclamation cover systems constructed at the site to ensure the design deficiency is confined to AGTI and A-9 and that other potential contributing factors are adequately addressed.

2.1 Above-Grade Tailings Impoundment

This section details the areas of concern and cause associated with erosion protection of the AGTI reclamation cover.

2.1.1 AGTI Areas of Concern and Cause

The areas of concern associated with the AGTI reclamation cover are:

- Type C (D_{50} = 6 inches) Erosion Protection – located on the lower portions of the northern and eastern reclamation cover slopes.
- Launched Rock – located at the bottom of the eastern slope of the reclamation cover.
- Off-Cover Erosion – occurring on the southeast corner of the repository.

Type C (D_{50} = 6 inches) Erosion Protection

Umetco field inspections identified areas of soil cover erosion beneath the riprap layer on the eastern and northeastern sides of the reclamation cover on those areas with Type C erosion protection material. These locations are also located in areas which receive substantial upland flow and are susceptible to large amounts of drifting snow during the winter months. The Type C erosion protection for the AGTI consists of a single layer of riprap with a minimum layer thickness of 12 inches.

Field investigations of these areas, conducted by Umetco, concluded that cover soil erosion beneath the riprap layer are caused by concentrated interstitial flows at the interface of the erosion protection layer and cover soil sub-grade. The erosion features typically extend about 200 feet and become stable at the downstream end due to filling of the riprap void space with sediment. The geometry of the erosion features is such that the bottoms of the incisions are perpendicular to the slope for the entire length of the incision and typically about 0.5 feet in depth.

Review of the AGTI (Shepherd Miller, 1997) design indicates appropriate and conservative methods were used to determine the size of rock for the Type C erosion protection. The design error is associated with the evaluation of the filter blanket. The Design Report evaluated the need for a filter blanket by calculating interstitial flow velocity which is an acceptable and recommended procedure established in NUREG 4620. While NUREG 4620 provides guidance on calculation of interstitial velocities it does not provide an acceptable velocity at which the sub-grade layer is erosionally stable. The Design Report utilized criteria presented in NRC STP (pp A1-A20, August 1990) to

determine an adjusted permissible velocity of 2.5 feet per second. Computation of the permissible interstitial velocity in this manner has resulted in unacceptable performance of the erosion protection layer at the locations noted. At about the same time as the design was approved, the NRC published draft guidance regarding adequate interstitial velocities in NUREG 1623 (Draft guidance, February 1999). This guidance states:

> *"When the computed interstitial velocity is less than 0.5 feet per second, a filter may not be needed. When velocities are between 0.5 and 1.0 feet per second, the need for a filter layer will be dependent upon the type of soil material placed at the interface. A filter should be provided when velocities are 1.0 feet per second or greater."*

The calculated interstitial velocities for the problematic Type C area of the AGTI vary between 0.6 and 0.7 feet per second. Accordingly the guidance provided by NUREG 1623 is very applicable to this site, weather conditions, and cover soils.

Another contributing factor associated with the rill formation is believed to be drifting of snow in these specific areas which tend to concentrate flows. During the winter months drifting snow fills void spaces in these areas, once the drifts begin to melt and the cover receives additional precipitation interstitial flows are diverted around and concentrated around the perimeter of the frozen drifts.

It should also be noted that there are several isolated areas within the problematic areas in which the riprap void spaces are filled with finer fraction material which is a typical artifact of the placement process. Where this condition is present there is no erosion of subsurface soils and up-slope rills are diverted around these areas, i.e., void space is filled and interstitial velocities are slowed.

There is an area within the Type C erosion protection where the slope gradient approaches 5(H) to 1(V), which is also the steepest slope on the AGTI reclamation cover. In this area a field decision was made to place a 3-inch thick layer of filter material. Inspection of this area shows no signs of sub-grade erosion which is a further indication of the design error associated with the Type C erosion protection.

Launched Rock

The launched rock located at the eastern toe of the AGTI repository cover was designed to address potential scour and head cut of East Canyon Creek under PMF conditions. Field inspections of the launched rock apron indicate that interstitial velocities through the Type C erosion protection immediately upgradient of the launched rock are causing sub-grade soil erosion. As with the Type C erosion protection the cause of this sub-grade soil erosion is the lack of filter material at the erosion protection sub-grade interface to slow interstitial velocities.

Off-Cover Erosion

An area located adjacent to the toe of the reclamation cover on the southeast corner of the cover is exhibiting incision formation caused by off-cover surface flows and drainage of the buried apron.

2.1.2 Evaluation of Hydrology and Erosion Protection Design

To ensure the cause of the sub-grade erosion was appropriately identified and to verify the adequacy of the erosion protection design a detailed evaluation of the designed/placed erosion protection layer was completed. This evaluation was based on current criteria found in NUREG-1623.

Evaluation of the AGTI erosion protection design was completed by identification of three critical hydraulic profiles, as shown on Drawing 2 of 8, which pass through the areas of concern associated with the Type C erosion protection. The approved PMP (one-hour thunderstorm) of 8.7 inches was used for this evaluation. Calculation of rock size was completed using the Safety Factors Method for slopes less then 10%; Stephenson Method for slopes greater then 10%; for slopes at or near 10% both Safety Factors and Stephenson Methods are shown; and for all slope segments the Abt and Johnson Method.

Results of this evaluation demonstrate that the rock size of the AGTI erosion protection layer is appropriate and conservative. The interstitial velocities for the upper slopes of the reclamation cap covered with Type A (D_{50} = 0.5 inches) and Type B (D_{50} = 3 inches) erosion protection are less than the 0.5 feet per second criteria established in NUREG 1623. In addition, there is no visual evidence of cover degradation or sub-grade erosion on the upper repository slopes where interstitial velocities are less then 0.5 feet per second.

The rock size for the lower portions of the AGTI slopes covered with Type C (D_{50} = 6 inches) erosion protection is also conservative, however the interstitial velocities associated with this larger erosion protection material for the most part exceed the 0.5 feet per second criteria causing isolated areas of erosion at the sub-grade erosion protection layer interface.

A summary of the erosion protection evaluation is shown on Table 2.0.

Table 2.0
Above-Grade Tailings Impoundment Reclamation Cover - Summary of Erosion Protection Evaluation

AGTI Profile 1	Segment Elev. Diff. (ft)	Segment Length (ft)	Hydraulic Length (ft)	Segment Slope (ft/ft)	Intensity (in/hr)	Peak Flow (cfs/ft)	Riprap Size Calculation Method	Riprap D_{50}		Interstitial Velocity [1] (fps)	Comment
								Calculated (inches)	In-Place (inches)		
Segment 1	9	1,254	1,254	0.0072	28.15	0.81	Safety Factors	0.4	3.0	0.12	Riprap Size ok, Interstitial Velocity ok
Segment 1	9	1,254	1,254	0.0072	28.15	0.81	Abt and Johnson	0.7	3.0	0.12	
Segment 2	70	1,130	2,384	0.0619	23.01	1.26	Safety Factors	3.0	3.0	0.37	Riprap Size ok, Interstitial Velocity ok
Segment 2	70	1,130	2,384	0.0619	23.01	1.26	Abt and Johnson	2.2	3.0	0.37	
Segment 3	50	493	2,877	0.1014	21.36	1.41	Safety Factors	5.0	6.0	0.69	Slope near 10% - Stephenson and Safety Factors Used. Riprap Size ok. Interstitial Velocity > 0.5 fps.
Segment 3	50	493	2,877	0.1014	21.36	1.41	Abt and Johnson	2.8	6.0	0.69	
Segment 3	50	493	2,877	0.1014	21.36	1.41	Stephenson	2.9	6.0	0.69	

AGTI Profile 2	Segment Elev. Diff. (ft)	Segment Length (ft)	Hydraulic Length (ft)	Segment Slope (ft/ft)	Intensity (in/hr)	Peak Flow (cfs/ft)	Riprap Size Calculation Method	Riprap D_{50}		Interstitial Velocity [1] (fps)	Comment
								Calculated (inches)	In-Place (inches)		
Segment 1	3	246	246	0.0122	54.21	0.31	Safety Factors	0.3	0.5	0.06	Riprap Size ok, Interstitial Velocity ok
Segment 1	3	246	246	0.0122	54.21	0.31	Abt and Johnson	0.5	0.5	0.06	
Segment 2	42	545	791	0.0771	43.69	0.79	Safety Factors	2.7	3.0	0.41	Riprap Size ok, Interstitial Velocity ok
Segment 2	42	545	791	0.0771	43.69	0.79	Abt and Johnson	1.8	3.0	0.41	
Segment 3	70	907	1,698	0.0772	32.97	1.29	Safety Factors	3.6	6.0	0.59	Riprap Size ok. Interstitial Velocity > 0.5 fps.
Segment 3	70	907	1,698	0.0772	32.97	1.29	Abt and Johnson	2.4	6.0	0.59	

AGTI Profile 1	Segment Elev. Diff. (ft)	Segment Length (ft)	Hydraulic Length (ft)	Segment Slope (ft/ft)	Intensity (in/hr)	Peak Flow (cfs/ft)	Riprap Size Calculation Method	Riprap D_{50}		Interstitial Velocity [1] (fps)	Comment
								Calculated (inches)	In-Place (inches)		
Segment 1	5	237	237	0.0211	57.42	0.31	Safety Factors	0.5	0.5	0.08	Riprap Size ok, Interstitial Velocity ok
Segment 1	5	237	237	0.0211	57.42	0.31	Abt and Johnson	0.6	0.5	0.08	
Segment 2	60	682	919	0.0880	45.06	0.95	Safety Factors	3.4	3.0	0.45	Riprap Size ok, Interstitial Velocity ok
Segment 2	60	682	919	0.0880	45.06	0.95	Abt and Johnson	2.2	3.0	0.45	
Segment 3	22	678	1,597	0.0324	32.70	1.20	Safety Factors	1.7	6.0	0.37	Riprap Size ok, Interstitial Velocity ok, Area of Concentrated Flow -- Repair
Segment 3	22	678	1,597	0.0324	32.70	1.20	Abt and Johnson	1.6	6.0	0.37	
Segment 4	23	410	2,007	0.0561	28.78	1.33	Safety Factors	2.8	6.0	0.50	Riprap Size ok, Interstitial Velocity marginal -- Repair
Segment 4	23	410	2,007	0.0561	28.78	1.33	Abt and Johnson	2.1	6.0	0.50	

[1] Interstitial Velocity based on the Placed/Specified D_{50}.

[2] Abt and Johnson: $D_{50} = 5.23\ q^{0.56}\ S^{0.43} \times 1.20$

2.1.3 Geotechnical – Potential Settlement

The geotechnical stability with respect to settlement has been evaluated as a potential cause of sub-grade soil erosion beneath the Type C erosion protection. Several factors, enumerated below indicate that negligible settlement has occurred on the AGTI and is not a concern or contributing factor associated with the rill formation.

In order to verify settlement is not a contributing factor in the formation of the erosion rill features, a minimum of one test excavation will be made on the AGTI and A-9 to expose and verify the integrity of the existing radon barrier or clay layer. Test excavations will be made in the vicinity of erosion rill features identified on both structures. Additional excavations may be required if it is determined that the radon barrier layer has experienced significant settlement or has otherwise been disturbed.

The approved AGTI reclamation plan (Shepherd Miller, 1997) evaluated settlement in two parts:

- Part 1 – from end of tailing deposition to present (i.e. 1997 being present).
- Part 2 – from present (1997) to the end of settlement.
  - Approach 1 – (Predictive Model) continued analysis from Part 1 until the pore pressures that were predicted in 1997 dissipate completely.
  - Approach 2 – (Current Field Conditions and Laboratory Results) conduct a separate settlement analysis using soil properties obtained from the field investigation conducted by Shepherd Miller and consolidation data from subsequent testing by Western Engineers, Inc. (WEI).

The following table, presented in the Design Report (Table 5-6, Shepherd Miller, 1997), provides the results of this analysis.

Table 2.1 Settlement Analysis

Zone	Total Settlement Based on the Model (ft)	Future Settlement Based on Model (ft)	Future Settlement Based on Current Conditions (ft)	Percentage of Total Settlement Completed	
				Based on Model (%)	Based on Current Conditions (%)
1	9.3	0.79	0.003	91	100
2	4.2	0.08	0.005	98	100
3	2.5	0.53	0.47	80	88
4	6.7	0.58	0.29	93	96

A conservative estimate (i.e., based on Approach 1 – model) of the total anticipated Future Settlement with the addition of secondary settlement is shown on the following Table 2.2 (also shown as Table 5-7, Shepherd Miller, 1997).

Table 2.2 Future Settlement Analysis

Zone	Future Primary Settlement (ft)	Secondary Settlement (ft)	Total Future Settlement (ft)
1	0.79	0.31	1.1
2	0.08	0.2	0.28
3	0.53	0.24	0.77
4	0.58	0.24	0.82

Based on the results of this evaluation it was determined that a flow concentration factor of 1 was appropriate for design of riprap for the top and sideslopes of the AGTI.

To evaluate settlement as a potential cause of the gully formation a survey was performed on a 100-foot grid system in the areas of concern. The 100-foot grid system is the same as-built survey grid used at the completion of cover construction. Results of this survey clearly indicate that the Approach 2 (based on current conditions) reflect the observed settlement for AGTI to date and the Approach 1 (model) represents a very conservative evaluation of anticipated settlement. As shown on Drawing 3 of 8, the actual settlement which has occurred since cover completion is very minimal.

2.1.4 Radon Attenuation

While there are some isolated locations of rill formation beneath the Type C erosion protection on the AGTI reclamation cover, the geometry of the rills are shallow and perpendicular to the slope. These rills, typically, appear to develop and extend for a length of approximately 200 feet and stabilize because eroded soils are deposited within the rock voids at the downstream end thus slowing or terminating interstitial velocities. The typical rill depth is about 6 inches and in no case incisions formed greater than one foot over the radon barrier. Since radon attenuation to 20 picocuries per meter squared per second (20 $pCi/m^2/s$) occurs at a much shallower depth within the cover system, based on conservative modeling, the cover system performance with respect to radon attenuation is functioning as designed.

2.2 A-9 Repository

This section details the areas of concern and cause associated with erosion protection of the A-9 reclamation cover.

2.2.1 A-9 Areas of Concern and Cause

The areas of concern associated with the A-9 reclamation cover are:

- Type C (D_{50} = 6 inches) Erosion Protection – located on the southern reclamation cover slopes.

Type C (D_{50} = 6 inches) Erosion Protection

Umetco field inspections identified areas of soil cover erosion beneath the riprap layer on the southern slope of the reclamation cover on those areas with Type C erosion protection material. These locations are also located in areas which receive substantial upland flow and are susceptible to large amounts of drifting snow during the winter months. The

Type C erosion protection for the A-9 consists of a single layer of riprap with a minimum layer thickness of 12 inches.

Umetco's field investigations of these areas concluded that cover soil erosion beneath the riprap layer are caused by concentrated interstitial flows at the interface of the erosion protection layer and cover soil sub-grade. The erosion incisions typically extend about 200 feet and become stable at the downstream due to filling of the riprap void space with sediment. The incisions also terminate near the lower portions of the slope where the slope flattens, i.e., interstitial velocities are reduced. The geometry of the erosion features are such that the bottom of the incisions are perpendicular to the slope for the entire length of the incision and typically about 0.5 feet in depth.

Review of the A-9 (Shepherd Miller, 1998) design indicates appropriate and conservative methods were used to determine the size of rock for the Type C erosion protection. The design error is associated with the evaluation of the filter blanket. The Design Report evaluated the need for a filter blanket by the calculating interstitial flow velocity which is an acceptable and recommended procedure established in NUREG 4620. While NUREG 4620 provides guidance on calculation of interstitial velocities it does not provide an acceptable velocity at which the sub-grade layer is erosionally stable. The Design Report utilized criteria presented in NRC STP (pp A1-A20, August 1990) to determine an adjusted permissible velocity of 2.5 feet per second. Computation of the permissible interstitial velocity in this manner has resulted in unacceptable performance of the erosion protection layer at the locations noted. At about the same time as the design was approved, the NRC published draft guidance regarding adequate interstitial velocities in NUREG 1623 (Draft guidance, February 1999). This guidance states:

> *"When the computed interstitial velocity is less than 0.5 feet per second, a filter may not be needed. When velocities are between 0.5 and 1.0 feet per second, the need for a filter layer will be dependent upon the type of soil material placed at the interface. A filter should be provided when velocities are 1.0 feet per second or greater."*

The calculated interstitial velocities for the problematic Type C area of the A-9 vary between 0.6 and 0.8 feet per second. Accordingly the guidance provided by NUREG 1623 is very applicable to this site, weather conditions, and cover soils.

Another contributing factor associated with the rill formation is believed to be drifting of snow in these specific areas which tend to concentrate flows. During the winter months drifting snow fills void spaces in these areas, once the drifts begin to melt and the cover receives additional precipitation, interstitial flows are diverted around and concentrated around the perimeter of the frozen drifts.

It should also be noted that there are several isolated areas within the problematic areas in which the riprap void spaces are filled with finer fraction material which is a typical artifact of the placement process. Where this condition is present there is no erosion of subsurface soils and up-slope gullies are diverted around these areas, i.e., void space is filled and interstitial velocities are slowed.

The southern slope of the A-9 flattens near the toe. At this location interstitial velocities slow to 0.54 feet per second and sub-grade incisions abruptly terminate indicating that the

0.5 feet per second criteria found in NUREG 1623 is very applicable to this site and the cover soils found at the riprap cover interface.

2.2.2 Evaluation of Hydrology and Erosion Protection Design

To ensure the cause of the sub-grade erosion was appropriately identified and to verify the adequacy of the erosion protection design, a detailed analysis of the designed/placed erosion protection layer was performed. This evaluation is based on the current criteria found in NUREG 1623.

Evaluation of the A-9 erosion protection design was completed by identification of the critical hydraulic profile, as shown on Drawing 2 of 8, which includes the area of concern located on the southern slope of the reclamation cover. The approved PMP (one-hour thunderstorm) of 8.7 inches was used for this evaluation. Calculation of rock size was performed using the Safety Factors Method for slopes less then 10%; Stephenson Method for slopes greater then 10%; for slopes at or near 10% both Safety Factors and Stephenson were utilized; and for all slope segments the Abt and Johnson Method was used, i.e., $D_{50} = 5.23\ q^{0.56}\ S^{0.43} \times 1.20$.

Results of this evaluation demonstrate that the rock size of the A-9 erosion protection is appropriate and conservative. The upper two segments of the profile are located on the Heap Leach reclamation cover which does incorporate a filter bedding layer at the interface between the riprap and soil cover.

The interstitial velocity for the top slope covered with Type B (D_{50} = 3 inches) of the A-9 reclamation cover is 0.24 feet per second which is well below the 0.5 feet per second criteria established in NUREG 1623. In addition, there is no visual evidence of cover degradation or sub-grade erosion on the upper repository slopes.

The rock size for the lower (southern) portion of the A-9, covered with Type C (D_{50} = 6 inches) erosion protection is also conservative, however, the interstitial velocities associated with this larger erosion protection material, for the most part, exceed the 0.5 feet per second criteria causing isolated areas of shallow incision at the interface of the erosion protection and cover soil.

A summary of the erosion protection evaluation is shown on Table 2.3.

Table 2.3
A-9 Repository Reclamation Cover - Summary of Erosion Protection Evaluation

A-9 Profile	Segment Elev. Diff. (ft)	Segment Length (ft)	Hydraulic Length (ft)	Segment Slope (ft/ft)	Intensity (in/hr)	Peak Flow (cfs/ft)	Riprap Size Calculation Method	Riprap D_{50}		Interstitial Velocity [1] (fps)	Comment
								Calculated (inches)	In-Place (inches)		
Segment 1	6	571	571	0.0105	42.08	0.55	Safety Factors	0.4	0.5	0.05	Segment on Heap Leach Reclamation Cover
Segment 1	6	571	571	0.0105	42.18	0.55	Abt and Johnson	0.6	0.5	0.05	
Segment 2	39	377	948	0.1034	36.52	0.79	Safety Factors	3.5	3.0	0.49	Segment on Heap Leach Reclamation Cover, Filter Layer in Place, Stephenson and Safety Factors used – slope near 10%
Segment 2	39	377	948	0.1034	36.52	0.79	Abt and Johnson	2.1	3.0	0.49	
Segment 2	39	377	948	0.1034	36.52	0.79	Stephenson	2.0	3.0	0.49	
Segment 3	10	161	1,109	0.0621	34.13	0.87	Safety Factors	2.3	6.0	0.53	Riprap Size ok, Interstitial Velocity marginal
Segment 3	10	161	1,109	0.0621	34.13	0.87	Abt and Johnson	1.8	6.0	0.53	
Segment 4	39	1,354	2,463	0.0288	23.88	1.35	Safety Factors	1.7	3.0	0.24	Riprap Size ok, Interstitial Velocity ok
Segment 4	39	1,354	2,463	0.0288	23.88	1.35	Abt and Johnson	1.6	3.0	0.24	
Segment 5	15	120	2,583	0.125	23.26	1.38	Stephenson	3.3	6.0	0.77	Riprap Size ok, Interstitial Velocity unacceptable -- Repair
Segment 5	15	120	2,583	0.125	23.26	1.38	Abt and Johnson	3.1	6.0	0.77	
Segment 6	8	124	2,707	0.0645	22.52	1.40	Safety Factors	3.3	6.0	0.54	Riprap Size ok, Interstitial Velocity marginal -- Repair
Segment 6	8	124	2,707	0.0645	22.52	1.40	Abt and Johnson	2.3	6.0	0.54	

[1] Interstitial Velocity based on the Placed/Specified D_{50}.

[2] Abt and Johnson: $D_{50} = 5.23\ q^{0.56} S^{0.43} \times 1.20$

2.2.3 Geotechnical – Potential Settlement

The geotechnical stability with respect to settlement has been evaluated as a potential cause of shallow sub-grade soil erosion beneath the Type C erosion protection material. Several factors as discussed below conclude that the observed settlement occurring on the A-9 is as predicted with no impact on erosion protection design.

The approved A-9 reclamation plan (Shepherd Miller, 2008) settlement analysis was performed in six stages.

- Stage 1 – deposition of tailings generated by Umetco (December 1979 to December 1984).
- Stage 2 – consolidation and drainage of Umetco tailings (December 1984 to September 1987).
- Stage 3 – placement of Susquehanna tailings and interim cover (September 1987 to December 1989).
- Stage 4 – consolidation and drainage of Susquehanna tailings and Umetco tailings (December 1989 to March 1998).
- Stage 5 – placement of additional waste and reclamation cover (March 1998 to April 1998).
- Stage 6 – consolidation and drainage subsequent to reclamation cover construction (April 1998 to end of consolidation).

For the purpose of this discussion the Stage 6 or anticipated settlement post reclamation cover construction are of interest. Results of the Stage 6 analysis predicted a maximum settlement of 1.65 feet. This settlement is anticipated subsequent to the Stage 5 immediate settlement resulting from placement of additional waste and reclamation cover loading.

Long-Term settlement (maximum creep) was predicted to be 0.87 feet. The total settlement is the sum of the immediate, consolidation, and creep settlements, however, for this evaluation the Stage 5 immediate settlement of 0.2 feet is neglected because the as-built (100-foot grid) survey was performed at the conclusion of completion of the reclamation cover, i.e., immediate settlement had occurred. Accordingly, the maximum predicted post reclamation cover loading settlement is the consolidation settlement of 1.65 feet plus long-term creep of 0.87 feet or 2.52 feet.

As part of this evaluation, Umetco performed a survey on the same 100-foot grid system to ensure settlement is occurring as predicted without differential settlement which could impact the radon barrier or concentrate surface flows. Results of the survey are shown on Drawing 4 of 8 along with comparison contours to identify any differential settlement. As shown on the drawing, settlement of about 1 foot has occurred at the maximum waste thickness section located at the southern end of the repository and diminishing near the northern end. Settlement is occurring in a uniform manner and well within the predicted limits of settlement, i.e., no strain on radon barrier or concentrated flows.

As stated above, the maximum settlement is occurring at the southern end of the repository which increases the slope across the top of the repository, however, the size of the riprap placed on the top slope of the repository (Segment 4) is such that it is oversized by almost a factor of 2 at the southern (critical) end of the slope. To ensure the Type B (D_{50} = 3 inches) is adequate

based on worst case settlement conditions, the required rock size was calculated assuming an additional 3 feet of settlement at the southern end of the repository resulting in a top slope of 0.0318 feet/foot. This scenario would result in an increase required D_{50} of 1.8 inches using the Safety Factors Method and 1.70 inches using the Abt and Johnson Method. The interstitial velocity would increase to only 0.26 feet per second which is well below the 0.5 feet per second criteria established in NUREG 1623.

Because of the uniform bottom configuration of the A-9 and waste placement, there is no reason to anticipate that settlement will occur in a non-uniform manner.

2.2.4 Radon Attenuation

While there are some isolated locations of rill formation beneath the Type C erosion protection on the A-9 reclamation cover, the geometry of the rills are shallow and perpendicular to the slope. These rills, typically, appear to develop and extend for a length of approximately 200 feet and stabilize because eroded soils are deposited within the rock voids thus slowing or terminating interstitial velocities. The typical rill depth is about 6 inches and in no case incisions formed greater than one foot over the radon barrier. Since radon attenuation to 20 $pCi/m^2/s$ occurs at a much shallower depth within the cover system, based on conservative modeling, the cover system performance with respect to radon attenuation is functioning as designed.

2.3 Evaluation of Heap Leach and GHP No. 2 Reclamation Covers

Umetco has evaluated the Heap Leach and GHP No. 2 Reclamation Covers to ensure the situation found with the AGTI and A-9 does not exist. The designs for both of these cover systems were prepared by Umetco, in-house, approved by the NRC, and contain filter layers beneath all Type B and Type C erosion protection which are placed on the 5(H) to 1(V) cover outslopes. Reclamation covers have been inspected in the field with no indication of cover degradation.

3.0 Enhancement of Erosion Protection Design

In order to correct the erosion features on the AGTI and A-9 structures, repair methodologies have been devised to provide adequate bedding material beneath/within the Type C erosion protection placed on the lower portions of the outslopes. A multi-layer filter system will be provided at the upstream and downstream sides of the launch rock structure located on the east side of the AGTI to reduce erosion. The off-cover erosion occurring on the southeast corner of the AGTI will be corrected by the installation of a riprap armored apron channel.

3.1 Above Grade Tailings Impoundment

This section details the design of repairs in areas of concern associated with erosion protection of the AGTI reclamation cover.

3.1.1 AGTI Areas of Concern and Repair

The areas of concern associated with the AGTI reclamation cover are:

- Type C (D_{50} = 6 inches) Erosion Protection Bedding – located on the lower portions of the northern and eastern reclamation cover slopes.
- Launched Rock Filter– located at the bottom of the eastern slope of the reclamation cover.

- Off-Cover Erosion Control Apron Channel– occurring on the southeast corner of the repository.

3.1.2 Type C Erosion Protection, Bedding Repair

Field investigations indicated that the rills in the existing erosion protection are generally confined to the eastern or lee side of the AGTI with some minor rills occurring on the north face. Two bedding repair methods have been devised for the AGTI.

In general, erosion protection materials will be transported from the Quarry and placed in their point of final use on an as needed load by load basis. No on-site stockpiling or re-handling of erosion protection materials is anticipated other than the re-handling of the 30/70 blended bedding material which will have to be transferred from delivery/haul trucks to front end loader type spreading equipment. While some stockpiling may be necessary, it will be conducted in a manner previously evaluated and assessed by the NRC during the execution of previous site reclamation activities.

The first method (repair method one) involves removal of the existing Type C erosion protection layer, placement of a minimum 3-inch thick layer of Type A bedding material (Design D_{50} = 0.5 inch, actual D_{50} = 1.0 inch, average from field gradations) and replacement of the Type C riprap to a minimum depth of 1 foot. The areas to receive this treatment method total approximately 19.5 acres and are shown on Drawings 5 of 8 and 6 of 8.

With respect to repair method 1 (Type C riprap removal, Type A bedding placement and riprap replacement), the existing Type C rock will be removed or windrowed in manageable panel widths (not to exceed 50-feet) running perpendicular to the side slope. Once the existing riprap material has been removed, the Type A bedding material will be placed, graded and proof rolled. The Type A bedding will be placed on the slope on an as needed load by load basis and little if any on-site stockpiling is anticipated.

The second repair method (repair method two) involves spreading a blended bedding material ($D_{50} \approx 0.64$ inch) over the surface of the existing Type C riprap and vibrating/working the material into the bottom portion of the 1-foot thick layer of erosion protection. Section 3.3 of this report discusses field tests conducted to verify the constructability of this method. A minimum 4-inch layer of blended bedding material will be provided and 25-foot wide staging bands will be provided on 10-foot elevation centers to access the slope. The existing Type C riprap will be removed from the access band areas and a minimum 3-inch layer of Type A bedding material will be placed to plate the existing frost barrier and act as a bedding layer. When the access/staging bands are no longer required, the Type C riprap previously removed will be replaced and blended/transitioned into the surrounding undisturbed erosion material to a minimum depth of 1 foot. The area to receive this treatment method totals 42.8 acres and encompasses the majority of the north outslope of the AGTI as shown on Drawings 5 of 8 and 6 of 8.

With respect to repair method 2 (contour bedding bands and 30/70 bedding material vibrated into the existing Type C riprap), the bedding bands will be prepared by removing the existing riprap and stockpiling it on the upslope side of the 25-foot wide band. Type A bedding (3-inches thick) will be placed (again, on a load by load basis) on the exposed frost barrier surface to act as a plated wear/staging surface and subsequently the bedding layer. The 30/70 blended bedding material will be delivered to the prepared bedding band and dumped/temporarily stockpiled for

pickup and placement on the slope between bedding bands (on 10-foot elevation centers) with front end loader type equipment. Again, due to the limited space available on the bedding bands, no long term stockpiling of bedding material is anticipated or feasible.

3.1.2.1 Repair Method One Compatibility Calculations:

An adequate quantity of Type A bedding material is stockpiled at the Rattlesnake Quarry to complete the repairs on the AGTI.

Bedding Filter Criteria:

Criterion 1*: D_{15} (Riprap) / D_{85} (Bedding Material) < 5, prevents migration of the bedding material into the riprap.

Criterion 2*: D_{15} (Bedding Material) / D_{85} Frost Barrier Material) < 10, prevents erosion of soil below the bedding material.

* NRC, NUREG/CR-4620 (USNRC 1986)

Material Gradation Data:

Frost Barrier Material* – D_{85} = 0.066 inch

Type A Bedding Material* – D_{15} = 0.52 inch, D_{85} = 1.95 inches

Type C Riprap Material* – D_{15} = 4.48 inches

*D_{15} and D_{85} sizes from averages of field gradations performed during construction.

Criterion 1 – 4.48/1.95 = 2.3 < 5, Check

Criterion 2 – 0.52/0.066 = 7.9 < 10, Check

Interstitial Velocity Criteria:

$Vv = W\ m^{0.5}\ I^{0.54}$, NUREG-1623 (USNRC, Draft Guidance 1999)

Recommended interstitial <0.5 feet per second (ft/s)

Where:
Vv = Interstitial velocity, inches per second (in/s)
W = Constant, 11.316
m = D_{50} of bedding material, inches, and
I = Hydraulic gradient, feet per foot (ft/ft)

Input Data:

D_{50} Type A Bedding = 1.0 inch, average from field gradations during construction

Assume worst case – 5H:1V slope, hydraulic gradient = 0.2 ft/ft

$Vv = 11.316 * 1^{0.5} * 0.2^{0.54} = 4.75$ in/s

4.75 in/s = 0.39 ft/s < 0.5 ft/s, Check

3.1.2.2 Repair Method Two Compatibility Calculations:

Repair method two will require the crushing of existing rock material stockpiled at the Rattlesnake Quarry. The crushed rock will be blended with existing quarry fines to produce the

desired bedding material gradation (30 percent quarry fines / 70 percent 2-inch minus crushed rock). The proposed individual material gradations and target bedding material gradations are as follows (blend calculations and a gradation graph are presented in Appendix A):

Crushed Rock Gradation:

Table 3.0, Crushed Rock Gradation

Size	Percent Passing
2-inch	100
1 ½-inch	80 - 100
1-inch	50 - 70
¾-inch	30 – 50
3/8-inch	0 - 5

Average Existing Quarry Fines Gradation:

Table 3.1, Existing Quarry Fines Gradation

Sieve Size	Percent Passing
¾-inch	100
3/8-inch	98
No. 4	77
No. 8	63
No. 16	55
No. 30	51
No. 50	47
No. 100	30
No. 200	5.4

Target 30/70 Bedding Blend Gradation:

Table 3.2, 30/70 Bedding Gradation Band

Sieve Size	Percent Passing
2-inch	100
1 ½-inch	80 – 100
¾-inch	40 – 70
3/8-inch	20 – 50
No. 4	10 – 40
No. 200	0 - 10

Bedding Filter Criteria:

Criterion 1*: D_{15} (Riprap) / D_{85} (Bedding Material) < 5, prevents migration of the bedding material into the riprap.

Criterion 2*: D_{15} (Bedding Material) / D_{85} Frost Barrier Material) < 10, prevents erosion of soil below the bedding material.

* NRC, NUREG/CR-4620 (USNRC 1986)

Material Gradation Data:

Frost Barrier Material[1] – D_{85} = 0.066 inch

30/70 Bedding Material[2] – D_{15} = minimum 0.006 inch, maximum 0.27 inch

D_{85} = minimum 1.05 inches, maximum 1.56 inches

Type C Riprap Material[1] – D_{15} = 4.48 inches

[1]D_{15} and D_{85} sizes averaged from field gradations performed during construction

[2]Minimum and maximum sizes from gradation band

Criterion 1 – Minimum bedding band - 4.48/1.05 = 4.27 < 5, Check

Criterion 1 – Maximum bedding band - 4.48/1.56 = 2.87 < 5, Check

Criterion 2 – Minimum bedding band – 0.006/0.066 = 0.09 < 10, Check

Criterion 2 – Maximum bedding band - 0.27/0.066 = 4.09 < 10, Check

Interstitial Velocity Criteria:

$Vv = W\ m^{0.5}\ I^{0.54}$, NUREG-1623 (USNRC, Draft Guidance 1999)

Recommended interstitial velocity <0.5 feet per second (ft/s)

Where:
Vv = Interstitial velocity, inches per second (in/s)
W = Constant, 11.316,
m = D_{50} of bedding material, inches, and
I = Hydraulic gradient, feet per foot (ft/ft)

Input Data:

D_{50} 30/70 Bedding Blend = minimum 0.38 inch, maximum 0.88 inch

Assume worst case – 5H:1V slope, hydraulic gradient = 0.2 f ft/ft

Minimum gradation band:

$Vv = 11.316 * 0.38^{0.5} * 0.2^{0.54} = 2.88$ in/s

2.88 in/s = 0.24 ft/s < 0.5 ft/s, Check

Maximum gradation band:

$Vv = 11.316 * 0.88^{0.5} * 0.2^{0.54} = 4.44$ in/s

4.44 in/s = 0.37 ft/s < 0.5 ft/s, Check

3.1.3 Launch Rock Structure Filter Installation

Multi-layer filter zones will be installed on both the upstream and downstream sides of the existing launch rock structure to reduce erosion and repair erosion sink holes that have developed upstream of the structure. The filter zone on the upstream side of the structure will consist of three filter material layers. The existing upstream face of the launch rock structure will be exposed (approximate 6-foot deep excavation) and a minimum 1-foot thick layer of Type C riprap will be placed next to the existing Type E launch rock material. A minimum 1-foot thick layer of Type A bedding will be placed next to the Type C rock followed by a minimum 1-foot thick layer of 30/70 blended bedding material. The filter zone will be backfilled with the frost barrier material previously removed and the filter zone will extend the full length of the launch rock structure. The required excavation is located well beyond the limits of the radon barrier on the east side of the AGTI and the radon barrier and waste materials will not be exposed. It is expected that the excavation required to facilitate installation of the filter zone will include and encompass all indentified sink hole features. Any sink hole features which may fall outside of the required excavation will be repaired by the placement of additional frost barrier material.

The existing Type C riprap located upstream or above the Launch Rock Filter Zone will be removed and stockpiled above the filter zone area at a distance to be determined in the field. The minimum distance will provide for the width of the filter trench excavation (30- to 40-feet), an access/staging road (25- to 30-feet wide), and a frost barrier temporary stockpile area (25- to 35-feet wide). The placement of the Type A side slope bedding material and installation of the

Launch Rock Filter Zone will be coordinated such that the two activities are performed in conjunction with each other, beginning at the south end of the east side slope and progressing to the north end of the Launch Rock structure.

The downstream side of the launch rock structure will receive a similar filter zone treatment. After a shallow trench has been excavated at the toe of the structure and filled with Type A bedding, Type C rock will be placed next to the existing Type E launch rock followed by minimum 1-foot layers each of Type A bedding, 30/70 blended bedding, another layer of Type A bedding which will be covered with a final layer of Type C rock. Details of both the upstream and downstream filter installation are shown on Drawing 6 of 8.

3.1.3.1 Launch Rock Filter Compatibility Calculations

Adequate quantities of Type A bedding material and Type C rock are stockpiled at the Rattlesnake Quarry to complete the filter zones on the AGTI launch rock structure. The quantity of 30/70 bedding material will have to be processed in the quarry as specified previously.

Piping Filter Criteria:

Criterion 1* - $5 < D_{15}$ (Filter) / D_{15} (Base) < 40,

Criterion 2* - D_{50} (Filter) / D_{85} (Base) ≤ 5, and

Criterion 3* - D_{50} (Filter) / D_{50} (Base) < 40

*US Bureau of Reclamation, Design of Small Dams, pg. 235, 1977

Filter Material Gradation Data:

Table 3.4, Filter Material Gradations

Material Type	D_{15} (in.)	D_{50} (in.)	D_{85} (in).
Frost Barrier[1]	0.0011	.02	.066
30/70 Bedding Blend[2]	0.02	0.64	1.31
Type A Bedding[1]	0.52	1.0	1.95
Type C Rock[1]	4.48	6.32	7.86
Type E Rock[1]	21	31	45.1

[1]Average gradation from field tests
[2]Calculated values of 30/70 blended material (See Figure 2 of Appendix A)

Compatibility Calculations:

30/70 Blend / Frost Barrier
Criterion 1, $5 < 0.02/0.0011 < 40$, $5 < 20 < 40$, Check
Criterion 2, $0.02/0.066 \leq 5$, $0.03 \leq 5$, Check
Criterion 3, $0.64/.02 < 40$, $32 < 40$, Check

Type A Bedding / 30/70 Blend
Criterion 1, $5 < 0.52/0.02 < 40$, $5 < 26 < 40$, Check
Criterion 2, $0.52/1.31 \leq 5$, $0.4 \leq 5$, Check
Criterion 3, $1.0/0.64 < 40$, $1.5 < 40$, Check

Type C Rock / Type A Bedding
Criterion 1, $5 < 4.48/0.52 < 40$, $5 < 9 < 40$, Check
Criterion 2, $4.48/1.95 \leq 5$, $2.3 \leq 5$, Check
Criterion 3, $6.32/1.0 < 40$, $6.3 < 40$, Check

Type E Rock / Type C Rock
Criterion 1, $5 < 21/4.48 < 40$, $5 < 4.7 < 40$, Check
Criterion 2, $21/7.86 \leq 5$, $2.7 \leq 5$, Check
Criterion 3, $31/6.32 < 40$, $4.9 < 40$, Check

3.1.4 Off-Cover Erosion Control Apron Channel

A slope area located adjacent to the toe of the impoundment cover on the southeast corner of the AGTI has experienced some erosion caused by off-cover surface runoff and drainage exiting the downstream end of the existing buried apron. This slope area will be stabilized by placement of a riprap armored apron channel. The erosion damage will be repaired by placing compacted random sub-grade material obtained from grading activities required to shape the slope area. After sub-grade preparation and shaping, the apron channel will receive a minimum 6-inch layer of Type A bedding material overlain by an 18-inch thick layer of Type C riprap. Near the downstream end of the apron channel the Type C riprap will be tied into the existing buried apron material to provide drainage of the buried apron. The entire length of the apron channel will match the existing surface of the impoundment cover erosion protection material (maximum slope 0.17 feet per foot.). The apron channel will vary in width from 141.0 feet to 78.0 feet. Details of the apron channel design are shown on Drawing 8 of 8.

3.1.4.1 Apron Channel Design Calculations

The erosion protection required for the apron channel was evaluated considering the approved PMP (one-hour thunderstorm) of 8.7 inches, using both the Stephenson Method for slopes greater than 10% and the Abt and Johnson Method.

The Stephenson Method returned a required D_{50} of 4.06 inches and the Abt and Johnson method also indicates that a minimum D_{50} of 4.06 inches is required. The D_{50} of the Type C riprap stockpiled in the Rattlesnake Quarry averages 6.34 inches with a D_{100} of 9 inches. Due to frequent wetting/concentrated flow, an 18-inch thick layer of Type C riprap will be placed on a 6-inch layer of Type A bedding material. It has been previously demonstrated, in this report, that the Type A bedding material will provide adequate bedding for a 0.2 feet per foot (5H:1V) slope. The Stephenson Method calculation sheets are presented in Appendix A and the Abt and Johnson Method calculation follows:

Abt and Johnson Rock Sizing Method:

$D_{50} = 5.23 * q^{0.56} * S^{0.43} * 1.20$, NRC NUREG-1623 (USNRC, Draft Guidance 1999)

Where,
D_{50} - Minimum median stone size, inches
q - Unit Flow Rate, feet per second (fps), (1.78 fps from Rational Formula for unit width analysis),

S - Slope, feet per foot (ft/ft), (0.17 ft/ft. from design Drawing)

$D_{50} = 5.23 * 1.79^{0.56} * 0.17^{0.43} * 1.20 = 4.06$ inches, D_{50} Type C riprap = 6.34 inches, Check

3.2 A-9 Repository

This section details the design of repairs in areas of concern associated with erosion protection of the A-9 reclamation cover.

3.2.1 A-9 Areas of Concern and Repair

The areas of concern associated with the A-9 reclamation cover are:

- Type C (D_{50} = 6 inches) Erosion Protection Bedding – located on the southern reclamation cover slopes.
- Type C Erosion Protection Bedding – located at the toe of the Heap Leach Repository (northeast edge of the A-9 Repository).

3.2.2 Type C Erosion Protection, Bedding Repair

Field investigations indicated that the rills in the existing erosion protection are generally confined to the southern crest area and outslope. Based on the erosion protection evaluation presented in Table 2.3 of this report, it appears that the interstitial velocity at the end of flow segment 3 is slightly higher than recommended. While no evidence of rill formation has been detected in this area, bedding material will be added here as well as repairs to the A-9 crest and southern slope. Two bedding repair methods have been devised for the AGTI.

The first method (repair method one) involves removal of the existing Type C erosion protection layer, placement of a minimum 3-inch thick layer of Type A bedding material (Design D_{50} = 0.5 inch, actual D_{50} = 1.0 inch from average of field gradations) and replacement of the Type C riprap to a minimum depth of 1 foot. A 30-foot wide zone of type B riprap at the southern crest will be removed, the sub-grade will be repaired with a minimum 3-inch layer of Type A bedding material (or greater depth as required to reestablish grade). The repaired/prepared sub-grade in this zone will be covered with the Type B riprap previously removed. In all cases the repaired erosion protection materials will be replaced at the originally required depths in a manner that will provide a smooth transition from the existing (undisturbed) material to the repair areas. The A-9 crest area and southern outslope will receive these treatments and the area totals approximately 5.9 acres as shown on Drawing 7 of 8.

The second repair method (repair method two) involves spreading a blended bedding material ($D_{50} \approx 0.64$ inch) over the surface of the existing Type C riprap and vibrating/working the material into the bottom portion of the 1-foot thick layer of erosion protection. Section 3.3 of this report discusses field tests conducted to verify the constructability of this method. A minimum 4-inch layer of blended bedding material will be provided and 25-foot wide staging/access corridors will be provided around the perimeter of the existing Type B erosion protection material on the top of the A-9. A minimum 3-inch layer of Type A bedding material will be placed on the existing Type B riprap to provide access and act as a staging area for the placement of bedding material on the adjacent Type C armored slopes. The Type A material will remain on the Type B riprap after repairs to the slopes are complete. The areas to receive this treatment method total 7.1 acres as shown on Drawing 7 of 8.

Bedding compatibility calculations for repair methods one and two presented in Sections 3.1.2.1 and 3.1.2.2 of this report also apply to the repair methods proposed for the A-9.

3.3 Constructability Verification Field Tests

The constructability of filling the void space of the existing Type C riprap (repair method two) was verified by field testing in the Rattlesnake Quarry. During the fall of 2010, an approximate 100-foot wide by 100-foot long test bed of Type C riprap was constructed in the Rattlesnake Quarry. The test bed was constructed on a sloping surface in the quarry which varied from 7(H):1(V) to 4(H):1(V) and simulates the existing slopes found on the AGTI and A-9. The test bed sub-grade was shaped and compacted and a minimum 12-inch thick layer of Type C erosion protection material was placed and compacted in accordance with the placement and compaction techniques incorporated on the completed AGTI and A-9.

Two bedding material types were spread over the riprap test bed in order to evaluate placement techniques and the feasibility of working bedding material into the void spaces in the riprap. The first bedding material type considered was a 30/70 blend of quarry fines and imported 1-inch minus crushed rock. This material readily penetrated the Type C rock material with dozer track walking and mechanical vibration. The second bedding material type considered was the existing Type A bedding material (3-inch minus material) stockpiled in the quarry. This material also penetrated the Type C material though not as readily and slightly more energy was required to work the coarser material into the riprap. Both material types were successfully worked into the bottom portion of the 12-inch thick Type C riprap layer.

Placement methods evaluated included conventional dumping of bedding material on the surface and spreading with a dozer tractor and sprinkling or spreading bedding materials on the surface of the riprap with loader type equipment. Again, both methods were successfully worked into the riprap layer, however, the more conventional dumping and dozer spreading of the material resulted in the waste of material, required significantly more vibratory effort and left bedding material visible on the surface. The second placement method (sprinkling bedding material with a loader) resulted in a more uniform distribution of bedding material, less vibratory effort and no wasted material. It was noted during the testing that point contact on the surface between the vibratory equipment and the Type C rock resulted in more effective penetration of the bedding materials.

In conclusion, the results of field testing indicate that bedding materials up to and including 3-inch minus material can effectively be worked into the existing Type C erosion material layer. Loader spreading of the material is the most desirable and economical bedding placement method. Therefore, a bedding material comprised of 70 percent 2-inch minus crushed rock and 30 percent quarry fines and spreading with loader type equipment is proposed as a viable method to introduce bedding material into the existing Type C erosion protection material where no rill damage has occurred on the AGTI and A-9. Photographs of the testing process and a gradation plot of bedding materials introduced into the erosion protection layer during testing are presented in Appendix B.

4.0 Technical Construction Specifications

4.1 Use of Site

All repair work, new construction and Contractor operations, including staging shall be conducted within the established Gas Hills site transfer boundary shown on the Drawings. No work or construction activities will be allowed outside such boundary without the Owner's approval.

Reclamation activities conducted within the established Gas Hills site boundary shall be conducted in accordance with the evaluations and assessments contained in existing or previous Environmental Site Assessments conducted/approved by the NRC. All proposed construction activities are consistent with previous activities evaluated and assessed by the NRC.

However, it is Umetco's desire to address/repair some erosion features located in the Rim Pit area, which falls outside of the site boundary, while a prime contractor is mobilized at the Gas Hills site. The Rim Pit area is located north of the reclamation site and falls within Umetco's Wyoming Department of Environmental Quality – Land Quality Division Mine/Drilling Notification Permit No. DN60. Permission to access the erosion features located in the Rim Pit area will be required by Umetco, as the area has been reclaimed and only the minimum amount of disturbance will be allowed to access and affect erosion repairs.

4.2 Required Excavation

Prior to initiation of repair activities, test excavations shall be made to verify the integrity of the existing radon barrier or clay layer in the vicinity of existing rill features. A minimum of one excavation shall be made on the AGTI and A-9, additional excavations may be required if it is determined that the radon barrier layer has been disturbed or excessive settlement has occurred. All soil material (frost barrier material) and erosion protection material shall be carefully removed and stockpiled for re-use. Material removed from required excavations shall be replaced in accordance with these Specifications.

4.3 Radon Barrier

This section discusses placement of the radon barrier layer of the reclamation cover should it become necessary to place radon barrier material during erosion protection repair activities or test pit examination of the radon barrier. It is anticipated that no radon barrier material will be disturbed or require placement.

4.3.1 Materials

Clayey soils for constructing the radon barrier layer have been obtained from a permitted borrow source and stockpiled on site. Should it become necessary to place radon barrier material, the in-place material removed from required excavations will be stockpiled for re-use. The Cody shale (claystone) material contained in the stockpile shall be conditioned prior to re-use placement in the radon barrier. The moisture content of the stockpiled material shall be within 2 percent of the specified moisture prior to placement.

Conditioning of this material shall (at a minimum) require application of water, disking and desiccation to the extent necessary to provide a homogeneous borrow material prior to

excavation and placement. Soils used in constructing the radon barrier shall conform to the following physical requirements:

- At least 50 percent passing the No. 200 sieve.
- Maximum particle size of 1 inch.
- Liquid limit of the material shall be at least 25 percent with a minimum plasticity index of 10.
- Maximum hydraulic conductivity of 1E-7 cm/sec when compacted to 95 percent of maximum standard Proctor density (ASTM D 698).

4.3.2 Placement

Radon barrier (clayey soil) shall be placed in equal continuous layers not exceeding 6 inches compacted thickness and shall be compacted to a minimum of 95 percent of the maximum standard Proctor density (ASTM D 698), at a moisture content of between optimum moisture content and 4 percent above optimum moisture content.

The placement areas and thickness for the radon barrier layer are shown on the drawings or shall match the depth removed from required excavations. Distribution and gradation of materials in each layer will be, as far as practicable, free of lenses, pockets, streaks, or layers of material differing substantially in texture, gradation or moisture content from surrounding materials.

Compacting radon barrier soils shall be accomplished using tamping foot (sheepsfoot) roller or mechanical hand tamping equipment. In placing the first lift of radon barrier material, care shall be taken to avoid mixing of underlying radiologically contaminated soils. The top surface of the compacted final lift of the radon barrier shall be bladed to the uniform and smooth grades established on the drawings or as modified by the engineer in the field.

If the compacted surface of any layer or fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or reworked with a harrow, scarifier, or suitable equipment, to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next layer of fill is placed. If the compacted surface of any layer of the placed material is too wet to obtain the specified compaction of the fill material to be placed thereon, the material shall be allowed to dry out, reworked, or scarified to reduce the moisture content and recompacted to the specified density.

Fill soils shall not be placed when the sub-grade is frozen, or when ambient temperatures do not permit placement or compaction of fill material to the specified density without developing frost lenses in the fill.

Construction surfaces, including lift surfaces, shall be protected from desiccation prior to placing subsequent lifts or frost protection materials.

The top of the radon barrier layer shall be graded to within +0.1 foot of the design grade shown on the drawings or as modified by the engineer in the field. The in-place thickness of the radon barrier layer shall be equal to or greater than 100 percent of the design thickness shown.

4.4 Frost Protection Layer/Random Fill

This section discusses placement of the frost protection layer of the reclamation cover where test pits are excavated to examine the condition of the radon barrier or where rill repairs are required

to reestablish grade. Random fill material shall be placed to establish sub-grade for the apron channel and shall be obtained from required excavations and/or grading activities in the vicinity of the apron channel.

In general, repairs to the existing frost barrier layer will be made with Type A bedding material.

4.4.1 Materials

Random fill and the frost protection layer of the cover shall be constructed with soils obtained from local mine spoil borrow sources, required excavations or the Rattlesnake Quarry. Suitable materials obtained from the borrow sources, Rattlesnake Quarry or required excavations shall consist of processed Type A rock bedding material, or clayey and/or silty sand, classified as SC, SM and/or SC-SM, in accordance with the Unified Soil Classification System. Soils used for random fill and construction of the frost protection layer shall be free of brush, roots, sod, lumps or rocks larger than one-half of the lift thickness, or other perishable or unsuitable materials.

All frost barrier material removed from required excavations, i.e., the radon barrier test trenches (one each on the AGTI and A-9 Repository) and Launch Rock Filter Zone trench will be stockpiled for re-use. The hierarchy or ranking of sources for frost barrier material will be re-use from required excavations, the Rattlesnake Quarry and frost barrier material deposited as sediment downstream of the Launch Rock Structure. The need for frost barrier material obtained from the mine spoil source is remote, however this source was approved for use in the past and has been included in the Specifications as a last resort source should the other material sources prove inadequate or un-usable.

A significant volume of soils obtained from mine spoil borrow sources at the site have radiological characteristics which are naturally occurring but unsuitable for cover construction. Umetco will continuously monitor borrow excavations in the field. If additional material is required to affect repairs or fill test pits, the radiological and characteristic suitability of borrow materials will be determined on a load-by-load basis. For the most part, radiologically elevated (naturally occurring) materials, which are present in borrow areas, occur in isolated ponds and at times small clusters of loosely cemented rock. Upon initial scanning of this material it may appear that radiologically elevated materials are wide spread and unsuitable for cover construction while post-handling measurements may indicate that the radiological characteristics of the material are suitable.

4.4.2 Placement

Random fill and frost protection soils shall be placed in equal continuous layers not exceeding 12 inches compacted depth and compacted to a minimum of 95 percent of maximum standard Proctor density (ASTM D 698), at a moisture content above minus 2 percent of optimum.

The placement areas and thickness for the frost protection layer are shown on the drawings or shall match existing depths removed from test pit excavations. Distribution and gradations of materials in each layer will be, as far as practicable, free of lenses, pockets, streaks, or layers of material differing substantially in texture, gradation, or moisture content from surrounding materials.

If the compacted surface of any layer of fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or reworked with a harrow, scarifier, or

other suitable equipment to a sufficient depth to provide a relatively uniform moisture content and a satisfactory bonding surface before the next layer of earthfill is placed.

No material will be placed in the fill layer when sub-grade soils are frozen or when ambient temperatures do not permit placement or compaction of soils to the specified density without developing frost lenses in the fill.

The top of the frost protection layer shall be graded to within +0.1 foot of the design grade shown on the drawings or as modified by the engineer in the field. The in-place thickness of the frost protection layer shall be equal to or greater than 100 percent of the design thickness shown.

4.5 Erosion Protection and Bedding Materials

Erosion protection materials shall be obtained from existing stockpiles in Umetco's Rattlesnake Quarry located approximately 6 miles east of the Gas Hills site. Erosion protection materials from this quarry site have been approved for use as erosion protection for repositories at the Gas Hills site, i.e., AGTI and A-9. Umetco has performed and documented quality control testing of erosion protection material to verify that processed materials meet durability requirements previously specified and gradation requirements specified herein. Gradation tests will be performed on the processed materials used as Type A bedding, the 30/70 blended bedding material and component materials used to create the blended bedding material. Type C riprap stockpiled in the quarry, to be used in the construction of the apron channel and launch rock filters has previously been verified to meet durability and gradation requirements and will not required further testing.

Erosion protection materials used as bedding material will initially be tested when each type of material is produced, blended or placed. Thereafter, the testing shall be performed at a minimum frequency of one test for each 10,000 cubic yards or fraction thereof produced and placed. No durability testing will be required. The 30/70 blended bedding material shall be blended by weight and suitable mixing and/or blending hoppers equipped with a weighing devise shall be provided to ensure a consistent blend or mix is produced.

In-place bedding material gradations and depth checks will be performed at a frequency of one set of tests (depth and bedding gradation) for every square acre of Type A bedding material placed or blended bedding material introduced into the existing erosion protection material. A minimum 3-foot square test pit will be excavated to perform gradation/depth check tests.

4.5.1 Gradation Requirements

Erosion protection (riprap) materials shall be reasonably well graded within the limits presented in Tables 4.0 and 4.1. The sizes are specified in terms of square opening of U. S. Standard Sieves or by the nominal sizes of the materials.

Table 4.0 Erosion Protection Gradation Requirements

Type A (D_{50} = 0.5")		Type B (D_{50} = 3")		Type C (D_{50} = 6")	
Sieve Size	**Percent Passing**	**Sieve Size**	**Percent Passing**	**Sieve Size**	**Percent Passing**
3"	100	6"	100	10"	100
1.5"	60 - 100	5"	50 - 100	9"	50 - 100
1"	40 - 100	4"	30 - 100	8"	20 - 100
3/4"	20 - 100	3"	0 - 50	6"	0 - 50
1/2"	5 - 50	2"	0 - 15	4"	0 - 15
3/8"	0 - 25				
No. 4	0 - 5				

Table 4.1 30/70 Blended Bedding Gradation Requirements

Crushed Rock		Quarry Fines (Average of existing material)		30/70 Bedding Blend (D_{50} = 0.64")	
Sieve Size	**Percent Passing**	**Sieve Size**	**Percent Passing**	**Sieve Size**	**Percent Passing**
2"	100	¾"	100	2"	100
1.5"	80 - 100	3/8"	98	1.5"	80 - 100
1"	50 - 70	No. 4	77	¾""	40 - 70
3/4"	30 – 50	No. 8	63	3/8"	20 - 50
3/8"	0 - 5	No. 16	55	No. 4	10 - 40
		No. 30	51	No. 200	0 - 10
		No. 50	47		
		No. 100	30		
		No. 200	5.4		

4.6 Erosion Protection Placement

This section discusses construction (placement) of the erosion protection layer(s), erosion protection bedding and filters on the reclamation covers and associated hydraulic structures, e.g., toe aprons, apron channel, etc.

4.6.1 Sub-grade Preparation

In areas designated for existing riprap removal and replacement (repair method one), the existing riprap material shall be carefully removed in panels no wider than 50 feet and temporarily stockpiled on the adjoining/completed panel. Removed riprap shall be replaced as soon as is practicable after the minimum 3-inch thick Type A bedding layer has been placed and approved by the Owner's representative. In general, the removal panels will be oriented perpendicular to the slope and the actual width of panels will be determined in the field dependent on the capabilities of the Contractor's equipment. All riprap and bedding materials shall be placed in accordance with these Specifications.

In areas designated to receive bedding material vibrated into the existing riprap (repair method two), the 30/70 blended bedding material shall be spread uniformly, with loader type equipment, over the slope between the access route bands (shown on the Drawings). Test panels will be prepared on the existing slope to determine the most acceptable method and amount of bedding material required (to be applied on the slope) to ensure that a minimum of 4-inches of bedding material is vibrated or worked into the bottom portion of the existing 12-inch layer of Type C

riprap. The number of passes and size of vibratory equipment shall also be determined on the test panels and the acceptable result shall be duplicated throughout the placement of subsequent bedding material. The access route/staging bands shall be plated with a minimum 3-inch thick layer of Type A bedding material (after the existing erosion protection material has been removed) which will act as a running or wear surface and a bedding layer for the riprap removed to construct the access band. Access/staging bands shall be provided as shown on the Drawings.

Surfaces to be prepared for placing erosion protection shall be cleared of rubbish and any deleterious material. Prior to placing erosion protection materials, the subsurface shall be graded to within +0.1 foot of the final design grade established on the drawings or as modified by the engineer in the field. All surfaces prepared to receive erosion protection materials and/or bedding material shall be proof rolled with a smooth drum roller or approved equivalent. A designated representative of the QC staff shall witness proof rolling. Damage to the prepared sub-grade by construction activities or erosional forces, i.e., storm runoff, etc., shall be repaired in accordance with these specifications prior to placing erosion protection materials.

Frozen or unsuitable materials shall not be used for sub-grade preparation. Preparing the sub-grade surface shall occur when ambient temperatures permit adequate grading and proof rolling of the sub-grade. Placing erosion protection materials shall not be allowed when snow is present on the sub-grade.

4.6.2 Placement and Compaction

Erosion protection materials shall be placed to the lines and grades established on the Drawings described in these Specifications or as established by the engineer in the field.

Erosion protection materials shall be handled, loaded, transported, stockpiled, and placed in a manner that avoids nonconformance with the specifications due to segregation and degradation, including materials moved to and from stockpiles. Various placement methods used by the contractor that tend to segregate particle sizes within the layer will not be permitted.

Erosion protection material, up to a maximum nominal size of 12 inches, may be placed by end dumping and spread by bulldozer, hydraulic excavator, or approved equivalent. Dumped riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the bedding material or sub-grade. The finished erosion protection layer shall be free from pockets of small stones and clusters of larger stones. Placing stone by dumping into chutes or by similar methods will likely cause segregation of the various sizes and will not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry, by controlled dumping of successive loads during final placement, or by other methods of placement that produce the specified results. Rearranging of individual stones by mechanical equipment or by hand may be required to the extent necessary to obtain a well-keyed and reasonably well graded distribution of stone sizes as specified above. Larger pieces of riprap may require individual placement. Hand arrangement will be required only to the extent necessary to secure acceptable results. Stones shall be selected and positioned so as to produce an essentially solid, densely placed face of rock with all stones firmly wedged in place. Any stones that are not firmly wedged shall be adjusted and additional selected stones inserted or existing stones replaced to achieve solid interlock.

Each layer of erosion protection materials shall be track-walked by two passes of Caterpillar D6 bulldozer, smooth drum roller, or approved equivalent. Erosion protection materials shall be

spread in a manner that will achieve full coverage and a uniformly distributed well-keyed, densely placed layer.

Construction equipment other than spreading and compaction equipment shall not be allowed to move over the placed erosion protection and bedding layers except at equipment crossovers as designated by the QC representative.

4.6.3 Tolerances

The erosion protection (riprap) layers shall be placed to the limits and thickness shown on the drawings and within the following tolerances.

1) The top of the frost protection or sub-grade shall be within $\pm$ 0.1 foot of the design elevation or grade established on the drawing or as modified by the engineer in the field.
2) The thickness of erosion protection and bedding layers shall be no less than 90 percent of the design thickness shown on the drawings.
3) Local irregularities not exceeding the tolerances above will be permitted, provided that such irregularities do not form mounds, ridges, swales, or depressions that in the opinion of the QC Officer could cause concentrations of surface runoff.

5.0 Quality Control Plan

This section details the quality control and quality assurance activities to be performed.

The objectives of the quality control plan are to effectively control the quality of work performed, to verify that construction activities are performed in accordance with the approved plans and specifications, and provide adequate checks and audits to assure proper implementation of the quality control activities. Proper implementation of these activities will provide detailed documentation of the project and assure construction reclamation activities have been performed in accordance with the approved plans and specifications.

5.1 Quality Control/Quality Assurance Personnel

Quality control activities shall be implemented and managed by the QC Officer. These activities include field sampling, construction inspection, field testing, and laboratory testing. The QC Officer, appointed by the engineer, shall supervise field and laboratory QC technicians and control documentation of construction and quality control activities. The QC Officer shall have the specific authority and responsibility to reject work or material, to stop work, to require removal or placement, to specify and require appropriate corrective actions if it is determined work is not in conformance with the approved plans and specifications.

Quality assurance activities shall be implemented by the QA Officer who is an independent consultant and/or Umetco technical staff member with expertise in a specific aspect of reclamation work being performed. Quality assurance functions include pre-qualification of QC personnel, verification of test procedures and results, equipment checks, and review of calculations and associated documentation.

5.2 Test Procedures and Documentation

QC procedures and report forms have been developed, approved, and utilized for reclamation activities associated with Gas Hills disposal cells, i.e., AGTI and A-9. These procedures and report forms (summarized below) will be used in the QC activities. Table 5.0 summarizes previously approved test procedures. Table 5.1 provides a summary of QC forms to be used in documenting QC sampling, testing, and inspection activities. Modification to these procedures and forms (from those previously reviewed and accepted) will be made only to the extent that reflects modification of ASTM standards or enhances/clarifies documentation associated with construction inspection and testing activities.

5.3 Environmental Quality, Health and Radiation Protection

Work will be performed in compliance with statutes, rules and regulations, licenses and permits rendered applicable under Source Material License No. SUA-648. Work will be monitored by the Owner in accordance with the site's Radiation Monitoring Procedures. Applicable procedures will be provided to the successful bidder. Procedures are available for review at Owner's Grand Junction offices prior to bidding.

Reclamation activities at the Gas Hills site are conducted in accordance with Radioactive Materials License SUA-648. This license requires that all equipment, vehicles and materials meet the established release criteria for fixed and removable surface contamination prior to leaving the site restricted area. These release criteria are intended to control the spread of radioactive materials off-site and keep personal exposure to radioactive materials as low as reasonably achievable (ALARA). Radiological scanning procedures are established for this site and will be utilized in execution of project work. These procedures are summarized as follows:

5.3.1 Surveys for Unrestricted Release

All equipment, vehicles and parts leaving the designated site restricted area or other areas identified as containing 11e.(2) materials will be surveyed to confirm the presence or absence of surface contamination. All light vehicles, equipment and parts leaving the designated restricted area or area where 11e.(2) materials are present will be washed to remove all visible soils and materials. The survey will be an alpha, beta/gamma survey, and a removable smear counted for alpha and beta/gamma activity. Release criteria cited in the Source Material License are 5,000-dpm/100cm^2 – Average, 15,000-dpm/cm^2 – Maximum and 1,000-dpm/cm^2 – Removable. If surface activities exceed the established release limits, further decontamination will be required until the release limits can be achieved. These surveys will be conducted by the Umetco's Radiation Safety Officer (RSO) or designated individuals. The surface activity levels for each piece of equipment released for unrestricted use will be documented and signed by the RSO and maintained on file. A copy of the equipment release will accompany all parts, equipment and vehicles not routinely leaving the site.

5.3.2 Surveys for Conditional Release

5.3.2.1 Pre-Entry Surveys

All of the Contractor's equipment used at the Gas Hills site will be subject to being surveyed for beta/gamma and alpha surface contamination prior to entry onto the site. The results of these surveys will be documented and may be reviewed at the Gas Hills site. Any equipment delivered

to the site in a contaminated condition will be reported immediately to the U. S. Nuclear Regulatory Commission (NRC) and the equipment will not be allowed to enter the site.

Any decontamination for entry onto the site will be at the Contractor's expense.

Storage and handling of hazardous materials, including flammable or combustible liquids, shall be in accordance with applicable County, State, Federal Regulations and Owner polices.

Construction activities will be performed using methods that will prevent entrance or accidental spillage of hazardous or contaminated liquids into nearby gullies or washes.

During construction, care shall be taken by the Contractor to preserve the natural landscape and prevent any unnecessary destruction, scarring or defacing of the natural surroundings in the vicinity of the work.

Best Management Practices (BMPs) will be used to prevent sediment from being transported off-site due to storm water runoff. BMPs include, but are not limited to, such sediment control practices as interceptor dikes/ditches, filter fences, straw bales, temporary sediment basins, check dams or methods approved by the Owner's project representative.

Reasonable and practical efforts will be made to operate construction equipment in a manner that minimizes emissions of air contaminates. Fugitive dust from unpaved haul roads, construction activities and other areas of heavy vehicle use will be controlled by watering, vehicle speed and/or dust suppression agents approved by Owner. If, during times of dry conditions and/or high wind, the release of fugitive dust becomes uncontrollable, Owner or Owner's representative may request that the Contractor temporarily suspend construction activities until dust releases can be controlled or atmospheric conditions improve. No compensation for the suspension of Work to comply with air quality requirements due to atmospheric conditions or excessive dust releases will be made.

Table 5.0 Summary of QC Test Procedures

Procedure No.	QC Procedure Title
QC GHP - 1	Field Inspections
QC GHP - 2	Sampling of Aggregates and Soils
QC GHP - 3	Field Description of Soils
QC GHP - 4	Particle Size Analysis
QC GHP - 5	Size Analysis of Soil Finer Than No. 200 Sieve
QC GHP - 6	Moisture Content of Soils
QC GHP - 7	Atterberg Tests
QC GHP - 8	Soil Classification for Engineering Purposes
QC GHP - 9	Laboratory Compaction Test
QC GHP - 10	In-Place Density Tests
QC GHP - 11	Compacted Soil Layer Thickness
QC GHP - 12	Particle Size Analysis of Natural and Man-Made Riprap Materials
QC GHP - 13	Rock Protection Layer Thickness

Table 5.1 Summary of QC Test and Inspection Forms

Form No.	QC Form Title
F-1	Construction Activities Report
F-2	Soil Sampling Log
F-3	Gradation Analysis Worksheet
F-4	Gradation Analysis with Hydrometer Worksheet
F-5	Gradation Test Results
F-6	Moisture & Density Worksheet
F-7	Atterberg Limits 1-Point Worksheet
F-8	Atterberg, -200, Moisture Density Worksheet
F-9	Atterberg Limits 3-Point Worksheet
F-10	Summary of Laboratory Tests
F-11	Field Density (Sand Cone, Balloon)
F-12	Laboratory Compaction Test
F-13	Rock and Moisture Correction Calculations
F-14	Moisture-Density Relationships - 1
F-15	Moisture-Density Relationships - 2
F-16	Nuclear Test Data
F-17	Grouting Logs
F-18	Compliance Report
F-19	Field Change Order
F-20	Design Change Order

5.4 Test Frequencies

The minimum test frequencies performed as part of the QC program are detailed below in Table 5.2.

Table 5.2 Minimum Test Frequencies

Test	Procedure	Standard	Frequency
Radon Barrier, Frost Protection Layer and Erosion Protection			
Field Moisture and Density	QC GHP - 10	ASTM D2922 ASTM D3017	1 test per 500 CY
Sand Cone Correlation	QC GHP - 10	ASTM D1556 ASTM D2216	1 test for every 10 nuclear gauge tests
Laboratory Compaction	QC GHP - 9	ASTM D698	1 test for every 10 field tests depending on variability of soils.
Soil Classification • Particle Size Analysis • Atterberg Limits	QC GHP - 7 QC GHP - 8 QC GHP - 12	ASTM D2487 ASTM D4318 ASTM D1140 ASTM D422	1 test per 1000 CY
Erosion Protection/Bedding Materials • Gradation (Quarry Production) • In-Place Bedding Depth Check and Gradation	QC GHP - 12	 ASTM C117,C136 ASTM C117,C136	 1 test per 10,000 CY 1 set of tests per 500 SF of bedding material placed.
Sub-grade, Random Fill, Grading			
Field Moisture and Density	QC GHP - 10	ASTM D2922 ASTM D3017	1 test per 1000 CY
Sand Cone Correlation	QC GHP - 10	ASTM D1556 ASTM D2216	1 test for every 10 nuclear gauge tests
Laboratory Compaction	QC GHP - 9	ASTM D698	1 test for every 10 field tests depending on variability of soils.
Soil Classification • Particle Size Analysis • Atterberg Limits	QC GHP - 7 QC GHP - 8 QC GHP - 12	ASTM D2487 ASTM D4318 ASTM D1140 ASTM D422	1 test per 2000 CY

Appendix C
2011 Construction Cost Estimate

Summary
Bid Schedule Sheet for Estimated Cost
Quantity Calculation Check Sheets

Summary of
2011 Gas Hills Erosion Protection Enhancement
Construction Estimate

The attached Construction Cost Estimate for the Erosion Protection Enhancements at the Umetco Gas Hills Reclamation site is based on the actual Construction Bid Schedule issued on Umetco's behalf by URS Corp. to Contractors for third party unit price quotes and combines the similar construction activities for the AGTI and A-9 Repository into one comprehensive schedule.

All Lump Sum and Unit Price costs provided in the revised cost estimate are based on the cost of contracting (including profit and overhead) with a third party to complete the reclamation work.

Reclamation Construction Task No. 12 - New Quarry Operations has been added to the Bid Schedule which addresses the need for a new quarry to be developed and the processing of required rock products in the event that the existing Rattlesnake Quarry and rock products stockpiled there are no longer available as first party materials to Umetco.

The estimated unit costs provided in the cost estimate are based on historic costs obtained from Bid Abstracts for third party performance of the same or similar work at the Gas Hills site. The historic costs were increased by a minimum 1.5-percent per year (for eleven-years) to arrive at the costs presented in the estimate and include third party profit and overhead.

Third party Bids for the Erosion Protection Enhancement Project at the Gas Hills Reclamation site are scheduled to be opened on May 27, 2011 and construction activities are scheduled to commence during June of 2011. Therefore, actual real time unit price quotes will be available and will be included in the June 13, 2011 annual update to the surety amount submittal.

As noted, all Lump Sum and Unit Costs are based on the cost of contracting (including profit and overhead) with a third party to complete the reclamation work. However, in the cost estimate a 12-percent oversight rate has been added to provide for construction management and oversight. The 12-perecnt rate is based on URS Corp. personnel and service rates to provide construction management, oversight, quality assurance/quality control, civil surveying and radiological surveying.

Volumes and quantity calculation used in preparing the cost estimate have been verified by and independent third party review/check (URS, Corp.). A copy of the the quantity verification check is included at the end of this Appendix.

A description of the work activities and method of measurement and payment associated with each Reclamation Construction Task follows:

Reclamation Construction Task No. 1 - Mobilization/Demobilization

- Transport Contractor equipment to and from the site.
- Transport and stockpile supplies at the site.
- Establish temporary offices (including a separate office facility for URS' use) and staging area.
- Prepare a Storm Water Pollution Prevention Plan submittal. Construct/install temporary erosion control devices to control storm water from the reclamation site surfaces/out-slopes and Rattlesnake Quarry during all reclamation construction activities in compliance with Umetco's WPDES permits and SWPPPs.
- Install and (subsequently) remove fuel storage facilities and provide and implement an SPCC Plan.
- Identify, locate and protect all utilities in work areas.
- Payment: The Lump Sum bid price for Mobilization/Demobilization shall include all costs associated with mobilization and demobilization of equipment, personnel, fuel, supplies, establishment of temporary offices and other facilities, storm water management, dewatering and incidental items, including acquisition of necessary permits, adherence to all regulations described in this section, profit, overhead and any and all related costs required to make the Work complete.

  In addition, demobilization shall include costs associated with radiological scanning, and removal of all Contractor's facilities and equipment as well as cleaning areas used/disturbed by the Contractor to the satisfaction of Umetco/URS.

Reclamation Construction Task No. 2 - Construction Water

- Inspect existing appurtenances (Process Water Well 6, aka "Deep Well" and existing HDPE/thin metal 6-inch diameter pipeline) and prepare a refurbishment/water delivery plan submittal. The Contractor may elect to refurbish the existing well (bypass the pipeline) and haul construction water approximately 3 miles from the Process Water Well 6 site to the East Gas Hills site, as long as an adequate quantity of water is readily available and can be reliably supplied when required.
- At a minimum the Contractor will be required to reestablish three-phase electrical service and provide switch gear to the existing 40-hp submersible well pump or provide a three-phase generator set and switch gear.
- Should the pipeline be utilized, an in-line booster pump may be required. If so elected by the Contractor, the Contractor shall provide, install/plumb, energize and maintain the booster pump in the existing pipeline.
- If utilized, the Contractor shall connect existing pump/well to existing pipeline and establish water distribution methods, i.e., storage tanks, water load out chutes, water trucks, etc.
- Measurement and Payment: Measurement and payment for construction water and dust control during construction will be made on a Lump Sum basis and shall include all costs associated with: inspection and preparing a plan; refurbishing existing

appurtenances; furnishing electricity and electrical service; pumps, products and materials; labor; tools; equipment; accessories; backup equipment, maintenance, repairs; profit, overhead and any and all other associated costs required to comply with the Specifications and make the Work complete.

Reclamation Construction Task No. 3 - Establish Access and Haul Routes

- Prepare an access/haul route plan submittal.
- Apply uncontaminated water to maintain access/haul routes and control fugitive dist emissions from the designated/refurbished construction water source (Process Water Well 6).
- Obliterate and reclaim access and haul routes when no longer required.
- Measurement and Payment: Measurement and payment for construction, maintenance and traffic control will be made on a Lump Sum basis and will include all costs associated with: inspection of site conditions, devising/construction of access/haul routes and Traffic Control Plan(s) preparation; storm water erosion control provisions; safety berms; traffic control and signage; products and materials; labor; tools; equipment; accessories; maintenance; repairs; profit, overhead and any and all other associated costs required to comply with the Specifications and make the Work complete.

Reclamation Construction Task No. 4 - Radon Barrier Test Trenches

- Excavate a minimum of two test trenches in rill locations (as directed by Umetco/URS in the field), one each on the AGTI and A-9 Repository. Excavated materials shall be stockpiled for replacement.
- Backfill and replace excavated materials in accordance with the Specifications.
- Measurement and Payment: Measurement for payment for the excavation of test trenches will be in cubic yards for material actually removed. The quantity for payment will be computed by the average end area method from surveys conducted by the Contractor before and after excavation operations and prior to backfilling. No separate measurement for payment will be made for stockpiling excavated materials for reuse or backfill placement of radon and/or frost barrier materials, these items shall be considered incidental to the test trench excavation. Placement of bedding and erosion protection materials shall be measured for payment under Reclamation Construction Task No. 5 – Erosion Protection Enhancement.

  Payment for test trench excavation will be made at the unit price quoted in the Bid Schedule. The price quoted shall include the associated cost of all labor, equipment, scheduling, de-watering excavation, temporary material stockpiling, any loading or transportation, hand excavation/probing, backfill placement and compaction activities required to comply with this Specification, profit, overhead and any and all incidental costs required to make the Work complete.

  Due to uncertainties associated with the final number, size and characteristics of materials removed from the required excavations, URS makes no warranty as to the

final quantities of Work. The combined estimated quantities provided in the Bid Schedule provide an estimated representation of the total magnitude of Work to be performed.

Reclamation Construction Task No. 5 - Erosion Protection Enhancement

- Process 30/70 Blended Bedding material in the Rattlesnake Quarry
- Affect erosion protection enhancements - haul and place bedding materials under/within the existing riprap on the AGTI and A-9 Repository according to two placement methods. Method No. 1 - remove/stockpile existing erosion protection materials in designated areas, place 3-inch minimum layer of Type A bedding and replace stockpiled erosion protection material. Method No. 2 - spread 30/70 bedding material over designated areas and work into the existing riprap layer by Dozer Tractor track walking and smooth drum vibration to form a minimum 4-inch layer of bedding material in the bottom portion of the existing riprap layer.
- Repair rills (associated with placement Method One) in the surface of the Frost Barrier layer (in designated areas), haul and place Type A bedding material to reestablish/match existing Frost Barrier sub-grade.
- Measurement and Payment: Measurement for payment for the following Bid Schedule items will be made for the number of cubic yards of erosion protection materials (bedding material and riprap) processed and/or delivered and placed in the completed Work in accordance with the Specifications. The quantities for payment will be computed by the average end area method and/or areal surveys conducted by the Contractor multiplied by the neat line depths Specified and/or shown on the Construction Drawings, as determined by the URS Representative.

  In addition, measurement for payment for processed 30/70 bedding material will also be made for the number of cubic yards of bedding material processed at the Quarry site in compliance with the Specifications. The processed quantity will be computed from the load factor determined by the Contractor, and agreed upon by URS, and weight tickets. Load factor determinations and/or quantity surveys conducted by the Contractor to verify URS' field measurements will be performed at the Contractor's expense.

  The quantity of erosion protection materials delivered to the site and incorporated in the Work will be compared to weight delivery tickets/records to verify accuracy.

  The following items will be measured for payment:

  Bid Schedule Item No. 5.1 - Process 30/70 Blended Bedding Material;

  Bid Schedule Item No. 5.2 – Transportation and Placement of 30/70 Blended Bedding Material on the AGTI and A-9 Repository;

  Bid Schedule Item No. 5.3 – Transportation and Placement of Type A Bedding Material on the AGTI and A-9 Repository;

  Bid Schedule Item No. 5.4 – Remove and Replace Existing Type C Erosion Protection Riprap on the AGTI and A-9 Repository;

Bid Schedule Item No. 5.5 – Transportation and Placement of 30/70 Blended Bedding Material in the Launch Rock Filter;

Bid Schedule Item No. 5.6 – Transportation and Placement of Type A Bedding Material in the Launch Rock Filter;

Bid Schedule Item No. 5.7 – Transportation and Placement of Type C Erosion Protection Riprap in the Launch Rock Filter;

Bid Schedule Item No. 5.8 – Transportation and Placement of Type A Bedding Material on the Apron Channel;

Bid Schedule Item No. 5.9 – Transportation and Placement of Type C Erosion Protection Riprap on the Apron Channel; and

Bid Schedule Item No. 5.10 – Transportation and Placement of Type C Erosion Protection Riprap to Stabilize Off-Site Erosion Features.

Payment for the Bid Schedule Items cited in Measurement, above, will be made at the unit price quoted in the Bid Schedule for the respective Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, placement and compaction, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 6 - Launch Rock Structure Enhancement

- Excavate U/S and D/S filter trenches and stockpile excavated materials for reuse.
- Haul and place multi-layer filter materials (U/S and D/s of Launch Rock structure).
- Backfill U/S filter and restore slope leading to the Launch Rock Structure and repair sinkholes as required. All backfill to be placed in accordance with these Specifications.
- Measurement and Payment: Measurement for payment of Launch Rock filter materials will be made for the number of cubic yards of filter materials placed in accordance with the Specifications. Measurements will be made to neat line widths and finish grades shown on the Construction Drawings or as modified by URS during execution of the work to include the actual depth of filter materials placed in accordance with the Specifications. The payment quantity will be calculated by the average end area method from URS accepted surveys provided by the Contractor. Measurement and payment for erosion protection material processing, transportation and placement shall be made in accordance with Reclamation Construction Task No. 5 – Erosion Protection Enhancement.

  Payment for the installation of the U/S and D/S Launch Rock filter zones will be made at the unit price quoted in the Bid Schedule for Launch Rock filter trench excavation. The price quoted shall include the associated cost of all labor, equipment, materials, incidental excavation, sub-grade preparation, furnish and install non-woven filter fabric, over burden/excess material relocation/disposal, Earthwork backfill

(excluding the Type C riprap (re)placement), hand work, compaction, profit, overhead and any and all associated costs required to comply with the Specifications and make the Work complete.

Payment for the Bid Schedule Items cited in Reclamation Construction Task No. 5 – Erosion Protection Enhancement - Measurement will be made at the unit price quoted in the Bid Schedule for the respective Launch Rock Filter material Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, special handling placement and compaction, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 7 - Apron Channel Construction

- Establish and maintain access/haul routes to the Apron Channel area located on the southwest edge of the AGTI.
- Prepare Apron Channel sub-grade with compacted on-site random soil fill material.
- Haul and place Erosion protection materials (18 inches of Type C riprap on a 6-inch layer of Type A bedding material).
- Measurement for payment for apron channel construction will be made by the linear foot measured along the length of the centerline alignment of the apron channel completed in accordance with the Specifications. The quantity will be calculated from centerline length surveys, accepted by URS, and performed by the Contractor, irrespective of the amount of backfill required to complete the sub-grade shaping.

Payment will be made at the unit price quoted in the Bid Schedule for apron channel construction. The price quoted shall include the cost of all labor, equipment, clearing and grubbing, sub-grade preparation and backfill, profit, overhead and any and all incidental costs required to make the Work complete in accordance with the Specifications.

Measurement for payment for the transportation and placement of erosion protection materials will be made by the cubic yard for erosion protection materials placed in the completed apron channel in accordance with the Specifications. The quantity will be calculated from cross-sectional and/or areal surveys, accepted by URS, and performed by the Contractor. The respective material quantities will be calculated by average end area method and/or by applying the neat line depth shown on the Construction Drawings and/or Specified herein to the accepted areal survey area(s).

No allowance will be made for over built erosion protection layers.

Payment for the Bid Schedule Items cited in Reclamation Construction Task No. 5 – Erosion Protection Enhancement– Measurement for apron channel erosion protection materials will be made at the unit price quoted in the Bid Schedule for the respective Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, placement and compaction, profit, overhead and any and all incidental

costs required comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 8 - Stabilization of Off-Site Erosion Features

- Erosion features are located in the Rim Pit area (north of the reclamation site), along the groin area between the reclamation cover and natural ground on the southeast side of the Heap Leach structure and near the toe of the northern slope of the AGTI.
- Re-grade/shape/compact erosion feature sub-grade with on-site/existing random soil material.
- Haul and place Erosion Protection materials.
- Measurement for stabilization of off-site erosion features shall be made on a Lump Sum basis for Work completed in accordance with the Specifications, irrespective of the number and location of individual erosion features to be stabilized.

  Payment will be made at the lump sum price quoted in the Bid Schedule for stabilization of off-site erosion features. The lump sum price quoted shall include all labor, equipment, filter fabric products and materials, access/haul routes, sub-grade preparation, proof rolling, profit, overhead and any and all other associated costs required to comply with this Specification and make the Work complete.

  Measurement for payment for the transportation and placement of Type C erosion protection riprap materials used to stabilize off-site erosion features will be made for the number of cubic yards of erosion protection materials placed in accordance with the Specifications. Measurements will be made to neat line widths, depths and finish grades shown on the Construction Drawings or as modified by URS during execution of the work to include the actual depth of erosion protection materials placed. The payment quantity will be calculated by the average end area method from URS accepted surveys provided by the Contractor. Measurement and payment for erosion protection material processing, transportation and placement will be made in accordance with Reclamation Construction Task No. 5 – Erosion Protection Enhancement, of these Specifications.

  Payment for the Bid Schedule Item cited in Reclamation Construction Task No. 5 – Erosion Protection Enhancement – Measurement will be made at the unit price quoted in the Bid Schedule for the material Item associated with the stabilization of off-site erosion features. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations, quality control testing, load out, load weight determinations, transportation, special handling placement and compaction, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

Reclamation Construction Task No. 9 - Well Abandonment

- Abandonment of three existing (permitted) wells within the site boundary by a Wyoming licensed Well Driller. The wells are shown on the Construction Drawings

and are designated as the A-8 Pit Well, the Aljob 2 Well (aka the Domestic Well) and the PW4 monitoring well.

- Abandon two existing line marker/leak detection wells along the County Road on the north side of the site utilizing simple Bentonite/sand/cement backfill materials.
- Measurement and Payment: Measurement for payment for abandoning ground water wells will be made in linear feet for every foot of well depth abandoned in accordance with the Specifications. Depth measurements shall be made by the Contractor and accepted by URS.

  Payment for abandoning ground water wells will be made by the unit price per foot quoted in the Bid Schedule. The price quoted shall include the cost all equipment, labor, materials, drill rig set up and tear down, grout mixture preparation, pressure grouting, individual well site cleanup and disposal of debris and any and all incidental costs required to comply with the Specifications and to make the Work complete.

  Measurement for payment for abandoning line marker wells will be made for each well installation abandoned in accordance with the Specifications. The Contractor and URS will agree upon the number of line marker wells.

  Payment for abandoning ground water wells will be made by the unit price each quoted in the Bid Schedule. The price quoted shall include the cost all equipment, labor, materials, introduction of bentonite chips, water mixture preparation, individual well site cleanup and disposal of debris, profit, overhead and any and all incidental costs required to comply with the Specifications and to make the Work complete.

Reclamation Construction Task No. 10 - Fencing

- Remove/realign/replace existing site security fencing as determined necessary by field operations to accommodate new Work (Apron Channel) and facilitate access to the various Work areas.
- Furnish and install temporary fencing as may be required to maintain site security and to prevent livestock from entering the site.
- Extend to include the wetland area located on the east side of the AGTI.
- Measurement and Payment: No separate measurement for payment for removing, disposing, and/or reestablishing security fencing during construction will be made. The cost for removing and reestablishing existing fencing systems during execution of the Work, including dismantling, disposal, salvage of reusable materials, establishing temporary fencing, daily inspection and maintenance and repairs shall be considered incidental to applicable items of the Work.

  Measurement to furnish new materials or obtain materials from salvage stockpiles and install permanent barbed wire fencing will be made by the linear foot of fence installed in accordance with the Specifications. Measurements will be made, by the Contractor, along the top of the completed and accepted fence to the nearest foot and shall include the installation of salvaged gates. No allowance will be made for the installation of gates by and for the Contractor's convenience and left in the completed Work.

Payment to furnish and install permanent barbed wire fencing will be made at the unit price quoted in the Bid Schedule. The unit price shall include cost for furnishing all labor, materials, tools, equipment, and accessories including preparation of the ground surface along the alignment of new fence lines, maintenance, profit, overhead and any and all incidental activities required to make the Work complete.

Reclamation Construction Task No. 11 - Site Reclamation

- Obliterate haul/access roads and provide re-grading/shaping as required to restore the site to previous/existing contours.
- Prepare the seedbed, fertilize/amend, seed and mulch all disturbed areas.
- Stabilize/re-grade/shape the Rattlesnake Quarry to provide stable contours and prevent/reduce erosion.
- Measurement for payment for site reclamation shall be made by surface acres of disturbed areas actually seeded and accepted. Quantities shall be computed from areal surveys conducted by the Contractor and accepted by URS of disturbed areas reclaimed in accordance with the Specifications. No measurement for payment will be made for reseeding and/or fertilizer replacement due to wash-outs, erosion or storm damage occurring prior to final acceptance.

  Payment will be made at the unit price quoted in the Bid Schedule for site reclamation. The price quoted shall include full compensation for furnishing all materials, labor, tools, equipment, grading and shaping, seedbed preparation, soil amendment application/incorporation, ALM and fertilizer materials and application, furnishing seed and seeding, product certifications, reseeding and/or replacement of lost or eroded fertilizer materials, maintenance, profit, overhead and any and all incidental costs required to make the Work complete.

Reclamation Construction Task No. 12 - New Quarry Operations

- Control storm water runoff and erosion from the Quarry site surface and out-slopes during all quarry construction and reclamation activities in compliance with applicable Wyoming Department of Environmental Quality mining permits and storm water plans.
- Prepare a Quarry Operation Plan submittal to site, permit and develop a new Quarry, conduct quarry operations as may be required (blast/crush/screen/stockpile) to produce the quantity of Type A, Type B and Type C rock materials cited in the Bid Schedule. The Quarry Operation Plan shall also address the load-out, measurement (weighting) and delivery of all required rock products.
- Implement the acceptable Quarry Operation Plan.
- Establish and maintain access/haul routes within and exiting the Quarry, to include fugitive dust suppression.
- Re-grade/shape disturbed Quarry surfaces/topography to prevent/reduce erosion.
- Measurement for payment for the following Bid Schedule items will be made for the number of cubic yards of erosion protection materials (bedding material and riprap) processed and stockpiled at the newly developed quarry in accordance with the

Specifications. The quantities for payment will be computed by load factor weight determinations and/or quantity surveys conducted by the Contractor of stockpiled material.

The following items will be measured for payment:

- Bid Schedule Item No. 12.1 – Process and stockpile Type A Bedding Material;
- Bid Schedule Item No. 12.2 – Process and stockpile Type B Bedding Material; and
- Bid Schedule Item No. 12.3 – Process and stockpile Type C Bedding Material.

Payment for the Bid Schedule Items cited in Measurement, above, will be made at the unit price quoted in the Bid Schedule for the respective Items. The price quoted shall include the associated cost of all labor, equipment, all Quarry operations (including site location and permitting), quality control testing, load factor weight determinations, blasting, crushing, screening, profit, overhead and any and all incidental costs required to comply with the Specifications and make the Work complete. No additional allowance will be made for temporary stockpiling, loss of materials, overbuilding, or mishandling of materials.

The Bid Schedule and Cost Estimate for the 2011 reclamation construction activities at the Gas Hills site is provided on the next pages.

Bid Schedule Sheet
for
East Gas Hills, WY, Erosion Protection Enhancement Project
NRC Cost Estimate, May 9, 2011

Item	Reclamation Construction Task	Quantity	Unit	Unit Price	Construction Oversight (12%)	Unit Cost w/Oversight	Amount in U. S. dollars
1	Mobilization / Demobilization	1	Lump Sum	$100,000.00	$12,000.00	$112,000.00	$112,000.00
2	Construction Water System and Dust Control During Construction	1	Lump Sum	$25,000.00	$3,000.00	$28,000.00	$28,000.00
3	Establish Access and Haul Routes	1	Lump Sum	$25,000.00	$3,000.00	$28,000.00	$28,000.00
4	Radon Barrier Test Trenches	425	Cubic Yards	$20.00	$2.40	$22.40	$9,520.00
5	Erosion Protection Enhancement						
5.1	Process 30/70 Blended Bedding Material	18,800	Cubic Yards	$7.50	$0.90	$8.40	$157,920.00
5.2	Transportation and Placement of 30/70 Blended Bedding Material on the AGTI and A-9 Repository	17,875	Cubic Yards	$10.00	$1.20	$11.20	$200,200.00
5.3	Transportation and Placement of Type A Bedding Material on the AGTI and A-9 Repository	15,100	Cubic Yards	$10.00	$1.20	$11.20	$169,120.00
5.4	Remove and Replace Existing Type C Erosion Protection Riprap on the AGTI and A-9 Repository	56,850	Cubic Yards	$10.00	$1.20	$11.20	$636,720.00
5.5	Transportation and Placement of 30/70 Blended Bedding Material in the Launch Rock Filter	910	Cubic Yards	$15.00	$1.80	$16.80	$15,288.00
5.6	Transportation and Placement of Type A Bedding Material in the Launch Rock Filter	2,010	Cubic Yards	$15.00	$1.80	$16.80	$33,768.00
5.7	Transportation and Placement of Type C Erosion Protection Riprap in the Launch Rock Filter	1,700	Cubic Yards	$15.00	$1.80	$16.80	$28,560.00
5.8	Transportation and Placement of Type A Bedding Material on the Apron Channel	800	Cubic Yards	$10.00	$1.20	$11.20	$8,960.00

Item	Reclamation Construction Task	Quantity	Unit	Unit Price	Construction Oversight (12%)	Unit Cost w/Oversight	Amount in U. S. dollars
5.9	Transportation and Placement of Type C Erosion Protection Riprap on the Apron Channel	2,150	Cubic Yards	$10.00	$1.20	$11.20	$24,080.00
5.10	Transportation and Placement of Type C Erosion Protection Riprap to Stabilize Off-Site Erosion Features	500	Cubic Yards	$10.00	$1.20	$11.20	$5,600.00
6	Launch Rock Filter Trench Excavation	3,700	Cubic Yards	$8.00	$0.96	$8.96	$33,152.00
7	Apron Channel Construction	300	Linear Feet	$41.00	$4.92	$45.92	$13,776.00
8	Stabilization of Off-Site Erosion Features	1	Lump Sum				
9	Well Abandonment						
9.1	Ground Water Well Abandonment	986	Linear Feet	$50.00	$6.00	$56.00	$55,216.00
9.2	Line Marker Well Abandonment	2	Each	$2,500.00	$300.00	$2,800.00	$5,600.00
10	Fencing	3,500	Linear Feet	$12.00	$1.44	$13.44	$47,040.00
11	Site Reclamation	10.5	Acres	$2,400.00	$288.00	$2,688.00	$28,224.00
12	New Quarry Operations						
12.1	Process and Stockpile Type A Bedding Material	15,100	Cubic Yards	$20.88	$2.51	$23.39	$353,122.56
12.2	Process and Stockpile Type B Bedding Material	17,875	Cubic Yards	$21.43	$2.57	$24.00	$429,028.60
12.3	Process and Stockpile Type C Rock Material	4,350	Cubic Yards	$18.10	$2.17	$20.27	$88,183.20
					Sub-Total		$2,511,078.36
					15% Contingency		$376,661.75
					Total:		**$2,887,740.11**

A. **QUANTITIES:** It is to be understood that the estimated quantities (where applicable) of each item set forth on this Bid Sheet are approximate only and are subject to revision based on actual measured quantities.

B. **BIDDER'S SOLE RESPONSIBILITY:** The undersigned has checked the foregoing figures inserted by him and understands that they are the Bidder's sole responsibility and that URS will not be responsible for any errors or omissions on the part of undersigned in preparing this Bid.

C. **T&M RATE SCHEDULE:** The Bidder shall provide a standard time and materials rate schedule as an attachment to this Bid Sheet that includes labor and equipment rates for use if additional work is requested. The rate schedule shall include fully burdended labor rates, equipment rates (fully fueled and maintained, not including operator), standby equipment rates, and markup for materials.

D. **COMPENSATION**: In every case the Unit Price/Unit Cost shall be applied to the applicable Unit cited in the Bid Schedule and all costs and reimbersements are understood to to be made in U. S. dollars.

URS CALCULATION COVER SHEET Quality

Project Name:	East Gas Hills Reclamation Project	**Project Number:**	41568996
Project Location:	Gas Hills, Wyoming	**Client Name:**	Umetco Minerals Corporation
PM Name:	Karen Maestas, PE	**PIC Name:**	

IDENTIFYING INFORMATION

(This section is to be completed by the Originator.)

Calculation Medium: ☒ Electronic — File Name: East Gas Hills Reclamation Project

(Select as appropriate) ☐ Hard-copy — Unique Identification:

Number of pages *(including cover sheet)*: 28

Discipline: Engineering Drawings and Quantities

Title of Calculation: Drawings and Quantities for Bid Documents and Construction

Calculation Originator: James H Heck

Calculation Contributors:

Calculation Checker: Rodger W Quinn

DESCRIPTION/PURPOSE

Drawings and Quantities for Bid Documents and Construction

BASIS//REFERENCE//ASSUMPTIONS

East Gas Hills Reclamation Project, quantities and areas checked using AutoCAD

ISSUE//REVISION RECORD

Checker comments, if any, provided on: ☐ hard-copy ☒ electronic file ☐ Form 3-5 (MM)

No.	Description	P	S	F	Originator Initials	Date	Checker Initials	Date
0	Initial Issue	☐	☐	☒	JHH	2/11	RWQ	4/11
1		☐	☐	☐	[ ]	[ ]	[ ]	[ ]
2		☐	☐	☐	[ ]	[ ]	[ ]	[ ]
3		☐	☐	☐	[ ]	[ ]	[ ]	[ ]

Note: For a given Revision No. Check off either P (Preliminary), S (Superseding) or F (Final). If there are no revisions to the Initial Issue check off F (Final). Comments may be provided on the hard-copy calculations, electronic file or on Form 3-5 (MM).

APPROVAL and DISTRIBUTION

☒ The calculations associated with this Cover Sheet have been checked.

Originator Signature — Date: 4/13/11

Checker Signature — Date: 4/13/2011

Project Manager Signature — Date

Distribution:

Project Central File – Quality file folder

Other Specify: ____

URS

DATE 3/29/2011
PROJECT NO. EGH Reclamation Project
PAGE NO. 1 OF 4 BY RWQ

Summary Bedding Mtl. Required

5.1/5.2 30/70 Blend.

AGTI = 13,272 cy — 10% Loss @ Quarry + 10% overbuild = 16,526 cy

A-9 = 3,039 cy — " " = 3,647 cy

LR Upper = 440 cy — " " = 528 cy

LR Lower = 468 cy — " " = 562 cy

17,719 cy 19,491 cy (19500) RWQ 24,263 cy
Del. Amt. Process Qty

USE Revised 4/1/11 AGTI/A-9 16,811 cy Del Amt
USE Revised 4/1/11 LR/908 cy Del. Amt
Revised 4/1/11 17,719 cy (17,750 cy process)

Use

Revised 4/21/11
Add 1,043 cy
= 18,793 cy Round to
18,800 cy

5.3/5.6 Type A Bedding

AGTI = 11,568 cy —
A-9 = 3,529 cy — } 15,097 cy Trans/place (5.3)

LR Upper = 293 cy —
LR Lower = 1,730 cy — } Trans/place (5.6) 2,023 cy

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SUMMARY BEDDING MTL / RIPRAP REQD

5.7 / TYPE C RIPRAP

LR UPPER = 295 cy
LR LOWER = 1,378 cy
} Trans/plan (5.7) 1673cy

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Summary
Launch Rock Structure
Excavation Filter Trench

6.0 Upper Trench = 2,871 c.y
Lower Trench = 820 c.y
3691 c.y

7.0 Apron Channel Construction
Shape/cut/Fill Lump Sum
Length of Area 300 ft

5.4 Remove/Replace Type C Riprap
(Includes A9 Type B)

AGT1 46,270 c.y
A9 13,454 c.y Remove Roads (Plated)
~~59,724~~ c.y TOTAL

4 AGT1 46,270 c.y
10,569 c.y
56,839 c.y Revised
Round to 56,850 c.y

Revised 4/4/2011
Add 2085 c.y (Type B) = 58,935 c.y
(Round 58,950 c.y) USE

5.8/5.9 Apron Channel Riprap/Bedding

Type A Bedding = 800 c.y.

Type C Riprap = 2,140 c.y.

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PAGE NO. 4 OF 4 BY Rwf

Summary

10/ Fencing and Site Reclamation (seeding)

Total Fence for EGH 3,500 ft

Site Reclamation (seeding)

EGH site = 9.68 acres
Rim Pit Area = 0.81 acres
10.49

Total 10.5 acres

4/ Radon Barrier Test Trenches

AGTI cut/fill 262 cy
A-9 cut/fill 153 cy
415 cy Round to 425 cy (AGTI Depth might be 1-ft deeper)

5,10/8 Transport Type C OFF-site Erosion Repair
Stabilize OFF-sit Erosion Features

Rim Pit
Upper Fill 190 cy
Lower Fill 124 cy

AGTI Blowouts 140 cy

HL Fill 24 cy

Total 478 cy Type C Riprap

Round to 500 cy Type C Riprap

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AGTI Qty's Riprap Bedding

5.1, Process / Place 30/70 Blend Bedding Material
5.2 Average Slope @ 10:1

AGTI AREAS CHECKED BY AutoCAD

①	106,743 sf	slope Corrected	= 107,276 sf
②	171,354 sf	"	= 172,209 sf
③	269,090 sf.	"	= 270,433 sf.
④	268,022 sf	"	= 269,359 sf.
⑤	239,118 sf	"	= 240,311 sf
⑥	232,428 sf.	"	= 233,588 sf.
⑦	193,197 sf	"	= 194,161 sf.

Total s.f. = 1,487,337 sf. AGTI
placed @ 3" THick = 13,772 c.y. TOTAL Blend

5.3 Type A Bedding

⑧	1,879,237 sf.	slope Corrected	= 1,888,614 sf.
⑨	110,650 sf.	"	= 111,202 sf.
⑩	822,223 sf	"	= 826,326 sf.
⑪	85,393 sf (NATE)	"	= 85,815 sf.

NOTE: AREA ⑧ has Bedding @ 5:1 slope
Used 10:1 to use to subtract
from total Area.

Qty's
AREA ⑧ "Haul Roads" 1,888,614 sf (-) 1,487,337 sf = 401,277 sf
" ⑨ = 111,202 sf.
" ⑩ EAST side (-) minus Area 11 (has Bedding) = 736,830 s.f.
822,223 (-) 85,393

TOTAL s.f. = 1,249,309 sf. AGTI
placed @ 3" THick = 11,568 c.y. TOTAL Type A

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AGT1

5.4 Remove/Replace Type C Riprap

Type C @ 12" (Neat Line)

AGT1

AREAS (slope corr)
9 = 111,202 sf
10 = 736,830 sf
8(RM) = 401,277 sf

1,249,309 sf

Neat Line @ 12" = 1,249,309 cf = 46,270 cy. AGT1 Remove/Place

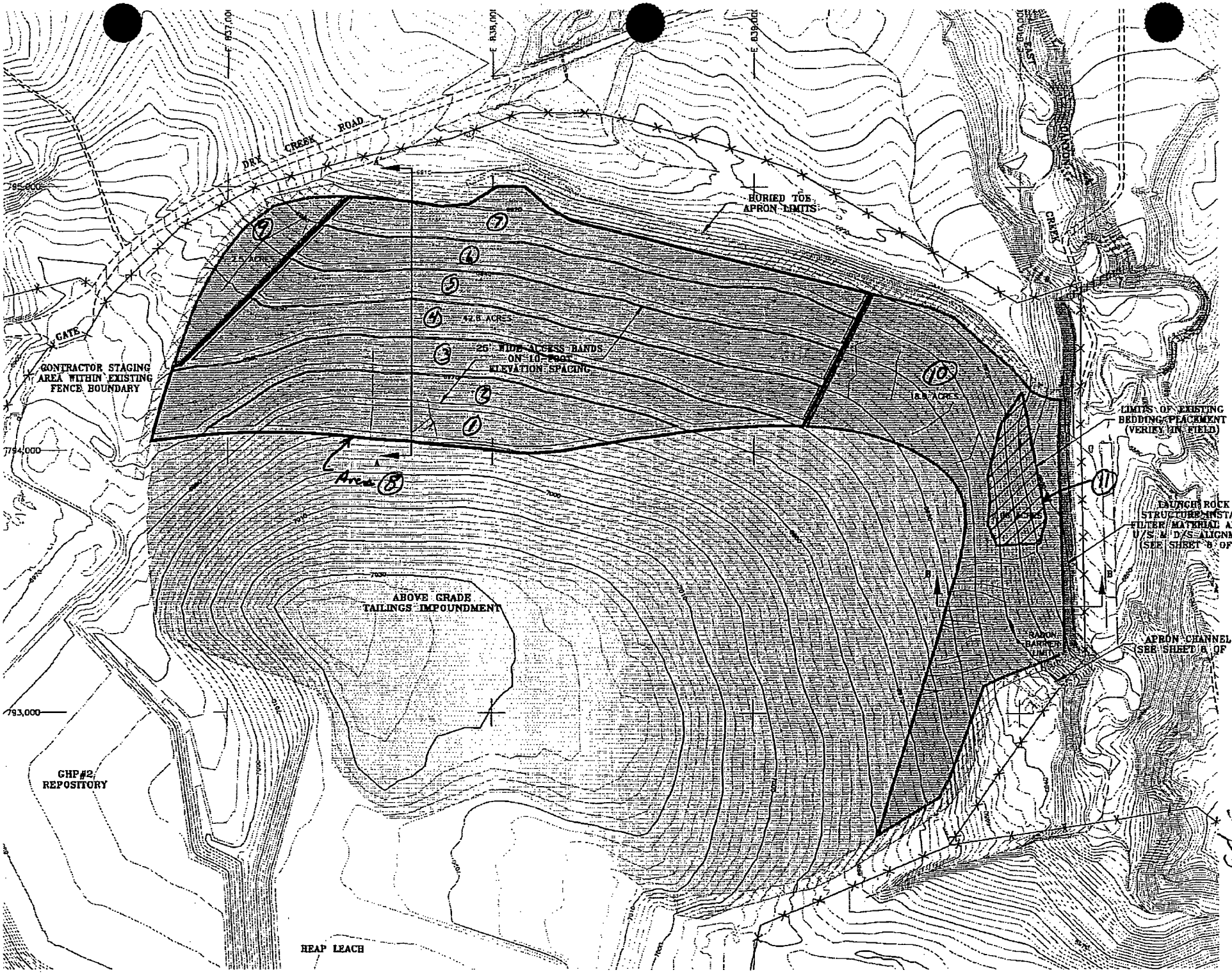
A9

AREAS (slope) Corrected
3 = 259,415 sf
4 = 25,955 sf
~~5 = 69,788 sf Roads~~ plus top Riprap (RWP 4-1-2011)

~~355,158 sf~~ RWP
285,370 sf RWP

Neat Line @ 12" = ~~355,158~~ 285,370 cf = ~~13,154~~ 10,569 cy A-9 Remove/Place

TOTAL ~~59,424~~ cy Remove/Replace
RWP 56,839 cy
4/1/2011 Round to 56,850 cy RWP


E 837,000
E 838,000
E 839,000
E 840,000
DRY CREEK ROAD
HURIED TOE APRON LIMITS
GATE
CONTRACTOR STAGING AREA WITHIN EXISTING FENCE BOUNDARY
25' WIDE ACCESS BANDS ON 10' FOOT ELEVATION SPACING
42.8 ACRES
7.5 ACRES
8.8 ACRES
LIMITS OF EXISTING BEDDING PLACEMENT (VERIFY IN FIELD)
LAUNCH ROCK STRUCTURE INSTALL FILTER MATERIAL ALONG U/S & D/S ALIGNMENT (SEE SHEET 8 OF 8)
APRON CHANNEL (SEE SHEET 8 OF 8)
ABOVE GRADE TAILINGS IMPOUNDMENT
GHP#2 REPOSITORY
HEAP LEACH
795,000
794,000
793,000
Area 8
1
2
3
4
5
6
7
8
9
10
11

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AGT1
Launch Rock Structure

UPSTREAM FILTER

Qtys Checked using AutoCAD

TOTAL LENGTH UPSTM FILTER = 1000 ft

6.0 EXCAVATE EXISTING SOIL (Frost Protection)
AREA 1) DWN TO BOTTOM L.R. = 68.49 sf.
AREA 2) 1'-0" Below L.R Elev. = 9.03 sf.
= 77.52 sf.
@ 1000 ft = 77,520 cf.
= 2,871 cy EXCAVATION

TYPE C RIPRAP
Area = 7.96 sf
@ 1000 ft = 7,960 cf.
= 295 cy Type C

TYPE A RIPRAP
Area = 7.91 sf.
@ 1000 ft = 7,910 cf.
= 293 cy Type A

30/70 BLEND
Area = 11.88 sf.
@ 1000 ft = 11,880 cf.
= 440 cy 30/70 BLEND

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AGT1

Launch Rock Structure

Downstream Filter

Qtys checked using AutoCAD

TOTAL Length Dwnstm FILTER = 1,325 ft.

Type A Riprap

Area 1) = 14.54 sf

Area 2) = 20.70 sf.

= 35.24 sf @ 1,325 L.f. = 46,693 cf.

= 1,730 cy Type A

30/70 Blend

Area = 9.53 sf

@ 1325 L.f = 12,628 cf.

= 468 cy 30/70 Blend.

Type C Riprap

Area = 28.07 sf

@ 1325 L.f = 37,193 cf

= 1,378 cy Type C

6.0 Excavation

Area = 16.7 sf.

@ 1325 L.f. = 22,128 cf.

= 820 cy.

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A-9 Qty's Riprap Bedding

5.1/5.2 Process/Place 30/70 Blend Bedding Material

A-9 Areas Checked By AutoCAD

1 99,475 sf. slope corrected = 103,951 sf.
2 214,578 sf. " = 224,233 sf.
corrected to 12:5:1 slope (1.04499)

TOTAS s.f. = 328,184 sf. A-9
placed @ 3" THICK = 3,039 cy. TOTAL Blend

5.3 Type A Bedding
Area 3 uses 7.5:1 slope corr. (1.000885)

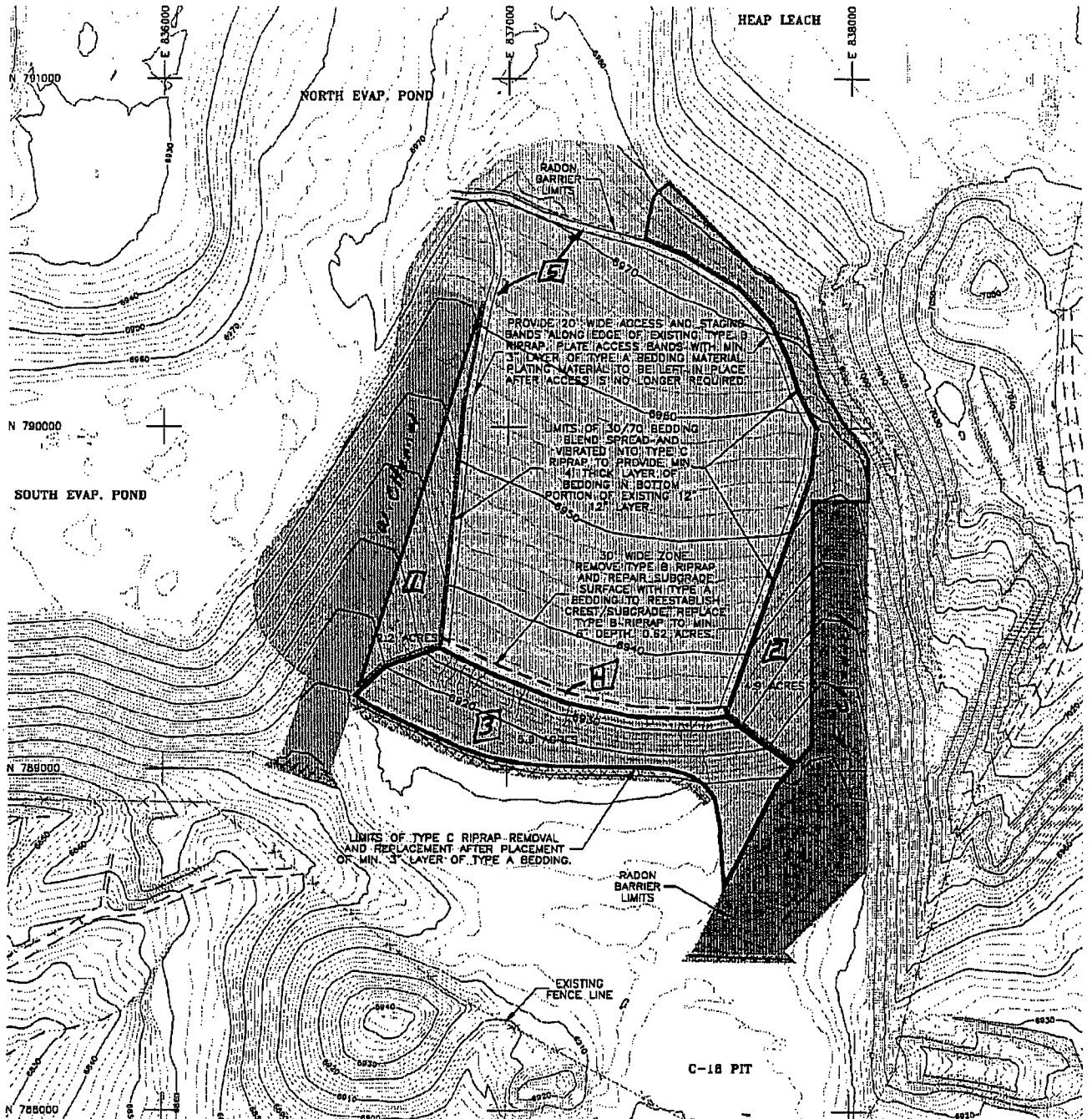
3 257,139 sf slopes corrected = 259,415 sf.
placed @ 3" Thick = 2,402 cy

Crest
4 25,955 sf = 25,955 sf
No slope correction
placed @ 6" Thick = 481 cy

Haul Roads
5 69,798 sf. = 69,788 sf.
no slope corr.
placed @ 3" Thick = 646 c.y.

A-9
TOTAL TYPE A Required 3,529 cy

A-9 Rock
20.E



A-9 REPOSITORY
RILL REPAIR PLAN

E. Channel (w. slope) = 12.5:1 slope
W. Channel (E. slope)

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5.8/5.9 Apron Channel

Qtys Checked using AutoCAD

AREA 1
Slope 15:1
18" Layer Type C Riprap
6" Layer Type A Bedding

Area 1 = 11,457 sf slope corrected = 11,483 sf

Type C @ 18" = 17,225 cf = 638 cy Type C

Type A @ 6" = 8,613 cf = 319 cy Type A

AREA 2
Slope 5.88
18" Layer Type C Riprap
6" Layer Type A Bedding

Area 2 = 14,248 sf slope corrected = 14,453 sf

Type C @ 18" = 21,680 cf = 803 cy Type C

Type A @ 6" = 7,227 cf = 268 cy Type A

AREA 3 (Buried Apron-Approach)
5:1 slope
18" Layer Type C Riprap
6" Layer Type A Bedding

Area 3 = 5,733 sf slope corrected = 5,847 sf

Type C @ 18" = 8,771 cf = 325 cy Type C

Type A @ 6" = 2,924 cf = 109 cy Type A

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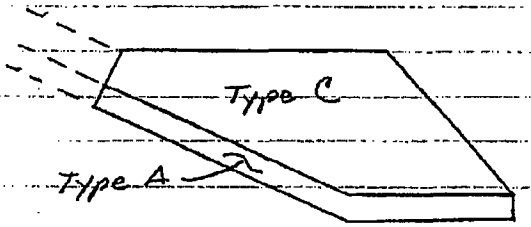
5.8/5.9 Apron Channel

Area 4

Cross-section Area = Type C = 49.1 sf Length = 115 ft
Type A = 11.6 sf

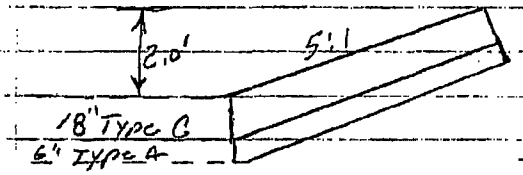


Type C @ 115 = 5,647 cf = 210 cy Type C

Type A @ 115 = 1,334 cf = 50 cy Type A

AREA 5

Cross Section AREA = Type C = 15.5 sf Length (slope length)
Type A = 5.3 sf 90 ft + 179 ft + 9 ft = 278 ft



Type C @ 278' = 4,309 cf = 160 cy Type C

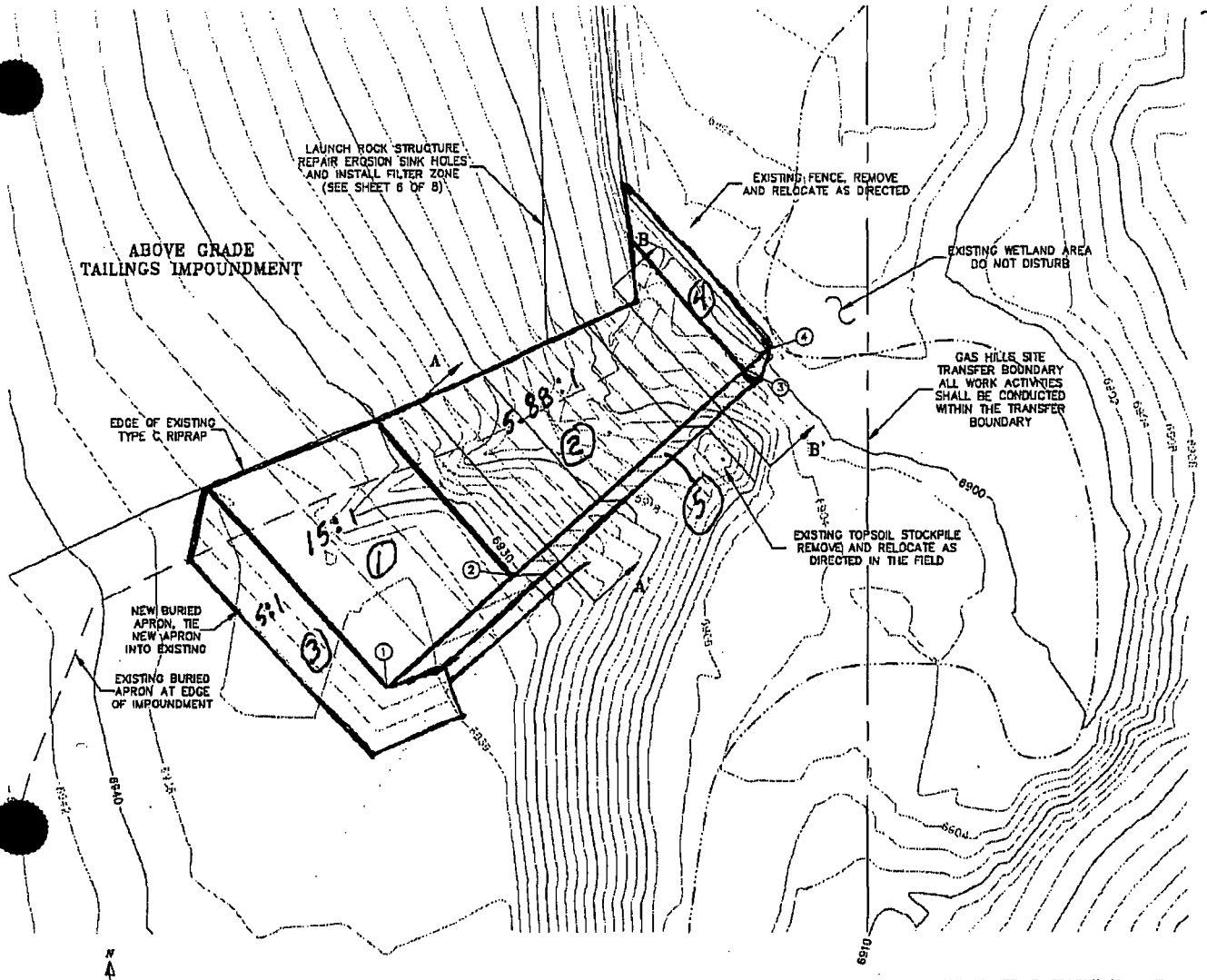
Type A @ 278' = 1,474 cf 55 cy Type A

TOTAL Type C for Apron Channel
638 + 803 + 325 + 210 + 160 = 2,136 cy

TOTAL Type A for Apron Channel
319 + 268 + 109 + 50 + 55 = 801 cy

Apron Channel
5.8/5.9

3/3



EXISTING 12" LAYER TYPE C RIPRAP C TAILINGS PILE

EXIS
TAIL

APRON CHANNEL PLAN

SCALE: 1" = 40'

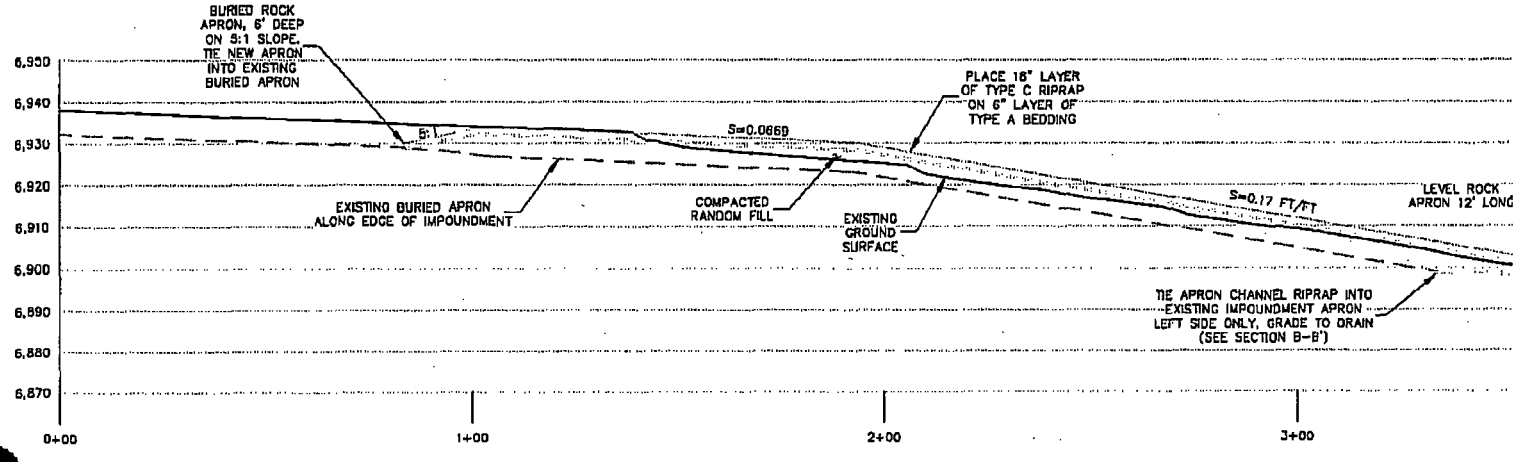
CHANNEL LAYOUT TABLE

POINT	NORTHING	EASTING	ELEV.
1	793,048.80	840,081.09	6,936.00
2	793,108.47	840,146.12	6,930.00
3	793,217.97	840,271.15	6,902.00
4	793,225.89	840,279.83	6,902.00

40 0 40

SCALE IN FEET

CONTOUR INTERVAL : 2'



APRON CHANNEL PROFILE

SCALE: 1" = 20'

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10/ Fencing

Remove/Replace Fence on East side
Launch Rock Structure and Apron Channel

check by AutoCAD

1750 feet

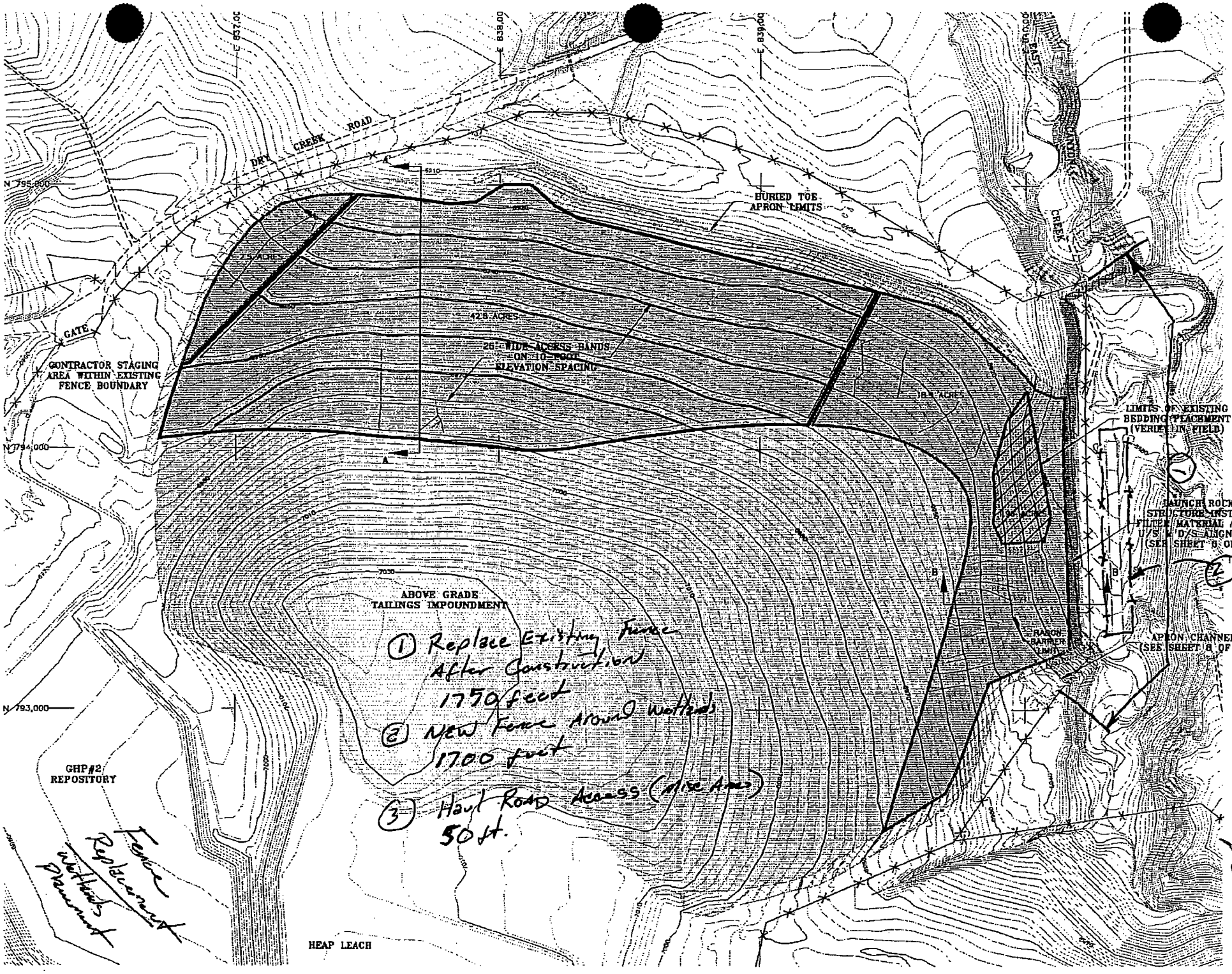
Gate Opening North side
of the AGTL

50 feet

Install fence Around Wetlands
install a 12ft. wire Gate.

1700 feet

Total Fence 3500-feet


DRY CREEK ROAD
HURIED TOE APRON LIMITS
GATE
CONTRACTOR STAGING AREA WITHIN EXISTING FENCE BOUNDARY
42.8 ACRES
26' WIDE ACCESS BANDS ON 10-FOOT ELEVATION SPACING
18.5 ACRES
LIMITS OF EXISTING BEDDING PLACEMENT (VERIFY IN FIELD)
LAUNCH ROCK SIZE TO BE INSTALL FILTER MATERIAL ALONG U/S & D/S ALIGNMENT (SEE SHEET 8 OF 8)
APRON CHANNEL (SEE SHEET 8 OF 8)
RADON BARRIER LIMITS
ABOVE GRADE TAILINGS IMPOUNDMENT
GHP#2 REPOSITORY
HEAP LEACH
N 795,000
N 794,000
N 793,000
E 837.00
E 838.00
E 839.00
EAST
CANYON CREEK
A
B
1 Replace Existing Fence After Construction 1750 feet
2 New Fence Around Wetlands 1700 feet
3 Haul Road Access (Use Apron) 50 ft.
Fence Replacement with Bedding Placement
Fencing 2 of 2

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Site Reclamation

10/

Areas Checked using AutoCAD

A-9 Access/Haul Road
30-ft wide Area = 83,313 sf = 1.91 AC

AGTI Access/Haul Road ①
30-ft wide Area = 29,662 sf = 0.68 AC

AGTI Access/Haul Road ②
30-ft wide Area = 4,846 sf = 0.11 AC

ECC Haul Road (Limit Access) short term
15-ft wide Area = 36,072 sf = 0.83 AC

ECC - LR Bedding / Approach Channel
Area = 137,185 sf = 3.15 AC

Staging Area (Limit to ≈ 3 AC)
Area = 130,615 sf = 3.0 AC

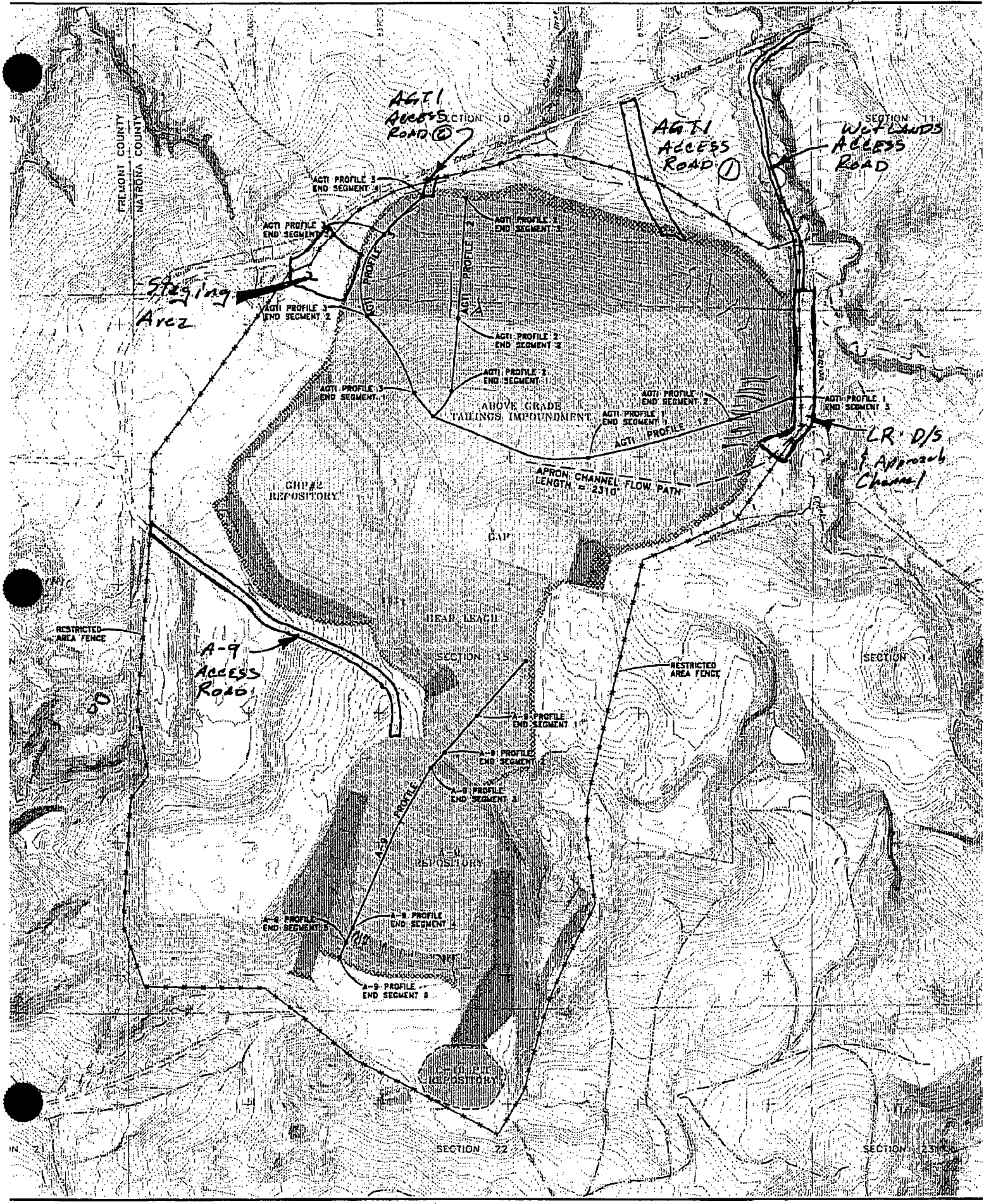
EGH SITE TOTAL = 9.68 ACRES

Rim Pit = 0.81 Acres

10.49

TOTAL 10.5 Acres

Site Rec
2 of 4



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10/ Rim Reclamation

Site Reclamation Areas

chkd by using AutoCAD

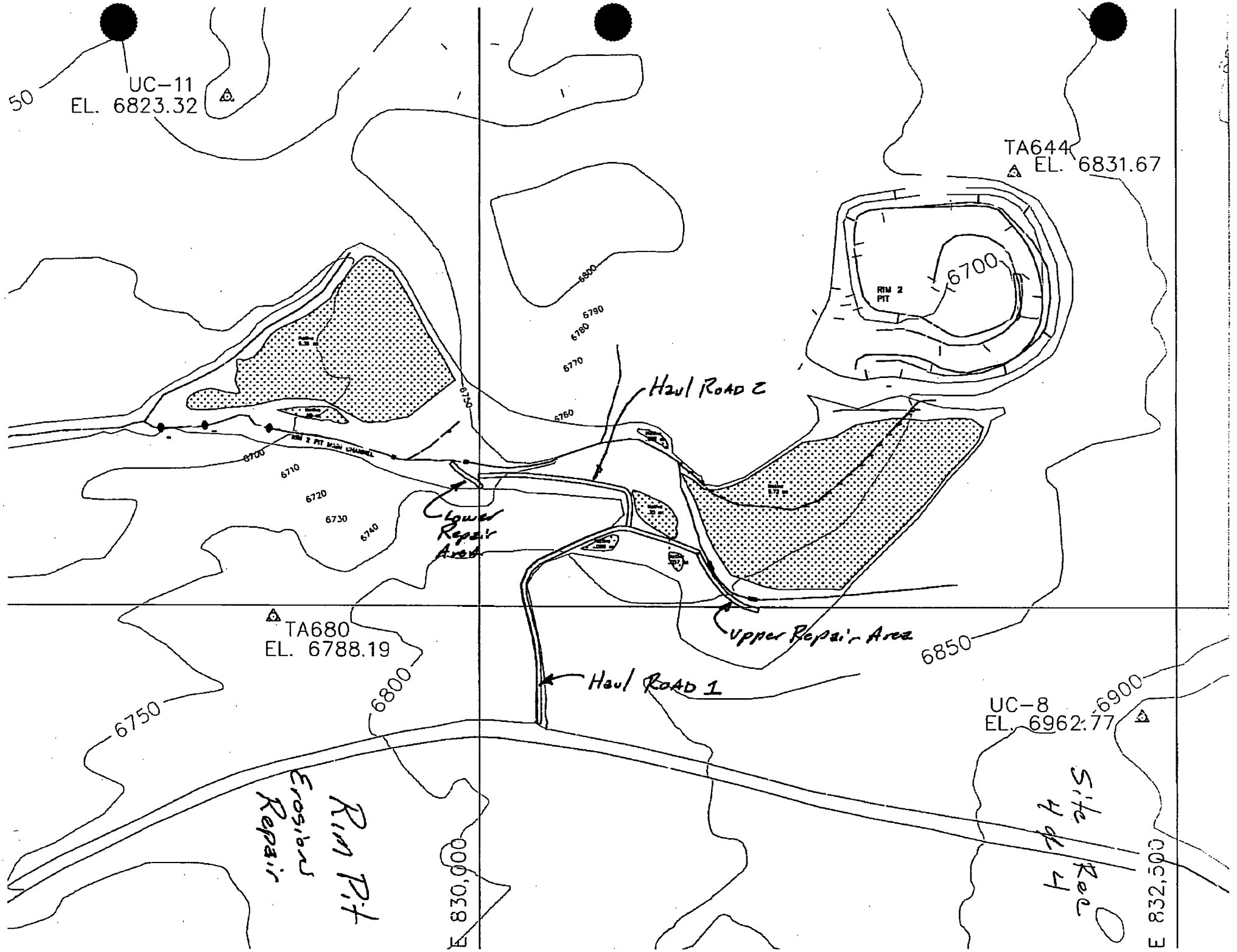
Haul ROAD 1 (two track - 15' wide typ)
Area = 18,428 sf. = 0.42 AC

Haul Road 2
Area = 10,072 sf = 0.23 AC

Upper Repair Area
Area = 4,697 sf = 0.11 AC

Lower Repair Area
Area = 2,145 sf = 0.05 AC

0.81 AC Total


UC-11
EL. 6823.32
TA644
EL. 6831.67
RIM 2
PIT
6700
6800
6790
6780
6770
6760
6750
6700
6710
6720
6730
6740
Haul Road 2
Lower
Repair
Area
Upper Repair Area
TA680
EL. 6788.19
6850
Haul Road 1
6750
6800
6900
UC-8
EL. 6962.77
Run Pit
Erosion
Repair
E 830,000
Site
Rec
E 832,500

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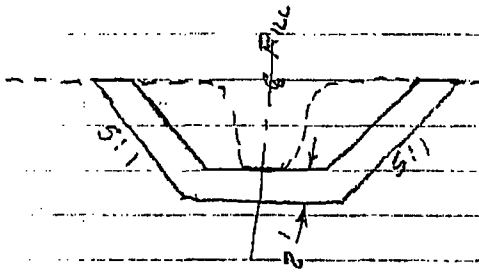
Rim Pit / Blowouts (AGTI) / HL Rill

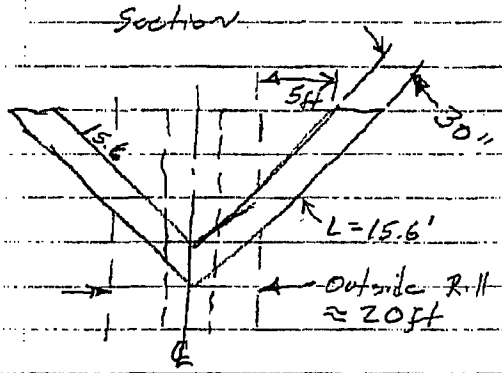
RimPit/Type C - Riprap

Lower Rill
9 structures



Section

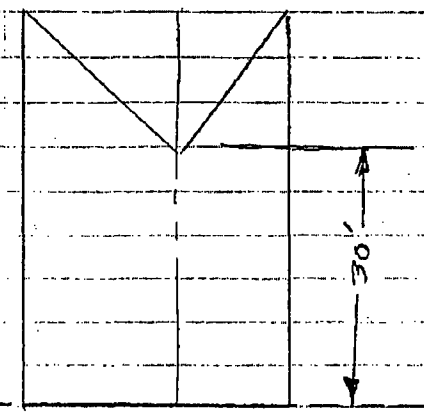
Bottom 3 times the width of Rill = 6'
thickness Riprap = 2'



PLAN

Area = 78.0 sf
Corrected 5:1 = 79.6 sf
@ 2ft depth = 159.2 cf = 5.9 cy
5.9 cy each structure.
5.9 cy (x) 9 = 53.1 cy
(Use 54 cy)

Tie-in to Existing
Riprap Channel



→ Existing Channel →

Area (CAD) = 914 sf
Corr for 5:1 = 932 sf
@ 2ft thick = 1864 cf = 69 cy
(Use 70 cy)

Total Riprap Lower Rill = 122.1 cy
(Use 124 cy)

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Rim Pit / Blow outs (Asti) / HL Rill

Rim Pit

Type C-Riprap

Upper Rill

Same structures shapes as Lower Rill

20 - V shape @ 5.9 cy each (use 6.0 cy)

= 120 cy Type C

Tie-in

Same as Lower Rill

30' Long x 30 wide x 2' Deep = 6.9 cy (use 70 cy)

1-structure = 70 cy Type C

Total Riprap upper Structure = 190 cy

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Rim Pit / Blowouts (AGTI) / HL Rill

Blowouts AGTI

Type C - Riprap

2 - Blowouts North side AGTI
SAME Structure as Typical for Rim Pit Rills
Each structure 30' x 30' (5:1 slope) use 70cy each structure

Total Riprap for AGTI Blowout Structures
= 140 cy Type C

HL Rill

Place Rock structures Behind Existing Hay Bales

Structure 20ft Lower (x) 2.5ft wide (x) 2ft Deep
= 3.7 cy per structure
(use 4cy)

6 Rock structures = 24 cy Type C Riprap for HL Rill

Sum

Rim Pit
Upper Rill 190 cy
Lower Rill 124 cy

AGTI Blowouts 140 cy

HL Rill 24 cy

478 cy Type C (Round up to 500 cy)

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AGT1 QTY - Riprap Remove/Replace (Type B) - Additional 30/70 Blend Bedding

Additional Qty 30/70 Blend

Remove 25' wide type "b" Riprap on AGT1

place 3" 30/70 Blend / Replace Type B Riprap

Adds to this Qty Areas

5.1 Process 30/70 Blend

5.2 Transport 30/70 Blend

5.4 Remove and Replace Type B Riprap (combine into type c price)

Area checked by using AutoCAD.

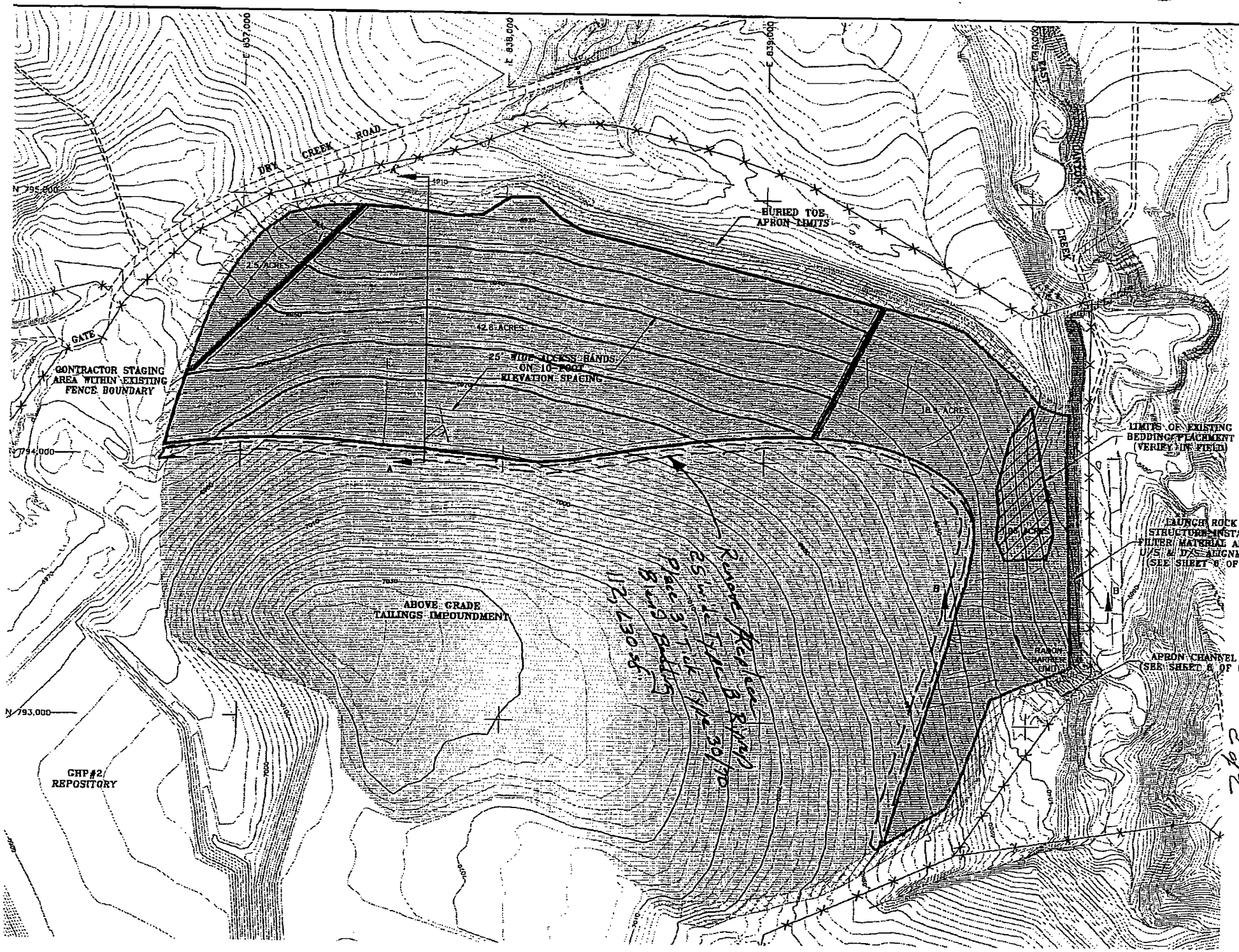
Area = 112,630 sf.

5.4 Remove/Replace 6" Type B Riprap

= 56,315 cf. = 2,085 cy

5.1/5.2 Process 30/70 Blend / Transport-Place 30/70 Blend

= 28,158 cf. = 1,043 cy



A671 - Addition 30/70

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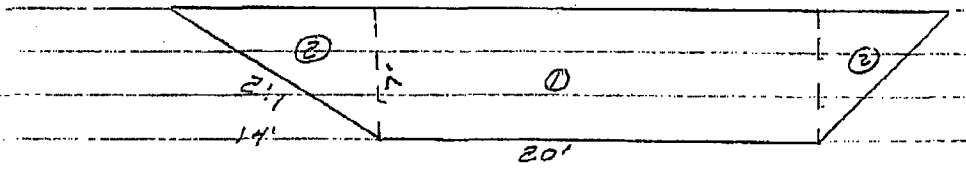
RADON BARRIER TEST TRENCHES
Bid item 4 (Section 6-1)

Excavate/Backfill

4.0/ AGTI

The ENHANCEMENT IN 1999 FILL FOR FROST PROTECTION Varied from 4.5-ft to 7.5(8:0)-ft at toe-no. Plus 1.0-ft Type C Rock (Riprap) cover

Excavation 7 ft deep (1-ft type C-Riprap)
Bottom Excavation 10-ft x 20-ft with 2:1 side slopes



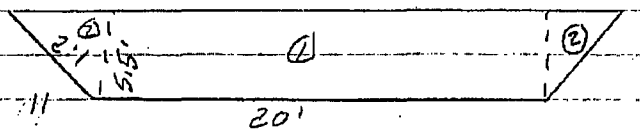
① 20 x 7 = 140sf @ 10ft length = 1400 cf = 51.9 cy
② (7 x 14)/2 = 49sf
2sides @ 20 ft long = (20+14)2 = 68 ft x 49sf = 3,332 cf = 123 cy
2sides @ 10ft long = (10+14)2 = 24ft x 49sf = 2,352 cf = 87 cy

Excavation AGTI = 262 cy

A9

Frost cover 4.5 ft thick plus 1-ft type C-Riprap

Excavate 5.5 ft with 2:1 side slopes - bottom excavation 10 x 20 ft



① 20' x 5.5' = 110sf @ 10' length = 1,100 cf = 40.7 cy
② (5.5' x 11')/2 = 30.25 sf.
2sides @ 31ft long = 31 x 2 = 62ft x 30.25sf = 1875.5 cf = 69.5 cy
2sides @ 21ft long = 21 x 2 = 42ft x 30.25sf = 1270.5 cf = 47.1 cy
Excavation A9 = 157.3 cy

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RADON BARRIER TEST Trenches

AGT1 Excavation = 262 cy

A-9 Excavation = 153.3 cy

TOTAL Excavation / Backfill

Section 6-1

B.1 ITEM 4

420 c.y.

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GAS HILLS, WYOMING

ABOVE-GRADE TAILINGS IMPOUNDMENT DESIGN ENHANCEMENT EROSION AND RILL REPAIR PLAN

SHEET 5 OF 8

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