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DENVER
COEUR D'ALENE

June 2, 1994

Mr. Ted Johnson
U.S. Nuclear Regulatory Commission
Uranium Recovery Branch
Division of Low-Level Waste Management
& Decommissioning, NMSS (5 E4)
11555 Rockville Pike
Rockville, MD 20850

Dear Mr. Johnson:

On behalf of Umetco Minerals, Inc., James L. Grant & Associates is submitting the attached information relative to Umetco's closure of the Heap Leach tailings pile at their Gas Hills, Wyoming facility. This information supplements our submittal dated April 12, 1994.

The following attachments are included in this submittal:

1. A corrected calculation of the length of the hydraulic jump on the apron at the base of the heap cover. The results of this calculation were used to check the length of the apron. The formula used in our April 12 submittal was wrong. The revised calculation shows a shorter jump than the previous calculation. We had selected a nominal length of 8 feet for the apron, and that length is adequate according to the corrected calculation.

2. Sizing of channel riprap using the Safety Factors method. The original design submitted by Umetco used Stephenson's method to determine the D_{50} of the riprap, and the USBR method to determine the maximum size. The Safety Factors method yields larger riprap than was proposed in the initial design . The attached calculations using the Safety Factors method provide conservatively large estimates of the size of the riprap. We still are working to refine the design of the channels, and expect to submit a refined design and associated revised riprap in the future. This issue does not impact directly upon the placement of the final cover over the Heap.

3. A redesign of the outlet to Channel C. Channel C will drain the Heap cover. Our original design incorporated a vertical riprap cutoff at the end of the channel extending below the maximum calculated depth of scour. The redesign provides a sloping apron that extends below the calculated scour depth. The design slope of the apron is 10%. A sketch depicting the revised design is included, as are calculations to support the design. The calculations include:

   - calculation of flow characteristics in the channel using the revised riprap,
   - calculations of scour depth at the end of the channel using Lacey's formula and US Department of Transportation Hydraulic Engineering Circular No. 14, and
   - calculation of the size of the riprap from which the apron will be constructed.

4. Responses to questions about the radon barrier. These questions were raised by Elaine Brummett of the NRC during a telephone call with Mr. P. J. Lyons of Umetco on May 17, 1994.

5. Additional data on the stone Umetco proposes to use for mulch on the Heap cover and for riprap in the associated drainage channels. The additional data include a petrographic examination of the stone, and additional laboratory tests to ascertain the durability of the stone and its suitability for riprap at this site.

NL05 1/1

As described in the attached response to the NRC questions, Umetco is gathering more information that is pertinent to the ultimate closure of the Heap tailings. This information includes:

1. A sample of the Heap tailings has been taken and submitted to Rogers and Associates to measure emanation and diffusion coefficients. This information will allow more precise calculation of radon movement in the tailings.
2. Umetco will complete canister tests on the current radon barrier. These tests will provide direct measures of the radon movement through the radon barrier as presently constructed.
3. Umetco will complete moisture measurements in a 12" clay core taken from the site. This test will provide information about the long-term moisture content of the soils comprising the radon barrier.

This information will be available within the next 30 days.

Very truly yours,

James L. Grant & Associates, Inc.

James L. Grant (cp)

James L. Grant
President

JLG:hs

Enclosures: as stated

RESPONSES TO NRC QUESTIONS

NRC's Comments/Questions

Telecon w/ NRC-Umetco (Elaine Brummett, P.J.L. Lyons) May 17, 1994

Subject: Heap Leach Reclamation Plan - NRC Concerns about the Radon Barrier

Question 1. What is "Clean Fill?" It doesn't seem to be any of the materials named by Umetco in Response 12 of 12/2/91 ("Response")

Response:

See response No. 12, page 4, paragraph 12.5

The "clean fill" is mine spoils compacted to 90% of maximum dry density and placed during the original construction of the side slopes of the Heap. (See also our February 1991 Plan, Appendix C, Figure 8.3.1.) The material has the characteristics of Compacted Structural Fill as defined in Response 12.3.1.

2. Radium Data

a) The clay reportedly has 15.8 pCi/g of radium. This is a high value, and is based on a single sample. Please comment.

b) What is "Tailings Slime?"

c) Need radium data on upper 16 feet of the Heap material.

d) Radon emanation results measured by Energy Labs are very low. Please provide supporting data such as laboratory QA data and/or more samples and results (say 5-10).

e) Confirm background activity - provide documentation of measurements to date.

Response:

a) The 15.8 pCi/g Ra 226 result for clay was obtained from a 1-foot drilled sample of clay in drill hole MWI-51 situated on the Inactive Tailings pile. The Radon Emanation Coefficient measured for this sample was 0.086. A sample grabbed from 10 points on a stockpile of bentonitic clay prior to placement and compaction on the Heap Leach had an assay of 7.8 pCi/g Ra 226 and a Radon Emanation Coefficient of 0.168. Both results are below the 20 pCi/m^2/sec allowable above background. LAACC tests conducted on the Inactive Tailings area indicate 3.87 pCi/m^2/sec. LAACC tests are to be conducted over the present Heap Leach surface in June when overnight temperatures will exceed 35° F.

b) Tailings slime refers to material encountered while drilling on the Inactive Tailings. Test data from these samples were erroneously used in the "Radon" simulations of the Heap Leach.

c) The Heap materials should be homogenous. See Response No. 15 that describes a 20 ft. channel cut and accompanying assay of the Heap materials in the cut.

d) Energy Labs is supplying additional QA/QC data for the time period when the I-51 samples (6/06/91) and Heap Leach samples (6/18/91) were assayed and the Radon Emanation Coefficients were calculated. Additional split-spoon core samples will be obtained at five locations on the Heap Leach, splits made of each sample for assay of Ra 226 and resultant Rn emanation coefficients at two labs (Energy Laboratories in Casper, and Rogers and Associates in Salt Lake City). Samples to be assayed will be of cover material, clay, filter material and Heap material with appropriate thickness and material-type descriptions and sample locations.

e) Background determination data have been supplied pertaining to the EGH site. A synopsis of all of these data will be supplied. No background values have been used in any calculations.

Question 3. Long-Term Moisture - Page 27 Feb. 1991 Plan

a) What is "Waste?"

b) Suggest using formula in the Reg. Guide, not the NUREG. May give less than 9% for "Waste."

c) How representative is the estimate of the amount of fines in the radon barrier soils (average 40.5% finer than a 200-mesh sieve).

d) Please provide any available information on "Clay content and Organics content" for the materials.

Note: Long-term effects Diffusion Coefficient which can also be determined by "Lab Values" which are preferred.

Response:

a) Waste is the Heap material and/or mine spoils, both of which are sandstone excavated without blasting and not processed through any comminution process (crushing, grinding)

b) We will evaluate the use of this formula, and will document and justify the parameters in our analyses.

c) There were five samples tested - B-spoils 2 samples; 3 samples from south of Heap piles. The test results were reported by Western Engineers, Inc on 7/31/90.

d) We have no information on the organic content of the soils, nor do we have any measurements of the fraction of the soil fines that is clay.

4. Clay Specifications

Page 17 of Feb. 1991 Plan says this material will have at least 25% by weight passing 200 mesh. But, we are using material with 80-90% passing 200. Are we sure? Why the big difference? Why did we specify a 25% - 200 when we knew we were going to use 80-90% - 200.

Response:

The 25% - 200 is the lowest limit for CL to CH and SC soils. Some of this material was available in adjacent pits but not enough of the material was available, and the quality of the available material was marginal. After prospecting for clay sources, we found a nearby source of high quality sodium bentonite soil. This is much better material. We have used exclusively the high quality sodium bentonite material as the clay radon barrier on all areas constructed to date and will continue to do so.

RIPRAP DATES

Petrographic Analysis of Dutton Anticline Limestone

The Dutton anticline limestone is known as the Alcova limestone, the basal member of the lower to middle Triassic age Chugwater formation. It is a marine limestone, ranging from 6 1/2 feet to 8 feet in thickness. This limestone unit was examined on outcrop and in an exposed pit blasted at the Dutton anticline site. Representative samples were taken and examined under a binocular microscope with magnification of 15X to 35 X.

Measured thickness and descriptions of limestone exposed in the Dutton pit are as seen from bottom to top with "0" representing the bottom limestone contact.

Interval (Measured from Bottom Contact)	Thickness	Description
0" to 16"	16"	Massive, dense, dark gray, calcitic limestone. Fractured into 6" to 10" blocks when blasted.
16" to 34"	18"	Thinly laminated, dense, light gray to ferruginous, calcitic limestone cyclothem. Some crenulations along laminae. Fractured into 2" to 6" blocks when blasted. Generally broke across laminations.
34" to 54"	20"	Massive, dense, dark gray, calcitic limestone. Fractured into 3" to 8" blocks when blasted.
54" to 58"	4"	Dense, ferruginous calcitic limestone with dolomitic and sillceous algal "mats" noted. Associated animal growths are probably bryozoans as noted by their moss-like appearance in the bioberms composed of limestone.
58" to 72"	14"	Fissile, dense, calcitic limestone, gray, ranging from 2" to 4" thick. The fissility is caused by very thin silt layers composed principally of silica and biotite particles with tiny manganese nodules.
72" to 84"	12"	Fissile, dense, calcitic limestone, light gray to reddish in layers ranging from 1" to 3" thick. Increasing thickness in the interbedded siltstone layers up to 1/8" thick.

The lower 54 inches of the formation is suitable for use as riprap. The rock is not fissle. It contains no obvious planes of weakness nor does it contain materials that would lead to accelerated deterioration upon weathering.

The upper 30 inches of the formation is not suitable for general use as riprap. The material is fissle. It contains layers of silt that create zones of weakness, and may weather faster than the limestone itself.

Results of laboratory testing of riprap stone.

Dutton limestone was blasted at the outcrop in the Gas Hills where Umetco proposes to quarry the stone as a source of riprap. About 200 cubic yards of limestone was blasted. The broken rock was gathered into a single stockpile. A large sample weighing about 2,740 pounds was taken from the stockpile. A representative sample weighing about 500 pounds was taken from the larger sample. The 500 pound sample was sent to Imberg-Miller for testing. The results of the testing are summarized below.

Laboratory Test	Test Result	Score	Weight	Weighted Score	Maximum Score
Specific Gravity	2.65	8.04	12	96.48	120
Absorption, %	0.61	7.35	12	95.59	130
Sodium Sulfate, %	1.60	9.70	4	38.80	40
LA Abrasion test (100 revs), %	5.70	7.59	1	7.59	10
Schmidt Hammer	33.30	4.16	11	45.79	110
Tensile Strength, psi	Not tested				
Total Scores				284.25	410
Rock Rating, %				69.33	

The above test results indicate that the limestone will be suitable for riprap at the Gas Hills facility. Oversizing of about 11% will be required both in critical and non-critical areas.

CALCULATIONS

1. Hydraulic Jumper Apron
2. Flow Characteristics of Channel C
3. Oversizing Riprap at End of Channel C
4. Scour at Channel C Outlet
5. Sizing Channel Riprap by Safety Factors Method

Umetco Heap Leach Facility
Calculating Properties of Hydraulic Jump at Apron
Project 883779
JLG 4/4/94 (revised 4/21/94)

For flow down the slope, use 3q, or 1 cfs/ft
Assume n = 0.04, a conservatively low number
S = 0.2, assuming normal depth

$Q := 1$ cfs $n := 0.04$ $S := 0.2$

$$d(Q,n,S) := \left[Q \cdot \frac{n}{\left(1.49 \cdot S^{0.5}\right)}\right]^{0.6}$$

$y_1 := d(Q,n,S)$ $y_1 = 0.185$ feet

$V_1 := \frac{Q}{y_1}$ $V_1 = 5.407$ fps

$Fr_1 := \frac{V_1}{\left(32.2 \cdot y_1\right)^{0.5}}$ $Fr_1 = 2.216$

Using Hydraluic Engineering Circular #14, Figure VI-4

$F(J) := 0.5 \cdot J^3 - \left(Fr_1^{\;2} + 0.5\right) \cdot J + Fr_1^{\;2}$

$Z := 2$ Initial guess of ratio

$Ratio := root(F(Z), Z)$

$Ratio = 2.673$

$y_2 := Ratio \cdot y_1$ $y_2 = 0.494$ feet

Tailwater depth, assuming n = 0.04, S = 0.01

$n := 0.04$ $S := 0.01$ $TW := d(Q,n,S)$

$TW = 0.454$ Feet, close to the conjugate depth

Length of jump, using Figure VI-11 is about 3 feet (15 * y_1)

Umetco Heap Leach Facility
Flow Characteristics of Lower Portion of Channel C
JLGA Project 883779

Channel Data and formulae

$P(b,y,s) := b + \sqrt{s^2 + 1} \cdot y \cdot 2$

$b := 24 \qquad q := 1269$

$N(D_{50}, S) := 0.0456 \cdot (D_{50} \cdot S)^{0.159}$

$A(b,y,s) := b \cdot y + s \cdot y^2$

$R(b,y,s) := \dfrac{A(b,y,s)}{P(b,y,s)}$

$Q(b,y,s,n,S) := \dfrac{1.49}{n} \cdot R(b,y,s)^{0.67} \cdot A(b,y,s) \cdot S^{0.5}$

$S := 0.0187$

$D_{50} := 13$ inches

$n := N(D_{50}, S) \qquad n = 0.036$

$s := 3 \qquad y := 3$

$Z(y) := Q(b,y,s,n,S) - q$

$y_n := \mathrm{root}(Z(y), y) \qquad y_n = 3.473$ feet

$V := \dfrac{Q(b, y_n, s, n, S)}{A(b, y_n, s)} \qquad V = 10.615$ fps

$A(b, y_n, s) = 119.548 \qquad P(b, y_n, s) = 45.967$

Umetco Heap Leach Facility

Oversizing riprap at end of Channel C
JLGA Project 813779 4/21/94

Uses Stephenson's method, assumes a washout at the end of the channel

Assume a porosity of 0.3
Assume a value of C of 0.25, about mid-range for the crushed limestone

The channel flow is 1269 cfs, the bottom width is 24 feet, sideslopes are 3:1

The density of the rock is about 2.65, from testing

$n := 0.3$

$C := 0.25$ $b := 24$

$Q := 1269$ cfs $q := \frac{Q}{(24 + 3 \cdot 3.47)}$ $q = 36.879$

$S := \frac{165}{62.4}$ $S = 2.644$

$\theta := \operatorname{atan}(0.1)$ assume the rock collapses to a 10:1 slope at the end of the channel

$g := 32.2$ acceleration of gravity in ft/sec2

$friction := 42$ friction angle of the larger stone is 42 degrees

$\phi := \pi \cdot \frac{friction}{180}$

$num := q \cdot \left(\tan(\theta)^{\frac{7}{6}}\right) \cdot n^{\frac{1}{6}}$ $den := C \cdot \left(\sqrt{g}\right) \cdot ((1 - n) \cdot (S - 1) \cdot \cos(\theta) \cdot (\tan(\phi) - \tan(\theta)))^{\frac{5}{3}}$

$d := \left(\frac{num}{den}\right)^{\frac{2}{3}}$ $num = 2.056$

$den = 1.227$

$d = 1.411$ in feet $d_{in} := 12 \cdot d$ d_{50} in inches

$d_{in} = 16.927$ inches

Stephensons method gives a d_{50} of about 17 inches

Umetco Heap Leach Facility
Calculating Depth of Scour at end of Channel C
Project 883779
JLG 5/9/94

Reference: Davis and Sorenson, Handbook of Applied Hydraulics, p 6-6 +

Lacey regime equations

$R(q,f_L) := 0.91 \cdot \frac{q^{\frac{2}{3}}}{f_L^{\frac{1}{3}}}$ Hydraulic radius, or flow depth, in feet, q in cfs,ft

$F_L(D_b) := 1.76 \cdot D_b^{0.5}$ Siltation factor, D_b in mm

The soil at the end of the apron is a fine sand, with D_{50} of about 0.2 mm, we ignore any cohesion

$d_{50} := 0.2$

$f_L := F_L(d_{50})$

$f_L = 0.787$

$q := 10$ cfs/ft, for 126.6 foot flare

$d := R(q, f_L)$ $d = 4.575$ Flow depth

Scour depth will be between 1.75 and 2.25 times the flow depth, so,

$Scour := 2.25 \cdot d$

$Scour = 10.293$ feet, maximum scour depth

Check by Simons relation, Graf, Hydraulics of Sediment Transport, McGraw Hill

$S\_D(Q) := 2 + 0.93 \cdot Q^{0.36}$

$S\_D(1296) = 14.275$ feet, pretty close to the Lacey estimate

Design of Outlet for Channel C
Umetco Heap Leach Facility
JLG A Project 883779
4/6/94 (Revised 4/21/94)

Channel Data

Variable	Channel C
Flow (cfs)	1269
Bottom Width	24
Channel Sideslopes	3:1
Depth at End	3.473
Velocity at End	10.62
Channel Slope	0.0187

Data from Umetco Closure Plan and Lower Channel C Hydraulics Calculation

Basic Formulae

$A(d) := 24\cdot d + 3\cdot d^2$ Flow Area

$P(d) := 24 + 2\cdot\sqrt{10}\cdot d$ Wetted Perimeter

$R(d) := \frac{A(d)}{P(d)}$ Hydraulic Radius

$F_r(y, V) := \frac{V}{\sqrt{(32.2\cdot y)}}$ Froude number

$y_e(A) := \sqrt{\left(\frac{A}{2}\right)}$

$g := 32.2$ ft/sec2

$g2 := \sqrt{g}$

Design of Outlet for Channel C
Umetco Heap Leach Facility
JLG A Project 883779
4/6/94

Scour formuale and data from US DOT HEC #14, Sept 1983, Chapter V

$\mathrm{ScourL}(y,Q) := 2.79 \cdot y \cdot \left(\frac{Q}{g2 \cdot y^{2.5}}\right)^{0.375} \cdot \left(\frac{30}{316}\right)^{0.1}$ for uniform sand, d50 = 0.2 mm

$\mathrm{WidthL}(y,Q) := 6.44 \cdot y \cdot \left(\frac{Q}{g2 \cdot y^{2.5}}\right)^{0.92} \cdot \left(\frac{30}{316}\right)^{0.15}$

For sandy clay

$\mathrm{ScourG}(y,Q) := 1.53 \cdot y \cdot \left(\frac{Q}{g2 \cdot y^{2.5}}\right)^{0.57} \cdot \left(\frac{30}{316}\right)^{0.1}$

$\mathrm{WidthG}(y,Q) := 9.14 \cdot y \cdot \left(\frac{Q}{g2 \cdot y^{2.5}}\right)^{0.35} \cdot \left(\frac{30}{316}\right)^{0.07}$

Channel C

$d := 3.473$

$a := A(d)$ $a = 119.537$ ft2

$p := P(d)$ $p = 45.965$ ft

$r := R(d)$ $r = 2.601$ ft

$Q := 1269$

$V_c := \frac{Q}{a}$ $V_c = 10.616$ fps

$F := F_r(r, V_c)$ $F = 1.16$ Froude number

DOT HEC # 14 states that for F <1.7, there will be only a slight disturbance of the water surface in a jump. We do not try to force a jump at the outlet

$y := y_e(a)$ $y = 7.731$ equivalent depth

Design of Outlet for Channel C
Umetco Heap Leach Facility
JLG A Project 883779
4/6/94

Scour := ScourL(y,Q)	Scour = 19.052	feet	for uniform sand
Width := WidthL(y,Q)	Width = 45.958	feet	
Scour := ScourG(y,Q)	Scour = 11.071	feet	for clayey sand
width := WidthG(y,Q)	Width = 45.958	feet	

The uniform sand scour depth is conservative, since the site soils have some cohesion
The scour predicted for the clayey sand is more representative of expected scour depth
We will use a conservative design depth of 12 feet for the depth of the cutoff at the end of the channel

Umetco Heap Leach Facility
Calculation of Channel Riprap
By Safety Factors Method

Ref: NUREG/CR-4620
JLG 4/21/94
Project 883779

Basic Flow Formulae

$$A(b,s,d) := b \cdot d + s \cdot d^2$$

$$P(b,s,d) := b + 2 \cdot \sqrt{(1 + s^2)} \cdot d$$

$$R(b,s,d) := \frac{A(b,s,d)}{P(b,s,d)}$$

$$Q(n,b,s,S,d) := \frac{1.49}{n} \cdot A(b,s,d) \cdot R(b,s,d)^{0.67} \cdot S^{0.5}$$

Safety Factors Formulae for horizontal flow

$$\theta(s) := \operatorname{atan}\left(\frac{1}{s}\right)$$

$$\phi := 42 \cdot \frac{\pi}{180}$$ friction angle is about 42 degrees for crushed rock

$$\gamma := 62.4 \qquad S_s := 2.65$$

$$\tau_0(d,s) := \gamma \cdot d \cdot s$$

$$\eta(t, S_s, D) := 21 \cdot \frac{t}{\left[(S_s - 1) \cdot \gamma D\right]}$$

$S_m(s) := \tan(\phi) \cdot s$ s is the side slope expressed as, eg, 3:1. s = 1/tan(theta)

Umetco Heap Leach Facility
Calculation of Channel Riprap
By Safety Factors Method

Ref: NUREG/CR-4620
JLG 4/21/94
Project 883779

$$S_f(S_s,D,z,s,d,S) = \frac{S_m(s)}{2}\cdot\left[\left(S_m(s)^2\cdot\eta\left(\tau_0(d,S),S_s,D\right)^2\cdot\sec(z)^2+4\right)^{0.5} - S_m(s)\cdot\eta\left(\tau_0(d,S),S_s,D\right)\cdot\sec(z)\right]$$

$N(D) = 0.0395\cdot D^{\frac{1}{6}}$ Corps formula for Mannings n as a function of riprap size

Channel data

Channel	Slope	Q	b	s
A	0.005	221	12	3
B	0.005	297	12	3
C	0.0188	693	12	3
C (downstream)	0.0188	1269	24	3
D	0.002	576	12	3

Umetco Heap Leach Facility
Calculation of Channel Riprap
By Safety Factors Method

Ref: NUREG/CR-4620
JLG 4/21/94
Project 883779

Channel A

$s := 3 \quad b := 12 \quad q := 221 \quad S := 0.005$

$D := \frac{2.5}{12} \quad n := N(D) \quad F(d) := Q(n,b,s,S,d) - q$

$d := 3$
$d := root(F(d),d)$
$d = 2.365$

$t := \theta(s)$

$sf := S_f(S_s, D, t, s, d, S)$

$sf = 1.097$ Riprap D50 of 2.5 inches

Channel B

$s := 3 \quad b := 12 \quad q := 297 \quad S := 0.005$

$D := \frac{2.75}{12} \quad n := N(D) \quad F(d) := Q(n,b,s,S,d) - q$

$d := 3$
$d := root(F(d),d)$
$d = 2.777$

$t := \theta(s)$

$sf := S_f(S_s, D, t, s, d, S)$

$sf = 1.046$ Riprap D50 of 2.75 inches

Umetco Heap Leach Facility
Calculation of Channel Riprap
By Safety Factors Method

Ref: NUREG/CR-4620
JLG 4/21/94
Project 883779

Channel C - upstream of confluence with D

$s := 3 \quad b := 12 \quad q := 693 \quad S := 0.0188$

$D := \frac{12}{12} \quad n := N(D) \quad F(d) := Q(n,b,s,S,d) - q$

$d := 3$
$d := \mathrm{root}(F(d), d)$
$d = 3.451$

$t := \theta(s)$

$sf := S_f(S_s, D, t, s, d, S)$

$sf = 0.994$ Riprap D50 of about 12 inches

Channel C - downstream of confluence with D

$s := 3 \quad b := 24 \quad q := 1269 \quad S := 0.0188$

$D := \frac{13}{12} \quad n := N(D) \quad F(d) := Q(n,b,s,S,d) - q$

$d := 3$
$d := \mathrm{root}(F(d), d)$
$d = 3.649$

$t := \theta(s)$

$sf := S_f(S_s, D, t, s, d, S)$

$sf = 1.012$ Riprap D50 of about 13 inches

Umetco Heap Leach Facility
Calculation of Channel Riprap
By Safety Factors Method

Ref: NUREG/CR-4620
JLG 4/21/94
Project 883779

Channel D

$s := 3 \quad b := 12 \quad q := 576 \quad S := 0.002$

$D := \frac{1.75}{12} \quad n := N(D) \quad F(d) := Q(n,b,s,S,d) - q$

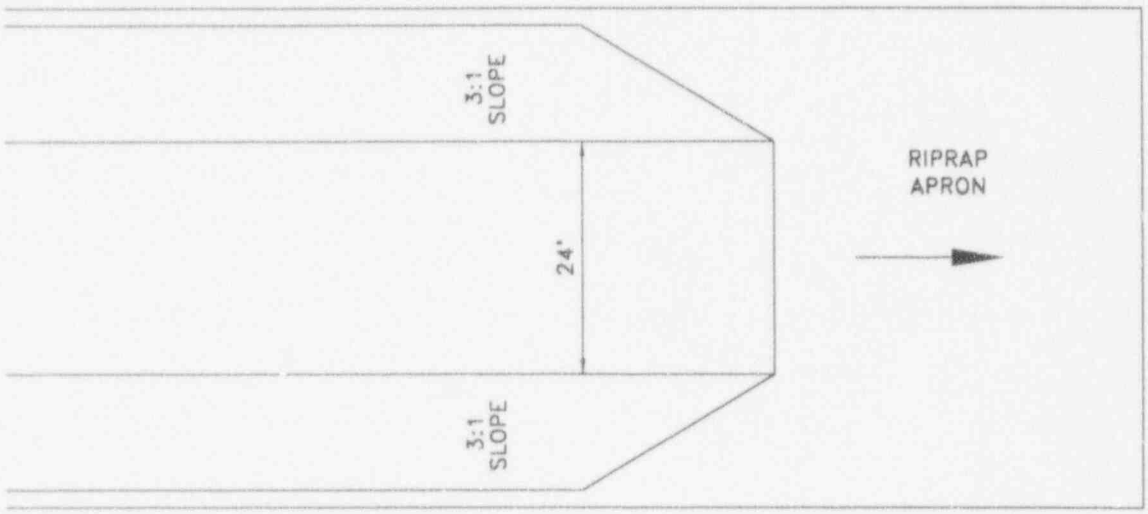
$d := 3$
$d := \mathrm{root}(F(d),d)$
$d = 4.656$

$t := \theta(s)$

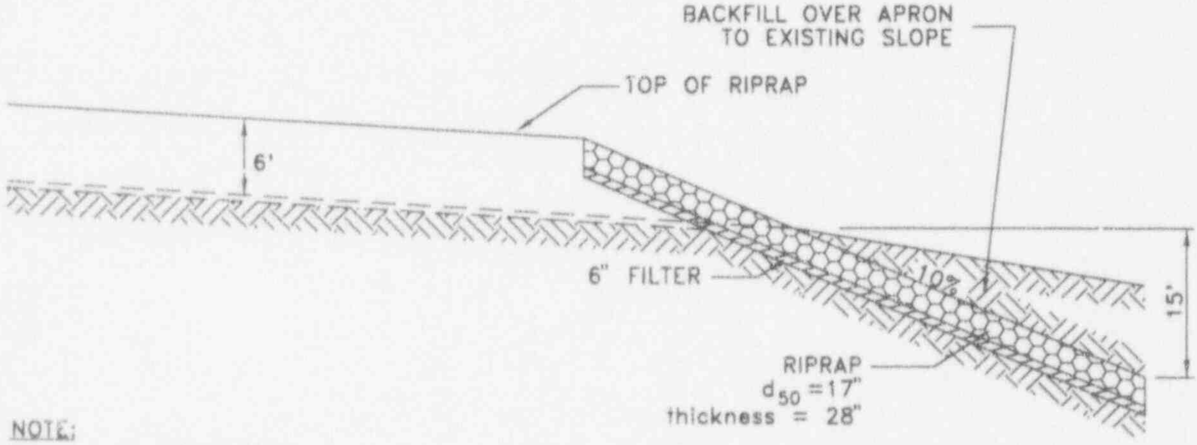
$sf := S_f(S_s, D, t, s, d, S)$

$sf = 1.006$ Riprap D50 of about 1.75 inches

FIGURES



PLAN VIEW



NOTE:
CUTOFF IS 12" RIPRAP.

SECTION

NO SCALE

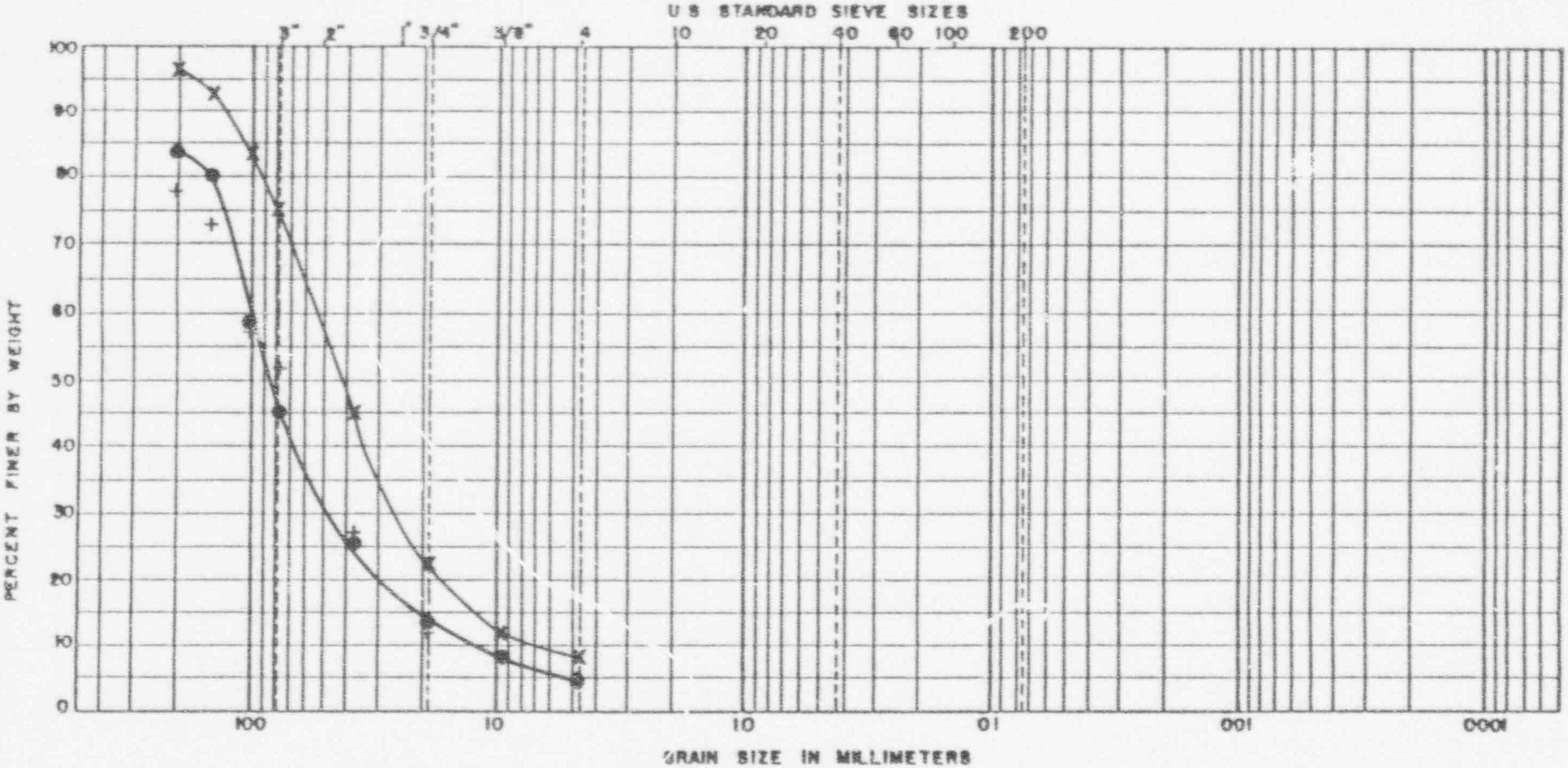
883779\CHAN_OUT.DWG 5/2/94

883779

GRANT ENVIRONMENTAL
consulting and engineering
DENVER, COLORADO

FIGURE 4.4

CHANNEL C OUTLET DETAILS



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	ELEV OR DEPTH	NAT WC	L L	P L	P I	DESCRIPTION OR CLASSIFICATION
						● MATERIAL OBTAINED AFTER RIPPING X MATERIAL FROM STOCKPILE + MATERIAL FROM EDGE OF TEST AREA AFTER BLASTING (ALMOST IDENTICAL TO MATERIAL AFTER RIPPING)

GRAIN SIZE DISTRIBUTION

JOB NO. 883779

GRANT ENVIRONMENTAL