Tenneco Minerals
A Tenneco Company

P.O. Box 2650
St. George, Utah 84770
(801) 673-1606

Jay Kirar

March 13, 1989

M/053/005

Mr. Don A. Ostler, PE
Executive Secretary
Bureau of Water Pollution Control
Department of Health
Division of Environmental Health
288 North 1460 West
PO Box 16690
Salt Lake City, Utah 84116-0690

Dear Don:

This letter is written to express consideration to several items specified in your November 3, 1988 letter granting Tenneco Minerals Company permission to construct its first leach pad. These items are:

1. Sulfide bearing ore or waste rock will not be removed or uncovered as a result of any of the construction on this project covered by this permit.

Tenneco Minerals has interpreted this to mean mineral which would require an acid leach, bio-oxidation, or methods other than a base cyanide leach process.

The Bureau should be aware that ore material exists within the Hamberg Pit that is both a sulfide/oxide mix and purely sulfide mineral. It is Tenneco Minerals intent that the sulfide/oxide mixed material will be mined and leached as typical ore. Results from our laboratory tests indicate that recoveries from this ore type are very nearly equivalent to the typical oxidized ore at the operation. Thus, economically it makes sense to extract and process this mineral. It should be noted that this ore type requires slightly more caustic (base) added to solution in order to reduce cyanide consumption, prevent cyanide volatilization to HCN (due to lowered pH), and create the necessary base environment to leach.

The sulfide ore in locations parallels the sulfide/oxide mix ore in the Hamberg Pit. Where it is evident that cyanide leaching will extract gold values economically, the material will be loaded and leached as typical oxide ore. Again, additional caustic (base) added to the leach solution will be required.

Environmental concerns for this sulfidic material on the pad are no different than any ore type. The addition of caustic (base) to the heap to create the proper leach environment will effectively buffer the acidic effects of the sulfide ore. In other words, leaching to

ABP = Paste Acid Potential
ABP = -5 limit for DOG

yield recovery of gold cannot occur until all sulfide has been effectively neutralized to a sulfate. This neutralization will occur by Tenneco applying enough caustic (base) to solution. Also, increased consumption of cyanide will occur although from an economic standpoint, we would want to minimize this.

Metallurgical test results have been enclosed for your review.

Waste material adjacent to sulfide ore will be effectively neutralized in the following manner:

A. Tenneco estimates 155,190 tons of sulfide waste in the Hamberg Pit which we believe will yield an average acid forming potential of -39.

B. Tenneco also estimates that approximately 2,073,000 tons of limestone exists within this same pit which will yield an average acid neutralizing potential of +603.

C. Thus, each 1 ton of limestone will effectively neutralize 15 times its weight in acid (or a potential of 31,095,000 tons of sulfidic waste).

D. Tenneco will perform mix waste dump operations to ensure this waste when extracted is effectively neutralized. Any remaining waste or sulfidic ore which is not extracted will be flagged to ensure backfilling will place sufficient limestone rock to neutralize this material. Tenneco Minerals conducted tests of this acidic material with ACZ, inc. to examine this problem and it should be noted that the Utah Division of Oil, Gas, & Mining (who expressed similar concerns to the Bureau's) reviewed and accepted Tenneco Minerals' response (this test information has been included for your review).

There does exist some sulfide mineral which does not lend itself to cyanide leaching (approximately 65,800 tons). Tenneco Minerals would like to have an opportunity to propose a small pilot plant and leach (bio-oxidation) test site at the operation in order to test extraction of gold values from this ore type. We would request that the Bureau consider our position upon final compilation of test work and analysis of the project. We anticipate a date to approach the Bureau with our concepts by late August, 1989.

2. Any liquids detected in any leak detection sump shall be reported to the bureau by phone within 24 hours and in writing within 5 days.

Tenneco Minerals would like to express a concern in that detection of fluids in the leak detection system might force abandonment from a leach cell or possibly an entire pad. We offer the following consideration in relationship to our first pad (calculations provided by JBR Consultants Group):

From the pad geometry of 12" of clay and 6" of leak detection gravel over the clay subgrade level the following penetration time can be arrived at:

A. Permeability of subgrade is $\leq 4 \times 10^{-7}$ cm/sec - field tests

B. Total head on top of subgrade is 18" with steady state saturated flow

C. Time to penetrate the layer by solution is 110 days

Given this situation, Tenneco would request that the Bureau consider what effective leaching time remains prior to forcing cell or pad abandonment.

3. Neutralization Criteria

Tenneco offers the following consideration in that we feel very strongly that the groundwater quality within our operational area is Class III (per recent groundwater quality regulations) due to the anomalously high levels of cadmium. Also, consideration as to the site's remote location and recognition that the future uses of this water are realistically limited, the neutralization criteria should reflect this.

Tenneco Minerals wants to emphasize this point because it is becoming apparent that the cost of leach pads for this project are extreme. Therefore, Tenneco Minerals is considering the possibility of loading ore, leaching, rinsing to a decommissioned standard, and unloading the spent ore. This will involve a significant change of project scope that Tenneco will need to provide data for (as to the mechanics of this type of operation).

We recognize that a portion of this letter addresses immediate concerns that we very much wish to resolve as soon as possible. Also, we wanted to introduce several concepts to problems we are facing at our operation. This purpose is to inform you of our plans to approach the Bureau once sufficient data exists to adequately propose our plans.

I appreciate your response to these concerns.

Sincerely,

Ken A. Kluksdahl

Ken A. Kluksdahl
Mine Manager

KAK:sl

Enclosure

Acid-Base Potential

Test Results

SUMMARY OF RESULTS

Average Total Sulfur (lbs/ton)	[illegible]
Average Total Pyrite (lbs/ton)	[illegible]
Average NaOCN Consumption (lbs/ton)	[illegible]
Average LAS Consumption (lbs/ton)	[illegible]

ACZ INC./LABORATORY DIVISION
SOILS ANALYSES REPORT

Client: Tenneco Minerals
P.O. Box 2650
St. George, Utah 84770

Attn: Ms. Julie Lewis

Report Date: 05/16/88
Date Received: 05/05/88

LAB NO.	SAMPLE I.D.	Sulfur Total %	Neutralization Potential % CaCO3	Acid-Base Potential Tons CaCO3/1000 tons
88-SI/0352	HB-1 (PC)	0.11	52.8	525
88-SI/0353	HB-2 (TL1)	0.04	66.8	667
88-SI/0354	HB-3 (MR)	0.03	67.2	671
88-SI/0355	MZ-1 (PC)	0.03	55.0	549

Ralph V. Poulsen

Ralph V. Poulsen, Laboratory Director

Goldstrike Mine

Date: 5/15/88

Acid/Base Spoil Analysis

Sample Name	Sulfur Total %	Neutralization Potential % CaCO3	Acid-Base Potential Tons CaCO3/1000 tons
Acid Forming Materials			
88-SI/0142	1.47%	<1	-46
88-SI/0143	1.25%	1	-38
88-SI/0144	0.82%	2	-24
88-SI/0145	1.20%	3	-35
88-SI/0146	1.66%	<1	-52
Total	6.40%	2	195
Average	1.28%	0.4	-39
Acid Neutralizing Materials			
88-SI/0252	0.11%	52.80%	525
88-SI/0253	0.04%	66.30%	667
88-SI/0254	0.03%	67.20%	67[illegible]
88-SI/0255	0.03%	55.00%	5[illegible]
Total	0.21%	241.80%	241[illegible]
Average	0.05%	60.45%	[illegible]

Available Neutralization At Goldstrike

603/39= 15.46

In other words 1000 tons limestone will neutralize 15460 tons of acid forming materials.

ACZ INC./LABORATORY DIVISION
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Ralph V. Poulsen

Ralph V. Poulsen, Laboratory Director

KRAIG:

HB-1 Hamburg - Penns. Calville
HB-2 Hamburg - Tert. Claron Lms.
HB-3 Hamburg - Miss. Redwall
MZ-1 Main Zone - Penna Calleville

} in case you need to break down Potential by lithology.

JPH

Metallurgical

Test Results

KAI

TENNECO MINERALS COMPANY

(COMPANY)

INTEROFFICE COMMUN

TO:

DA 10/27/88

RECEIVE

FOR: R. A. HODGSON

FROM: J. W. GREENE

RE: MONTHLY REPORT FOR AUGUST & SEPTEMBER 1988

1.0 GOLDSTRIKE - BOTTLE LEACH TESTS ON SULFIDE ORE (FIRST TEST SERIES)

A series of six bottle leaches were run on six Goldstrike sulfide bearing composites. The composites were composed of t following samples:

Composite No.	Drill Hole	Depth	Assay OPT Au	Assay OPT Ag	% Pyrite	% Total S
GS-1	86-121	120-140	.045	.44	3.18	2.00
GS-2	86-123	135-200	.052	.55	0.95	0.64
GS-3	86-132	75-105	.039	.35	2.99	2.00
GS-4	87-13	25-30	.042	<.06	0.65	0.56
GS-5	87-13	90-100	.026	.18	1.42	0.96
GS-6	87-24	5-15	.034	1.20	0.34	0.19

The bottle leach test results were as follows:

	COMPOSITE NUMBER					
	GS-1	GS-2	GS-3	GS-4	GS-5	GS-
Au Extraction (%)	53.1	49.5	12.2	80.6	70.6	76.
Ag Extraction (%)	20.6	37.4	35.2	0	0	51.
Au Accountability (%)	102.3	100.6	98.1	121.6	88.6	101.
NaCN Consumption (lbs/ton)	1.81	2.08	1.74	2.18	1.82	1.
CaO Consumption (lbs/ton)	8.0	10.0	4.0	15.0	5.8	4.
% Pyrite in head	3.18	.95	2.99	.65	1.42	.

KAK - St. Gen

TENNECO MINERALS COMPANY
(COMPANY)

INTEROFFICE COMMUNIC

TO:

DATE: 11/8/88

FOR: R. A. HODGSON

FROM: J. W. GREENE

RE: MONTHLY REPORT FOR OCTOBER, 1988

NOV 22 1988

1.0 GOLDSTRIKE-BOTTLE LEACH TESTS ON SULFIDE ORE

An additional ten bottle leaches were run on ten Goldstrike composite Assay results are available on six of the bottle leach tests.

The composites were composed of the following samples:

Comp. No.	Drill Hole No.	Depth	ASSAY Au (OPT)	Ag (OPT)	Pyrite (%)	Sul.S (%)	Mineralogy
GS-1-7	88-11	60-85	.0499	.0583	NA	NA	Sulfides
GS-1-8	88-07	0-25	.0169	.233	NA	NA	Silicified, oxides
GS-1-13	88-87	30-45	.0174	<.058	2.25	1.20	Pyrite
GS-1-14	88-87	45-65	.0408	.058	.262	.14	Iron oxides, sulfides
GS-1-15	88-91	20-45	.0426	.117	.786	.42	Silicified, clay, oxidiz minor sulfid
GS-1-16	88-91	45-65	.0452	<.058	1.03	.55	Pyrite, sulfides and oxides

NA = not available

The bottle leach test results were as follows:

	COMPOSITE NUMBER					
	GS-1-7	GS-1-8	GS-1-13	GS-1-14	GS-1-15	GS-1-[illegible]
% Au Extract.	59.8	76.6	77.1	84.2	76.1	71.8
% Ag Extract.	0	75.1	0	0	0	0
% Au Account.	96.8	109.3	130.5	111.1	106.7	114.9
NaCn Consump. (lbs/ton)	1.31	2.21	2.52	1.01	1.18	2.6[illegible]
CaO Consump. (lbs/ton)	5.04	2.98	21.2	4.02	6.03	15.1[illegible]
% Pyrite	NA	NA	2.25	.262	.786	1.0[illegible]

Slightly lower gold extractions were obtained from ores containing ov 0.5% pyrite. However, the gold extraction from ores containing over 0.5% pyrite do not decrease with increasing pyrite content. For example, 77.1% of the gold was extracted from an ore containing 2.25% pyrite while 76.1% of the gold was extracted from an ore containing .786% pyrite.

As was concluded in the last monthly report the refractioness of the sulfide zones is not completely dependent on the sulfide content. Other factors are involved.

1.2 GOLDSTRIKE - SODIUM CYANIDE CONCENTRATION COLUMN LEACH TESTS

All of the column residue assays are not available. Once these resul are available a final report on this test series will be written.

2.0 SOUTH MOUTH FONDAWAY COLUMN LEACH TESTS

An 8 inch diameter 10 foot high column containing 2 inch rock was set up. Leaching was started on September 27, 1988. Leach solution is being fed in at a rate of 0.002 GPM/ft.^{2} for 24 hours per day.

Table 1 lists the head analyses of the ore.

Cyanidation is currently underway on the ore in the column.