

December 23, 2008

Mr. Leo Francendese
On-Scene Coordinator
U.S. Environmental Protection Agency
61 Forsyth Street, SW 11th Floor
Atlanta, Georgia 30303

**Subject: Fracture Trend Analysis Letter Report
Barite Hills Nevada Goldfields Site
McCormick, McCormick County, South Carolina
Contract No. EP-W-05-053
Technical Direction Document (TDD) No.: TNA-05-003-0049**

Dear Mr. Francendese:

The TN & Associates, Inc. (TN&A), Superfund Technical Assessment and Response Team (START), has prepared this Letter Report detailing activities performed in support of the Barite Hills Nevada Goldfields site (the site) investigation under Contract Number (No.) EP-W-05-053, Technical Direction Document (TDD) No. TNA-05-003-0049. All activities and procedures were performed in accordance with the EPA Science and Ecosystems Support Division (SESD) Region 4 Field Branches Quality System and Technical Procedures dated November 2007, and the EPA-approved site-specific Quality Assurance Project Plan (QAPP).

Under this work assignment, START was tasked with conducting a geologic assessment at the site to include an evaluation of fractures in rock units at various locations therein. Iron pyrite minerals (pyritic rock) within rock units around the Main Pit, leach sulfates during rain events resulting in an extremely low pH of the Main Pit water. This low pH condition creates a human and ecological exposure risk. The surrounding rock has been capped aiding neutralization of the pit water to prevent further sulfates from leaching into the pit. The general purpose of the assessment was to delineate zones of weakness and other acid generating units along the Hawes Creek tributary, Mineral Springs. This was established by performing a fracture trend analysis from 35 fracture orientation measurements collected from in-situ rock exposures in the Main Pit, Mineral Springs, and along strike rock units.

Site Background

The site is an abandoned pit mine located approximately 3 miles south of McCormick, McCormick County, South Carolina between US Highway (Hwy) 378 and US Hwy 221 on the northern side of Road 30. The site is located in a relatively remote area; there are no buildings, homes, or commercial buildings within 0.5 mile of the site boundary.

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The site is located along a topographic high ridge area forming the headwaters of Mineral Springs. The topography of the area consists of rolling hills with ridgelines at an elevation of about 500 feet above mean sea level (amsl). Within the site, the ridgeline comprising the site has a high point of about 510 feet amsl and an average elevation of approximately 480 feet amsl.

The Main Pit from the mining operations remains. When the mine was abandoned, the Main Pit flooded. This introduction of water was the initial step in acid rock drainage. The waste rock stockpiles previously surrounding the eastern and southeastern portions of the Main Pit were a source of acid rock drainage. The pit contains approximately 60 million gallons of water with an historical pH of 2 and a high dissolved metal content. Current pH is 5.43.

Permeability and reservoir potential of a rock unit is affected by fractures. Fractures usually occur as sets with smaller subparallel fractures. The relationship between fracture sets affects drainage through rock units. To understand the water pathway of the seeps on the creek, rock fracture orientations were measured on 11/19/08 and 11/21/08.

Field Investigation Activities

On 11/19/08, START conducted a field investigation to delineate areas of weakness in rock units. The investigation consisted of measuring fracture orientations around the pit and along the creek on 11/21/08. A Health and Safety Plan (HASP) was developed for the site prior to fieldwork activities.

START collected orientations 35 in-situ measurements from the northeast and east Main Pit walls, the southwest rock exposure near the cap rock, and within and along the creek from Seep 1 upstream to Seep 3 (Figure 1). Orientations were measured using a Brunton quadrant compass. Each orientation includes strike and dip of the measured feature. Orientations were plotted on an equal area rose diagram using StereoWin 1.2 © for trend analysis. A photographic log of the geologic investigation is located in Attachment B.

Two main rock units outcrop along the pit and creek: tan to light-orange, well-foliated felsic metavolcanic unit (LFV); and greenish-gray, thinly bedded, interlayered metavolcanic and metasedimentary unit (US). Both units are competent and most resistant to weathering compared to other rock units. Fracture sets are easily observable and accessible to measurement. Other incompetent rock units provide scarce observable and accessible fracture sets due to extensive weathering. Therefore, orientation measurements reflect competent rock unit trends only.

Conclusions

Figure 2 is a rose diagram with all fracture orientations. From this diagram, one major fracture set is illustrated. Orientations lie between 40°-60° and 310°-330° azimuth. The angle between the two fracture orientations ranges from 70° to 120°. The mean fracture set of LFV is 45° and 325° with an average angle of 90°. US mean fracture set is 52° and

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313° with an average angle of 99°. Zones of weakness following this trend are highlighted in Figure 3.

Other smaller subparallel fractures are observable in the rock units. These fractures were not measured because they were irregular and erratic, not consistent with on-site trends or regional trends. Surfaces of these fractures are curved unlike the planar fracture sets observed in the competent units. These irregular fractures were only observed around the pit and not in the creek. The fractures are most likely associated with blasting during mining and not naturally occurring.

Iron oxide mineralization was observed on fracture surfaces near the Main Pit wall. Stormwater run-off near the lake will follow the fractures and contact mineralization before discharging into the pit lake. See Attachment B photographic log.

Up hill, northeast from Seep 2, boulders approximately 3 feet in diameter with iron oxide mineralization lie on the slope. Stormwater run-off from the hill drains into the creek carrying iron oxides from these boulders. This provides influence on creek pH changes in addition to the seeps. These additional areas of acid rock drainage are recommended for further characterization to determine their relative contribution to creek pH.

If you have any questions or comments regarding this Letter Report or require any additional information, please contact me at (678) 355-5550.

Sincerely,



Dannena Bowman

Jr. Geologist

T N & Associates, Inc.

Superfund Technical Assessment and Response Team (START)

Enclosures

Attachment A – Figures

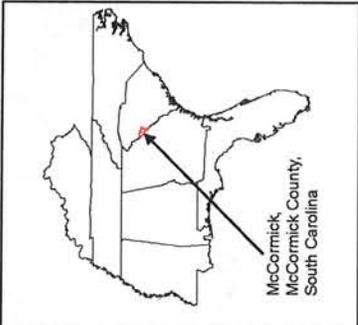
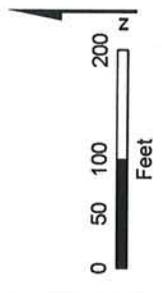
Attachment B – Photographic Log

Attachment A
Figures



Legend

- Seep Locations
- Hawes Creek Tributary
- ▭ Fracture Measurement Zones

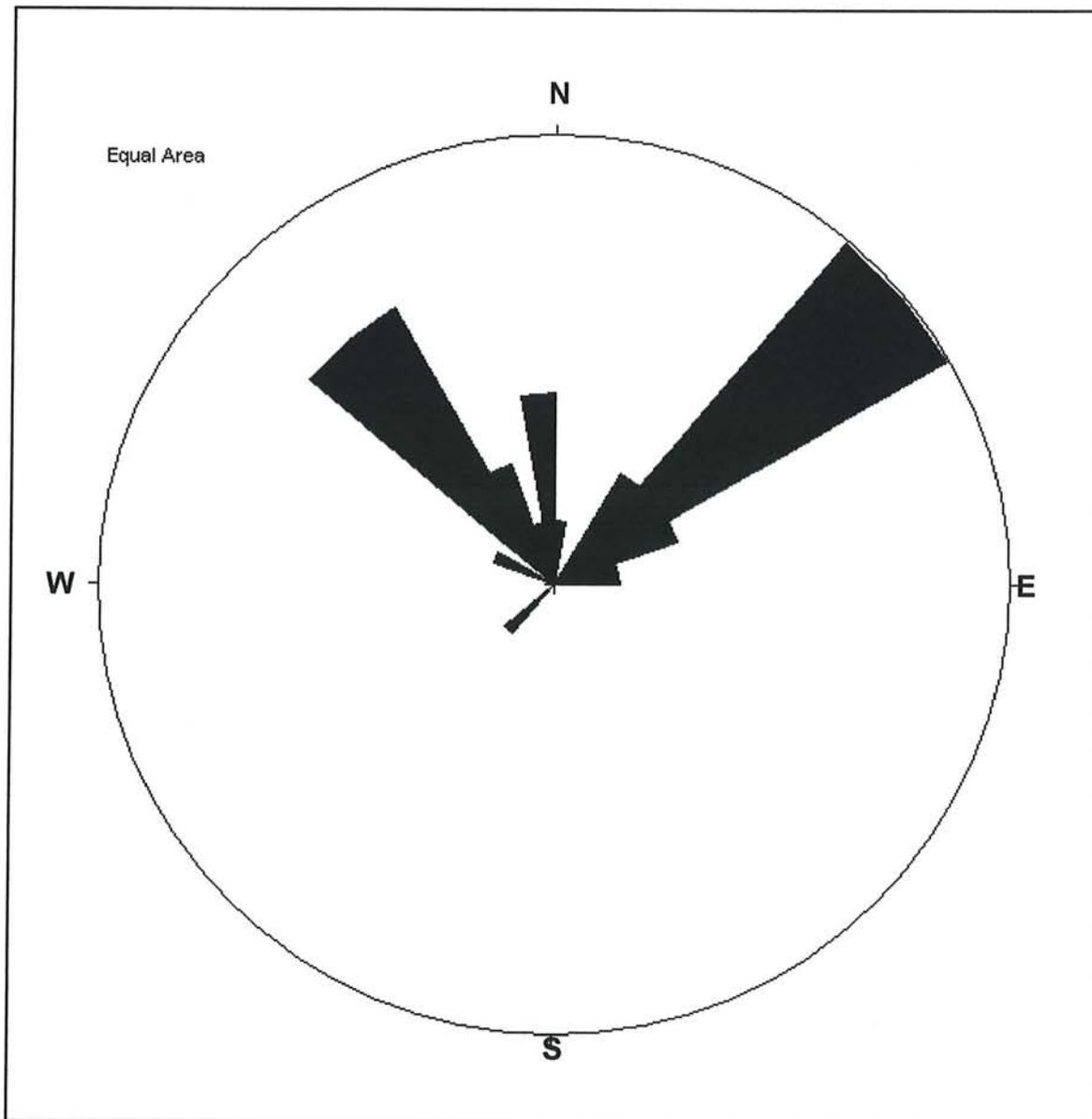


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FIGURE 1
FRACTURE MEASUREMENT &
CREEK SEEP LOCATIONS

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 in consultation with Steve Bell and Alexander



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FIGURE 2

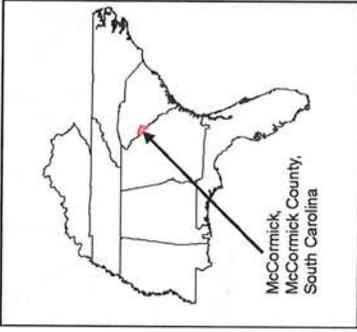
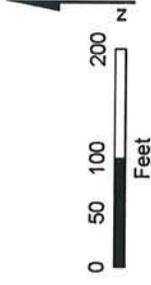
Rose diagram illustrating fracture orientation trends, n=35.

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Legend

- Seep Locations
- Hawes Creek Tributary
- ▭ Fracture Zones



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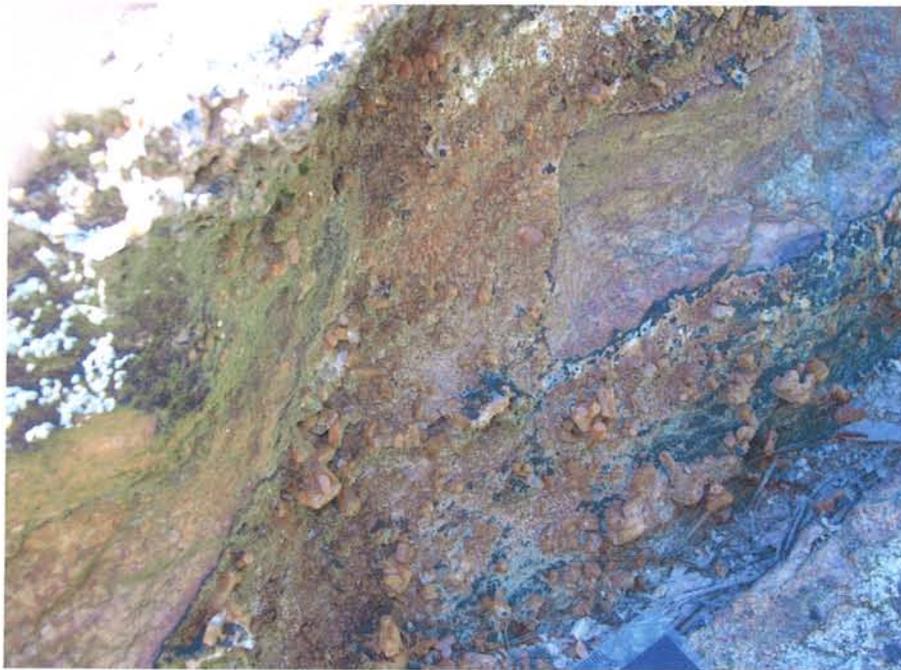
**BARITE HILLS
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TDD No. TNA-05-003-0049

FIGURE 3 ROCK UNIT FRACTURE ZONES

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Attachment B
Photographic Log



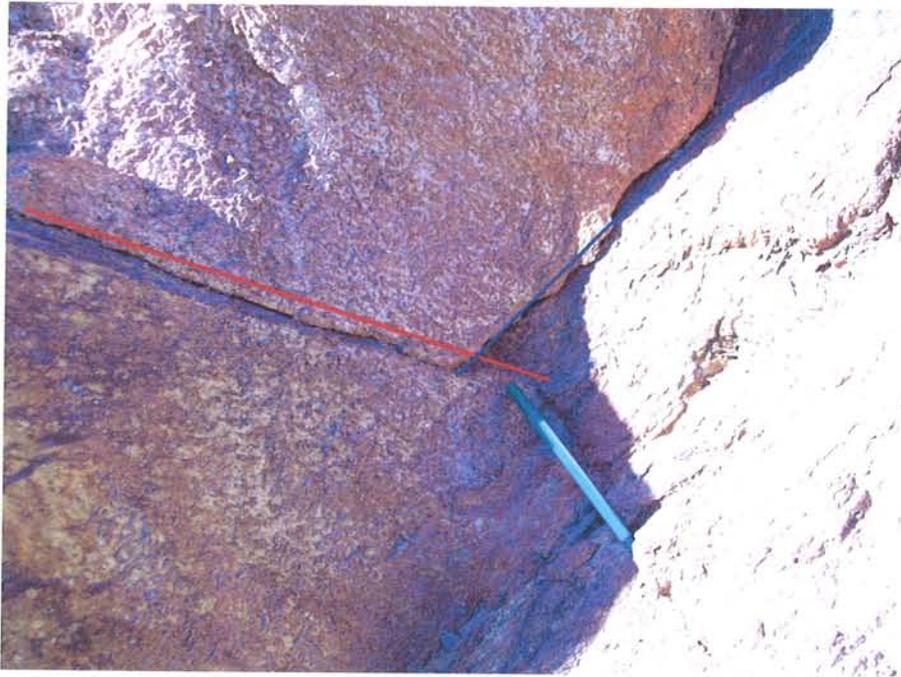
Official Photograph No. 1

Site Name: Barite Hills **Date:** November 19, 2008
Location: McCormick, McCormick Cnty., S. Car. **TDD No:** TNA-05-003-0049
Photographer: Dannena Bowman, START
Subject: Facing west, east side of Main Pit, iron oxide crystals on fracture surface.



Official Photograph No. 2

Site Name: Barite Hills **Date:** November 19, 2008
Location: McCormick, McCormick Cnty., S. Car. **TDD No:** TNA-05-003-0049
Photographer: Dannena Bowman, START
Subject: Facing east, major fractures in rock outcrop alongside lake pit. Red line is approximate trend of fracture. Blue line is approximate trend of secondary fracture.



Official Photograph No. 3

Site Name: Barite Hills **Date:** November 19, 2008
Location: McCormick, McCormick Cnty., S. Car. **TDD No:** TNA-05-003-0049
Photographer: Dannena Bowman, START
Subject: Facing northwest, fracture surfaces along west wall of Main Pit. Red line is approximate trend of fracture. Blue line is approximate trend of secondary fracture.



Official Photograph No. 4

Site Name: Barite Hills **Date:** November 19, 2008
Location: McCormick, McCormick Cnty., S. Car. **TDD No:** TNA-05-003-0049
Photographer: Dannena Bowman, START
Subject: Facing northwest, fracture surfaces along west wall of Main Pit. Red and blue lines same as previous photo, green line is irregular blast fracture.



Official Photograph No. 5

Site Name: Barite Hills **Date:** November 21, 2008
Location: McCormick, McCormick Cnty., S. Car. **TDD No:** TNA-05-003-0049
Photographer: Dannena Bowman, START
Subject: Facing northeast, major fractures in rock outcrop alongside creek near Seep 2. Red line is approximate trend of fracture. Blue line is approximate trend of secondary fracture.



Official Photograph No. 6

Site Name: Barite Hills **Date:** November 19, 2008
Location: McCormick, McCormick Cnty., S. Car. **TDD No:** TNA-05-003-0049
Photographer: Dannena Bowman, START
Subject: Facing east, major fractures in rock outcrop alongside creek near Seep 2. Red line is approximate trend of fracture. Blue line is approximate trend of secondary fracture.