



Copper Queen Branch/Freeport-McMoRan Corporation
36 West Highway 92
Bisbee, Arizona 85603

VIA UPS EXPRESS A559 180 510 9

February 6, 2009

Ms. Cynthia S. Campbell
Manager, Water Quality Compliance Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

**RE: Mitigation Order, Docket No. P-121-07
Results of Monthly Sulfate Monitoring and Trend Analysis**

Dear Ms. Campbell:

In accordance with Mitigation Order on Consent, Docket No. P-121-07 Freeport-McMoRan Corporation, Copper Queen Branch (CQB) has conducted monthly water quality sampling at six drinking water supply wells that had sulfate concentrations between 135 mg/L (milligrams per liter) and 250 mg/L in their initial samples. Recommendations for ongoing monitoring at five of the six wells were made in a previous letter.¹ In that letter, recommendations were made for an additional monthly sampling at the Schwartz well. The enclosed letter from Hydro Geo Chem, Inc. evaluates the results of the water quality sampling at the Schwartz well and recommends revising the sampling frequency to quarterly based on their evaluation of the prior sampling results. CQB plans to implement the proposed monitoring schedule in second quarter 2009 unless we hear otherwise from Arizona Department of Environmental Quality by February 28, 2009. The monitoring recommendations for drinking water supplies will be re-evaluated for development of the Mitigation Plan.

If you have any questions or require anything additional please contact me at 520-432-6206.

Sincerely,

Rebecca A. Sawyer
Senior Environmental Engineer
Copper Queen Branch

Enclosure

cc: J. Norris, HGC
S. Brown, Bridgewater
N. Hall, FMC
S. Deely, FMC

¹ Rebecca A. Sawyer, Freeport-McMoRan Copper & Gold, to Cynthia S. Campbell, ADEQ, 01 October 2008.



January 29, 2009

Rebecca A. Sawyer
Senior Environmental Engineer
Freeport-McMoRan Copper Queen Branch
36 West Highway 92
Bisbee, Arizona 85603

**RE: Mitigation Order on Consent No. P-121-07
SCHWARTZ Well - Monthly Sulfate Monitoring and Trend Analysis**

Dear Ms. Sawyer:

This letter describes and evaluates the results of monthly water sampling and analysis of sulfate in drinking water supply well SCHWARTZ conducted pursuant to Section 4 of the Work Plan¹.

In February 2008 water quality sampling for the well inventory² identified six wells (BIMA, BLOMMER, FULTZ, RAY, ROGERS 803, and SCHWARTZ) verified as drinking water supply wells that had a discrete sulfate concentration between 135 milligrams per liter (mg/l) and 250 mg/l. These wells were sampled monthly for sulfate and a trend analysis³ was conducted. Based on the results of the trend analysis it was recommended that wells BIMA, BLOMMER, FULTZ, RAY, and ROGER 803 be monitored on a quarterly schedule. SCHWARTZ having a positive Mann-Kendall statistic, indicating that the sulfate concentration may be increasing, was to remain on a monthly monitoring schedule an additional quarter at which time another trend analysis would be conducted.

The following table provides the results of that sampling. Analytical reports for February through September 2008 are included as Appendix D in both the First and Second Quarters and Third Quarter Groundwater Reports^{4 5}. Analytical reports for the October through December 2008 sampling will be included in the fourth quarter monitoring report.

| Feb-08 | Apr-08 | May-08 | Jun-08 | Jul-08 | Aug-08 | Sep-08 | Oct-08 | Nov-08 | Dec-08 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 158 | 122 | 130 | 129 | 245 | 131 | 124 | 135 | 140 | 144 |

Results presented as sulfate in mg/l

¹ Hydro Geo Chem, Inc. (HGC) 2008. Revision 1, Work Plan to Characterize and Mitigate Sulfate with Respect to Drinking Water Supplies in the Vicinity of the Concentrator Tailing Storage Area, Cochise County, Arizona. July 3, 2008.

² HGC, 2008. Well Inventory Report, Task 1 of Aquifer Characterization Plan for Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. July 3, 2008.

³ HGC, 2008. Results of Monthly Sulfate Monitoring and Trend Analysis. September 29, 2008.

⁴ HGC, 2008. First and Second Quarters 2008 Groundwater Monitoring Report, Task 2.2 of Aquifer Characterization Plan Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. July 30, 2008.

⁵ HGC, 2008. Third Quarter 2008 Groundwater Monitoring Report, Task 1.0, 2.2 and 2.3 of Aquifer Characterization Plan Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. October 27, 2008.

Mann-Kendall Analysis

A Mann-Kendall statistical trend analysis was conducted to determine if concentrations of sulfate are increasing or decreasing over time in samples collected from the SCHWARTZ drinking water supply well. The Mann-Kendall test is a non-parametric test for identifying trends in time series data. The test compares the relative magnitudes of sample data rather than the data values themselves. One particular benefit of this test is that the data need not conform to any particular distribution. Moreover, the test can be used with a minimum of four rounds of sampling results. The attached Excel based macro⁶ was used to process the input time series data, perform the trend analysis, and report the results.

Mann-Kendall Trend Results

Based on guidance in Gilbert⁷, a trend was considered significant if the "confidence in trend" metric, $(1-p) \times 100\%$, was $\geq 80\%$ which represents a significance level of $\alpha = 0.2$. A statistically significant (81% confidence level) increasing trend was observed in the SCHWARTZ well. The results are shown in the following table.

| Event | Sample Date | SCHWARTZ |
|------------------------------------|-------------|------------|
| 1 | Feb-08 | 158 |
| 2 | Apr-08 | 122 |
| 3 | May-08 | 130 |
| 4 | Jun-08 | 129 |
| 5 | Jul-08 | 245 |
| 6 | Aug-08 | 131 |
| 7 | Sep-08 | 124 |
| 8 | Oct-08 | 135 |
| 9 | Nov-08 | 140 |
| 10 | Dec-08 | 144 |
| Mann-Kendall Statistic (S) | | 11 |
| Probability (p) | | 0.190 |
| Confidence in Trend (1-p) | | 81% |
| Number of Rounds (n) | | 10 |
| Average | | 145.8 |
| Standard Deviation | | 36.417 |
| Coefficient of Variation (COV) | | 0.250 |
| Trend $\geq 80\%$ Confidence Level | | INCREASING |
| Trend $\geq 90\%$ Confidence Level | | No Trend |

Monthly monitoring data for drinking water supply well SCHWARTZ, although having a statistically significant increasing trend has discrete sulfate detected at concentrations <250 mg/l during the ten months of sampling, with an average sulfate concentration of 145.8 mg/l. As such, quarterly monitoring is recommended for this well.

⁶ State of Wisconsin, 2001. Department of Natural Resources, Chapter NR 700 Appendix A, Mann-Kendall Statistical Test, Form 4400-215.

⁷ Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York.

Please do not hesitate to call us if you have any questions about the data analysis or the monitoring recommendations described in this letter.

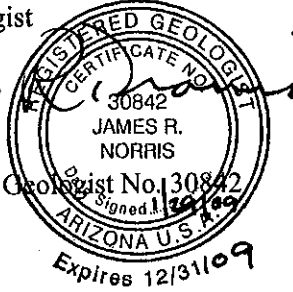
Sincerely,



Daniel R. Simpson
Senior Hydrogeologist



James R. Norris
Arizona Registered Geologist No. 30842



Attachment

cc: Michael Jaworski, Freeport-McMoRan Copper Queen Branch
Ned Hall, Freeport-McMoRan Sierrita Inc.
Sheila Deely, Freeport-McMoRan Copper & Gold, Inc.
Dalva Moellenberg, Gallagher & Kennedy
Stuart Brown, Bridgewater Group, Inc.

**ATTACHMENT
MANN-KENDALL TREND ANALYSIS**

Bisbee Mitigation Order - Sulfate Trend Analysis

| Event | Sample Date | SCHWARTZ | | | | | |
|--------------------------------|-------------|----------|---|---|---|---|---|
| 1 | Feb-08 | 158 | | | | | |
| 2 | Apr-08 | 122 | | | | | |
| 3 | May-08 | 130 | | | | | |
| 4 | Jun-08 | 129 | | | | | |
| 5 | Jul-08 | 245 | | | | | |
| 6 | Aug-08 | 131 | | | | | |
| 7 | Sep-08 | 124 | | | | | |
| 8 | Oct-08 | 135 | | | | | |
| 9 | Nov-08 | 140 | | | | | |
| 10 | Dec-08 | 144 | | | | | |
| Mann-Kendall Statistic (S) | | 11 | 0 | 0 | 0 | 0 | 0 |
| Probability (p) | | 0.190 | 0 | 0 | 0 | 0 | 0 |
| Confidence in Trend (1-p) | | 81% | 0 | 0 | 0 | 0 | 0 |
| Number of Rounds (n) | | 10 | 0 | 0 | 0 | 0 | 0 |
| Average | | 145.8 | 0 | 0 | 0 | 0 | 0 |
| Standard Deviation | | 36.417 | 0 | 0 | 0 | 0 | 0 |
| Coefficient of Variation (COV) | | 0.250 | 0 | 0 | 0 | 0 | 0 |

| | | | | | |
|-----------------------------------|-----|-----|-----|-----|-----|
| Error Check, If No Errors - Blank | n<4 | n<4 | n<4 | n<4 | n<4 |
|-----------------------------------|-----|-----|-----|-----|-----|

| | | | | | | |
|------------------------------|------------|-----|-----|-----|-----|-----|
| Trend ≥ 80% Confidence Level | INCREASING | n<4 | n<4 | n<4 | n<4 | n<4 |
| Trend ≥ 90% Confidence Level | No Trend | n<4 | n<4 | n<4 | n<4 | n<4 |

| | | | | | | |
|--|----|-----|-----|-----|-----|-----|
| Stability Test; If No Trend Exists at 80% Confidence Level | NA | n<4 | n<4 | n<4 | n<4 | n<4 |
|--|----|-----|-----|-----|-----|-----|

| THIS BLOCK OF CELLS IS USED TO SEARCH FOR DATA ENTRY ERRORS | | | | | | | |
|--|-------------|----------|----------|----------|----------|----------|----------|
| DATA ERROR CHECKS | Event | SCHWARTZ | 0 | 0 | 0 | 0 | 0 |
| | 1 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 2 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 3 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 4 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 5 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 6 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 7 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 8 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 9 | -1 | -1 | -1 | -1 | -1 | -1 |
| | 10 | -1 | -1 | -1 | -1 | -1 | -1 |
| Checks for data with values less than zero or text (a space is seen as text in Excel). | | | | | | | |
| Minus one (-1) shown if no error. | Data Error? | no error | no error | no error | no error | no error | no error |

| THIS BLOCK OF CELLS USED TO FIND ERRORS IN DATES | | | | |
|---|-------------|---------------|--------------|-----------------|
| DATE ERROR CHECKS | Date | Text in Date? | Consecutive? | Data w no date? |
| | Feb-08 | -1 | -1 | -1 |
| | Apr-08 | -1 | -1 | -1 |
| | May-08 | -1 | -1 | -1 |
| | Jun-08 | -1 | -1 | -1 |
| | Jul-08 | -1 | -1 | -1 |
| | Aug-08 | -1 | -1 | -1 |
| | Sep-08 | -1 | -1 | -1 |
| | Oct-08 | -1 | -1 | -1 |
| | Nov-08 | -1 | -1 | -1 |
| | Dec-08 | -1 | -1 | -1 |
| Checks include a test for consecutive dates and text. | | | | |
| Minus one (-1) shown if no error. | Date Error? | no error | no error | no error |

| Mann Kendall S Values | | |
|-----------------------|----------|----------|
| Values of n | Smax@0.2 | Smax@0.1 |
| 4 | -4 | -6 |
| 5 | -5 | -7 |
| 6 | -6 | -8 |
| 7 | -7 | -10 |
| 8 | -8 | -11 |
| 9 | -10 | -14 |
| 10 | -11 | -16 |

| TEST FOR INCREASING OR DECREASING TREND @ 80% | Number of Rounds | SCHWARTZ | 0 | 0 | 0 | 0 | 0 |
|--|------------------|----------|------------|---------|---------|---------|---------|
| | 4 | | | | | | |
| | 5 | | | | | | |
| | 6 | | | | | | |
| | 7 | | | | | | |
| | 8 | | | | | | |
| | 9 | | | | | | |
| | 10 | 1 | Increasing | Neither | Neither | Neither | Neither |
| If +1, Increasing If -1, decreasing If 0, neither. | | | | | | | |

| TEST FOR INCREASING OR DECREASING TREND @ 90% | Number of Rounds | SCHWARTZ | 0 | 0 | 0 | 0 | 0 |
|--|------------------|----------|---------|---------|---------|---------|---------|
| | 4 | | | | | | |
| | 5 | | | | | | |
| | 6 | | | | | | |
| | 7 | | | | | | |
| | 8 | | | | | | |
| | 9 | | | | | | |
| | 10 | 0 | Neither | Neither | Neither | Neither | Neither |
| If +1, Increasing If -1, decreasing If 0, neither. | | | | | | | |

**ATTACHMENT
MANN-KENDALL TREND ANALYSIS**

| Bieber Mitigation Order - Sulfate Trend Analysis | | | | | | | | | | Well: SCHWARTZ |
|--|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------------|
| Event 1 | Event 2 | Event 3 | Event 4 | Event 5 | Event 6 | Event 7 | Event 8 | Event 9 | Event 10 | Sum Rows |
| 158 | 122 | 130 | 129 | 245 | 131 | 124 | 135 | 140 | 144 | -7 |
| | -1 | -1 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | -7 |
| | | 1 | -1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| | | | -1 | 1 | 1 | -1 | 1 | 1 | 1 | 3 |
| | | | | 1 | 1 | -1 | 1 | 1 | 1 | 4 |
| | | | | | -1 | -1 | -1 | -1 | -1 | -5 |
| | | | | | | -1 | 1 | 1 | 1 | 2 |
| | | | | | | | 1 | 1 | 1 | 3 |
| | | | | | | | | 1 | 1 | 2 |
| | | | | | | | | | 1 | 1 |
| | | | | | | | | | | 1 |
| Mann Kendall Statistic (S) = | | | | | | | | | | 11 |