TA-16

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Date: July 28, 2006
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JUL 2006
NMED Hazardous Waste Bureau

Mr. James Bearzi
NMED-Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

SUBJECT: UPDATE ON STATUS OF GROUNDWATER WELL R-25

Dear Mr. Bearzi:

As you know, the Compliance Order on Consent gave Los Alamos National Laboratory (LANL) the opportunity to demonstrate that water quality data from well R-25 are, or will be, valid and reliable. Los Alamos National Laboratory submitted the "Plan to Demonstrate Validity of R-25 Data" (LANL 2005a) on May 1, 2005. This letter is to inform you that our plans for actions related to R-25 presented in this document have been superseded by the "Workplan for R-Well Rehabilitation and Replacement" (LANL 2006) submitted to the Hazardous Waste Bureau on May 31, 2006. This information is also presented in section 4.4.6 of the "Workplan for R-Well Rehabilitation and Replacement." The "Plan to Demonstrate Validity of R-25 Data" no longer requires review and approval by the New Mexico Environment Department (NMED) Hazardous Waste Bureau.

In the "Workplan for Well Rehabilitation and Replacement," we proposed that the rehabilitation plans for R-25 be reviewed after the results of the pilot well rehabilitation and the subsequent rehabilitation of five other wells. Thus, we will have completed a thorough investigation of the success of the well rehabilitation before making final decisions on R-25. Seven of the nine R-25 screens are being considered for rehabilitation because two screens (#3 and #9) are unusable as a result of construction problems.

We continue to sample R-25 and review the results. As you know, nickel and chromium levels at R-25 screens #1 and #2 have been elevated since the time the well was drilled (LANL 2002; LANL 2003; LANL 2004; LANL 2005b). This trend has continued in 2005 (Attachment 1). The rise in filtered sample levels of nickel and chromium in the last year suggest increased breakdown and mobility of stainless steel from corrosion of screens #1 and #2 and/or particles remaining from construction problems. To evaluate stainless steel as the source, we have reviewed concentrations of other metal indicators by performing calculations using the PHREEQC2.2 computer code (Attachment 2).

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These results support the understanding that corrosion of stainless steel is occurring in R-25 screens #1 and #2.

Other R-25 screens do not demonstrate corrosion of the well casing. In addition, we reviewed metals data from wells R-9, R9i, and R-12. These wells were constructed during the same time period as R-25. These wells do not demonstrate corrosion of the well casing.

Over time, the corrosion of stainless steel is a potential source of groundwater contamination (EPA 1995). Because of this concern, we are reevaluating our well rehabilitation plan proposal for R-25. Our preliminary proposal consists of

- isolating R-25 screens #1 and #2 because of the potential for introducing contamination into the groundwater, and
- evaluating and proposing the ongoing need for other R-25 screens as part of the South Canyons work plan that is due to NMED on September 30, 2006.

We would like to meet with you to discuss the R-25 data and our proposed path forward. If you have any questions, please call Ardyth Simmons at 665-3935 or Mat Johansen at 665-5046.

Sincerely,

Andrew Phelps,
Associate Director,
Environmental Programs
Los Alamos National Laboratory

Sincerely,

David Gregory,
Federal Project Director
Department of Energy
Los Alamos Site Office

AP/DG/JD/jr

Attachments:
1. Observations of Metals in R-9, R-9i, R-25, R-12
2. Results of Geochemical Modeling of Nickel at R-25 using PHREEQC2.2
3. References

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EP-WSP File, MS M992
IRM-RMMSO, MS A150
RPF, MS M707

Attachment 1
Observations of Metals in R-9, R-9i, R-25, R-12

R-25 (Figures 1–5)

- Figures 1–3 show nickel, chromium, and molybdenum concentrations versus time for all screens in R-25. Only the upper two screens exhibit increasing concentrations with time.
- Figures 4–5 show increasing values for chromium, manganese, nickel, and iron, but not molybdenum, for the top two screens.
- Filtered Cr does not appear to be increasing.
- Unfiltered values tend to be higher than filtered values.
- There appears to be some elevated concentrations in 2002 that are not congruent with the other values.

R-12 (Figures 6–7)

- R-12 does not exhibit elevated metal concentrations.
- All nickel concentrations in R-12 are below 10 µg/L, with the exception of the values from the screen at 898.1 ft bgs which have elevated concentrations in the first sampling event only.
- Iron and manganese also show elevated concentration only in the first sampling event (not shown graphically).
- Molybdenum remains relatively constant (not shown graphically).

R-9/R-9i (Figures 8–9)

- Chromium and nickel decrease 2 to 3 orders of magnitude from initial sampling in R-9.
- All chromium values have been below 10 µg/L since 2001.
- Nickel concentrations are between 10–100 µg/L in well R-9i and below 10 µg/L in well R-9.
- Note: R-9 was installed earlier than R-9i.

Conclusions

Elevated metal concentrations exist in the top two screens of R-25. The other screens in R-25 and all screens in wells R-9, R-9i, and R-12 do not exhibit elevated metal concentrations. Nickel, manganese, iron, and chromium concentrations are elevated and increasing with time in the upper two screens of R-25. Unfiltered values are generally higher than filtered values.

Attachment 2
Results of Geochemical Modeling of Nickel at R-25 Using PHREEQC2.2

Geochemical modeling was performed using the PHREEQC2.2 (pH-Redox-Equilibrium) computer code to address the source of nickel identified in groundwater samples collected from R-25. The hypothesis that was tested consisted of addressing the following question: could oxidation (corrosion) of nickel metal present in the well screen and/or casing material result in elevated concentrations of dissolved nickel observed in groundwater samples collected from screen number 1 at R-25? Nickel is a constituent of stainless steel (A 304) comprising 0.65 to 3.80 weight percent (6500 to 38,000 mg/kg or ppm). Background concentration of nickel in the Bandelier Tuff is 2 mg/kg and the trace element is associated with iron oxides-hydroxides. Nickel has not been identified as a contaminant associated with high explosive operations at TA-16.

Analytical results for filtered samples collected from screen number 1 on August 2, 2005 were used as input for the calculation, which are provided in Table 1. The dissolved concentration of nickel used as input for the calculation was set at 0.001 ppm (median LANL background). The amount of nickel metal was set at 0.722 ppm (1.23E-05 moles per liter). This amount is equal to the concentration of dissolved nickel measured in groundwater collected from screen number 1 on August 2, 2005.

Results of the computer modeling show that nickel metal present in casing material is not stable in R-25 groundwater and it can oxidized to nickel(II) aqueous species. The calculated concentration of nickel was 0.722 ppm (1.232E-05 moles per liter) produced through oxidation. The dominant forms of dissolved nickel(II) predicted to occur in groundwater at R-25 include $NiCO_3^0$ (56.8 percent), Ni^{2+} (39.3 percent), and $NiHCO_3^+$ (3.4 percent). These dissolved forms of nickel are not expected to be removed from groundwater through adsorption processes with ferric hydroxide and clay minerals present in the Bandelier Tuff. Precipitation of nickel(II) is unlikely based on modeling results. Groundwater is predicted to be undersaturated with respect to $NiCO_3$, $Ni(OH)_2$, and $Ni_4(OH)_6SO_4$.

Not all of the nickel metal present in the well screen and casing material at R-25 (screen number 1) has oxidized to nickel(II), based on measured dissolved concentrations of this solute. Concentrations of dissolved nickel in samples collected from screen number 1, however, have increased over time. The maximum amount of dissolved nickel that could be produced from oxidation of well materials is 38,000 ppm (0.647 moles per liter). This amount, however, is very unlikely under existing site conditions and observed water chemistry.

Table 1. Groundwater Chemistry of R-25, Screen #1, for PHREEQC2.2 Calculations (sampled on 08/02/06)

Parameter	Concentration (mg/L)
Ca	18.2
Mg	6.08
Na	9.77
K	1.33
NO_3 (N)	1.04
Ni	0.001
Fe(II)	0.192
Cl	13.5
HCO_3	72.5
SO_4	8.48

pH = 6.82, temperature = 17.8°C, Corrected field Eh = 461 millivolt

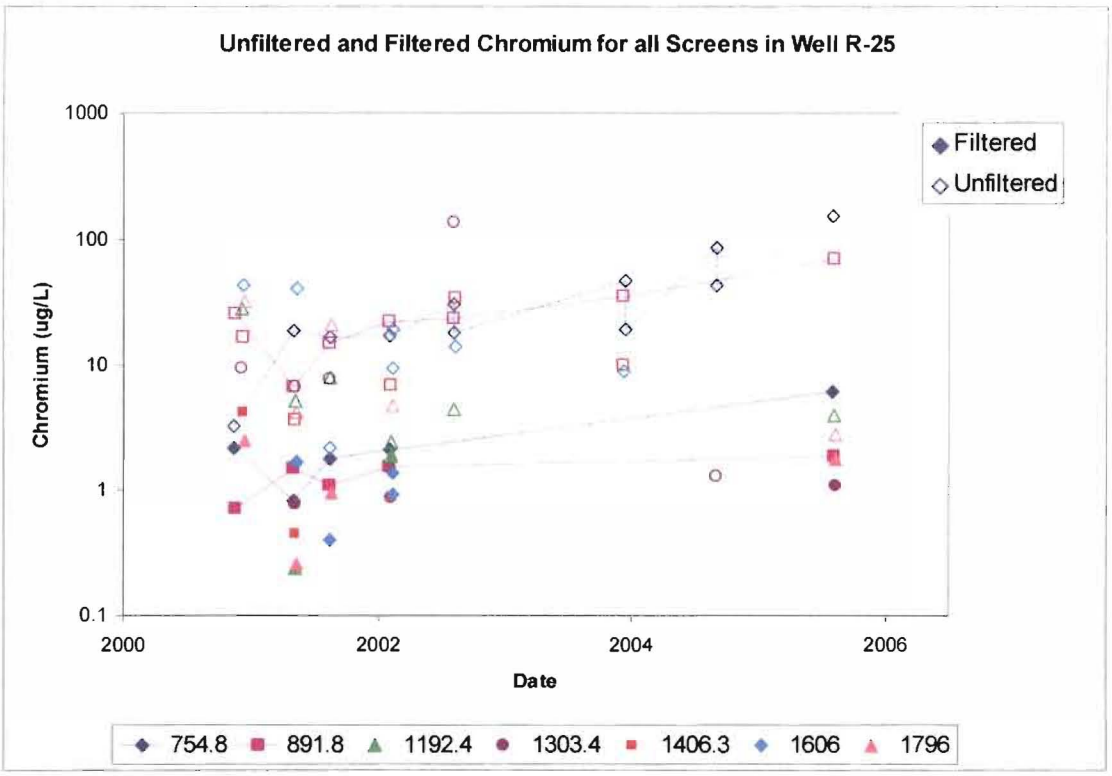

Figure 1. Chromium concentrations versus time for all screens in well R-25. Note the logarithmic Y-axis.

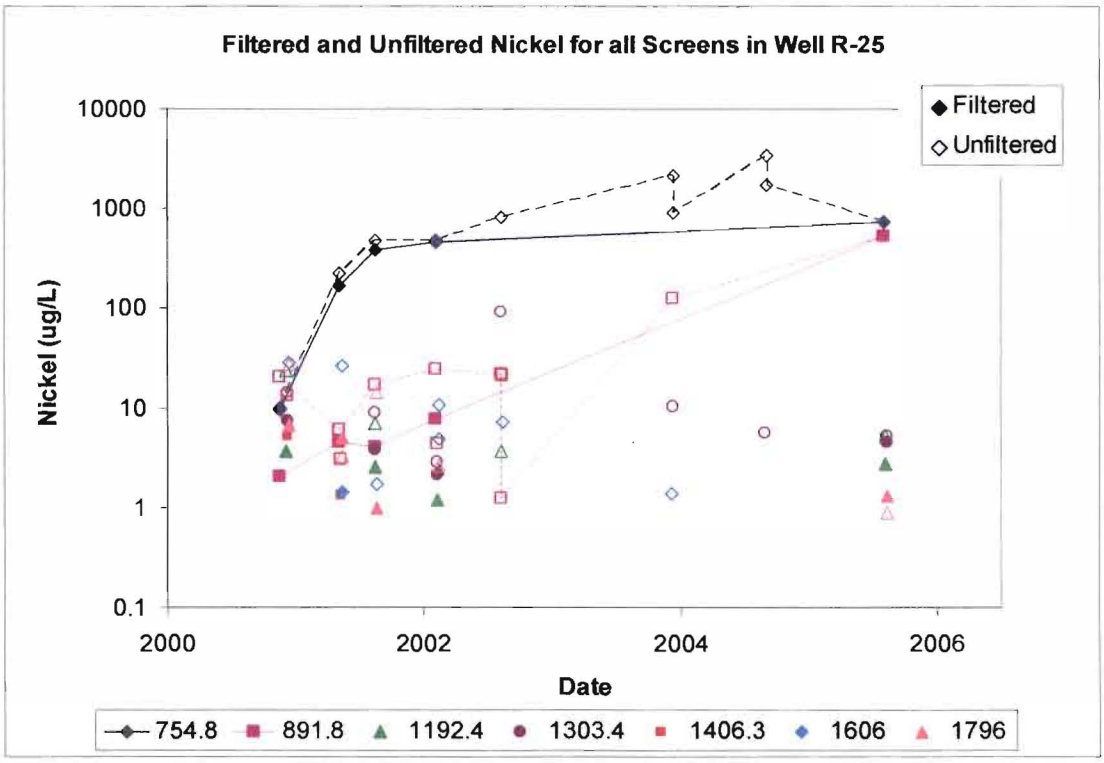

Figure 2. Nickel concentrations versus time for all screens in well R-25. Note the logarithmic Y-axis.

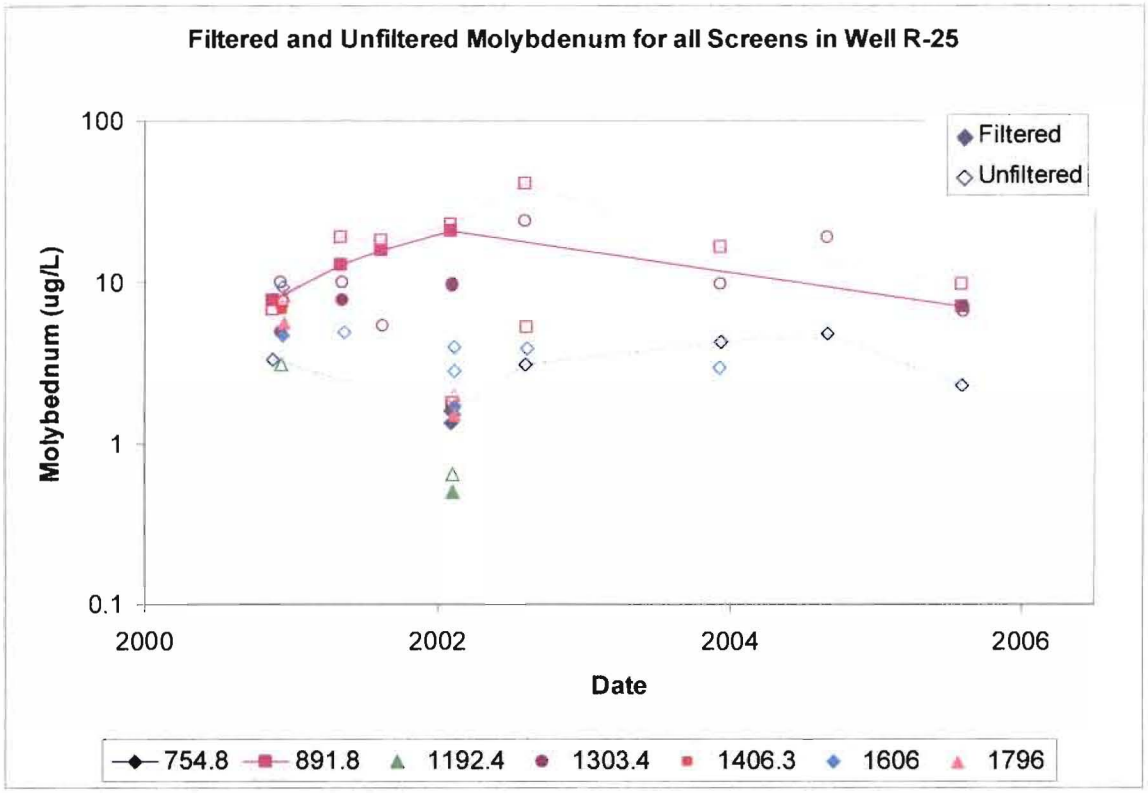

Figure 3. Molybdenum concentrations versus time for all screens in well R-25. Note the logarithmic Y-axis.

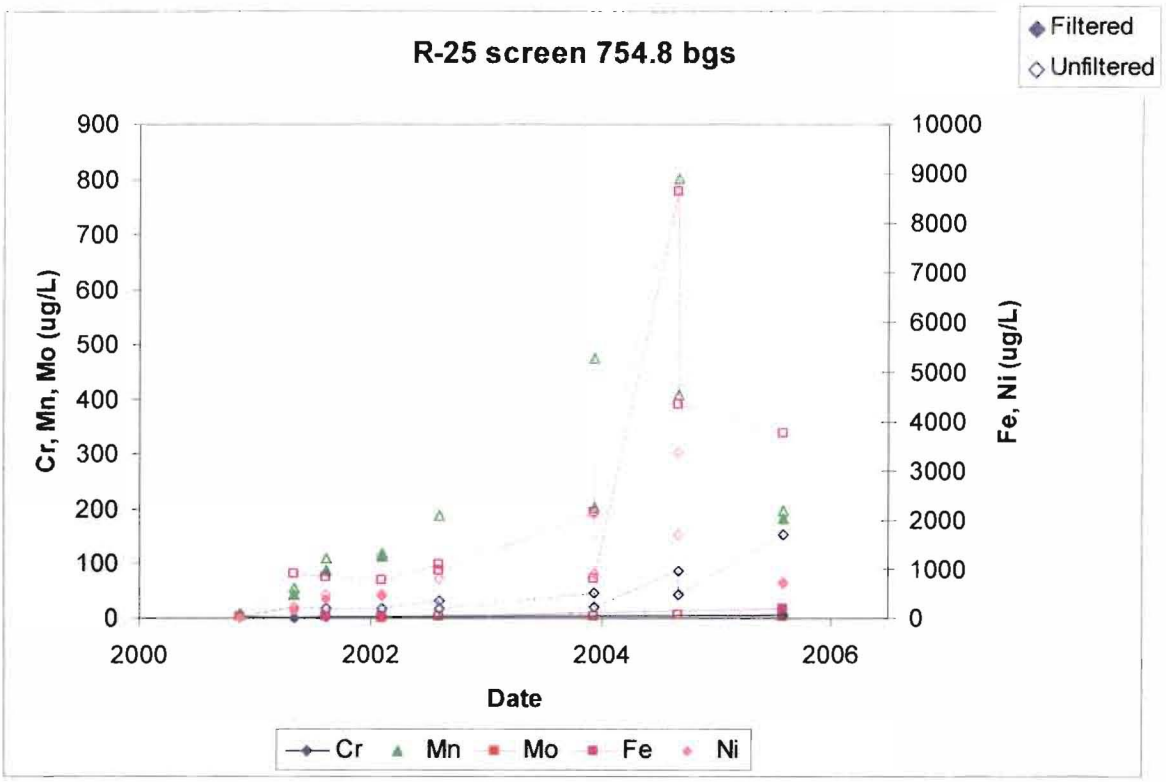

Figure 4. Metal concentrations for first screen (754.8 ft bgs) in well R-25

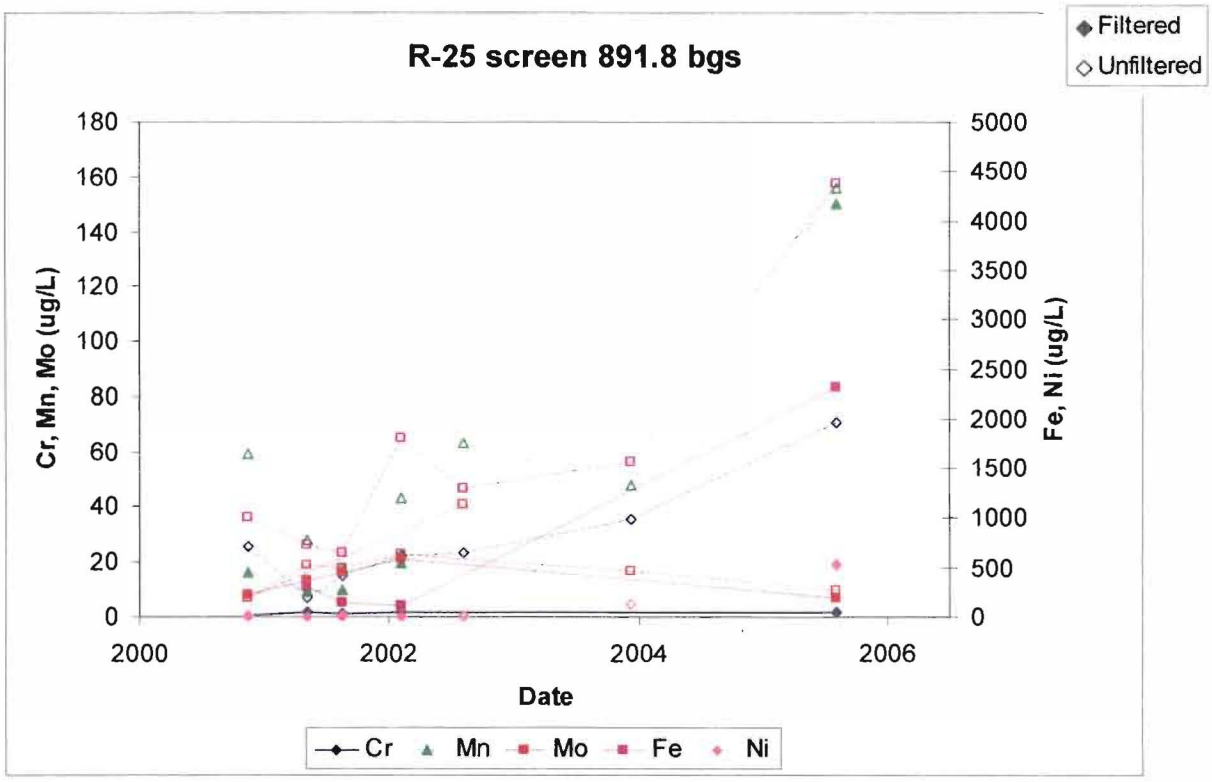

Figure 5. Metal concentrations for second screen (891.8 ft bgs) in well R-25

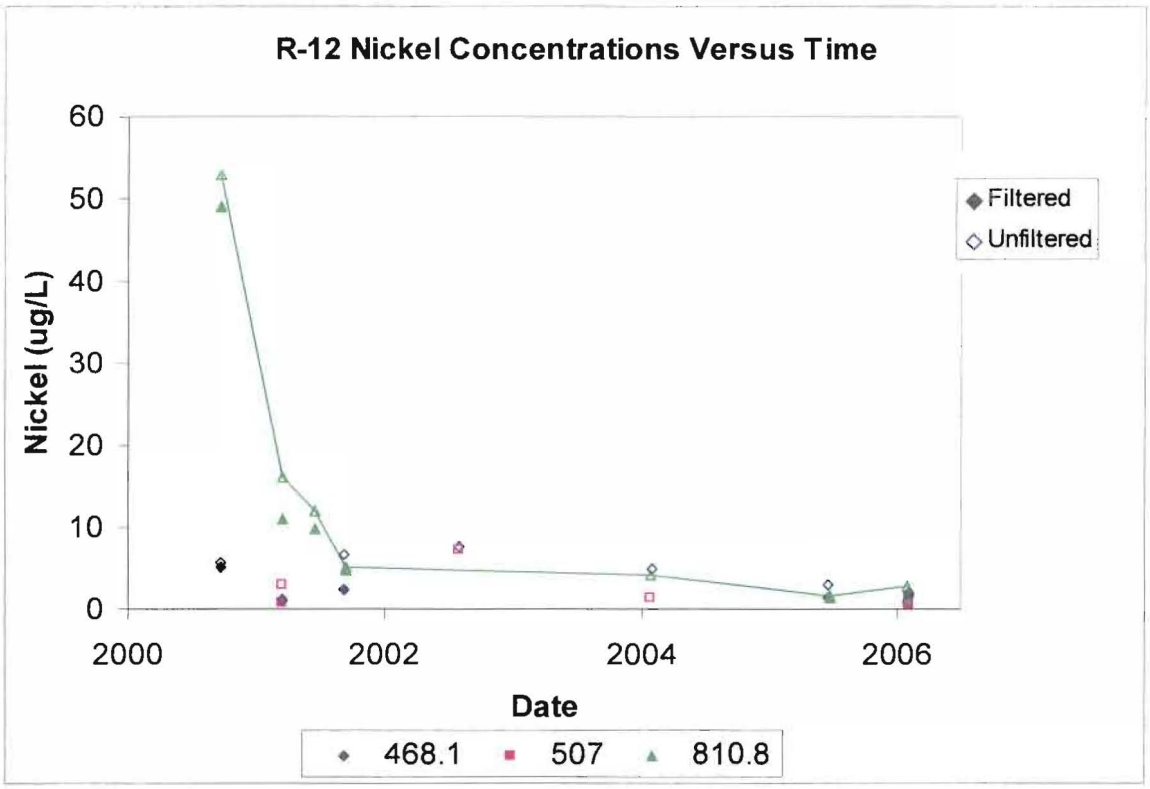

Figure 6. Nickel concentrations versus time for all screens in R-12

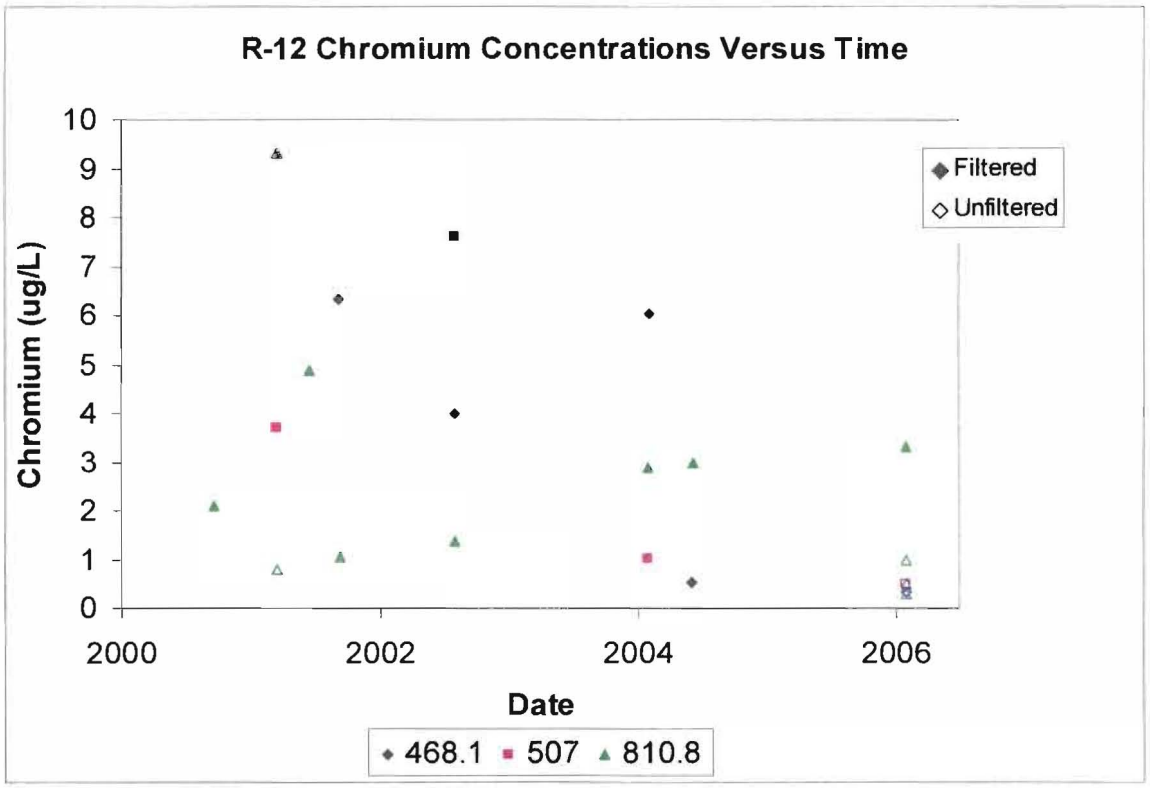

Figure 7. Chromium concentrations versus time for all screens in R-12

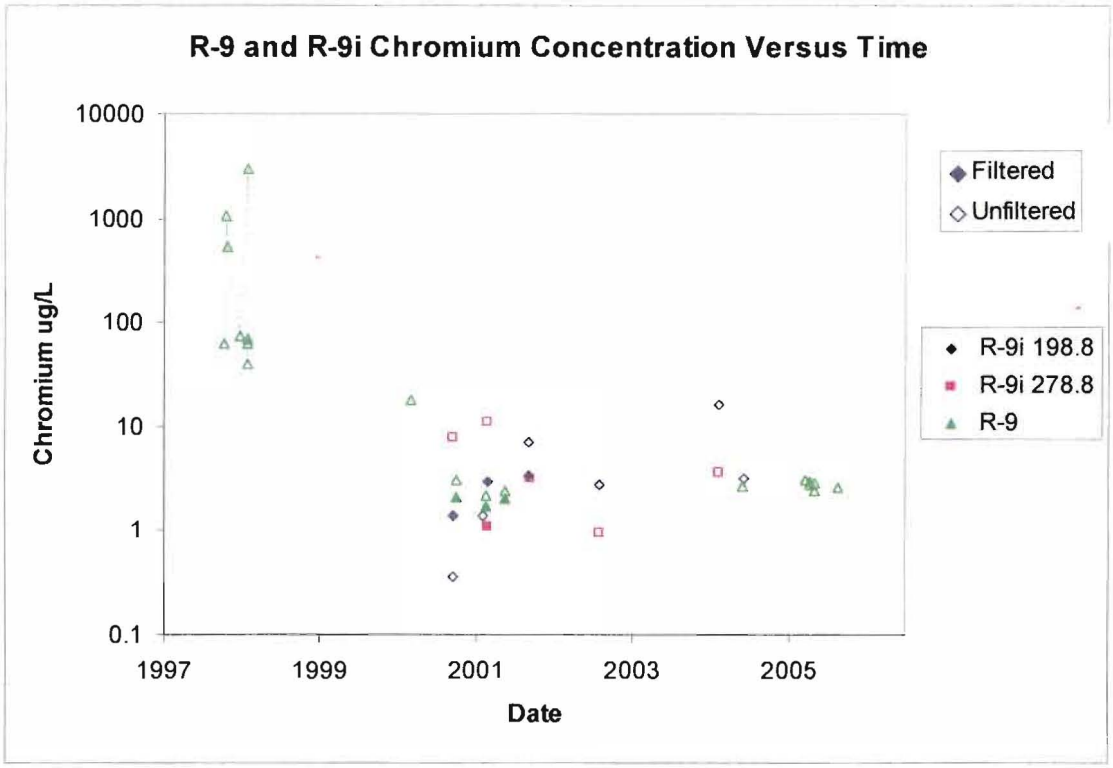

Figure 8. Chromium versus time for all screens in wells R-9 and R-9i. Note logarithmic Y-axis.

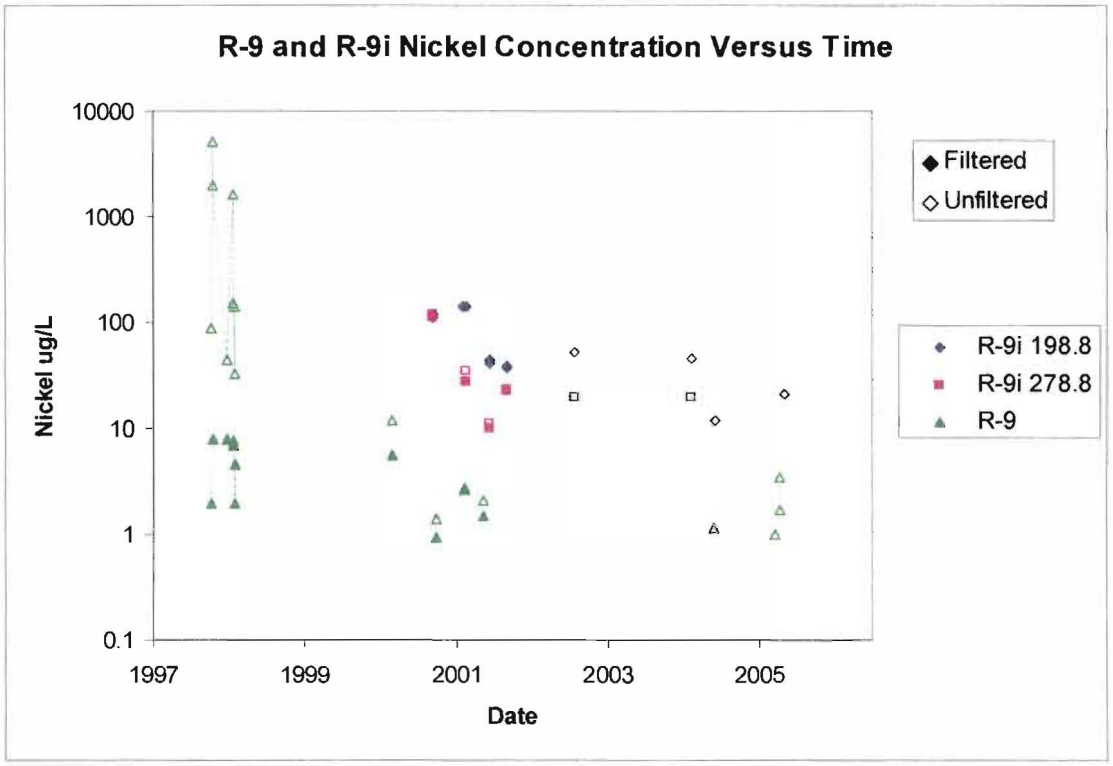

Figure 9. Nickel concentration versus time for all screens in wells R-9 and R-9i. Note logarithmic Y-axis.