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Environmental Sciences Laboratory

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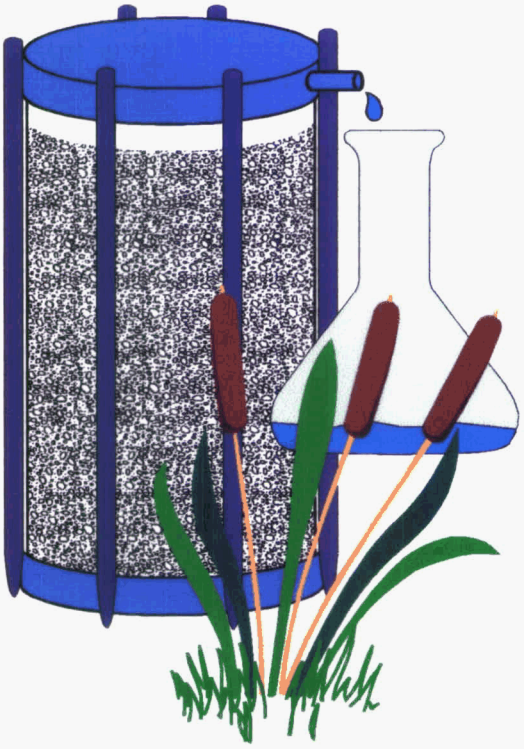
DETERMINATION OF DISTRIBUTION RATIOS –
MONTICELLO SITE 7-01

Determination of Distribution Ratios

Monticello Mill Tailings Site — Operable Unit III
Monticello, Utah



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Monticello Mill Tailings Site—Operable Unit III
Monticello, Utah

July 2001

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Appendices

Appendix A. Environmental Sciences Laboratory Work Submittal
Appendix B. Environmental Sciences Laboratory Notes

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Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
DOE	U.S. Department of Energy
ESL	Environmental Sciences Laboratory
GJO	Grand Junction Office
g	gram
Kd	distribution coefficient
µg/L	micrograms per liter
µm	micrometers
mg/L	milligrams per liter
mL	milliliters
mL/g	milliliters per gram
mm	millimeters
MMTS	Monticello Mill Tailings Site
OU III	Operable Unit III
Rd	distribution ratio
UMTRA	Uranium Mill Tailings Remedial Action (Project)

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Definition of Terms

Isotherm—An *XY* log-log plot, where *X* is the concentration of a constituent in the aqueous phase and *Y* is the concentration of the constituent on the solid phase at constant temperature.

Linear Isotherm—An isotherm that plots as a straight line with a slope of 1. These isotherms are linear on arithmetic plots.

Distribution Ratio (*Rd*)—The empirically determined ratio of the concentration of the solid phase to the concentration in the aqueous phase. It is usually expressed in units of milliliters per gram.

Distribution Coefficient (*Kd*)—A constant used in contaminant-transport modeling. *Kd* is numerically equivalent to the distribution ratio (*Rd*) if the system is at equilibrium and constant over the range of conditions being modeled.

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Executive Summary

This report presents the laboratory analysis methods and analytical results of a study that determined distribution ratios (*Rd*) for soils collected alongside Montezuma Creek at the Monticello Mill Tailings Site. The results of this work will assist in the selection of an appropriate compliance strategy for contaminated ground water associated with Operable Unit III of the Monticello project.

Distribution ratios for uranium, arsenic, and vanadium were determined on samples of alluvial backfill along the newly constructed channel of Montezuma Creek as it traverses the former tailings area. Chemical analyses were also performed to ensure that the samples were uncontaminated. Isotherms were obtained for each of three locations. Synthetic ground water representative of the Monticello site that had been spiked with uranium, arsenic, or vanadium was used as the contaminant source.

The laboratory results demonstrate that the soils have a moderate capacity for retaining uranium and a much stronger propensity for removal of arsenic and vanadium. The laboratory results, however, were obtained from the <2-millimeter (mm) fraction, and these samples had substantial fractions greater than 2 mm. After correction for grain size, therefore, the soils have overall little tendency for removal of uranium but are still relatively retentive of arsenic and vanadium. The grain-size-corrected *Rd* values for uranium are consistent with those determined at several Uranium Mill Tailings Remedial Action sites. Vanadium and arsenic, in contrast to uranium, form less soluble compounds and are more easily taken up by soil materials. *Rd* values for vanadium and arsenic were approximately two orders of magnitude greater than those measured for uranium.

The *Rd* values differ among the three locations. Location NEF351 has larger values than NEF352 and NEF354, for which the results are quite similar. This difference is probably explained by the grain-size distribution, because the fraction of sample less than 2 mm was much greater for NEF351, suggesting that the <2-mm fraction may have contained more clay than the other samples.

End of current text

1.0 Introduction

The report presents the laboratory analysis methods and analytical results of a study that determined uranium, arsenic, and vanadium distribution ratios (*Rd*) for soil samples collected from Operable Unit III (OU III) at the Monticello Mill Tailings Site (MMTS). The results of this work will be used to assist the selection of an appropriate compliance strategy for contaminated ground water associated with OU III. For example, a contaminant transport model incorporating a distribution coefficient (*Kd*) can be used to evaluate whether natural attenuation is likely to satisfy the ground water standards within a given time period. The results of this study can also be used to assist in estimating of the volume of ground water that might require pumping or passive treatment to satisfy State and Federal ground water standards.

These data will be used in the OU III feasibility contaminant transport modeling. Modeling details and application of the distribution ratios will be topics of future technical meetings between the U.S. Department of Energy (DOE), the Utah Department of Environmental Quality, and the U.S. Environmental Protection Agency.

OU III personnel collected samples for the tests from strategic locations at the millsite. The water used to leach the columns, designated 92–05 by the Environmental Sciences Laboratory (ESL), was designed to simulate ground water that may contact the sediments. Personnel from the MMTS OU III project requested that the ESL conduct experiments to determine distribution ratios for the submitted soils. Pertinent details regarding the objectives, scope, and design of the study are presented in the *Monticello Mill Tailings Site, Interim Remedial Action Work Plan for Operable Unit III—Surface Water and Ground Water* (DOE 2000a). Laboratory tests were completed in May 2001. A copy of the ESL work submittal is in Appendix A, and laboratory notes are in Appendix B.

The ESL was established in 1991 to provide support to programs at DOE's Grand Junction Office (GJO). The geochemical laboratories are equipped with bench space and equipment to conduct research, treatability studies, and pilot-scale tests to supplement numerical modeling efforts and to evaluate promising remedial technologies. The ESL also maintains an ecology laboratory equipped to conduct testing to design and evaluate landfill covers and phytoremediation technologies, and operates a mobile laboratory that is routinely used for expedited site characterization at field sites.

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2.0 Sample Locations

Samples were collected from the banks of the reconstructed Montezuma Creek channel within the former tailings area. All samples were collected by hand from survey block MS00893. Initially, eight samples were collected and submitted for chemical analysis to ensure that they were uncontaminated (T. Bartlett, personal communication). From these eight, three were selected for the determination of distribution ratios. The locations are shown on Figure 1.

End of current text

3.0 Background

As contaminated ground water migrates through soils and rocks, the contamination is distributed between the solid and liquid phases. This phenomenon causes the contamination to travel at a slower rate than the average ground water velocity. Chemical processes that retard the contaminant plume can include adsorption, absorption, mineral precipitation, diffusion into immobile porosity, attachment to microbes, and transfer to vapor phases. It is generally not possible to differentiate among these processes. However, a bulk parameter (*Kd*) has been used with some success to model the retardation of contaminant migration for many aquifer systems. Most numerical ground water models use the *Kd* concept in simulations of contaminant transport. Site-specific *Kd* values are approximated from *Rd* values that are empirically determined. This laboratory study was conducted to determine *Rd* values applicable to OU III at the MMTS.

Rd is defined as the concentration of a constituent on the solid fraction divided by the concentration in the aqueous phase:

$$Rd = \frac{\text{(mass of solute sorbed per unit mass of solids)}}{\text{(mass of solute per volume of solution)}} \tag{1}$$

Rd values are calculated from experimental data as

$$Rd = \frac{(A - B)V}{M_s B} \tag{2}$$

where

Rd = distribution ratio in milliliters per gram (mL/g).
A = initial concentration of the constituent in milligrams per liter (mg/L),
B = final concentration of the constituent,
V = volume of solution (100 milliliters [mL] in all cases),
M_s = mass of soil used in grams (g), and

Kd is numerically equivalent to *Rd* if the system is at equilibrium and *Rd* is constant over the range of conditions being considered. If *Rd* is constant over a large range of contaminant concentrations, it is said to be "linear" because a plot of aqueous concentration against solid-phase concentration forms a straight line on an arithmetic plot. *Rd* data are often displayed on log-log concentration plots. A linear plot of *Rd* (referred to as a linear isotherm because temperature is held constant) is a line with a slope of 1 on a log-log plot.

At elevated concentrations of a constituent, *Rd* often varies with the aqueous concentration. In this case, the isotherm is said to be nonlinear and cannot be accurately represented by *Kd*.

The distribution of grain size influences the effect that sediment has on retarding migration of contaminants by sorption. For example, sediment that has a high proportion of fines will usually have a high *Rd* value compared with mineralogically similar but coarser grained sediment. The

increase in sorption is due to a high proportion of sorbent phases, such as clay minerals and iron oxyhydroxides, and a high surface area.

Fine-grained splits are commonly used in the laboratory to determine *Rd* values. The finer grain sizes are easier to work with and require less equipment. Because more contaminant is sorbed to finer grained sediment, the analysis is more sensitive and has lower detection limits than would be possible using the coarser grained fractions. However, the results are biased toward elevated values of *Rd*. The laboratory-derived *Rd* values should be adjusted to account for actual grain-size distributions in the aquifer.

Grain-size distribution data can be used to adjust the laboratory-derived values of *Rd* to the coarse-grained alluvial aquifer (DOE 2000b). Values of *Rd* can be adjusted according to:

$$Rd_{adj} = Rd_{(<2\ mm)} * f \tag{3}$$

where

Rd_{adj}	=	adjusted *Rd* values,
$Rd_{(<2\ mm)}$	=	laboratory *Rd* measured on the less-than-2-millimeter (mm) fraction, and
f	=	weight fraction of sediment less than 2 mm (from sieve analysis).

Use of this method assumes that there is no sorption on the >2-mm fraction. This is a reasonable method for estimating distribution coefficients for input into contaminant transport models. For example, a recent study concluded that assuming the >2-mm fraction had no sorptive capacity and only served to dilute sorption from the <2-mm fraction "may be a reasonable alternative" to explicitly measuring the sorptive capacity of the larger fraction (Kaplan et al. 2000).

4.0 Methods

The work was conducted at the DOE–GJO ESL. *Rd* data were obtained using ESL Procedure CB(BE–3) (MACTEC–ERS 1999), which follows an American Society for Testing and Materials (ASTM) procedure for batch-type experiments (ASTM 1993).

A representative portion of each sample was air dried at room temperature. The samples were sieved to less-than-10 mesh (<2 mm). Past experience has demonstrated that the difference between air-dried and oven-dried weights is less than 2 percent and usually less than 1 percent. Therefore, no correction was made for the water content of the air-dried samples.

Synthetic ground water representative of the MMTS (Table 1) was spiked with approximately 1,000 micrograms per liter (μg/L) of uranium or vanadium and approximately 500 μg/L of arsenic for use in the *Rd* determinations. Control solutions prepared at the beginning of the experiment were analyzed at the GJO Analytical Chemistry Laboratory for the determination of the initial concentration.

A six-point isotherm was determined for each sample. The appropriate mass of soil sample (1, 2.5, 5, 10, 15, or 20 g) was placed in a 125-mL Nalgene bottle with 100 mL of the ground water. Samples were rotated end-over-end at 8 revolutions per minute for 24 hours, centrifuged at 3,000 revolutions per minute, then vacuum filtered through a 0.45-micrometer (μm) filter. The samples were divided into two groups and processed on consecutive days. Blanks were run each day, and the parent solution was also analyzed at the beginning and at the end of the experiment. Samples were analyzed in the GJO Analytical Chemistry Laboratory (Table 2). Procedure AS–5 Rev. 06 was used for both arsenic and vanadium, AS–6 Rev.06 was used for uranium. These procedures employ an inductively coupled plasma for an excitation source. The vanadium and arsenic are quantified by atomic emission and the uranium by mass spectrometry.

End of current text

5.0 Results and Discussion

Results of the *Rd* measurements on the <2-mm fraction are presented in Tables 3, 4, and 5 and on Figures 2, 3, and 4. The colored lines on the figures show the position of theoretical isotherm *Rd* values of 10, 20, 30, 40, 50, 60, and 70 mL/g for comparison. Isotherms will behave ideally only if chemical conditions such as pH, alkalinity, conductivity, temperature, and oxidation-reduction potential remain relatively constant in all experiments. Previous experiments at the ESL have documented that these parameters often remain constant during the course of an *Rd* determination.

As Figure 2 and Table 3 demonstrate, there is little difference in the uranium values, all the results are within a factor of about 2.5. The raw data indicate a moderate tendency for these soils to remove uranium spiked into the synthetic water sample. These data also indicate that the *Rd* for uranium is higher than has been measured at most other uranium mill tailings sites (Table 6). However, the data in Tables 3 and 6 are from the <2-mm fraction. As Table 7 demonstrates, these samples contained a significant portion of coarse material, and the <2-mm fraction was a relatively small component of the bulk soil. Hence, the grain-size corrected values are much less (Table 8).

Both vanadium and arsenic, in contrast to uranium, form less soluble compounds and are more easily taken up by soil materials (Tables 4 and 5). An *Rd* for arsenic has not been determined for other uranium mill tailings sites, but the representative value for vanadium from this study (24 mL/g) compares very closely to the value recommended as representative for the Slick Rock site (21 mL/g) (DOE 2001).

Samples used for the *Rd* measurements were from the <2-mm fraction. The smaller grain-size fraction is more convenient for laboratory measurements because smaller-sized equipment can be used for the experiments. However, the *Rd* values from the <2-mm fraction are somewhat biased toward high values compared with the bulk sediment in the aquifer. More sorption typically occurs in finer grained soils because more highly sorptive minerals are present and the surface area density is greater.

The *Rd* values for these soils can be estimated from the <2-mm fraction by normalization to the size distribution and assuming that the larger fractions are nonadsorptive. Grain-size distributions were not evaluated, but it was reported that the samples contained considerable cobbles (S. Campbell, personal communication).

The chemical and physical properties of the OU III soils probably vary substantially both vertically and horizontally, as demonstrated by the difference in grain-size distribution shown in Table 7. For this reason, it is common to apply parameters such as *Kd* uniformly for an entire aquifer to estimate contaminant transport. Although this approach is not likely to predict accurately all details of contaminant migration, it provides a useful estimate for contaminant migration trends.

In this case, errors will be related to grain-size distribution. Areas where there are few fines are apt to be poorly retentive for the contaminants. Where fines are present, even the uranium will be retained to some extent. Ground water, however, will tend to flow through the coarse zones in preference to fine-grained zones, consequently the data for sample NEF351, which had a much higher percentage of fine-grained matter than the other two samples, may yield too conservative a value. The *Rd* values recommended as most representative for OU III are an average of the size-adjusted values for NEF352 and NEF354. For uranium, therefore, the recommended value is 0.65 mL/g.

The isotherms for both vanadium and arsenic are relatively linear and parallel to the theoretical lines. This is particularly true if data from some of the 1 g samples are not used. The smaller sample has a greater potential for error from sample heterogeneity, sample handling, and analysis. One or all of these factors may explain the few anomalous points. As with uranium, it appears to be most reasonable to select the *Rd* value by averaging the results from NEF352 and NEF354. Hence, the most representative *Rd* for arsenic is 40 mL/g, and the most representative *Rd* for vanadium is 24 mL/g.

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Tables

Table 1. Composition of Synthetic Ground Water for Well 92–05

Component	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	C (mg/L)	pH
17 mL of 50 g/L $NaHCO_3$	136.90				71.43	
500 mL of 1.08 g/L $CaSO_4$		159.05		380.95		
2 mL of 200 g/L $MgSO_4 \cdot 7H2O$			39.46	155.91		
TOTALS	**136.90**	**159.05**	**39.46**	**536.86**	**71.43**	**6.70**
WELL 92–05	40.00	250.00	40.00	540.00	70.00*	6.70

*Estimated from alkalinity.

Table 2. Analytical Methods

Analyte	Procedure[a]	Description
Arsenic	AS–5 Rev. 06	ICP–AES
Uranium	AS–6 Rev. 06	ICP–MS
Vanadium	AS–5 Rev. 06	ICP–AES

[a]Analysis performed at the GJO Analytical Chemistry Laboratory (*WASTREN*)
ICP–MS = Inductively Coupled Plasma–Mass Spectrometry
ICP–AES = Inductively Coupled Plasma–Atomic Emission Spectrometry

*Table 3. Uranium Distribution Ratios (*Rd*) Measured for Monticello OU III (<2-mm fraction)*

Location	Sample Weight (g)	Uranium (µg/L)	*Rd*[a] (mL/g)	Mean *Rd* (mL/g)
NEF 0351	1	866	3.75	3.28
	2.5	820	3.83	
	5	763	3.55	
	10	685	3.12	
	15	631	3.63	
	20	591	3.60	
NEF 0352	1	848	5.96	3.8
	2.5	793	5.32	
	5	744	4.15	
	10	696	2.91	
	15	667	2.31	
	20	631	2.12	
NEF 0354	1	866	3.75	2.81
	2.5	829	3.35	
	5	783	2.95	
	10	707	2.71	
	15	665	2.34	
	20	631	2.12	

[a]Each of the six individual *Rd* measurements is presented. The measurements correspond to sample weights of 1, 2.5, 5, 10, 15, and 20 grams.

Table 4. Arsenic Distribution Ratios (Rd) Measured for Monticello OU III (<2-mm fraction)

Location	Sample Weight (g)	Arsenic (µg/L)	*Rd*[a] (mL/g)	Mean *Rd* (mL/g)
NEF 0351	1	250	114	172
	2.5	110	155	
	5	46.2	212	
	10	24.1	212	
	15	18.6	185	
	20	16.7	155	
NEF 0352	1	172	211	254
	2.5	64.4	293	
	5	31.3	322	
	10	16.8	309	
	15	17.8	194	
	20	13.6	192	
NEF 0354	1	258	108	164
	2.5	117	143	
	5	50.6	192	
	10	26.2	195	
	15	19.1	180	
	20	15.4	169	

[a]Each of the six individual *Rd* measurements is presented. The measurements correspond to sample weights of 1, 2.5, 5, 10, 15, and 20 grams.

Table 5. Vanadium Distribution Ratios (Rd) Measured for Monticello OU III (<2-mm fraction)

Location	Sample Weight (g)	Vanadium (µg/L)	*Rd*[a] (mL/g)	Mean *Rd* (mL/g)
NEF 0351	1	576	76	140
	2.5	295	98	
	5	128	138	
	10	57.8	166	
	15	35.8	182	
	20	27.4	180	
NEF 0352	1	449	126	196
	2.5	188	176	
	5	87.7	211	
	10	42.3	230	
	15	29.4	223	
	20	23.4	212	
NEF 0354	1	616	65	81
	2.5	345	78	
	5	180	93	
	10	98.2	93	
	15	75.3	83	
	20	62.2	77	

[a]Each of the six individual *Rd* measurements is presented. The measurements correspond to sample weights of 1, 2.5, 5, 10, 15, and 20 grams.

Table 6. Mean Distribution Ratios (Rd) for Uranium From Monticello OU III Compared With Selected UMTRA Project Sites[a]

Site	Location or Formation[b]	*Rd* (mL/g)
Monticello NEF351	Alluvial Backfill	3.28
Monticello NEF352	Alluvial Backfill	3.8
Monticello NEF354	Alluvial Backfill	2.81
Slick Rock – well 0300 – 12.5 ft	Qal	1.64
Slick Rock – well 0300 - 17 ft	Qal	1.22
Slick Rock – well 0301 – 13.5 ft	Qal	1.08
Slick Rock – well 0301 – 17.5 ft	Qal	0.69
Slick Rock – well 0323 – 14 ft	Qal	0.76
Slick Rock – well 0323 – 16.8 ft	Qal	0.30
Shiprock	Weathered Km	1.59[c]
Shiprock	Unweathered Km	2.13[c]
Shiprock	Qal (floodplain)	0.54[c]
New Rifle	Qal	0.7[d]
Old Rifle	Qal	0.5[e]
Old Rifle	Wasatch claystone	1.3[e]
Grand Junction	Qal	2.15[f]
Gunnison – 30 ft	Qal	11.4[g]
Gunnison – 54 ft	Qal	4.70[g]

[a]All samples were sieved to less than 2 mm, but values are not corrected to grain size.
[b] Qal = Quaternary alluvium; Km = Mancos Shale Formation.
[c]DOE (1999a)
[d]DOE (1999b)
[e]DOE (1999c)
[f]DOE (1999d)
[g]DOE (2000c)

Table 7. Grain-Size Distribution of Monticello OU III Soils

Sample Location	Size Fraction	Weight (g)	Weight Fraction
NEF 351	> 2 mm	10.2	0.36
	< 2 mm	17.9	0.64
NEF 352	> 2 mm	25.2	0.87
	< 2 mm	3.9	0.13
NEF 354	> 2 mm	31.2	0.72
	< 2 mm	12	0.28

Table 8. Mean Distribution Ratios (Rd) for Uranium, Arsenic, and Vanadium From Monticello OU III Adjusted for Grain Size

Sample Location	Uranium Mean *Rd* (mL/g)	Arsenic Mean *Rd* (mL/g)	Vanadium Mean *Rd* (mL/g)
NEF 351	2.1	110	90
NEF 352	0.5	33	25
NEF 354	0.79	46	23
Representative Value	0.65[a]	40[a]	24[a]

[a]The representative *Rd* is an average of the values for NEF 352 and NEF 354. See text for explanation.

Figures

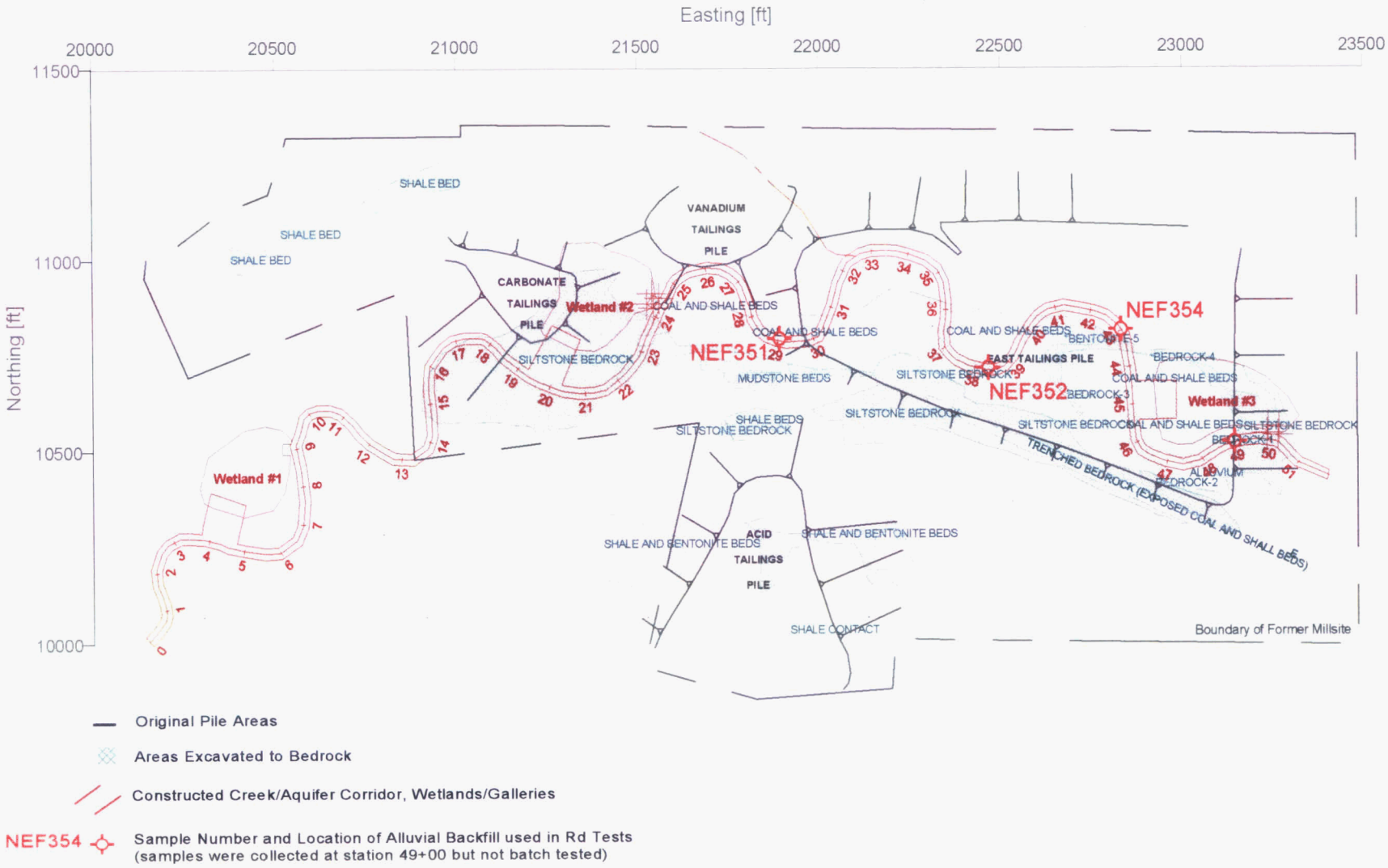

Figure 1. Location Map

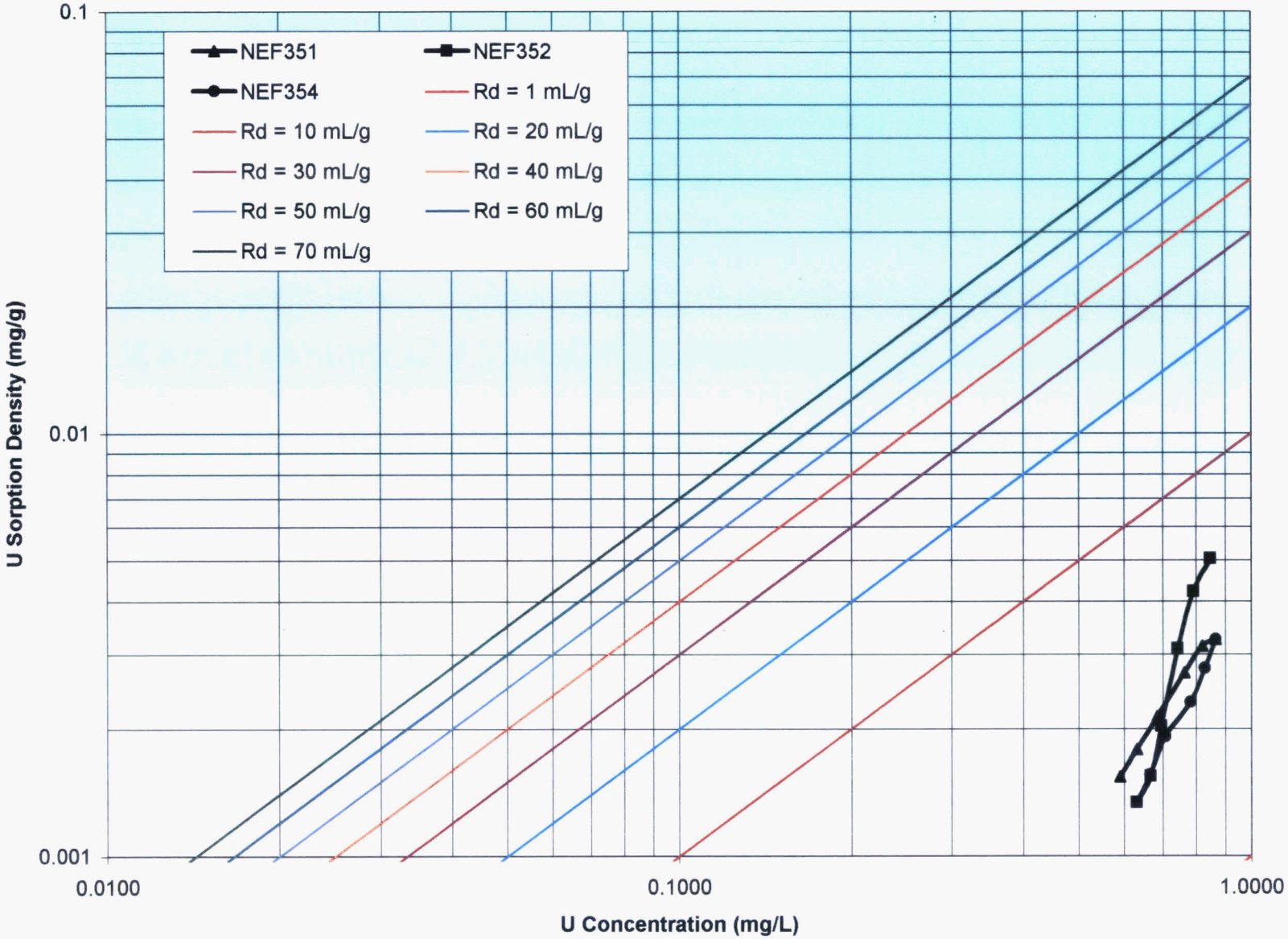

Figure 2. Measured Isotherms for the Monticello OU III Samples Compared With Theoretical Isotherms—Uranium

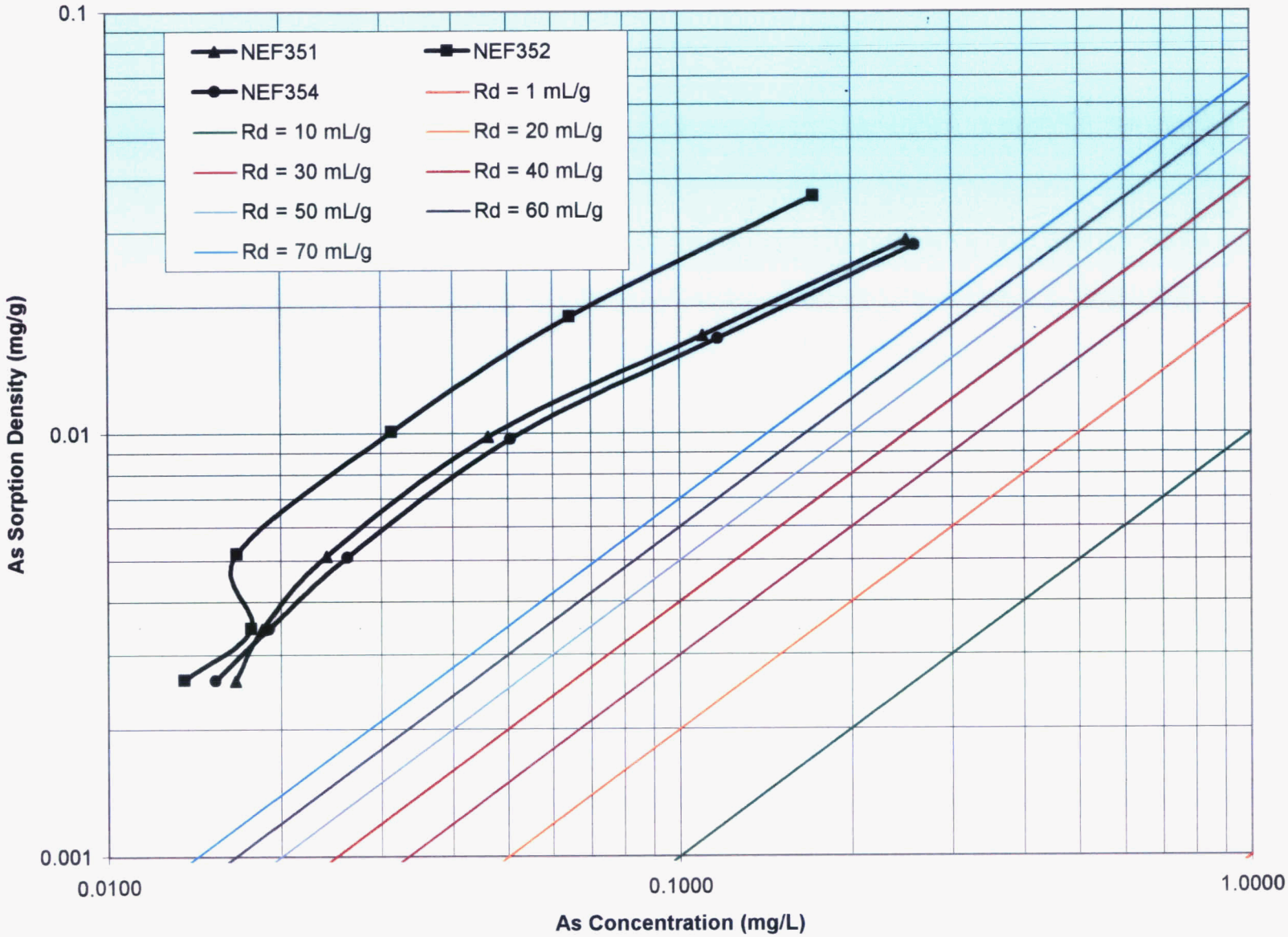

Figure 3. Measured Isotherms for the Monticello OU III Samples Compared With Theoretical Isotherms—Arsenic

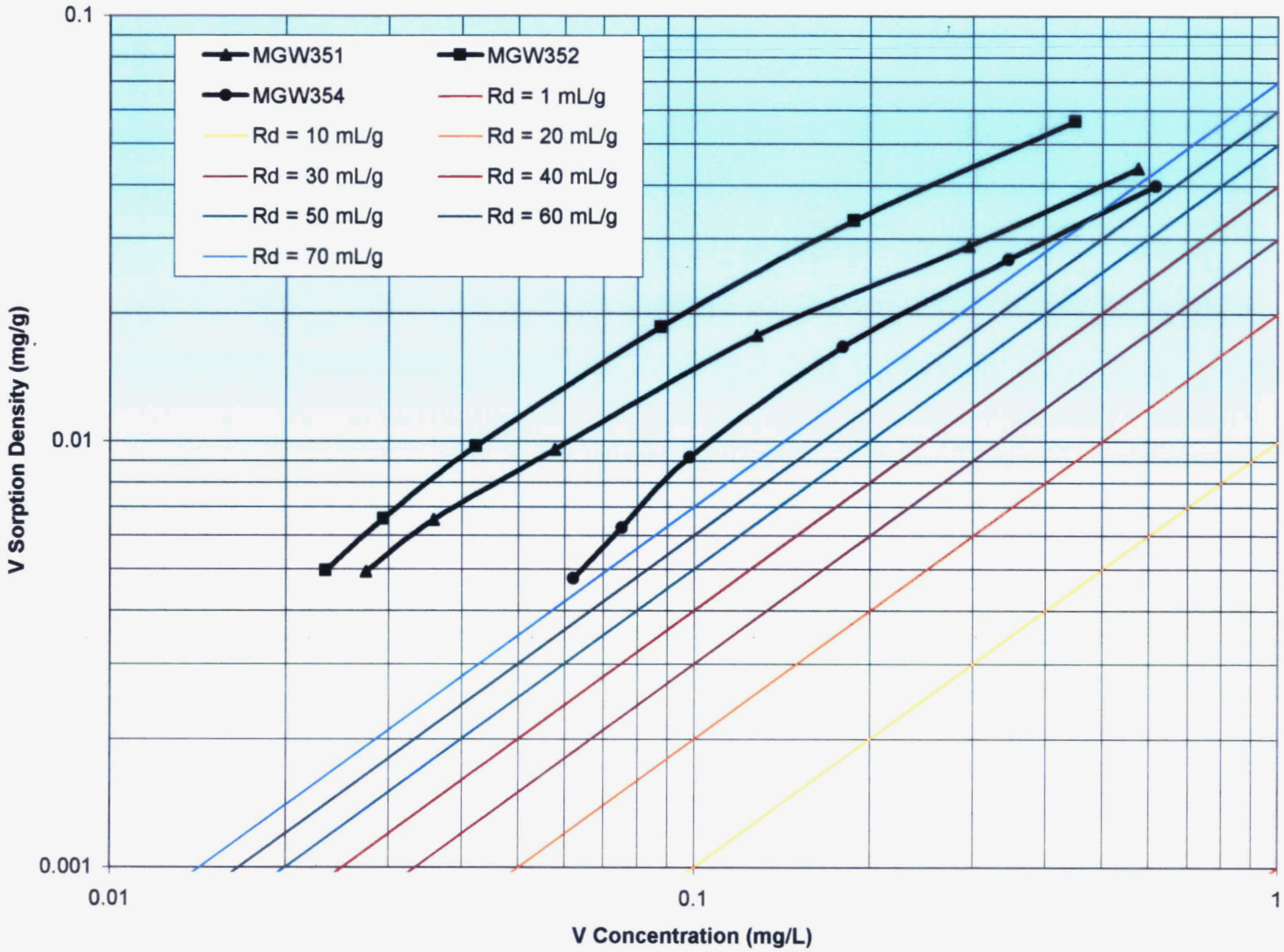

Figure 4. Measured Isotherms for the Monticello OU III Samples Compared With Theoretical Isotherms—Vanadium

Appendix A

Appendix A

Environmental Sciences Laboratory Work Submittal

WORK SUBMITTAL TO ENVIRONMENTAL SCIENCES LABORATORY

Submittal Date 1/16/01 Date Required Varies

Submitted By TBartlett Signature Smarris for TBartlett

Formal Report Required (check one)? Yes ✓ No ___

Project: Mont OU3 Charge No. ~~3515 12 001~~

Analysis Type (check one): Kd ✓ Leaching ✓ Other ✓ column ✓ size fraction

Sample Numbers 3507-05-012

Analytes

Solution Composition

Comments (attach procedure if needed).
See attached emails. Clarification of remaining work to be done for OU3

Tracking (ESL use only):

Actual Labor Hours (ESL use only):

Author: Sarah Morris at DOEGJPO
Date: 1/16/01 4:25 PM
Priority: Normal
TO: Stan Morrison, Timothy Bartlett, mkortel@email.msn.com at INTERNET, Dezbah Tso, Robert Lucero
Subject: Monticello OU3 Work.

---------- Message Contents ----------

Tim and I just sat down and discussed the work remaining to complete the Monticello job submittal.

1. A 5% HNO3 leach will be done on the 8 aquifer substrate samples. This will be parent (or virgin) soils that have not been tested previously. A split of the parent soil will also be sent (at the same time the nitric leach solution is sent) to the ACL for total digestion.

2. There will be 2 additional columns run (to complete the 10 ordered), but those soils will not be collected for several months. The system needs to obtain equilibrium now that the waters are not being diverted before the samples will be obtained.

Tim, at that time, will you want those 2 parent soils leached? yes

3A. The Kd tests will consist of 3 samples with a 6 point isotherm for each. They will be performed using a spiked 92-05 water. The water will be spiked with U (1 mg/L), V (1 mg/L), and As (0.5 mg/L).

3B. The Kd soils have not been obtained yet. It will be several weeks, at a minimum, before they are collected. The Kd analysis is being done on fill material sorted to spec. We will need to do a size fraction analysis on this material prior to the Kd work to confirm that the spec was met (or at least what we're testing is what it's supposed to be). Tim anticipates that this fill material will be of a larger size fraction than what we normally see - very few fines/sands - and that the Kd results will be conservatively biased if we use the standard <2mm (-10mesh). To do a weighted average we need the size fraction. I suggested that we might do parallel Kd's, one using just a grab sample of unsorted material, and another with the <2mm fraction and compare results. That is something he wants to consider and will make a decision prior to the work being done.

Give me a call with any questions/concerns/comments.

Thanks
Sarah
X6514

Author: Stan Morrison at DOEGJPO
Date: 1/18/01 6:52 PM
Priority: Normal
TO: Timothy Bartlett
: mkortel@msn.com at INTERNET, Sarah Morris
bject: Re:Monticello ESL work

---------- Message Contents ----------

Tim,

That sounds good to me. Nic can keep on his regular schedule to get the reports out. We will write up the last 2 columns separately.

Stan

_____Reply Separator_____
Subject: Monticello ESL work
Author: Timothy Bartlett
Date: 01/18/2001 2:45 PM

Stan:
The 2 remaining column test samples are indeed a couple or few months from being collected. I think we should prepare a report on the original 8 tests after the last bit of lab work is finished, instead of waiting to complete the other 2. OU III will benefit by seeing the results sooner rather than later, Nic's schedule may be better accommodated, loose ends would be tied, etc..

Monticello OU III and PRB water sampling is taking place over the next 2 weeks. I may be able to get the samples for the Kd tests during that time, if not, then the following week. The ESL will determine the proportion of <2mm and > 2mm (10 to 12 samples), then submit a split of the <2mm fraction to ACL for metals analysis (temporarily archive >2mm fraction). Kd tests will start after ACL results come back. Kd tests/results will be reported by ESL separately from lumn study. I'll collect enough sample to yield a 500mL bottle of <2mm [about 0 g].

See any problems? Will you forward this info to Nic, et al ?
Thanks. Tim x7741

Author: Timothy Bartlett at DOEGJPO
Date: 4/2/01 1:47 PM
Priority: Normal
To: Stan Morrison
: Sarah Morris, Kristen McClellen
Subject: OU III batch tests

---------- Message Contents ----------

The following samples have been selected for the Monticello Kd batch tests:

NEF351
NEF352
NEF354

These are the orinial sample ids submitted to ESL by me on 2/20/01. The samples were separated into >2mm and <2mm fractions by ESL. The <2mm fractions were then split and a sample sent to the ACL for metals analysis. Conduct the batch tests on the <2mm fractions of the above samples retained by ESL.

Tim.

See items 3A&B

Appendix B

Appendix B

Environmental Sciences Laboratory Notes

(prepared by Sarah Morris)

AMPAD EFFICIENCY LINE® 22-210

MSG OU3 MOU3-02-08-P1

2/20/01 Receive the following 5 gallon buckets filled with wet soil

Sample #	Sample Location	Block
NEF 350	29+00 N	MS00893
351	29+00 S	↓
352	38+25 N	
353	38+25 S	
354	43+00 N	
355	43+00 S	
356	49+00 N	
357	49+00 S	

2/24/01 Place all soils on trays to air dry

3/5/01 Submit small aliquot split to ACL for total digestion. Since the block # is the same on all samples and the sample locations are quite similar, will use the sample # as the name that will carry through.

3/7/01 Since the split between >2mm and <2mm is necessary to determine, a decision to wet sieve the soils was made. OKd c̄ T Bartlett Smemson

Wet sieve complete. ~~Submit <2mm fraction to ACL for analysis~~ SM

4/2/01 Per T Bartlett, use NEF 351, 352, 354 for Kd analysis

4/8/01 Prepare 4L MGW9205 spiked w/ U=1mg/L, V=1mg/L, As=0.5 mg/L
pH adjust c̄ 0.550mL HNO3 to 6.70 Dennis Spring 5/29/01

AMPAD EFFICIENCY LINE® 22-210

Montticello OU3 Kd's

MOU3-02-08-02

4/8/01 Prepare the following 125 ml Nalge bottles w/ given amts of Pbl. Add 100 ml (w

weight) of MGW 92-05 spiked c̄ U = 1 mg/L V = 1 mg/L As = 0.5 mg/L. pH = 6.70

		Mass (g)	pH	ACL #	
MGW 351	1	1	7.29	NBA 026	
	2	2.5	7.38	027	
	3	5	7.31	028	
	4	10	7.35	029	
	5	15	7.46	030	
	6	20	7.36	031	
	7				note gap in #'s pages missing in sample ticket book
MGW 352	8	1	7.23	034	
	9	2.5	7.27	035	
	10	5	7.37	036	
	11	10	7.41	037	
	12	15	7.52	038	
	13	20	7.53	039	
	14				
MGW 354	15	1	7.36	040	
	16	2.5	7.36	041	
	17	5	7.41	042	
	18	10	7.39	043	
	19	15	7.54	044	
	20	20	7.51	045	
	21				
B-1	22	0	7.50	046	Blank went through process, inc. filter
B-2	23	0	7.40	047	" " " " " "
P-1	24	0	7.12	048	Parent. no action, no filter
P-2	25	0	7.07	049	

[illegible] 5/29/01

AMPAD EFFICIENCY LINE® 22-210

Monticello 003 Saturated Kd's MOU3-02-08-03

4/8/01 1100	Place on rotating stir bar ± 8RPM w/exception of parent samples												
4/9/01 1100	Remove from stir bar. Spin 30' x 3500 RPM. Filter all w/ exception of parent samples through 0.45 µm filter.												
	Measure pH. Acidify												
4/10/01 0845	Submit to Acc for U, V, As analysis on Req. # 17391												

Thomas Spyla

Monticello soil sample results

Sample ID	Total sample mass (lbs)	>2mm mass (lbs)	<2mm mass (lbs)
NEF-350	25.5	15.5	10.0
NEF-351	28.1	10.2	17.9
NEF-352*	29.1	25.2	3.9
NEF-353	47.1	36.2	10.9
NEF-354*	43.2	31.2	12.0
NEF-355	36.6	22.7	13.9
NEF-356*	26.5	16.6	9.9
NEF-357	39.5	28.7	10.8

MOU3-02-08-04

10/27/01

	A	B	C	D	E	F	G	H	I	J	K
1	9205 10/3/95 (Actuals provided by Tim Bartlett)										
2		mL per									
3		L of	Na	K	Ca	Mg	NH4	SO4	Cl	NO3	C
4		Soln	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
5	Liquid Components										
6											
7	100g/L K2CO3	0.00		0.00							0.00
8	**50g/L NaHCO3**	17.00	232.74								121.43
9	100g/L Na2SO4.10H2O	0.00	0.00					0.00			
10	100g/L Na2SO4.(0.89 H2O)	0.00	0.00					0.00			
11	500g/L (NH4)2SO4	0.00					0.00	0.00			
12	1.5g/L CaSO4.2H2O	455.00			158.96			380.75			
13	**1.08 g/L CaSO4**	0.00			0.00			0.00			
14	**200g/L MgSO4.7H2O**	2.00				39.46		155.91			
15	100g/L K2SO4	0.00		0.00				0.00			
16	conc H2SO4(36N)	0.00						0.00			
17	927.2 g/L CaCl2.2H2O	0.00			0.00				0.00		
18	92.72 g/L CaCl2.2H2O	0.00			0.00				0.00		
19	300g/L NaCl	0.00	0.00						0.00		
20	100g/L MgCl2.6H2O	0.00				0.00			0.00		
21	100g/L NH4Cl	0.00					0.00		0.00		
22	100g/L NaNO3	0.00	0.00							0.00	
23	2% HNO3	0.00								0.00	
24	66.67 g/L NaN3	0.00	0.00								
25	U 10,000 mg/L	0.1									
26	V 1000 mg/L	1									
27	As 1000 mg/L	0.5									
28	Totals (mg/L)	474.00	232.74	0.00	158.96	39.46	0.00	536.66	0.00	0.00	121.43
29	ACTUAL (mg/L)		40.00	?	250.00	40.00	?	540.00	?	?	70.00
30	Totals (mol/L)		1.01E-02	0.00E+00	3.97E-03	1.62E-03	0.00E+00	5.59E-03	0.00E+00	0.00E+00	1.01E-02
31											
32	ACTUAL pH	6.70									
33	Measured pH(no acid or base)	?									
34	Measured pH (_____added)										
35	ACTUAL Alk (mg/L CaCO3)	290.00									
36	Measure Alk (no acid or base)	?									
37	Measure Alk (_____added)										
38											
39											