

TA-03

John



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Date: March 10, 2003  
Refer to: RRES-WQH: 03-053

Mr. Curt Frischkorn  
Ground Water Protection Bureau  
New Mexico Environmental Department  
1190 St. Francis Drive  
P.O. Box 26110  
Santa Fe, New Mexico 87502

**SUBJECT: NOTICE OF INTENT TO DISCHARGE (NOI) PERMEABLE REACTIVE BARRIER (PRB) INSTALLATION, SUPPLEMENTAL INFORMATION**

Dear Mr. Frischkorn:

On February 10, 2003 the Water Quality and Hydrology Group (RRES-WGH) submitted a Notice of Intent to Discharge (NOI) to the New Mexico Environmental Department (NMED) pursuant to 20 NMAC 6.2.1201 of the New Mexico Water Quality Control Commission (NMWQCC) Regulations. The NOI covered the installation of the Permeable Reactive Barrier (PRB) in Mortandad Canyon. On February 19, 2003 NMED-GWQB requested additional information concerning this NOI, which included the Sampling & Analysis Plan (SAP) for the PRB. The PRB SAP is included as Enclosure 1 for your review. The extent of sampling and analysis reflected in the enclosed SAP is contingent on funding availability.

Please contact Mark Haagenstad (505) 665-2014 or Mike Saladen (505) 665-6085 should you have questions or require additional information.

Sincerely,

A handwritten signature in black ink, appearing to read 'Steven Rae'.

Steven Rae  
Group Leader  
Water Quality & Hydrology Group

SR:MH/tml



Enclosures: a/s

Cy: B. Lucas, NMED/SWQB, Santa Fe, NM, w/enc.  
J. Young, NMED/HWB, Santa Fe, NM, w/enc.  
S. Yanicak, NMED/DOE/OB, w/enc., MS J993  
J. Vozella, DOE/OLASO, w/o enc., MS A316  
G. Turner, DOE/OLASO, w/enc., MS A316  
B. Ramsey, RRES-DO, w/o enc., MS J591  
K. Hargis, RRES-DO, w/o enc., MS J591  
D. Stavert, RRES-EP, w/o enc., MS J591  
A. Pratt, RRES-DO, w/o enc., MS J591  
M. Saladen, RRES-WQH, w/o enc., MS K497  
M. Haagenstad, RRES-WQH, w/enc., MS K497  
S. Veenis, RRES-WQH, w/enc., MS K497  
J. Kaszuba, C-INC, w/enc., MS J514  
RRES-WQH File, w/enc., MS K497  
IM-5, w/enc., MS A150

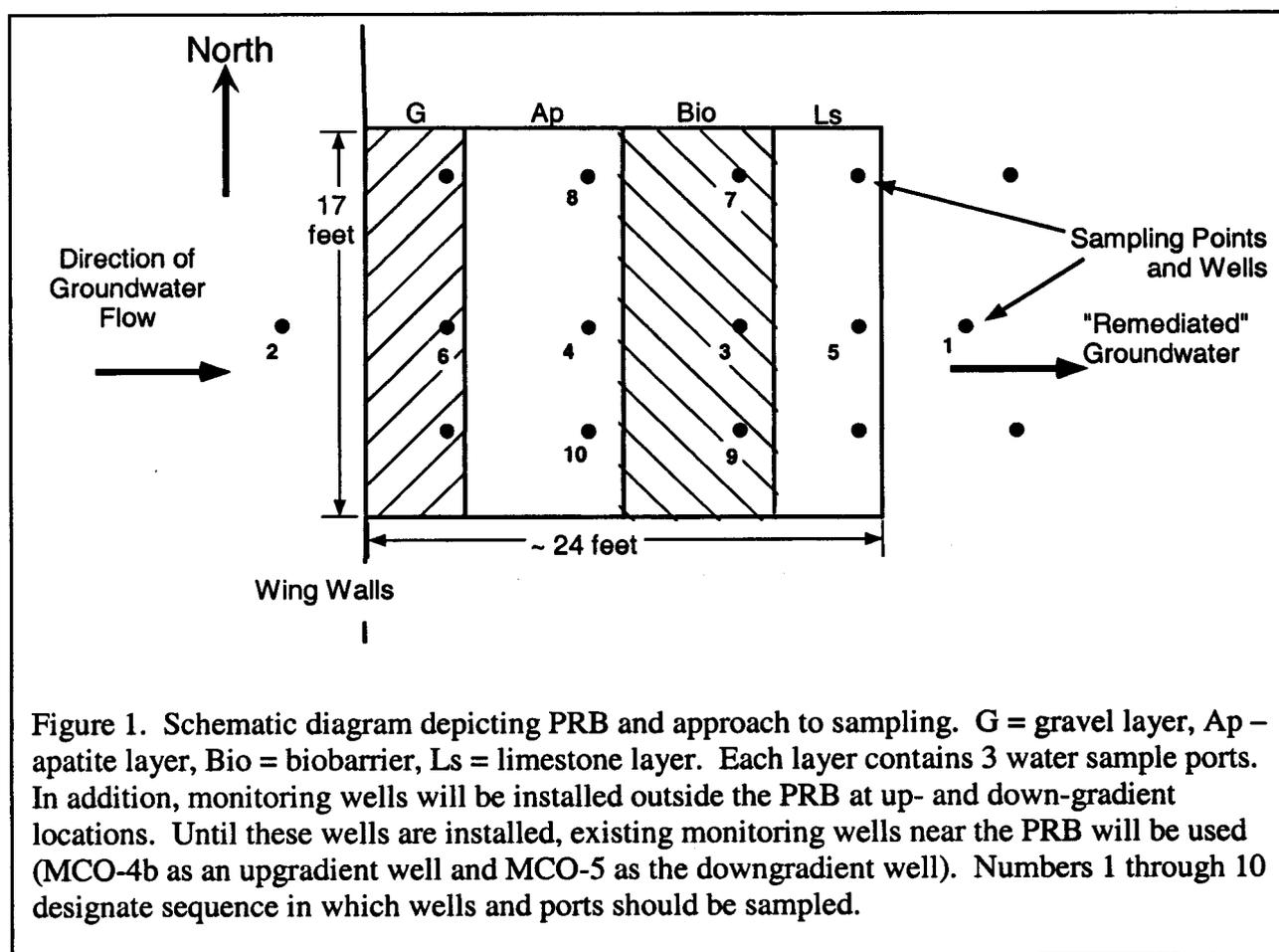


## ENCLOSURE 1

### Sampling & Analysis of the Multi-Layered Permeable Reactive Barrier, Mortandad Canyon John Kaszuba, C-INC February 28, 2003

#### Introduction and Background

A Multi-Layered Permeable Reactive Barrier (PRB) is installed in Mortandad Canyon. The barrier incorporates a sequence of four reactive media layers to immobilize or destroy a suite of contaminants present in alluvial groundwater, including strontium-90, plutonium, americium, perchlorate, and nitrate. The four sequential media cells consist of lava rock gravel, apatite, pecan shells/cottonseed with an admixture of gravel (biobarrier), and limestone (Figure 1).



#### Objectives and Goals, Approach

To evaluate performance of the PRB, we will systematically sample water from within each of the individual layers, and from upgradient and downgradient locations. The frequency of sampling and the analyses to be performed are presented in Tables 1 and 2, respectively. Note that sampling locations and sample parameters listed in Tables 1 and 2 and depicted in Figure 1

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are prioritized. Sampling priorities are needed in case low water flows exist through the PRB in dry seasons and dry years. The water-sampling ports in the PRB will not be purged of 3 casing volumes. These ports are not standard monitoring wells. More importantly, the ports within the PRB are closely spaced (2 to 5 feet), and excessive sampling of these ports may lead to localized cross-layer flow. Since detailed sampling of the PRB is designed to elucidate reaction mechanisms as well as performance, it is important to sample *in-situ* waters as much as possible.

The following summarizes our approach for the first year of operation, assuming that sufficient water is flowing through the PRB. Each of the 12 water-sampling ports in the PRB and two monitor wells (one up- and one down-gradient) will be measured for field parameters on a monthly basis. Monthly samples will also be collected from 8 of the 16 water-sampling ports plus the 2 monitor wells (Figure 1) for laboratory analysis of a suite of indicator parameters (Table 2). Samples will be collected every third month (i.e., quarterly) from 4 of the 16 water-sampling ports plus the 2 monitor wells for more detailed laboratory analysis (Table 2). At the end of the first year, we will evaluate analytical results to determine whether monitoring parameters can be reduced or otherwise modified.

Field parameters include water levels, temperature, pH, Eh, dissolved oxygen, turbidity, and specific conductance (Table 2). Analytical methods for characterizing basic water chemistry within the PRB are ion chromatography (nitrate, perchlorate, sulfate, fluoride, phosphate, bromide, and chloride); inductively coupled mass spectrometry (Al, As, Sb, Ba, Be, Cd, Cr, Co, Ni, Fe, Mn, Hg, Se, Sr, U, Th, and Zn); inductively coupled emission spectrometry (Ca, Mg, Na, K); organic carbon analyzer (TOC and DOC), and alkalinity titration. Sulfide and the redox couple of ferric/ferrous iron will be determined in the field using Hach kits tests. Radiochemical analyses include alpha spectrometry (Am-241, Pu-238, Pu-239,240, U-234, U-235, U-238); gas proportional counting (Sr-90), liquid scintillation (H-3); gamma spectroscopy (Cs-137 and other gamma emitting isotopes). To evaluate the biochemistry of the biobarrier, analyses to be performed are MPN (most probably number of specified bacteria), TEAP (total electron accepting potential) for dissolved hydrogen, HPLC (high pressure liquid chromatography) for organic acids (acetate, propionate), and total DNA. Stable isotopes of nitrogen ( $\delta^{15}\text{N}$ ) shall be analyzed by isotope ratio mass spectrometry (IRMS) to evaluate the extent of denitrification within the biobarrier. Total and dissolved analyses will be performed quarterly to evaluate the efficiency of the colloid barrier. Each year, one of the monthly sampling events will be duplicated for QA/QC purposes.

EES-6 will perform analyses for inorganic analytes, including major ions, trace elements, TOC, DOC, nitrate, and perchlorate. General Engineering Laboratories (GEL) will analyze the samples for radionuclides. C-INC will perform selected analyses on radionuclides using thermal ionization mass spectrometry (TIMS). EES-6 or Coastal Sciences shall perform the IRMS analyses for  $\delta^{15}\text{N}$ .

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Table 1. Frequency of Sampling, First Year of Operation

Field Measurements	Comment	Indicator analyses for sampling ports/wells	Comment	Detailed analyses for sampling ports/wells	Comment
Ports and Wells	One up- and one down-gradient well, all 12 ports within PRB	One up- and one down-gradient well, 8 ports within PRB labeled 3-10	<b>Frequency:</b> monthly.  <b>Frequency:</b> monthly. Sequence priority listed in Figure 1.	One up- and one down-gradient well, 4 ports within PRB labeled 3-6	<b>Frequency:</b> quarterly. Sequence priority listed in Figure 1.
Total number of wells/ports to sample	14	10		6	

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Table 2. Sampling matrix, First Year of Operation

	Field Measurements	Comment	Indicator analyses for sampling ports/wells	Comment	Detailed analyses for sampling ports/wells	Comment
Measurements and analyses	<p><b>Priority<sup>1</sup>:</b> Water level (hydraulic head), pH, temperature, dissolved oxygen</p> <p><b>Additional<sup>2</sup>:</b> specific conductivity, turbidity, redox potential (ORP)</p>	While the PRB should produce enough water in all seasons to support all field measurements, a priority sequence is established in case extreme dryness prevails.	<p><b>Priority<sup>1</sup>:</b> Non-filtered: Sr90, TOC; filtered: nitrate, perchlorate</p> <p><b>Additional<sup>2</sup>:</b> Non-filtered: ferric/ferrous iron and sulfide (field); filtered: alkalinity, cations, anions; non-filtered: DNA</p>	Sequence priority listed in Figure 1. Samples listed as "additional" are listed in order of priority	<p><b>Priority<sup>1</sup>:</b> Non-filtered: Sr90, TOC; filtered: nitrate, perchlorate</p> <p><b>Additional<sup>2</sup>:</b> Non-filtered: ferric/ferrous iron and sulfide (field); filtered: alkalinity, cations, anions; non-filtered: DNA; non-filtered: MPN, HPLC, TEAP, DOC; non-filtered: Am, Pu, U, gamma spectroscopy; non-filtered: H3; non-filtered: <math>\delta^{15}\text{N}</math>; filtered: Am, Pu, U, gamma spectroscopy; non-filtered: TMS</p>	Sequence priority listed in Figure 1. Samples listed as "additional" are listed in order of priority

<sup>1</sup> Priority analyses will provide the minimum data needed to determine the extent to which the PRB is working.

<sup>2</sup> Additional analyses are not needed to determine PRB performance. These analyses are desired by LANL scientists to evaluate the geochemical and biogeochemical processes taking place within the PRB. These analyses will be performed depending on a variety of factors, including seasonal and longer-term precipitation cycles that control volumes of water available for sampling;