

ENVIRONMENTAL SAMPLE DATA

4th Quarter 1993

PETROTOMICS COMPANY
Shirley Basin, WY

9403140109 940224
PDR ADDCK 04006659
B PDR

1. STACK SAMPLES

No discharge stacks present - Deleted by Amendment No. 21

2. AIR SAMPLES

LOCATIONS: Site 1 - 7800' WNW of where yellowcake dryer stack had been located.
 Rn-222 only - Amendment No. 21.
 Site 2 - Discontinued - Amendment No. 21.
 Site 3 - Discontinued - Amendment No. 21.
 Site 4 - Discontinued - Amendment No. 21.
 Site 5 - 2000' NE of where yellowcake dryer stack had been located.
 Site 6 - Discontinued - Amendment No. 21.

DATE COLLECTED: 4th Quarter 1993
 LOCATION: Site 1

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)	<u>%MPC</u>
Rn-222	1.5 X 10 ⁻⁹	± 0.12 X 10 ⁻⁹	0.2 X 10 ⁻⁹	50.0

DATE COLLECTED: 4th Quarter 1993
 LOCATION: Site 5

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)	<u>%MPC</u>
U-nat	* X 10 ⁻¹⁵		X 10 ⁻¹⁶	
Th-230	* X 10 ⁻¹⁵	+ X 10 ⁻¹⁵	X 10 ⁻¹⁶	
Ra-226	* X 10 ⁻¹⁵	+ X 10 ⁻¹⁵	X 10 ⁻¹⁷	
Pb-210	* X 10 ⁻¹⁵	+ X 10 ⁻¹⁵	X 10 ⁻¹⁶	
Rn-222	1.6 X 10 ⁻⁹	+ 0.13 X 10 ⁻⁹	X 10 ⁻⁹	53

* Report to follow.

3. LIQUID SAMPLES

DATE COLLECTED: November 23, 1993
 LOCATION: Mine Shop Well
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LDD (uCi/ml)
U-nat (Dissolved)	1.35 X 10 ⁻⁹		
U-Nat (Suspended)	12.19 X 10 ⁻⁹		
Th-230 (Dissolved)	0.00 X 10 ⁻⁹	± 0.20 X 10 ⁻⁹	4.0 X 10 ⁻¹⁰
Th-230 (Suspended)	0.00 X 10 ⁻⁹	± 0.65 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Ra-226 (Dissolved)	0.36 X 10 ⁻⁹	± 0.12 X 10 ⁻⁹	1.0 X 10 ⁻¹⁰
Ra-226 (Suspended)	0.43 X 10 ⁻⁹	± 0.29 X 10 ⁻⁹	5.0 X 10 ⁻¹⁰
Ra-228 (Dissolved)	2.27 X 10 ⁻⁹	± 1.51 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Ra-228 (Suspended)	13.20 X 10 ⁻⁹	± 2.20 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Pb-210 (Dissolved)	0.00 X 10 ⁻⁹	± 1.71 X 10 ⁻⁹	4.0 X 10 ⁻⁹
Pb-210 (Suspended)	0.00 X 10 ⁻⁹	± 4.10 X 10 ⁻⁹	6.0 X 10 ⁻⁹
Po-210 (Dissolved)	0.00 X 10 ⁻⁹	± 0.39 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Po-210 (Suspended)	0.07 X 10 ⁻⁹	± 0.14 X 10 ⁻⁹	1.0 X 10 ⁻⁹

* Samples not run.



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307/789-6420

Lab # : 93-5201

Petrotomics Company
P.O.Box 8509, Shirley Basin, YW 82615-8509
Attention: Steve Pfaff

Mine Shop Well
November 23, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

	mg/L
pH, Units	8.02
Total Dissolved Solids (TDS)	478
Chloride (Cl)	3.8
Sulfate (SO4)	236
Nitrate (as N)	<0.01
Arsenic (As)	<0.001
Selenium (Se)	<0.001
Barium (Ba)	<0.05
Cadmium (Cd)	<0.01
Chromium (Cr)	0.01
Lead (Pb)	<0.05
Nickel (Ni)	<0.03
Conductivity @ 25C, umho/cm	759

	DISSOLVED		SUSPENDED	
	pCi/L	LLD uCi/ml	pCi/L	LLD uCi/ml
Radium 226	0.36 ± 0.12	1x10E-10	0.43 ± 0.29	5x10E-10
Radium 228	2.27 ± 1.51	1x10E-9	13.2 ± 2.2	1x10E-9
Thorium 230	0.00 ± 0.20	4x10E-10	0.00 ± 0.65	1x10E-9
Lead 210	0.00 ± 1.71	4x10E-9	0.00 ± 4.10	6x10E-9
Polonium 210	0.00 ± 0.39	1x10E-9	0.07 ± 0.14	1x10E-9
Uranium (U)	mg/L 0.002		mg/L 0.018	

Date Submitted: 11-23-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-20-94

Neil L. Rasmussen

Laboratory Supervisor

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3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 23, 1993
 LOCATION: 1-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	16.25 X 10 ⁻⁹		
Th-230	1.93 X 10 ⁻⁹	± 0.52 X 10 ⁻⁹	4 X 10 ⁻¹⁰
Ra-226	2.50 X 10 ⁻⁹	± 0.32 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	4.96 X 10 ⁻⁹	± 1.92 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.62 X 10 ⁻⁹	± 1.52 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.06 X 10 ⁻⁹	± 0.24 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: November 23, 1993
 LOCATION: 3-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	10222.70 X 10 ⁻⁹		
Th-230	2.55 X 10 ⁻⁹	± 0.26 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	2.16 X 10 ⁻⁹	± 0.31 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	27.4 X 10 ⁻⁹	± 2.64 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.21 X 10 ⁻⁹	± 1.62 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.28 X 10 ⁻⁹	± 0.51 X 10 ⁻⁹	1 X 10 ⁻⁹



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Lab #: 93-5200-3

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Attention: Steve Pfaff

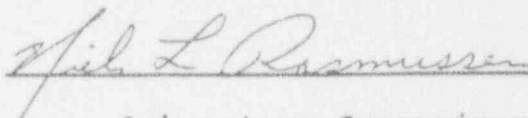
1 SC
November 23, 1993
Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	3003
pH, units	3.68
Total Dissolved Solids, mg/l	2981
Chloride (Cl), mg/l	138
Sulfate (SO ₄), mg/l	1800
Nitrate (NO ₃ as N), mg/l	1.5
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.02
Chromium (Cr), mg/l	<0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.14
Selenium (Se), mg/l	0.0069
Uranium (U), mg/l	0.024

		LLD uCi/ml
Radium 226, pCi/l	2.50 ± 0.32	1x10E-10
Radium 228, pCi/l	4.96 ± 1.92	1x10E-9
Thorium 230, pCi/l	1.93 ± 0.52	4x10E-10
Lead 210, pCi/l	3.62 ± 1.52	2x10E-9
Polonium 210, pCi/l	0.06 ± 0.24	2x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94


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Lab #: 93-5200-5

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Attention: Steve Pfaff

3 SC

November 23, 1993

Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	8714
pH, units	3.56
Total Dissolved Solids, mg/l	10111
Chloride (Cl), mg/l	371
Sulfate (SO4), mg/l	8000
Nitrate (NO3 as N), mg/l	7.5
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.07
Chromium (Cr), mg/l	0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	1.4
Selenium (Se), mg/l	0.063
Uranium (U), mg/l	15.1

		LLD uCi/ml
Radium 226, pCi/l	2.16 ± 0.31	2x10E-10
Radium 228, pCi/l	27.4 ± 2.64	1x10E-9
Thorium 230, pCi/l	2.55 ± 0.26	1x10E-9
Lead 210, pCi/l	3.21 ± 1.62	2x10E-9
Polonium 210, pCi/l	0.28 ± 0.51	1x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94

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Lab #: 93-5200-7

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49 SC

November 23, 1993

Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	3120
pH, units	5.74
Total Dissolved Solids, mg/l	3410
Chloride (Cl), mg/l	52.7
Sulfate (SO4), mg/l	2400
Nitrate (NO3 as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.02
Chromium (Cr), mg/l	<0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.20
Selenium (Se), mg/l	0.0031
Uranium (U), mg/l	0.010

		LLD uCi/ml
Radium 226, pCi/l	1.18 ± 0.21	1x10E-10
Radium 228, pCi/l	3.89 ± 1.38	1x10E-9
Thorium 230, pCi/l	1.57 ± 0.50	4x10E-10
Lead 210, pCi/l	0.00 ± 1.22	2x10E-9
Polonium 210, pCi/l	0.17 ± 0.46	2x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94

Neil L. Rasmussen

Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 30, 1993
 LOCATION: 51-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	42.65 X 10 ⁻⁹		
Th-230	30.2 X 10 ⁻⁹	± 3.34 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	4.82 X 10 ⁻⁹	± 0.43 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	1.14 X 10 ⁻⁹	± 1.64 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.05 X 10 ⁻⁹	± 2.44 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.37 X 10 ⁻⁹	± 0.97 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: November 30, 1993
 LOCATION: 52-SC
 TYPE OF SAMPLE: Groundwater - Dry

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹



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Lab #: 93-5209-5

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51 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	13188
pH, units	3.83
Total Dissolved Solids, mg/l	28815
Chloride (Cl), mg/l	352
Sulfate (SO4), mg/l	18300
Nitrate (NO3 as N), mg/l	0.29
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.96
Cadmium (Cd), mg/l	0.06
Chromium (Cr), mg/l	0.32
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	4.5
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.063

		LLD uCi/ml
Radium 226, pCi/l	4.82 ± 0.43	1x10E-10
Radium 228, pCi/l	1.14 ± 1.64	1x10E-9
Thorium 230, pCi/l	30.2 ± 3.34	2x10E-9
Lead 210, pCi/l	3.05 ± 2.44	3x10E-9
Polonium 210, pCi/l	0.37 ± 0.97	2x10E-9

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94

Laboratory Supervisor

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3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 30, 1993
 LOCATION: 53-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	24.37 X 10 ⁻⁹		
Th-230	QNS X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	4.36 X 10 ⁻⁹	± 0.62 X 10 ⁻⁹	5 X 10 ⁻¹⁰
Ra-228	12.7 X 10 ⁻⁹	± 2.47 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	QNS X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	QNS X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹

DATE COLLECTED: November 22, 1993
 LOCATION: 54-SC
 TYPE OF SAMPLE: Groundwater - Bailed.

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	0.68 X 10 ⁻⁹		
Th-230	1.90 X 10 ⁻⁹	± 0.73 X 10 ⁻⁹	8 X 10 ⁻¹⁰
Ra-226	9.04 X 10 ⁻⁹	± 0.59 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	7.27 X 10 ⁻⁹	± 3.03 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 3.48 X 10 ⁻⁹	5 X 10 ⁻⁹
Po-210	0.07 X 10 ⁻⁹	± 0.10 X 10 ⁻⁹	5 X 10 ⁻⁹



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Lab #: 93-5209-6

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Attention: Steve Pfaff

53 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

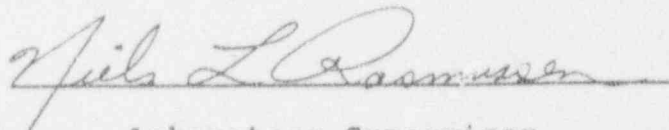
WATER ANALYSIS

Conductivity @ 25C, umho/cm	4062
pH, units	5.44
Total Dissolved Solids, mg/l	4918
Chloride (Cl), mg/l	68.7
Sulfate (SO4), mg/l	2820
Nitrate (NO3 as N), mg/l	17.8
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.18
Cadmium (Cd), mg/l	0.02
Chromium (Cr), mg/l	<0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.47
Selenium (Se), mg/l	0.016
Uranium (U), mg/l	0.036

		LLD uCi/ml
Radium 226, pCi/l	4.36 ± 0.62	5x10E-10
Radium 228, pCi/l	12.7 ± 2.47	1x10E-9
Thorium 230, pCi/l	Ins ±	
Lead 210, pCi/l	Ins ±	
Polonium 210, pCi/l	Ins ±	

Ins = Insufficient sample for analysis.

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94


Laboratory Supervisor



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Lab #: 93-5197-4

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Attention: Steve Pfaff

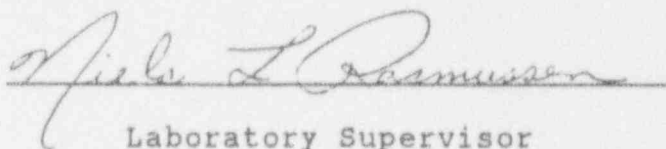
54 SC
November 22, 1993
Field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	8339
pH, units	4.34
Total Dissolved Solids, mg/l	11298
Chloride (Cl), mg/l	369
Sulfate (SO4), mg/l	6440
Nitrate (NO3 as N), mg/l	0.30
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.03
Chromium (Cr), mg/l	0.05
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.92
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	<0.001

		LLD uCi/ml
Radium 226, pCi/l	9.04 ± 0.59	2x10E-10
Radium 228, pCi/l	7.27 ± 3.03	3x10E-9
Thorium 230, pCi/l	1.90 ± 0.73	8x10E-10
Lead 210, pCi/l	0.00 ± 3.48	5x10E-9
Polonium 210, pCi/l	0.07 ± 0.10	5x10E-9

Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-13-94


Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 22, 1993
 LOCATION: 55-SC
 TYPE OF SAMPLE: Groundwater - Dry

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹

DATE COLLECTED: November 30, 1993
 LOCATION: 56-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	19.63 X 10 ⁻⁹		
Th-230	6.2 X 10 ⁻⁹	± 1.79 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	4.07 X 10 ⁻⁹	± 0.41 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	11.7 X 10 ⁻⁹	± 1.88 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	5.31 X 10 ⁻⁹	± 3.30 X 10 ⁻⁹	5 X 10 ⁻⁹
Po-210	0.03 X 10 ⁻⁹	± 1.18 X 10 ⁻⁹	2 X 10 ⁻⁹



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Lab #: 93-5209-7

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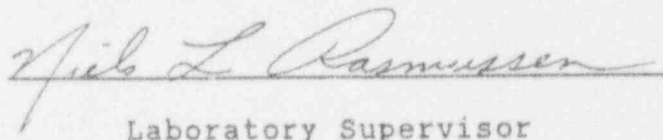
56 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	8478
pH, units	3.88
Total Dissolved Solids, mg/l	13946
Chloride (Cl), mg/l	292
Sulfate (SO4), mg/l	9800
Nitrate (NO3 as N), mg/l	0.89
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.12
Cadmium (Cd), mg/l	0.03
Chromium (Cr), mg/l	0.05
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	3.2
Selenium (Se), mg/l	0.002
Uranium (U), mg/l	0.029

		LLD uCi/ml
Radium 226, pCi/l	4.07 ± 0.41	1x10E-10
Radium 228, pCi/l	11.7 ± 1.88	2x10E-9
Thorium 230, pCi/l	6.2 ± 1.79	2x10E-9
Lead 210, pCi/l	5.31 ± 3.30	5x10E-9
Polonium 210, pCi/l	0.03 ± 1.18	2x10E-9

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94


Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 30, 1993
 LOCATION: 57-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	7.44 X 10 ⁻⁹		
Th-230	3.25 X 10 ⁻⁹	± 1.88 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	0.76 X 10 ⁻⁹	± 0.20 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	2.95 X 10 ⁻⁹	± 1.61 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 2.45 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.10 X 10 ⁻⁹	± 1.29 X 10 ⁻⁹	5 X 10 ⁻⁹

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 22, 1993
 LOCATION: 58-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	8.80 X 10 ⁻⁹		
Th-230	21.1 X 10 ⁻⁹	± 3.2 X 10 ⁻⁹	30 X 10 ⁻¹⁰
Ra-226	10.6 X 10 ⁻⁹	± 0.6 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	66.2 X 10 ⁻⁹	± 5.1 X 10 ⁻⁹	4 X 10 ⁻⁹
Pb-210	0.80 X 10 ⁻⁹	± 3.74 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.16 X 10 ⁻⁹	2 X 10 ⁻⁹



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Lab #: 93-5209-8

Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff


57 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	7654
pH, units	3.91
Total Dissolved Solids, mg/l	11360
Chloride (Cl), mg/l	288
Sulfate (SO4), mg/l	8000
Nitrate (NO3 as N), mg/l	0.69
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.11
Cadmium (Cd), mg/l	0.02
Chromium (Cr), mg/l	0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	1.7
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.011

		LLD uCi/ml
Radium 226, pCi/l	0.76 ± 0.20	2x10E-10
Radium 228, pCi/l	2.95 ± 1.61	2x10E-9
Thorium 230, pCi/l	3.25 ± 1.88	2x10E-9
Lead 210, pCi/l	0.00 ± 2.45	3x10E-9
Polonium 210, pCi/l	0.10 ± 1.29	5x10E-9

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94


Laboratory Supervisor

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Lab Number : 93-5196-6

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Attention: Steve Pfaff

58 SC

November 22, 1993

Sample was field filtered & preserved by S. Pfaff.

	mg/l		mg/l
TDS (Calculated)	24358	Boron (B)	<0.05
TDS (Observed)	27717	Cadmium (Cd)	0.07
Conductivity @25c, umho/cm	15057	Chromium (Cr)	0.45
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.10
Tot. Hardness (as CaCO3)	6615	Fluoride (F)	0.96
Sodium (Na, Calculated)	934	Iron (Fe)	2603
Sodium (Na, Observed)	488	Lead (Pb)	<0.05
Potassium (K)	29.2	Manganese (Mn)	92.0
Calcium (Ca)	329	Mercury (Hg)	<0.001
Magnesium (Mg)	1408	Molybdenum (Mo)	<0.1
Chloride (Cl)	379	Nickel (Ni)	4.5
Sulfate (SO4)	18000	Nitrate (NO3 as N)	0.30
Bicarbonate (HCO3)	0	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	0.013
pH, Units	3.49	Vanadium (V)	7.5
Aluminum (Al)	968	Zinc (Zn)	6.2
Ammonia (NH3 as N)	153		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	10.6 ± 0.6	1x10E-10
Radium 228	66.2 ± 5.1	3x10E-9
Thorium 230	21.1 ± 3.2	3x10E-9
Lead 210	0.80 ± 3.74	4x10E-9
Polonium 210	0.00 ± 0.16	2x10E-9

Radium 226 was determined by de-emanation.

Submitted By: S. Pfaff
Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Analyzed : 01-10-94

Niels L. Rasmussen

Laboratory Supervisor

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3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 22, 1993
 LOCATION: 59-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	0.68 X 10 ⁻⁹		
Th-230	4.36 X 10 ⁻⁹	± 1.45 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	5.48 X 10 ⁻⁹	± 0.45 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	23.6 X 10 ⁻⁹	± 4.16 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	1.13 X 10 ⁻⁹	± 2.63 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.49 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: November 30, 1993
 LOCATION: 60-SC
 TYPE OF SAMPLE: Groundwater - Bailed.

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	618.78 X 10 ⁻⁹		
Th-230	9.37 X 10 ⁻⁹	± 2.38 X 10 ⁻⁹	20 X 10 ⁻⁹
Ra-226	3.23 X 10 ⁻⁹	± 0.37 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	15.3 X 10 ⁻⁹	± 2.39 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.55 X 10 ⁻⁹	± 2.30 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.63 X 10 ⁻⁹	3 X 10 ⁻⁹



Lab #: 93-5197-5

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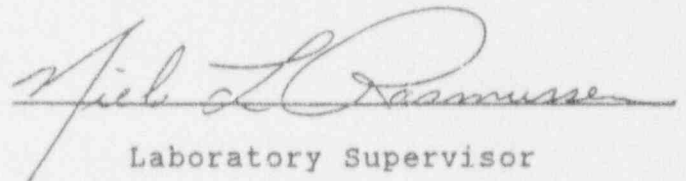
59 SC
November 22, 1993
Field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	12624
pH, units	3.55
Total Dissolved Solids, mg/l	23693
Chloride (Cl), mg/l	321
Sulfate (SO4), mg/l	14900
Nitrate (NO3 as N), mg/l	0.81
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.05
Chromium (Cr), mg/l	0.23
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	3.5
Selenium (Se), mg/l	0.002
Uranium (U), mg/l	<0.001

		LLD uCi/ml
Radium 226, pCi/l	5.48 ± 0.45	1x10E-10
Radium 228, pCi/l	23.6 ± 4.16	3x10E-9
Thorium 230, pCi/l	4.36 ± 1.45	1x10E-9
Lead 210, pCi/l	1.13 ± 2.63	4x10E-9
Polonium 210, pCi/l	0.00 ± 0.49	1x10E-9

Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-13-94


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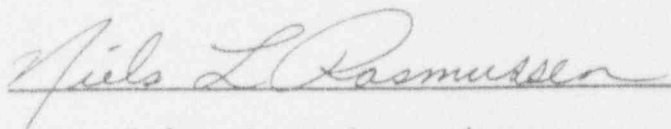
60 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	6241
pH, units	4.91
Total Dissolved Solids, mg/l	8207
Chloride (Cl), mg/l	268
Sulfate (SO4), mg/l	5320
Nitrate (NO3 as N), mg/l	0.29
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.12
Cadmium (Cd), mg/l	0.04
Chromium (Cr), mg/l	0.06
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	1.6
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.914

		LLD uCi/ml
Radium 226, pCi/l	3.23 ± 0.37	1x10E-10
Radium 228, pCi/l	15.3 ± 2.39	2x10E-9
Thorium 230, pCi/l	9.37 ± 2.38	2x10E-9
Lead 210, pCi/l	0.55 ± 2.30	3x10E-9
Polonium 210, pCi/l	0.00 ± 0.63	3x10E-9

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94


Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 30, 1993
 LOCATION: 61-SC
 TYPE OF SAMPLE: Groundwater - Not sampled

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹

DATE COLLECTED: November 22, 1993
 LOCATION: 62-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	792.09 X 10 ⁻⁹		
Th-230	320. X 10 ⁻⁹	± 11. X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	3.94 X 10 ⁻⁹	± 0.38 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	16.4 X 10 ⁻⁹	± 4.49 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	3.00 X 10 ⁻⁹	± 2.32 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.37 X 10 ⁻⁹	± 1.06 X 10 ⁻⁹	3 X 10 ⁻⁹



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Lab #: 93-5197-6

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Attention: Steve Pfaff


62 SC
November 22, 1993
Field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	13898
pH, units	3.35
Total Dissolved Solids, mg/l	26644
Chloride (Cl), mg/l	386
Sulfate (SO4), mg/l	16700
Nitrate (NO3 as N), mg/l	0.30
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.06
Chromium (Cr), mg/l	1.0
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	4.1
Selenium (Se), mg/l	0.0014
Uranium (U), mg/l	1.17

		LLD uCi/ml
Radium 226, pCi/l	3.94 ± 0.38	1x10E-10
Radium 228, pCi/l	16.4 ± 4.19	3x10E-9
Thorium 230, pCi/l	320 ± 11	1x10E-9
Lead 210, pCi/l	3.00 ± 2.32	3x10E-9
Polonium 210, pCi/l	0.37 ± 1.06	3x10E-9

Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-13-94


Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 22, 1993
 LOCATION: 63-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	3181.90 X 10 ⁻⁹		
Th-230	4020. X 10 ⁻⁹	± 84. X 10 ⁻⁹	30 X 10 ⁻¹⁰
Ra-226	1.33 X 10 ⁻⁹	± 0.22 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	2.58 X 10 ⁻⁹	± 3.86 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	0.06 X 10 ⁻⁹	± 2.30 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.21 X 10 ⁻⁹	4 X 10 ⁻⁹

DATE COLLECTED: November 22, 1993
 LOCATION: 64-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	4217.71 X 10 ⁻⁹		
Th-230	5996. X 10 ⁻⁹	+109. X 10 ⁻⁹	30 X 10 ⁻¹⁰
Ra-226	0.44 X 10 ⁻⁹	± 0.14 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	1.51 X 10 ⁻⁹	± 1.25 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	10.3 X 10 ⁻⁹	± 5.54 X 10 ⁻⁹	5 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.35 X 10 ⁻⁹	2 X 10 ⁻⁹



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Petrotomics Company
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Attention: Steve Pfaff


63 SC
November 22, 1993
Field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	9150
pH, units	2.62
Total Dissolved Solids, mg/l	12811
Chloride (Cl), mg/l	237
Sulfate (SO4), mg/l	9000
Nitrate (NO3 as N), mg/l	0.75
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.06
Chromium (Cr), mg/l	0.93
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	2.1
Selenium (Se), mg/l	0.080
Uranium (U), mg/l	4.70

		LLD uCi/ml
Radium 226, pCi/l	1.33 ± 0.22	1x10E-10
Radium 228, pCi/l	2.58 ± 3.86	3x10E-9
Thorium 230, pCi/l	4020 ± 84	3x10E-9
Lead 210, pCi/l	0.00 ± 2.30	3x10E-9
Polonium 210, pCi/l	0.00 ± 0.21	4x10E-9

Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-13-94


Laboratory Supervisor



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Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff


64 SC
November 22, 1993
Field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	10598
pH, units	2.58
Total Dissolved Solids, mg/l	15492
Chloride (Cl), mg/l	268
Sulfate (SO4), mg/l	10300
Nitrate (NO3 as N), mg/l	0.30
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.08
Chromium (Cr), mg/l	1.0
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	3.2
Selenium (Se), mg/l	0.051
Uranium (U), mg/l	6.23

		LLD uCi/ml
Radium 226, pCi/l	0.44 ± 0.14	1x10E-10
Radium 228, pCi/l	1.51 ± 1.25	1x10E-9
Thorium 230, pCi/l	5996 ± 109	3x10E-9
Lead 210, pCi/l	10.3 ± 5.54	5x10E-9
Polonium 210, pCi/l	0.00 ± 0.35	2x10E-9

Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-13-94


Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 23, 1993
 LOCATION: 65-SC
 TYPE OF SAMPLE: Groundwater - Dry

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹

DATE COLLECTED: November 23, 1993
 LOCATION: 66-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	3.38 X 10 ⁻⁹		
Th-230	3.48 X 10 ⁻⁹	± 1.37 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	7.73 X 10 ⁻⁹	± 0.55 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	32.99 X 10 ⁻⁹	± 2.66 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 1.36 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.22 X 10 ⁻⁹	± 0.51 X 10 ⁻⁹	1 X 10 ⁻⁹



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Lab #: 93-5200-8

Petrotomics Company
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Attention: Steve Pfaff

66 SC
November 23, 1993
Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	10715
pH, units	3.87
Total Dissolved Solids, mg/l	21581
Chloride (Cl), mg/l	345
Sulfate (SO4), mg/l	14300
Nitrate (NO3 as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.08
Cadmium (Cd), mg/l	0.05
Chromium (Cr), mg/l	0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	3.1
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.005

		LLD uCi/ml
Radium 226, pCi/l	7.73 ± 0.55	1x10E-10
Radium 228, pCi/l	32.9 ± 2.66	1x10E-9
Thorium 230, pCi/l	3.48 ± 1.37	1x10E-9
Lead 210, pCi/l	0.00 ± 1.36	3x10E-9
Polonium 210, pCi/l	0.22 ± 0.51	1x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94

Phil L. Rasmussen

Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 30, 1993
 LOCATION: 67-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	13.54 X 10 ⁻⁹		
Th-230	0.17 X 10 ⁻⁹	+ 0.22 X 10 ⁻⁹	3 X 10 ⁻¹⁰
Ra-226	26.6 X 10 ⁻⁹	+ 1.0 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	14.6 X 10 ⁻⁹	+ 2.57 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	+ 2.00 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.09 X 10 ⁻⁹	+ 1.75 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: November 30, 1993
 LOCATION: 68-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	9.48 X 10 ⁻⁹		
Th-230	0.12 X 10 ⁻⁹	+ 0.25 X 10 ⁻⁹	4 X 10 ⁻¹⁰
Ra-226	5.68 X 10 ⁻⁹	+ 0.49 X 10 ⁻⁹	3 X 10 ⁻¹⁰
Ra-228	13.15 X 10 ⁻⁹	+ 2.73 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	+ 2.25 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.05 X 10 ⁻⁹	+ 1.59 X 10 ⁻⁹	2 X 10 ⁻⁹



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Lab #: 93-5209-10

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Attention: Steve Pfaff

67 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	2944
pH, units	6.96
Total Dissolved Solids, mg/l	2681
Chloride (Cl), mg/l	117
Sulfate (SO4), mg/l	1280
Nitrate (NO3 as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.11
Cadmium (Cd), mg/l	0.01
Chromium (Cr), mg/l	<0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.03
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.020

		LLD uCi/ml
Radium 226, pCi/l	26.6 ± 1.0	1x10E-10
Radium 228, pCi/l	14.6 ± 2.57	2x10E-9
Thorium 230, pCi/l	0.17 ± 0.22	3x10E-10
Lead 210, pCi/l	0.00 ± 2.00	3x10E-9
Polonium 210, pCi/l	0.09 ± 1.75	2x10E-9

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94

Nels L. Rasmussen
Laboratory Supervisor

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307/789-6420

Lab #: 93-5209-11

Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff


68 SC
November 30, 1993
Sample field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	8360
pH, units	6.21
Total Dissolved Solids, mg/l	14052
Chloride (Cl), mg/l	355
Sulfate (SO4), mg/l	8900
Nitrate (NO3 as N), mg/l	0.22
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.12
Cadmium (Cd), mg/l	0.03
Chromium (Cr), mg/l	0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.85
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.014

		LLD uCi/ml
Radium 226, pCi/l	5.68 ± 0.49	3x10E-10
Radium 228, pCi/l	13.15 ± 2.73	2x10E-9
Thorium 230, pCi/l	0.12 ± 0.25	4x10E-10
Lead 210, pCi/l	0.00 ± 2.25	3x10E-9
Polonium 210, pCi/l	0.05 ± 1.59	2x10E-9

Date Submitted: 11-30-93
Analyzed By: RC, KAH, GLH, JPM
Date Reported: 02-04-94


Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 23, 1993
 LOCATION: 5-DC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	6.77 X 10 ⁻⁹		
Th-230	5.42 X 10 ⁻⁹	± 1.61 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	4.86 X 10 ⁻⁹	± 0.43 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	12.6 X 10 ⁻⁹	± 2.11 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 1.54 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.26 X 10 ⁻⁹	± 0.41 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: November 23, 1993
 LOCATION: 6-DC
 TYPE OF SAMPLE: Groundwater - Dry

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹



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Lab #: 93-5200-9

Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

5 DC
November 23, 1993
Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	6594
pH, units	3.93
Total Dissolved Solids, mg/l	10423
Chloride (Cl), mg/l	129
Sulfate (SO ₄), mg/l	7100
Nitrate (NO ₃ as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.06
Cadmium (Cd), mg/l	0.05
Chromium (Cr), mg/l	0.04
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	1.4
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.010

		LLD uCi/ml
Radium 226, pCi/l	4.86 ± 0.43	1x10E-10
Radium 228, pCi/l	12.6 ± 2.11	1x10E-9
Thorium 230, pCi/l	5.42 ± 1.61	1x10E-9
Lead 210, pCi/l	0.00 ± 1.54	3x10E-9
Polonium 210, pCi/l	0.26 ± 0.41	1x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94

Nick L. Rasmussen

Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 23, 1993
 LOCATION: 7-DC
 TYPE OF SAMPLE: Groundwater - Dry

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹

DATE COLLECTED: November 23, 1993
 LOCATION: 8-DC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	15.57 X 10 ⁻⁹		
Th-230	125. X 10 ⁻⁹	± 7. X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	2.57 X 10 ⁻⁹	± 0.33 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	5.17 X 10 ⁻⁹	± 1.15 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.80 X 10 ⁻⁹	± 1.52 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.06 X 10 ⁻⁹	± 0.37 X 10 ⁻⁹	1 X 10 ⁻⁹



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Lab #: 93-5200-10

Petrotomics Company
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Attention: Steve Pfaff

8 DC

November 23, 1993

Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	9773
pH, units	3.51
Total Dissolved Solids, mg/l	18233
Chloride (Cl), mg/l	280
Sulfate (SO4), mg/l	12400
Nitrate (NO3 as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.69
Chromium (Cr), mg/l	0.23
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	3.1
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.023

		LLD uCi/ml
Radium 226, pCi/l	2.57 ± 0.33	2x10E-10
Radium 228, pCi/l	5.17 ± 1.15	1x10E-9
Thorium 230, pCi/l	125 ± 7	1x10E-9
Lead 210, pCi/l	2.80 ± 1.52	2x10E-9
Polonium 210, pCi/l	0.06 ± 0.37	1x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94

Field L. Rasmussen

Laboratory Supervisor

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3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 23, 1993
 LOCATION: 9-DC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	0.68 X 10 ⁻⁹		
Th-230	2.37 X 10 ⁻⁹	± 1.92 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	5.56 X 10 ⁻⁹	± 0.46 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	25.5 X 10 ⁻⁹	± 2.16 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 1.34 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.11 X 10 ⁻⁹	± 0.43 X 10 ⁻⁹	3 X 10 ⁻⁹

DATE COLLECTED: November 22, 1993
 LOCATION: 10-DC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	7.45 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 0.33 X 10 ⁻⁹	6 X 10 ⁻¹⁰
Ra-226	22.3 X 10 ⁻⁹	± 0.9 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	11.15 X 10 ⁻⁹	± 3.59 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 1.44 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.16 X 10 ⁻⁹	3 X 10 ⁻⁹



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Lab #: 93-5200-11

Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

9 DC

November 23, 1993

Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	8243
pH, units	4.45
Total Dissolved Solids, mg/l	11357
Chloride (Cl), mg/l	355
Sulfate (SO4), mg/l	7216
Nitrate (NO3 as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	0.06
Cadmium (Cd), mg/l	0.03
Chromium (Cr), mg/l	0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.17
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	<0.001

		LLD uCi/ml
Radium 226, pCi/l	5.56 ± 0.46	2x10E-10
Radium 228, pCi/l	25.5 ± 2.16	1x10E-9
Thorium 230, pCi/l	2.37 ± 1.92	2x10E-9
Lead 210, pCi/l	0.00 ± 1.34	3x10E-9
Polonium 210, pCi/l	0.11 ± 0.43	3x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94

Neil L. Rasmussen

Laboratory Supervisor



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Lab Number : 93-5196-7

Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

10 DC

November 22, 1993

Sample was field filtered & preserved by S. Pfaff.

	mg/l		mg/l
TDS (Calculated)	1655	Boron (B)	<0.05
TDS (Observed)	1881	Cadmium (Cd)	0.01
Conductivity @25c, umho/cm	2143	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	181	Copper (Cu)	<0.01
Tot. Hardness (as CaCO3)	1196	Fluoride (F)	0.15
Sodium (Na, Calculated)	38.4	Iron (Fe)	34.3
Sodium (Na, Observed)	70.7	Lead (Pb)	<0.05
Potassium (K)	11.4	Manganese (Mn)	1.1
Calcium (Ca)	308	Mercury (Hg)	<0.001
Magnesium (Mg)	104	Molybdenum (Mo)	<0.1
Chloride (Cl)	63.3	Nickel (Ni)	<0.03
Sulfate (SO4)	1050	Nitrate (NO3 as N)	<0.01
Bicarbonate (HCO3)	221	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	0.011
pH, Units	6.42	Vanadium (V)	<0.1
Aluminum (Al)	0.10	Zinc (Zn)	0.03
Ammonia (NH3 as N)	1.9		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	22.3 ± 0.9	2x10E-10
Radium 228	11.15 ± 3.59	3x10E-9
Thorium 230	0.00 ± 0.33	6x10E-10
Lead 210	0.00 ± 1.44	2x10E-9
Polonium 210	0.00 ± 0.16	3x10E-9

Radium 226 was determined by de-emanation.

Submitted By: S. Pfaff
Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Analyzed : 01-10-94

Niels L. Basmussen
Laboratory Supervisor

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 22, 1993
 LOCATION: 11-DC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	0.68 X 10 ⁻⁹		
Th-230	0.16 X 10 ⁻⁹	± 0.20 X 10 ⁻⁹	3 X 10 ⁻¹⁰
Ra-226	8.27 X 10 ⁻⁹	± 0.55 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	4.24 X 10 ⁻⁹	± 3.56 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	2.31 X 10 ⁻⁹	± 2.54 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.26 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: November 22, 1993
 LOCATION: 12-DC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	4048.46 X 10 ⁻⁹		
Th-230	52.6 X 10 ⁻⁹	± 4.3 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	215. X 10 ⁻⁹	± 3. X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	11.05 X 10 ⁻⁹	± 3.59 X 10 ⁻⁹	3 X 10 ⁻⁹
Pb-210	0.00 X 10 ⁻⁹	± 3.16 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.47 X 10 ⁻⁹	± 0.51 X 10 ⁻⁹	1 X 10 ⁻⁹



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Lab #: 93-5197-1

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Attention: Steve Pfaff

11 DC
November 22, 1993
Field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	2548
pH, units	6.75
Total Dissolved Solids, mg/l	2246
Chloride (Cl), mg/l	94.4
Sulfate (SO4), mg/l	1140
Nitrate (NO3 as N), mg/l	<0.01
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.03
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	<0.001

		LLD uCi/ml
Radium 226, pCi/l	8.27 ± 0.55	2x10E-10
Radium 228, pCi/l	4.24 ± 3.56	3x10E-9
Thorium 230, pCi/l	0.16 ± 0.20	3x10E-10
Lead 210, pCi/l	2.31 ± 2.54	3x10E-9
Polonium 210, pCi/l	0.00 ± 0.26	1x10E-9

Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-13-94

Mich L Rasmussen

Laboratory Supervisor



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Lab Number : 93-5196-8

Petrotomics Company
P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

12 DC
November 22, 1993
Sample was field filtered & preserved by S. Pfaff.

	mg/l		mg/l
TDS (Calculated)	24800	Boron (B)	<0.05
TDS (Observed)	28607	Cadmium (Cd)	0.07
Conductivity @25c, umho/cm	21137	Chromium (Cr)	0.26
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.09
Tot. Hardness (as CaCO3)	5397	Fluoride (F)	0.62
Sodium (Na, Calculated)	1170	Iron (Fe)	2411
Sodium (Na, Observed)	444	Lead (Pb)	<0.05
Potassium (K)	117	Manganese (Mn)	111
Calcium (Ca)	324	Mercury (Hg)	<0.001
Magnesium (Mg)	1115	Molybdenum (Mo)	<0.1
Chloride (Cl)	343	Nickel (Ni)	4.0
Sulfate (SO4)	18600	Nitrate (NO3 as N)	0.27
Bicarbonate (HCO3)	0	Selenium (Se)	0.003
Carbonate (CO3)	0	Uranium (U)	5.98
pH, Units	3.64	Vanadium (V)	15.6
Aluminum (Al)	1145	Zinc (Zn)	7.6
Ammonia (NH3 as N)	301		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	215 ± 3	1x10E-10
Radium 228	11.05 ± 3.59	3x10E-9
Thorium 230	52.6 ± 4.3	2x10E-9
Lead 210	0.00 ± 3.16	3x10E-9
Polonium 210	0.47 ± 0.51	1x10E-9

Radium 226 was determined by de-emanation.

Submitted By: S. Pfaff
Date Submitted: 11-22-93
Analyzed By: RC, GLH, KAH, JPM
Date Analyzed : 01-10-94

Niel L. Rasmussen
Laboratory Supervisor

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3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: November 23, 1993
 LOCATION: 13-DC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	0.68×10^{-9}		
Th-230	1.57×10^{-9}	$\pm 0.96 \times 10^{-9}$	10×10^{-10}
Ra-226	5.64×10^{-9}	$\pm 0.44 \times 10^{-9}$	1×10^{-10}
Ra-228	2.27×10^{-9}	$\pm 1.51 \times 10^{-9}$	1×10^{-9}
Pb-210	0.00×10^{-9}	$\pm 1.36 \times 10^{-9}$	3×10^{-9}
Po-210	0.00×10^{-9}	$\pm 0.17 \times 10^{-9}$	2×10^{-9}



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Lab #: 93-5200-12

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Attention: Steve Pfaff

13 DC

November 23, 1993

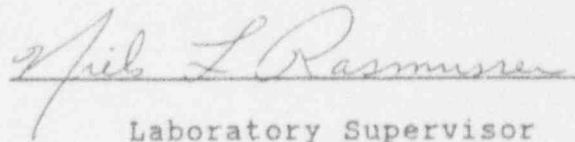
Sample was field filtered & preserved by S. Pfaff

WATER ANALYSIS

Conductivity @ 25C, umho/cm	1460
pH, units	7.12
Total Dissolved Solids, mg/l	1159
Chloride (Cl), mg/l	9.6
Sulfate (SO4), mg/l	660
Nitrate (NO3 as N), mg/l	2.4
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.01
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	<0.03
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	<0.001

		LLD uCi/ml
Radium 226, pCi/l	5.64 ± 0.44	1x10E-10
Radium 228, pCi/l	2.27 ± 1.51	1x10E-9
Thorium 230, pCi/l	1.57 ± 0.96	1x10E-9
Lead 210, pCi/l	0.00 ± 1.36	3x10E-9
Polonium 210, pCi/l	0.00 ± 0.17	2x10E-9

Date Submitted: 11-23-94
Analyzed By: RC, GLH, KAH, JPM
Date Reported: 01-25-94


Laboratory Supervisor

4. VEGETATION, FOOD, AND FISH SAMPLES

Deleted by Amendment No. 21

5. SOIL AND SEDIMENT SAMPLES

Deleted by Amendment No. 21

6. DIRECT RADIATION MEASUREMENTS

DATE: 4th Quarter 1993

<u>LOCATION</u>	<u>EXPOSURE RATE</u> <u>(mr/qr)</u>	<u>ERROR ESTIMATE</u> <u>(mr/qr)</u>
Site 1	51.0	+ 4.9
Site 5	73.8	±12.0

LOCATIONS: Site 1 - 7800' WNW of where yellowcake dryer stack had been located.

- Site 2 - Discontinued.
- Site 3 - Discontinued.
- Site 4 - Discontinued.
- Site 5 - 1800' NE of where yellowcake dryer stack had been located.
- Site 6 - Discontinued.

LLD CALCULATIONS

$$\text{LLD} = \frac{4.66 \sqrt{C_B * T}}{(2.22)(E)(R)(V)(T)} \quad \text{in pCi/units used (V)}$$

WHERE:

C_B = BACKGROUND COUNT RATE

T = COUNT TIME (SAME FOR SAMPLE AND BACKGROUND)

E = DETECTOR EFFICIENCY (CPM/DPM)

R = FRACTIONAL RECOVERY

V = SAMPLE SIZE LITERS OF AIR OR WATER
 GRAMS OF SOIL
 KILOGRAMS OF VEGETATION

2.22 = DPM/pCi

Since the LLD is a function of sample volume, counting efficiency, radiochemical yield, etc., it may vary for different sampling and analysis procedures. The following are some of the normal values used.

$R_{I^{226}}$

C_B = 0.05 to 0.30 counts per minute

T = 50 minutes

E = about 0.9

R = about 0.9 frequently less in soil and vegetation

V = 1 liter of water

= 20 grams of soil

= air volume taken is usually 1/4 of volume sampled

= vegetation weight is usually 1/2 of sample provided

Th²³⁰

C_B = 0.04 to 0.20 cpm

T = 200 minutes, may be less for "hot" samples like tailings pond

E*R = combined recovery and efficiency from Th²³⁰ tracer varies greatly from 0.02 to 0.20

V = 1 liter of water, or less if high in iron. Iron interferes and volumes as low as 25 or 50 ml. may be used.
= 1.0 grams soil
= air volume taken is usually 1/4 of volume sampled (about 7 x 10⁶ L)

Pb²¹⁰

C_B = 1 to 2 cpm

T = 100 to 200 minutes

E = 0.25 to 0.33

R = usually 0.75 to 0.90 but may be less for vegetation and waters high in TDS

V = 1 liter of water, again samples high in iron will be less to lessen its interference.
= air volume taken is usually 1/4 of sample (about 7 x 10⁶ L)
= vegetation weight is usually 1/2 of sample provided.

Po²¹⁰

C_B = about 0.2 cpm

T = 100 to 200 minutes

E = 0.15 to 0.20

R = 0.5 to 0.8

V = 1 liter of water, iron causes interference so smaller volumes of samples high in iron are used, down to about 200 ml.

%MPC CALCULATION

The %MPC is calculated using the values obtained from 10 CFR 20 Appendix B for unrestricted limits in air.

The calculation is as follows:

$$\%MPC = \frac{\text{sample concentration}}{\text{unrestricted limit}}$$

unrestricted limits for air from 10 CFR 20 Appendix B

U nat	5000×10^{-15}
Th ²³⁰	80×10^{-15}
Ra ²²⁶	3000×10^{-15}
Pb ²¹⁰	4000×10^{-15}
Rn ²²²	3×10^{-9}