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FIELD STUDY OF DISPOSED WASTES FROM ADVANCED COAL PROCESSES

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DOE Quarterly Technical Progress Report

January to April 1994

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MASTER

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1.0

OBJECTIVES

The Department of Energy/Morgantown Energy Technology Center (DOE/METC) has initiated research on the disposal of solid wastes from advanced coal processes. The objective of this research is to develop information to be used by private industry and government agencies for planning waste disposal practices associated with advanced coal processes. To accomplish this objective, DOE has contracted Radian Corporation and the North Dakota Energy & Environmental Research Center (EERC) to design, construct, and monitor a limited number of field disposal tests with advanced coal process wastes. These field tests will be monitored over a three year period with the emphasis on collecting data on the field disposal of these wastes.

There has been considerable research on the characteristics and laboratory leaching behavior of coal wastes -- a lesser amount on wastes from advanced coal processes. However, very little information exists on the field disposal behavior of these wastes. Information on field disposal behavior is needed (a) as input to predictive models being developed, b) as input to the development of rule of thumb design guidelines for the disposal of these wastes, and c) as evidence of the behavior of these wastes in the natural environment.

2.0

SUMMARY OF PREVIOUS WORK

This study is organized into four major Tasks. Tasks 1 and 2 were devoted to planning the Task 3 field study. Task 4 uses the results of the field testing to produce an Engineering Design Manual for the utilities and industrial users who manage wastes from advanced coal combustion technologies.

Task 1 identified and rated test design options. A Test Design Manual was prepared and submitted to METC in 1988. Specific test procedures suitable for each design option were identified under Task 2. These test methods were documented in a

Test Procedures Manual, submitted to METC in 1988. Also under Task 2, test sites were selected and site access was negotiated. Sites in Illinois and North Dakota were delayed at this stage, and the North Dakota site was dropped from consideration. Task 2 was completed and Final Test Plans were submitted to METC for three sites in 1988.

Task 3 progress for each of the test sites is summarized below:

2.1 Colorado

The test cell was constructed in June, 1989 with CFBC ash from a low sulfur western coal. The ash has low lime and sulfate content. Core samples were collected in June and December 1989, in March, June and December of 1990, in June 1991, and most recently in June 1992. No groundwater or porewater samples have been recovered; one surface runoff sample was collected. At this time the three year monitoring period at the Colorado site is completed. The DOE plans further field monitoring at this site on an annual basis. A draft site assessment report, based on the initial three years of monitoring, was completed in December, 1992.

The strength of core samples from the Colorado site is low to moderate (200 psi to 900 psi), with permeabilities of 2×10^{-3} to 3×10^{-4} . Laboratory leachates show moderate concentrations of calcium, sulfate, and other common ions. Trace element concentrations in test leachates are low compared to regulatory limits. No leachate has been generated from the test cell at this site.

A draft final report on the Colorado site has been prepared and submitted to DOE/METC. Comments on the draft report have been received and a final report will be issued in May 1994.

Two test cells were constructed, in February and April of 1989, using LIMB ash from an Ohio coal with 2.4% sulfur. The ash has a high lime and sulfate content. Test case 1 (north cell) was constructed with 25% moisture; test case 2 (south cell) was constructed with 38% moisture to optimize compaction. The wastes expanded, heaved, and fractured during the first year, particularly in the south cell. Mineralogical changes in the wastes with hydration and weathering are the primary cause. Core strength is low to moderate (<100 psi to 2000 psi) and highly variable because of fracturing. Field measurements of permeability vary from 3×10^{-3} to 5×10^{-5} cm/sec. Permeabilities are lowest in the north cell.

Large amounts of water were bound in the wastes in the first year as the waste saturated and hydrated. Starting in the second year, leachate appears to have migrated out of the south cell into one downgradient well. The leachate at the bottom of the test cell contains up to several thousand mg/L of sulfate, chloride, potassium, and sodium, with somewhat lower concentrations of calcium and silicon. Trace metal concentrations are generally low compared to regulatory limits, but a few samples contain arsenic at concentrations of up to 0.35 mg/L.

Core samples were first collected in June, 1989, and quarterly and annual core sampling events have taken place according to schedule since that time. Water samples have been collected on a quarterly basis since October, 1989. Final core sampling for the three year monitoring period took place in August, 1992. Further monitoring, on an annual basis, is planned by the DOE.

A draft final report on the Ohio site has been prepared and submitted to DOE/METC. Following receipt of comments from the DOE, the report will be finalized.

2.3

Illinois

The first Illinois test cell was completed in April, 1991, with BFBC ash from a Illinois coal with 3.1% sulfur. A large excess of limestone is used in the combustor; the ash is high in lime relative to most FBC wastes, containing up to 30% CaO. The ash also contains abundant sulfate, but has relatively low concentrations of typical coal ash constituents compared to other wastes included in this study. The two test cells planned for the second Illinois test case will evaluate the effects of added coal ash on cementitious reactions in the waste. Laboratory studies to define the optimum mix of FBC waste and coal fly ash were conducted and two mixes were selected. Both mixes contain equal amounts of pulverized coal fly ash and FBC ash by weight; the mix for Cell 2 was placed at optimum moisture for compaction with a smooth roller, and the mix for Cell 3 was placed as a pumpable slurry at a moisture content 10% over OMC. Cell construction, planned for late fall, 1992, was completed in June, 1993 because of permit complications.

The initial cell was instrumented and sampled in June 1991. Water samples and additional cores were collected in August and November, 1991, and February and May, 1992. No expansion has been noted at the site. The wastes are solidified with unconfined compressive strength between approximately 150 and 550 psi, although some fracture zones may be present in the waste and may reduce overall strength. The permeability measured on cores recovered from the test cell ranges from 1×10^{-6} to 2×10^{-4} ; field permeability measurements range from a high of 3×10^{-3} near the surface to a low of 2×10^{-5} at depth in the test cell. Two years of sampling have been completed at Cell 1 at the site.

Core samples from Cells 2 and 3 have been collected on one occasion since construction, and porewater samples have been sampled twice. The analytical results from the latest monitoring are discussed in this report.

Task 4 work on the Disposal Facility Design Manual is under way. A draft of the Design Manual is anticipated by early summer, 1994.

3.0 OBJECTIVES FOR THE CURRENT REPORTING PERIOD

The specific objectives for the reporting period of January, 1994 to April, 1994 were as follows:

- Complete a draft of the Ohio site report;
- Finalize Year 4 funding and contract modifications;
- Start Year 4 sampling and analysis; and
- Prepare results from the Illinois site for presentation at the conference on Management of High Sulfur Coal Combustion Residues in Springfield, Illinois on April 6, 1994.

4.0 ACTIVITIES FOR THE REPORTING PERIOD

4.1 Colorado Ute Site

Comments on the Draft Final Site Report were received, and the final report is in preparation.

4.2 Ohio Site

The draft Final Site Report was submitted to DOE/METC and Ohio Edison for review. A final report will be issued pending receipt of comments.

4.3

Illinois Site

The eleventh set of quarterly water samples was collected in February, 1994. The analytical results for the groundwater and lysimeter samples are shown in Tables 1 through 5. Additional mineralogical and physical properties data was also received from the North Dakota EERC during this quarter, and is presented later in this section.

4.3.1

Groundwater Chemistry

Major element concentrations in groundwater samples from monitoring wells upgradient and downgradient from the test cells at the Illinois test site are shown in Figures 1 through 3. Results from the shallow groundwater upgradient and downgradient from the test site are further detailed in Figure 4, showing results for four chemical species which have increased in concentration, apparently in response to leachate migration from Cell 1. Chemical data for the most recent samples from all locations are shown in Table 1.

Reexamination of data collected downgradient from Cell 1 indicates that potassium and molybdenum have increased in concentration in the shallow downgradient well (ILMW-3). This is in addition to the increased sodium and chloride concentrations noted previously. Over the last quarter, concentrations of all of these species declined somewhat, although all remain above background levels. At least one additional shallow well downgradient from Cell 1 may be installed during the May, 1994 sampling event to further characterize the plume development in this area. Groundwater data from this site will be used with available groundwater transport/dispersion models as part of the reporting process after the initial three year monitoring period is completed.

The magnesium concentration in ILMW-3 also may be affected by leachate migration, although in this case the response is a decline in concentration starting

ILMW-1 ILMW-2 ILMW-3
 480' 490' 500'

ILMW-4 ILMW-5 ILMW-6
 490' 500' 510'

Figure 1. Major cation concentrations in groundwater downgradient from Test Cell 1 at the Illinois site. Upgradient concentrations are shown for comparison. The numbers shown in the legend indicate the approximate elevation at the bottom of the screened interval in each well in feet above mean seal level.

Downgradient

ILMW-1 ILMW-2 ILMW-3
480' 490' 500'
■ ◆ ☆

Upgradient

ILMW-4 ILMW-5 ILMW-6
490' 500' 510'
■ ◆ ☆

Figure 2. Major anion concentrations in groundwater downgradient from Test Cell 1 at the Illinois site. Upgradient concentrations are shown for comparison. The numbers shown in the legend indicate the approximate elevation at the bottom of the screened interval in each well in feet above mean sea level.

Calcium, mg/L

Magnesium, mg/L

Sulfate, mg/L

Alkalinity, mg/L HCO₃

Sodium, mg/L

Chloride, mg/L

ILMW-7 ILMW-8 ILMW-9
 490' 500' 510'
 ■ ◆ ☆

Figure 3. Major ion concentrations in groundwater downgradient from Test Cells 2 and 3 at the Illinois site. The numbers shown in the legend indicate the approximate elevation at the bottom of the screened interval in each well in feet above mean sea level.

Figure 4. Concentration trends of the four species in the shallow groundwater which are affected by leachate migration from Cell 1. No other species exhibit a consistent increase in concentration over this period. Magnesium (not shown) decreases in concentration beginning in Quarter 6.

between quarters 5 and 6, somewhat before the rise in concentrations of other species was noted. The ILMW-3 magnesium concentration has a higher variability than the other affected species, and appears to have a sensitive dependence on the groundwater pH, which is slightly higher in ILMW-3 than in the other shallow wells.

4.3.2 Porewater Chemistry

Concentration trends for major species in porewaters in all cells are similar to the patterns observed in previous samples. Figures 5 through 7 show the vertical distribution of several major species in November 1993 and February 1994 samples from Cells 1, 2, and 3 respectively. In Cell 1 all major analytes except calcium are relatively depleted in near-surface pore water, and reach maximum concentrations near the base of the test cell at approximately 10 feet of depth. Calcium is held at low concentrations in porewaters within the ash because of solubility constraints, and significant amounts of calcium are only found beneath the test cell.

Porewater from Cell 2, containing the compacted fly ash/FBC mix, shows the same variability in major ion concentrations with depth for samples collected during both of the two recent sampling events. Concentrations of most species decline between November and February, especially sulfate and silicon. This does not appear to be correlated to the washing out of the most soluble species, and may indicate additional mineral formation within the test cell.

Pore water from Cell 3, containing the pumpable fly ash/FBC mix, also shows declining concentrations of most species between November and February; however, only two samples were collected from this test cell in February making any conclusions somewhat speculative. Concentrations of most species in Cell 3 remain significantly lower than in Cell 2 porewater. Dilution of Cell 3 porewater by percolating rainwater is the most likely explanation of this difference (see discussion of physical properties below).

Figure 5. Depth trends in the composition of lysimeter samples collected in November 1993 (gray) and February 1994 from the Illinois site Cell 1 (FBC ash only). A consistent trend is shown in both sampling events with all species except calcium generally increasing in concentration with depth in the ash and dropping sharply in lysimeters beneath the ash. Calcium distribution follows the opposite pattern. Concentrations are shown on a logarithmic scale.

Figure 6. Depth trends for lysimeter samples collected in November 1993 (gray) and February 1994 (black) from the Illinois site Cell 2 (compacted FBC/fly ash mix). Most species decline slightly in concentration during this period.

Figure 7. Depth trends for lysimeter samples collected in November 1993 (gray) and February 1994 (black) from the Illinois site Cell 3 (pumpable FBC/fly ash mix). Concentrations of most species in Cell 3 are significantly lower than in Cell 2.

4.3.3 Mineralogy

The results from X-ray diffraction analysis of Cell 1 cores collected in May, 1993 are shown in Table 6. Figure 8 presents the updated data on the mineralogical evolution of the materials in Cell 1. The abundances of most major phases has remained constant following rapid growth of portlandite, gypsum, and ettringite in the first month following construction. Gypsum is the only phase which has varied significantly in abundance, declining from approximately 30 weight percent to just over 10% during the period between 10 and 25 months following construction. The disappearance of gypsum may be primarily due to simple dissolution since no other mineral phases appear to be formed during this time period. It is not clear what combination of kinetic and equilibrium factors favors dissolution of gypsum over portlandite. Simple modelling using MINTEQA2 suggests that portlandite is generally vastly undersaturated in porewater solutions, but these modelling efforts do not account for the effects on chemical equilibrium of the large amounts of ettringite present in the test cells.

4.3.4 Physical Properties

The results of physical properties measurements on recent core samples are shown in Table 7. Figure 9 shows the continued changes in the moisture content, hydraulic conductivity, and unconfined compressive strength of the materials in core samples collected from Cell 1. Over the last 12 months the average moisture content has increased from approximately 50% to 70% on a dry weight basis. The increase in moisture content at the Illinois site is slightly more rapid than was observed at the Ohio site, and is consistent with the large amount of rainfall experienced in central Illinois during 1993.

The average hydraulic conductivity of Cell 1 cores is virtually unchanged since construction, remaining at approximately 2×10^{-5} cm/sec. The hydraulic conductivity of Cell 1 is similar to the final measurements after three years exposure at the

Cell 1: FBC Only

Figure 8. X-ray diffraction mineralogy of core samples from Illinois Cell 1. Most mineral phases have a fairly constant abundance after a brief period of initial reaction. Gypsum has been progressively lost over the last 15 months.

Figure 9. Average physical properties of core samples collected from the Illinois site Cell 1. Core moistures increase steadily over time, while compressive strengths decrease. There has been little change in hydraulic conductivity.

Colorado and Ohio sites. Average core strengths continue to decline, with an average core strength of only 50 psi after two years of exposure.

Results for the physical properties of initial core samples from Cells 2 and 3 were also received during the last quarter. Figure 10 compares the results from cores collected approximately 4 months after construction with the results from test cylinders prepared during the mix design program. The unconfined compressive strengths of core samples from Cell 1 (FBC only) and Cell 3 (grout mix) are significantly lower than the strengths of the test cylinders, suggesting rapid weathering of these materials on exposure to the environment. Cores from Cell 2 (compacted mix) are stronger than the test cylinders, suggesting that cementation, rather than weathering, has been the primary mechanism operating in this test cell. Data from hydraulic conductivity tests show similar results. Cells 1 and 3 perform more poorly than predicted from the mix design results, while Cell 2 performs above expectations. The hydraulic conductivity of Cell 3 is especially high, approaching values associated with coarse sands. The high hydraulic conductivity of Cell 3 allows rapid penetration and flushing by rainwater falling on the surface of the cell.

5.0 MANAGEMENT

Results from the Illinois site were highlighted in a paper prepared for the conference on Management of Residues from Combustion of High Sulfur Coals in Springfield, IL. A copy of the paper was sent to Jerry Harness for review on April 1, 1994. Following receipt of comments the paper will be finalized before the May 25 deadline for submission for printing in the conference proceedings.

Radian has been informed that changes will be made in the technical direction for this program in order to simplify contract administration. Radian will modify test plans and other project documentation as required upon receipt of revised directions.

Figure 10. Comparison of the strengths and hydraulic conductivities of core samples from Cells 2 and 3 with test cylinders prepared before cell construction. Test cylinders were prepared from subsamples of the same mix which was placed in the test cells except for the FBC only cylinders, which were prepared for preconstruction Proctor moisture/density testing. Cells 1 and 3 generally performed worse in the field environment, while Cell 2 cores outperformed the test cylinders.

6.0**ACTIVITIES PLANNED FOR THE NEXT QUARTER**

The following activities are planned for the period of April, 1994 through July, 1994:

Finalize the Ohio site report;

Finalize the Illinois Coal Combustion Residues paper;

Finalize Year 4 funding and contract modifications;

Start Year 4 sampling and analysis; and

Complete a draft of the Disposal Facility Design Manual.

Table 1

Upgradient Groundwater, February 1994

		Site ID / Location ID							
		Sample ID							
		Log Date							
Parameter	Units	IL4 / ILMW04		IL4 / ILMW05		IL4 / ILMW05		IL4 / ILMW06	
		IL279		IL280		IL286 Dup of IL280		IL281	
		2/23/94		2/23/94				2/23/94	
<hr/>									
Anions									
Chloride	mg/L	15.8	(0.200)	15.2	(0.200)	16.0	(0.200)	22.1	(0.200)
Fluoride	mg/L	0.222	B (0.0235)	0.221	B (0.0235)	0.217	B (0.0235)	0.128	B (0.0235)
Sulfate	mg/L	424	(0.600)	400	(0.600)	451	(0.600)	1490	(6.00)
<hr/>									
Elements by ICPEs or AA									
Aluminum	mg/L	ND	(0.0284)	ND	(0.0284)	ND	(0.0284)	< DL	(0.0284)
Arsenic	mg/L	ND	(0.00065)	ND	(0.00065)	ND	(0.00065)	ND	(0.00065)
Barium	mg/L	0.0142	(0.00053)	0.0140	(0.00053)	0.0135	(0.00053)	0.0111	(0.00053)
Beryllium	mg/L	< DL	(0.00055)	< DL	(0.00055)	< DL	(0.00055)	ND	(0.00055)
Boron	mg/L	1.15	(0.0150)	1.14	(0.0150)	1.18	(0.0150)	1.16	(0.0150)
Cadmium	mg/L	ND	(0.00023)	ND	(0.00023)	ND	(0.00023)	ND	(0.00023)
Calcium	mg/L	162	B (0.148)	159	B (0.148)	165	B (0.148)	356	B (0.148)
Chromium	mg/L	ND	(0.00249)	ND	(0.00249)	ND	(0.00249)	ND	(0.00249)
Cobalt	mg/L	0.00585	(0.00340)	0.00655	(0.00340)	0.00620	(0.00340)	0.00661	(0.00340)
Copper	mg/L	< DL	(0.00381)	< DL	(0.00381)	ND	(0.00381)	ND	(0.00381)
Iron	mg/L	0.833	(0.00596)	0.805	(0.00596)	0.801	(0.00596)	ND	(0.00596)
Lead	mg/L	ND	(0.00080)	ND	(0.00080)	ND	(0.00080)	ND	(0.00080)
Magnesium	mg/L	85.7	(0.0228)	83.8	(0.0228)	88.5	(0.0228)	214	(0.0228)
Manganese	mg/L	0.360	(0.00039)	0.358	(0.00039)	0.374	(0.00039)	1.17	(0.00039)
Molybdenum	mg/L	0.00606	(0.00463)	< DL	(0.00463)	0.00651	(0.00463)	< DL	(0.00463)
Nickel	mg/L	ND	(0.00986)	ND	(0.00986)	< DL	(0.00986)	0.0171	(0.00986)
Potassium	mg/L	6.03	(0.370)	5.71	(0.370)	5.85	(0.370)	12.4	(0.370)
Selenium	mg/L	ND	(0.00140)	ND	(0.00140)	ND	(0.00140)	ND	(0.00140)
Silicon	mg/L	6.98	B (0.0273)	6.90	B (0.0273)	6.97	B (0.0273)	6.30	B (0.0273)
Silver	mg/L	ND	(0.00492)	ND	(0.00492)	ND	(0.00492)	ND	(0.00492)
Sodium	mg/L	143	B (0.0397)	140	B (0.0397)	144	B (0.0397)	157	B (0.0397)
Strontium	mg/L	1.65	(0.00016)	1.62	(0.00016)	1.68	(0.00016)	2.82	(0.00016)
Tin	mg/L	< DL	(0.0144)	< DL	(0.0144)	< DL	(0.0144)	ND	(0.0144)
Vanadium	mg/L	< DL	(0.00236)	0.00325	(0.00236)	< DL	(0.00236)	0.00256	(0.00236)

() = Reporting Limit

C1-1

Table 1
(Continued)

Parameter	Units	Site ID / Location ID							
		IL4 / ILMW04		IL4 / ILMW05		IL4 / ILMW05		IL4 / ILMW06	
		IL279		IL280		IL286 Dup of IL280		IL281	
		2/23/94		2/23/94				2/23/94	
-----	-----	-----		-----		-----		-----	
Elements by ICPES or AA, cont.									
Zinc	mg/L	< DL	(0.00153)	0.00159 B	(0.00153)	< DL	(0.00153)	0.00969 B	(0.00153)
Field measurements									
Conductivity	umhos/cm	1910	(5)	1850	(5)	1850	(5)	3380	(5)
Diss. O2 as %	percent	1.8	()	7.1	()	7.1	()	31.1	()
Redox (Eh)	mV	28	()	32	()	32	()	89	()
Temperature	deg. C	10.71	()	9.62	()	9.62	()	9.30	()
Total Alkalinity	meq/L	13.64	(0.03)	13.72	(0.03)	13.8	(0.03)	15.16	(0.03)
Total Dissolved Solids	mg/L	1400	(1)	1372	(1)	1440	(1)	3259	(1)
pH	pH units	6.50	()	6.53	()	6.53	()	6.32	()

() = Reporting Limit

C1-2

Table 1
(Continued)

		Site ID / Location ID	
		Sample ID	
		Log Date	
		IL / ILBLNK	
		IL285	
		2/23/94	
Parameter	Units		

Anions			
Chloride	mg/L	ND	(0.0200)
Fluoride	mg/L	0.0281 B	(0.0235)
Sulfate	mg/L	ND	(0.0600)
Elements by ICPEs or AA			
Aluminum	mg/L	ND	(0.0284)
Arsenic	mg/L	ND	(0.00065)
Barium	mg/L	0.000620	(0.00053)
Beryllium	mg/L	ND	(0.00055)
Boron	mg/L	ND	(0.0150)
Cadmium	mg/L	ND	(0.00023)
Calcium	mg/L	< DL	(0.148)
Chromium	mg/L	ND	(0.00249)
Cobalt	mg/L	ND	(0.00340)
Copper	mg/L	0.0168	(0.00381)
Iron	mg/L	0.00975	(0.00596)
Lead	mg/L	ND	(0.00080)
Magnesium	mg/L	< DL	(0.0228)
Manganese	mg/L	< DL	(0.00039)
Molybdenum	mg/L	< DL	(0.00463)
Nickel	mg/L	ND	(0.00986)
Potassium	mg/L	ND	(0.370)
Selenium	mg/L	ND	(0.00140)
Silicon	mg/L	0.0485 B	(0.0273)
Silver	mg/L	ND	(0.00492)
Sodium	mg/L	0.0628 B	(0.0397)
Strontium	mg/L	ND	(0.00016)
Tin	mg/L	ND	(0.0144)
Vanadium	mg/L	ND	(0.00236)

() = Reporting Limit

Table 1
(Continued)

		Site ID / Location ID	
		Sample ID	
		Log Date	
		IL / ILBLNK	
		IL285	
		2/23/94	
Parameter	Units		
-----	-----	-----	
Elements by ICPEs or AA, cont.			
Zinc	mg/L	< DL	(0.00153)
Field measurements			
Conductivity	umhos/cm	6.58	(5)
Total Alkalinity	meq/L	0.03	(0.03)
Total Dissolved Solids	mg/L	88	(1)
pH	pH units	4.62	()

Table 2

Illinois Downgradient Groundwater, February 1994

		Site ID / Location ID					
		Sample ID					
		Log Date					
		IL5 / ILMW01		IL5 / ILMW02		IL5 / ILMW03	
		IL276		IL277		IL278	
		2/23/94		2/23/94		2/23/94	
Parameter	Units						

Anions							
Chloride	mg/L	21.6	(0.200)	42.5	(0.200)	231	(1.00)
Fluoride	mg/L	0.187 B	(0.0235)	0.157 B	(0.0235)	0.124 B	(0.0235)
Sulfate	mg/L	466	(0.600)	1360	(6.00)	1010	(3.00)
Elements by ICPEs or AA							
Aluminum	mg/L	ND	(0.0284)	< DL	(0.0284)	ND	(0.0284)
Arsenic	mg/L	ND	(0.00065)	0.00122 B	(0.00065)	ND	(0.00065)
Barium	mg/L	0.0243	(0.00053)	0.00956	(0.00053)	0.0200	(0.00053)
Beryllium	mg/L	< DL	(0.00055)	ND	(0.00055)	< DL	(0.00055)
Boron	mg/L	1.21	(0.0150)	0.339	(0.0150)	0.154	(0.0150)
Cadmium	mg/L	ND	(0.00023)	< DL	(0.00023)	ND	(0.00023)
Calcium	mg/L	180 B	(0.148)	367 B	(0.148)	244 B	(0.148)
Chromium	mg/L	ND	(0.00249)	< DL	(0.00249)	ND	(0.00249)
Cobalt	mg/L	0.00549	(0.00340)	0.00382	(0.00340)	0.00374	(0.00340)
Copper	mg/L	< DL	(0.00381)	ND	(0.00381)	< DL	(0.00381)
Iron	mg/L	0.797	(0.00596)	ND	(0.00596)	ND	(0.00596)
Lead	mg/L	ND	(0.00080)	ND	(0.00080)	ND	(0.00080)
Magnesium	mg/L	95.9	(0.0228)	187	(0.0228)	29.5	(0.0228)
Manganese	mg/L	1.17	(0.00039)	2.56	(0.00039)	0.540	(0.00039)
Mercury	mg/L	ND	(0.00004)	ND	(0.00004)	ND	(0.00004)
Molybdenum	mg/L	< DL	(0.00463)	< DL	(0.00463)	0.121	(0.00463)
Nickel	mg/L	< DL	(0.00986)	0.0154	(0.00986)	< DL	(0.00986)
Potassium	mg/L	6.27	(0.370)	3.23	(0.370)	35.7	(0.370)
Selenium	mg/L	ND	(0.00140)	ND	(0.00280)	ND	(0.00140)
Silicon	mg/L	6.79 B	(0.0273)	6.06 B	(0.0273)	3.22 B	(0.0273)
Silver	mg/L	ND	(0.00492)	ND	(0.00492)	ND	(0.00492)
Sodium	mg/L	116 B	(0.0397)	75.6 B	(0.0397)	328 B	(0.0397)
Strontium	mg/L	1.59	(0.00016)	0.847	(0.00016)	1.13	(0.00016)
Tin	mg/L	ND	(0.0144)	< DL	(0.0144)	< DL	(0.0144)

() = Reporting Limit

C1-1

Table 2
(Continued)

Parameter	Units	Site ID / Location ID					
		IL5 / ILMW01		IL5 / ILMW02		IL5 / ILMW03	
		IL276		IL277		IL278	
		2/23/94		2/23/94		2/23/94	
-----	-----	-----	-----	-----	-----	-----	-----
Elements by ICPEs or AA, cont.							
Vanadium	mg/L	< DL	(0.00236)	< DL	(0.00236)	< DL	(0.00236)
Zinc	mg/L	0.00360 B	(0.00153)	0.00370 B	(0.00153)	ND	(0.00153)
Field measurements							
Conductivity	umhos/cm	1840	(5)	2890	(5)	2910	(5)
Diss. O2 as %	percent	7.6	()	29.5	()	58.6	()
Redox (Eh)	mV	30	()	245	()	156	()
Temperature	deg. C	10.18	()	10.56	()	9.82	()
Total Alkalinity	meq/L	12.12	(0.03)	8.88	(0.03)	1.8	(0.03)
Total Dissolved Solids	mg/L	1436	(1)	2906	(1)	2345	(1)
pH	pH units	6.56	()	6.62	()	6.59	()

Table 2
(Continued)

		Site ID / Location ID					
		Sample ID					
		Log Date					
		IL6 / ILMW07		IL6 / ILMW08		IL6 / ILMW09	
		IL282		IL283		IL284	
Parameter	Units	2/22/94		2/22/94		2/22/94	
<hr/>							
Anions							
Chloride	mg/L	37.7	(0.200)	11.2	(0.0400)	12.1	(0.0400)
Fluoride	mg/L	0.336 B	(0.0235)	0.154 B	(0.0235)	0.145 B	(0.0235)
Sulfate	mg/L	222	(0.600)	2840	(6.00)	2820	(6.00)
<hr/>							
Elements by ICPEs or AA							
Aluminum	mg/L	ND	(0.0284)	< DL	(0.0284)	ND	(0.0284)
Arsenic	mg/L	ND	(0.00065)	ND	(0.00065)	ND	(0.00065)
Barium	mg/L	0.0311	(0.00053)	0.00970	(0.00053)	0.00844	(0.00053)
Beryllium	mg/L	ND	(0.00055)	ND	(0.00055)	ND	(0.00055)
Boron	mg/L	1.64	(0.0150)	0.280	(0.0150)	0.282	(0.0150)
Cadmium	mg/L	ND	(0.00023)	< DL	(0.00023)	ND	(0.00023)
Calcium	mg/L	113 B	(0.148)	426 B	(0.148)	444 B	(0.148)
Chromium	mg/L	ND	(0.00249)	ND	(0.00249)	ND	(0.00249)
Cobalt	mg/L	< DL	(0.00340)	0.0146	(0.00340)	0.0146	(0.00340)
Copper	mg/L	ND	(0.00381)	ND	(0.00381)	< DL	(0.00381)
Iron	mg/L	1.41	(0.00596)	ND	(0.00596)	ND	(0.00596)
Lead	mg/L	ND	(0.00080)	ND	(0.00080)	ND	(0.00080)
Magnesium	mg/L	62.0	(0.0228)	550	(0.0228)	588	(0.0228)
Manganese	mg/L	0.348	(0.00039)	6.62	(0.00039)	7.89	(0.00039)
Mercury	mg/L	ND	(0.00004)	ND	(0.00004)	ND	(0.00004)
Molybdenum	mg/L	< DL	(0.00463)	0.00662	(0.00463)	0.00737	(0.00463)
Nickel	mg/L	ND	(0.00986)	0.0322	(0.00986)	0.0456	(0.00986)
Potassium	mg/L	5.00	(0.370)	3.89	(0.370)	3.90	(0.370)
Selenium	mg/L	ND	(0.00140)	ND	(0.00140)	ND	(0.00140)
Silicon	mg/L	7.76 B	(0.0273)	5.55 B	(0.0273)	5.36 B	(0.0273)
Silver	mg/L	ND	(0.00492)	ND	(0.00492)	ND	(0.00492)
Sodium	mg/L	154 B	(0.0397)	59.7 B	(0.0397)	64.1 B	(0.0397)
Strontium	mg/L	1.24	(0.00016)	1.40	(0.00016)	1.48	(0.00016)
Tin	mg/L	ND	(0.0144)	ND	(0.0144)	ND	(0.0144)

() = Reporting Limit

C1-1

Table 2
(Continued)

Parameter	Units	Site ID / Location ID					
		Sample ID		Log Date			
		IL6 / ILMW07		IL6 / ILMW08		IL6 / ILMW09	
		IL282		IL283		IL284	
		2/22/94		2/22/94		2/22/94	
<hr/>							
Elements by ICPEs or AA, cont.							
Vanadium	mg/L	< DL	(0.00236)	0.00688	(0.00236)	0.00530	(0.00236)
Zinc	mg/L	0.00428	B (0.00153)	0.0347	B (0.00153)	0.0103	B (0.00153)
Field measurements							
Conductivity	umhos/cm	1580	(5)	2900	(5)	4770	(5)
Diss. O2 as %	percent	3.1	()	54.6	()	21.3	()
Redox (Eh)	mV	2	()	83	()	91	()
Temperature	deg. C	10.41	()	8.39	()	NA	
Total Alkalinity	meq/L	12.36	(0.03)	12.68	(0.03)	12.72	(0.03)
Total Dissolved Solids	mg/L	1066	(1)	5002	(1)	5460	(1)
pH	pH units	6.71	()	6.69	()	6.41	()

Table 3

Illinois Cell 1 Porewater, February 1994

		Site ID / Location ID							
		Sample ID							
		Log Date							
		IL1 / ILLY14		IL1 / ILLY17		IL1 / ILLY19		IL1 / ILLY25	
		IL294		IL296		IL297		IL303	
		2/24/94				2/23/94		2/23/94	
Parameter	Units								

Anions									
Chloride	mg/L	37.0	(0.200)	684	(2.00)	NA		NA	
Fluoride	mg/L	0.245 B	(0.0235)	0.201 B	(0.0235)	NA		NA	
Sulfate	mg/L	2050	(6.00)	4380	(6.00)	NA		NA	
Elements by ICPEs or AA									
Aluminum	mg/L	< DL	(0.0284)	0.922	(0.0284)	NA		ND	(0.0284)
Arsenic	mg/L	ND	(0.00065)	0.0473 S	(0.00657)	NA		< DL	(0.00263)
Barium	mg/L	0.0168	(0.00053)	0.0106 B	(0.00053)	NA		0.00397 B	(0.00053)
Beryllium	mg/L	ND	(0.00055)	ND	(0.00055)	NA		ND	(0.00055)
Boron	mg/L	0.331	(0.0150)	0.106	(0.0150)	NA		0.0403	(0.0150)
Cadmium	mg/L	0.00268	(0.00023)	0.00148 SX	(0.00062)	NA		< DL	(0.00031)
Calcium	mg/L	473 B	(0.148)	4.99	(0.148)	NA		21.8	(0.148)
Chromium	mg/L	< DL	(0.00249)	0.00474	(0.00249)	NA		0.00851	(0.00249)
Cobalt	mg/L	< DL	(0.00340)	ND	(0.00340)	NA		ND	(0.00340)
Copper	mg/L	0.0135	(0.00381)	ND	(0.00381)	NA		ND	(0.00381)
Iron	mg/L	< DL	(0.00596)	0.0471	(0.00596)	NA		0.0411	(0.00596)
Lead	mg/L	ND	(0.00080)	< DL	(0.00220)	NA		< DL	(0.00220)
Magnesium	mg/L	156	(0.0228)	1.02	(0.0228)	NA		0.356	(0.0228)
Manganese	mg/L	0.0502	(0.00039)	ND	(0.00039)	NA		0.00174	(0.00039)
Molybdenum	mg/L	0.0103	(0.00463)	1.19	(0.00463)	NA		0.216	(0.00463)
Nickel	mg/L	< DL	(0.00986)	< DL	(0.00986)	NA		0.0207	(0.00986)
Potassium	mg/L	1.94	(0.370)	3320	(3.70)	NA		452	(0.370)
Selenium	mg/L	ND	(0.00140)	0.00878	(0.00140)	NA		0.00616	(0.00140)
Silicon	mg/L	29.6 B	(0.0273)	1060 B	(0.273)	NA		273 B	(0.0273)
Silver	mg/L	ND	(0.00492)	ND	(0.00492)	NA		ND	(0.00492)
Sodium	mg/L	226 B	(0.0397)	3040	(0.397)	NA		551	(0.0397)
Strontium	mg/L	1.02	(0.00016)	3.99	(0.00016)	NA		4.03	(0.00016)
Tin	mg/L	< DL	(0.0144)	ND	(0.0144)	NA		ND	(0.0144)
Vanadium	mg/L	0.00824	(0.00236)	0.0310	(0.00236)	NA		0.0172	(0.00236)

() = Reporting Limit

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Table 3
(Continued)

Parameter	Units	Site ID / Location ID Sample ID Log Date					
		IL1 / ILLY14 IL294 2/24/94	IL1 / ILLY17 IL296	IL1 / ILLY19 IL297 2/23/94	IL1 / ILLY25 IL303 2/23/94		
-----	-----	-----	-----	-----	-----		
Elements by ICPES or AA, cont.							
Zinc	mg/L	0.0394 B (0.00153)	0.00839 (0.00153)	NA		0.0102	(0.00153)
Field measurements							
Conductivity	umhos/cm	NA	NA	22900	(5)	3790	(5)
pH	pH units	NA	NA	12.71	()	11.64	()

Table 3
(Continued)

		Site ID / Location ID	
		Sample ID	
		Log Date	
		IL1 / ILLY27	
		IL305	
		2/24/94	
Parameter	Units		
<hr/>			
Anions			
Chloride	mg/L	327	(1.00)
Fluoride	mg/L	0.259 B	(0.0235)
Sulfate	mg/L	2570	(3.00)
Elements by ICPEs or AA			
Aluminum	mg/L	0.645	(0.0284)
Arsenic	mg/L	0.0131 B	(0.00065)
Barium	mg/L	0.00789	(0.00053)
Beryllium	mg/L	ND	(0.00055)
Boron	mg/L	0.102	(0.0150)
Cadmium	mg/L	0.00108	(0.00023)
Calcium	mg/L	1.13 B	(0.148)
Chromium	mg/L	0.0330	(0.00249)
Cobalt	mg/L	0.00513	(0.00340)
Copper	mg/L	0.371	(0.00381)
Iron	mg/L	0.0815	(0.00596)
Lead	mg/L	ND	(0.00080)
Magnesium	mg/L	0.135	(0.0228)
Manganese	mg/L	0.00202	(0.00039)
Molybdenum	mg/L	0.599	(0.00463)
Nickel	mg/L	0.0146	(0.00986)
Potassium	mg/L	2210	(0.370)
Selenium	mg/L	ND	(0.00140)
Silicon	mg/L	7610 B	(0.0273)
Silver	mg/L	ND	(0.00492)
Sodium	mg/L	2530 B	(0.198)
Strontium	mg/L	0.869	(0.00016)
Tin	mg/L	ND	(0.0144)
Vanadium	mg/L	0.0373	(0.00236)

() = Reporting Limit

Table 3
(Continued)

		Site ID / Location ID	
		Sample ID	
		Log Date	
		IL1 / ILLY27	
		IL305	
		2/24/94	
Parameter	Units		
-----	-----	-----	
Elements by ICPES or AA, cont.			
Zinc	mg/L	0.136	B (0.00153)
Field measurements			
Conductivity	umhos/cm	18320	(5)
Total Alkalinity	meq/L	119.16	(0.03)
Total Dissolved Solids	mg/L	14468	(1)
pH	pH units	12.14	()

Table 4

Illinois Cell 2 (Compacted Mix) Porewater, February 1994

		Site ID / Location ID					
		Sample ID					
		Log Date					
Parameter	Units	IL2 / IL2LY06		IL2 / IL2LY07		IL2 / IL2LY08	
		IL307		IL308		IL309	
		2/24/94		2/24/94		2/24/94	
<hr/>							
Anions							
Chloride	mg/L	200	(1.00)	516	(2.00)	183	(1.00)
Fluoride	mg/L	0.117 B	(0.0235)	0.619 B	(0.0235)	0.323 B	(0.0235)
Sulfate	mg/L	2020	(3.00)	3700	(6.00)	3250	(3.00)
<hr/>							
Elements by ICPEs or AA							
Aluminum	mg/L	< DL	(0.0284)	ND	(0.0284)	< DL	(0.0284)
Arsenic	mg/L	ND	(0.00065)	0.0197 S	(0.00657)	ND	(0.00065)
Barium	mg/L	0.00828	(0.00053)	0.0126 B	(0.00053)	0.0300	(0.00053)
Beryllium	mg/L	ND	(0.00055)	ND	(0.00055)	< DL	(0.00055)
Boron	mg/L	3.16	(0.0150)	0.616	(0.0150)	1.96	(0.0150)
Cadmium	mg/L	ND	(0.00023)	0.000850 R	(0.00031)	0.000260	(0.00023)
Calcium	mg/L	34.0 B	(0.148)	7.01	(0.148)	334 B	(0.148)
Chromium	mg/L	ND	(0.00249)	ND	(0.00249)	ND	(0.00249)
Cobalt	mg/L	ND	(0.00340)	ND	(0.00340)	0.00468	(0.00340)
Copper	mg/L	0.00684	(0.00381)	ND	(0.00381)	< DL	(0.00381)
Iron	mg/L	< DL	(0.00596)	0.0583	(0.00596)	ND	(0.00596)
Lead	mg/L	ND	(0.00080)	0.00332	(0.00220)	ND	(0.00080)
Magnesium	mg/L	0.395	(0.0228)	0.638	(0.0228)	106	(0.0228)
Manganese	mg/L	0.00139	(0.00039)	ND	(0.00039)	0.267	(0.00039)
Molybdenum	mg/L	3.02	(0.00463)	6.03	(0.00463)	0.821	(0.00463)
Nickel	mg/L	< DL	(0.00986)	0.0130	(0.00986)	< DL	(0.00986)
Potassium	mg/L	433	(0.370)	471	(0.370)	43.3	(0.370)
Selenium	mg/L	0.00307	(0.00140)	0.00690 X	(0.00280)	ND	(0.00140)
Silicon	mg/L	249 B	(0.0273)	2490 B	(0.273)	37.9 B	(0.0273)
Silver	mg/L	ND	(0.00492)	ND	(0.00492)	ND	(0.00492)
Sodium	mg/L	1170 B	(0.198)	3560	(0.397)	1220 B	(0.198)
Strontium	mg/L	1.68	(0.00016)	0.663	(0.00016)	1.66	(0.00016)
Tin	mg/L	ND	(0.0144)	ND	(0.0144)	ND	(0.0144)
Vanadium	mg/L	0.00457	(0.00236)	0.0840	(0.00236)	0.00287	(0.00236)

() = Reporting Limit

Table 4
(Continued)

		Site ID / Location ID					
		Sample ID					
		Log Date					
		IL2 / IL2LY06		IL2 / IL2LY07		IL2 / IL2LY08	
		IL307		IL308		IL309	
		2/24/94		2/24/94		2/24/94	
Parameter	Units						
-----	-----	-----		-----		-----	
Elements by ICPEs or AA, cont.							
Zinc	mg/L	0.00352	B (0.00153)	0.0100	(0.00153)	< DL	(0.00153)
Field measurements							
Conductivity	umhos/cm	5900	(5)	11850	(5)	6060	(5)
Total Alkalinity	meq/L	11.6	(0.03)	NA		4.04	(0.03)
Total Dissolved Solids	mg/L	5205	(1)	NA		5926	(1)
pH	pH units	10.76	()	11.16	()	7.79	()

Table 5

Illinois Cell 3 (Grout Mix) Porewater, February 1994

		Site ID / Location ID			
		Sample ID		Log Date	
		IL3 / IL3LY03		IL3 / IL3LY04	
		IL314		IL315	
		2/24/94		2/24/94	
Parameter	Units				

Anions					
Chloride	mg/L	258	(1.00)	95.4	(1.00)
Fluoride	mg/L	0.0983 B	(0.0235)	0.0540 B	(0.0235)
Sulfate	mg/L	2010	(3.00)	2460	(3.00)
Elements by ICPEs or AA					
Aluminum	mg/L	< DL	(0.0284)	< DL	(0.0284)
Arsenic	mg/L	ND	(0.00065)	ND	(0.00065)
Barium	mg/L	0.00741	(0.00053)	0.0198	(0.00053)
Beryllium	mg/L	ND	(0.00055)	< DL	(0.00055)
Boron	mg/L	2.05	(0.0150)	4.59	(0.0150)
Cadmium	mg/L	ND	(0.00023)	0.00127	(0.00023)
Calcium	mg/L	33.0 B	(0.148)	376 B	(0.148)
Chromium	mg/L	ND	(0.00249)	ND	(0.00249)
Cobalt	mg/L	< DL	(0.00340)	< DL	(0.00340)
Copper	mg/L	0.0129	(0.00381)	< DL	(0.00381)
Iron	mg/L	0.00619	(0.00596)	ND	(0.00596)
Lead	mg/L	ND	(0.00080)	ND	(0.00080)
Magnesium	mg/L	0.276	(0.0228)	202	(0.0228)
Manganese	mg/L	0.000730	(0.00039)	0.274	(0.00039)
Molybdenum	mg/L	3.80	(0.00463)	0.262	(0.00463)
Nickel	mg/L	0.0372	(0.00986)	0.0111	(0.00986)
Potassium	mg/L	493	(0.370)	41.2	(0.370)
Selenium	mg/L	0.00228	(0.00140)	< DL	(0.00140)
Silicon	mg/L	151 B	(0.0273)	38.0 B	(0.0273)
Silver	mg/L	ND	(0.00492)	ND	(0.00492)
Sodium	mg/L	1250 B	(0.198)	774 B	(0.0397)
Strontium	mg/L	1.82	(0.00016)	1.44	(0.00016)
Tin	mg/L	< DL	(0.0144)	< DL	(0.0144)
Vanadium	mg/L	0.0148	(0.00236)	0.0101	(0.00236)

() = Reporting Limit

C1-1

Table 5
(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID		Log Date	
		IL3 / IL3LY03		IL3 / IL3LY04	
		IL314		IL315	
		2/24/94		2/24/94	
-----	-----	-----		-----	
Elements by ICPEs or AA, cont.					
Zinc	mg/L	ND	(0.00153)	0.00708 B	(0.00153)
Field measurements					
Conductivity	umhos/cm	7450	(5)	5040	(5)
Total Alkalinity	meq/L	17.36	(0.03)	9.44	(0.03)
Total Dissolved Solids	mg/L	4789	(1)	5288	(1)
pH	pH units	11.66	()	7.67	()

Table 6

X-Ray Diffraction Mineralogy of Year 2 Ash Cores: Illinois Cell 1

Sample ID	Depth Interval	Location	Comments/ Loc. ID	Wt. Percent										
				Gp	Et	Tm	Ah	Qz	Cc	Pl	Lm	Mu	Sp	SUM
93MAYIL1-2	(1.5-2')	Illinois	Cell-1	3.0	31.0	?	0.0	17.2	4.7	12.4	0.0			68.3
93MAYIL1-4	(3.5-4')	Illinois	Cell-1	9.0	23.0		0.0	4.6	5.8	17.3	0.0			59.7
93MAYIL1-6	(5.5-6')	Illinois	Cell-1	13.0	28.0		0.0	6.9	7.5	13.1	0.0			68.5
93MAYIL1-7.5	(7-7.5')	Illinois	Cell-1	11.0	25.0		0.0	6.4	7.8	11.3	0.0			61.5
93MAYIL1-10	(9.5-10')	Illinois	Cell-1	9.0	24.0	?	0.0	7.2	9.5	13.3	0.0			63.0
93MAYIL2-1.5	(1-1.5')	Illinois	Cell-1	15.0	37.0		0.0	5.6	7.8	18.6	0.0			84.0
93MAYIL2-4	(3.5-4')	Illinois	Cell-1	10.0	25.0		0.0	7.7	6.7	12.3	0.0			61.7
93MAYIL2-6.5	(6-6.5')	Illinois	Cell-1	11.0	32.0	?	0.0	6.7	9.1	8.3	0.0			67.1
93MAYIL2-8	(8-8.5')	Illinois	Cell-1	11.0	31.0		0.0	7.0	6.2	13.2	0.0			68.4
93MAYIL2-10.5	(10-10.5')	Illinois	Cell-1	9.0	22.0		0.0	14.3	5.5	13.4	0.0			64.2

XRD Mineral Key

Anhydrite	Ah	CaSO ₄
Calcite	Cc	CaCO ₃
Ettringite	Et	Ca ₆ Al ₂ (SO ₄) ₃ (OH) ₁₂ ·26H ₂ O
Thaumasite	Tm	Ca ₃ Si ₂ [(SO ₄) ₂ (CO ₃) ₂](OH) ₁₂ ·24H ₂ O
Fe-Spinel	Sp	Fe ₃ O ₄
Gypsum	Gp	CaSO ₄ ·2H ₂ O
Hematite	Hm	Fe ₂ O ₃
Lime	Lm	CaO
Mullite	Mu	Al ₆ Si ₂ O ₁₃
Portlandite	Pl	Ca(OH) ₂
Quartz	Qc	SiO ₂

Table 7

Physical Testing Data: Illinois Cells 1, 2, and 3

Sample Description						Physical Parameters			
Sample ID	Depth Interval (ft.)	Sample Type	Cell No.	Moisture Content % - dry basis		Unconfined Compressive Strength (psf)	Permeability (cm/sec)	Field Bulk Density (pcf)	Dry Density (100° C) (pcf)
				@ 100° C	@ 60° C				
93MAYIL1-1	0-2'	Soil	1	15.1			2.4E-06		
93MAYIL1-3	2-4'	Ash	1	78.2		32.0	1.1E-05		
93MAYIL1-5	4-6'	Ash	1	78.7		60.0	1.5E-05		
93MAYIL 1-7	6-8'	Ash	1	71.7		10.0	1.6E-05		
93MAYIL1-9	8-10'	Ash	1	75.2		75.0	1.2E-05		
93MAYIL1-11	1-12'	Soil	1	16.4			5.8E-07		
93MAYIL1-13	12-14'	Soil	1	21.7			4.2E-07		
93MAYIL1-15	14-16'	Soil	1	13.4			1.7E-07		
93MAYIL1-17	16-18'	Soil	1	14.4			2.3E-07		
93MAYIL2-1	0-2'	Soil	1	13.0			7.3E-07		
93MAYIL2-3	2-4'	Ash	1	95.9		90.0	3.5E-05		
93MAYIL2-5	4-6'	Ash	1	FP ¹		FP	FP		
93MAYIL2-7	6-8'	Ash	1	66.9		10.0	6.8E-05		
93MAYIL2-9	8-10'	Ash	1	81.2		85.0	9.6E-06		
93MAYIL2-10.5	10-11'	Ash	1	83.4		12.0	9.0E-06		
93MAYIL2-11.5	11-12'	Soil	1	15.2			1.1E-04		
93MAYIL2-13	12-14'	Soil	1	55.7			2.7E-03		
93MAYIL2-15	14-16'	Soil	1	16.9			4.8E-07		
93MAYIL2-17	16-18	Soil	1	17.3			2.9E-07		
ILN-05-03	Cylndr	Ash	3			1163.0		93.5	
ILS-13-08	Cylndr	Ash	2			1564.0		105.6	
93SEPIL2-1	0-1.5'	Ash	3	34.60	25.71	156.0	1.7E-05	95.0	70.55
93SEPIL2-2.5	1.5-3'	Ash	3	31.12		1114.0	2.7E-06	87.2	66.5
93SEPIL2-3.5	3-4.5'	Ash	3	32.58	32.90	184.0	2.5E-02	75.5	56.97
93SEPIL2-5	4.5-6'	Ash	3	44.67	36.23	169.0	7.6E-03	83.3	57.60

Table 7

(Continued)

Sample Description						Physical Parameters			
Sample ID	Depth Interval (ft.)	Sample Type	Cell No.	Moisture Content % - dry basis		Unconfined Compressive Strength (psi)	Permeability (cm/sec)	Field Bulk Density (pcf)	Dry Density (100° C) (pcf)
				@ 100° C	@ 60° C				
93SEPIL2-6.5	6-7.5'	Soil	3	14.25			2.E-07	118.0	103.31
93SEPIL4-1.5	0-1.5'	Ash	2	20.52	16.48	935.0	4.4E-08	100.5	83.36
93SEPIL4-3	1.5-3'	Ash	2	19.86	21.20	2389.0	4.6E-07	111.9	93.37
93SEPIL4-4.5	3-4.5'	Ash	2	25.49		2354.0	1.6E-07	104.8	83.56
93SEPIL4-6	4.5-6'	Soil	2	17.21			3.9E-08	15.1	106.71
ILW-05-04	Cylndr	Ash	3					92.6	
ILW-05-05	Cylndr	Ash	3					90.0	
ILW-05-06	Cylndr	Ash	3						
ILS-13-09	Cylndr	Ash	2				2.0E-07		
ILS-13-10	Cylndr	Ash	2					95.7	
ILS-13-11	Cylndr	Ash	2					99.2	
							1.5E-06		

¹ FP - Sample is fractured or poorly consolidated.

DATE

FILMED

7/6/94

END