Special Waste-Form Lysimeters-Arid: Three-Year Monitoring Report

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April 1988

**Prepared for the U.S. Department of Energy
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**Pacific Northwest Laboratory
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Richland, Washington 99352

EXECUTIVE SUMMARY

Regulations governing the disposal of commercial low-level waste require all liquid waste to be solidified before burial. Most waste must be solidified into a rigid matrix such as cement or plastic to prevent waste consolidation and site slumping after burial. These solidification processes affect the rate at which radionuclides and other solutes are released into the soil. In 1983, a program was initiated at Pacific Northwest Laboratory to study the release of waste from samples of low-level radioactive waste that had been commercially solidified. The primary method used by this program is to bury sample waste forms in field lysimeters and monitor leachate composition from the release and transport of solutes.

The lysimeter facility consists of 10 lysimeters, each containing one sample of solidified waste. Five different waste forms are being tested, allowing duplicate samples of each one to be evaluated. The samples were obtained from operating nuclear power plants and are actual waste forms routinely generated at these facilities. All solidification was accomplished by commercial processes. Sample size is a partially filled 210-L drum. All containers were removed prior to burial leaving the bare waste form in contact with the lysimeter soil.

The waste streams represented in the five waste forms are two boric acid evaporator concentrates, one sodium sulfate evaporator concentrate, and one sodium sulfate evaporator concentrate with spent ion exchange resin added. The solidification agents used were masonry cement, Portland III cement, Dow polymer, and bitumen. The dominant radionuclides contained in the waste are cobalt-60 and cesium-137. Additional radioactive elements include cesium-134, manganese-54, and tritium. Total inventory of radionuclides in each sample is in the millicurie range. According to the waste classification system of 10 CFR part 61, these waste samples would be class A waste.

The hydrologic environment of the lysimeters shows rather large seasonal variations. The volumetric water content at the depth of the waste samples ranges from approximately 11% in the late winter to a low of about 7% in the late summer. Drainage rates also vary from winter to summer. The resulting pore water velocities reach a peak of approximately 1 cm/wk in the late winter

and decline steadily to less than 0.05 cm/wk in late summer. Total drainage resulting from natural precipitation was 4 cm drainage out of 14 cm precipitation during the 1984-1985 climatic cycle, and 12 cm drainage out of 24 cm precipitation during 1985-1986.

Two radionuclides have been found in lysimeter leachates to date. Cobalt-60 has been found in five lysimeters. The total amount of cobalt-60 leached to the bottom of the lysimeters is <0.1% of the total inventory. This total amount is small but interesting because laboratory sorption studies indicate that cobalt-60 should be highly sorbed onto soil clays and therefore no measurable quantities should leach to the lysimeter drain. The presence of this small amount suggests that leaching of a small but highly mobile fraction of cobalt-60 has occurred. It is likely that the formation of organic complexes between cobalt-60 and organic chelating agents found in the waste is responsible for the cobalt-60 mobility. The second radionuclide found in lysimeter leachate is tritium. Tritium is only found in one of the waste forms being tested, but is found in the leachate from both lysimeters containing these samples. Tritium leached to the lysimeter drain is about 30% of total tritium inventory.

Analysis of the lysimeter leachates extends beyond identifying radionuclide content. A complete chemical inventory of leachates is made on a quarterly basis. Results of these analyses reveals migration of other constituents of the waste in addition to radionuclides. High amounts of sodium, sulfate, boron, calcium, and magnesium are found in various waste forms. All of these major components are found in the respective leachate samples. A complete quantitative analysis of these leachates will require extensive geochemical and transport modeling; however, some qualitative trends have been identified. It appears that much of the sodium being released from the sodium sulfate wastes is displacing calcium from the soil and then replacing calcium on the soil exchange sites. This results in excess calcium appearing in the leachates and sodium levels being lower than anticipated. It also appears that the release of boron from the boric acid waste forms is being retarded to a significant degree. In the boric acid/masonry cement waste form, the retardation mechanism may be a solubility control with boron precipitating with cement solid phases. In the case of the boric acid/bitumen waste form the mechanism may be physical entrapment of the boron inside the bitumen structure.

The program has collected extensive hydrologic and chemical data over the last 3 years relating to the leaching of commercial waste forms under field conditions. At this point, the analysis has been largely qualitative and speculative. The final phase of the program will rely extensively on the iterative process of model simulation and model calibration to provide quantitative interpretation to the existing data. However, preliminary analysis of the data indicates that these data will allow a more definitive analysis of source terms associated with commercial low-level waste than is possible with laboratory data alone.

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CONTENTS

EXECUTIVE SUMMARY	iii
ACKNOWLEDGMENTS	vii
1.0 INTRODUCTION	1.1
2.0 BACKGROUND	2.1
2.1 DESCRIPTION OF LYSIMETER FACILITY	2.2
3.0 DESCRIPTION OF WASTES SOLIDIFIED AND PLACED IN THE LYSIMETERS . . .	3.1
3.1 ANALYSIS OF LIQUID WASTE STREAMS	3.1
3.1.1 Boric Acid Waste #1	3.3
3.1.2 Boric Acid Waste #2	3.4
3.1.3 Sodium Sulfate Evaporator Concentrate	3.7
3.1.4 Evaporator Concentrate With Ion Exchange Resin	3.8
3.2 CALCULATION OF RADIONUCLIDE INVENTORY IN EACH DRUM	3.9
3.2.1 Drums 4-1B and 4-2B	3.11
3.2.2 Drums #1 and #2	3.14
3.2.3 Drums 1-1B and 1-2B	3.14
3.2.4 Drums 2-1B, 2-2B, 2-3B	3.15
3.2.5 Drums 7-2B and 7-3B	3.15
3.3 CALCULATION OF CHEMICAL INVENTORY IN EACH DRUM	3.16
4.0 LYSIMETER HYDROLOGY	4.1
4.1 SOIL HYDRAULIC PROPERTIES	4.1
4.2 LYSIMETER WATER BALANCE	4.4
4.3 WATER BALANCE PARAMETERS RELEVANT TO TRANSPORT	4.15
5.0 WASTE-FORM LEACHING RESULTS	5.1
5.1 RADIONUCLIDE MIGRATION	5.1
5.2 MIGRATION OF NONRADIOACTIVE ELEMENTS	5.7

6.0 REFERENCES	6.1
APPENDIX A - DETAILED ORGANIC ANALYSIS OF COMMERCIAL REACTOR WASTE STREAMS	A.1
APPENDIX B - SOIL-WATER CONTENT OF LYSIMETERS MEASURED BY NEUTRON PROBE	B.1
APPENDIX C - FIELD RADIOCHEMISTRY DATA	C.1
APPENDIX D - CHEMICAL ANALYSES OF LEACHATES	D.1

FIGURES

2.1	Schematic of Lysimeter Facility	2.3
4.1	Water Retention and Hydraulic Conductivity Curve for Lysimeter Soil	4.2
4.2	Initial Water Content Profile for Lysimeters 1, 4, 7, and 9	4.5
4.3	Profile Water Storage for Lysimeters 1, 4, and 7	4.6
4.4	Cumulative Drainage for Lysimeters 1, 4, and 7	4.8
4.5	Water Content Profile for Lysimeters 1, 5, 6, and 7 for 9/25/84	4.9
4.6	Profile Water Storage for Lysimeters, 1, 5, and 6	4.10
4.7	Cumulative Drainage for Lysimeters 1, 5, and 6	4.11
4.8	Profile Water Storage for Lysimeters 1, 5, and 8	4.13
4.9	Cumulative Drainage for Lysimeters, 1, 5, and 8	4.14
5.1	Cumulative Release of Tritium from Lysimeters 1 and 7 Versus Time	5.2
5.2	Cumulative Release of Tritium from Lysimeters 1 and 7 Versus Cumulative Drainage	5.4
5.3	Cumulative Release of Cobalt-60 from Lysimeters 2, 3, 4, 8, and 9 Versus Time	5.5
5.4	Cumulative Release of Cobalt-60 from Lysimeters 2, 3, 4, 8, and 9 Versus Cumulative Drainage	5.6

TABLES

3.1	Description of Waste Streams and Solidification Agents Used to Generate Waste Forms Buried in the Lysimeter Facility	3.1
3.2	Radioisotope Inventory of Boric Acid Waste #1	3.3
3.3	Comparison of BNL and PNL Analyses of Boric Acid Waste #1 Supernatant	3.4
3.4	Chemical Analysis of Boric Acid Waste #1 Slurry	3.5
3.5	Radionuclide Content of Boric Acid Waste #2	3.5
3.6	Chemical Analysis of Boric Acid Waste #2 Slurry	3.6
3.7	Radionuclide Content of Evaporator Concentrate	3.7
3.8	Chemical Composition of Evaporator Concentrate Slurry	3.8
3.9	Radionuclide Content of Evaporator Concentrate Plus Ion Exchange Resin	3.9
3.10	Chemical Composition of Evaporator Concentrate Plus Ion Exchange Resin	3.10
3.11	Description of Drums	3.12
3.12	Decay-Corrected Source Inventories of Radionuclides in Drums . . .	3.13
3.13	Process Volumes Selected to Estimate Chemical Inventories	3.16
3.14	Estimated Chemical and Preferred Radionuclide Inventory in Waste Forms	3.17
4.1	Average Water Balance Parameters for 1984-1986	4.15
5.1	Total Amount of Nonradioactive Elements Leached from Lysimeters	5.8

1.0 INTRODUCTION

In 1983 the Special Waste-Form Lysimeters-Arid (SWLA) program was initiated to evaluate radionuclide source terms associated with low-level waste being produced and solidified at commercial power reactors. The research is sponsored by the U.S. Department of Energy (DOE) Low-Level Waste Management Program and is being conducted at the Hanford Site near Richland, Washington by the Pacific Northwest Laboratory (PNL)(a). The objectives of the research program are to: 1) monitor the release of radionuclides from solidified waste forms under field conditions; 2) correlate laboratory estimates of source term and transport with measured field results; 3) determine, where possible, the chemical and physical mechanisms controlling source terms and the relative role played by waste form and environment; and 4) make recommendations on how source terms for solidified waste should be characterized and modeled to support a burial site performance assessment. The primary benefit this program will offer to commercial waste management is an experimental evaluation of the validity of available source term models.

The first objective is being met by the construction and operation of a field lysimeter facility where large-scale (210-L drum) samples of solidified waste have been buried in soil-filled caissons since the spring of 1984. The lysimeters are free of vegetation and only receive natural precipitation. The inventory of the waste forms was measured for each sample before burial. Leaching of the waste forms is currently being monitored through analysis of drainage water collected at the bottom of the lysimeter. Future measurements of leaching will come from exhumation of the waste forms, which will permit remeasurement of radionuclide inventories, together with detailed measurement of radionuclide concentrations within the lysimeter.

The samples of solidified waste being studied in the lysimeter facility were obtained from three commercial power reactors currently operating in the United States. The samples were manufactured as part of routine waste solidification operations at the reactor and with actual waste streams. As such, they represent waste forms routinely produced by the reactors and shipped to

(a) Operated by Battelle Memorial Institute for the U.S. Department of Energy.

near-surface burial sites. The lysimeter facility contains duplicate samples (individual inventories vary by about 10-15%) for each of the five waste forms. The waste streams were solidified with agents designed to meet the structural specifications of class B or C waste, although the radionuclide concentrations are well below the upper limit of class A waste set by 10 CFR 61.

In addition to the lysimeter study, the program also includes laboratory leaching studies and a transport modeling effort. The laboratory leaching studies include traditional water leaching tests such as ANS 16.1 (ANS 1986), soil column leach tests, as well as soil column and batch sorption tests (Walter, Graham and Gee 1984). Historically, field performance of solid waste forms has been predicted solely on the basis of these types of laboratory tests. However, the correlation between laboratory leaching results and field performance has not been adequately validated through experimentation. An important objective in this research program is to evaluate predictions based on laboratory measurements by comparison with measurements made in the lysimeter facility.

Modeling will be used extensively to help interpret experimental results and formulate recommendations. The solution chemistry of laboratory and field leachate samples will be analyzed with geochemical models to aid in estimating the speciation component of source terms and to evaluate sorption parameters. Hydrologic models will be used to evaluate the effects of waste form geometry on water contents and flow rates, which are difficult to measure experimentally.

The results of laboratory leaching tests (i.e., estimated diffusion coefficients, adsorption surfaces, etc.) will not be directly comparable to data collected in the field (i.e., leachate concentrations, soil radionuclide distributions, water drainage rates, etc). Thus, hydrologic, geochemical, and dispersive transport models will be used to translate laboratory measured parameters into field measured results. Using the models to make predictions based on laboratory data will clarify which laboratory measurements are most descriptive and which conceptual models of leaching and transport are most effective in predicting field performance.

The remainder of this paper will discuss the design and operation of the field lysimeter facility, and the preliminary results obtained over the past 3 years. The important characteristics of the annual water balance are

explained together with the relationship between lysimeter hydrology and local soil and climatic conditions. This discussion is followed by a summary of radionuclide leaching data and some preliminary observations on the relationship between the site hydrology and leaching history of the waste forms.

Section 2.0 of this report will discuss the technical background of the SWLA program, including the licensing regulations that motivate this program, and a brief description of the lysimeter facility where data presented in this report was collected. Section 3.0 presents a detailed explanation of the waste streams and solidification agents used to generate the waste forms buried in the lysimeter facility. The waste stream chemistry has been characterized in detail and data are presented on waste stream chemistry as well as the total inventory of radionuclides and nonradioactive chemicals contained in each waste form buried in the lysimeters. The hydrology of the lysimeter facility is presented in Section 4.0. This discussion includes a summary of the hydraulic properties of the lysimeter soil material, as well as an explanation of the seasonal patterns of water storage and drainage rates. The chemistry of the lysimeter leachate samples is presented in Section 5.0. The cumulative release of radionuclides is discussed first, followed by a summary of the total amount of nonradioactive chemicals that have leached from the lysimeters. The report is supplemented with four appendices that contain listings of measurements of water contents of the lysimeters and chemical analyses of the lysimeter leachates.

2.0 BACKGROUND

Licensing requirements (NRC 1986) prohibit the near-surface disposal of low-level radioactive waste in a liquid form. Consequently, generators of low-level waste, such as commercial power reactors, solidify their liquid waste streams before shipment to a waste disposal facility. A liquid waste is considered solidified if less than 0.5% by volume remains as a free liquid (NRC 1983). The U.S. Nuclear Regulatory Commission (NRC) has devised a three-tier waste classification system (classes A, B, and C), that guides the solidification process. Class A waste contains the lowest concentration of radionuclides and can be solidified by adding any absorbent, such as sawdust or vermiculite, that will reduce the free liquid content. Class B and C waste contain higher concentrations of radionuclides and must meet additional requirements of stability such as minimum compressive strength, resistance to corrosion, dissolution, biodegradation, and leaching. Therefore, class B and C wastes are commonly solidified with materials such as cement, bitumen or vinyl-ester styrene (i.e., Dow(a) polymer).

The stability requirements are primarily designed to prevent the slumping and subsidence of surface covers that result from compaction and degradation of unstabilized buried waste. However, solidification can also affect the release rate and speciation of radionuclides entering the soil. Understanding these latter effects becomes important when predicting the performance of a buried waste site. A minimum of two performance assessments are required by 10 CFR 61 in the life of a burial site. The first assessment is in the initial licensing process and the second is at site closure. Additional assessments may be required if significant migration of radionuclides is detected during the operational phase. Each assessment includes extensive modeling of radionuclide transport from the waste site by pertinent pathways such as groundwater, air, plants, and burrowing animals.

While these diverse pathways are different in terms of transport mechanisms and modeling strategy, they share a common origin or source: the waste form. To enter any of the pathways, contaminants must first leave the waste form.

(a) Dow-Corning Corporation, Midland, Michigan.

Therefore, the initial modeling step, regardless of the pathway, is to characterize the release of contaminants from the waste form.

There are three characteristics of a waste form that determine its role as a contamination source: 1) the inventory of contaminants contained in the waste form; 2) the chemical speciation of the contaminants being released from the waste; and 3) the tendency of the contaminants to leave the waste form. This latter characteristic differs from the other two in that it may depend as heavily on the burial environment (i.e., soil type and climate) as on properties of the waste form. The tendency of contaminants to leave a waste form may be quantified as a known flux of contaminant at the waste form surface, or as a known solution concentration at some point in the soil profile. Together, inventory, species, and release rate or concentration constitute what in modeling is known as the source term. Any transport calculation, regardless of the pathway involved, must make some assumption about or prediction of the source term associated with the burial site.

2.1 DESCRIPTION OF LYSIMETER FACILITY

The lysimeter complex (Figure 2.1) was constructed in the summer of 1983 and consists of 10 soil-filled caissons (183 cm x 305 cm), placed concentrically around a central access caisson (365 cm x 365 cm). Each lysimeter contains one waste form sample that has been removed from its 210-L (55-gallon) barrel leaving the waste form in direct contact with the soil. Each lysimeter is equipped with a gravity drain leading to the central access caisson for collection of leachate water. The central caisson also provides access to each lysimeter through horizontal sampling ports. A 15-cm-diameter well is installed at the side of each lysimeter to allow downwell gamma-ray scanning and neutron probe measurements of soil water content. Lysimeters are instrumented with thermocouples to measure the vertical soil temperature profile, fiberglass resistance blocks to monitor soil water potential, and suction candles to allow extraction of soil solution samples.

The bottom of the waste sample in each lysimeter is at 250 cm; however, the height of individual samples ranges from 60 to 80 cm. The waste samples were located deep in the lysimeter to minimize the transport distance to the drain (gravel layer), thereby isolating the source term as much as possible.

FIGURE 2.1. Schematic of Lysimeter Facility

Fiberglass moisture blocks were placed above the waste samples in an effort to detect ponding of water on top of the sample. Suction candles were placed immediately below the waste and between the waste and the drain to allow samples to be collected along the transport stream. Selected meteorological measurements are made on site and these are supplemented with data from the Hanford Meteorological Station located 30 miles north of the lysimeter facility. A complete description of all instrumentation and their placement is contained in Walter, Graham and Gee (1984).

Eight of the ten lysimeters were filled in March 1984; these included lysimeters 1-4 and 7-10, which contain the waste samples solidified with cement and Dow polymer. The bitumen waste forms were buried in lysimeters 5 and 6 in September 1984. Drainage measurements were made approximately once a month during 1985 and once every 2 to 3 weeks during 1986 and 1987. All drainage samples are analyzed for radionuclides, while a complete cation/anion analysis

2.4

3.0 DESCRIPTION OF WASTES SOLIDIFIED AND PLACED IN THE LYSIMETERS

Ten samples of five waste forms were buried in the SWLA lysimeter facility. The five waste-forms represent four waste streams and four solidification agents. Table 3.1 shows the combinations of waste stream and solidification agent used to generate the five waste forms. Table 3.1 also lists the lysimeters that contain each of the duplicate pairs of each waste-form. A brief description of the characterization methods used and individual waste forms follows. The acquisition of the waste forms and liquid waste streams was performed by employees of Brookhaven National Laboratory (BNL). Most of the radionuclide analyses and some of the total chemical analyses were also performed by BNL.

3.1 ANALYSIS OF LIQUID WASTE STREAMS

Soon after acquisition, the liquid waste streams were analyzed for pH, Eh, percent solids, and gamma emitting radionuclides. For one waste stream, anions were also measured by ion chromatography soon after collection. Three to four years after collection, samples that had been archived were analyzed,

TABLE 3.1. Description of Waste Streams and Solidification Agents Used to Generate Waste Forms Buried in the Lysimeter Facility

Waste Stream	Solid Matrix	Lysimeter #
Evaporator concentrate (boric acid)	Masonry cement	1,7
	Bitumen	5,6
Evaporator concentrate (Na ₂ SO ₄)	Portland III cement	2,8
Evaporator concentrate + exchange resin (Na ₂ SO ₄)	Portland III cement	3,9
	Dow polymer	4,10

after total digestion by acidification, for common cations and anions and selected trace metals. Cations and trace metals were measured by inductively coupled plasma (ICP) spectroscopy and ion chromatography was used to measure the anions. At this time supernatant samples were also characterized for ^3H content and gamma-emitting radionuclides. The ^3H determination was performed by liquid scintillation after distillation in a holdback solution to separate ^3H from other beta emitters. The holdback solution contains high concentrations of stable isotopes of elements, which could have been present as other beta emitters in the waste stream. All gamma analyses performed at BNL and PNL used Ge(Li), intrinsic Ge and/or NaI detectors. Radionuclide contents are decay corrected back to the date of acquisition April 20, 1983, for boric acid #1; August 29, 1984, for boric acid #2; and September 27, 1983, for the evaporator concentrate and concentrate with resin.

For boric acid waste #1 the ^{90}Sr content was determined by BNL 90 days after waste stream acquisition by adding a stable yttrium carrier to both the supernatant and dry solid. The solid was extracted in 6N hot HCl, then filtered to remove solids. The acid extract was extracted with HDEHP, the organic phase was then washed several times with dilute HCl, then yttrium was back extracted into 9N HCl. The supernatant and aqueous phases from solids dissolution were purified by methyltricapril ammonium chloride. Yttrium was precipitated as the hydroxide, collected on a filter, dissolved in acid and reprecipitated as the oxalate. The precipitate was collected onto a filter disk by vacuum filtration, dried and weighed to calculate the yttrium carrier yield. The filter disks were mounted on planchets and beta counted on a gas flow Geiger counter. The sample was recounted 2 days later to check the radiochemical purity (in growth of ^{90}Y with a 64-hour half-life). The ^{90}Sr was determined by the measured activity of its daughter ^{90}Y .

A detailed organic analysis was performed on the boric acid #1, evaporator concentrate, and evaporator concentrate with ion exchange resin beads within 1 year of acquisition. The supernatant and solid fraction of the waste streams were analyzed separately, and two fractions of organic compounds: hydrophobic and hydrophilic, were identified. Details of the analysis procedures and results are included in Appendix A.

3.1.1 Boric Acid Waste #1

This liquid sample was analyzed by BNL 90 days after collection. The sample was brownish pink in color with precipitate present (likely undissolved boric acid). The sample weighed 457.82 g and had a volume of 437.6 cm³, thus the specific density was 1.046. The sample was centrifuged until the supernatant was clear. The centrifuged solids, after drying, weighed 25.31 g. A portion of the supernatant was evaporated to dryness and the dissolved solids content determined, 42.4 g/L. The pH and Eh of the slurry was 3.18 and +690 mV. The supernatant had a pH = 3.20 and Eh = 740 mV.

The radionuclide content of both the supernatant and dried solid were determined. From the weight of centrifuged solids (25.31 g) and volume of supernatant liquid (419.9 ml), the activity of the total slurry could also be calculated. The results are shown in Table 3.2.

The solid phase accounted for about 10% of the total activity in the slurry while accounting for only 5.5% of the slurry's total weight. Thus, the solids are enriched over the supernatant by a factor of 2. In April 1987, PNL analyzed a sample of this waste stream's supernatant for gamma emitters and ³H. The results are shown in Table 3.3. The PNL values for gamma emitters are about one-half as large as the BNL values. No explanation is offered other than perhaps the residual solids from the PNL slurry may have picked up more radionuclides after 4 years of storage.

TABLE 3.2. Radioisotope Inventory of Boric Acid Waste #1 (decay corrected to 4/20/83)

Radionuclide	Supernatant, $\mu\text{Ci/L}$	Dry Solids, $\mu\text{Ci/g}$	Total Slurry, $\mu\text{Ci/L}$
¹³⁷ Cs	160.0 $\pm$ 0.4	0.31 $\pm$ 0.01	170.3 $\pm$ 0.4
¹³⁴ Cs	92.8 $\pm$ 0.8	0.18 $\pm$ 0.01	99.2 $\pm$ 0.8
⁶⁰ Co	6.3 $\pm$ 0.2	0.02 $\pm$ 0.002	7.1 $\pm$ 0.2
⁵⁸ Co	1.7 $\pm$ 0.1	0.003 $\pm$ 0.0002	1.8 $\pm$ 0.1
⁵⁴ Mn	1.8 $\pm$ 0.1	0.003 $\pm$ 0.00001	1.9 $\pm$ 0.1
⁹⁰ Sr	0.038 $\pm$ 0.002	0.00008 $\pm$ 0.000003	0.045 $\pm$ 0.002

TABLE 3.3. Comparison of BNL and PNL Analyses of Boric Acid Waste #1 Supernatant (decay corrected to 4/20/83)

Radionuclide	$\mu\text{Ci/L}$	
	BNL	PNL
^{137}Cs	160.0	82.5
^{134}Cs	92.8	50.6
^{60}Co	6.3	3.4
^{58}Co	1.7	<
^{54}Mn	1.8	<
^3H	--	70.0

Table 3.4 shows the total chemical analysis values determined by PNL about 4 years after acquisition. The inorganic values represent the total slurry content as the samples were acid digested. The anion determinations performed by BNL 90 days after acquisition are shown in parenthesis in Table 3.4. In the 4 years of storage the anion composition of the waste slurry has remained constant. The waste form is a predominantly sodium borate solution with significant amounts of sulfate, nitrate, chloride, and calcium being present. Details on the organic analysis are found in Appendix A. The total organic carbon value in Table 3.4 arbitrarily assumes carbon constitutes 75% of the organic matter.

3.1.2 Boric Acid Waste #2

The second boric acid evaporator concentrate waste stream was acquired at the same time two 55-gallon drums of bitumen waste forms were prepared (August 29, 1984). The waste stream sample was approximately 4 L and consisted of a clear supernatant liquid and two visible precipitates. The density of the slurry after homogenization by stirring was 1.015 ± 0.007 g/mL. The supernatant liquid had a pH value of 8.4 and an Eh of 225 mV. At the time of acquisition, power plant chemists estimated that the waste stream contained 4.9% suspended solids (similar to the 5.5% calculated for boric acid evaporator concentrate waste #1). An aliquot of the slurry was redissolved in concentrated nitric and hydrochloric acid. The acid digest was analyzed for gamma radionuclides. Table 3.5 gives the results in terms of microcuries per liter of original slurry. For comparative purposes, PNL measurements made 32 months

TABLE 3.4. Chemical Analysis of Boric Acid Waste #1 Slurry

Element	$\mu\text{g/g}$	mg/L (a)	
Al	6.2	6.5	
B	9460.	9897.	
Ba	0.4	0.4	
Ca	437.	457.	
Cr	18.6	19.5	
Fe	115.	120.3	
K	188.	196.7	
Li	56.9	59.5	
Mg	53.1	55.6	
Mn	23.6	24.7	
Mo	5.2	5.4	
Na	1242.	1299.	
Ni	3.2	3.4	
Si	110.	115	
Sr	1.2	1.3	
Zn	147.	154.	
Zr	2.4	2.5	
Cl	750	785	(530)
NO ₃	1800	1883	(1900)
SO ₄	2800	2929	(3120)
PO ₄	<20	<21	(<10)
Total Organic Matter		163	(b)
Total Organic Carbon	(c)	122	

- (a) If we assume specific density of the slurry remained constant over the 4-year storage period (1.046 g/mL), we can convert to the volume concentration.
- (b) Based on liquid fraction = 96% and solid fraction = 4% (see Appendix A for details).
- (c) Assumes carbon content of organic matter is 75%.

TABLE 3.5. Radionuclide Content of Boric Acid Waste #2 (decay corrected to 8/29/84)

Radionuclide	$\mu\text{Ci/L}$ of Slurry, BNL	$\mu\text{Ci/L}$ of Supernatant, PNL
⁶⁰ Co	0.78 ± 0.003	0.75
¹³⁷ Cs	0.79 ± 0.002	0.79
¹³⁴ Cs	0.29 ± 0.003	0.31
⁵⁴ Mn	0.13 ± 0.006	<
³ H	--	14.26

after acquisition on the supernatant only are shown on Table 3.5. The ^3H content of the supernatant was also measured at this time.

The BNL and PNL measurements agree very well suggesting that the precipitates not included in the PNL analysis may contain insignificant amounts of radionuclides (for comparison the precipitates in boric acid waste #1 contained about 10% of the total gamma emitters in the slurry). Table 3.6 contains the chemical analyses of the total slurry after storage for 32 months. The waste stream is sodium borate solution with moderate amounts of sulfate, chloride, and aluminum. The sodium concentration is much higher than in boric acid waste #1 likely because sodium hydroxide was used to neutralize the slurry. The boron concentration of waste #2 is about 10% lower than waste #1, while chloride, nitrate, sulfate, calcium, iron, lithium, magnesium, manganese, and

TABLE 3.6. Chemical Analysis of Boric Acid Waste #2 Slurry

Element	$\mu\text{g/g}$	$\text{mg/L}^{(a)}$
Al	22.4	22.7
B	9080.	9216.2
Ba	0.4	0.4
Ca	15.8	16.0
Cr	13.8	14.0
Fe	10.4	10.6
K	34.	34.5
Li	0.4	0.4
Mg	4.8	4.9
Mn	0.4	0.4
Mo	<0.5	<0.5
Na	5520.	5603.
Ni	<0.5	<0.5
Si	43.2	43.8
Sr	0.3	0.3
Ti	0.14	0.14
Zn	3.0	3.0
Zr	2.6	2.6
Cl	130.	132.
NO_3	16.	16.2
PO_4	<10.	<10
SO_4	270.	274.

(a) Calculations assume density = 1.015 g/mL.

zinc are significantly lower. The radionuclide content of boric acid evaporator concentrate #2 is also much less (.01 to 0.1 x) than #1, suggesting perhaps that waste #1 contains some waste from another plant process. The difference in pH, waste stream #1 pH = 3.2 and waste stream #2 pH = 8.4, may explain the much lower Fe, Mn, and Zn concentrations as these metals are not very soluble in neutral environments. No organic analyses were completed on this waste stream.

3.1.3 Sodium Sulfate Evaporator Concentrate

On September 27, 1983, this sodium sulfate evaporator concentrate was sampled from a commercial boiling water reactor (BWR) site. The waste was a slurry of thick dark brown sludge, crystallized salts and an almost colorless liquid. The slurry has a density of 1.13 g/mL. The suspended solids content of the slurry was 26.0% by weight. The supernatant solution had a pH and Eh value of 11.05 and 290-300 mV, respectively.

Aliquots of the slurry were digested with fuming HNO₃, H₂SO₄, and HCl. The gamma emitters were determined on the digested solution. The PNL measurements on the supernatant only are presented for comparison in Table 3.7. Both data sets are decay corrected to September 27, 1983. The PNL data suggest that most of the activity is associated with the suspended solids.

A portion of the slurry that had been in storage for about 3 1/2 years was totally digested and the chemical composition of the waste determined. The results are found in Table 3.8. Details of the organic analysis are found in Appendix A. There is a fairly large organic matter content in this

TABLE 3.7. Radionuclide Content of Evaporator Concentrate (decay corrected to 9/23/83)

<u>Radionuclide</u>	<u>μCi/L of Slurry, BNL</u>	<u>μCi/L of Supernatant, PNL</u>
⁵⁴ Mn	39.2 ± 5.9	<
⁶⁰ Co	845. ± 130	110.
¹³⁴ Cs	17.4 ± 2.6	<
¹³⁷ Cs	155 ± 23	22.
¹⁴⁴ Ce	2.7 ± 0.6	<

TABLE 3.8. Chemical Composition of Evaporator Concentrate Slurry

<u>Element</u>	<u>μg/g</u>	<u>mg/L (a)</u>
Al	561	630.
B	37.4	42.
Ba	9.4	11.
Ca	1090.	1230.
Cr	22.1	25.
Fe	2789.	3150.
K	374.	423.
Mg	372.	420.
Mn	34.	38.
Na	36100.	40710.
Ni	22.1	25.
Si	81.6	92.
Sr	5.1	6.
Ti	11.6	13.
Zn	49.3	56.
Zr	3.4	4.
Cl	650.	735.
NO ₃	<100.	<113.
PO ₄	3800.	4290.
SO ₄	49200.	55600.
Total Organic Matter		382.
TOC(b)		286.

(a) Based on slurry density = 1.13 g/mL.

(b) Assumes that organic carbon represents 75% of organic matter.

waste stream. The total organic carbon value arbitrarily assumes that carbon constitutes 75% of the organic matter.

The waste stream is predominately a sodium sulfate waste as expected but there is also considerable concentrations of phosphate, iron, calcium, chloride, aluminum, potassium, and magnesium. It is likely that much of the iron, phosphate, aluminum, and magnesium is part of the solid phase in the slurry because these elements are not readily soluble at pH = 11.

3.1.4 Evaporator Concentrate With Ion Exchange Resin

On September 27, 1983, a second waste stream from the BWR was obtained. The waste stream was the same sodium sulfate waste with spent ion exchange resins added. This waste stream also consisted of a thick dark brown sludge that contained visible resin beads, more crystallized salts than the evaporator

concentrate, and an almost colorless liquid. The density of this slurry was 1.27, g/mL and the suspended solids content was 38.4%. The pH and Eh values of the supernatant were 10.36 ± 0.02 and 260 mV, respectively. Aliquots were totally digested in sequential treatments with HNO_3 , H_2SO_4 , and H_2O_2 , HF, and $\text{H}_2\text{SO}_4\text{-HCl}$. The gamma nuclide inventory decay corrected to September 27, 1983, are shown in Table 3.9. Measurements on the supernatant made by PNL approximately 3.5 years after acquisition are also shown in Table 3.9.

Again it appears that the bulk (approximately 90%) of the radionuclide content is present in the suspended solids. This waste stream contains about twice as much radioactivity as the evaporator concentrate waste suggesting that the resin beads are quite radioactive.

An aliquot of the slurry was totally digested in concentrated acids and the chemical composition determined. The results are shown in Table 3.10. A complete analysis of the waste stream for organic matter was also performed. Details are shown in Appendix A. The total organic carbon number found in Table 3.10 is an estimate assuming that the average organic carbon content of the organic matter is arbitrarily 75% of the total molecular weight.

3.2 CALCULATION OF RADIONUCLIDE INVENTORY IN EACH DRUM

The volume of each waste stream that was solidified in each 55-gallon drum was estimated by process flow sheet information in most cases. For many of the solidified waste drums a second independent method based on nondestructive gamma logging of the entire drum was performed. For the bitumen waste form actual dissolution of a representative solid sample was performed. In general, the accuracy of the drum inventories varies with solidification

TABLE 3.9. Radionuclide Content of Evaporator Concentrate Plus Ion Exchange Resin (decay corrected to 9/27/83)

<u>Radionuclide</u>	<u>$\mu\text{Ci/L}$ of Slurry, BNL</u>	<u>$\mu\text{Ci/L}$ of Supernatant, PNL</u>
^{54}Mn	87.2 ± 13.1	<
^{60}Co	$1580. \pm 240$	150.
^{134}Cs	36.0 ± 5.4	<
^{137}Cs	$234. \pm 35$	25.8
^{144}Ce	4.0 ± 1.3	<

TABLE 3.10. Chemical Composition of Evaporator Concentrate Plus Ion Exchange Resin

Element	$\mu\text{g/g}$	mg/L (a)
Al	844.	1072.
B	64.4	82.
Ba	14.7	18.7
Ca	1542.	1958.
Cr	30.4	38.6
Fe	3918.	4976.
K	662.	841.
Mg	556.	706.
Mn	48.3	61.3
Na	45700.	58040.
Ni	32.2	40.9
Si	82.3	104.
Sr	7.7	9.8
Ti	15.0	19.0
Zn	62.6	79.5
Zr	5.4	6.9
Cl	1100.	1397.
NO ₃	<100.	<127.
PO ₄	8400.	10668.
SO ₄	66000.	83820.
Total Organic Matter		116.
TOC(b)		87.

(a) Conversion based on density = 1.27 g/cm^3 .

(b) Assumes OC = 75% of total organic matter.

process. When properly calibrated, the nondestructive gamma logging technique is more accurate than process flow sheet or production line monitoring. The nondestructive technique is also less tedious than product dissolution and measurement. The details for the nondestructive counting can be found in Brodzinski (1986) and Brodzinski et al. (1987). Briefly, the steel drum containing the waste form is placed on a rotating table top and counted with a high-resolution germanium diode, well-logging, gamma-ray spectrometer fit with a variable width tungsten horizontal slit collimator. The waste form is slowly rotated on the table top as the collimator is fixed at each height. Counts around the perimeter of the cylinder at each height are recorded and compared with known standards of gamma emitters in cement or vinyl-ester styrene polymer.

A physical description of the drums is found in Table 3.11. The total inventories for the barrels as calculated by BNL personnel are compared to nondestructive counting of waste-forms performed by PNL personnel in Table 3.12. Where available comments on the accuracy are provided. The activities are decay corrected to the date of fabrication.

3.2.1 Drums 4-1B and 4-2B

Drums 4-1B and 4-2B contained boric acid waste stream #1 solidified in masonry cement, which consists of 50% Portland Type I cement and 50% lime. The solidification was performed using an Atcor Engineered Systems, Inc. (Farmington, Connecticut) in-line mixer/feeder. The process consisted of first placing a thin base of dry binder into the drum, next some liquid waste was pumped into the drum; then both binder and waste were added at a preset feed rate of 1:1 by volume. The drums were filled only two-thirds full. Drum 4-1B weighed 283 kg (625 lb) and had a dose rate of 40 mR/hr at contact. Drum 4-2B weighed 272 kg (600 lb) and had a higher dose rate of 45 mR/hr. It would appear from the dose rates and weights that drum 4-2B should have a larger weight or smaller dose rate all other things being constant. The system operators were quite confident ($\pm 10\%$) that each drum received about 76 L of liquid waste. The BNL personnel calculated the drum inventories based on drum 4-1B containing exactly 76 L of waste with the slurry activities reported in Table 3.2. Drum 4-2B was assumed to contain slightly less, based on the lower weight, even though drum 4-2B showed more dose. Table 3.12 compares the direct counting values versus the estimates based on liquid waste volume. The direct counting of drum 4-2B suggests that it contains more inventory than drum 4-1B, which agrees with the dose measurements. From the directly measured inventories, the volume of liquid slurry found in each drum can be calculated from Table 3.2. The average liters of waste calculate to be 74 ± 6 and 84 ± 8 L, respectively, for drums 4-1B and 4-2B. These values compare favorably with the plant operators estimate that each drum contained 76 L. Because the direct counting values agree closer with the observed dose rates, PNL believes these values are most accurate. The tritium inventories were calculated assuming 74 and 84 L of waste in drums 4-1B and 4-2B, respectively.

TABLE 3.11. Description of Drums

<u>Drum #</u>	<u>Waste Stream</u>	<u>Binder</u>	<u>Weight, kg</u>	<u>Dose, mR/hr at contact</u>
4-1B	Boric acid #1	Masonry cement	283	40
4-2B	Boric acid #1	Masonry cement	272	45
Drum 1	Boric acid #2	Bitumen	160	na ^(a)
Drum 2	Boric acid #2	Bitumen	170	na
1-1B	Evaporator conc.	Portland III cement	345	500
1-2B	Evaporator conc.	Portland III cement	346	500
2-1B	Evap. + IEX resin	Portland III cement	342	600
2-2B	Evap. + IEX resin	Portland III cement	342	800
2-3B	Evap. + IEX resin	Portland III cement	351	1200
7-2B	Evap. + IEX resin	Polymer	170	700
7-3B	Evap. + IEX resin	Polymer	189	900

(a) Not available.

TABLE 3.12. Decay-Corrected Source Inventories of Radionuclides in Drums, mCi

Waste Stream	Drum #	Lysimeter #	⁵⁴ Mn	⁶⁰ Co	¹³⁷ Cs	¹³⁴ Cs	⁹⁰ Sr	⁵⁸ Co	¹⁴⁴ Ce	³ H	Method
Boric acid #1	4-1B	1	0.144	0.539	12.9	7.54	0.003	0.137	---	5.2	Waste volume
			0.132	0.548	11.5	7.98	---	---	---	---	Direct count
Boric acid #1	4-2B	7	0.137	0.514	12.3	7.19	0.003	0.131	---	5.9	Waste volume
			0.144	0.608	13.5	9.42	---	---	---	---	Direct count
Boric acid #2	Drum #1	5	<	1.12	0.82	0.30	---	---	---	---	Dissolution of Bitumen
			0.10	0.59	0.80	0.22	---	---	---	(a)	Waste volume
Boric acid #2	Drum #2	6	<	1.19	0.87	0.32	---	---	---	---	Dissolution of Bitumen
			0.15	0.80	0.90	0.33	---	---	---	(a)	Waste volume
Evaporator conc.	1-1B	2	6.0	94.0	14.74	<12.0	---	---	---	---	Direct count
Evaporator conc.	1-2B	8	7.5	95.5	18.70	1.76	---	---	---	---	Direct count
Evap. + IEX resins	2-1B	3	12.3	223	33.1	5.1	---	---	0.57	---	Waste volume
			9.9	142	38.2	<8.5	---	---	---	---	Direct count
Evap. + IEX resins	2-2B	9	12.3	223	33.1	5.1	---	---	0.57	---	Waste volume
			9.9	163	19.6	2.7	---	---	---	---	Direct count
Evap. + IEX resins	2-3B	---	13.0	235	34.8	5.4	---	---	0.60	---	Waste volume
			24.1	279	37.1	<3.2	---	---	---	---	Direct count
Evap. + IEX resins	7-2B	4	1.95	40.0	7.28	0.85	---	---	0.13	---	Waste volume
			4.46	117.6	<11.1	<13.8	---	---	---	---	Direct count
Evap. + IEX resins	7-3B	10	2.53	53.5	9.6	1.11	---	---	0.17	---	Waste volume
			6.23	138.6	<20.2	<7.25	---	---	---	---	Direct count

(a) Although waste stream has measurable ³H, it is assumed that it evaporates during bitumen processing.

3.2.2 Drums #1 and #2

Two drums that contain boric acid waste stream #2 solidified in bitumen were generated with a Waste Chem extruder. Liquid waste and molten bitumen are pumped into a screw extruder where they are thoroughly mixed and heated to temperatures between 132 and 188°C. The mixing process continues for an adequate time for >99% water evaporation. The final product, salts bound in bitumen, is extruded directly into the drums. According to plant personnel, drum #1 contained the salts from 757 L of waste bound in 122 L of bitumen. The filling process took 10 hours, and the drum weighed 160 kg (352 lb). Drum #2 contained the salts from 1135 L of waste bound in 136 L of bitumen. The filling process took 8.5 hours and the drum weighed 170 kg (374 lb).

The total radionuclide inventory of the bitumen drums was calculated two ways. The first attempt relied on dissolution (using 100 mL xylene) of numerous 1-g samples of bitumen taken from several small right cylinders produced during the filling of the drums. The results suggest that the radionuclide content is not homogeneously distributed throughout the bitumen. The BNL staff speculated that radionuclide-bearing salts may settle during bitumen cooling. The second method of calculating drum inventories was to multiply the observed radionuclide concentrations in the liquid waste stream by the estimated volumes of waste solidified in each drum. The BNL staff prefer the latter approach. No nondestructive barrel counting was performed on the bitumen drums because they were received months after the counting and emplacement in the lysimeters of the other eight waste forms. Following BNL's judgment, PNL used the inventories based on the liquid waste stream concentrations. It is assumed that ^3H present in the liquid waste evaporates and is not present in the final solid waste drums.

3.2.3 Drums 1-1B and 1-2B

The waste stream solidified in drums 1-1B and 1-2B was sodium sulfate evaporator concentrate. This liquid waste was solidified with Portland Type III cement using Stock Equipment Company (Cleveland, Ohio) machinery. First the cement is added to the drum and then 55% of the predetermined volume of liquid waste is added. The drum is closed and tumbled end over end for 6 minutes. The drum is reopened and the remaining 45% waste volume is added and the drum tumbled end over end for 5 minutes. The weight and dose levels

for the two cement drums are shown in Table 3.11. No inventory estimates were supplied as the volume of waste was not specified. The only estimate for the total inventories of radionuclides in these drums is the nondestructive barrel counting. The direct counts suggest that the drums contain between 120 and 130 L of liquid waste, which compares closely with the 141-L estimate for the solidified evaporator concentrate plus ion exchange resin to be discussed next.

3.2.4 Drums 2-1B, 2-2B, 2-3B

The waste stream solidified in drums 2-1B, 2-2B, and 2-3B contained the same sodium sulfate evaporator concentrate found in drums 1-1B and 1-2B. However, series #2 drums also contained spent ion exchange resin in addition to the evaporator concentrate. The plant operators estimated that 141 L of liquid waste slurry was mixed into the drums. For drum 2-3B the liquid volume was estimated to be 149 L. BNL thus estimated the total drum inventories based on the product of the slurry concentrations and this volume. The wide range in measured dose rates, 600, 800, and 1200 mR/hr respectively, suggests that the volumes of waste in each drum is not so uniform or that the distribution of radionuclides within the drums is not uniform. The direct count ^{60}Co data show the same progression as the dose rate data. For this reason we have elected to use the direct barrel counting inventory in further radionuclide calculations. Drum 2-1B direct counting suggests that the drum contains 122 ± 40 L of slurry waste and drum 2-2B direct counting data suggests that the drum contains 94 ± 18 L of waste. These values are not as close to the 141 L suggested by plant operators as agreement for some of the other waste forms. Drum 2-3B was an extra and is not emplaced in the field lysimeter.

3.2.5 Drums 7-2B and 7-3B

Drums 7-2B and 7-3B of evaporator concentrate plus ion exchange resins were solidified into vinyl-ester styrene using a mobile system of Dow Chemical Nuclear and Solidification Services (Midland, Michigan). Briefly, the procedure is to place a premeasured quantity of vinyl-ester styrene in a 55-gallon drum. The aqueous waste and promoter catalyst was mixed under high shear mixing. One drum of this waste type and two drums of evaporator concentrate did not solidify. To effectively set up, different ratios of evaporator concentrate and ion exchange resins were used than the ratios emplaced in cement. The total inventory of each polymer drum was estimated by BNL

from the volume of evaporator concentrate and ion exchange resin added as given by process information. The BNL assumptions used to generate inventory calculations are not clear, but available waste volume (BNL) calculations and direct measurement (PNL) inventories are found in Tables 3.11 and 3.12, respectively. The direct count data were chosen for future calculations.

PNL's best estimates of the volume of waste in each drum is shown in Table 3.13. The preferred radionuclide inventories for each waste drum and the lysimeter designations are shown in Table 3.14 along with selected chemical inventories.

3.3 CALCULATION OF CHEMICAL INVENTORY IN EACH DRUM

As mentioned, approximately 3.5 years after acquisition the slurry waste streams were analyzed for total chemical composition. The total waste stream chemical inventory was calculated from these data and estimates of the volume of slurry in each drum. The inventories represent only mass originating in the liquid slurries; in other words, the chemical composition of the binding agents (cement, polymer, and bitumen) is ignored. The inventory data for selected chemicals (those observed to leach and reach the lysimeter drains in concentrations above ambient background) are shown in Table 3.14.

TABLE 3.13. Process Volumes Selected to Estimate Chemical Inventories

<u>Drum</u>	<u>Waste Stream</u>	<u>Volume, L</u>
4-1B	Boric acid #1	74
4-2B	Boric acid #1	84
Drum 1	Boric acid #2	757
Drum 2	Boric acid #2	1135
1-1B	Evaporator conc.	120
1-2B	Evaporator conc.	128
2-1B	Evap. + IEX resins	122
2-2B	Evap. + IEX resins	94
7-2B	Evap. + IEX resins	63
7-3B	Evap. + IEX resins	80

TABLE 3.14. Estimated Chemical and Preferred Radionuclide Inventory in Waste Forms

Drum	Ca	Na	K	Mg	Sr	NO ₃	SO ₄	Cl	B	TOC	⁵⁴ Mn	⁶⁰ Co	¹³⁷ Cs	¹³⁴ Cs	³ H
	grams										mCi				
4-1B	33.8	96.1	14.8	4.1	0.18	139.3	218.7	58.1	732.4	9.8	0.132	0.648	11.5	7.98	5.2
1-1B	147.8	4885.2	58.8	58.4	0.72	<13.6	6672	88.2	5.8	34.3	6.8	94.8	14.74	<12	---
2-1B	238.9	7881	182.8	88.1	1.2	<16.5	18228	178.4	18.8	18.8	9.9	142	38.2	<8.6	---
7-2B	123.3	3657	53.8	44.5	0.82	<8.8	5281	88.8	5.2	5.5	4.5	117.8	<11.1	<13.8	---
Drum 1	12.1	4241	26.1	3.7	0.23	12.3	287.4	99.9	8977	---	0.18	0.59	0.68	0.22	(a)
Drum 2	18.2	6359	39.2	5.8	0.34	18.4	311.8	149.8	18468	---	0.15	0.89	0.98	0.33	(a)
4-2B	38.4	189.1	18.5	4.7	0.11	158.2	248.8	85.9	831.3	18.2	0.144	0.688	13.5	9.42	5.9
1-2B	157.4	5211	54.1	53.8	0.77	<14.5	7117	94.1	5.4	38.6	7.5	95.5	16.78	1.78	---
2-2B	184.1	5456	79.1	68.4	0.92	<11.9	7879	131.3	7.7	6.2	9.9	183	19.8	2.7	---
7-3B	158.8	4843	67.3	58.5	0.78	<18.2	6788	111.8	8.8	7.1	8.2	138.8	<28.2	<7.25	---

(a) During bitumen processing ³H should evaporate and leave waste form.

The chosen volumes are shown in Table 3.13. These values when multiplied by the concentrations shown in Tables 3.3, 3.5, 3.7, and 3.9 yield the estimates found in Table 3.14. For the drums of Dow polymer we had to assume that the waste slurry was identical to that used to create the cement waste forms even though it is known that more resin beads and less evaporator concentrate was used to get the polymer to set up. No samples or data on the actual waste mixture placed in polymer are available.

The total inventories of chemicals and radionuclides in each drum can be compared with the mass of each constituent collected in the lysimeter drainage to determine the relative migration rate of constituents. For the chemicals, the comparison is confounded by the potential for the solid binder and sediment to add leachable mass to the drainage mass. Thus, for most of the chemicals, the comparison should be viewed qualitatively. Further, the chemical composition of drainage leachates is determined only every 3 months while drainage water is collected every 2 weeks. Thus an extrapolation scheme was devised to approximate masses of each constituent that has drained. The radionuclide drainage data also suffers from this need to extrapolate many of the early samples. Since June 6, 1986, the radionuclide contents of each drainage sample (taken every 14 days) has been measured to facilitate accurate mass balance calculations. Total chemistry has not been performed on every sample because of budget constraints. The interpolation scheme is described in Appendix D.

4.0 LYSIMETER HYDROLOGY

The release of contaminants from the solid waste forms and subsequent transport through the soil depend on the hydrologic environment of the lysimeters as well as on the chemistry of the waste. The water content of the soil can affect solute diffusion coefficients and, to some degree, solubility processes. The flux or rate of water flow through the soil controls the convective and dispersive transport of solutes once they leave the waste form and enter the soil system. Soil-water contents and fluxes are determined by the climatic conditions such as precipitation, temperature, and solar radiation, as well as the soil hydraulic properties such as hydraulic conductivity and water holding capacity. In this section, the most important hydraulic properties of the lysimeter soil material are discussed, and the lysimeter water balance is described in terms of the storage of water in the soil profile and the drainage of water out the lysimeter. Finally, the effect of these water balance parameters on relevant transport parameters is summarized.

4.1 SOIL HYDRAULIC PROPERTIES

The soil material used to fill the lysimeters is from flood deposits found throughout the Hanford Site. These sediments consist of coarse sands and gravels, with minimal silt and clay fractions. The material used to fill the lysimeters was screened to remove the gravel and the remaining material consists of 92% sand, 6% silt, and 2% clay (Walter, Graham and Gee 1984).

The coarse nature of the sandy material is illustrated by the water retention curve and hydraulic conductivity function shown in Figure 4.1. Measurements of water retention and saturated hydraulic conductivity were made on samples from each lysimeter individually to check for variability among lysimeters. These data are reported in Walter, Graham and Gee (1984). No obvious trend in variability was discovered, and the data shown in Figure 4.1 are average values. The unsaturated hydraulic conductivity data shown in Figure 4.1 are calculated from field measurements of soil water content and drainage rates. The composite data represent at least two data points from each of the 10 lysimeters. Four observations can be made from the data in Figure 4.1 that are all consistent with the known coarse nature of the lysimeter fill

FIGURE 4.1. Water Retention and Hydraulic Conductivity Curve for Lysimeter Soil

material: 1) the saturated hydraulic conductivity is relatively high; 2) the air entry potential is ~ -1 J/kg (~ 10 cm of water); 3) the water content ($\sim 8.0\%$) at a water potential of only -10 J/kg (~ 100 cm of water) is relatively low; and 4) the hydraulic conductivity drops four orders of magnitude in the 0 to -10 J/kg range.

The smooth curves in Figure 4.1 come from an analysis described by van Genuchten (1978). The equation describing the water retention curve is of the form:

$$\theta = \theta_r + (\theta_s - \theta_r) \left[\frac{1}{1 + (\alpha\psi)^n} \right]^m \quad (4.1)$$

where θ = volumetric water content, m^3/m^3
 θ_s = SAT WTR = saturated water content, m^3/m^3
 θ_r = RES WTR = residual water content, m^3/m^3
 ψ = soil water potential, J/kg
 α = ALPHA = fitting parameter
 $n = N$ = fitting parameter
 $M = 1 - 1/n$.

The saturated water content was calculated from the bulk density of the samples, and the residual water content was taken as zero. The parameters ALPHA and N were curve fit from the data according to the procedure described by van Genuchten (1978).

The hydraulic conductivity curve shown in Figure 4.1 is predicted from the measured desorption curve following the theory of Mualem (1976). The theory requires one matching point. In Figure 4.1 the curve was matched to the measured saturated hydraulic conductivity as reported by Walter, Graham and Gee (1984). The equation is of the form:

$$K(\theta) = K_s \theta^{1/2} [1 - (1 - \theta^{1/M})^M]^2 \quad (4.2)$$

where K_s is K_{SAT} is saturated hydraulic conductivity and $\theta = \frac{(\theta - \theta_r)}{(\theta_s - \theta_r)}$.

4.2 LYSIMETER WATER BALANCE

The soil physical properties measured for the lysimeter soil (i.e., particle size distribution, water retention, and saturated hydraulic conductivity) show no systematic difference in soil properties among lysimeters. Therefore, the water balance of each lysimeter should be similar. A preliminary analysis of the data has confirmed that the water balance of the lysimeters are similar. Water balance data are summarized here; however, complete water content data are listed in Appendix B, and complete drainage data are given in Appendix D.

Figure 4.2 shows the initial water contents of lysimeters 1, 4, 7, and 9. The water contents are quite similar both with depth and among lysimeters with the exception of the slightly dryer surface soil of lysimeter 4. The wetter surface soil found in other lysimeters is due to rain events during and immediately after filling of the lysimeters.

The seasonal pattern of water storage in lysimeters 1, 4, and 7 is shown in Figure 4.3. The small differences in initial storage values are because of the differences in initial water contents already mentioned. These differences quickly disappear as the winter precipitation wets the soil and soil water storage increases. By late winter, the amount of water stored in all three lysimeters is essentially equal and remains so for most of the next 2 years.

Figure 4.3 also shows the distinctive seasonal pattern in water storage observed in all lysimeters. The peak soil-water storage occurs during the late winter months, which corresponds with the season of peak precipitation at the Hanford Site. Additionally, most of this winter precipitation occurs as snow. Both the winter of 1984-85 and the winter of 1985-86 were extremely cold, preventing significant snow melt during the winter. In both years, most of the winter snowpack melted rapidly in February and produced the sharp peaks in seasonal storage.

The high water storage in February is followed by a steady decline throughout the spring and summer, with minimum storage occurring in early fall just prior to the onset of the next winter's precipitation. Note again the similarity in water storage among the three lysimeters shown in Figure 4.3,

FIGURE 4.2. Initial Water Content Profile for Lysimeters 1, 4, 7, and 9

FIGURE 4.3. Profile Water Storage for Lysimeters 1, 4, and 7

particularly during 1985 and the winter of 1986. Lysimeter 1 shows less storage during the summer of 1986, but not to any large degree.

The drainage pattern for lysimeters 1, 4, and 7 is shown in Figure 4.4. As expected, the patterns are somewhat the inverse of the storage patterns shown in Figure 4.3. As the water storage is declining from February to October each year, the cumulative drainage is increasing. The drainage rate, however, decreases as the soil profile dries.

The similarity in the water balance behavior of lysimeters 1, 4, and 7 also holds for lysimeters 2 and 3. This similarity was expected because of the similarity in soil properties discussed above. However, there are factors other than soil type that can influence the water balance of a soil profile. There were two anomalies that made the water balance of lysimeters 5, 6, and 8-10 temporarily different from the other 5. The water balance of lysimeters 5 and 6 was significantly affected by low initial water contents. As stated above, lysimeters 5 and 6 were filled in September 1984, 6 months later than the others. As a result, the soil used to fill the top 2 m of lysimeters 5 and 6 had been dried to a relatively low water content during the summer. Figure 4.5 shows that in September 1984 the volumetric water content in the top 1.5 m of lysimeters 5 and 6 was approximately 2.5%, in contrast to the 7% water content of lysimeters 1 and 9. The higher water content illustrated by lysimeters 1 and 9 is also representative of the other six lysimeters that had been filled in March.

The effect of these dry initial conditions was to retard the wetting of the soil profile in lysimeters 5 and 6 during the winter of 1984-85. Figure 4.6 shows how the storage of water in lysimeters 5 and 6 lagged behind lysimeter 1. Similar comparisons can be made with other lysimeters as well. By the end of the first wetting and drying cycle (September 1985), the effect of the initially dry conditions was effectively removed. Lysimeter 6 still lags behind during the second cycle (1985-86), but not by as much as in 1984-85. All three lysimeters (1, 5, and 6) seemed to respond similarly during the winter of 1986-87.

The dry initial conditions also affected drainage from lysimeters 5 and 6. Figure 4.7 shows how the initial drainage of water from lysimeters 5 and 6 was delayed by almost 1 year. This delay in initiation of drainage was

FIGURE 4.4. Cumulative Drainage for Lysimeters 1, 4, and 7

FIGURE 4.5. Water Content Profile for Lysimeters 1, 5, 6, and 7 for 9/25/84

FIGURE 4.6. Profile Water Storage for Lysimeters, 1, 5, and 6

FIGURE 4.7. Cumulative Drainage for Lysimeters 1, 5, and 6

because the precipitation received during the winter of 1984-85 was not enough to wet the dryer soil of lysimeters 5 and 6 sufficiently to allow measurable drainage. However, by the second winter (1985-86), the drainage rates of lysimeters 5 and 6 were comparable to the rest of the lysimeters, as represented by lysimeter 1 in Figure 4.5. In fact, the cumulative drainage from lysimeter 6 caught up to the rest of the lysimeters, even with the one-year delay in the start of drainage.

The second anomaly that affected the hydrology of the lysimeter facility occurred in February 1985. Because of rapid snow melt and frozen soil conditions, lysimeters 8-10 received from 5 to 15 cm extra water supplied by runoff from areas adjacent to the lysimeter facility. This additional water resulted in the flooding of the three lysimeters and a temporary, yet dramatic increase, in both storage and drainage.

Figure 4.8 presents a comparison of the three distinct storage patterns that were seen during 1984-85 at the lysimeter facility. The curves show the reduced storage of lysimeter 5 as a result of dry initial conditions and the temporary spike in water storage of lysimeter 9 caused by flooding in early 1985. The different water storage patterns illustrated by these three lysimeters were not caused so much by differences in soil properties, but by the factors of initial conditions and runoff discussed above. Figure 4.8 also shows how, when these factors were not present (1985-86), the storage patterns were very similar among these and the other lysimeters. The same results are also shown for the case of drainage in Figure 4.9. Lysimeter 5 shows delayed onset of drainage relative to lysimeter 1 because of dry initial conditions while lysimeter 9 shows significantly more drainage caused by the flooding of 1985. Both drainage rates and amounts, however, were similar during 1986.

The overall water balance of the lysimeters is summarized in Table 4.1. The calculations for the year 1984-85 exclude lysimeters 8-10, because the exact water input is not known. Lysimeters 5 and 6 are also excluded from the drainage averaging for reasons discussed previously. The average values and standard deviations listed in Table 4.1 represent parameters for the lysimeters excluding temporary anomalies such as those mentioned above. The relatively small standard deviations shown for water balance components illustrate the small variability in behavior among lysimeters due to variability in soil

FIGURE 4.8. Profile Water Storage for Lysimeters 1, 5, and 8

FIGURE 4.9. Cumulative Drainage for Lysimeters 1, 5, 8

properties. Another interesting observation is the similarity in estimated evaporation for the 2 years, even though 1985-86 received 50% more precipitation. This similarity illustrates the complex relationship that exists among precipitation and either drainage or evaporation. In this case, it is because of the extra precipitation in the form of snow, and quickly entering the soil as snow melt during late winter when evaporation was low.

The seasonal changes in total water storage shown above correspond to changes in average soil water contents. As shown in Table 4.1, the volumetric water content at the depth of the waste samples ranged from 7 to 11% in both years. This is a fairly narrow range considering the significant amount of drainage water moving through the soil profile. However, this is typical of coarse soils. Drainage rates also fluctuate during the year. The annual rates shown in Table 4.1 are annual averages. During 1986, the drainage rate ranged from a high of over 1 cm/wk in February to less than 0.05 cm/wk in November.

4.3 WATER BALANCE PARAMETERS RELEVANT TO TRANSPORT

Two contaminant transport processes are known to vary with water content and drainage rate. The first is hydrodynamic dispersion. This is the process

TABLE 4.1. Average Water Balance Parameters for 1984-1986.

	9/1/84 ^(a) to 8/31/85	9/1/85 to 8/31/86
total precip, cm	13.8	21.7
snow, cm	55.6	86.6
Δ storage, cm	2.1 ± 0.5	-0.6 ± 2.2
drainage, cm	4.2 ± 0.5	12.3 ± 1.2
evaporation, cm	7.5 ± 0.6	10.0 ± 2.8
Δ water content, cm/m	6.8 - 11.4	6.9 - 10.7
Δ matric potential, cm	-40 to -80	-40 to -80

(a) Calculations for 9/1/84 to 8/31/85 are only for lysimeters 1, 2, 3, 4, and 7.

that causes a solute pulse to spread (i.e., disperse) as it moves through a soil profile. It is usually characterized by a dispersion coefficient, which is commonly modeled as a linear function of pore water velocity. Pore water velocity in the case of the lysimeters is the drainage rate divided by the volumetric water content. Winter drainage rates are associated with a water content of about 11% and summer rates with 7%. Therefore, pore water velocities are ranging from a high of ~ 1 cm/wk to less than 0.05 cm/wk. This change in pore water velocity can result in an order of magnitude change in dispersion.

The other transport parameter thought to vary with water content is solute retardation. The most popular model for sorption and transport of radionuclides in soil is the linear Freundlich isotherm combined with the classical convective-dispersive equation. In this model, sorption is expressed as a retardation factor R , defined as the ratio of water velocity to solute velocity. The usual formulation expresses R as inversely proportional to volumetric water content. A change in water content of 7 to 11% would reduce the retardation factor by 60%. Therefore, in the winter when drainage rates are at their highest, sorption and retardation may be at their lowest.

5.0 WASTE-FORM LEACHING RESULTS

Leachate samples are collected from the lysimeter drains at regular intervals (currently every 2 weeks) and analyzed for radioactive elements. A complete chemical analysis (ICP and IC) is done quarterly. The results of these analyses are summarized in this section. Complete listings of these data are presented in Appendix C and Appendix D.

5.1 RADIONUCLIDE MIGRATION

Drainage water collected from the bottom of each lysimeter is analyzed for radionuclide content as one measure of release and transport. Tritium and cobalt-60 are the only radionuclides identified in any of the leachates. Tritium is part of the source inventory of only the boric acid/masonry cement waste forms and is present in the leachate of lysimeters 1 and 7, which contain samples of this waste form. The total amount collected from the bottom of the lysimeters represents approximately 30% of the estimated tritium inventory of these waste forms.

Cobalt-60 is present in all waste streams, but is a primary constituent in the sodium sulfate evaporator concentrate waste streams. Cobalt-60 has been identified in all four cement waste forms constructed with the concentrate or concentrate plus exchange resin (lysimeter 2, 8 and 3, 9, respectively). Cobalt-60 has also been detected in one of the lysimeters containing a polymer waste form (lysimeter 4). The total amount of cobalt-60 collected from the lysimeters is less than 0.1% of the estimated cobalt-60 inventory for each of the waste forms. Complete data on the radionuclide concentrations and cumulative migration is given in Appendix C.

The pattern of radionuclide release from the lysimeters is shown in Figures 5.1 through 5.4. The cumulative release is plotted versus time and also versus cumulative drainage from each of the lysimeters. Figure 5.1 shows the release of tritium from lysimeters 1 and 7 versus time. The total amount and temporal pattern of tritium arrival at the lysimeter drain are nearly identical for each lysimeter. Figure 5.1 indicates that there is a seasonal nature to tritium arrival at the lysimeter drain. More tritium arrives at the lysimeter bottom with the spring drainage of winter precipitation and snowmelt than with the

FIGURE 5.1. Cumulative Release of Tritium from Lysimeters 1 and 7 Versus Time

drainage water arriving in the summer and fall. This seasonal variability is essentially eliminated when the cumulative amount of tritium is plotted or normalized by the cumulative drainage (Figure 5.2). Figure 5.2 shows that there is less variability in the amount of tritium contained in a unit of drainage water than drains in a unit of time.

The pattern of cobalt-60 drainage is shown in Figures 5.3 and 5.4. Drawing source term conclusions from these curves is more speculative than for the tritium because these releases represent less than 0.1% of the total inventory of cobalt in the waste forms. Lysimeters 3 and 9 are replicate lysimeters that contain the same waste form; this is also true of lysimeters 2 and 8. These replicate lysimeters seem to be releasing similar amounts of cobalt. Figures 5.3 and 5.4 show less variability in cumulative release among replicate lysimeters than among waste forms. The replicate of lysimeter 4 is lysimeter 10, which has not shown any levels of cobalt above limits of detection. The polymer waste forms (lysimeters 4 and 10) are releasing less cobalt than the cement (lysimeters 2, 8 and 3, 9). The higher amount of cobalt released from lysimeters 3 and 9 relative to lysimeters 2 and 8 is probably due to the higher cobalt inventory of lysimeters 3 and 9.

Figure 5.3 indicates a seasonal variability in drainage as was discussed above for tritium. The possible conclusions are also the same. Mobile cobalt-60 is generally thought to result from complex formation with some chelating agent. Chelating agents are present in the waste streams and the formation of complexes is a likely possibility. Solubility controls do not seem plausible for the mobile fraction of the cobalt. A comparison of Figure 5.3 with Figure 5.4 shows that the release is more strongly dependent on time than on cumulative drainage. The flooding of lysimeters 8, 9, and 10 does not seem to have had much effect on total amount or time of release. A cumulative release that depends more on time than drainage seems more consistent with some sort of diffusion-controlled source term although more data and extensive modeling will be necessary to confirm the most representative source term formulation.

FIGURE 5.2. Cumulative Release of Tritium from Lysimeters 1 and 7 Versus Cumulative Drainage

FIGURE 5.3. Cumulative Release of Cobalt-60 from Lysimeters 2, 3, 4, 8, and 9 Versus Time

FIGURE 5.4. Cumulative Release of Cobalt-60 from Lysimeters 2, 3, 4, 8, and 9 Versus Cumulative Drainage

5.2 MIGRATION OF NONRADIOACTIVE ELEMENTS

The waste forms buried in the SWLA lysimeters contain significant amounts of nonradioactive components in addition to the radioactive waste. These components leach from the waste form and migrate to the lysimeter drain and are detected in the lysimeter leachate. Monitoring the release of the nonradioactive components is important for two reasons. First, obtaining a complete chemical inventory of leachate samples allows application of geochemical models to identify speciation and solubility processes controlling leachate composition. Lysimeter leachates will be analyzed by the geochemical model MINTEQ (Peterson et al. 1987) in the same way as leachates from this program's laboratory leaching experiments were analyzed by Criscenti and Serne (1987). The second importance of complete chemical analysis is that the nonradioactive components provide additional leachable components useful in developing and evaluating source term and transport models.

A summary of the cumulative amounts of nonradioactive components identified in the lysimeter leachate is presented in Table 5.1. A more complete listing of leachate chemistry is found in Appendix D. The data in Table 5.1 can only be analyzed qualitatively without the use of MINTEQ and transport models; however, some interesting trends can be observed.

A comparison of Table 2.14 with Table 5.1 shows that the cumulative release of several components exceeds estimated inventory. This implies that the soil and/or the solidification agents in the lysimeters are also a source of these constituents. These components include calcium, magnesium, strontium, and nitrate. These constituents are known to leach from the soil material used to fill the lysimeters and laboratory experiments are under way to try to estimate this effect.

Two particularly interesting components listed in Table 5.1 are sodium and sulfate. All wastes contain these two constituents, particularly the sodium sulfate evaporator concentrate found in lysimeters 2, 3, 4, 8, 9, and 10. Table 5.1 shows that between 10 and 15% of the total inventory of sulfate has leached from all waste forms. This is in spite of the fact that the total inventory of sulfate varies by as much as a factor of 5 among different waste forms. Also, the effect of the flooding of lysimeters 8, 9, and 10 appears to

TABLE 5.1. Total Amount of Nonradioactive Elements Leached from Lysimeters

Drum	Ca	Na	K	Mg	Sr	NO ₃	SO ₄	Cl	B
	-----grams-----								
4-1B	41.4	12.3	4.9	9.8	0.17	99.2	23.0	2.1	0.06
1-1B	152.0	198.6	8.3	42.2	0.65	48.2	764.6	14.0	0.02
2-1B	163.6	309.5	8.2	50.5	0.70	23.2	1114.3	18.3	0.02
7-2B	163.8	170.4	8.2	41.5	0.71	34.8	675.2	20.6	0.05
Drum 1	21.7	9.1	4.0	5.0	0.10	34.1	17.5	1.4	4.28
Drum 2	39.0	12.7	4.7	9.4	0.18	54.2	21.9	2.5	8.89
4-2B	40.1	14.1	5.1	8.2	0.21	76.6	29.4	2.3	0.10
1-2B	147.3	290.9	24.3	54.3	0.79	33.7	1021.1	21.2	0.05
2-2B	152.5	392.0	28.1	53.9	0.82	46.4	1143.8	23.1	0.04
7-3B	46.3	20.3	3.0	10.9	0.21	7.5	78.9	3.5	0.04

have had little effect in accelerating the release of sulfate from these three lysimeters. The small increase in the leaching of nonradioactive chemicals from the flooded lysimeters relative to the nonflooded lysimeters is similar to the lack of excess leaching of cobalt-60 from the flooded lysimeters discussed above.

The leaching of sodium is interesting because of the small amount of sodium found in leachate samples relative to sulfate levels and to sodium inventories. Percentage of sodium inventories leached is only comparable to sulfate leaching in lysimeters 1 and 7 (approximately 12%). In all other lysimeters, the amount of sodium leached out of the lysimeters ranges from 2 to 4%. One possible explanation of this is the interaction of sodium with calcium leaching out of the waste form and also calcium occurring naturally in the soil. Sodium will compete with calcium for soil exchange sites. Normally, calcium will compete more effectively and little or no sodium will be sorbed onto soil clays. However, when soluble sodium levels are high, calcium can be displaced from soil exchange sites and sodium become the dominant exchange bound cation. It appears that this is happening to a certain extent in the SWLA lysimeters. This

displacing of soil calcium is one explanation for the high calcium levels found in leachate samples relative to calcium inventories in the waste forms. Another possible explanation of the high calcium levels would be dissolution of the cement in lysimeters 2, 3, 8, and 9.

Examining the two boric acid waste forms provides some indication of how the solidification agent can affect release of solutes. The two elements of interest are sodium and boron. As mentioned above, the boric acid/masonry cement samples (drums 4-1B and 4-2B) show the highest percentage of sodium leaching. One explanation has already been given that has to do with the low inventories of sodium, preventing sodium from competing effectively with calcium for soil exchange sites. If this is a viable explanation of leachate composition in lysimeters 1 and 7, then there must be some other explanation for the relatively low leaching percentage for drums #1 and #2 (lysimeters 5 and 6). These samples also have low sodium inventories.

Lysimeters 5 and 6 contain the boric acid/bitumen waste forms. Laboratory leaching studies indicate that unless the bitumen is crushed or physically degraded, most solutes are physically trapped inside the complex structure of the bitumen. Therefore, the low leaching percentage for sodium may be the result of the waste form retarding release rather than the soil retarding transport as with the other cement waste forms.

The second element of interest in the boric acid waste forms is boron. Table 2.14 shows that both boric acid waste streams have significant amounts of boron. However, the leaching percentage is low for all four lysimeters containing these waste forms (Table 5.1). Boron is not likely to be retarded by the soil in any significant amount because it travels as a neutral or anionic species. The low leaching percentage is an indication of low release rates from the waste forms. It has been speculated that boron can be tied up with solid phases in cement and therefore its solution concentration is controlled at a low level by solubility relationships. This could be the explanation relevant to samples 4-1B and 4-2B. In the case of the bitumen waste form (samples #1 and #2), the explanation is likely to be physical entrapment in the bitumen structure rather than solubility control.

There is much more to be learned from the leachate results presented here. However, a more detailed understanding of why the leachate composition

is as measured and how leachate composition relates to source term functions will require more quantitative analysis. This analysis will come from applying geochemical modeling, as described above, as well as using solute release and transport models to simulate leachate results. The iterative process of simulation and calibration is the only way to document which types of source term models and which specific release parameters will effectively support low-level waste performance assessments.

6.0 REFERENCES

- ANS. 1986. Measurement of the Leachability of Solidified Low-Level Radioactive Wastes by a Short-Term Test Procedure, American Nuclear Society, Standards Committee, Working Group, ANSI/ANS 16.1, Champaign, Illinois.
- Brodzinski, R. L., R. W. Perkins, H. G. Rieck and N. A. Wogman. 1987. "Measurement of Radionuclides in Waste Packages." U.S. Patent 4617169.
- Brodzinski, R. L. 1986. An Instrument for Assaying the Radionuclide Concentrations in 208-liter Drums. PNL-SA-13572S, Pacific Northwest Laboratory, Richland, Washington - presented at ANS Society Meeting, Reno, Nevada, June 1986.
- Criscenti, L. J. and R. J. Serne. 1987. Geochemical Analysis of Leachates From Cement-Low Level Radioactive Waste-Soil Systems. PNL-6544, Pacific Northwest Laboratory, Richland, Washington.
- Muallem, Y. 1976. "A New Model for Predicting the Hydraulic Conductivity of Unsaturated Porous Media." Water Resour. Res. 12(3):513-522.
- NRC. 1986. Licensing Requirements for Land Disposal of Radioactive Waste, 10 CFR Part 61, U.S. Nuclear Regulatory Commission, Washington, D.C.
- Peterson, S. R., C. J. Hostetler, W. J. Deutsch and C. E. Cowan. 1987. MINTEQ User's Manual. NUREG/CR-4808, U.S. Nuclear Regulatory Commission, Washington D.C.
- Toste, A. P., T. R. Pahl, R. B. Lucke and R. B. Myers. 1987. Analysis of Complex Organic Mixtures in Nuclear Wastes. To be published in Proceedings of 24th Hanford Life Sciences Symposium, PNL-SA-13078, Pacific Northwest Laboratory, Richland, Washington.
- van Genuchten, Rien. 1978. Calculating the Unsaturated Hydraulic Conductivity with a New Closed-Form Analytical Model. 78-WR-08, Department of Civil Engineering, Princeton University.
- Walter, M.B., M.J. Graham and G.W. Gee. 1984. A Field Lysimeter Facility for Evaluating the Performance of Commercial Solidified Low-Level Waste. PNL-5253, Pacific Northwest Laboratory, Richland, Washington.
- Walter, M. B., R. J. Serne, T. L. Jones and S. B. McLaurine. 1986. Chemical Characterization, Leach, and Adsorption Studies of Solidified Low-Level Wastes. PNL-6047, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX A

DETAILED ORGANIC ANALYSIS OF COMMERCIAL
REACTOR WASTE STREAMS

(summarized from Toste et al. 1987)

APPENDIX A

DETAILED ORGANIC ANALYSIS OF COMMERCIAL REACTOR WASTE STREAMS

The material presented in this appendix is summarized and in some cases excerpted from Toste et al. (1987). Shortly after PNL received the liquid waste samples from BNL, aliquots were sent to Dr. Anthony Toste (PNL) for complete organic analyses.

The samples were a mixture of liquid and solids. Each phase was further broken into two categories: hydrophilic and hydrophobic. The supernatant solution was extracted with chloroform to remove hydrophobic organic compounds; this extract, the hydrophobic organic fraction, was concentrated and set aside for analysis by GC and combined GC-MS. The extracted water sample, containing hydrophilic organic compounds, was evaporated to dryness under nitrogen. The residue of each aqueous fraction was then methylated in a sealed reaction vial with 1 mL of BF_3 /methanol (14% w/v) at 100°C for 40 minutes. After cooling, 1 mL of chloroform was added, the mixture was transferred to a test tube containing 3 mL of 1M KH_2PO_4 buffer solution (pH 7) with a 0.2 mL chloroform rinse and vortexed. Part of the chloroform layer (0.6 mL), which contained the methylated hydrophilic organic compounds, was then evaporated under nitrogen. The residue of this dried sample was immediately redissolved in chloroform, yielding the hydrophilic organic extract. This extract was analyzed by GC and GC-MS.

About 2 g of each commercial waste solid phase was extracted by stirring with distilled-deionized water at pH 11 for 48 hours. The alkaline extract of the solids was then prepared as just described for the liquid phases, again yielding a hydrophobic and hydrophilic extract.

GC Analysis. GC analyses were performed on a Hewlett-Packard (HP) 5880 gas chromatograph equipped with a 30 m x 0.25 mm I.D. fused-silica capillary column coated with a 0.25- μm film of DB-5 and a splitless injection system. From an initial value of 40°C , the column temperature was programmed at 20°C per minute for 3 minutes to 100°C , followed by 8°C per minute for 25 minutes to 300°C , and finally maintained isothermally at 300°C for 10 minutes.

GC-MS Analysis. GC-MS analyses were performed on an HP 5985 GC-MS instrument in the electron-impact (70-eV) mode. The gas chromatograph on the 5985 instrument was equipped with a 60 m x 0.25 mm I.D. fused silica capillary column coated with 0.25 μm of SE-54; the column was programmed from 40°C to 300°C at 5°C per minute, where it was maintained isothermally for 8 minutes. A splitless injection system was used to introduce the sample into the GC-MS instrument. A mass range of 50 to 400 atomic mass units (AMU) was scanned every second by the computer (HP-7920 large disc drive).

GC/FTIR. Analyses were performed on a Nicolet 60SX FTIR (Nicolet Analytical Instruments, Madison, WI) instrument equipped with a Nicolet 1280 computer and interfaced to an HP 5840 GC. The GC was equipped with a wide-bore, fused silica capillary column (10 m x 0.53 mm I.D. coated with a 1.5- μm film of OV-17) and a splitless injection system, which was maintained at 200°C. The GC column temperature was programmed from 40°C to 250°C at 30°C per minute. Helium was used as the carrier gas at 5 mL per minute. The temperature of the GC/FTIR interface was maintained at 250°C. The FTIR instrument was operated at a resolution of 8 cm^{-1} with a scan rate of 2 scans per second over a wavenumber range of 5000 to 700 cm^{-1} . The temperature of the light pipe was maintained at 200°C.

Quantitation. The organic species identified by the GC-MS analyses were quantitated by GC (with flame ionization detection) analysis using internal and external standards representative of compounds identified by GC-MS. Pure compounds representative of the various compound classes identified by GC-MS were selected as standards and methylated. A specific amount (1-2 μL) of each standard was co-injected with each sample to confirm the GC-MS identifications. To quantify, each standard was also injected onto the gas chromatograph prior to and following sample analyses. The response factor of each standard was calculated under analytical conditions identical to those of the sample analyses.

The results are summarized in Tables A.2 and A.3. The wastes were described by Toste et al. (1987) differently than the names that were used in the main text of this report. The names used in Tables A.2 and A.3 correspond as follows:

<u>Main Text</u>	<u>Appendix A</u>
Boric acid #1	PWR
Evaporator concentrate	BWR1
Concentrate with resin	BWR2

The samples consisted of the percentage of solids and liquids shown in Table A.1. The table compares the percentages determined by Toste et al. to those determined by BNL when the wastes were obtained at the reactors.

Various hydrophobic organic compounds were identified, particularly in the BWR wastes, at relatively high concentrations (ppm, Table A.2). The two most abundant types of compounds are a class of alkylphenols and two classes of alkylphenyl phosphate esters. The latter were the prominent, or characteristic, classes in the BWR wastes, but a number of alkylphenols were also present in the solid phase of the boric acid #1 waste. These compounds are commonly used as hydraulic fluids and plasticizers. The liquid phase of the boric acid #1 waste contained few identifiable hydrophobic organic compounds. The two BWR wastes differed; the solid phase of evaporator concentrate contained most of the hydrophobic organic species (149.9 ppm versus 49.1 ppm for the solid and liquid phases, respectively), whereas the liquid phase of concentrate with resin contained most of the hydrophobic species (109 ppm versus 56.30 ppm for the liquid and solid phases, respectively). These observations confirm the need to perform thorough source-term characterization on wastes. Related wastes may vary with respect to chemical content, making simplistic predictions about their leachability meaningless.

Various hydrophilic compounds, consisting mainly of organic acids, were identified in the commercial wastes (Table A.3). No hydrophilic species were identified in the solid phase of the boric acid #1.

The predominant class of hydrophilic organics identified are chelating agents, which were characteristic of the boric acid #1 waste. EDTA and the chelator fragment ED3A are the major components; nine other chelator fragments were also identified at concentrations ranging from 0.1 to 17.9 μM (39.3 μM

TABLE A.1. Phase Distribution in Waste Streams

	Toste et al.		BNL	
	Organic Aliquots Liquid, %	Solid, %	Original Analysis Liquid, %	Solid, %
Boric acid #1	96	4	94.5	5.5
Evaporator concentrate	63	37	74.	26.
Concentrate with resin	47	53	61.6	38.4

TABLE A.2. Hydrophobic Organic Compounds Identified in Commercial Nuclear Wastes From Nuclear Power Reactors

	Concentration, ppm ^(a)					
	PWR Waste		BWR Waste No. 1		BWR Waste No. 2	
	Liquid	Solid	Liquid	Solid	Liquid	Solid
<u>Alkyl Phenols</u>						
Cresol (methylphenol)		1.5	3.2	25.8	4.3	5.9
Dimethylphenols (3) ^(b)		11.1	1.3	14.4	0.7	16.2
Ethylphenol		7.1	3.9	8.8	1.7	9.5
C ₂ -phenols (6) ^(b)			10.8	89.7	16.3	17.2
2,6(di-t-butyl)4-ethylphenol		0.3		1.3		0.5
4-methyl, 2-nitrophenol				6.4		
Ethylnitrophenols (3) ^(b)						1.6
<u>Phosphate Esters</u>						
Di(alkylphenyl)methyl-phosphates (3) ^(b)					73.2	
Tri(alkylphenyl)phosphates (22) ^(b)			15.4		11.1	2.9
<u>Phthalate Esters</u>						
Diethylphthalate	33.2					
Dimethylphthalates (2) ^(b)			14.4		1.5	
Alkylphthalate			0.1	1.8	0.2	1.2
Hydroxybenzaldehyde	46.0					
N-(phenyl,methyl)amine				0.8		
Benzene sulfonamide				0.9		0.8
Polyethylene glycol						0.5

(a) No entry indicates compound was below detection level (0.1 ppb).

(b) Number of compounds identified.

TABLE A.3 Hydrophilic Organic Compounds^(a) Identified in Commercial Nuclear Wastes From Nuclear Power Reactors

	Concentration, ppm ^(b)					
	PWR Waste		BWR Waste No. 1		BWR Waste No. 2	
	Liquid	Solid ^(c)	Liquid	Solid	Liquid	Solid
<u>Chelating Agents^(a)</u>						
Ethylenediaminetetraacetic acid (EDTA)	11.2		2.1	66.8		
Ethylenediaminetriacetic acid (ED3A)	22.5		1.8			
Iminodiacetic acid (IDA)	0.2					
N-(2-Hydroxyethyl)iminodiacetic acid (HEIDA)	0.1					
N-Methylethylenediamine-N,N'-diacetic acid (MeEDD'A)	6.4					
N-Methylethylenediamine-N,N'-diacetic acid (MeDDA)	2.8					
Chelator fragments ^(d)	31.2					
<u>Tricarboxylic Acids^(a)</u>						
Methane Tricarboxylic Acid	7.8					
Citric acid	7.1		1.8		0.4	
<u>Dicarboxylic Acids^(a)</u>						
Oxalic acid	0.2		11.2	76.5	0.8	0.4
Propanedioic acid			2.1	16.5	0.7	
Methylpropanedioic acid				4.1		
Hydroxypentanedioic acid	0.2					
Maleic acid			5.0	21.0	0.4	
Butanedioic acid			10.9	47.6	4.8	0.2
Methylbutanedioic acid			3.7	18.8	1.7	
Hydroxybutanedioic acid	0.03		15.3	11.5	9.3	
2-Ketoglutaric acid			2.7		3.9	
Hexanedioic acid			10.5	11.2	6.5	0.8
Octanedioic acid			2.1			
Nonanedioic acid			3.2		2.9	
<u>Monocarboxylic Acids^(a)</u>						
2-Methylpropanoic acid				8.6		0.8
Butanoic acid				8.0		0.4
2-Butenoic acid			1.5			

TABLE A.3. (contd)

Monocarboxylic Acids (a)	Concentration, ppm (b)					
	PWR Waste		BWR Waste No. 1		BWR Waste No. 2	
	Liquid	Solid	Liquid	Solid	Liquid	Solid
3-Methylbutanoic acid			1.1	25.3		
2-Butanoic acid						0.6
2-Pentenoic acid			0.5	7.6		
Hexanoic acid				13.0		
2-Ethylhexanoic acid				2.2		
Octanoic acid				15.1		0.70
Nonanoic acid				12.8		1.1
Dodecanoic acid						0.9
Hexadecanoic acid				41.0		
Octadecanoic acid				17.9		
Oxygenated Acids (a)						
Glycolic acid				5.3		0.6
Lactic Acid			2.1		0.3	
2-Hydroxypropanoic acid				19.0		1.2
3-Hydroxybutanoic acid			12.3	73.6	18.3	3.4
Glyoxylic acid				3.8		
Pyruvic acid				14.5		
3-Hydroxypentanoic acid				20.2		
4-Methyl,1,2-oxopentanoic acid						0.6
Furancarboxylic acid				2.3		
4-Oxopentanoic acid				1.4		1.1
5-Oxoproline			1.8	1.3		
Aromatic Acids (a)						
Benzoic acid			13.3	28.6	3.6	
Methylbenzoic acid				3.5		
Benzeneacetic acid			2.7	12.1		
2-Hydroxybenzeneacetic acid			1.4			
Ketones						
3-Methyl,3-hydroxy,2-butenone						0.3
4-Methoxybenzaldehyde						3.3
4-Hydroxy,phenyl,1-ethanone			1.4		1.4	

(a) Methylated (BF₃/methano) acids identified as methyl esters.

(b) No entry indicates compound was below detection level (0.1 ppb).

(c) Solid phase of waste from PWR contained no identifiable hydrophilic organics.

(d) Four unknown compounds detected: A) unknown, 1.0 ppm; B) unknown, 1.7 ppm; C) MW 247 species, 17.9 ppm; D) MW 318 species, 1.4 ppm.

collectively). Of the nine chelator fragments, Toste et al. (1987) have identified the structure of four: 1) IDA, 0.2 ppm; 2) HEIDA, 0.1 ppm; 3) MeEDD'A, 6.4 ppm; and 4) MeEDDA, 2.8 ppm. The five unknown fragments include a MW-190 species; 7.8 ppm; a MW-247 species, 17.9 ppm; a MW-318 species (possibly a lactam), 1.4 ppm; and two other unspecified species, 7.8 and 1.7 ppm.

The boric acid #1 waste contained more ED3A and other chelator fragments than nondegraded EDTA, presumably reflecting greater chemical/radiolytic decomposition of EDTA than the BWR wastes. In contrast, most hydrophilic organic species were found in the liquid phase of the concentrate with resin waste (55.0 ppm versus 16.4 ppm for the liquid and solid phases, respectively). A similar trend was observed for the hydrophobic organic fraction.

APPENDIX B

SOIL-WATER CONTENT OF LYSIMETERS
MEASURED BY NEUTRON PROBE

APPENDIX B

SOIL-WATER CONTENT OF LYSIMETERS MEASURED BY NEUTRON PROBE

The following listing of data are soil-water contents as measured by a Model 503 Hydroprobe manufactured by Campbell Pacific Nuclear. Data shown covers the period of March 1984 through January 1987. Lysimeters 5 and 6 were not filled until September 1984; therefore, no data are available until then. The row of data marked AVG % is the average water content calculated for the entire lysimeter. The row marked WASTE % is the average water content measured over the length of the waste forms (183- to 244-cm readings). The row marked STRG cm is the total amount of water stored in the lysimeter where the volume of soil in the lysimeter has been corrected for the volume of the waste form.

DATE: 03-27-84
 DAY: 87
 PROBE: 2499 STANDARD COUNTS: 17063

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	9.8	9.6	9.6	7.2	0.0	0.0	9.1	7.7	9.2	9.4
46.0	11.1	10.9	10.6	7.6	0.0	0.0	10.0	11.0	10.1	10.9
61.0	10.1	9.6	10.7	7.0	0.0	0.0	10.5	10.8	10.2	11.1
76.0	8.4	8.6	8.8	6.9	0.0	0.0	8.4	9.0	9.8	10.6
91.0	7.3	7.6	7.2	7.0	0.0	0.0	7.8	7.6	8.4	9.5
107.0	7.3	7.6	7.6	6.1	0.0	0.0	7.5	7.3	7.3	8.1
122.0	7.3	7.3	7.7	5.5	0.0	0.0	7.3	7.7	7.0	6.7
137.0	6.9	7.5	7.5	5.7	0.0	0.0	7.2	7.2	7.2	6.5
152.0	7.2	8.4	7.3	6.4	0.0	0.0	7.4	7.3	7.7	7.1
167.0	7.2	7.8	7.7	6.9	0.0	0.0	6.8	7.5	8.0	7.0
183.0	7.3	7.1	7.8	7.1	0.0	0.0	6.8	7.6	7.7	7.3
198.0	7.0	7.1	7.7	7.6	0.0	0.0	6.5	8.4	8.5	8.1
213.0	7.6	7.0	8.1	8.3	0.0	0.0	6.7	9.1	9.2	7.6
229.0	7.0	7.6	7.4	8.0	0.0	0.0	6.5	8.6	9.1	7.5
244.0	7.2	8.1	7.9	8.3	0.0	0.0	7.1	8.3	8.4	7.3
259.0	8.1	9.6	9.2	9.2	0.0	0.0	8.7	8.9	9.2	8.2
274.0	9.8	10.2	10.5	8.8	0.0	0.0	11.0	11.4	9.5	9.9
AVG %	7.5	7.7	7.8	6.7	0.0	0.0	7.3	7.9	8.1	7.8
WASTE %	7.2	7.6	7.7	7.5	0.0	0.0	6.8	8.1	8.4	7.4
STRG cm	20.5	21.2	21.5	18.5	0.0	0.0	20.1	21.7	22.2	21.5

DATE: 05-02-84
 DAY: 122
 PROBE: 5140 STANDARD COUNTS: 11254

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	9.0	9.0	9.3	6.6	0.0	0.0	8.7	9.1	8.6	8.1
46.0	10.0	10.7	10.3	7.2	0.0	0.0	9.3	10.3	10.1	9.8
61.0	11.2	10.8	10.6	7.7	0.0	0.0	10.1	10.6	10.1	10.4
76.0	10.6	9.5	10.4	7.7	0.0	0.0	10.0	9.7	10.3	10.2
91.0	8.8	8.4	9.8	7.2	0.0	0.0	9.1	8.6	9.6	9.3
107.0	7.1	7.8	9.1	7.5	0.0	0.0	8.0	8.0	8.6	9.4
122.0	7.2	7.8	8.2	6.3	0.0	0.0	7.4	6.9	7.5	8.2
137.0	7.1	7.3	7.3	5.4	0.0	0.0	6.7	7.2	7.3	7.2
152.0	7.3	7.6	7.6	6.3	0.0	0.0	7.0	6.8	7.5	7.0
167.0	7.3	7.6	7.6	7.5	0.0	0.0	6.4	7.0	7.8	7.0
183.0	6.6	7.4	7.5	7.2	0.0	0.0	6.3	7.0	7.5	6.9
198.0	6.9	7.7	8.1	7.8	0.0	0.0	6.1	7.9	8.4	7.7
213.0	7.2	7.7	8.4	8.3	0.0	0.0	6.3	8.3	8.8	7.3
229.0	7.1	7.4	7.7	7.8	0.0	0.0	6.0	8.3	8.5	7.2
244.0	7.1	8.3	7.9	7.9	0.0	0.0	6.5	7.8	8.5	7.1
259.0	8.3	9.1	9.1	8.8	0.0	0.0	8.1	8.8	9.2	8.2
274.0	10.0	10.4	10.7	8.7	0.0	0.0	10.5	10.6	9.3	9.5
AVG %	7.6	7.9	8.2	6.9	0.0	0.0	7.2	7.8	8.1	7.7
WASTE %	7.1	7.7	7.8	7.5	0.0	0.0	6.4	7.6	8.2	7.2
STRG cm	20.8	21.7	22.5	18.9	0.0	0.0	19.7	21.4	22.4	21.2

DATE: 05-18-84
 DAY: 139
 PROBE: 5140 STANDARD COUNTS: 11254

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	8.3	7.7	8.5	5.7	0.0	0.0	8.5	8.6	7.9	7.5
46.0	10.4	10.1	9.6	7.8	0.0	0.0	8.9	9.8	9.5	10.0
61.0	11.2	9.9	10.7	7.7	0.0	0.0	9.5	10.3	10.2	10.3
76.0	10.1	9.7	10.0	7.9	0.0	0.0	9.6	9.8	10.2	10.4
91.0	8.8	8.9	9.8	7.5	0.0	0.0	9.5	9.1	9.7	10.0
107.0	7.9	8.2	9.6	7.6	0.0	0.0	8.7	8.0	8.8	9.7
122.0	7.1	8.0	7.9	6.6	0.0	0.0	7.2	7.2	7.7	8.3
137.0	6.7	7.2	7.6	6.3	0.0	0.0	7.1	7.0	7.2	7.5
152.0	7.2	7.4	7.5	6.7	0.0	0.0	6.9	6.9	7.6	7.5
167.0	7.2	7.8	7.8	6.7	0.0	0.0	6.6	6.8	7.7	7.2
183.0	7.1	7.8	7.4	7.0	0.0	0.0	6.3	7.0	7.9	6.8
198.0	6.7	6.8	7.5	7.5	0.0	0.0	6.4	7.7	8.4	7.4
213.0	6.7	6.9	7.6	7.8	0.0	0.0	6.3	8.0	8.5	7.6
229.0	6.3	7.4	7.6	7.3	0.0	0.0	6.4	7.9	8.5	6.7
244.0	7.3	8.0	7.2	7.6	0.0	0.0	6.7	7.6	9.1	7.4
259.0	8.0	9.0	8.7	8.7	0.0	0.0	8.0	8.5	9.2	8.7
274.0	9.6	10.3	10.7	8.8	0.0	0.0	10.4	10.5	8.7	9.5
AVG %	7.5	7.7	7.9	6.8	0.0	0.0	7.2	7.7	8.1	7.8
WASTE %	6.9	7.5	7.5	7.2	0.0	0.0	6.5	7.4	8.2	7.2
STRG cm	20.5	21.2	21.9	18.8	0.0	0.0	19.8	21.1	22.3	21.5

DATE: 06-01-84
 DAY: 153
 PROBE: 5140 STANDARD COUNTS: 11317

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	7.7	7.5	7.9	5.3	0.0	0.0	7.7	7.7	7.3	7.3
46.0	9.1	9.9	9.6	7.4	0.0	0.0	8.9	8.9	9.1	9.1
61.0	10.3	10.4	10.6	7.4	0.0	0.0	9.4	9.4	9.4	9.8
76.0	10.1	10.3	10.2	7.5	0.0	0.0	9.0	9.0	9.9	9.7
91.0	9.3	9.5	9.7	7.2	0.0	0.0	9.1	9.1	9.6	9.5
107.0	7.5	9.3	9.2	7.3	0.0	0.0	8.5	8.5	9.2	9.4
122.0	7.5	8.4	8.2	7.0	0.0	0.0	7.5	7.5	7.3	8.5
137.0	6.9	7.9	7.5	6.2	0.0	0.0	6.7	6.9	7.1	8.0
152.0	6.8	7.3	7.3	6.5	0.0	0.0	6.8	7.0	7.1	7.6
167.0	7.1	7.9	7.4	7.2	0.0	0.0	6.6	6.7	7.2	7.0
183.0	6.7	7.8	7.4	6.7	0.0	0.0	6.3	6.7	7.8	7.0
198.0	6.7	7.6	7.5	7.2	0.0	0.0	6.3	7.9	7.8	7.4
213.0	6.7	7.5	7.3	7.4	0.0	0.0	5.7	7.9	8.4	7.0
229.0	6.2	7.1	7.3	7.7	0.0	0.0	6.2	7.7	7.6	7.1
244.0	6.8	7.2	7.6	8.3	0.0	0.0	6.0	8.2	8.2	7.3
259.0	8.3	7.7	8.5	8.6	0.0	0.0	7.8	8.6	9.1	8.5
274.0	9.3	9.8	10.7	8.6	0.0	0.0	9.6	10.7	9.1	9.9
AVG %	7.3	7.8	7.8	6.7	0.0	0.0	7.0	7.5	7.8	7.7
WASTE %	6.7	7.5	7.4	7.3	0.0	0.0	6.3	7.4	7.7	7.2
STRG cm	20.0	21.6	21.6	18.6	0.0	0.0	19.1	20.6	21.4	21.1

DATE: 06-22-84
 DAY: 174
 PROBE: 5140 STANDARD COUNTS: 11280

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	6.8	7.1	7.3	5.0	0.0	0.0	7.4	7.6	7.1	6.7
46.0	9.2	8.9	9.4	6.3	0.0	0.0	9.2	9.4	8.8	9.1
61.0	10.1	10.2	10.4	7.1	0.0	0.0	9.9	10.1	9.8	10.1
76.0	9.8	9.7	10.5	7.3	0.0	0.0	9.6	9.7	9.8	10.2
91.0	9.3	9.4	9.7	7.2	0.0	0.0	9.8	9.4	9.7	10.0
107.0	8.1	8.9	9.6	7.3	0.0	0.0	8.9	8.5	9.4	9.4
122.0	7.3	8.3	9.0	6.8	0.0	0.0	8.6	7.8	7.8	9.5
137.0	7.0	7.5	7.8	6.4	0.0	0.0	7.1	6.9	7.1	9.0
152.0	7.0	7.8	7.5	6.9	0.0	0.0	6.7	6.8	7.3	8.0
167.0	6.8	7.5	7.5	7.2	0.0	0.0	6.2	6.6	7.5	6.7
183.0	6.8	7.2	7.3	6.7	0.0	0.0	6.1	6.8	7.7	7.1
198.0	6.3	7.4	7.5	6.8	0.0	0.0	5.9	7.8	7.7	7.1
213.0	6.7	6.8	7.6	7.4	0.0	0.0	6.2	8.2	7.9	7.1
229.0	6.5	7.1	7.6	7.4	0.0	0.0	6.0	7.8	7.7	6.9
244.0	6.8	7.6	7.4	7.5	0.0	0.0	6.6	7.9	8.3	7.3
259.0	7.9	8.6	8.7	8.6	0.0	0.0	7.6	8.6	8.7	9.0
274.0	9.1	9.5	9.5	8.4	0.0	0.0	8.8	10.1	9.1	9.1
AVG %	7.2	7.6	7.9	6.6	0.0	0.0	7.2	7.7	7.8	7.8
WASTE %	6.7	7.3	7.5	7.1	0.0	0.0	6.2	7.4	7.7	7.2
STRG cm	19.8	21.0	21.8	18.1	0.0	0.0	19.7	21.0	21.4	21.6

DATE: 07-10-84
 DAY: 192
 PROBE: 5140 STANDARD COUNTS: 11159

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.9	6.6	6.1	4.5	0.0	0.0	6.7	7.1	6.0	6.4
46.0	8.8	8.6	8.8	6.5	0.0	0.0	8.6	8.9	8.2	8.8
61.0	10.1	10.0	10.0	7.1	0.0	0.0	9.4	9.8	9.9	9.9
76.0	10.1	9.7	9.8	7.0	0.0	0.0	9.4	9.9	9.9	9.5
91.0	9.5	9.4	9.6	7.2	0.0	0.0	9.4	9.7	9.9	9.8
107.0	8.6	9.3	9.3	7.2	0.0	0.0	9.3	9.2	9.3	9.6
122.0	7.6	9.1	8.8	7.1	0.0	0.0	8.6	8.3	8.3	9.5
137.0	7.6	8.1	8.1	6.8	0.0	0.0	7.5	7.4	7.3	9.1
152.0	7.2	7.8	7.0	7.4	0.0	0.0	6.6	7.2	7.7	8.7
167.0	7.1	7.9	7.2	7.9	0.0	0.0	6.8	7.0	7.3	7.7
183.0	6.8	7.6	7.8	7.2	0.0	0.0	6.6	6.5	7.5	7.2
198.0	6.9	7.5	7.7	7.5	0.0	0.0	6.3	7.8	7.8	7.4
213.0	6.7	7.3	7.4	7.9	0.0	0.0	6.1	7.8	8.4	7.0
229.0	6.6	7.0	7.2	7.8	0.0	0.0	6.4	7.3	7.5	7.0
244.0	7.2	7.7	7.1	7.7	0.0	0.0	6.6	7.9	8.5	7.4
259.0	8.0	8.3	8.5	8.7	0.0	0.0	7.8	8.6	8.8	9.2
274.0	9.3	9.4	9.5	9.3	0.0	0.0	9.0	10.8	9.0	9.2
AVG %	7.3	7.8	7.7	6.8	0.0	0.0	7.2	7.7	7.8	7.9
WASTE %	6.9	7.6	7.4	7.6	0.0	0.0	6.5	7.4	7.8	7.5
STRG cm	20.2	21.4	21.1	18.6	0.0	0.0	19.8	21.1	21.4	21.7

DATE: 07-27-84
 DAY: 209
 PROBE: 5140 STANDARD COUNTS: 11171

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.4	5.3	5.6	3.3	0.0	0.0	5.7	6.0	5.0	4.4
46.0	8.1	8.5	8.3	5.9	0.0	0.0	7.9	8.2	7.3	6.9
61.0	9.9	9.2	9.5	7.2	0.0	0.0	8.9	9.3	8.6	8.8
76.0	9.8	9.3	9.7	6.8	0.0	0.0	9.6	9.4	9.1	9.1
91.0	9.0	9.2	9.6	7.3	0.0	0.0	9.3	9.1	9.0	8.7
107.0	8.4	9.1	9.5	7.0	0.0	0.0	9.2	8.4	8.8	8.6
122.0	8.1	8.4	9.3	7.0	0.0	0.0	8.8	8.0	8.4	8.9
137.0	7.4	8.3	8.4	6.7	0.0	0.0	8.3	7.7	7.3	8.9
152.0	7.6	7.8	7.5	7.7	0.0	0.0	7.5	7.1	7.5	9.1
167.0	6.9	7.0	7.6	8.0	0.0	0.0	6.8	7.1	7.5	8.4
183.0	6.7	7.1	7.5	7.4	0.0	0.0	6.4	6.7	7.4	7.3
198.0	6.6	7.7	7.4	7.4	0.0	0.0	6.4	7.9	7.9	7.3
213.0	6.6	7.2	7.7	7.3	0.0	0.0	6.4	7.7	8.0	7.5
229.0	6.3	6.7	7.3	7.5	0.0	0.0	5.9	7.7	8.2	6.8
244.0	6.5	7.5	7.5	7.8	0.0	0.0	6.3	8.1	8.1	7.4
259.0	8.3	8.7	8.7	8.5	0.0	0.0	7.7	8.8	8.8	8.4
274.0	9.5	9.3	10.0	8.8	0.0	0.0	9.4	10.3	8.3	9.2
AVG %	7.2	7.5	7.7	6.6	0.0	0.0	7.1	7.5	7.5	7.4
WASTE %	6.7	7.3	7.5	7.6	0.0	0.0	6.5	7.5	7.8	7.7
STRG cm	19.7	20.5	21.2	18.2	0.0	0.0	19.6	20.6	20.5	20.4

DATE: 08-30-84
 DAY: 243
 PROBE: 5140 STANDARD COUNTS: 11297

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	4.4	4.3	4.5	2.1	0.0	0.0	4.9	4.7	4.0	3.7
46.0	6.7	7.0	7.3	4.1	0.0	0.0	6.7	6.9	6.2	6.6
61.0	8.1	7.7	8.6	5.0	0.0	0.0	7.8	8.1	7.8	7.7
76.0	8.8	7.8	9.1	5.7	0.0	0.0	8.3	8.2	8.3	7.8
91.0	8.1	7.9	9.2	5.7	0.0	0.0	8.9	8.4	8.5	7.8
107.0	8.4	8.4	9.3	5.8	0.0	0.0	8.7	8.5	8.1	7.6
122.0	7.8	8.5	9.4	5.8	0.0	0.0	8.7	7.4	7.9	8.0
137.0	7.5	8.4	8.6	6.4	0.0	0.0	8.2	7.3	7.6	7.9
152.0	7.6	7.7	8.3	7.2	0.0	0.0	7.5	6.3	7.2	8.1
167.0	6.8	7.3	7.8	7.6	0.0	0.0	6.9	6.1	6.9	8.2
183.0	7.1	7.2	7.3	7.4	0.0	0.0	6.5	6.0	7.0	7.1
198.0	6.6	7.1	7.5	7.0	0.0	0.0	6.4	6.9	7.6	7.2
213.0	6.6	7.1	7.7	7.1	0.0	0.0	6.3	7.0	8.0	7.1
229.0	6.3	7.1	7.1	7.3	0.0	0.0	6.1	7.3	7.4	6.0
244.0	6.7	7.5	7.0	7.5	0.0	0.0	6.4	7.5	7.6	6.7
259.0	8.2	8.5	8.5	8.3	0.0	0.0	7.5	8.2	8.7	8.8
274.0	9.2	9.3	9.5	8.1	0.0	0.0	8.8	9.5	8.8	9.1
AVG %	6.8	7.0	7.5	5.9	0.0	0.0	6.8	6.7	7.0	6.8
WASTE %	6.8	7.3	7.5	7.3	0.0	0.0	6.6	6.7	7.4	7.2
STRG cm	18.8	19.3	20.6	16.2	0.0	0.0	18.7	18.6	19.2	18.8

DATE: 09-25-84
 DAY: 269
 PROBE: 5140 STANDARD COUNTS: 11253

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	5.0	5.3	5.4	4.7	2.1	2.7	6.4	5.4	5.1	5.5
46.0	6.3	7.2	6.7	6.5	2.6	2.8	7.4	6.6	6.1	6.4
61.0	7.7	7.5	8.0	7.7	2.8	3.0	8.4	7.6	7.0	7.2
76.0	8.3	7.6	8.9	8.0	2.8	2.5	8.6	7.9	7.9	7.0
91.0	8.4	7.8	8.4	8.0	3.8	2.4	9.2	8.3	8.3	7.3
107.0	8.0	8.3	8.7	8.6	3.6	3.0	9.1	7.9	8.2	7.8
122.0	7.8	8.2	9.3	8.8	3.1	2.5	8.6	8.0	7.9	7.6
137.0	7.6	7.8	8.3	8.5	3.1	2.5	8.2	7.8	7.8	7.7
152.0	7.3	8.2	8.0	8.3	3.2	3.7	7.2	6.9	8.0	8.1
167.0	6.9	7.7	7.8	9.4	4.3	5.2	8.0	6.7	7.5	7.8
183.0	6.7	7.2	7.1	8.8	5.3	5.4	6.9	6.7	7.4	6.8
198.0	6.4	7.0	7.2	8.0	6.2	6.5	6.6	7.1	7.7	6.9
213.0	6.5	7.0	7.5	7.6	6.9	7.2	6.5	7.3	8.2	6.9
229.0	6.4	7.0	6.9	7.3	7.1	7.7	6.3	7.3	7.4	6.7
244.0	6.5	7.7	7.2	7.5	7.0	8.4	6.9	7.6	7.7	7.3
259.0	7.4	8.3	8.4	8.8	7.3	9.1	7.7	8.6	8.6	8.7
274.0	8.4	9.3	9.0	9.4	8.5	10.8	9.3	10.2	8.6	9.2
AVG %	6.7	7.0	7.3	7.4	4.2	4.4	7.2	6.9	7.1	6.8
WASTE %	6.7	7.4	7.4	8.1	5.7	6.3	6.9	7.1	7.7	7.2
STRG cm	18.3	19.4	20.0	20.5	11.5	12.1	19.7	19.0	19.6	18.7

DATE: 11-09-84
 DAY: 314
 PROBE: 5140 STANDARD COUNTS: 11293

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.1	5.2	5.6	4.6	1.9	2.0	5.0	5.3	5.1	4.8
46.0	6.5	6.4	6.9	5.9	3.0	2.0	6.4	6.1	6.5	6.8
61.0	7.6	7.0	7.6	7.0	2.6	2.8	6.7	6.5	7.5	7.1
76.0	7.6	6.9	7.9	7.4	2.5	2.6	7.3	6.9	8.0	7.2
91.0	7.7	7.4	8.1	7.9	3.3	2.9	8.2	7.6	7.6	6.4
107.0	7.5	7.2	8.3	8.3	3.5	2.8	7.8	7.7	8.1	7.3
122.0	7.7	7.5	9.2	8.3	3.5	3.1	8.7	8.2	7.9	7.3
137.0	7.6	7.8	8.7	8.4	2.9	3.2	8.2	7.7	7.8	7.2
152.0	7.5	7.8	8.5	8.4	3.6	3.5	8.1	7.1	7.4	7.8
167.0	7.8	7.5	8.2	8.8	4.2	4.7	7.6	6.7	8.2	7.5
183.0	6.8	7.5	8.0	8.3	5.2	5.4	6.1	6.9	8.0	7.2
198.0	6.6	7.0	7.3	8.2	6.2	6.3	6.1	7.1	7.6	6.8
213.0	6.5	6.7	7.4	7.8	6.3	7.1	5.6	7.1	7.7	6.2
229.0	6.2	6.7	7.0	7.3	6.5	7.4	6.3	7.6	7.1	6.2
244.0	6.5	7.7	7.7	7.3	6.8	8.1	5.5	8.1	8.1	7.0
259.0	7.2	8.5	8.3	8.7	7.3	9.1	6.6	8.0	8.4	8.6
274.0	8.4	9.6	9.9	8.5	8.1	11.3	8.2	10.6	8.5	9.2
AVG %	6.6	6.7	7.3	7.2	4.1	4.3	6.5	6.7	7.1	6.6
WASTE %	6.9	7.3	7.7	8.0	5.5	6.1	6.5	7.2	7.7	7.0
STRG cm	18.2	18.6	20.2	19.9	11.2	11.8	17.8	18.6	19.6	18.0

DATE: 12-13-84
 DAY: 348
 PROBE: 5140 STANDARD COUNTS: 12175

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	9.4	9.7	9.8	9.0	8.9	9.3	9.2	9.7	9.3	9.4
46.0	9.9	10.9	10.5	9.5	9.3	8.0	10.0	10.2	10.4	10.8
61.0	10.8	10.7	10.4	9.4	7.4	5.0	9.9	10.1	10.4	10.7
76.0	10.7	10.1	10.7	9.0	4.2	3.5	10.0	10.0	10.6	10.4
91.0	9.7	9.7	10.2	8.3	3.6	2.8	9.3	10.2	10.1	9.9
107.0	8.6	8.9	10.1	8.5	4.0	3.1	9.0	9.2	9.8	9.5
122.0	7.4	8.3	9.6	7.8	3.5	3.3	8.4	8.1	8.9	8.5
137.0	7.5	8.3	8.6	7.7	3.3	3.5	8.4	7.3	8.4	7.5
152.0	7.8	8.7	8.9	7.6	4.0	4.7	8.2	7.1	8.6	7.9
167.0	7.9	8.5	8.7	8.2	5.0	5.3	7.8	6.0	7.9	7.4
183.0	7.4	7.6	7.4	8.0	5.6	5.5	6.7	6.1	7.4	6.9
198.0	6.4	7.6	7.4	7.3	6.3	6.0	6.1	6.7	8.0	7.1
213.0	6.5	7.4	6.9	7.2	6.2	6.7	6.3	6.8	7.7	6.8
229.0	5.9	7.3	7.2	6.6	6.4	7.0	6.4	6.7	7.2	6.3
244.0	6.6	6.9	7.0	7.2	6.9	7.1	6.0	7.4	8.0	6.8
259.0	7.0	8.7	7.7	8.0	7.2	8.2	6.8	7.7	8.2	8.4
274.0	8.3	9.8	9.1	8.3	8.2	9.7	8.3	9.2	8.0	8.8
AVG %	7.6	8.2	8.3	7.6	5.4	5.2	7.6	7.6	8.3	7.9
WASTE %	6.9	7.7	7.6	7.5	5.8	6.0	6.8	6.7	7.8	7.0
STRG cm	21.0	22.5	22.8	20.9	14.9	14.4	20.8	20.9	22.8	21.7

DATE: 02-04-85
 DAY: 401
 PROBE: 5140 STANDARD COUNTS: 22628

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	9.4	9.8	10.5	9.4	8.7	9.7	10.5	10.6	9.8	9.7
46.0	10.2	11.0	10.8	9.7	9.5	9.3	9.8	11.0	10.7	10.6
61.0	10.6	10.3	10.2	9.7	8.5	7.2	10.0	10.1	9.9	9.8
76.0	10.3	10.3	10.8	9.7	6.9	5.3	10.4	10.0	10.1	9.8
91.0	9.8	9.9	10.7	9.8	5.2	3.4	10.6	10.8	10.5	9.6
107.0	9.8	9.8	11.1	9.7	4.0	3.1	10.7	10.2	10.4	9.9
122.0	9.3	9.5	10.6	9.1	3.1	3.4	11.0	9.6	10.4	9.7
137.0	9.2	9.6	10.3	8.9	3.6	4.1	10.4	9.0	9.5	10.1
152.0	8.2	9.1	9.4	8.5	4.6	5.4	10.0	8.6	9.8	10.0
167.0	8.9	8.4	9.6	8.7	5.0	5.8	10.4	8.2	9.4	9.9
183.0	7.5	8.1	8.2	8.5	6.1	5.9	10.0	7.0	9.1	9.3
198.0	7.1	8.1	8.4	8.2	6.5	6.8	9.3	7.0	8.8	8.7
213.0	7.2	7.8	7.7	7.8	6.8	7.4	8.7	7.5	8.3	7.2
229.0	6.3	7.5	7.5	7.2	6.6	7.3	7.0	7.2	7.8	5.6
244.0	6.5	7.7	7.1	7.5	7.3	8.2	6.8	7.7	8.3	6.5
259.0	8.0	8.8	8.1	8.4	7.3	8.8	7.9	8.2	8.8	7.8
274.0	9.1	9.6	9.1	8.5	8.2	10.8	8.7	9.4	8.6	8.3
AVG %	8.1	8.6	8.9	8.3	5.9	5.9	9.0	8.4	8.9	8.5
WASTE %	7.4	8.1	8.3	8.1	6.1	6.7	8.9	7.6	8.8	8.2
STRG cm	22.4	23.6	24.4	22.8	16.2	16.3	24.9	23.1	24.5	23.3

DATE: 02-12-85
 DAY: 409
 PROBE: 2499 STANDARD COUNTS: 34529

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	16.2	16.3	16.8	15.5	17.2	17.1	15.3	15.4	16.3	26.8
46.0	16.8	16.9	16.2	15.0	17.1	16.7	14.2	15.0	15.6	25.2
61.0	16.1	15.7	15.2	14.7	11.4	10.7	14.4	13.7	14.2	20.5
76.0	15.4	15.4	15.0	14.1	7.4	6.4	14.7	13.4	14.0	14.0
91.0	13.9	14.8	14.9	13.4	5.4	4.2	14.9	13.9	14.0	13.8
107.0	12.9	13.8	15.2	13.0	4.4	3.2	14.9	14.0	14.1	14.3
122.0	11.1	11.6	14.5	10.9	4.4	3.5	15.1	13.9	13.8	14.4
137.0	10.5	10.4	12.8	9.2	4.3	3.8	15.0	13.9	13.6	14.4
152.0	9.8	10.5	11.5	9.3	4.9	5.1	14.9	14.5	14.4	15.0
167.0	9.6	9.8	10.1	10.1	6.0	6.0	13.2	14.3	15.5	14.8
183.0	9.1	9.0	9.4	9.2	6.7	6.3	11.0	14.9	16.2	14.5
198.0	8.7	9.2	9.0	8.7	7.2	7.1	11.1	16.2	17.0	15.9
213.0	8.2	8.6	8.6	9.1	7.9	7.7	10.2	16.7	16.8	17.3
229.0	7.9	8.4	8.3	8.5	7.6	7.6	9.2	16.1	17.0	30.1
244.0	7.8	8.7	8.2	8.3	7.2	8.1	7.8	18.2	16.9	44.0
259.0	9.0	9.2	8.3	9.1	7.8	9.0	8.4	28.4	20.0	44.0
274.0	10.1	10.2	9.5	9.4	8.0	11.1	8.8	44.0	44.0	44.0
AVG %	10.8	11.1	11.4	10.5	7.5	7.2	12.0	14.9	14.7	19.9
WASTE %	8.7	9.2	9.3	9.0	6.8	6.8	11.1	15.9	16.3	21.6
STRG cm	29.6	30.5	31.4	28.8	20.5	19.8	33.0	40.9	40.3	54.8

DATE: 02-27-85
 DAY: 424
 PROBE: 2499 STANDARD COUNTS: 17234

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	8.2	8.8	8.8	9.2	10.1	9.9	9.6	9.5	7.9	8.7
46.0	10.7	11.2	10.6	10.6	12.0	11.8	10.2	10.4	10.7	10.7
61.0	12.2	12.0	12.4	10.8	14.4	12.5	11.3	10.8	11.2	11.1
76.0	12.2	12.0	12.4	11.7	13.2	12.7	12.1	11.8	10.9	11.2
91.0	11.4	12.4	12.6	11.8	13.8	11.7	11.9	11.7	10.8	11.6
107.0	11.5	13.2	12.8	11.7	13.3	8.8	11.8	11.2	11.8	11.6
122.0	11.2	13.0	12.2	12.3	10.1	5.6	11.5	11.3	12.0	11.2
137.0	11.5	12.6	12.5	12.2	6.4	4.5	12.5	10.7	11.6	11.9
152.0	11.5	13.2	12.2	12.2	5.6	5.6	12.5	11.5	12.0	11.4
167.0	11.2	13.6	13.2	12.2	5.8	5.9	12.7	11.4	13.1	11.4
183.0	10.6	13.2	12.1	12.7	6.0	6.3	12.6	12.8	13.7	11.7
198.0	11.6	13.2	12.3	13.3	7.2	7.5	13.0	12.8	14.6	11.9
213.0	12.0	13.4	12.0	13.2	7.3	8.1	13.4	13.0	14.3	12.3
229.0	11.3	12.5	11.8	12.7	7.7	7.7	13.2	12.6	13.9	12.0
244.0	11.1	13.0	11.8	12.5	7.9	7.8	12.7	13.4	14.0	14.3
259.0	12.3	13.1	11.9	12.1	8.2	9.2	13.3	14.9	15.5	24.2
274.0	12.4	13.4	11.9	10.6	9.2	10.8	14.0	28.1	23.9	44.0
AVG %	10.6	11.8	11.3	11.2	8.8	8.0	11.4	11.2	11.7	11.6
WASTE %	11.3	13.2	12.2	12.7	6.8	7.0	12.9	12.5	13.7	12.1
STRG cm	29.2	32.4	31.0	30.9	24.1	21.9	31.4	30.7	32.0	31.9

DATE: 03-12-85
DAY: 437
PROBE: 5140 STANDARD COUNTS: 11947

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	8.7	8.2	8.7	8.9	9.3	9.3	8.8	8.9	7.8	8.7
46.0	10.2	10.6	10.4	9.9	10.6	10.3	10.1	10.3	10.1	10.4
61.0	11.2	10.9	10.8	10.4	11.8	10.9	10.7	10.5	10.5	11.0
76.0	10.9	11.1	11.1	10.6	11.5	11.4	10.5	10.0	11.0	10.2
91.0	10.8	10.7	11.6	10.4	12.7	10.1	10.5	10.1	10.5	9.9
107.0	10.2	11.0	11.4	10.7	13.3	8.7	10.7	9.9	10.6	10.0
122.0	10.3	10.7	11.7	11.0	12.0	7.2	11.0	9.9	10.9	10.4
137.0	10.2	11.2	11.9	10.5	10.7	6.0	10.6	9.8	10.5	10.8
152.0	10.4	11.6	12.2	10.3	8.4	5.6	10.9	10.0	10.9	10.7
167.0	10.9	11.4	12.0	11.0	6.7	6.1	11.0	9.8	11.1	10.8
183.0	10.7	11.4	11.5	11.0	6.3	6.5	10.9	10.2	11.3	10.6
198.0	11.0	11.4	11.8	10.6	6.6	6.8	11.8	10.4	11.3	11.2
213.0	10.6	11.6	11.4	11.0	6.5	7.7	11.2	10.5	11.0	10.2
229.0	10.5	10.6	11.5	11.1	7.0	7.5	11.1	10.4	11.1	10.6
244.0	11.0	11.2	11.5	11.3	7.4	8.2	10.8	10.7	11.2	12.1
259.0	12.4	12.3	12.2	11.7	8.0	9.2	11.6	11.7	12.9	22.0
274.0	13.2	13.0	12.6	12.3	8.6	11.2	13.0	15.5	13.7	44.0
AVG %	10.0	10.3	10.7	10.0	8.8	7.7	10.1	9.6	10.2	10.6
WASTE %	10.7	11.3	11.7	10.9	7.0	6.9	11.1	10.3	11.1	10.9
STRG cm	27.5	28.4	29.4	27.6	24.1	21.3	27.9	26.4	27.9	29.0

DATE: 03-25-85
 DAY: 450
 PROBE: 5140 STANDARD COUNTS: 11933

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	7.2	8.1	8.0	8.1	7.8	8.5	8.6	8.0	6.6	6.6
46.0	9.8	10.1	10.4	9.4	9.4	9.3	9.8	8.9	9.6	9.5
61.0	10.8	10.8	10.9	10.1	10.5	10.4	10.4	9.6	10.1	10.2
76.0	10.7	10.9	11.8	10.4	11.0	10.7	10.6	9.4	10.7	10.1
91.0	10.5	10.6	11.4	10.1	12.0	10.3	10.6	9.3	10.6	9.7
107.0	10.1	11.0	11.5	10.9	12.1	9.5	10.9	9.2	11.0	9.6
122.0	10.4	10.8	11.5	11.0	10.3	8.2	11.1	9.2	10.6	10.0
137.0	10.0	11.0	11.3	10.6	10.5	7.6	10.7	9.3	10.2	9.4
152.0	10.3	11.7	11.7	10.6	9.4	7.3	11.0	9.0	11.1	10.1
167.0	10.6	11.3	11.8	10.8	7.5	6.7	11.0	9.3	10.3	9.7
183.0	10.9	11.6	11.3	10.9	6.7	6.1	10.6	9.1	10.7	9.8
198.0	11.0	11.7	11.3	11.6	7.0	7.2	10.8	9.6	11.5	10.0
213.0	10.9	11.5	11.3	11.5	6.9	7.7	11.0	9.9	11.7	9.7
229.0	10.8	11.3	11.3	11.2	7.1	7.6	11.0	10.1	11.1	9.5
244.0	11.4	11.8	11.8	10.9	7.3	8.1	12.0	10.2	11.2	11.1
259.0	12.6	13.0	12.3	11.7	8.2	8.8	12.2	10.7	12.2	19.1
274.0	13.6	13.9	13.5	12.9	8.6	10.4	13.9	13.9	14.1	44.0
AVG %	9.9	10.4	10.6	10.0	8.4	7.9	10.1	8.9	10.0	9.7
WASTE %	10.8	11.6	11.5	11.1	7.4	7.3	11.0	9.6	11.1	10.0
STRG cm	27.2	28.6	29.1	27.4	23.2	21.7	27.9	24.4	27.4	26.5

DATE: 04-10-85
 DAY: 466
 PROBE: 5140 STANDARD COUNTS: 11861

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	6.3	6.9	6.7	6.7	6.8	7.7	6.9	7.4	5.4	6.8
46.0	8.4	9.9	9.3	8.6	9.0	8.9	8.9	8.8	8.5	8.9
61.0	9.8	10.4	10.3	9.5	10.0	9.6	9.9	9.7	9.6	10.2
76.0	10.6	10.2	10.7	9.5	10.2	10.5	10.2	10.1	10.4	10.1
91.0	9.7	10.6	10.9	10.0	10.8	9.8	10.0	9.8	9.9	10.1
107.0	9.7	10.5	11.0	10.8	11.1	9.4	10.2	9.5	10.8	10.1
122.0	9.3	10.4	11.6	10.7	10.7	8.4	10.7	9.4	10.7	9.6
137.0	9.5	10.8	10.8	9.9	10.2	8.6	10.4	9.5	9.9	9.9
152.0	9.3	11.2	11.3	10.4	9.5	7.8	10.7	9.5	10.0	10.9
167.0	10.0	10.7	11.8	10.6	8.4	7.0	10.7	9.4	10.5	10.5
183.0	10.3	11.3	11.1	10.7	7.4	6.2	10.9	9.4	10.3	10.5
198.0	9.9	10.9	11.6	11.2	7.3	7.1	10.9	10.4	11.0	10.4
213.0	10.4	11.1	11.2	11.2	7.4	7.5	11.0	10.1	10.8	10.6
229.0	11.1	11.1	11.3	11.3	7.2	7.1	10.8	10.4	10.8	9.7
244.0	10.3	11.2	11.6	11.2	7.4	8.0	11.2	10.4	11.0	10.4
259.0	11.9	12.2	12.1	12.1	7.7	8.8	12.1	10.8	12.4	12.7
274.0	13.1	13.6	13.4	14.4	8.6	10.5	13.3	14.0	12.7	18.8
AVG %	9.2	10.0	10.2	9.7	8.3	7.8	9.7	9.1	9.5	9.5
WASTE %	10.2	11.1	11.4	11.0	7.8	7.2	10.9	9.9	10.6	10.4
STRG cm	25.3	27.4	28.1	26.6	22.8	21.4	26.8	25.0	26.2	26.1

DATE: 04-24-85
 DAY: 480
 PROBE: 5140 STANDARD COUNTS: 11835

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	6.0	6.7	6.4	6.1	6.6	7.2	7.2	7.2	5.8	5.9
46.0	8.3	9.6	8.6	8.4	8.1	8.3	8.4	9.0	8.2	8.2
61.0	10.3	10.0	9.9	9.5	9.7	9.2	9.7	9.8	9.8	10.0
76.0	10.5	10.2	10.9	10.3	9.6	10.0	9.8	9.6	10.4	9.6
91.0	10.2	10.1	10.2	10.2	10.6	9.5	10.4	9.6	10.3	9.7
107.0	9.4	10.3	11.0	10.3	11.2	9.4	10.4	9.8	10.1	9.9
122.0	9.0	10.6	10.7	10.2	10.1	8.5	10.5	9.3	10.4	9.7
137.0	9.3	10.7	10.8	9.9	9.9	9.1	10.3	9.1	9.8	9.9
152.0	9.5	10.6	11.1	10.2	9.3	8.9	10.3	9.6	10.4	11.0
167.0	10.0	11.4	11.3	9.9	8.6	7.7	10.8	9.5	10.5	10.2
183.0	9.7	11.0	10.3	10.9	8.3	7.0	10.6	9.6	10.5	9.9
198.0	10.3	11.6	11.1	10.8	7.8	7.4	10.9	10.6	11.0	10.5
213.0	10.5	11.0	11.2	11.5	7.3	8.0	10.7	10.7	11.0	9.8
229.0	10.3	11.4	11.1	11.4	7.0	7.6	11.3	10.2	10.3	9.7
244.0	10.5	11.8	11.7	11.3	7.2	8.1	11.3	10.3	11.1	10.8
259.0	11.1	12.5	11.7	12.2	7.8	8.8	12.2	11.2	11.8	12.9
274.0	13.3	14.2	13.9	14.2	8.7	10.8	14.2	14.3	12.9	18.8
AVG %	9.1	10.0	9.9	9.6	8.2	7.9	9.7	9.1	9.5	9.3
WASTE %	10.1	11.3	11.1	10.9	7.9	7.8	10.8	10.1	10.7	10.3
STRG cm	25.1	27.4	27.2	26.4	22.5	21.8	26.6	25.1	26.1	25.5

DATE: 05-08-85
 DAY: 494
 PROBE: 5140 STANDARD COUNTS: 11920

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	5.9	6.5	5.7	5.9	6.1	6.1	6.8	6.7	5.0	5.1
46.0	7.9	9.0	8.2	7.9	7.8	7.8	8.4	8.2	7.4	7.4
61.0	9.9	9.9	9.8	9.1	8.3	8.7	9.6	8.8	8.8	8.8
76.0	10.4	9.8	9.9	9.7	9.2	9.2	10.0	9.0	9.3	9.1
91.0	9.5	9.6	10.0	10.0	10.1	9.1	10.2	9.3	9.7	9.2
107.0	9.4	9.8	10.2	10.2	10.9	9.2	10.0	9.1	9.3	9.4
122.0	9.3	9.8	10.2	9.9	10.0	8.1	10.2	8.5	9.6	9.7
137.0	9.5	10.4	10.6	9.9	9.2	8.6	10.5	9.3	9.2	9.7
152.0	9.8	9.9	10.5	10.2	9.2	8.4	10.4	8.9	9.7	10.1
167.0	10.0	10.1	10.7	10.1	8.7	8.1	10.2	8.7	10.0	10.2
183.0	10.2	10.3	10.8	10.3	8.3	7.4	10.2	8.9	10.1	9.6
198.0	10.2	10.6	11.1	10.5	7.9	7.2	10.7	9.6	10.3	10.1
213.0	10.5	10.5	11.4	10.8	7.7	7.9	10.6	9.6	10.0	10.0
229.0	10.6	10.3	10.7	10.7	7.7	7.4	10.9	9.5	10.3	9.8
244.0	11.2	10.9	11.3	10.9	7.4	8.1	10.9	9.7	10.5	10.6
259.0	11.9	11.5	12.7	11.8	7.9	9.1	11.9	11.0	12.0	12.8
274.0	13.9	13.2	19.5	14.0	8.5	10.6	13.9	14.3	13.1	20.4
AVG %	9.2	9.3	9.6	9.3	8.0	7.7	9.5	8.5	8.9	8.9
WASTE %	10.4	10.4	10.9	10.5	8.1	7.8	10.5	9.3	10.1	10.0
STRG cm	25.3	25.7	26.5	25.5	22.1	21.1	26.1	23.4	24.5	24.5

DATE: 05-21-85
 DAY: 507
 PROBE: 5140 STANDARD COUNTS: 11823

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.4	11.4	6.0	5.8	5.6	5.5	6.5	6.3	4.6	4.5
46.0	8.2	8.7	8.6	7.7	7.6	7.4	8.3	8.1	7.6	7.0
61.0	9.5	9.5	10.3	8.8	8.7	8.1	9.2	9.3	8.7	9.0
76.0	10.1	9.7	10.0	9.4	8.8	8.7	9.6	9.2	9.5	9.2
91.0	9.3	9.3	10.1	9.3	9.6	8.6	9.4	9.4	9.7	9.1
107.0	9.5	9.9	10.4	9.7	9.7	8.3	9.8	9.4	9.6	9.6
122.0	9.6	9.7	10.6	9.5	9.1	8.1	10.3	9.4	9.4	10.0
137.0	9.3	10.0	10.8	9.5	8.9	7.8	10.0	9.3	9.8	9.8
152.0	9.8	10.2	10.6	10.0	8.7	8.0	9.5	9.4	9.7	10.4
167.0	10.6	10.0	10.8	10.5	8.3	8.1	9.7	8.8	10.2	10.1
183.0	10.0	10.0	11.1	10.8	8.5	7.3	10.0	8.9	10.5	10.1
198.0	10.5	10.4	10.9	10.5	8.5	7.7	9.7	9.7	10.6	10.5
213.0	10.7	9.9	11.2	10.8	7.5	7.5	10.4	10.3	10.2	9.7
229.0	10.9	10.1	11.5	10.7	7.3	7.4	10.3	9.8	10.1	9.7
244.0	11.5	11.0	11.3	10.8	7.5	7.9	10.4	10.2	10.6	11.1
259.0	12.5	11.4	11.9	11.6	7.9	8.7	11.3	11.2	11.9	12.1
274.0	14.9	13.5	14.1	14.6	8.4	10.6	13.7	15.2	13.5	20.9
AVG %	9.3	9.5	9.8	9.1	7.8	7.4	9.1	8.7	9.0	8.9
WASTE %	10.6	10.2	11.0	10.6	8.0	7.7	10.0	9.6	10.2	10.2
STRG cm	25.5	26.1	26.9	25.1	21.4	20.2	25.0	24.1	24.7	24.6

DATE: 06-17-85
 DAY: 534
 PROBE: 2499 STANDARD COUNTS: 33930

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	5.5	6.2	5.1	5.4	5.4	6.4	6.3	6.7	4.9	4.2
46.0	7.4	8.4	8.3	6.9	7.8	7.6	8.1	8.4	7.6	7.3
61.0	9.7	9.2	9.8	8.7	8.4	8.2	9.1	9.2	9.2	8.7
76.0	9.9	9.5	9.5	9.0	8.6	8.7	9.1	9.3	10.4	8.6
91.0	9.1	9.7	9.9	9.4	9.3	8.7	9.4	9.1	10.0	9.3
107.0	9.1	9.6	10.1	9.7	9.5	8.7	9.8	9.2	10.2	9.5
122.0	9.2	9.6	10.7	9.7	9.1	8.5	10.3	9.6	10.1	9.7
137.0	9.2	9.4	10.7	9.4	8.8	8.6	9.8	9.7	10.0	9.7
152.0	9.6	9.7	10.9	10.4	9.0	8.7	10.1	10.2	11.1	11.3
167.0	10.2	10.6	11.2	10.7	8.5	8.5	10.1	9.9	12.1	10.5
183.0	10.0	10.5	11.1	10.8	8.7	8.0	10.6	10.4	12.4	10.4
198.0	9.9	10.7	11.9	11.2	9.3	8.4	10.9	11.2	13.3	10.8
213.0	10.8	11.0	12.0	11.7	8.7	8.6	11.5	11.2	13.2	10.8
229.0	8.1	10.7	12.2	11.8	8.4	8.2	11.5	11.3	12.7	10.7
244.0	11.1	11.1	12.4	12.2	7.9	8.7	12.1	11.0	12.5	11.9
259.0	11.8	12.2	12.0	13.0	8.5	9.0	13.2	11.8	13.2	14.3
274.0	14.7	14.8	15.3	18.7	9.2	11.1	17.2	16.8	15.4	25.9
AVG %	8.9	9.3	9.9	9.4	8.0	7.8	9.5	9.3	10.2	9.3
WASTE %	9.9	10.6	11.7	11.3	8.6	8.4	11.0	10.7	12.5	10.9
STRG cm	24.4	25.5	27.2	25.9	22.0	21.6	26.2	25.6	28.0	25.5

DATE: 07-11-85
 DAY: 558
 PROBE: 6031 STANDARD COUNTS: 8486

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	3.2	3.8	3.8	3.9	3.8	4.5	4.6	4.3	2.8	2.4
46.0	6.7	7.3	7.5	6.8	6.3	6.6	7.3	7.5	6.1	6.2
61.0	8.6	8.2	8.4	7.4	7.7	7.3	8.2	8.8	8.1	8.0
76.0	8.6	8.4	9.3	8.8	8.8	8.3	9.1	9.0	9.2	8.0
91.0	8.6	8.8	9.6	9.1	9.0	8.5	9.3	8.6	9.0	8.1
107.0	8.3	9.4	9.4	8.8	9.3	8.5	9.3	9.1	9.5	8.5
122.0	8.9	9.2	11.1	9.2	8.3	7.7	9.6	9.0	9.5	9.0
137.0	8.5	9.3	10.5	9.8	8.0	8.8	9.3	8.9	9.4	9.3
152.0	9.8	9.2	10.3	10.1	8.4	8.6	9.8	9.1	9.6	10.0
167.0	9.2	10.0	10.5	9.9	8.3	8.5	9.7	9.0	10.5	8.8
183.0	10.2	10.1	10.1	10.0	8.7	8.5	10.0	9.0	10.2	9.5
198.0	9.9	10.1	10.9	10.4	8.7	7.7	9.8	9.8	10.8	9.8
213.0	10.2	10.2	11.3	10.3	9.0	8.4	10.1	9.9	9.9	9.9
229.0	10.0	10.6	10.5	10.2	8.1	8.2	10.2	10.1	10.1	9.4
244.0	9.8	11.1	11.1	10.2	7.9	8.3	10.1	9.9	10.5	10.2
259.0	11.4	12.3	11.5	11.6	8.0	9.3	11.6	10.7	12.6	13.6
274.0	14.2	14.1	13.6	13.6	8.9	11.2	13.3	14.6	12.6	24.9
AVG %	8.3	8.7	9.2	8.6	7.6	7.5	8.7	8.4	8.7	8.3
WASTE %	9.9	10.2	10.7	10.1	8.4	8.3	10.0	9.6	10.2	9.6
STRG cm	23.0	23.9	25.2	23.7	20.8	20.6	23.9	23.1	23.9	22.7

DATE: 08-14-85
 DAY: 592
 PROBE: 6031 STANDARD COUNTS: 8504

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	2.9	3.2	3.5	3.5	3.4	3.8	4.0	3.8	1.9	2.6
45.0	6.4	6.7	6.6	5.6	6.3	5.9	6.4	5.7	5.9	5.5
60.0	7.7	7.5	7.9	6.9	6.9	6.8	7.2	7.3	7.4	6.7
75.0	8.7	7.5	7.7	7.6	7.4	7.2	8.2	7.5	8.4	7.1
90.0	8.1	7.4	9.0	8.3	8.0	7.3	8.2	7.9	8.2	7.4
105.0	7.6	8.3	9.3	9.1	8.2	7.8	8.7	8.6	9.4	7.8
120.0	7.8	8.1	9.2	9.1	7.6	7.4	8.4	8.7	8.8	8.2
135.0	8.0	8.5	9.6	8.2	8.3	8.4	9.4	8.1	8.7	7.7
150.0	9.0	8.5	9.7	9.4	7.9	8.2	9.5	8.0	9.7	8.8
165.0	8.9	8.5	10.0	9.3	8.1	8.6	9.4	8.0	10.2	8.8
180.0	9.3	8.8	9.7	9.5	7.9	8.1	9.4	8.2	9.7	8.9
195.0	9.7	9.4	10.0	10.1	8.4	8.2	9.2	9.0	10.4	9.1
210.0	9.7	9.4	10.4	10.1	8.9	9.1	9.7	8.6	10.7	8.6
225.0	9.6	9.6	11.0	10.6	8.1	9.0	10.1	9.0	10.0	8.5
240.0	9.8	10.1	10.9	10.1	8.6	9.3	10.5	9.0	9.6	8.5
255.0	11.7	12.0	11.7	11.3	8.1	9.4	11.3	9.8	11.4	8.5
270.0	13.6	12.6	13.4	13.6	9.3	13.1	13.5	12.4	13.4	8.5
AVG %	7.9	7.8	8.6	8.2	7.2	7.3	8.2	7.5	8.3	7.2
WASTE %	9.4	9.2	10.3	9.9	8.3	8.7	9.7	8.5	10.0	8.7
STRG cm	21.8	21.6	23.7	22.4	19.8	20.2	22.6	20.6	22.7	19.9

DATE: 09-03-85
 DAY: 612
 PROBE: 6031 STANDARD COUNTS: 8542

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	2.5	2.8	3.5	3.6	3.3	3.7	3.5	3.7	1.6	2.0
45.0	5.7	6.2	5.9	5.5	5.8	5.8	6.3	6.1	5.3	5.1
60.0	7.4	6.1	7.9	6.4	6.2	7.2	7.3	6.8	6.7	6.8
75.0	7.0	7.2	8.5	7.6	6.8	6.9	8.1	7.3	6.9	7.1
90.0	8.0	7.4	8.4	7.8	7.8	7.4	8.1	7.6	8.5	7.1
105.0	7.4	8.2	8.3	8.2	8.2	7.3	7.8	7.7	8.0	6.8
120.0	7.8	8.4	9.8	8.4	7.0	7.2	8.3	8.1	8.7	7.1
135.0	8.5	8.1	9.5	8.1	7.7	7.3	8.3	7.7	8.3	7.7
150.0	8.4	8.3	9.0	8.3	7.7	8.1	8.5	7.7	9.1	8.0
165.0	8.8	8.3	9.7	9.5	8.0	7.9	8.6	7.9	9.1	7.4
180.0	8.9	8.7	9.7	8.8	7.9	7.8	8.7	8.1	9.9	7.5
195.0	9.0	9.5	9.8	9.3	9.0	8.4	9.6	8.6	10.1	8.1
210.0	9.3	9.2	10.3	9.8	8.7	8.5	9.6	9.3	10.4	7.5
225.0	8.8	9.9	10.4	10.0	8.4	8.5	10.1	9.4	9.8	8.2
240.0	9.3	10.1	10.5	10.3	8.8	8.6	9.5	9.4	9.2	8.2
255.0	10.5	10.6	11.2	11.7	8.7	9.3	9.9	10.3	10.9	8.2
270.0	12.9	12.3	12.9	12.6	10.2	11.0	11.1	12.9	12.0	8.2
AVG %	7.5	7.6	8.4	7.8	7.1	7.1	7.8	7.4	7.8	6.6
WASTE %	8.9	9.1	9.9	9.4	8.3	8.3	9.2	8.6	9.7	7.8
STRG cm	20.6	20.9	23.1	21.5	19.4	19.4	21.4	20.3	21.4	18.3

DATE: 09-25-85
 DAY: 634
 PROBE: 6031 STANDARD COUNTS: 8571

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	3.4	3.5	3.9	3.6	3.8	3.8	3.8	4.2	2.8	3.1
45.0	5.8	6.3	6.5	5.6	5.2	6.3	5.8	5.8	5.6	5.4
60.0	6.6	6.8	7.6	6.4	6.7	6.8	6.5	6.9	6.2	6.6
75.0	7.1	6.5	7.6	7.1	6.2	6.9	7.7	7.1	7.4	6.4
90.0	7.7	7.3	8.0	6.8	7.3	7.5	7.0	7.4	7.2	6.6
105.0	7.8	8.3	8.4	7.9	7.7	7.4	7.4	7.7	7.7	7.6
120.0	7.8	8.3	8.7	7.8	7.4	6.5	8.2	7.9	8.0	8.0
135.0	7.0	8.0	8.7	8.1	7.2	7.2	8.2	7.6	8.0	7.3
150.0	8.3	8.6	9.2	8.1	7.4	8.6	8.4	8.3	8.3	8.5
165.0	9.2	7.9	9.8	8.8	7.1	8.2	9.1	7.5	8.9	8.0
180.0	8.9	8.4	9.4	9.2	8.0	7.6	8.8	7.4	9.5	8.0
195.0	9.5	8.8	10.0	8.8	7.7	8.3	8.9	9.0	10.2	8.7
210.0	9.5	9.4	10.8	9.3	8.1	8.3	9.1	8.6	9.9	8.4
225.0	8.8	9.0	10.1	8.9	8.6	8.8	9.6	9.3	9.3	8.2
240.0	10.4	9.6	9.7	9.4	8.1	8.8	8.7	9.7	10.0	8.2
255.0	13.4	10.7	11.0	10.9	8.8	10.0	10.1	9.0	10.6	8.2
270.0	12.7	13.0	11.9	12.9	9.9	11.6	12.3	12.2	12.5	8.2
AVG %	7.7	7.5	8.2	7.5	6.8	7.1	7.5	7.3	7.6	6.9
WASTE %	9.2	8.8	9.9	8.9	7.8	8.4	8.9	8.5	9.5	8.3
STRG cm	21.2	20.6	22.6	20.5	18.6	19.6	20.6	20.0	21.0	19.0

DATE: 10-23-85
 QAY: 662
 PROBE: 6031 STANDARD COUNTS: 8597

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	3.6	3.9	4.0	3.6	4.1	4.1	4.3	5.6	3.3	1.4
45.0	5.1	5.9	6.4	5.6	5.8	5.2	5.7	6.7	5.2	5.5
60.0	7.0	7.1	7.3	6.1	6.0	6.3	6.9	6.7	6.7	6.3
75.0	7.0	6.5	7.0	6.7	7.0	5.8	6.8	6.2	7.0	6.6
90.0	6.9	7.7	6.9	6.7	7.1	6.1	6.6	7.3	7.7	6.3
105.0	6.8	7.3	8.4	7.5	7.1	6.4	7.5	7.4	7.5	6.4
120.0	7.2	7.5	8.8	8.0	6.9	6.8	7.4	7.6	7.7	7.1
135.0	7.6	8.1	8.8	7.0	6.2	7.2	7.8	7.4	7.6	6.9
150.0	7.5	8.3	8.8	7.6	6.6	7.2	7.6	7.6	8.3	8.4
165.0	8.5	7.9	9.2	8.6	6.7	7.2	7.7	7.7	8.7	7.4
180.0	8.2	8.5	9.0	9.1	7.2	7.3	7.9	7.5	8.9	7.4
195.0	8.6	8.9	8.9	9.0	7.6	7.5	8.2	8.1	8.9	7.3
210.0	8.2	9.5	9.7	8.6	7.9	8.3	8.1	8.1	9.8	8.5
225.0	8.0	8.8	9.3	9.4	7.7	7.3	8.6	8.5	9.7	7.6
240.0	8.3	9.2	9.6	9.3	8.0	8.2	8.4	9.2	9.6	8.1
255.0	9.8	10.8	10.7	10.2	8.4	8.6	9.1	9.7	11.2	10.1
270.0	12.2	12.1	11.8	12.9	10.1	10.1	11.1	11.9	12.7	13.5
AVG %	6.9	7.4	7.8	7.2	6.5	6.4	7.0	7.1	7.5	6.6
WASTE %	8.2	8.7	9.2	8.8	7.4	7.5	8.1	8.1	9.1	7.8
STRG cm	19.1	20.4	21.5	19.9	17.8	17.7	19.2	19.6	20.7	18.0

DATE: 11-19-85
 DAY: 689
 PROBE: 6031 STANDARD COUNTS: 8636

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	4.4	4.5	5.0	4.5	4.5	4.7	5.1	5.2	4.1	4.1
45.0	5.3	6.1	6.1	5.3	5.3	5.1	5.5	6.1	6.0	5.4
60.0	6.1	6.5	6.9	5.7	6.1	6.1	5.9	6.5	6.6	5.9
75.0	6.7	6.4	6.9	6.2	6.4	5.8	6.5	6.5	7.2	5.7
90.0	6.2	6.8	7.1	6.2	6.3	6.0	6.7	6.5	7.2	6.4
105.0	6.5	6.7	7.3	7.2	7.0	6.1	6.8	6.8	6.7	6.7
120.0	6.9	7.0	8.7	6.6	6.5	6.2	7.7	6.8	7.5	6.6
135.0	6.7	7.2	7.6	7.5	6.2	7.1	7.1	7.5	7.4	7.1
150.0	7.9	7.4	8.3	7.2	6.9	6.8	7.9	7.9	8.7	7.4
165.0	8.0	7.7	9.2	7.9	6.8	7.1	8.1	7.3	9.1	7.6
180.0	8.0	7.5	8.8	7.6	7.1	7.2	8.3	7.3	9.1	7.7
195.0	7.8	7.7	8.9	8.0	7.6	7.3	8.3	8.3	9.1	7.8
210.0	8.0	8.1	9.6	7.9	7.6	7.5	8.5	8.2	9.5	7.6
225.0	8.0	8.5	10.1	8.3	8.5	8.0	8.5	8.2	9.7	7.8
240.0	8.7	8.9	9.2	8.3	8.5	8.2	8.9	8.9	9.0	8.3
255.0	9.2	10.0	10.6	8.9	9.0	8.2	10.3	9.2	11.0	9.7
270.0	11.6	12.1	11.9	11.4	9.8	10.8	11.6	11.4	12.3	11.6
AVG %	6.7	6.9	7.7	6.7	6.5	6.3	7.1	6.9	7.5	6.6
WASTE %	8.1	8.0	9.1	7.9	7.6	7.4	8.3	8.0	9.2	7.7
STRG cm	18.5	19.0	21.1	18.3	17.8	17.3	19.4	19.0	20.7	18.1

DATE: 12-20-85
 DAY: 720
 PROBE: 6031 STANDARD COUNTS: 8701

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	9.3	9.1	9.0	9.5	8.2	8.5	7.0	8.3	8.7	8.3
45.0	9.1	8.8	9.1	8.8	8.5	9.6	7.3	8.9	8.8	8.5
60.0	9.8	8.3	9.0	10.0	7.2	8.5	7.7	10.4	10.2	9.3
75.0	7.9	8.7	10.0	10.0	6.5	7.5	7.4	9.5	10.3	8.8
90.0	7.2	8.3	9.5	10.5	6.5	6.7	7.0	8.3	10.7	8.7
105.0	7.4	7.8	10.0	10.7	6.7	6.3	6.5	8.0	11.1	8.3
120.0	7.7	6.6	10.7	9.9	6.5	6.2	6.9	7.3	11.1	7.5
135.0	7.3	7.2	11.1	8.3	6.5	6.3	6.9	7.1	10.5	7.1
150.0	7.4	7.4	11.0	7.6	6.6	6.5	8.2	7.2	10.2	7.6
165.0	8.2	7.3	11.1	8.5	6.3	7.0	7.6	7.9	9.4	8.0
180.0	8.4	7.3	10.2	8.7	6.4	7.1	8.2	7.6	8.8	7.3
195.0	8.4	7.4	9.7	7.9	6.5	7.8	8.1	8.1	9.1	7.5
210.0	7.6	8.2	9.3	8.7	7.6	7.9	7.7	8.9	10.1	7.7
225.0	8.1	8.1	9.1	8.7	7.6	7.9	8.2	8.8	9.7	7.6
240.0	8.6	8.8	9.3	8.9	8.2	7.9	7.8	8.8	9.7	7.8
255.0	9.3	9.4	9.8	10.3	8.9	8.8	9.1	9.5	10.8	9.6
270.0	11.9	11.9	11.9	12.9	9.8	11.1	11.9	11.9	12.7	12.3
AVG %	7.8	7.6	9.3	8.6	6.8	7.1	7.1	7.9	9.4	7.6
WASTE %	8.1	7.8	9.9	8.4	7.0	7.4	8.0	8.2	9.6	7.6
STRG cm	21.3	20.8	25.5	23.8	18.6	19.5	19.7	21.8	25.8	21.0

DATE: 01-21-86
 DAY: 757
 PROBE: 6031 STANDARD COUNTS: 8628

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	9.9	8.9	9.5	8.3	8.8	9.2	8.5	9.2	7.5	8.5
45.0	11.4	10.6	10.8	9.9	11.1	11.1	10.3	10.8	11.0	10.3
60.0	13.1	12.1	11.9	11.2	11.8	11.0	11.1	11.2	11.6	11.3
75.0	13.2	11.9	12.5	11.7	13.3	11.5	11.6	11.1	11.8	11.2
90.0	13.2	11.9	12.6	11.9	13.7	11.0	11.5	11.4	12.4	11.4
105.0	12.9	12.3	13.4	12.2	14.6	9.4	12.5	11.9	12.4	11.4
120.0	13.2	12.1	12.8	13.0	14.2	8.1	12.3	12.0	12.6	12.2
135.0	12.7	12.5	12.8	12.1	13.2	7.9	13.1	11.3	12.2	12.0
150.0	12.6	11.5	13.4	12.7	12.1	7.8	12.8	11.4	13.2	12.6
165.0	12.9	11.5	13.7	12.4	10.1	7.5	12.5	11.2	12.6	11.8
180.0	13.3	11.5	12.6	12.3	7.8	8.1	12.4	11.5	12.8	11.5
195.0	13.2	11.5	12.4	12.0	7.9	8.2	12.2	11.2	13.2	12.2
210.0	12.2	11.7	12.4	12.3	8.3	7.9	11.5	11.3	13.5	11.6
225.0	12.9	11.4	12.9	10.7	7.9	7.9	10.8	9.4	11.9	12.1
240.0	12.3	11.2	13.0	10.2	8.9	8.5	9.4	8.6	11.0	11.8
255.0	13.9	12.6	13.1	12.2	9.3	9.9	9.6	9.1	11.3	13.2
270.0	15.4	13.4	14.3	13.3	10.6	11.2	12.4	11.8	12.5	13.0
AVG %	11.9	10.9	11.8	10.9	10.2	8.5	10.7	10.1	11.2	10.9
WASTE %	12.8	11.5	12.9	11.8	9.0	8.0	11.7	10.6	12.6	11.9
STRG cm	32.8	30.0	32.3	29.9	28.0	23.4	29.5	27.9	30.9	29.9

DATE: 02-04-86
 DAY: 766
 PROBE: 6031 STANDARD COUNTS: 8673

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	9.8	9.6	9.3	8.9	8.9	9.1	9.2	9.5	8.3	9.6
45.0	11.2	10.6	10.7	10.2	11.2	10.6	10.3	11.3	10.6	10.7
60.0	12.0	10.9	10.7	10.7	12.3	10.5	10.8	11.0	11.3	11.1
75.0	11.8	11.6	12.0	11.4	12.0	11.0	10.9	11.2	11.4	11.0
90.0	11.4	11.8	11.9	11.6	12.3	10.5	11.6	10.8	11.5	11.5
105.0	10.7	11.4	12.3	12.1	13.0	9.7	10.9	10.7	11.8	11.1
120.0	11.1	11.7	12.7	11.6	12.5	8.6	10.9	10.8	11.5	11.1
135.0	11.6	11.2	12.2	11.0	12.2	8.3	11.2	10.8	11.6	11.8
150.0	12.0	12.2	12.3	11.4	11.2	8.5	11.3	10.7	12.0	11.6
165.0	11.5	11.3	12.7	11.3	10.6	8.6	11.8	11.2	12.3	12.2
180.0	12.1	12.3	12.0	12.0	10.3	8.3	11.9	11.0	12.2	12.2
195.0	11.5	11.7	11.3	11.9	10.1	7.8	11.7	12.0	12.5	11.8
210.0	12.0	11.4	11.9	12.4	10.4	8.1	12.2	11.3	13.2	11.9
225.0	12.0	11.7	11.2	11.7	8.5	8.4	12.1	11.2	13.1	10.2
240.0	11.5	12.1	11.6	12.6	9.1	8.3	12.0	11.5	11.8	11.7
255.0	12.9	13.2	12.2	12.7	9.4	9.8	12.4	11.6	13.0	13.0
270.0	14.9	13.6	13.8	13.7	12.2	13.0	14.1	13.2	13.3	13.6
AVG %	10.9	10.9	11.0	10.8	10.2	8.6	10.7	10.4	11.1	10.7
WASTE %	11.8	11.8	11.9	11.9	10.0	8.3	11.9	11.3	12.4	11.7
STRG cm	30.0	29.9	30.2	29.7	28.1	23.6	29.3	28.5	30.4	29.5

DATE: 02-19-86
 DAY: 781
 PROBE: 6031 STANDARD COUNTS: 8709

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	8.9	9.4	8.8	9.1	8.5	8.5	8.9	9.7	8.1	8.5
45.0	10.4	11.1	10.3	11.1	10.5	10.4	10.3	10.7	10.3	10.2
60.0	11.4	11.5	10.4	10.3	10.9	10.3	10.5	10.3	11.3	11.4
75.0	10.9	10.7	9.8	10.5	10.6	11.1	10.4	10.1	11.7	11.1
90.0	10.2	10.2	10.4	10.3	10.8	10.9	9.9	9.8	11.4	11.4
105.0	10.3	10.2	10.9	10.1	11.1	9.8	10.4	9.9	10.8	11.4
120.0	10.0	10.1	11.6	9.8	11.1	9.2	10.0	9.4	11.1	11.1
135.0	10.3	9.9	10.7	9.7	10.8	9.1	10.1	9.8	10.9	11.7
150.0	10.0	10.4	12.0	10.4	9.9	9.2	10.8	9.6	11.7	10.5
165.0	10.7	10.9	11.3	10.6	10.3	8.7	10.5	10.7	11.9	10.9
180.0	10.4	10.8	11.3	11.4	9.9	8.7	11.3	10.8	11.2	10.2
195.0	10.4	11.6	11.9	11.2	10.7	8.6	11.6	11.2	12.7	10.9
210.0	11.1	11.3	12.6	11.5	10.2	8.7	11.5	11.0	12.3	10.9
225.0	11.6	11.5	11.6	11.8	10.4	8.8	11.9	12.6	12.2	10.4
240.0	10.8	12.1	12.6	11.9	11.0	8.1	12.5	11.8	12.8	11.1
255.0	11.2	12.9	13.2	13.1	11.1	10.2	13.2	12.3	12.9	11.5
270.0	14.6	13.6	14.1	15.8	13.1	14.3	15.2	15.3	14.9	14.5
AVG %	9.9	10.3	10.5	10.2	9.9	8.8	10.2	10.0	10.8	10.2
WASTE %	10.7	11.2	11.9	11.3	10.3	8.7	11.4	11.1	12.1	10.7
STRG cm	27.3	28.2	29.0	27.9	27.1	24.3	28.1	27.5	29.7	28.0

DATE: 03-06-86
 DAY: 796
 PROBE: 6031 STANDARD COUNTS: 8614

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	6.6	6.8	6.9	7.5	7.0	7.4	7.1	7.4	6.6	6.7
45.0	8.9	9.3	9.9	9.0	9.6	9.3	9.1	9.1	9.2	8.7
60.0	10.5	10.6	10.6	9.5	10.7	9.3	10.4	9.9	9.9	9.9
75.0	11.8	10.4	11.7	10.7	11.1	9.7	10.5	9.8	10.2	9.4
90.0	10.9	10.7	10.8	10.8	11.6	10.1	10.7	9.6	10.9	10.3
105.0	10.2	10.4	11.5	10.9	12.2	9.6	10.3	10.4	11.1	9.9
120.0	10.3	10.8	11.8	11.0	11.6	8.6	10.6	10.2	10.6	10.4
135.0	10.4	11.3	11.8	10.9	11.0	9.6	10.8	10.5	11.2	10.9
150.0	10.7	11.5	11.9	11.6	10.6	9.5	11.5	10.0	11.4	10.6
165.0	11.1	10.4	12.2	11.4	10.3	9.1	11.1	10.4	12.1	11.2
180.0	11.8	11.2	12.0	11.5	9.9	9.2	11.2	11.2	12.1	11.3
195.0	11.0	11.3	12.2	11.6	10.8	8.7	12.3	11.9	12.9	11.6
210.0	11.5	11.8	11.7	12.4	11.2	9.1	12.4	12.1	13.2	11.8
225.0	11.4	11.2	12.1	12.5	11.3	9.7	12.7	11.9	12.3	11.6
240.0	11.9	11.8	11.9	12.5	11.4	10.0	12.6	11.8	12.8	11.9
255.0	12.2	12.4	12.9	13.5	11.4	11.0	14.1	12.3	14.1	13.1
270.0	13.9	13.9	13.8	16.5	13.5	15.9	16.9	16.2	16.3	17.2
AVG %	10.1	10.1	10.7	10.4	10.1	8.8	10.4	9.9	10.6	10.0
WASTE %	11.3	11.3	12.0	11.9	10.8	9.3	12.0	11.3	12.4	11.4
STRG cm	27.7	27.8	29.4	28.7	27.8	24.3	28.7	27.3	29.2	27.4

DATE: 03-20-86
 DAY: 810
 PROBE: 6031 STANDARD COUNTS: 8426

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	8.4	8.7	9.0	8.1	8.2	8.7	8.4	8.6	8.1	7.9
45.0	9.8	9.9	9.8	10.2	9.9	10.5	10.2	10.7	9.9	10.1
60.0	11.8	11.2	10.9	9.7	11.1	9.7	10.2	10.8	10.9	9.8
75.0	10.6	10.4	11.4	11.1	10.9	10.8	10.4	10.4	10.4	10.1
90.0	10.7	11.0	11.2	10.0	11.3	10.7	10.5	9.9	10.7	9.8
105.0	10.2	10.5	10.8	10.9	11.6	8.9	10.4	9.6	10.8	9.8
120.0	10.0	10.4	10.6	10.5	10.7	9.2	10.7	9.9	10.0	9.7
135.0	10.4	9.6	10.9	9.9	11.0	9.3	10.9	9.8	10.8	10.0
150.0	10.6	11.1	11.0	10.5	10.1	9.7	10.3	10.6	11.7	10.7
165.0	11.5	11.2	11.5	11.3	9.9	9.9	10.9	10.7	12.3	10.4
180.0	11.2	11.4	11.6	11.2	10.0	9.1	11.2	11.1	11.8	10.7
195.0	11.8	11.5	11.2	11.6	10.6	9.8	11.9	12.3	12.2	11.8
210.0	11.9	12.4	12.4	12.2	10.0	10.1	12.0	12.9	13.7	11.2
225.0	11.9	11.7	12.2	11.9	11.1	10.3	11.8	12.8	12.0	11.5
240.0	11.7	12.1	12.7	12.8	10.9	9.7	11.3	12.7	12.8	11.7
255.0	13.6	13.0	13.6	13.8	12.0	11.4	12.2	14.0	14.1	14.6
270.0	15.8	14.9	15.7	16.2	13.4	14.3	13.6	18.7	19.7	23.2
AVG %	10.4	10.4	10.6	10.3	10.0	9.3	10.2	10.4	10.7	10.0
WASTE %	11.5	11.6	11.8	11.6	10.4	9.8	11.4	11.9	12.3	11.1
STRG cm	28.5	28.5	29.2	28.4	27.4	25.5	28.0	28.6	29.5	27.5

DATE: 05-08-86
 DAY: 859
 PROBE: 6031 STANDARD COUNTS: 8423

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.9	5.3	5.9	5.5	5.5	6.2	5.6	6.1	5.5	4.6
45.0	8.4	8.6	8.2	7.8	7.7	7.5	8.0	8.0	7.7	8.4
60.0	9.8	9.5	10.1	9.3	9.1	8.9	8.9	8.9	8.9	9.3
75.0	10.5	9.4	10.4	9.0	8.7	8.8	9.4	8.8	9.9	9.3
90.0	10.0	9.7	10.5	10.3	10.1	8.9	9.7	9.6	10.3	9.3
105.0	9.6	9.8	11.1	10.1	9.9	8.8	10.2	9.3	10.4	9.7
120.0	9.4	10.0	10.4	10.3	9.9	8.7	10.2	9.3	10.2	9.8
135.0	9.9	10.6	11.1	9.5	9.1	8.7	10.0	9.9	9.9	9.8
150.0	9.7	10.1	11.2	9.7	9.4	8.7	10.3	9.5	10.8	10.5
165.0	10.9	10.0	11.7	10.6	9.0	9.2	10.4	9.4	11.8	11.1
180.0	10.7	10.3	11.0	10.5	9.0	9.9	10.3	10.2	10.8	11.4
195.0	10.6	11.3	11.3	11.2	9.8	9.2	11.1	11.0	11.6	11.5
210.0	10.9	10.6	12.4	11.4	10.4	9.9	10.8	11.5	11.5	11.3
225.0	11.3	11.2	12.2	11.9	10.7	10.0	11.4	11.2	11.4	11.2
240.0	11.5	12.3	12.2	11.8	10.8	10.6	11.4	11.8	11.9	12.0
255.0	12.3	12.7	12.3	13.0	10.7	10.6	11.6	11.6	13.0	14.0
270.0	14.1	14.1	13.8	15.0	12.6	13.2	12.7	13.5	12.7	13.8
AVG %	9.5	9.5	10.1	9.5	8.8	8.5	9.4	9.2	9.7	9.6
WASTE %	10.8	10.8	11.7	11.0	9.9	9.6	10.8	10.6	11.4	11.3
STRG cm	26.1	26.1	27.8	26.2	24.2	23.4	25.8	25.3	26.8	26.4

DATE: 05-23-86
 DAY: 874
 PROBE: 6031 STANDARD COUNTS: 8392

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.1	5.8	5.3	5.7	5.1	5.7	5.8	6.0	5.4	5.2
45.0	7.5	8.2	8.7	7.4	7.1	7.5	8.0	7.8	7.3	7.9
60.0	10.3	9.2	9.8	9.2	8.3	8.2	9.2	8.6	9.1	9.0
75.0	9.8	9.6	9.8	8.9	8.7	8.5	9.3	9.2	10.1	8.8
90.0	9.3	9.2	10.2	9.5	9.8	8.9	9.7	9.5	9.9	9.3
105.0	9.0	9.4	10.5	9.5	10.4	8.5	9.3	9.3	10.4	9.0
120.0	9.2	9.6	10.4	9.4	9.4	8.4	10.3	9.6	10.2	9.5
135.0	8.9	9.4	10.4	9.4	8.6	8.6	10.0	8.7	9.9	10.0
150.0	9.7	9.7	11.2	9.5	8.9	9.2	9.7	9.3	10.5	10.5
165.0	9.9	10.3	11.4	10.4	9.3	8.9	9.9	9.9	11.1	10.8
180.0	10.3	11.1	10.6	10.3	9.5	8.9	10.3	9.4	11.4	10.8
195.0	10.0	10.9	11.1	10.8	10.4	9.9	11.2	10.6	11.8	11.5
210.0	10.3	10.7	11.5	10.6	10.5	10.4	11.6	11.1	11.9	10.9
225.0	10.5	10.6	11.6	11.0	10.4	10.1	11.1	11.8	11.9	11.3
240.0	11.2	11.5	11.7	11.1	10.5	9.6	11.2	11.6	12.3	11.4
255.0	11.7	12.5	13.7	12.4	11.8	10.8	12.1	11.9	12.7	13.1
270.0	13.5	13.6	14.5	15.0	12.9	12.7	12.9	13.6	13.3	14.7
AVG %	9.0	9.3	9.9	9.1	8.7	8.4	9.3	9.1	9.8	9.4
WASTE %	10.3	10.7	11.3	10.5	9.9	9.6	10.7	10.5	11.6	11.0
STRG cm	24.7	25.5	27.2	25.1	24.1	23.0	25.7	25.0	26.8	25.7

DATE: 06-09-86
 DAY: 891
 PROBE: 6031 STANDARD COUNTS: 8510

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	4.2	5.2	4.8	4.7	4.7	5.0	4.7	5.4	4.0	4.5
45.0	7.9	8.3	7.6	7.2	7.4	6.9	7.1	6.9	7.2	7.7
60.0	9.0	9.2	8.9	8.6	8.7	7.4	8.2	8.1	8.3	9.2
75.0	8.8	9.1	9.5	9.2	8.2	7.8	9.2	8.8	8.9	9.5
90.0	8.7	8.9	10.1	9.4	9.6	8.6	9.4	8.8	9.3	8.8
105.0	8.5	8.5	10.2	8.9	10.5	8.2	8.6	8.6	9.7	9.0
120.0	8.6	9.4	9.9	9.9	9.0	7.6	9.0	9.4	9.7	9.5
135.0	8.7	9.5	10.6	9.1	8.5	7.8	8.9	8.7	9.8	9.1
150.0	9.0	9.8	10.1	9.4	8.8	8.3	9.3	9.4	10.1	9.4
165.0	9.6	10.0	9.8	9.5	8.2	8.3	9.6	9.1	10.7	9.6
180.0	9.6	9.8	10.5	10.2	8.7	8.4	9.9	9.0	10.4	9.8
195.0	10.0	10.1	10.7	10.2	9.8	8.6	10.7	9.7	10.8	9.9
210.0	9.8	11.0	10.8	10.7	9.9	9.8	10.5	11.0	11.7	9.4
225.0	10.5	10.5	11.2	10.6	10.7	9.8	10.0	10.9	10.7	9.8
240.0	9.9	11.0	11.7	11.1	10.6	10.0	9.8	11.2	11.1	10.1
255.0	12.2	11.6	11.7	11.9	10.9	10.4	11.4	10.9	11.9	11.2
270.0	14.5	12.8	13.3	14.4	12.5	12.0	12.1	13.2	13.2	12.6
AVG %	8.5	8.9	9.3	8.9	8.5	7.8	8.6	8.6	9.1	8.6
WASTE %	9.8	10.3	10.7	10.2	9.5	9.0	10.0	10.0	10.8	9.7
STRG cm	23.5	24.6	25.6	24.4	23.4	21.5	23.7	23.6	25.0	23.7

DATE: 06-26-86
 DAY: 908
 PROBE: 6031 STANDARD COUNTS: 8529

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	4.2	4.4	3.9	4.0	3.9	4.1	3.9	4.9	3.2	3.9
45.0	6.8	7.3	7.0	6.5	6.5	6.4	7.1	6.8	6.5	6.5
60.0	9.0	8.4	8.2	8.5	7.4	6.6	8.4	8.4	7.9	9.3
75.0	9.1	8.4	8.7	8.5	7.4	7.5	8.9	8.2	8.6	9.0
90.0	8.3	9.6	8.9	9.2	8.3	7.8	9.2	8.8	9.0	8.8
105.0	8.5	9.1	9.6	9.3	8.2	7.7	9.3	8.3	9.2	8.5
120.0	8.7	9.3	9.7	9.2	8.3	7.6	9.3	9.0	9.2	9.1
135.0	8.8	9.0	9.7	8.8	8.4	7.6	9.3	8.5	9.0	8.8
150.0	8.7	9.4	9.6	9.1	8.5	8.6	9.0	8.7	9.5	9.2
165.0	9.7	9.2	10.5	9.7	8.3	8.1	9.6	9.2	10.7	9.4
180.0	9.5	10.0	9.8	9.7	8.5	8.2	9.6	8.9	10.3	9.9
195.0	9.4	10.0	10.0	9.7	9.4	9.0	9.6	10.0	10.8	9.2
210.0	9.9	10.0	10.5	10.0	10.1	9.3	10.3	10.5	10.8	9.5
225.0	9.7	10.4	10.7	10.1	9.7	9.4	10.5	10.0	10.8	9.7
240.0	10.2	10.6	11.6	10.7	10.1	9.6	10.2	10.7	10.7	10.1
255.0	11.2	11.3	11.3	11.5	10.6	10.7	10.4	10.8	11.8	11.4
270.0	13.3	12.7	12.8	14.1	12.2	11.9	11.9	13.6	12.5	12.4
AVG %	8.3	8.6	8.8	8.5	7.9	7.5	8.5	8.3	8.7	8.4
WASTE %	9.6	9.9	10.4	9.9	9.2	8.9	9.8	9.7	10.5	9.6
STRG cm	22.9	23.7	24.2	23.4	21.6	20.7	23.4	22.9	23.9	23.0

DATE: 07-11-86
 DAY: 923
 PROBE: 6031 STANDARD COUNTS: 8720

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	3.5	4.3	3.6	4.8	4.4	5.2	4.0	4.1	3.3	4.0
45.0	6.0	6.4	6.2	6.5	6.1	6.4	6.2	5.8	6.4	6.3
60.0	7.9	8.1	8.0	8.3	6.7	7.4	7.9	7.6	7.6	6.9
75.0	7.9	8.0	8.2	8.1	7.2	7.6	8.0	8.0	8.2	7.4
90.0	7.9	8.2	8.5	8.3	8.1	7.5	7.8	7.7	8.4	7.5
105.0	7.7	8.7	9.3	8.3	8.1	6.8	8.4	8.0	8.0	8.1
120.0	8.1	7.9	9.5	9.2	7.7	8.2	8.7	7.8	8.4	8.0
135.0	7.8	8.4	9.5	9.0	7.5	8.0	9.2	8.8	7.3	8.5
150.0	8.0	8.9	9.2	9.0	7.4	9.1	8.7	8.6	9.0	9.1
165.0	8.8	9.1	9.4	9.2	8.1	8.1	9.1	8.4	9.8	8.4
180.0	9.4	9.1	9.5	9.9	8.0	8.7	9.2	9.0	9.4	8.8
195.0	9.5	8.9	9.6	9.3	8.8	9.3	9.4	9.6	10.0	8.8
210.0	9.0	9.3	10.0	10.0	9.2	9.4	9.7	10.3	10.3	9.0
225.0	8.8	9.6	10.1	10.5	9.7	9.8	10.0	9.7	10.1	8.6
240.0	8.7	10.0	9.6	10.3	10.0	10.4	8.8	10.3	10.6	9.2
255.0	9.8	10.5	10.4	12.0	9.6	10.8	10.5	10.7	11.4	10.3
270.0	13.0	12.3	12.8	15.0	11.6	12.5	12.0	13.1	11.9	12.6
AVG %	7.6	8.0	8.3	8.4	7.4	7.8	8.0	7.9	8.1	7.6
WASTE %	8.9	9.3	9.6	9.7	8.7	9.3	9.3	9.4	9.9	8.9
STRG cm	20.8	21.9	22.8	23.1	20.5	21.5	21.9	21.7	22.3	20.9

DATE: 07-28-86
 DAY: 923
 PROBE: 6031 STANDARD COUNTS: 8720

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m							8	9	10
	4	5	6	7									
30.0	3.2	3.9	3.5	3.3	3.4	4.6	4.2	4.2	3.0	3.4			
45.0	6.7	6.2	6.9	5.8	5.6	6.5	5.7	6.1	6.1	6.9			
60.0	7.7	7.6	8.2	7.4	6.5	6.8	7.5	6.9	7.8	7.8			
75.0	8.6	8.2	7.9	7.7	6.0	7.4	7.6	7.6	8.2	7.6			
90.0	7.3	8.5	8.7	8.2	7.2	7.3	8.1	7.5	8.2	7.5			
105.0	7.4	8.1	9.3	8.3	7.5	7.6	8.5	7.8	8.4	8.1			
120.0	7.9	8.0	9.3	8.6	7.1	6.9	8.6	7.9	8.3	8.7			
135.0	7.9	8.5	9.2	8.1	7.6	7.7	8.3	8.2	7.6	8.7			
150.0	8.4	8.2	9.9	8.7	7.0	7.7	8.4	8.4	8.8	9.4			
165.0	8.9	8.5	9.9	9.2	7.5	7.9	8.5	8.1	9.3	8.7			
180.0	9.4	8.6	9.7	9.1	7.8	8.2	8.7	9.0	9.7	9.1			
195.0	8.8	9.1	9.8	9.2	8.6	8.4	9.3	8.5	10.4	9.9			
210.0	8.8	8.8	10.6	9.7	8.4	9.4	9.7	9.5	9.9	9.8			
225.0	8.9	9.3	10.0	9.9	9.5	9.1	10.0	9.8	9.6	8.6			
240.0	9.6	9.9	10.4	10.4	9.0	9.1	9.5	10.0	10.1	9.1			
255.0	10.3	10.3	11.2	10.6	10.0	10.2	10.5	10.3	11.2	11.2			
270.0	13.1	12.1	12.8	14.1	11.6	11.4	11.6	12.6	11.5	12.8			
AVG %	7.6	7.7	8.5	7.9	7.0	7.3	7.8	7.6	8.0	7.9			
WASTE %	9.0	8.9	10.0	9.4	8.2	8.5	9.2	9.0	9.7	9.2			
STRG cm	21.0	21.3	23.4	21.7	19.2	20.2	21.5	21.0	22.1	21.8			

DATE: 08-07-86
 DAY: 950
 PROBE: 6031 STANDARD COUNTS: 8621

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	3.3	4.2	3.6	3.8	3.2	4.4	4.2	3.8	2.4	3.4
45.0	6.0	6.5	6.7	6.2	5.9	6.3	6.1	6.3	6.2	6.4
60.0	7.3	7.7	7.4	7.4	6.2	6.6	7.7	6.7	7.2	7.6
75.0	7.5	8.1	8.3	8.0	6.4	6.5	7.9	7.5	7.8	7.9
90.0	7.8	8.8	8.5	8.4	6.6	7.3	8.2	7.6	8.2	8.1
105.0	7.3	8.0	9.2	8.4	7.8	7.3	8.7	7.8	8.6	8.1
120.0	7.9	8.6	9.5	8.5	7.0	7.0	8.8	8.3	8.2	8.1
135.0	7.2	8.9	9.1	8.5	7.2	7.5	8.3	8.2	8.7	8.2
150.0	8.0	9.3	9.4	9.0	7.4	8.1	9.3	8.6	8.8	9.2
165.0	8.9	8.7	9.8	9.0	7.6	8.2	8.8	8.9	9.4	9.4
180.0	9.1	9.6	9.7	8.9	7.6	8.4	8.6	8.7	9.1	8.4
195.0	9.2	9.3	9.8	9.5	8.8	8.5	8.9	8.9	10.2	9.5
210.0	9.3	9.3	10.3	9.3	8.7	9.1	9.6	9.5	10.3	9.7
225.0	9.3	9.6	10.2	9.3	9.1	9.6	9.2	9.6	9.8	8.8
240.0	9.2	9.0	10.5	9.6	9.2	9.5	8.9	10.3	10.2	9.5
255.0	10.7	10.7	10.7	10.9	10.3	10.1	10.1	10.9	11.4	10.8
270.0	12.8	12.9	12.7	13.4	11.7	12.2	11.8	12.5	12.0	13.4
AVG %	7.5	8.0	8.4	7.9	7.0	7.3	7.8	7.8	8.0	7.8
WASTE %	9.0	9.3	10.0	9.2	8.3	8.8	9.1	9.2	9.7	9.2
STRG cm	20.7	22.1	23.1	21.8	19.2	20.1	21.6	21.3	22.1	21.6

DATE: 08-22-86
 DAY: 965
 PROBE: 6031 STANDARD COUNTS: 8622

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	2.4	2.7	2.3	2.9	2.3	3.1	0.0	2.7	2.3	2.7
45.0	4.7	6.6	5.6	5.4	5.6	5.2	3.0	5.1	5.5	6.2
60.0	5.8	7.5	5.9	6.8	6.1	5.7	5.3	6.2	7.2	7.1
75.0	6.1	7.3	6.1	7.4	6.6	6.8	7.4	7.0	7.8	7.4
90.0	6.0	8.2	6.5	8.1	6.8	6.7	7.8	6.8	8.3	7.1
105.0	5.7	8.8	7.7	8.5	7.5	6.9	7.3	7.6	8.7	8.3
120.0	6.4	7.9	7.6	8.6	6.7	7.0	8.8	8.1	8.0	7.3
135.0	6.2	8.3	7.9	8.6	7.3	7.6	8.5	7.3	7.9	8.2
150.0	6.3	9.0	8.1	9.1	7.3	8.1	8.1	7.8	8.7	8.3
165.0	7.2	9.3	9.1	9.9	7.1	7.1	9.1	8.1	9.4	8.9
180.0	7.5	8.4	8.7	9.3	7.5	8.2	9.2	8.2	9.3	8.7
195.0	7.3	9.1	9.1	10.0	8.3	8.5	8.8	9.2	10.1	8.7
210.0	7.9	9.5	9.2	9.4	8.7	8.9	9.0	9.2	10.2	8.7
225.0	8.4	8.6	9.3	9.4	9.8	8.7	9.5	9.4	9.8	8.7
240.0	8.5	9.8	9.5	9.9	10.2	9.3	9.5	9.3	9.7	8.8
255.0	10.0	10.4	10.1	11.0	10.1	10.3	8.6	9.7	10.9	9.8
270.0	12.0	12.2	13.7	14.8	11.8	12.0	10.0	12.9	11.6	11.7
AVG %	6.3	7.7	7.2	7.9	6.9	6.9	7.0	7.2	7.9	7.3
WASTE %	7.6	9.1	9.0	9.6	8.4	8.4	9.0	8.7	9.6	8.7
STRG cm	17.2	21.2	19.8	21.7	19.1	19.1	19.4	19.7	21.6	20.2

DATE: 09-05-86
 DAY: 979
 PROBE: 6031 STANDARD COUNTS: 8612

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	2.2	3.1	2.5	2.8	2.8	3.1	2.3	3.0	1.9	2.8
45.0	4.2	5.9	5.0	5.5	5.2	4.5	5.9	5.3	5.7	6.0
60.0	6.1	7.1	5.7	6.6	6.0	6.0	6.8	6.7	7.1	7.1
75.0	6.0	7.1	6.0	7.3	6.3	5.9	7.8	6.3	7.4	7.0
90.0	5.3	7.8	5.8	7.6	6.3	6.4	7.8	6.9	8.0	7.0
105.0	5.4	7.7	6.2	7.6	7.4	6.8	8.5	6.7	8.1	7.1
120.0	5.2	8.1	6.8	8.3	6.6	6.3	8.2	7.5	7.9	8.0
135.0	5.8	8.2	6.9	8.0	7.4	7.2	7.9	7.6	8.4	7.6
150.0	5.5	8.4	7.6	8.4	7.0	7.4	8.5	7.8	8.8	8.8
165.0	6.4	8.3	7.3	9.2	7.2	7.7	7.9	7.7	8.5	8.6
180.0	6.3	8.1	7.3	8.6	7.9	7.6	8.7	8.0	8.8	8.0
195.0	6.4	8.8	7.1	9.1	7.9	7.4	9.1	8.8	9.1	8.6
210.0	6.8	10.0	7.7	9.1	9.1	9.1	9.0	9.6	9.9	8.3
225.0	7.4	9.4	7.6	9.0	8.6	8.2	9.1	9.9	10.0	8.6
240.0	7.5	9.5	7.7	9.2	8.7	9.5	9.0	9.9	9.7	9.2
255.0	9.2	10.5	9.3	10.2	9.9	9.8	10.0	9.9	10.5	10.4
270.0	12.0	13.2	11.9	13.3	11.7	12.3	11.6	12.7	11.9	12.2
AVG %	5.6	7.5	6.3	7.5	6.7	6.6	7.4	7.1	7.6	7.2
WASTE %	6.6	8.9	7.5	8.9	8.1	8.1	8.8	8.8	9.3	8.6
STRG cm	15.5	20.7	17.2	20.5	18.5	18.3	20.5	19.6	21.0	19.9

DATE: 09-19-86
 DAY: 993
 PROBE: 6031 STANDARD COUNTS: 8284

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	3.5	4.7	3.0	5.0	4.1	4.6	4.6	4.3	4.2	4.5
45.0	5.1	6.8	5.4	6.5	6.1	6.0	6.2	5.9	6.3	6.7
60.0	6.4	7.8	6.2	6.8	6.2	6.9	6.8	6.9	7.1	7.3
75.0	6.1	7.9	6.1	7.8	6.6	7.2	7.2	7.2	8.0	7.7
90.0	6.2	8.0	6.6	8.3	7.4	6.9	7.7	7.2	8.2	8.1
105.0	5.7	8.8	6.9	9.2	7.2	7.0	8.8	8.2	8.4	8.0
120.0	5.8	8.5	7.6	8.7	7.6	7.5	9.4	8.1	8.8	8.2
135.0	5.7	9.1	7.4	8.5	7.4	8.4	8.7	7.9	8.7	8.9
150.0	6.5	9.2	7.7	8.8	7.4	8.8	8.8	8.3	9.3	9.3
165.0	7.3	9.7	8.0	9.9	8.3	8.7	9.1	8.2	10.3	9.6
180.0	7.2	9.2	8.3	9.5	7.9	8.5	8.9	9.0	9.7	8.8
195.0	7.4	10.1	8.5	9.8	8.6	8.8	9.0	9.6	9.6	9.9
210.0	8.2	10.0	8.8	10.0	9.6	10.1	10.1	9.8	10.6	9.3
225.0	7.6	9.6	8.6	10.1	10.0	10.0	9.2	9.8	10.2	9.1
240.0	8.3	10.7	8.4	10.0	9.7	10.3	10.2	14.5	10.8	9.5
255.0	9.3	11.4	9.4	11.0	10.9	11.7	10.0	11.0	11.9	11.3
270.0	13.1	13.1	13.4	14.7	12.5	13.0	12.5	13.1	12.3	22.3
AVG %	6.2	8.3	6.9	8.2	7.4	7.7	7.9	8.0	8.4	8.0
WASTE %	7.5	9.8	8.3	9.7	8.8	9.3	9.3	9.9	10.1	9.4
STRG cm	17.2	22.9	18.9	22.7	20.2	21.3	21.8	22.0	23.0	22.0

DATE: 10-03-86
 DAY: 1007
 PROBE: 6031 STANDARD COUNTS: 8655

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	4.5	5.4	3.7	5.3	4.9	5.4	5.4	4.7	4.7	4.3
45.0	5.6	6.1	5.4	5.5	6.2	5.6	6.0	5.3	6.2	6.6
60.0	5.9	7.1	5.7	6.4	6.1	5.6	6.5	5.7	7.1	6.5
75.0	6.0	7.2	6.4	6.8	6.7	6.4	6.9	6.7	7.7	6.9
90.0	5.0	6.8	6.1	7.4	6.6	6.4	7.6	6.8	8.1	7.3
105.0	5.3	7.8	6.8	7.2	6.5	6.4	8.5	6.8	8.0	7.9
120.0	5.4	7.4	7.0	7.9	6.8	6.3	8.5	7.4	8.2	7.1
135.0	5.9	7.9	6.6	7.8	6.5	7.2	8.5	7.3	7.2	8.2
150.0	5.7	8.1	7.2	8.3	7.0	7.7	8.7	7.9	8.4	8.3
165.0	6.0	8.7	7.5	8.7	6.3	7.3	8.9	7.4	8.9	9.0
180.0	6.3	8.2	7.3	8.7	7.3	7.4	9.2	7.3	9.0	8.1
195.0	6.4	8.8	7.9	8.5	7.7	7.6	9.4	8.6	9.2	8.6
210.0	6.5	9.0	7.4	8.8	8.4	8.6	9.6	9.6	9.5	9.1
225.0	6.8	9.4	8.0	8.9	8.4	8.3	9.2	9.0	9.5	8.4
240.0	7.0	9.3	7.7	8.9	8.8	9.4	9.1	9.3	9.5	8.8
255.0	9.0	10.5	8.8	10.4	9.7	9.4	10.1	9.9	11.0	10.6
270.0	10.9	12.4	11.9	13.5	10.7	12.6	11.3	12.0	11.7	12.5
AVG %	5.7	7.5	6.4	7.4	6.7	6.8	7.8	7.0	7.8	7.4
WASTE %	6.4	8.8	7.6	8.7	7.7	8.0	9.2	8.4	9.1	8.6
STRG cm	15.7	20.7	17.7	20.3	18.4	18.6	21.4	19.4	21.4	20.3

DATE: 10-21-86
 DAY: 1025
 PROBE: 6031 STANDARD COUNTS: 8811

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	2.9	4.0	3.6	3.7	3.4	3.8	3.3	4.0	2.7	3.3
45.0	4.7	6.3	5.0	5.7	4.9	5.8	4.5	5.8	5.4	5.4
60.0	5.4	7.0	5.8	5.8	5.9	6.1	6.1	6.2	6.3	6.4
75.0	6.2	6.1	6.4	6.7	5.5	6.0	6.2	5.9	6.3	5.9
90.0	5.2	6.8	5.6	6.9	5.9	6.6	6.4	6.1	6.8	6.6
105.0	4.8	7.0	6.0	7.1	6.0	5.6	7.1	6.5	7.2	6.7
120.0	5.1	7.9	6.9	7.4	5.8	5.8	7.4	6.9	7.1	6.5
135.0	5.6	7.4	7.2	7.6	5.8	7.0	7.3	7.4	6.6	7.0
150.0	5.6	7.7	7.5	7.5	6.4	7.1	7.8	7.4	7.8	7.6
165.0	6.4	7.9	7.9	8.3	6.6	7.2	8.2	7.4	8.6	8.0
180.0	6.5	7.9	7.6	8.2	6.4	6.7	7.9	7.1	8.3	7.6
195.0	6.4	8.2	7.7	8.6	7.5	8.1	8.1	8.3	9.0	7.7
210.0	6.4	9.0	8.3	9.2	7.5	7.9	8.2	8.2	9.2	7.9
225.0	6.5	8.1	8.2	8.6	8.0	7.8	8.1	8.1	9.2	8.0
240.0	6.4	8.2	8.0	8.6	7.9	8.8	8.1	8.5	9.3	7.7
255.0	8.7	9.7	8.7	9.6	8.8	9.1	9.1	9.4	9.9	9.9
270.0	11.0	11.5	12.1	14.2	11.1	10.6	10.8	11.6	11.6	11.7
AVG %	5.5	7.0	6.5	7.0	6.0	6.4	6.7	6.7	7.0	6.6
WASTE %	6.3	8.1	7.9	8.4	7.2	7.7	8.0	7.9	8.8	7.8
STRG cm	15.0	19.2	17.8	19.3	16.5	17.7	18.4	18.3	19.4	18.1

DATE: 10-31-86
 DAY: 1035
 PROBE: 6031 STANDARD COUNTS: 8700

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	5.5	6.8	5.9	5.2	5.1	5.2	5.3	5.8	5.2	5.6
45.0	5.4	6.6	6.0	6.1	5.9	5.6	6.3	6.6	6.0	6.1
60.0	5.8	7.1	6.0	6.7	5.7	5.7	6.8	6.4	5.9	6.6
75.0	5.9	7.6	5.8	6.7	5.6	6.0	6.7	6.2	6.9	6.8
90.0	5.3	6.6	5.9	7.3	5.4	6.6	7.1	6.9	6.8	6.7
105.0	5.1	7.3	6.4	7.6	6.2	5.8	7.9	6.8	7.4	7.6
120.0	5.1	7.7	7.0	8.4	5.9	5.7	7.6	7.5	7.4	6.8
135.0	5.1	7.4	6.6	7.7	6.0	6.9	7.9	7.2	6.9	7.0
150.0	6.0	7.7	6.6	8.3	6.4	6.9	8.6	7.0	8.1	8.2
165.0	6.7	8.4	7.1	9.1	6.0	6.6	8.6	7.5	8.6	7.7
180.0	6.7	7.8	7.3	9.5	6.9	6.8	8.2	7.4	8.9	8.1
195.0	7.0	8.4	7.2	8.6	7.8	7.3	8.0	8.0	8.8	8.3
210.0	6.4	9.1	7.7	9.7	8.4	8.2	8.1	8.6	9.2	8.1
225.0	7.0	8.4	7.8	9.1	8.4	8.1	8.5	8.4	8.7	8.1
240.0	6.7	9.2	7.6	9.7	9.1	8.4	9.1	9.4	9.5	8.2
255.0	9.0	10.1	8.8	10.4	9.8	9.2	9.0	9.0	9.9	10.3
270.0	11.5	12.7	10.8	13.9	11.4	11.1	11.3	11.6	11.1	11.5
AVG %	5.8	7.4	6.5	7.7	6.4	6.4	7.3	7.0	7.3	7.1
WASTE %	6.6	8.4	7.3	9.2	7.6	7.5	8.4	8.1	8.8	8.1
STRG cm	16.0	20.4	17.7	21.1	17.6	17.7	20.0	19.2	20.1	19.5

DATE: 11-17-86
 DAY: 1052
 PROBE: 6031 STANDARD COUNTS: 8831

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	4.2	5.2	4.4	4.6	4.5	4.9	4.9	1.0	4.2	3.5
45.0	5.5	6.4	5.5	5.7	5.5	5.6	5.5	4.4	5.8	5.9
60.0	5.9	6.5	6.0	5.8	2.6	6.2	6.4	5.8	6.6	5.8
75.0	5.4	6.4	5.6	6.4	5.6	5.4	5.6	5.8	6.8	5.9
90.0	5.2	6.5	5.4	6.4	5.6	5.5	6.4	6.4	6.8	5.8
105.0	5.3	6.9	5.6	6.8	5.8	5.2	7.2	5.6	7.1	6.6
120.0	4.9	7.2	6.4	7.3	6.3	6.1	7.1	5.8	6.9	6.5
135.0	4.8	7.8	6.8	7.0	6.3	7.0	7.2	7.1	7.1	6.9
150.0	5.5	8.2	7.0	7.1	6.4	6.9	7.8	6.5	7.9	7.6
165.0	6.6	7.9	7.4	7.8	6.3	6.6	7.5	7.2	8.4	7.6
180.0	6.4	7.7	7.2	7.9	6.5	7.0	7.9	6.9	8.6	7.8
195.0	6.5	7.6	8.1	8.4	7.5	7.4	7.3	7.4	8.8	7.4
210.0	6.4	8.1	8.3	8.1	7.6	7.5	7.8	7.7	9.1	7.2
225.0	6.6	7.8	8.2	8.4	8.0	8.0	8.0	8.0	8.4	7.3
240.0	7.1	8.3	8.1	8.4	7.4	8.0	7.8	8.8	9.1	8.0
255.0	8.1	9.7	9.0	10.1	8.6	9.8	8.7	9.1	10.2	9.4
270.0	13.9	11.3	11.2	13.7	10.7	11.5	10.3	8.9	11.5	10.6
AVG %	5.5	6.9	6.4	6.8	5.9	6.3	6.7	6.1	7.2	6.4
WASTE %	6.4	7.9	7.8	8.0	7.1	7.3	7.7	7.5	8.6	7.6
STRG cm	15.3	19.1	17.6	18.8	16.3	17.3	18.3	16.8	19.7	17.7

DATE: 12-01-86
 DAY: 1066
 PROBE: 6031 STANDARD COUNTS: 8646

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	7.1	7.8	7.2	7.1	7.0	6.5	7.0	7.7	7.7	6.7
45.0	6.5	7.8	6.7	6.7	7.1	6.8	7.2	7.3	7.8	7.2
60.0	6.4	7.2	6.2	6.3	6.5	6.0	7.1	6.7	7.2	6.7
75.0	7.0	6.9	6.0	6.4	6.2	6.5	6.5	6.8	6.8	6.4
90.0	5.5	6.4	6.5	7.0	6.3	6.7	7.1	6.7	7.3	6.9
105.0	4.8	7.3	6.8	6.6	6.9	5.9	7.0	7.0	7.2	6.9
120.0	5.5	7.1	7.0	7.4	6.2	6.0	7.3	7.1	7.4	7.3
135.0	5.1	7.8	6.8	7.2	6.0	6.6	7.2	7.5	7.6	7.4
150.0	5.4	7.5	6.8	7.7	6.5	7.1	7.7	6.7	8.6	7.9
165.0	6.1	8.1	7.7	8.5	6.2	6.7	8.2	7.4	8.6	7.7
180.0	5.7	8.0	7.9	8.1	6.7	6.9	7.7	7.9	9.3	8.5
195.0	5.7	7.8	7.8	8.1	6.8	7.5	7.8	8.7	9.1	8.8
210.0	6.7	8.7	7.9	8.0	7.8	8.0	8.4	8.5	9.5	8.2
225.0	7.1	7.7	8.0	8.2	7.9	8.3	8.1	8.9	9.5	8.1
240.0	6.9	8.7	7.8	8.7	7.9	8.9	8.1	9.3	9.1	8.1
255.0	8.8	10.0	8.3	10.0	9.2	9.9	8.5	9.2	10.4	10.1
270.0	11.5	12.5	11.3	12.7	10.7	11.3	11.2	11.4	11.2	12.1
AVG %	5.9	7.3	6.8	7.2	6.5	6.7	7.1	7.3	7.8	7.2
WASTE %	6.2	8.1	7.7	8.2	7.1	7.6	8.0	8.2	9.1	8.2
STRG cm	16.2	20.2	18.7	19.7	17.9	18.4	19.6	20.0	21.5	19.9

DATE: 12-29-86
 DAY: 1094
 PROBE: 6031 STANDARD COUNTS: 8641

DEPTH cm	1	2	3	% VOL WATER CONTENT, cm/m				8	9	10
	4	5	6	7						
30.0	8.5	9.1	8.7	9.9	9.1	8.9	9.0	9.6	8.4	9.0
45.0	10.5	10.6	9.8	10.0	11.1	9.8	10.2	10.7	10.3	10.6
60.0	9.7	9.4	8.4	8.5	11.0	9.0	10.2	10.0	10.6	9.0
75.0	7.6	8.1	7.0	7.3	8.2	7.8	7.5	7.9	8.8	8.1
90.0	6.5	7.2	5.8	6.7	7.4	7.3	7.3	7.3	7.6	6.5
105.0	5.8	7.6	6.6	7.0	6.8	5.9	6.9	7.3	7.5	6.9
120.0	5.5	7.4	7.0	7.1	6.2	6.1	7.1	7.0	6.8	7.1
135.0	5.4	7.8	7.1	7.2	6.5	6.4	7.5	6.4	7.3	7.0
150.0	5.8	8.0	6.6	7.5	6.1	6.8	7.9	6.7	7.8	8.3
165.0	6.4	7.8	8.2	7.8	6.7	6.6	8.1	7.4	8.7	8.1
180.0	6.4	8.0	8.5	8.3	6.5	6.4	8.2	7.7	8.2	8.0
195.0	6.5	8.6	7.8	7.3	6.9	6.9	7.8	8.1	8.9	7.9
210.0	6.1	8.4	8.3	8.4	7.5	8.2	8.0	8.2	8.9	8.2
225.0	6.7	8.5	7.4	8.4	7.3	8.1	8.0	7.8	8.7	8.3
240.0	6.8	8.8	7.9	8.5	7.8	8.6	7.1	8.4	9.1	8.1
255.0	8.7	9.6	8.6	10.4	8.5	9.6	8.3	9.6	10.4	10.3
270.0	11.7	12.4	12.1	12.4	10.6	11.5	10.8	11.5	11.2	12.0
AVG %	6.6	7.9	7.3	7.7	7.3	7.2	7.6	7.7	8.1	7.7
WASTE %	6.4	8.3	7.8	8.0	7.0	7.4	7.9	7.8	8.6	8.1
STRG cm	18.2	21.8	20.0	21.1	20.0	19.8	20.9	21.1	22.3	21.3

DATE: 01-12-87
 DAY: 1108
 PROBE: 6031 STANDARD COUNTS: 8867

DEPTH cm	% VOL WATER CONTENT, cm/m									
	1	2	3	4	5	6	7	8	9	10
30.0	6.4	7.6	7.7	7.3	6.6	7.4	7.4	8.1	7.2	6.9
45.0	9.1	9.7	10.0	9.8	9.0	9.7	8.6	9.3	9.7	9.9
60.0	10.2	9.8	11.1	9.9	10.5	9.8	9.5	10.3	10.1	10.1
75.0	9.9	9.6	10.1	9.4	11.0	9.9	9.4	9.9	10.5	9.6
90.0	8.3	8.6	8.2	8.0	10.8	10.3	8.7	8.5	9.2	9.0
105.0	6.4	7.6	6.9	7.2	10.0	8.0	7.8	8.1	9.0	8.1
120.0	6.3	7.0	7.3	7.0	7.4	7.1	7.6	7.2	7.7	6.8
135.0	6.0	7.4	6.7	6.7	6.2	6.9	6.9	7.4	8.1	6.8
150.0	5.9	6.8	7.2	7.4	5.4	6.5	7.5	6.9	7.9	7.4
165.0	6.8	6.8	7.6	7.9	5.7	6.5	7.6	7.2	8.5	7.5
180.0	6.4	7.0	7.2	8.0	5.7	6.2	7.4	6.4	8.4	7.6
195.0	6.6	7.6	7.5	7.6	6.5	6.6	7.2	7.6	8.4	7.8
210.0	6.5	7.2	7.8	8.0	6.9	7.3	8.0	7.8	8.8	7.3
225.0	6.3	7.7	7.5	8.6	7.4	7.8	7.6	8.3	8.4	7.0
240.0	7.2	8.3	8.0	8.3	7.6	8.2	7.1	8.2	8.5	8.2
255.0	9.2	9.3	8.8	9.6	7.9	8.7	8.3	8.7	9.8	9.3
270.0	11.8	10.3	10.5	14.1	9.5	10.8	10.3	11.1	11.4	11.2
AVG %	6.9	7.5	7.6	7.7	7.3	7.5	7.4	7.6	8.2	7.6
WASTE %	6.5	7.3	7.5	8.0	6.5	7.0	7.5	7.5	8.4	7.5
STRG cm	19.0	20.7	21.0	21.1	20.2	20.5	20.5	21.0	22.6	20.9

APPENDIX C

FIELD RADIOCHEMISTRY DATA

APPENDIX C

FIELD RADIOCHEMISTRY DATA

The data shown in this appendix are concentrations and cumulative amounts of radionuclides measured in lysimeter leachates. Tritium is the only radionuclide found in the leachates of lysimeters 1 and 7. Cobalt-60 is the only radionuclide found in the leachates of lysimeters 2, 8, 3, 9, 4, and 10. No measurable radionuclides have been found in the leachates of lysimeters 5 and 6. The column marked DAY is the number of days since January 1, 1984, and is used to facilitate plotting the data. The date and amount of drainage water extracted from the lysimeters is also shown in the listing. When a sample of drainage water was not analyzed for radionuclides, the sample was assigned the mean concentration of the closest sample that was counted before and after the uncounted sample. Cumulative amounts were calculated using this interpolation scheme.

Lysimeter #1 field radiochemistry
Masonry Cement
Boric Acid Concentrate
Drum 4-1

DATE	DAY	DRAIN L	CMLTV DRAIN cm	TRITIUM CONC $\mu\text{Ci/L}$	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	1.1	0.04	0.171	0.19	0.19
11-16-84	321.0	0.2	0.05		0.03	0.22
1-24-85	390.0		0.05			0.22
2-13-85	410.0	0.0	0.05			0.22
3-11-85	436.0		0.05			0.22
3-12-85	437.0		0.05			0.22
3-29-85	454.0	0.0	0.05			0.22
4-04-85	460.0		0.05			0.22
4-12-85	468.0		0.05			0.22
6-20-85	537.0	50.2	1.96		105.19	105.41
7-23-85	570.0		1.96			105.41
8-14-85	592.0	27.7	3.01		58.05	163.46
10-24-85	663.0	24.2	3.93	4.020	97.28	260.74
1-30-86	761.0	28.5	5.01	5.160	147.06	407.80
2-22-86	784.0		5.01			407.80
2-28-86	790.0	50.8	6.95		219.46	627.26
3-07-86	797.0		6.95			627.26
3-13-86	803.0		6.95			627.26
3-21-86	811.0	58.0	9.15		250.56	877.82
3-28-86	818.0	14.0	9.68		60.48	938.30
4-03-86	824.0	9.0	10.02		38.88	977.18
4-10-86	831.0	13.0	10.52		56.16	1033.34
4-17-86	838.0	9.0	10.86		38.88	1072.22
4-25-86	846.0	9.7	11.23	3.480	33.76	1105.97
5-01-86	852.0	7.5	11.52		22.61	1128.59
5-08-86	859.0	9.5	11.88		28.64	1157.23
5-15-86	866.0	9.8	12.25		29.55	1186.77
5-22-86	873.0	7.4	12.53		22.31	1209.09
5-29-86	880.0	8.0	12.83		24.12	1233.21
6-06-86	888.0	9.4	13.19	2.550	23.97	1257.18
6-09-86	891.0		13.19			1257.18
6-12-86	894.0	5.6	13.40		14.78	1271.96
6-19-86	901.0	6.7	13.66		17.69	1289.65
6-26-86	908.0	6.9	13.92	2.730	18.84	1308.48
7-03-86	915.0	7.0	14.19		19.57	1328.05
7-10-86	922.0	5.8	14.41	2.860	16.59	1344.64
7-17-86	929.0	5.0	14.60		14.13	1358.76
7-24-86	936.0	4.7	14.78	2.790	13.11	1371.88
8-07-86	951.0	2.7	14.88	2.530	6.83	1378.71
8-13-86	956.0	7.5	15.16		19.13	1397.83
8-28-86	971.0	8.2	15.48		20.91	1418.74
9-10-86	984.0	7.1	15.75	2.570	18.25	1436.99

Lysimeter #1 field radiochemistry (continued)
Masonry Cement
Boric Acid Concentrate
Drum 4-1

DATE	DAY	DRAIN L	CMLTV DRAIN cm	TRITIUM CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	6.6	16.00	2.450	16.17	1453.16
10-02-86	1006.0	5.1	16.19	2.450	12.50	1465.65
10-23-86	1027.0	5.2	16.39	3.380	17.58	1483.23
11-06-86	1041.0	3.1	16.51	5.630	17.45	1500.68
11-20-86	1055.0	2.6	16.61	2.340	6.08	1506.77
12-10-86	1075.0	2.5	16.70	2.430	6.08	1512.84
12-30-86	1095.0	3.2	16.82	2.520	8.06	1520.91
1-13-87	1109.0	1.6	16.88	2.630	4.21	1525.11
1-26-87	1122.0	1.5	16.94	4.590	6.89	1532.00
2-09-87	1136.0	1.3	16.99	5.630	7.32	1539.32
3-09-87	1164.0	2.4	17.08	2.760	6.69	1546.01
3-23-87	1178.0	1.6	17.14	2.140	3.32	1549.33
4-07-87	1193.0	1.8	17.21	2.540	4.64	1553.96
4-21-87	1207.0	4.6	17.38	2.280	10.37	1564.34
5-08-87	1224.0	7.3	17.66	2.270	16.63	1580.96
5-27-87	1243.0	9.2	18.01	3.980	36.62	1617.58

Lysimeter #7 field radiochemistry
Masonry Cement
Boric Acid Concentrate
Drum 4-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	TRITIUM CONC $\mu\text{Ci/L}$	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	0.818	0.03	0.072	0.06	0.06
1-24-85	390.0	0.055	0.03	0.141	0.01	0.07
2-13-85	410.0	0.000	0.03			0.07
3-11-85	436.0		0.03			0.07
3-12-85	437.0		0.03			0.07
3-29-85	454.0	8.571	0.36	2.890	24.77	24.84
4-04-85	460.0		0.36			24.84
4-12-85	468.0		0.36			24.84
6-20-85	537.0	67.245	2.92	3.370	226.62	251.45
7-23-85	570.0		2.92			251.45
8-14-85	592.0	27.398	3.96		104.52	355.98
10-24-85	663.0	24.712	4.90	4.260	105.27	461.25
1-30-86	761.0	32.283	6.12	4.300	138.82	600.07
2-22-86	784.0		6.12			600.07
2-28-86	790.0	26.000	7.11		91.26	691.33
3-07-86	797.0		7.11			691.33
3-13-86	803.0	100.000	10.91		351.00	1042.33
3-21-86	811.0	32.000	12.13		112.32	1154.65
3-28-86	818.0	14.000	12.66		49.14	1203.79
4-03-86	824.0	14.000	13.20		49.14	1252.93
4-10-86	831.0	11.000	13.61		38.61	1291.54
4-17-86	838.0	9.000	13.96		31.59	1323.13
4-25-86	846.0	9.355	14.31	2.720	25.45	1348.57
5-01-86	852.0	8.390	14.63		22.19	1370.76
5-08-86	859.0	7.480	14.92		19.78	1390.55
5-15-86	866.0	9.000	15.26		23.81	1414.35
5-22-86	873.0	7.665	15.55		20.27	1434.63
5-29-86	880.0	6.480	15.80		17.14	1451.77
6-06-86	888.0	9.050	16.14	2.570	23.26	1475.02
6-09-86	891.0		16.14			1475.02
6-12-86	894.0	5.620	16.35		14.08	1489.10
6-19-86	901.0	6.620	16.60		16.58	1505.69
6-26-86	908.0	6.420	16.85	2.440	15.66	1521.35
7-03-86	915.0	6.220	17.09		15.55	1536.90
7-10-86	922.0	5.000	17.28	2.560	12.80	1549.70
7-17-86	929.0	4.520	17.45		9.88	1559.58
7-24-86	936.0	5.020	17.64	1.810	9.09	1568.66
8-07-86	951.0	3.520	17.77	2.390	8.41	1577.08
8-13-86	956.0	6.600	18.02		13.99	1591.07
8-28-86	971.0	6.100	18.25	1.850	11.29	1602.35
9-10-86	984.0	5.560	18.47	2.310	12.84	1615.20
9-25-86	999.0	5.340	18.67	2.220	11.85	1627.05

Lysimeter #7 field radiochemistry (continued)
 Masonry Cement
 Boric Acid Concentrate
 Drum 4-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	TRITIUM CONC $\mu\text{Ci/L}$	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-02-86	1006.0	3.500	18.80	1.970	6.90	1633.95
10-23-86	1027.0	4.100	18.96	2.950	12.10	1646.04
11-06-86	1041.0	3.120	19.08	5.180	16.16	1662.20
11-20-86	1055.0	2.525	19.17	2.230	5.63	1667.83
12-10-86	1075.0	2.925	19.28	2.180	6.38	1674.21
12-30-86	1095.0	3.150	19.40	2.230	7.02	1681.23
1-13-87	1109.0	2.025	19.48	2.230	4.52	1685.75
1-26-87	1122.0	1.800	19.55	4.280	7.70	1693.45
2-09-87	1136.0	1.650	19.61	5.410	8.93	1702.38
3-09-87	1164.0	3.950	19.76	2.400	9.48	1711.86
3-23-87	1178.0	2.250	19.85	2.820	6.35	1718.21
4-07-87	1193.0	3.125	19.97	2.810	8.78	1726.99
4-21-87	1207.0	4.150	20.12	2.980	12.37	1739.35
5-08-87	1224.0	6.650	20.38	4.470	29.73	1769.08
5-27-87	1243.0	3.600	20.51	4.470	16.09	1785.17

Lysimeter #2 field radiochemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-1

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	1.070	0.04	0.000		0.00
11-16-84	321.0	0.175	0.05			0.00
1-24-85	390.0	0.210	0.06			0.00
2-13-85	410.0	0.000	0.06	0.000		0.00
3-11-85	436.0		0.06			0.00
3-12-85	437.0		0.06			0.00
3-29-85	454.0	16.141	0.67	0.000		0.00
4-04-85	460.0		0.67			0.00
4-12-85	468.0		0.67			0.00
6-20-85	537.0	57.781	2.87	0.000		0.00
7-23-85	570.0		2.87			0.00
8-14-85	592.0	29.391	3.98		0.36	0.36
10-24-85	663.0	23.712	4.88	0.024	0.57	0.93
1-30-86	761.0	17.142	5.54	0.001	0.01	0.94
2-22-86	784.0		5.54			0.94
2-28-86	790.0	40.500	7.08		0.86	1.80
3-07-86	797.0		7.08			1.80
3-13-86	803.0		7.08			1.80
3-21-86	811.0	62.000	9.43		1.32	3.12
3-28-86	818.0	14.000	9.97		0.30	3.42
4-03-86	824.0	10.000	10.35		0.21	3.63
4-10-86	831.0	11.000	10.76		0.23	3.87
4-17-86	838.0	9.000	11.11		0.19	4.06
4-25-86	846.0	10.460	11.50	0.042	0.44	4.50
5-01-86	852.0	7.050	11.77		0.36	4.85
5-08-86	859.0	9.200	12.12		0.46	5.31
5-15-86	866.0	8.735	12.45		0.44	5.75
5-22-86	873.0	7.435	12.74		0.37	6.13
5-29-86	880.0	7.490	13.02		0.38	6.51
6-06-86	888.0	8.215	13.33	0.059	0.48	6.99
6-09-86	891.0		13.33			6.99
6-12-86	894.0	5.540	13.54		0.31	7.30
6-19-86	901.0	6.980	13.81		0.39	7.68
6-26-86	908.0	7.290	14.09	0.052	0.38	8.06
7-03-86	915.0	7.600	14.38		0.70	8.75
7-10-86	922.0	6.140	14.61	0.132	0.81	9.56
7-17-86	929.0	5.380	14.81		0.78	10.34
7-24-86	936.0	4.800	15.00	0.157	0.75	11.09
8-07-86	951.0	3.900	15.14		0.62	11.71
8-13-86	956.0	7.440	15.43	0.160	1.19	12.90
8-28-86	971.0	7.900	15.73	0.115	0.91	13.81
9-10-86	984.0	7.260	16.00	0.108	0.79	14.60

Lysimeter #2 field radiochemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-1

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	6.810	16.26	0.097	0.66	15.26
10-02-86	1006.0	5.100	16.46	0.092	0.47	15.73
10-23-86	1027.0	4.620	16.63	0.094	0.43	16.16
11-06-86	1041.0	4.160	16.79	0.131	0.54	16.71
11-20-86	1055.0	3.350	16.92	0.082	0.28	16.98
12-10-86	1075.0	3.750	17.06	0.071	0.27	17.25
12-30-86	1095.0	3.250	17.18	0.071	0.23	17.48
1-13-87	1109.0	2.100	17.26	0.432	0.91	18.39
1-26-87	1122.0	1.800	17.33	0.071	0.13	18.51
2-09-87	1136.0	1.600	17.39	0.061	0.10	18.61

Lysimeter #8 field radiochemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	0.675	0.03	0.000	0.00	0.00
11-16-84	321.0		0.03			0.00
1-24-85	390.0	0.069	0.03	0.000	0.00	0.00
2-13-85	410.0	173.343	6.62	0.002	0.29	0.29
3-11-85	436.0	125.918	11.41		0.11	0.39
3-12-85	437.0	39.747	12.92	0.000	0.00	0.39
3-29-85	454.0	31.283	14.11	0.001	0.02	0.41
4-04-85	460.0		14.11			0.41
4-12-85	468.0		14.11			0.41
6-20-85	537.0	55.888	16.23	0.002	0.13	0.54
7-23-85	570.0		16.23			0.54
8-14-85	592.0	23.712	17.13		0.26	0.80
10-24-85	663.0	18.034	17.82	0.020	0.35	1.15
1-30-86	761.0	36.069	19.19	0.044	1.60	2.76
2-22-86	784.0	82.000	22.31		3.96	6.72
2-28-86	790.0	14.000	22.84		0.68	7.40
3-07-86	797.0		22.84			7.40
3-13-86	803.0	30.000	23.98		1.45	8.85
3-21-86	811.0	12.000	24.44		0.58	9.43
3-28-86	818.0	19.000	25.16		0.92	10.35
4-03-86	824.0	14.500	25.71		0.70	11.05
4-10-86	831.0	11.000	26.13		0.53	11.58
4-17-86	838.0	9.000	26.47		0.44	12.01
4-25-86	846.0	9.740	26.84	0.052	0.51	12.52
5-01-86	852.0	7.485	27.13		0.55	13.07
5-08-86	859.0	8.260	27.44		0.60	13.68
5-15-86	866.0	8.680	27.77		0.63	14.31
5-22-86	873.0	7.225	28.04		0.53	14.84
5-29-86	880.0	7.825	28.34		0.57	15.41
6-06-86	888.0	10.375	28.74	0.094	0.98	16.39
6-09-86	891.0		28.74			16.39
6-12-86	894.0	5.900	28.96		0.45	16.84
6-19-86	901.0	7.720	29.25		0.59	17.43
6-26-86	908.0	7.560	29.54	0.059	0.45	17.88
7-03-86	915.0	7.400	29.82		0.66	18.54
7-10-86	922.0	5.680	30.04	0.120	0.68	19.23
7-17-86	929.0	5.920	30.26		0.81	20.04
7-24-86	936.0	4.680	30.44	0.153	0.72	20.75
8-07-86	951.0	3.840	30.59		0.51	21.26
8-13-86	956.0	7.580	30.88	0.112	0.85	22.11
8-28-86	971.0	7.300	31.15	0.122	0.89	23.00
9-10-86	984.0	6.360	31.40	0.145	0.92	23.92

Lysimeter #8 field radiochemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	6.180	31.63	0.116	0.72	24.64
10-02-86	1006.0	4.900	31.82	0.272	1.33	25.97
10-23-86	1027.0	4.700	32.00	0.142	0.67	26.64
11-06-86	1041.0	3.760	32.14	0.127	0.48	27.12
11-20-86	1055.0	3.050	32.25	0.568	1.73	28.85
12-10-86	1075.0	3.300	32.38	0.091	0.30	29.15
12-30-86	1095.0	3.100	32.50	0.619	1.92	31.07
1-13-87	1109.0	1.800	32.57	0.097	0.18	31.25
1-26-87	1122.0	1.550	32.62	0.092	0.14	31.39
2-09-87	1136.0	1.350	32.68	0.086	0.12	31.51

Lysimeter #3 field radiochemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 2-1

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	0.850	0.03	0.000	0.00	0.00
11-16-84	321.0	0.850	0.06		0.00	0.00
1-24-85	390.0	0.691	0.09	0.000	0.00	0.00
2-13-85	410.0	0.000	0.09		0.00	0.00
3-11-85	436.0		0.09			0.00
3-12-85	437.0		0.09			0.00
3-29-85	454.0	1.400	0.14	0.001	.00	.00
4-04-85	460.0		0.14			.00
4-12-85	468.0		0.14			.00
6-20-85	537.0	50.210	2.05	0.004	0.19	0.19
7-23-85	570.0		2.05			0.19
8-14-85	592.0	31.083	3.23		0.06	0.26
10-24-85	663.0	19.927	3.99	.000	0.01	0.26
1-30-86	761.0	24.712	4.93	0.087	2.14	2.40
2-22-86	784.0		4.93			2.40
2-28-86	790.0	39.000	6.41		3.43	5.83
3-07-86	797.0		6.41			5.83
3-13-86	803.0		6.41			5.83
3-21-86	811.0	57.000	8.58		5.01	10.84
3-28-86	818.0	15.000	9.15		1.32	12.15
4-03-86	824.0	12.000	9.61		1.05	13.21
4-10-86	831.0	11.000	10.03		0.97	14.17
4-17-86	838.0	10.000	10.41		0.88	15.05
4-25-86	846.0	10.000	10.79	0.089	0.89	15.94
5-01-86	852.0	6.730	11.04		0.87	16.81
5-08-86	859.0	7.145	11.31		0.92	17.73
5-15-86	866.0	9.850	11.69		1.27	19.01
5-22-86	873.0	6.950	11.95		0.90	19.90
5-29-86	880.0	8.755	12.29		1.13	21.03
6-06-86	888.0	8.405	12.61	0.169	1.42	22.45
6-09-86	891.0		12.61			22.45
6-12-86	894.0	5.040	12.80		0.76	23.21
6-19-86	901.0	7.360	13.08		1.11	24.33
6-26-86	908.0	7.480	13.36	0.133	0.99	25.32
7-03-86	915.0	7.600	13.65		1.25	26.57
7-10-86	922.0	6.940	13.91	0.195	1.35	27.92
7-17-86	929.0	4.860	14.10		1.01	28.93
7-24-86	936.0	4.720	14.28	0.221	1.04	29.97
8-07-86	951.0	4.140	14.44		0.96	30.93
8-13-86	956.0	8.680	14.77	0.244	2.12	33.05
8-28-86	971.0	7.950	15.07	0.208	1.65	34.71
9-10-86	984.0	7.820	15.37	0.214	1.67	36.38

Lysimeter #3 field radiochemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 2-1

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	6.520	15.61	0.249	1.62	38.00
10-02-86	1006.0	5.840	15.84	0.253	1.48	39.48
10-23-86	1027.0	5.280	16.04	0.227	1.20	40.67
11-06-86	1041.0	3.250	16.16	0.227	0.74	41.41
11-20-86	1055.0	3.100	16.28	0.228	0.71	42.12
12-10-86	1075.0	3.150	16.40	1.153	3.63	45.75
12-30-86	1095.0	3.050	16.51	1.037	3.16	48.91
1-13-87	1109.0	1.200	16.56	0.182	0.22	49.13
1-26-87	1122.0	1.750	16.63	1.007	1.76	50.89
2-09-87	1136.0	1.000	16.66	1.064	1.06	51.96

Lysimeter #9 field radiochemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 2-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	1.090	0.04	0.000	0.00	0.00
11-16-84	321.0	0.260	0.05		.00	.00
1-24-85	390.0	0.010	0.05		.00	.00
2-13-85	410.0	199.734	7.65	0.001	0.11	0.11
3-11-85	436.0	120.240	12.22		0.17	0.28
3-12-85	437.0	19.873	12.97	0.002	0.05	0.33
3-29-85	454.0	23.712	13.87		1.45	1.78
4-04-85	460.0		13.87			1.78
4-12-85	468.0		13.87			1.78
6-20-85	537.0	48.318	15.71		2.96	4.73
7-23-85	570.0		15.71			4.73
8-14-85	592.0	26.551	16.72		1.62	6.36
10-24-85	663.0	20.873	17.51	0.120	2.50	8.86
1-30-86	761.0	13.910	18.04	0.188	2.62	11.48
2-22-86	784.0	113.000	22.34		16.39	27.86
2-28-86	790.0	23.000	23.21		3.34	31.20
3-07-86	797.0		23.21			31.20
3-13-86	803.0	0.000	23.21		0.00	31.20
3-21-86	811.0	4.000	23.37		0.58	31.78
3-28-86	818.0	17.000	24.01		2.47	34.24
4-03-86	824.0	12.500	24.49		1.81	36.06
4-10-86	831.0	11.000	24.91		1.60	37.65
4-17-86	838.0	10.000	25.29		1.45	39.10
4-25-86	846.0	8.600	25.61	0.102	0.88	39.98
5-01-86	852.0	6.950	25.88		0.96	40.93
5-08-86	859.0	7.345	26.16		1.01	41.94
5-15-86	866.0	7.430	26.44		1.02	42.97
5-22-86	873.0	6.210	26.67		0.85	43.82
5-29-86	880.0	6.830	26.93		0.94	44.76
6-06-86	888.0	8.000	27.24	0.173	1.38	46.14
6-09-86	891.0		27.24			46.14
6-12-86	894.0	5.445	27.45		1.37	47.51
6-19-86	901.0	6.840	27.71		1.72	49.24
6-26-86	908.0	7.250	27.98	0.331	2.40	51.64
7-03-86	915.0	7.660	28.27		2.54	54.18
7-10-86	922.0	6.180	28.51	0.333	2.06	56.24
7-17-86	929.0	5.360	28.71		1.43	57.67
7-24-86	936.0	4.660	28.89		1.25	58.92
8-07-86	951.0	3.960	29.04		1.06	59.97
8-13-86	956.0	7.840	29.34	0.201	1.58	61.55
8-28-86	971.0	7.320	29.62	0.195	1.43	62.98
9-10-86	984.0	6.700	29.87	0.187	1.25	64.23

Lysimeter #9 field radiochemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 2-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	6.320	30.11	0.246	1.55	65.79
10-02-86	1006.0	4.100	30.27	0.263	1.08	66.86
10-23-86	1027.0	4.100	30.42	0.233	0.95	67.82
11-06-86	1041.0	3.340	30.55	0.190	0.63	68.45
11-20-86	1055.0	2.700	30.65	0.162	0.44	68.89
12-10-86	1075.0	3.200	30.77	0.177	0.57	69.45
12-30-86	1095.0	2.700	30.88	0.191	0.51	69.97
1-13-87	1109.0	1.525	30.93	0.165	0.25	70.22
1-26-87	1122.0	1.225	30.98	0.176	0.22	70.44
2-09-87	1136.0	1.300	31.03	1.118	1.45	71.89

Lysimeter #4 field radiochemistry
Dow Polymer
Na₂SO₄ Evaporator Concentrate w/ Resin
Drum 7-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0	1.100	0.04	0.000	0.00	0.00
11-16-84	321.0	0.010	0.04		0.00	0.00
1-24-85	390.0	0.175	0.05	0.000	0.00	0.00
2-13-85	410.0	0.000	0.05		0.00	0.00
3-11-85	436.0		0.05			0.00
3-12-85	437.0		0.05			0.00
3-29-85	454.0	1.000	0.09	0.001	.00	.00
4-04-85	460.0		0.09			.00
4-12-85	468.0		0.09			.00
6-20-85	537.0	57.781	2.28	0.004	0.22	0.22
7-23-85	570.0		2.28			0.22
8-14-85	592.0	27.497	3.33		0.06	0.28
10-24-85	663.0	27.498	4.37	.000	0.01	0.29
1-30-86	761.0	24.712	5.31	0.055	1.36	1.64
2-22-86	784.0		5.31			1.64
2-28-86	790.0	55.000	7.41		2.28	3.92
3-07-86	797.0	50.000	9.31		2.07	6.00
3-13-86	803.0		9.31			6.00
3-21-86	811.0	40.000	10.83		1.66	7.65
3-28-86	818.0	14.000	11.36		0.58	8.23
4-03-86	824.0	11.000	11.78		0.46	8.69
4-10-86	831.0	10.000	12.16		0.41	9.10
4-17-86	838.0	9.000	12.50		0.37	9.48
4-25-86	846.0	4.600	12.67	0.028	0.13	9.61
5-01-86	852.0	7.400	12.96		0.19	9.80
5-08-86	859.0	8.425	13.28		0.22	10.02
5-15-86	866.0	9.250	13.63		0.24	10.27
5-22-86	873.0	7.220	13.90		0.19	10.46
5-29-86	880.0	7.790	14.20		0.21	10.66
6-06-86	888.0	7.990	14.50	0.025	0.20	10.86
6-09-86	891.0		14.50			10.86
6-12-86	894.0	5.555	14.71		0.14	11.00
6-19-86	901.0	6.750	14.97		0.17	11.18
6-26-86	908.0	6.825	15.23	0.027	0.18	11.36
7-03-86	915.0	6.900	15.49		0.17	11.53
7-10-86	922.0	5.920	15.72	0.023	0.14	11.67
7-17-86	929.0	4.580	15.89		0.16	11.83
7-24-86	936.0	4.940	16.08	.0	0.23	12.07
8-07-86	951.0	3.940	16.23		0.20	12.26
8-13-86	956.0	8.190	16.54	0.052	0.43	12.69
8-28-86	971.0	8.220	16.85	0.050	0.41	13.10
9-10-86	984.0	7.540	17.14	0.068	0.51	13.61

Lysimeter #4 field radiochemistry (continued)
 Dow Polymer
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 7-2

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	7.180	17.41	0.061	0.44	14.05
10-02-86	1006.0	5.100	17.61	0.065	0.33	14.38
10-23-86	1027.0	6.100	17.84	0.075	0.45	14.84
11-06-86	1041.0	3.400	17.97	0.076	0.26	15.09
11-20-86	1055.0	3.550	18.10	0.066	0.24	15.33
12-10-86	1075.0	3.600	18.24	0.074	0.27	15.59
12-30-86	1095.0	3.550	18.37	0.077	0.27	15.87
1-13-87	1109.0	1.750	18.44	0.083	0.14	16.01
1-26-87	1122.0	2.125	18.52	0.472	1.00	17.02
2-09-87	1136.0	1.650	18.58	0.452	0.75	17.76

Lysimeter #10 field radiochemistry
 Dow Polymer
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 7-3

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
10-26-84	300.0		0.00			0.00
11-16-84	321.0		0.00			0.00
1-24-85	390.0	0.081	.00	.000	.00	.00
2-13-85	410.0	12.831	0.49	0.000	0.00	.00
3-11-85	436.0		0.49			.00
3-12-85	437.0		0.49			.00
3-29-85	454.0	0.500	0.51	0.000	0.00	.00
4-04-85	460.0	147.631	6.12		0.00	.00
4-12-85	468.0	11.356	6.55		0.00	.00
6-20-85	537.0	0.000	6.55		0.00	.00
7-23-85	570.0	97.663	10.27		0.00	.00
8-14-85	592.0		10.27			.00
10-24-85	663.0	46.425	12.03		0.00	.00
1-30-86	761.0	9.571	12.40	0.000	0.00	.00
2-22-86	784.0		12.40			.00
2-28-86	790.0		12.40			.00
3-07-86	797.0		12.40			.00
3-13-86	803.0		12.40			.00
3-21-86	811.0	51.000	14.34		.00	.00
3-28-86	818.0	105.000	18.33		0.01	0.01
4-03-86	824.0		18.33			0.01
4-10-86	831.0		18.33			0.01
4-17-86	838.0	48.000	20.15		.00	0.01
4-25-86	846.0	6.215	20.39	.000	.00	0.02
5-01-86	852.0		20.39			0.02
5-08-86	859.0	22.000	21.23		0.02	0.04
5-15-86	866.0		21.23			0.04
5-22-86	873.0		21.23			0.04
5-29-86	880.0		21.23			0.04
6-06-86	888.0		21.23			0.04
6-09-86	891.0	32.225	22.45	0.002	0.06	0.10
6-12-86	894.0		22.45			0.10
6-19-86	901.0	8.500	22.77	0.0	0.00	0.10
6-26-86	908.0	10.615	23.18		0.01	0.11
7-03-86	915.0	12.730	23.66	0.001	0.02	0.13
7-10-86	922.0		23.66			0.13
7-17-86	929.0	6.220	23.90		0.01	0.14
7-24-86	936.0	4.980	24.09	.0	0.01	0.15
8-07-86	951.0		24.09			0.15
8-13-86	956.0	10.900	24.50	0.001	0.01	0.16
8-28-86	971.0	6.100	24.73	0.000	0.00	0.16
9-10-86	984.0	5.000	24.92	0.000	0.00	0.16

Lysimeter #10 field radiochemistry (continued)
 Dow Polymer
 Na₂SO₄ Evaporator Concentrate w/ Resin
 Drum 7-3

DATE	DAY	DRAIN L	CMLTV DRAIN cm	COBALT CONC μCi/L	TOTAL RELEASED μCi	CMLTV RELEASED μCi
9-25-86	999.0	6.600	25.17	0.000	0.00	0.16
10-02-86	1006.0	4.100	25.33	0.001	0.01	0.16
10-23-86	1027.0	4.000	25.48	0.000	0.00	0.16
11-06-86	1041.0	6.000	25.71	0.001	.00	0.17
11-20-86	1055.0		25.71			0.17
12-10-86	1075.0		25.71			0.17
12-30-86	1095.0	7.100	25.98	0.000	0.00	0.17

APPENDIX D

CHEMICAL ANALYSES OF LEACHATES

APPENDIX D

CHEMICAL ANALYSES OF LEACHATES

The first listing of data in this appendix is the complete chemical analyses of all quarterly samples taken at the lysimeter facility. Some lysimeters have more results than others depending on whether there was leachate collected on the particular sampling dates. The cations were analyzed with ICP and the anions with IC. All concentrations presented in the listing are milligrams per liter. Less than values represent limits of detection for the individual chemical species. The second data listing presents both drainage data and cumulative amounts of selected chemicals leached from each lysimeter. The data are similar to those presented for radionuclides in Appendix C.

LYSIMETER 1

	24OCT84	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	8.340	8.270	8.240	8.160	8.290	8.230	8.520	8.620
2 Eh	312.000	257.000	270.000	236.700	249.400	296.000	382.000	321.000
4 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
5 B	0.120	<0.010	0.056	0.042	0.117	0.200	0.188	0.140
6 H ₃ BO ₃	0.685	<5.710	0.320	0.240	0.668	1.142	1.073	0.799
7 Ba	0.120	0.230	0.268	0.150	0.060	0.060	0.098	0.110
8 Ca	54.700	98.100	103.000	130.000	74.900	70.000	70.400	82.600
9 Cd	<0.004	<0.004	<0.004	0.007	<0.004	<0.004	<0.004	<0.004
10 Cr	<0.020	0.020	0.043	0.042	<0.020	<0.020	<0.020	<0.020
11 Cu	0.010	<0.004	0.021	0.009	0.005	<0.004	0.020	0.018
12 Fe	<0.005	<0.005	<0.025	<0.025	0.011	<0.005	0.010	0.010
13 K	46.000	10.400	16.000	13.000	7.300	<0.300	29.000	35.400
14 Li	<0.004	<0.004	<0.073	0.084	0.080	<0.004	0.078	0.062
15 Mg	11.020	22.200	23.700	31.500	18.500	16.000	15.900	19.100
16 Mn	0.150	<0.002	0.005	0.003	<0.002	<0.002	<0.002	<0.002
17 Na	127.000	31.200	37.000	33.000	17.000	22.000	39.000	45.600
18 Ni	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
19 P	0.200	<0.100	0.100	0.200	<0.100	<0.100	<0.100	<0.100
20 Si	23.500	14.100	17.600	15.700	18.800	20.000	17.700	14.400
21 Sr	0.320	0.460	0.511	0.578	0.320	0.300	0.330	0.380
22 Zn	0.510	0.150	0.057	0.110	0.100	<0.020	0.094	0.060
23 F-	9.200	0.510	0.700	0.700	<1.000	<1.000	<1.000	0.600
24 Cl-	3.990	6.600	5.700	5.200	4.100	3.600	3.400	4.300
25 NO ₂ -	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	1.000
26 NO ₃ -	0.300	246.000	296.000	435.000	32.000	210.000	190.000	240.000
27 SO ₄ -	60.300	66.000	68.000	65.000	39.000	38.000	40.000	47.000
28 PO ₄ -	0.613	0.3065	0.306	0.306	<0.306	<0.306	<0.306	<0.306
29 ALKALINITY	206.280	30.000	54.000	40.908	NA	45.000	NA	96.600
30 IC	104.600	NA	30.750	22.910	15.900	20.120	NA	145.730
31 TOC	124.400	NA	10.160	7.350	7.200	7.120	NA	11.770
32 CATIONS	10.340	8.355	9.119	10.860	6.193	5.773	7.266	8.590
33 ANIONS	8.734	7.160	8.189	9.918	NA	5.780	NA	8.245

LYSIMETER 2

	24OCT84	29MAR85	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	8.250	8.300	8.340	8.320	8.220	8.200	8.180	8.470	8.600
2 Eh	134.000	296.000	282.000	310.200	240.400	270.400	302.000	378.000	313.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.200	<0.010	<0.010	0.054	0.046	0.044	<0.100	<0.010	<0.010
5 H ₃ BO ₃	1.142	<5.710	<5.710	0.308	0.263	0.251	<5.710	<5.710	<5.710
6 Ba	0.130	0.250	0.240	0.078	0.098	0.500	0.520	0.060	0.190
7 Ca	47.100	41.100	93.900	295.000	386.000	263.000	610.000	510.000	622.000
8 Cd	<0.004	<0.004	<0.004	0.009	<0.004	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	0.020	<0.020	0.025	<0.020	<0.020	<0.020	<0.020	<0.020
10 Cu	<0.004	0.020	<0.004	0.230	0.016	0.160	<0.004	<0.004	<0.004
11 Fe	<0.005	<0.005	<0.005	0.030	0.029	0.028	<0.005	<0.005	<0.005
12 K	77.000	78.700	6.900	18.000	20.000	7.400	17.000	43.000	45.100
13 Li	<0.040	<0.040	<0.040	0.180	<0.040	0.224	0.540	0.360	0.470
14 Mg	9.920	11.500	20.800	66.000	91.000	70.700	180.000	188.000	229.000
15 Mn	0.110	<0.002	<0.002	0.009	<0.002	0.030	0.190	<0.002	<0.002
16 Na	168.000	64.100	25.100	131.000	240.000	241.000	1100.000	1470.000	1500.000
17 Ni	<0.020	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.020
18 P	0.200	<0.100	<0.100	0.350	0.500	<0.100	<0.100	<0.100	<0.100
19 Si	22.500	13.300	17.600	19.900	15.900	22.000	26.000	21.000	18.700
20 Sr	0.290	0.230	0.420	1.410	1.660	1.030	2.580	2.400	2.900
21 Zn	0.060	0.120	0.180	0.100	0.340	0.180	0.300	0.310	0.250
22 F-	12.100	0.500	0.580	0.800	1.000	<1.000	<1.000	<1.000	5.800
23 Cl-	2.490	7.800	9.500	30.000	48.000	20.000	47.000	44.000	46.000
24 NO ₂ -	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	0.300	136.000	179.000	128.000	167.000	23.000	80.000	93.000	160.000
26 SO ₄ -	45.300	81.000	90.000	960.000	1400.000	1100.000	3750.000	4400.000	5400.000
27 PO ₄ -	<0.306	<0.306	<0.306	1.073	<0.306	<0.306	<0.306	<0.306	<0.306
28 ALKALINITY	210.420	48.000	36.000	36.000	67.908	NA	129.000	NA	165.600
29 IC	118.900	NA	NA	30.300	31.600	22.500	60.010	NA	69.740
30 TOC	242.400	NA	NA	26.200	31.500	32.500	102.330	NA	74.850
31 CATIONS	12.445	7.801	7.675	26.338	37.736	29.636	93.576	105.986	116.319
32 ANIONS	8.670	5.728	6.261	24.154	35.532	NA	85.043	NA	122.186

LYSIMETER 3

	24OCT84	29MAR85	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	8.050	8.140	8.330	8.120	8.230	8.060	8.130	8.320	8.350
2 Eh	6.000	343.000	293.000	307.500	229.400	290.400	281.000	375.000	330.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.210	<0.010	<0.010	0.066	0.056	0.036	<0.010	<0.010	<0.010
5 H3BO3	1.199	<5.710	<5.710	0.377	0.320	0.206	<5.710	<5.710	<5.710
6 Ba	0.110	0.260	0.230	0.048	0.147	0.170	0.200	0.140	0.100
7 Ca	51.800	54.700	74.500	312.000	380.000	350.000	640.000	520.000	579.000
8 Cd	<0.004	<0.004	<0.004	0.007	0.005	<0.004	<0.004	<0.004	<0.004
9 Co	<2.500	<2.500	<2.500	3.300	<2.500	8.400	36.400	26.200	21.000
10 Cr	<0.020	0.030	<0.020	<0.020	0.035	<0.020	<0.020	<0.020	<0.020
11 Cu	<0.004	0.010	<0.004	0.014	0.029	0.026	<0.004	<0.004	0.130
12 Fe	<0.005	<0.005	<0.005	0.208	0.036	0.028	<0.005	0.070	0.060
13 K	49.000	32.900	6.600	16.000	14.000	10.000	24.000	67.000	74.400
14 Li	<0.004	<0.004	<0.004	0.080	0.050	0.280	0.540	0.300	0.490
15 Mg	7.670	11.300	16.300	70.000	92.000	94.000	220.000	260.000	286.000
16 Mn	0.100	<0.002	<0.002	0.003	0.015	0.062	0.800	0.640	0.220
17 Na	106.000	32.400	22.000	120.000	245.000	405.000	1700.000	2650.000	3010.000
18 Ni	0.040	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
19 P	0.100	<0.100	<0.100	0.230	0.200	<0.100	<0.100	<0.100	<0.100
20 Si	44.400	19.600	20.400	23.500	19.100	24.000	29.000	27.000	23.500
21 Sr	0.390	0.310	0.330	1.450	1.520	1.430	2.750	2.670	2.610
22 Zn	0.690	0.090	0.350	0.210	0.170	0.550	0.800	0.870	1.170
23 F-	14.300	0.400	0.500	0.800	<1.000	<1.000	<1.000	<1.000	11.000
24 Cl-	14.300	5.800	5.400	40.000	54.000	30.000	63.000	76.000	78.000
25 NO2-	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
26 NO3-	0.300	109.000	101.000	35.000	84.000	22.000	23.000	48.000	130.000
27 SO4-	111.000	74.000	70.000	1060.000	1530.000	1900.000	5300.000	7600.000	8400.000
28 PO4-	0.306	<0.306	<0.306	0.705	0.613	<0.306	<0.306	<0.300	<0.300
29 ALKALINITY	125.400	36.000	36.000	42.000	54.576	NA	165.000	NA	143.520
30 IC	65.900	NA	NA	34.520	24.630	26.100	81.920	NA	74.820
31 TOC	130.600	NA	NA	24.460	30.020	53.200	115.820	NA	107.340
32 CATIONS	9.083	5.915	6.192	26.988	37.582	43.101	124.634	164.330	185.261
33 ANIONS	7.650	4.685	4.466	25.219	36.575	NA	118.067	NA	184.663

LYSIMETER 4

	24OCT84	29MAR85	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	8.120	8.260	8.390	8.000	8.150	8.060	8.020	8.070	8.130
2 Eh	-17.000	319.000	293.000	314.100	254.200	315.100	311.000	387.000	328.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.420	<0.010	<0.010	0.076	0.123	0.100	0.100	0.260	0.240
5 H ₃ BO ₃	2.398	<0.571	<0.571	0.434	0.702	0.571	0.571	1.485	1.370
6 Ba	0.180	0.350	0.310	0.400	0.180	0.140	0.220	0.190	0.380
7 Ca	62.000	148.000	190.000	271.000	525.000	187.000	320.000	585.000	829.000
8 Cd	<0.004	<0.004	<0.004	0.008	0.009	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	0.010	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.020
10 Cu	<0.004	0.050	<0.004	0.014	0.041	0.014	<0.004	<0.004	<0.000
11 Fe	0.200	<0.005	<0.005	0.048	0.069	0.038	<0.005	0.140	0.120
12 K	173.000	286.000	10.300	15.000	17.000	10.000	7.000	52.000	52.700
13 Li	<0.004	<0.004	<0.004	0.090	0.060	0.194	0.250	0.280	0.530
14 Mg	18.610	44.900	42.800	61.500	135.000	45.000	73.000	174.000	265.000
15 Mn	0.220	<0.002	0.080	0.046	0.017	0.006	<0.002	0.060	<0.002
16 Na	266.000	105.000	34.000	99.000	430.000	261.000	290.000	1220.000	1500.000
17 Ni	<0.020	0.040	0.020	0.020	0.150	<0.020	<0.020	0.200	0.210
18 P	0.200	<0.100	<0.100	0.200	1.000	0.400	<0.100	1.300	2.000
19 Si	33.200	13.300	14.000	17.700	14.000	17.000	18.000	15.000	13.400
20 Sr	0.420	0.830	0.880	1.330	2.170	0.780	1.350	2.780	3.910
21 Zn	0.170	0.300	1.820	0.310	0.070	0.600	1.200	2.330	3.200
22 F-	25.400	4.100	0.490	0.700	1.300	<1.000	<1.000	<1.000	2.400
23 Cl-	5.490	72.000	49.000	65.000	65.000	17.000	24.000	53.000	69.000
24 NO ₂ -	<1.000	3.000	6.000	5.600	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	0.300	108.000	104.000	52.000	128.000	14.000	71.000	54.000	105.000
26 SO ₄ -	90.700	447.000	326.000	690.000	2230.000	740.000	1060.000	3900.000	5100.000
27 PO ₄ -	0.613	<0.306	<0.306	0.613	3.065	1.226	<0.306	3.984	6.130
28 ALKALINITY	293.700	72.000	60.000	84.000	109.152	NA	171.000	NA	212.520
29 IC	163.700	NA	NA	NA	NA	45.300	178.000	NA	508.140
30 TOC	343.400	NA	NA	NA	NA	195.000	304.200	NA	936.740
31 CATIONS	20.621	22.975	14.764	23.300	56.492	24.657	34.796	97.944	129.826
32 ANIONS	13.170	8.710	7.380	20.000	51.780	NA	29.600	83.610	117.100

LYSIMETER 5

	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	7.930	8.230	8.050	8.110	8.200	8.030
2 Eh	319.800	263.300	333.400	314.000	382.000	354.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.100	0.056	17.300	18.000	17.800	16.600
5 H ₃ BO ₃	0.571	0.320	98.783	102.780	101.638	94.786
6 Ba	0.345	0.118	0.048	0.060	0.084	0.080
7 Ca	54.000	70.000	59.100	66.000	72.200	88.500
8 Cd	0.005	<0.004	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	0.020	<0.020	<0.020	<0.020	<0.020
10 Cu	0.042	0.011	<0.004	<0.004	0.008	<0.004
11 Fe	0.021	0.009	0.005	<0.005	<0.005	<0.005
12 K	42.000	27.000	6.400	<2.000	19.000	6.000
13 Li	0.070	0.060	0.073	0.100	0.072	<0.004
14 Mg	10.500	16.000	14.200	15.000	16.300	19.900
15 Mn	0.004	0.003	<0.002	<0.002	<0.002	<0.002
16 Na	53.000	38.000	20.000	25.000	33.400	33.900
17 Ni	0.020	<0.020	<0.020	<0.020	<0.020	<0.002
18 P	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
19 Si	15.600	13.500	17.800	19.000	18.100	14.000
20 Sr	0.260	0.337	0.274	0.310	0.354	0.400
21 Zn	0.200	0.150	0.034	<0.020	0.132	0.200
22 F-	0.400	<1.000	<1.000	<1.000	0.400	<1.000
23 Cl-	3.300	5.200	3.100	4.000	5.200	5.900
24 NO ₂ -	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	73.000	170.000	15.000	150.000	180.000	223.000
26 SO ₄ -	79.000	104.000	29.000	36.000	46.000	60.000
27 PO ₄ -	<0.306	<0.306	<0.306	<0.306	<0.306	<0.400
28 ALKALINITY	48.000	59.124	NA	63.000	NA	82.800
29 IC	NA	NA	29.400	28.410	NA	36.520
30 TOC	NA	NA	6.100	6.670	NA	11.350
31 CATIONS	6.943	7.160	5.157	5.622	6.890	7.690
32 ANIONS	4.538	7.026	NA	5.382	NA	7.747

LYSIMETER 6

	24OCT84	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	7.640	8.210	8.100	8.040	8.020	8.180	8.260
2 Eh	259.000	338.700	272.300	332.400	319.000	386.000	341.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.060	0.082	0.064	24.500	36.000	32.200	16.000
5 H ₃ BO ₃	0.342	0.468	0.365	139.895	205.560	183.862	91.360
6 Ba	0.124	0.279	0.124	0.059	0.070	0.100	0.120
7 Ca	90.000	83.000	83.000	74.200	85.000	83.800	97.200
8 Cd	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	<0.020
10 Cu	0.010	0.018	0.009	0.029	<0.004	0.010	0.016
11 Fe	<0.005	0.019	0.056	0.041	0.100	0.012	0.014
12 K	54.000	29.000	16.000	5.100	<2.000	17.000	25.600
13 Li	<0.004	0.084	0.056	0.080	0.060	0.072	0.086
14 Mg	20.720	21.000	20.000	18.200	20.000	20.200	23.000
15 Mn	0.020	0.005	0.008	<0.002	<0.002	<0.002	0.004
16 Na	71.400	40.000	34.000	19.000	24.000	30.400	35.400
17 Ni	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	<0.020
18 P	0.200	0.200	<0.100	<0.100	<0.100	<0.100	<0.100
19 Si	20.000	14.900	13.900	18.800	21.000	19.300	14.600
20 Sr	0.520	0.459	0.428	0.320	0.380	0.392	0.440
21 Zn	0.870	0.230	0.220	0.160	<0.020	0.106	0.100
22 F-	0.500	0.400	0.700	<1.000	<1.000	0.400	<1.000
23 Cl-	5.180	4.400	4.800	5.200	5.300	5.600	5.500
24 NO ₂ -	27.100	<1.000	1.200	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	52.300	118.000	158.000	25.000	190.000	210.000	360.000
26 SO ₄ -	69.000	56.000	61.000	34.000	39.000	42.000	60.000
27 PO ₄ -	0.613	0.613	<0.306	<0.306	<0.306	<0.306	<0.306
28 ALKALINITY	178.200	66.000	86.412	NA	81.000	NA	113.160
29 IC	81.200	NA	NA	25.000	32.820	NA	37.970
30 TOC	14.700	NA	NA	6.400	8.300	NA	9.330
31 CATIONS	10.690	8.359	7.684	6.164	6.939	7.609	8.947
32 ANIONS	9.931	5.415	6.898	NA	6.727	NA	10.984

LYSIMETER 7

	24OCT84	29MAR85	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	8.190	8.080	8.460	8.020	8.070	8.070	8.150	8.220	8.320
2 Eh	339.000	339.000	290.000	368.700	279.900	336.600	317.000	379.000	345.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.150	<0.010	<0.010	0.057	0.046	0.270	0.500	0.500	0.400
5 H ₃ BO ₃	0.856	<0.571	<0.571	0.325	0.263	1.542	2.855	2.855	2.284
6 Ba	0.130	0.320	0.260	0.107	0.123	0.047	0.050	0.088	0.080
7 Ca	96.100	81.000	102.000	95.000	96.000	56.700	51.000	70.400	66.600
8 Cd	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	0.020	0.010	<0.020	0.020	<0.020	<0.004	<0.020	<0.020
10 Cu	0.040	0.040	0.010	0.021	0.091	0.013	<0.004	0.032	0.028
11 Fe	<0.005	<0.005	<0.005	0.016	<0.005	<0.005	<0.005	0.020	<0.005
12 K	62.000	46.000	9.700	12.000	11.000	6.400	<3.000	21.000	20.000
13 Li	<0.004	<0.004	<0.004	0.087	0.080	0.071	<0.004	0.064	0.066
14 Mg	16.210	15.700	21.100	21.000	22.000	13.200	<0.060	14.800	14.500
15 Mn	0.120	<0.002	0.020	0.003	<0.002	<0.002	<0.002	<0.002	<0.002
16 Na	130.000	65.800	29.700	32.000	31.000	18.000	23.000	39.200	36.400
17 Ni	0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.010	<0.020	<0.020
18 P	0.200	<0.100	<0.100	0.100	<0.100	<0.100	<0.100	<0.100	<0.100
19 Si	31.800	13.900	14.700	17.000	14.600	17.500	18.000	17.700	13.900
20 Sr	0.600	0.210	0.820	0.444	0.436	0.251	0.230	0.330	0.290
21 Zn	1.240	0.210	0.290	0.060	0.100	0.070	<0.020	0.120	0.090
22 F-	17.200	0.470	0.540	0.700	0.800	<1.000	<1.000	0.700	<1.000
23 Cl-	5.710	6.800	5.000	5.000	5.400	3.100	3.100	6.100	3.700
24 NO ₂ -	<1.000	21.000	1.100	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	0.300	181.000	184.000	240.000	260.000	19.000	110.000	170.000	160.000
26 SO ₄ -	216.000	132.000	90.000	65.000	64.000	36.000	35.000	55.000	40.000
27 PO ₄ -	0.613	<0.306	<0.306	0.306	<0.306	<0.306	<0.306	<0.306	<0.306
28 ALKALINITY	153.480	42.000	48.000	42.000	59.124	NA	99.000	NA	91.080
29 IC	94.800	NA	NA	NA	NA	18.000	26.140	NA	140.900
30 TOC	186.900	NA	NA	NA	NA	9.600	8.930	NA	12.060
31 CATIONS	13.377	9.380	8.376	8.177	8.240	4.868	3.550	6.980	6.618
32 ANIONS	10.688	7.743	6.636	6.803	7.692	NA	5.890	NA	6.555

LYSIMETER 8

	24OCT84	29MAR85	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	7.730	7.780	8.370	8.190	8.210	8.000	8.130	8.460	8.520
2 Eh	288.000	322.000	290.000	353.400	269.600	365.700	296.000	389.000	341.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.180	<0.010	<0.010	0.065	0.049	0.038	<0.010	<0.010	<0.010
5 H ₃ BO ₃	1.028	<0.571	<0.571	0.371	0.280	0.217	<0.571	<0.571	<0.571
6 Ba	0.130	0.250	0.260	0.214	0.137	0.180	0.410	0.060	0.210
7 Ca	76.000	91.800	94.100	256.000	331.000	252.000	48.000	424.000	513.000
8 Cd	<0.004	<0.004	<0.004	<0.004	0.006	<0.004	<0.004	<0.004	<0.004
9 Cr	0.020	0.030	<0.020	<0.020	0.035	<0.020	<0.020	<0.020	<0.020
10 Cu	0.020	0.020	0.010	0.017	0.045	0.046	0.050	0.130	0.120
11 Fe	<0.005	<0.005	<0.005	0.064	0.035	0.020	0.080	0.240	<0.005
12 K	88.000	5.200	7.400	18.000	17.000	7.400	24.000	56.000	54.000
13 Li	<0.004	<0.004	<0.004	0.190	0.050	0.212	0.430	0.260	0.290
14 Mg	16.040	21.400	21.100	61.000	81.000	72.000	210.000	198.000	227.000
15 Mn	0.070	<0.002	<0.002	0.128	0.012	0.058	0.990	0.020	<0.002
16 Na	153.000	21.800	21.300	113.000	193.000	207.000	1700.000	2100.000	2050.000
17 Ni	0.020	0.010	<0.020	0.020	0.110	0.046	<0.020	<0.020	<0.020
18 P	0.200	0.300	<0.100	0.200	0.400	<0.100	1.000	<0.100	<0.100
19 Si	37.900	18.500	19.800	23.300	14.600	23.000	30.000	25.600	23.200
20 Sr	0.560	0.340	0.400	1.210	1.370	1.000	2.150	1.960	2.260
21 Zn	1.150	0.280	0.820	0.230	0.167	0.240	0.400	0.220	<0.020
22 F-	13.100	0.620	0.500	0.800	0.700	<1.000	<1.000	<1.000	7.100
23 Cl-	3.730	7.500	57.000	32.000	46.000	18.000	52.000	49.000	47.000
24 NO ₂ -	<1.000	<1.000	1.500	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	0.200	88.000	57.000	9.000	49.000	14.000	<2.000	69.000	126.000
26 SO ₄ -	181.000	195.000	187.000	955.000	1300.000	1100.000	5100.000	5600.000	5800.000
27 PO ₄ -	0.613	0.919	<0.306	0.613	1.226	<0.306	3.065	<0.306	<0.306
28 ALKALINITY	199.680	24.000	30.000	42.000	63.672	NA	225.000	NA	173.880
29 IC	102.300	NA	NA	NA	NA	26.000	100.760	NA	74.880
30 TOC	181.900	NA	NA	NA	NA	33.300	139.350	NA	82.500
31 CATIONS	14.023	7.432	7.557	23.194	32.043	27.715	94.211	130.233	134.845
32 ANIONS	10.375	6.526	7.484	22.388	31.332	NA	115.219	NA	130.360

LYSIMETER 9

D.10

	24OCT84	29MAR85	20JUN85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86	9FEB87
1 pH	7.930	8.010	8.320	8.220	8.360	8.260	8.430	8.480	8.500
2 Eh	376.000	352.000	299.000	336.000	266.700	281.800	271.000	401.000	334.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	0.110	<0.010	<0.010	0.067	0.043	0.042	<0.010	<0.010	<0.010
5 H ₃ BO ₃	0.628	<0.571	<0.571	0.383	0.246	0.240	<0.571	<0.571	<0.571
6 Ba	0.120	0.240	0.260	0.156	0.129	0.220	0.260	0.210	0.180
7 Ca	141.500	70.100	92.100	245.000	370.000	272.000	34.000	445.000	511.000
8 Cd	<0.004	<0.004	<0.004	0.008	0.006	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	0.020	<0.020	0.025	0.044	<0.020	<0.020	<0.020	<0.020
10 Cu	1.000	0.170	0.040	0.070	0.170	0.070	0.140	0.210	0.270
11 Fe	<0.005	<0.005	<0.005	0.033	0.038	0.042	<0.005	<0.005	<0.005
12 K	87.000	6.500	8.200	22.000	26.000	15.000	52.000	58.000	65.000
13 Li	<0.004	<0.004	<0.004	0.200	0.120	0.440	0.330	0.300	0.390
14 Mg	19.620	16.400	20.300	57.000	88.000	96.500	200.000	188.000	237.000
15 Mn	0.140	<0.002	<0.002	0.116	0.034	0.510	0.320	0.140	0.080
16 Na	110.000	17.800	21.900	196.000	253.000	486.000	2600.000	2290.000	2530.000
17 Ni	0.030	0.010	<0.020	0.026	0.140	0.040	<0.020	<0.020	<0.020
18 P	0.100	<0.100	<0.100	1.100	1.600	2.000	7.000	1.400	<0.100
19 Si	22.300	20.500	19.800	26.000	24.300	30.000	42.000	34.900	33.100
20 Sr	0.710	0.300	0.400	1.190	1.660	1.250	1.860	2.090	2.350
21 Zn	1.030	0.220	1.610	0.470	0.122	0.200	0.200	<0.020	<0.020
22 F-	24.500	0.650	0.690	0.700	<1.000	<1.000	<1.000	<1.000	8.900
23 Cl-	6.900	8.000	9.000	50.000	81.000	23.000	59.000	58.000	65.000
24 NO ₂ -	<1.000	<1.000	2.400	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	0.300	112.000	71.000	50.000	123.000	11.000	<2.000	78.000	160.000
26 SO ₄ -	261.000	95.000	171.000	915.000	1360.000	1800.000	6000.000	5600.000	7200.000
27 PO ₄ -	0.306	<0.306	<0.306	3.371	4.904	6.130	21.455	4.291	<0.306
28 ALKALINITY	123.780	24.000	42.000	54.000	81.864	NA	333.000	NA	212.520
29 IC	99.000	NA	NA	NA	NA	45.900	151.130	NA	86.400
30 TOC	212.000	NA	NA	NA	NA	74.200	255.230	NA	118.260
31 CATIONS	15.697	5.795	7.438	26.026	37.408	43.056	132.534	138.772	156.719
32 ANIONS	11.053	4.846	6.450	23.118	35.334	NA	137.767	NA	161.969

LYSIMETER 10

	29MAR85	24OCT85	30JAN86	25APR86	24JUL86	6NOV86
1 pH	8.240	8.240	8.260	8.180	8.160	8.330
2 Eh	335.000	358.600	271.600	373.400	313.000	382.000
3 Al	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
4 B	<0.010	0.065	0.045	0.089	<0.010	0.130
5 H ₃ BO ₃	<0.571	0.371	0.257	0.508	<0.571	0.742
6 Ba	0.040	0.117	0.102	0.080	0.090	0.114
7 Ca	41.100	58.000	71.000	85.300	97.000	102.000
8 Cd	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
9 Cr	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
10 Cu	0.020	0.014	0.009	0.010	<0.004	0.026
11 Fe	<0.005	0.016	0.014	0.008	0.060	0.014
12 K	3.800	5.600	4.400	4.000	<2.000	11.000
13 Li	<0.004	0.052	0.056	0.088	0.100	0.102
14 Mg	10.400	13.400	16.800	20.300	22.000	23.600
15 Mn	<0.002	0.029	0.010	0.005	<0.002	0.004
16 Na	10.600	36.000	35.000	32.000	37.000	44.600
17 Ni	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
18 P	0.100	0.200	0.100	<0.100	<0.100	<0.100
19 Si	16.400	17.300	12.500	16.300	17.000	15.400
20 Sr	0.145	0.277	0.329	0.395	0.450	0.486
21 Zn	<0.020	0.220	0.658	0.405	0.500	0.378
22 F-	0.480	0.600	0.500	<1.000	<1.000	0.600
23 Cl-	1.500	4.400	6.700	6.900	7.000	9.500
24 NO ₂ -	<1.000	<1.000	<1.000	<1.000	<1.000	<1.000
25 NO ₃ -	28.000	<2.000	6.500	5.400	23.000	1.900
26 SO ₄ -	20.000	80.000	148.000	160.000	210.000	260.000
27 PO ₄ -	0.306	0.613	0.306	<0.306	<0.306	<0.306
28 ALKALINITY	42.000	42.000	68.178	NA	99.000	NA
29 IC	NA	NA	NA	33.100	42.340	NA
30 TOC	NA	NA	NA	5.100	6.370	NA
31 CATIONS	3.469	5.711	6.567	7.429	8.269	9.263
32 ANIONS	2.336	32.225	5.676	NA	8.244	NA

Lysimeter #1 field chemistry
Masonry Cement
Boric Acid Concentrate
Drum 4-1

CUMULATIVE LEACHED, g														
DATE	DAY	DRAIN liters	CMLTV DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	1.10	0.04	0.137	0.060	0.012	.000	0.140	0.051	.000	0.004	.000	0.066	0.026
11-16-84	321	0.17	0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
1-24-85	390		0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
2-13-85	410	0.00	0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
3-11-85	436		0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
3-12-85	437		0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
3-29-85	454	0.00	0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
4-04-85	460		0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
4-12-85	488		0.05	0.148	0.073	0.015	.000	0.153	0.055	.000	0.005	0.021	0.077	0.029
6-28-85	537	50.20	1.90	3.528	4.998	1.120	0.024	1.719	0.577	0.012	0.337	12.370	3.390	0.737
7-23-85	570		1.90	3.528	4.998	1.120	0.024	1.719	0.577	0.012	0.337	12.370	3.390	0.737
8-14-85	592	27.70	3.01	5.389	7.783	1.765	0.037	2.064	0.943	0.019	0.507	19.077	5.246	1.176
10-24-85	683	24.20	3.93	5.635	10.276	2.339	0.049	3.559	1.330	0.025	0.645	27.040	6.892	1.602
1-30-86	761	20.50	5.01	5.845	13.981	3.238	0.066	4.500	1.701	0.029	0.793	39.438	8.744	2.049
2-22-86	784		5.01	5.845	13.981	3.238	0.066	4.500	1.701	0.029	0.793	39.438	8.744	2.049
2-28-86	790	50.80	8.95	8.214	19.185	4.500	0.089	5.770	2.210	0.035	1.029	51.300	11.386	2.926
3-07-86	797		8.95	8.214	19.185	4.500	0.089	5.770	2.210	0.035	1.029	51.300	11.386	2.926
3-13-86	803		8.95	8.214	19.185	4.500	0.089	5.770	2.210	0.035	1.029	51.300	11.386	2.926
3-21-86	811	50.00	9.15	8.836	25.127	5.958	0.115	7.220	2.805	0.041	1.299	64.843	14.402	3.926
3-28-86	818	14.00	9.68	8.738	28.561	6.300	0.121	7.570	2.947	0.042	1.364	68.112	15.130	4.188
4-03-86	824	9.00	10.02	8.804	27.484	6.531	0.125	7.795	3.039	0.043	1.400	70.213	15.598	4.323
4-10-86	831	13.00	10.52	8.890	28.815	6.856	0.131	8.120	3.171	0.045	1.466	73.249	16.274	4.547
4-17-86	838	9.00	10.86	8.984	29.737	7.061	0.135	8.345	3.262	0.046	1.500	75.350	16.742	4.702
4-25-86	846	9.70	11.23	7.033	30.464	7.261	0.138	8.510	3.333	0.046	1.548	75.661	17.120	4.885
5-01-86	852	7.50	11.52	7.087	31.007	7.390	0.139	8.656	3.368	0.047	1.577	76.568	17.409	5.030
5-08-86	859	9.50	11.88	7.155	31.696	7.554	0.141	8.841	3.412	0.047	1.613	77.718	17.775	5.214
5-15-86	866	9.80	12.25	7.225	32.406	7.723	0.143	9.032	3.457	0.048	1.651	78.903	18.152	5.405
5-22-86	873	7.40	12.53	7.278	32.942	7.851	0.144	9.177	3.492	0.048	1.680	79.799	18.437	5.548

Lysimeter #1 field chemistry (continued)
Masonry Cement
Boric Acid Concentrate
Drum 4-1

			CUMULATIVE LEACHED, g											
DATE	DAY	DRAIN liters	CMLTY DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
5-29-86	880	8.00	12.83	7.338	33.621	7.989	0.145	9.333	3.529	0.049	1.711	80.767	18.746	5.703
6-06-86	888	9.40	13.19	7.403	34.202	8.151	0.147	9.516	3.573	0.049	1.747	81.904	19.107	5.888
6-09-86	891		13.19	7.403	34.202	8.151	0.147	9.516	3.573	0.049	1.747	81.904	19.107	5.888
6-12-86	894	5.00	13.40	7.443	34.608	8.248	0.148	9.625	3.599	0.050	1.768	82.582	19.322	5.994
6-19-86	901	6.70	13.86	7.491	35.094	8.363	0.149	9.756	3.630	0.050	1.794	83.392	19.580	6.124
6-26-86	908	6.90	13.92	7.540	35.593	8.482	0.150	9.890	3.662	0.050	1.821	84.227	19.848	6.258
7-03-86	915	7.00	14.19	7.591	36.101	8.603	0.152	10.027	3.694	0.051	1.848	85.074	20.115	6.394
7-10-86	922	5.80	14.41	7.632	36.521	8.703	0.153	10.140	3.721	0.051	1.870	85.776	20.339	6.507
7-17-86	929	5.00	14.60	7.668	36.883	8.789	0.153	10.237	3.745	0.051	1.889	86.381	20.531	6.604
7-24-86	936	4.70	14.78	7.701	37.212	8.864	0.154	10.341	3.754	0.052	1.906	87.368	20.716	6.698
8-07-86	951	2.70	14.88	7.727	37.402	8.907	0.154	10.423	3.798	0.052	1.916	87.908	20.815	6.748
8-13-86	956	7.50	15.18	7.798	37.928	9.027	0.155	10.652	3.912	0.053	1.942	89.408	21.108	6.890
8-28-86	971	8.20	15.48	7.875	38.504	9.158	0.157	10.902	4.039	0.053	1.970	91.048	21.427	7.044
9-10-86	984	7.10	15.75	7.942	39.002	9.271	0.158	11.119	4.149	0.054	1.995	92.468	21.704	7.178
9-25-86	999	8.60	16.00	8.004	39.465	9.376	0.159	11.320	4.252	0.054	2.018	93.788	21.962	7.303
10-02-86	1006	5.10	16.19	8.053	39.823	9.458	0.160	11.475	4.331	0.055	2.038	94.808	22.161	7.399
10-23-86	1027	5.20	16.39	8.102	40.189	9.541	0.161	11.634	4.411	0.055	2.054	95.848	22.363	7.497
11-06-86	1041	3.10	16.51	8.131	40.407	9.590	0.162	11.755	4.501	0.055	2.065	96.437	22.487	7.552
11-20-86	1055	2.60	16.61	8.156	40.606	9.635	0.163	11.865	4.585	0.056	2.075	96.996	22.601	7.593
12-10-86	1075	2.50	16.70	8.179	40.797	9.679	0.164	11.971	4.665	0.058	2.085	97.534	22.709	7.633
12-30-86	1095	3.20	16.82	8.209	41.042	9.735	0.165	12.106	4.768	0.056	2.097	98.222	22.849	7.685
1-13-87	1109	1.00	16.88	8.225	41.164	9.763	0.166	12.174	4.820	0.056	2.103	98.566	22.918	7.711
1-26-87	1122	1.50	16.94	8.239	41.279	9.789	0.166	12.237	4.868	0.057	2.109	98.888	22.983	7.735
2-09-87	1136	1.30	16.99	8.254	41.386	9.814	0.167	12.298	4.914	0.057	2.114	99.200	23.044	7.753

Lysimeter #2 field chemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-1

				CUMULATIVE LEACHED, g										
DATE	DAY	DRAIN liters	CMLTV DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	1.07	0.04	0.259	0.050	0.011	.000	0.100	0.002	.000	0.003	.000	0.048	0.024
11-16-84	321	0.66	0.07	0.347	0.079	0.018	.000	0.250	0.133	.000	0.006	0.045	0.090	0.036
1-24-85	390	0.02	0.07	0.350	0.080	0.010	.000	0.250	0.135	.000	0.006	0.046	0.091	0.036
2-13-85	410	0.00	0.07	0.350	0.080	0.010	.000	0.250	0.135	.000	0.006	0.046	0.091	0.036
3-11-85	436	0.00	0.07	0.350	0.080	0.018	.000	0.250	0.135	.000	0.006	0.046	0.091	0.036
3-12-85	437	0.00	0.07	0.350	0.080	0.018	.000	0.250	0.135	.000	0.006	0.046	0.091	0.036
3-29-85	454	18.14	0.68	2.518	0.744	0.203	0.004	1.293	1.405	.000	0.132	2.242	1.399	0.251
4-04-85	460	0.00	0.68	2.518	0.744	0.203	0.004	1.293	1.405	.000	0.132	2.242	1.399	0.251
4-12-85	460	0.00	0.68	2.518	0.744	0.203	0.004	1.293	1.405	.000	0.132	2.242	1.399	0.251
6-20-85	537	57.78	2.80	10.278	5.169	1.405	0.028	2.743	1.604	0.001	0.681	12.584	6.599	1.268
7-23-85	570	0.00	2.80	10.278	5.169	1.405	0.028	2.743	1.604	0.001	0.681	12.584	6.599	1.268
8-14-85	592	29.39	3.99	14.225	11.084	2.681	0.055	5.037	2.170	0.002	1.281	17.096	22.020	1.819
10-24-85	663	23.71	4.90	14.848	18.879	4.246	0.089	8.143	2.597	0.003	1.973	20.131	44.793	2.291
1-30-86	781	17.14	5.55	15.388	25.496	5.006	0.117	12.257	2.940	0.004	2.796	22.994	68.791	2.563
2-22-86	784	0.00	5.55	15.388	25.496	5.006	0.117	12.257	2.940	0.004	2.796	22.994	68.791	2.563
2-28-86	790	40.50	7.09	16.682	38.638	9.080	0.172	21.998	3.494	0.006	4.173	26.841	119.416	3.331
3-07-86	797	0.00	7.09	16.682	38.638	9.080	0.172	21.998	3.494	0.006	4.173	26.841	119.416	3.331
3-13-86	803	0.00	7.09	16.682	38.638	9.080	0.172	21.998	3.494	0.006	4.173	26.841	119.416	3.331
3-21-86	811	62.00	9.44	18.866	58.757	14.093	0.255	36.909	4.344	0.009	6.281	32.731	196.916	4.506
3-28-86	818	14.00	9.98	19.114	63.300	15.225	0.274	40.276	4.536	0.009	6.757	34.061	214.416	4.771
4-03-86	824	10.00	10.36	19.434	66.545	16.033	0.287	42.601	4.673	0.010	7.097	35.011	226.916	4.980
4-10-86	831	11.00	10.78	19.786	70.115	16.923	0.302	45.326	4.823	0.010	7.471	36.058	240.688	5.169
4-17-86	838	9.00	11.12	20.074	73.035	17.650	0.314	47.491	4.947	0.011	7.777	36.911	251.916	5.339
4-25-86	846	10.48	11.52	20.414	75.786	18.390	0.325	50.012	5.024	0.011	7.986	37.152	263.422	5.570
5-01-86	852	7.05	11.78	20.890	78.864	19.274	0.338	54.739	5.110	0.012	8.222	37.515	280.519	5.739
5-08-86	859	9.20	12.13	21.510	82.800	20.427	0.354	60.907	5.222	0.012	8.530	37.989	302.829	5.960
5-15-86	866	8.74	12.47	22.099	86.892	21.522	0.370	66.764	5.329	0.013	8.823	38.439	324.011	6.169
5-22-86	873	7.44	12.75	22.600	89.938	22.454	0.384	71.749	5.420	0.013	9.072	38.821	342.041	6.348

Lysimeter #2 field chemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-1

CUMULATIVE LEACHED, g														
DATE	DAY	DRAIN liters	CMLTV DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
5-29-88	888	7.49	13.83	23.185	93.287	23.393	0.397	78.771	5.511	0.014	9.323	39.287	368.284	8.527
6-06-88	888	8.22	13.34	23.659	96.793	24.422	0.412	82.279	5.611	0.015	9.598	39.838	388.126	8.725
6-09-88	891	8.88	13.34	23.659	96.793	24.422	0.412	82.279	5.611	0.015	9.598	39.838	388.126	8.725
6-12-88	894	5.54	13.56	24.832	99.211	25.117	0.422	85.994	5.879	0.015	9.784	39.918	393.568	8.858
6-19-88	901	8.98	13.82	24.583	102.258	25.992	0.435	90.874	5.764	0.015	10.017	40.275	418.487	7.825
6-26-88	908	7.29	14.18	24.994	105.448	26.988	0.448	95.562	5.853	0.016	10.262	40.858	428.185	7.288
7-03-88	915	7.88	14.39	25.588	108.757	27.858	0.461	100.858	5.948	0.017	10.518	41.842	448.595	7.382
7-10-88	922	6.14	14.62	25.928	111.438	28.828	0.472	104.775	6.028	0.017	10.722	41.358	461.484	7.538
7-17-88	929	5.38	14.82	26.283	113.788	29.382	0.482	108.382	6.888	0.017	10.982	41.835	474.531	7.659
7-24-88	936	4.88	15.01	26.774	116.714	30.188	0.495	113.862	6.188	0.018	11.128	42.819	492.531	7.784
8-07-88	951	3.98	15.16	27.128	118.898	30.884	0.504	118.873	6.285	0.018	11.385	42.358	508.423	7.875
8-13-88	956	7.44	15.44	27.779	123.884	32.253	0.523	128.234	6.588	0.018	11.644	43.888	538.741	8.858
8-28-88	971	7.98	15.74	28.479	127.488	33.788	0.542	138.385	6.745	0.019	12.883	43.883	578.934	8.238
9-18-88	984	7.28	16.01	29.122	131.554	35.842	0.561	147.714	6.983	0.019	12.334	44.311	608.518	8.488
9-25-88	999	8.81	16.27	29.725	135.388	38.295	0.578	158.485	7.187	0.028	12.843	44.988	628.289	8.587
10-02-88	1008	5.18	16.47	30.177	138.224	37.234	0.598	163.819	7.328	0.028	12.875	45.342	649.852	8.688
10-23-88	1027	4.82	16.64	30.588	148.811	38.884	0.682	168.956	7.459	0.028	13.888	45.741	667.878	8.795
11-08-88	1041	4.18	16.88	30.956	142.932	38.888	0.612	175.871	7.837	0.028	13.269	48.128	688.182	8.882
11-20-88	1055	3.35	16.93	31.252	144.828	39.584	0.621	180.845	7.785	0.028	13.419	48.552	702.597	8.949
12-18-88	1075	3.75	17.87	31.584	148.951	40.348	0.631	185.814	7.958	0.028	13.568	47.826	728.972	9.823
12-30-88	1095	3.25	17.28	31.872	148.798	41.824	0.839	198.448	8.893	0.028	13.734	47.437	738.897	9.888
1-13-87	1109	2.18	17.27	32.858	149.979	41.482	0.845	193.559	8.188	0.028	13.829	47.783	747.187	9.129
1-26-87	1122	1.88	17.34	32.217	158.998	41.837	0.849	198.232	8.265	0.028	13.918	47.931	758.887	9.185
2-09-87	1138	1.88	17.48	32.337	151.993	42.283	0.854	198.832	8.337	0.028	13.984	48.187	764.647	9.195

Lysimeter #3 field chemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
 Drum 2-1

CUMULATIVE LEACHED, g														
DATE	DAY	DRAIN liters	CMLTY DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	0.85	0.03	0.111	0.044	0.007	.000	0.090	0.042	.000	0.012	.000	0.094	0.038
11-16-84	321	1.75	0.10	0.247	0.137	0.023	0.001	0.211	0.113	.000	0.030	0.098	0.258	0.094
1-24-85	390	0.89	0.13	0.300	0.174	0.030	0.001	0.259	0.142	.000	0.037	0.134	0.320	0.116
2-13-85	410	0.00	0.13	0.300	0.174	0.030	0.001	0.259	0.142	.000	0.037	0.134	0.320	0.116
3-11-85	436	0.00	0.13	0.300	0.174	0.030	0.001	0.259	0.142	.000	0.037	0.134	0.320	0.116
3-12-85	437	0.00	0.13	0.300	0.174	0.030	0.001	0.259	0.142	.000	0.037	0.134	0.320	0.116
3-29-85	454	1.40	0.18	0.409	0.251	0.045	0.002	0.304	0.188	.000	0.045	0.288	0.424	0.143
4-04-85	480	0.00	0.18	0.409	0.251	0.045	0.002	0.304	0.188	.000	0.045	0.288	0.424	0.143
4-12-85	468	0.00	0.18	0.409	0.251	0.045	0.002	0.304	0.188	.000	0.045	0.288	0.424	0.143
6-20-85	537	50.21	2.09	4.302	3.991	0.864	0.018	1.409	0.619	0.001	0.318	5.367	3.938	1.188
7-23-85	570	0.00	2.09	4.302	3.991	0.864	0.018	1.409	0.619	0.001	0.318	5.367	3.938	1.188
8-14-85	592	31.08	3.27	6.711	9.998	2.205	0.046	3.018	0.870	0.002	1.022	7.471	21.500	1.850
10-24-85	663	19.93	4.03	7.199	16.215	3.800	0.075	6.007	1.189	0.003	1.819	8.189	42.023	2.318
1-30-86	761	24.71	4.97	7.941	25.806	5.874	0.112	12.002	1.535	0.005	3.153	10.244	80.432	2.790
2-22-86	784	0.00	4.97	7.941	25.806	5.874	0.112	12.002	1.535	0.005	3.153	10.244	80.432	2.790
2-28-86	790	39.00	6.46	9.564	39.841	9.501	0.170	24.737	2.003	0.007	4.791	12.311	147.317	3.831
3-07-86	797	0.00	6.46	9.564	39.841	9.501	0.170	24.737	2.003	0.007	4.791	12.311	147.317	3.831
3-13-86	803	0.00	6.46	9.564	39.841	9.501	0.170	24.737	2.003	0.007	4.791	12.311	147.317	3.831
3-21-86	811	57.00	8.02	11.935	80.646	14.002	0.254	43.262	2.007	0.009	7.186	15.332	245.072	4.859
3-28-86	818	15.00	9.19	12.559	68.121	10.197	0.276	48.137	2.867	0.010	7.815	16.127	270.797	5.182
4-03-86	824	12.00	9.64	13.059	70.501	17.313	0.294	52.037	3.011	0.011	8.319	16.783	291.377	5.441
4-10-86	831	11.00	10.08	13.516	74.516	18.336	0.310	56.812	3.143	0.011	8.781	17.346	310.242	5.678
4-17-86	838	10.00	10.44	13.933	78.166	19.266	0.325	58.862	3.283	0.011	9.201	17.876	327.392	5.893
4-25-86	846	10.00	10.82	14.485	81.666	20.206	0.339	62.912	3.383	0.012	9.501	18.096	346.392	6.133
5-01-86	852	6.73	11.00	15.033	84.997	21.262	0.353	69.995	3.478	0.012	9.814	18.248	370.620	6.312
5-08-86	859	7.15	11.35	15.637	88.534	22.384	0.368	77.515	3.599	0.012	10.146	18.409	398.342	6.501
5-15-86	866	9.85	11.72	16.470	93.410	23.930	0.389	87.882	3.766	0.012	10.604	18.630	431.802	6.782
5-22-86	873	0.95	11.99	17.057	98.850	25.022	0.403	95.197	3.885	0.013	10.927	18.787	458.822	6.946

Lysimeter #3 field chemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
 Drum 2-1

DATE	DAY	DRAIN liters	CMLTY DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
6-29-86	888	8.78	12.32	17.797	101.184	26.398	0.421	104.412	4.833	0.013	11.335	18.984	488.348	7.178
6-06-86	888	8.41	12.84	18.507	105.344	27.716	0.439	113.258	4.176	0.013	11.725	19.173	518.598	7.401
6-09-86	891	8.80	12.84	18.507	105.344	27.716	0.439	113.258	4.176	0.013	11.725	19.173	518.598	7.401
6-12-86	894	5.84	12.83	18.933	107.839	28.507	0.458	118.563	4.282	0.013	11.968	19.288	536.742	7.535
6-19-86	901	7.36	13.11	19.555	111.482	29.682	0.465	126.389	4.387	0.013	12.382	19.452	563.238	7.738
6-26-86	908	7.48	13.48	20.187	115.185	30.837	0.481	134.182	4.514	0.013	12.658	19.628	590.166	7.928
7-03-86	915	7.68	13.68	20.829	118.947	32.038	0.496	142.181	4.843	0.014	13.003	19.791	617.526	8.129
7-10-86	922	6.94	13.95	21.416	122.382	33.128	0.511	149.485	4.781	0.014	13.328	19.947	642.518	8.313
7-17-86	929	4.88	14.13	21.827	124.788	33.883	0.521	154.888	4.844	0.014	13.552	20.058	668.888	8.442
7-24-86	936	4.72	14.31	22.373	127.889	34.921	0.534	162.824	4.957	0.014	13.849	20.185	685.822	8.579
8-07-86	951	4.14	14.47	22.835	130.218	35.915	0.545	171.829	5.148	0.014	14.137	20.312	711.725	8.895
8-13-86	956	8.68	14.88	23.884	135.244	37.998	0.569	190.588	5.541	0.014	14.748	20.828	787.711	8.938
8-28-86	971	7.95	15.18	24.891	139.855	39.986	0.598	207.799	5.982	0.014	15.293	20.982	818.989	9.168
9-18-86	984	7.82	15.48	25.583	144.391	41.783	0.812	224.887	6.258	0.014	15.838	21.188	869.428	9.379
9-25-86	999	8.52	15.65	26.291	148.172	43.347	0.829	238.988	6.555	0.014	16.289	21.411	911.482	9.562
10-02-86	1008	5.84	15.87	26.943	151.588	44.749	0.845	251.698	6.821	0.014	16.895	21.619	949.158	9.725
10-23-86	1027	5.28	18.87	27.532	154.822	48.816	0.859	283.174	7.881	0.014	17.862	21.888	983.288	9.873
11-08-86	1041	3.25	18.19	27.894	155.312	48.881	0.868	271.787	7.279	0.014	17.389	21.962	1007.988	9.961
11-28-86	1055	3.18	18.31	28.248	158.815	47.787	0.878	288.588	7.498	0.014	17.548	22.238	1032.788	10.039
12-18-86	1075	3.15	18.43	28.592	159.748	48.567	0.885	289.474	7.728	0.014	17.798	22.518	1057.988	10.119
12-30-86	1095	3.05	18.55	28.932	161.422	49.488	0.893	298.188	7.938	0.014	18.825	22.798	1082.388	10.188
1-13-87	1109	1.28	18.59	29.886	182.882	49.728	0.898	301.582	8.821	0.014	18.118	22.897	1091.988	10.228
1-26-87	1122	1.75	18.86	29.281	183.843	50.285	0.788	308.454	8.145	0.014	18.252	23.052	1105.988	10.278
2-09-87	1136	1.88	18.78	29.388	183.822	50.491	0.783	309.484	8.219	0.015	18.338	23.182	1114.388	10.294

Lysimeter #4 field chemistry
Dow Polymer
Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
Drum 7-2

DATE	DAY	DRAIN liters	CMLTV DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
10-26-84	300	1.10	0.04	0.378	0.068	0.020	.000	0.293	0.190	.000	0.006	.000	0.100	0.037
11-16-84	321	0.91	0.00	0.823	0.184	0.049	0.001	0.461	0.399	0.001	0.041	0.050	0.344	0.058
1-24-85	390	0.10	0.00	0.670	0.182	0.055	0.001	0.494	0.439	0.001	0.048	0.059	0.391	0.062
2-13-85	410	0.00	0.00	0.670	0.182	0.055	0.001	0.494	0.439	0.001	0.048	0.059	0.391	0.062
3-11-85	436	0.00	0.00	0.670	0.182	0.055	0.001	0.494	0.439	0.001	0.048	0.059	0.391	0.062
3-12-85	437	0.00	0.00	0.670	0.182	0.055	0.001	0.494	0.439	0.001	0.048	0.059	0.391	0.062
3-29-85	454	1.00	0.12	0.939	0.330	0.100	0.002	0.599	0.725	0.001	0.120	0.167	0.838	0.075
4-04-85	460	0.00	0.12	0.939	0.330	0.100	0.002	0.599	0.725	0.001	0.120	0.167	0.838	0.075
4-12-85	460	0.00	0.12	0.939	0.330	0.100	0.002	0.599	0.725	0.001	0.120	0.167	0.838	0.075
6-20-85	537	57.78	2.32	16.494	11.309	2.573	0.053	2.583	1.320	0.001	2.951	0.170	19.075	0.884
7-23-85	570	0.00	2.32	16.494	11.309	2.573	0.053	2.583	1.320	0.001	2.951	0.170	19.075	0.884
8-14-85	592	27.50	3.38	23.896	17.647	4.007	0.083	4.392	1.860	0.002	4.519	0.321	33.044	1.320
10-24-85	663	27.50	4.41	31.290	25.099	5.698	0.120	7.114	2.081	0.005	6.306	0.751	52.617	1.007
1-30-86	761	24.71	5.35	37.951	30.072	9.034	0.173	17.740	2.501	0.008	7.912	12.914	107.725	2.152
2-22-86	784	0.00	5.35	37.951	30.072	9.034	0.173	17.740	2.501	0.008	7.912	12.914	107.725	2.152
2-28-86	790	55.00	7.44	52.757	57.652	13.904	0.255	36.743	3.243	0.014	10.167	10.819	189.400	3.005
3-07-86	797	50.00	9.34	60.217	75.452	18.484	0.328	54.010	3.918	0.019	12.217	20.309	263.050	3.700
3-13-86	803	0.00	9.34	60.217	75.452	18.484	0.328	54.010	3.918	0.019	12.217	20.309	263.050	3.700
3-21-86	811	40.00	10.06	78.905	89.692	22.084	0.387	67.830	4.450	0.024	13.057	23.209	323.050	4.400
3-28-86	810	14.00	11.39	80.754	94.676	23.344	0.400	72.675	4.647	0.025	14.431	24.203	343.840	4.617
4-03-86	824	11.00	11.81	83.715	98.592	24.334	0.424	78.475	4.790	0.027	14.882	24.984	360.175	4.787
4-10-86	831	10.00	12.19	86.407	102.152	25.234	0.439	79.930	4.931	0.028	15.292	25.694	375.026	4.942
4-17-86	838	9.00	12.53	88.830	105.350	26.044	0.452	83.040	5.052	0.029	15.661	26.333	388.390	5.082
4-25-86	848	4.00	12.71	89.727	106.217	26.251	0.450	84.241	5.090	0.029	15.740	26.390	391.794	5.100
5-01-86	852	7.40	12.99	91.574	108.092	26.668	0.464	86.279	5.161	0.030	15.891	26.712	398.454	5.290
5-08-86	859	0.43	13.31	93.077	110.220	27.185	0.473	88.000	5.233	0.031	16.064	27.070	400.030	5.437
5-15-86	866	9.25	13.60	95.985	112.573	27.730	0.482	91.149	5.312	0.032	16.254	27.463	414.361	5.599
5-22-86	873	7.22	13.94	97.787	114.403	28.156	0.490	93.138	5.373	0.032	16.402	27.770	420.059	5.725

Lysimeter #4 field chemistry (continued)
Dow Polymer
Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
Drum 7-2

DATE	DAY	CMLTV		CUMULATIVE LEACHED, g										
		DRAIN liters	DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
6-29-86	888	7.79	14.23	99.732	116.378	28.616	0.490	95.284	5.439	0.033	16.561	28.101	427.870	5.862
8-06-86	888	7.99	14.54	101.726	118.404	29.087	0.507	97.485	5.507	0.034	16.725	28.441	435.081	6.002
8-09-86	891	8.00	14.54	101.726	118.404	29.087	0.507	97.485	5.507	0.034	16.725	28.441	435.081	6.002
8-12-86	894	5.56	14.75	103.113	119.812	29.415	0.513	99.016	5.564	0.034	16.839	28.677	440.081	6.099
8-19-86	901	6.75	15.00	104.797	121.523	29.813	0.520	100.875	5.612	0.035	16.977	28.964	446.136	6.217
8-26-86	908	8.83	15.26	106.501	123.253	30.218	0.527	102.758	5.670	0.036	17.117	29.254	452.278	6.336
7-03-86	915	6.90	15.53	108.223	125.002	30.623	0.535	104.656	5.728	0.037	17.259	29.547	458.488	6.457
7-10-86	922	5.92	15.75	109.701	126.503	30.973	0.541	106.287	5.779	0.037	17.380	29.799	463.816	6.561
7-17-86	929	4.58	15.93	110.844	127.664	31.243	0.546	107.549	5.818	0.038	17.474	29.993	467.938	6.641
7-24-86	936	4.94	16.11	112.347	129.245	31.603	0.553	108.982	5.852	0.038	17.592	30.344	473.175	6.730
8-07-86	951	3.94	16.28	114.791	131.026	32.000	0.561	111.957	5.908	0.039	17.744	30.590	482.946	6.795
8-13-86	958	8.19	16.57	119.873	134.734	33.181	0.578	118.140	6.210	0.040	18.059	31.102	503.257	6.930
8-28-86	971	8.22	16.89	124.973	138.453	34.117	0.595	124.346	6.452	0.042	18.376	31.616	523.643	7.065
9-10-86	984	7.54	17.17	129.652	141.865	35.048	0.610	130.039	6.675	0.043	18.666	32.007	542.342	7.190
9-25-86	999	7.18	17.45	134.107	145.114	35.935	0.625	135.460	6.887	0.044	18.943	32.538	560.140	7.308
10-02-86	1006	5.10	17.64	137.271	147.422	36.564	0.635	139.310	7.037	0.045	19.139	32.855	572.796	7.393
10-23-86	1027	6.10	17.87	141.058	150.182	37.318	0.648	143.916	7.217	0.046	19.374	33.238	587.924	7.493
11-06-86	1041	3.40	18.00	143.165	152.171	37.909	0.658	148.064	7.394	0.047	19.554	33.419	601.184	7.544
11-20-86	1055	3.55	18.14	145.388	154.681	38.689	0.669	152.892	7.580	0.048	19.771	33.702	617.159	7.595
12-10-86	1075	3.60	18.27	147.602	157.228	39.479	0.681	157.788	7.768	0.049	19.990	33.988	633.359	7.646
12-30-86	1095	3.55	18.41	149.805	159.738	40.258	0.693	162.616	7.954	0.050	20.207	34.270	649.334	7.696
1-13-87	1109	1.75	18.48	150.890	160.973	40.642	0.699	164.996	8.046	0.050	20.314	34.489	657.209	7.721
1-26-87	1122	2.13	18.56	152.209	162.475	41.109	0.706	167.886	8.157	0.051	20.443	34.578	666.772	7.751
2-09-87	1138	1.85	18.62	153.754	163.843	41.546	0.713	170.361	8.244	0.051	20.557	34.751	675.187	7.773

Lysimeter #5 field chemistry
 Bitumen
 Boric Acid Evaporator Concentrate
 Drum #1

DATE	DAY	DRAIN liters	CMLTV		TOC	CUMULATIVE LEACHED, g									
			DRAIN	cm		Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11-16-84	321	0.24	0.01	0.001	0.013	0.002	.000	.000	0.012	0.010	.000	0.001	0.017	0.019	0.004
1-24-85	390	0.02	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
2-13-85	410	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
3-11-85	436	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
3-12-85	437	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
3-29-85	454	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
4-04-85	480	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
4-12-85	488	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
6-20-85	537	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
7-23-85	570	0.00	0.01	0.001	0.014	0.003	.000	.000	0.014	0.011	.000	0.001	0.019	0.020	0.004
8-14-85	592	0.03	0.01	0.001	0.015	0.003	.000	.000	0.015	0.012	.000	0.001	0.021	0.023	0.004
10-24-85	663	0.50	0.03	0.004	0.042	0.008	.000	.000	0.042	0.033	.000	0.003	0.057	0.062	0.012
1-30-86	761	0.30	0.04	0.006	0.063	0.013	.000	.000	0.053	0.041	.000	0.004	0.108	0.093	0.016
2-22-86	764	0.00	0.04	0.006	0.063	0.013	.000	.000	0.053	0.041	.000	0.004	0.108	0.093	0.016
2-28-86	790	29.25	1.15	0.184	1.952	0.455	0.009	0.901	0.530	0.254	0.126	2.814	2.030	0.474	
3-07-86	797	65.00	3.02	0.581	6.147	1.436	0.029	2.786	1.615	0.810	0.395	0.027	0.381	1.491	
3-13-86	803	0.00	3.02	0.581	6.147	1.436	0.029	2.786	1.615	0.810	0.395	0.027	0.381	1.491	
3-21-86	811	30.00	5.07	0.813	8.600	2.010	0.041	3.880	2.250	1.148	0.553	12.342	0.888	2.086	
3-28-86	818	12.00	5.53	0.886	9.375	2.191	0.044	4.238	2.450	1.252	0.603	13.452	9.686	2.274	
4-03-86	824	11.00	5.94	0.953	10.005	2.357	0.048	4.555	2.634	1.347	0.648	14.469	10.417	2.448	
4-10-86	831	10.00	6.32	1.014	10.730	2.500	0.051	4.845	2.801	1.434	0.690	15.394	11.082	2.602	
4-17-86	838	9.50	6.89	1.072	11.344	2.652	0.054	5.121	2.959	1.517	0.729	16.273	11.714	2.751	
4-25-86	846	11.20	7.11	1.140	12.005	2.811	0.057	5.345	3.031	1.710	0.764	16.441	12.039	2.951	
5-01-86	852	0.80	7.45	1.196	12.558	2.939	0.059	5.543	3.080	1.860	0.795	17.166	12.325	3.112	
5-08-86	859	8.61	7.77	1.251	13.094	3.065	0.062	5.736	3.104	2.017	0.826	17.876	12.804	3.271	
5-15-86	866	9.16	8.12	1.310	13.667	3.199	0.065	5.942	3.143	2.179	0.858	18.632	12.902	3.439	
5-22-86	873	7.41	8.40	1.357	14.130	3.307	0.067	6.109	3.174	2.310	0.885	19.243	13.143	3.576	

Lysimeter #5 field chemistry (continued)
 Bitumen
 Boric Acid Evaporator Concentrate
 Drum #1

DATE	DAY	DRAIN liters	CMLTV DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
5-29-88	888	7.27	8.68	1.483	14.585	3.413	0.089	8.273	3.284	2.438	0.910	19.843	13.379	3.789
6-06-88	888	7.43	8.96	1.451	15.049	3.521	0.071	8.440	3.238	2.589	0.937	20.456	13.621	3.848
6-09-88	891	8.00	8.96	1.451	15.049	3.521	0.071	8.440	3.238	2.569	0.937	20.456	13.621	3.848
6-12-88	894	5.45	9.17	1.488	15.390	3.601	0.073	8.562	3.258	2.685	0.958	20.905	13.798	3.948
6-19-88	901	6.00	9.40	1.524	15.760	3.688	0.074	8.697	3.284	2.771	0.977	21.400	13.993	4.057
6-26-88	908	6.21	9.63	1.564	16.154	3.779	0.078	8.837	3.310	2.881	1.000	21.913	14.195	4.171
7-03-88	915	6.43	9.88	1.605	16.558	3.873	0.078	8.982	3.337	2.994	1.022	22.443	14.403	4.289
7-10-88	922	5.33	10.08	1.639	16.890	3.951	0.080	7.102	3.359	3.080	1.041	22.883	14.577	4.387
7-17-88	929	4.26	10.24	1.686	17.152	4.012	0.081	7.198	3.377	3.163	1.058	23.229	14.713	4.465
7-24-88	936	4.84	10.42	1.698	17.472	4.086	0.082	7.317	3.388	3.250	1.076	23.955	14.887	4.556
8-07-88	951	3.02	10.54	1.725	17.680	4.132	0.083	7.485	3.418	3.304	1.089	24.453	15.011	4.612
8-13-88	956	7.02	10.83	1.794	18.287	4.251	0.088	7.628	3.498	3.440	1.124	25.711	15.324	4.754
8-28-88	971	7.38	11.11	1.860	18.717	4.387	0.088	7.843	3.578	3.572	1.158	26.928	15.628	4.891
9-10-88	984	6.80	11.37	1.921	19.187	4.473	0.091	8.042	3.647	3.694	1.198	28.050	15.905	5.017
9-25-88	999	6.60	11.62	1.981	19.843	4.576	0.093	8.235	3.718	3.812	1.220	29.139	16.178	5.139
10-02-88	1006	4.50	11.79	2.021	19.954	4.647	0.094	8.368	3.784	3.893	1.241	29.882	16.360	5.223
10-23-88	1027	5.50	12.00	2.071	20.334	4.733	0.096	8.527	3.821	3.991	1.266	30.789	16.588	5.325
11-06-88	1041	3.52	12.13	2.103	20.588	4.790	0.097	8.644	3.888	4.054	1.284	31.423	16.748	5.389
11-20-88	1055	3.08	12.25	2.130	20.835	4.848	0.098	8.748	3.927	4.107	1.301	32.043	16.911	5.438
12-10-88	1075	3.25	12.37	2.160	21.098	4.905	0.100	8.857	3.967	4.163	1.319	32.697	17.083	5.490
12-30-88	1095	2.88	12.48	2.186	21.328	4.957	0.101	8.954	4.003	4.212	1.335	33.278	17.235	5.538
1-13-87	1109	1.33	12.53	2.198	21.434	4.981	0.101	8.999	4.020	4.235	1.343	33.545	17.308	5.558
1-20-87	1122	1.65	12.60	2.212	21.567	5.011	0.102	9.054	4.040	4.263	1.352	33.877	17.393	5.584
2-09-87	1136	1.10	12.64	2.225	21.684	5.033	0.102	9.091	4.047	4.282	1.358	34.123	17.459	5.599

Lysimeter #6 field chemistry
 Bitumen
 Boric Acid Evaporator Concentrate
 Drum #2

DATE	DAY	DRAIN liters	CMLTV DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	0.95	0.04	0.010	0.002	0.020	0.000	0.053	0.039	0.000	0.005	0.001	0.059	0.017
11-16-84	321	1.50	0.09	0.020	0.212	0.051	0.001	0.138	0.102	0.000	0.012	0.209	0.153	0.043
1-24-85	390	0.15	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
2-13-85	410	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
3-11-85	436	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
3-12-85	437	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
3-29-85	454	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
4-04-85	480	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
4-12-85	488	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
6-20-85	537	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
7-23-85	570	0.00	0.10	0.027	0.225	0.054	0.001	0.145	0.100	0.000	0.012	0.221	0.162	0.045
8-14-85	592	1.00	0.14	0.030	0.311	0.075	0.002	0.200	0.149	0.000	0.017	0.306	0.225	0.063
10-24-85	663	0.30	0.15	0.041	0.336	0.081	0.002	0.212	0.150	0.000	0.019	0.342	0.242	0.067
1-30-86	761	11.48	0.58	0.162	1.287	0.311	0.007	0.602	0.341	0.001	0.074	2.153	0.941	0.227
2-22-86	784	0.00	0.58	0.162	1.287	0.311	0.007	0.602	0.341	0.001	0.074	2.153	0.941	0.227
2-28-86	790	24.00	1.50	0.415	3.174	0.769	0.016	1.238	0.595	0.200	0.194	4.349	2.001	0.619
3-07-86	797	65.00	3.97	1.101	8.203	2.010	0.040	2.901	1.200	1.094	0.519	10.296	5.160	1.602
3-13-86	803	119.00	8.49	2.350	17.630	4.283	0.085	6.114	2.536	2.556	1.114	21.185	10.021	3.627
3-21-86	811	44.00	10.18	2.821	21.095	5.124	0.101	7.280	3.090	3.090	1.334	25.211	12.911	4.347
3-28-86	818	15.00	10.74	2.979	22.274	5.410	0.107	7.678	3.150	3.280	1.409	26.603	13.623	4.592
4-03-86	824	14.00	11.27	3.127	23.374	5.670	0.112	8.049	3.300	3.452	1.479	27.864	14.280	4.821
4-10-86	831	12.00	11.72	3.253	24.317	5.907	0.110	8.367	3.433	3.600	1.539	28.982	14.850	5.017
4-17-86	838	11.00	12.14	3.369	25.182	6.117	0.121	8.658	3.549	3.735	1.594	29.909	15.381	5.197
4-25-86	846	13.75	12.06	3.457	26.202	6.367	0.125	8.919	3.619	4.072	1.665	30.313	15.848	5.455
5-01-86	852	0.70	13.00	3.522	26.901	6.535	0.120	9.100	3.650	4.337	1.711	31.257	16.109	5.630
5-08-86	859	10.51	13.40	3.599	27.737	6.738	0.132	9.334	3.887	4.655	1.786	32.386	16.552	5.839
5-15-86	866	10.00	13.70	3.672	28.533	6.927	0.135	9.549	3.723	4.957	1.819	33.461	16.917	6.038
5-22-86	873	0.42	14.10	3.734	29.203	7.087	0.138	9.730	3.753	5.212	1.863	34.388	17.225	6.200

Lysimeter #6 field chemistry (continued)
 Bitumen
 Boric Acid Evaporator Concentrate
 Drum #2

DATE	DAY	DRAIN liters	CMLTV DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
5-29-86	888	7.53	14.38	3.790	29.802	7.231	0.141	9.892	3.779	5.440	1.983	35.175	17.499	8.358
6-06-86	888	7.73	14.68	3.848	30.417	7.379	0.143	10.058	3.807	5.674	1.943	36.005	17.781	8.509
6-09-86	891	8.00	14.68	3.846	30.417	7.379	0.143	10.058	3.807	5.674	1.943	36.005	17.781	8.509
6-12-86	894	8.70	14.93	3.898	30.950	7.507	0.148	10.202	3.830	5.876	1.978	36.725	18.026	8.843
6-19-86	901	8.88	15.19	3.946	31.498	7.638	0.148	10.350	3.855	6.084	2.014	37.485	18.277	8.779
6-26-86	908	8.87	15.46	3.997	32.045	7.769	0.151	10.497	3.879	6.292	2.050	38.203	18.527	8.918
7-03-86	915	8.88	15.72	4.047	32.591	7.900	0.153	10.645	3.904	6.499	2.086	38.941	18.778	7.053
7-10-86	922	5.84	15.94	4.090	33.050	8.012	0.155	10.770	3.924	6.876	2.117	39.568	18.991	7.169
7-17-86	929	5.00	16.13	4.127	33.454	8.107	0.157	10.878	3.942	6.827	2.143	40.100	19.174	7.268
7-24-86	936	4.78	16.31	4.166	33.858	8.202	0.159	10.992	3.952	6.999	2.169	41.010	19.359	7.368
8-07-86	951	3.98	16.46	4.201	34.194	8.282	0.160	11.100	3.989	7.134	2.190	41.808	19.520	7.449
8-13-86	956	8.04	16.77	4.272	34.873	8.444	0.163	11.319	4.068	7.409	2.234	43.414	19.846	7.611
8-28-86	971	7.56	17.05	4.339	35.511	8.596	0.168	11.525	4.138	7.600	2.275	44.928	20.152	7.783
9-10-86	984	6.92	17.32	4.400	36.095	8.735	0.169	11.713	4.203	7.902	2.313	46.310	20.432	7.902
9-25-86	999	6.62	17.57	4.458	36.654	8.888	0.171	11.893	4.266	8.128	2.349	47.634	20.701	8.036
10-02-86	1006	5.10	17.76	4.503	37.084	8.971	0.173	12.032	4.315	8.302	2.377	48.654	20.907	8.138
10-23-86	1027	5.10	17.96	4.548	37.514	9.073	0.175	12.171	4.363	8.476	2.405	49.674	21.114	8.241
11-06-86	1041	3.54	18.09	4.579	37.811	9.145	0.177	12.278	4.423	8.590	2.424	50.418	21.262	8.310
11-20-86	1055	2.65	18.19	4.603	38.051	9.202	0.178	12.365	4.480	8.654	2.439	51.173	21.397	8.354
12-10-86	1075	3.10	18.31	4.630	38.332	9.269	0.179	12.467	4.548	8.729	2.456	52.056	21.556	8.407
12-30-86	1095	2.65	18.41	4.653	38.571	9.328	0.180	12.554	4.602	8.792	2.471	52.812	21.691	8.452
1-13-87	1109	1.68	18.47	4.668	38.723	9.362	0.181	12.610	4.636	8.833	2.480	53.289	21.776	8.480
1-26-87	1122	1.50	18.53	4.681	38.859	9.395	0.182	12.659	4.670	8.869	2.489	53.717	21.853	8.508
2-09-87	1136	1.40	18.58	4.695	38.995	9.427	0.182	12.709	4.706	8.891	2.496	54.221	21.937	8.526

Lysimeter #7 field chemistry
Masonry Cement
Boric Acid Concentrate
Drum 4-2

CUMULATIVE LEACHED, g														
DATE	DAY	DRAIN liters	CMLTV DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	0.82	0.03	0.153	0.079	0.009	0.000	0.107	0.051	0.000	0.005	0.000	0.177	0.026
11-16-84	321	0.45	0.05	0.197	0.118	0.015	0.001	0.150	0.075	0.000	0.007	0.041	0.255	0.030
1-24-85	390	0.06	0.05	0.202	0.123	0.016	0.001	0.158	0.078	0.000	0.008	0.046	0.264	0.030
2-13-85	410	0.00	0.05	0.202	0.123	0.016	0.001	0.158	0.078	0.000	0.008	0.046	0.264	0.030
3-11-85	436	0.00	0.05	0.202	0.123	0.016	0.001	0.158	0.078	0.000	0.008	0.046	0.264	0.030
3-12-85	437	0.00	0.05	0.202	0.123	0.016	0.001	0.158	0.078	0.000	0.008	0.046	0.264	0.030
3-29-85	454	0.57	0.38	1.044	0.817	0.150	0.002	0.720	0.472	0.000	0.066	1.597	1.395	0.157
4-04-85	460	0.00	0.38	1.044	0.817	0.150	0.002	0.720	0.472	0.000	0.066	1.597	1.395	0.157
4-12-85	480	0.00	0.38	1.044	0.817	0.150	0.002	0.720	0.472	0.000	0.066	1.597	1.395	0.157
8-20-85	537	67.25	2.93	7.651	7.676	1.589	0.058	2.717	1.124	0.001	0.402	13.970	7.448	1.145
7-23-85	570	0.00	2.93	7.651	7.676	1.589	0.058	2.717	1.124	0.001	0.402	13.970	7.448	1.145
8-14-85	592	27.40	3.97	10.343	10.376	2.146	0.076	3.582	1.422	0.002	0.539	19.778	9.571	1.579
10-24-85	663	24.71	4.91	12.771	12.723	2.865	0.086	4.353	1.718	0.003	0.883	25.709	11.177	2.000
1-30-86	761	32.28	6.14	15.943	15.822	3.375	0.100	5.353	2.073	0.005	0.837	34.103	13.243	2.471
2-22-86	784	0.00	6.14	15.943	15.822	3.375	0.100	5.353	2.073	0.005	0.837	34.103	13.243	2.471
2-26-86	790	26.00	7.13	18.497	17.807	3.833	0.109	5.990	2.300	0.009	0.948	37.730	14.543	2.888
3-07-86	797	0.00	7.13	18.497	17.807	3.833	0.109	5.990	2.300	0.009	0.948	37.730	14.543	2.888
3-13-86	803	100.00	10.93	28.322	25.442	5.593	0.143	8.440	3.170	0.025	1.373	51.680	19.543	4.493
3-21-86	811	32.00	12.15	31.486	27.885	6.150	0.154	9.224	3.448	0.030	1.509	56.144	21.143	5.007
3-28-86	818	14.00	12.68	32.842	28.954	6.402	0.169	9.587	3.570	0.032	1.568	58.097	21.843	5.231
4-03-86	824	14.00	13.21	34.217	30.023	6.649	0.184	9.910	3.692	0.034	1.628	60.050	22.543	5.458
4-10-86	831	11.00	13.63	35.298	30.863	6.842	0.188	10.180	3.787	0.036	1.674	61.584	23.093	5.833
4-17-86	838	9.00	13.97	36.182	31.550	7.001	0.171	10.400	3.866	0.037	1.713	62.640	23.543	5.777
4-25-86	846	9.38	14.33	36.272	32.080	7.124	0.173	10.589	3.925	0.040	1.742	63.010	23.880	5.941
5-01-86	852	8.39	14.65	36.350	32.532	7.180	0.175	10.741	3.965	0.043	1.780	63.559	24.170	6.090
5-08-86	859	7.48	14.93	36.410	32.935	7.229	0.177	10.894	4.000	0.046	1.791	64.041	24.443	6.223
5-15-86	866	9.00	15.27	36.503	33.420	7.289	0.179	11.079	4.042	0.049	1.819	64.622	24.763	6.382
5-22-86	873	7.67	15.57	36.574	33.832	7.340	0.181	11.238	4.078	0.052	1.843	65.118	25.035	6.518

Lysimeter #7 field chemistry
Masonry Cement
Boric Acid Concentrate
Drum 4-2

DATE	DAY	DRAIN liters	CMLTY DRAIN cm	TOC	CUMULATIVE LEACHED, g									
					Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
6-29-88	888	8.48	15.81	36.634	34.181	7.383	0.182	11.369	4.189	0.055	1.863	65.534	25.285	6.633
8-08-88	888	9.05	16.16	36.718	34.669	7.443	0.185	11.554	4.161	0.058	1.891	66.118	25.586	6.794
8-09-88	891	0.00	16.16	36.718	34.669	7.443	0.185	11.554	4.161	0.058	1.891	66.118	25.586	6.794
8-12-88	894	5.62	16.37	36.778	34.971	7.488	0.188	11.809	4.178	0.060	1.908	66.480	25.786	6.894
8-19-88	901	6.62	16.62	36.831	35.328	7.524	0.188	11.805	4.209	0.063	1.929	66.907	26.021	7.011
8-26-88	908	6.42	16.87	36.890	35.673	7.567	0.189	11.937	4.239	0.065	1.949	67.321	26.249	7.125
7-03-88	915	6.22	17.18	36.948	36.008	7.608	0.191	12.064	4.268	0.068	1.968	67.723	26.478	7.238
7-10-88	922	6.00	17.29	36.994	36.278	7.641	0.192	12.167	4.292	0.070	1.983	68.045	26.647	7.324
7-17-88	929	4.62	17.46	37.036	36.521	7.671	0.193	12.259	4.313	0.072	1.997	68.337	26.808	7.405
7-24-88	936	5.02	17.66	37.081	36.777	7.671	0.194	12.375	4.328	0.074	2.013	68.689	26.983	7.495
8-07-88	951	3.52	17.79	37.118	36.991	7.697	0.195	12.484	4.370	0.076	2.029	69.382	27.142	7.558
8-13-88	956	6.66	18.04	37.187	37.391	7.746	0.197	12.698	4.449	0.079	2.059	70.306	27.439	7.676
8-28-88	971	6.16	18.27	37.251	37.762	7.792	0.199	12.879	4.523	0.082	2.088	71.160	27.713	7.784
9-10-88	984	5.56	18.48	37.318	38.099	7.833	0.200	13.052	4.589	0.085	2.113	71.938	27.983	7.884
9-25-88	999	5.34	18.69	37.386	38.423	7.873	0.202	13.218	4.653	0.088	2.138	72.686	28.204	7.979
10-02-88	1006	3.50	18.82	37.402	38.636	7.899	0.203	13.327	4.695	0.089	2.154	73.176	28.361	8.042
10-23-88	1027	4.10	18.98	37.445	38.885	7.929	0.204	13.455	4.745	0.091	2.173	73.750	28.546	8.115
11-06-88	1041	3.12	19.09	37.478	39.104	7.975	0.205	13.577	4.816	0.093	2.192	74.288	28.717	8.178
11-20-88	1055	2.53	19.19	37.505	39.277	8.012	0.206	13.672	4.862	0.094	2.204	74.697	28.837	8.218
12-10-88	1075	2.93	19.36	37.535	39.478	8.055	0.207	13.783	4.922	0.095	2.218	75.179	28.978	8.258
12-30-88	1095	3.15	19.42	37.568	39.693	8.101	0.208	13.902	4.986	0.097	2.234	75.699	29.126	8.308
1-13-87	1109	2.83	19.50	37.598	39.832	8.131	0.208	13.979	5.028	0.098	2.244	76.033	29.222	8.338
1-26-87	1122	1.80	19.57	37.609	39.955	8.157	0.209	14.047	5.065	0.099	2.253	76.338	29.307	8.366
2-09-87	1136	1.65	19.63	37.629	40.085	8.181	0.209	14.107	5.098	0.099	2.259	76.594	29.373	8.389

Lysimeter #8 field chemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-2

CUMULATIVE LEACHED, g														
DATE	DAY	DRAIN liters	CMLTY DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	0.68	0.03	0.123	0.051	0.011	.000	0.103	0.059	.000	0.003	.000	0.122	0.026
11-16-84	321	0.49	0.04	0.176	0.092	0.020	0.001	0.146	0.082	.000	0.005	0.022	0.214	0.039
1-24-85	390	0.07	0.05	0.183	0.090	0.021	0.001	0.152	0.085	.000	0.006	0.025	0.227	0.041
2-13-85	410	173.34	6.04	18.835	14.842	3.266	0.079	15.302	0.163	0.017	0.979	7.669	32.818	4.930
3-11-85	438	125.92	11.42	32.383	25.206	5.023	0.135	26.308	14.031	0.029	1.686	13.222	56.488	8.481
3-12-85	437	39.75	12.94	38.660	28.541	6.368	0.153	29.781	15.083	0.032	1.909	14.975	63.961	9.601
3-29-85	454	31.28	14.13	40.026	31.413	7.037	0.164	30.463	16.046	0.033	2.144	17.728	70.061	10.180
4-04-85	460	0.00	14.13	40.026	31.413	7.037	0.164	30.463	16.046	0.033	2.144	17.728	70.061	10.180
4-12-85	460	0.00	14.13	40.026	31.413	7.037	0.164	30.463	16.046	0.033	2.144	17.728	70.061	10.180
6-20-85	537	55.89	16.25	46.040	36.672	8.216	0.186	31.654	16.459	0.033	5.329	20.914	80.512	11.287
7-23-85	570	0.00	16.25	46.040	36.672	8.216	0.186	31.654	16.459	0.033	5.329	20.914	80.512	11.287
8-14-85	592	23.71	17.15	48.591	40.823	9.190	0.205	33.246	16.761	0.034	6.385	21.606	94.052	11.790
10-24-85	663	18.03	17.84	50.532	45.439	10.290	0.227	35.284	17.085	0.035	6.962	21.658	111.274	12.210
1-30-86	761	36.07	19.21	54.413	57.378	13.211	0.276	42.245	17.690	0.037	8.621	23.626	158.164	12.744
2-22-86	784	82.00	22.33	63.236	81.281	19.484	0.374	50.845	18.699	0.041	11.245	26.209	258.564	14.286
2-28-86	790	14.00	22.86	64.742	85.382	20.555	0.390	61.445	18.870	0.041	11.693	26.650	273.384	14.549
3-07-86	797	0.00	22.86	64.742	85.382	20.555	0.390	61.445	18.870	0.041	11.693	26.650	273.384	14.549
3-13-86	803	30.00	24.00	67.970	94.107	22.850	0.426	67.445	19.236	0.043	12.653	27.595	309.384	15.113
3-21-86	811	12.00	24.46	69.281	97.005	23.768	0.446	69.645	19.382	0.043	13.037	27.973	323.784	15.339
3-28-86	818	19.00	25.18	71.306	103.144	25.222	0.463	73.645	19.614	0.044	13.845	28.571	346.584	15.696
4-03-86	824	14.50	25.73	72.066	107.370	26.331	0.480	76.545	19.791	0.045	14.109	29.020	363.964	15.989
4-10-86	831	11.00	26.15	74.050	110.577	27.173	0.493	78.745	19.925	0.045	14.461	29.374	377.184	16.175
4-17-86	838	9.00	26.49	75.018	113.200	27.801	0.503	80.545	20.035	0.045	14.749	29.658	387.964	16.345
4-25-86	846	9.74	26.86	75.342	115.655	28.582	0.513	82.581	20.187	0.046	14.924	29.794	398.676	16.569
5-01-86	852	7.49	27.14	75.989	116.778	29.610	0.525	89.698	20.224	0.046	15.186	29.854	421.801	16.767
5-08-86	859	8.26	27.46	76.702	118.017	30.702	0.538	97.574	20.354	0.046	15.475	29.920	447.487	16.986
5-15-86	868	8.60	27.79	77.451	119.319	32.006	0.552	105.851	20.490	0.046	15.779	29.990	474.395	17.216
5-22-86	873	7.23	28.06	78.075	120.402	33.025	0.563	112.740	20.604	0.047	16.032	30.048	496.793	17.407

Lysimeter #8 field chemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate
 Drum 1-2

DATE	DAY	DRAIN liters	CMLTY DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
5-29-88	888	7.33	28.34	78.787	121.581	34.858	8.575	119.724	28.719	8.847	18.288	38.188	519.588	17.882
8-08-88	888	18.38	28.74	79.883	123.857	35.521	8.591	129.817	28.882	8.847	18.851	38.189	551.883	17.878
8-09-88	891	8.88	28.74	79.883	123.857	35.521	8.591	129.817	28.882	8.847	18.851	38.189	551.883	17.878
8-12-88	894	5.98	28.98	88.112	123.942	38.353	8.888	135.242	28.974	8.847	18.858	38.238	569.953	18.833
8-19-88	981	7.72	29.25	88.778	125.188	37.441	8.812	142.883	21.895	8.847	17.128	38.298	593.885	18.237
8-28-88	988	7.78	29.55	81.448	128.284	38.535	8.825	149.999	21.217	8.847	17.488	38.388	617.928	18.443
7-03-88	915	7.48	29.83	82.887	127.374	39.578	8.838	157.855	21.333	8.848	17.859	38.419	648.888	18.639
7-18-88	922	5.88	38.85	82.577	128.228	48.379	8.845	182.478	21.423	8.848	17.857	38.485	658.478	18.798
7-17-88	929	5.92	38.27	83.888	129.114	41.214	8.854	188.115	21.515	8.848	18.885	38.512	678.828	18.948
7-24-88	938	4.88	38.45	83.748	129.338	42.198	8.885	178.871	21.828	8.848	18.388	38.522	788.898	18.887
8-07-88	951	3.84	38.59	84.188	138.245	42.988	8.872	183.387	21.781	8.848	18.582	38.858	721.248	18.194
8-13-88	958	7.58	38.88	85.887	132.834	44.528	8.888	197.789	22.885	8.848	18.885	38.927	781.793	19.484
8-28-88	971	7.38	31.18	85.817	133.758	48.815	8.783	211.839	22.377	8.848	19.253	31.188	888.848	19.887
9-18-88	984	8.38	31.48	88.522	135.257	47.313	8.718	223.723	22.831	8.848	19.575	31.412	834.874	19.784
9-25-88	999	8.18	31.84	87.288	138.718	48.573	8.729	235.485	22.878	8.848	19.887	31.831	887.937	19.958
10-02-88	1888	4.98	31.82	87.751	137.872	49.573	8.739	244.775	23.874	8.848	28.134	31.885	894.152	28.892
10-23-88	1827	4.78	32.88	88.273	138.981	58.532	8.749	253.785	23.282	8.848	28.371	31.972	919.297	28.223
11-08-88	1841	3.78	32.15	88.898	148.578	51.278	8.758	281.881	23.473	8.848	28.558	32.231	948.353	28.319
11-28-88	1855	3.85	32.28	89.828	142.885	51.924	8.782	287.938	23.848	8.848	28.782	32.529	957.738	28.393
12-18-88	1875	3.38	32.39	89.394	143.551	52.828	8.789	274.777	23.822	8.848	28.888	32.851	978.548	28.474
12-38-88	1895	3.18	32.58	89.738	145.883	53.284	8.778	281.218	23.992	8.849	21.889	33.153	994.218	28.558
1-13-87	1189	1.88	32.57	89.938	145.848	53.887	8.788	284.945	24.891	8.849	21.898	33.328	1884.478	28.594
1-28-87	1122	1.55	32.83	98.189	148.572	53.998	8.783	288.181	24.177	8.849	21.178	33.479	1813.313	28.831
2-09-87	1138	1.35	32.88	98.221	147.285	54.383	8.788	298.929	24.258	8.849	21.233	33.658	1821.143	28.883

Lysimeter #9 field chemistry
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
 Drum 2-2

DATE	DAY	DRAIN liters	CMLTY DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO3-	SO4--	Si
10-26-84	300	1.09	0.04	0.231	0.154	0.021	0.001	0.120	0.095	.000	0.000	.000	0.284	0.024
11-16-84	321	0.67	0.07	0.327	0.225	0.033	0.001	0.183	0.126	.000	0.013	0.038	0.404	0.039
1-24-85	390	0.01	0.07	0.328	0.226	0.034	0.001	0.183	0.127	.000	0.013	0.039	0.406	0.039
2-13-85	410	199.73	7.66	28.910	21.358	3.631	0.102	12.926	9.484	0.012	1.501	11.264	35.958	4.313
3-11-85	438	120.24	12.23	48.117	34.079	5.798	0.163	20.810	15.085	0.019	2.398	18.005	57.361	8.886
3-12-85	437	19.87	12.99	48.980	36.182	6.154	0.173	21.080	16.014	0.021	2.544	19.121	60.898	7.312
3-29-85	454	23.71	13.09	52.354	37.844	6.543	0.180	22.302	16.189	0.021	2.734	21.777	63.151	7.798
4-04-85	460	0.00	13.89	52.354	37.844	6.543	0.180	22.302	16.189	0.021	2.734	21.777	63.151	7.798
4-12-85	460	0.00	13.89	52.354	37.844	6.543	0.180	22.302	16.189	0.021	2.734	21.777	63.151	7.798
6-20-85	537	48.32	15.73	59.268	42.294	7.524	0.199	23.380	16.565	0.021	3.189	25.207	71.413	8.754
7-23-85	570	0.00	15.73	59.280	42.294	7.524	0.199	23.380	16.585	0.021	3.189	25.207	71.413	8.754
8-14-85	592	26.55	16.74	63.067	48.079	8.905	0.231	34.909	17.077	0.022	3.833	28.014	100.850	9.421
10-24-85	663	20.87	17.53	66.054	53.993	10.094	0.258	39.000	17.536	0.024	4.076	27.857	127.949	9.964
1-30-86	761	13.91	18.06	68.045	59.140	11.319	0.279	42.599	17.898	0.024	6.003	29.568	146.067	10.302
2-22-86	784	113.00	22.35	84.215	95.413	21.743	0.443	84.353	20.215	0.029	11.879	37.139	325.407	13.300
2-28-86	790	23.00	23.23	87.506	102.796	23.065	0.477	92.851	20.686	0.030	13.075	38.680	361.747	13.994
3-07-86	797	0.00	23.23	87.506	102.796	23.065	0.477	92.851	20.686	0.030	13.075	38.680	361.747	13.994
3-13-86	803	0.00	23.23	87.506	102.796	23.065	0.477	92.851	20.686	0.030	13.075	38.680	361.747	13.994
3-21-86	811	4.00	23.38	88.079	104.000	24.234	0.482	94.329	20.768	0.030	13.283	38.948	368.067	14.103
3-28-86	818	17.00	24.03	90.512	109.537	25.802	0.507	100.611	21.117	0.031	14.187	40.087	394.927	14.564
4-03-86	824	12.50	24.50	92.300	113.549	26.955	0.525	105.230	21.373	0.032	14.817	40.925	414.677	14.903
4-10-86	831	11.00	24.92	93.074	117.000	27.970	0.541	109.294	21.598	0.032	15.389	41.682	432.057	15.282
4-17-86	838	10.00	25.30	95.305	120.290	28.892	0.556	112.909	21.803	0.032	15.909	42.332	447.657	15.474
4-25-86	846	0.60	25.63	95.944	122.029	29.722	0.567	117.169	21.932	0.033	16.107	42.426	463.337	15.732
5-01-86	852	6.95	25.89	97.088	123.693	30.752	0.577	127.893	22.165	0.033	16.392	42.471	490.442	15.982
5-08-86	859	7.35	26.17	98.298	124.816	31.841	0.589	139.226	22.411	0.033	16.693	42.519	519.087	16.246
5-15-86	866	7.43	26.45	99.522	125.953	32.943	0.600	150.691	22.660	0.033	16.998	42.567	546.064	16.514
5-22-86	873	6.21	26.69	100.545	126.903	33.863	0.610	160.273	22.880	0.034	17.252	42.600	572.283	16.737

Lysimeter #9 field chemistry (continued)
 Portland III Cement
 Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
 Drum 2-2

DATE	DAY	DRAIN liters	CMLTV DRAIN cm	CUMULATIVE LEACHED, g										
				TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
5-29-86	888	8.83	28.95	101.678	127.948	34.878	8.821	178.811	23.897	8.834	17.532	42.852	598.928	18.983
6-06-86	888	8.88	27.25	102.988	129.172	36.882	8.833	183.155	23.385	8.834	17.868	42.784	638.128	17.271
6-09-86	891	8.88	27.25	102.988	129.172	36.882	8.833	183.155	23.385	8.834	17.868	42.784	638.128	17.271
6-12-86	894	5.45	27.48	103.884	130.885	36.889	8.842	191.557	23.547	8.834	18.884	42.748	651.358	17.487
6-19-86	901	8.84	27.72	105.811	131.852	37.883	8.852	202.111	23.777	8.834	18.384	42.784	678.832	17.713
6-26-86	906	7.25	28.88	106.285	132.181	38.958	8.864	213.298	24.819	8.834	18.881	42.831	708.387	17.974
7-03-86	916	7.88	28.29	107.487	133.333	40.894	8.875	225.117	24.278	8.835	18.975	42.881	738.181	18.258
7-10-86	922	6.18	28.52	108.485	134.279	41.818	8.885	234.853	24.483	8.835	19.229	42.921	768.283	18.473
7-17-86	929	5.38	28.73	109.388	135.899	41.884	8.893	242.923	24.883	8.835	19.448	42.958	781.187	18.888
7-24-86	938	4.88	28.98	110.557	136.257	42.738	8.782	255.839	24.985	8.835	19.723	42.985	809.147	18.861
8-07-86	951	3.98	29.85	111.297	136.288	43.585	8.718	284.722	25.123	8.835	19.955	43.124	832.115	19.814
8-13-86	958	7.84	29.35	112.761	138.883	45.828	8.725	283.898	25.554	8.835	20.414	43.437	877.587	19.315
8-28-86	971	7.32	29.83	114.128	139.838	46.448	8.748	301.788	25.957	8.835	20.842	43.738	928.843	19.598
9-18-86	984	8.78	29.89	115.379	141.441	47.745	8.753	318.189	26.325	8.835	21.234	43.988	958.983	19.854
9-25-86	999	8.32	30.13	116.559	142.955	48.972	8.788	333.822	26.873	8.835	21.884	44.251	995.559	20.897
10-02-86	1006	4.18	30.28	117.325	143.937	49.787	8.774	343.848	26.898	8.835	21.843	44.415	1019.339	20.255
10-23-86	1027	4.18	30.44	118.898	144.919	50.582	8.782	353.871	27.124	8.835	22.883	44.579	1043.119	20.412
11-06-86	1041	3.34	30.58	118.714	146.485	51.188	8.789	361.319	27.317	8.835	22.277	44.839	1061.823	20.529
11-20-86	1055	2.78	30.87	119.218	147.895	51.784	8.795	367.828	27.483	8.835	22.443	45.181	1079.183	20.821
12-18-86	1075	3.28	30.79	119.818	149.225	52.444	8.882	375.538	27.888	8.835	22.848	45.542	1099.583	20.738
12-30-86	1095	2.78	30.89	120.328	150.518	53.818	8.888	382.845	27.848	8.835	22.888	45.883	1118.883	20.821
1-13-87	1109	1.53	30.95	120.885	151.245	53.342	8.811	385.728	27.948	8.835	22.988	46.844	1128.823	20.873
1-26-87	1122	1.23	31.88	120.834	151.838	53.882	8.814	388.873	28.815	8.838	22.975	46.198	1134.483	20.915
2-09-87	1136	1.38	31.85	120.988	152.494	53.918	8.817	391.982	28.188	8.838	23.888	46.398	1143.823	20.958

Lysimeter #10 field chemistry
Dow Polymer
Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
Drum 7-3

				CUMULATIVE LEACHED, g										
DATE	DAY	DRAIN liters	CMLTV DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
10-26-84	300	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11-16-84	321	0.05	.00	.000	0.002	.000	.000	.000	.000	.000	.000	0.001	0.001	0.001
1-24-85	390	0.08	.00	0.001	0.005	0.001	.000	0.001	.000	.000	.000	0.004	0.003	0.002
2-13-85	410	12.01	0.49	0.066	0.532	0.135	0.002	0.137	0.049	.000	0.019	0.302	0.259	0.212
3-11-85	436	0.00	0.49	0.066	0.532	0.135	0.002	0.137	0.049	.000	0.019	0.302	0.259	0.212
3-12-85	437	0.00	0.49	0.066	0.532	0.135	0.002	0.137	0.049	.000	0.019	0.302	0.259	0.212
3-29-85	454	0.50	0.51	0.069	0.552	0.140	0.002	0.142	0.051	.000	0.020	0.376	0.269	0.220
4-04-85	480	147.03	6.12	0.821	7.067	1.897	0.033	3.582	0.745	0.006	0.458	2.591	7.650	2.708
4-12-85	488	11.30	0.50	0.879	8.430	2.032	0.035	3.047	0.798	0.006	0.489	2.761	8.210	2.099
6-20-85	537	0.00	0.50	0.879	8.430	2.032	0.035	3.047	0.798	0.006	0.489	2.761	8.210	2.099
7-23-85	570	97.66	10.27	1.377	13.269	3.194	0.050	6.122	1.257	0.010	0.777	4.226	13.101	4.545
8-14-85	592	0.00	10.27	1.377	13.269	3.194	0.050	6.122	1.257	0.010	0.777	4.226	13.101	4.545
10-24-85	663	46.43	12.03	1.614	16.962	3.816	0.069	7.794	1.517	0.013	0.902	4.310	16.815	5.348
1-30-86	761	9.57	12.40	1.663	16.641	3.977	0.072	8.129	1.559	0.013	1.046	4.381	18.232	5.468
2-22-86	784	0.00	12.40	1.663	16.641	3.977	0.072	8.129	1.559	0.013	1.046	4.381	18.232	5.468
2-26-86	790	0.00	12.40	1.663	16.641	3.977	0.072	8.129	1.559	0.013	1.046	4.381	18.232	5.468
3-07-86	797	0.00	12.40	1.663	16.641	3.977	0.072	8.129	1.559	0.013	1.046	4.381	18.232	5.468
3-13-86	803	0.00	12.40	1.663	16.641	3.977	0.072	8.129	1.559	0.013	1.046	4.381	18.232	5.468
3-21-86	811	51.00	14.34	1.923	20.027	4.923	0.091	9.837	1.774	0.017	1.392	4.684	20.066	6.202
3-28-86	818	105.00	18.33	2.459	28.833	6.871	0.129	13.355	2.215	0.024	2.106	5.309	42.256	7.714
4-03-86	824	0.00	18.33	2.459	28.833	6.871	0.129	13.355	2.215	0.024	2.106	5.309	42.256	7.714
4-10-86	831	0.00	18.33	2.459	28.833	6.871	0.129	13.355	2.215	0.024	2.106	5.309	42.256	7.714
4-17-86	838	48.00	20.15	2.703	32.584	7.761	0.146	14.903	2.418	0.027	2.433	5.596	49.648	8.406
4-25-86	846	0.22	20.39	2.735	33.114	7.887	0.148	15.182	2.441	0.027	2.476	5.628	50.642	8.507
5-01-86	852	0.00	20.39	2.735	33.114	7.887	0.148	15.182	2.441	0.027	2.476	5.628	50.642	8.507
5-08-86	859	22.00	21.23	2.861	35.119	8.352	0.158	15.921	2.507	0.029	2.629	5.941	54.712	8.873
5-15-86	866	0.00	21.23	2.861	35.119	8.352	0.158	15.921	2.507	0.029	2.629	5.941	54.712	8.873
5-22-86	873	0.00	21.23	2.861	35.119	8.352	0.158	15.921	2.507	0.029	2.629	5.941	54.712	8.873

Lysimeter #10 field chemistry (continued)
 Oow Polymer
 Na₂SO₄ Evaporator Concentrate w/ Ion Exchange Resin
 Drum 7-3

DATE	DAY	DRAIN liters	CUMULATIVE LEACHED, g											
			CMLTV DRAIN cm	TOC	Ca++	Mg++	Sr+	Na+	K+	B	Cl-	NO ₃ -	SO ₄ --	Si
5-29-88	888	0.00	21.23	2.861	35.119	8.352	0.158	15.921	2.507	0.029	2.629	5.941	54.712	8.873
6-06-88	888	0.00	21.23	2.861	35.119	8.352	0.158	15.921	2.507	0.029	2.629	5.941	54.712	8.873
6-09-88	891	32.23	22.45	3.046	38.057	9.034	0.171	17.032	2.604	0.030	2.653	6.398	60.674	9.409
6-12-88	894	0.00	22.45	3.046	38.057	9.034	0.171	17.032	2.604	0.030	2.653	6.398	60.674	9.409
6-19-88	901	8.50	22.77	3.095	38.832	9.214	0.175	17.326	2.629	0.031	2.912	6.519	62.246	9.551
6-26-88	908	10.62	23.18	3.156	39.799	9.438	0.179	17.692	2.681	0.031	2.985	6.670	64.210	9.728
7-03-88	915	12.73	23.66	3.229	40.959	9.708	0.185	18.131	2.699	0.032	3.074	6.851	66.585	9.946
7-10-88	922	0.00	23.66	3.229	40.959	9.708	0.185	18.131	2.699	0.032	3.074	6.851	66.585	9.946
7-17-88	929	6.22	23.98	3.264	41.526	9.839	0.187	18.346	2.718	0.032	3.117	6.939	67.716	10.043
7-24-88	936	4.98	24.09	3.296	42.009	9.949	0.190	18.530	2.728	0.032	3.152	7.053	68.762	10.128
8-07-88	951	0.00	24.09		42.009	9.949	0.190	18.530	2.728	0.032	3.152	7.053	68.762	10.128
8-13-88	956	10.90	24.50		43.094	10.197	0.195	18.975	2.799	0.033	3.242	7.189	71.323	10.304
8-28-88	971	6.10	24.73		43.701	10.336	0.198	19.223	2.838	0.033	3.292	7.266	72.757	10.403
9-10-88	984	5.00	24.92		44.196	10.450	0.200	19.427	2.871	0.034	3.334	7.327	73.932	10.484
9-25-88	999	6.60	25.18		44.655	10.601	0.203	19.697	2.914	0.034	3.380	7.410	75.483	10.591
10-02-88	1006	4.10	25.33		45.263	10.894	0.205	19.864	2.940	0.034	3.422	7.481	76.446	10.658
10-23-88	1027	4.00	25.48		45.661	10.785	0.207	20.027	2.966	0.035	3.455	7.510	77.386	10.722
11-06-88	1041	6.00	25.71		46.273	10.927	0.210	20.295	3.032	0.035	3.512	7.522	78.946	10.815

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