APPENDIX 11-K

LEACH STUDY

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Due to reformatting of the Navajo Mine PAP, the following references in this appendix (formerly Appendix 27-B under NM-0003C) have been changed, deleted or renumbered:

NM-0003C Reference	NM-0003D Reference
Exhibit 12-1	Exhibit 6-6
CHAPTER 12	CHAPTER 6
CHAPTER 13	CHAPTER 7

LEACH STUDY

1. Description of Air Pollution Control System

The owners of the Four Corners Power Plant have been required by New Mexico Air Quality Control Regulations 504 and 602 to install new air pollution control equipment to reduce stack emissions of particulates and sulfur dioxide from Units 4 and 5 at the Four Corners Power Plant. The particulate control equipment was required to be operational on Units 4 and 5 by December 31, 1982, while sulfur dioxide removal equipment on Units 4 and 5 was to be operational by December 31, 1984. The solid wastes from these pollution control systems were to be disposed of in the Navajo Mine.

Unit 4 and 5 each was retrofitted with four baghouses for fly ash emission control. Each baghouse contains 4,968 bags, one foot in diameter and 32 feet long. These bags act much like a large filter. Fly ash lacen flue gas enters through the center of the bags and passes through the filter material to the outside. Fly ash is trapped on the inside surface of the bags and is knocked loose by intermittent reverse gas flow through the bags. Fly ash is collected in hoppers at the bottom of the baghouses and pneumatically conveyed to storage silos in the waste processing area. Collection efficiency from the flue gas is greater than 99.9 percent.

The fly ash-free flue gas then passes from the baghouses to SO_2 absorbers. Each unit has four operating absorbers and one spare. Each absorber is 40 feet in diameter and 98 feet high. Normally, 88 percent of the flue gas will be scrubbed; with the remainder bypassed for later recombination with absorber outflow gases to maintain temperature in this exit gas. Lime slurry is produced in slakers and sprayed into the absorbers. The SO_2 in the flue gas is absorbed in the resulting droplets and reacts with the lime to form calcium sulfite or calcium sulfate.

The slurry droplets are collected in the sump at the bottom of the tower and recycled to the spray nozzles for full utilization of the lime.

A portion of the slurry is blown down and goes to a 150-foot-diameter thickener where the solids are separated from the liquid. The overflow from the thickener, which is low in solids, is reused in the absorbers. The underflow, which is about 30 to 35 percent solids, is transferred to the waste processing area. There it is mixed with the fly ash to form a physically stable product for disposal. This mixture composes the sludge/fly ash mixture that was sampled as part of this study.

The underflow or sludge can either be mixed directly with the fly ash or further dewatered in the vacuum filters. The quantities of fly ash and sludge available determine how much additional dewatering is required. The sludge and/or filter cake is mixed with the fly ash in the pugmills and loaded onto the trucks for mine disposal. The addition of dry fly ash increases the overall solids content in the final product to 75 to 85 percent solids.

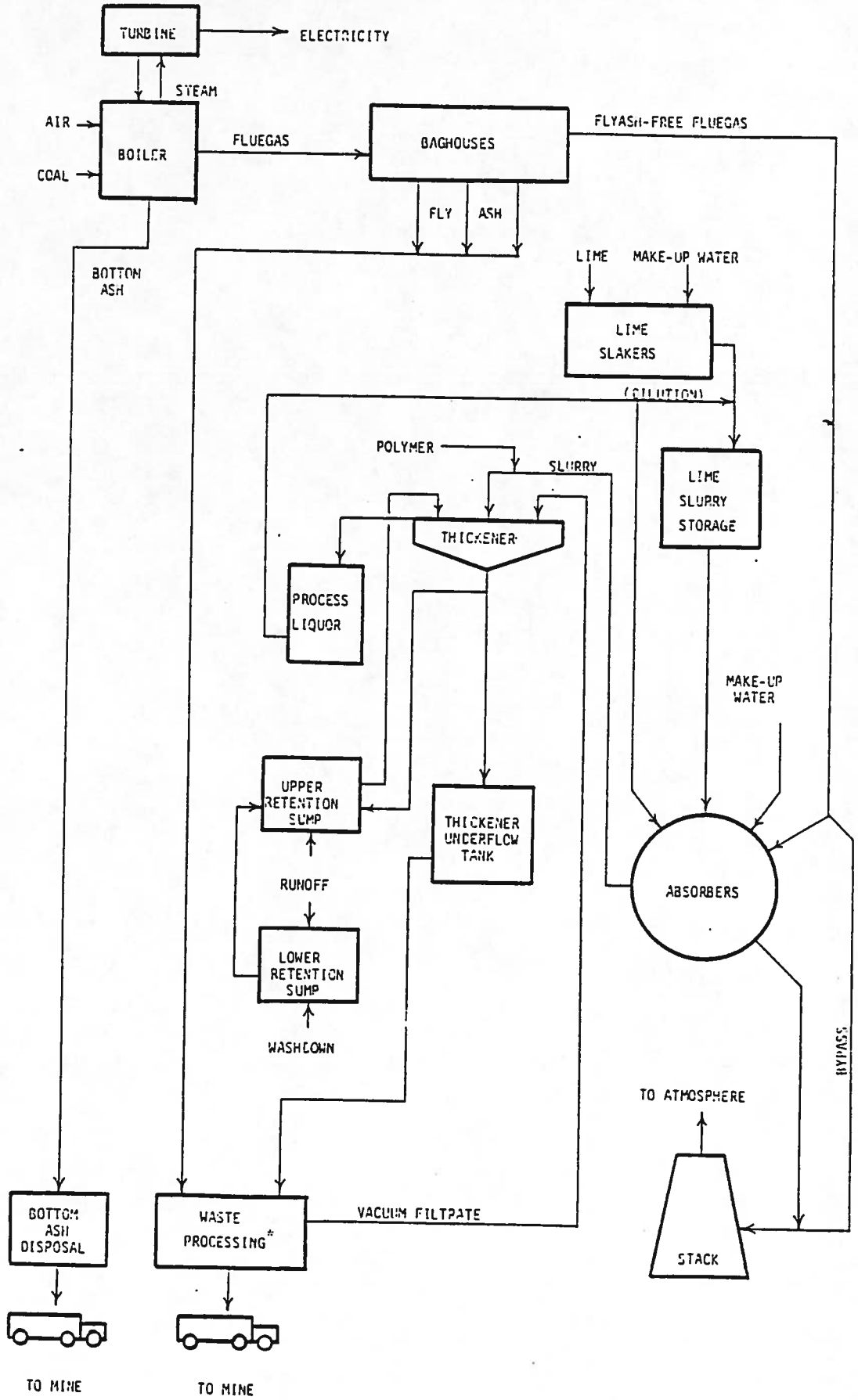
Figure 27-B1 illustrates the interrelation of the air pollution control equipment and describes the flow of wastes to the mine for disposal. Figure 27-B2 shows the details of waste handling in the waste processing area.

2. GEOCHEMICAL EVALUATION OF POWER PLANT WASTE DISPOSAL

2.1 Introduction

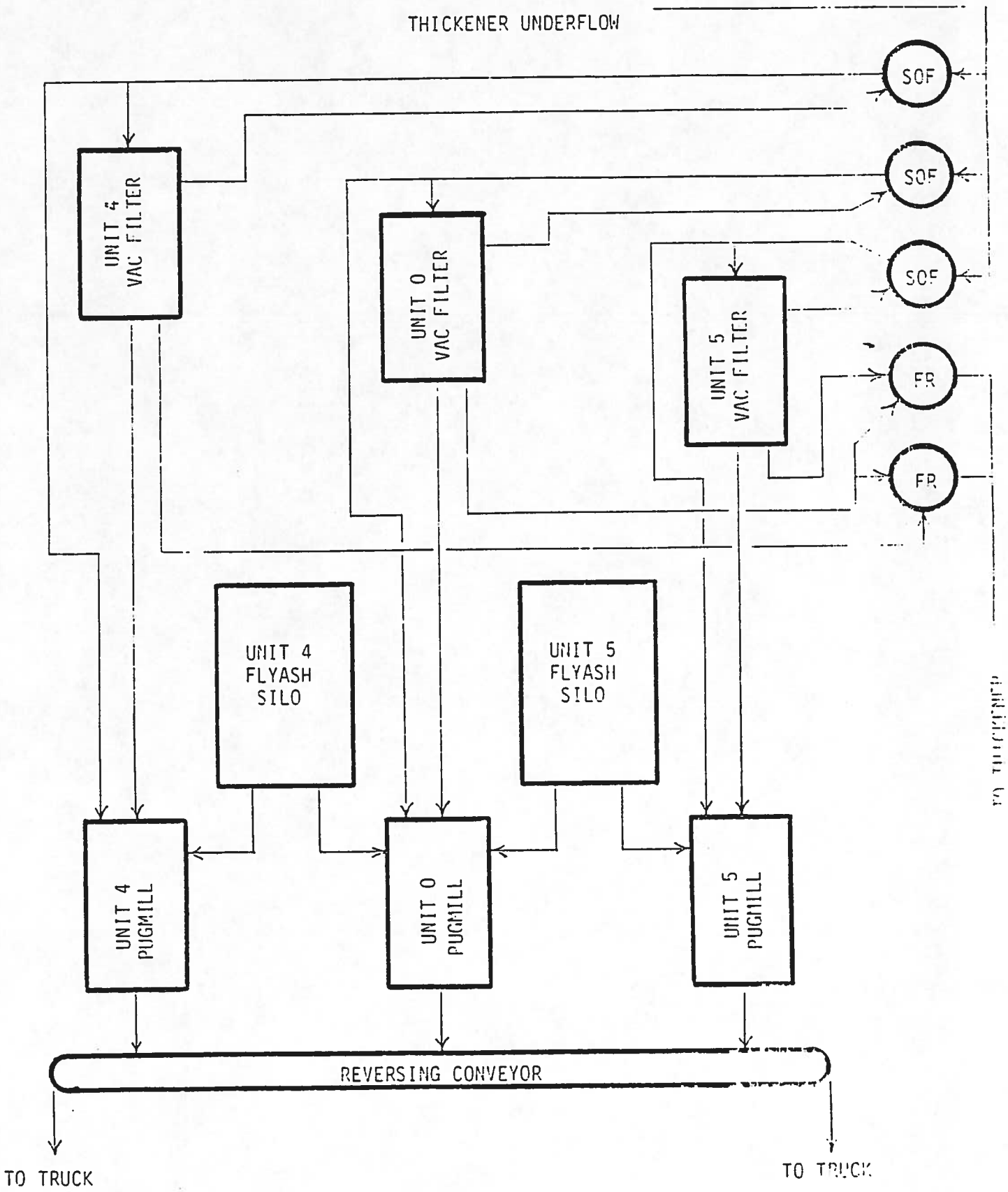
The geochemical evaluation of power plant waste disposal was conducted to quantify the interactions that would take place between the spoils, fly ash, bottom ash, sludge/fly ash, coals and the ground water. The interactions will take place as a result of concurrently burying the power plant wastes in the mined out pits as the mine progresses. The power plant wastes may ultimately be buried in mine pits throughout the

Figure 27-B1



*SEE SEPARATE DRAWING

Figure 27-B2


THICKENER UNDERFLOW
SOF
SOF
SOF
FR
FR
UNIT 4
VAC FILTER
UNIT 0
VAC FILTER
UNIT 5
VAC FILTER
UNIT 4
FLYASH
SILO
UNIT 5
FLYASH
SILO
UNIT 4
PUGMILL
UNIT 0
PUGMILL
UNIT 5
PUGMILL
REVERSING CONVEYOR
TO TRUCK
TO TRUCK

mine area. Waste is hauled from the power plant and placed in the pits by dump truck and covered with spoil material in successive layers to facilitate compaction, placement, access, and construction. With such placement over the long life of the mine and power plant, it can be assumed, for all practical purposes, that the power plant wastes will be evenly mixed with the spoil material as the pits are backfilled and reclaimed. Also, in the long term, after all mining and reclamation is complete and the ground water in the mine area has returned to its premine levels, the chemistry of the water will be determined by its long-term reactions with all the materials that it contacts in its slow migration toward discharge points such as the San Juan River.

The geochemical evaluation began by evaluating existing data for the mine site. These data included ground water and overburden analyses and information on coal geology. Prior to the beginning of the geochemical evaluation, the mine was already well understood with regard to ground water quantities and flow directions. Climatological data was also available along with infiltration studies (Stone, 1984) and in situ permeability data for the coal seams and overburden. Studies had also established that distinct areas within the mine had no ground water and other areas had limited ground water. Exhibit 12-1 notes the dividing line between areas with no saturation and areas with saturation as well as the potentiometric contours of ground water within the individual coal seams.

6-2 → 6-5

The sampling procedure used for the geochemical evaluation ensured that representative samples of all materials were obtained. All spoil and overburden samples were collected using the EPA guidance document SW 846 "Test Methods for Evaluating Solid Waste". This procedure, based on preliminary chemical analysis of the spoil/overburden, provided guidance on the number of aliquots per sample needed to provide statistical validity to both the sampling and subsequent analysis of the spoil/overburden. Samples were collected from all areas on the mine site.

Before water samples were collected, an evaluation of existing data from mine area wells was conducted to determine if their waters were the same or different chemically. After chemical review of the waters, a review of the geohydrological data in the mine was conducted to determine the relative quantities of the chemically different waters on the mine site. The locations of wells were also evaluated to assure that the well distribution could be representative for the entire mine site. Composite samples of chemically similar waters were collected and mixed in ratios to match their relative ratios within the mine. This was done in an effort to reduce the volume of samples to be analyzed and the batch leaching necessary for the geochemical evaluation.

Coal samples were taken at random from high walls where access was available. All coal seams being mined on the permit area were sampled. Power plant fly ash and bottom ash samples were taken at random from ash storage bins in the power plant. Power plant sludge/fly ash was collected at 12 different times during an eight-week period to establish consistent analytical data for the sludge/fly ash.

Procedures for the geochemical evaluation were divided into two categories: physical and analytical. Physical properties of all solid samples were determined. These properties included: unit weight, permeability, void ratio, porosity, grain size distribution, and moisture density relationships (ASTMD 698-78 Method A and/or ASTMD 4254-83, Method A).

Analytical procedures were conducted to determine the concentration levels within the solids and the water of various parameters listed by the State of New Mexico with regard to human health, irrigation use, other domestic uses, as well as for major ions.

After all analytical and physical testing was complete, batch leach testing of all the solids with all of the various ground waters and one surface water sample was conducted. In addition, mixtures of spoil and

power plant wastes, in their relative disposal ratios, were leached in the batch leaching process with the natural waters from the site. The batch leaching procedures accelerate the leaching process and determine in a short period of time what long-term contact between natural ground water, waste, and spoils will produce in terms of water chemistry. The resultant data from all testing was then evaluated to determine the net geochemical impact expected as a result of the power plant waste disposal at the mine site. The attenuation properties of the solid materials were also evaluated. In some instances, it was found that the addition of power plant waste leachates to existing ground waters actually made a net improvement in water quality.

Utilization of Existing Data

Existing data was used to assist in designing the program developed for geochemical evaluation of waste disposal for this project. Existing data were used to determine which sampling points would be most beneficial and which samples to collect in order to most closely approximate the conditions occurring at the mine site.

Ground water data presented in Chapter 12 was used to select ground water wells to be sampled as well as to determine which of the ground waters should be mixed to form the composite samples needed for analysis and batch leach testing. The samples were evaluated to determine which wells produced water that is chemically similar based on milliequivalent calculations of the ionic constituents. Relative quantities of water available from the various strata were also used to calculate compositing ratios. Chapter 12 provides data on ground water flow directions and quantities. The compositing utilized for sampling ground waters was determined to be as follows:

COMPOSITE NUMBER	WELL NUMBER	COMPOSITE RATIO
1	KF 84 SJ5	None
2*	KF 84 21 (b)	None
3	KF 84 22 (a)	None
4	KF 84 18 (a), (b)	50:50
5	KF 84 20 (a), (c)	58% of total
	KF 84 21 (a), (c)	
	KF 84 22 (b), (c), (d), (e)	42% of total

*Well yields from Well KF 84 21 (b) were not sufficient enough for the collection of the desired ten gallon ground water sample (i.e, only one gallon was obtained).

Overburden/spoil existing data presented in Chapter 11 (1981 interim permit application) was evaluated to determine where and how many samples should be collected to represent the spoil backfill material on the mine site. It was decided that two samples should be collected in the north area where movement of ground water to the San Juan River would be most likely to occur. An additional five samples were evenly distributed throughout the mine site Areas I, II and III (see Exhibit 27-B1). The two overburden samples in the north area had to be collected by drilling because the old mine pits in that area have been backfilled and it was no longer possible to collect samples from the backfilled spoil that would be representative of the different horizontal strata. The drill hole locations (see Exhibit 27-B1) were selected at sites that had not been mined so that a drill rig would be able to cut efficiently for sample collection.

The spoil sample locations were preselected on a map for even distribution. To decide the number of aliquots to collect for each spoil sample, the EPA guidance documents SW-846 "Test Methods for Evaluating Solid Waste" was used. The EPA requires that document preliminary data for the material to be sampled be available. Overburden data from the 1981

interim permit application was therefore analyzed prior to sampling to determine the number of aliquots per sample needed for statistical validity.

The parameter that showed the maximum number of aliquots per sample was selected as the controlling factor. The number of aliquots required was calculated from the mean of the parameter values and the standard deviation and the variance of sample data. Sulfate was the controlling parameter for the available data on overburden with the number of aliquots required at 176. Coal sample points (see Exhibit 27-B2) were selected from the available data on mine site geology as presented in Chapter 11.

Sampling

Overburden/spoil samples were collected by two methods in the field. Samples D-1 and D-2 were drill hole locations where samples were collected using a rotary drill. No drilling fluids were used. All cuttings from the drill were collected on a canvas placed adjacent to the drill hole. After the drill hole was extended to the top of the No. 8 coal seam, drilling was stopped and the cuttings on the canvas thoroughly mixed to represent backfill from the previous mining operations. A large sample (approximately 150 pounds) was then collected from the mixed drill cuttings.

Spoil samples S-1 through S-5 were collected using small scoops to pick up aliquots at random locations over an entire spoil pile area that was exposed near to or at the predesignated sample point. A total of 180 aliquots were collected for each sample over the selected sample area. In the process of collecting aliquots, care was taken to select as many variations of color, site, and particle size as were practical. The aliquots were collected in 30 small pails (6 aliquots per pail) and then dumped onto a canvas and thoroughly mixed before being placed in a large sample container. This procedure was followed for all five spoil samples. Collection of 180 aliquots rather than the calculated 176 was done to facilitate ease of collection.

The size of the spoil sample areas varied, depending upon access and available area adjacent to the predesignated sample points. The samples collected and the area covered at each sample location were as follows:

S-1	4,000 feet by 300 feet
S-2	2,000 feet by 1,000 feet
S-3	2,600 feet by 1,000 feet
S-4	2,200 feet by 200 feet
S-5	2,000 feet by 3000 feet

The large areas represented by the individual samples provided an opportunity for a wide range of the overburden material to be represented in the total sample and thereby improve its approximation of overall postmining conditions.

Coal samples were collected where random as mining operations provided an open pit and access to a coal seam. The pits were selected based on availability of access to a particular seam and the need to distribute the sample points so that field conditions in the seam would be best represented. A total of six coal seams were sampled. Two samples were collected from the No. 8 seam because it is the thickest seam in the mine, the most extensive, and also transmits water directly to the San Juan River. As a result, a total of seven coal samples were collected. A channel sample was collected at each coal sample point. A channel sample is where a pick is used to chip equal amounts of coal from each horizontal layer allowing the chips to fall onto a canvas spread at the base of the seam. These chips were mixed and the sample collected.

Ground water samples were collected in the field from the designated wells by airjet using a trailer-mounted air compressor. Ten gallon samples were collected in nalgen buckets or containers from which all mixing or compositing took place. Leaching samples were set aside for later use. Ground water samples so collected were immediately placed in sample bottles and preserved by the following methods:

PARAMETER	BOTTLE SIZE AND TYPE	PRESERVATIVE	CHILLED TO $4^{o}C$
Phenolics	1 liter amber glass	$CuSO_4$	Yes
	H_3PO_4 to pH $\leq$ 4		
Nitrate	1/2 liter plastic	H_2SO_4 to pH $\leq$ 2	Yes
Cyanide	1/2 liter plastic	H_2SO_4 to pH $\leq$ 2	Yes
Fluoride, Boron Sulfate, Chloride, TDS, Calcium, Mg, Na, K	1 liter plastic	NaOH to pH $\geq$12	Yes
Total Metals	1 liter glass	HNO_3 to pH $\leq$ 2	Yes

As the samples were collected, all bottles were rinsed with sample water, and the rinse discarded. The sample bottles were then filled completely with sample water, preservative added as appropriate, capped tightly, and placed inside a ziploc plastic bag. Both the bag and bottle were labeled with waterproof marker as to sample identification, preservative, and parameters for analysis. The bottles were then placed in large ice chests and cooled to 4 degrees Centigrade with ice prior to shipment to the IT laboratory in Knoxville, Tennessee.

A single ten gallon surface water sample was collected from Chinde Wash at the location shown on the attached map, Exhibit 27-B3. The sample was collected approximately 12 hours after the end of a significant thunderstorm when the flow in the stream was approximately one cubic foot per second (cfs). The surface water sample was taken and preserved using the same methods described above for ground water samples.

Fly ash and bottom ash were sampled concurrently with the water samples. A bottom ash sample (approximately 120 pounds) was collected from the

top of a waste bin as a grab sample. The bottom ash sample collected from a spot in the bin that appeared to have the same physical characteristics as the rest as bin ash material. Sampling of the bin was done when all equipment at the power plant was in continuous operation to ensure that a fresh sample was obtained. The fly ash sample was collected at the discharge point from a storage bin prior to the fly ash being wetted for dust suppression. Approximately 150 pounds of dry fly ash material was collected from the power plant. All of the fly ash material was observed to have the same physical characteristics. Combined sludge/fly ash samples could not be collected on this sample trip because the flue gas scrubbers were not yet operational. When the flue gas scrubbers did become operational, several weeks were allowed to pass before sampling began to ensure that all startup problems had been resolved in the operations. A total of 12 sludge/fly ash samples were collected periodically between December 1984 and February 4, 1985. The samples were collected by extracting sample portions from a belt discharge in the plant where trucks were loaded for disposal. A plastic bucket was passed through the waste stream several times over a period of approximately ten minutes. A total of approximately 120 pounds of sludge/fly ash was collected in this manner for each sample. The samples were sealed in water-tight plastic pails and shipped immediately to the IT laboratory in Knoxville, Tennessee. Upon arrival, the samples were thoroughly mixed to achieve consistency and subdivided for analytical and physical testing.

Sludge/fly ash analytical data were obtained for all 12 samples collected prior to beginning the batch leach testing. For the batch leaching, an aliquot of each of the 12 samples was collected and thoroughly mixed to form a composite sample. This composite was also submitted for analytical testing. By mixing the aliquots from 12 samples taken to form one composite sample for batch leaching, a single sample that was most representative of the actual sludge/fly ash material that is being placed in the pits for burial was produced. This process was used because it was desirable to account for any operational variances that might be occurring.

All of the data collected is presented in tabular form in this section. The tables are organized to show the data for all materials collected: spoil overburden, coal, waste, and water and the results of the batch leach testing. The batch leach testing data is also presented in tabular form so that it can readily be determined what interactions occurred when the various waters contacted different samples of solids.

Physical Testing

Physical testing was performed on all solids samples collected. Information determined included specific gravity, density, permeability, porosity, void ratio, grain size distribution, and moisture-density relationships. The moisture-density relationship provided information on the maximum dry density for the material at an optimum moisture content. The only information determined for the coals were density, specific gravity, and grain size distribution of the sample. The physical test data was used to predict travel times through the backfill materials. All physical data determined is presented in the back of this Appendix.

Chemical Testing

All wastes, spoils, and waters used in this study were analyzed for the chemical parameters listed in Table 27.B1. The table generally is divided into four categories of constituents based upon (1) human health standards; (2) standards for domestic water supply; (3) standards for irrigation waters; and (4) water type or major ionic constituents. These categories reflect the areas of concern in relation to preventing or minimizing impacts upon the hydrologic environment of the mine site and adjacent areas. Other parameters included on the data sheets were simply part of the total information obtained from the ICAP scan and are included here only to demonstrate the total analytical program conducted. Coal samples were also analyzed for these parameters. The coal samples, however, were not used in any of the batch leaching studies.

Table 27-B1

CHEMICAL SPECIES TO BE ANALYZED IN SOLIDS, WATER, AND EXTRACTS*

Human Health Standards

Arsenic (As)	0.5 mg/l	Lead (Pb)	.050 mg/l
Barium (Ba)	1 mg/l	Total Mercury (Hg)	2.0 μg/l
Cadmium (Cd)	.01 mg/l	Nitrate (NO_3 as N)	10 mg/l as N
Chromium (Cr)	.05 mg/l	Selenium (Se)	.01 mg/l
Cyanide (Cn)	0.2 mg/l	Silver (Ag)	.05 mg/l
Fluoride (F)	$\geq$1.7 mg/l variable		

Other Standards for Domestic Water Supply

Chloride (Cl)	250 mg/l	Phenols	0.3 mg/l
Copper (Cu)	1 mg/l	Sulfate (SO_4)	250 mg/l (desirable)
Iron (Fe)	.3 mg/l		
	1.0 mg/l (aquatic life)	Total Dissolved Solids (TDS)	500
Manganese (Mn)	.050 mg/l	Zinc (Zn)	5 mg/l
		pH	5-9 range

Standards for Irrigation Use

Aluminum (Al)	1.0 mg/l	Molybdenum (Mo)	.05 mg/l
Boron (B)	.75 mg/l	Nickel (Ni)	0.01 of 96-hr LC_{50} (aquatic life)
Cobalt (Co)	.2 mg/l		

Major Ions

Calcium (Ca)	(Water type, hardness)	Magnesium (Mg)	(water type, hardness)
Sodium (Na)	(water type)	Potassium (K)	(water type)
Alkalinity	(water type)		

*New Mexico Water Quality Control Commission Regulations, 1982.

Cation exchange capacities (CEC) were determined for all spoil and overburden samples. Since the cation exchange capacities resides primarily in clay minerals and colloidal particles, these values qualitatively indicate the mineralogical composition of the material analyzed. Also, the CEC provides a measure of the ability of the overburden/spoil material to attenuate the movement of cationic species through them.

Results of all analyses presented in Tables 27.B2 through 27.B9 were obtained in accordance with U.S. Environmental Protection Agency analytical procedures. The contractor doing the analytical work operates completely under an approved EPA QA/QC program. This included doing appropriate duplicate and spike samples for this project to ensure adequate QA/QC.

Statistical Evaluation of Data

Assuming that the 12 samples of sludge/fly ash collected as described in Section 2 are representative of sludge/fly ash produced under normal operating conditions, they may be used to infer the chemical composition of sludge/fly ash in the future. Because several of the chemical constituent concentrations exhibit a high degree of variability over the sampling period and accumulation prior to disposal of the sludge/fly ash does not occur after the point in processing where these samples were taken, inferences regarding the future chemical composition should be made regarding the population of means resulting from future similar sample collections. For the present purpose, it is useful to calculate that concentration below which a fixed portion, say 95 percent, of future mean chemical analysis will fall. Further, it is desirable to do so with a specified high degree of confidence, say 90 percent.

Table 27-B2

WATER ANALYSIS SUMMARY

PARAMETER	UNITS	SAMPLE IDENTIFICATION SURFACE WATER	COMPOSITE 1	COMPOSITE 2	COMPOSITE 3
General Chemistry:					
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	NA[3]	<1
Alkalinity	mg/ℓ $CaCO_3$	88	3,100	NA	940
Chloride	mg/ℓ	15	380	7.5	310
Cyanide	mg/ℓ	<0.02	<0.02	<0.01	<0.02
Fluoride	mg/ℓ	1.0	2.2	0.62	2.6
Nitrate	mg/ℓ NO_3-N	9.7	4.5	0.03	1.3
pH	--	7.80	8.80	11.98	8.70
Phenolics	mg/ℓ	<0.01	<0.01	0.07	0.01
Residue:					
Filterable @ 180°C	mg/ℓ	1,900	4,400	7,260	4,100
Specific Conductance	umhos/cm @ 25°C	2,310	5,900	NA	6,000
Sulfate	mg/ℓ SO_4^{-2}	1,200	22	<1.0	1,500
Metals:					
Aluminum	mg/ℓ	0.69/0.75[2]	0.68	5.0	1.3
Arsenic	mg/ℓ	<0.001	0.004	<0.001	0.008
Barium	mg/ℓ	0.03/0.02	1.5	3.9	0.06
Boron	mg/ℓ	0.31	0.97	<0.01	0.20
Cadmium	mg/ℓ	<0.001/<0.002	<0.001/0.002	<0.004/0.004	0.002/0.002
Calcium	mg/ℓ	230	11	620	36
Chromium	mg/ℓ	0.002	0.001	0.14	0.006
Cobalt	mg/ℓ	<0.001/0.001	0.008/0.002	<0.01/<0.004	0.014/0.012
Copper	mg/ℓ	0.04/0.031	0.02/0.051	<0.02/0.029	<0.01/0.017
Iron	mg/ℓ	0.45	2.8	0.07	3.7/3.8
Lead	mg/ℓ	<0.01/<0.01	0.03/0.03	0.1	0.02/<0.01
Magnesium	mg/ℓ	28	3.6	0.8	4.5
Manganese	mg/ℓ	0.08	0.47	0.06	0.38
Mercury (Total)	mg/ℓ	<0.0002	<0.0002	<0.001	<0.0002
Molybdenum	mg/ℓ	<0.001	0.005	<0.05	0.003
Nickel	mg/ℓ	0.04	0.11	<0.01	0.07
Potassium	mg/ℓ	11	7.2	66	8.4
Selenium	mg/ℓ	<0.001	0.006	<0.018	0.014
Silver	mg/ℓ	<0.001/<0.002	<0.001/<0.002	<0.002	0.001/<0.002
Sodium	mg/ℓ	280	1,600	2,300	1,400
Zinc	mg/ℓ	0.06	0.07	0.04	0.08
Total Alpha	pCi/ℓ[4]	0.5±0.5	1.7±0.6	1.0±0.5	0.8±0.7
Total Beta	pCi/ℓ	4.7±4.7	4.2±4.1	5.2±4.5	4.0±4.3
Total Radium (226 and 228)	pCi/ℓ	0.3±0.6	0.3±0.6	0.5±0.7	0.2±0.5

(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION COMPOSITE 4	COMPOSITE 5
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	510	940
Chloride	mg/ℓ	5,200	2,000
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	0.3	1.3
Nitrate	mg/ℓ NO_3-N	18	11
pH	--	8.20	9.50
Phenolics	mg/ℓ	0.04	0.02
Residue:			
Filterable @ 180°C	mg/ℓ	9,800	4,600
Specific Conductance	μmhos/cm @ 25°C	15,600	8,100
Sulfate	mg/ℓ SO_4^{-2}	120	55
Metals:			
Aluminum	mg/ℓ	<0.01	1.7
Arsenic	mg/ℓ	0.015	0.017
Barium	mg/ℓ	0.92	2.5
Boron	mg/ℓ	0.53	0.42
Cadmium	mg/ℓ	0.001	0.002/<0.001
Calcium	mg/ℓ	140	140
Chromium	mg/ℓ	0.008	0.034
Cobalt	mg/ℓ	0.035/0.034	0.017
Copper	mg/ℓ	<0.01	0.04
Iron	mg/ℓ	0.15	5.6
Lead	mg/ℓ	0.12	0.08
Magnesium	mg/ℓ	32	11
Manganese	mg/ℓ	0.03	0.70/0.70
Mercury (Total)	mg/ℓ	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.025	0.008/0.006
Nickel	mg/ℓ	0.11	0.04/0.04
Potassium	mg/ℓ	19	12
Selenium	mg/ℓ	0.011	0.020
Silver	mg/ℓ	<0.001/<0.002	0.015/<0.002
Sodium	mg/ℓ	3,500	1,600
Zinc	mg/ℓ	0.21/0.22	0.09
Total Alpha	pCi/ℓ[4]	1.9±0.5	<0.1
Total Beta	pCi/ℓ	4.0±3.7	3.9±3.9
Total Radium (226 and 228)	pCi/ℓ	0.4±0.6	0.4±0.6

(1) mg/ℓ = milligrams per liter or parts per million.
(2) The indicated sample was analyzed in duplicate.
(3) Not analyzed.
(4) pCi/ℓ = pico curies per liter.

Table 27-B3

ASH ANALYSIS SUMMARY

PARAMETER	UNIT	ASH FLY ASH (No Sludge)	ASH BOTTOM ASH
Acidity[1]	mg/kg $CaCO_3$	<100[3]	397
Alkalinity[1]	mg/kg $CaCO_3$	11,577	2,976
Chloride[1]	mg/kg	100	124
Cyanide	mg/kg	0.20	0.22
Fluoride	mg/kg	176	81
Nitrate[1]	mg/kg NO_3-N	<1	2
pH		NA[2]	NA
Phenolics	mg/kg	1.29	1.36
Residue:			
Filterable @ 180°C	mg/kg	NA	NA
Specific Conductance @ 25°C	µmhos/cm	NA	NA
Sulfate[1]	mg/kg SO_4^{-2}	1,667	<100
Metals:			
Aluminum	mg/kg	6,600	2,000
Arsenic	mg/kg	11	0.38
Barium	mg/kg	850	420
Boron	mg/kg	160	10
Cadmium	mg/kg	0.4	<0.1
Calcium	mg/kg	12,000	3,000
Chromium	mg/kg	5	<1
Cobalt	mg/kg	2	1
Copper	mg/kg	0.063	0.023
Iron	mg/kg	5,300	2,100
Lead	mg/kg	26	<1
Magnesium	mg/kg	530	150
Manganese	mg/kg	99	32
Mercury	mg/kg	0.2	<0.1
Molybdenum	mg/kg	<6	<6
Nickel	mg/kg	2	<1
Potassium	mg/kg	162	44
Selenium	mg/kg	6.5	<2[4]
Silver	mg/kg	<0.2	<0.2
Sodium	mg/kg	430	84
Zinc	mg/kg	13	5

(1) Water leachable.

(2) NA - not analyzed.

(3) < - less than.

(4) Higher detection limits due to matrix interference.

Table 27-B4

SPOILS AND OVERBURDEN ANALYSIS SUMMARY

PARAMETER	UNIT	S-1	S-2	S-3	S-4	S-5	D-1	D-2
Acidity[1]	mg/kg $CaCO_3$	399	299	197	399	298	399	398
Alkalinity[1]	mg/kg $CaCO_3$	3,293	3,693	3,945	3,593	3,777	7,186	3,877
Chloride[1]	mg/kg	250	150	246	200	248	399	149
Cyanide	mg/kg	0.17	1.18	0.20	0.25	0.20	0.08	0.20
Fluoride	mg/kg	471	463	420	575	503	403	332
Nitrate[1]	mg/kg NO_3-N	29	16	12	20	24	15	20
pH		NA[2]	NA	NA	NA	NA	NA	NA
Phenolics	mg/kg	1.09	1.19	1.09	1.18	1.05	0.90	1.98
Residue:								
Filterable @ 180°C	mg/kg	NA	NA	NA	NA	NA	NA	NA
Specific Conductance @ 25°C	µmhos/cm	NA	NA	NA	NA	NA	NA	NA
Sulfate[1]	mg/kg SO_4^{-2}	8,982	7,236	6,410	12,724	6,610	1,946	3,529
Metals:								
Aluminum	mg/kg	8,100	7,400	5,500	6,600	6,600	9,200	6,200
Arsenic	mg/kg	6.5	6.0	36	17	4.3	4.5	4.6
Barium	mg/kg	180	42	130	520	150	110	120
Boron	mg/kg	9	8	4	<3[3]	4	<3	<3
Cadmium	mg/kg	1.0	0.9	1.1	0.9	0.8	1.1	0.9
Calcium	mg/kg	16,000	17,000	7,900	9,500	27,000	14,000	11,000
Chromium	mg/kg	3	3	2	3	3	6	6
Cobalt	mg/kg	7	7	8	7	9	7	6
Copper	mg/kg	11	6	6	15	9	10	0.143
Iron	mg/kg	14,000	13,000	39,000	27,000	14,000	20,000	18,000
Lead	mg/kg	35	32	58	34	32	42	72
Magnesium	mg/kg	2,900	3,100	2,300	2,100	2,900	4,100	6,200
Manganese	mg/kg	200	200	360	190	470	350	250
Mercury	mg/kg	<0.1	<0.1	0.2	0.8	<0.1	0.2	0.2
Molybdenum	mg/kg	<6	<6	<6	<6	<6	<6	<6
Nickel	mg/kg	10	9	13	10	13	10	9
Potassium	mg/kg	1,100	1,400	906	1,200	1,400	903	801
Selenium	mg/kg	<1[4]	<2[4]	<2[4]	<2[4]	<2[4]	<1[4]	<1[4]
Silver	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sodium	mg/kg	2,600	2,700	2,700	3,500	2,700	2,900	1,400
Zinc	mg/kg	66	63	58	71	69	63	56

[1] Water leachable.

[2] NA - not analyzed.

[3] < - less than.

[4] Higher detection limits due to matrix interference.

COAL ANALYSIS SUMMARY

PARAMETER	UNIT	SAMPLE NUMBER C-1	C-2	C-3	C-4	C-5	C-6	C-7
	SEAM NO.	NO. 8	NO. 2	NO. 4	NO. 3	NO. 7	NO. 8	NO. 6
Acidity(1)	mg/kg $CaCO_3$	198	399	399	198	393	295	399
Alkalinity(1)	mg/kg $CaCO_3$	790	2,595	798	100	3,929	4,715	898
Chloride(1)	mg/kg	247	349	175	222	196	196	150
Cyanide	mg/kg	0.05	0.07	2.22	0.30	0.35	0.12	0.20
Fluoride	mg/kg	26	23	13	36	248	380	364
Nitrate(1)	mg/kg $NO_3^{-}N$	5	4	6	5	14	5	3
pH		NA(2)	NA	NA	NA	NA	NA	NA
Phenolics	mg/kg	0.19	0.39	0.10	0.40	0.59	0.29	0.89
Residue:								
Filterable @ 180°C	mg/kg	NA	NA	NA	NA	NA	NA	NA
Specific Conductance @ 25°C	)mhos/cm	NA	NA	NA	NA	NA	NA	NA
Sulfate(1)	mg/kg SO_4^{-2}	524	748	499	3,508	1,965	1,130	<100(3)
Metals:								
Aluminum	mg/kg	290	1,800	650	1,300	720	2,300	680
Arsenic	mg/kg	<0.1	<0.1	<0.1	0.24	<0.2(4)	5.7	4.5
Barium	mg/kg	58	8.9	33	57	38	38	69
Boron	mg/kg	45	110	24	39	40	58	53
Cadmium	mg/kg	<0.1	<0.3	0.2	<0.1	<0.1	0.4	<0.3
Calcium	mg/kg	210	1,300	630	760	780	1,200	670
Chromium	mg/kg	<1	<1	<1	<1	<1	<1	<1
Cobalt	mg/kg	<0.5	2	<0.8(4)	<0.6(4)	3	2	1
Copper	mg/kg	0.020	0.028	0.029	0.033	0.044	0.071	<2
Iron	mg/kg	290	2,800	1,300	3,600	1,600	4,400	1,200
Lead	mg/kg	<1	<1	13	<1	2.6	3.8	<10
Magnesium	mg/kg	100	650	210	360	220	460	210
Manganese	mg/kg	<2	12	2	2	14	4	2
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	mg/kg	<6	<6	<6	<6	<6	<6	<6
Nickel	mg/kg	<1	2	1	<1	4	2	2
Potassium	mg/kg	17	19	17	45	34	102	15
Selenium	mg/kg	0.30	<0.4(4)	1.2	<0.8(4)	<0.8(4)	<0.3(4)	<0.4(4)
Silver	mg/kg	<0.2	<0.2	<0.3(4)	<0.2	<0.2	<0.2	<0.2
Sodium	mg/kg	510	1,000	510	810	690	1,200	1,500
Zinc	mg/kg	5	36	38	11	8	25	9

(1) Water leachable.
(2) NA - not analyzed.
(3) < - less than.
(4) [illegible]

Table 27-B5

ANALYTICAL SUMMARY OF SLUDGE SAMPLES

PARAMETER	UNITS	SLUDGE NO. 1	SLUDGE NO. 2	SLUDGE NO. 3	SLUDGE NO. 4
General Chemistry:					
Acidity	mg/kg $CaCO_3$	3,000	NA	7,600	4,400
Alkalinity	mg/kg $CaCO_3$	2,600	NA	2,800	2,000
Chloride	mg/kg	2,375	1,800	2,375	1.800
Cyanide	mg/kg	0.07	0.05	0.12	0.08
Fluoride	mg/kg	269	39	405	419
Nitrate	mg/kg NO_3-N	5	4.5	5	36
pH		NA(2)	11.37	NA	NA
Phenolics	mg/kg	0.1	<0.01	0.1	0.07
Residue: Filterable @ 180°C	mg/kg	NA	NA	NA	NA
Specific Conductance @ 25°C	µmhos/cm	NA	NA	NA	NA
Sulfate(1)	mg/kg SO_4^{-2}	8,350	3,100	4,200	8,150
Metals:	mg/kg				
Aluminum	mg/kg	9,400	9,900	6,500	8,400
Arsenic	mg/kg	22	11	12	11
Barium	mg/kg	780	650	490	430
Boron	mg/kg	230	300	220	230
Cadmium	mg/kg	0.62	0.73	0.67	0.87
Calcium	mg/kg	19,000	40,000	37,000	39,000
Chromium	mg/kg	10	11	6.7	7.7
Cobalt	mg/kg	2.1	2.3	1.8	2.0
Copper	mg/kg	7.4	8.5	6.5	5.2
Iron	mg/kg	4,300	4,400	2,800	4,400
Lead	mg/kg	16	12	<10(3)	37
Magnesium	mg/kg	760	780	580	700
Manganese	mg/kg	90	120	100	72
Mercury	mg/kg	0.2	<.1	0.2	0.10
Molybdenum	mg/kg	8.6	7.9	<6	7.4
Nickel	mg/kg	3.6	3.5	2.[illegible]	2.0
Potassium	mg/kg	430	270	250	290
Selenium	mg/kg	<2.0	7.0	1.4	6.0
Silver	mg/kg	<3	1.0	<3	<0.2
Sodium	mg/kg	800	1,000	600	790
Zinc	mg/kg	21	18	12	19

SLUDGE

PARAMETER	UNITS	NO. 5	NO. 6	NO. 7	NO. 8
General Chemistry:					
Acidity	mg/kg $CaCO_3$	3,200	4,200	2,745	2,559
Alkalinity	mg/kg $CaCO_3$	2,200	2,400	3,725	3,150
Chloride	mg/kg	1,975	1,750	1,961	2,042
Cyanide	mg/kg	0.08	0.08	0.05	0.08
Fluoride	mg/kg	567	532	146	322
Nitrate	mg/kg NO_3-N	31	30.5	26.5	24.6
pH		NA(2)	NA	NA	NA
Phenolics	mg/kg	0.07	0.07	<0.01	<0.01
Residue: Filterable @ 180°C	mg/kg	NA	NA	NA	NA
Specific Conductance @ 25°C	umhos/cm	NA	NA	NA	NA
Sulfate(1)	mg/kg SO_4^{-2}	7,000	7,700	7,598	6,939
Metals:					
Aluminum	mg/kg	7,100	8,100	7,000	6,000
Arsenic	mg/kg	7.8	11	16	7.9
Barium	mg/kg	270	630	1,020	590
Boron	mg/kg	230	220	240	230
Cadmium	mg/kg	0.69	0.39	0.71	0.64
Calcium	mg/kg	63,000	26,000	17,000	48,000
Chromium	mg/kg	5.7	9.0	9.3	7.4
Cobalt	mg/kg	1.6	2.7	2.6	1.8
Copper	mg/kg	3.5	5.5	2.6	2.2
Iron	mg/kg	3,400	3,700	2,900	2,100
Lead	mg/kg	28	17	6.0	25
Magnesium	mg/kg	640	660	670	640
Manganese	mg/kg	57	73	60	40
Mercury	mg/kg	0.13	<0.1	0.12	<0.2(4)
Molybdenum	mg/kg	<6(3)	11	9.1	6.9
Nickel	mg/kg	2.0	3.4	2.0	1.9
Potassium	mg/kg	310	300	220	230
Selenium	mg/kg	4.1	8.3	8.8	3.6
Silver	mg/kg	<0.2	<3	<0.2	<0.2
Sodium	mg/kg	740	750	510	460
Zinc	mg/kg	17	19	16	14

PARAMETER	UNITS	SLUDGE NO. 9	SLUDGE NO. 10	SLUDGE NO. 11
General Chemistry:				
Acidity	mg/kg $CaCO_3$		11,000	11,000
Alkalinity	mg/kg $CaCO_3$		4,600	6,600
Chloride	mg/kg		100	80
Cyanide	mg/kg		<0.5	<0.5
Fluoride	mg/kg		1.0	1.0
Nitrate	mg/kg NO_3-N		7.9	5.1
pH	--		11.50	12.00
Phenolics	mg/kg		1.6	0.75
Residue: Filterable @ 180°C	mg/kg		5,700	6,600
Specific Conductance	umhos/cm @ 25°C		9,520	15,800
Sulfate	mg/kg SO_4^{-2}		1,600	1,400
Metals:				
Aluminum	mg/kg	10,000/9,800	10,000	12,000/12,000
Arsenic	mg/kg	17/14	9.4/9.7	18
Barium	mg/kg	190/230	350	300
Boron	mg/kg	<10/<10	71	121
Cadmium	mg/kg	0.24/0.24	0.33/0.33	0.43
Calcium	mg/kg	98,000/83,000	67,000	20,000
Chromium	mg/kg	12/13	9.3/9.6	13
Cobalt	mg/kg	8.5/7.5	1.4/1.4	2.5
Copper	mg/kg	13/13	9.7	12
Iron	mg/kg	4,400/4,500	4,500/4,400	5,400
Lead	mg/kg	5.0/5.90	9.9	12
Magnesium	mg/kg	820/820	640	750
Manganese	mg/kg	63/63	120	100
Mercury (Total)	mg/kg	0.37/0.25	<0.10	<0.10
Molybdenum	mg/kg	7.5/5.4	4.3	6.1
Nickel	mg/kg	6.3/4.3	<1.0/<1.0	<1.0
Potassium	mg/kg	410/360	310	420
Selenium	mg/kg	6.6/7.6	0.28	7.2/7.7
Silver	mg/kg	0.15/0.15	0.10	0.10
Sodium	mg/kg	1,200/1,000	1,000	1,200
Zinc	mg/kg	22/22	16	23

PARAMETER	UNITS	SLUDGE NO. 12	COMPOSITE SLUDGE
General Chemistry:			
Acidity	mg/kg $CaCO_3$	11,000	32,000
Alkalinity	mg/kg $CaCO_3$	1,000	<5
Chloride	mg/kg	110	110
Cyanide	mg/kg	<0.5	<0.5
Fluoride	mg/kg	2.0	2.0
Nitrate	mg/kg NO_3-N	5.9	5.5
pH	--	16.60	9.20
Phenolics	mg/kg	0.75	0.95
Residue: Filterable @ 180°C	mg/kg	5,300	4,500
Specific Conductance	µmhos/cm @ 25°C	7,950	6,980
Sulfate	mg/kg SO_4^{-2}	2,000	2,200
Metals:			
Aluminum	mg/kg	10,000	11,000
Arsenic	mg/kg	15	17
Barium	mg/kg	150	140/150
Boron	mg/kg	91	<10
Cadmium	mg/kg	0.53	1.5
Calcium	mg/kg	27,000	46,000/46,000
Chromium	mg/kg	11	18
Cobalt	mg/kg	1.7	2.4
Copper	mg/kg	8.7	13/13
Iron	mg/kg	4,900	6,000
Lead	mg/kg	8.8	8.8
Magnesium	mg/kg	680/680	870
Manganese	mg/kg	68	76/77
Mercury (Total)	mg/kg	<0.10/<0.10	<0.10
Molybdenum	mg/kg	4.9	11
Nickel	mg/kg	<1.0	8.7
Potassium	mg/kg	310/310	390
Selenium	mg/kg	3.8	1.4
Silver	mg/kg	0.10	0.10
Sodium	mg/kg	880	950/950
Zinc	mg/kg	15	49/49

(1) Water leachable
(2) NA = not analyzed
(3) < = less than.

Table 27-B7

CATION EXCHANGE CAPACITY AND
EXCHANGEABLE CATIONS FOR
SPOILS AND OVERBURDENS

PARAMETER	UNITS	SAMPLE IDENTIFICATION						
		D-1	D-2	S-1	S-2	S-3	S-4	S-5
Cation Exchange Capacity	$\frac{meq}{100g}$	39	24	52	52	44	59	53
Calcium	mg/kg	3,700	2,800	6,500	7,000	5,800	8,600	7,700
Magnesium	mg/kg	190	520	660	570	520	380	410
Potassium	mg/kg	240	100	240	220	170	310	290
Sodium	mg/kg	4,400	1,100	3,100	2,700	2,400	2,800	2,400

Table 27-B8

RADIOLOGICAL TEST DATA FOR SOLIDS SAMPLES

	Ra226 (pCi/g)[1]	Ra 228 (pCi/g)
Coal C-1	0.6±0.1	0.6±0.2
Coal C-2	1.5±0.1	0.7±0.3
Coal C-3	0.5±0.1	0.4±0.2
Coal C-4	0.8±0.1	0.9±0.3
Coal C-5	0.4±0.1	0.5±0.2
Coal C-6	1.0±0.1	0.3±0.2
Coal C-7	1.0±0.1	1.3±0.3
Spoil S-1	1.3±0.1	0.9±0.5
Spoil S-2	1.4±0.1	1.5±0.5
Spoil S-3	1.4±0.1	1.0±0.5
Spoil S-4	1.5±0.1	2.2±0.4
Spoil S-5	1.0±0.1	1.0±0.2
Overburden D-1	1.3±0.1	2.2±0.6
Overburden D-2	0.8±0.1	2.1±0.6
Fly Ash	3.2±0.1	3.8±0.6
Bottom Ash	2.9±0.1	4.3±0.7
Sludge No. 1	2.1	3.2
Sludge No. 3	2.0	2.7

	Total Radium (pCi/g)
Sludge No. 2	2.1
Sludge No. 4	1.5
Sludge No. 5	1.6
Sludge No. 6	15.5±0.6
Sludge No. 7	6.6±0.6
Sludge No. 8	6.0±0.5
Sludge No. 9	NA[2]
Sludge No. 10	NA
Sludge No. 11	NA
Sludge No. 12	NA

[1] pCi/g = pico curies per gram.

[2] NA = not analyzed

Table 27-B9
SLUDGE PHYSICAL CHARACTERIZATION SUMMARY

SAMPLE IDENTIFICATION	MOISTURE CONTENT (%)	PERCENT SOLIDS (%)	pH (1:1)
Sludge No. 1	18.7/17.8[1]	81.3/82.2	10.84/10.50
Sludge No. 2	13.3/24.2	86.7/75.8	10.96/9.25
Sludge No. 3	23.9/24.7	76.1/75.3	12.05/9.35
Sludge No. 4	20.6/21.8	79.4/78.2	11.11/9.40
Sludge No. 5	25.5/27.6	74.5/72.4	11.21/9.35
Sludge No. 6	15.8/19.2	84.2/80.8	11.44/9.35
Sludge No. 7	10.8/14.6	89.2/85.4	11.20/9.35
Sludge No. 8	21.0/20.6	79.0/79.4	11.37/9.80
Sludge No. 9	24.5/23.7	75.5/76.3	9.15/10.05
Sludge No. 10	11.0	89.0	11.50
Sludge No. 11	11.6	88.4	12.00
Sludge No. 12	16.2	83.8	10.60
Composite	16.7	83.8	9.20

[1] Duplicate analyses performed at different laboratories.

Calculation of the constituent chemical concentration for which one is 90 percent confident that at least 95 percent of the population of future means sets of 12 samples will be less than that value can be achieved through the use of a statistical tolerance limit. Such a limit, L, is calculated as follows:

$$L = \overline{X} + KS$$

Where $\overline{X}$ is the mean concentration, S is the standard deviation of the concentration, and K is the tolerance limit factor corresponding to the number of observations used to calculate S and the desired population percentage and degree of confidence. To ensure that a correct tolerance limit statement is made regarding the distribution of means sets of 12 samples, K is calculated according to the procedure proposed by Wallis.*

Applying this procedure and assuming that the concentration of each chemical constituent is statistically independent, the tolerance limits for those analyzed constituents are presented in Table 27.B10. The assumption of statistical independence among constituents is conservative as significant correlations among constituents would serve to decrease the conditional tolerance limit.

EP Toxicity Extraction Tests

All solid samples underwent the RCRA Extraction Procedure (EP Toxicity Test) as described in the Federal Register, 45 (98), May 19, 1980. The extracts from these tests were analyzed for the chemical constituents presented in Table 27.B1. Table 27.B11 presents the results of the extraction tests. The results are all below the limits for EP toxicity used to classify a material as toxic.

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*Churchill Eisenhart, Mellard W. Hastay, and W. Alley Wallis, ed: Selected Techniques of Statistical Analysis for Scientific and Industrial Research and Production and Management Engineering; McGraw-Hill Book Co., Inc., New York. NY, 1947, pp. 95-110, 59.

Table 27-B10
SLUDGE/FLY ASH CONSTITUENT TOLERANCE
LIMITS FOR 12-SAMPLE MEAN

CONSTITUENT	NUMBER OF SAMPLES	SAMPLE MEAN	STANDARD DEVIATION	95 PERCENT* TOLERANCE LIMIT
Acidity	10.00	6070.40	3690.62	9687.21
Alkalinity	10.00	3107.50	1568.88	4645.01
Chloride	11.00	1488.00	917.20	2361.18
Cyanide	11.00	0.19	0.20	0.38
Fluoride	11.00	245.73	218.81	453.60
Nitrate	11.00	16.55	12.95	28.85
pH	12.00	10.58	0.63	11.17
Phenolics	11.00	0.32	0.51	0.80
Residue	0.00			
Conductance	0.00			
Sulfate	11.00	5276.09	2826.23	7961.01
Aluminum	12.00	8691.67	1800.74	10366.35
Arsenic	12.00	13.06	4.30	17.06
Barium	12.00	489.17	256.18	727.41
Boron	12.00	182.75	87.02	263.68
Cadmium	12.00	0.57	0.19	0.75
Calcium	12.00	41125.00	22567.20	62112.49
Chromium	12.00	9.40	2.26	11.50
Cobalt	12.00	2.524	1.77	4.19
Copper	12.00	7.07	3.49	10.31
Iron	12.00	3933.33	964.91	4830.70
Lead	12.00	15.60	9.69	24.61
Magnesium	12.00	693.33	70.37	758.77
Manganese	12.00	80.25	25.54	104.00
Mercury	12.00	0.15	0.07	0.21
Molybdenum	12.00	7.05	1.88	8.80
Nickel	12.00	2.40	1.31	3.61
Potassium	12.00	310.42	68.97	374.56
Selenium	12.00	4.99	2.85	7.64
Silver	12.00	0.94	1.27	2.12
Sodium	12.00	819.17	229.21	1032.33
Zinc	12.00	18.67	3.31	20.75

*With 90 percent confidence.

(Continued)

PARAMETER	UNIT	SPOIL S-1	S-2	S-3	S-4	S-5
General Chemistry:						
Acidity	mg/ℓ $CaCO_3$	NA	NA	NA	NA	NA
Alkalinity	mg/ℓ $CaCO_3$	NA	NA	NA	NA	NA
Chlorine	mg/ℓ	0.85	1.3	2.2/0.85	2.5/1.3	2.5
Cyanide	mg/ℓ	<0.01	<0.01	<0.01/<0.01	<0.01/<0.01	<0.01
Fluoride	mg/ℓ	0.12	0.13	0.1/0.12	0.10/0.09	0.10
Nitrate	mg/ℓ NO_3-N	0.88	0.75	0.36/0.01	0.85/0.71	1.6
pH		5.17	4.99	5.11/5.23	5.01/4.98	5.00
Phenolics	mg/ℓ	0.01	0.01	0.01/0.01	0.01/0.01	0.01
Residue:						
Filterable @ 180°C	mg/ℓ	2.368	4,606	3,292/2,408	3,277/2,622	3,504
Specific Conductance	umhos/cm at 25°C	NA	NA	NA	NA	NA
Sulfate	mg/ℓ SO_4^{-2}	425	188	512/938	412/362	250
Metals:						
Aluminum	mg/ℓ	3.1	3.2	4.4	1.7/1.9	2.6
Arsenic	mg/ℓ	0.001	<0.001	<0.001/<0.001	0.001/<0.001	0.001
Barium	mg/ℓ	0.152	0.192	0.159	0.066/0.053	0.196
Boron	mg/ℓ	0.05	0.11	0.207	0.12/0.12	0.10
Cadmium	mg/ℓ	<0.004	<0.003	<0.004	<0.003/<0.003	<0.003
Calcium	mg/ℓ	440	900	670	560/500	590
Chromium	mg/ℓ	<0.01	<0.01	<0.01	<0.01/<0.01	<0.01
Cobalt	mg/ℓ	0.03	0.05	0.02	0.04/0.03	0.01
Copper	mg/ℓ	0.02	<0.02	0.02	<0.02/<0.02	<0.02
Iron	mg/ℓ	0.04	0.4	0.04	<0.05/0.1	<0.05
Lead	mg/ℓ	0.1	<0.1	0.2	<0.1/<0.1	<0.1
Magnesium	mg/ℓ	38	46	39	22/21	27
Manganese	mg/ℓ	4.4	9.9	7.3	7.0/6.4	7.2
Mercury	mg/ℓ	<0.001	<0.001	<0.001/<0.001	<0.001/<0.001	<0.001
Molybdenum	mg/ℓ	<0.05	<0.06	<0.05	<0.06/<0.06	<0.06
Nickel	mg/ℓ	0.02	0.04	0.02	0.04/0.05	<0.01
Potassium	mg/ℓ	6.2	9.0	8.2/7.2	11/9.8	10
Selenium	mg/ℓ	<0.009	<0.01	<0.01/<0.008	<0.01/<0.01	<0.01
Silver	mg/ℓ	<0.01	<0.03	<0.01	<0.03/<0.03	<0.03
Sodium	mg/ℓ	170	160	230	170/160	120
Zinc	mg/ℓ	0.077	0.14	0.190	0.14/0.14	0.11

Table 27-B11
EP TOXICITY EXTRACTION ANALYSES

PARAMETER	UNITS	ASH		OVERBURDEN	
		FLY ASH	BOTTOM ASH	D-1	D-2
General Chemistry:					
Acidity	mg/ℓ $CaCO_3$	NA(1)	NA	NA	NA
Alkalinity	mg/ℓ $CaCO_3$	NA	NA	NA	NA
Chlorine	mg/ℓ	1.2	2	10	1.2
Cyanide	mg/ℓ	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/ℓ	2.2	0.1	0.10	0.08
Nitrate	mg/ℓ NO_3-N	<0.01	<0.01	0.17	<0.01
pH		5.02	6.27	5.14	5.49
Phenolics	mg/ℓ	0.01	<0.01	0.01	<0.01
Residue:					
Filterable @ 180°C	mg/ℓ	1,900	316	2,177	868
Specific Conductance	umhos/cm at 25°C	NA	NA	NA	NA
Sulfate	mg/ℓ SO_4^{-2}	82	12	76	375
Metals:					
Aluminum	mg/ℓ	5.8	0.6	1.3	1.1
Arsenic	mg/ℓ	0.014	<0.001	0.001	<0.001
Barium	mg/ℓ	0.447	0.635	0.793	0.101
Boron	mg/ℓ	6.3	0.09	0.14	0.03
Cadmium	mg/ℓ	0.004	<0.004	<0.003	<0.004
Calcium	mg/ℓ	430	62	340	150
Chromium	mg/ℓ	0.03	<0.01	<0.01	<0.01
Cobalt	mg/ℓ	<0.01	<0.01	0.03	0.01
Copper	mg/ℓ	0.02	<0.02	<0.02	<0.02
Iron	mg/ℓ	<0.01	<0.01	0.5	0.02
Lead	mg/ℓ	<0.1	<0.1	<0.1	<0.1
Magnesium	mg/ℓ	4.3	1.3	29	42
Manganese	mg/ℓ	1.2	0.220	5.9	1.7
Mercury	mg/ℓ	<0.001	<0.001	<0.001	<0.001
Molybdenum	mg/ℓ	0.11	<0.05	<0.06	<0.05
Nickel	mg/ℓ	0.02	0.01	0.05	0.01
Potassium	mg/ℓ	0.627	0.333	9	3.4
Selenium	mg/ℓ	0.190	<0.001	<0.005	<0.002
Silver	mg/ℓ	<0.01	<0.01	<0.03	<0.01
Sodium	mg/ℓ	11	3.0	200	71
Zinc	mg/ℓ	0.117	0.105	0.19	0.039

PARAMETER	UNIT	SLUDGE NO. 1	NO. 2	NO. 3	NO. 4	NO. 5
en[illegible] Chemistry:						
Acidity	mg/ℓ $CaCO_3$	NA	NA	NA	NA	NA
Alkalinity	mg/ℓ $CaCO_3$	NA	NA	NA	NA	NA
Chlorine	mg/ℓ	2.1	2.9	3.2	5.3/5.8(2)	5.1
Cyanide	mg/ℓ	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.9	1.8	1.5	2.2	2.7
Nitrate	mg/ℓ NO_3-N	0.2	0.2	0.3	0.3	0.5
pH		NA	NA	NA	NA	NA
Phenolics	mg/ℓ	0.04	0.04	0.03	0.03	0.03
Residue:						
Filterable @ 180°C	mg/ℓ	3,900	3,900	4,300	4,500	4,100
Specific Conductance	umhos/cm at 25°C	NA	NA	NA	NA	NA
Sulfate	mg/ℓ SO_4^{-2}	1,600	1,400	1,600	1,900	1,700
[illegible]etals:						
Aluminum	mg/ℓ(1)	22	24	29	26	23
[illegible]nic	mg/ℓ	0.13/0.12(2)	0.08	0.12	0.21	0.20
Barium	mg/ℓ	0.14	0.30	0.20	0.40	0.48
Boron	mg/ℓ	4.2	6.6/7.0	5.4	4.4	5.1
Cadmium	mg/ℓ	0.03	0.03/0.03	0.03	0.04	0.03
Calcium	mg/ℓ	950	810	1,000	1,200	1,000
Chromium	mg/ℓ	0.09	0.10	0.11	0.08/0.08	0.05
Cobalt	mg/ℓ	0.003	0.005	0.003	0.003	0.001
Copper	mg/ℓ	0.11/0.11	0.12	0.12	0.13	0.10
Iron	mg/ℓ	10/10	13	15	7.2	5.1
Lead	mg/ℓ	0.30	0.27	0.32	0.34/0.35	0.33
Magnesium	mg/ℓ	7.8	8.7	9.4	12	15
Manganese	mg/ℓ	1.7/1.7	2.1	2.7	1.5	1.1
Mercury	mg/ℓ	0.0036	0.0025	0.0036	0.0029	0.0004
Molybdenum	mg/ℓ	0.36/0.40	0.34	0.33	0.41	0.31
Nickel	mg/ℓ	0.16	0.13/0.13	0.15	0.16	0.14
Potassium	mg/ℓ	1.8	2.0	1.9	2.0	1.8
Selenium	mg/ℓ	0.20	0.20	0.18	0.18	0.18
[illegible]ver	mg/ℓ	0.04	0.04	0.05	0.05	0.04
Sodium	mg/ℓ	9.9	10	9.5	13	11
Zinc	mg/ℓ	0.21	0.20	0.18	0.21	0.17

(Continued)

PARAMETER	UNIT	SLUDGE NO. 6	NO. 7	NO. 8	NO. 9
General Chemistry:					
Acidity	mg/ℓ $CaCO_3$	NA	NA	NA	NA
Alkalinity	mg/ℓ $CaCO_3$	NA	NA	NA	NA
Chlorine	mg/ℓ	6.1	3.7	5.3/5.6	5.8/6.9
Cyanide	mg/ℓ	<0.02	<0.02	<0.02/<0.02	<0.02/<0.02
Fluoride	mg/ℓ	1.8	1.7	2.2/2.4	3.0/3.0
Nitrate	mg/ℓ NO_3-N	0.3	0.3	0.4/0.5	0.5/0.6
pH		NA	NA	NA	NA
Phenolics	mg/ℓ	0.29	0.05	<0.01/<0.01	0.03/0.02
Residue:					
Filterable @ 180°C	mg/ℓ	4,300	4,300	4,000/3,900	4,100/4,100
Specific Conductance	μmhos/cm at 25°C	NA	NA	NA	NA
Sulfate	mg/ℓ SO_4^{-2}	1,800	1,900	1,800/1,800	1,800/1,800
Metals:					
Aluminum	mg/ℓ	26/26	25	20/20	22/23
Arsenic	mg/ℓ	0.23	0.26	0.28/0.30	0.26/0.26
Barium	mg/ℓ	0.49	0.39	0.41	1.6/0.21
Boron	mg/ℓ	3.7	4.2	3.5/3.9	4.2/4.4
Cadmium	mg/ℓ	0.04	0.04	0.04/0.03	0.04/0.04
Calcium	mg/ℓ	1,200	920	1,000/1,200	1,000/1,100
Chromium	mg/ℓ	0.09	0.07	0.06/0.06	0.05/0.06
Cobalt	mg/ℓ	0.002	0.004	0.003/0.004	0.003/0.004
Copper	mg/ℓ	0.11	0.12	0.11/0.10	0.11/0.12
Iron	mg/ℓ	9.9	8.7	4.8/4.7	6.1/4.9
Lead	mg/ℓ	0.36	0.37	0.28/0.27	0.32/0.31
Magnesium	mg/ℓ	9.7	8.1	12/11	13/11
Manganese	mg/ℓ	1.6	1.3	0.99/0.91	1.1/1.1
Mercury	mg/ℓ	0.0046	0.0044	0.0037/0.0019	0.0025/0.0030
Molybdenum	mg/ℓ	0.44	0.44	0.34/0.35	0.29/0.24
Nickel	mg/ℓ	0.15	0.14	0.11/0.07	0.14/0.10
Potassium	mg/ℓ	1.6	1.6	1.7/2.0	2.4/2.0
Selenium	mg/ℓ	0.24	0.24	0.25/0.22	0.25/0.25
Silver	mg/ℓ	0.05	0.05	0.04/0.05	0.04/0.05
Sodium	mg/ℓ	11	11	11/11	11/11
Zinc	mg/ℓ	0.19	0.17	0.16/0.16	0.17/0.16

PARAMETER	UNITS	SLUDGE NO. 10	SLUDGE NO. 11
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	960	960
Alkalinity	mg/ℓ $CaCO_3$	140	280
Chloride	mg/ℓ	5.9	3.9
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	1.2	1.2
Nitrate	mg/ℓ NO_3-N	2.0	2.0
pH	--	4.60	4.70
Phenolics	mg/ℓ	0.02	0.02
Residue:			
Filterable @ 180°C	mg/ℓ	4400	4800
Specific Conductance	µmhos/cm @ 25°C	3860	4000
Sulfate	mg/ℓ SO_4^{-2}	1,600	1,500
Metals:			
Aluminum	mg/ℓ	24	24
Arsenic	mg/ℓ	0.028/0.030[2]	0.019
Barium	mg/ℓ	0.27	0.29
Boron	mg/ℓ	7.9/7.8	6.5
Cadmium	mg/ℓ	0.005/0.005	0.004
Calcium	mg/ℓ	27	26
Chromium	mg/ℓ	0.064	0.044
Cobalt	mg/ℓ	0.003/0.005	0.003
Copper	mg/ℓ	0.09	0.08
Iron	mg/ℓ	7.7/7.7	6.8
Lead	mg/ℓ	<0.01/<0.01	<0.01
Magnesium	mg/ℓ	10	8.5/8.5
Manganese	mg/ℓ	2.2	3.1
Mercury	mg/ℓ	0.0003	0.0003
Molybdenum	mg/ℓ	0.24	0.16
Nickel	mg/ℓ	0.11/0.13	0.12
Potassium	mg/ℓ	1.3	1.0
Selenium	mg/ℓ	0.019/0.017	0.004
Silver	mg/ℓ	<0.001/<0.001	<0.001
Sodium	mg/ℓ	9.5	7.6
Zinc	mg/ℓ	0.18/0.18	0.15

PARAMETER	UNITS	SLUDGE NO. 12	SLUDGE COMPOSITE
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	870	2,300
Alkalinity	mg/ℓ $CaCO_3$	<1	<1
Chloride	mg/ℓ	5.9	7.8
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	1.4	1.2
Nitrate	mg/ℓ NO_3-N	2.5	6.8
pH	--	4.50	4.10
Phenolics	mg/ℓ	0.03	<0.02
Residue:			
Filterable @ 180°C	mg/ℓ	4,100	4,300
Specific Conductance	umhos/cm @ 25°C	3,650	4,600
Sulfate	mg/ℓ SO_4^{-2}	1,600	1,600
Metals:			
Aluminum	mg/ℓ	22/22	29/28
Arsenic	mg/ℓ	0.11	0.17
Barium	mg/ℓ	0.29	0.48/0.48
Boron	mg/ℓ	6.9	9.3
Cadmium	mg/ℓ	0.004	0.006
Calcium	mg/ℓ	23	31/31
Chromium	mg/ℓ	0.053	0.097
Cobalt	mg/ℓ	0.003	0.005
Copper	mg/ℓ	0.07	0.12/0.12
Iron	mg/ℓ	9.5	9.3
Lead	mg/ℓ	<0.01	<0.01
Magnesium	mg/ℓ	9.8	10
Manganese	mg/ℓ	1.6	1.9/1.9
Mercury	mg/ℓ	0.0019	0.0033
Molybdenum	mg/ℓ	0.20	0.28/0.28
Nickel	mg/ℓ	0.10	0.28
Potassium	mg/ℓ	1.2	1.8/1.8
Selenium	mg/ℓ	0.015	0.007
Silver	mg/ℓ	<0.001	<0.001
Sodium	mg/ℓ	8.9	11/11
Zinc	mg/ℓ	0.16	0.65

(1) mg/ℓ = milligrams per liter or parts per million.
(2) The indicated sample was analyzed in duplicate.

3. BATCH LEACH TESTING

Introduction

One of the objectives of the study was to assess the ability of the overburden and spoils to attenuate chemical species present in the ground water resulting from contact with the wastes. Attenuation capacities can be expressed in terms of a distribution ratio, K_r. The ratio for a particular chemical species is defined as the mass sorbed onto the solid phase to the mass remaining in solution:

$$K_r = \frac{\text{Mass of Solute on the Solid Phase Per Unit Mass of Solid Phase}}{\text{Concentration of Solute in Solution}}$$

It is conventional to express K_r in units of milliliters of solution per gram of sample.

Testing Method

The laboratory methods generally used to assess K_r are the batch test and column test. The batch test method (jar test) is used to define the distribution ratios for metal species that exhibit absorption/adsorption potential.

Samples for testing were prepared by mixing 0.47 percent bottom ash, 97.30 percent spoil/overburden, and 2.23 percent composite sludge by weight. These percentages for mixing the samples were calculated from the following estimates of wastes generated over the project lifetime:

Total Spoil = 760 million cubic yards (cyd.) weighing;
3,000 pounds per cyd.

Total Ash = 31.6 million tons consisting of 17.5 percent; bottom ash and 82.5 percent fly ash (sludge). Bottom ash weighs 30 pounds per ft^3 and fly ash is 58 pounds per ft^3.

A composite sludge was formed from the 12 sludge samples for use in the leach testing by mixing equal aliquots of sludge from each of the 12 sludge samples. This approach was thought to be more representative of the waste and the number of leach tests that were needed.

Each of the five spoils and the two overburdens were mixed individually with the sludge-bottom ash composite and two duplicates were prepared for quality assurance/quality control. The samples were placed in two liter glass or plastic bottles that had been acid cleaned and thoroughly rinsed with distilled water. All other plastic and glassware used in this study were similarly cleaned.

Each of these mixtures were then mixed with each of the composited ground waters and the one surface water sample. In addition, distilled water was used as a leaching medium. The total number of sample mixtures generated was 42 plus two duplicates. The ratio of solid to water for each test was always kept at 1:4.

In addition to the waste overburden mixtures, similar testing was performed on the spoil/overburden samples alone, as well as the composite sludge, the fly ash, and the bottom ash. The purpose of these experiments was to assess what each individual component might be expected to contribute to the overall chemistry of the composited sample leachates. The experimental procedure for each of these tests was done in the same manner described above. The composition of generated leachates is presented in Tables 27.B13 through 27.B29 for each of the water samples used (one surface water and four composited ground water).

1:4 ASTM LEACHATE ANALYSIS SUMMARY FOR OVERBURDEN D-1

PARAMETER	UNITS	OVERBURDEN D-1 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	230	2,700/2,700	860
Chloride	mg/ℓ	27	410/410	160
Cyanide	mg/ℓ	0.02	<0.02/<0.02	<0.02
Fluoride	mg/ℓ	1.3	2.3/2.0	1.8
Nitrate	mg/ℓ NO_3-N	12	2.4/2.2	3.6
pH	--	8.20	9.10/8.60	8.90
Phenolics	mg/ℓ	0.02	0.01/0.01	0.12
Residue:				
Filterable @ 180°C	mg/ℓ	2,500	4,200/4,300	4,100
Specific Conductance	µmhos/cm @ 25°C	3,760	5,980/6,280	6,170
Sulfate	mg/ℓ SO_4^{-2}	1,300	200/100	1,600
Metals:				
Aluminum	mg/ℓ	1.9	1.3/1.8	1.0
Arsenic	mg/ℓ	0.002	0.003/0.010	0.003
Barium	mg/ℓ	0.040	0.092/0.142	0.029
Boron	mg/ℓ	<0.5	0.8/0.7	<0.5
Cadmium	mg/ℓ	<0.001	<0.001/<0.001	<0.001
Calcium	mg/ℓ	41	11/17	30
Chromium	mg/ℓ	0.035	0.028/0.030	0.031
Cobalt	mg/ℓ	0.005	<0.001/0.003	0.008
Copper	mg/ℓ	0.02	<0.01/0.11	0.02
Iron	mg/ℓ	0.59	1.1/0.16	1.2
Lead	mg/ℓ	<0.01	<0.01/<0.01	<0.01
Magnesium	mg/ℓ	5.3	5.5/4.7	5.6
Manganese	mg/ℓ	0.08	0.04/0.05	0.12
Mercury	mg/ℓ	<0.0002	0.0005	<0.0002
Molybdenum	mg/ℓ	0.008	0.021/0.025	<0.001
Nickel	mg/ℓ	<0.01	<0.01/0.01	0.01
Potassium	mg/ℓ	14	17/15	16
Selenium	mg/ℓ	0.020	0.018/0.018	0.012
Silver	mg/ℓ	0.002	<0.001/<0.001	0.002
Sodium	mg/ℓ	740	1,500/1,300	1,100
Zinc	mg/ℓ	0.06	0.09/0.08	0.05

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	420	570	200
Chloride	mg/ℓ	5,200	1,900	20
Cyanide	mg/ℓ	<0.02	0.03	<0.02
Fluoride	mg/ℓ	0.7	1.6	1.2
Nitrate	mg/ℓ NO_3-N	21	2.2	<0.1
pH	--	7.90	8.50	8.15
Phenolics	mg/ℓ	0.02	0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	9,800	4,300	1,300
Specific Conductance	µmhos/cm @ 25°C	17,600	8,070	1,000
Sulfate	mg/ℓ SO_4^{-2}	200	150	100
Metals:				
Aluminum	mg/ℓ	0.9	4.4	3.4
Arsenic	mg/ℓ	0.006	0.001	0.006
Barium	mg/ℓ	0.18	0.14	0.026
Boron	mg/ℓ	0.7	0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	150	16	2
Chromium	mg/ℓ	0.003	0.034	0.018
Cobalt	mg/ℓ	0.052	0.002	0.008
Copper	mg/ℓ	0.02/<0.01	0.04	0.02
Iron	mg/ℓ	0.06	1.4	5.2
Lead	mg/ℓ	0.10	<0.01	<0.01
Magnesium	mg/ℓ	27	3.9	0.9
Manganese	mg/ℓ	0.17	0.06	0.06
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.046	0.030	0.037
Nickel	mg/ℓ	0.02	<0.01	<0.01
Potassium	mg/ℓ	35	16	3.9
Selenium	mg/ℓ	0.034	0.014	0.026
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	3,000	1,200	230
Zinc	mg/ℓ	0.03	0.08	0.10

1:4 ASTM LEACHATE ANALYSIS SUMMARY FOR OVERBURDEN D-2

PARAMETER	UNITS	OVERBURDEN D-2 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1/<1
Alkalinity	mg/ℓ $CaCO_3$	150	2,600	860/780
Chloride	mg/ℓ	18	190	290/150
Cyanide	mg/ℓ	<0.02	<0.02	<0.02/<0.02
Fluoride	mg/ℓ	0.8	1.8	1.8/1.8
Nitrate	mg/ℓ NO_3-N	9.0	11	5.2/6.9
pH	--	8.10	8.60	8.70/8.40
Phenolics	mg/ℓ	0.04	0.01	0.03/0.01
Residue:				
Filterable @ 180°C	mg/ℓ	2,800	4,200	5,000/5,000
Specific Conductance	µmhos/cm @ 25°C	3,400	6,950	6,470/7,130
Sulfate	mg/ℓ SO_4^{-2}	1,800	400	2,500/2,500
Metals:				
Aluminum	mg/ℓ	<0.1	0.2	0.1/0.1
Arsenic	mg/ℓ	0.001	0.002	0.004/0.003
Barium	mg/ℓ	0.060	0.077	0.062/0.043
Boron	mg/ℓ	<0.5	0.5	<0.5/<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001/0.001
Calcium	mg/ℓ	320	60	190/190
Chromium	mg/ℓ	<0.001	0.002	0.004/<0.001
Cobalt	mg/ℓ	<0.001	<0.001	0.022/0.029
Copper	mg/ℓ	0.02	0.02	0.04/0.02
Iron	mg/ℓ	0.06	0.08	0.10/0.08
Lead	mg/ℓ	<0.01	<0.01	0.02/0.02
Magnesium	mg/ℓ	59	28	40/45
Manganese	mg/ℓ	0.08	0.04	0.26/0.15
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002/<0.0002
Molybdenum	mg/ℓ	0.002	0.005	0.004/0.006
Nickel	mg/ℓ	<0.01	<0.01	0.01/0.02
Potassium	mg/ℓ	14	15	17/17
Selenium	mg/ℓ	0.014	0.008	0.006/0.006
Silver	mg/ℓ	<0.001	<0.001	0.002/0.002
Sodium	mg/ℓ	530	1,400	1,200/1,200
Zinc	mg/ℓ	<0.01	<0.01	0.06/0.03

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	540	560	76
Chloride	mg/ℓ	5,600	2,000	3.9
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.7	1.3	0.7
Nitrate	mg/ℓ NO_3-N	18	13	6.3
pH	--	8.05	8.20	8.25
Phenolics	mg/ℓ	0.04	<0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	11,000	5,100	1,300
Specific Conductance	µmhos/cm @ 25°C	17,800	9,020	1,780
Sulfate	mg/ℓ SO_4^{-2}	1,000	500	980
Metals:				
Aluminum	mg/ℓ	0.4	<0.1	<0.1
Arsenic	mg/ℓ	0.007	0.001	<0.001
Barium	mg/ℓ	0.16	0.063	0.046
Boron	mg/ℓ	0.6	<0.5	<0.5
Cadmium	mg/ℓ	0.001	<0.001	0.005
Calcium	mg/ℓ	340	80	130
Chromium	mg/ℓ	0.041	0.006	0.003
Cobalt	mg/ℓ	0.13	<0.001	<0.001
Copper	mg/ℓ	0.06	0.04	<0.01
Iron	mg/ℓ	0.10	0.07	0.07
Lead	mg/ℓ	0.21	0.02	<0.01
Magnesium	mg/ℓ	77	32	29
Manganese	mg/ℓ	0.38	0.13	0.09
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.008	0.005	0.020
Nickel	mg/ℓ	0.04	<0.01	<0.01
Potassium	mg/ℓ	31	18	9.2
Selenium	mg/ℓ	0.018	0.011	0.014
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,000	1,500	250
Zinc	mg/ℓ	0.04	<0.01	<0.01

1:4 ASTM LEACHATE ANALYSIS SUMMARY FOR SPOIL S-1

PARAMETER	UNITS	SPOIL S-1 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	160	2100	810
Chloride	mg/ℓ	20	420	170
Cyanide	mg/ℓ	0.02	0.08	<0.02
Fluoride	mg/ℓ	1.1	1.4	1.5
Nitrate	mg/ℓ NO_3-N	17	18	17
pH	--	8.10	8.35	8.15
Phenolics	mg/ℓ	0.03	<0.01	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	5,000	6,200	6,900
Specific Conductance	µmhos/cm @ 25°C	6,010	8,450	8,600
Sulfate	mg/ℓ SO_4^{-2}	3,000	4,000	3,700
Metals:				
Aluminum	mg/ℓ	<0.1	1.4	<0.1
Arsenic	mg/ℓ	0.002	0.003	0.004
Barium	mg/ℓ	0.085	0.039	0.072
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	400	80	360
Chromium	mg/ℓ	0.005	0.055	0.006
Cobalt	mg/ℓ	0.007	0.003	0.012
Copper	mg/ℓ	0.05	0.04	0.06
Iron	mg/ℓ	0.08	0.30	0.08
Lead	mg/ℓ	0.03	0.03	0.05
Magnesium	mg/ℓ	50	34	42
Manganese	mg/ℓ	0.13	0.05	0.15
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.007	0.013	0.013
Nickel	mg/ℓ	0.03	<0.01	0.08
Potassium	mg/ℓ	23	20	23
Selenium	mg/ℓ	0.021	0.012	0.013
Silver	mg/ℓ	0.002	0.002	0.002
Sodium	mg/ℓ	1,000	1,700	1,500
Zinc	mg/ℓ	0.04	0.04	0.04

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	460	530	140
Chloride	mg/ℓ	5,300	2100	12
Cyanide	mg/ℓ	0.05	0.05	<0.02
Fluoride	mg/ℓ	0.8	1.6	2.5
Nitrate	mg/ℓ NO_3-N	31	16	12
pH	--	8.05	8.40	7.90
Phenolics	mg/ℓ	0.04	0.04	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	13,000	6,100	3,500
Specific Conductance	µmhos/cm @ 25°C	22,800	9,670	4,830
Sulfate	mg/ℓ SO_4^{-2}	2,300	1,000	2,200
Metals:				
Aluminum	mg/ℓ	<0.1	0.1	<0.1
Arsenic	mg/ℓ	0.002	0.002	0.001
Barium	mg/ℓ	0.20	0.12	0.10
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	0.002	<0.001	<0.001
Calcium	mg/ℓ	770	130	310
Chromium	mg/ℓ	0.004	0.029	0.004
Cobalt	mg/ℓ	0.096	0.001	0.002
Copper	mg/ℓ	0.05	0.04	0.02
Iron	mg/ℓ	0.24	0.24	0.04
Lead	mg/ℓ	0.25	0.04	0.02
Magnesium	mg/ℓ	79	24	28
Manganese	mg/ℓ	0.34	0.11	0.06
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.016	0.009	0.009
Nickel	mg/ℓ	0.08	0.04	0.03
Potassium	mg/ℓ	40	19	16
Selenium	mg/ℓ	0.022	0.009	0.012
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	3,400	1,700	770
Zinc	mg/ℓ	0.05	0.03	0.01

1:4 ASTM LEACHATE ANALYSIS SUMMARY FOR SPOIL S-2

PARAMETER	UNITS	SPOIL S-2 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	200	2,200	720
Chloride	mg/ℓ	29	390	310
Cyanide	mg/ℓ	0.06	<0.02	<0.02
Fluoride	mg/ℓ	1.0	1.3	1.6
Nitrate	mg/ℓ NO_3-N	8.7	10	9.2
pH	--	7.90	8.90	8.40
Phenolics	mg/ℓ	0.02	0.04	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	3,800	5,000	5,000
Specific Conductance	µmhos/cm @ 25°C	5,300	7,290	6,760
Sulfate	mg/ℓ SO_4^{-2}	2,500	800	2,400
Metals:				
Aluminum	mg/ℓ	<0.1	3.8	3.2
Arsenic	mg/ℓ	0.001	0.001	0.001
Barium	mg/ℓ	0.038	0.045	0.031
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	290	60	110
Chromium	mg/ℓ	0.004	0.049	0.033
Cobalt	mg/ℓ	0.002	0.001	0.001
Copper	mg/ℓ	0.02	0.08	0.02
Iron	mg/ℓ	0.06	0.76	0.50
Lead	mg/ℓ	0.02	0.04	0.04
Magnesium	mg/ℓ	37	20	22
Manganese	mg/ℓ	0.27	0.14	0.20
Mercury	mg/ℓ	0.0004	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.011	0.023	0.020
Nickel	mg/ℓ	<0.01	0.09	<0.01
Potassium	mg/ℓ	26	21	25
Selenium	mg/ℓ	0.014	0.013	0.004
Silver	mg/ℓ	0.002	0.002	0.003
Sodium	mg/ℓ	810	1,400	1,300
Zinc	mg/ℓ	0.02	0.08	0.02

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	370/440	520	170
Chloride	mg/ℓ	5,100/5,300	1,900	11
Cyanide	mg/ℓ	<0.02/<0.02	0.02	<0.02
Fluoride	mg/ℓ	0.6/0.7	1.3	1.2
Nitrate	mg/ℓ NO_3-N	21/19	9.5	2.4
pH	--	8.00/8.10	8.20	8.20
Phenolics	mg/ℓ	0.02/0.03	<0.01	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	11,000/10,000	4,900	1,700
Specific Conductance	µmhos/cm @ 25°C	18,400/17,600	8,460	2,450
Sulfate	mg/ℓ SO_4^{-2}	600/500	400	650
Metals:				
Aluminum	mg/ℓ	<0.1/0.1	0.2	0.6
Arsenic	mg/ℓ	0.004/0.004	<0.001	0.004
Barium	mg/ℓ	0.11/0.16	0.037	0.016
Boron	mg/ℓ	<0.5/0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	300/260	60	33
Chromium	mg/ℓ	0.006/0.004	0.004	0.005
Cobalt	mg/ℓ	0.055/0.076	<0.001	<0.001
Copper	mg/ℓ	0.03/0.02	0.04	<0.01
Iron	mg/ℓ	0.06/0.18	0.06	0.12
Lead	mg/ℓ	0.17/0.16	0.02	0.01
Magnesium	mg/ℓ	58/59	17	4.9
Manganese	mg/ℓ	0.50/0.41	0.16	0.07
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.025/0.024	0.029	0.012
Nickel	mg/ℓ	0.08/0.08	<0.01	<0.01
Potassium	mg/ℓ	41/40	20	7.1
Selenium	mg/ℓ	0.016/0.017	0.014	0.011
Silver	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,200/3,100	1,400	290
Zinc	mg/ℓ	0.04/0.01	0.02	0.03

Table 27-B17
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR SPOIL S-3

PARAMETER	UNITS	SPOIL S-3 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	200	1,400	860
Chloride	mg/ℓ	29	390	320
Cyanide	mg/ℓ	0.02	0.02	0.02
Fluoride	mg/ℓ	1.3	1.8	2.2
Nitrate	mg/ℓ NO_3-N	12	16	12
pH	--	8.20	8.10	8.30
Phenolics	mg/ℓ	0.01	0.01	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	2,900	5,300	4,800
Specific Conductance	µmhos/cm @ 25°C	4,130	7,700	6,840
Sulfate	mg/ℓ SO_4^{-2}	1,900	1,000	1,800
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	0.1
Arsenic	mg/ℓ	0.002	0.001	0.003
Barium	mg/ℓ	0.053	0.093	0.037
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	160	140	110
Chromium	mg/ℓ	<0.001	0.004	0.005
Cobalt	mg/ℓ	0.011	0.004	0.012
Copper	mg/ℓ	0.02	0.02	0.02
Iron	mg/ℓ	0.02	0.06	0.08
Lead	mg/ℓ	0.02	0.02	0.03
Magnesium	mg/ℓ	23	25	19
Manganese	mg/ℓ	0.60	0.19	0.26
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.012	0.002	0.007
Nickel	mg/ℓ	<0.01	0.02	<0.01
Potassium	mg/ℓ	19	18	16
Selenium	mg/ℓ	0.019	0.026	0.020
Silver	mg/ℓ	0.002	0.002	0.002
Sodium	mg/ℓ	750	1,500	1,300
Zinc	mg/ℓ	0.05	0.06	0.05

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	440	630	260
Chloride	mg/ℓ	5,600	2,100	13
Cyanide	mg/ℓ	0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.7	1.9	1.4
Nitrate	mg/ℓ NO_3-N	23	17	52
pH	--	7.90	8.20	8.10
Phenolics	mg/ℓ	<0.01	0.16	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	11,400	5,100	1,700
Specific Conductance	µmhos/cm @ 25°C	17,900	8,950	2,230
Sulfate	mg/ℓ SO_4^{-2}	1,600	300	650
Metals:				
Aluminum	mg/ℓ	<0.1	0.3	<0.1
Arsenic	mg/ℓ	0.006	<0.001	0.001
Barium	mg/ℓ	0.37	0.078	0.098
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	0.002	<0.001	<0.001
Calcium	mg/ℓ	470	60	50
Chromium	mg/ℓ	<0.001	0.005	0.001
Cobalt	mg/ℓ	0.13	0.002	<0.001
Copper	mg/ℓ	0.03	0.06	<0.01
Iron	mg/ℓ	0.06	0.06	0.02
Lead	mg/ℓ	0.18	0.01	<0.01
Magnesium	mg/ℓ	65	15	6.3
Manganese	mg/ℓ	0.76	0.17	0.11
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.008	0.008	0.013
Nickel	mg/ℓ	0.07	0.03	<0.01
Potassium	mg/ℓ	34	18	8.9
Selenium	mg/ℓ	0.032	0.024	0.026
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,100	1,500	420
Zinc	mg/ℓ	0.04	0.05	0.05

1:4 ASTM LEACHATE ANALYSIS SUMMARY FOR SPOIL S-4

PARAMETER	UNITS	SPOIL S-4 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ (1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	200/190	1,800	690
Chloride	mg/ℓ	43/51	410	340
Cyanide	mg/ℓ	0.03/0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.6/0.7	0.9	0.9
Nitrate	mg/ℓ NO_3-N	11/11	11	19
pH	--	7.85/8.00	8.15	7.80
Phenolics	mg/ℓ	0.02/<0.01	<0.01	0.01
Residue:				
Filterable @ 180°C	mg/ℓ	4,600/4,000	8,800	6,700
Specific Conductance	µmhos/cm @ 25°C	5,450/5,120	7,490	8,230
Sulfate	mg/ℓ SO_4^{-2}	2,700/2,800	1,300	3,000
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	0.7	<0.1
Arsenic	mg/ℓ	0.002/0.002	0.003	0.005
Barium	mg/ℓ	0.038/0.048	0.069	0.046
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	640/530	210	460
Chromium	mg/ℓ	<0.001/0.003	0.006	0.001
Cobalt	mg/ℓ	0.006/0.007	0.009	0.024
Copper	mg/ℓ	0.02/<0.01	0.06	<0.01
Iron	mg/ℓ	0.06/0.04	0.31	0.04
Lead	mg/ℓ	<0.01/<0.01	<0.01	0.02
Magnesium	mg/ℓ	37/33	21	27
Manganese	mg/ℓ	0.70/0.86	0.32	0.62
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.004/0.005	0.003	0.003
Nickel	mg/ℓ	<0.01/<0.01	0.06	0.03
Potassium	mg/ℓ	31/30	28	32
Selenium	mg/ℓ	0.020/0.020	0.018	0.012
Silver	mg/ℓ	0.002/0.002	0.002	0.002
Sodium	mg/ℓ	850/830	1,500	1,400
Zinc	mg/ℓ	0.04/0.04	0.05	0.04

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	420/780	500	160
Chloride	mg/ℓ	5,500/5,600	2,400	19
Cyanide	mg/ℓ	0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.5/0.5	0.7	0.5
Nitrate	mg/ℓ NO_3-N	20/18	11	1.0
pH	--	8.00/7.60	7.85	7.90
Phenolics	mg/ℓ	0.01/0.01	0.04	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	12,000/13,000	6,800	3,500
Specific Conductance	µmhos/cm @ 25°C	19,100/20,600	9,390	4,140
Sulfate	mg/ℓ SO_4^{-2}	1,300/2,000	1,500	2,000
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	<0.1	<0.1
Arsenic	mg/ℓ	0.005/0.006	<0.001	<0.001
Barium	mg/ℓ	0.079/0.083	0.051	0.072
Boron	mg/ℓ	0.6/<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/0.002	<0.001	<0.001
Calcium	mg/ℓ	730/800	410	520
Chromium	mg/ℓ	0.001/<0.001	0.003	0.001
Cobalt	mg/ℓ	0.092	0.017	0.005
Copper	mg/ℓ	0.02/0.02	<0.01	<0.01
Iron	mg/ℓ	0.06/0.06	0.04	0.04
Lead	mg/ℓ	0.19/0.22	0.03	<0.01
Magnesium	mg/ℓ	53/56	27	25
Manganese	mg/ℓ	0.85/0.89	0.46	0.56
Mercury	mg/ℓ	<0.0002/<0.0002	0.0002	0.0004
Molybdenum	mg/ℓ	0.007/0.006	0.003	0.004
Nickel	mg/ℓ	0.08/0.14	0.04	<0.01
Potassium	mg/ℓ	50/50	35	26
Selenium	mg/ℓ	0.020/0.024	0.022	0.022
Silver	mg/ℓ	<0.001/<0.001	<0.001	0.002
Sodium	mg/ℓ	3,200/3,200	1,700	600
Zinc	mg/ℓ	0.04/0.04	0.04	0.03

Table 27-B19

1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR SPOIL S-5

PARAMETER	UNITS	SPOIL S-5 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	180	1,700	670
Chloride	mg/ℓ	27	300	320
Cyanide	mg/ℓ	<0.02	<0.02	0.05
Fluoride	mg/ℓ	0.9	0.9	1.3
Nitrate	mg/ℓ NO_3-N	13	13	12
pH	--	8.20	8.60	8.25
Phenolics	mg/ℓ	0.01	0.06	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	3,500	3,800	5,300
Specific Conductance	µmhos/cm @ 25°C	4,300	5,480	6,960
Sulfate	mg/ℓ SO_4^{-2}	2,300	500	2,100
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	2.5
Arsenic	mg/ℓ	0.002	0.001	0.003
Barium	mg/ℓ	0.055	0.076	0.048
Boron	mg/ℓ	<0.5	0.6	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	320	100	240
Chromium	mg/ℓ	<0.001	0.006	0.024
Cobalt	mg/ℓ	0.008	0.006	0.022
Copper	mg/ℓ	0.04	0.07	<0.01
Iron	mg/ℓ	0.02	0.06	0.20
Lead	mg/ℓ	<0.01	<0.01	0.02
Magnesium	mg/ℓ	30	17	25
Manganese	mg/ℓ	0.26	0.08	0.12
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.003	0.005	0.005
Nickel	mg/ℓ	0.01	0.03	<0.01
Potassium	mg/ℓ	26	22	27
Selenium	mg/ℓ	0.018	0.020	0.014
Silver	mg/ℓ	0.002	<0.001	0.002
Sodium	mg/ℓ	750	1,400	1,300
Zinc	mg/ℓ	<0.01	0.04	0.02

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	470/440	480	120
Chloride	mg/ℓ	5,600/5,600	2,200	16
Cyanide	mg/ℓ	0.02/<0.02	0.03	<0.02
Fluoride	mg/ℓ	0.6/0.6	1.0	1.0
Nitrate	mg/ℓ NO_3-N	21/25	15	6.0
pH	--	8.25/8.20	8.40	7.85
Phenolics	mg/ℓ	0.09/0.03	0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	11,000/11,000	6,000	2,000
Specific Conductance	µmhos/cm @ 25°C	18,200/17,500	9,310	2,760
Sulfate	mg/ℓ SO_4^{-2}	1,300/800	1,100	1,200
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	<0.1	<0.1
Arsenic	mg/ℓ	0.006/0.005	0.001	0.001
Barium	mg/ℓ	0.15/0.12	0.075	0.041
Boron	mg/ℓ	0.6/0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/0.002	<0.001	<0.001
Calcium	mg/ℓ	530/520	210	110
Chromium	mg/ℓ	0.001/0.001	0.021	0.002
Cobalt	mg/ℓ	0.079/0.070	0.002	0.009
Copper	mg/ℓ	0.02/0.02	<0.01	<0.01
Iron	mg/ℓ	0.07/0.07	0.11	0.02
Lead	mg/ℓ	0.28/0.25	<0.01	<0.01
Magnesium	mg/ℓ	57/57	25	11
Manganese	mg/ℓ	0.37/0.37	0.14	0.06
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.009/0.010	0.005	0.006
Nickel	mg/ℓ	0.09/0.08	0.01	<0.01
Potassium	mg/ℓ	43/45	28	15
Selenium	mg/ℓ	0.022/0.024	0.018	0.020
Silver	mg/ℓ	<0.001/<0.001	0.002	0.002
Sodium	mg/ℓ	3,200/3,100	1,600	520
Zinc	mg/ℓ	0.03/0.04	0.03	0.03

Table 27-B20
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR FLY ASH

PARAMETER	UNITS	FLY ASH LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	820	2,600	840
Chloride	mg/ℓ	16	360	290
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.9	1.6	0.4
Nitrate	mg/ℓ NO_3-N	3.3	2.0	2.0
pH	--	12.20	10.30	11.80
Phenolics	mg/ℓ	0.03	0.03	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	2,000	4,300	4,500
Specific Conductance	umhos/cm @ 25°C	5,490	7,470	7,350
Sulfate	mg/ℓ SO_4^{-2}	590	510	1,200
Metals:				
Aluminum	mg/ℓ	0.8	15	16
Arsenic	mg/ℓ	0.009	1.00	0.140
Barium	mg/ℓ	0.49	0.30	0.33
Boron	mg/ℓ	1.0	20	12
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	290	7	80
Chromium	mg/ℓ	0.14	0.24	0.22
Cobalt	mg/ℓ	<0.001	0.005	0.004
Copper	mg/ℓ	<0.01	<0.01	<0.01
Iron	mg/ℓ	0.02	0.07	0.04
Lead	mg/ℓ	<0.01	0.01	0.01
Magnesium	mg/ℓ	0.2	0.8	0.2
Manganese	mg/ℓ	0.02	0.02	<0.01
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	1.4	0.75	0.64
Nickel	mg/ℓ	<0.01	<0.01	<0.01
Potassium	mg/ℓ	17	7.0	9.2
Selenium	mg/ℓ	0.09	0.83	0.32
Silver	mg/ℓ	<0.001/<0.001	<0.001/0.002	0.001
Sodium	mg/ℓ	380	1,300	1,100
Zinc	mg/ℓ	0.01	0.01	0.01

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ (1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	960	1,000	1,400
Chloride	mg/ℓ	5,600	2,100	3.9
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	3.1	1.9	3.3
Nitrate	mg/ℓ NO_3-N	19	3.3	2.5
pH	--	12.00	12.15	12.10
Phenolics	mg/ℓ	0.03	0.05	0.05
Residue:				
Filterable @ 180°C	mg/ℓ	10,000	4,800	1,600
Specific Conductance	µmhos/cm @ 25°C	1,970	12,500	5,710
Sulfate	mg/ℓ SO_4^{-2}	320	370	130
Metals:				
Aluminum	mg/ℓ	0.3	2.0	<0.1
Arsenic	mg/ℓ	0.017	0.030	0.010
Barium	mg/ℓ	1.3	1.7	4.9
Boron	mg/ℓ	6.2	6.2	5.1
Cadmium	mg/ℓ	<0.001	<0.001	<0.001/<0.001
Calcium	mg/ℓ	520	160	590
Chromium	mg/ℓ	0.070	0.118	0.036
Cobalt	mg/ℓ	0.070	0.006	<0.001
Copper	mg/ℓ	<0.01	<0.01	<0.01/0.05
Iron	mg/ℓ	0.04	0.03	0.02
Lead	mg/ℓ	0.19	0.04	<0.01/<0.01
Magnesium	mg/ℓ	0.2	<0.1	0.2
Manganese	mg/ℓ	0.02	<0.01	0.02/0.02
Mercury	mg/ℓ	0.0006	<0.0002	<0.0002
Molybdenum	mg/ℓ	1.5	1.2	1.5
Nickel	mg/ℓ	0.05	<0.01	0.07
Potassium	mg/ℓ	22	14	2.0/2.0
Selenium	mg/ℓ	0.22	0.38	0.24
Silver	mg/ℓ	0.001/0.002	<0.001/0.001	0.016/0.014
Sodium	mg/ℓ	3,000	1,900	41
Zinc	mg/ℓ	0.01	0.01	0.04/0.04

Table 27-B21
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR BOTTOM ASH

PARAMETER	UNITS	BOTTOM ASH LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	80	2900	900
Chloride	mg/ℓ	22	2.4	290
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.9	1.9	2.1
Nitrate	mg/ℓ NO_3-N	2.5	5.8	3.0
pH	--	8.15	8.90	8.60
Phenolics	mg/ℓ	0.02	0.02	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	2,000	3,800	3,900
Specific Conductance	µmhos/cm @ 25°C	2,350	5,940	5,510
Sulfate	mg/ℓ SO_4^{-2}	940	44	1,100
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	<0.1
Arsenic	mg/ℓ	<0.001	0.004	<0.001
Barium	mg/ℓ	0.30	1.4	0.13
Boron	mg/ℓ	<0.5	0.8	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	260	18	50
Chromium	mg/ℓ	0.001	0.003	0.001
Cobalt	mg/ℓ	<0.001	0.004	0.005
Copper	mg/ℓ	<0.01	0.02	<0.01
Iron	mg/ℓ	0.03	0.08	0.04
Lead	mg/ℓ	<0.01	<0.01	<0.01
Magnesium	mg/ℓ	28	4.6	6.2
Manganese	mg/ℓ	0.07	0.04	0.06
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.023	0.024	0.003
Nickel	mg/ℓ	0.06	<0.01	0.04
Potassium	mg/ℓ	11	7.7	8.3
Selenium	mg/ℓ	0.046	0.023	0.023
Silver	mg/ℓ	0.004/0.003[2]	<0.001/<0.001	0.002
Sodium	mg/ℓ	330	1,200	1,000
Zinc	mg/ℓ	0.02	0.01	0.02

(Continued)

PARAMETER	UNITS	BOTTOM ASH LEACHED WITH: COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	470	870	40
Chloride	mg/ℓ	5,500	2,100	5.9
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.7	1.0	0.1
Nitrate	mg/ℓ NO_3-N	15	3.5	0.3
pH	--	8.25	9.50	7.80
Phenolics	mg/ℓ	0.03	0.04	0.05
Residue:				
Filterable @ 180°C	mg/ℓ	8,700	4,500	100
Specific Conductance	µmhos/cm @ 25°C	15,900	8930	157
Sulfate	mg/ℓ SO_4^{-2}	170	210	50
Metals:				
Aluminum	mg/ℓ	<0.1	0.3	0.2
Arsenic	mg/ℓ	<0.001	0.010	<0.001
Barium	mg/ℓ	0.93	0.81	0.30
Boron	mg/ℓ	0.6	0.6	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	170	7	21
Chromium	mg/ℓ	<0.001	0.048	0.002
Cobalt	mg/ℓ	0.076/0.070	0.004	<0.001
Copper	mg/ℓ	0.02	0.02	<0.01
Iron	mg/ℓ	0.05	0.09	0.06
Lead	mg/ℓ	0.24	0.04	<0.01
Magnesium	mg/ℓ	37	4.4	1.4
Manganese	mg/ℓ	0.14	0.02	0.02
Mercury	mg/ℓ	<0.0002	<0.0002	0.0002
Molybdenum	mg/ℓ	0.031	0.019	0.017
Nickel	mg/ℓ	0.08	0.06	0.02
Potassium	mg/ℓ	20	11	0.83
Selenium	mg/ℓ	0.020	0.013	0.006
Silver	mg/ℓ	<0.001/<0.001	<0.001/<0.001	<0.001/<0.001
Sodium	mg/ℓ	3,500	1,300	11
Zinc	mg/ℓ	0.02	0.02	0.01

Table 27-B22
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED SLUDGE

PARAMETER	UNITS	COMPOSITE SLUDGE LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ (1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	96	1,100	160
Chloride	mg/ℓ	55	200	330
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.8	11	8.5
Nitrate	mg/ℓ NO_3-N	11	2.5	6.1
pH	--	10.40	8.60	9.90
Phenolics	mg/ℓ	0.02	<0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	2,000	4,800	4,700
Specific Conductance	µmhos/cm @ 25°C	2,570	7,300	5,730
Sulfate	mg/ℓ SO_4^{-2}	1,400	1,300	2,600
Metals:				
Aluminum	mg/ℓ	0.3	0.3	0.6
Arsenic	mg/ℓ	0.018	0.223	0.140
Barium	mg/ℓ	0.39	0.53	0.41
Boron	mg/ℓ	3.1	33	14
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	330	130	170
Chromium	mg/ℓ	0.096	0.084	0.081
Cobalt	mg/ℓ	<0.001	<0.001	0.003
Copper	mg/ℓ	<0.01	<0.01	<0.01
Iron	mg/ℓ	0.02	0.12	0.02
Lead	mg/ℓ	<0.01	0.03	0.03
Magnesium	mg/ℓ	0.2	9.5	3.2
Manganese	mg/ℓ	0.05	0.11	0.06
Mercury	mg/ℓ	<0.0002	0.0003	<0.0002
Molybdenum	mg/ℓ	0.90	1.0	0.80
Nickel	mg/ℓ	0.04	0.04	0.05
Potassium	mg/ℓ	18	13	14
Selenium	mg/ℓ	0.018	0.54	0.12
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	350	1,200	1,100
Zinc	mg/ℓ	0.02	0.04	0.02

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140/140	210	110
Chloride	mg/ℓ	4,900/4,900	2,200	22
Cyanide	mg/ℓ	<0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	5.7/6.0	5.7	1.6
Nitrate	mg/ℓ NO_3-N	16/16	6.5	2.0
pH	--	9.80/9.60	10.80	10.70
Phenolics	mg/ℓ	0.01/0.03	0.03	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	9,800/9,800	5,000	520
Specific Conductance	µmhos/cm @ 25°C	17,700/17,800	7,950	927
Sulfate	mg/ℓ SO_4^{-2}	400/500	1,500	100
Metals:				
Aluminum	mg/ℓ	0.2/0.5	1.4	0.9
Arsenic	mg/ℓ	0.057/0.057	0.076	0.013
Barium	mg/ℓ	0.88/0.77	0.39	1.0
Boron	mg/ℓ	15/11	15	2.9
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	340/410	120	120
Chromium	mg/ℓ	0.11/0.10	0.14	0.078
Cobalt	mg/ℓ	0.008/0.011	<0.001	<0.001
Copper	mg/ℓ	<0.01/<0.01	<0.01	<0.01
Iron	mg/ℓ	0.04/0.08	0.02	0.02
Lead	mg/ℓ	0.12/0.12	0.04	<0.01
Magnesium	mg/ℓ	2.6/8.3	<0.1	<0.1
Manganese	mg/ℓ	0.07/0.06	0.06	0.05
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	1.3/1.4	1.3	1.2
Nickel	mg/ℓ	0.06/0.06	0.05	<0.01
Potassium	mg/ℓ	25/25	17	6.6
Selenium	mg/ℓ	0.14/0.15	0.17	0.045
Silver	mg/ℓ	0.002/0.002	<0.001	<0.001
Sodium	mg/ℓ	2,800/2,800	1,300	44
Zinc	mg/ℓ	0.03/0.04	<0.01	0.03

Table 27-B23
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND OVERBURDEN D-1

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH, AND OVERBURDEN D-1 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140	2,300	740
Chloride	mg/ℓ	25	190	320
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	3.0	3.0	2.9
Nitrate	mg/ℓ NO_3-N	2.2	2.4	2.2
pH	--	7.85	8.55	8.45
Phenolics	mg/ℓ	0.03	0.02	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	3,000	4,100	4,900
Specific Conductance	µmhos/cm @ 25°C	4,300	6,490	6,660
Sulfate	mg/ℓ SO_4^{-2}	1,700	500	2,100
Metals:				
Aluminum	mg/ℓ	3.3	11	0.6
Arsenic	mg/ℓ	0.003	0.003	0.004
Barium	mg/ℓ	0.036	0.088	0.053
Boron	mg/ℓ	<0.5	0.9	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	110	32	80
Chromium	mg/ℓ	0.010	0 018	0.018
Cobalt	mg/ℓ	0.016	<0.001	0.043
Copper	mg/ℓ	0.03	0.02	0.02
Iron	mg/ℓ	0.38	0.54	0.62
Lead	mg/ℓ	0.02	0.01	0.04
Magnesium	mg/ℓ	8.6	5.8	7.4
Manganese	mg/ℓ	0.10	0.06	0.10
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.026	0.027	0.018
Nickel	mg/ℓ	<0.01	<0.01	<0.01
Potassium	mg/ℓ	18	16	17
Selenium	mg/ℓ	0.013	0.008	0.004
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	820	1,300	1,200
Zinc	mg/ℓ	0.03	0.03	0.05

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	380/420	490	120
Chloride	mg/ℓ	5,400/5,200	2,100	20
Cyanide	mg/ℓ	<0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.4/1.9	2.3	4.3
Nitrate	mg/ℓ NO_3-N	19/16	5.0	<0.1
pH	--	7.80/7.90	8.30	7.70
Phenolics	mg/ℓ	0.02/0.05	<0.01	0.01
Residue:				
Filterable @ 180°C	mg/ℓ	10,000/10,000	5,200	1,700
Specific Conductance	µmhos/cm @ 25°C	20,100/18,000	9,050	2,650
Sulfate	mg/ℓ SO_4^{-2}	1,700/1,900	400	1,000
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	1.0	4.0
Arsenic	mg/ℓ	0.008/0.003	0.002	0.014
Barium	mg/ℓ	0.17/0.13	0.090	0.12
Boron	mg/ℓ	1.0/1.0	0.8	0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	220/250	50	37
Chromium	mg/ℓ	0.002/<0.001	<0.001	0.032
Cobalt	mg/ℓ	0.013/0.011	<0.001	<0.001
Copper	mg/ℓ	0.02/<0.01	0.03	0.02
Iron	mg/ℓ	0.06/0.04	0.56	1.0
Lead	mg/ℓ	0.18/0.11	0.02	0.01
Magnesium	mg/ℓ	30/28	7.1	2.5
Manganese	mg/ℓ	0.18/0.20	0.10	0.07
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.050/0.029	0.016	0.020
Nickel	mg/ℓ	0.03/0.04	<0.01	<0.01
Potassium	mg/ℓ	38/28	18	9.2
Selenium	mg/ℓ	0.018/0.011	0.006	0.013
Silver	mg/ℓ	<0.001/0.002	<0.001	0.002
Sodium	mg/ℓ	3,100/2,400	1,500	500
Zinc	mg/ℓ	0.03/0.02	0.06	0.08

Table 27-B24
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND OVERBURDEN D-2

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH, AND OVERBURDEN D-2 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	130	2,300	730
Chloride	mg/ℓ	22	360	290
Cyanide	mg/ℓ	0.05	0.02	<0.02
Fluoride	mg/ℓ	2.3	2.6	3.0
Nitrate	mg/ℓ NO_3-N	10	4.3	5.4
pH	--	7.80	8.25	7.90
Phenolics	mg/ℓ	0.05	0.03	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	3,700	5,000	5,400
Specific Conductance	umhos/cm @ 25°C	4,300	7,920	8,070
Sulfate	mg/ℓ SO_4^{-2}	2,200	2,000	3,200
Metals:				
Aluminum	mg/ℓ	<0.1	1.4	<0.1
Arsenic	mg/ℓ	<0.001	0.001	<0.001
Barium	mg/ℓ	0.15	0.093	0.075
Boron	mg/ℓ	0.6	1.1	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	500	110	320
Chromium	mg/ℓ	0.004	0.017	0.002
Cobalt	mg/ℓ	<0.001	<0.001	0.002
Copper	mg/ℓ	<0.01	0.06	<0.01
Iron	mg/ℓ	0.04	0.30	0.04
Lead	mg/ℓ	<0.01	0.02	0.03
Magnesium	mg/ℓ	75	37	56
Manganese	mg/ℓ	0.31	0.17	0.39
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.032	<0.001	0.023
Nickel	mg/ℓ	0.02	0.04	0.02
Potassium	mg/ℓ	17	17	18
Selenium	mg/ℓ	0.020	0.014	0.007
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	550	1,400	1,200
Zinc	mg/ℓ	0.03	0.04	0.02

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	740	480	80
Chloride	mg/ℓ	5,600	2,000	3.9
Cyanide	mg/ℓ	<0.02	0.03	0.03
Fluoride	mg/ℓ	1.9	2.6	2.4
Nitrate	mg/ℓ NO_3-N	16	11	8.5
pH	--	8.00	8.20	7.90
Phenolics	mg/ℓ	0.03	0.02	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	11,000	6,000	2,100
Specific Conductance	µmhos/cm @ 25°C	20,500	9,600	2,470
Sulfate	mg/ℓ SO_4^{-2}	1,400	1,000	1,400
Metals:				
Aluminum	mg/ℓ	0.1	<0.1	<0.1
Arsenic	mg/ℓ	0.005	<0.001	<0.001
Barium	mg/ℓ	0.24	0.12	0.079
Boron	mg/ℓ	0.8	0.8	0.5
Cadmium	mg/ℓ	0.004	<0.001	<0.001
Calcium	mg/ℓ	540	240	340
Chromium	mg/ℓ	0.002	0.006	0.003
Cobalt	mg/ℓ	0.16	<0.001	<0.001
Copper	mg/ℓ	0.03	0.03	<0.01
Iron	mg/ℓ	0.06	0.06	0.04
Lead	mg/ℓ	0.29	0.03	<0.01
Magnesium	mg/ℓ	90	51	46
Manganese	mg/ℓ	0.53	0.28	0.27
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.034	0.016	0.047
Nickel	mg/ℓ	0.08	0.06	<0.01
Potassium	mg/ℓ	30	20	11
Selenium	mg/ℓ	0.019	0.013	0.020
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,700	1,400	250
Zinc	mg/ℓ	0.02	0.03	<0.01

Table 27-B25
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITE WASTE AND SPOIL S-1

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH AND SPOIL S-1 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	320	2,100	680
Chloride	mg/ℓ	43	390	340
Cyanide	mg/ℓ	<0.02	0.09	0.02
Fluoride	mg/ℓ	1.3	1.8	1.7
Nitrate	mg/ℓ NO_3-N	14	15	12
pH	--	8.30	8.50	8.00
Phenolics	mg/ℓ	0.03	0.03	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	5,800	6,200	7,400
Specific Conductance	umhos/cm @ 25°C	6,390	8,040	8,780
Sulfate	mg/ℓ SO_4^{-2}	3,500	1,800	3,900
Metals:				
Aluminum	mg/ℓ	0.3	0.1	0.8
Arsenic	mg/ℓ	0.005	0.003	0.005
Barium	mg/ℓ	0.20	0.26	0.15
Boron	mg/ℓ	<0.5	0.8	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	600	230	450
Chromium	mg/ℓ	0.004	0.005	0.009
Cobalt	mg/ℓ	0.006	0.006	0.007
Copper	mg/ℓ	0.05	0.05	0.11
Iron	mg/ℓ	0.16	0.12	0.22
Lead	mg/ℓ	0.02	0.01	0.04
Magnesium	mg/ℓ	64	36	46
Manganese	mg/ℓ	0.59	0.31	0.55
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.005	0.005	0.006
Nickel	mg/ℓ	0.07	0.07	0.12
Potassium	mg/ℓ	25	22	23
Selenium	mg/ℓ	0.017	0.016	0.010
Silver	mg/ℓ	0.001	0.001	0.001
Sodium	mg/ℓ	900	1,600	1,500
Zinc	mg/ℓ	0.04	0.05	0.12

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	1,100	500	300
Chloride	mg/ℓ	5,700	2,300	35
Cyanide	mg/ℓ	0.04	0.02	<0.02
Fluoride	mg/ℓ	1.1	1.6	1.2
Nitrate	mg/ℓ NO_3-N	21	15	10
pH	--	8.30	8.50	8.10
Phenolics	mg/ℓ	0.03	0.04	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	14,000	8,300	4,400
Specific Conductance	µmhos/cm @ 25°C	20,400	11,400	5,080
Sulfate	mg/ℓ SO_4^{-2}	3,500	2,800	3,000
Metals:				
Aluminum	mg/ℓ	0.1	0.2	0.2
Arsenic	mg/ℓ	0.002	0.003	0.002
Barium	mg/ℓ	0.34	0.26	0.10
Boron	mg/ℓ	<0.5	<0.5	0.8
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	900	570	470
Chromium	mg/ℓ	<0.001	0.011	0.002
Cobalt	mg/ℓ	0.092/0.091	0.007	0.002
Copper	mg/ℓ	0.06	0.05	0.02
Iron	mg/ℓ	0.16	0.08	0.10
Lead	mg/ℓ	0.24	0.04	<0.01
Magnesium	mg/ℓ	94	60	45
Manganese	mg/ℓ	1.2	0.55	0.60
Mercury	mg/ℓ	0.0007	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.007	0.004	0.008
Nickel	mg/ℓ	0.18	0.14	0.01
Potassium	mg/ℓ	41	27	18
Selenium	mg/ℓ	0.010	0.014	0.016
Silver	mg/ℓ	0.001	0.001	0.001
Sodium	mg/ℓ	3,900	2,300	800
Zinc	mg/ℓ	0.04	0.04	0.05

Table 27-B26
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND SPOIL S-2

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH, AND SPOIL S-2 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	220	2,000	610
Chloride	mg/ℓ	27	370	320
Cyanide	mg/ℓ	<0.02	0.05	0.04
Fluoride	mg/ℓ	1.5	2.3	1.9
Nitrate	mg/ℓ NO_3-N	9.5	3.5	6.8
pH	--	8.30	8.20	8.05
Phenolics	mg/ℓ	0.03	0.03	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	4,100	5,400	6,200
Specific Conductance	µmhos/cm @ 25°C	4,950	8,270	8,950
Sulfate	mg/ℓ SO_4^{-2}	2,200	1,500	3,400
Metals:				
Aluminum	mg/ℓ	0.4	3.9	0.1
Arsenic	mg/ℓ	0.002	0.003	0.005
Barium	mg/ℓ	0.047	0.097	0.043
Boron	mg/ℓ	<0.5	1.0	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	340	130	310
Chromium	mg/ℓ	<0.001	0.013	<0.001
Cobalt	mg/ℓ	0.003	0.007	0.006
Copper	mg/ℓ	0.05	0.05	0.03
Iron	mg/ℓ	0.07	0.93	0.07
Lead	mg/ℓ	<0.01	<0.01	0.01
Magnesium	mg/ℓ	41	30	44
Manganese	mg/ℓ	0.48	0.21	0.23
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.007	0.009	0.007
Nickel	mg/ℓ	0.04	0.04	0.03
Potassium	mg/ℓ	26	24	27
Selenium	mg/ℓ	0.016	0.010	0.007
Silver	mg/ℓ	0.001	0.001	0.001
Sodium	mg/ℓ	860	1,500	1,300
Zinc	mg/ℓ	0.05	0.05	0.03

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	360/460	460	220
Chloride	mg/ℓ	5,800/5,600	2,300	14
Cyanide	mg/ℓ	0.02/<0.02	0.04	<0.02
Fluoride	mg/ℓ	1.2/1.8	1.6	2.2
Nitrate	mg/ℓ NO_3-N	14/17	6.5	3.0
pH	--	8.35/8.20	8.10	8.25
Phenolics	mg/ℓ	0.04/0.02	0.04	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	12,000/12,000	6,600	3,000
Specific Conductance	µmhos/cm @ 25°C	17,600/18,400	9,950	3,730
Sulfate	mg/ℓ SO_4^{-2}	1,700/1,500	1,700	1,800
Metals:				
Aluminum	mg/ℓ	<0.1/0.2	0.5	0.4
Arsenic	mg/ℓ	<0.001	0.002	<0.001
Barium	mg/ℓ	0.20/0.27	0.096	0.068
Boron	mg/ℓ	<0.5/<0.5	<0.5	<0.5
Cadmium	mg/ℓ	0.056/0.052	<0.001	<0.001
Calcium	mg/ℓ	650/510	270	270
Chromium	mg/ℓ	<0.001/<0.001	0.003	0.004
Cobalt	mg/ℓ	0.11/0.086	0.005	0.002
Copper	mg/ℓ	0.04/0.03	0.05	0.05
Iron	mg/ℓ	0.09/0.07	0.09	0.07
Lead	mg/ℓ	0.23	0.04	<0.01
Magnesium	mg/ℓ	83/76	40	28
Manganese	mg/ℓ	1.1/0.93	0.30	0.29
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.012	0.007	0.008
Nickel	mg/ℓ	0.07/0.07	<0.01	0.03
Potassium	mg/ℓ	43/44	29	18
Selenium	mg/ℓ	0.010/0.018	0.014	0.003
Silver	mg/ℓ	0.003/0.005	0.001/0.004	0.001
Sodium	mg/ℓ	3,000/2,800	1,600	580
Zinc	mg/ℓ	0.04/0.03	0.04	0.04

Table 27-B27
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND SPOIL S-3

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH, AND SPOIL S-3 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	150	2,000	760
Chloride	mg/ℓ	29	390	380
Cyanide	mg/ℓ	0.05	<0.02	0.04
Fluoride	mg/ℓ	2.0	2.8	2.7
Nitrate	mg/ℓ NO_3-N	13	17	11
pH	--	7.80	8.45	8.20
Phenolics	mg/ℓ	0.04	0.03	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	4,800	5,500	6,800
Specific Conductance	µmhos/cm @ 25°C	6,190	8,030	9,300
Sulfate	mg/ℓ SO_4^{-2}	3,200	1,400	3,600
Metals:				
Aluminum	mg/ℓ	<0.1	0.5	0.1
Arsenic	mg/ℓ	0.003	0.003	0.005
Barium	mg/ℓ	0.056	0.058	0.050
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	490	110	430
Chromium	mg/ℓ	0.004	0.004	0.004
Cobalt	mg/ℓ	0.009	0.011	0.031
Copper	mg/ℓ	0.03	0.16	0.03
Iron	mg/ℓ	0.04	0.08	0.06
Lead	mg/ℓ	0.02	0.02	0.04
Magnesium	mg/ℓ	48	23	43
Manganese	mg/ℓ	1.2	0.24	1.2
Mercury	mg/ℓ	0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.033	0.009	0.022
Nickel	mg/ℓ	<0.01	0.04	<0.01
Potassium	mg/ℓ	25	17	22
Selenium	mg/ℓ	0.018	0.019	0.012
Silver	mg/ℓ	0.002	0.002	0.002
Sodium	mg/ℓ	900	1,400	1,300
Zinc	mg/ℓ	0.04	0.05	0.04

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ (1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	450	530	130
Chloride	mg/ℓ	5,500	2,200	14
Cyanide	mg/ℓ	0.02	0.09	<0.02
Fluoride	mg/ℓ	1.4	2.1	1.6
Nitrate	mg/ℓ NO_3-N	20	14	10
pH	--	7.85	8.05	7.60
Phenolics	mg/ℓ	0.05	0.03	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	12,000	6,900	3,100
Specific Conductance	µmhos/cm @ 25°C	20,200	11,700	3,790
Sulfate	mg/ℓ SO_4^{-2}	1,500	670	1900
Metals:				
Aluminum	mg/ℓ	0.2	0.1	0.2
Arsenic	mg/ℓ	0.006	0.002	0.002
Barium	mg/ℓ	0.18	0.098	0.047
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	540	340	350
Chromium	mg/ℓ	0.004	0.008	<0.001
Cobalt	mg/ℓ	0.035/0.047	0.007	0.003
Copper	mg/ℓ	0.05	0.03	0.02
Iron	mg/ℓ	0.06	0.06	0.02
Lead	mg/ℓ	0.12	0.02	<0.01
Magnesium	mg/ℓ	72	40	34
Manganese	mg/ℓ	1.2	0.72	0.64
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.032	0.020	0.022
Nickel	mg/ℓ	0.12	0.08	<0.01
Potassium	mg/ℓ	35	23	16
Selenium	mg/ℓ	0.023	0.021	0.023
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,800	2,000	580
Zinc	mg/ℓ	0.03	0.01	0.02

Table 27-B28
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND SPOIL S-4

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH, AND SPOIL S-4 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	210/180	1,600	690
Chloride	mg/ℓ	37/16	400	310
Cyanide	mg/ℓ	<0.02/<0.02	<0.02	0.04
Fluoride	mg/ℓ	1.0/1.0	2.2	1.4
Nitrate	mg/ℓ NO_3-N	9.5/11	4.0	7.2
pH	--	7.70/7.90	8.40	8.00
Phenolics	mg/ℓ	0.03/0.02	0.10	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	5,300/5,200	6,000	6,900
Specific Conductance	µmhos/cm @ 25°C	5,970/6,800	8,370	9,560
Sulfate	mg/ℓ SO_4^{-2}	3,200/3,400	2,300	3,800
Metals:				
Aluminum	mg/ℓ	0.2/0.1	3.6	0.1
Arsenic	mg/ℓ	0.003/0.002	0.004	0.005
Barium	mg/ℓ	0.076/0.049	0.025	0.052
Boron	mg/ℓ	<0.5/<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	670/680	100	500
Chromium	mg/ℓ	0.027/0.006	0.008	0.004
Cobalt	mg/ℓ	0.015/0.012	0.023	0.042
Copper	mg/ℓ	<0.01/0.02	0.02	0.02
Iron	mg/ℓ	0.02/0.02	0.13	0.02
Lead	mg/ℓ	0.01/0.01	0.02	0.04
Magnesium	mg/ℓ	47/45	24	31
Manganese	mg/ℓ	1.4/1.2	0.08	0.90
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.020/0.017	0.007	0.015
Nickel	mg/ℓ	0.02/0.02	0.04	0.06
Potassium	mg/ℓ	32/30	30	30
Selenium	mg/ℓ	0.018/0.013	0.004	0.004
Silver	mg/ℓ	0.002/<0.001	0.002	0.002
Sodium	mg/ℓ	850/870	1,500	1,300
Zinc	mg/ℓ	0.05/0.05	0.03	0.05

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	350	460	110
Chloride	mg/ℓ	5,700	2,200	20
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	0.9	1.3	1.2
Nitrate	mg/ℓ NO_3-N	15	5.3	4.3
pH	--	7.90	8.20	7.90
Phenolics	mg/ℓ	0.03	0.03	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	12,000	7,600	3,700
Specific Conductance	µmhos/cm @ 25°C	19,800	12,100	4,330
Sulfate	mg/ℓ SO_4^{-2}	2,000	2,300	2,400
Metals:				
Aluminum	mg/ℓ	0.1	<0.1	0.1
Arsenic	mg/ℓ	0.009	0.003	<0.001
Barium	mg/ℓ	0.095	0.093	0.077
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	790	470	530
Chromium	mg/ℓ	0.002	0.002	0.004
Cobalt	mg/ℓ	0.052	0.028	0.005
Copper	mg/ℓ	0.02	<0.01	0.14
Iron	mg/ℓ	0.04	<0.01	0.02
Lead	mg/ℓ	0.15	0.04	<0.01
Magnesium	mg/ℓ	62	33	28
Manganese	mg/ℓ	1.3	0.51	0.78
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.016	0.014	0.020
Nickel	mg/ℓ	0.08	<0.01	<0.01
Potassium	mg/ℓ	49	40	26
Selenium	mg/ℓ	0.016	0.012	0.006
Silver	mg/ℓ	<0.001	0.002	<0.001
Sodium	mg/ℓ	3,100	2,100	610
Zinc	mg/ℓ	0.06/0.06	0.03	0.11/0.10

Table 27-B29
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND SPOIL S-5

PARAMETER	UNITS	COMPOSITE SLUDGE, BOTTOM ASH, AND SPOIL S-5 LEACHED WITH: SURFACE WATER	COMPOSITE 1	COMPOSITE 3
General Chemistry:				
Acidity	mg/ℓ (1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140	1,900	740
Chloride	mg/ℓ	29	360	300
Cyanide	mg/ℓ	<0.02	<0.02	0.08
Fluoride	mg/ℓ	1.8	2.1	2.1
Nitrate	mg/ℓ NO_3-N	14	12	12
pH	--	8.10	8.80	8.05
Phenolics	mg/ℓ	<0.01	0.05	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	4,500	4,900	6,500
Specific Conductance	µmhos/cm @ 25°C	5,210	6,860	9,040
Sulfate	mg/ℓ SO_4^{-2}	3,000	1,400	3,600
Metals:				
Aluminum	mg/ℓ	0.1	1.0	0.2
Arsenic	mg/ℓ	0.003	0.002	0.005
Barium	mg/ℓ	0.080	0.065	0.075
Boron	mg/ℓ	<0.5	0.8	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	550	110	410
Chromium	mg/ℓ	0.002	0.016	0.002
Cobalt	mg/ℓ	0.011	0.008	0.034
Copper	mg/ℓ	0.04	0.07	0.06
Iron	mg/ℓ	0.08	0.27	0.08
Lead	mg/ℓ	0.01	0.01	0.03
Magnesium	mg/ℓ	43	17	33
Manganese	mg/ℓ	0.39	0.08	0.46
Mercury	mg/ℓ	0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.023	0.010	0.020
Nickel	mg/ℓ	<0.01	0.04	0.06
Potassium	mg/ℓ	29	21	29
Selenium	mg/ℓ	0.010	0.003	0.002
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	800	1,300	1,300
Zinc	mg/ℓ	0.05	0.04	0.03

(Continued)

PARAMETER	UNITS	COMPOSITE 4	COMPOSITE 5	DEIONIZED WATER
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	440	450	90
Chloride	mg/ℓ	5,600	2,100	16
Cyanide	mg/ℓ	0.06	<0.02	<0.02
Fluoride	mg/ℓ	1.3	1.7	1.9
Nitrate	mg/ℓ NO_3-N	17	13	7.8
pH	--	7.95	8.20	7.80
Phenolics	mg/ℓ	0.02	0.02	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	12,000	5,800	3,700
Specific Conductance	µmhos/cm @ 25°C	21,500	10,200	4,670
Sulfate	mg/ℓ SO_4^{-2}	2,000	1,500	2,200
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	0.2
Arsenic	mg/ℓ	0.008	0.002	<0.001
Barium	mg/ℓ	0.20	0.098	0.11
Boron	mg/ℓ	0.9	0.8	0.6
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	740	310	520
Chromium	mg/ℓ	0.004	0.016	0.002
Cobalt	mg/ℓ	0.096	0.009	0.005
Copper	mg/ℓ	0.06	0.05	0.05
Iron	mg/ℓ	0.09	0.06	0.06
Lead	mg/ℓ	0.20	0.02	<0.01
Magnesium	mg/ℓ	67	30	30
Manganese	mg/ℓ	0.64	0.23	0.12
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.030	0.022	0.042
Nickel	mg/ℓ	0.12	0.04	0.02
Potassium	mg/ℓ	44	29	24
Selenium	mg/ℓ	0.009	0.008	0.003
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,700	1,600	560
Zinc	mg/ℓ	0.03	<0.01	0.02

The batch test jars with their contents were placed in a tumble agitator and periodically tumbled for a total of 48 hours during a seven-day period. After the seven-day reaction period, the solid-leachate mixtures were centrifuged and the clear supernatants decanted into clean plastic bottles. The remaining supernatant was filtered through a 0.45 membrane filter to remove all sus- pended material from the leachate and placed into the same plastic bottles for chemical analysis.

Distribution Ratio Calculation and Summary of Results

The method for calculating the distribution ratio is given in Table 27.B12. A summary of determined K_r values is presented in Tables 27.B30 through 27.B36.

Discussion and Data Evaluation

Chemical quality was determined for all waters used in this study. This included the surface water collected from Chinde Wash and five composited ground waters. The sampling and compositing procedures are explained in Section 2. Analytical results for these waters were presented in Table 27.B2. Batch attenuation tests were performed on samples of overburden and spoil material to evaluate changes that might be expected from interactions of the various waters with the geomedia alone. These results are presented in Tables 27.B13 through 27.B22.

The existing water that intermittently runs in Chinde Wash is of poor quality. Total dissolved solids (TDS) are high and Federal Drinking Water Standards (FDWS) are exceeded for sulfate, iron, and manganese. Results of batch testing with the spoils/overburden alone in all cases produced changes in the quality of this water. TDS increases to values within the range of 2,500 to 5,000 milligrams per liter (mg/l) and sulfate and manganese levels further increase. However, in most cases, levels of iron fall below FDWS levels and aluminum, copper, and zinc levels decrease, suggesting that colloidal hydroxides are forming. Al-

Table 27-B12
CALCULATION METHOD
BATCH DISTRIBUTION RATIO DETERMINATIONS

The distribution ratio K_r is defined as:

$$K_r = \frac{\text{mass of solute on the solid phase per unit mass of solute}}{\text{concentration of solute in solution}}$$

The method of calculation is outlined as follows:

(1) Calculate the mass of solute on the solid phase: $M = C_o - C_f \times V$

where:

M = mass sorbed in entire sample
C_o = initial concentration of a particular metal
C_f = final concentration in the leachate
V = solution volume.

(2) Reduce the sorbed mass (M) to mass sorbed per gram of sample (m):

$$m = M/\text{mass of sample}$$

(3) Calculate K_r:

$$K_r = \frac{m}{C_f}$$

(4) Convert into standard reported units:

$$\frac{l}{g} \times \frac{1{,}000\ ml}{l} = \frac{1{,}000\ ml}{g}$$

Table 27-B30
BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR OVERBURDEN D-1

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	--(2)	--	4.61	BD(3)	2.80
Arsenic	--	1.33	4.00	3.50/16.00(1)	30.00
Barium	BD/BD	64.18	0.53	17.65/24.31	107.11
Boron	--	0.31	BD	0.0	--
Cadmium	BD	--	4.00	BD	4.00
Chromium	--	--	--	12.00/28.00	132.00
Cobalt	--	28.00	--	6.77/8.73 8.36/8.36	64.00
Copper	1.33	--	--		1.33
Iron	--	16.74	19.87/20.52	6.00/11.00	36.00
Lead	BD	8.00	--	--	12.00
Manganese	--	27.33	176.00	--	24.00
Mercury	BD	BD	BD	BD	BD
Molybdenum	--	--	--	--	--
Nickel	12.00	40.00	--	10.67/7.00	BD
Selenium	--	--	10.00	--	9.33
Silver	--	--	--	--	56.00
Zinc	4.00	5.33	2.40	--	2.00

(1) Duplicate sample.
(2) - no attenuation.
(3) BD = below detection limit in leachate.

Table 27-B31
BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR OVERBURDEN D-2

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	23.60/26.00[1]	--	48.00	--	64.00
Arsenic	BD[3]	12.00	28.00	8.00	64.00
Barium	--[2]	60.52	--	11.33	79.33
Boron	--	--	BD	--	--
Cadmium	BD	BD	4.00	--	4.00
Chromium	--	--	8.00	12.00	18.67
Cobalt	BD	28.00	24.00	--	64.00
Copper	12.00	--	--	--	1.33
Iron	41.00	33.33	366.0/376.0	6.00	369.33
Lead	BD	2.00	--	--	6.67
Manganese	--	7.06	--	--	6.00
Mercury	BD	BD	BD	BD	BD
Molybdenum	--	16.00	--	--	--
Nickel	4.00	7.00	10.00	1.50	--
Selenium	--	--	4.00	--	2.15
Silver	BD	--	--	--	56.00
Zinc	4.00	3.00	12.00	38.00/40.00	8.00

(1) Duplicate sample.
(2) - no attenuation.
(3) BD = below detection limit in leachate.

Table 27-B32
BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR SPOIL S-1

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	5.2/6.0(1)	23.2	2.5	--	30.0
Arsenic	--(2)	1.3	2.4	26.0	18.7
Barium	--	19.1	--	6.8	34.4
Boron	--	0.85	BD(3)	0.24	BD
Cadmium	BD	--	BD	BD	BD
Chromium	--	--	--	28.0	8.4
Cobalt	--	1.3	4.0	--	5.7
Copper	--	--	--	--	--
Iron	7.25	11.0	63.3/65.1	--	276
Lead	--	6.0	--	--	4.0
Manganese	--	2.1	--	--	1.1
Mercury	BD	--	BD	--	BD
Molybdenum	--	--	--	10.3	4.0/2.0
Nickel	--	2.3	--	--	--
Selenium	--	--	1.6	1.6	1.7
Silver	--	--	--	--	56.0
Zinc	2.00	1.6	--	12.8/13.5	5.0

(1) Duplicate sample.
(2) - no attenuation.
(3) BD = below detection limit in leachate.

Table 27-B33
BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR SPOIL S-2

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	2.90/3.50(1)	--	48.00	BD	9.60
Arsenic	--(2)	1.33	2.40	56.00	30.00
Barium	--	57.86	1.58	14.40/9.63	100.17
Boron	--	--	BD	0.24	BD
Cadmium	BD	--	4.00	00	4.0
Chromium	4.00	--	20.00	28.00	41.33
Cobalt	--	--	5.33	--	9.60
Copper	--	--	--	--	--
Iron	21.71	8.04	207.43/213.14	--	244.89
Lead	BD	8.00	4.00	--	4.00
Manganese	--	4.95	2.61	--	5.33
Mercury	--	BD	--	--	--
Molybdenum	--	--	--	4.33	--
Nickel	--	7.00	BD	2.29	12.00
Selenium	--	--	4.00	--	1.71
Silver	--	--	--	--	56.00/11.00
Zinc	0.80	1.60	6.67	--	5.0

(1) Duplicate sample.
(2) - no attenuation.
(3) BD = below detection limit in leachate.

Table 27-B34
BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR SPOIL S-3

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	23.60/26.00(1)	1.44	48.00	--	64.00
Arsenic	--(2)	1.33	2.40	6.00	30.00
Barium	--	BD(3)	0.80	16.44	98.04
Boron	--	--	BD	.24	--
Cadmium	BD	BD	BD	0.00	4.00
Chromium	--	--	2.00	4.00	13.00
Cobalt	--	--	--	--	5.71
Copper	1.33	--	--	BD	1.33
Iron	41.00	136.0	242.67/249.33	369.33	369.33
Lead	--	BD	--	--	12.00
Manganese	--	3.83	--	--	--
Mercury	--	BD	--	BD	BD
Molybdenum	--	--	--	--	--
Nickel	12.00	7.00	24.00	--	--
Selenium	--	--	0.67	--	--
Silver	--	--	--	--	56.00
Zinc	2.00	2.00	4.00	24.00/25.83	32.00

(1) Duplicate sample.
(2) - no attenuation.
(3) BD = below detection limit in leachate.

Table 27-B35

BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR SPOIL S-4

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	9.80/23.60[1] 11.00/26.00	--	48.00	--	64.00
Arsenic	--[2]	--	2.40	2.67	18.67
Barium	--	236.00	0.62	--	103.53
Boron	--	3.76	BD	.24	--
Cadmium	BD[3]	--	4.0	0.00	4.00
Chromium	--	--	2.0	12.00	64.00
Cobalt	--	--	--	--	--
Copper	12.00/4.00	--	--	--	12.00
Iron	86.00	82.15	736.00/756.00	11.00	2,236.0
Lead	--	BD	--	--	4.0
Manganese	--	--	19.50	--	1.49/1.49
Mercury	BD	BD	BD	BD	BD
Molybdenum	--	--	--	--	--
Nickel	4.00	7.00	0.67	1.50	12.00
Selenium	--	2.00	10.00	--	2.67
Silver	--	--	--	--	26.00
Zinc	80	5.33	2.40	--	8.00

(1) Duplicate sample.
(2) - no attenuation.
(3) BD = below detection limit in leachate.

Table 27-B36
BATCH DISTRIBUTION COEFFICIENT
RESULTS FOR SPOIL S-5

PARAMETER	SURFACE WATER	COMPOSITE 1	COMPOSITE 3	COMPOSITE 4	COMPOSITE 5
Aluminum	23.60/26.00[1]	--	22.00	--	64.00
Arsenic	--[2]	4.00	2.40	3.50	30.00
Barium	--	88.31	--	14.40	98.04
Boron	--	0.85	BD	--	--
Cadmium	--	--	4.00	0.00	--
Chromium	--	--	8.00	4.00	4.50
Cobalt	--	--	--	--	3.56
Copper	--	--	--	--	--
Iron	18.50	37.48	181.00/186.00	2.67	369.33
Lead	--	8.00	--	--	12.00
Manganese	--	19.50	--	--	8.17
Mercury	BD[3]	BD	BD	BD	BD
Molybdenum	--	--	--	--	--
Nickel	12.00	7.00	0.67	--	--
Selenium	--	4.00	24.00	0.89	6.00
Silver	--	--	--	--	56.00
Zinc	0.80	3.00	6.67	--	32.00

[1] Duplicate sample.
[2] - no attenuation.
[3] BD = below detection limit in leachate.

though the levels of other metals generally increase, it is reasonable to expect that many of the metals, particularly those that exist in the cationic form, would gradually be attenuated due to sorption and coprecipitation processes, particularly with iron.

The quality of all composited natural ground waters is very poor. Total dissolved solids range from 4,100 to 9,800 mg/l. With the exception of Composite 3 which is sodium-sulfate, all of these waters can be characterized as sodium-bicarbonate type. Drinking water standards are exceeded for chloride, fluoride, and iron in all of the composited waters. Other metals (e.g., barium, manganese, lead, and selenium) exceed FDWS limits in many of the waters. In addition, Composites 4 and 5 are high in nitrate.

Analysis of leachates from the batch testing shows a general increase in total dissolved solids. However, the increase is small in comparison to the original TDS concentration of the waters. For waters reacted with Overburden D-1, the levels of dissolved solids actually decrease or remain constant. In most of the batch tests, leachate levels for barium, iron, and fluoride fall below drinking water standards. The concentrations of other metals such as lead, zinc, nickel, arsenic, cadmium, chromium, manganese, aluminum, boron, and selenium also decrease in some of the tests. This decrease is probably caused by colloidal metal hydroxides that have precipitated and are attenuating many of these species. These hydroxides further increase the already high cation exchange capacities present in the spoils and overburden.

To examine the impact of waste on the chemistry of the hydrologic system, batch tests were performed by adding sludge and bottom ash to spoils and overburden as outlined in Section 3. The results are presented in Tables 27.B23 through 27.B29. Chinde Wash Surface waters exhibit slight to moderate changes in total dissolved solids over the levels observed from reaction with spoils alone. This result is primarily due to increased concentrations of sodium, calcium, sulfate, and bicar-

bonate. The attenuation of metals is consistent with results obtained from the spoils tests and supports the conclusion that the soils are capable of retarding the movement of metals in water. All composited waste matrices show similar behavior when leached with the ground waters. The increases in total dissolved solids are again primarily due to elevated levels of sulfate and calcium. In many cases, levels of metals such as barium, iron, selenium, and lead actually decrease to levels below drinking water standards. This is particularly true for composited waste and spoils that are reacted with the ground water Composite No. 5.

It should also be noted that the levels of cyanide and phenolic compounds observed never exceeded the U.S. Environmental Protection Agency criteria for the protection of human health.

Batch distribution coefficients (K_r) were calculated for trace metal species in all spoil/overburden experiments performed with composited wastes. The results are presented in Tables 27.B30 through 27.B36.

K_r is a measure of the attenuation of a species in solution. The values do not solely represent absorption, but can also include precipitation controlled changes. In both cases, the attenuation of a species is highly dependent upon pH, the oxidizing potential of the solution, temperature, the total chemical composition of the liquid, and the amount and types of solids in contact with the solution. Therefore, K_r values should not remain constant for a particular sample if it is interacting with different waters. Trends, however, can be observed. Iron usually is not attenuated to any large degree by absorption reactions. However, large iron K_r's are noted in many of the samples. Precipitation of iron hydroxides appears to be the mechanism by which this decrease in levels of iron is occurring. It is also known that as colloidal iron hydr- oxides form, they are able to assist in the coprecipitation and sorption of other metals onto their surfaces. This phenomenon also appears to be occurring in many of the samples tested.

Barium also appears to be controlled by precipitation processes. As levels of sulfate increase in the leachate, barium sulfate precipitate can form, thereby reducing the solution concentration of barium.

Similarly, adsorption can help to attenuate various species. Many metals such as silver, cadmium, cobalt, lead, and nickel can be adsorbed by mineral surfaces. Because spoils and overburdens exhibit high cation exchange capacities, it is probable that the concentrations of many of the metals are being significantly reduced by sorption processes.

In addition to whole-sample chemical analyses presented in Table 27.B4, the cation exchange capacities (CEC) were measured for all spoils and overburdens. These values are presented in Table 27.B7. CEC values are generally high and indicate good sorption potential for the cations in the sample. The measurement of CEC is done in a solution buffered to approximately pH of 7. Due to mineral surface reactions, CEC tends to increase with increasing pH. Measured ground water pH is greater than 8.2 in all cases, which suggests that actual CEC values may be higher.

Exchangeable cations were also analyzed in the leachate from the CEC determinations. High levels of monovalent cations such as sodium and potassium are present in all leachates, particularly overburden D-1. In exchange reactions occurring within the ground water system, divalent metals substitute for monovalent cations with considerably more ease than a divalent-divalent exchange. This occurrence further suggests that the overburden and spoils will be capable of attenuating metals resulting from the leaching of waste material at the disposal site.

A second phase of the batch leach testing was so similate the effects of a coal seam on the chemistry of ground waters that have passed through a spoil-sludge matrix. The concept used in the laboratory program was based on infiltration followed by migration, in which ground water passes through spoil and waste and leaches trace quantities of chemical species. Then, the water carries the chemical species into the geologic

formation surrounding the waste, where constituents in the water react with, in this case, the coal seam. If chemical species are leached freely from the waste, it is their reactions with the coal that determine their migratory behavior. This concept was mathematically modeled using the previously defined distribution coefficient and simplifying assumptions concerning the chemical reactions of coal with waste leachate to calculate the migration by flow in the coal with defined velocities.

The selection of spoils and ground waters used was made based upon the location of various sampling points to the San Juan River. Applying this criteria, samples of Overburden D-1, Spoil S-1, Spoil S-4, and ground water Composites 1 and 4 were selected. It is believed that leachates from these locations will migrate to the river faster than leachates from other areas of the mine.

Three mixtures of composite waste were prepared from bottom ash and composite sludge No. 4817. One of the spoil or overburden samples was then added to each of the mixtures to create three samples. The final composition was:

Bottom Ash	-	0.47 Weight Precent
Sludge	-	2.23 Weight Percent
Spoil or Overburden	-	97.30 Weight Percent

Each of the three mixtures was leached with ground water Composite No. 1 and Composite No. 4 (chemical analyses presented in Table 27.B37). One duplicate sample was prepared from the composited waste, Spoil S-4, and ground water Composite 1. A total of seven composited samples underwent an American Society for Testing and Materials (ASTM) type seven-day leach test with 48 hours of agitation. The results of the leachate chemical analyses are presented in Table 27.B38 through 27.B40. Comparison of leachates generated from Phases I and II of the study were in good agreement. Minor differences in analytical data are attributable to the variability of natural materials.

Table 27-B37
WATER ANALYSIS SUMMARY

PARAMETER	UNITS	COMPOSITE WATER NO. 1	COMPOSITE WATER NO. 4
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	3,100	510
Chloride	mg/ℓ	380	5,200
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	2.2	0.3
Nitrate	mg/ℓ NO_3-N	4.5	18
pH	--	8.80	8.20
Phenolics	mg/ℓ	<0.01	0.04
Residue:			
Filterable at 180°C	mg/ℓ	4,400	9,800
Specific Conductance	µmhos/cm @25°C	5,900	15,600
Sulfate	mg/ℓ	22	120
Metals:			
Aluminum	mg/ℓ	0.68	<0.01
Arsenic	mg/ℓ	0.004	0.015
Barium	mg/ℓ	1.5	0.92
Boron	mg/ℓ	0.97	0.53
Cadmium	mg/ℓ	<0.001/0.002[2]	0.001
Calcium	mg/ℓ	11	140
Chromium	mg/ℓ	0.001	0.008
Cobalt	mg/ℓ	0.008/0.002	0.035/0.034
Copper	mg/ℓ	0.02/0.051	<0.01
Iron	mg/ℓ	2.8	0.15
Lead	mg/ℓ	0.03/0.03	0.12
Magnesium	mg/ℓ	3.6	32
Manganese	mg/ℓ	0.47	0.03
Mercury (Total)	mg/ℓ	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.005	0.025
Nickel	mg/ℓ	0.11	0.11
Potassium	mg/ℓ	7.2	19
Selenium	mg/ℓ	0.006	0.011
Silver	mg/ℓ	<0.001/<0.002	<0.001/<0.002
Sodium	mg/ℓ	1,600	3,500
Zinc	mg/ℓ	0.07	0.21/0.22

(1) Milligrams per liter.
(2) Duplicate analysis.

Table 27-B38
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND SPOIL S-1

PARAMETER	UNITS	COMPOSITE WATER 1	COMPOSITE WATER 4
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	1,800	360
Chloride	mg/ℓ	430	5,700/5,600
Cyanide	mg/ℓ	0.05	<0.02
Fluoride	mg/ℓ	2.0	1.4
Nitrate	mg/ℓ NO_3-N	8.5	7.4
pH	--	7.82	7.84
Phenolics	mg/ℓ	<0.02	<0.02
Residue:			
Filterable at 180°C	mg/ℓ	7,300	14,000
Specific Conductance	µmhos/cm @25°C	9,500	20,900
Sulfate	mg/ℓ	3,000/3,000	2,800
Sulfide	mg/ℓ	<0.5	<0.5
Metals:			
Aluminum	mg/ℓ	0.12	0.07
Arsenic	mg/ℓ	0.010	0.002
Barium	mg/ℓ	0.24	0.38
Boron	mg/ℓ	0.8/0.7	0.3
Cadmium	mg/ℓ	0.007	0.038
Calcium	mg/ℓ	400	1,000
Chromium	mg/ℓ	0.012/0.008[2]	0.005
Cobalt	mg/ℓ	0.024/0.016	0.027
Copper	mg/ℓ	0.03/0.03	0.05
Iron	mg/ℓ	0.02	0.06
Lead	mg/ℓ	0.02/0.02	0.17
Magnesium	mg/ℓ	45	94/93
Manganese	mg/ℓ	0.59	1.1
Mercury (Total)	mg/ℓ	<0.0002	0.0002
Molybdenum	mg/ℓ	0.012/0.014	0.031
Nickel	mg/ℓ	0.15	0.16
Potassium	mg/ℓ	20/21	35
Selenium	mg/ℓ	0.025/0.023	0.019
Silver	mg/ℓ	<0.001	<0.001
Sodium	mg/ℓ	2,000/2,000	3,600
Zinc	mg/ℓ	0.03	0.05

[1] Milligrams per liter.

[2] Duplicate analysis.

Table 27-B39
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND SPOIL S-4

PARAMETER	UNITS	COMPOSITE WATER NO. 1	1(3)	4
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1/<1	<1/<1
Alkalinity	mg/ℓ $CaCO_3$	1,900	1,800/1,700	380
Chloride	mg/ℓ	420	410/420	5,600/5,600
Cyanide	mg/ℓ	0.02	<0.02/<0.02	<0.02
Fluoride	mg/ℓ	2.0	1.8/1.6	1.2/1.2
Nitrate	mg/ℓ NO_3-N	1.1/1/0(2)	0.2	0.8/0.8
pH	--	7.98	8.02	7.76
Phenolics	mg/ℓ	<0.02	<0.02/<0.02	<0.02/<0.02
Residue:				
Filterable at 180°C	mg/ℓ	6,200	6,400/6,000	13,000/13,000
Specific Conductance	µmhos/cm @25°C	8,460	9,010/8,550	20,000/19,900
Sulfate	mg/ℓ	2,200	2,600	2,200
Sulfide	mg/ℓ	<0.5	<0.05/0.7	<0.5/<0.5
Metals:				
Aluminum	mg/ℓ	0.15	0.15	0.10
Arsenic	mg/ℓ	0.006	0.007	0.002
Barium	mg/ℓ	0.39	0.16	0.21
Boron	mg/ℓ	0.4/0.5	0.4	0.8
Cadmium	mg/ℓ	0.005	0.006	0.029
Calcium	mg/ℓ	300	380	910
Chromium	mg/ℓ	0.008	0.008	0.004
Cobalt	mg/ℓ	0.010	0.014	0.035
Copper	mg/ℓ	<0.01	0.02	0.02
Iron	mg/ℓ	<0.01	<0.01	0.06
Lead	mg/ℓ	0.02	0.01	0.12
Magnesium	mg/ℓ	23	27	68
Manganese	mg/ℓ	0.33	0.42	1.1
Mercury (Total)	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.015	0.015	0.019
Nickel	mg/ℓ	0.11	0.07	0.11
Potassium	mg/ℓ	25	28	45
Selenium	mg/ℓ	0.018	0.015	0.015
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	1,800	1,800/1,800	3,300
Zinc	mg/ℓ	0.05	0.03	0.05/0.05

(1) Milligrams per liter.

(2) Duplicate analysis.

(3) Duplicate sample.

Table 27-B40
1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR COMPOSITED WASTE AND OVERBURDEN D-1

PARAMETER	UNITS	COMPOSITE WATER NO. 1	COMPOSITE WATER NO. 4
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	2,500	360
Chloride	mg/ℓ	430	5,600
Cyanide	mg/ℓ	0.02	<0.02
Fluoride	mg/ℓ	3.8	1.9
Nitrate	mg/ℓ NO_3-N	0.6/0.6[2]	7.5
pH	--	8.46	8.04
Phenolics	mg/ℓ	<0.02	<0.02
Residue:			
Filterable at 180°C	mg/ℓ	4,900	11,000
Specific Conductance	µmhos/cm @25°C	7,390	18,400
Sulfate	mg/ℓ	850	900
Sulfide	mg/ℓ	<0.5	<0.5
Metals:			
Aluminum	mg/ℓ	0.29	0.40
Arsenic	mg/ℓ	0.003/0.003	0.015/0.020
Barium	mg/ℓ	0.27	0.26
Boron	mg/ℓ	1.3	1.0
Cadmium	mg/ℓ	0.003/0.003	0.056
Calcium	mg/ℓ	54	400
Chromium	mg/ℓ	0.003/0.002	0.004
Cobalt	mg/ℓ	0.004/0.003	0.11
Copper	mg/ℓ	<0.01	0.03/0.02
Iron	mg/ℓ	0.04	0.39/0.36
Lead	mg/ℓ	<0.01	0.34
Magnesium	mg/ℓ	7.2	40/39
Manganese	mg/ℓ	0.05/0.04	0.26
Mercury (Total)	mg/ℓ	<0.0002	0.0003
Molybdenum	mg/ℓ	0.021	0.054
Nickel	mg/ℓ	0.07	0.14
Potassium	mg/ℓ	17	35
Selenium	mg/ℓ	0.024	0.039
Silver	mg/ℓ	<0.001	<0.001
Sodium	mg/ℓ	1,700	3,500
Zinc	mg/ℓ	0.04	0.07

(1) Milligrams per liter.

(2) Duplicate analysis.

The net effect of coal on the overall quality of the waste leachate is relatively small. Slight changes in total dissolved solids may be largely due to decreases in calcium, magnesium, and alkalinity suggesting the precipitation of carbonate minerals has occurred. Slight increases in chloride and sodium concentrations may be due to the dissolution of soluble chloride salts present within the coal. Sulfide, sulfate, the pH levels remain relatively constant suggesting that oxidation of sulfides within the coal is very small. In all samples, nitrate levels decrease following interaction with the coal. The concentrations of phenolic compounds remain below analytical detection limits. Cyanide concentrations increase in only two samples and either decrease or remain below detection in the remaining samples. The increase of cyanide may be due to the variability of concentrations within the coal samples.

Qualitatively, the distribution coefficients show the following attenuation of mobilization of metals due to interaction with the coal:

- Barium, nickel, molybdenum, manganese, and zine were attenuated in all leachates;

- Copper, silver and mercury in the coal leachates were below analytical detection limits in most cases;

- Arsenic, cadmium, and selenium were not attenuated in any of the leachates, however, their increase in concentrations were small;

- Aluminum, boron, copper, iron, and lead were attenuated or slightly mobilized to varying degrees depending upon the composition of the initial waste matrix.

Changes, in concentration for all metal following interaction with the coal are presented in Table 27.B44. Batch distribution coefficients (Table 27.B45) were calculated based upon these changes. As seen, several constituents are retarded or will lab behind the flow of ground water.

Table 27-B41

LEACHATE METAL CONCENTRATION CHANGES FOLLOWING EXPOSURE TO COAL

INITIATE LEACHATE:	S-4 COMPOSITE 1	S-4 COMPOSITE 1	S-4 COMPOSITE 4	S-1 COMPOSITE 1	S-1 COMPOSITE 4	D-1 COMPOSITE 1	D-1 COMPOSITE 4
Aluminum	-0.08[1]	0.03	0	-0.04	0.01	-0.13	-0.35
Arsenic	0.004	0.004	0.029	0.003	0.016	0.0	0.021
Barium	-0.33	-0.12	-0.09	-0.15	-0.23	-0.22	-0.10
Boron	0.1	0.2	0.2	-0.5	0.2	0.0	0.3
Cadmium	0.002	0.002	0.027	0.002	0.018	0.001	0.026
Calcium	-180.0	-230.0	-200.0	-180.0	-120.0	-38.0	-120.0
Chromium	0.0	0.008	-0.002	0.0	0.001	0.002	-0.001
Cobalt	0.001	0.005	-0.004	0.0	-0.001	0.004	-0.074
Copper	0.0	-0.01	0.01	-0.01	-0.03	0.0	0.0
Iron	0.07	0.03	0.0	-0.01	0.0	0.0	-0.36
Lead	0.0	0.02	0.11	0.02	0.08	0.01	-0.08
Magnesium	-5.0	-2.0	4.0	-5.0	3.0	-0.5	5.0
Manganese	-0.30	-0.37	-0.52	-0.46	-0.56	-0.03	-0.15
Mercury	0.0	0.0	0.0	0.0	0.0	0.0	-0.0001
Molybdenum	-0.007	-0.005	-0.007	0.0	-0.008	-0.006	-0.048
Nickel	-0.06	-0.02	-0.01	-0.06	-0.04	-0.05	-0.07
Potassium	-7.0	-8.0	-4.0	-5.0	-4.0	-6.0	-6.0
Selenium	0.036	0.012	0.038	0.004	0.005	0.001	0.018
Silver	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sodium	0.0	0.0	100.0	0.0	300.0	-100.0	300.0
Zinc	-0.03	-0.01	-0.02	0.0	-0.02	-0.02	-0.04

[1] All changes in concentration are reported in milligrams per liter.

Table 27-B42 (Conti.)
LEACHATE FROM COMPOSITE WASTE AND
SPOIL S-1 REACTED WITH COAL SEAM 8

PARAMETER	UNITS	COMPOSITE WATER NO. 1	COMPOSITE WATER NO. 4
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	1,800	340
Chloride	mg/ℓ	450	5,600
Cyanide	mg/ℓ	0.04	<0.02
Fluoride	mg/ℓ	1.5	0.9
Nitrate	mg/ℓ NO_3-N	6.2	6.2/6.6
pH	--	7.89	7.62
Phenolics	mg/ℓ	<0.02	<0.02
Residue:			
Filterable at 180°C	mg/ℓ	7,000	13,000
Specific Conductance	µmhos/cm @25°C	9,670	20,800
Sulfate	mg/ℓ	3,000	3,000
Sulfide	mg/ℓ	<0.5	<0.5
Metals:			
Aluminum	mg/ℓ	0.08	0.08
Arsenic	mg/ℓ	0.013	0.018
Barium	mg/ℓ	0.09	0.15
Boron	mg/ℓ	0.2	0.5
Cadmium	mg/ℓ	0.009	0.056
Calcium	mg/ℓ	210/210[2]	880
Chromium	mg/ℓ	0.011	0.006
Cobalt	mg/ℓ	0.020	0.026
Copper	mg/ℓ	0.02	0.03
Iron	mg/ℓ	<0.01	0.06
Lead	mg/ℓ	0.04	0.25
Magnesium	mg/ℓ	40	96
Manganese	mg/ℓ	0.13	0.54
Mercury (Total)	mg/ℓ	<0.0002/<0.002	<0.0002
Molybdenum	mg/ℓ	0.013	0.023
Nickel	mg/ℓ	0.09	0.12
Potassium	mg/ℓ	16	31
Selenium	mg/ℓ	0.027	0.024
Silver	mg/ℓ	<0.001	<0.001
Sodium	mg/ℓ	2,000	3,900
Zinc	mg/ℓ	0.03	0.03

(1) Milligrams per liter.

(2) Duplicate analysis.

Table 27-B43 (Conti.)

LEACHATE FROM COMPOSITE WASTE AND SPOIL S-4 REACTED WITH COAL SEAM 8

PARAMETER	UNITS	COMPOSITE WATER NO. 1	1(3)	4
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	1,800	1,700	280/360
Chloride	mg/ℓ	430/440	430	5,500/5,500
Cyanide	mg/ℓ	<0.02	0.36	0.08
Fluoride	mg/ℓ	1.6	1.4	0.7
Nitrate	mg/ℓ NO_3-N	0.3	<0.1/<0.1	0.3
pH	--	8.23	8.06	7.74
Phenolics	mg/ℓ	<0.02	<0.02	<0.02
Residue:				
Filterable at 180°C	mg/ℓ	5,800	6,100	12,000
Specific Conductance	µmhos/cm @25°C	8,590	8,890	20,200
Sulfate	mg/ℓ	2,200	2,700	2,200/2,200
Sulfide	mg/ℓ	<0.5	<0.5	<0.5
Metals:				
Aluminum	mg/ℓ	0.07	0.18	0.10
Arsenic	mg/ℓ	0.010	0.011	0.031
Barium	mg/ℓ	0.06	0.04	0.12
Boron	mg/ℓ	0.5	0.2	1.0
Cadmium	mg/ℓ	0.007	0.008	0.056
Calcium	mg/ℓ	120	150/150	710
Chromium	mg/ℓ	0.008	0.016	0.003/0.002
Cobalt	mg/ℓ	0.011	0.019	0.031
Copper	mg/ℓ	<0.01	<0.01	0.03
Iron	mg/ℓ	0.08	0.04	0.06
Lead	mg/ℓ	0.02	0.03	0.23
Magnesium	mg/ℓ	18	25	72
Manganese	mg/ℓ	0.03	0.05	0.58
Mercury (Total)	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.008	0.010	0.012
Nickel	mg/ℓ	0.03/0.05(2)	0.05/0.05	0.10
Potassium	mg/ℓ	18	20	41
Selenium	mg/ℓ	0.054	0.027	0.053
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	1,800	1,800	3,400
Zinc	mg/ℓ	0.02	0.02	0.03

(1) Milligrams per liter.

(2) Duplicate analysis.

(3) Duplicate sample.

Table 276-B44
LEACHATE FROM COMPOSITE WASTE AND
OVERBURDEN D-1 REACTED WITH COAL SEAM 8

PARAMETER	UNITS	COMPOSITE WATER NO. 1	COMPOSITE WATER NO. 4
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	2,200	240
Chloride	mg/ℓ	440	5,600
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	2.9	0.9
Nitrate	mg/ℓ NO_3-N	0.2	0.3
pH	--	8.27	7.66
Phenolics	mg/ℓ	<0.02	<0.02
Residue:			
Filterable at 180°C	mg/ℓ	4,700	11,000
Specific Conductance	µmhos/cm @25°C	7,380	19,300
Sulfate	mg/ℓ	1,000	1,200
Sulfide	mg/ℓ	<0.5	<0.5
Metals:			
Aluminum	mg/ℓ	0.16	0.05/0.02[2]
Arsenic	mg/ℓ	0.003	0.036
Barium	mg/ℓ	0.05	0.14/0.16
Boron	mg/ℓ	1.3	1.3
Cadmium	mg/ℓ	0.004	0.082
Calcium	mg/ℓ	16	280
Chromium	mg/ℓ	0.004	0.003
Cobalt	mg/ℓ	0.007	0.036
Copper	mg/ℓ	<0.01	0.02
Iron	mg/ℓ	0.04	0.01/<0.01
Lead	mg/ℓ	0.01	0.26
Magnesium	mg/ℓ	6.7	44
Manganese	mg/ℓ	0.02	0.11
Mercury (Total)	mg/ℓ	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.015	0.006
Nickel	mg/ℓ	0.02	0.07
Potassium	mg/ℓ	11	29/29
Selenium	mg/ℓ	0.025	0.057
Silver	mg/ℓ	<0.001	<0.001/<0.001
Sodium	mg/ℓ	1,600	3,800
Zinc	mg/ℓ	0.02	0.02/0.03

(1) Milligrams per liter.

(2) Duplicate analysis.

Table 27-B45

BATCH DISTRIBUTION COEFFICIENTS FOR LEACHATE EXPOSED TO COAL

INITIAL LEACHATE:	S-4 COMPOSITE 1	S-4[1] COMPOSITE 1	S-4 COMPOSITE 4	S-1 COMPOSITE 1	S-1 COMPOSITE 4	D-1 COMPOSITE 1	D-1 COMPOSITE 4
Aluminum	4.6	-	0.0	2.0	-	3.2	28/76
Arsenic	-[2]	-	-	-	-	0.0/0.0	-/-
Barium	22	12	3.0	6.7	6.1	18	3.4/2.5
Boron	0.0	4.0	-	12/10	-	0.0	-
Cadmium	-	-	-	-	-	-/-	-
Calcium	6.0	6.1	1.1	3.6	0.55	9.5	1.7
Chromium	0.0	-	1.3/4.0	0.36/-	-	-/-	1.3
Cobalt	-	-	0.52	0.80/-	0.15	-/-	8.2
Copper	BD[3]	BD	-	2.0/2.0	6.0	-	2.0/0.0
Iron	-	-	0.0	BD	0.0	0.0	152/140
Lead	0.0	-	-	-/-	-	-	1.2
Magnesium	1.1	0.32	-	0.50	-/-	0.30	-/-
Manganese	40	30	3.6	14	4.2	6.0/4.0	5.4
Mercury (total)	BD	BD	BD	-/BD	BD	BD	BD
Molybdenum	3.5	2.0	2.3	-/0.31	1.4	1.6	32
Nickel	11/4.8[4]	1.6/1.6	0.40	2.7	1.3	10	4.0
Potassium	1.6	1.6	0.39	1.0/1.2	0.52	2.2	0.83/0.83
Selenium	-	-	-	-/-	-	-	-
Silver	BD	BD	BD	BD	BD	BD	BD/BD
Sodium	0.0	0.0/0.0	-	0.0/0.0	-	0.25	-
Zinc	6.0	2.0	2.7	0.0	2.7	4.0	10/5.3

(1) Duplicate sample.

(2) No attenuation, concentration increases in coal leachate.

(3) Below detection in coal leachate.

(4) Duplicate analysis.

For instance, calcium will lag behind the constaminent front by 10^{-2} to 10^{-3} orders-of-magnitude. This indicates that while the ground water is flowing at a rate of 7.2×10^{-2} ft/day towards the San Juan River, iron concentrations would lag behind at a rate of 7.2×10^{-5} ft/day to 7.2×10^{-6} ft/day.

LABORATORY DATA SHEETS

LABORATORY IDENTIFICATION NUMBER
AND CORRESPONDING FIELD SAMPLE NUMBER

LABORATORY NUMBER	FIELD SAMPLE IDENTIFICATION
334-68-1	Sludge No. 2
4765	Sludge No. 4
4770	Sludge No. 5
4774	Sludge No. 6
4785, 334-7	Sludge No. 7
4786, 334-72	Sludge No. 8
334-68-2A and 2B	Sludge No. 1
334-68-3A and 3B	Sludge No. 3
334-66-1A and 1B	Fly Ash
334-66-2A and 2B	Bottom Ash
334-66-3A and 3B	Spoil S-3
334-67-4A and 4B	Spoil S-1
334-67-5A and 5B	Overburden D-1
334-67-6A and 6B	Spoil S-3 Duplicate
334-70-1A and 1B	Overburden D-1 Duplicate
334-70-2A and 2B	Spoil S-5
334-70-3A and 3B	Spoil S-4
334-71-6A and 6B	Water Blank
334-71-4A and 4B	Spoil S-4 Duplicate
334-71-5A and 5B	Spoil S-2
Composite No. 6	Surface Water
4686	Composite No. 4
4789 and 4790	Sludge No. 9
4791	Sludge No. 10
4800	Sludge No. 11
4801	Sludge No. 12
4818	Surface Water
4819	Composite No. 1
4820	Composite No. 3
4821	Composite No. 4
4822	Composite No. 5
4808	Fly Ash
4809	Bottom Ash
4810	Spoil S-1
4811	Spoil S-2
4812	Spoil S-3
4813	Spoil S-4
4814	Spoil S-5
4815	Overburden D-1
4816	Overburden D-2

Chemical Testing Laboratory Data

MATRIX SPIKE PERCENT RECOVERY SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

PARAMETER	PERCENT RECOVERY
General Chemistry:	
Chloride	95.3%/98.0%/97.1%/95.3%/95.7% 97.1%/100%/96.7%/98.7%/91.4%
Cyanide	100%/128%/106%/94.4%/94.1%/91.8%/91.8%/ 90.6%/94.1%/97.0%/100%/100%/97.0%/93.9%
Fluoride	96.0%/100%/100%/96.0%/100%/96.0%/ 104%/84.0%/96.0%/84.0%/100%/100%
Phenolics	105%/105%/97.5%/102%/110%/100%/90.0%/97.5% 103%/98.5%/100%/101%/101%/100%/101%/101%
Sulfate	80.0%/105%/120%/120%/135%/135%/ 120%/90.0%/120%/120%/110%/120%
Metals:	
Aluminum	94.4%/102%/106%/103%/88.0%/100%/94.0%/ 84.0/%/93.0%/104%/79.0%/82.0%/94.0%/84.4%
Arsenic	92.0%/78.0%
Barium	101%/98.9%/100%/125%/109%/127%/115%/136%
Boron	92.0/88.0%/100%/92.0%/80.0%/ 60.0%/100%/82.0%/60.0%/60.0%
Cadmium	110%/90.0%
Calcium	102%/82.4%/113%/114%/111%/108%/ 108%115%/110%/112%/112%/107%
Chromium	78.0%
Cobalt	97.6%/84.0%/100%
Copper	100%/100%/100%
Iron	102%/95.6%/99.2%
Lead	48.0%/48.0%/60.0%
Manganese	130%/132%/131%
Magnesium	103%/101%/98.0%/100%/101%/103%/ 99.0%/99.0%/98.0%/98.0%/102%/103%
Mercury (Total)	94.2%
Molybdenum	92.0%/96.0%/100%
Nickel	100%/99.6%/99.6%
Potassium	101%/107%
Selenium	100%
Silver	96.0%
Sodium	100%/100%/99.0%/98.0%/101%/94.0%/ 95.0%/113%/97.0%/96.0%/96.0%/94.0%
Zinc	101%/98.0%/100%

MATRIX SPIKE PERCENT RECOVERY SUMMARY
FOR IT CORPORATION/KNOXVILLE
PROJECT NO. 84-8045
JOB NO. 8549.02

PARAMETER	PERCENT RECOVERY
Aluminum	108%
Arsenic	95.0%
Barium	62.8%
Boron	__(1)
Cadmium	97.4%
Calcium	101%
Chloride	79.8%
Chromium	94.5%
Cobalt	96.0%
Copper	102%
Cyanide	100%
Fluoride	56.0%
Iron	99.2%
Lead	101%
Magnesium	99.6%
Manganese	98.7%
Mercury (Total)	104%
Mercury	110%
Molybdenum	100%
Nickel	101%
Nitrate	100%
Phenolics	97.7%
Potassium	107%
Selenium	95.0%
Silver	93.0%
Sodium	98.0%
Sulfate	110/114%
Zinc	92.0%

(1) The indicated percent recovery was not determined on this sample set.

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Enviroscience
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: September 18, 1984
PROJECT CODE: ITEK 18470
ORDER NUMBER:

Sample Description: Six (6) water samples received August 20, 1984

Concentration units are mg/liter (ppm)

	Cyanide
Comp. #1, Cyanide	<0.01
Comp. #2, Cyanide	<0.01
Comp. #3, Cyanide	<0.01
Comp. #4, Cyanide	<0.01
Comp. #5, Cyanide	<0.01
Surface Water, Cyanide	<0.01

	Nitrate
Comp. #1, Nitrate	<0.01
Comp. #2, Nitrate	0.03
Comp. #3, Nitrate	<0.01
Comp. #4, Nitrate	<0.01
Comp. #5, Nitrate	<0.01
Surface Water, Nitrate	3.7

Sworn to and subscribed before me this 18th
day of September, 1984
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical fields of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Enviroscience
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: September 18, 1984
PROJECT CODE: ITEK 18470
ORDER NUMBER:

Sample Description: Five (5) water samples received August 20, 1984

Concentration units are mg/liter (ppm)

	Composite #1	Composite #2	Composite #3	Composite #4	Composite #5
Aluminum	14.	5.0	2.7	170.	47.
Antimony	<0.1	<0.1	0.1	0.1	<0.1
Arsenic	<0.4	<0.4	<0.4	0.5	<0.4
Barium	1.4	3.9	0.085	1.1	3.0
Beryllium	<0.001	<0.001	<0.001	0.030	0.003
Boron	0.72	<0.01	0.19	0.30	0.38
Cadmium	<0.004	<0.004	<0.004	0.016	<0.004
Calcium	23.	620.	15.	300.	100.
Chromium	0.01	0.14	<0.01	0.10	0.16
Cobalt	<0.01	<0.01	<0.01	0.08	0.04
Copper	<0.02	<0.02	<0.02	0.26	0.09
Iron	7.1	0.07	2.3	230.	54.
Lead	<0.1	0.1	<0.1	0.6	0.2
Lithium	0.5	0.7	0.4	0.9	0.6
Magnesium	7.3	0.8	3.5	77.	22.
Manganese	0.56	0.064	0.21	5.2	1.4
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	0.01	<0.01	<0.01	0.15	0.06
Selenium	0.3	0.4	0.3	0.3	0.2
Silicon	3.1	1.1	1.6	50.	34.
Silver	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	1700.	2300.	1300.	3500.	1900.
Strontium	0.73	13.	0.65	7.9	2.2
Thallium	<1.	<1.	<1.	<1.	<1.
Tin	<0.5	<0.5	<0.5	<0.5	<0.5
Titanium	<0.02	<0.02	<0.02	0.04	0.05
Vanadium	0.02	<0.02	<0.02	0.29	0.09
Zinc	0.08	0.04	0.02	0.83	0.28
Uranium	<2.	<2.	<2.	<2.	<2.

Sworn to and subscribed before me this 18th day of September, 1984
My commission expires January 16, 1988

Notary Public

Approved by Alyce K. Thrasher
Laboratory Manager
Title

AALA Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Enviroscience
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: September 18, 1984
PROJECT CODE: ITEK 18470
ORDER NUMBER:

Sample Description: One (1) water sample received August 20, 1984

Concentration units are mg/liter (ppm)

	Surface Water
Aluminum	12.
Antimony	<0.1
Arsenic	<0.4
Barium	0.12
Beryllium	<0.001
Boron	<0.03
Cadmium	<0.004
Calcium	200.
Chromium	<0.01
Cobalt	<0.01
Copper	<0.02
Iron	10.
Lead	<0.1
Lithium	0.3
Magnesium	30.
Manganese	0.14
Molybdenum	<0.05
Nickel	0.02
Selenium	<0.2
Silicon	2.2
Silver	<0.01
Sodium	330.
Strontium	2.4
Thallium	<1.
Tin	<0.5
Titanium	<0.02
Vanadium	<0.02
Zinc	0.03
Uranium	<2.

Sworn to and subscribed before me this 18th day of September, 1984
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Enviroscience
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: September 18, 1984
PROJECT CODE: ITEK 18470
ORDER NUMBER:

Sample Description: Six (6) water samples received August 20, 1984

Concentration units are mg/liter (ppm)

	Mercury	Arsenic	Selenium	Potassium
Comp #1	<0.001	<0.001	<0.002*	8.7
Comp #2	<0.001	<0.001	<0.018*	66.
Comp #3	<0.001	0.010	0.015	6.4
Comp #4	<0.001	0.105	<0.029*	40.
Comp #5	<0.001	0.011	<0.016*	18.
Comp #6	<0.001	0.005	<0.024*	11.

* = Higher detection limit due to matrix interference

Sworn to and subscribed before me this 18th
day of September, 1984
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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rec'd. 9/20/84

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IT CORPORATION

CERTIFICATE OF ANALYSIS

TO: IT Enviroscience
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: September 18, 1984
PROJECT CODE: ITEK 18470
ORDER NUMBER:

Sample Description: Six (6) water samples received August 20, 1984

Concentration units are mg/liter (ppm) unless otherwise stated

	Chloride	pH (standard units)	Total Dissolved Solids	Fluoride	Sulfate
Comp. #1, Fluoride-Sulfate	0.75	8.30	4120.	2.1	1.0
Comp. #2, Fluoride-Sulfate	7.5	11.98	7260.	0.62	<1.0
Comp. #3, Fluoirde-Sulfate	2.5	8.05	3640.	2.6	1250.
Comp. #4, Fluoride-Sulfate	5550.	7.61	9110.	0.59	70.
Comp. #5, Fluoride-Sulfate	75.	9.41	5130.	1.3	<1.0
Surface Water, Fluoride-Sulfate	15.5	7.78	2000.	0.92	1200.

	Phenols
Comp. #1, Phenols	<0.01
Comp. #2, Phenols	0.07
Comp. #3, Phenols	0.01
Comp. #4, Phenols	0.01
Comp. #5, Phenols	0.01
Surface Water, Phenols	<0.01

Sworn to and subscribed before me this 18th
day of September, 1984
My commission expires January 16, 1988

Janice G. Abernathy
Notary Public

Alfred R. Thrasher
Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: November 21, 1984
PROJECT CODE: ITEK 18669
ORDER NUMBER: 8549.02

Sample Description: Six (6) water samples received September 19, 1984

Concentration units are pCi/liter

	Total Alpha	Total Beta	Total Radium (226 & 228)
UII - Composite #1	1.7 ± 0.6	4.2 ± 4.1	0.3 ± 0.6
UII - Composite #2	1.0 ± 0.5	5.2 ± 4.5	0.5 ± 0.7
UII - Composite #3	0.8 ± 0.7	4.0 ± 4.3	0.2 ± 0.5
UII - Composite #4	1.9 ± 0.5	4.0 ± 3.7	0.4 ± 0.6
UII - Composite #5	<0.1	3.9 ± 3.9	0.4 ± 0.6
UII - Surface Water	0.5 ± 0.5	4.7 ± 4.7	0.3 ± 0.6

Sworn to and subscribed before me this 21st
day of November, 1984
My commission expires March 18, 1985

Alyce K. Moore
Notary Public

Approved by
General Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical

rec'd 04/5/84

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 4, 1984
PROJECT CODE: ITDK 19026
ORDER NUMBER: Ref. #4686

Sample Description: One (1) water sample received November 20, 1984

Concentration units are mg/liter (ppm)

	#4686, 11/19/84
Aluminum	23.
Antimony	0.1
Barium	3.6
Beryllium	0.001
Boron	0.77
Cadmium	<0.004
Calcium	130.
Chromium	<0.01
Cobalt	0.01
Copper	0.03
Iron	25.
Lead	<0.1
Lithium	0.3
Magnesium	42.
Manganese	0.861
Molybdenum	0.06
Nickel	0.01
Silicon	16.
Silver	0.02
Sodium	3300.
Strontium	6.5
Thallium	<1.
Tin	<0.5
Titanium	0.05
Vanadium	0.04
Zinc	0.062

Sworn to and subscribed before me this 4th
day of December, 1984
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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1-d208 11/6/84

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 4, 1984
PROJECT CODE: ITDK 19026
ORDER NUMBER: Ref. #4686

Sample Description: One (1) water sample received November 20, 1984

Concentration units are mg/liter (ppm)

	unpreserved sample from groundwater composite # 4 #4686, 11/19/84
Chloride	6500.
Fluoride	0.75
Total Dissolved Solids	9170.
Arsenic	0.005
Mercury	0.002
Potassium	36.
Selenium	<0.01

Sworn to and subscribed before me this 4th
day of December, 1984
My commission expires January 16, 1988

Janice T. Stone
Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Five (5) spoil samples received October 30, 1984
Concentration units are µg/gram (ppm)

	Spoil S-1	Spoil S-2	Spoil S-3	Spoil S-4	Spoil S-5
Aluminum	8100.	7400.	5500.	6600.	6600.
Antimony	<10.	<10.	<10.	<10.	<10.
Arsenic	6.5	6.0	36.	17.	4.3
Barium	180.	42.	130.	520.	150.
Beryllium	1.0	1.0	1.8	1.3	1.5
Boron	9.	8.	4.	<3.	4.
Cadmium	1.0	0.9	1.1	0.9	0.8
Calcium	16,000.	17,000.	7900.	9500.	27,000.
Chromium	3.	3.	2.	3.	3.
Cobalt	7.	7.	8.	7.	9.
Copper	11.	6.	6.	15.	9.
Iron	14,000.	13,000.	39,000.	27,000.	14,000.
Lead	35.	32.	58.	34.	32.
Lithium	31.	41.	<20.	35.	28.
Magnesium	2900.	3100.	2300.	2100.	2900.
Manganese	200.	200.	360.	190.	470.
Molybdenum	<6.	<6.	<6.	<6.	<6.
Nickel	10.	9.	13.	10.	13.
Selenium	<1.*	<2.*	<2.*	<2.*	<2.*
Silicon	550.	560.	440.	410.	760.
Silver	<3.	<3.	<3.	<3.	<3.
Sodium	2600.	2700.	2700.	3500.	2700.
Strontium	150.	92.	96.	110.	120.
Thallium	<100.	<100.	<100.	<100.	<100.
Tin	<50.	<50.	<50.	<50.	<50.
Titanium	59.	35.	60.	110.	71.
Vanadium	17.	15.	15.	20.	15.
Zinc	66.	63.	58.	71.	69.
Potassium	1100.	1400.	906.	1200.	1400.
Mercury	<0.1	<0.1	0.2	0.8	<0.1

* Higher detection limits due to matrix interference

Sworn to and subscribed before me this 13th
day of December, 1984
My commission expires December 16, 1987

Notary Public

Approved by: Alyce K. Moore
Laboratory Manager
Title

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5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Five (5) spoil samples received October 30, 1984

Concentration units are mg/liter (ppm)

	Spoil S-1	Spoil S-2	Spoil S-3	Spoil S-4	Spoil S-5
Cyanide	0.17	1.18	0.20	0.25	0.20
Fluoride	471.	463.	420.	575.	503.
Phenols	1.09	1.19	1.09	1.18	1.05
Sulfate (water leachable)	8982.	7236.	6410.	12,724.	6610.
Chloride (water leachable)	250.	150.	246.	200.	248.
Acidity (water leachable)	399.	299.	197.	399.	298.
Alkalinity (water leachable)	3293.	3693.	3945.	3593.	3777.
Nitrate (water leachable)	29.	16.	12.	20.	24.

Sworn to and subscribed before me this 13th
day of December, 1984
My commission expires December 16, 1987

Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Two (2) overburden samples received October 30, 1984

Concentration units are µg/gram (ppm)

	Sample Overburden D-1	Sample Overburden D-2
Aluminum	9200.	6200.
Antimony	<10.	<10.
Arsenic	4.5	4.6
Barium	110.	120.
Beryllium	1.0	0.9
Boron	<3.	<3.
Cadmium	1.1	0.9
Calcium	14,000.	11,000.
Chromium	6.	6.
Cobalt	7.	6.
Copper	10.	<2.
Iron	20,000.	18,000.
Lead	42.	72.
Lithium	<20.	<20.
Magnesium	4100.	6200.
Manganese	350.	250.
Molybdenum	<6.	<6.
Nickel	10.	9.
Selenium	<1.*	<2.*
Silicon	610.	380.
Silver	<3.	<3.
Sodium	2900.	1400.
Strontium	94.	36.
Thallium	<100.	<100.
Tin	<50.	<50.
Titanium	39.	68.
Vanadium	16.	16.
Zinc	63.	56.
Potassium	903.	801.
Mercury	0.2	0.2

* Higher detection limits due to matrix interference

Sworn to and subscribed before me this 13th day of December, 1984
My commission expires December 16, 1987

Notary Public

Approved by Alyce K. Moore
Laboratory Manager
Title

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IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Two (2) overburden samples received October 30, 1984

Concentration units are mg/liter (ppm)

	Sample Overburden D-1	Sample Overburden D-2
Cyanide	0.08	0.20
Fluoride	403.	332.
Phenols	0.90	1.98
Sulfate (water leachable)	1946.	3529.
Chloride (water leachable)	399.	149.
Acidity (water leachable)	399.	398.
Alkalinity (water leachable)	7186.	3877.
Nitrate (water leachable)	15.	20.

Sworn to and subscribed before me this 13th
day of December, 1984
My commission expires December 16, 1987

Notary Public

Alyce K. Moore
Approved by

Laboratory Manager
Title

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TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Two (2) fly ash samples received October 30, 1984

Concentration units are µg/gram (ppm)

	PP #1, Fly Ash	PP #2, Bottom Ash
Aluminum	6600.	2000.
Antimony	<10.	<10.
Arsenic	11.	0.38
Barium	850.	420.
Beryllium	1.5	0.3
Boron	160.	10.
Cadmium	0.4	<0.3
Calcium	12,000.	3000.
Chromium	5.	<1.
Cobalt	2.	1.
Copper	<2.	<2.
Iron	5300.	2100.
Lead	26.	<10.
Lithium	<20.	21.
Magnesium	530.	150.
Manganese	99.	32.
Molybdenum	<6.	<6.
Nickel	2.	<1.
Selenium	6.5	<2.*
Silicon	1200.	670.
Silver	<3.	<3.
Sodium	430.	84.
Strontium	87.	16.
Thallium	<100.	<100.
Tin	<50.	<50.
Titanium	300.	39.
Vanadium	20.	<10.
Zinc	13.	5.
Potassium	162.	44.
Mercury	0.2	<0.1

* Higher detection limits due to matrix interference

Sworn to and subscribed before me this 13th
day of December, 1984
My commission expires December 16, 1987

Notary Public

Alyce K. Moore
Approved by

Laboratory Manager
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ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Two (2) fly ash samples received October 30, 1984

Concentration units are mg/liter (ppm)

	PP #1, Fly Ash	PP #2, Bottom Ash
Cyanide	0.20	0.22
Fluoride	176.	81.
Phenols	1.29	1.36
Sulfate (water leachable)	1667.	<100.
Chloride (water leachable)	100.	124.
Acidity (water leachable)	<100.	397.
Alkalinity (water leachable)	11,577.	2976.
Nitrate (water leachable)	<1.	2.

Sworn to and subscribed before me this 13th
day of December, 1984
My commission expires December 16, 1987

Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Seven (7) coal samples received October 30, 1984

Concentration units are mg/liter (ppm)

	Coal Sample #C-1 Seam #8, Northface	Coal Sample #C-2 Seam #2	Coal Sample #C-3 Seam #4	Coal Sample #C-4 Seam #3	Coal Sample #C-5 Seam #7	Coal Sample Seam #8, #C-6, South	Coal Sample #C-7 Seam #6
Cyanide	0.05	0.07	2.22	0.30	0.35	0.12	0.20
Fluoride	26.	23.	13.	36.	248.	380.	364.
Phenols	0.19	0.39	0.10	0.40	0.59	0.29	0.86
Sulfate (water leachable)	524.	748.	499.	3508.	1965.	1130.	<100.
Chloride (water leachable)	247.	349.	175.	222.	196.	196.	150.
Acidity (water leachable)	198.	399.	399.	198.	393.	295.	399.
Alkalinity (water leachable)	790.	2595.	798.	100.	3929.	4715.	898.
Nitrate (water leachable)	5.	4.	6.	5.	14.	5.	3.

Sworn to and subscribed before me this 13th day of December, 1984
My commission expires December 16, 1987

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical [illegible] as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

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5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: December 13, 1984
PROJECT CODE: ITEK 18902 Partial Report
ORDER NUMBER: 8544.02

Sample Description: Seven (7) coal samples received October 30, 1984
Concentration units are µg/gram (ppm)

	Coal Sample #C-1 Seam #8, Northface	Coal Sample #C-2 Seam #2	Coal Sample #C-3 Seam #4	Coal Sample #C-4 Seam #3	Coal Sample #C-5 Seam #7	Coal Sample Seam #8, #C-6, South	Coal Sample #C-7 Seam #6
Aluminum	290.	1800.	650.	1300.	720.	2300.	680.
Antimony	<10.	<10.	<10.	<10.	<10.	<10.	<10.
Arsenic	<0.1	<0.1	<0.1	0.24	<0.2*	5.7	4.5
Barium	58.	8.9	33.	57.	38.	38.	69.
Beryllium	0.5	0.9	0.4	0.3	0.2	0.8	0.8
Boron	45.	110.	24.	39.	40.	58.	53.
Cadmium	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	<0.3
Calcium	210.	1300.	630.	760.	780.	1200.	670.
Chromium	<1.	<1.	<1.	<1.	<1.	<1.	<1.
Cobalt	<1.	2.	<1.	<1.	3.	2.	1.
Copper	<2.	<2.	<2.	<2.	<2.	<2.	<2.
Iron	290.	2800.	1300.	3600.	1600.	4400.	1200.
Lead	<10.	<10.	13.	<10.	10.	<10.	<10.
Lithium	27.	<20.	24.	23.	<20.	<20.	<20.
Magnesium	100.	650.	210.	360.	220.	460.	210.
Manganese	<2.	12.	2.	2.	14.	4.	2.
Molybdenum	<6.	<6.	<6.	<6.	<6.	<6.	<6.
Nickel	<1.	2.	1.	<1.	4.	2.	2.
Selenium	0.30	<0.4*	1.2	<0.8*	<0.8*	<0.3*	<0.4*
Silicon	40.	310.	120.	140.	150.	240.	100.
Silver	<3.	<3.	<3.	<3.	<3.	<3.	<3.
Sodium	510.	1000.	510.	810.	690.	1200.	1500.
Strontium	17.	40.	22.	27.	32.	41.	62.
Thallium	<100.	<100.	<100.	<100.	<100.	<100.	<100.
Tin	<50.	<50.	<50.	<50.	<50.	<50.	<50.
Titanium	51.	45.	47.	110.	99.	160.	100.
Vanadium	<10.	<10.	<10.	<10.	<10.	10.	<10.
Zinc	5.	36.	38.	11.	8.	25.	9.
Potassium	17.	19.	17.	45.	34.	102.	15.
Mercury	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

* Higher detection limits due to matrix interference

Sworn to and subscribed before me this 13th
day of December, 1984
My commission expires December 16, 1987

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 11, 1985
PROJECT CODE: ITDK 19245
ORDER NUMBER: Project #8549.02

Sample Description: One (1) sludge sample received December 26, 1984

Concentration units are mg/kg, unless otherwise stated

	#2 Sludge Sample #334-68-1, 12/21/84
pH (standard units)	11.37
Total Solids (% by wt.)	81.33
Chloride	1800.
Fluoride	39.
Sulfate	3100.
Cyanide	0.05
Nitrate, as N	4.5
Phenols	<0.01
Potassium	270.
Mercury	<0.1
Selenium	7.0
Arsenic	11.

Sworn to and subscribed before me this 11th
day of January, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical fields of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 11, 1985
PROJECT CODE: ITDK 19245
ORDER NUMBER: Project #8549.02

Sample Description: Three (3) water samples received December 27, 1984

Concentration units are mg/liter (ppm) unless otherwise stated

	EP Toxicity Extract #334-67-4A, 4B 12/20/84	EP Toxicity Extract #334-67-5A, 5B 12/21/84	EP Toxicity Extract #334-67-6A, 6B 12/21/84
pH (standard units)	5.17	5.49	5.23
Total Dissolved Solids	2368.	868.	2408.
Chloride	0.85	1.2	0.85
Fluoride	0.12	0.08	0.12
Sulfate	425.	375.	938.
Cyanide	<0.01	<0.01	<0.01
Nitrate, as N	0.88	<0.01	<0.01
Phenols	0.01	<0.01	0.01
Potassium	6.2	3.4	7.2
Mercury	<0.001	<0.001	<0.001
Selenium	<0.009*	<0.002*	<0.008*
Arsenic	0.001	<0.001	<0.001

* Higher detection limit due to sample matrix interference

Sworn to and subscribed before me this 11th day of January, 1985
My commission expires January 16, 1988

Notary Public

Approved by Alyce R. Moore
Laboratory Manager
Title

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IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 11, 1985
PROJECT CODE: ITDK 19245
ORDER NUMBER: Project #8549.02

Sample Description: Three (3) water samples received December 27, 1984

Concentration units are mg/liter (ppm) unless otherwise stated

	EP Toxicity Extract #334-66-1A, 1B 12/19/84	EP Toxicity Extract #334-66-2A, 2B 12/19/84	EP Toxicity Extract #334-66-3A, 3B 12/20/84
pH (standard units)	5.02	6.27	5.11
Total Dissolved Solids	1900.	316.	3292.
Chloride	1.2	2.	2.2
Fluoride	2.2	0.1	0.1
Sulfate	82.	12.	512.
Cyanide	<0.01	<0.01	<0.01
Nitrate, as N	<0.01	<0.01	0.36
Phenols	0.01	<0.01	0.01
Potassium	0.627	0.333	8.2
Mercury	<0.001	<0.001	<0.001
Selenium	0.190	<0.001	<0.01*
Arsenic	0.014	<0.001	<0.001

* Higher detection limit due to sample matrix interference

Sworn to and subscribed before me this 11th
day of January, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Technology Development
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 15, 1985
PROJECT CODE: ITDK 19269 Partial Report
ORDER NUMBER: Project #8549.02

Sample Description: Two (2) solid samples received January 2, 1985

Concentration units are mg/kg (ppm)

	#1	#3
	Filter Sludge 01/02/85	
	#334-68-2A & 2B	#334-68-3A & 3B
Aluminum	9400.	6500.
Antimony	10.	<10.
Arsenic	22.	12.
Barium	780.	490.
Beryllium	1.1	0.58
Boron	230.	220.
Cadmium	0.62	0.67
Calcium	19,000.	37,000.
Chromium	10.	6.7
Cobalt	2.1	1.8
Copper	7.4	6.5
Iron	4300.	2800.
Lead	16.	<10.
Lithium	<20.	<20.
Magnesium	760.	580.
Manganese	90.	100.
Molybdenum	8.6	<6.
Nickel	3.6	2.1
Selenium	<2.0	1.4
Silicon	2100.	1900.
Silver	<3.	<3.
Sodium	800.	600.
Strontium	97.	73.
Thallium	<100.	<100.
Tin	<50.	<50.
Titanium	500.	380.
Vanadium	35.	28.
Zinc	21.	12.
Uranium	<200.	<200.
Mercury	0.2	0.2
Potassium	430.	250.

Sworn to and subscribed before me this 15th
day of January, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Technology Development
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 15, 1985
PROJECT CODE: ITDK 19269 Partial Report
ORDER NUMBER: Project #8549.02

Sample Description: Two (2) solid samples received January 2, 1985

Concentration units are mg/kg (ppm) unless otherwise stated

	#1	#3
	Filter Sludge 01/02/85	
	#334-68-2A & 2B	#334-68-3A & 3B
Alkalinity (mg/liter, water leachable)	2600.	2800.
Acidity (mg/liter, water leachable)	3000.	7600.
Chloride (water leachable)	2375.	2375.
Cyanide	0.07	0.12
Fluoride	269.	405.
Nitrate, as N (water leachable)	5.	5.
Phenols	0.1	0.1
Sulfate (water leachable)	8350.	4200.

Sworn to and subscribed before me this 15th day of January, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager

Title

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IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19345
ORDER NUMBER: 8549.02

Sample Description: Two (2) solid samples received January 10, 1985

Concentration units are mg/liter (ppm)

	#4675 Filter Sludge #4, 01/09/85	#4770, Filter Sludge #5, 01/09/85
Cyanide	0.08	0.08
Fluoride	419.	567.
Phenols	0.07	0.07
Sulfate (water leachable)	8150.	7000.
Chloride (water leachable)	1800.	1975.
Acidity (water leachable)	4400.	3200.
Alkalinity (water leachable)	2000.	2200.
Nitrate, as N (water leachable)	36.	31.

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Alyce K. Moore
Notary Public

Jack R. Hall
Approved by

Laboratory Director
Title

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IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19345
ORDER NUMBER: 8549.02

Sample Description: Two (2) solid samples received January 10, 1985

Concentration units are µg/gram (ppm)

	#4675, Filter Sludge #4, 01/09/85	#4770, Filter Sludge #5, 01/09/85
Aluminum	8400.	7100.
Antimony	<10.	<10.
Arsenic	11.	7.8
Barium	430.	270.
Beryllium	0.86	0.72
Boron	230.	230.
Cadmium	0.87	0.69
Calcium	39,000.	63,000.
Chromium	7.7	5.7
Cobalt	2.0	1.6
Copper	5.2	3.5
Iron	4400.	3400.
Lead	37.	28.
Lithium	<20.	<20.
Magnesium	700.	640.
Manganese	72.	57.
Molybdenum	7.4	<6.
Nickel	2.0	2.0
Selenium	6.0	4.1
Silicon	430.	1000.
Silver	<3.	<3.
Sodium	790.	740.
Strontium	97.	91.
Thallium	<100.	<100.
Tin	<50.	<50.
Titanium	440.	360.
Vanadium	30.	20.
Zinc	19.	17.
Mercury	0.10	0.13
Potassium	290.	310.

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Alyce R. Moore
Notary Public

Jack R. Hall
Approved By

Laboratory Director
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19352
ORDER NUMBER: 8549.02

Sample Description: One (1) solid sample received January 11, 1985

Concentration units are µg/gram (ppm)

sample #6

	IT #4774, Filter Sludge
Aluminum	8100.
Antimony	<10.
Arsenic	11.
Barium	630.
Beryllium	0.85
Boron	220.
Cadmium	0.39
Calcium	26,000.
Chromium	9.0
Cobalt	2.7
Copper	5.5
Iron	3700.
Lead	17.
Lithium	<20.
Magnesium	660.
Manganese	73.
Molybdenum	11.
Nickel	3.4
Selenium	8.3
Silicon	840.
Silver	<3.
Sodium	750.
Strontium	84.
Thallium	<100.
Tin	<50.
Titanium	510.
Vanadium	30.
Zinc	19.
Mercury	<0.1
Potassium	300.

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Notary Public

Approved by

Laboratory Director
Title

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IT CORPORATION

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19352
ORDER NUMBER: 8549.02

Sample Description: One (1) solid sample received January 11, 1985

Concentration units are mg/liter (ppm)

	IT #4774, Filter Sludge Sample #6
Cyanide	0.08
Fluoride (total fusion)	532.
Phenols	0.07
Sulfate (water leachable)	7700.
Chloride (water leachable)	1750.
Acidity (water leachable)	4200.
Alkalinity (water leachable)	2400.
Nitrate, as N (water leachable)	30.5

Sworn to and subscribed before me this 28th day of January, 1985
My commission expires March 18, 1985

Alyce F. Morris
Notary Public

Jack A. Hall
Approved by

Laboratory Director
Title

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19351
ORDER NUMBER: 8549.02

Sample Description: Two (2) EP Toxicity extract samples received January 11, 1985

Concentration units are µg/ml (ppm)

	EP Toxicity Extract	
	#334-71-4A, 4B	#334-71-5A, 5B
Aluminum	1.9	3.2
Antimony	<0.1	<0.1
Arsenic	<0.001	<0.001
Barium	0.053	0.192
Beryllium	<0.001	<0.001
Boron	0.12	0.11
Cadmium	<0.003	<0.003
Calcium	500.	900.
Chromium	<0.01	<0.01
Cobalt	0.03	0.05
Copper	<0.02	<0.02
Iron	0.1	0.4
Lead	<0.1	<0.1
Lithium	0.34	<0.2
Magnesium	21.	46.
Manganese	6.4	9.9
Molybdenum	<0.06	<0.06
Nickel	0.05	0.04
Selenium	<0.01	<0.01
Silicon	5.0	4.9
Silver	<0.03	<0.03
Sodium	160.	160.
Strontium	2.3	4.3
Thallium	<1.	<1.
Tin	<0.5	<0.5
Titanium	<0.02	<0.02
Vanadium	<0.1	<0.1
Zinc	0.14	0.14
Mercury	<0.001	<0.001
Potassium	9.8	9.0

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Alyce R. Moore
Notary Public

Jack A. Hall
Approved by

Laboratory Director
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19351
ORDER NUMBER: 8549.02

Sample Description: Two (2) liquid samples received January 11, 1985

Concentration units are mg/liter (ppm) unless otherwise stated

	EP TOX Extract #334-71-4A, 4B	EP TOX Extract #334-71-5A, 5B
Chloride	1.3	1.3
pH (standard units)	4.98	4.99
Total Dissolved Solids	2622.	4606.
Fluoride	0.09	0.13
Sulfate	362.	188.
Phenols	0.01	0.01
Cyanide	<0.01	<0.01
Nitrate, as N	0.71	0.75

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Alyce R. Moore
Notary Public

Approved by: Joe R. Hall
Laboratory Director
Title

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IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19350
ORDER NUMBER: 8549.02

Sample Description: Four (4) EP Toxicity extract samples received January 10, 1985

Concentration units are µg/ml (ppm)

	EP Toxicity Extracts			
	#334-70-1A, 1B	#334-70-2A, 2B	#334-70-3A, 3B	#334-71-6A, 6B
Aluminum	1.3	2.6	1.7	<0.1
Antimony	<0.1	<0.1	<0.1	<0.1
Arsenic	0.001	0.001	0.001	0.001
Barium	0.793	0.196	0.066	<0.003
Beryllium	<0.001	<0.001	<0.001	<0.001
Boron	0.14	0.10	0.12	<0.01
Cadmium	<0.003	<0.003	<0.003	<0.003
Calcium	340.	590.	560.	<0.2
Chromium	<0.01	<0.01	<0.01	<0.01
Cobalt	0.03	0.01	0.04	<0.01
Copper	<0.02	<0.02	<0.02	<0.02
Iron	0.5	<0.05	<0.05	<0.05
Lead	<0.1	<0.1	<0.1	<0.1
Lithium	0.23	0.23	<0.2	<0.2
Magnesium	29.	27.	22.	<0.1
Manganese	5.9	7.2	7.0	<0.02
Molybdenum	<0.06	<0.06	<0.06	<0.06
Nickel	0.05	<0.01	0.04	0.01
Selenium	<0.005*	<0.01*	<0.01*	0.012
Silicon	4.7	5.9	5.2	<0.1
Silver	<0.03	<0.03	<0.03	<0.03
Sodium	200.	120.	170.	0.78
Strontium	2.7	3.2	2.4	<0.001
Thallium	<1.	<1.	<1.	<1.
Tin	<0.5	<0.5	<0.5	<0.5
Titanium	<0.02	<0.02	<0.02	<0.02
Vanadium	<0.1	<0.1	<0.1	<0.1
Zinc	0.19	0.11	0.14	<0.02
Mercury	<0.001	<0.001	<0.001	<0.001
Potassium	9.	10.	11.	9.8

* Higher detection limit due to matrix interference

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Alyce L. Moore
Notary Public

Approved by
Laboratory Director
Title

Accredited by the American Association for Laboratory Accreditation in the chemical
data reporting, as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: January 28, 1985
PROJECT CODE: ITEK 19350
ORDER NUMBER: 8549.02

Sample Description: Four (4) water samples received January 10, 1985

Concentration units are mg/liter (ppm) unless otherwise stated

	EP TOX Extract #334-70-1A, 1B	EP TOX Extract #334-70-2A, 2B	EP TOX Extract #334-70-3A, 3B	EP TOX Extract #334-71-6A, 6B
Chloride	10.	2.5	2.5	0.8
pH (standard units)	5.14	5.00	5.01	4.63
Total Dissolved Solids	2177.	3504.	3277.	7.
Fluoride	0.10	0.10	0.10	<0.05
Sulfate	76.	250.	412.	138.
Phenols	0.01	0.01	0.01	<0.01
Cyanide	<0.01	<0.01	<0.01	<0.01
Nitrate, as N	0.17	1.6	0.85	<0.01

Sworn to and subscribed before me this 28th
day of January, 1985
My commission expires March 18, 1985

Notary Public

Approved by

Laboratory Director
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 4, 1985
PROJECT CODE: ITEK 19406
ORDER NUMBER: 8549.02

Sample Description: Two (2) samples of filter sludge received January 18, 1985

Concentration units are µg/gram (ppm) as received basis

	#4785, 334-7, #7	#4786, 334-72, #8
Aluminum	7000.	6000.
Antimony	<10.	<10.
Arsenic	16.	7.9
Barium	1020.	590.
Beryllium	<1.	<1.
Boron	240.	230.
Cadmium	0.71	0.64
Calcium	17,000.	48,000.
Chromium	9.3	7.4
Cobalt	2.6	1.8
Copper	2.6	2.2
Iron	2900.	2100.
Lead	<10.	25.
Lithium	<20.	<20.
Magnesium	670.	640.
Manganese	60.	40.
Molybdenum	9.1	6.9
Nickel	2.0	1.9
Selenium	8.8	3.6
Silicon	1050.	890.
Silver	<3.	<3.
Sodium	510.	460.
Strontium	97.	70.
Thallium	<100.	<100.
Tin	<50.	<50.
Titanium	420.	270.
Vanadium	23.	16.
Zinc	16.	14.
Potassium	220.	230.
Mercury	0.12	<0.2*

* Higher detection limit due to sample matrix interference

Sworn to and subscribed before me this 4th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by Alya R. Moore

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing, as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 4, 1985
PROJECT CODE: ITEK 19406
ORDER NUMBER: 8549.02

Sample Description: Two (2) solid samples received January 18, 1985

Concentration units are µg/gram (ppm)

	Filter Sludge #4785, 334-7, #7	Filter Sludge #4786, 334-72, #8
Cyanide	0.05	0.08
Fluoride (total fusion)	146.	322.
Phenols	<0.01	<0.01
Sulfate (water leachable)	7598.	6939.
Chloride (water leachable)	1961.	2042.
Acidity, as $CaCO_3$ (water leachable)	2745.	2559.
Alkalinity, as $CaCO_3$ (water leachable)	3725.	3150.
Nitrate, as N (water leachable)	26.5	24.6

Sworn to and subscribed before me this 4th
day of February, 1985
My commission expires January 16, 1988

Janice G. Atwood
Notary Public

Alyce R. Moore
Approved by

Laboratory Manager
Title

AALA Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 11, 1985
PROJECT CODE: ITDK 19341
ORDER NUMBER:

Sample Description: One (1) solid sample received December 27, 1984

		Total Radium (pCi/gram)
#2	#334-68-1, 12/21/84	2.1

Sworn to and subscribed before me this 11th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 11, 1985
PROJECT CODE: ITEK 19346
ORDER NUMBER: 1870.09

Sample Description: Two (2) solid samples received January 11, 1985

	Total Radium (pCi/gram)
#4765, Filter Sludge #4	1.5
#4770, Filter Sludge #5	1.6

Sworn to and subscribed before me this 11th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical fields of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 11, 1985
PROJECT CODE: ITDK 19269
ORDER NUMBER: 8549.02

Sample Description: Two (2) solid samples received January 2, 1985

		Radium 226 (pCi/gram)	Radium 228 (pCi/gram)
#1	#334-68-2A & 2B, 01/02/85	2.1	3.2
#3	#334-68-3A & 3B, 01/02/85	2.0	2.7

Sworn to and subscribed before me this 11th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 13, 1985
PROJECT CODE: ITEK 19509
ORDER NUMBER:

Sample Description: Eight (8) solid samples received February 7, 1985

	pH (standard units)
#334-68-1, 12/21/84	10.84
#334-68-2A & 2B, 01/02/85	10.96
#334-68-3A & 3B, 01/02/85	12.09
#4765, Filter Sludge #4, 01/09/85	11.11
#4770, Filter Sludge #5, 01/09/85	11.24
#4774, Filter Sludge	11.44
Filter Sludge #4785, 334-7, #7	11.20
Filter Sludge #4786, 334-72, #8	11.37

Sworn to and subscribed before me this 13th day of February, 1985
My commission expires March 18, 1985

Notary Public

Approved by

Laboratory Director
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 15, 1985
PROJECT CODE: ITEK 18902
ORDER NUMBER: 8549.02

Sample Description: Seven (7) coal samples, two (2) flyash samples, two (2) overburden samples, and five (5) spoil samples received October 30, 1984

	Ra 226 (pCi/g)	Ra 228 (pCi/g)
Coal-C-1-Seam #8, N. Face	0.6 ± 0.1	0.6 ± 0.2
Coal-C-2-Seam #2, N. Face	1.5 ± 0.1	0.7 ± 0.3
Coal-C-3-Seam #4, N. Face	0.5 ± 0.1	0.4 ± 0.2
Coal-C-4-Seam #3, N. Face	0.8 ± 0.1	0.9 ± 0.3
Coal-C-5-Seam #7, N. Face	0.4 ± 0.1	0.5 ± 0.2
Coal-C-6-Seam #8, S. Face	1.0 ± 0.1	0.3 ± 0.2
Coal-C-7-Seam #6, S. Face	1.0 ± 0.1	1.3 ± 0.3
Spoil-S-1	1.3 ± 0.1	0.9 ± 0.5
Spoil-S-2	1.4 ± 0.1	1.5 ± 0.5
Spoil-S-3	1.4 ± 0.1	1.0 ± 0.5
Spoil-S-4	1.5 ± 0.1	2.2 ± 0.4
Spoil-S-5	1.0 ± 0.1	1.0 ± 0.2
Sample Overburden-D-1	1.3 ± 0.1	2.2 ± 0.6
Sample Overburden-D-2	0.8 ± 0.1	2.1 ± 0.6
PP #1-Fly Ash	3.2 ± 0.1	3.8 ± 0.6
PP #2-Bottom Ash	2.9 ± 0.1	4.3 ± 0.7

Sworn to and subscribed before me this 15th
day of February, 1984
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing, as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Cliff Vaughn
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 20, 1985
PROJECT CODE: ITEK 19439
ORDER NUMBER:

Sample Description: Six (6) EP Toxicity extracts from ITEK 19350 and ITEK 19351

Concentration units are mg/liter (ppm)

	#334-70-1A,1B	#334-70-2A,2B	#334-70-3A,3B	#334-71-6A,6B	#334-71-4A,4B	#334-71-5A,5B
Silver	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	0.002	0.001	0.001	0.001	0.001	0.002
Copper	0.019	0.023	0.023	0.003	0.018	0.026
Iron	*	0.03	0.04	<0.01	*	*
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thallium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Vanadium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

* Analysis not requested

Sworn to and subscribed before me this 20th
day of February, 1985
My commission expires January 16, 1988

Janice E. Strauss
Notary Public

Alyce K. Moore
Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical fields of testing, as listed in the current AALA Directory of Accredited Laboratories

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Cliff Vaughn
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 20, 1985
PROJECT CODE: ITEK 19439
ORDER NUMBER:

Sample Description: Three (3) filter sludge samples from ITEK 19352 and ITEK 19406

Concentration units are µg/gram (ppm)

	Filter Sludge #4774	Filter Sludge #4785, 334-7, #7	Filter Sludge #4786, 334-72, #8
Silver	<0.2	<0.2	<0.2
Lead	*	6.0	*
Antimony	0.4	0.6	0.5
Tin	<10.	<10.	<10.
Thallium	<2.	<2.	<2.

* Analysis not requested

Sworn to and subscribed before me this 20th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Cliff Vaughn
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 20, 1985
PROJECT CODE: ITEK 19439
ORDER NUMBER:

Sample Description: Sixteen (16) coal, spoil, overburden, fly ash, and bottom ash samples from ITEK 18902

Concentration units are µg/gram (ppm)

	Coal C-1 Seam #8 North	Coal C-2 Seam #2 North	Coal C-3 Seam #4 North	Coal C-4 Seam #3 North	Coal C-5 Seam #7 North	Coal C-6 Seam #8 South
Silver	<0.2	<0.2	<0.3**	<0.2	<0.2	<0.2
Cadmium	<0.1	*	0.2	<0.1	<0.1	*
Cobalt	<0.5	*	<0.8**	<0.6**	*	*
Copper	0.020	0.028	0.029	0.033	0.044	0.071
Lead	<1.	<1.	*	<1.	2.6	3.8
Antimony	0.3	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	<10.	<10.	<10.	<10.	<10.	<10.
Thallium	<2.	<2.	<2.	<2.	<2.	<2.
Vanadium	<2.	<2.	<3.**	<2.	<2.	*

	Coal C-7, Seam #6 South	Spoil S-1	Spoil S-2	Spoil S-3	Spoil S-4	Spoil S-5
Silver	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	<10.	<10.	32.	<10.	<10.	<10.
Thallium	<2.	<2.	<2.	<2.	<2.	<2.

	Sample Overburden D-1	Sample Overburden D-2	PP #1 Fly Ash	PP #2 Bottom Ash
Silver	<0.2	<0.2	<0.2	<0.2
Cadmium	*	*	*	<0.1
Copper	*	0.143	0.063	0.023
Lead	*	*	*	<1.
Antimony	<0.1	<0.1	<0.1	<0.1
Tin	<10.	11.	11.	<10.
Thallium	<2.	<2.	<2.	<2.
Vanadium	*	*	*	<2.

* Analysis not requested
** Detection limit higher than normal due to matrix interference

Sworn to and subscribed before me this 20th day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by: Alice K. Tiller
Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

IT CORPORATION

IT ANALYTICAL SERVICES

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Cliff Vaughn
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 20, 1985
PROJECT CODE: ITEK 19439
ORDER NUMBER:

Sample Description: Six (6) water samples from ITEK 18470

Concentration units are mg/liter (ppm)

	Comp #1	Comp #2	Comp #3	Comp #4	Comp #5	Surface Water
Silver	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	0.002	0.004	0.002	*	<0.001	0.002
Cobalt	0.025	<0.006**	0.012	*	*	<0.005
Copper	0.051	0.029	0.017	*	*	0.031
Lead	0.03	*	<0.01	*	*	<0.01
Antimony	<0.001	<0.001	*	*	<0.001	0.001
Tin	<0.1	<0.1	<0.1	0.3	<0.1	<0.1
Thallium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

* Analysis not requested
** Detection limit higher than normal due to matrix interference

Sworn to and subscribed before me this 20th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Cliff Vaughn
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: February 20, 1985
PROJECT CODE: ITEK 19439
ORDER NUMBER:

Sample Description: Two (2) filter sludge samples from ITEK 19345

Concentration units are µg/gram (ppm)

	#4765, 1/09/85 Filter Sludge #4	#4770, 1/09/85 Filter Sludge #5
Silver	<0.2	<0.2
Antimony	0.3	0.5
Tin	32.	21.
Thallium	<2.	<2.

Sworn to and subscribed before me this 20th
day of February, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: March 5, 1985
PROJECT CODE: ITEK 19431
ORDER NUMBER:

Sample Description: Two (2) solid samples received January 11, 1985

	Total Radium (pCi/l)
Filter Sludge #4785, 334-7, #7	6.6 ± 0.6
Filter Sludge #4786, 334-72, #8	6.0 ± 0.5

Sworn to and subscribed before me this 5th
day of March, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical fields of testing as listed in the current AALA Directory of Accredited Laboratories

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: March 5, 1985
PROJECT CODE: ITEK 19353
ORDER NUMBER:

Sample Description: One (1) solid sample received January 11, 1985

	Total Radium (pCi/l)
IT #4774, Filter Sludge #6	15.5 ± 0.6

Sworn to and subscribed before me this 5th
day of March, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

Accredited by the American Association for Laboratory Accreditation in the chemical field of testing as listed in the current AALA Directory of Accredited Laboratories

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CERTIFICATE OF ANALYSIS

TO: IT Engineering/Assessment
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: March 5, 1985
PROJECT CODE: ITEK 19635
ORDER NUMBER:

Sample Description: Eight (8) solid samples received February 26, 1985

Concentration units are mg/liter (ppm)

	% Solids
#334-68-1, 12/21/84	81.3
#334-68-2A & 2B, 01/02/85	86.7
#334-68-3A & 3B, 01/02/85	76.1
#4765, Filter Sludge #4, 01/09/85	79.4
#4770, Filter Sludge #5, 01/09/85	74.5
IT #4774, Filter Sludge	84.2
Filter Sludge #4785, 334-7, #7	89.2
Filter Sludge #4786, 334-72, #8	79.0

Sworn to and subscribed before me this 5th
day of March, 1985
My commission expires January 16, 1988

Notary Public

Approved by

Laboratory Manager
Title

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CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: March 15, 1985
PROJECT CODE: ITDK 19245
ORDER NUMBER: Project #8549.02

Sample Description: Five (5) liquid samples received December 26, 1984

Concentration units are mg/liter (ppm)

	#334-66-1A, 1B	#334-66-2A, 2B	#334-66-3A, 3B	#334-67-4A, 4B	#334-67-5A, 5B
Aluminum	5.8	0.6	4.4	3.1	1.1
Antimony	<0.1	0.1	0.1	<0.1	<0.1
Arsenic	<0.4	<0.4	<0.4	<0.4	<0.4
Barium	0.447	0.635	0.159	0.152	0.101
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	6.3	0.09	0.207	0.05	0.03
Cadmium	0.004	<0.004	<0.004	<0.004	<0.004
Calcium	430.	62.	670.	440.	150.
Chromium	0.03	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.01	<0.01	0.02	0.03	0.01
Copper	0.02	<0.02	0.02	0.02	<0.02
Iron	<0.01	<0.01	0.04	0.04	0.02
Lead	<0.1	<0.1	0.2	0.1	<0.1
Lithium	0.1	0.1	0.1	0.1	0.1
Magnesium	4.3	1.3	39.	38.	42.
Manganese	1.2	0.220	7.3	4.4	1.7
Molybdenum	0.11	<0.05	<0.05	<0.05	<0.05
Nickel	0.02	0.01	0.02	0.02	0.01
Selenium	0.2	<0.2	0.3	<0.2	<0.2
Silicon	19.	2.9	6.4	3.9	1.9
Silver	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	11.	3.0	230.	170.	71.
Strontium	1.0	0.143	3.2	2.7	0.673
Thallium	<1.	<1.	<1.	<1.	<1.
Tin	<0.5	<0.5	<0.5	<0.5	<0.5
Titanium	<0.02	<0.02	<0.02	<0.02	<0.02
Vanadium	0.04	<0.02	<0.02	<0.02	<0.02
Zinc	0.117	0.105	0.190	0.077	0.039

Sworn to and subscribed before me this 15th day of March, 1985
My commission expires March 18, 1985

Notary Public

Authority

Laboratory Director
Title

AALA

IT CORPORATION

IT ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville Tennessee 37921 • 615 588 6401

CERTIFICATE OF ANALYSIS

TO: IT Corporation
ATTN: Arie Groen
312 Directors Drive
Knoxville, TN 37923

DATE REPORTED: March 15, 1985
PROJECT CODE: ITDK 19245
ORDER NUMBER: Project #8549.02

Sample Description: One (1) liquid and one (1) solid sample received December 26, 1984

Concentration units are mg/liter (ppm) for liquid; µg/gram (ppm) for solid

	#334-67-6A, 6B	#334-68-1
Aluminum	3.2	9900.
Antimony	0.1	<10.
Arsenic	<0.4	41.
Barium	0.193	650.
Beryllium	0.001	0.94
Boron	0.04	300.
Cadmium	<0.004	0.73
Calcium	470.	40,000.
Chromium	<0.01	11.
Cobalt	0.03	2.3
Copper	0.02	8.5
Iron	0.03	4400.
Lead	<0.1	12.
Lithium	<0.1	28.
Magnesium	42.	780.
Manganese	5.1	120.
Molybdenum	<0.05	7.9
Nickel	0.02	3.5
Selenium	<0.2	20.
Silicon	4.0	350.
Silver	<0.01	1.0
Sodium	170.	1000.
Strontium	2.8	120.
Thallium	<1.	<100.
Tin	<0.5	<50.
Titanium	<0.02	580.
Vanadium	<0.02	37.
Zinc	0.083	18.

Sworn to and subscribed before me this 15th day of March, 1985
My commission expires March 18, 1985

Notary Public

Author

Laboratory Director

Title

The laboratory is a member of the American Association for Laboratory Accreditation (A2LA)

IT CORPORATION

Memorandum

To: A. Groen
J. Nuter

Date: March 15, 1985

From: R. M. Burke RMB 3/15/85
J. J. Duck JJD 3/15/85

Subject: Transmittal
Analytical Results for IT Corporation/Utah International
Project No. 85-8019; Job No. 8549.02

The IT Analytical Services (ITAS) Murrysville Laboratory has completed the analysis of the eighteen (18) samples received in our laboratory on February 15, 1985. Results of the analyses are presented in the enclosed tables and were determined in accordance with U.S. Environmental Protection Agency analytical procedures.

Should you have any questions or need additional information, please contact us at the Murrysville Laboratory.

JJD;RMB:ws

TABLE 1

1:4 ASTM LEACHATE ANALYSIS SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

PARAMETER	UNITS	SAMPLE IDENTIFICATION BA-4818	BA-4819	BA-4820
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	80	2900	900
Chloride	mg/ℓ	22	2.4	290
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.9	1.9	2.1
Nitrate	mg/ℓ NO_3-N	2.5	5.8	3.0
pH	--	8.15	8.90	8.60
Phenolics	mg/ℓ	0.02	0.02	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	2,000	3,800	3,900
Specific Conductance	µmhos/cm @ 25°C	2,350	5,940	5,510
Sulfate	mg/ℓ SO_4^{-2}	940	44	1,100
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	<0.1
Arsenic	mg/ℓ	<0.001	0.004	<0.001
Barium	mg/ℓ	0.30	1.4	0.13
Boron	mg/ℓ	<0.5	0.8	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	260	18	50
Chromium	mg/ℓ	0.001	0.003	0.001
Cobalt	mg/ℓ	<0.001	0.004	0.005
Copper	mg/ℓ	<0.01	0.02	<0.01
Iron	mg/ℓ	0.03	0.08	0.04
Lead	mg/ℓ	<0.01	<0.01	<0.01
Magnesium	mg/ℓ	28	4.6	6.2
Manganese	mg/ℓ	0.07	0.04	0.06
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.023	0.024	0.003
Nickel	mg/ℓ	0.06	<0.01	0.04
Potassium	mg/ℓ	11	7.7	8.3
Selenium	mg/ℓ	0.046	0.023	0.023
Silver	mg/ℓ	0.004/0.003[2]	<0.001/<0.001	0.002
Sodium	mg/ℓ	330	1,200	1,000
Zinc	mg/ℓ	0.02	0.01	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION BA-4821	BA-4822	BA-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	470	870	40
Chloride	mg/ℓ	5,500	2,100	5.9
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.7	1.0	0.1
Nitrate	mg/ℓ NO_3-N	15	3.5	0.3
pH	--	8.25	9.50	7.80
Phenolics	mg/ℓ	0.03	0.04	0.05
Residue:				
Filterable @ 180°C	mg/ℓ	8,700	4,500	100
Specific Conductance	µmhos/cm @ 25°C	15,900	8930	157
Sulfate	mg/ℓ SO_4^{-2}	170	210	50
Metals:				
Aluminum	mg/ℓ	<0.1	0.3	0.2
Arsenic	mg/ℓ	<0.001	0.010	<0.001
Barium	mg/ℓ	0.93	0.81	0.30
Boron	mg/ℓ	0.6	0.6	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	170	7	21
Chromium	mg/ℓ	<0.001	0.048	0.002
Cobalt	mg/ℓ	0.076/0.070	0.004	<0.001
Copper	mg/ℓ	0.02	0.02	<0.01
Iron	mg/ℓ	0.05	0.09	0.06
Lead	mg/ℓ	0.24	0.04	<0.01
Magnesium	mg/ℓ	37	4.4	1.4
Manganese	mg/ℓ	0.14	0.02	0.02
Mercury	mg/ℓ	<0.0002	<0.0002	0.0002
Molybdenum	mg/ℓ	0.031	0.019	0.017
Nickel	mg/ℓ	0.08	0.06	0.02
Potassium	mg/ℓ	20	11	0.83
Selenium	mg/ℓ	0.020	0.013	0.006
Silver	mg/ℓ	<0.001/<0.001	<0.001/<0.001	<0.001/<0.001
Sodium	mg/ℓ	3,500	1,300	11
Zinc	mg/ℓ	0.02	0.02	0.01

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION CS-4818	CS-4819	CS-4820
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	96	1,100	160
Chloride	mg/ℓ	55	200	330
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.8	11	8.5
Nitrate	mg/ℓ NO_3-N	11	2.5	6.1
pH	--	10.40	8.60	9.90
Phenolics	mg/ℓ	0.02	<0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	2,000	4,800	4,700
Specific Conductance	µmhos/cm @ 25°C	2,570	7,300	5,730
Sulfate	mg/ℓ SO_4^{-2}	1,400	1,300	2,600
Metals:				
Aluminum	mg/ℓ	0.3	0.3	0.6
Arsenic	mg/ℓ	0.018	0.223	0.140
Barium	mg/ℓ	0.39	0.53	0.41
Boron	mg/ℓ	3.1	33	14
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	330	130	170
Chromium	mg/ℓ	0.096	0.084	0.081
Cobalt	mg/ℓ	<0.001	<0.001	0.003
Copper	mg/ℓ	<0.01	<0.01	<0.01
Iron	mg/ℓ	0.02	0.12	0.02
Lead	mg/ℓ	<0.01	0.03	0.03
Magnesium	mg/ℓ	0.2	9.5	3.2
Manganese	mg/ℓ	0.05	0.11	0.06
Mercury	mg/ℓ	<0.0002	0.0003	<0.0002
Molybdenum	mg/ℓ	0.90	1.0	0.80
Nickel	mg/ℓ	0.04	0.04	0.05
Potassium	mg/ℓ	18	13	14
Selenium	mg/ℓ	0.018	0.54	0.12
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	350	1,200	1,100
Zinc	mg/ℓ	0.02	0.04	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION CS-4821	CS-4822	CS-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140/140	210	110
Chloride	mg/ℓ	4,900/4,900	2,200	22
Cyanide	mg/ℓ	<0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	5.7/6.0	5.7	1.6
Nitrate	mg/ℓ NO_3-N	16/16	6.5	2.0
pH	--	9.80/9.60	10.80	10.70
Phenolics	mg/ℓ	0.01/0.03	0.03	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	9,800/9,800	5,000	520
Specific Conductance	µmhos/cm @ 25°C	17,700/17,800	7,950	927
Sulfate	mg/ℓ SO_4^{-2}	400/500	1,500	100
Metals:				
Aluminum	mg/ℓ	0.2/0.5	1.4	0.9
Arsenic	mg/ℓ	0.057/0.057	0.076	0.013
Barium	mg/ℓ	0.88/0.77	0.39	1.0
Boron	mg/ℓ	15/11	15	2.9
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	340/410	120	120
Chromium	mg/ℓ	0.11/0.10	0.14	0.078
Cobalt	mg/ℓ	0.008/0.011	<0.001	<0.001
Copper	mg/ℓ	<0.01/<0.01	<0.01	<0.01
Iron	mg/ℓ	0.04/0.08	0.02	0.02
Lead	mg/ℓ	0.12/0.12	0.04	<0.01
Magnesium	mg/ℓ	2.6/8.3	<0.1	<0.1
Manganese	mg/ℓ	0.07/0.06	0.06	0.05
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	1.3/1.4	1.3	1.2
Nickel	mg/ℓ	0.06/0.06	0.05	<0.01
Potassium	mg/ℓ	25/25	17	6.6
Selenium	mg/ℓ	0.14/0.15	0.17	0.045
Silver	mg/ℓ	0.002/0.002	<0.001	<0.001
Sodium	mg/ℓ	2,800/2,800	1,300	44
Zinc	mg/ℓ	0.03/0.04	<0.01	0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION FA-4818	FA-4819	FA-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	820	2,600	840
Chloride	mg/ℓ	16	360	290
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.9	1.6	0.4
Nitrate	mg/ℓ NO_3-N	3.3	2.0	2.0
pH	--	12.20	10.30	11.80
Phenolics	mg/ℓ	0.03	0.03	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	2,000	4,300	4,500
Specific Conductance	µmhos/cm @ 25°C	5,490	7,470	7,350
Sulfate	mg/ℓ SO_4^{-2}	590	510	1,200
Metals:				
Aluminum	mg/ℓ	0.8	15	16
Arsenic	mg/ℓ	0.009	1.00	0.140
Barium	mg/ℓ	0.49	0.30	0.33
Boron	mg/ℓ	1.0	20	12
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	290	7	80
Chromium	mg/ℓ	0.14	0.24	0.22
Cobalt	mg/ℓ	<0.001	0.005	0.004
Copper	mg/ℓ	<0.01	<0.01	<0.01
Iron	mg/ℓ	0.02	0.07	0.04
Lead	mg/ℓ	<0.01	0.01	0.01
Magnesium	mg/ℓ	0.2	0.8	0.2
Manganese	mg/ℓ	0.02	0.02	<0.01
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	1.4	0.75	0.64
Nickel	mg/ℓ	<0.01	<0.01	<0.01
Potassium	mg/ℓ	17	7.0	9.2
Selenium	mg/ℓ	0.09	0.83	0.32
Silver	mg/ℓ	<0.001/<0.001	<0.001/0.002	0.001
Sodium	mg/ℓ	380	1,300	1,100
Zinc	mg/ℓ	0.01	0.01	0.01

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION FA-4821	FA-4822	FA-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	960	1,000	1,400
Chloride	mg/ℓ	5,600	2,100	3.9
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	3.1	1.9	3.3
Nitrate	mg/ℓ NO_3-N	19	3.3	2.5
pH	--	12.00	12.15	12.10
Phenolics	mg/ℓ	0.03	0.05	0.05
Residue:				
Filterable @ 180°C	mg/ℓ	10,000	4,800	1,600
Specific Conductance	µmhos/cm @ 25°C	1,970	12,500	5,710
Sulfate	mg/ℓ SO_4^{-2}	320	370	130
Metals:				
Aluminum	mg/ℓ	0.3	2.0	<0.1
Arsenic	mg/ℓ	0.017	0.030	0.010
Barium	mg/ℓ	1.3	1.7	4.9
Boron	mg/ℓ	6.2	6.2	5.1
Cadmium	mg/ℓ	<0.001	<0.001	<0.001/<0.001
Calcium	mg/ℓ	520	160	590
Chromium	mg/ℓ	0.070	0.118	0.036
Cobalt	mg/ℓ	0.070	0.006	<0.001
Copper	mg/ℓ	<0.01	<0.01	<0.01/0.05
Iron	mg/ℓ	0.04	0.03	0.02
Lead	mg/ℓ	0.19	0.04	<0.01/<0.01
Magnesium	mg/ℓ	0.2	<0.1	0.2
Manganese	mg/ℓ	0.02	<0.01	0.02/0.02
Mercury	mg/ℓ	0.0006	<0.0002	<0.0002
Molybdenum	mg/ℓ	1.5	1.2	1.5
Nickel	mg/ℓ	0.05	<0.01	0.07
Potassium	mg/ℓ	22	14	2.0/2.0
Selenium	mg/ℓ	0.22	0.38	0.24
Silver	mg/ℓ	0.001/0.002	<0.001/0.001	0.016/0.014
Sodium	mg/ℓ	3,000	1,900	41
Zinc	mg/ℓ	0.01	0.01	0.04/0.04

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4810C-4818	4810C-4819	4810C-4820
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	320	2,100	680
Chloride	mg/ℓ	43	390	340
Cyanide	mg/ℓ	<0.02	0.09	0.02
Fluoride	mg/ℓ	1.3	1.8	1.7
Nitrate	mg/ℓ NO_3-N	14	15	12
pH	--	8.30	8.50	8.00
Phenolics	mg/ℓ	0.03	0.03	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	5,800	6,200	7,400
Specific Conductance	µmhos/cm @ 25°C	6,390	8,040	8,780
Sulfate	mg/ℓ SO_4^{-2}	3,500	1,800	3,900
Metals:				
Aluminum	mg/ℓ	0.3	0.1	0.8
Arsenic	mg/ℓ	0.005	0.003	0.005
Barium	mg/ℓ	0.20	0.26	0.15
Boron	mg/ℓ	<0.5	0.8	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	600	230	450
Chromium	mg/ℓ	0.004	0.005	0.009
Cobalt	mg/ℓ	0.006	0.006	0.007
Copper	mg/ℓ	0.05	0.05	0.11
Iron	mg/ℓ	0.16	0.12	0.22
Lead	mg/ℓ	0.02	0.01	0.04
Magnesium	mg/ℓ	64	36	46
Manganese	mg/ℓ	0.59	0.31	0.55
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.005	0.005	0.006
Nickel	mg/ℓ	0.07	0.07	0.12
Potassium	mg/ℓ	25	22	23
Selenium	mg/ℓ	0.017	0.016	0.010
Silver	mg/ℓ	0.001	0.001	0.001
Sodium	mg/ℓ	900	1,600	1,500
Zinc	mg/ℓ	0.04	0.05	0.12

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4810C-4821	4810C-4822	4810C-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	1,100	500	300
Chloride	mg/ℓ	5,700	2,300	35
Cyanide	mg/ℓ	0.04	0.02	<0.02
Fluoride	mg/ℓ	1.1	1.6	1.2
Nitrate	mg/ℓ NO_3-N	21	15	10
pH	--	8.30	8.50	8.10
Phenolics	mg/ℓ	0.03	0.04	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	14,000	8,300	4,400
Specific Conductance	µmhos/cm @ 25°C	20,400	11,400	5,080
Sulfate	mg/ℓ SO_4^{-2}	3,500	2,800	3,000
Metals:				
Aluminum	mg/ℓ	0.1	0.2	0.2
Arsenic	mg/ℓ	0.002	0.003	0.002
Barium	mg/ℓ	0.34	0.26	0.10
Boron	mg/ℓ	<0.5	<0.5	0.8
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	900	570	470
Chromium	mg/ℓ	<0.001	0.011	0.002
Cobalt	mg/ℓ	0.092/0.091	0.007	0.002
Copper	mg/ℓ	0.06	0.05	0.02
Iron	mg/ℓ	0.16	0.08	0.10
Lead	mg/ℓ	0.24	0.04	<0.01
Magnesium	mg/ℓ	94	60	45
Manganese	mg/ℓ	1.2	0.55	0.60
Mercury	mg/ℓ	0.0007	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.007	0.004	0.008
Nickel	mg/ℓ	0.18	0.14	0.01
Potassium	mg/ℓ	41	27	18
Selenium	mg/ℓ	0.010	0.014	0.016
Silver	mg/ℓ	0.001	0.001	0.001
Sodium	mg/ℓ	3,900	2,300	800
Zinc	mg/ℓ	0.04	0.04	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4810S-4818	4810S-4819	4810S-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	160	2100	810
Chloride	mg/ℓ	20	420	170
Cyanide	mg/ℓ	0.02	0.08	<0.02
Fluoride	mg/ℓ	1.1	1.4	1.5
Nitrate	mg/ℓ NO_3-N	17	18	17
pH	--	8.10	8.35	8.15
Phenolics	mg/ℓ	0.03	<0.01	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	5,000	6,200	6,900
Specific Conductance	μmhos/cm @ 25°C	6,010	8,450	8,600
Sulfate	mg/ℓ SO_4^{-2}	3,000	4,000	3,700
Metals:				
Aluminum	mg/ℓ	<0.1	1.4	<0.1
Arsenic	mg/ℓ	0.002	0.003	0.004
Barium	mg/ℓ	0.085	0.039	0.072
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	400	80	360
Chromium	mg/ℓ	0.005	0.055	0.006
Cobalt	mg/ℓ	0.007	0.003	0.012
Copper	mg/ℓ	0.05	0.04	0.06
Iron	mg/ℓ	0.08	0.30	0.08
Lead	mg/ℓ	0.03	0.03	0.05
Magnesium	mg/ℓ	50	34	42
Manganese	mg/ℓ	0.13	0.05	0.15
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.007	0.013	0.013
Nickel	mg/ℓ	0.03	<0.01	0.08
Potassium	mg/ℓ	23	20	23
Selenium	mg/ℓ	0.021	0.012	0.013
Silver	mg/ℓ	0.002	0.002	0.002
Sodium	mg/ℓ	1,000	1,700	1,500
Zinc	mg/ℓ	0.04	0.04	0.04

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4810S-4821	4810S-4822	4810S-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	460	530	140
Chloride	mg/ℓ	5,300	2100	12
Cyanide	mg/ℓ	0.05	0.05	<0.02
Fluoride	mg/ℓ	0.8	1.6	2.5
Nitrate	mg/ℓ NO_3-N	31	16	12
pH	—	8.05	8.40	7.90
Phenolics	mg/ℓ	0.04	0.04	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	13,000	6,100	3,500
Specific Conductance	µmhos/cm @ 25°C	22,800	9,670	4,830
Sulfate	mg/ℓ SO_4^{-2}	2,300	1,000	2,200
Metals:				
Aluminum	mg/ℓ	<0.1	0.1	<0.1
Arsenic	mg/ℓ	0.002	0.002	0.001
Barium	mg/ℓ	0.20	0.12	0.10
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	0.002	<0.001	<0.001
Calcium	mg/ℓ	770	130	310
Chromium	mg/ℓ	0.004	0.029	0.004
Cobalt	mg/ℓ	0.096	0.001	0.002
Copper	mg/ℓ	0.05	0.04	0.02
Iron	mg/ℓ	0.24	0.24	0.04
Lead	mg/ℓ	0.25	0.04	0.02
Magnesium	mg/ℓ	79	24	28
Manganese	mg/ℓ	0.34	0.11	0.06
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.016	0.009	0.009
Nickel	mg/ℓ	0.08	0.04	0.03
Potassium	mg/ℓ	40	19	16
Selenium	mg/ℓ	0.022	0.009	0.012
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	3,400	1,700	770
Zinc	mg/ℓ	0.05	0.03	0.01

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4811C-4818	4811C-4819	4811C-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	220	2,000	610
Chloride	mg/ℓ	27	370	320
Cyanide	mg/ℓ	<0.02	0.05	0.04
Fluoride	mg/ℓ	1.5	2.3	1.9
Nitrate	mg/ℓ NO_3-N	9.5	3.5	6.8
pH	--	8.30	8.20	8.05
Phenolics	mg/ℓ	0.03	0.03	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	4,100	5,400	6,200
Specific Conductance	µmhos/cm @ 25°C	4,950	8,270	8,950
Sulfate	mg/ℓ SO_4^{-2}	2,200	1,500	3,400
Metals:				
Aluminum	mg/ℓ	0.4	3.9	0.1
Arsenic	mg/ℓ	0.002	0.003	0.005
Barium	mg/ℓ	0.047	0.097	0.043
Boron	mg/ℓ	<0.5	1.0	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	340	130	310
Chromium	mg/ℓ	<0.001	0.013	<0.001
Cobalt	mg/ℓ	0.003	0.007	0.006
Copper	mg/ℓ	0.05	0.05	0.03
Iron	mg/ℓ	0.07	0.93	0.07
Lead	mg/ℓ	<0.01	<0.01	0.01
Magnesium	mg/ℓ	41	30	44
Manganese	mg/ℓ	0.48	0.21	0.23
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.007	0.009	0.007
Nickel	mg/ℓ	0.04	0.04	0.03
Potassium	mg/ℓ	26	24	27
Selenium	mg/ℓ	0.016	0.010	0.007
Silver	mg/ℓ	0.001	0.001	0.001
Sodium	mg/ℓ	860	1,500	1,300
Zinc	mg/ℓ	0.05	0.05	0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4811C-4821	4811C-4822	4811C-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	360/460	460	220
Chloride	mg/ℓ	5,800/5,600	2,300	14
Cyanide	mg/ℓ	0.02/<0.02	0.04	<0.02
Fluoride	mg/ℓ	1.2/1.8	1.6	2.2
Nitrate	mg/ℓ NO_3-N	14/17	6.5	3.0
pH	—	8.35/8.20	8.10	8.25
Phenolics	mg/ℓ	0.04/0.02	0.04	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	12,000/12,000	6,600	3,000
Specific Conductance	µmhos/cm @ 25°C	17,600/18,400	9,950	3,730
Sulfate	mg/ℓ SO_4^{-2}	1,700/1,500	1,700	1,800
Metals:				
Aluminum	mg/ℓ	<0.1/0.2	0.5	0.4
Arsenic	mg/ℓ	<0.001	0.002	<0.001
Barium	mg/ℓ	0.20/0.27	0.096	0.068
Boron	mg/ℓ	<0.5/<0.5	<0.5	<0.5
Cadmium	mg/ℓ	0.056/0.052	<0.001	<0.001
Calcium	mg/ℓ	650/510	270	270
Chromium	mg/ℓ	<0.001/<0.001	0.003	0.004
Cobalt	mg/ℓ	0.11/0.086	0.005	0.002
Copper	mg/ℓ	0.04/0.03	0.05	0.05
Iron	mg/ℓ	0.09/0.07	0.09	0.07
Lead	mg/ℓ	0.23	0.04	<0.01
Magnesium	mg/ℓ	83/76	40	28
Manganese	mg/ℓ	1.1/0.93	0.30	0.29
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.012	0.007	0.008
Nickel	mg/ℓ	0.07/0.07	<0.01	0.03
Potassium	mg/ℓ	43/44	29	18
Selenium	mg/ℓ	0.010/0.018	0.014	0.003
Silver	mg/ℓ	0.003/0.005	0.001/0.004	0.001
Sodium	mg/ℓ	3,000/2,800	1,600	580
Zinc	mg/ℓ	0.04/0.03	0.04	0.04

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4811S-4818	4811S-4819	4811S-4820
General Chemistry:				
Acidity	mg/ℓ[(1)] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	200	2,200	720
Chloride	mg/ℓ	29	390	310
Cyanide	mg/ℓ	0.06	<0.02	<0.02
Fluoride	mg/ℓ	1.0	1.3	1.6
Nitrate	mg/ℓ NO_3-N	8.7	10	9.2
pH	--	7.90	8.90	8.40
Phenolics	mg/ℓ	0.02	0.04	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	3,800	5,000	5,000
Specific Conductance	µmhos/cm @ 25°C	5,300	7,290	6,760
Sulfate	mg/ℓ SO_4^{-2}	2,500	800	2,400
Metals:				
Aluminum	mg/ℓ	<0.1	3.8	3.2
Arsenic	mg/ℓ	0.001	0.001	0.001
Barium	mg/ℓ	0.038	0.045	0.031
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	290	60	110
Chromium	mg/ℓ	0.004	0.049	0.033
Cobalt	mg/ℓ	0.002	0.001	0.001
Copper	mg/ℓ	0.02	0.08	0.02
Iron	mg/ℓ	0.06	0.76	0.50
Lead	mg/ℓ	0.02	0.04	0.04
Magnesium	mg/ℓ	37	20	22
Manganese	mg/ℓ	0.27	0.14	0.20
Mercury	mg/ℓ	0.0004	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.011	0.023	0.020
Nickel	mg/ℓ	<0.01	0.09	<0.01
Potassium	mg/ℓ	26	21	25
Selenium	mg/ℓ	0.014	0.013	0.004
Silver	mg/ℓ	0.002	0.002	0.003
Sodium	mg/ℓ	810	1,400	1,300
Zinc	mg/ℓ	0.02	0.08	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4811S-4821	4811S-4822	4811S-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	370/440	520	170
Chloride	mg/ℓ	5,100/5,300	1,900	11
Cyanide	mg/ℓ	<0.02/<0.02	0.02	<0.02
Fluoride	mg/ℓ	0.6/0.7	1.3	1.2
Nitrate	mg/ℓ NO_3-N	21/19	9.5	2.4
pH	--	8.00/8.10	8.20	8.20
Phenolics	mg/ℓ	0.02/0.03	<0.01	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	11,000/10,000	4,900	1,700
Specific Conductance	μmhos/cm @ 25°C	18,400/17,600	8,460	2,450
Sulfate	mg/ℓ SO_4^{-2}	600/500	400	650
Metals:				
Aluminum	mg/ℓ	<0.1/0.1	0.2	0.6
Arsenic	mg/ℓ	0.004/0.004	<0.001	0.004
Barium	mg/ℓ	0.11/0.16	0.037	0.016
Boron	mg/ℓ	<0.5/0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	300/260	60	33
Chromium	mg/ℓ	0.006/0.004	0.004	0.005
Cobalt	mg/ℓ	0.055/0.076	<0.001	<0.001
Copper	mg/ℓ	0.03/0.02	0.04	<0.01
Iron	mg/ℓ	0.06/0.18	0.06	0.12
Lead	mg/ℓ	0.17/0.16	0.02	0.01
Magnesium	mg/ℓ	58/59	17	4.9
Manganese	mg/ℓ	0.50/0.41	0.16	0.07
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.025/0.024	0.029	0.012
Nickel	mg/ℓ	0.08/0.08	<0.01	<0.01
Potassium	mg/ℓ	41/40	20	7.1
Selenium	mg/ℓ	0.016/0.017	0.014	0.011
Silver	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,200/3,100	1,400	290
Zinc	mg/ℓ	0.04/0.01	0.02	0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4812C-4818	4812C-4819	4812C-4820
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	150	2,000	760
Chloride	mg/ℓ	29	390	380
Cyanide	mg/ℓ	0.05	<0.02	0.04
Fluoride	mg/ℓ	2.0	2.8	2.7
Nitrate	mg/ℓ NO_3-N	13	17	11
pH	--	7.80	8.45	8.20
Phenolics	mg/ℓ	0.04	0.03	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	4,800	5,500	6,800
Specific Conductance	µmhos/cm @ 25°C	6,190	8,030	9,300
Sulfate	mg/ℓ SO_4^{-2}	3,200	1,400	3,600
Metals:				
Aluminum	mg/ℓ	<0.1	0.5	0.1
Arsenic	mg/ℓ	0.003	0.003	0.005
Barium	mg/ℓ	0.056	0.058	0.050
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	490	110	430
Chromium	mg/ℓ	0.004	0.004	0.004
Cobalt	mg/ℓ	0.009	0.011	0.031
Copper	mg/ℓ	0.03	0.16	0.03
Iron	mg/ℓ	0.04	0.08	0.06
Lead	mg/ℓ	0.02	0.02	0.04
Magnesium	mg/ℓ	48	23	43
Manganese	mg/ℓ	1.2	0.24	1.2
Mercury	mg/ℓ	0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.033	0.009	0.022
Nickel	mg/ℓ	<0.01	0.04	<0.01
Potassium	mg/ℓ	25	17	22
Selenium	mg/ℓ	0.018	0.019	0.012
Silver	mg/ℓ	0.002	0.002	0.002
Sodium	mg/ℓ	900	1,400	1,300
Zinc	mg/ℓ	0.04	0.05	0.04

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4812C-4821	4812C-4822	4812C-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	450	530	130
Chloride	mg/ℓ	5,500	2,200	14
Cyanide	mg/ℓ	0.02	0.09	<0.02
Fluoride	mg/ℓ	1.4	2.1	1.6
Nitrate	mg/ℓ NO_3-N	20	14	10
pH	--	7.85	8.05	7.60
Phenolics	mg/ℓ	0.05	0.03	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	12,000	6,900	3,100
Specific Conductance	µmhos/cm @ 25°C	20,200	11,700	3,790
Sulfate	mg/ℓ SO_4^{-2}	1,500	670	1900
Metals:				
Aluminum	mg/ℓ	0.2	0.1	0.2
Arsenic	mg/ℓ	0.006	0.002	0.002
Barium	mg/ℓ	0.18	0.098	0.047
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	540	340	350
Chromium	mg/ℓ	0.004	0.008	<0.001
Cobalt	mg/ℓ	0.035/0.047	0.007	0.003
Copper	mg/ℓ	0.05	0.03	0.02
Iron	mg/ℓ	0.06	0.06	0.02
Lead	mg/ℓ	0.12	0.02	<0.01
Magnesium	mg/ℓ	72	40	34
Manganese	mg/ℓ	1.2	0.72	0.64
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.032	0.020	0.022
Nickel	mg/ℓ	0.12	0.08	<0.01
Potassium	mg/ℓ	35	23	16
Selenium	mg/ℓ	0.023	0.021	0.023
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,800	2,000	580
Zinc	mg/ℓ	0.03	0.01	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4812S-4818	4812S-4819	4812S-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	200	1,400	860
Chloride	mg/ℓ	29	390	320
Cyanide	mg/ℓ	0.02	0.02	0.02
Fluoride	mg/ℓ	1.3	1.8	2.2
Nitrate	mg/ℓ NO_3-N	12	16	12
pH	--	8.20	8.10	8.30
Phenolics	mg/ℓ	0.01	0.01	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	2,900	5,300	4,800
Specific Conductance	µmhos/cm @ 25°C	4,130	7,700	6,840
Sulfate	mg/ℓ SO_4^{-2}	1,900	1,000	1,800
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	0.1
Arsenic	mg/ℓ	0.002	0.001	0.003
Barium	mg/ℓ	0.053	0.093	0.037
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	160	140	110
Chromium	mg/ℓ	<0.001	0.004	0.005
Cobalt	mg/ℓ	0.011	0.004	0.012
Copper	mg/ℓ	0.02	0.02	0.02
Iron	mg/ℓ	0.02	0.06	0.08
Lead	mg/ℓ	0.02	0.02	0.03
Magnesium	mg/ℓ	23	25	19
Manganese	mg/ℓ	0.60	0.19	0.26
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.012	0.002	0.007
Nickel	mg/ℓ	<0.01	0.02	<0.01
Potassium	mg/ℓ	19	18	16
Selenium	mg/ℓ	0.019	0.026	0.020
Silver	mg/ℓ	0.002	0.002	0.002
Sodium	mg/ℓ	750	1,500	1,300
Zinc	mg/ℓ	0.05	0.06	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4812S-4821	4812S-4822	4812S-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	440	630	260
Chloride	mg/ℓ	5,600	2,100	13
Cyanide	mg/ℓ	0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.7	1.9	1.4
Nitrate	mg/ℓ NO_3-N	23	17	52
pH	--	7.90	8.20	8.10
Phenolics	mg/ℓ	<0.01	0.16	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	11,400	5,100	1,700
Specific Conductance	µmhos/cm @ 25°C	17,900	8,950	2,230
Sulfate	mg/ℓ SO_4^{-2}	1,600	300	650
Metals:				
Aluminum	mg/ℓ	<0.1	0.3	<0.1
Arsenic	mg/ℓ	0.006	<0.001	0.001
Barium	mg/ℓ	0.37	0.078	0.098
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	0.002	<0.001	<0.001
Calcium	mg/ℓ	470	60	50
Chromium	mg/ℓ	<0.001	0.005	0.001
Cobalt	mg/ℓ	0.13	0.002	<0.001
Copper	mg/ℓ	0.03	0.06	<0.01
Iron	mg/ℓ	0.06	0.06	0.02
Lead	mg/ℓ	0.18	0.01	<0.01
Magnesium	mg/ℓ	65	15	6.3
Manganese	mg/ℓ	0.76	0.17	0.11
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.008	0.008	0.013
Nickel	mg/ℓ	0.07	0.03	<0.01
Potassium	mg/ℓ	34	18	8.9
Selenium	mg/ℓ	0.032	0.024	0.026
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,100	1,500	420
Zinc	mg/ℓ	0.04	0.05	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4813C-4818	4813C-4819	4813C-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	210/180	1,600	690
Chloride	mg/ℓ	37/16	400	310
Cyanide	mg/ℓ	<0.02/<0.02	<0.02	0.04
Fluoride	mg/ℓ	1.0/1.0	2.2	1.4
Nitrate	mg/ℓ NO_3-N	9.5/11	4.0	7.2
pH	--	7.70/7.90	8.40	8.00
Phenolics	mg/ℓ	0.03/0.02	0.10	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	5,300/5,200	6,000	6,900
Specific Conductance	µmhos/cm @ 25°C	5,970/6,800	8,370	9,560
Sulfate	mg/ℓ SO_4^{-2}	3,200/3,400	2,300	3,800
Metals:				
Aluminum	mg/ℓ	0.2/0.1	3.6	0.1
Arsenic	mg/ℓ	0.003/0.002	0.004	0.005
Barium	mg/ℓ	0.076/0.049	0.025	0.052
Boron	mg/ℓ	<0.5/<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	670/680	100	500
Chromium	mg/ℓ	0.027/0.006	0.008	0.004
Cobalt	mg/ℓ	0.015/0.012	0.023	0.042
Copper	mg/ℓ	<0.01/0.02	0.02	0.02
Iron	mg/ℓ	0.02/0.02	0.13	0.02
Lead	mg/ℓ	0.01/0.01	0.02	0.04
Magnesium	mg/ℓ	47/45	24	31
Manganese	mg/ℓ	1.4/1.2	0.08	0.90
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.020/0.017	0.007	0.015
Nickel	mg/ℓ	0.02/0.02	0.04	0.06
Potassium	mg/ℓ	32/30	30	30
Selenium	mg/ℓ	0.018/0.013	0.004	0.004
Silver	mg/ℓ	0.002/<0.001	0.002	0.002
Sodium	mg/ℓ	850/870	1,500	1,300
Zinc	mg/ℓ	0.05/0.05	0.03	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4813C-4821	4813C-4822	4813C-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	350	460	110
Chloride	mg/ℓ	5,700	2,200	20
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	0.9	1.3	1.2
Nitrate	mg/ℓ NO_3-N	15	5.3	4.3
pH	--	7.90	8.20	7.90
Phenolics	mg/ℓ	0.03	0.03	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	12,000	7,600	3,700
Specific Conductance	µmhos/cm @ 25°C	19,800	12,100	4,330
Sulfate	mg/ℓ SO_4^{-2}	2,000	2,300	2,400
Metals:				
Aluminum	mg/ℓ	0.1	<0.1	0.1
Arsenic	mg/ℓ	0.009	0.003	<0.001
Barium	mg/ℓ	0.095	0.093	0.077
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	790	470	530
Chromium	mg/ℓ	0.002	0.002	0.004
Cobalt	mg/ℓ	0.052	0.028	0.005
Copper	mg/ℓ	0.02	<0.01	0.14
Iron	mg/ℓ	0.04	<0.01	0.02
Lead	mg/ℓ	0.15	0.04	<0.01
Magnesium	mg/ℓ	62	33	28
Manganese	mg/ℓ	1.3	0.51	0.78
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.016	0.014	0.020
Nickel	mg/ℓ	0.08	<0.01	<0.01
Potassium	mg/ℓ	49	40	26
Selenium	mg/ℓ	0.016	0.012	0.006
Silver	mg/ℓ	<0.001	0.002	<0.001
Sodium	mg/ℓ	3,100	2,100	610
Zinc	mg/ℓ	0.06/0.06	0.03	0.11/0.10

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4813S-4818	4813S-4819	4813S-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	200/190	1,800	690
Chloride	mg/ℓ	43/51	410	340
Cyanide	mg/ℓ	0.03/0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.6/0.7	0.9	0.9
Nitrate	mg/ℓ NO_3-N	11/11	11	19
pH	--	7.85/8.00	8.15	7.80
Phenolics	mg/ℓ	0.02/<0.01	<0.01	0.01
Residue:				
Filterable @ 180°C	mg/ℓ	4,600/4,000	8,800	6,700
Specific Conductance	µmhos/cm @ 25°C	5,450/5,120	7,490	8,230
Sulfate	mg/ℓ SO_4^{-2}	2,700/2,800	1,300	3,000
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	0.7	<0.1
Arsenic	mg/ℓ	0.002/0.002	0.003	0.005
Barium	mg/ℓ	0.038/0.048	0.069	0.046
Boron	mg/ℓ	<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	640/530	210	460
Chromium	mg/ℓ	<0.001/0.003	0.006	0.001
Cobalt	mg/ℓ	0.006/0.007	0.009	0.024
Copper	mg/ℓ	0.02/<0.01	0.06	<0.01
Iron	mg/ℓ	0.06/0.04	0.31	0.04
Lead	mg/ℓ	<0.01/<0.01	<0.01	0.02
Magnesium	mg/ℓ	37/33	21	27
Manganese	mg/ℓ	0.70/0.86	0.32	0.62
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.004/0.005	0.003	0.003
Nickel	mg/ℓ	<0.01/<0.01	0.06	0.03
Potassium	mg/ℓ	31/30	28	32
Selenium	mg/ℓ	0.020/0.020	0.018	0.012
Silver	mg/ℓ	0.002/0.002	0.002	0.002
Sodium	mg/ℓ	850/830	1,500	1,400
Zinc	mg/ℓ	0.04/0.04	0.05	0.04

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4813S-4821	4813S-4822	4813S-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	420/780	500	160
Chloride	mg/ℓ	5,500/5,600	2,400	19
Cyanide	mg/ℓ	0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.5/0.5	0.7	0.5
Nitrate	mg/ℓ NO_3-N	20/18	11	1.0
pH	--	8.00/7.60	7.85	7.90
Phenolics	mg/ℓ	0.01/0.01	0.04	<0.01
Residue:				
Filterable @ 180°C	mg/ℓ	12,000/13,000	6,800	3,500
Specific Conductance	µmhos/cm @ 25°C	19,100/20,600	9,390	4,140
Sulfate	mg/ℓ SO_4^{-2}	1,300/2,000	1,500	2,000
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	<0.1	<0.1
Arsenic	mg/ℓ	0.005/0.006	<0.001	<0.001
Barium	mg/ℓ	0.079/0.083	0.051	0.072
Boron	mg/ℓ	0.6/<0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/0.002	<0.001	<0.001
Calcium	mg/ℓ	730/800	410	520
Chromium	mg/ℓ	0.001/<0.001	0.003	0.001
Cobalt	mg/ℓ	0.092	0.017	0.005
Copper	mg/ℓ	0.02/0.02	<0.01	<0.01
Iron	mg/ℓ	0.06/0.06	0.04	0.04
Lead	mg/ℓ	0.19/0.22	0.03	<0.01
Magnesium	mg/ℓ	53/56	27	25
Manganese	mg/ℓ	0.85/0.89	0.46	0.56
Mercury	mg/ℓ	<0.0002/<0.0002	0.0002	0.0004
Molybdenum	mg/ℓ	0.007/0.006	0.003	0.004
Nickel	mg/ℓ	0.08/0.14	0.04	<0.01
Potassium	mg/ℓ	50/50	35	26
Selenium	mg/ℓ	0.020/0.024	0.022	0.022
Silver	mg/ℓ	<0.001/<0.001	<0.001	0.002
Sodium	mg/ℓ	3,200/3,200	1,700	600
Zinc	mg/ℓ	0.04/0.04	0.04	0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4814C-4818	4814C-4819	4814C-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140	1,900	740
Chloride	mg/ℓ	29	360	300
Cyanide	mg/ℓ	<0.02	<0.02	0.08
Fluoride	mg/ℓ	1.8	2.1	2.1
Nitrate	mg/ℓ NO_3-N	14	12	12
pH	--	8.10	8.80	8.05
Phenolics	mg/ℓ	<0.01	0.05	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	4,500	4,900	6,500
Specific Conductance	μmhos/cm @ 25°C	5,210	6,860	9,040
Sulfate	mg/ℓ SO_4^{-2}	3,000	1,400	3,600
Metals:				
Aluminum	mg/ℓ	0.1	1.0	0.2
Arsenic	mg/ℓ	0.003	0.002	0.005
Barium	mg/ℓ	0.080	0.065	0.075
Boron	mg/ℓ	<0.5	0.8	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	550	110	410
Chromium	mg/ℓ	0.002	0.016	0.002
Cobalt	mg/ℓ	0.011	0.008	0.034
Copper	mg/ℓ	0.04	0.07	0.06
Iron	mg/ℓ	0.08	0.27	0.08
Lead	mg/ℓ	0.01	0.01	0.03
Magnesium	mg/ℓ	43	17	33
Manganese	mg/ℓ	0.39	0.08	0.46
Mercury	mg/ℓ	0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.023	0.010	0.020
Nickel	mg/ℓ	<0.01	0.04	0.06
Potassium	mg/ℓ	29	21	29
Selenium	mg/ℓ	0.010	0.003	0.002
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	800	1,300	1,300
Zinc	mg/ℓ	0.05	0.04	0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4814C-4821	4814C-4822	4814C-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	440	450	90
Chloride	mg/ℓ	5,600	2,100	16
Cyanide	mg/ℓ	0.06	<0.02	<0.02
Fluoride	mg/ℓ	1.3	1.7	1.9
Nitrate	mg/ℓ NO_3-N	17	13	7.8
pH	--	7.95	8.20	7.80
Phenolics	mg/ℓ	0.02	0.02	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	12,000	5,800	3,700
Specific Conductance	µmhos/cm @ 25°C	21,500	10,200	4,670
Sulfate	mg/ℓ SO_4^{-2}	2,000	1,500	2,200
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	0.2
Arsenic	mg/ℓ	0.008	0.002	<0.001
Barium	mg/ℓ	0.20	0.098	0.11
Boron	mg/ℓ	0.9	0.8	0.6
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	740	310	520
Chromium	mg/ℓ	0.004	0.016	0.002
Cobalt	mg/ℓ	0.096	0.009	0.005
Copper	mg/ℓ	0.06	0.05	0.05
Iron	mg/ℓ	0.09	0.06	0.06
Lead	mg/ℓ	0.20	0.02	<0.01
Magnesium	mg/ℓ	67	30	30
Manganese	mg/ℓ	0.64	0.23	0.12
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.030	0.022	0.042
Nickel	mg/ℓ	0.12	0.04	0.02
Potassium	mg/ℓ	44	29	24
Selenium	mg/ℓ	0.009	0.008	0.003
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,700	1,600	560
Zinc	mg/ℓ	0.03	<0.01	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4814S-4818	4814S-4819	4814S-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	180	1,700	670
Chloride	mg/ℓ	27	300	320
Cyanide	mg/ℓ	<0.02	<0.02	0.05
Fluoride	mg/ℓ	0.9	0.9	1.3
Nitrate	mg/ℓ NO_3-N	13	13	12
pH	--	8.20	8.60	8.25
Phenolics	mg/ℓ	0.01	0.06	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	3,500	3,800	5,300
Specific Conductance	µmhos/cm @ 25°C	4,300	5,480	6,960
Sulfate	mg/ℓ SO_4^{-2}	2,300	500	2,100
Metals:				
Aluminum	mg/ℓ	<0.1	<0.1	2.5
Arsenic	mg/ℓ	0.002	0.001	0.003
Barium	mg/ℓ	0.055	0.076	0.048
Boron	mg/ℓ	<0.5	0.6	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	320	100	240
Chromium	mg/ℓ	<0.001	0.006	0.024
Cobalt	mg/ℓ	0.008	0.006	0.022
Copper	mg/ℓ	0.04	0.07	<0.01
Iron	mg/ℓ	0.02	0.06	0.20
Lead	mg/ℓ	<0.01	<0.01	0.02
Magnesium	mg/ℓ	30	17	25
Manganese	mg/ℓ	0.26	0.08	0.12
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.003	0.005	0.005
Nickel	mg/ℓ	0.01	0.03	<0.01
Potassium	mg/ℓ	26	22	27
Selenium	mg/ℓ	0.018	0.020	0.014
Silver	mg/ℓ	0.002	<0.001	0.002
Sodium	mg/ℓ	750	1,400	1,300
Zinc	mg/ℓ	<0.01	0.04	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4814S-4821	4814S-4822	4814S-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	470/440	480	120
Chloride	mg/ℓ	5,600/5,600	2,200	16
Cyanide	mg/ℓ	0.02/<0.02	0.03	<0.02
Fluoride	mg/ℓ	0.6/0.6	1.0	1.0
Nitrate	mg/ℓ NO_3-N	21/25	15	6.0
pH	--	8.25/8.20	8.40	7.85
Phenolics	mg/ℓ	0.09/0.03	0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	11,000/11,000	6,000	2,000
Specific Conductance	μmhos/cm @ 25°C	18,200/17,500	9,310	2,760
Sulfate	mg/ℓ SO_4^{-2}	1,300/800	1,100	1,200
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	<0.1	<0.1
Arsenic	mg/ℓ	0.006/0.005	0.001	0.001
Barium	mg/ℓ	0.15/0.12	0.075	0.041
Boron	mg/ℓ	0.6/0.5	<0.5	<0.5
Cadmium	mg/ℓ	<0.001/0.002	<0.001	<0.001
Calcium	mg/ℓ	530/520	210	110
Chromium	mg/ℓ	0.001/0.001	0.021	0.002
Cobalt	mg/ℓ	0.079/0.070	0.002	0.009
Copper	mg/ℓ	0.02/0.02	<0.01	<0.01
Iron	mg/ℓ	0.07/0.07	0.11	0.02
Lead	mg/ℓ	0.28/0.25	<0.01	<0.01
Magnesium	mg/ℓ	57/57	25	11
Manganese	mg/ℓ	0.37/0.37	0.14	0.06
Mercury	mg/ℓ	<0.0002/<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.009/0.010	0.005	0.006
Nickel	mg/ℓ	0.09/0.08	0.01	<0.01
Potassium	mg/ℓ	43/45	28	15
Selenium	mg/ℓ	0.022/0.024	0.018	0.020
Silver	mg/ℓ	<0.001/<0.001	0.002	0.002
Sodium	mg/ℓ	3,200/3,100	1,600	520
Zinc	mg/ℓ	0.03/0.04	0.03	0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4815C-4818	4815C-4819	4815C-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140	2,300	740
Chloride	mg/ℓ	25	190	320
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	3.0	3.0	2.9
Nitrate	mg/ℓ NO_3-N	2.2	2.4	2.2
pH	--	7.85	8.55	8.45
Phenolics	mg/ℓ	0.03	0.02	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	3,000	4,100	4,900
Specific Conductance	µmhos/cm @ 25°C	4,300	6,490	6,660
Sulfate	mg/ℓ SO_4^{-2}	1,700	500	2,100
Metals:				
Aluminum	mg/ℓ	3.3	11	0.6
Arsenic	mg/ℓ	0.003	0.003	0.004
Barium	mg/ℓ	0.036	0.088	0.053
Boron	mg/ℓ	<0.5	0.9	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	110	32	80
Chromium	mg/ℓ	0.010	0 018	0.018
Cobalt	mg/ℓ	0.016	<0.001	0.043
Copper	mg/ℓ	0.03	0.02	0.02
Iron	mg/ℓ	0.38	0.54	0.62
Lead	mg/ℓ	0.02	0.01	0.04
Magnesium	mg/ℓ	8.6	5.8	7.4
Manganese	mg/ℓ	0.10	0.06	0.10
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.026	0.027	0.018
Nickel	mg/ℓ	<0.01	<0.01	<0.01
Potassium	mg/ℓ	18	16	17
Selenium	mg/ℓ	0.013	0.008	0.004
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	820	1,300	1,200
Zinc	mg/ℓ	0.03	0.03	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4815C-4818	4815C-4819	4815C-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	140	2,300	740
Chloride	mg/ℓ	25	190	320
Cyanide	mg/ℓ	<0.02	0.04	<0.02
Fluoride	mg/ℓ	3.0	3.0	2.9
Nitrate	mg/ℓ NO_3-N	2.2	2.4	2.2
pH	--	7.85	8.55	8.45
Phenolics	mg/ℓ	0.03	0.02	0.04
Residue:				
Filterable @ 180°C	mg/ℓ	3,000	4,100	4,900
Specific Conductance	µmhos/cm @ 25°C	4,300	6,490	6,660
Sulfate	mg/ℓ SO_4^{-2}	1,700	500	2,100
Metals:				
Aluminum	mg/ℓ	3.3	11	0.6
Arsenic	mg/ℓ	0.003	0.003	0.004
Barium	mg/ℓ	0.036	0.088	0.053
Boron	mg/ℓ	<0.5	0.9	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	110	32	80
Chromium	mg/ℓ	0.010	0 018	0.018
Cobalt	mg/ℓ	0.016	<0.001	0.043
Copper	mg/ℓ	0.03	0.02	0.02
Iron	mg/ℓ	0.38	0.54	0.62
Lead	mg/ℓ	0.02	0.01	0.04
Magnesium	mg/ℓ	8.6	5.8	7.4
Manganese	mg/ℓ	0.10	0.06	0.10
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.026	0.027	0.018
Nickel	mg/ℓ	<0.01	<0.01	<0.01
Potassium	mg/ℓ	18	16	17
Selenium	mg/ℓ	0.013	0.008	0.004
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	820	1,300	1,200
Zinc	mg/ℓ	0.03	0.03	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4815C-4821	4815C-4822	4815C-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1/<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	380/420	490	120
Chloride	mg/ℓ	5,400/5,200	2,100	20
Cyanide	mg/ℓ	<0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.4/1.9	2.3	4.3
Nitrate	mg/ℓ NO_3-N	19/16	5.0	<0.1
pH	--	7.80/7.90	8.30	7.70
Phenolics	mg/ℓ	0.02/0.05	<0.01	0.01
Residue:				
Filterable @ 180°C	mg/ℓ	10,000/10,000	5,200	1,700
Specific Conductance	µmhos/cm @ 25°C	20,100/18,000	9,050	2,650
Sulfate	mg/ℓ SO_4^{-2}	1,700/1,900	400	1,000
Metals:				
Aluminum	mg/ℓ	<0.1/<0.1	1.0	4.0
Arsenic	mg/ℓ	0.008/0.003	0.002	0.014
Barium	mg/ℓ	0.17/0.13	0.090	0.12
Boron	mg/ℓ	1.0/1.0	0.8	0.5
Cadmium	mg/ℓ	<0.001/<0.001	<0.001	<0.001
Calcium	mg/ℓ	220/250	50	37
Chromium	mg/ℓ	0.002/<0.001	<0.001	0.032
Cobalt	mg/ℓ	0.013/0.011	<0.001	<0.001
Copper	mg/ℓ	0.02/<0.01	0.03	0.02
Iron	mg/ℓ	0.06/0.04	0.56	1.0
Lead	mg/ℓ	0.18/0.11	0.02	0.01
Magnesium	mg/ℓ	30/28	7.1	2.5
Manganese	mg/ℓ	0.18/0.20	0.10	0.07
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.050/0.029	0.016	0.020
Nickel	mg/ℓ	0.03/0.04	<0.01	<0.01
Potassium	mg/ℓ	38/28	18	9.2
Selenium	mg/ℓ	0.018/0.011	0.006	0.013
Silver	mg/ℓ	<0.001/0.002	<0.001	0.002
Sodium	mg/ℓ	3,100/2,400	1,500	500
Zinc	mg/ℓ	0.03/0.02	0.06	0.08

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4815S-4818	4815S-4819	4815S-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	230	2,700/2,700	860
Chloride	mg/ℓ	27	410/410	160
Cyanide	mg/ℓ	0.02	<0.02/<0.02	<0.02
Fluoride	mg/ℓ	1.3	2.3/2.0	1.8
Nitrate	mg/ℓ NO_3-N	12	2.4/2.2	3.6
pH	--	8.20	9.10/8.60	8.90
Phenolics	mg/ℓ	0.02	0.01/0.01	0.12
Residue:				
Filterable @ 180°C	mg/ℓ	2,500	4,200/4,300	4,100
Specific Conductance	µmhos/cm @ 25°C	3,760	5,980/6,280	6,170
Sulfate	mg/ℓ SO_4^{-2}	1,300	200/100	1,600
Metals:				
Aluminum	mg/ℓ	1.9	1.3/1.8	1.0
Arsenic	mg/ℓ	0.002	0.003/0.010	0.003
Barium	mg/ℓ	0.040	0.092/0.142	0.029
Boron	mg/ℓ	<0.5	0.8/0.7	<0.5
Cadmium	mg/ℓ	<0.001	<0.001/<0.001	<0.001
Calcium	mg/ℓ	41	11/17	30
Chromium	mg/ℓ	0.035	0.028/0.030	0.031
Cobalt	mg/ℓ	0.005	<0.001/0.003	0.008
Copper	mg/ℓ	0.02	<0.01/0.11	0.02
Iron	mg/ℓ	0.59	1.1/0.16	1.2
Lead	mg/ℓ	<0.01	<0.01/<0.01	<0.01
Magnesium	mg/ℓ	5.3	5.5/4.7	5.6
Manganese	mg/ℓ	0.08	0.04/0.05	0.12
Mercury	mg/ℓ	<0.0002	0.0005	<0.0002
Molybdenum	mg/ℓ	0.008	0.021/0.025	<0.001
Nickel	mg/ℓ	<0.01	<0.01/0.01	0.01
Potassium	mg/ℓ	14	17/15	16
Selenium	mg/ℓ	0.020	0.018/0.018	0.012
Silver	mg/ℓ	0.002	<0.001/<0.001	0.002
Sodium	mg/ℓ	740	1,500/1,300	1,100
Zinc	mg/ℓ	0.06	0.09/0.08	0.05

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4815S-4821	4815S-4822	4815S-DI
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	420	570	200
Chloride	mg/ℓ	5,200	1,900	20
Cyanide	mg/ℓ	<0.02	0.03	<0.02
Fluoride	mg/ℓ	0.7	1.6	1.2
Nitrate	mg/ℓ NO_3-N	21	2.2	<0.1
pH	—	7.90	8.50	8.15
Phenolics	mg/ℓ	0.02	0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	9,800	4,300	1,300
Specific Conductance	µmhos/cm @ 25°C	17,600	8,070	1,000
Sulfate	mg/ℓ SO_4^{-2}	200	150	100
Metals:				
Aluminum	mg/ℓ	0.9	4.4	3.4
Arsenic	mg/ℓ	0.006	0.001	0.006
Barium	mg/ℓ	0.18	0.14	0.026
Boron	mg/ℓ	0.7	0.5	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	150	16	2
Chromium	mg/ℓ	0.003	0.034	0.018
Cobalt	mg/ℓ	0.052	0.002	0.008
Copper	mg/ℓ	0.02/<0.01	0.04	0.02
Iron	mg/ℓ	0.06	1.4	5.2
Lead	mg/ℓ	0.10	<0.01	<0.01
Magnesium	mg/ℓ	27	3.9	0.9
Manganese	mg/ℓ	0.17	0.06	0.06
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.046	0.030	0.037
Nickel	mg/ℓ	0.02	<0.01	<0.01
Potassium	mg/ℓ	35	16	3.9
Selenium	mg/ℓ	0.034	0.014	0.026
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	3,000	1,200	230
Zinc	mg/ℓ	0.03	0.08	0.10

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4816C-4818	4816C-4819	4816C-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	130	2,300	730
Chloride	mg/ℓ	22	360	290
Cyanide	mg/ℓ	0.05	0.02	<0.02
Fluoride	mg/ℓ	2.3	2.6	3.0
Nitrate	mg/ℓ NO_3-N	10	4.3	5.4
pH	--	7.80	8.25	7.90
Phenolics	mg/ℓ	0.05	0.03	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	3,700	5,000	5,400
Specific Conductance	µmhos/cm @ 25°C	4,300	7,920	8,070
Sulfate	mg/ℓ SO_4^{-2}	2,200	2,000	3,200
Metals:				
Aluminum	mg/ℓ	<0.1	1.4	<0.1
Arsenic	mg/ℓ	<0.001	0.001	<0.001
Barium	mg/ℓ	0.15	0.093	0.075
Boron	mg/ℓ	0.6	1.1	<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001
Calcium	mg/ℓ	500	110	320
Chromium	mg/ℓ	0.004	0.017	0.002
Cobalt	mg/ℓ	<0.001	<0.001	0.002
Copper	mg/ℓ	<0.01	0.06	<0.01
Iron	mg/ℓ	0.04	0.30	0.04
Lead	mg/ℓ	<0.01	0.02	0.03
Magnesium	mg/ℓ	75	37	56
Manganese	mg/ℓ	0.31	0.17	0.39
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.032	<0.001	0.023
Nickel	mg/ℓ	0.02	0.04	0.02
Potassium	mg/ℓ	17	17	18
Selenium	mg/ℓ	0.020	0.014	0.007
Silver	mg/ℓ	<0.001	<0.001	0.002
Sodium	mg/ℓ	550	1,400	1,200
Zinc	mg/ℓ	0.03	0.04	0.02

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4816C-4821	4816C-4822	4816C-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	740	480	80
Chloride	mg/ℓ	5,600	2,000	3.9
Cyanide	mg/ℓ	<0.02	0.03	0.03
Fluoride	mg/ℓ	1.9	2.6	2.4
Nitrate	mg/ℓ NO_3-N	16	11	8.5
pH	--	8.00	8.20	7.90
Phenolics	mg/ℓ	0.03	0.02	0.03
Residue:				
Filterable @ 180°C	mg/ℓ	11,000	6,000	2,100
Specific Conductance	µmhos/cm @ 25°C	20,500	9,600	2,470
Sulfate	mg/ℓ SO_4^{-2}	1,400	1,000	1,400
Metals:				
Aluminum	mg/ℓ	0.1	<0.1	<0.1
Arsenic	mg/ℓ	0.005	<0.001	<0.001
Barium	mg/ℓ	0.24	0.12	0.079
Boron	mg/ℓ	0.8	0.8	0.5
Cadmium	mg/ℓ	0.004	<0.001	<0.001
Calcium	mg/ℓ	540	240	340
Chromium	mg/ℓ	0.002	0.006	0.003
Cobalt	mg/ℓ	0.16	<0.001	<0.001
Copper	mg/ℓ	0.03	0.03	<0.01
Iron	mg/ℓ	0.06	0.06	0.04
Lead	mg/ℓ	0.29	0.03	<0.01
Magnesium	mg/ℓ	90	51	46
Manganese	mg/ℓ	0.53	0.28	0.27
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.034	0.016	0.047
Nickel	mg/ℓ	0.08	0.06	<0.01
Potassium	mg/ℓ	30	20	11
Selenium	mg/ℓ	0.019	0.013	0.020
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,700	1,400	250
Zinc	mg/ℓ	0.02	0.03	<0.01

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4816S-4818	4816S-4819	4816S-4820
General Chemistry:				
Acidity	mg/ℓ(1) $CaCO_3$	<1	<1	<1/<1
Alkalinity	mg/ℓ $CaCO_3$	150	2,600	860/780
Chloride	mg/ℓ	18	190	290/150
Cyanide	mg/ℓ	<0.02	<0.02	<0.02/<0.02
Fluoride	mg/ℓ	0.8	1.8	1.8/1.8
Nitrate	mg/ℓ NO_3-N	9.0	11	5.2/6.9
pH	--	8.10	8.60	8.70/8.40
Phenolics	mg/ℓ	0.04	0.01	0.03/0.01
Residue:				
Filterable @ 180°C	mg/ℓ	2,800	4,200	5,000/5,000
Specific Conductance	µmhos/cm @ 25°C	3,400	6,950	6,470/7,130
Sulfate	mg/ℓ SO_4^{-2}	1,800	400	2,500/2,500
Metals:				
Aluminum	mg/ℓ	<0.1	0.2	0.1/0.1
Arsenic	mg/ℓ	0.001	0.002	0.004/0.003
Barium	mg/ℓ	0.060	0.077	0.062/0.043
Boron	mg/ℓ	<0.5	0.5	<0.5/<0.5
Cadmium	mg/ℓ	<0.001	<0.001	<0.001/0.001
Calcium	mg/ℓ	320	60	190/190
Chromium	mg/ℓ	<0.001	0.002	0.004/<0.001
Cobalt	mg/ℓ	<0.001	<0.001	0.022/0.029
Copper	mg/ℓ	0.02	0.02	0.04/0.02
Iron	mg/ℓ	0.06	0.08	0.10/0.08
Lead	mg/ℓ	<0.01	<0.01	0.02/0.02
Magnesium	mg/ℓ	59	28	40/45
Manganese	mg/ℓ	0.08	0.04	0.26/0.15
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002/<0.0002
Molybdenum	mg/ℓ	0.002	0.005	0.004/0.006
Nickel	mg/ℓ	<0.01	<0.01	0.01/0.02
Potassium	mg/ℓ	14	15	17/17
Selenium	mg/ℓ	0.014	0.008	0.006/0.006
Silver	mg/ℓ	<0.001	<0.001	0.002/0.002
Sodium	mg/ℓ	530	1,400	1,200/1,200
Zinc	mg/ℓ	<0.01	<0.01	0.06/0.03

TABLE 1
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4816S-4821	4816S-4822	4816S-DI
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	540	560	76
Chloride	mg/ℓ	5,600	2,000	3.9
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	0.7	1.3	0.7
Nitrate	mg/ℓ NO_3-N	18	13	6.3
pH	--	8.05	8.20	8.25
Phenolics	mg/ℓ	0.04	<0.01	0.02
Residue:				
Filterable @ 180°C	mg/ℓ	11,000	5,100	1,300
Specific Conductance	µmhos/cm @ 25°C	17,800	9,020	1,780
Sulfate	mg/ℓ SO_4^{-2}	1,000	500	980
Metals:				
Aluminum	mg/ℓ	0.4	<0.1	<0.1
Arsenic	mg/ℓ	0.007	0.001	<0.001
Barium	mg/ℓ	0.16	0.063	0.046
Boron	mg/ℓ	0.6	<0.5	<0.5
Cadmium	mg/ℓ	0.001	<0.001	0.005
Calcium	mg/ℓ	340	80	130
Chromium	mg/ℓ	0.041	0.006	0.003
Cobalt	mg/ℓ	0.13	<0.001	<0.001
Copper	mg/ℓ	0.06	0.04	<0.01
Iron	mg/ℓ	0.10	0.07	0.07
Lead	mg/ℓ	0.21	0.02	<0.01
Magnesium	mg/ℓ	77	32	29
Manganese	mg/ℓ	0.38	0.13	0.09
Mercury	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.008	0.005	0.020
Nickel	mg/ℓ	0.04	<0.01	<0.01
Potassium	mg/ℓ	31	18	9.2
Selenium	mg/ℓ	0.018	0.011	0.014
Silver	mg/ℓ	<0.001	<0.001	<0.001
Sodium	mg/ℓ	3,000	1,500	250
Zinc	mg/ℓ	0.04	<0.01	<0.01

(1) mg/ℓ = milligrams per liter or parts per million.
(2) The indicated sample was analyzed in duplicate.

TABLE 2

EP TOXICITY LEACHATE SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4791, NO. 10	4800, NO. 11
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	960	960
Alkalinity	mg/ℓ $CaCO_3$	140	280
Chloride	mg/ℓ	5.9	3.9
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	1.2	1.2
Nitrate	mg/ℓ NO_3-N	2.0	2.0
pH	--	4.60	4.70
Phenolics	mg/ℓ	0.02	0.02
Residue:			
Filterable @ 180°C	mg/ℓ	4400	4800
Specific Conductance	µmhos/cm @ 25°C	3860	4000
Sulfate	mg/ℓ SO_4^{-2}	1,600	1,500
Metals:			
Aluminum	mg/ℓ	24	24
Arsenic	mg/ℓ	0.028/0.030[2]	0.019
Barium	mg/ℓ	0.27	0.29
Boron	mg/ℓ	7.9/7.8	6.5
Cadmium	mg/ℓ	0.005/0.005	0.004
Calcium	mg/ℓ	27	26
Chromium	mg/ℓ	0.064	0.044
Cobalt	mg/ℓ	0.003/0.005	0.003
Copper	mg/ℓ	0.09	0.08
Iron	mg/ℓ	7.7/7.7	6.8
Lead	mg/ℓ	<0.01/<0.01	<0.01
Magnesium	mg/ℓ	10	8.5/8.5
Manganese	mg/ℓ	2.2	3.1
Mercury	mg/ℓ	0.0003	0.0003
Molybdenum	mg/ℓ	0.24	0.16
Nickel	mg/ℓ	0.11/0.13	0.12
Potassium	mg/ℓ	1.3	1.0
Selenium	mg/ℓ	0.019/0.017	0.004
Silver	mg/ℓ	<0.001/<0.001	<0.001
Sodium	mg/ℓ	9.5	7.6
Zinc	mg/ℓ	0.18/0.18	0.15

TABLE 3
SOIL ANALYSIS SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4791, NO. 10	4800, NO. 11
General Chemistry:			
Acidity	mg/kg(1) $CaCO_3$	11,000	11,000
Alkalinity	mg/kg $CaCO_3$	4,600	6,600
Chloride	mg/kg	100	80
Cyanide	mg/kg	<0.5	<0.5
Fluoride	mg/kg	1.0	1.0
Nitrate	mg/kg NO_3-N	7.9	5.1
pH	--	4.65	4.80
Phenolics	mg/kg	1.6	0.75
Residue:			
Filterable @ 180°C	mg/kg	5,700	6,600
Specific Conductance	µmhos/cm @ 25°C	9,520	15,800
Sulfate	mg/kg SO_4^{-2}	1,600	1,400
Metals:			
Aluminum	mg/kg	10,000	12,000/12,000(2)
Arsenic	mg/kg	9.4/9.7	18
Barium	mg/kg	350	300
Boron	mg/kg	71	121
Cadmium	mg/kg	0.33/0.33	0.43
Calcium	mg/kg	67,000	20,000
Chromium	mg/kg	9.3/9.6	13
Cobalt	mg/kg	1.4/1.4	2.5
Copper	mg/kg	9.7	12
Iron	mg/kg	4,500/4,400	5,400
Lead	mg/kg	9.9	12
Magnesium	mg/kg	640	750
Manganese	mg/kg	120	100
Mercury (Total)	mg/kg	<0.10	<0.10
Molybdenum	mg/kg	4.3	6.1
Nickel	mg/kg	<1.0/<1.0	<1.0
Potassium	mg/kg	310	420
Selenium	mg/kg	0.28	7.2/7.7
Silver	mg/kg	0.10	0.10
Sodium	mg/kg	1,000	1,200
Zinc	mg/kg	16	23

TABLE 3
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4810, NO. 12	4817, CS
General Chemistry:			
Acidity	mg/kg[1] $CaCO_3$	11,000	32,000
Alkalinity	mg/kg $CaCO_3$	1,000	<5
Chloride	mg/kg	110	110
Cyanide	mg/kg	<0.5	<0.5
Fluoride	mg/kg	2.0	2.0
Nitrate	mg/kg NO_3-N	5.9	5.5
pH	--	4.60	4.40
Phenolics	mg/kg	0.75	0.95
Residue:			
Filterable @ 180°C	mg/kg	5,300	4,500
Specific Conductance	µmhos/cm @ 25°C	7,950	6,980
Sulfate	mg/kg SO_4^{-2}	2,000	2,200
Metals:			
Aluminum	mg/kg	10,000	11,000
Arsenic	mg/kg	15	17
Barium	mg/kg	150	140/150
Boron	mg/kg	91	<10
Cadmium	mg/kg	0.53	1.5
Calcium	mg/kg	27,000	46,000/46,000
Chromium	mg/kg	11	18
Cobalt	mg/kg	1.7	2.4
Copper	mg/kg	8.7	13/13
Iron	mg/kg	4,900	6,000
Lead	mg/kg	8.8	8.8
Magnesium	mg/kg	680/680	870
Manganese	mg/kg	68	76/77
Mercury (Total)	mg/kg	<0.10/<0.10	<0.10
Molybdenum	mg/kg	4.9	11
Nickel	mg/kg	<1.0	8.7
Potassium	mg/kg	310/310	390
Selenium	mg/kg	3.8	1.4
Silver	mg/kg	0.10	0.10
Sodium	mg/kg	880	950/950
Zinc	mg/kg	15	49/49

(1) mg/kg = milligrams per kilogram or parts per million.
(2) The indicated sample was analyzed in duplicate.

TABLE 3
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4810, NO. 12	4817, CS
General Chemistry:			
Acidity	mg/kg[1] $CaCO_3$	11,000	32,000
Alkalinity	mg/kg $CaCO_3$	1,000	<5
Chloride	mg/kg	110	110
Cyanide	mg/kg	<0.5	<0.5
Fluoride	mg/kg	2.0	2.0
Nitrate	mg/kg NO_3-N	5.9	5.5
pH	--	4.60	4.40
Phenolics	mg/kg	0.75	0.95
Residue:			
Filterable @ 180°C	mg/kg	5,300	4,500
Specific Conductance	µmhos/cm @ 25°C	7,950	6,980
Sulfate	mg/kg SO_4^{-2}	2,000	2,200
Metals:			
Aluminum	mg/kg	10,000	11,000
Arsenic	mg/kg	15	17
Barium	mg/kg	150	140/150
Boron	mg/kg	91	<10
Cadmium	mg/kg	0.53	1.5
Calcium	mg/kg	27,000	46,000/46,000
Chromium	mg/kg	11	18
Cobalt	mg/kg	1.7	2.4
Copper	mg/kg	8.7	13/13
Iron	mg/kg	4,900	6,000
Lead	mg/kg	8.8	8.8
Magnesium	mg/kg	680/680	870
Manganese	mg/kg	68	76/77
Mercury (Total)	mg/kg	<0.10/<0.10	<0.10
Molybdenum	mg/kg	4.9	11
Nickel	mg/kg	<1.0	8.7
Potassium	mg/kg	310/310	390
Selenium	mg/kg	3.8	1.4
Silver	mg/kg	0.10	0.10
Sodium	mg/kg	880	950/950
Zinc	mg/kg	15	49/49

(1) mg/kg = milligrams per kilogram or parts per million.
(2) The indicated sample was analyzed in duplicate.

TABLE 4

GROUND WATER ANALYSIS SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4818	4819	4820
General Chemistry:				
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	88	3,100	940
Chloride	mg/ℓ	15	380	310
Cyanide	mg/ℓ	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.0	2.2	2.6
Nitrate	mg/ℓ NO_3-N	9.7	4.5	1.3
pH	—	7.80	8.80	8.70
Phenolics	mg/ℓ	<0.01	<0.01	0.01
Residue:				
Filterable @ 180°C	mg/ℓ	1,900	4,400	4,100
Specific Conductance	µmhos/cm @ 25°C	2,310	5,900	6,000
Sulfate	mg/ℓ SO_4^{-2}	1,200	22	1,500
Metals:				
Aluminum	mg/ℓ	0.69/0.75[2]	0.68	1.3
Arsenic	mg/ℓ	<0.001	0.004	0.008
Barium	mg/ℓ	0.03/0.02	1.5	0.06
Boron	mg/ℓ	0.31	0.97	0.20
Cadmium	mg/ℓ	<0.001	<0.001	0.002
Calcium	mg/ℓ	230	11	36
Chromium	mg/ℓ	0.002	0.001	0.006
Cobalt	mg/ℓ	<0.001/0.001	0.008	0.014
Copper	mg/ℓ	0.04	0.02	<0.01
Iron	mg/ℓ	0.45	2.8	3.7/3.8
Lead	mg/ℓ	<0.01/<0.01	0.03	0.02
Magnesium	mg/ℓ	28	3.6	4.5
Manganese	mg/ℓ	0.08	0.47	0.38
Mercury (Total)	mg/ℓ	<0.0002	<0.0002	<0.0002
Molybdenum	mg/ℓ	<0.001	0.005	0.003
Nickel	mg/ℓ	0.04	0.11	0.07
Potassium	mg/ℓ	11	7.2	8.4
Selenium	mg/ℓ	<0.001	0.006	0.014
Silver	mg/ℓ	<0.001	<0.001	0.001
Sodium	mg/ℓ	280	1,600	1,400
Zinc	mg/ℓ	0.06	0.07	0.08

TABLE 4
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4821	4822
General Chemistry:			
Acidity	mg/ℓ[1] $CaCO_3$	<1	<1
Alkalinity	mg/ℓ $CaCO_3$	510	940
Chloride	mg/ℓ	5,200	2,000
Cyanide	mg/ℓ	<0.02	<0.02
Fluoride	mg/ℓ	0.3	1.3
Nitrate	mg/ℓ NO_3-N	18	11
pH	--	8.20	9.50
Phenolics	mg/ℓ	0.04	0.02
Residue:			
Filterable @ 180°C	mg/ℓ	9,800	4,600
Specific Conductance	µmhos/cm @ 25°C	15,600	8,100
Sulfate	mg/ℓ SO_4^{-2}	120	55
Metals:			
Aluminum	mg/ℓ	<0.01	1.7
Arsenic	mg/ℓ	0.015	0.017
Barium	mg/ℓ	0.92	2.5
Boron	mg/ℓ	0.53	0.42
Cadmium	mg/ℓ	0.001	0.002
Calcium	mg/ℓ	140	140
Chromium	mg/ℓ	0.008	0.034
Cobalt	mg/ℓ	0.035/0.034	0.017
Copper	mg/ℓ	<0.01	0.04
Iron	mg/ℓ	0.15	5.6
Lead	mg/ℓ	0.12	0.08
Magnesium	mg/ℓ	32	11
Manganese	mg/ℓ	0.03	0.70/0.70
Mercury (Total)	mg/ℓ	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.025	0.008/0.006
Nickel	mg/ℓ	0.11	0.04/0.04
Potassium	mg/ℓ	19	12
Selenium	mg/ℓ	0.011	0.020
Silver	mg/ℓ	<0.001	0.015
Sodium	mg/ℓ	3,500	1,600
Zinc	mg/ℓ	0.21/0.22	0.09

(1) mg/ℓ = milligrams per liter or parts per million.
(2) The indicated sample was analyzed in duplicate.

TABLE 5

PHYSICAL CHARACTERIZATION SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

SAMPLE IDENTIFICATION	MOISTURE CONTENT %	PERCENT SOLIDS %	pH 1:1
4791	11.0	89.0	11.50
4800	11.6	88.4	12.00
4801	16.2	83.8	10.60
4817	16.7	83.3	9.20

TABLE 6

MATRIX SPIKE PERCENT RECOVERY SUMMARY
FOR UTAH INTERNATIONAL
PROJECT NO. 85-8019

PARAMETER	PERCENT RECOVERY
General Chemistry:	
Chloride	95.3%/98.0%/97.1%/95.3%/95.7% 97.1%/100%/96.7%/98.7%/91.4%
Cyanide	100%/128%/106%/94.4%/94.1%/91.8%/91.8%/ 90.6%/94.1%/97.0%/100%/100%/97.0%/93.9%
Fluoride	96.0%/100%/100%/96.0%/100%/96.0%/ 104%/84.0%/96.0%/84.0%/100%/100%
Phenolics	105%/105%/97.5%/102%/110%/100%/90.0%/97.5% 103%/98.5%/100%/101%/101%/100%/101%/101%
Sulfate	80.0%/105%/120%/120%/135%/135%/ 120%/90.0%/120%/120%/110%/120%
Metals:	
Aluminum	94.4%/102%/106%/103%/88.0%/100%/94.0%/ 84.0/%/93.0%/104%/79.0%/82.0%/94.0%/84.4%
Arsenic	92.0%/78.0%
Barium	101%/98.9%/100%/125%/109%/127%/115%/136%
Boron	92.0/88.0%/100%/92.0%/80.0%/ 60.0%/100%/82.0%/60.0%/60.0%
Cadmium	110%/90.0%
Calcium	102%/82.4%/113%/114%/111%/108%/ 108%115%/110%/112%/112%/107%
Chromium	78.0%
Cobalt	97.6%/84.0%/100%
Copper	100%/100%/100%
Iron	102%/95.6%/99.2%
Lead	48.0%/48.0%/60.0%
Manganese	130%/132%/131%
Magnesium	103%/101%/98.0%/100%/101%/103%/ 99.0%/99.0%/98.0%/98.0%/102%/103%
Mercury (Total)	94.2%
Molybdenum	92.0%/96.0%/100%
Nickel	100%/99.6%/99.6%
Potassium	101%/107%
Selenium	100%
Silver	96.0%
Sodium	100%/100%/99.0%/98.0%/101%/94.0%/ 95.0%/113%/97.0%/96.0%/96.0%/94.0%
Zinc	101%/98.0%/100%

TABLE 1

SOIL ANALYSIS SUMMARY
FOR IT CORPORATION/KNOXVILLE
PROJECT NO. 84-8045
JOB NO. 8549.02

PARAMETER	UNITS	SAMPLE IDENTIFICATION						
		D-1	D-2	S-1	S-2	S-3	S-4	S-5
Cation Exchange Capacity	$\frac{meq}{100\ g}$ (1)	39	24	52	52	44	59	53
Calcium	mg/kg (2)	3700	2800	6500	7000	5800	8600	7700
Magnesium	mg/kg	190	520	660	570	520	380	410
Potassium	mg/kg	240	100	240	220	170	310	290
Sodium	mg/kg	4400	1100	3100	2700	2400	2800	2400

(1) meq/100 g = milliequivalents per one hundred grams of sample.

(2) mg/kg = milligrams per kilogram or parts per million.

TABLE 2

EP TOXICITY LEACHATE SUMMARY
FOR IT CORPORATION/KNOXVILLE
PROJECT NO. 84-8045
JOB NO. 8549.02

		SAMPLE IDENTIFICATION			
PARAMETER	UNITS	4762	4763	4764	4765
Aluminum	mg/ℓ(1)	22	24	29	26
Arsenic	mg/ℓ	0.13/0.12(2)	0.08	0.12	0.21
Barium	mg/ℓ	0.14	0.30	0.20	0.40
Boron	mg/ℓ	4.2	6.6/7.0	5.4	4.4
Cadmium	mg/ℓ	0.03	0.03/0.03	0.03	0.04
Calcium	mg/ℓ	950	810	1000	1200
Chromium	mg/ℓ	0.09	0.10	0.11	0.08/0.08
Cobalt	mg/ℓ	0.003	0.005	0.003	0.003
Copper	mg/ℓ	0.11/0.11	0.12	0.12	0.13
Iron	mg/ℓ	10/10	13	15	7.2
Lead	mg/ℓ	0.30	0.27	0.32	0.34/0.35
Magnesium	mg/ℓ	7.8	8.7	9.4	12
Manganese	mg/ℓ	1.7/1.7	2.1	2.7	1.5
Mercury	mg/ℓ	0.0036	0.0025	0.0036	0.0029
Molybdenum	mg/ℓ	0.36/0.40	0.34	0.33	0.41
Nickel	mg/ℓ	0.16	0.13/0.13	0.15	0.16
Potassium	mg/ℓ	1.8	2.0	1.9	2.0
Selenium	mg/ℓ	0.20	0.20	0.18	0.18
Silver	mg/ℓ	0.04	0.04	0.05	0.05
Sodium	mg/ℓ	9.9	10	9.5	13
Uranium	mg/ℓ	0.029	0.035	0.041	0.030
Zinc	mg/ℓ	0.21	0.20	0.18	0.21

TABLE 2
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4770	4774	4785	4786
Aluminum	mg/ℓ(1)	23	26/26	25	20/20
Arsenic	mg/ℓ	0.20	0.23	0.26	0.28/0.30
Barium	mg/ℓ	0.48	0.49	0.39	0.41
Boron	mg/ℓ	5.1	3.7	4.2	3.5/3.9
Cadmium	mg/ℓ	0.03	0.04	0.04	0.04/0.03
Calcium	mg/ℓ	1000	1200	920	1000,1200
Chromium	mg/ℓ	0.05	0.09	0.07	0.06/0.06
Cobalt	mg/ℓ	0.001	0.002	0.004	0.003/0.004
Copper	mg/ℓ	0.10	0.11	0.12	0.11/0.10
Iron	mg/ℓ	5.1	9.9	8.7	4.8/4.7
Lead	mg/ℓ	0.33	0.36	0.37	0.28/0.27
Magnesium	mg/ℓ	15	9.7	8.1	12/11
Manganese	mg/ℓ	1.1	1.6	1.3	0.99/0.91
Mercury	mg/ℓ	0.0004	0.0046	0.0044	0.0037/0.0019
Molybdenum	mg/ℓ	0.31	0.44	0.44	0.34/0.35
Nickel	mg/ℓ	0.14	0.15	0.14	0.11/0.07
Potassium	mg/ℓ	1.8	1.6	1.6	1.7/2.0
Selenium	mg/ℓ	0.18	0.24	0.24	0.25/0.22
Silver	mg/ℓ	0.04	0.05	0.05	0.04/0.05
Sodium	mg/ℓ	11	11	11	11/11
Uranium	mg/ℓ	0.027	0.042	0.039	0.033/0.027
Zinc	mg/ℓ	0.17	0.19	0.17	0.16/0.16

TABLE 2
(Continued)

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4789	4790	BLANK 1	BLANK 2
Aluminum	mg/ℓ[1]	22	23/22	<1.0	<1.0
Arsenic	mg/ℓ	0.26	0.26/0.20	<0.01	<0.01
Barium	mg/ℓ	1.6/1.6	0.21/0.23	0.02	0.02
Boron	mg/ℓ	4.2	4.4	<0.1	<0.1
Cadmium	mg/ℓ	0.04	0.04/0.04	<0.01	<0.01
Calcium	mg/ℓ	1000	1100/1200	<1.0	<1.0
Chromium	mg/ℓ	0.05	0.06/0.08	0.01	0.01
Cobalt	mg/ℓ	0.003	0.004/0.003	<0.001	<0.001
Copper	mg/ℓ	0.11	0.12/0.10	0.03	0.03
Iron	mg/ℓ	6.1	4.9/6.7	0.02	0.03
Lead	mg/ℓ	0.32	0.31/0.29	<0.01	<0.01
Magnesium	mg/ℓ	13/13	11/11	0.03	0.04
Manganese	mg/ℓ	1.1	1.1/1.1	<0.01	<0.01
Mercury	mg/ℓ	0.0025	0.0030	<0.0002	<0.0002
Molybdenum	mg/ℓ	0.29	0.24/0.24	0.03	0.02
Nickel	mg/ℓ	0.14	0.10/0.08	0.01	<0.01
Potassium	mg/ℓ	2.4	2.0/1.7	<0.01	<0.01
Selenium	mg/ℓ	0.25	0.25/0.25	<0.01	<0.01
Silver	mg/ℓ	0.04	0.05/0.05	<0.01	<0.01
Sodium	mg/ℓ	11	11/10	0.13	0.17
Uranium	mg/ℓ	0.021	0.027/0.026	<0.001	<0.001
Zinc	mg/ℓ	0.17	0.16/0.15	0.03	<0.01

(1) mg/ℓ = milligrams per liter or parts per million.

(2) The indicated sample was analyzed in duplicate.

TABLE 3

TOTAL METAL ANALYSIS SUMMARY
FOR IT CORPORATION/KNOXVILLE
PROJECT NO. 84-8045
JOB NO. 8549.02

PARAMETER	UNITS	SAMPLE IDENTIFICATION 4789	4790
Aluminum	mg/kg[1]	10,000	9,800/9,800[2]
Arsenic	mg/kg	17	14
Barium	mg/kg	190	230
Boron	mg/kg	<10/<10	<10
Cadmium	mg/kg	0.24	0.24
Calcium	mg/kg	99,000/98,000	83,000/82,000
Chromium	mg/kg	12	13
Cobalt	mg/kg	8.5/8.5	7.5
Copper	mg/kg	13	13/13
Iron	mg/kg	4,400/4,400	4,500/4,500
Lead	mg/kg	5.0/5.9	5.9
Magnesium	mg/kg	820	820
Manganese	mg/kg	63/63	63
Mercury	mg/kg	0.30/0.37	0.25
Molybdenum	mg/kg	7.5	5.4
Nickel	mg/kg	6.3	4.3/5.3
Potassium	mg/kg	410	360/360
Selenium	mg/kg	6.4/6.6	7.8/7.6
Silver	mg/kg	0.15/0.15	0.15
Sodium	mg/kg	1,100/1,200	1,000
Zinc	mg/kg	22	22/22

(1) mg/kg = milligrams per kilogram or parts per million.

(2) The indicated sample was analyzed in duplicate.

TABLE 4

EP TOXICITY LEACHATE SUMMARY
FOR IT CORPORATION/KNOXVILLE
PROJECT NO. 84-8045
JOB NO. 8549.02

PARAMETER	UNITS(1)	SAMPLE IDENTIFICATION					
		4762	4763	4764	4765	4770	4774
Chloride	mg/ℓ	2.1	2.9	3.2	5.3/5.8(2)	5.1	6.1
Cyanide	mg/ℓ	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.9	1.8	1.5	2.2	2.7	1.8
Nitrate	mg/ℓ NO_3-N	0.2	0.2	0.3	0.3	0.5	0.3
Phenolics	mg/ℓ	0.04	0.04	0.03	0.03	0.03	0.29
Residue:							
Filterable @ 180°C	mg/ℓ	3900	3900	4300	4500	4100	4300
Sulfate	mg/ℓ SO_4^{-2}	1600	1400	1600	1900	1700	1800

TABLE 4
(Continued)

PARAMETER	UNITS[1]	SAMPLE IDENTIFICATION 4785	4786	4789	4790	BLANK 1	BLANK 2
Chloride	mg/ℓ	3.7	5.3/5.6	5.8	6.9/6.6	<0.5	<0.5
Cyanide	mg/ℓ	<0.02	<0.02/<0.02	<0.02	<0.02/<0.02	<0.02	<0.02
Fluoride	mg/ℓ	1.7	2.2/2.4	3.0	3.0/2.9	<0.1	<0.1
Nitrate	mg/ℓ NO_3-N	0.3	0.4/0.5	0.5	0.6/0.6	<0.1	<0.1
Phenolics	mg/ℓ	0.05	<0.01/<0.01	0.03	0.02/0.02	0.03	0.03
Residue:							
Filterable @ 180°C	mg/ℓ	4300	4000/3900	4100	4100/3600	25	22
Sulfate	mg/ℓ SO_4^{-2}	1900	1800/1800	1800	1800/1600	<1	<1

(1) mg/ℓ = milligrams per liter or parts per million.

(2) The indicated sample was analyzed in duplicate.

TABLE 5

SOIL ANALYSIS SUMMARY
FOR IT CORPORATION/KNOXVILLE
PROJECT NO. 84-8045
JOB NO. 8549.02

SAMPLE IDENTIFICATION	MOISTURE CONTENT %	PERCENT SOLIDS %	pH
4762	17.8	82.2	10.50
4763	24.2	75.8	9.25
4764	24.7	75.3	9.35
4765	21.8	78.2	9.40
4770	27.6	72.4	9.35
4774	19.2/20.8[1]	80.8/79.2	9.35
4785	15.9/14.6	84.1/85.4	9.35
4786	20.6	79.4	9.80
4789	24.5	75.5	9.15
4790	23.7	76.3	10.05

[1] The indicated sample was anayzed in duplicate.

Physical Testing Laboratory Data

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 5, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLES

This report includes the minimum index density test results of sample SS-1 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: S-1

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.55

Minimum Index: 75.9 $lbs./Ft^3$

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Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLE S-1

Length = 2.45 in. Weight = 1.028 lbs. Specific Gravity = 2.55

Diameter = 2.88 in. Moisture = 21.4 % Total Volume = 0.00924 Ft^3

$Weight_w$ = 1.028 lbs. - 0.847 = 0.181 lbs.

$Volume_w$ = 0.181 lbs./62.4 lbs./Ft^3 = 0.0029 Ft^3

$Volume_s$ = 0.847 lbs./(62.4 lbs./Ft^3) (2.55) = 0.00532 Ft^3

$Volume_a$ = 0.00924 Ft^3-(0.0029Ft^3 + 0.00532 Ft^3) = 0.00102 Ft^3

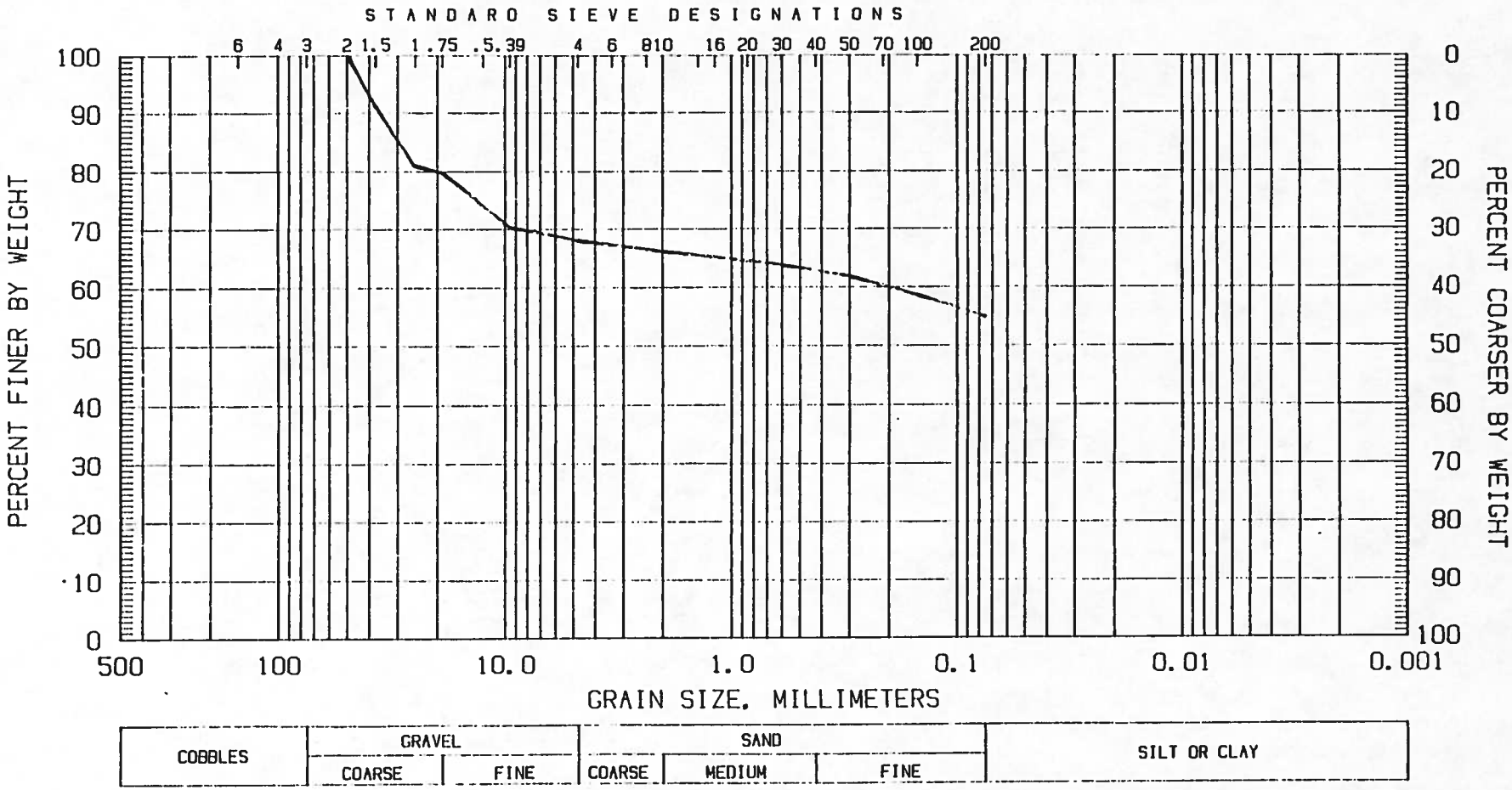
$Volume_v$ = 0.0029 Ft^3 + 0.00102 Ft^3 = 0.00392 Ft^3

$$e = \frac{0.00392}{0.00532} = 0.737$$

$$n = \frac{0.00392}{0.00924} = 42.4 \ \%$$

$$k = \frac{0.6114}{175177} = 3.5 \times 10^{-6} \text{ cm/sec (@ 96.1\% Compaction)}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 17, 1984

SAMPLE: S-1

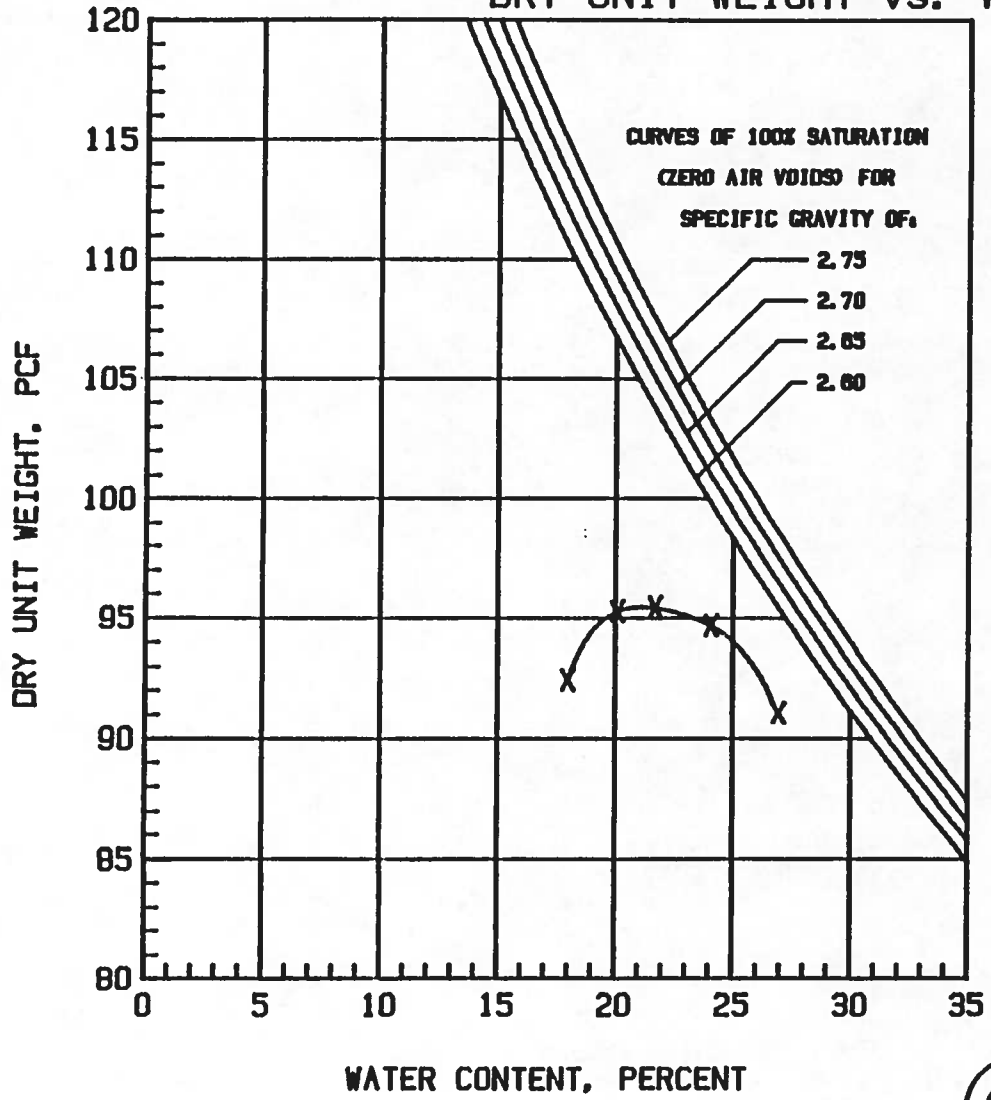
DEPTH: N/A FT

SPOIL
NATURAL MOISTURE CONTENT= 3.7 %

GEOLOGIC ASSOCIATES, INC.

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 17, 1984
CONTROL TEST NUMBER: 5

S-1/SPOIL
NATURAL MOISTURE CONTENT: 3.7 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
95.5 PCF	21.2 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

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Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 5, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLES

This report includes the minimum index density test results of sample SS-2 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: S-2

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.60

Minimum Index: 78.4 $lbs./Ft^3$

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REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLE S-2

Length = 3.15 in. Weight = 1.382 lbs. Specific Gravity = 2.60

Diameter = 2.88 in. Moisture = 22.1 % Total Volume = 0.01187 Ft^3

$Weight_w$ = 1.382 lbs.-1.132 lbs. = 0.250 lbs.

$Volume_w$ = 0.250 lbs./62.4 lbs./Ft^3 = 0.004 Ft^3

$Volume_s$ = 1.132 lbs./ (62.4 lbs./Ft^3) (2.60) = 0.00698 Ft^3

$Volume_a$ = 0.01187 Ft^3-(0.004 Ft^3+0.00698 Ft^3) = 0.00089 Ft^3

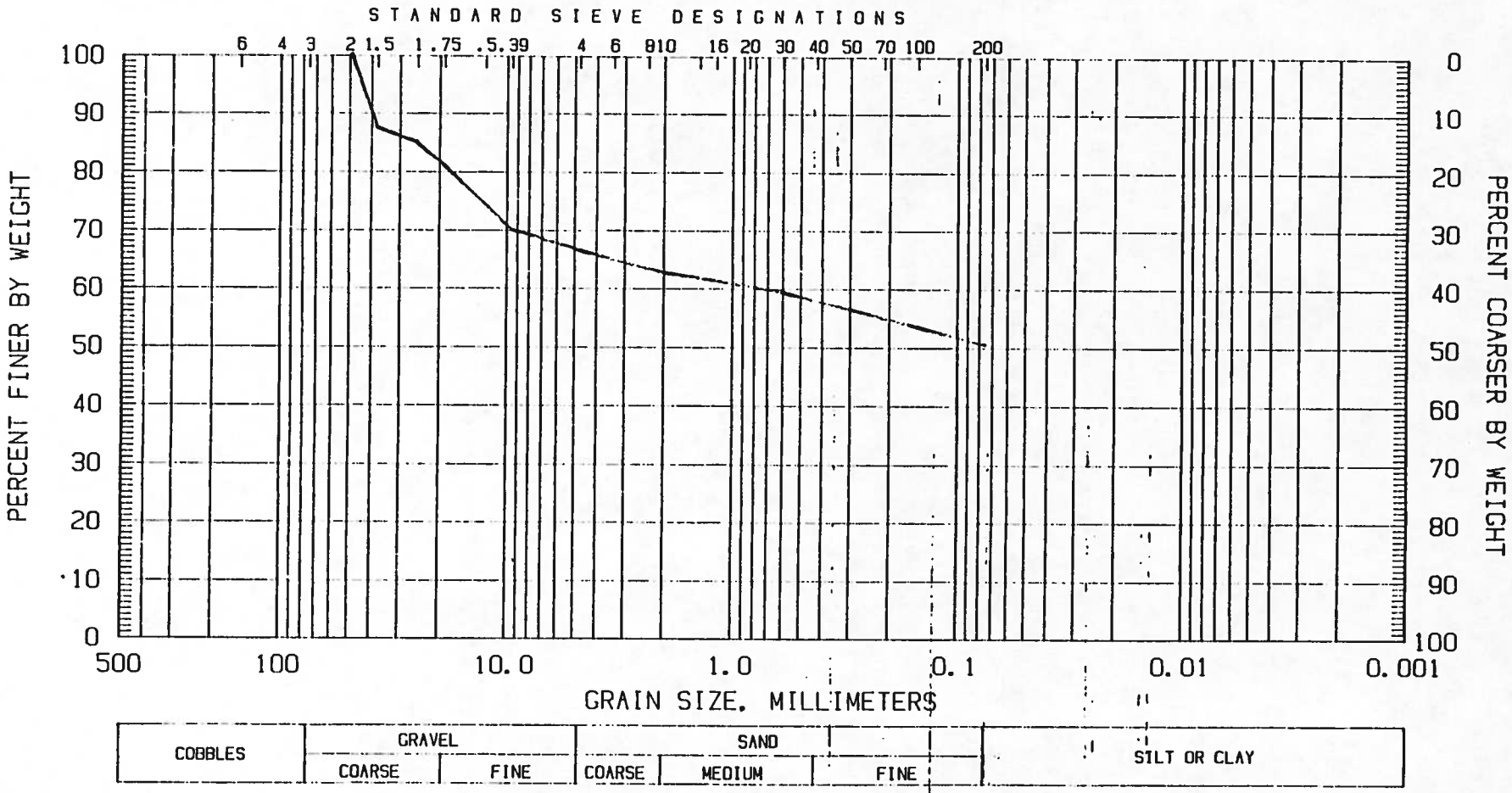
$Volume_v$ = 0.01187 Ft^3-0.00698 Ft^3 = 0.00489 Ft^3

$$e = \frac{0.00489}{0.00698} = 0.701$$

$$n = \frac{0.00489}{0.01187} = 41.2 \%$$

$$k = \frac{0.786}{473810.4} = 1.66 \times 10^{-6} \text{ cm/sec (@ 95.9\% Compaction)}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 17, 1984

SAMPLE: S-2

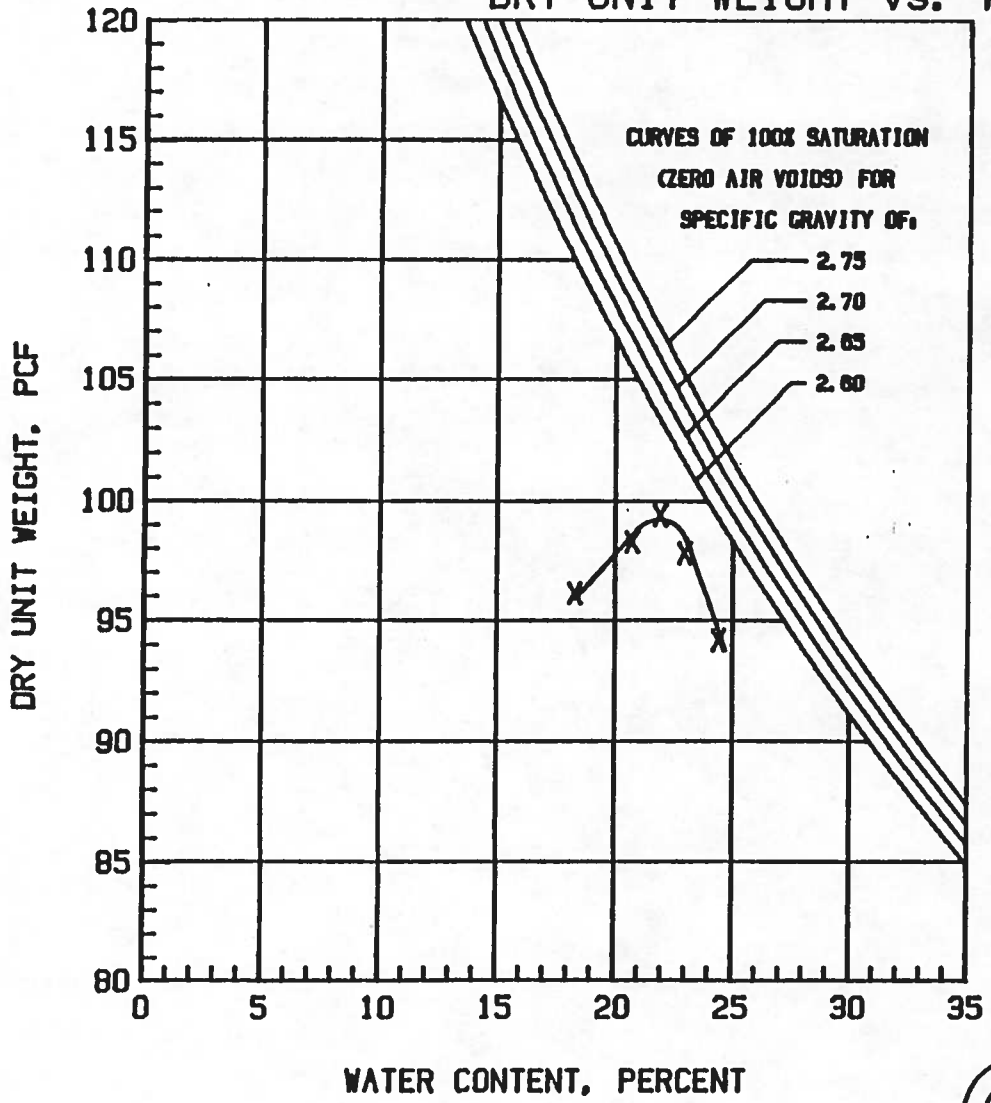
DEPTH: N/A FT

SPOIL
NATURAL MOISTURE CONTENT= 5.2 %

GEOLOGIC ASSOCIATES, INC.

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 17, 1984
CONTROL TEST NUMBER: 6

S-2/SPOIL
NATURAL MOISTURE CONTENT: 5.2 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
99.4 PCF	21.9 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 5, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLES

This report includes the minimum index density test results of sample SS-3 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: S-3

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.43

Minimum Index: 83.4 $lbs./Ft^3$

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REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLE S-3

Length = 3.00 in. Weight = 1.259 lbs. Specific Gravity = 2.43

Diameter = 2.87 in. Moisture = 19.9 % Total Volume = 0.01123 Ft^3

$Weight_w$ = 1.259 lbs. - 1.050 lbs. = 0.209 lbs.

$Volume_w$ = 0.209 lbs./62.4 lbs./Ft^3 = 0.00335 Ft^3

$Volume_s$ = 1.050/(62.4) (2.43) = 0.00693 Ft^3

$Volume_a$ = 0.01123-(0.00335 + 0.00693) = 0.00095 Ft^3

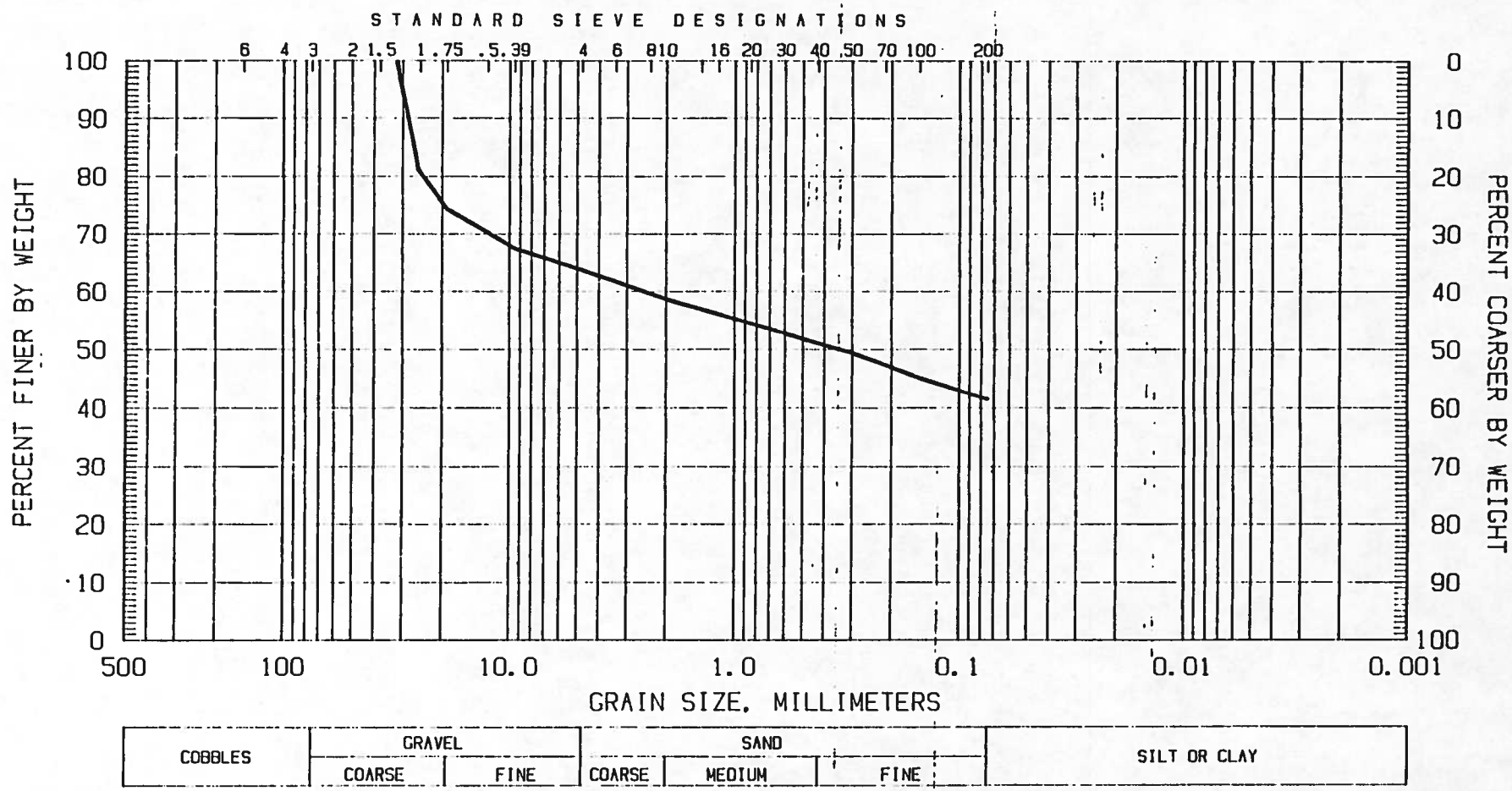
$Volume_v$ = 0.00095 + 0.00335 = 0.0043 Ft^3

$$e = \frac{0.00430}{0.00693} = 0.621$$

$$n = \frac{0.00430}{0.01123} = 38.3\ \%$$

$$k = \frac{0.749}{154291.2} = 4.9 \times 10^{-6}\ \text{cm/sec (@94.7\% Compaction)}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 20, 1984

SAMPLE: S-3

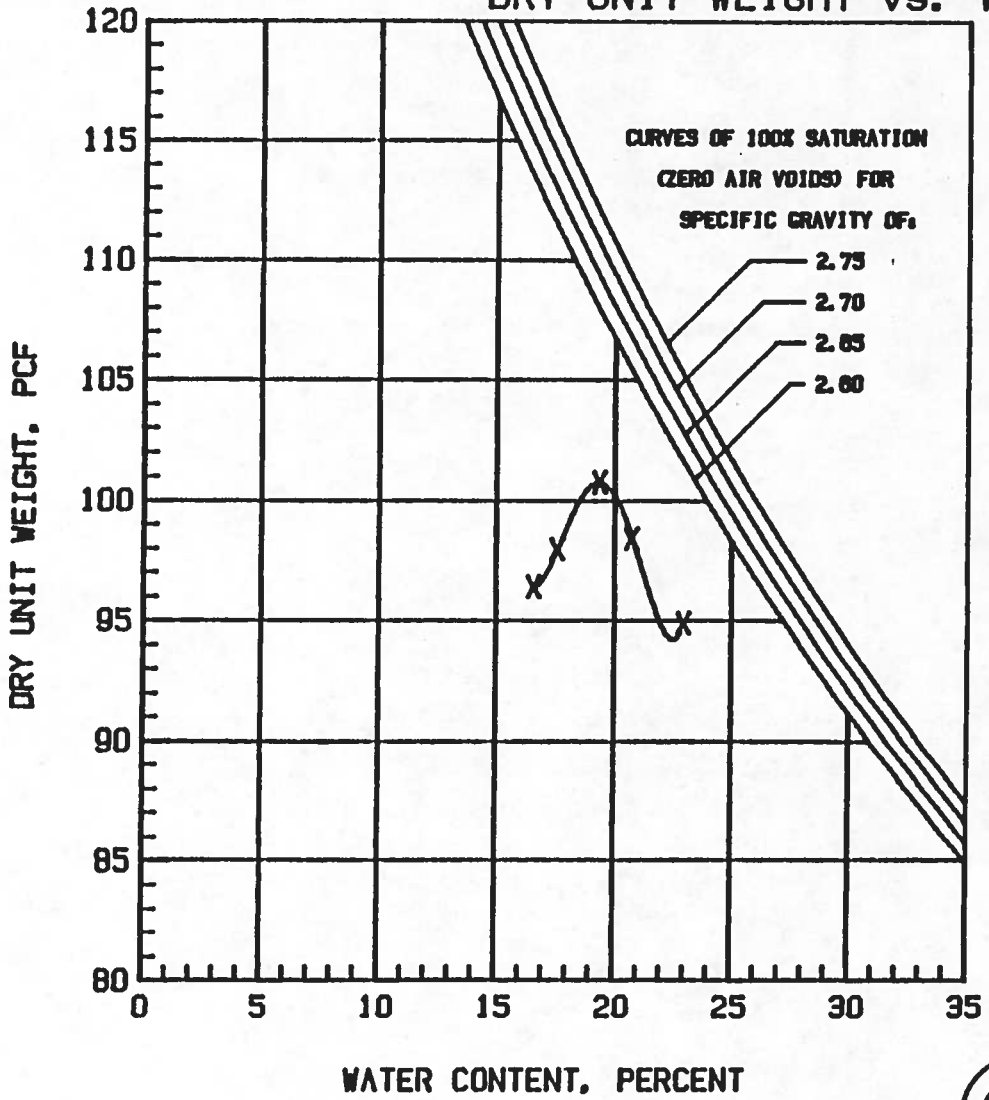
DEPTH: N/A FT

SPOIL
NATURAL MOISTURE CONTENT= 4.0 %

GEOLOGIC ASSOCIATES, INC.

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 20, 1984
CONTROL TEST NUMBER: 7

S-3/SPOIL
NATURAL MOISTURE CONTENT: 4.0 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
100.8 PCF	19.4 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 5, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLES

This report included the minimum index density test results of sample SS-4 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: S-4

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.56

Minimum Index: 75.6 $lbs./Ft^3$

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLE S-4

Length = 2.75 in. Weight = 1.146 lbs. Specific Gravity = 2.55

Diameter = 2.84 in. Moisture = 20.4 % Total Volume = 0.01008 Ft^3

$Weight_w$ = 1.146 lbs. - 0.952 lbs. = 0.194 lbs.

$Volume_w$ = 0.194 lbs./62.4 lbs./Ft^3 = 0.00311 Ft^3

$Volume_s$ = 0.952/(62.4)(2.55) = 0.00598 Ft^3

$Volume_a$ = 0.01008-(0.00311+0.00598) = 0.00099

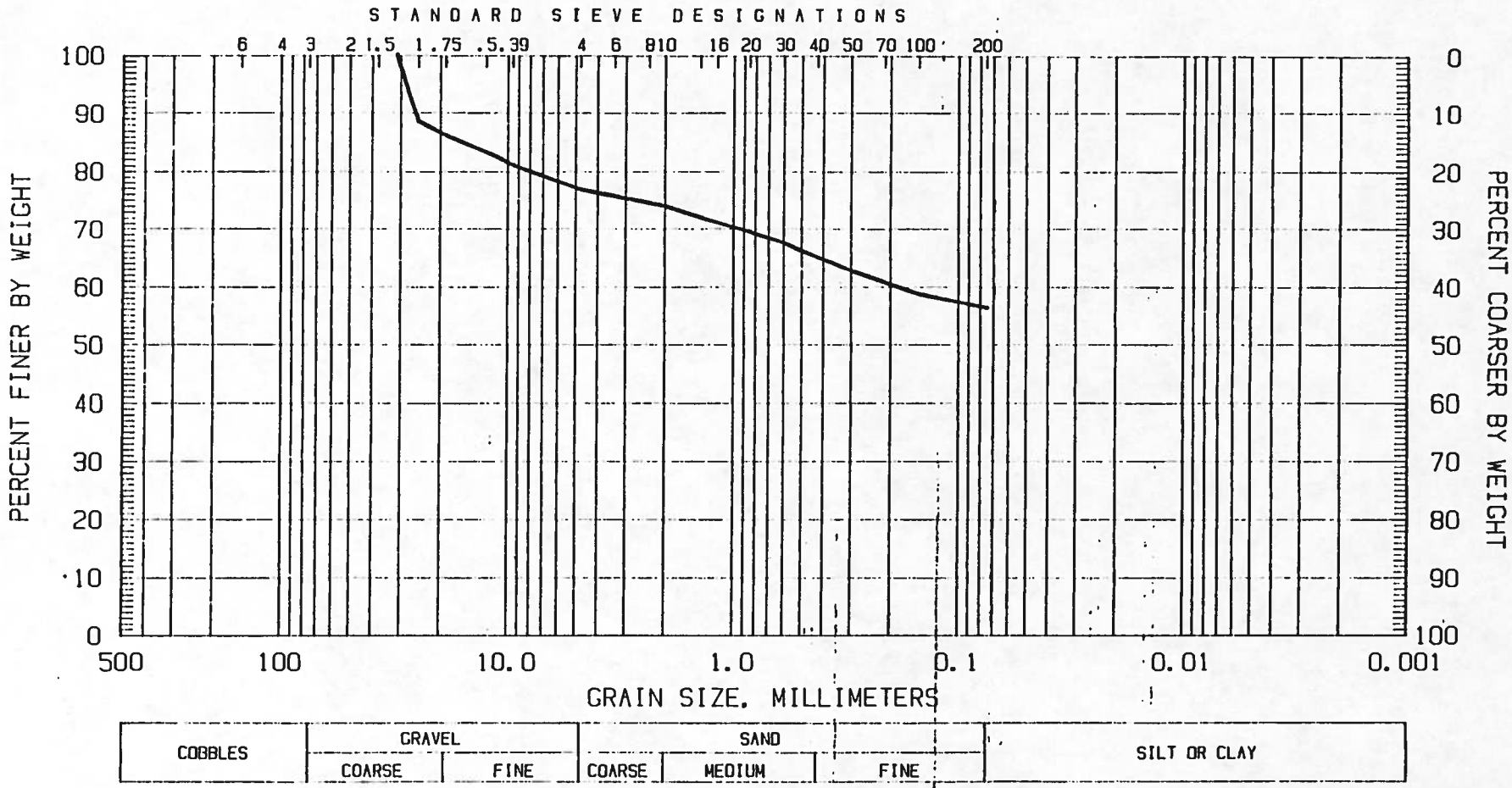
$Volume_v$ = 0.00099 + 0.00311 = 0.0041

$$e = \frac{0.0041}{0.00598} = 0.686$$

$$n = \frac{0.0041}{0.01008} = 40.7 \quad \%$$

$$k = \frac{0.686}{127948.8} = 5.4 \times 10^{-6} \text{ cm/sec (@ 95.8\% Compaction)}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 20, 1984

SAMPLE: S-4

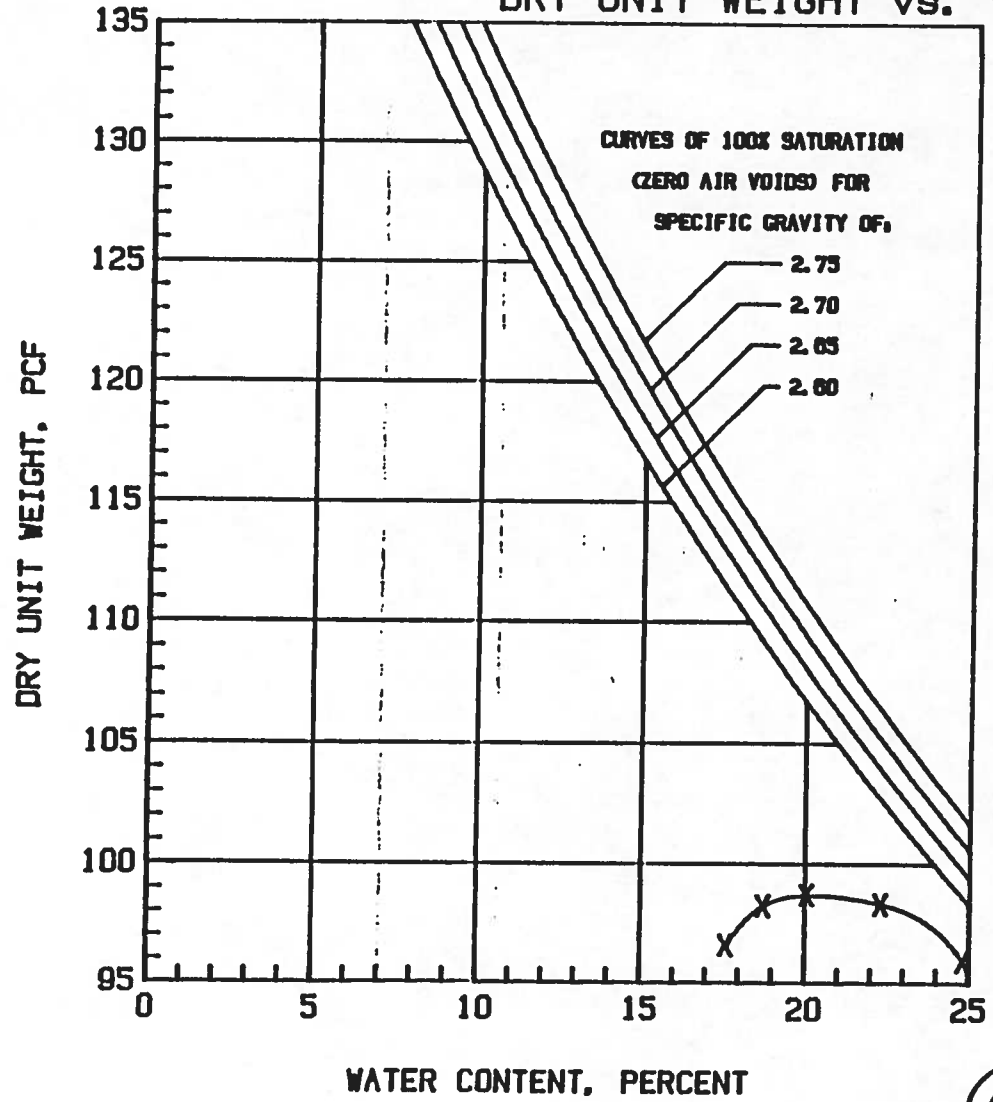
DEPTH: N/A FT

SPOIL
NATURAL MOISTURE CONTENT= 6.3 %

GEOLOGIC ASSOCIATES, INC.

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 20, 1984
CONTROL TEST NUMBER: 8

S-4/SPOIL
NATURAL MOISTURE CONTENT: 6.3 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
98.7 PCF	20.2 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 5, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLES

This report includes the minimum index density test results of sample SS-5 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: S-5

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.55

Minimum Index: 77.2 lbs./Ft^3

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I.-T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

SPOIL SAMPLE S-5

Length = 3.15 in. Weight = 1.356 lbs. Specific Gravity = 2.55

Diameter = 2.87 in. Moisture = 21.0 % Total Volume = 0.01179 Ft^3

$Weight_w$ = 1.356 lbs.-1.121 lbs. = 0.235 lbs.

$Volume_w$ = 0.235 lbs./62.4 lbs./Ft^3 = 0.00377 Ft^3

$Volume_s$ = 1.121 lbs./(62.4)(2.55)= 0.00705 Ft^3

$Volume_a$ = 0.01179 Ft^3 - (0.00377 + 0.00705) = 0.00097 Ft^3

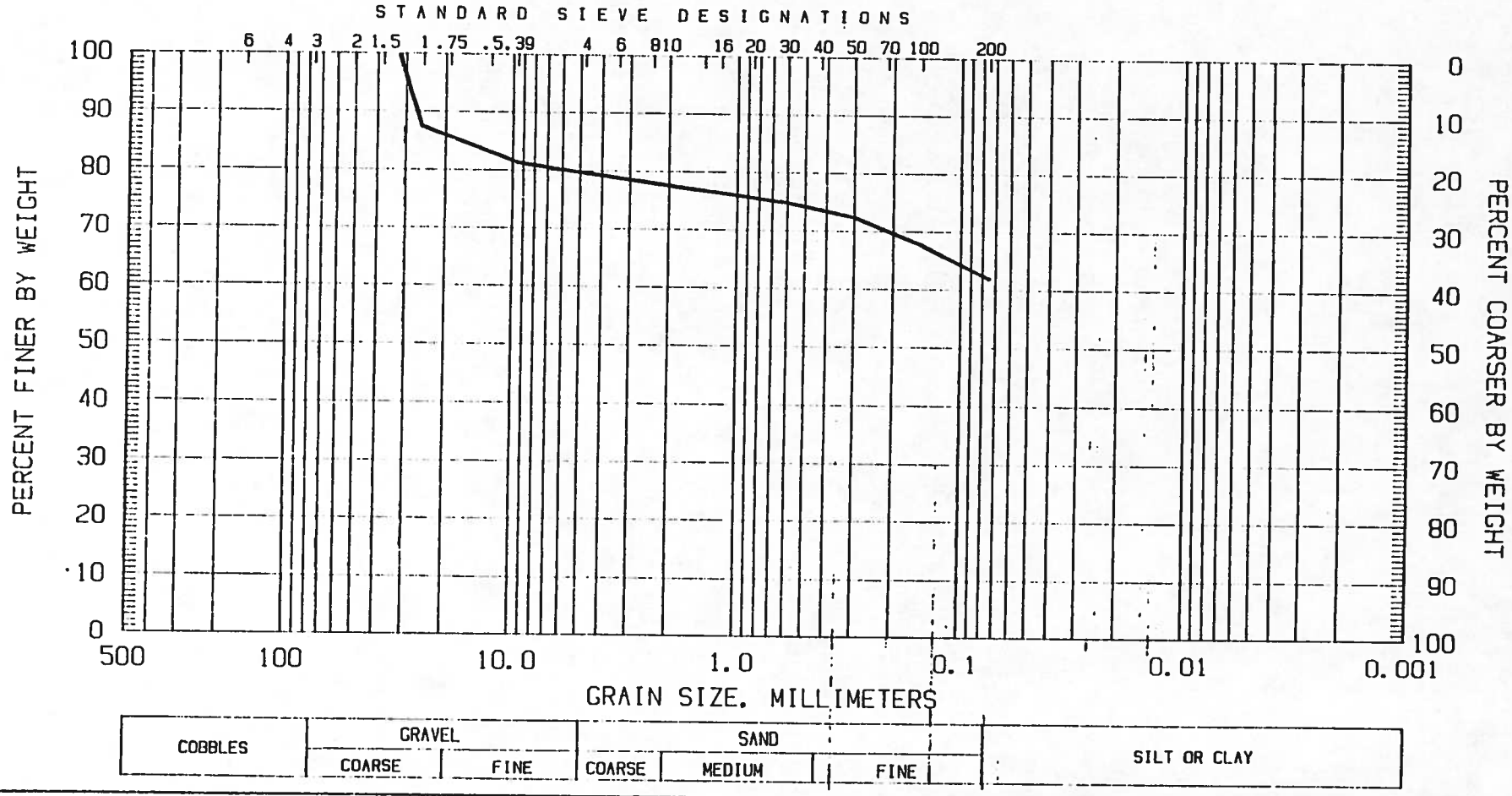
$Volume_v$ = 0.00097 Ft^3 + 0.00377 = 0.00474 Ft^3

$$e = \frac{0.00474}{0.00705} = 0.672$$

$$n = \frac{0.00474}{0.01179} = 40.2\ \%$$

$$k = \frac{0.786}{180336.3} = 4.4 \times 10^{-6}\ \text{cm/sec (@94.0\% Compaction)}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 26, 1984

SAMPLE: S-5

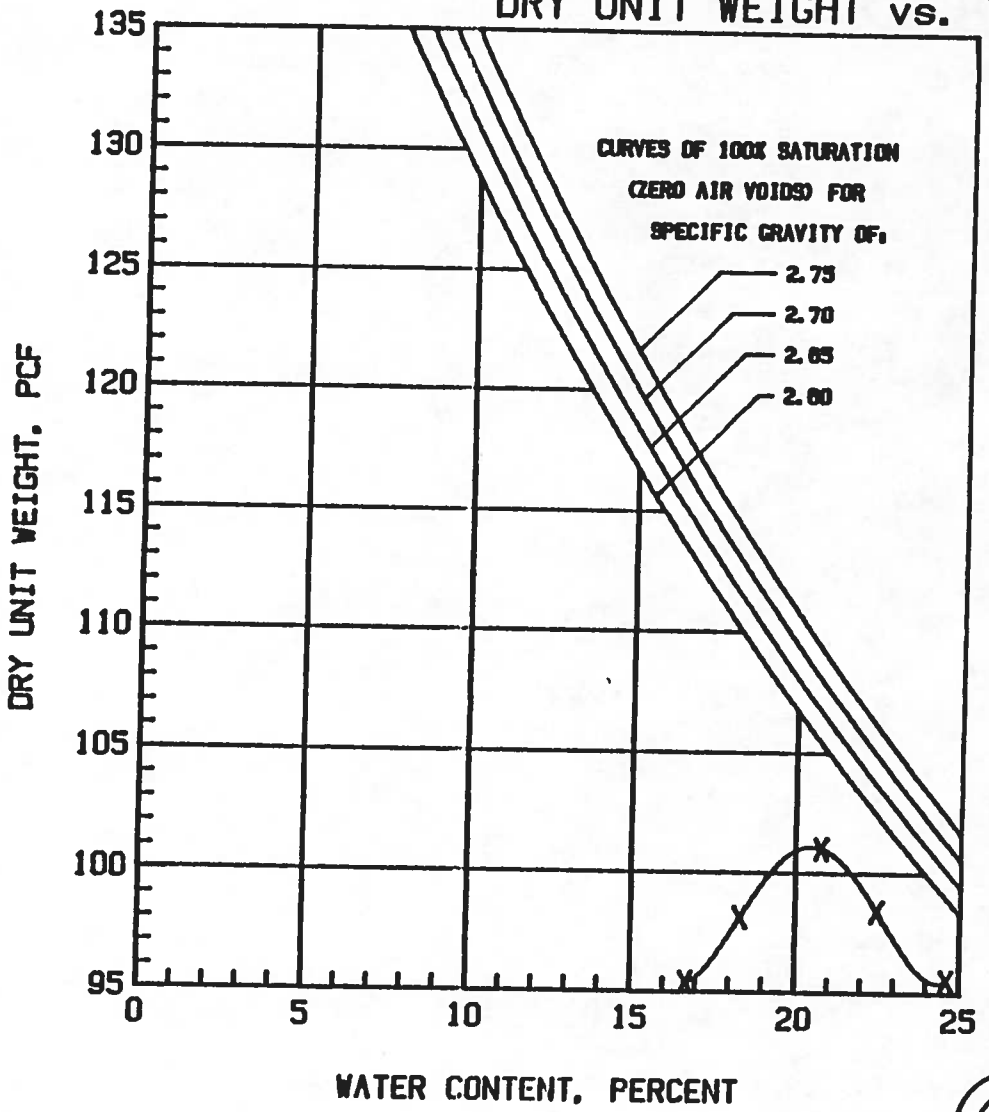
DEPTH: N/A FT

SPOIL
NATURAL MOISTURE CONTENT= 6.1 %
REMARKS:

GEOLOGIC ASSOCIATES, INC.

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 26, 1984
CONTROL TEST NUMBER: 9

S-5/SPOIL
NATURAL MOISTURE CONTENT: 6.1 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
101.1 PCF	20.5 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date September 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of samples D-1 and D-2, as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Methods A and B.

Sample: D-1

Method: B

Volume of Mold: 0.100 ft^3

Specific Gravity: 2.58

Minimum Index: 88.6 PCF

Sample: D-2

Method: A

Volume of Mold: 0.100 ft^3

Specific Gravity: 2.48

Minimum Index: 92.5 PCF

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Knoxville, Tennessee 615 966-9761
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Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing Sample D-1 Overburden

Length = 2.63 in. Weight = 1.161 lbs. Specific Gravity = 2.60

Diameter = 2.88 in. Moisture = 17.2 % Total Volume = 0.00991 Ft^3

$Weight_w$ = 1.161 lbs. - 0.9906 lbs. = 0.1704 lbs.

$Volume_w$ = 0.1704 lbs./62.4 lbs/cu.ft. = 0.00273 Ft^3

$Volume_s$ = 0.9906 lbs./(62.4 lbs./cu.ft.) (2.60) = 0.0061 Ft^3

$Volume_a$ = 0.00991 (0.00273 + 0.0061) = 0.00108 Ft^3

$Volume_v$ = 0.00991 - 0.0061 = 0.00381 Ft^3

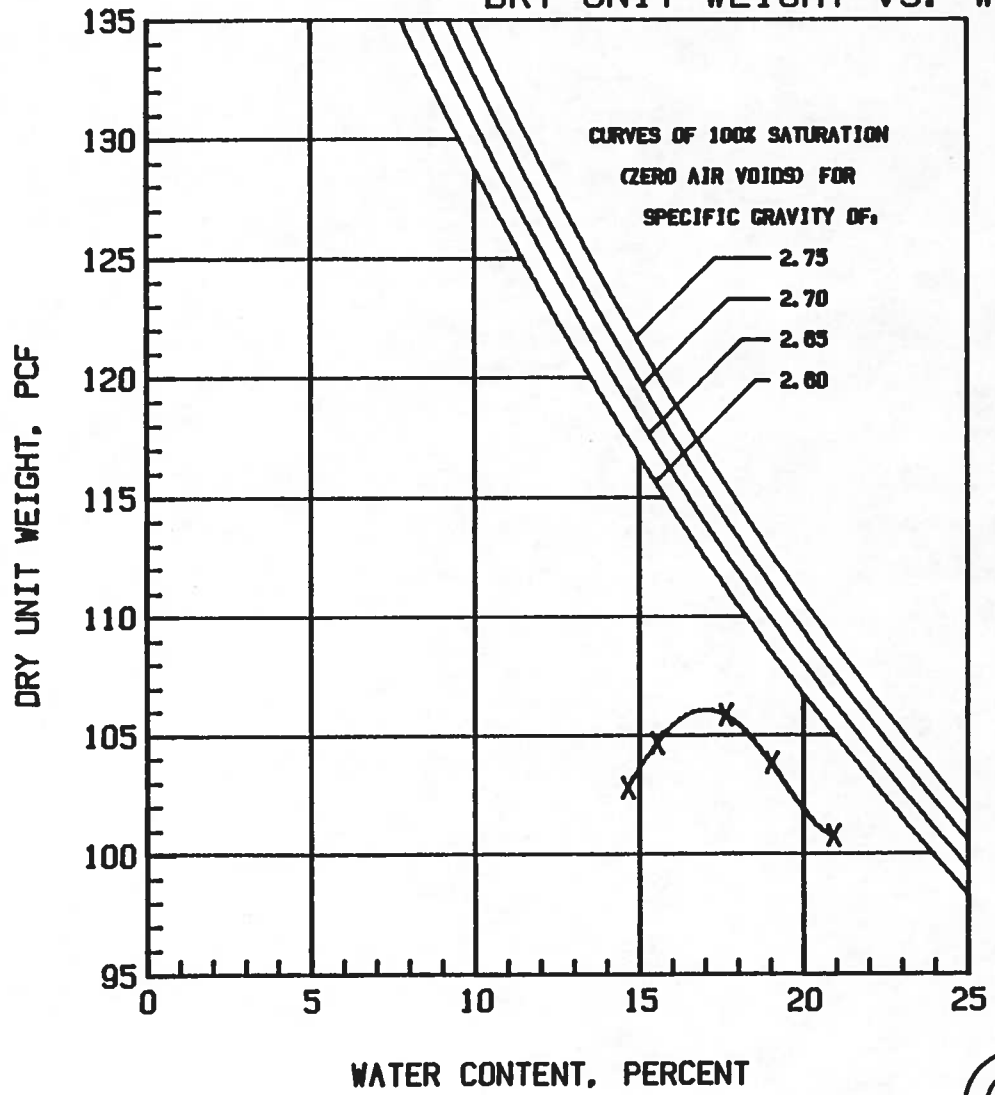
$$e = \frac{0.00381}{0.0061} = 0.625$$

$$n = \frac{0.00381}{0.00991} = 38.5 \ \%$$

$$k = \frac{0.6563}{1305830.4} = 5.03 \times 10^{-7} \text{ cm/sec}$$

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 14, 1984
CONTROL TEST NUMBER: 3

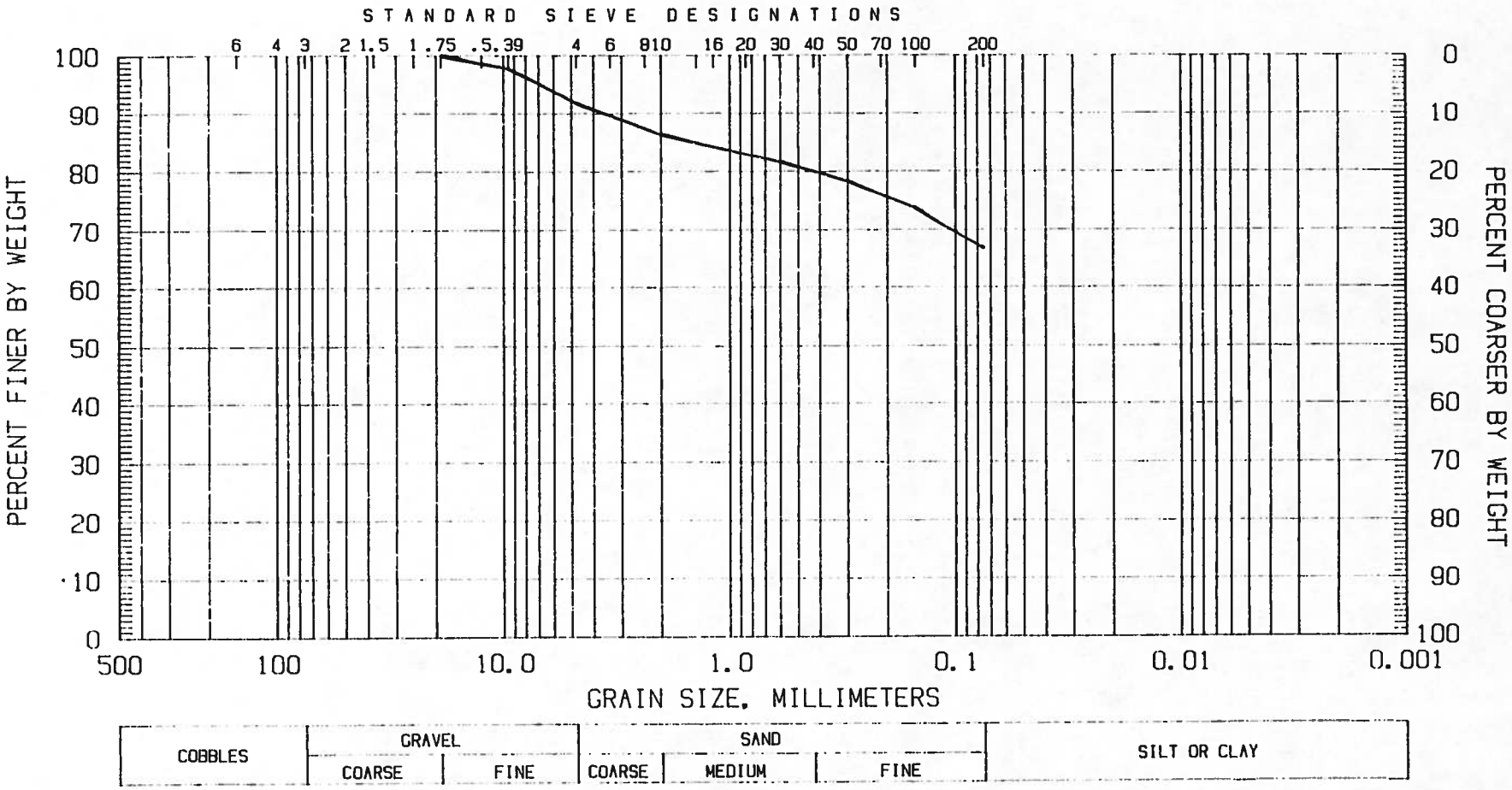
D-1/OVERBURDEN
NATURAL MOISTURE CONTENT: 10.0 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
106.1 PCF	17.0 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

GEOLOGIC ASSOCIATES, INC.

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 14, 1984

SAMPLE: D-1

DEPTH: N/A FT

OVERBURDEN
NATURAL MOISTURE CONTENT= 10.0 %

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date September 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of samples D-1 and D-2, as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Methods A and B.

Sample: D-1

Method: B

Volume of Mold: 0.100 ft^3

Specific Gravity: 2.58

Minimum Index: 88.6 PCF

Sample: D-2

Method: A

Volume of Mold: 0.100 ft^3

Specific Gravity: 2.48

Minimum Index: 92.5 PCF

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Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing Sample D-2 Overburden

Length = 2.66 in. Weight = 1.192 lbs. Specific Gravity = 2.5

Diameter = 2.88 in. Moisture = 15.3 % Total Volume = 0.0100 Ft^3

$Weight_w$ = 1.192 lbs. - 1.034 = 0.158 lbs.

$Volume_w$ = 0.158 lbs./62.4 lbs./cu.ft. = 0.00663 Ft^3

$Volume_s$ = 1.034 lbs./(62.4 lbs./cu.ft.) (2.50) = 0.00663 Ft^3

$Volume_a$ = 0.0100 (0.00253 + 0.00663) = 0.00084 Ft^3

$Volume_v$ = 0.01 - 0.00663 = 0.00337 Ft^3

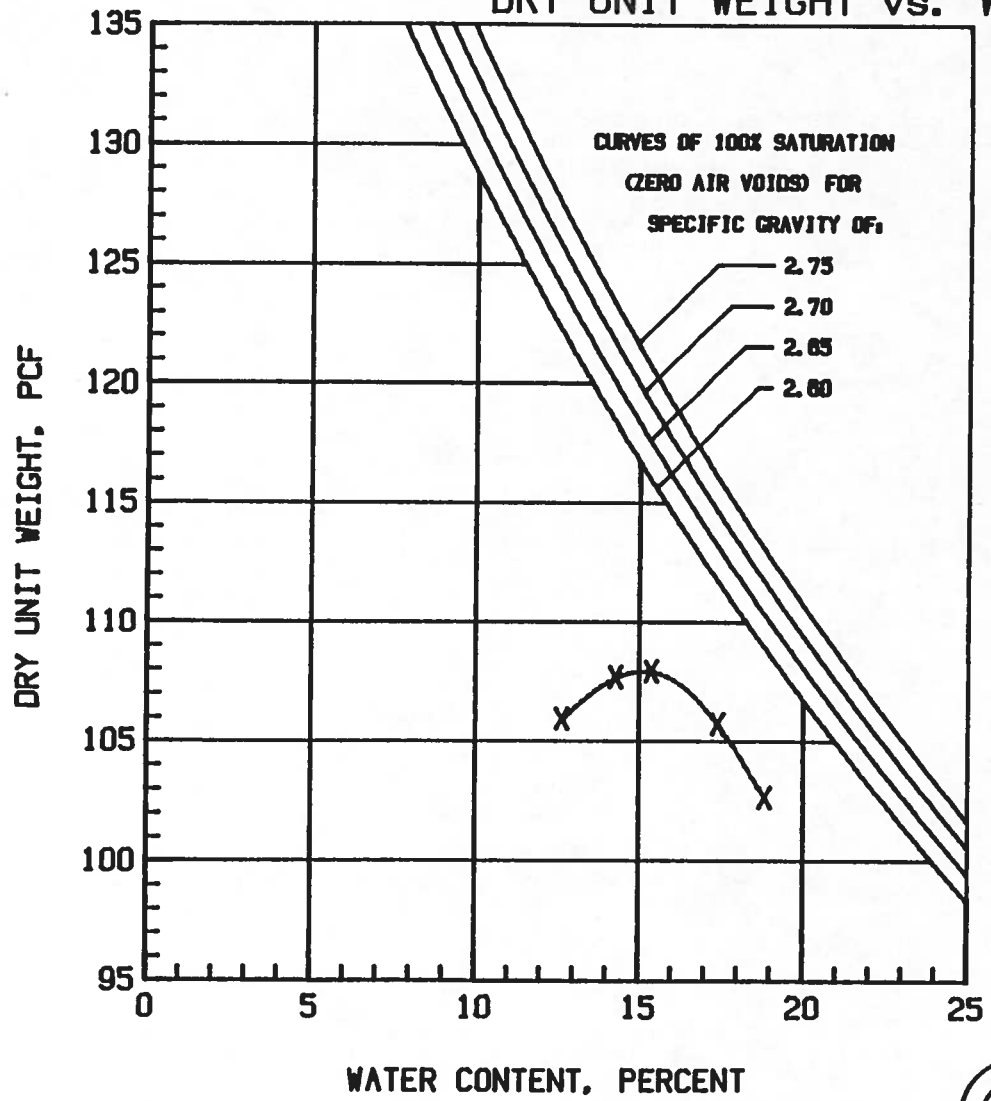
$$e = \frac{0.00337}{0.00663} = 0.508$$

$$n = \frac{0.00337}{0.010} = 33.7\ \%$$

$$k = \frac{0.6524}{1919232} = 3.4 \times 10^{-7}\ cm/sec$$

MOISTURE-DENSITY RELATIONSHIP

DRY UNIT WEIGHT vs. WATER CONTENT



PROJECT NO.: 84-3105

UTAH INTERNATIONAL
SOILS TESTING
I.T. ENVIROSCIENCE

SEPTEMBER 14, 1984
CONTROL TEST NUMBER: 4

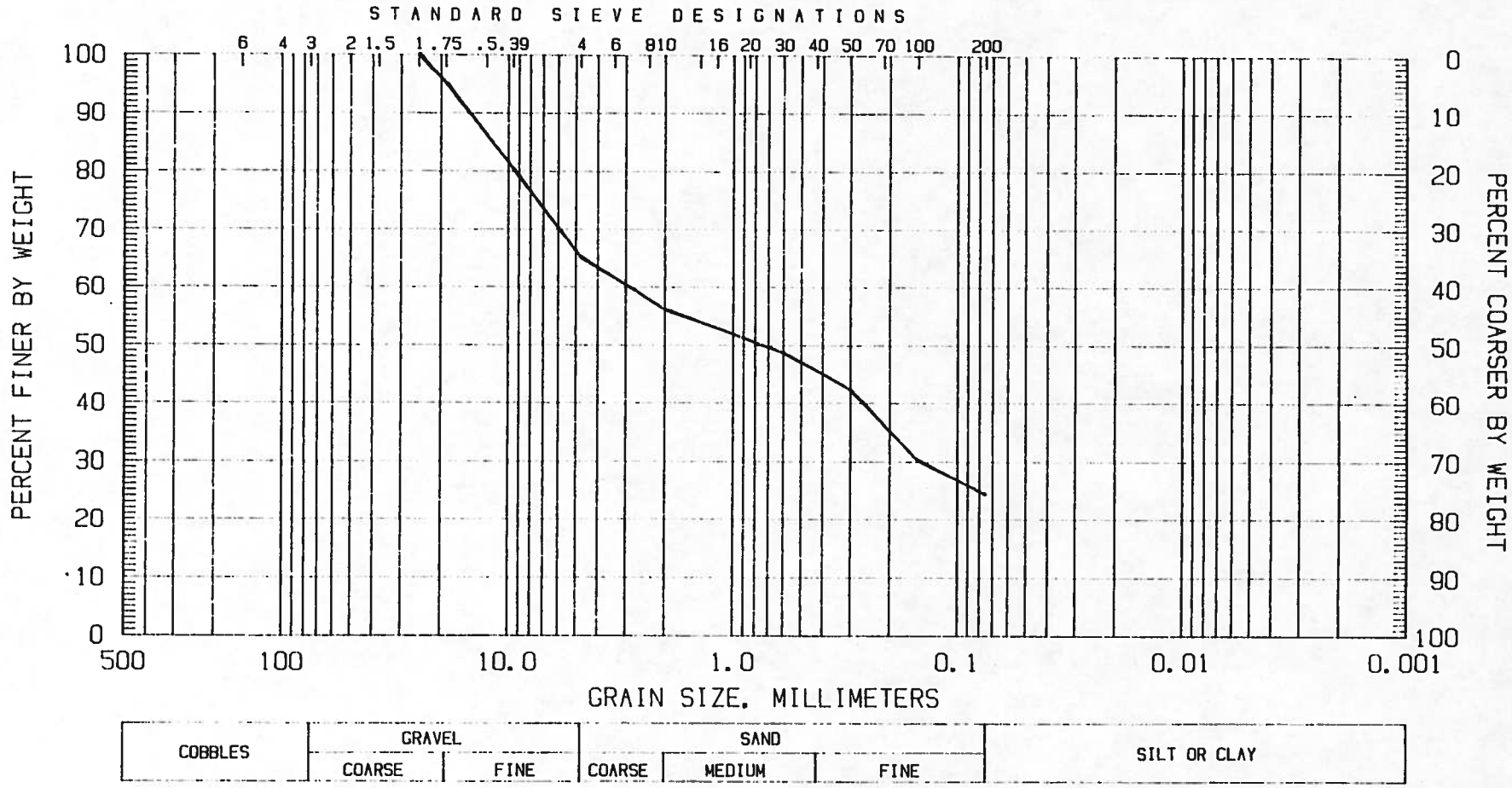
D-2/OVERBURDEN
NATURAL MOISTURE CONTENT: 5.6 %
TEST PROCEDURE: ASTM D 698
TEST METHOD: C

MAXIMUM DRY DENSITY	OPTIMUM MOISTURE CONTENT
108.0 PCF	15.0 %

NOTE: RESULTS OF THIS TEST WILL BE USED TO DETERMINE COMPACTION PERCENTAGES IN THE FIELD

GEOLOGIC ASSOCIATES, INC.

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 14, 1984

SAMPLE: D-2

DEPTH: N/A FT

OVERBURDEN
NATURAL MOISTURE CONTENT= 5.6 %

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Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date September 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of samples PP-1 and PP-2, as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Methods B and C.

Sample: PP-1 Fly ash

Method: C

Volume of Mold: 0.100 ft^3

Specific Gravity: 1.89

Minimum Index: 60.6 PCF

Sample: PP-2 Bottom ash

Method: B

Volume of Mold: 0.100 ft^3

Specific Gravity: 1.92

Minimum Index: 41.8 PCF

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Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing Sample PP-1 Fly Ash

Length = 2.41 in. Weight = .6944 lbs. Specific Gravity = 1.90

Diameter = 2.88 in. Moisture = 21.2 % Total Volume = 0.009054 Ft^3

$Weight_w$ = 0.6944 - 0.5729 = .1215 lbs.

$Volume_w$ = 0.1215 lbs/62.4 PCF = .001947 Ft^3

$Volume_s$ = 5729 lbs/(62.4) (1.8) = .004832 Ft^3

$Volume_a$ = 0.009054 (.001947 + (.004832) = .002275 Ft^3

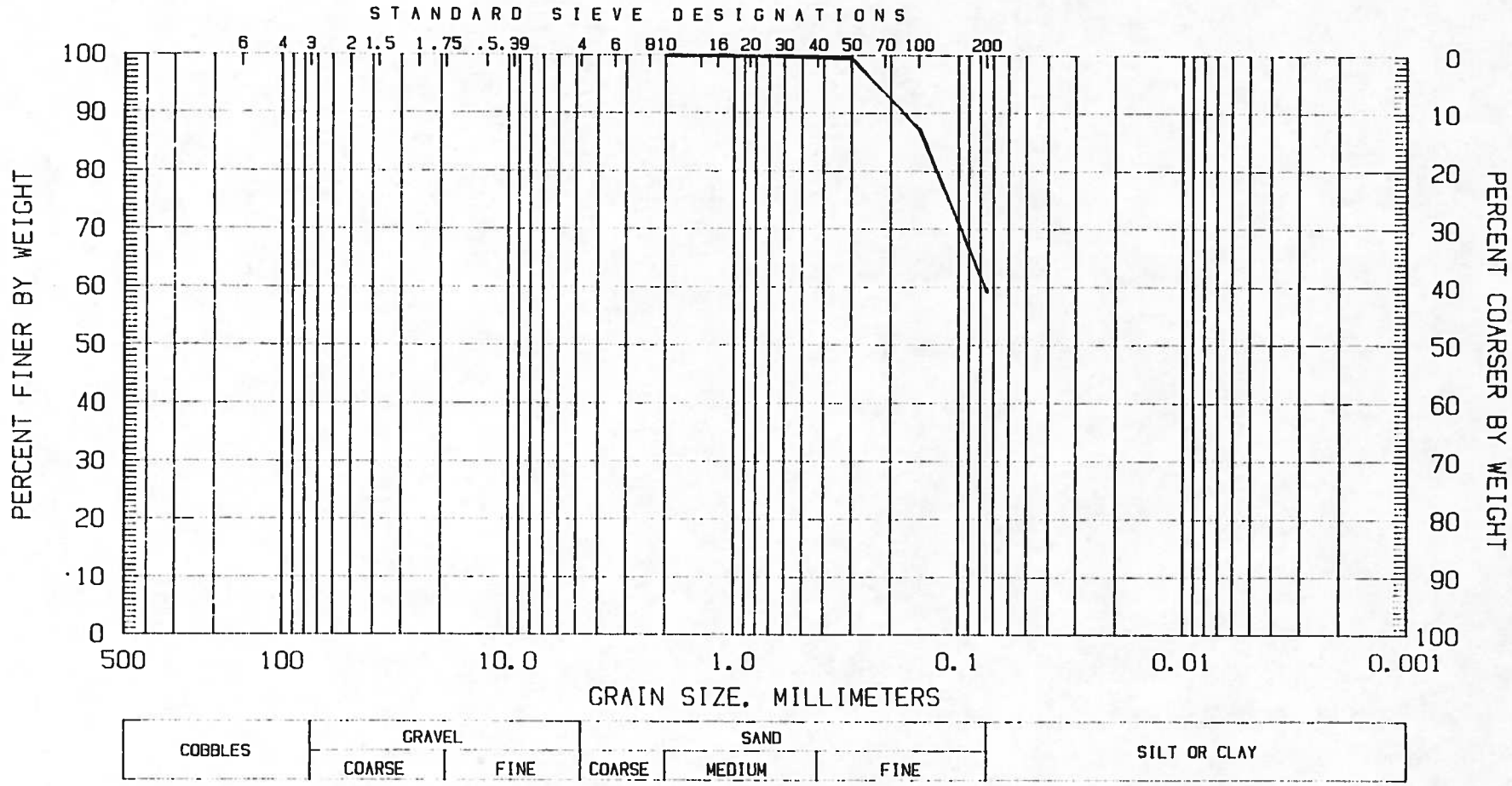
$Volume_v$ = 0.009054 - 0.004832 = 0.004222

$$e = \frac{0.004222}{0.004832} = 0.8737$$

$$n = \frac{0.004222}{0.009054} = 46.6\ \%$$

$$k = \frac{0.6014}{4437.5} = 1.36 \times 10^{-4}\ cm/sec$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 14, 1984

SAMPLE: PP1

DEPTH: N/A FT

FLY ASH
NATURAL MOISTURE CONTENT= 16.4 %

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Franklin, Tennessee 615 794-3556
Knoxville, Tennessee 615 573-7383
Hopkinsville, Kentucky 502 886-0721

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

CLIENT: I.T. Enviroscience DATE: September 4, 1984

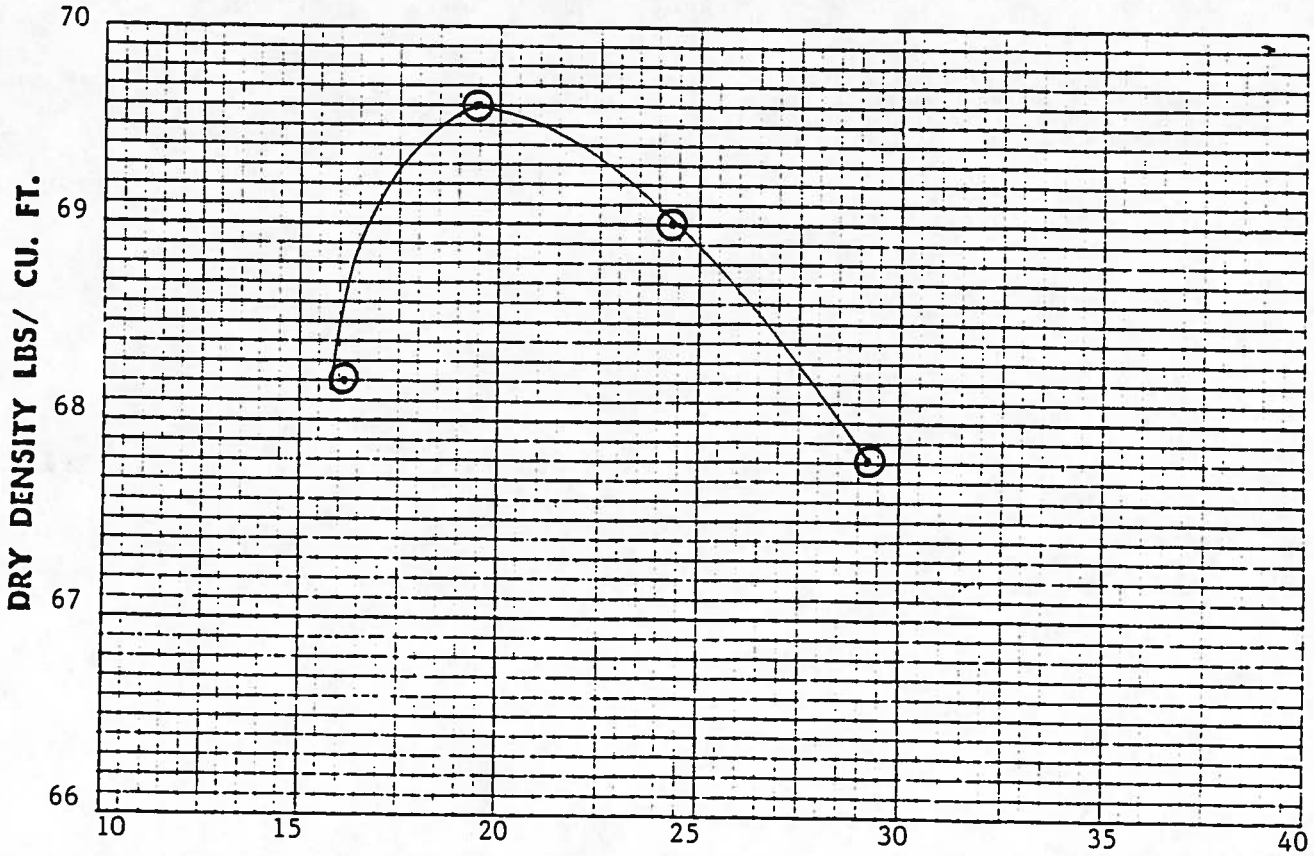
PROJECT: Utah International Soils Testing

SAMPLE LOCATION: PP#1

SAMPLE DESCRIPTION: Fly Ash

TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 19.4 % BY WEIGHT FIELD MOISTURE 0.4 % BY WEIGHT

MAX DRY DENSITY 69.6 LBS/CU. FT.

LAB TEST BY:

REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date September 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of samples PP-1 and PP-2, as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Methods B and C.

Sample: PP-1 Fly ash

Method: C

Volume of Mold: 0.100 ft^3

Specific Gravity: 1.89

Minimum Index: 60.6 PCF

Sample: PP-2 Bottom ash

Method: B

Volume of Mold: 0.100 ft^3

Specific Gravity: 1.92

Minimum Index: 41.8 PCF

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date September, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing PP-2 Bottom Ash

Length = 2.50 in. Weight = 0.6618 lbs. Specific Gravity = 1.92

Diameter = 2.88 in. Moisture = 41.0 % Total Volume = 0.009392 Ft^3

$Weight_w$ = 0.6618 - 0.4694 = 0.1924 lbs.

$Volume_w$ = 0.1924 lbs./62.4 lbs./Ft^3 = 0.00308 Ft^3

$Volume_s$ = 0.4694 lbs./(62.4) (1.92) = 0.00392 Ft^3

$Volume_a$ = 0.009392 - (0.00308 +0.00392) = 0.00239

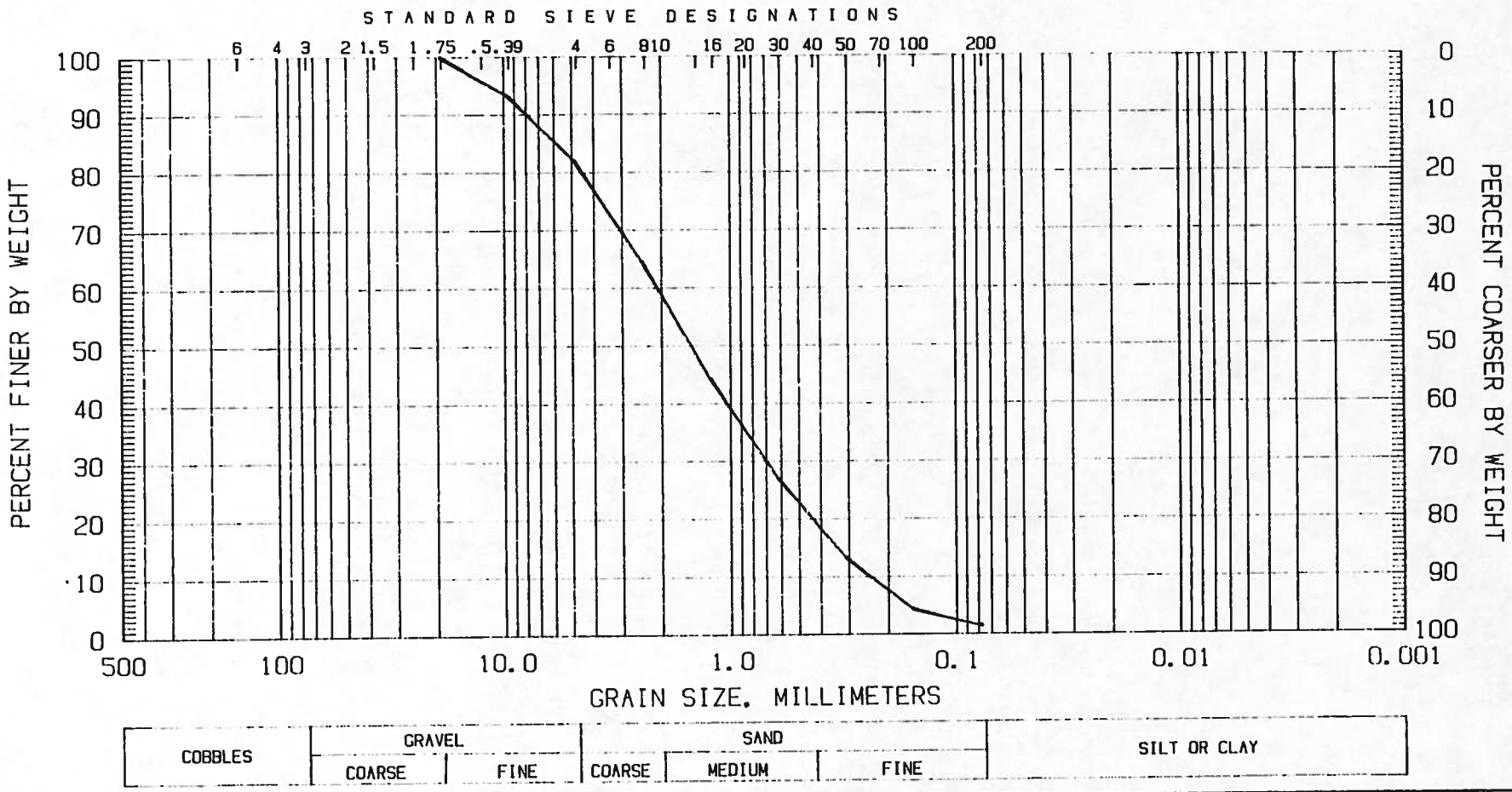
$Volume_v$ = 0.009392 - 0.00392 = 0.005472

$$e = \frac{.005472}{.00392} = 1.396$$

$$n = \frac{.005472}{.009392} = 58.3 \%$$

$$k = \frac{0.6239}{2654.2} = 2.35 \times 10^{-4} \text{ cm/sec}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
SEPTEMBER 14, 1984

SAMPLE: PP2

DEPTH: N/A FT

BOTTOM ASH
NATURAL MOISTURE CONTENT= .4 %

GEOLOGIC ASSOCIATES, INC.

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3556
Knoxville, Tennessee 615 573-7383
Hopkinsville, Kentucky 502 886-0721

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Enviroscience DATE: September 6, 1984

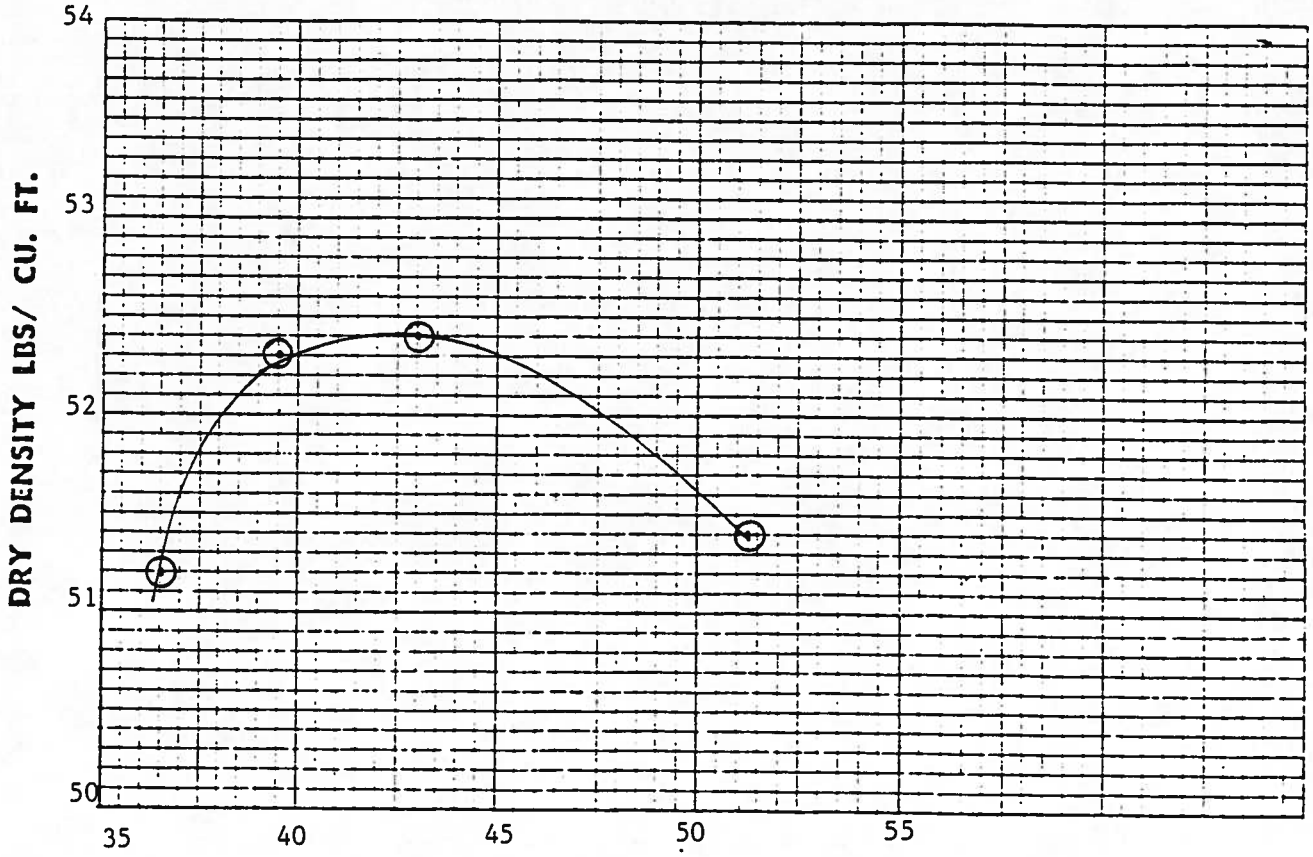
PROJECT: Utah International Soils Testing

SAMPLE LOCATION: PP#2

SAMPLE DESCRIPTION: Bottom ash

TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 42.5 % BY WEIGHT FIELD MOISTURE 16.4 % BY WEIGHT

MAX DRY DENSITY 52.4 LBS/CU. FT.

LAB TEST BY:

REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3576
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-1 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-1/Seam #8-North

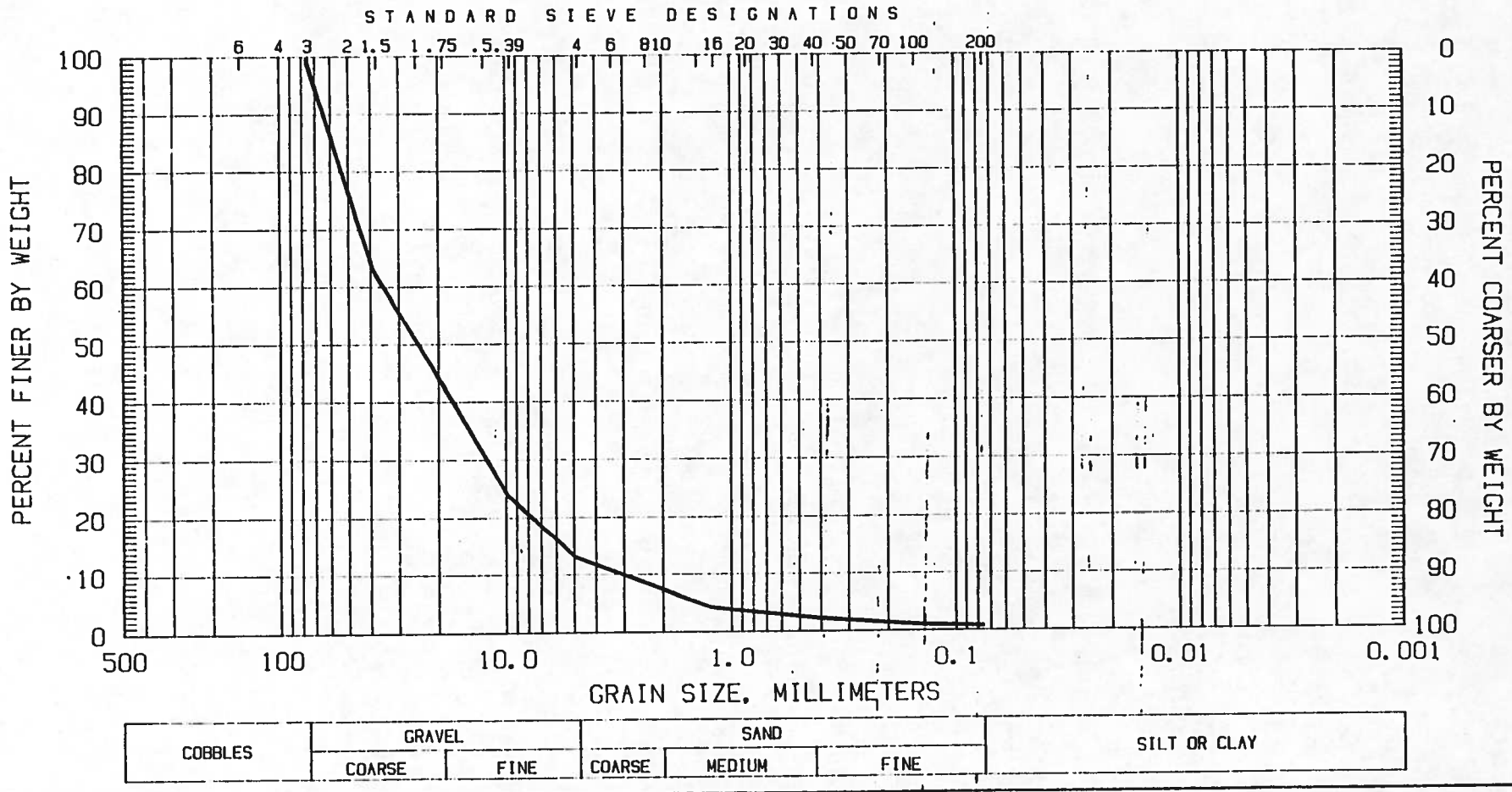
Method: A

Volume of Mold: 0.100 $Ft.^3$

Specific Gravity: 1.48

Minimum Index: 48.1 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C1 SAMPLE: S8
DEPTH: N/A FT

COAL SAMPLE C-1/SEAM NO. 8
REMARKS: SPECIFIC GRAVITY=1.48

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Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-2 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-2

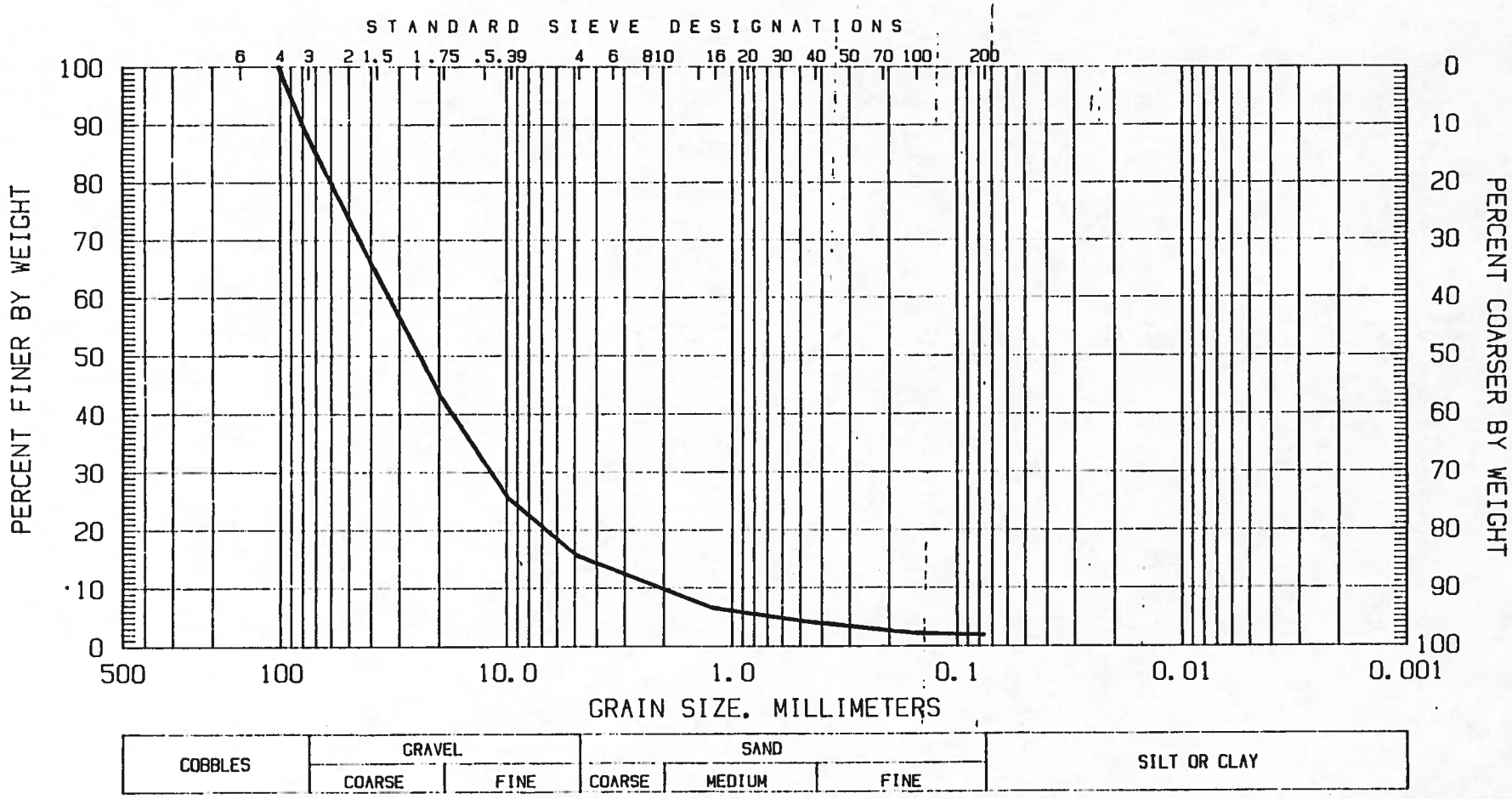
Method: A

Volume of Mold: 0.100 $ft.^3$

Specific Gravity: 1.51

Minimum Index: 49.9 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C2 SAMPLE: S2
DEPTH: N/A FT

COAL SAMPLE C-2/SEAM NO. 2
REMARKS: SPECIFIC GRAVITY=1.51

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-3 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-3, Seam #4

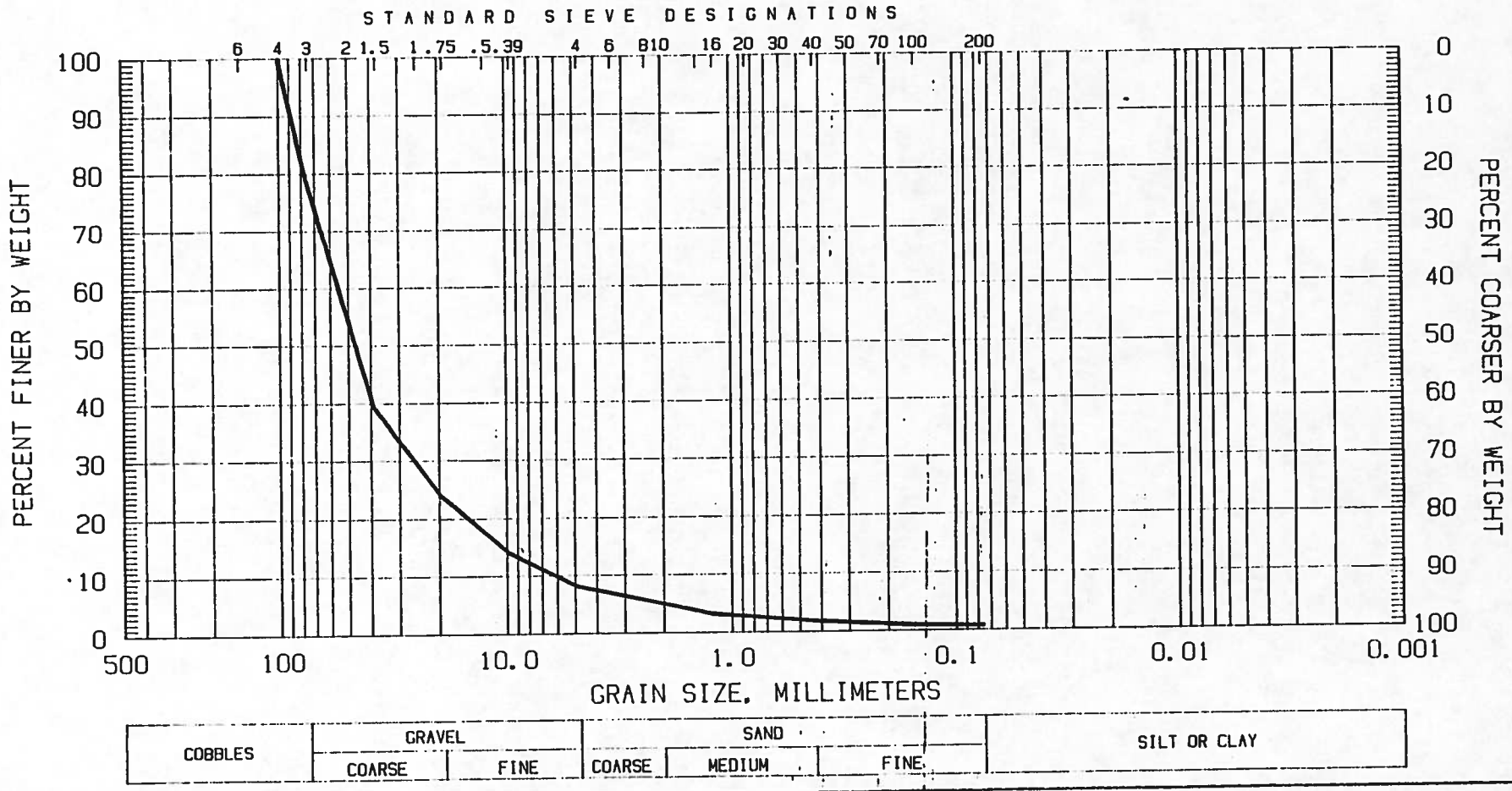
Method: A

Volume of Mold: 0.100 $ft.^3$

Specific Gravity: 1.46

Minimum Index: 50.3 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C3 SAMPLE: S4
DEPTH: N/A FT

COAL SAMPLE C-3/SEAM NO. 4
REMARKS: SPECIFIC GRAVITY=1.46

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Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-4 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-4/Seam #3

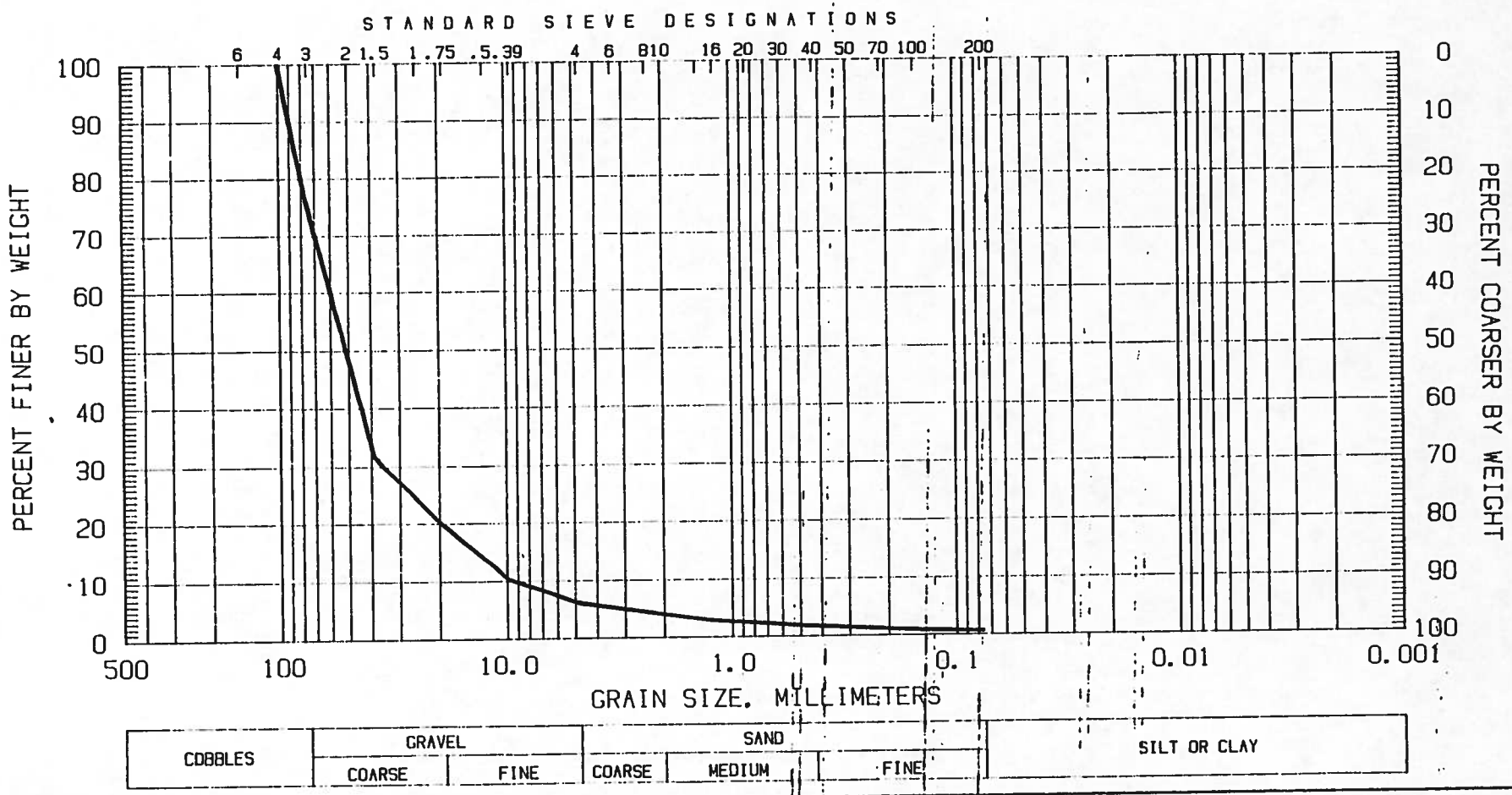
Method: A

Volume of Mold: 0.100 $ft.^3$

Specific Gravity: 1.55

Minimum Index: 53.8 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C4 SAMPLE: S3
DEPTH: N/A FT

COAL SAMPLE C-4/SEAM NO. 3
REMARKS: SPECIFIC GRAVITY=1.55

GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-5 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-5/Seam #7

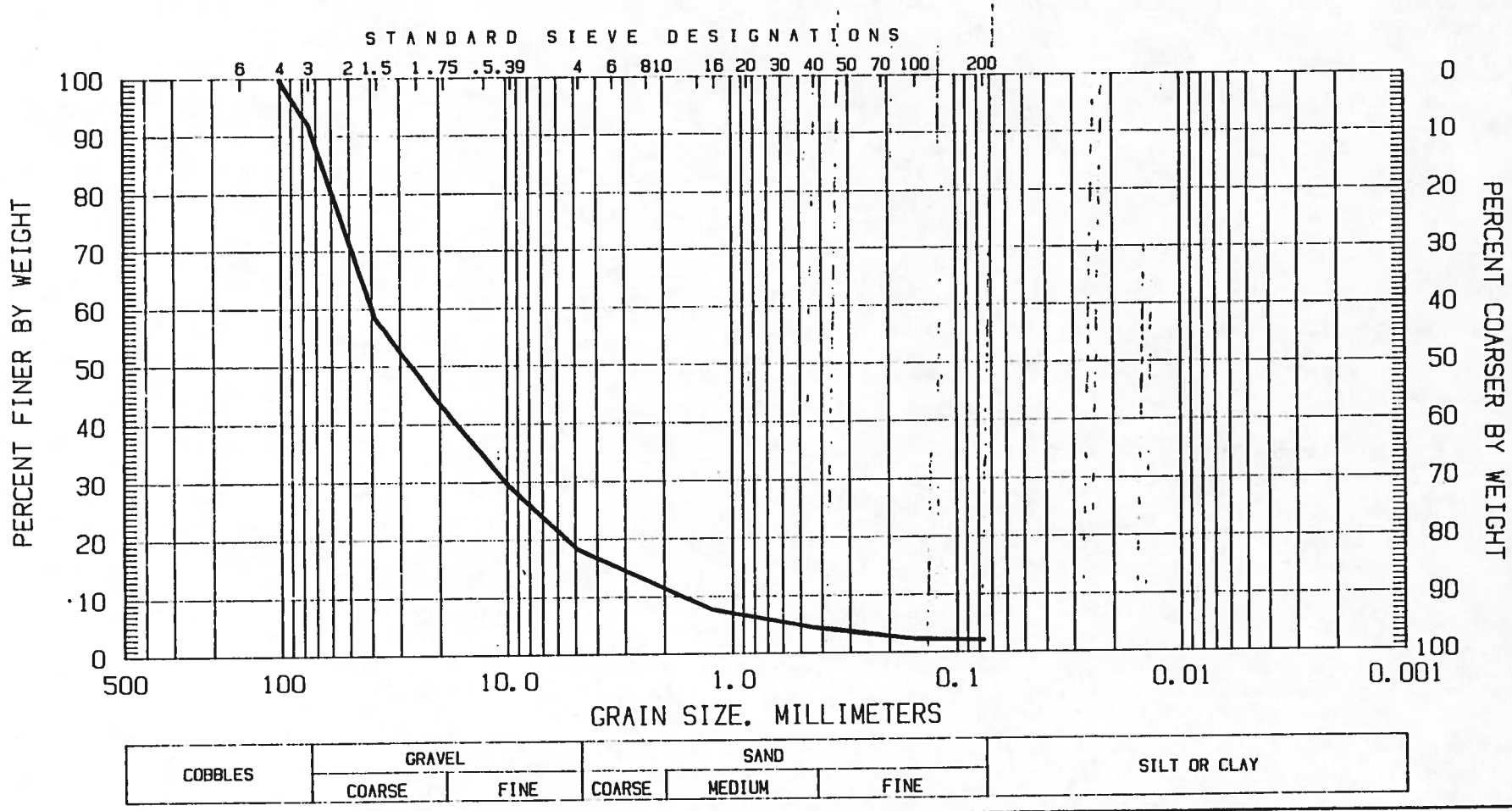
Method: A

Volume of Mold: 0.100 $ft.^3$

Specific Gravity: 1.45

Minimum Index: 54.5 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C5 SAMPLE: S7
DEPTH: N/A FT

COAL SAMPLE C-5/SEAM NO. 7
REMARKS: SPECIFIC GRAVITY=1.45

GEOLOGIC ASSOCIATES, INC.

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-6 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-6/Seam #8-South

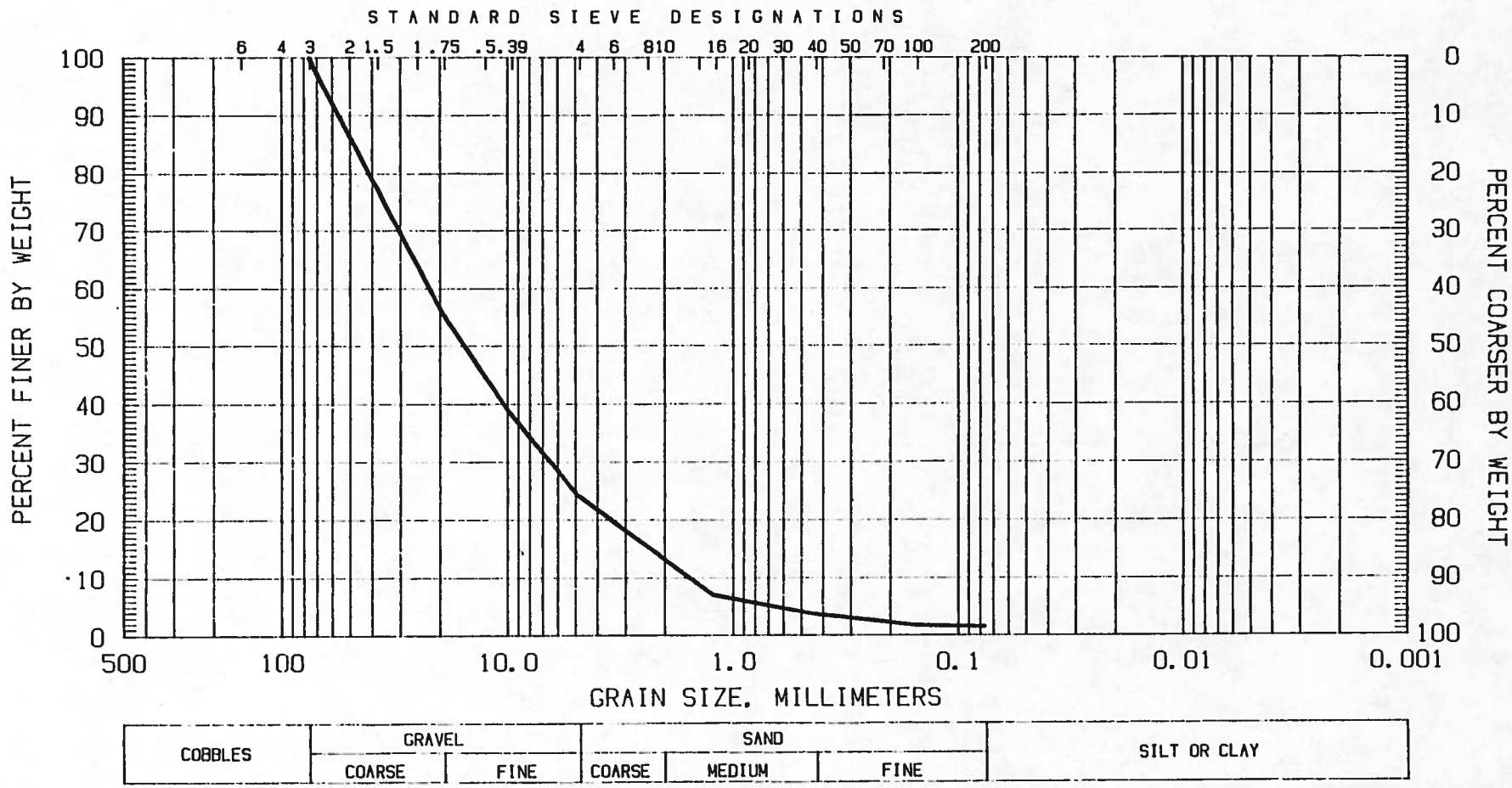
Method: A

Volume of Mold: 0.100 $ft.^3$

Specific Gravity: 1.53

Minimum Index: 58.7 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C6 SAMPLE: S8
DEPTH: N/A FT

COAL SAMPLE C-6/SEAM NO. 8-SOUTH
REMARKS: SPECIFIC GRAVITY=1.53

GEOLOGIC ASSOCIATES, INC.

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date October 18, 1984

Project No. 84-3105 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample C-7 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: C-7, Seam #6

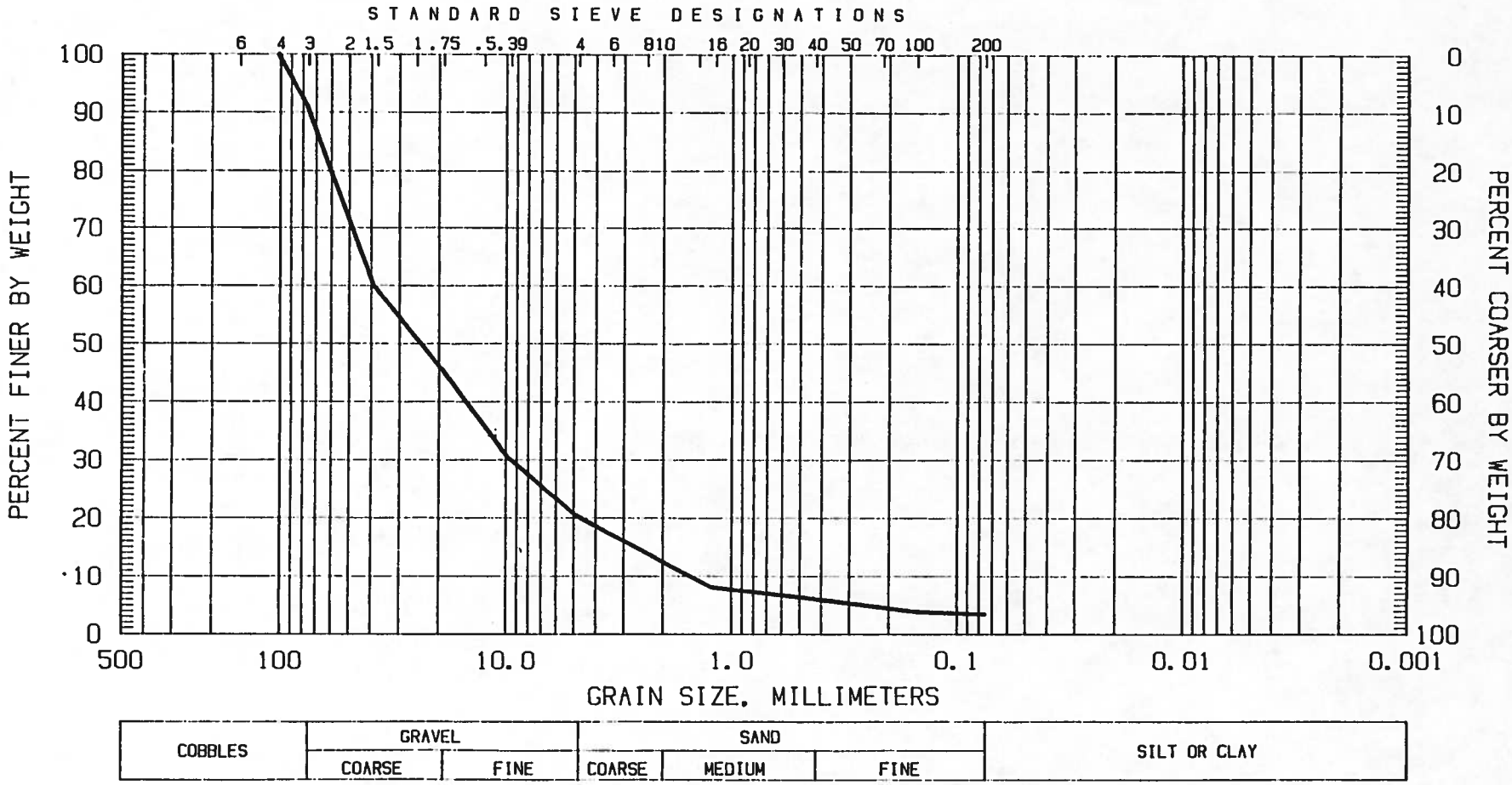
Method: A

Volume of Mold: 0.100 $ft.^3$

Specific Gravity: 1.50

Minimum Index: 57.4 $lbs/ft.^3$

GRAIN SIZE ANALYSIS



PROJECT NO.: 84-3105
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE CORPORATION
OCTOBER 18, 1984
TEST PIT: C7 SAMPLE: S6
DEPTH: N/A FT

COAL SAMPLE C-7/SEAM NO. 6
REMARKS: SPECIFIC GRAVITY=1.50

GEOLOGIC ASSOCIATES, INC.

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4762 (Study #1) as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4762

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.16

Minimum Index: 48.9 $lbs./Ft^3$

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Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4762

Length = 3.00 in. Weight = 0.985 lbs. Specific Gravity = 2.16

Diameter = 2.8 in. Moisture = 28.2 % Total Volume = 0.0107 Ft^3

$Weight_w$ = 0.985 lbs. - 0.768 lbs. = 0.217 lbs.

$Volume_w$ = 0.217 lbs./62.4 lbs./Ft^3 = 0.00348 Ft^3

$Volume_s$ = 0.768 lbs./(62.4)(2.16) = 0.00570 Ft^3

$Volume_a$ = 0.0107 Ft^3 - (0.00348 + 0.00570) = 0.00152 Ft^3

$Volume_v$ = 0.0107 Ft^3 - 0.00570 Ft^3 = 0.005 Ft^3

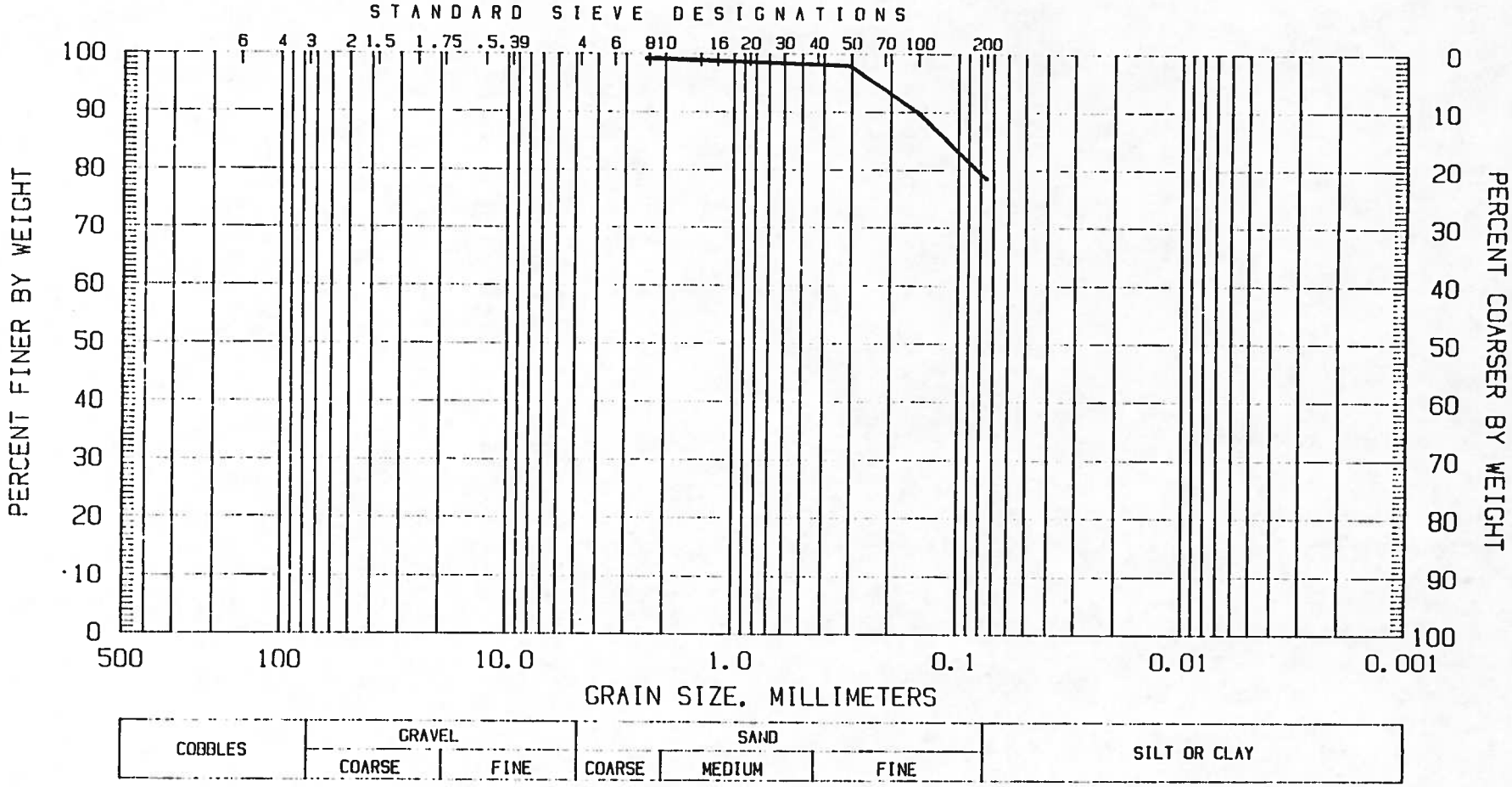
$$e = \frac{0.005}{0.0057} = 0.877$$

$$n = \frac{0.005}{0.0107} = 46.7 \%$$

$$k = 1.1 \times 10^{-5} \text{ cm/sec}$$

NOTE: All permeabilities calculated on samples remolded to 95 ± 1% compaction as determined by the standard Proctor (ASTM D 698-78).

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
JANUARY 28, 1985
TEST PIT: 1 SAMPLE: 2
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4762
NATURAL MOISTURE CONTENT= 24.2 %
REMARKS:

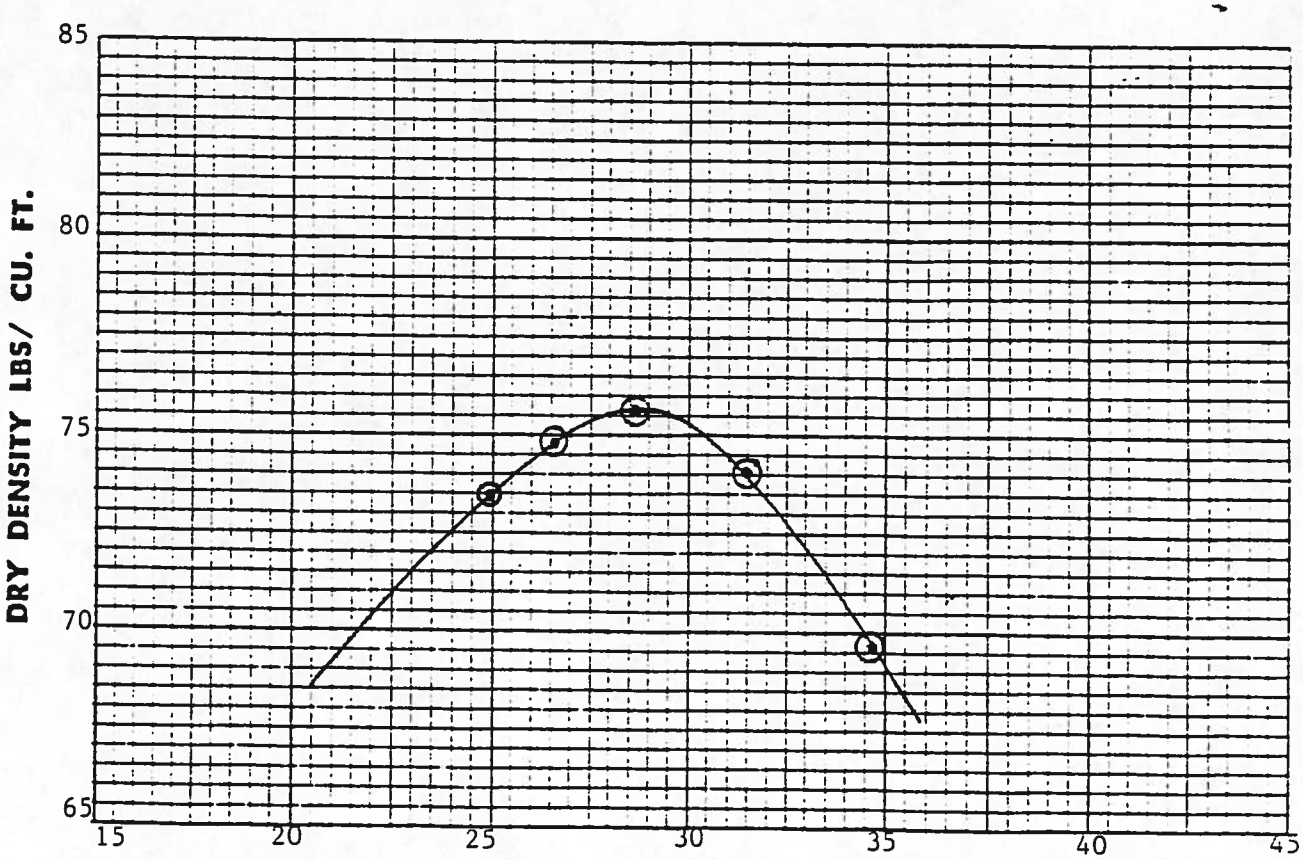
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: January, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly ash sample 4762
TEST METHOD: ASTM D 698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 28.6 % BY WEIGHT FIELD MOISTURE 24.2 % BY WEIGHT
MAX DRY DENSITY 75.6 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9751
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4763 Sludge #2 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4763

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.21

Minimum Index: 44.7 $lbs./Ft^3$

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4763

Length = 2.20 in. Weight = 0.661 lbs. Specific Gravity = 2.21

Diameter = 2.8 in. Moisture = 26.2 % Total Volume = 0.0078 Ft^3

$Weight_w$ = 0.661 lbs. - 0.524 lbs. = 0.137 lbs.

$Volume_w$ = 0.137 lbs./62.4 lbs./Ft^3 = 0.0022 Ft^3

$Volume_s$ = 0.524 lbs./(62.4 lbs./Ft^3) (2.21) = 0.0038 Ft^3

$Volume_a$ = 0.0078 Ft^3 - (0.0022 + 0.0038) = 0.0018 Ft^3

$Volume_v$ = 0.0078 Ft^3 - 0.0038 Ft^3 = 0.0040 Ft^3

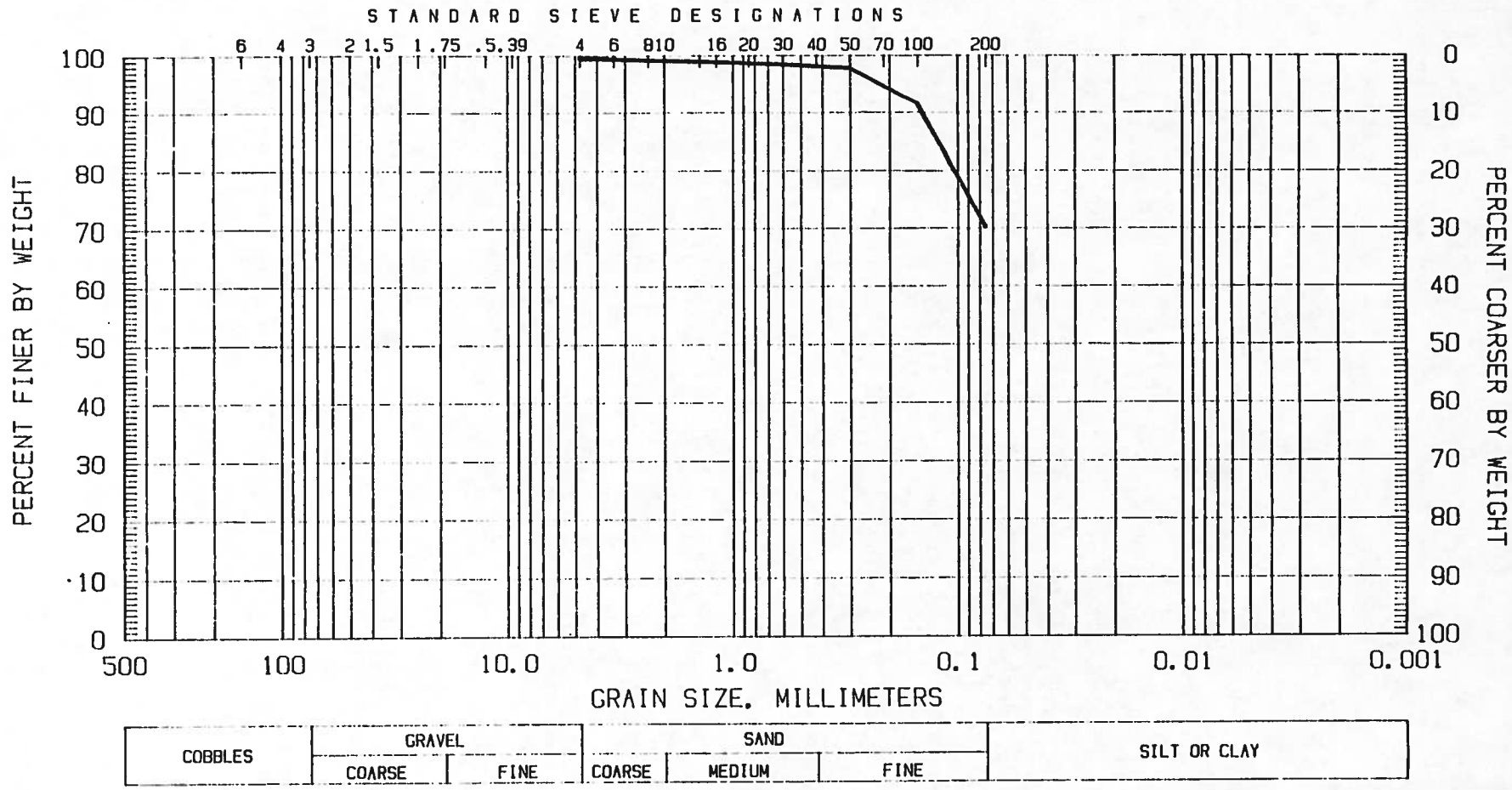
$$e = \frac{0.0040}{0.0038} = 1.053$$

$$n = \frac{0.0040}{0.0078} = 51.3\ \%$$

$$k = 7.6 \times 10^{-6}\ cm/sec$$

NOTE: All permeabilities calculated on samples remolded to 95 ± 1% compaction as determined by the standard Proctor (ASTM D 698-78).

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014
UTAH INTERNATIONAL SOILS TESTING
I.T. ENVIROSCIENCE
JANUARY 28, 1985
TEST PIT: 1 SAMPLE: 3
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4763
NATURAL MOISTURE CONTENT= 31.8 %
REMARKS:

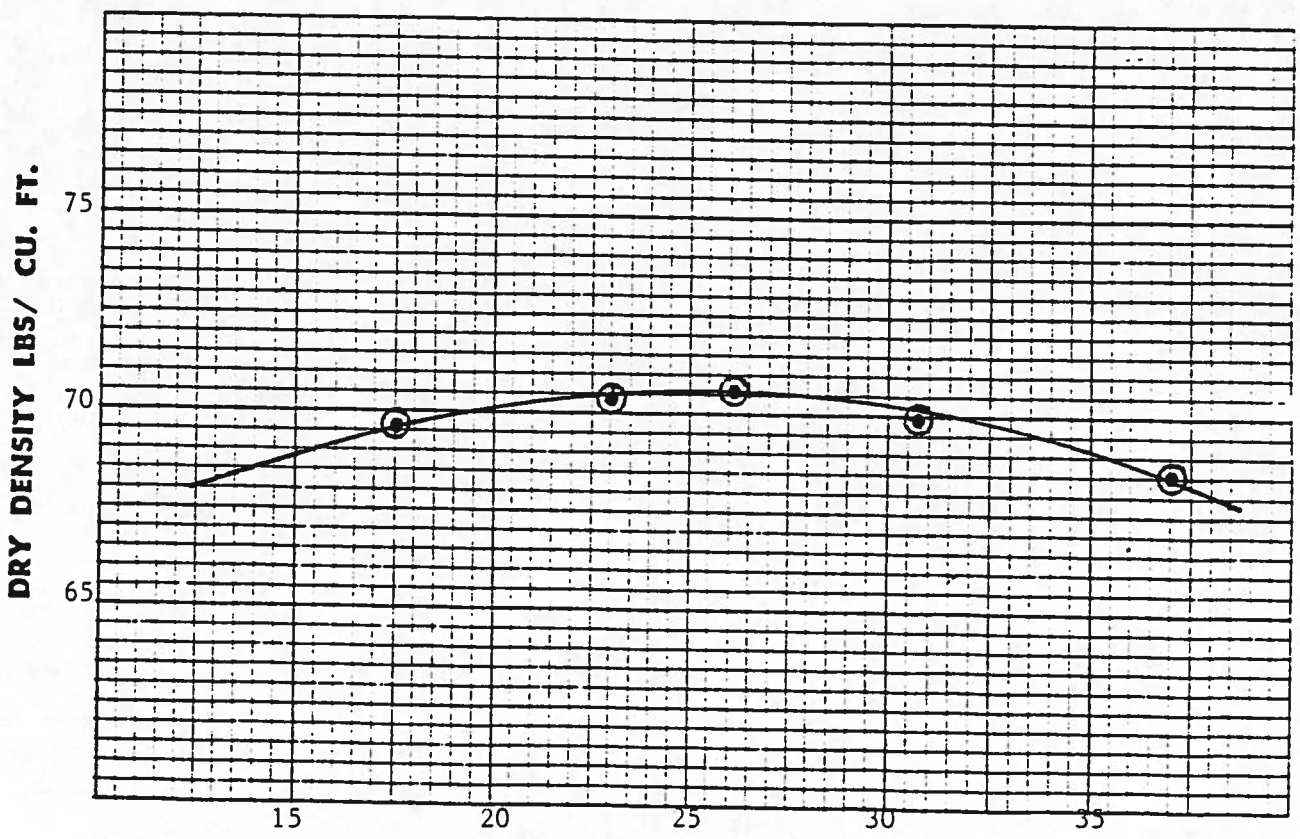
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: January, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly ash sample 4763
TEST METHOD: ASTM D 698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 26.1 % BY WEIGHT FIELD MOISTURE 31.8 % BY WEIGHT
MAX DRY DENSITY 70.6 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4764 Sludge #7 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4764

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.22

Minimum Index: 50.6 $lbs./Ft^3$

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4764

Length = 3.13 in. Weight = 0.981 lbs. Specific Gravity = 2.22

Diameter = 2.8 in. Moisture = 23.1 % Total Volume = 0.0112 Ft^3

$Weight_w$ = 0.981 lbs. - 0.797 lbs. = 0.184 lbs.

$Volume_w$ = 0.184 lbs./62.4 lbs./Ft^3 = 0.00295 Ft^3

$Volume_s$ = 0.797 lbs./(62.4 lbs./Ft^3) (2.22) = 0.00575 Ft^3

$Volume_a$ = 0.0112 Ft^3 - (0.00295 + 0.00575) = 0.0025 Ft^3

$Volume_v$ = 0.0112 Ft^3 - 0.00575 Ft^3 = 0.00545 Ft^3

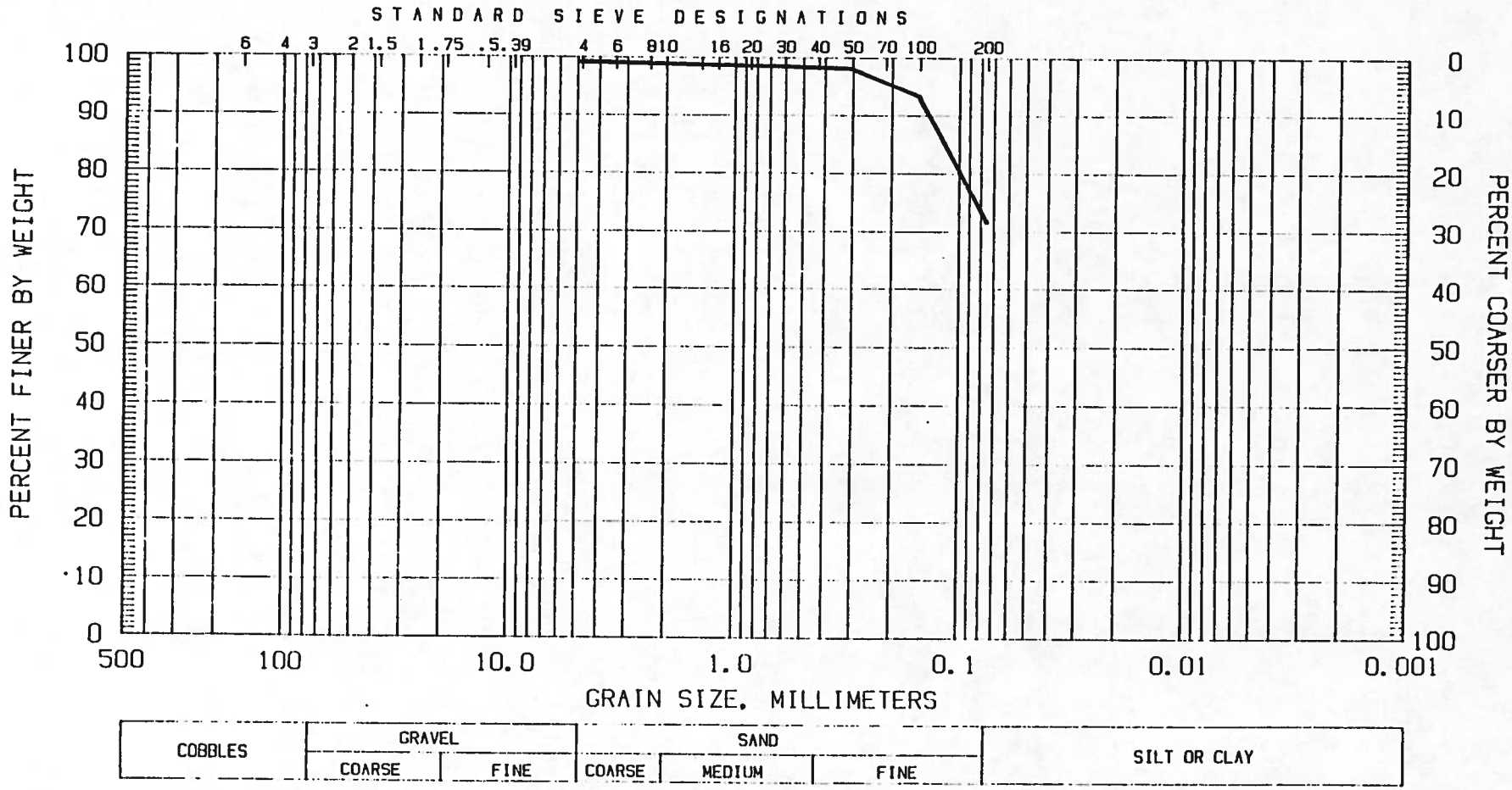
$$e = \frac{0.00545}{0.00575} = 0.948$$

$$n = \frac{0.00545}{0.0112} = 48.7 \%$$

$$k = 9.8 \times 10^{-6} \text{ cm/sec}$$

NOTE: All permeabilities calculated on samples remolded to 95 ± 1% compaction as determined by the standard Proctor (ASTM D 698-78).

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
JANUARY 28, 1985
TEST PIT: 1 SAMPLE: 4
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4764
NATURAL MOISTURE CONTENT= 34.4 %
REMARKS:

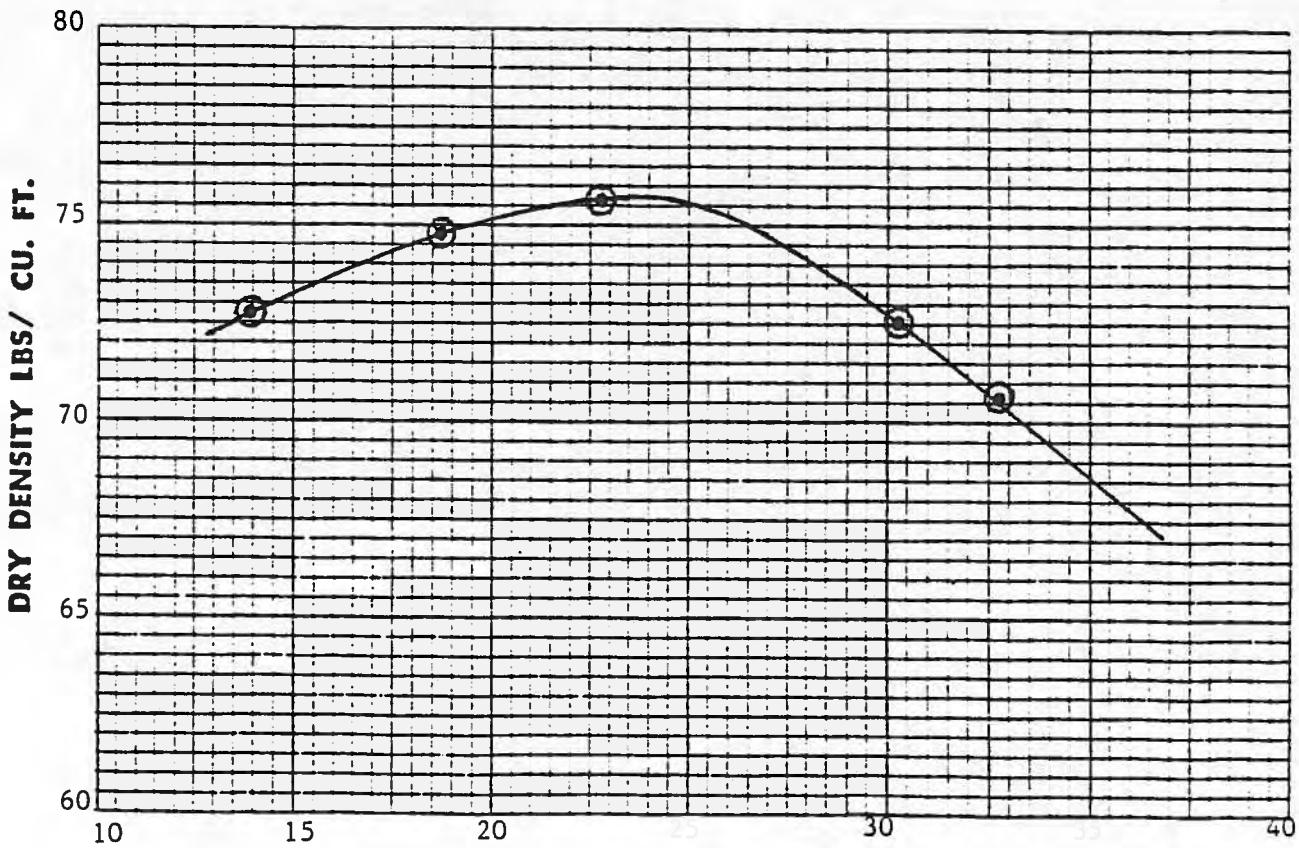
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

CLIENT: I.T. Corporation DATE: January, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly ash sample 4764
TEST METHOD: ASTM D 698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 22.8 % BY WEIGHT FIELD MOISTURE 34.4 % BY WEIGHT
MAX DRY DENSITY 75.5 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9741
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4765 sludge #4 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4765

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.3

Minimum Index: 51.1 $lbs./Ft^3$

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4765

Length = 3.25 in. Weight = 1.069 lbs. Specific Gravity = 2.31

Diameter = 2.8 in. Moisture = 28.3 % Total Volume = 0.01158 Ft^3

$Weight_w$ = 1.069 lbs. - 0.833 lbs. = 0.236 lbs.

$Volume_w$ = 0.236 lbs./ 62.4 lbs./Ft^3 = 0.00378 Ft^3

$Volume_s$ = 0.833 lbs./(62.4 lbs./Ft^3) (2.3) = 0.0058 Ft^3

$Volume_a$ = 0.01158 Ft^3 - (0.00378 + 0.0058) = 0.001996 Ft^3

$Volume_v$ = 0.01158 Ft^3 - 0.0058 Ft^3 = 0.00578 Ft^3

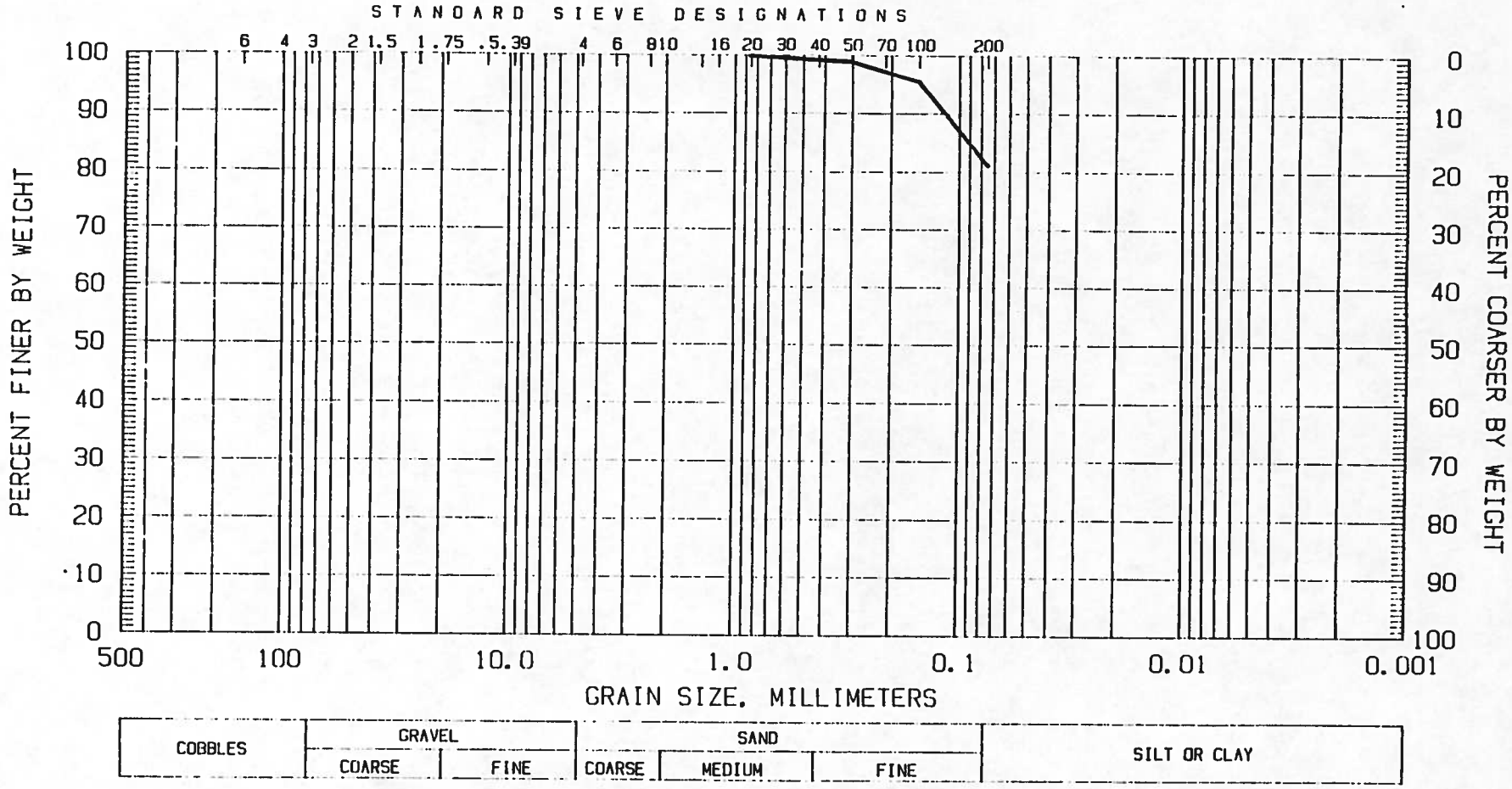
$$e = \frac{0.00578}{0.0058} = 0.997$$

$$n = \frac{0.00578}{0.01158} = 49.9 \quad \%$$

$$k = 8.3 \times 10^{-6} \text{ cm/sec}$$

NOTE: All permeabilities calculated on samples remolded to 95 ± 1% compaction as determined by the standard Proctor (ASTM D 698-78).

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
JANUARY 28, 1985
TEST PIT: 1 SAMPLE: 5
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4765
NATURAL MOISTURE CONTENT= 29.3 %
REMARKS:

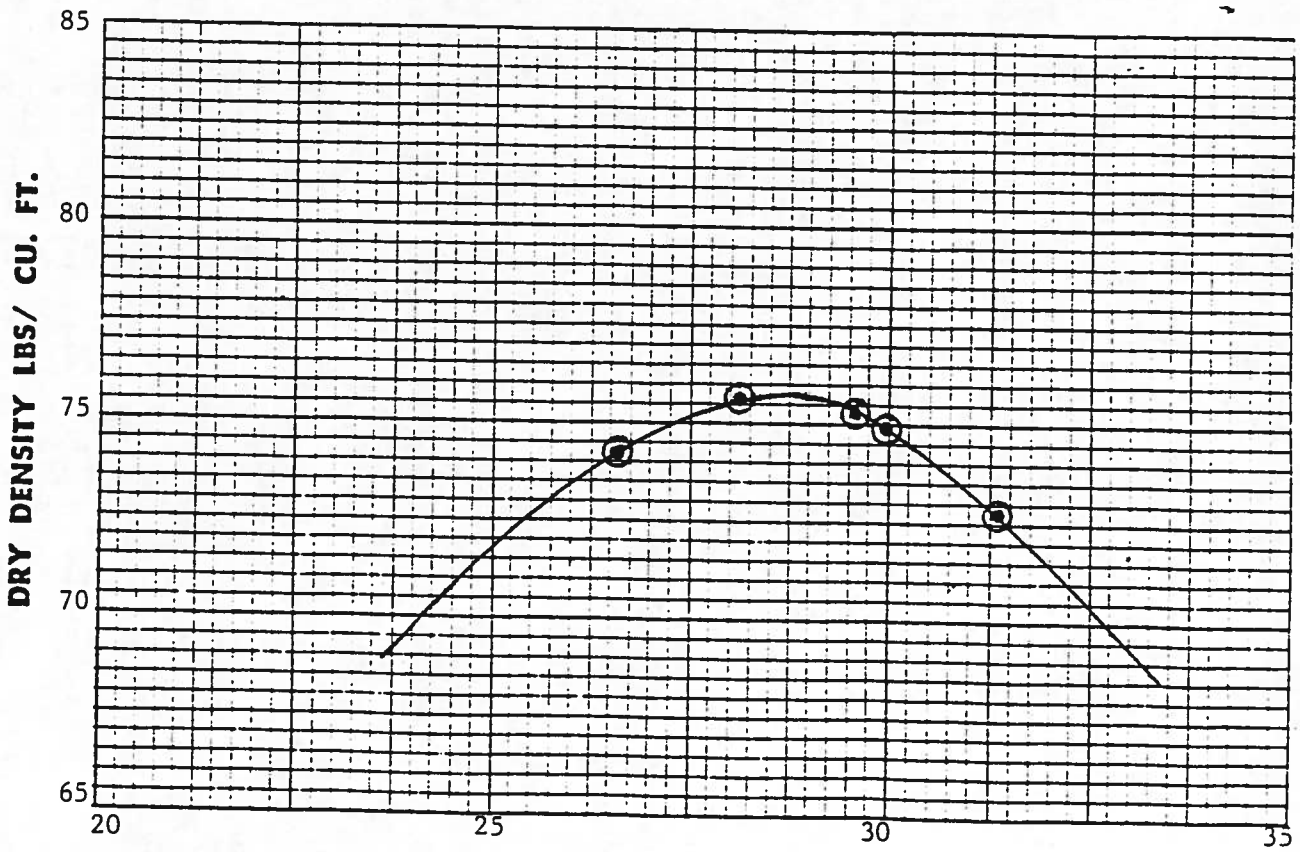
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: January, 1985
PROJECT: Utah International Soils Testing 85-3014
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly ash sample 4765
TEST METHOD: ASTM D 698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 28.1 % BY WEIGHT FIELD MOISTURE 29.3 % BY WEIGHT
MAX DRY DENSITY 75.6 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4770 Sludges as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4770

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.3

Minimum Index: 48.2 $lbs./Ft^3$

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4770

Length = 3.73 in. Weight = 1.205 lbs. Specific Gravity = 2.3

Diameter = 2.8 in. Moisture = 31.6 % Total Volume = 0.01329 Ft^3

$Weight_w$ = 1.205 lbs. - 0.916 lbs. = 0.289 lbs.

$Volume_w$ = 0.289 lbs./62.4 lbs./Ft^3 = 0.00464 Ft^3

$Volume_s$ = 0.916 lbs./(62.4 lbs./Ft^3) (2.3) = 0.00638 Ft^3

$Volume_a$ = 0.01329 Ft^3 - (0.00464 + 0.00638) = 0.00227 Ft^3

$Volume_v$ = 0.01329 Ft^3 - 0.00638 Ft^3 = 0.00691 Ft^3

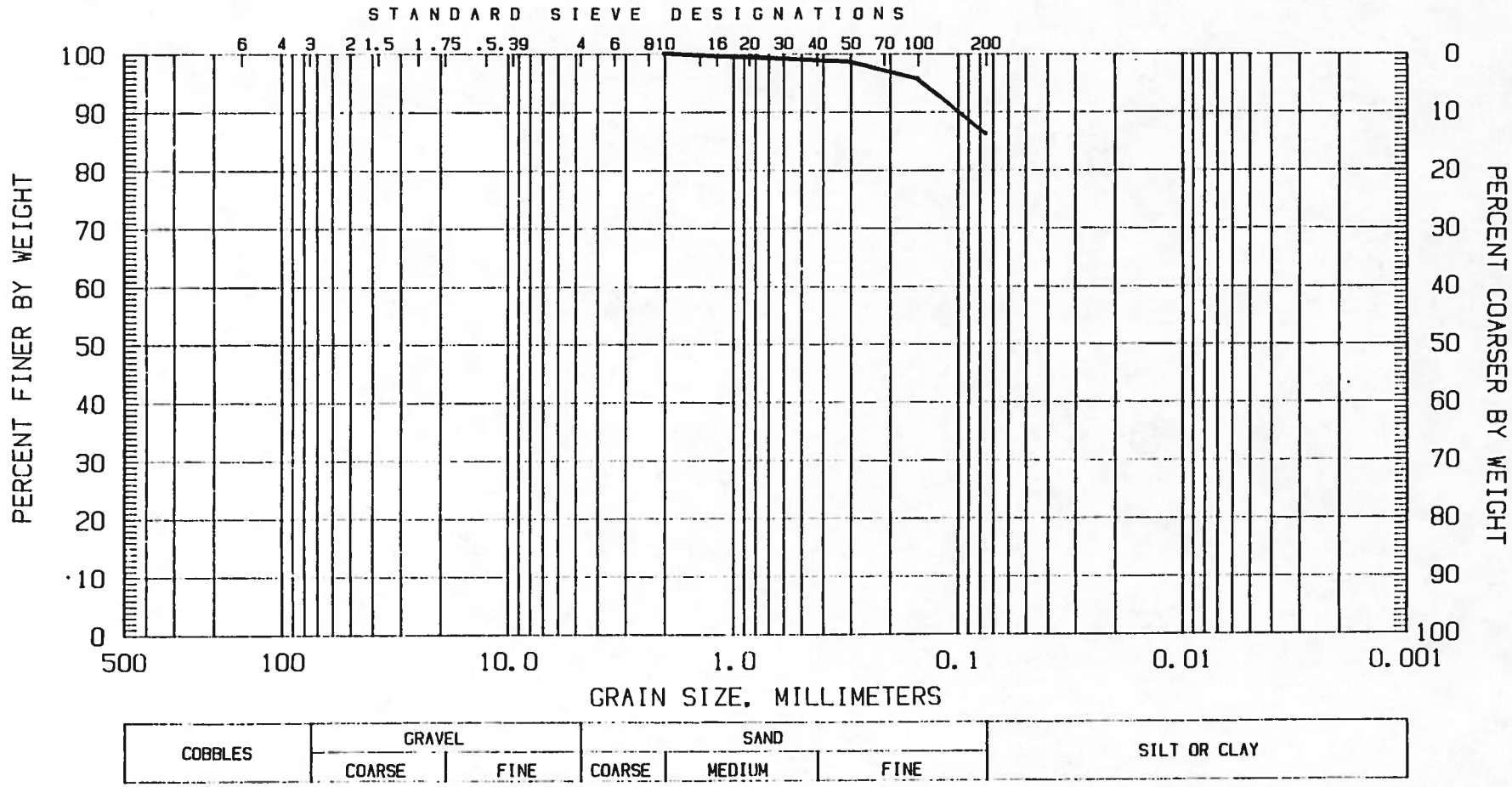
$$e = \frac{0.00691}{0.00638} = 1.083$$

$$n = \frac{0.00691}{0.01329} = 52.0 \%$$

$$k = 8.2 \times 10^{-6} \text{ cm/sec}$$

NOTE: All permeabilities calculated on samples remolded to 95 ± 1% compaction as determined by the standard Proctor (ASTM D 698-78).

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
JANUARY 28, 1985
TEST PIT: 1 SAMPLE: 1
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4770
NATURAL MOISTURE CONTENT= 37.4 %
REMARKS:

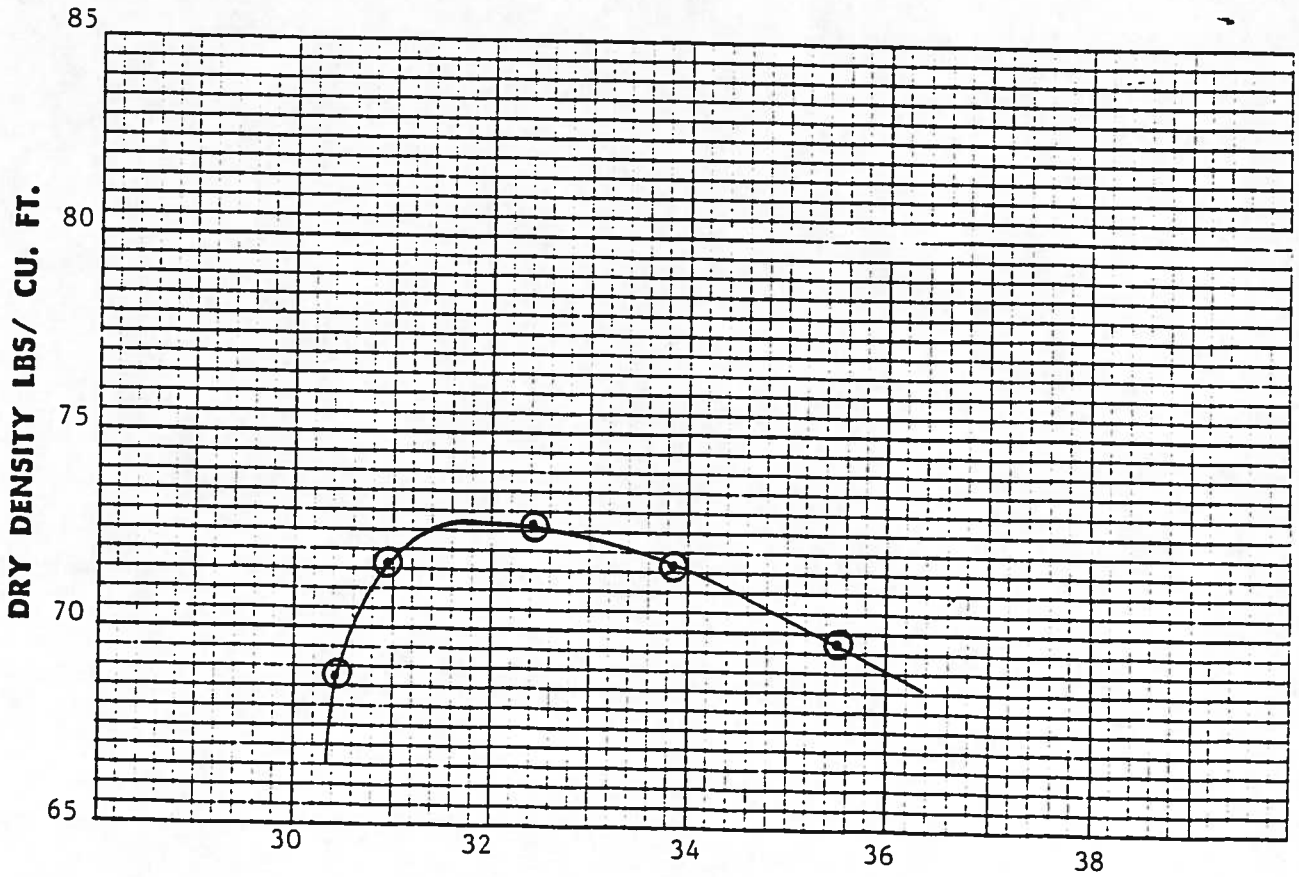
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: January, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly Ash Sample No. 4770
TEST METHOD: ASTM D 698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 32.4 % BY WEIGHT FIELD MOISTURE 37.4 % BY WEIGHT
MAX DRY DENSITY 72.7 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date January, 1985.

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4774 Sludge #6 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4774

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.21

Minimum Index: 50.3 lbs./Ft^3

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date January, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4774

Length = 3.50 in. Weight = 1.11 lbs. Specific Gravity = 2.21

Diameter = 2.8 in. Moisture = 25.2 % Total Volume = 0.01247 Ft^3

$Weight_w$ = 1.11 lbs. - 0.0887 lbs. = 0.223 lbs.

$Volume_w$ = 0.223 lbs./62.4 lbs./ft^3 = 0.00358 ft^3

$Volume_s$ = 0.887 lbs./(62.4) (2.21) = 0.00643 ft^3

$Volume_a$ = 0.01247 ft^3 - (0.00358 + 0.00643) = 0.00246 ft^3

$Volume_v$ = 0.01247 ft^3 - 0.00643 ft^3 = 0.00604 ft^3

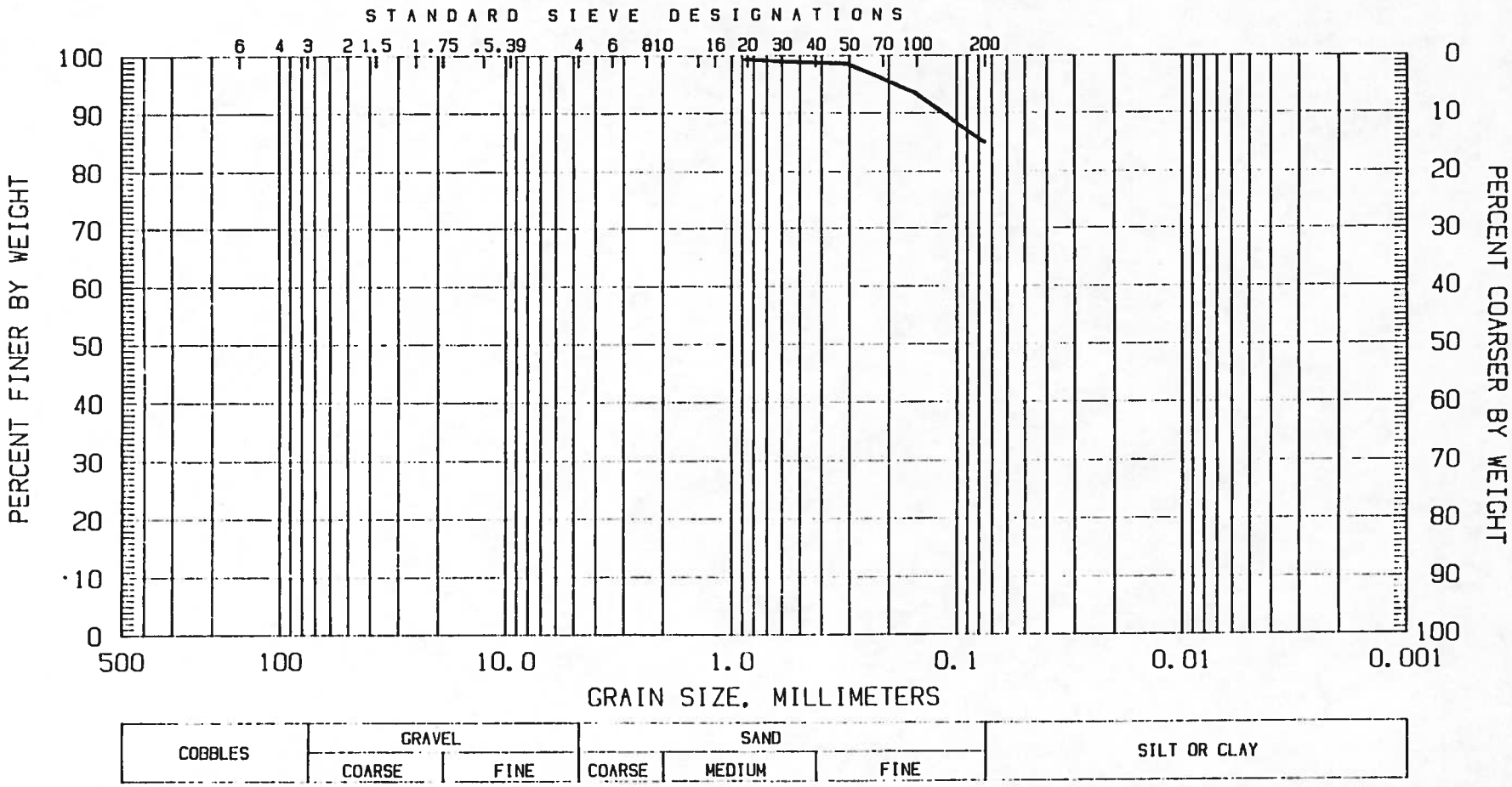
$$e = \frac{0.00604}{0.00643} = 0.939$$

$$n = \frac{0.00604}{0.01247} = 48.4 \quad \%$$

$$k = 7.3 \times 10^{-6} \text{ cm/sec}$$

NOTE: All permeabilities calculated on samples remolded to 95 ± 1% compaction as determined by the standard Proctor (ASTM D 698-78).

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
JANUARY 28, 1985
TEST PIT: 1 SAMPLE: 6
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4774
NATURAL MOISTURE CONTENT= 21.4 %
REMARKS:

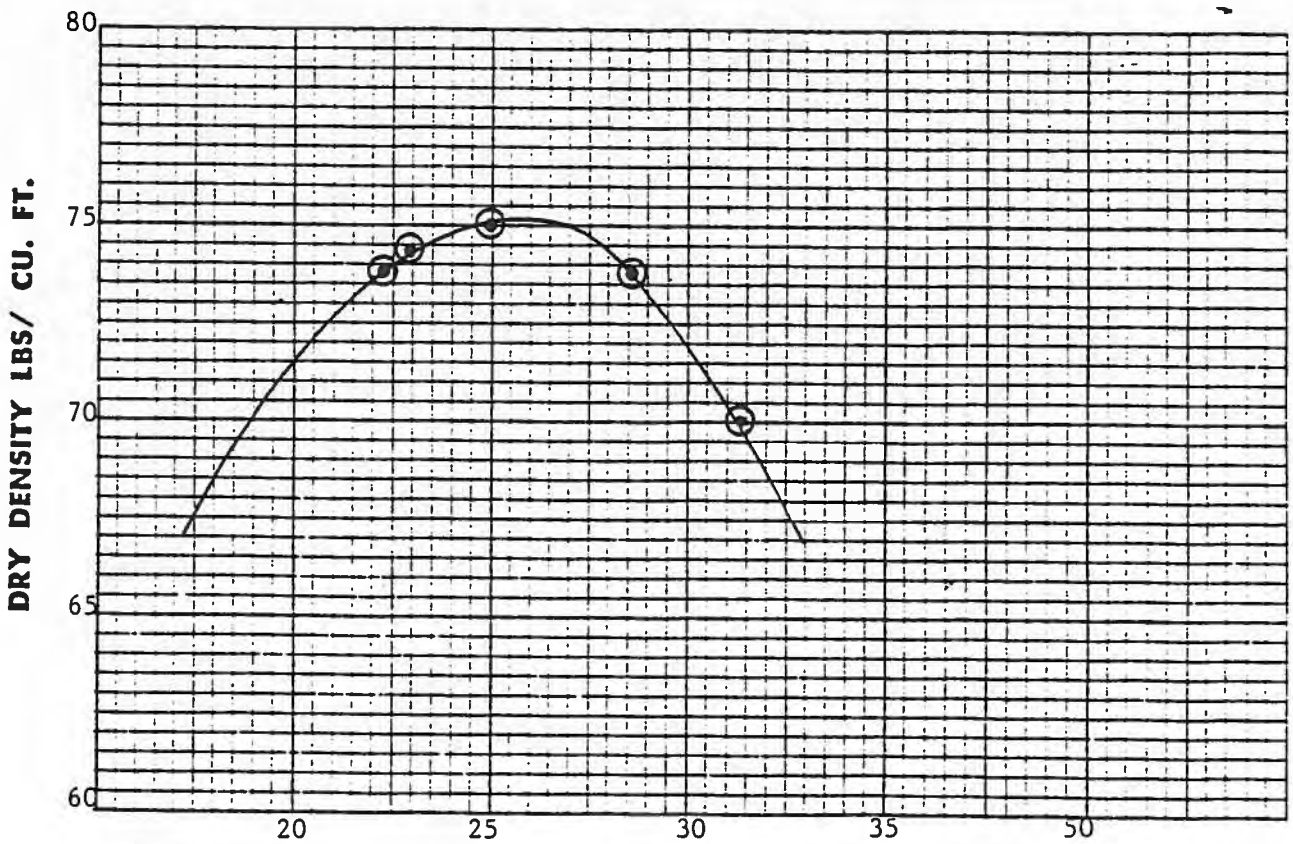
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: January, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly ash sample 4774
TEST METHOD: ASTM D 698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 24.9 % BY WEIGHT FIELD MOISTURE 21.4 % BY WEIGHT
MAX DRY DENSITY 74.9 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date February, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4785 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4785 - Sludge # 7

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.11

Minimum Index: 51.4 lbs/Ft^3

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Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date February, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4785

Length = 3.50 in. Weight = 1.105 lbs. Specific Gravity = 2.11

Diameter = 2.8 in. Moisture = 28.5 % Total Volume = 0.01247 Ft^3

$Weight_w$ = 1.105 lbs.-0.860 lbs. = 0.245 lbs.

$Volume_w$ = 0.245 lbs./62.4 lbs./Ft^3 = 0.00393 Ft^3

$Volume_s$ = 0.860 lbs./(2.11) (62.4 lbs/Ft^3) = 0.00653 Ft^3

$Volume_a$ = 0.01247 Ft^3 - (0.00393 + 0.00653) = 0.00201 Ft^3

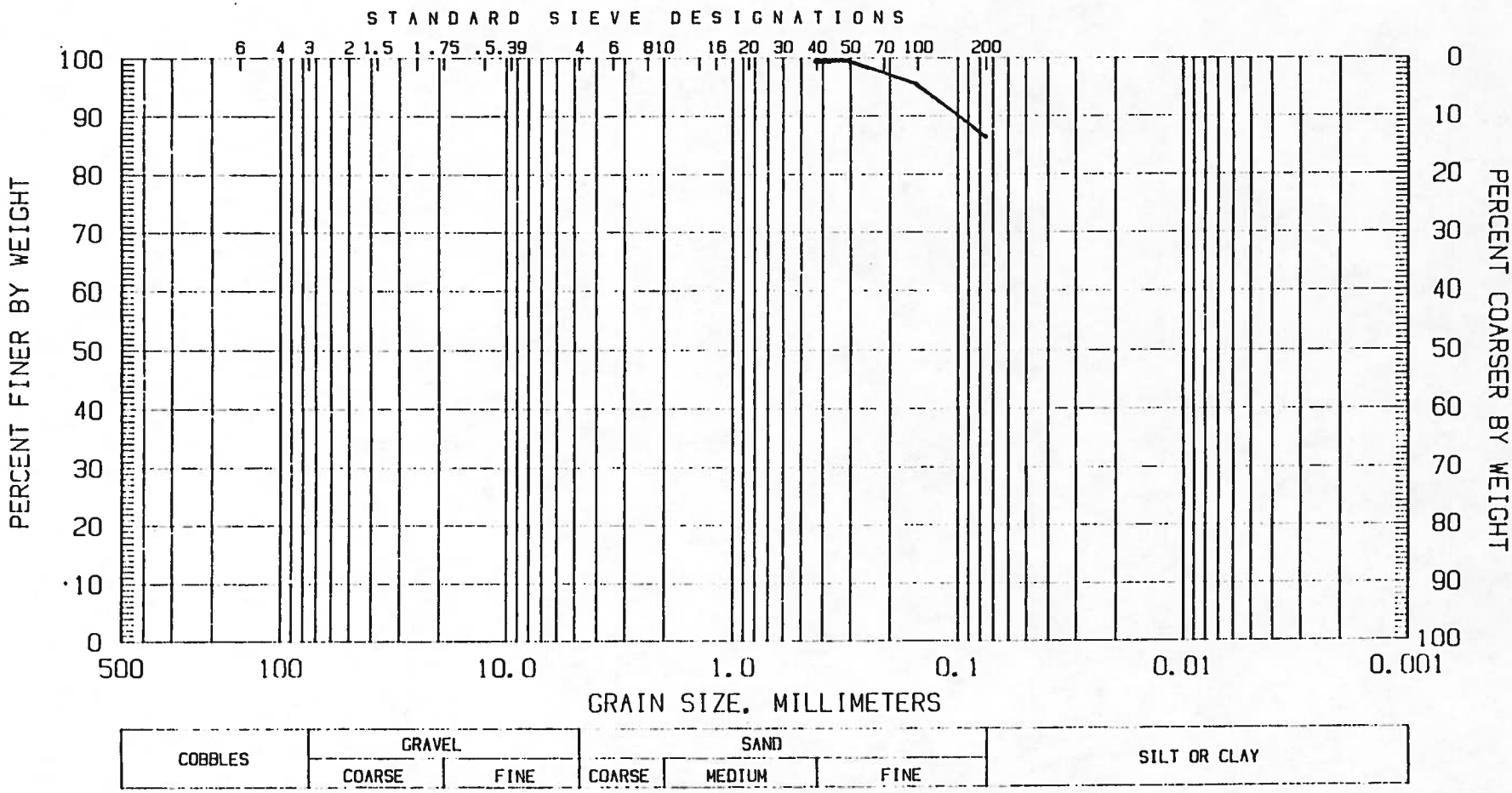
$Volume_v$ = 0.01247 Ft^3 - 0.00653 Ft^3 = 0.00594

$$e = \frac{0.00594}{0.00653} = 0.9096$$

$$n = \frac{0.00594}{0.01247} = 47.6 \%$$

$$k = 4.9 \times 10^{-6} \text{ cm/sec}$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014K
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
FEBRUARY 27, 1985
TEST PIT: 2 SAMPLE: 1
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4785
NATURAL MOISTURE CONTENT= 20.1 %
REMARKS:

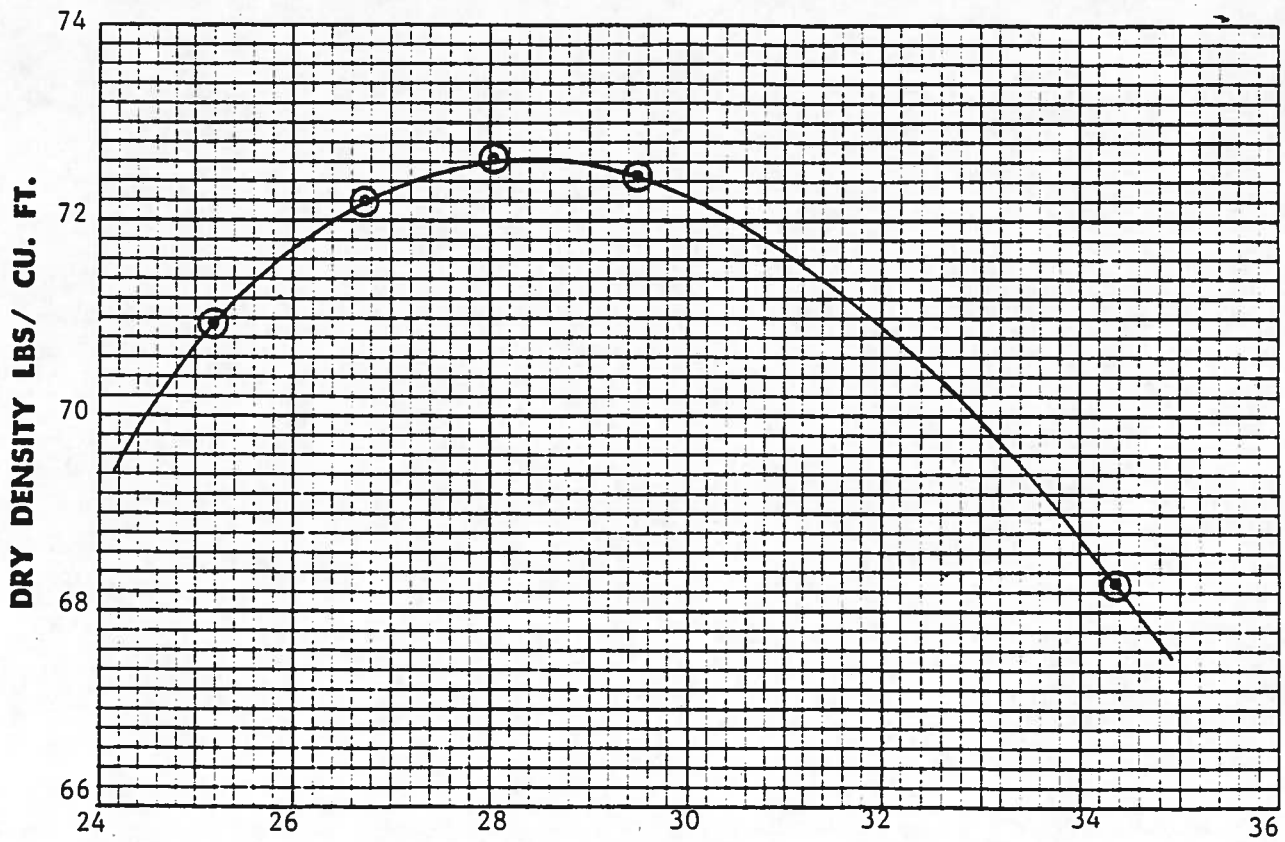
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: February, 1985
PROJECT: Utah International Soils Testing 85-3014
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly Ash Sample No. 4785
TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



MOISTURE CONTENT % BY WEIGHT

OPTIMUM MOISTURE: 28.2 % BY WEIGHT FIELD MOISTURE 20.1 % BY WEIGHT
MAX DRY DENSITY 72.7 LBS/CU. FT.
LAB TEST BY:
REMARKS:

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 237-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date February, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4786 -Sample #8 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4786

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.12

Minimum Index: 53.1 lbs./Ft^3

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date February, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4786

Length = 3.44 in. Weight = 1.142 lbs. Specific Gravity = 2.12

Diameter = 2.8 in. Moisture = 22.9 % Total Volume = 0.01225 Ft^3

$Weight_w$ = 1.142 lbs.-0.929 lbs. = 0.213 lbs.

$Volume_w$ = 0.213 lbs./62.4 lbs./Ft^3 = 0.00341 Ft^3

$Volume_s$ = 0.929 lbs./(2.12)(62.4 lbs./Ft^3) = 0.00702 Ft^3

$Volume_a$ = 0.01225 Ft^3-(0.00341 + 0.00702) = 0.00182 Ft^3

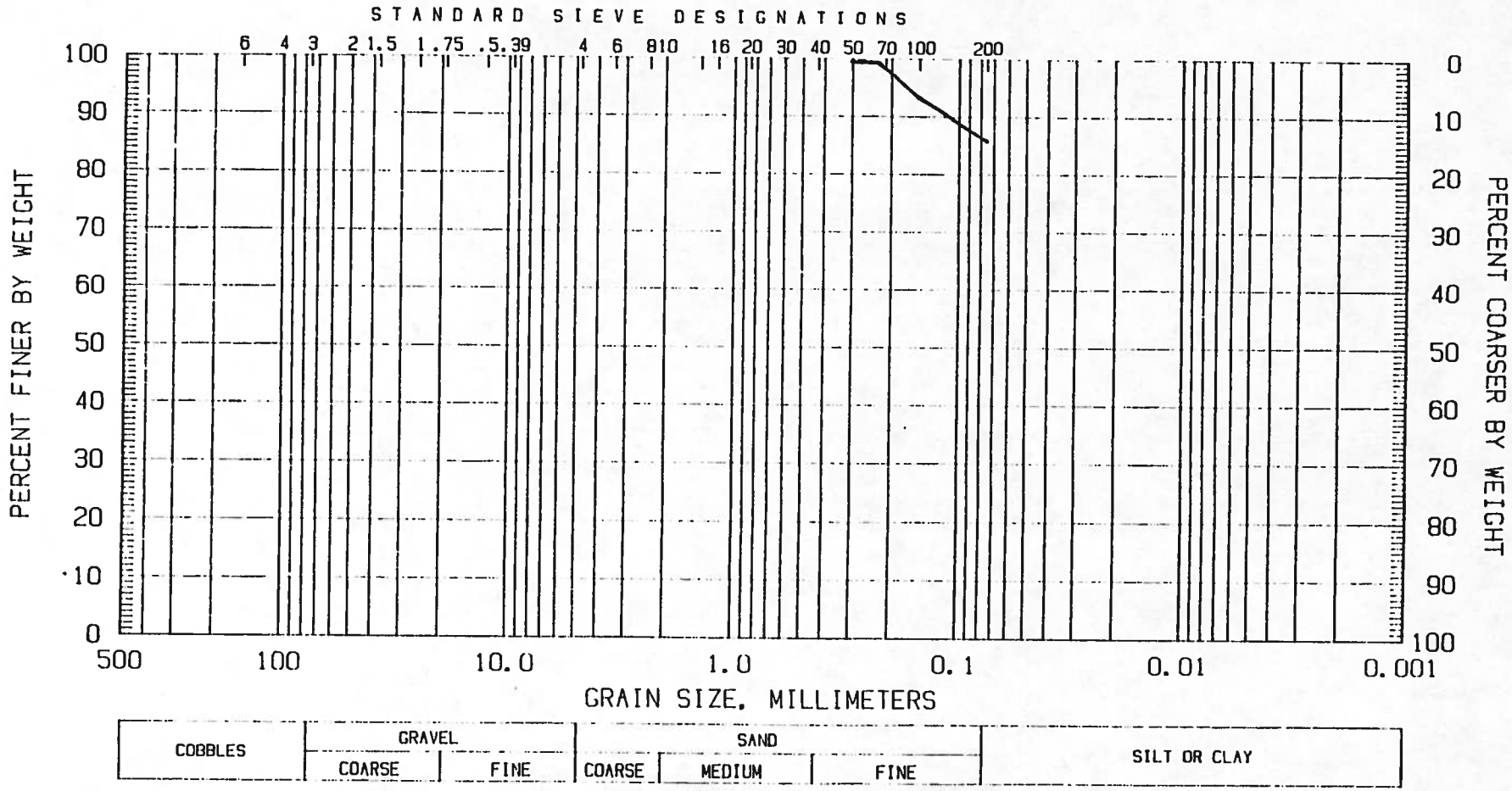
$Volume_v$ = 0.01225 Ft^3 - 0.00702 Ft^3 = 0.00523 Ft^3

$$e = \frac{0.00523}{0.00702} = 0.745$$

$$n = \frac{0.00523}{0.01225} = 42.7\ \%$$

$$k = 4.9 \times 10^{-6}\ cm/sec$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014K
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
FEBRUARY 27, 1985
TEST PIT: 2 SAMPLE: 2
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4786
NATURAL MOISTURE CONTENT= 31.5 %
REMARKS:

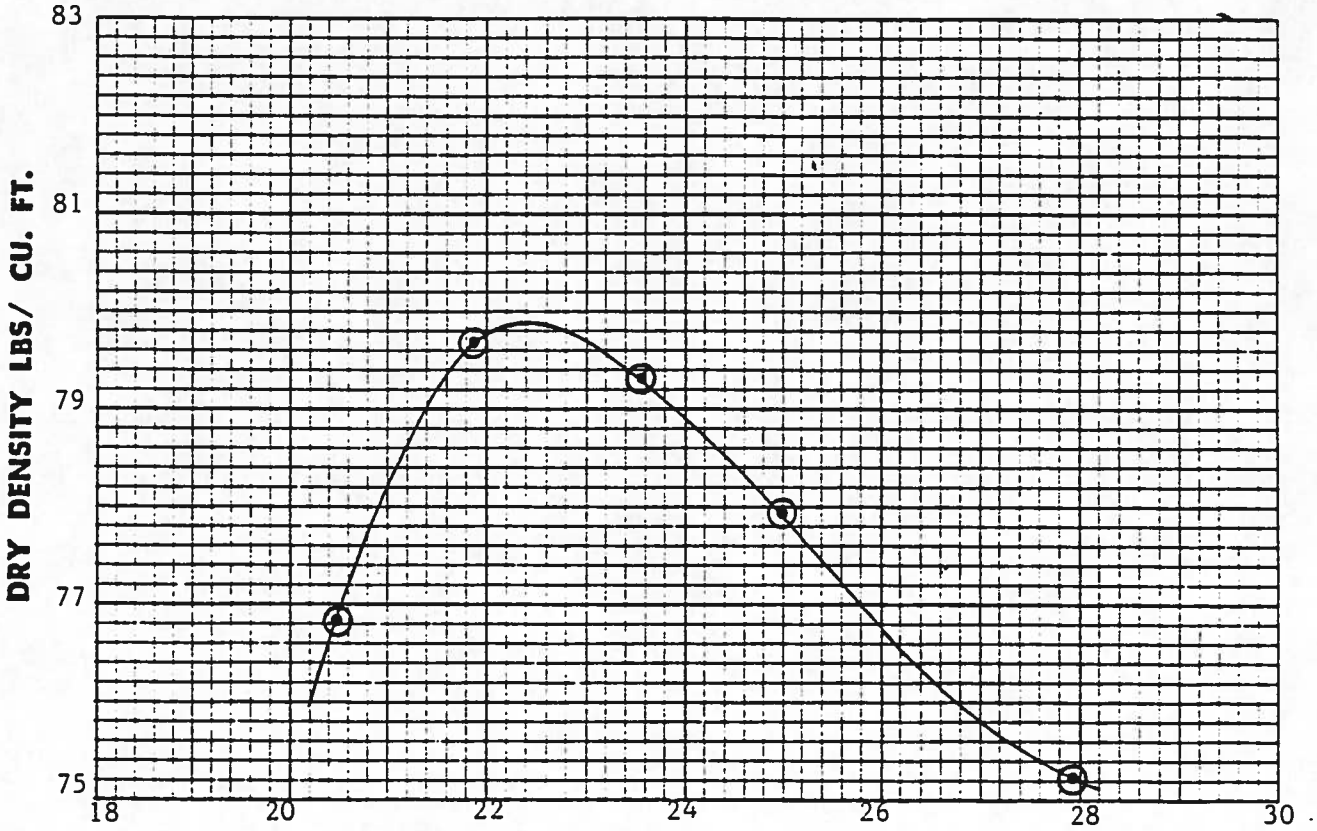
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: February, 1985
PROJECT: Utah International Soils Testing 85-3014
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly Ash Sample No. 4786
TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 22.5 % BY WEIGHT FIELD MOISTURE 31.5 % BY WEIGHT
MAX DRY DENSITY 79.9 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date February, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4789 Sample #
as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4789

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.22

Minimum Index: 56.6 $lbs./Ft^3$

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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date February, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4789

Length = 3.59 in. Weight = 1.190 lbs. Specific Gravity = 2.22

Diameter = 2.8 in. Moisture = 28.3 % Total Volume = 0.01279 Ft^3

$Weight_w$ = 1.19 lbs. - 0.928 lbs. = 0.262 lbs.

$Volume_w$ = 0.262 lbs./62.4 lbs./cu. ft^3 = 0.0042 cu. ft^3

$Volume_s$ = 0.928 lbs./(2.22) (62.4 lbs./cu. ft^3) = 0.0067 cu. ft^3

$Volume_a$ = 0.01279 Ft^3 (0.0042 + 0.0067) = 0.00189 Ft^3

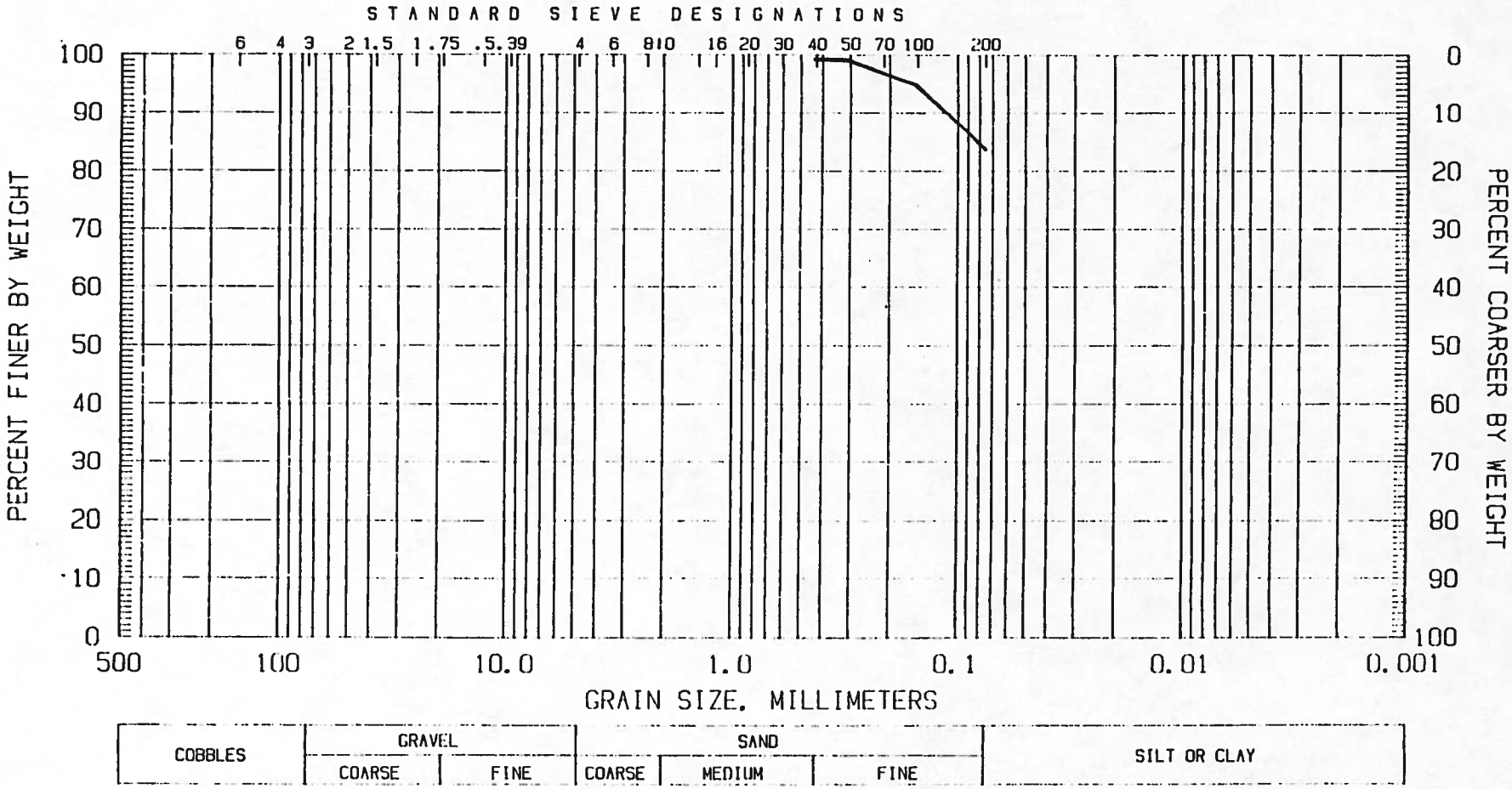
$Volume_v$ = 0.01279 Ft^3 - 0.0067 Ft^3 = 0.00609 Ft^3

$$e = \frac{0.00609}{0.00670} = 0.909$$

$$n = \frac{0.00609}{0.01279} = 47.6\ \%$$

$$k = 4.6 \times 10^{-6}\ cm/sec$$

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014K
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
FEBRUARY 27, 1985
TEST PIT: 2 SAMPLE: 3
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4789
NATURAL MOISTURE CONTENT= 33.4 %
REMARKS:

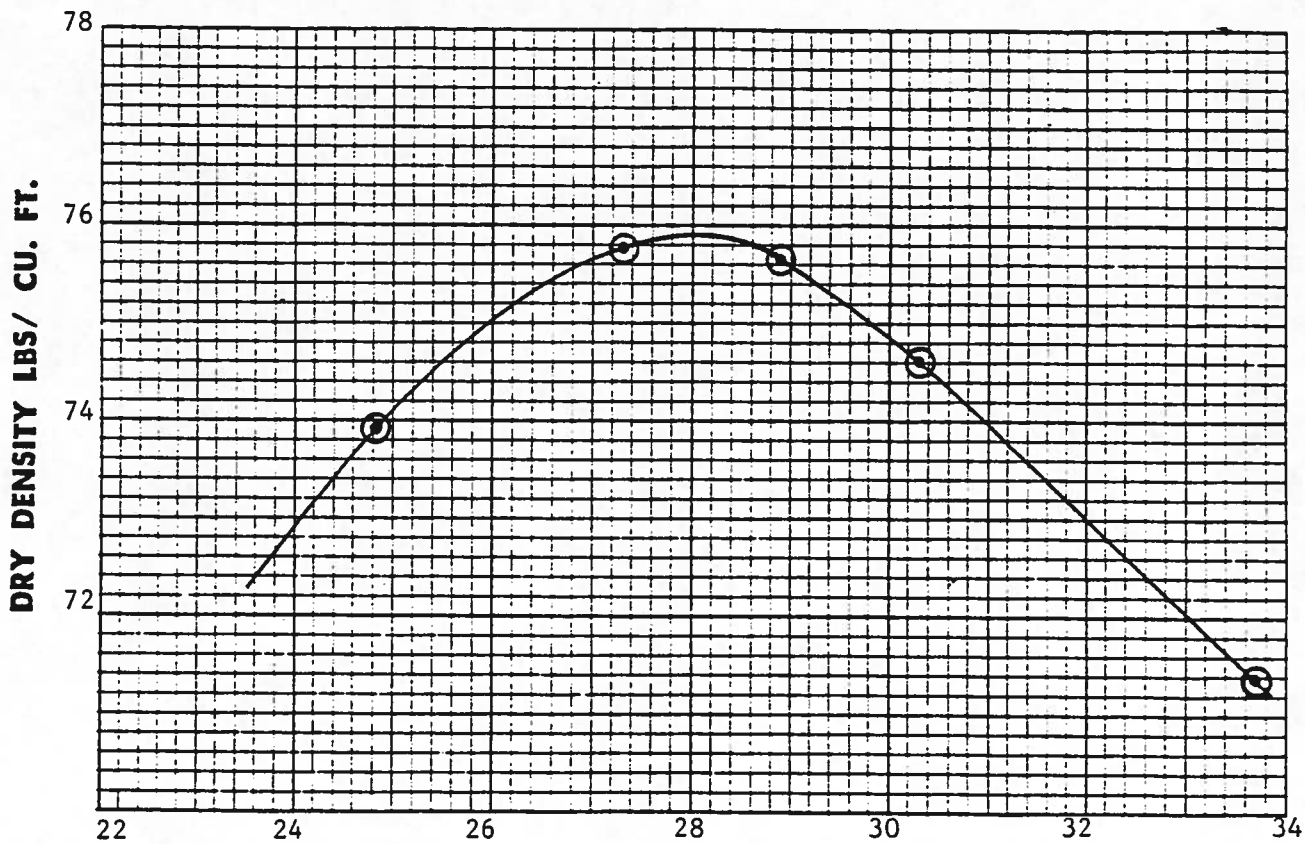
GEOLOGIC ASSOCIATES, INC.

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: February, 1985
PROJECT: Utah International Soils Testing 85-3014
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly Ash Sample No. 4789
TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 28.1 % BY WEIGHT FIELD MOISTURE 33.4 % BY WEIGHT
MAX DRY DENSITY 75.9 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
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Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date March, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4791 Sludge #10 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4791

Method: A

Volume of Mold: 0.100 Ft^3

Specific Gravity: 2.20

Minimum Index: 51.2 lbs/Ft^3

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Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date March, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4791

Length = 4.00 in. Weight = 1.232 lbs. Specific Gravity = 2.20

Diameter = 2.8 in. Moisture = 25.5 % Total Volume = 0.01425 Ft^3

$Weight_w$ = 1.232 lbs.-0.981 lbs. = 0.251 lbs.

$Volume_w$ = 0.251 lbs./62.4 lbs./cu.ft.^{3} = 0.00402 cu.ft.^{3}

$Volume_s$ = 0.981 lbs./(62.4 lbs./cu.ft.^{3}) (2.20) = 0.00715 cu.ft.^{3}

$Volume_a$ = 0.01425 Ft^3 - (0.00402 + 0.00715) = 0.00308 Ft^3

$Volume_v$ = 0.01425 Ft^3 - 0.00715 Ft^3 = 0.0071 Ft^3

$$e = \frac{0.00710}{0.00715} = 0.993$$

$$n = \frac{0.00710}{0.01425} = 49.8 \ \%$$

$$k = 6.2 \times 10^{-6} \text{ cm/sec}$$

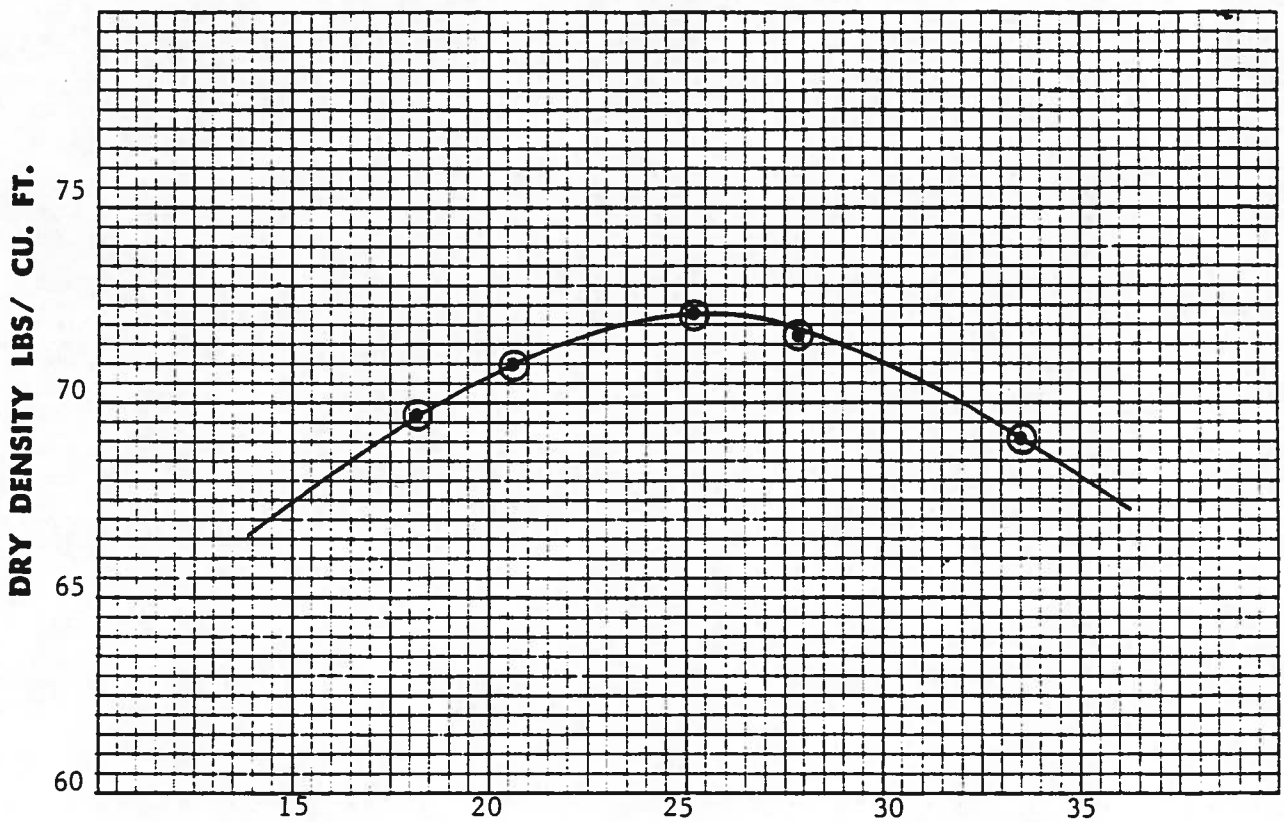
NOTE: All permeability tests conducted were remolded to 95%±1% of the maximum dry density as determined by the standard Proctor (ASTM D698-78).

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

CLIENT: I. T. Corporation DATE: March, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly Ash Sample No. 4791
TEST METHOD: ASTM D698-78 Method A

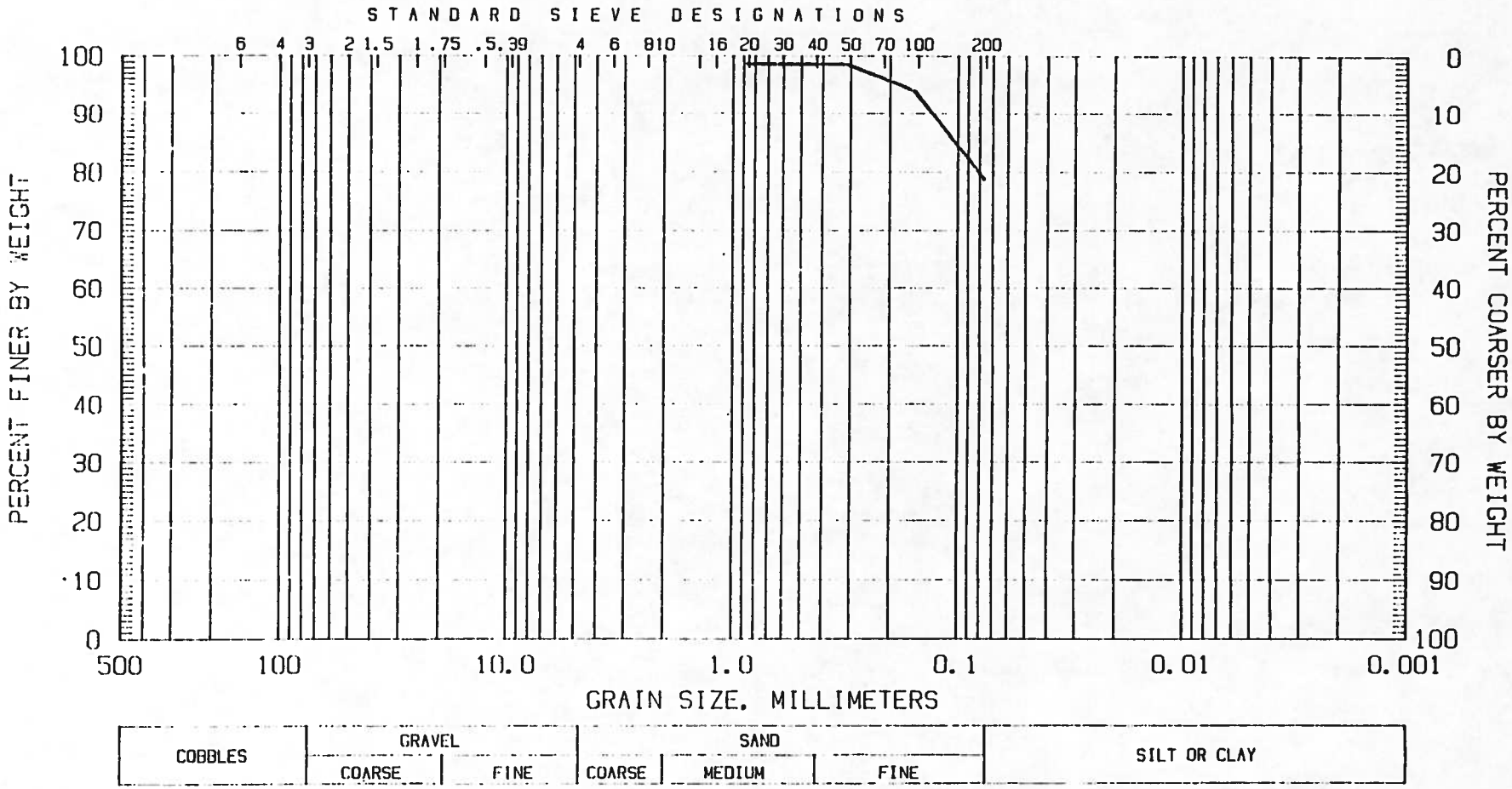
MOISTURE DENSITY RELATIONSHIP



MOISTURE CONTENT % BY WEIGHT

OPTIMUM MOISTURE: 25.1 % BY WEIGHT FIELD MOISTURE 18.5 % BY WEIGHT
MAX DRY DENSITY 72.4 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014K
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
MARCH 8, 1985
TEST PIT: 3 **SAMPLE: 1**
DEPTH: N/A **FT**

FLY ASH SAMPLE NO. 4791
NATURAL MOISTURE CONTENT= 18.5 %
REMARKS:

GEOLOGIC ASSOCIATES, INC.

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date March, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4800 Sludge #11 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4800

Method: A

Volume of Mold: 0.100 $Ft.^3$

Specific Gravity: 2.10

Minimum Index: 48.8 $lbs./Ft.^3$

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date March, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4800

Length = 3.84 in. Weight = 1.188 lbs. Specific Gravity = 2.10

Diameter = 2.8 in. Moisture = 29.9 % Total Volume = 0.01368 Ft^3

$Weight_w$ = 1.188 lbs. - 0.915 lbs. = 0.273 lbs.

$Volume_w$ = 0.273 lbs./62.4 lbs./cu.ft.^{3} = 0.00438 Ft.^{3}

$Volume_s$ = 0.915 lbs./(62.4 lbs./cu.ft.^{3}) (2.10) = 0.00698 Ft.^{3}

$Volume_a$ = 0.01368 Ft.^{3} - (0.00438 + 0.00698) = 0.01136 Ft.^{3}

$Volume_v$ = 0.01368 Ft.^{3} - 0.00698 Ft.^{3} = 0.0067 Ft.^{3}

$$e = \frac{0.0067}{0.00698} = 0.96$$

$$n = \frac{0.0067}{0.01368} = 49.0 \ \%$$

$$k = 6.6 \times 10^{-6} \text{ cm/sec}$$

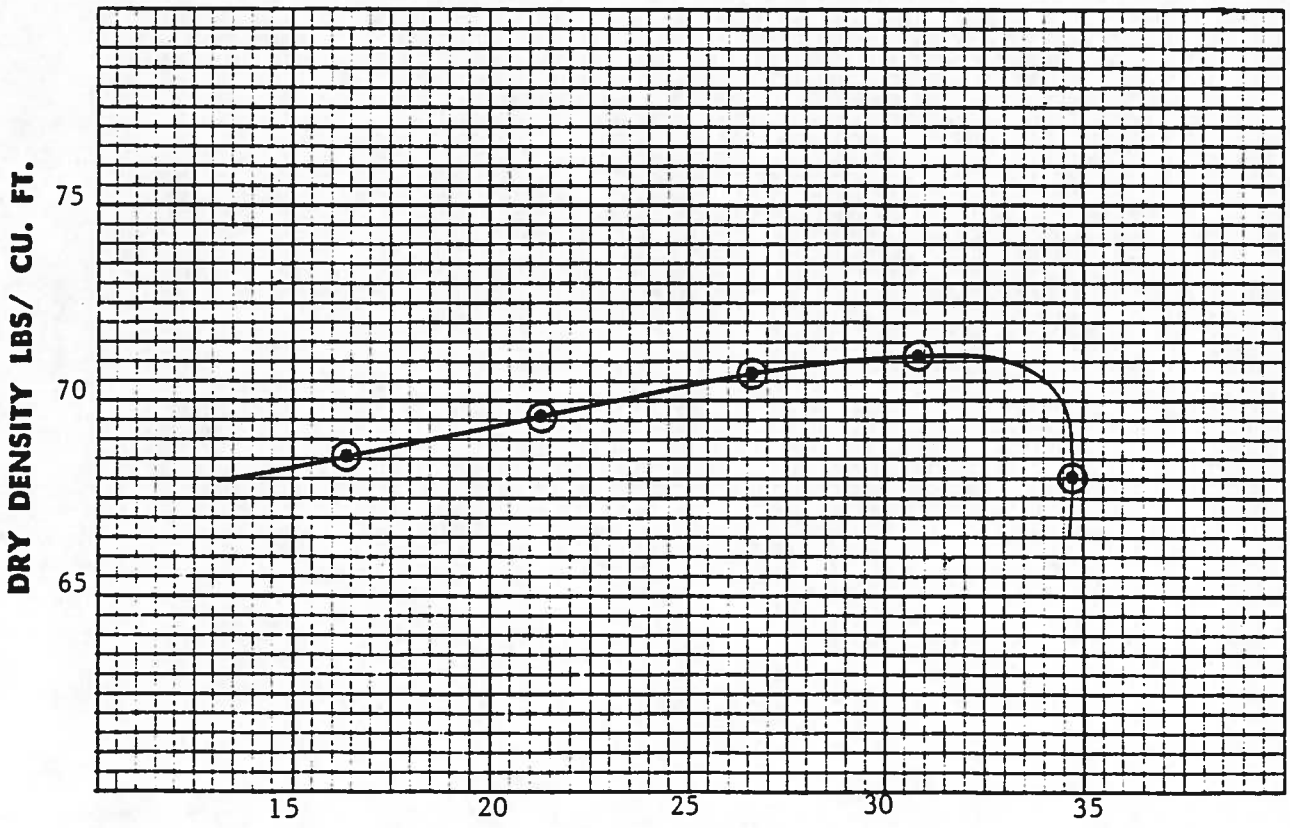
NOTE: All permeability tests conducted were remolded to 95%±1% of the maximum dry density as determined by the standard Proctor (ASTM D698-78).

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST — MOISTURE DENSITY RELATIONSHIP

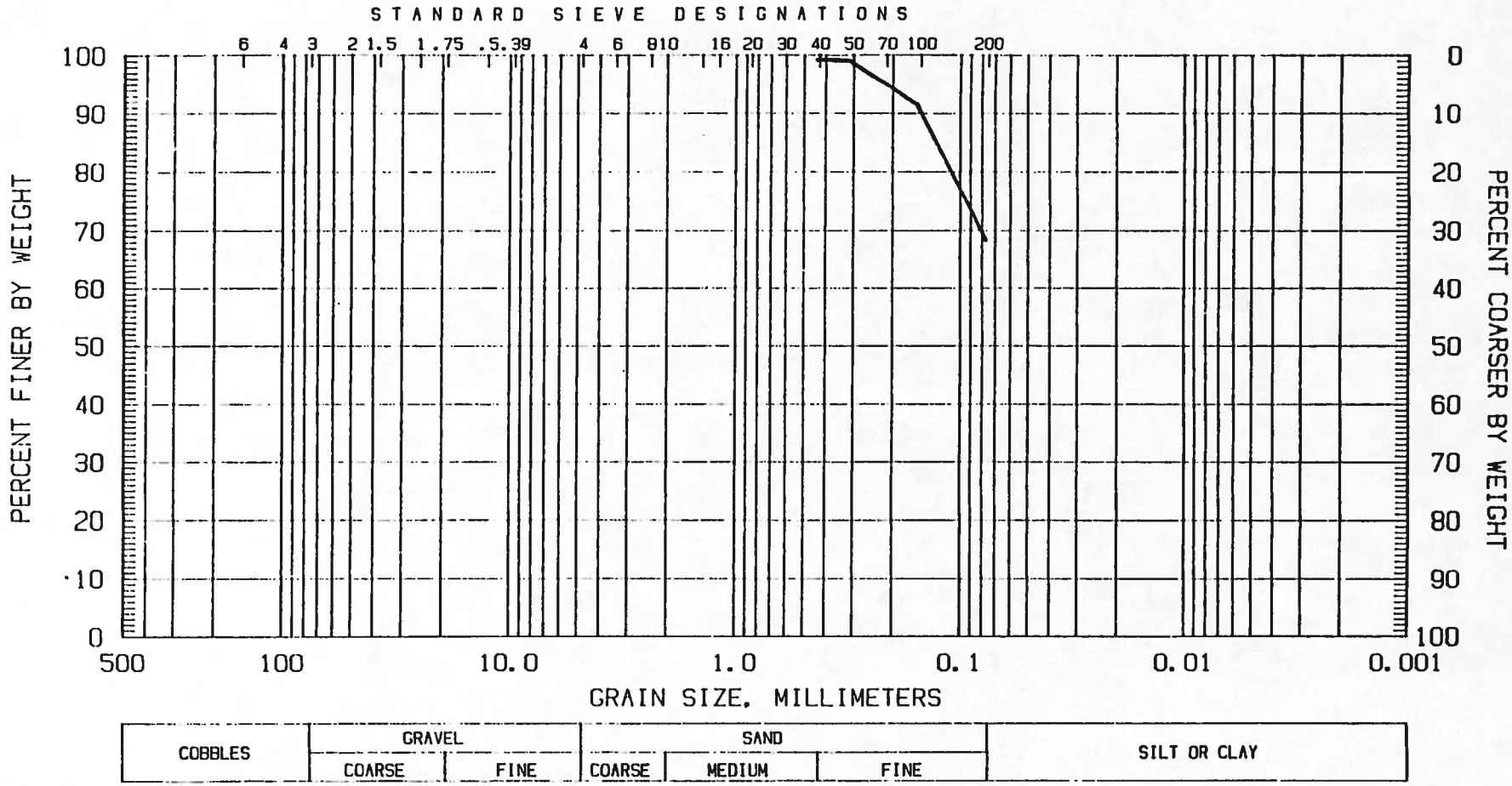
CLIENT: I. T. Corporation DATE: March, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Sample No. 4800
TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 30.8 % BY WEIGHT FIELD MOISTURE 16.1 % BY WEIGHT
MAX DRY DENSITY 70.8 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014K
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
MARCH 8, 1985
TEST PIT: 3 SAMPLE: 2
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4800
NATURAL MOISTURE CONTENT= 16.1 %
REMARKS:

GEOLOGIC ASSOCIATES, INC.

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF MINIMUM INDEX DENSITY OF SOILS

ASTM D 4254-83

Client I. T. Enviroscience Date March, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

This report includes the minimum index density test results of sample 4801 Sludge #12 as delivered by I. T. Enviroscience. These tests were conducted in accordance with ASTM D 4254-83, Method A.

Sample: Fly Ash Sample No. 4801

Method: A

Volume of Mold: 0.100 $Ft.^3$

Specific Gravity: 2.14

Minimum Index: 52.3 $lbs./Ft.^3$

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LABORATORY DIVISION
Franklin, Tennessee 615 794-3596
Knoxville, Tennessee 615 966-9761
Kingsport, Tennessee 615 239-5192

Report No. _____

REPORT OF POROSITY AND PERMEABILTY CALCULATIONS

Client I. T. Corporation Date March, 1985

Project No. 85-3014 Project Name & Location Utah International Soils Testing

Fly Ash Sample No. 4801

Length = 4.09 in. Weight = 1.304 lbs. Specific Gravity = 2.14

Diameter = 2.8 in. Moisture = 29.1 % Total Volume = 0.01457 Ft^3

$Weight_w$ = 1.304 lbs. - 1.01 lbs. = 0.294 lbs.

$Volume_w$ = 0.294 lbs./62.4 lbs./$Ft.^3$ = 0.0047 $Ft.^3$

$Volume_s$ = 1.01 lbs./(62.4 lbs./$Ft.^3$) (2.14) = 0.00756 $Ft.^3$

$Volume_a$ = 0.01457 $Ft.^3$ - (0.0047 + 0.00756) = 0.00231 $Ft.^3$

$Volume_v$ = 0.01457 $Ft.^3$ - 0.00756 $Ft.^3$ = 0.00701 $Ft.^3$

$$e = \frac{0.00701}{0.00756} = 0.927$$

$$n = \frac{0.00701}{0.01457} = 48.1 \%$$

$$k = 6.2 \times 10^{-6} \text{ cm/sec}$$

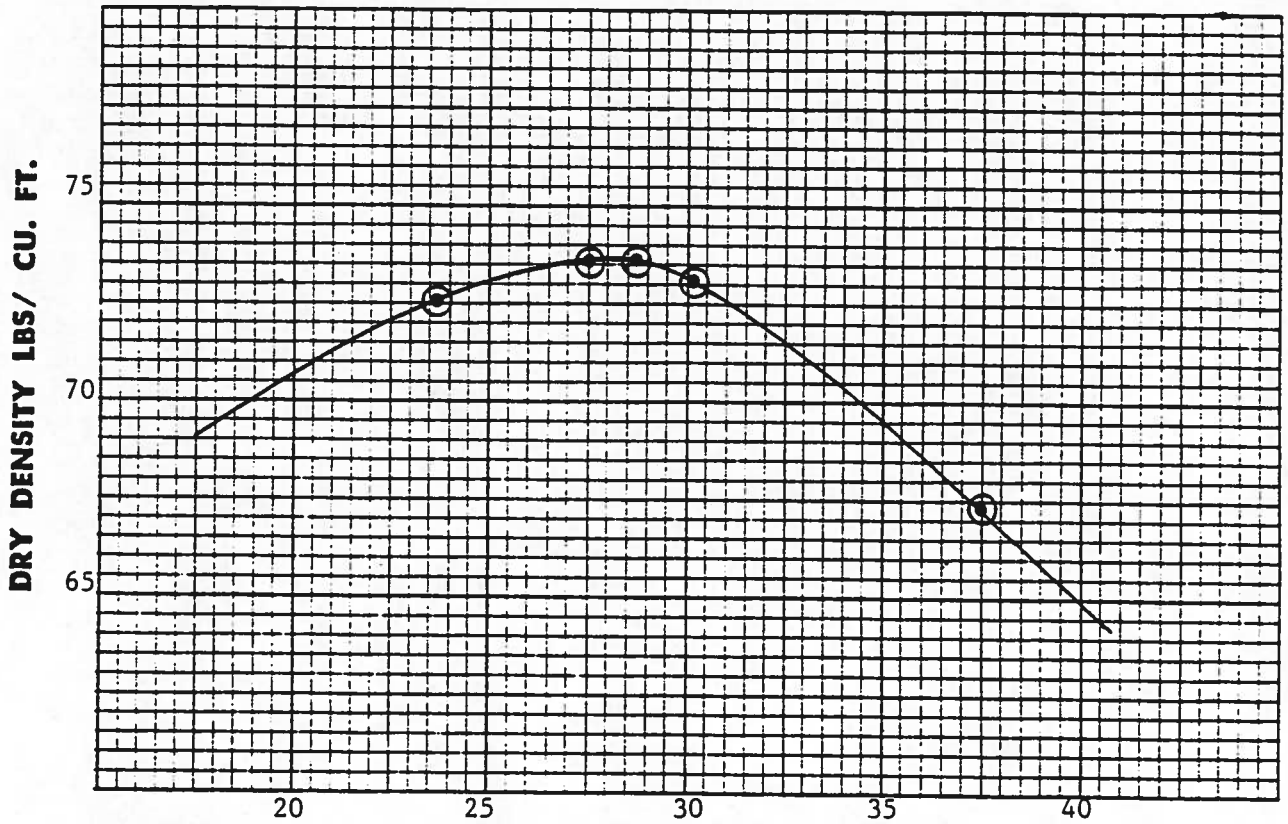
NOTE: All permeability tests conducted were remolded to 95%±1% of the maximum dry density as determined by the standard Proctor (ASTM D698-78).

GEOLOGIC ASSOCIATES, INC.
LABORATORY DIVISION
Knoxville, Tennessee (615)-966-9761

LABORATORY TEST – MOISTURE DENSITY RELATIONSHIP

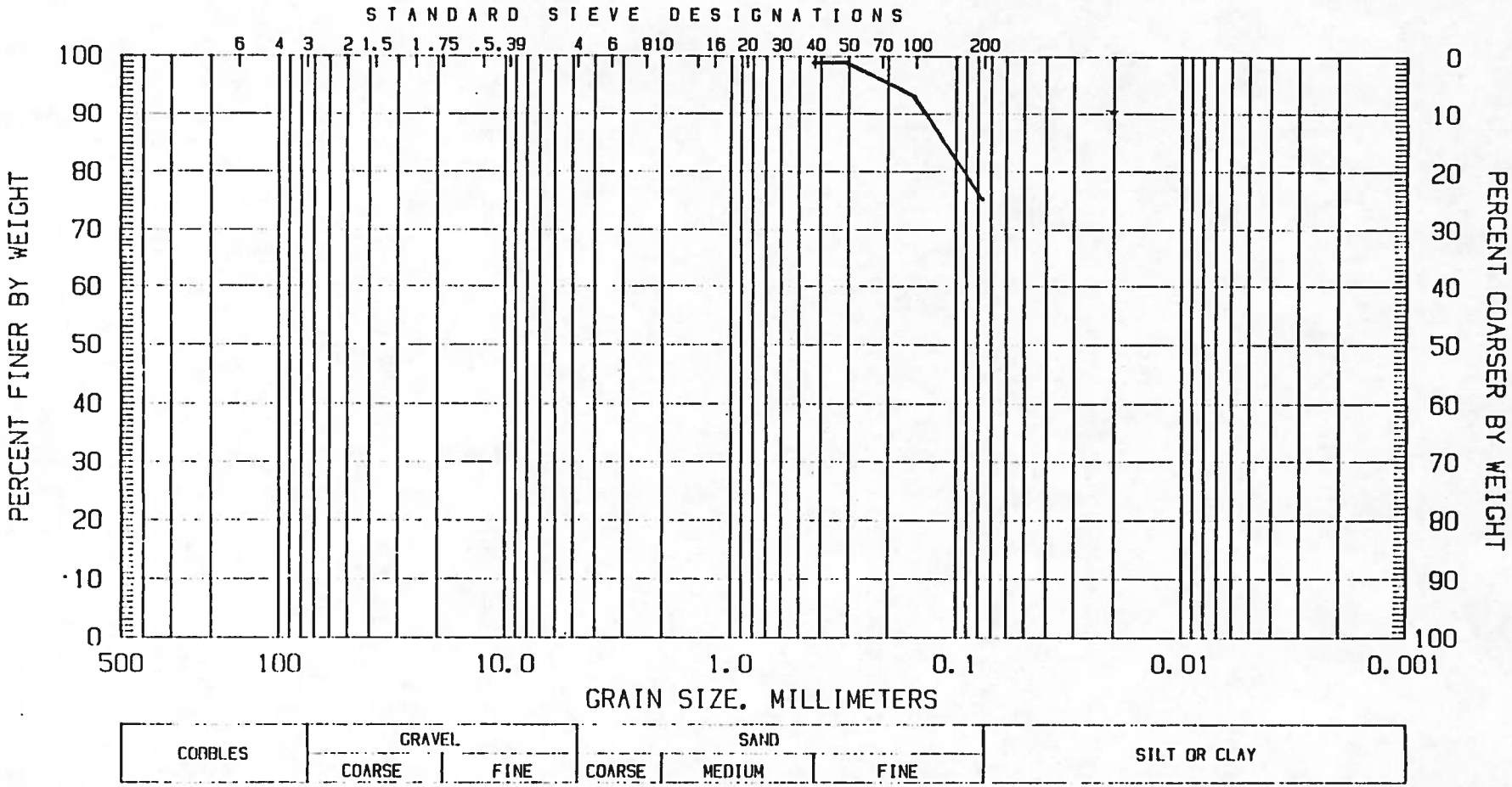
CLIENT: I. T. Corporation DATE: March, 1985
PROJECT: Utah International Soils Testing
SAMPLE LOCATION: Four Corners Power Plant
SAMPLE DESCRIPTION: Fly Ash Sample No. 4801
TEST METHOD: ASTM D698-78 Method A

MOISTURE DENSITY RELATIONSHIP



OPTIMUM MOISTURE: 28.7 % BY WEIGHT FIELD MOISTURE 19.4 % BY WEIGHT
MAX DRY DENSITY 73.6 LBS/CU. FT.
LAB TEST BY:
REMARKS:

GRAIN SIZE ANALYSIS



PROJECT NO.: 85-3014K
UTAH INTERNATIONAL SOILS TESTING
I.T. CORPORATION
MARCH 8, 1985
TEST PIT: 3 SAMPLE: 3
DEPTH: N/A FT

FLY ASH SAMPLE NO. 4801
NATURAL MOISTURE CONTENT= 19.4 %
REMARKS:

GEOLOGIC ASSOCIATES, INC.