76071

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ER ID NO. 76071 ***Date Received:*** 10/30/2003 ***Processor:*** EMR ***Page Count:*** 30

Privileged: (Y/N) N ***Record Category:*** P

FileFolder: N/A

Correction: (Y/N) N ***Corrected No.*** 0 ***Corrected By Number:*** 0

Administrative Record: (Y/N) Y

Refilmed: (Y/N) N ***Old ER ID Number:*** 0 ***New ER ID Number:*** 0

Miscellaneous Comments:

REFERENCED

30868

THIS FORM IS SUBJECT TO CHANGE. CONTACT THE RPF FOR LATEST VERSION. (JUNE 1997)

(30)

Recieved 3/9/95
#76071

DANIEL B. STEPHENS & ASSOCIATES, INC.

ENVIRONMENTAL SCIENTISTS AND ENGINEERS

LABORATORY ANALYSIS OF SOIL HYDRAULIC PROPERTIES OF BOREHOLES 54-1001, 1002, 1003, AND 1006

Prepared for

Los Alamos National Laboratories

Los Alamos, New Mexico

July 1994

RECEIVED
OCT 30 2003
By

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SUMMARY

The Hydrologic Testing Laboratory at Daniel B. Stephens & Associates, Inc. (DBS&A) has completed laboratory tests on Boreholes 54-1001, 1002 and 1003 as specified by Daniel James and summarized in Table 1. Tables 2 through 8 give the results of the specified analyses. Raw laboratory data and graphical plots of data (where appropriate) are contained in Appendices A through G. Appendix H lists the methods used in these analyses. A detailed description of each method is available upon request.

Overall, the results appear reasonable and internally consistent. However, DBS&A cannot guarantee that these results are representative of the undisturbed materials at the field site, nor can we assume any responsibility for interpretations or analyses based on these data. We recommend that careful evaluation of these laboratory results be made for your particular application.

TABLE 1. SUMMARY OF TESTS PERFORMED

Laboratory Sample Number	Initial Moisture Content	Dry Bulk Density	Calculated Porosity	Saturated Hydraulic Conductivity	Moisture Characteristics		Particle Density	Air Permeability	Chemistry - Bet	VEQ Relative Humidity
					Pressure Plate	Thermocouple Psychrometer				
54-1001 67.8-68.4	X	X	X	X	X	X	X	X	X	X
54-1001 82.5-83.0	X	X	X	X	X	X	X	X	X	X
54-1001 101.5-102	X	X	X	X	X	X	X	X	X	X
54-1001 121.5-122	X	X	X	X	X	X	X	X	X	X
54-1001 141.5-142	X	X	X	X	X	X	X	X	X	X
54-1002 91.8-92.5	X	X	X	X	X	X	X	X	X	X
54-1002 121.5-122.0	X	X	X	X	X	X	X	X	X	X
54-1002 142.0-142.5	X	X	X	X	X	X	X	X	X	X
54-1002 178.5-179.3	X	X	X	X	X	X	X	X	X	X
54-1002 243.5-244.0	X	X	X	X	X	X	X	X	X	X
54-1003 101.5-102.0	X	X	X	X	X	X	X	X	X	X

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TABLE 1. SUMMARY OF TESTS PERFORMED (CONTINUED)

Laboratory Sample Number	Initial Moisture Content	Dry Bulk Density	Calculated Porosity	Saturated Hydraulic Conductivity	Moisture Characteristics		Particle Density	Air Permeability	Chemistry - Bet	VEQ Relative Humidity
					Pressure Plate	Thermocouple Psychrometer				
54-1003 119.0-119.5	X	X	X	X	X	X	X	X	X	X
54-1003 156.0-157.0	X	X	X	X	X	X	X	X	X	X
54-1003 206.0-207.0	X	X	X	X	X	X	X	X	X	X
54-1003 260.5-261.0	X	X	X	X	X	X	X	X	X	X
54-1003 270.5-271.5	X	X	X	X	X	X	X	X	X	X
54-1006 41.5-42.0	X	X	X	X	X	X	X	X	X	X
54-1006 76.2-76.9	X	X	X	X	X	X	X	X	X	X
54-1006 124.0-124.5	X	X	X	X	X	X	X	X	X	X
54-1006 136.0-136.7	X	X	X	X	X	X	X	X	X	X
54-1006 160.5-161.0	X	X	X	X	X	X	X	X	X	X

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TABLE 2. SUMMARY OF INITIAL MOISTURE CONTENT, DRY BULK DENSITY, AND CALCULATED POROSITY

Sample Number	Initial Moisture Content		Dry Bulk Density (g/cm^3)	Calculated Porosity (%)
	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)		
54-1001 67.8-68.4*	0.14	0.17	1.20	53.1
54-1001 82.5-83.0	2.05	2.57	1.25	51.7
54-1001 101.5-102	5.8	6.9	1.19	53.3
54-1001 121.5-122	7.6	9.0	1.18	53.9
54-1001 141.5-142	13.0	15.6	1.20	51.6
54-1002 91.8-92.5	1.2	1.5	1.26	50.2
54-1002 121.5-122.0	2.6	3.2	1.23	50.3
54-1002 142.0-142.5	9.6	11.5	1.19	53.1
54-1002 178.5-179.3**	5.7	6.6	1.16	49.8
54-1002 243.5-244.0**	23.8	27.0	1.14	51.3
54-1003 101.5-102.0	1.3	1.5	1.22	51.8
54-1003 119.0-119.5	5.2	6.4	1.22	51.4
54-1003 156.0-157.0	4.3	4.9	1.14	48.3
54-1003 206.0-207.0	6.8	8.0	1.18	48.2
54-1003 260.5-261.0	8.6	9.6	1.11	49.5
54-1003 270.5-271.5	9.2	12.1	1.31	44.3
54-1006 41.5-42.0	3.7	4.7	1.28	50.1

* Sample had been left open. These results are lower than the actual moisture contents.
** Sample was repacked.

TABLE 2. SUMMARY OF INITIAL MOISTURE CONTENT, DRY BULK DENSITY, AND CALCULATED POROSITY (CONTINUED)

Sample Number	Initial Moisture Content		Dry Bulk Density (g/cm^3)	Calculated Porosity (%)
	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)		
54-1006 76.2-76.9	0.50	0.64	1.28	49.5
54-1006 124.0-124.5	2.1	2.5	1.22	51.6
54-1006 136.0-136.7	4.9	6.3	1.28	49.5
54-1006 160.5-161.0	1.6	1.8	1.13	49.7

* Sample had been left open. These results are lower than the actual moisture contents.
** Sample was repacked.

TABLE 3. SUMMARY OF SATURATED HYDRAULIC CONDUCTIVITY TESTS

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
54-1001 67.8-68.4	1.3×10^{-4}	X	
54-1001 82.5-83.0	1.1×10^{-4}	X	
54-1001 101.5-102	1.6×10^{-4}	X	
54-1001 121.5-122	2.2×10^{-5}		X
54-1001 141.5-142	8.2×10^{-5}	X	
54-1002 91.8-92.5	8.1×10^{-5}	X	
54-1002 121.5-122.0	4.6×10^{-5}	X	
54-1002 142.0-142.5	2.5×10^{-5}	X	
54-1002 178.5-179.3*	6.5×10^{-5}	X	
54-1002 243.5-244.0*	1.7×10^{-4}	X	
54-1003 101.5-102.0	1.3×10^{-4}	X	
54-1003 119.0-119.5	9.9×10^{-5}	X	
54-1003 156.0-157.0	1.3×10^{-4}	X	
54-1003 206.0-207.0	1.5×10^{-4}	X	
54-1003 260.5-261.0	2.7×10^{-4}	X	
54-1003 270.5-271.5	2.6×10^{-4}	X	
54-1006 41.5-42.0	4.1×10^{-3}	X	
54-1006 76.2-76.9	9.8×10^{-5}	X	

* Sample was repacked.

TABLE 3. SUMMARY OF SATURATED HYDRAULIC CONDUCTIVITY TESTS (CONTINUED)

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
54-1006 124.0-124.5	4.5×10^{-5}	X	
54-1006 136.0-136.7	5.7×10^{-5}	X	
54-1006 160.5-161.0	1.2×10^{-4}	X	

* Sample was repacked.

TABLE 4. SUMMARY OF MOISTURE CHARACTERISTICS OF THE INITIAL DRAINAGE CURVE

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1001 67.8-68.4	0	41.4
	51	38.6
	112	37.3
	326	29.3
	918	25.7
	6884*	1.3
	18101*	1.2
54-1001 82.5-83.0	0	46.0
	51	43.3
	112	41.3
	326	38.1
	918	35.1
	4304*	2.0
	14012*	1.1
54-1001 101.5-102	0	51.4
	51	46.8
	112	44.1
	326	37.3
	918	21.4
	6333*	1.9
	12656*	1.2
54-1001 121.5-122	0	46.4
	51	42.4
	99	40.4
	306	34.6
	920	21.7
	5303*	6.5
	12074*	3.8

* Thermocouple psychrometer data

TABLE 4. SUMMARY OF MOISTURE CHARACTERISTICS OF THE INITIAL DRAINAGE CURVE (CONTINUED)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1001 141.5-142	0	48.2
	51	44.6
	112	43.1
	326	37.7
	918	28.8
	5599*	11.2
	21283*	7.8
54-1002 91.8-92.5	0	46.0
	51	43.6
	112	42.4
	311	38.4
	903	32.3
	5915*	2.1
	17948*	0.7
54-1002 121.5-122.0	0	49.5
	51	45.3
	112	43.6
	311	37.4
	903	22.5
	6884*	1.9
	20886*	1.2
54-1002 142.0-142.5	0	49.1
	61	43.6
	102	33.9
	301	27.8
	923	26.6
	7118*	9.0
	17071*	7.0

* Thermocouple psychrometer data

TABLE 4. SUMMARY OF MOISTURE CHARACTERISTICS OF THE INITIAL DRAINAGE CURVE (CONTINUED)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1002 178.5-179.3**	0	39.3
	51	37.7
	102	35.2
	306	25.9
	918	20.9
	5721*	2.0
	25495*	1.6
54-1002 243.5-244.0**	0	39.3
	51	37.3
	102	33.1
	306	22.0
	918	20.7
	5283*	2.2
	14094*	1.9
54-1003 101.5-102.0	0	51.0
	51	46.1
	112	44.4
	311	37.8
	903	27.7
	5599*	1.7
	27769*	0.7
54-1003 119.0-119.5	0	59.9
	51	43.9
	102	43.5
	306	40.7
	918	35.9
	6792*	3.1
	14542*	2.4

* Thermocouple psychrometer data

** Sample was repacked.

TABLE 4. SUMMARY OF MOISTURE CHARACTERISTICS OF THE INITIAL DRAINAGE CURVE (CONTINUED)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1003 156.0-157.0	0	43.2
	51	41.7
	102	40.0
	306	30.2
	918	28.1
	7169*	5.3
	14818*	4.6
54-1003 206.0-207.0	0	42.8
	61	31.3
	102	18.4
	301	14.7
	923	13.1
	7241*	9.1
	26015*	1.2
54-1003 260.5-261.0	0	48.8
	61	41.6
	102	21.4
	301	18.4
	923	14.7
	6812*	2.9
	16347*	1.8
54-1003 270.5-271.5	0	41.0
	61	27.4
	102	23.9
	301	21.9
	923	19.4
	5864*	4.1
	20702*	3.9

* Thermocouple psychrometer data

TABLE 4. SUMMARY OF MOISTURE CHARACTERISTICS OF THE INITIAL DRAINAGE CURVE (CONTINUED)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1006 41.5-42.0	0	44.9
	51	40.8
	102	38.5
	296	24.8
	918	15.5
	7536*	2.0
	13257*	1.1
54-1006 76.2-76.9	0	44.5
	51	42.1
	112	40.9
	311	34.4
	903	29.3
	6098*	2.5
	21630*	0.9
54-1006 124.0-124.5	0	43.5
	51	39.8
	102	38.7
	296	33.3
	923	20.5
	6557*	3.8
	14104*	2.2
54-1006 136.0-136.7	0	47.2
	51	45.3
	112	44.3
	311	40.7
	903	29.8
	4691*	4.0
	14746*	1.9

* Thermocouple psychrometer data

TABLE 4. SUMMARY OF MOISTURE CHARACTERISTICS OF THE INITIAL DRAINAGE CURVE (CONTINUED)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1006 160.5-161.0	0	52.6
	51	42.3
	102	40.5
	306	34.0
	918	32.0
	6853*	0.8**
	13961*	0.9**

* Thermocouple psychrometer data
**Moisture contents are considered suspect

TABLE 5. SUMMARY OF PARTICLE DENSITY TESTS

Sample Number	Particle Density (g/cm^3)
54-1001 67.8-68.4	2.56
54-1001 82.5-83.0	2.60
54-1001 101.5-102	2.54
54-1001 121.5-122	2.56
54-1001 141.5-142	2.48
54-1002 91.8-92.5	2.54
54-1002 121.5-122.0	2.53
54-1002 142.0-142.5	2.55
54-1002 178.5-179.3	2.31
54-1002 243.5-244.0	2.33
54-1003 101.5-102.0	2.54
54-1003 119.0-119.5	2.52
54-1003 156.0-157.0	2.20
54-1003 206.0-207.0	2.28
54-1003 260.5-261.0	2.20
54-1003 270.5-271.5	2.35
54-1006 41.5-42.0	2.56

TABLE 5. SUMMARY OF PARTICLE DENSITY TESTS (CONTINUED)

Sample Number	Particle Density (g/cm^3)
54-1006 76.2-76.9	2.54
54-1006 124.0-124.5	2.51
54-1006 136.0-136.7	2.53
54-1006 160.5-161.0	2.24

TABLE 6. SUMMARY OF AIR PERMEABILITY AS A FUNCTION OF SOIL WATER CONTENT

Sample Number	Moisture Content (% Vol)	Extrapolated Intrinsic Permeability (micrometers^2)	Slope (KPA)
54-1001 67.8-68.4	38.6	3.865×10^{-3}	-0.30
	37.3	8.121×10^{-3}	-0.37
	29.3	7.028×10^{-2}	1.37
	0.3	4.385×10^{-1}	11.80
54-1001 82.5-83.0	43.3	4.746×10^{-3}	-0.36
	41.3	1.049×10^{-2}	-0.57
	38.1	1.302×10^{-2}	0.38
	0.2	2.985×10^{-1}	8.85
54-1001 101.5-102	46.8	4.183×10^{-1}	-7.92
	44.1	2.294×10^{0}	43.20
	37.3	1.406×10^{0}	48.94
	0.3	2.893×10^{0}	138.50
54-1001 121.5-122	42.4	2.322×10^{0}	-27.17
	40.4	2.738×10^{0}	157.60
	34.6	3.069×10^{0}	204.20
	0.1	2.294×10^{0}	120.30
54-1001 141.5-142	44.6	9.118×10^{-1}	-58.12
	43.1	8.396×10^{-1}	-0.86
	37.7	9.972×10^{-1}	23.56
	0.4	1.044×10^{0}	32.49
54-1002 91.8-92.5	43.6	1.626×10^{-2}	-0.098
	42.4	2.287×10^{-2}	-0.806
	38.4	-1.892×10^{-2}*	4.22
	0.12	2.855×10^{-1}	8.24

* Due to poor linear fit, the intercept is unreasonable.

** Sample was repacked.

***The sample was disturbed during testing, the moisture content value is considered suspect.

NA = Slipflow at this high water content is considered neglible.

TABLE 6. SUMMARY OF AIR PERMEABILITY AS A FUNCTION OF SOIL WATER CONTENT (CONTINUED)

Sample Number	Moisture Content (% Vol)	Extrapolated Intrinsic Permeability (micrometers^2)	Slope (KPA)
54-1002 121.5-122.0	45.3	NA	NA
	43.6	3.911×10^{-2}	-2.44
	37.4	5.616×10^{-2}	-1.23
	1.0	1.653×10^{-1}	4.88
54-1002 142.0-142.5	43.6	2.808×10^{-2}	-0.44
	33.9	1.856×10^{-1}	4.49
	27.8	2.407×10^{-1}	8.06
	0.44	2.984×10^{-1}	7.62
54-1002 178.5-179.3**	37.7	3.384×10^{-1}	-29.98
	35.2	6.499×10^{-1}	-20.44
	25.9	9.924×10^{-1}	11.33
	0.63	1.087×10^{0}	21.25
54-1002 243.5-244.0**	37.3	1.405×10^{0}	-58.30
	33.1	1.579×10^{0}	4.37
	22.0	2.073×10^{0}	12.79
	0.57	2.624×10^{0}	25.14
54-1003 101.5-102.0	46.1	1.472×10^{0}	-10.71
	44.4	1.366×10^{0}	44.24
	37.8	9.382×10^{-1}	85.61
	0.11***	1.657×10^{0}	75.67
54-1003 119.0-119.5	43.9	1.793×10^{-1}	-4.94
	43.5	1.630×10^{-1}	-4.13
	40.7	1.029×10^{-1}	3.13
	0.26*	2.213×10^{-1}	7.85

* Due to poor linear fit, the intercept is unreasonable.

** Sample was repacked.

***The sample was disturbed during testing, the moisture content value is considered suspect.

NA = Slipflow at this high water content is considered neglible.

TABLE 6. SUMMARY OF AIR PERMEABILITY AS A FUNCTION OF SOIL WATER CONTENT (CONTINUED)

Sample Number	Moisture Content (% Vol)	Extrapolated Intrinsic Permeability (micrometers^2)	Slope (KPA)
54-1003 156.0-157.0	41.7	3.665×10^{-1}	-23.43
	40.0	6.302×10^{-1}	-23.20
	30.2	1.014×10^{0}	32.60
	0.44	1.803×10^{0}	30.65
54-1003 206.0-207.0	31.3	6.908×10^{-1}	-2.07
	18.4	1.075×10^{0}	16.46
	14.7	1.023×10^{0}	23.85
	1.02	1.035×10^{0}	19.31
54-1003 260.5-261.0	41.6	2.618×10^{-1}	-3.31
	21.4	7.129×10^{-1}	12.73
	18.4	9.285×10^{-1}	22.56
	0.72	1.107×10^{0}	77.81
54-1003 270.5-271.5	27.4	9.774×10^{-1}	10.69
	23.9	1.617×10^{0}	34.52
	21.9	2.231×10^{0}	48.89
	1.11	3.228×10^{0}	50.17
54-1006 41.5-42.0	40.8	9.56×10^{-1}	-11.85
	38.5	-3.938×10^{-1}*	96.11
	24.8	1.012×10^{0}	44.53
	0.18	4.58×10^{0}	841.81
54-1006 76.2-76.9	42.1	NA	NA
	40.9	1.801×10^{-2}	-1.03
	34.4	1.464×10^{-2}	0.86
	0.03*	3.113×10^{-1}	8.82

* Due to poor linear fit, the intercept is unreasonable.

** Sample was repacked.

***The sample was disturbed during testing, the moisture content value is considered suspect.

NA = Slipflow at this high water content is considered neglible.

TABLE 6. SUMMARY OF AIR PERMEABILITY AS A FUNCTION OF SOIL WATER CONTENT (CONTINUED)

Sample Number	Moisture Content (% Vol)	Extrapolated Intrinsic Permeability (micrometers^2)	Slope (KPA)
54-1006 124.0-124.5	39.8	6.173×10^{-1}	-21.58
	38.7	9.297×10^{-1}	-17.73
	33.3	7.059×10^{-1}	82.45
	0.10	1.155×10^{0}	95.21
54-1006 136.0-136.7	45.3	4.551×10^{-1}	-22.75
	44.3	3.096×10^{-1}	-6.21
	40.7	2.471×10^{-1}	8.51
	0.18	4.512×10^{-1}	15.84
54-1006 160.5-161.0	42.3	6.569×10^{-1}	-4.53
	40.5	1.410×10^{-1}	-7.63
	34.0	1.159×10^{-1}	6.75
	0.60	2.575×10^{-1}	3.87

* Due to poor linear fit, the intercept is unreasonable.

** Sample was repacked.

***The sample was disturbed during testing, the moisture content value is considered suspect.

NA = Slipflow at this high water content is considered neglible.

TABLE 7. SUMMARY OF SPECIFIC SURFACE ANALYSIS

Sample Number	BET Surface Area m^2/g
54-1001 67.8-68	0.4981
54-1001 82.5-83.0	0.6599
54-1001 101.5-102	1.0081
54-1001 121.5-122	1.3965
54-1001 141.5-142	4.3374
54-1002 91.8-92.5	0.5293
54-1002 121.5-122.0	0.8630
54-1002 142.0-142.5	5.3856
54-1002 178.5-179.3	0.8248
54-1002 243.5-244.0	1.3925
54-1003 101.5-102.0	0.7371
54-1003 119.0-119.5	1.3981
54-1003 156.0-157.0	0.8177
54-1003 206.0-207.0	2.6186
54-1003 260.5-261.0	1.0031
54-1003 270.5-271.5	4.7158
54-1006 41.5-42.0	0.5418

TABLE 7. SUMMARY OF CHEMICAL ANALYSIS (CONTINUED)

54-1006 76.2-76.9	0.5498
54-1006 124.0-124.5	1.3348
54-1006 136.0-136.7	1.5015
54-1006 160.5-161.0	0.6443

TABLE 8. SUMMARY OF VAPOR EQUILIBRIUM SYSTEM TESTS

Sample Number	Relative Humidity (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1001 67.8-68.4	1196403	0.46
	2200728	0.35
	2823292	0.31
	3214970	0.30
54-1001 82.5-83.0	414742	0.20*
	1846671	0.31*
	2653867	0.19*
	3130830	0.24*
54-1001 101.5-102	180332	1.32
	1166487	0.84
	2224071	0.51
	3121928	0.34
54-1001 121.5-122	754246	0.45
	1097985	0.30
	1484783	0.19
	2352189	0.11
54-1001 141.5-142	640171	1.00
	1134136	0.62
	1834860	0.42
	2886132	0.37
54-1002 91.8-92.5	1425040	0.18
	2132733	0.14
	2590935	0.13
	2948208	0.12
54-1002 121.5-122.0	259170	1.58
	585877	1.36
	807289	1.10
	2757592	1.00

* Sample was disturbed during testing. Moisture contents are invalid.

TABLE 8. SUMMARY OF VAPOR EQUILIBRIUM SYSTEM TESTS (CONTINUED)

Sample Number	Relative Humidity (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1002 142.0-142.5	272604	1.49
	721211	0.81
	1434670	0.55
	2943918	0.44
54-1002 178.5-179.3**	325982	0.79
	1959262	0.73
	2918879	0.63
54-1002 243.5-244.0**	311744	3.22
	701541	1.27
	1393152	0.70
	3166026	0.57
54-1003 101.5-102.0	1336319	0.13
	1919598	0.12
	2554225	0.09*
	3039169	0.11*
54-1003 119.0-119.5	432374	0.17*
	710012	0.06*
	1990179	0.27*
	3036694	0.26*
54-1003 156.0-157.0	309089	3.92
	703989	1.21
	1307136	0.61
	3026439	0.44

* Sample was disturbed during testing. Moisture contents are invalid.
** Sample was repacked.

NA = Not available due to laboratory error.

TABLE 8. SUMMARY OF VAPOR EQUILIBRIUM SYSTEM TESTS (CONTINUED)

Sample Number	Relative Humidity (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1003 206.0-207.0	1349502	1.80
	1937393	1.45
	2438163	1.37
	3046247	1.02
54-1003 260.5-261.0	570389	1.34
	1385303	0.88
	2330099	0.77
	2877551	0.72
54-1003 270.5-271.5	1597922	1.65
	2208219	1.38
	2473816	1.24
	2802813	1.11
54-1006 41.5-42.0	3728619	0.18
	NA	NA
	NA	NA
	NA	NA
54-1006 76.2-76.9	1156553	0.14
	1874018	-0.05*
	2467558	-0.01*
	2866458	0.03
54-1006 124.0-124.5	434084	1.30
	872501	0.55
	1561001	0.17
	2575888	0.10
54-1006 136.0-136.7	388807	1.70
	749196	0.89
	1449257	0.38
	2983676	0.18

* Sample was disturbed during testing; therefore results are considered suspect

TABLE 8. SUMMARY OF VAPOR EQUILIBRIUM SYSTEM TESTS (CONTINUED)

Sample Number	Relative Humidity (-cm water)	Moisture Content (%, cm^3/cm^3)
54-1006 160.5-161.0	333678	1.90
	723647	1.01
	1790411	0.64
	3008743	0.60

* Sample was disturbed during testing; therefore results are considered suspect

SUMMARY OF LABORATORY METHODS

Methods	Reference
Moisture Content	ASTM D 2216-90
Bulk Density	MOSA*, 1986. Chp. 13, pp. 363-367
Porosity	MOSA*, 1986. Chp. 18, pp. 444-445
Saturated Hydraulic Conductivity	
Constant Head	ASTM D 2434-68(74)
Falling Head	MOSA*, 1986. Chp. 28, pp. 700-703
Moisture Retention Characteristics	
Pressure Plate Extractor	ASTM D 2325-68(81)
Thermocouple Psychrometer	MOSA*, 1986. Chp. 26, pp. 597-618 Operators Manual for the SC-10A Thermocouple Psychrometer Sample Chamber (manufactured by Decagon Devices, Inc., Pullman, WA)
Particle Density	ASTM D 854-91
Air Permeability	API Recommended Practice for Core Analysis Procedure Manual, API RP40. August 1960
BET	ASTM C 1069 Test Method for Specific Surface Area of Alumina or Quartz by Nitrogen Adsorption ASTM D 3037 Test Methods for Carbon Black - Surface Area by Nitrogen Adsorption ASTM D 3663 Test Method for Surface Area of Catalysts ASTM D 4365 Test Method for Determining Zeolite Area of a Catalyst ASTM D 4567 Test Method for Single-Point Determination of Specific Surface Area of Catalysts Using Nitrogen Adsorption by Continuous Flow Method

* Klute, A. (ed.) 1986. *Methods of Soil Analysis. Part 1.* 2nd ed. American Society of Agronomy. Madison, WI.

SUMMARY OF LABORATORY METHODS (CONTINUED)

Methods	Reference
	ASTM D 4820 Test Method for Carbon Black - Surface Area by Multipoint BET Netrogen Adsorption
Vapor Equilibrium System	DBS&A-developed proprietary method

* Klute, A. (ed.) 1986. *Methods of Soil Analysis. Part 1.* 2nd ed. American Society of Agronomy. Madison, WI.