START

009242

44

UNCLASSIFIED

BEST AVAILABLE COPY

HW-76181

[redacted]

CHEMICAL AND PHYSICAL PROPERTIES OF 100 AREA SOILS

D. W. Bensen[1], J. L. Nelson, G. J. Alkire[2]

Process Research and Development
Chemical Effluents Technology
CHEMICAL LABORATORY

JUN 1990
RECEIVED
EDMC

DEC 26 1963
CIRCULATING
COPY
TECHNICAL INFO. SECTION

SEP 27 1977

HANFORD LABORATORIES

October 10, 1963

HANFORD ATOMIC PRODUCTS OPERATION

General Electric Company
Richland, Washington

1/ D. W. Bensen, Isotopes, Inc., Westwood, New Jersey
2/ J. L. Nelson, G. J. Alkire, General Electric Company, Richland, Washington.

Work performed under Contract No. AT(45-1)-1350 between General Electric Company and the U. S. Atomic Energy Commission.

RECEIVED
OCT 21 1963
R. L. JUNKINS

UNCLASSIFIED

DISTRIBUTION

		Bldg.	Area			Bldg.	Area
1.	G. J. Alkire	222-U	200-W	12.	W. N. Koop	1760-D	100-D
2.	G. E. Backman	3746	300	13.	G. J. Myers	105-N	100-N
3.	D. W. Bensen	Westwood, N.J.		14.	J. L. Nelson	222-U	200-W
4.	D. J. Brown	222-U	200-W	15.	J. M. Nielsen	325	300
5.	J. P. Corley	3746	300	16.	W. H. Reas	326	300
6.	R. Foster	3746	300	17.	A. E. Reisenauer	222-U	200-W
7.	R. G. Geier	1760-D	100-D	18.	R. E. Trumble	1100-N	100-N
8.	W. A. Haney	222-U	200-W	19.	J. W. Vanderbeek	1100-N	100-N
9.	E. R. Irish	329	300	20.	M. T. Walling	325	300
10.	R. T. Jaske	1761-H	100-H	21.	300 Files	3760	300
11.	R. L. Junkins	309	300	22.	File Copy	3760	300
				23-44.	Extra		

9413722.0003

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

NOTICE!

This report was prepared for use within General Electric Company in the course of work under Atomic Energy Commission Contract AT-(45-1)-1350, and any views or opinions expressed in the report are those of the authors only. This report is subject to revision upon collection of additional data.

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

54-3000-366 (9-59) AEC-GE RICHLAND, WASH.

CHEMICAL AND PHYSICAL PROPERTIES OF 100 AREA SOILS

INTRODUCTION

Physical and chemical properties of 100 Area soils were determined to characterize the soil and to provide data for use in selection of sites which might be best suited for disposal of reactor wastes.

This report presents a summary of the cation exchange capacities and the particle size distribution of samples of subsoil taken from wells in and near the 100 Areas.

9413222.0004

CONCLUSIONS

New sites for ground disposal of reactor wastes should be selected as far inland as practical. The inland sites offer the advantage of longer effective soil volumes, higher cation exchange capacities, and thus additional time for radioactive decay. However, the existence of unique situations such as old river channels or ground water mounds could alter this generalization and each situation should be considered separately. Soil samples from proposed disposal sites should be examined for chemical and physical properties before final selections are made.

METHOD

Subsoil samples used to determine the physical and chemical properties of 100 Area soil were selected from churn drilled samples taken during construction of 100 Area monitoring wells or from test borings at proposed building sites.

The hydrometer method of Bouyoucos[1] was used to determine the amount of

POOR COPY RECEIVED

9413222.0005

sand, silt and clay in the < 2mm sized soil fraction. On the basis of these results and the percentage of > 2 mm sized soil particles in the sample, the soils were classified according to the standard U.S.D.S. method[2].

A modification of the AOAC centrifuge method[3] was used to determine the cation exchange capacity of the subsoils. Five grams of the < 2mm sized soil fraction were treated with 4 - 35 ml increments of neutral molar ammonium acetate. The soil was washed free of excess salt with 3 - 35 ml increments of 95 percent ethyl alcohol. The adsorbed ammonium ion was extracted with 4 - 35 ml increments of 1M KCl, distilled into saturated boric acid solution and titrated to the methyl red end point with standard hydrochloric acid solution.

DISCUSSION AND RESULTS

In general the cation exchange capacity of the sediments examined increased with distance inland from the Columbia River. However some irregularities were observed at 100-F and 100-H Areas. The total effective cation exchange capacity also increased with distance from the river because of the increasing depth to ground water.

The subsoils examined fall into two groups. Subsoils underlying the B, D, and K Areas and surroundings have an average ion exchange capacity of about 4 meq/100g of soil. Soils in the H and F Areas have an average ion exchange capacity of about 2 meq/100g of soil.

Mechanical analysis shows that in most areas the upper 10 to 15 feet of soil is somewhat finer textured than those soils immediately underlying. The

coarser underlying materials are in general highly permeable sands and gravels which frequently extend to the ground surface near the river, and especially in the vicinity of downstream reactor sites. Finer silts and clays are present in the underlying material with highest amounts found at the upstream reactor sites, and inland from the river.

Average cation exchange capacities for soils in four 100 Exclusion Areas are given in Figures 1 through 4 along with a plan view of the well locations. The values shown are an average of all but the samples of the five and ten-foot levels for a given well. Results on samples from the five and ten-foot levels are not included in the averages because most disposal cribs and trenches bottom below the ten-foot level. Ion exchange data for wells outside the exclusion areas are given in Figure 5.

Profiles of soil particle size distribution in four 100 Exclusion Areas are given in Figures 6 through 9. The soil class names in Figures 6 through 9 are standard soil classification terminology. For example "loam" is defined as a soil material for which the less than 2 mm fraction contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. The other names indicate that there are disproportionately larger amounts of one or two particle sizes in that sample, as defined in detail in reference 2. Particle size distribution data of samples in K Area and inland from the exclusion areas are also given in Figure 5.

Data on all individual samples analyzed are given in the Appendix.

9413222.0006

ACKNOWLEDGMENT

The authors wish to acknowledge the assistance and helpful suggestions of Mrs. Helen LaPorte in the laboratory work, and A. E. Reisenauer in setting up the machine tabulation of the results.

REFERENCES

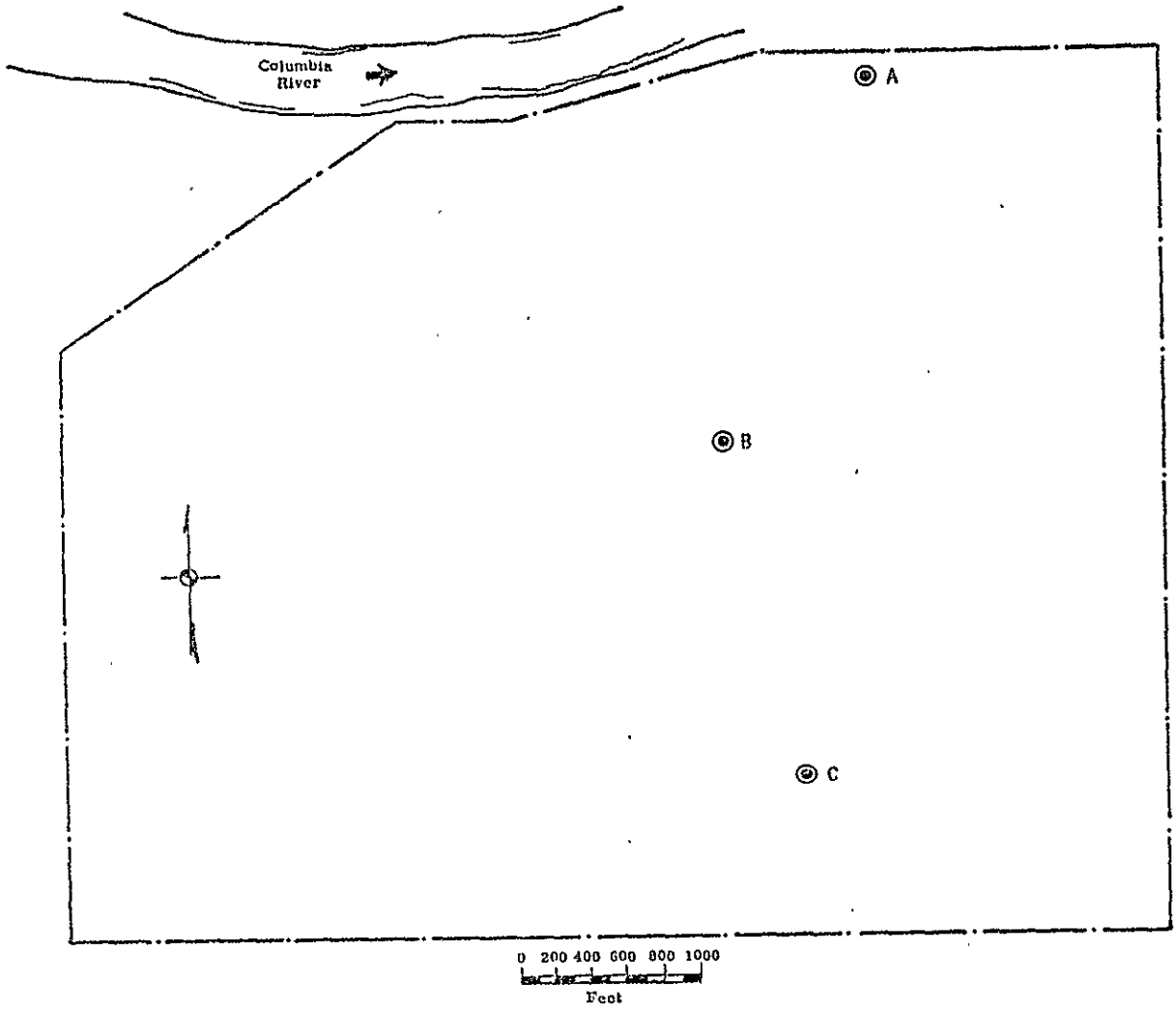
(1) G. J. Bouyoucos. "A Recalibration of the Hydrometer Method for Making Mechanical Analysis of Soils." Agron. Jour. Vol. 43, pp. 434-438. 1951.

(2) Soil Survey Staff, Soil Survey Manual, U. S. Dept. of Agri. Handbook, No. 18, pp. 209-215. 1951.

(3) A.O.A.C. Methods of Analysis, Association of Official Agricultural Chemists, Washington 4, D. C., p. 17. 1945.

(4) D. F. Brown and V. L. McGhan. Hanford Wells, HW-44355, Rev. 2. June, 1963.

9413222.0007



Location	Depth To Ground Water (Feet)	Well Designations	Average Exchange Capacity meq/100 g	Effective Exchange Capacity meq/ft^2
A	30	B3-1	1.7	17×10^3
B	50	B4-1 B4-3 B4-4	3.9	98×10^3
C	70	B9-1 B9-1	4.8	143×10^3

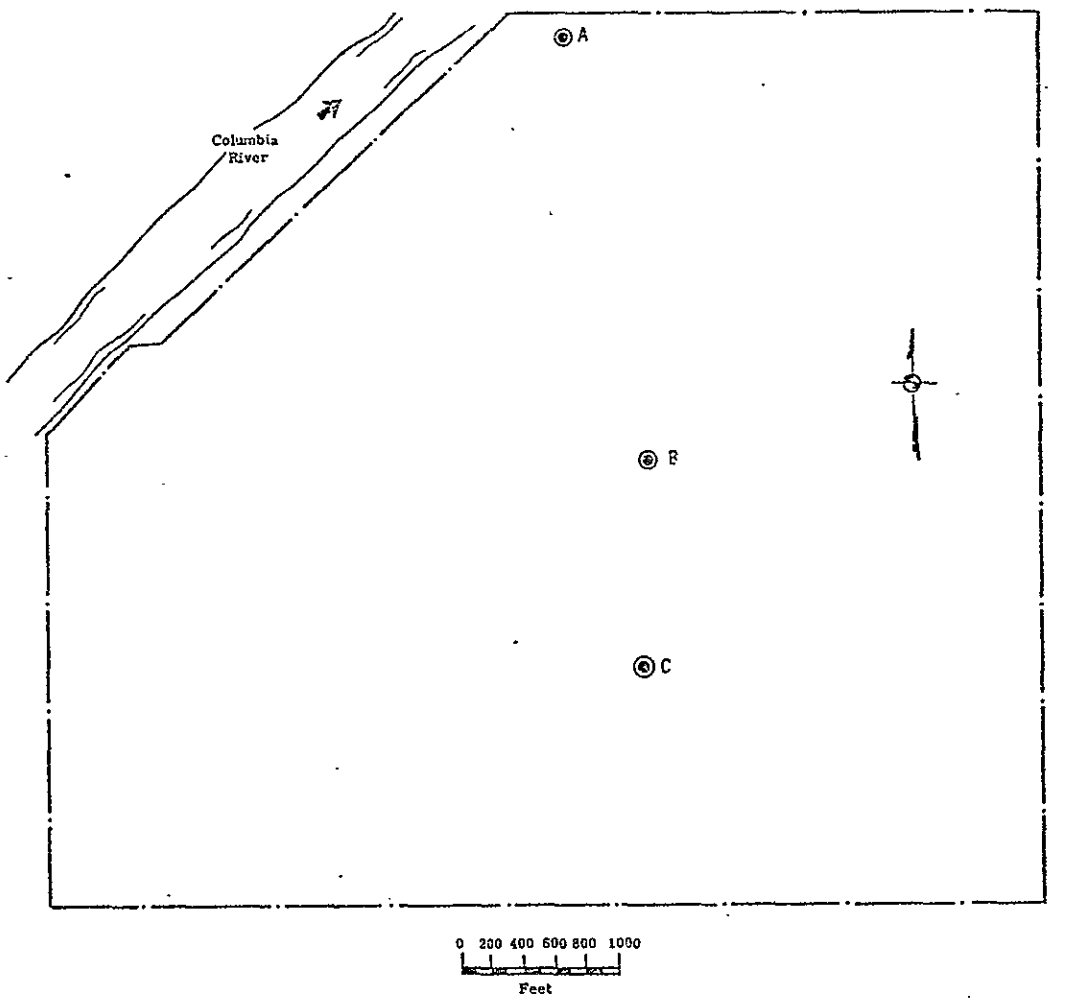
Figure 1

Exchange Capacity Data - 100 B-C Area

9413222.0005

9413222.0009

UNCLASSIFIED

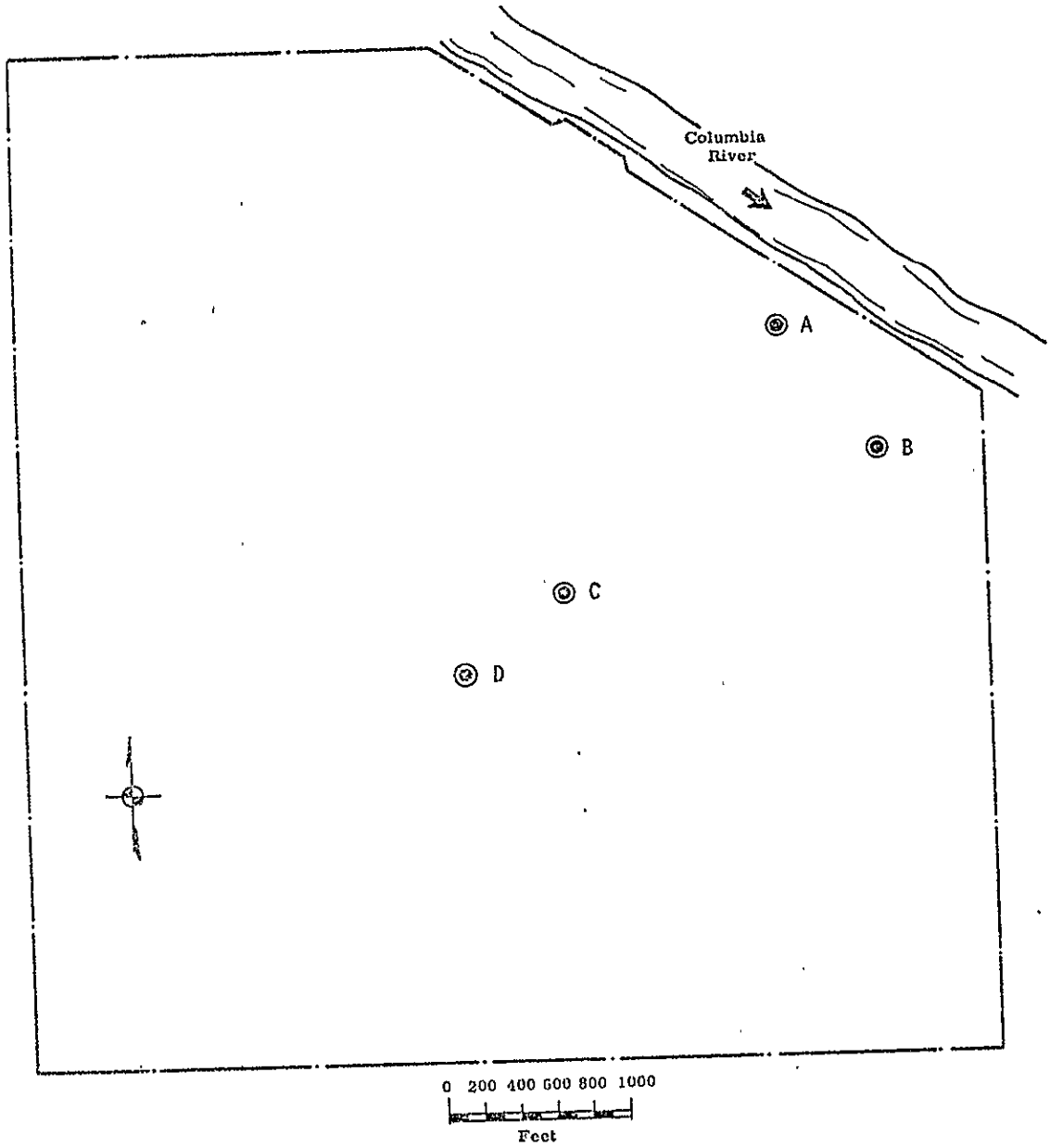


Location	Depth To Ground Water (Feet)	Well Designations	Average Exchange Capacity meq/100 g	Effective Exchange Capacity meq/ft^2
A	---	D8-2	3.2	64 x 10^3
B	75	D5-12	4.0	130 x 10^3
C	73	D2-5	4.2	137 x 10^3

Figure 2

Exchange Capacity Data - 100-D Area

UNCLASSIFIED

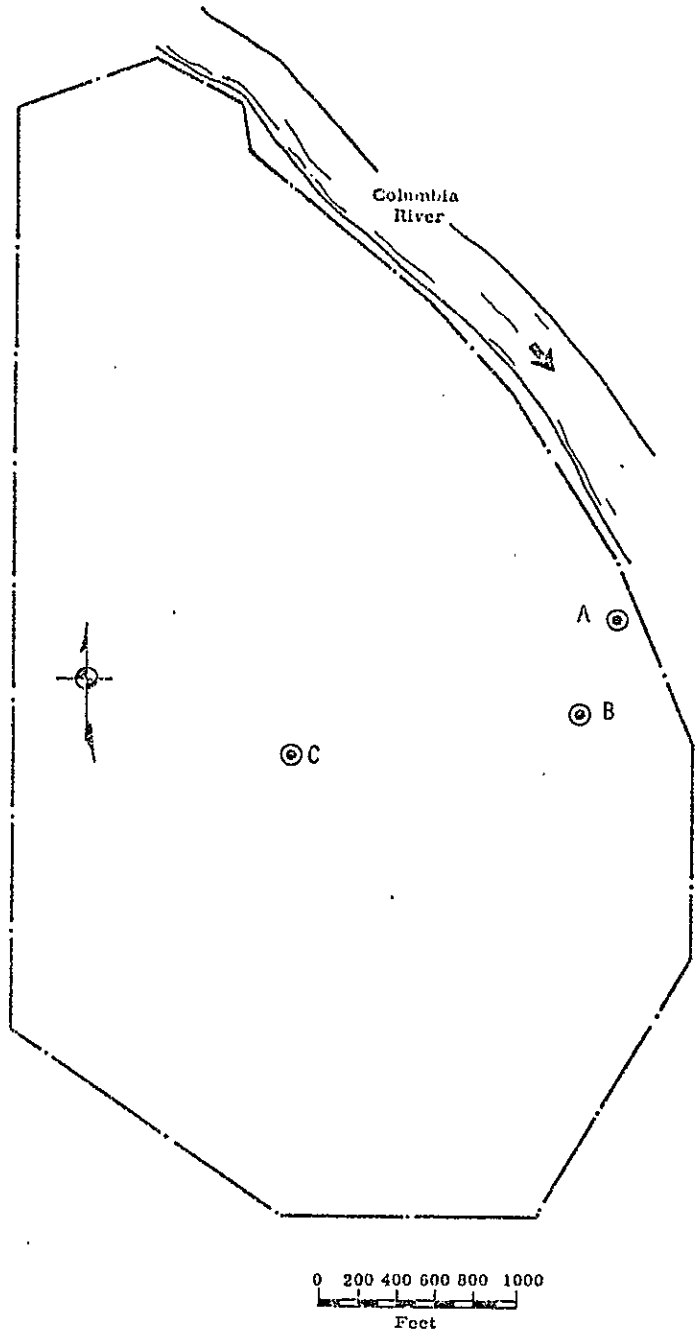


Location	Depth To Ground Water (Feet)	Well Designations	Average Exchange Capacity meq/100 g	Effective Exchange Capacity meq/ft^2
A	30	F5-6	0.5	5×10^3
B	20	F5-3 F5-2 F5-5	1.7	13×10^3
C	25	F5-4	.9	9×10^3
D	20	F8-1 F8-2	2.1	11×10^3

Figure 3

Exchange Capacity Data - 100-F Area

9413222.0010

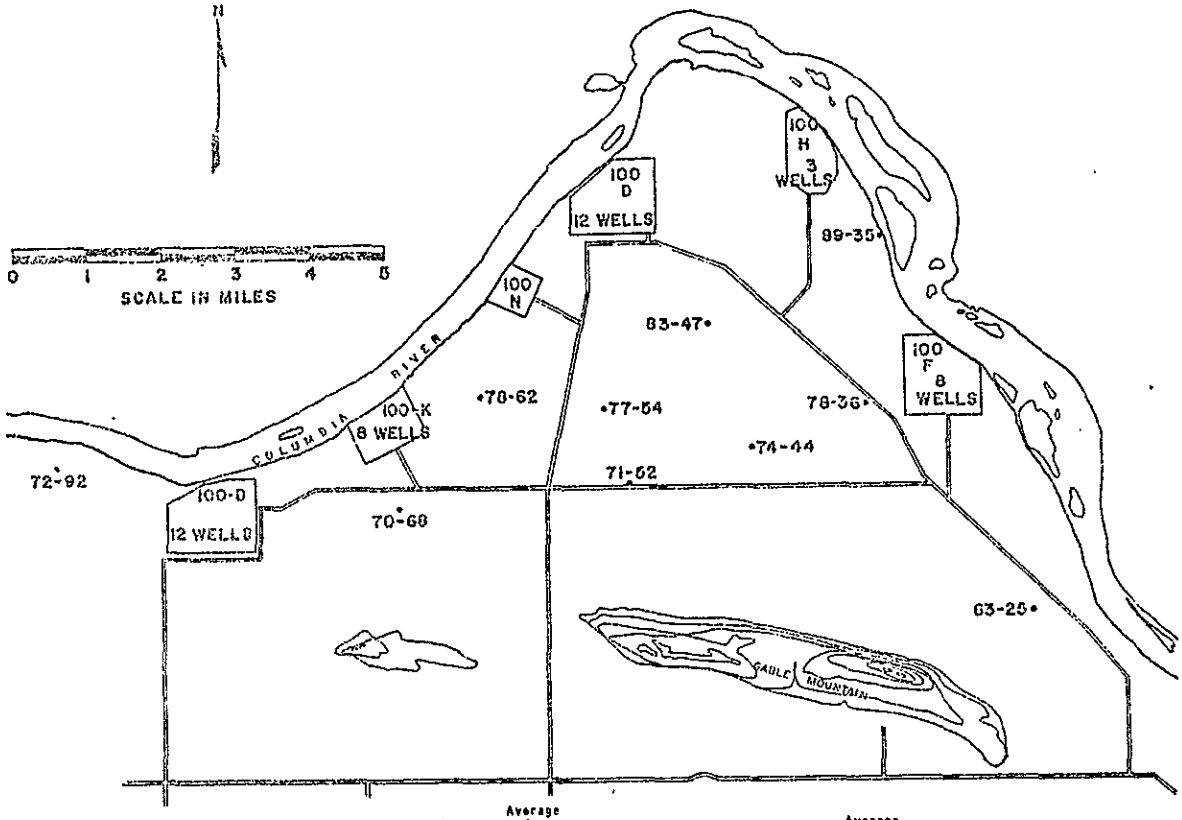


Location	Depth To Ground Water (Feet)	Well Designations	Average Exchange Capacity meq/100 g	Effective Exchange Capacity meq/ft^2
A	24	H4-1	2.1	21×10^3
B	20	H4-2	2.2	11×10^3
C	38	H3-1	2.3	34×10^3

Figure 4

Exchange Capacity Data - 100-H Area

9413222.0011



Well	Depth to Water Ft.	Average >2mm Fraction (Gravel) Percent	Average Sand Percent	Average Silt Percent	Average Clay Percent	Average Exchange Capacity meq/100 g.
77-54	82	59	32	7	2	2
78-62	62	23	55	16	6	4
74-44	50	40	44	11	5	5
71-52	122	21	73	4	2	4
63-25	33	33	51	11	6	4
70-60	123	34	58	6	2	3
*89-35	22	75	22	2	1	1
83-47	44	18	60	18	4	3
78-36	33	30	51	14	5	2
72-92	45	47	49	3	1	2

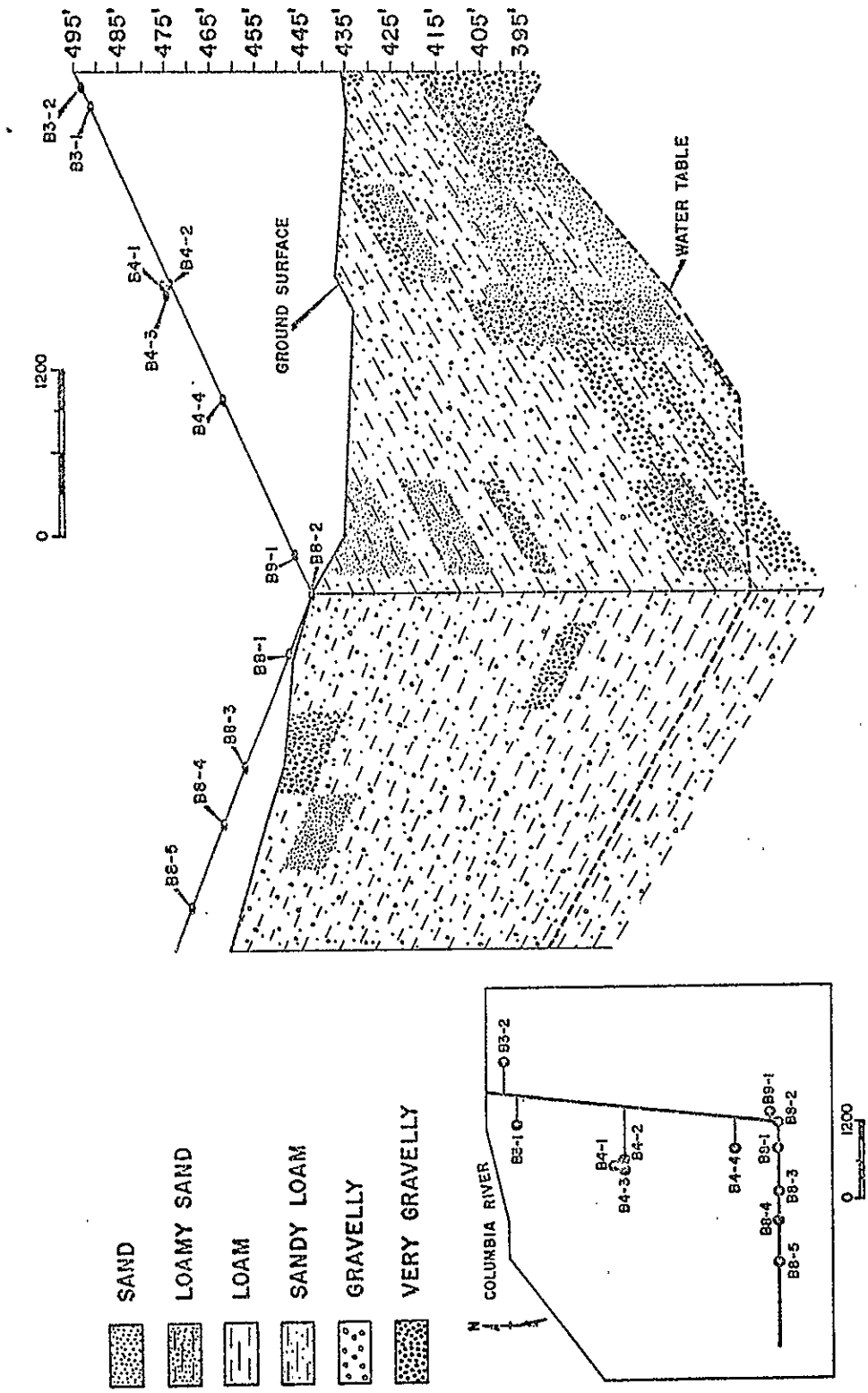
*Only Samples to 30 Feet from this Well Used in Averages.

Figure 5

Exchange Capacity Data - Vicinity 100 Areas

9413222.0012

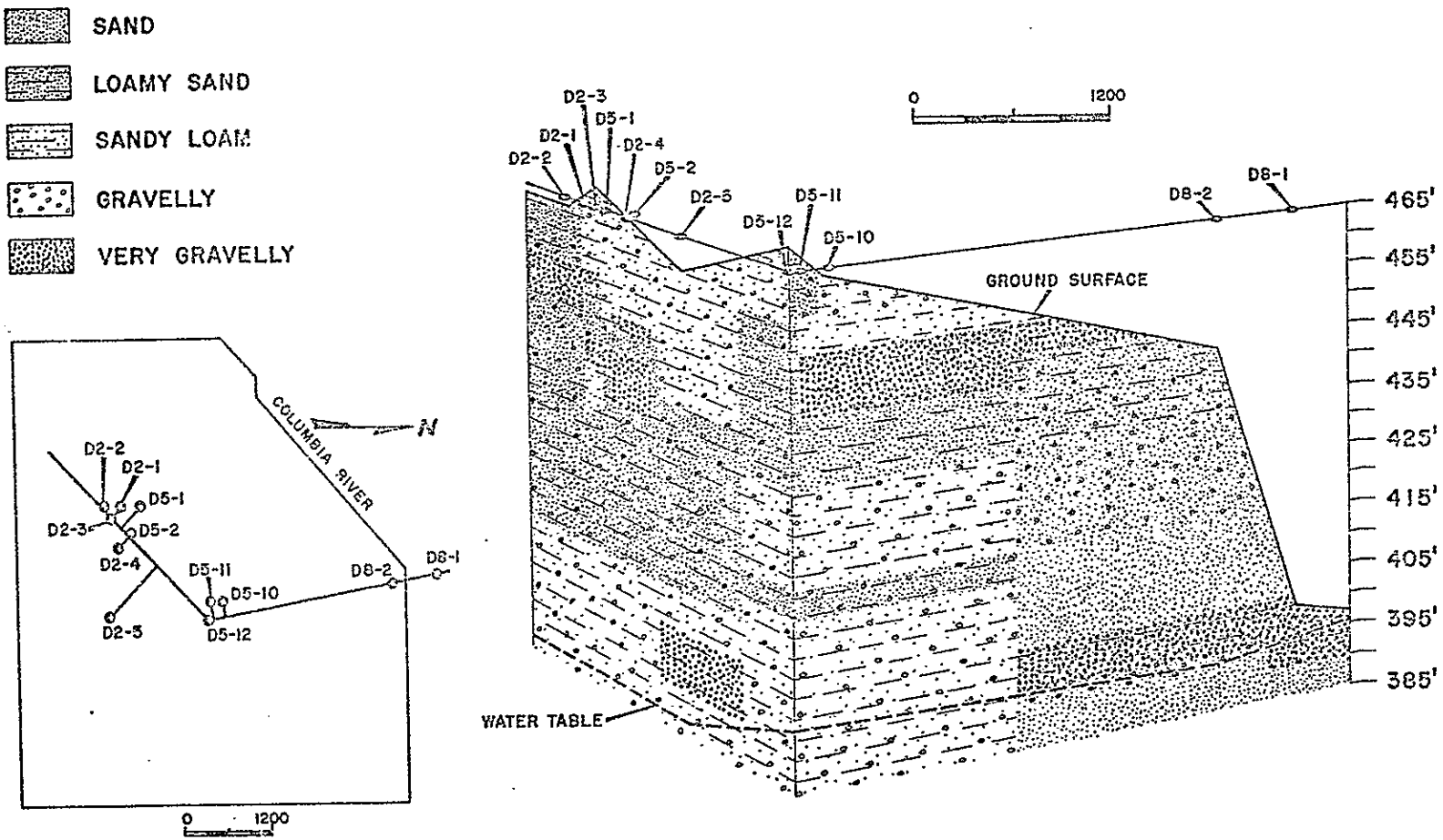
9413222.0013



100B-C AREA SUBSOIL PARTICLE SIZE DISTRIBUTION

Figure 6

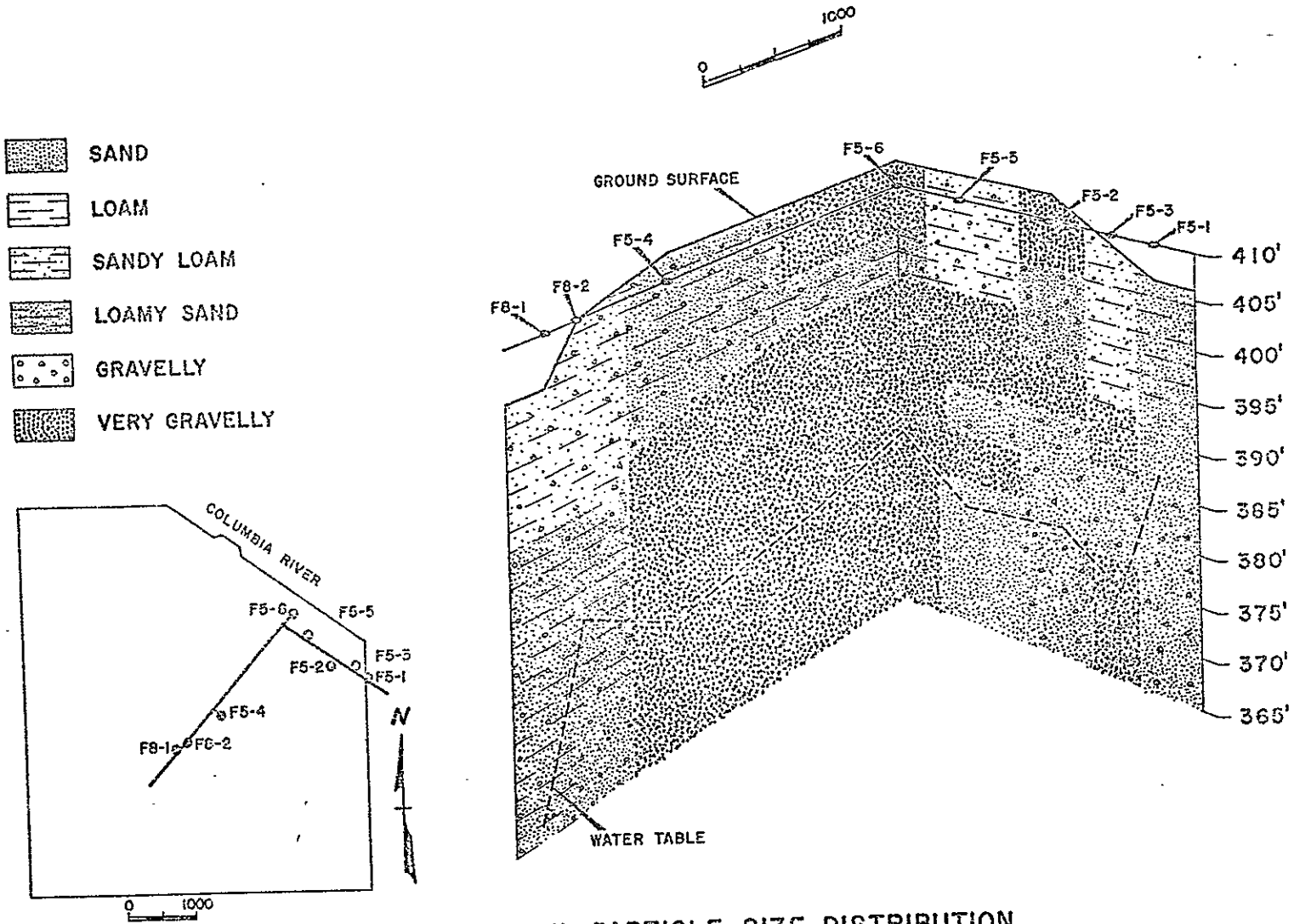
UNCLASSIFIED



IOOD AREA SUBSOIL PARTICLE SIZE DISTRIBUTION

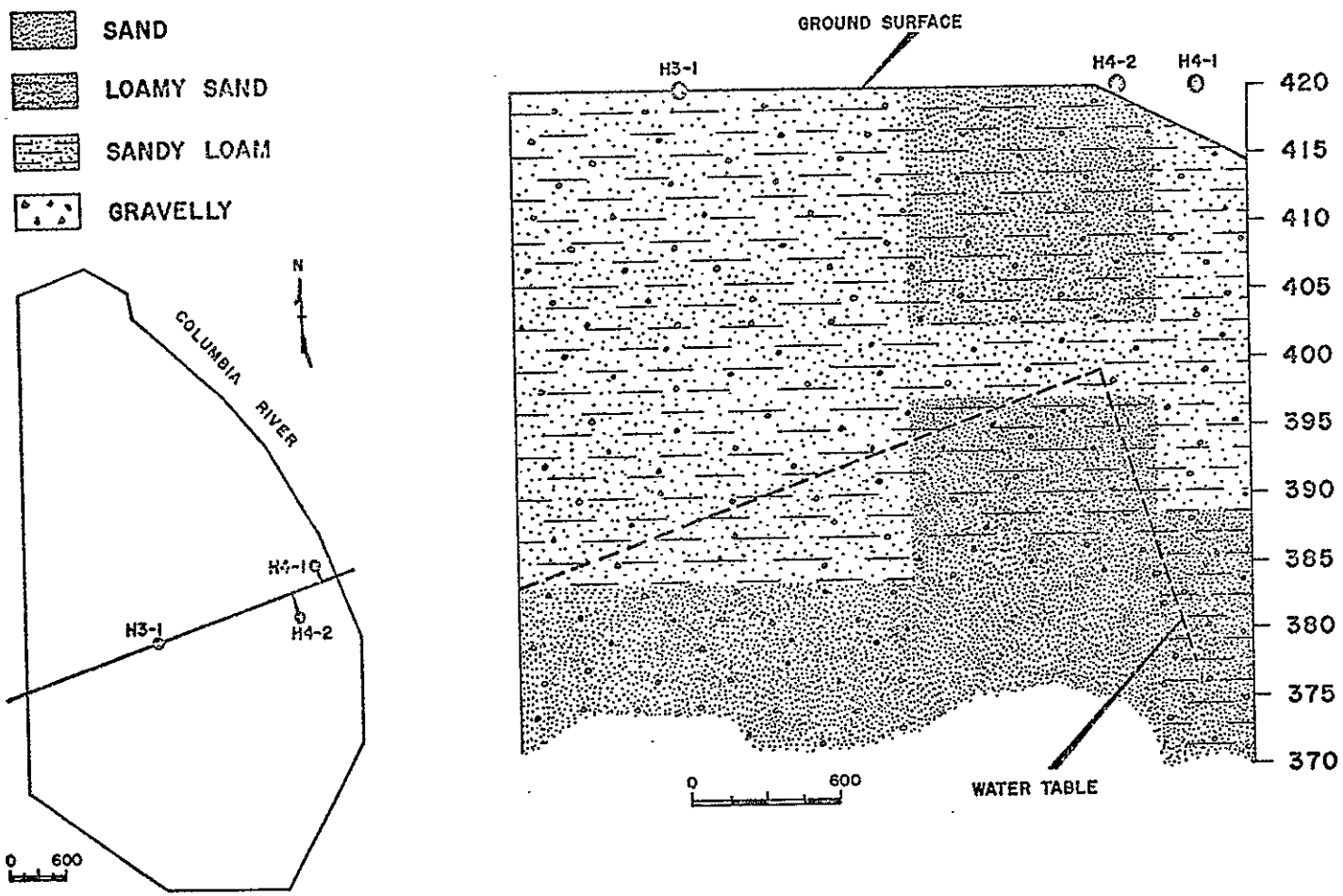
Figure 7

UNCLASSIFIED



100F AREA SUBSOIL PARTICLE SIZE DISTRIBUTION

Figure 8



100H AREA SUBSOIL PARTICLE SIZE DISTRIBUTION

Figure 9

APPENDIX

The column headings in the Appendix are explained as follows:

Well designation

Wells are numbered according to the system described by Brown and McGhan[4].

Depth of sample

The depth in feet below ground surface at which the driller reported the sample was taken.

Depth to Water

The distance in feet from the lip of the casing (about 2.5 feet above ground surface) to the water table as of July, 1963, except for Wells 199-F5-2, (1957), 199-K-20, K-21, K-22, (12-1962). (Blank indicates data not available).

Material above 2 mm

Percentage of bulk sample that failed to pass a 2 mm sieve; gravel.

Sand

Percentage of particles in bulk sample with diameters from .05 to 2 mm.

Silt

Percentage of particles in bulk sample with diameters from .002 to .05 mm.

Clay

Percentage of particles in bulk sample with diameters less than 0.002 mm.

Cation exchange capacity

Milliequivalents of exchangeable cation per 100 grams of bulk soil.

9413222.0017

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
199-B3- 1	31	5	26	48	15.9	9.6	6.7
		10	25	49	17.3	9.4	6.1
		15	36	42	13.7	7.6	4.1
		20	77	18	3.7	1.6	0.9
		25	64	29	4.7	2.7	1.3
		30	61	37	1.4	0.8	0.9
		35	67	30	2.2	1.0	1.2
199-B3- 2	40	5	72	25	2.2	0.8	1.5
		15	33	50	11.9	5.9	3.2
		20	50	37	8.5	4.1	1.9
		30	91				0.2
		35	53	38	6.6	3.0	1.2
		40	69	24	4.8	2.1	0.8
199-B4- 1	56	5	16	64	12.9	6.8	6.1
		10	27	56	11.1	5.9	5.6
		15	57	32	8.5	2.9	3.1
		20	3	88	7.1	2.2	5.5
		25	29	54	12.7	4.8	5.6

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		30	32	51	12.0	4.6	5.4
		35	42	46	8.8	3.3	4.9
		40	25	69	3.0	2.3	5.1
		45	27	59	9.9	4.6	4.8
		50	32	50	14.0	4.3	4.0
		55	5	86	6.2	3.1	4.1
		60	62	35	2.1	1.2	1.1
		65	55	36	6.3	2.6	1.5
		70	63	31	4.1	1.8	1.6
199-B4- 2	56	5	20	52	21.3	6.1	10.6
		10	25	52	17.7	5.7	6.2
		15	25	52	18.0	5.3	5.7
		20	21	57	16.7	5.5	5.4
		25	23	56	16.4	5.3	5.5
		30	9	84	4.8	2.6	5.9
		35	59	37	3.2	0.9	3.0
		40	40	50	7.2	2.2	4.1
		45	36	56	6.7	1.4	4.3

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		50	10	83	4.9	2.0	5.4
		55	6	90	2.8	1.6	6.1
		60	6	90	2.1	1.3	5.6
		65	10	86	2.9	1.2	5.6
		70	10	83	4.9	1.2	3.8
		75	28	67	4.1	1.0	1.6
199-B4- 3	56	5	10	64	18.5	7.9	7.0
		10	36	46	15.9	2.1	4.8
		15	40	42	13.5	5.3	4.6
		20	34	46	14.1	5.2	5.1
		25	73	23	3.0	1.1	1.6
		30	85	14	0.1	0.4	1.1
		35	65	30	3.6	1.0	2.6
		40	75	20	4.1	1.3	2.0
		45	54	33	9.0	3.3	2.9
		50	67	28	4.2	1.5	2.0
		55	9	80	8.2	2.9	3.4
		60	25	55	14.6	5.0	4.3

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		65	38	52	7.2	2.9	2.6
		70	25	63	8.2	4.0	3.4
		75	26	57	11.8	5.4	2.5
199-B4- 4	68	5	17	58	18.2	6.9	6.4
		10	19	53	20.2	7.5	6.2
		15	39	41	13.8	6.0	4.9
		20	41	39	14.7	4.9	4.6
		25	29	48	17.3	6.4	6.0
		30	41	41	14.4	3.7	4.9
		35	34	46	15.5	4.1	5.9
		40	48	37	12.3	2.8	4.2
		45	58	31	8.8	2.2	2.8
		50	41	40	15.9	3.7	4.7
		55	53	32	12.1	3.7	3.6
		60	40	40	15.4	4.7	4.3
		65	67	22	8.6	2.4	2.4
		70	63	26	8.3	2.1	2.6
		75	61	36	3.0	0.9	1.7

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
199-B8- 1	70	5	24	54	15.6	5.8	6.1
		10	22	57	15.1	5.8	6.4
		15	45	40	9.4	5.5	5.2
		20	25	50	16.2	8.6	7.9
		25	47	35	12.5	5.0	4.5
		30	34	47	12.6	6.2	6.7
		35	42	40	11.9	5.8	4.9
		40	44	40	11.0	5.3	4.8
		45	53	38	6.6	2.1	2.9
		50	44	40	11.4	5.3	4.7
		55	46	39	10.2	4.6	4.9
		60	43	40	11.8	4.8	5.2
		65	50	35	10.9	4.8	4.5
		70	33	46	14.6	6.4	5.5
		75	33	46	14.5	5.6	5.6
199-B8- 2		10	19	56	17.4	7.1	6.5
		20	30	51	13.7	5.8	5.0
		25	31	49	14.0	6.2	4.9

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
199-B8- 3		5	54	41	3.6	1.6	2.5
		10	40	43	11.8	5.0	4.3
		15		70	21.3	9.0	8.0
		25	31	45	17.2	7.2	5.6
199-B8- 4		5	37	48	11.1	4.4	4.7
		10	10	82	5.4	2.0	5.6
		20	49	38	9.8	3.2	4.2
		25	33	44	16.8	6.2	6.0
199-B8- 5		5	28	54	11.8	6.5	6.2
		10	23	56	13.9	7.3	6.2
		15	33	47	13.2	6.3	5.8
		20	37	45	12.4	5.0	5.7
		25	24	50	18.1	7.6	8.1
199-B9- 1	74	5	32	59	6.4	2.7	5.0
		10	34	47	14.3	5.3	5.9
		15	32	53	10.7	4.4	5.5
		20	40	49	7.7	3.3	4.9
		25	34	46	13.7	6.2	5.1

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		30	60	35	3.6	1.4	2.6
		35	38	44	12.3	5.2	5.5
		40	31	49	13.8	5.8	6.0
		45	36	46	13.5	4.8	5.1
		50	40	41	13.1	5.0	5.0
		55	57	32	8.6	2.8	3.1
		60	56	35	6.6	2.3	3.3
		65	33	45	16.4	5.9	6.1
		70	95				0.4
199-D2- 1		5	39	45	11.9	3.8	4.1
		10	38	44	13.1	4.9	4.4
		15	58	41	0.8	0.5	2.8
		20	41	45	10.3	3.1	2.4
		25	60	30	7.9	2.3	2.2
		30	35	49	12.8	3.3	4.0
199-D2- 2		5	8	76	11.3	4.5	4.1
		10	31	53	11.2	4.4	3.4
		15	62	32	4.9	1.3	1.9

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		20	34	60	4.9	1.3	2.9
		25	22	69	6.9	1.9	3.6
		30	40	48	9.1	3.0	3.0
199-D2- 3		5	34	49	11.8	5.3	4.4
		10	35	48	11.4	5.1	4.1
		15	40	43	11.8	4.8	3.5
		20	33	47	14.3	5.7	4.8
		25	73	20	4.7	2.0	1.6
		30	35	51	10.0	4.5	4.3
199-D2- 4		5	31	51	13.1	5.0	4.3
		10	39	46	11.0	3.7	3.5
		15	33	49	13.0	4.4	4.1
		20	17	77	5.0	1.8	4.1
		25	27	60	10.3	3.0	4.3
		32	27	60	9.6	3.3	3.6
199-D2- 5	73	5	44	41	11.5	3.6	3.1
		10	28	53	14.0	4.8	4.0
		15	38	43	14.0	5.0	3.7

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		20	44	42	9.7	3.9	3.2
		25	32	54	10.2	4.0	3.9
		30	33	54	9.4	3.2	4.1
		35	2	80	12.8	5.7	6.8
		40	3	81	10.6	5.3	7.8
		45	38	50	8.4	3.7	3.2
		50	42	46	8.2	3.3	3.4
		55	31	49	14.5	5.4	3.7
		60	56	33	8.4	3.0	2.3
199-D5- 1		5	22	59	13.7	5.3	4.7
		10	30	54	11.6	4.8	4.2
		15	41	43	11.2	4.9	3.7
		20	42	47	7.4	3.2	3.1
		25	60	34	4.5	2.2	2.2
		30	49	43	6.7	1.8	2.8
199-D5- 2		5	19	60	16.2	5.1	4.3
		10	35	48	12.7	4.7	3.7
		15	44	42	10.4	3.8	3.1

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		20	58	32	7.7	2.5	2.4
		25	70	24	5.2	1.4	1.7
		30	59	33	6.5	1.8	2.0
199-D5-10		5	31	52	11.9	5.2	4.5
		10	18	60	16.0	5.9	5.7
		15	50	40	7.1	2.5	2.7
		20	65	30	3.8	1.2	1.7
		25	10	78	8.6	3.1	4.3
199-D5-11		5	31	54	11.4	4.0	4.3
		10	18	61	16.5	5.1	4.4
		15	50	39	8.4	2.1	2.5
		20	65	33	1.9	0.8	1.7
		25	10	81	7.5	1.8	4.0
199-D5-12	75	5	35	50	11.2	4.1	4.1
		10	28	54	13.4	4.9	4.6
		15	33	53	10.5	3.9	4.1
		20	17	66	13.4	3.6	5.2
		25	9	74	11.9	5.0	6.7

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		30	6	76	12.4	5.6	7.3
		35	22	64	9.8	3.9	5.7
		40	35	46	13.5	4.8	3.5
		45	27	54	14.5	4.2	3.8
		50	30	52	14.0	4.8	2.0
		55	47	42	8.7	2.9	1.1
		60	37	47	11.7	4.5	1.5
199-D8- 1		5	63	32	3.5	1.6	2.0
		20	9	84	4.8	2.5	3.4
		30	20	76	2.4	1.8	2.7
		40	65	34	0.9	0.6	1.2
		50	97				0.1
		60	16	77	5.3	2.4	1.7
		70	18	62	13.6	6.6	5.8
199-D8- 2		5	33	53	9.2	4.8	4.2
		10	33	52	10.7	4.5	4.0
		15	22	76	0.8	1.4	2.7
		20	33	62	2.7	1.9	4.0

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		25	25	71	3.3	1.5	3.5
		30	13	84	1.9	1.9	4.3
		35	2	92	3.6	2.1	3.0
		40	1	92	5.1	2.1	4.0
		45	65	29	4.7	1.3	1.4
		50	23	63	10.1	4.0	3.0
199-F5- 1	24	5		81	17.0	1.8	4.8
		10		84	14.0	2.3	3.4
		15	2	90	6.6	1.7	3.0
199-F5- 2	25	5	66	33	0.4	0.3	0.8
		10	47	52	0.3	0.8	1.2
		15	33	65	0.3	1.1	1.8
		20	77	21	0.7	0.7	0.6
		25	47	52	0.3	0.9	1.2
		30	29	68	1.9	1.2	1.7
		35	36	62	0.1	2.7	1.9
199-F5- 3	20	5	36	46	12.3	5.1	
		10	26	55	12.1	6.3	3.4

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		15	29	55	10.8	5.7	2.5
		20	52	38	7.7	1.8	1.4
		25	38	61		0.9	1.5
		30	45	53	0.7	1.0	2.1
		35	57	41	0.6	0.8	1.1
199-F6- 4	25	5	22	64	10.0	4.3	3.0
		25	77	22	0.6	0.2	0.6
		30	52	47	0.6	0.5	1.1
199-F6- 5	16	5	34	48	13.8	4.5	3.2
		10	33	50	12.4	4.2	2.5
		15	63	29	6.1	2.3	1.7
		20	54	43	1.8	0.8	1.4
		25	25	68	5.9	1.7	2.1
		30	60	39	0.7	0.5	1.3
		35	2	94	2.8	1.2	3.3
199-F6- 6	30	5	77	22	1.1	0.7	1.6
		10	37	54	5.7	2.8	2.3
		15	85	12	2.4	0.1	0.4

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		20	90				0.3
		25	93				0.2
		30	70	27	2.0	0.5	0.9
199-F8- 1	20	5	34	50	12.1	3.9	3.0
		10	28	52	14.3	5.1	2.6
		15	26	59	11.1	4.2	2.4
		20	20	62	12.8	5.3	2.6
		25	8	76	12.4	4.3	2.3
		30	41	49	6.8	3.0	1.4
		35	32	58	6.5	3.3	1.7
199-F8- 2		5	42	43	10.7	4.5	2.6
		10	37	48	11.0	4.3	2.1
		15	30	53	12.0	4.9	2.2
		20	24	63	9.9	3.2	2.0
		25	16	69	10.2	5.2	2.3
		30	38	54	5.7	2.6	1.5
		35	75	23	1.1	0.9	0.6
		45	76	22	1.5	0.8	0.5

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
199-H3- 1	38	5	32	50	12.3	5.9	2.5
		10	35	49	10.3	5.5	2.4
		15	21	56	15.9	7.6	2.7
		20	35	48	11.7	5.6	2.1
		25	29	54	11.2	6.3	2.3
		30	33	52	9.3	5.9	2.3
		35	43	44	9.0	4.5	1.9
		40	35	59	3.4	2.1	1.7
199-H4- 1	24	5	31	50	13.6	5.6	2.3
		10	32	48	13.4	6.2	2.0
		15	29	53	11.9	5.8	2.8
		20	35	49	11.8	4.6	2.3
		25	30	53	13.4	4.3	2.2
		30	23	64	9.2	3.9	2.1
		35	33	54	8.6	4.2	1.7
		40	28	59	9.4	4.2	1.7
199-H4- 2	20	5	46	44	7.6	3.0	2.1
		10	44	48	5.6	2.5	2.1

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		15	23	65	5.7	6.4	2.8
		20	38	48	10.2	4.5	2.1
		25	32	53	10.0	4.6	2.1
		30	34	58	5.5	2.8	1.8
		35	45	51	2.8	2.0	2.1
		40		90	4.7	5.1	3.5
199- K-11	60	5	34	44	17.1	4.7	
		10	17	62	15.6	5.9	
		15	17	60	17.0	6.3	
		20	21	58	15.0	5.6	
		25	53	37	8.0	1.9	
		30	22	52	18.9	6.7	
		35	12	53	25.1	9.9	
		40	4	65	21.7	9.9	
		45	28	54	12.3	5.6	
		50	15	57	20.4	7.9	
		55	32	46	15.5	6.3	
		60	22	54	17.0	7.2	

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		65	23	58	12.9	5.6	
		70	20	54	18.2	7.5	
		75	26	61	8.9	3.9	
		80	23	57	14.4	6.0	
199- K-18		5	20	75	2.4	1.7	2.5
		11	19	76	2.8	1.8	2.0
		15	61	36	1.9	0.9	0.5
		20	23	71	4.4	2.1	0.1
		25	63	35	0.9	0.4	0.5
		30	17	79	2.8	0.9	1.2
		35		94	4.5	1.6	1.2
		40	49	48	2.0	1.2	1.0
		45	47	50	2.1	0.7	1.6
		50	37	56	5.4	2.1	1.7
		55	61	37	1.0	0.7	1.1
		60	34	62	2.6	1.5	2.1
199- K-19	4	10	42	54	1.9	1.9	1.4
		15	28	60	7.7	4.9	2.0

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		20	31	54	9.0	5.8	1.5
		25	26	59	9.4	5.9	1.4
		30	30	59	7.8	4.2	1.1
		35	54	45	0.4	0.9	0.5
		40	88	8	1.7	1.0	0.3
		45	29	65	0.9	4.5	1.6
199- K-20	5	40	46	51	2.0	1.1	
		45	61	34	3.7	1.5	
		50	33	55	7.7	3.6	
199- K-21	10	5	36	50	10.4	3.6	
		10	35	49	12.7	3.8	
		15	24	68	6.1	2.4	
		20	25	55	14.4	5.1	
		25	83	15	2.4	0.4	
		30	42	49	6.9	2.5	
		35	82	17	0.4	0.2	
199- K-22	13	5	48	39	9.5	3.1	
		10	45	41	10.9	3.6	

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		15	38	51	8.6	2.8	
		20	27	60	9.3	3.3	
		25	47	47	4.4	1.3	
		30	66	33	0.9	0.2	
		35	65	32	2.3	0.3	
		50	69	30	0.7	0.1	
199- K-25		5	35	50	9.9	5.0	3.7
		10	32	51	11.3	5.5	4.3
		15	10	62	20.1	8.7	6.0
		20	59	38	1.7	0.9	1.5
		25	75	25	0.1	0.3	0.9
		30	31	65	2.5	1.1	1.7
		35	21	73	5.9		1.6
		40	41	53	4.3	1.6	1.3
		45	57	40	2.4	0.8	1.3
		50	59	39	1.2	0.6	0.6
		55	52	44	2.9	1.2	1.2
		60	50	48	1.9	1.0	1.1

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		65	60	39	0.9	0.6	0.7
		70	49	45	3.6	2.3	0.8
		75	59	40	0.7	0.8	0.4
199- K-26		5	21	70	6.3	3.0	4.9
		10	33	57	7.0	2.9	4.4
		15	45	54	1.1	0.4	3.4
		20	32	51	12.0	5.0	5.4
		25	29	53	13.8	4.5	5.9
		30	39	55	3.7	2.5	1.2
		35	24	59	12.9	4.0	1.5
		40	24	72	2.3	1.7	1.2
		45	49	49	1.5	0.7	0.4
		50	38	58	1.6	2.4	1.6
		55	32	58	7.1	3.2	1.6
699-63-25	33	5	33	50	10.4	7.1	3.7
		10	7	60	22.1	11.1	6.0
		15	33	51	10.8	6.1	3.5
699-70-68	123	5	38	42	14.2	5.2	3.3

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		10	40	40	14.4	5.7	3.2
		15	43	43	9.7	4.3	3.0
		20	51	39	6.8	2.7	2.4
		25	71	23	4.3	1.7	1.5
		30	10	84	4.0	1.8	3.9
		35	28	64	5.5	2.1	3.8
		40	5	90	4.0	1.4	5.1
		45	10	84	4.2	1.8	6.8
		50	57	41	0.9	0.6	1.6
		55	37	50	10.8	1.5	3.1
		60	25	69	3.6	1.6	2.8
		65	16	62	20.6	1.8	3.1
		70	19	60	19.9	1.7	3.0
		75	65	31	2.7	1.3	1.6
		80	75	22	1.8	1.2	1.7
		85	7	89	2.8	0.7	3.0
		90	40	57	2.1	0.8	2.9
		95	17	79	3.3	1.1	4.1

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		100	5	88	5.7	1.7	4.9
		105	49	45	4.9	1.7	2.8
		110	59	33	6.1	1.9	2.6
		115	27	68	3.7	2.0	2.6
		120	11	85	3.2	1.1	2.6
		125	62	36	1.4	0.9	1.2
		130	45	51	2.6	1.0	1.2
699-71-52	122	5	15	68	12.7	5.0	5.3
		10	23	63	9.9	4.5	4.7
		15	18	68	9.7	4.9	5.7
		20	4	85	7.5	3.8	6.0
		25	3	90	4.7	1.9	5.4
		30	53	45	1.8	0.9	2.7
		35	2	93	2.4	2.0	1.7
		40	1	88	9.4	1.5	1.6
		45	1	97	1.5	1.0	5.3
		50	1	88	7.9	3.0	3.5
		55	2	90	5.4	2.5	6.4

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		60	1	94	3.5	1.5	5.2
		65	1	91	5.4	2.5	5.7
		70	2	94	3.3	1.3	5.6
		75		96	3.0	1.3	5.2
		80	2	92	2.5	3.3	5.4
		85	4	88	5.6	2.7	5.3
		90	2	93	3.8	1.8	5.6
		95	76	23	1.4	0.4	1.2
		100	79	20	1.0	0.3	1.0
		105	89				0.5
		110	75	24	0.4	0.4	1.4
		115	31	58	8.9	2.8	3.5
		120	44	44	8.2	3.3	1.4
699-72-92	45	5	22	63	10.3	4.1	2.8
		10	24	63	[illegible].7	3.2	2.5
		15	20	74	3.9	1.8	2.6
		20	54	44	2.0	0.8	1.5
		25	9	84	5.3	2.1	1.9

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		30	71	23	4.4	1.7	0.8
		35	59	40	0.2	0.5	1.4
		40	71	28	1.0	0.5	1.3
699-75-44	50	5		68	23.8	7.8	6.4
		10	27	55	13.2	5.1	4.4
		15	37	53	7.9	2.9	3.7
		20	59	31	7.5	2.6	2.6
		25	32	51	12.2	4.7	3.9
		30	72	24	2.8	1.1	1.3
		35	54	33	9.2	4.1	2.7
		40	29	53	12.5	5.9	6.8
		45	32	51	11.9	5.7	3.4
		50	23	58	12.5	6.4	4.1
		55	24	37	22.3	16.2	15.3
699-77-54	82	5	16	57	20.2	6.4	6.0
		10	41	47	10.0	2.8	3.5
		15	50	41	8.0	1.8	2.8
		20	68	24	6.1	1.6	1.9

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		25	51	36	9.7	2.8	3.1
		30	67	25	6.4	2.1	1.9
		35	70	24	4.9	1.6	1.9
		40	61	28	4.0	3.3	3.1
		45	41	45	11.2	3.5	2.6
		50	30	52	13.8	4.7	4.1
		55	59	32	7.7	1.9	2.1
		60	66	28	5.3	1.4	2.1
		65	56	34	7.4	2.5	2.8
		70	76	19	3.9	1.9	1.0
		75	54	36	7.0	2.8	1.8
		80	78	17	3.2	1.7	1.2
699-78-36	33	5	33	62	3.6	1.4	1.4
		10	25	55	14.2	5.8	1.8
		15	23	59	13.0	5.3	2.4
		20	36	49	12.0	4.4	1.6
		25	24	52	17.4	7.1	1.9
		30	32	48	14.9	5.7	1.6

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		35	33	50	12.6	4.9	1.8
699-78-62	62	5	28	49	16.5	6.2	4.9
		10	25	61	8.5	6.1	5.6
		15	19	54	21.0	5.5	5.2
		20	32	47	16.3	4.7	4.7
		25	21	58	16.1	5.0	5.0
		30	29	52	14.8	4.7	4.6
		35	28	49	17.2	6.4	4.9
		40	32	47	15.4	5.3	4.6
		45	25	50	17.0	7.3	4.1
		50	25	52	16.0	7.0	3.4
		55	14	61	17.6	8.1	3.2
		60	21	60	14.1	5.4	2.2
		65	16	61	16.7	6.6	2.3
		70	12	68	14.8	5.1	2.0
699-85-47	44	5		73	21.8	5.5	4.3
		10		75	19.8	5.3	3.6
		15	1	74	20.7	4.4	2.9

UNCLASSIFIED

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		20	0	62	31.8	6.5	3.2
		25	0	54	39.2	6.9	2.8
		30	34	47	16.1	3.3	2.4
		35	35	49	12.9	2.9	3.9
		40	28	58	11.1	3.6	2.0
		45	25	67	5.9	1.8	4.7
		50	20	69	7.8	2.9	4.5
699-89-35	22	5	0	73	22.7	4.1	5.7
		10	3	51	38.6	7.9	6.7
		15	77	21	1.0	0.4	0.8
		20	43	55	1.3	0.9	1.5
		25	95				0.1
		30	87	11	2.2	0.7	0.8
		35	32	54	9.6	3.8	2.2
		40	32	59	5.9	2.8	2.2
		45	36	64	0.1	0.4	1.5
		50	2	65	24.6	8.4	11.3
		55	4	54	31.1	10.9	8.6

UNCLASSIFIED

WELL DESIGNATION	DEPTH TO WATER FEET	DEPTH OF SAMPLE FEET	MATERIAL ABOVE 2MM PERCENT	SAND PERCENT	SILT PERCENT	CLAY PERCENT	CATION EXCHANGE CAPACITY MEQ/100G SOIL
		60	31	63	4.0	2.3	3.6
		65	1	64	25.1	9.6	9.5
		70	2	68	21.6	8.1	9.1

UNCLASSIFIED