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COASTAL AND MARINE GEOI
WOODS HOLE FIELD CEN
384 Woods Hole Road, Woods Hole,
Phone: (508) 548-870

#105122 PIKE 94-1
PIKE 94027
Western Lake Erie
June 14-27, 1994
G.Shideler,B.Stone
PARTICLE SIZE ANALYSES
June 14-27, 1994

94027 psa

GRAB OPERATIONS AND PROCESSING LOG

Particle Size Analysis
(Central Region Lab)

SHIP AND CRUISE: PIKE 94-1 (94027)

AREA: Western Lake Erie

DATES: June 14-27, 1994

CHIEF SCIENTIST: G. Shideler / B. Stone

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Box 25046 M.S. 913
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO:

Office: (303)236-1273
Fax: (303)236-0214

MEMORANDUM

July 26, 1994

To: David W. Folger, BAMG, Woods Hole

From: Gerald L. Shideler, BCRG, Denver GLS

Subject: Cruise Report (R/V Pike 94-1)

Location: Western Lake Erie Coastal Zone--Locust Point, Ohio, to Pointe Mouillee, Michigan.

Date: June 14-27, 1994.

Purpose: (1) To determine the Quaternary geologic framework of the western Lake Erie basin along the northwestern Ohio-southeastern Michigan coastal zone, using a high-resolution seismic reflection survey; (2) to determine the offshore areal distribution of coastal sand bodies for sediment-budget analysis, using a side-scan sonar survey and lakebed grab samples for ground-truth verification.

Vessel: R/V Pike (NBS/USFWS 22-foot Boston Whaler from the NASA Plum Brook Station in Sandusky, Ohio).

Crew: G. Shideler and B. Stone (Co-Chief Scientists), D. Nichols (Electronics Technician), B. Irwin (Navigator), K. MacKinnon (NAGT Student).

Equipment: Geopulse Seismic System, Klein Side-Scan Sonar System, Differential GPS Navigation System, grab sampler.

Log:

June 14--Mobilization of the R/V Pike in the City of Sandusky, Ohio, at the Ohio Geological Survey facility.

June 16--Installed differential GPS antenna at Ward Canal marina and tested system; embarked from Ward Canal and initiated side-scan sonar survey in the Locust Point-Turtle Creek area; lakebed grab samples obtained for ground-truth verification.

June 17--Embarked from Ward Canal and continued side-scan sonar survey and lakebed sampling of area from Turtle Creek to Little Cedar Point.

June 18--Embarked from Ward Canal and continued side-scan sonar survey and lakebed sampling of Little Cedar Point-Woodtick Peninsula area of Maumee Bay.

June 19--Embarked from Ward Canal and continued side-scan sonar survey of Metzger Marsh area.

June 20--Embarked from Ward Canal and continued side-scan sonar survey of Little Cedar Point shoal-Woodtick Peninsula area of Maumee Bay.

June 21--Embarked from Ward Canal and continued side-scan sonar survey of Little Cedar Point shoal area of Maumee Bay; side-scan sonar work completed.

June 22--Rigged R/V Pike for seismic operations and tested Geopulse system; embarked from Ward Canal and initiated seismic survey from Metzger Marsh across Maumee Bay and along Woodtick Peninsula.

June 23--Embarked from Toledo U.S. Coast Guard station at mouth of Maumee River; conducted seismic survey along Toledo shipping channel and southern Maumee Bay-Cedar Point shoal area.

June 24--No operations due to bad weather (rain, thunderstorms, heavy sea state).

June 25--No operations due to bad weather.

June 26--Embarked from Luna Pier, Michigan, and continued seismic survey of northern Maumee Bay and along Michigan coast from northern Woodtick Peninsula to Pointe Mouillee near Detroit River mouth; seismic system power supply failed near end of last trackline and operations were terminated at Pointe Mouillee.

June 27--Demobilization of R/V Pike in Sandusky, Ohio, at the Ohio Geological Survey facility; R/V Pike returned to NBS/USFWS at the NASA Plum Brook Station facility in Sandusky.

<u>Summary</u>: The cruise successfully resulted in the acquisition of 46 statute miles of side-scan sonar profiles, 65 statute miles of seismic-reflection profiles, and 20 lakebed-sediment samples. The seismic and side-scan sonar profiles were of variable quality, depending upon the composition of the surficial sediments, the substrate materials, and sea state conditions.

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Box 25046 M.S. 913
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO:

October 4, 1995

Mr. Jonathan A. Fuller
Ohio Department of Natural Resources
Division of Geological Survey
Great Lakes Center
1634 Sycamore Line
Sandusky, Ohio 44870-4132

Dear Nate:

I will no longer be working with the USGS after October 14, and I thought that you might be able to use these few nearshore Side-Scan sonar records that were obtained during the summer of 1994. You might want to incorporate them into your larger Side-Scan database. These records were obtained between Locust Point and Maumee Bay. I also enclosed the trackline map (100,000 scale), but the USGS Woods Hole Office could easily print out a better copy at any scale you prefer. Also enclosed are some ground-truth granulometric analyses of bottom samples taken along lines 5, 9, 11, and 15. I hope the records will be of some use in your nearshore survey.

Best Regards,

Gerald L. Shideler
Research Geologist
Central Regional Geology Branch

Enclosures:
Side-Scan Sonar Records
Trackline Map
Granulometric Data

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 5A
Cylinder No. 1
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 22.166
Calculated Sample Wt. 21.302
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.987	7.369	0.561	17.412	81.74	18.26
4.5	0.0442	00:01:46	20	8.106	7.503	0.546	16.946	79.55	20.45
5.0	0.0312	00:01:46	10	7.932	7.376	0.499	15.487	72.70	27.30
5.5	0.0221	00:03:32	10	7.786	7.381	0.348	10.801	50.70	49.30
6.0	0.0156	00:07:05	10	7.840	7.526	0.257	7.976	37.45	62.55
8.0	0.0039	01:53:12	10	11.289	11.054	0.178	5.525	25.93	74.07
11.0	0.00049	48:19:00	4	11.332	11.176	0.099	3.073	14.42	85.58

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.75	96.48	3.52
1.0	0.50	35	1.48	93.05	6.95
2.0	0.25	60	2.74	87.14	12.86
3.0	0.125	120	3.66	82.82	17.18
4.0	0.0625	230	3.89	81.74	18.26

% GRAVEL 21.89
% SAND 14.26
% SILT 52.58
% CLAY 11.26

Date 9 NOV 94 By PLF

ab No. 94-7-3
set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 5D
Cylinder No. 2
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 26.050
Calculated Sample Wt. 25.406
Removed: $CaCO_3$ – Organics –
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.841	7.170	0.614	19.056	75.01	24.99
4.5	0.0442	00:01:46	20	8.324	7.667	0.600	18.622	73.30	26.70
5.0	0.0312	00:01:46	10	8.151	7.503	0.591	18.343	72.20	27.80
5.5	0.0221	00:03:32	10	7.791	7.170	0.564	17.505	68.90	31.10
6.0	0.0156	00:07:05	10	8.040	7.458	0.525	16.294	64.13	35.87
8.0	0.0039	01:53:12	10	11.602	11.177	0.368	11.421	44.95	55.05
11.0	0.00049	48:19:00	4	10.557	10.268	0.232	7.200	28.34	71.66

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.96	96.22	3.78
1.0	0.50	35	1.86	92.68	7.32
2.0	0.25	60	3.61	85.79	14.21
3.0	0.125	120	5.70	77.56	22.44
4.0	0.0625	230	6.35	75.01	24.99

% GRAVEL 80.65
% SAND 4.84
% SILT 9.03
% CLAY 5.48

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 5E
Cylinder No. 3
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 3.675
Calculated Sample Wt. 3.547
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.285	7.163	0.065	2.017	56.87	43.13
4.5	0.0442	00:01:46	20	7.625	7.505	0.063	1.955	55.12	44.88
5.0	0.0312	00:01:46	10	7.484	7.366	0.061	1.893	53.37	46.63
5.5	0.0221	00:03:32	10	7.282	7.168	0.057	1.769	49.87	50.13
6.0	0.0156	00:07:05	10	7.708	7.596	0.055	1.707	48.12	51.88
8.0	0.0039	01:53:12	10	10.368	10.274	0.037	1.148	32.37	67.63
11.0	0.00049	48:19:00	4	10.363	10.284	0.022	0.683	19.25	80.75

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.04	98.87	1.13
1.0	0.50	35	0.15	95.77	4.23
2.0	0.25	60	0.55	84.50	15.50
3.0	0.125	120	1.29	63.64	36.36
4.0	0.0625	230	1.53	56.87	43.13

% GRAVEL —
% SAND 43.13
% SILT 37.62
% CLAY 19.25

Date 9 NOV 94 By PLF

ab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 5F
Cylinder No. 4
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 4.608
Calculated Sample Wt. 4.564
Removed: $CaCO_3$ – Organics –
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.601	7.502	0.042	1.304	28.56	71.44
4.5	0.0442	00:01:46	20	7.467	7.370	0.040	1.241	27.20	72.80
5.0	0.0312	00:01:46	10	7.607	7.511	0.039	1.210	26.52	73.48
5.5	0.0221	00:03:32	10	7.251	7.157	0.037	1.148	25.16	74.84
6.0	0.0156	00:07:05	10	7.392	7.299	0.036	1.117	24.48	75.52
8.0	0.0039	01:53:12	10	11.051	10.967	0.027	0.838	18.36	81.64
11.0	0.00049	48:19:00	4	11.024	10.955	0.012	0.372	8.16	91.84

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.43	90.58	9.42
1.0	0.50	35	0.85	81.37	18.63
2.0	0.25	60	1.87	59.02	40.98
3.0	0.125	120	3.02	33.82	66.18
4.0	0.0625	230	3.26	28.56	71.44

% GRAVEL 25.41
% SAND 53.29
% SILT 15.22
% CLAY 6.09

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 9D
Cylinder No. 8
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 77.053
Calculated Sample Wt. 76.099
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.036	7.382	0.597	18.529	24.35	75.65
4.5	0.0442	00:01:46	20	8.063	7.510	0.496	15.394	20.23	79.77
5.0	0.0312	00:01:46	10	7.940	7.468	0.415	12.880	16.93	83.07
5.5	0.0221	00:03:32	10	7.924	7.502	0.365	11.328	14.89	85.11
6.0	0.0156	00:07:05	10	8.062	7.672	0.333	10.335	13.58	86.42
8.0	0.0039	01:53:12	10	11.370	11.065	0.248	7.697	10.11	89.89
11.0	0.00049	48:19:00	4	11.161	10.954	0.150	4.655	6.12	93.88

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	6.58	91.35	8.65
1.0	0.50	35	17.06	77.58	22.42
2.0	0.25	60	36.14	52.51	47.49
3.0	0.125	120	50.70	33.38	66.62
4.0	0.0625	230	57.57	24.35	75.65

% GRAVEL 14.35 } 79.14
% SAND 64.79
% SILT 15.61
% CLAY 5.24

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 9C
Cylinder No. 7
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 28.531
Calculated Sample Wt. 28.132
Removed: $CaCO_3$ — Organics —
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.346	7.171	0.118	3.662	13.02	86.98
4.5	0.0442	00:01:46	20	7.310	7.166	0.087	2.700	9.60	90.40
5.0	0.0312	00:01:46	10	7.283	7.157	0.069	2.142	7.61	92.39
5.5	0.0221	00:03:32	10	7.485	7.368	0.060	1.862	6.62	93.38
6.0	0.0156	00:07:05	10	7.786	7.673	0.056	1.738	6.18	93.82
8.0	0.0039	01:53:12	10	11.243	11.146	0.040	1.241	4.41	95.59
11.0	0.00049	48:19:00	4	10.951	10.873	0.021	0.652	2.32	97.68

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	4.44	84.22	15.78
1.0	0.50	35	11.70	58.41	41.59
2.0	0.25	60	19.56	30.47	69.53
3.0	0.125	120	22.91	18.56	81.44
4.0	0.0625	230	24.47	13.02	86.98

% GRAVEL 19.80
% SAND 69.76
% SILT 8.58
% CLAY 1.86

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 9B
Cylinder No. 6
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 24.057
Calculated Sample Wt. 23.683
Removed: $CaCO_3$ — Organics —
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.120	7.501	0.562	17.443	73.65	26.35
4.5	0.0442	00:01:46	20	7.961	7.368	0.536	16.636	70.24	29.76
5.0	0.0312	00:01:46	10	7.931	7.363	0.511	15.860	66.97	33.03
5.5	0.0221	00:03:32	10	7.901	7.363	0.481	14.929	63.04	36.96
6.0	0.0156	00:07:05	10	7.981	7.471	0.453	14.060	59.37	40.63
8.0	0.0039	01:53:12	10	11.538	11.187	0.294	9.125	38.53	61.47
11.0	0.00049	48:19:00	4	11.260	11.076	0.127	3.942	16.64	83.36

Temperature = 23°C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.79	96.66	3.34
1.0	0.50	35	1.71	92.78	7.22
2.0	0.25	60	3.00	87.33	12.67
3.0	0.125	120	4.60	80.58	19.42
4.0	0.0625	230	6.24	73.65	26.35

% GRAVEL 25.80
% SAND 19.55
} 45.3
% SILT 42.30
% CLAY 12.35

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 9A
Cylinder No. 5
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 32.213
Calculated Sample Wt. 31.433
Removed: $CaCO_3$ ✓ Organics ~
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.969	7.157	0.755	23.433	74.55	25.45
4.5	0.0442	00:01:46	20	8.198	7.510	0.631	19.584	62.30	37.70
5.0	0.0312	00:01:46	10	7.949	7.367	0.525	16.294	51.84	48.16
5.5	0.0221	00:03:32	10	8.027	7.505	0.465	14.432	45.91	54.09
6.0	0.0156	00:07:05	10	7.644	7.157	0.430	13.346	42.46	57.54
8.0	0.0039	01:53:12	10	11.238	10.900	0.281	8.721	27.75	72.25
11.0	0.00049	48:19:00	4	11.032	10.852	0.123	3.818	12.15	87.85

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	1.24	96.06	3.94
1.0	0.50	35	2.34	92.56	7.44
2.0	0.25	60	3.71	88.20	11.80
3.0	0.125	120	5.33	83.04	16.96
4.0	0.0625	230	8.00	74.55	25.45

% GRAVEL 10.38
% SAND 22.81
% SILT 55.92
% CLAY 10.89

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 9E
Cylinder No. 9
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 18.113
Calculated Sample Wt. 17.424
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.870	7.298	0.515	15.984	91.74	8.26
4.5	0.0442	00:01:46	20	8.019	7.464	0.498	15.456	88.71	11.29
5.0	0.0312	00:01:46	10	8.047	7.518	0.472	14.649	84.08	15.92
5.5	0.0221	00:03:32	10	8.164	7.670	0.437	13.563	77.84	22.16
6.0	0.0156	00:07:05	10	7.757	7.298	0.402	12.477	71.61	28.39
8.0	0.0039	01:53:12	10	11.415	11.069	0.289	8.970	51.48	48.52
11.0	0.00049	48:19:00	4	11.196	10.961	0.178	5.525	31.71	68.29

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.09	99.48	0.52
1.0	0.50	35	0.24	98.62	1.38
2.0	0.25	60	0.66	96.21	3.79
3.0	0.125	120	1.15	93.40	6.60
4.0	0.0625	230	1.44	91.74	8.26

% GRAVEL 0.07
% SAND 8.25
% SILT 59.99
% CLAY 31.69

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
ø

Sample No. 11A
Cylinder No. 10
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 19.428
Calculated Sample Wt. 18.852
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.990	7.516	0.417	12.942	68.65	31.35
4.5	0.0442	00:01:46	20	7.737	7.297	0.383	11.887	63.05	36.95
5.0	0.0312	00:01:46	10	7.887	7.471	0.359	11.142	59.10	40.90
5.5	0.0221	00:03:32	10	7.996	7.599	0.340	10.552	55.97	44.03
6.0	0.0156	00:07:05	10	7.978	7.601	0.320	9.932	52.68	47.32
8.0	0.0039	01:53:12	10	10.588	10.280	0.251	7.790	41.32	58.68
11.0	0.00049	48:19:00	4	11.180	10.965	0.158	4.904	26.01	73.99

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.44	97.67	2.33
1.0	0.50	35	0.97	94.85	5.15
2.0	0.25	60	1.50	92.04	7.96
3.0	0.125	120	1.96	89.60	10.40
4.0	0.0625	230	5.91	68.65	31.35

% GRAVEL 3.57 } 33.8
% SAND 30.23
% SILT 41.12
% CLAY 25.08

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 11B
Cylinder No. 11
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 23.774
Calculated Sample Wt. 22.929
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.862	7.295	0.510	15.829	69.03	30.97
4.5	0.0442	00:01:46	20	7.972	7.477	0.438	13.594	59.29	40.71
5.0	0.0312	00:01:46	10	8.100	7.683	0.360	11.173	48.73	51.27
5.5	0.0221	00:03:32	10	7.875	7.529	0.289	8.970	39.12	60.88
6.0	0.0156	00:07:05	10	7.584	7.302	0.225	6.983	30.46	69.54
8.0	0.0039	01:53:12	10	10.465	10.264	0.144	4.469	19.49	80.51
11.0	0.00049	48:19:00	4	10.414	10.262	0.095	2.948	12.86	87.14

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.02	99.91	0.09
1.0	0.50	35	0.06	99.74	0.26
2.0	0.25	60	0.22	99.04	0.96
3.0	0.125	120	0.52	97.73	2.27
4.0	0.0625	230	7.10	69.03	30.97

% GRAVEL 0.04
% SAND 30.96 } 31.0
% SILT 56.15
% CLAY 12.85

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 11C
Cylinder No. 12
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 31.025
Calculated Sample Wt. 30.123
Removed: $CaCO_3$ – Organics –
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.333	7.511	0.765	23.743	78.82	21.18
4.5	0.0442	00:01:46	20	8.248	7.514	0.677	21.012	69.75	30.25
5.0	0.0312	00:01:46	10	8.168	7.516	0.595	18.467	61.30	38.70
5.5	0.0221	00:03:32	10	8.103	7.511	0.535	16.605	55.12	44.88
6.0	0.0156	00:07:05	10	8.064	7.520	0.487	15.115	50.18	49.82
8.0	0.0039	01:53:12	10	11.359	10.954	0.348	10.801	35.86	64.14
11.0	0.00049	48:19:00	4	11.335	11.068	0.210	6.518	21.64	78.36

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.009	99.97	0.03
1.0	0.50	35	0.04	99.87	0.13
2.0	0.25	60	0.14	99.54	0.46
3.0	0.125	120	0.38	98.74	1.26
4.0	0.0625	230	6.38	78.82	21.18

% GRAVEL 0.14
% SAND 21.15
} 21.29
% SILT 57.10
% CLAY 21.61

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 11D
Cylinder No. 13
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 19.987
Calculated Sample Wt. 19.390
Removed: $CaCO_3$ — Organics —
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.053	7.494	0.502	15.580	80.35	19.65
4.5	0.0442	00:01:46	20	7.992	7.493	0.442	13.718	70.75	29.25
5.0	0.0312	00:01:46	10	7.946	7.491	0.398	12.353	63.70	36.30
5.5	0.0221	00:03:32	10	7.991	7.575	0.359	11.142	57.46	42.54
6.0	0.0156	00:07:05	10	7.653	7.267	0.329	10.211	52.66	47.34
8.0	0.0039	01:53:12	10	11.162	10.868	0.237	7.356	37.93	62.07
11.0	0.00049	48:19:00	4	11.075	10.875	0.143	4.438	22.89	77.11

Temperature = 23°C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.01	99.95	0.05
1.0	0.50	35	0.04	99.79	0.21
2.0	0.25	60	0.12	99.38	0.62
3.0	0.125	120	0.28	98.56	1.44
4.0	0.0625	230	3.81	80.35	19.65

% GRAVEL 0.10
% SAND 19.63
} 19.7
% SILT 57.40
% CLAY 22.87

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 11E
Cylinder No. 14
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 13.415
Calculated Sample Wt. 12.881
Removed: $CaCO_3$ — Organics —
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.698	7.273	0.368	11.421	88.67	11.33
4.5	0.0442	00:01:46	20	7.901	7.511	0.333	10.335	80.23	19.77
5.0	0.0312	00:01:46	10	7.632	7.272	0.303	9.404	73.00	27.00
5.5	0.0221	00:03:32	10	7.834	7.494	0.283	8.783	68.19	31.81
6.0	0.0156	00:07:05	10	7.597	7.276	0.264	8.194	63.61	36.39
8.0	0.0039	01:53:12	10	11.326	11.077	0.192	5.959	46.26	53.74
11.0	0.00049	48:19:00	4	10.462	10.288	0.117	3.631	28.19	71.81

Temperature = 23°C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.007	99.95	0.05
1.0	0.50	35	0.02	99.84	0.16
2.0	0.25	60	0.07	99.46	0.54
3.0	0.125	120	0.18	98.60	1.40
4.0	0.0625	230	1.46	88.67	11.33

% GRAVEL 0.05
% SAND 11.32 } 11.3
% SILT 60.45
% CLAY 28.18

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
ø

Sample No. 15A
Cylinder No. 15
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 20.728
Calculated Sample Wt. 19.923
Removed: $CaCO_3$ ✓ Organics ✓
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.173	7.573	0.543	16.853	84.59	15.41
4.5	0.0442	00:01:46	20	8.050	7.507	0.486	15.084	75.71	24.29
5.0	0.0312	00:01:46	10	7.915	7.472	0.386	11.980	60.13	39.87
5.5	0.0221	00:03:32	10	7.852	7.492	0.303	9.404	47.20	52.80
6.0	0.0156	00:07:05	10	7.879	7.571	0.251	7.790	39.10	60.90
8.0	0.0039	01:53:12	10	11.168	10.953	0.158	4.904	24.61	75.39
11.0	0.00049	48:19:00	4	10.422	10.275	0.090	2.793	14.02	85.98

Temperature = 23°C

Sieve Analysis
SANDS

Grain Size ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.10	99.50	0.50
1.0	0.50	35	0.21	98.95	1.05
2.0	0.25	60	0.92	95.38	4.62
3.0	0.125	120	2.24	88.76	11.24
4.0	0.0625	230	3.07	84.59	15.41

% GRAVEL 0.47
% SAND 15.34
% SILT 70.24
% CLAY 13.95

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 15B
Cylinder No. 16
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 21.170
Calculated Sample Wt. 20.410
Removed: $CaCO_3$ — Organics —
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.901	7.275	0.569	17.660	86.53	13.47
4.5	0.0442	00:01:46	20	8.145	7.584	0.504	15.642	76.64	23.36
5.0	0.0312	00:01:46	10	8.047	7.582	0.408	12.663	62.04	37.96
5.5	0.0221	00:03:32	10	7.677	7.282	0.338	10.490	51.40	48.60
6.0	0.0156	00:07:05	10	7.838	7.499	0.282	8.752	42.88	57.12
8.0	0.0039	01:53:12	10	11.194	10.955	0.182	5.649	27.68	72.32
11.0	0.00049	48:19:00	4	10.422	10.257	0.108	3.352	16.42	83.58

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.28	98.63	1.37
1.0	0.50	35	0.61	97.01	2.99
2.0	0.25	60	1.11	94.56	5.44
3.0	0.125	120	1.72	91.57	8.43
4.0	0.0625	230	2.75	86.53	13.47

% GRAVEL 12.29
% SAND 11.81
% SILT 61.49
% CLAY 14.40

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 15C
Cylinder No. 17
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 15.153
Calculated Sample Wt. 14.654
Removed: $CaCO_3$ ✓ Organics
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.181	7.676	0.448	13.904	94.88	5.12
4.5	0.0442	00:01:46	20	7.956	7.508	0.391	12.135	82.81	17.19
5.0	0.0312	00:01:46	10	8.045	7.671	0.317	9.839	67.14	32.86
5.5	0.0221	00:03:32	10	7.794	7.473	0.264	8.194	55.91	44.09
6.0	0.0156	00:07:05	10	7.772	7.489	0.226	7.014	47.86	52.14
8.0	0.0039	01:53:12	10	11.272	11.065	0.150	4.655	31.77	68.23
11.0	0.00049	48:19:00	4	11.324	11.184	0.083	2.576	17.58	82.42

Temperature = 23°C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.008	99.95	0.05
1.0	0.50	35	0.03	99.80	0.20
2.0	0.25	60	0.11	99.25	0.75
3.0	0.125	120	0.32	97.82	2.18
4.0	0.0625	230	0.75	94.88	5.12

% GRAVEL —
% SAND 5.12
% SILT 77.30
% CLAY 17.58

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 15D
Cylinder No. 18
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 15.387
Calculated Sample Wt. 14.898
Removed: $CaCO_3$ ✓ Organics
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	7.829	7.311	0.461	14.308	96.04	3.96
4.5	0.0442	00:01:46	20	7.956	7.473	0.426	13.222	88.75	11.25
5.0	0.0312	00:01:46	10	7.954	7.521	0.376	11.670	78.33	21.67
5.5	0.0221	00:03:32	10	7.913	7.521	0.335	10.397	69.79	30.21
6.0	0.0156	00:07:05	10	7.660	7.303	0.300	9.311	62.50	37.50
8.0	0.0039	01:53:12	10	11.139	10.884	0.198	6.145	41.25	58.75
11.0	0.00049	48:19:00	4	11.128	10.956	0.115	3.569	23.96	76.04

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.01	99.93	0.07
1.0	0.50	35	0.03	99.80	0.20
2.0	0.25	60	0.10	99.33	0.67
3.0	0.125	120	0.26	98.25	1.75
4.0	0.0625	230	0.59	96.04	3.96

% GRAVEL 0.41
% SAND 3.94
% SILT 71.78
% CLAY 23.86

Date 9 NOV 94 By PLF

Lab No. 94-7-3
Set No. 94-4

CENTRAL REGIONAL GEOLOGY LABORATORY
PARTICLE SIZE ANALYSIS
Ø

Sample No. 15F
Cylinder No. 19
Pipet No. 1 Vol. 32.22 ml
Dispersant Wt. 0.057 gm

% H_2O
% Organics
% $CaCO_3$

Original Sample Wt. 20.862
Calculated Sample Wt. 20.009
Removed: $CaCO_3$ — Organics —
Silica Gypsum

Pipet Analysis
SILTS AND CLAYS

Grain Size Ø	Grain Size mm	Time Hr:Min:Sec	Depth cm	Gross Wt. gm	Tare Wt. gm	Sample Wt. gm	Total Wt. gm	% Finer	Cum. %
total	total	00:00:20	20	8.205	7.522	0.626	19.429	97.10	2.90
4.5	0.0442	00:01:46	20	7.927	7.301	0.569	17.660	88.26	11.74
5.0	0.0312	00:01:46	10	7.846	7.300	0.489	15.177	75.85	24.15
5.5	0.0221	00:03:32	10	8.078	7.597	0.424	13.160	65.77	34.23
6.0	0.0156	00:07:05	10	8.028	7.597	0.374	11.608	58.01	41.99
8.0	0.0039	01:53:12	10	11.445	11.136	0.252	7.821	39.09	60.91
11.0	0.00049	48:19:00	4	10.472	10.261	0.154	4.780	23.89	76.11

Temperature = 23° C

Sieve Analysis
SANDS

Grain Size Ø	Grain Size mm	Sieve No.	Cum. Wt. gm	% Finer	Cum. %
0.0	1.00	18	0.002	99.99	0.01
1.0	0.50	35	0.01	99.95	0.05
2.0	0.25	60	0.05	99.75	0.25
3.0	0.125	120	0.16	99.20	0.80
4.0	0.0625	230	0.58	97.10	2.90

% GRAVEL —
% SAND 2.90
% SILT 73.21
% CLAY 23.89

Date 9 NOV 94 By PLF