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BIODENITRIFICATION FACILITY UPGRADE FEED MATERIALS PRODUCTION CENTER (FMPC) FERNALD, OHIO
PROJECT NO. 4144-88-462 RUST W.O. NO. 1227

12/31/88

WMCO/RUST
50
REPORT

Westinghouse
Environmental Services

Environmental Engineering

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Fairfield, Ohio 45014
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December 31, 1988

RECEIVED
JAN 05 1989
The Rust Engineering Co.
Fernald, Ohio

The Rust Engineering Company
P.O. Box 368
Ross, Ohio 45061

Attention: Mr. Fran Maranda
Senior Purchasing Agent

Regarding: Biodenitrification Facility Upgrade
Feed Materials Production Center (FMPC)
Fernald, Ohio
Project No. 4144-88-462
Rust W.O. No.: 1227

Gentlemen:

Submitted herewith is our report of the geotechnical exploration and sampling completed for the above-referenced project. The evaluation was completed in general accordance with the Request for Proposal No. 13173, dated September 28, 1988, and Change Order No. 1 dated November 4, 1988 submitted to us by Mr. Fran Maranda of The Rust Engineering Company. Technical information about the projects was provided by Mr. Michael W. Griffin, Senior Engineer, Westinghouse Materials Company of Ohio.

The Biodenitrification (BDN) Facility Upgrade project entails the exploration and/or soil sampling of four(4) separate sites at the FMPC as shown on Figure 1 located on the next page. The purpose and scope of work for each site are different, therefore we have separated the four site reports into the following appendices:

Site	Appendix	Project
1	A	BDN Holding Tank
2	B	BDN Building
3	C	BDN Effluent Treatment System
4	D	Calcium Removal System

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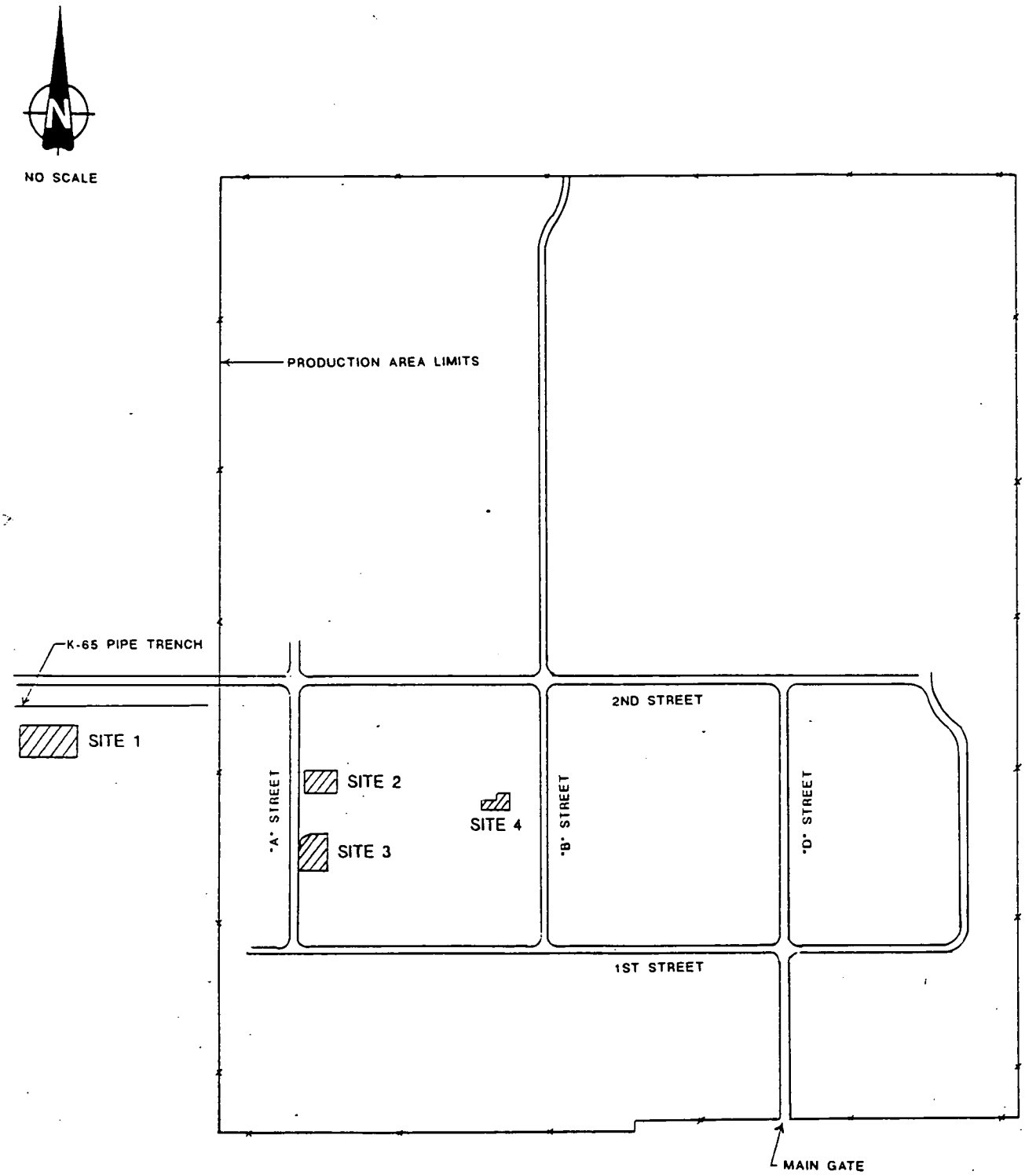

Rust Engineering Company
Biodenitrification Facility Upgrade
FMPC Fernald, Ohio

SITE LOCATION PLAN

Westinghouse
Environmental Engineering
CINCINNATI, OHIO

PROJ. NO. 4144-88-462 FIG. NO. 1

N21259

We appreciate the opportunity of continuing our services to The Rust Engineering Company on this project. If you have any questions regarding the information presented in this report or if we may be of further service, please contact us.

Respectfully submitted,

Westinghouse Environmental Engineering

Ronald F. Roelker, E.I.T.
Geotechnical Engineer

Reviewed by:

James E. Veith, P.E.
Branch Manager

RFR:kd

Attachments

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APPENDIX A

SITE 1 - BDN HOLDING TANK

INTRODUCTION

This report presents the results of the geotechnical exploration completed for the BDN Holding Tank Site at the Feed Materials Production Center (FMPC) in Fernald, Ohio. The field exploration program consisted of soil test borings and site reconnaissance by the geotechnical engineer. Recovered soil samples were tested in our laboratory to assist in the analysis of the subsurface.

The BDN Holding Tank Site is located just outside the west edge of the main production area as shown in Figure 1. The proposed holding tank will have a capacity of 500,000 gallons and will be constructed of steel with a concrete secondary containment structure. The tentative design is a circular tank with a 60 ft. diameter and 30 to 40 ft. height.

The following sections of this report present the exploration procedures employed, subsurface conditions encountered, and detailed recommendations concerning site grading and foundation design. The test boring location plan, boring logs, subsurface profiles, and a tabulation of the test results is located at the end of Appendix A.

EXPLORATION PROCEDURES

Five (5) soil test borings were drilled at the site between October 26 and 27, 1988. Four borings were advanced to a depth of 20 ft. and one boring, at the center of the site, was advanced to a depth of 30 ft. below grade. The boring locations are shown in plan on Figure 1A.

Four(4) shallow-sampling holes were also drilled at the site. Soil samples at the shallow-sampling holes were obtained at depths of 0, 1, 2 and 3 ft. below the ground surface. This sampling method was also used for the upper 3 ft. of the geotechnical borings. Samples from the upper 3 ft. were submitted to the Westinghouse Materials Company of Ohio (WMCO). Samples from these depths were recovered in accordance with sampling specifications outlined by WMCO Environmental Compliance.

As the augers were advanced beyond a depth of 3-ft., soil samples were obtained in the undisturbed material below the augered depth using the Standard Method for Penetration Test and Split-Barrel Sampling of Soil (ASTM D 1586). Samples were obtained at 2.5-ft. intervals to 10 ft. below present grades and then at 5-ft. intervals to the depths explored.

Groundwater conditions were observed during drilling and upon completion of the test borings. The geotechnical borings were backfilled with a bentonite-grout mix using the tremie method.

Recovered soil samples were visually classified in our laboratory and test boring logs prepared by methods outlined in ASTM D 2487. Indicated on each log are the descriptions of the primary strata encountered, depths of strata changes, sample types and depths, Standard Penetration Resistances, and groundwater conditions. The boring logs are presented at the end of this text, in Appendix A.

LABORATORY TESTING

Representative samples were selected for testing in our laboratory to determine their physical characteristics and engineering properties. Included in the testing program were natural moisture contents, Atterberg Limits, and grain-size analyses. The plotted data and a summary of the test results are also presented in Appendix A.

SITE CONDITIONS

The project involves a section of land just west of the production area, adjacent to the existing K-65 pipe trench. The level ground surface in this area is mainly grass-covered. Other than a thin root mat supporting the surface vegetation, topsoil does not exist as fill is immediately encountered beneath the grass-covering.

The area of the FMPC at Fernald, Ohio, is along the western extent of the ancestral Great Miami River Valley. Soil stratigraphy is generally a product of glaciation as sand and gravel outwash deposits have filled the ancient valley and have since been covered with a layer of glacial till. Several types of cohesive soils have developed atop the glacial till.

The surface grass is immediately underlain by 2 to 6.5 ft. of fill material. The fill material is a brown lean clay (CL) which is moist and hard, having an average Penetration Resistance value of 38. Average thickness of the fill layer is about 2.5 ft.

Beneath the fill material is about 3.5 to 7-ft. of soft to stiff, low plasticity, natural brown lean clay. The natural brown lean clay (CL) has an average Standard Penetration Resistance value of 10. At Borings 1 and 2, the value for Penetration Resistance was lower at 6 and 4, indicating soft areas in the natural brown lean clay. Natural moisture content is high, typically being greater than 25%.

Gray glacial till, clayey sand, or lakebed clay was encountered below the natural brown lean clay at a depth of 10 ft. below grade at all borings. Gray varved lakebed clays were encountered below the upper lean clay at Borings 2, 3, 4 and 5. This soil consists of thin alternating layers of silt and high plasticity clay, which when mixed, classifies as a lean clay (CL). The lakebed clay

encountered is highly variable in thickness ranging from 3 to 16.5 ft. thick and is medium stiff to very stiff in consistency. The lakebed clays previously encountered at other sites of the FMPC have been found to be moderately compressible.

About 3.5 to 4 ft. of clayey sand was penetrated at Borings 1, 2 and 3. We believe that this sand reflects the presence of an isolated sand lens lying beneath the northwest portion of the site at a depth between 10 and 18 ft. below present grade.

The gray glacial till is a mixture of clay, silt, sand and gravel which classifies as a sandy lean clay (CL) in the Unified Soil Classification System (USCS). The glacial till is stiff in consistency when encountered above a depth of 20 ft. At Boring 5, the gray glacial till was encountered below the lakebed clay at a depth of 26.5 ft. and is very hard in consistency at that depth.

Groundwater was encountered in all borings, the depth to which was measured at the time of drilling and before backfilling the holes. The depth to water measured in the boreholes varied from 5 to 11.5 ft. below existing grades. It is probable that the water encountered is the result of seepage into the borehole from a layer of groundwater perched atop the low-permeability lakebed clays or trapped within the sand lenses. We anticipate that this type of perched groundwater condition is more likely to occur during the wetter seasons. It is also likely that a static groundwater table is not present within the depth explored of 30 ft.

CONCLUSIONS AND RECOMMENDATIONS

The proposed site poses several geotechnical problems with respect to construction of the holding tank. The concerns are as follows:

1) Surface fill,
2) Soft to stiff soils at frost depth,
3) Compressible lakebed clays, and
4) A perched groundwater table.

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We understand from Mr. David Hale of Q source Engineering, Inc. that design of the holding tank and containment structure has not been finalized at this time. Based on subsurface conditions encountered in the project vicinity and proposed tank size, we recommend that the holding tank be supported by means of conventional continuous spread footings. The foundation may consist of a continuous ring footing or mat footing as dictated by the loads and allowable bearing capacity. The following sections present design and construction criteria to be considered for design of foundations and slabs-on-grade.

Foundations

As previously indicated, spread footings may be used to support the holding tank. All footings should bear in natural soil and sized for no greater than 1500 psf net allowable bearing pressure. Since the holding tank will not be heated, we recommend that all footings bear at least 30 inches below exterior finished grades for frost protection of the bearing soils. It should be noted that some fill may be present at frost depth. Footings should be extended through this fill and into natural soil.

We performed settlement analysis assuming a circular mat footing 60 ft. in diameter bearing 30 inches below existing grade with a bearing pressure of 1500 psf. The settlement for this structure constructed on the subsurface soils at the site was about 1-1/4 inch at the tank center and 3/4 inch at the tank diameter, resulting in a total differential settlement of 1/2 inch. Actual settlement will depend upon type of foundation selected and magnitude and frequency of loading. We would anticipate at least half of this settlement to occur upon initial filling of the tank. We suggest that additional settlement analysis be performed once a final design has been selected.

The presence of perched groundwater 5 to 10 ft. below grade and cohesive type bearing soils presents the potential for frost heave of the bearing soils. To prevent frost heave, a recommendation has been made to locate all footings below the frost depth of 30 inches below exterior finished grade. If this condition cannot be maintained, it may be desirable to place a layer of open graded gravel (GP) or uniformly graded sand (bankrun sand) (SP) beneath potentially affected areas to form a capillary break.

The secondary containment walls, if located below grade or backfilled above grade, should be designed to withstand lateral earth pressures. The walls should be designed using a hydrostatic pressure distribution with equivalent fluid weight of backfill of 45 pcf. Passive lateral earth pressures should be based upon 250 pcf for the compacted cohesive backfill soils. The coefficient of friction estimated to develop between the footing or slab concrete and the natural clay overburden is about 0.30.

Slabs-on-Grade

Preparation to slab-on-grade subgrade elevation should be completed as presented in the subsequent section of this report. At least 6 inches of granular material should be placed beneath all slabs to form a capillary break and to provide a leveling course for construction of the slab. The granular soil should be placed as a single lift and compacted to a minimum of 95% of the Standard Proctor maximum dry density (ASTM D 698).

The design of the slab-on-grade should be based upon a subgrade modulus, k, of 300 pci for the granular base course and 150 pci for natural soil or clay fill beneath the slab.

Site Grading

Although the site is relatively flat, minor cutting and filling may be required to provide a level construction site or remove existing fill. The existing grass covering and/or root mat should be stripped in all construction areas. Prior to fill placement and for subgrade preparation for slabs-on-grade where grades will not change, the soil surface should be scarified to a depth of 6 inches and recompacted to at least 95% of the Standard Proctor maximum dry density. Areas not stabilized under repeated compactive effort should be undercut and replaced with suitable compacted material.

Fill placed in structural areas should be a suitable lean (plasticity index less than 20) cohesive clay or granular material. The average in situ moisture content of the upper lean clays local to the project vicinity is greater than 25%. Some aeration of the soil may be required to achieve the specified compaction criteria. Actual moisture control required will depend upon weather conditions at the time of earthwork. All fill should be placed in maximum 8 inch thick loose lifts and compacted to 95% of the Standard Proctor maximum dry density.

Earthwork operations should be completed as previously described with qualified geotechnical personnel present on a full-time basis to observe undercutting and placement of compacted fill. In-place density tests should be performed to confirm the degree of compaction and compliance with project specifications.

Cuts into soil to form footings should be neat. The footing excavation should be free of water and debris, including loose soil prior to concrete placement. We recommend that footing sections be poured the same day the excavation is made. If this is impractical, a thin seal slab of lean concrete should be poured over the

base of the excavation. Observations of the excavations should be made by qualified geotechnical personnel immediately prior to concrete placement.

Temporary cut slopes less than 4 ft. deep may be left near-vertical. Cut slopes greater than 4 ft. deep should be excavated no steeper than 1 horizontal to 1 vertical (1H:1V). Localized sloughing of the sidewalls in areas of subsurface seepage may dictate the necessity for flatter slopes. Final grades adjacent to the completed structure should slope away from the tank to provide positive drainage.

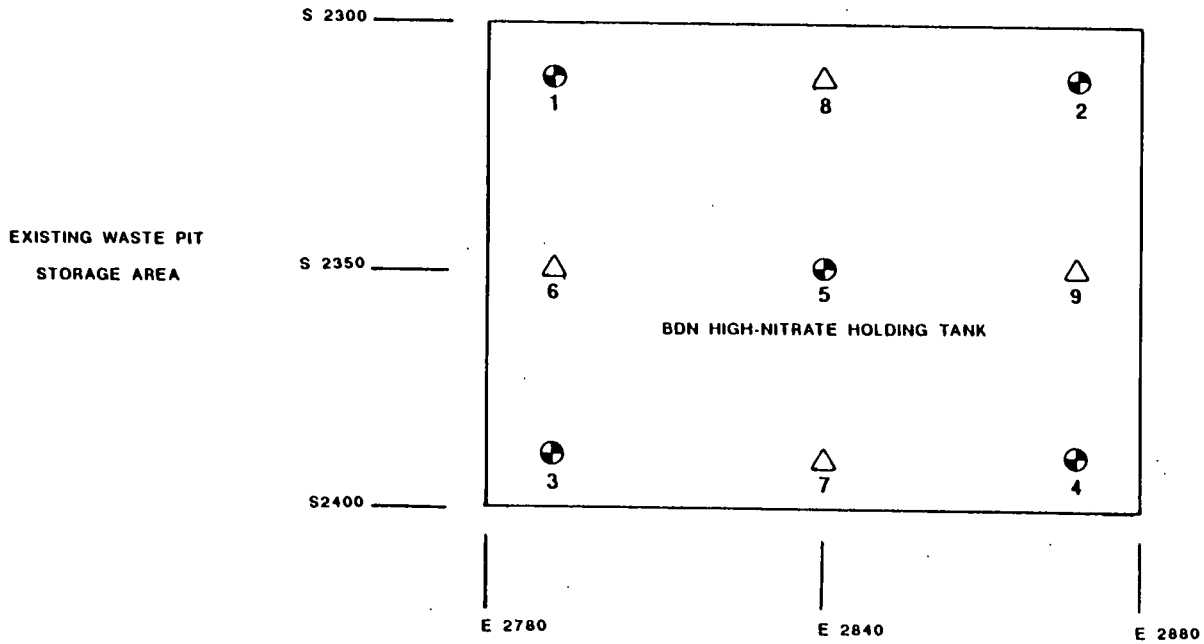
CLOSING

The recommendations presented in this report are based upon subsurface conditions encountered at the test boring locations and the preliminary structural information provided to us. We request the opportunity to review foundation plans and project specifications for consistency with our recommendations.

This report contains recommendations for inspection services. These services should be performed by an experienced geotechnical engineer. Should we be chosen to perform these service, we request the opportunity to review the construction plans and specifications, and meet with the contractor, designer and owner prior to construction. It is our experience that a well-planned inspection program and proper communication amount all parties involved can help eliminate many construction problems and result in a more efficient, economical project.

K-65 PIPE TRENCH

NO SCALE



LEGEND...

GEOTECHNICAL BORING

SHALLOW SAMPLING

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Rust Engineering Company
Biodenitrification Facility Upgrade
FMPC Fernald, Ohio

BORING PLAN: SITE 1

Westinghouse
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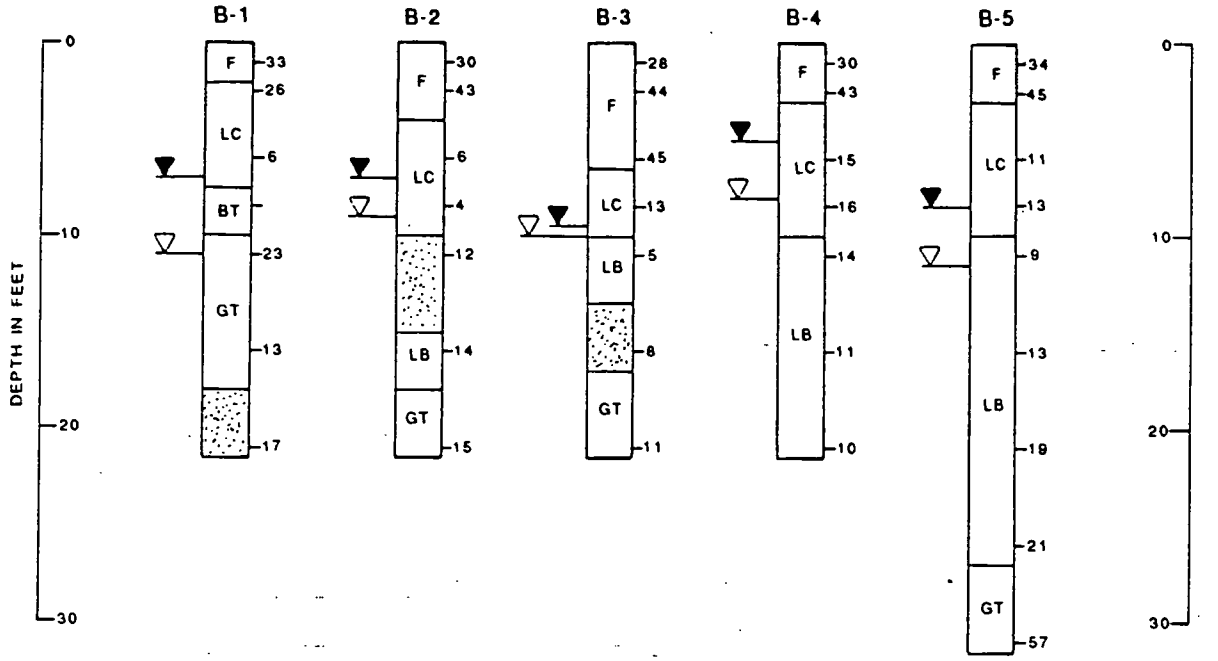
CINCINNATI, OHIO

PROJ. NO. 4144 28-462 FIG. NO. 1A

N21259



LEGEND...

F	FILL
LC	BROWN LEAN CLAY
BT	BROWN GLACIAL TILL
GT	GRAY GLACIAL TILL
LB	LAKEBED CLAY
	SILTY SAND
	STANDARD PENETRATION RESISTANCE VALUE
	INITIAL WATER LEVEL
	FINAL WATER LEVEL

Rust Engineering Co.
BDN Facility Upgrade Site 1 - BDN High Nitrate Holding Tank
FMPC Fernald, Ohio

SOIL BORING PROFILE

Westinghouse Environmental Engineering
CINCINNATI, OHIO

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PROJ. NO. 4144-88-462 FIG. NO. 2A

N21259

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	Penetration Resistance (1) (blows/ft.)	Relative Density
SAND and/or GRAVEL	0 to 4	Very Loose
	5 to 10	Loose
	11 to 30	Medium Dense
	31 to 50	Dense
	Over 50	Very Dense
		Consistency
SILTS and CLAY	0 to 2	Very soft
	3 to 4	Soft
	5 to 8	Medium Stiff
	9 to 15	Stiff
	16 to 30	Very Stiff
	21 to 50	Hard
	Over 50	Very Hard

(1) ASTM D 1586-74
A 2-inch outside-diameter by 1-3/8-inch inside-diameter split-barrel sampler is driven 18 inches with a 140-pound hammer falling 30 inches. The number of blows required for each 6 inches of penetration is recorded. The sum of the blows required for the final 12 inches of penetration is the Standard Penetration Resistance

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Environmental Engineering

225 Corporate Court
Fairfield, Ohio 45014
(513) 874-4111

RECORD OF BORING NO. 1

Client: Rust Engineering Company **Page:** 1 of 1

Project: Biodentitrification Facility Upgrade (Site 1)

Project No.: 4144-88-462 Rust W.O. No.: 1227

Site Coordinate: E2790, S2310

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
	0.0						
		Brown lean clay, moist - hard (Fill)	1	0.0-1.5	SS	6-15-18	15
	2.0						
		Brown lean clay, moist - medium stiff to very stiff	2	2.5-3.0	SS	18-12-14	12
			3	5.0-6.5	SS	2-3-3	18
	7.5						
		Brown sandy lean clay, moist - stiff	4	7.5-9.0	SS	3-4-5	18
	10.0						
		Gray sandy silty clay, moist - stiff to very stiff	5	10.0-11.5	SS	9-10-13	18
			6	15.0-16.5	SS	4-5-8	18
	18.0						
		Brown uniformly graded fine sand, wet - medium dense	7	20-21.5	SS	5-7-10	6
	21.5						
		Boring terminated at 21.5 ft.					

Dates Drilled: 10-26-88 **Driller:** F. Moore

Water Depth: Initial: 11.0 ft.

1 Day after Completion: 7.0 ft.

Days after Completion:

Drilling Method: 6" O.D. Hollow-Stem Augers

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Cincinnati, Ohio

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RECORD OF BORING NO. 2

Client: Rust Engineering Company **Page:** 1 of 1

Project: Biodentitrification Facility Upgrade (Site 1)

Project No.: 4144-88-462 Rust W.O. No.: 1227

Site Coordinate: E2790, S2310

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
	0.0						
		Brown silty clay, moist - very stiff to hard (Fill)	1	0.0-1.5	SS	5-9-21	15
			2	1.5-3.0	SS	24-20-23	17
	4.0						
		Brown lean clay, moist - soft to medium stiff	3	5.0-6.5	SS	2-3-3	18
			4	7.5-9.0	SS	3-2-2	18
	10.0						
		Brown uniformly-graded fine sand, wet - medium dense	5	10.0-11.5	SS	5-6-6	6
	15.0						
		Gray lean clay, moist - stiff	6	15.0-16.5	SS	4-7-7	18
	18.0	Gray sandy silty clay, moist - stiff	7	20.0-21.5	SS	6-7-8	18
	21.5						
		Boring terminated at 21.5 ft.					

Dates Drilled: 10-26-88 **Driller:** F. Moore

Water Depth: Initial: 9.0 ft.

1 **Day after Completion:** 7.0 ft.

Days after Completion:

Drilling Method: 6" O.D. Hollow-Stem Augers

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RECORD OF BORING NO. 3

Client: Rust Engineering Company **Page:** 1 of 1

Project: Biodentitrification Facility Upgrade (Site 1)

Project No.: 4144-88-462 Rust W.O. No.: 1227

Site Coordinate: E2870, S2310

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
	0.0						
		Brown silty clay, moist - very stiff to hard (Fill)	1	0.0-1.5	SS	6-10-18	18
			2	1.5-3.0	SS	15-20-24	18
			3	5.0-6.5	SS	10-22-23	18
	6.5						
		Brown lean clay, moist - stiff to hard	4	7.5-9.0	SS	3-5-8	18
	10.0						
		Gray fat clay, very moist - soft	5	10.0-11.5	SS	2-2-3	18
	13.5						
		Brown uniformly graded fine sand, wet - loose	6	15.0-16.5	SS	3-4-4	18
	17.0						
		Gray sandy silty clay, moist - stiff	7	20.0-21.5	SS	4-5-6	18
	21.5						
		Boring terminated at 21.5 ft.					

Dates Drilled: 10-26-88 **Driller:** F. Moore

Water Depth: Initial: 10.0 ft.

1 **Day after Completion:** 9.5 ft.

Days after Completion:

Drilling Method: 6" O.D. Hollow-Stem Augers

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Cincinnati, Ohio

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RECORD OF BORING NO. 4

Client: Rust Engineering Company **Page:** 1 of 1

Project: Biodentitrification Facility Upgrade (Site 1)

Project No.: 4144-88-462 Rust W.O. No.: 1227

Site Coordinate: E2870, S2390

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
	0.0						
		Brown silty clay, moist - very stiff to hard (Fill)	1	0.0-1.5	SS	7-12-18	15
			2	1.5-3.0	SS	25-24-19	14
	3.0						
		Brown lean clay, very moist - stiff	3	5.0-6.5	SS	6-6-9	18
			4	7.5-9.0	SS	5-8-8	18
	10.0						
		Gray lean clay, very moist - stiff	5	10.0-11.5	SS	3-6-8	18
			6	15.0-16.5	SS	4-5-6	18
			7	20.0-21.5	SS	3-4-6	18
	21.5						
		Boring terminated at 21.5 ft.					

Dates Drilled: 10-26-88 **Driller:** F. Moore

Water Depth: Initial: 8.0 ft.

1 Day after Completion: 5.0 ft.

Days after Completion:

Drilling Method: 6" O.D. Hollow-Stem Augers

Westinghouse Environmental Engineering
Cincinnati, Ohio

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RECORD OF BORING NO. 5

Client: Rust Engineering Company **Page:** 1 of 1

Project: Biodentitrification Facility Upgrade (Site 1)

Project No.: 4144-88-462 Rust W.O. No.: 1227

Site Coordinate: E2840, S2350

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
	0.0						
		Brown silty clay, moist - hard (Fill)	1	0.0-1.5	SS	6-13-21	18
			2	1.5-3.0	SS	19-21-24	18
	3.0						
		Brown lean clay, moist - stiff	3	5.0-6.5	SS	5-4-7	18
			4	7.5-9.0	SS	6-6-7	18
	10.0						
		Gray lean clay, moist - stiff	5	10.0-11.5	SS	3-4-5	18
			6	15.0-16.5	SS	5-6-7	18
			7	20.0-21.5	SS	10-8-11	18
			8	25.0-26.5	SS	8-9-12	18
	27.0						
		Gray sandy silty clay, moist - very hard	9	30.0-31.5	SS	27-35-22	18
	31.5						
		Boring terminated at 31.5 ft.					

Dates Drilled: 10-27-88 **Driller:** F. Moore

Water Depth: Initial: 11.5 ft.

1 **Day after Completion:** 8.5 ft.

Days after Completion:

Drilling Method: 6" O.D. Hollow-Stem Augers

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Cincinnati, Ohio

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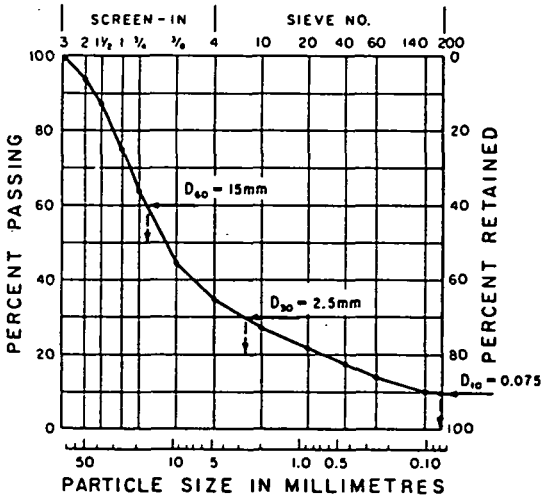
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D 2487 – 85
(Based on Unified Soil Classification System)

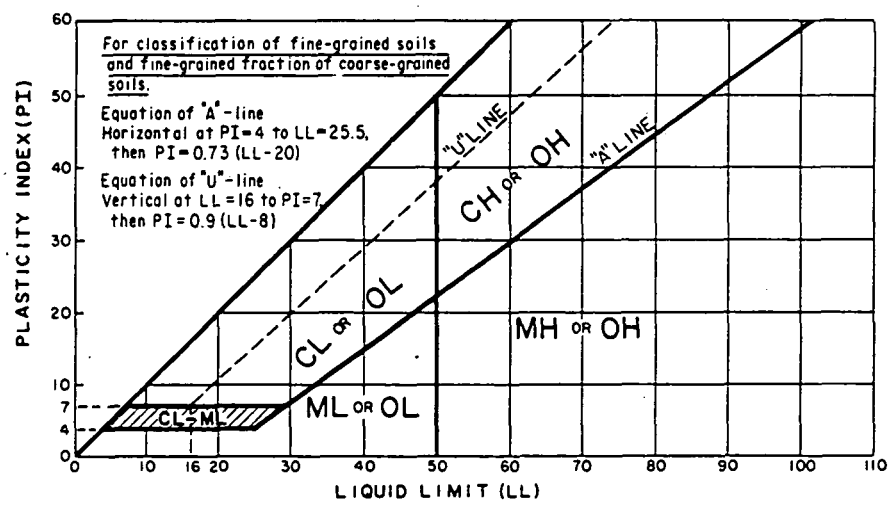
Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50 % retained on No. 200 sieve	Gravels More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5 % fines[C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3[E]	GW	Well-graded gravel[F]
			Cu < 4 and/or 1 > Cc > 3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12 % fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50 % or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines[D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3[E]	SW	Well-graded sand[I]
			Cu < 6 and/or 1 > Cc > 3[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12 % fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50 % or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[D] Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15 % sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15 % gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30 % plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

SIEVE ANALYSIS



$Cu = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$



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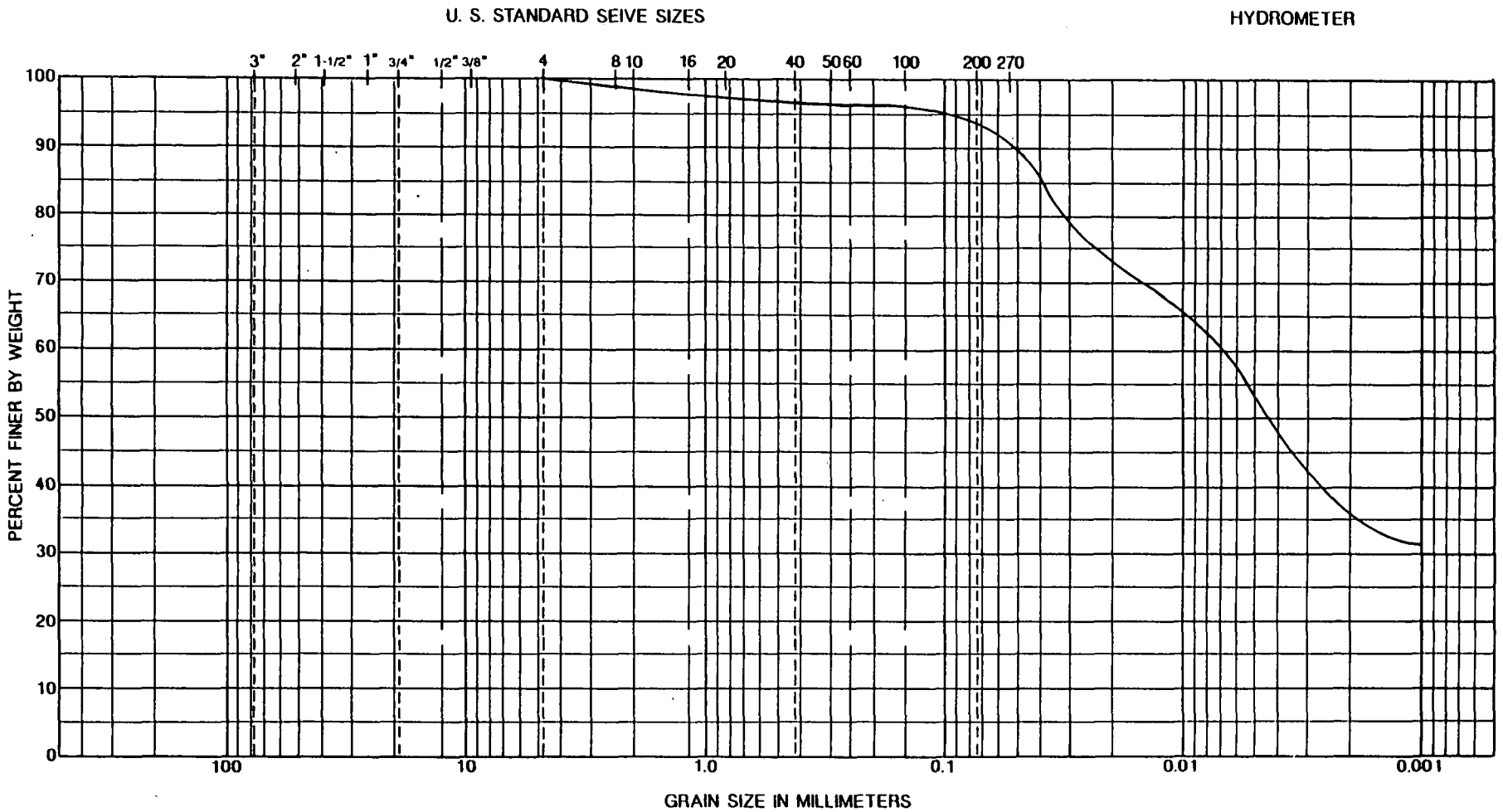
Environmental Engineering
225 Corporate Court
Fairfield, Ohio 45014
(513) 874-4111

W44-06

CLIENT: The Rust Engineering Company
PROJECT: BDN Facility Upgrade
PROJECT NO.: 4144-88-462

WESTINGHOUSE ENVIRONMENTAL ENGINEERING
LABORATORY TEST RESULTS

Boring No.	Sample No.	Depth ft.	Moisture Content %	Atterberg Limits LL %	PL %	PI %	Grain Size Analysis Gravel %	Sand %	Silt %	Clay %
3	3	5.0-6.5		33	19	14	0	6	58	36
	5	10.0-11.5		28	18	10	0	1	63	36
	6	15.0-16.5					0	57	-43-	
5	3	5.0-6.5	26							
	4	7.5-9.0	29							
	5	10.0-11.5	24							
	6	15.0-16.5	18							
	7	20.0-21.5	21							
	8	25.0-26.5	15							
	9	30.0-31.5	12	23	14	9	3	30	57	24



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

SAMPLE NUMBER	ELEVATION OR DEPTH	DESCRIPTION OR CLASSIFICATION	NAT W %	LL	PL	PI
B-3	5.0-6.5	Lean clay (CL)	NA	33	19	14

PROJECT NO: 4144-88-462 DATE: 11-23-88

PROJECT: B.D.N. Facility Upgrade

LOCATION: Fernald, Ohio

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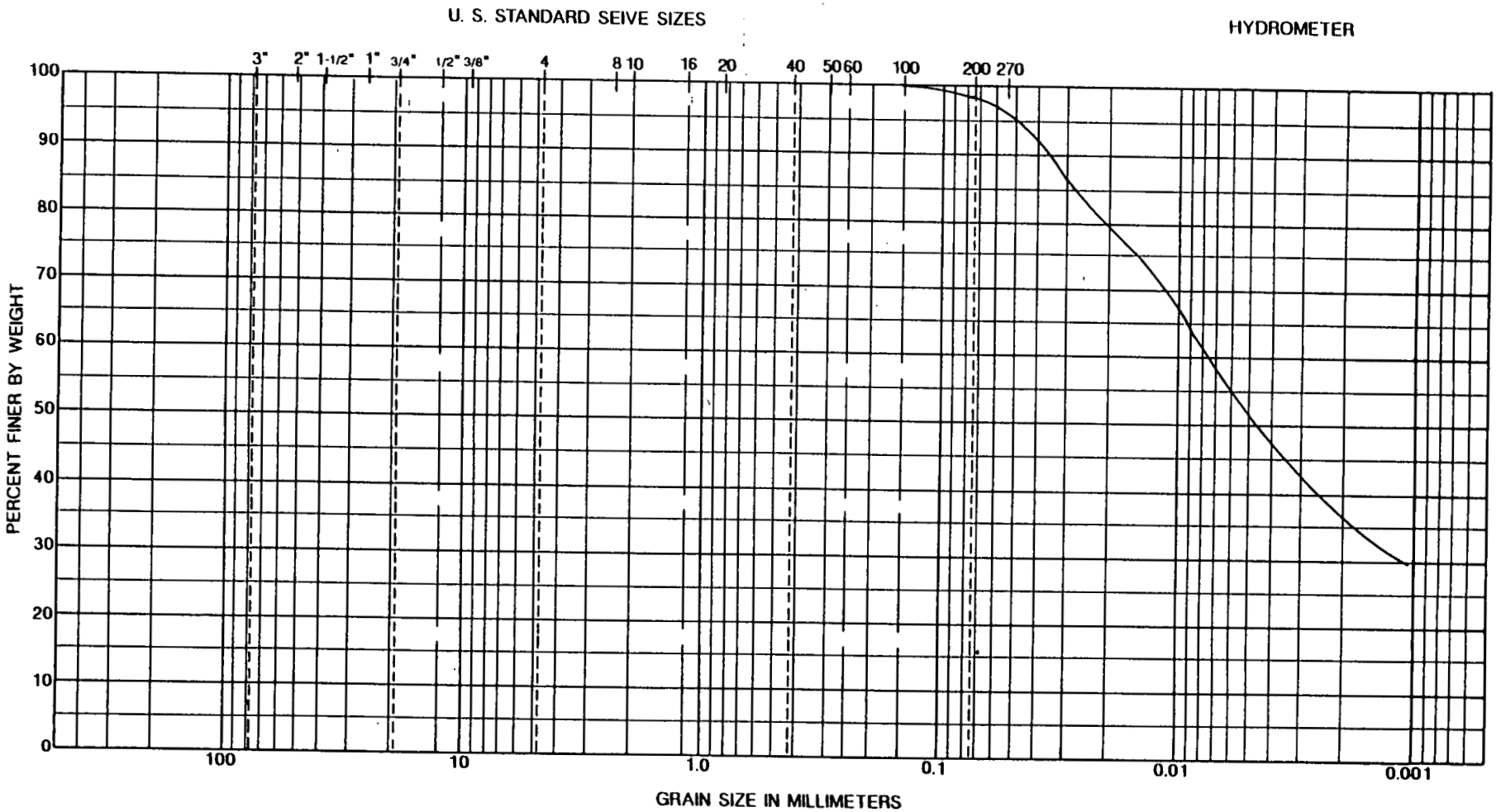
GRAIN SIZE DISTRIBUTION

23

369

W48-02



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

SAMPLE NUMBER	ELEVATION OR DEPTH	DESCRIPTION OR CLASSIFICATION	NAT W %	LL	PL	PI
B-3	10.0-11.5	Lean clay (CL)	NA	28	18	10

24

PROJECT NO: 4144-88-462 DATE: 11-23-88

PROJECT: B.D.N. Facility Upgrade

LOCATION: Fernald, Ohio

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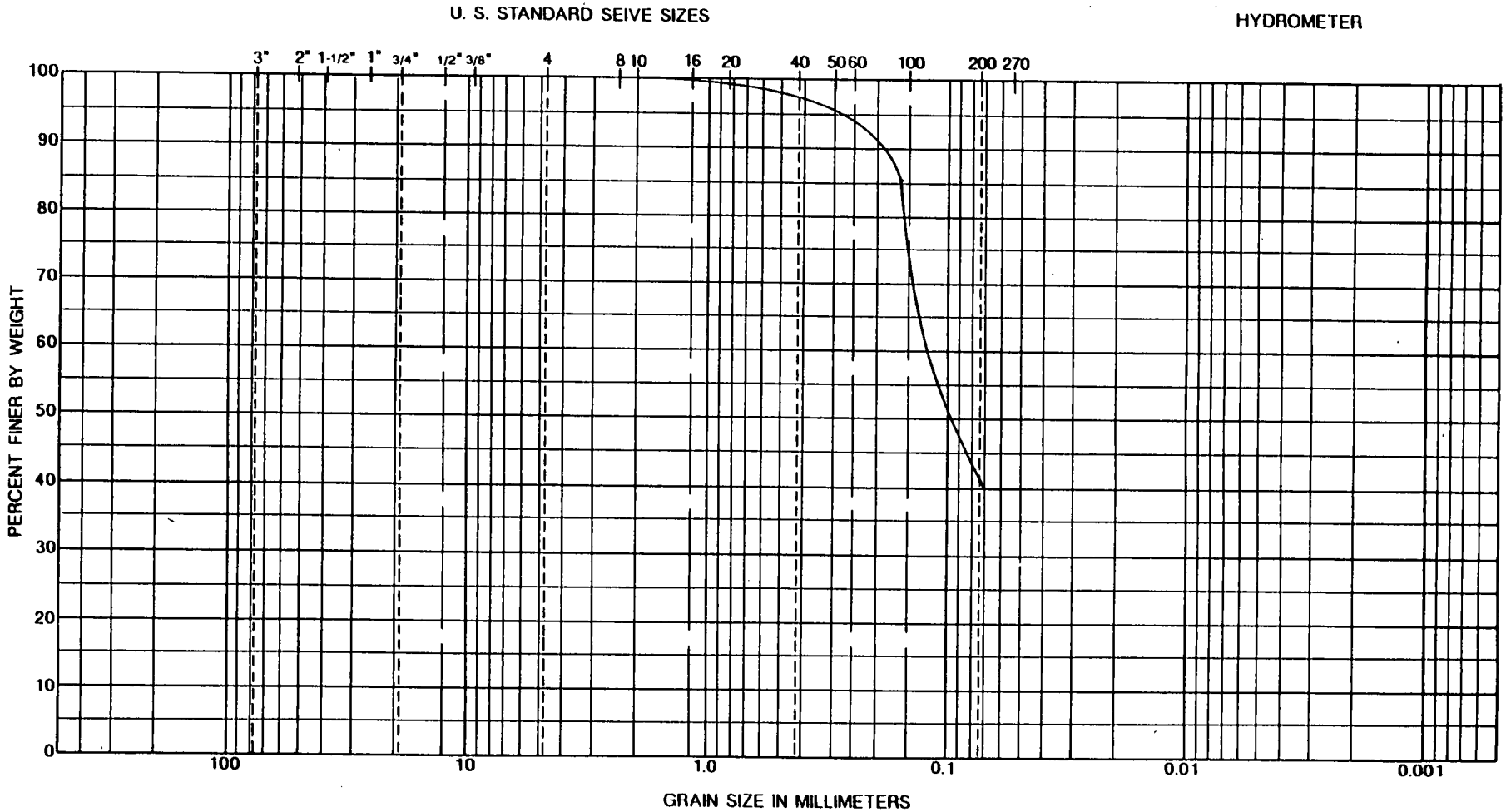
Westinghouse Environmental Engineering

GRAIN SIZE DISTRIBUTION

W48-02

369



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

SAMPLE NUMBER	ELEVATION OR DEPTH	DESCRIPTION OR CLASSIFICATION	NAT W %	LL	PL	PI
B-3 25	15.0-16.5	Clayey Sand (SC)	NA	NA	NA	NA

PROJECT NO: 4144-88-462 DATE: 11-23-88

PROJECT: B.D.N. Facility Upgrade

LOCATION: Fernald, Ohio

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GRAIN SIZE DISTRIBUTION

W48-02

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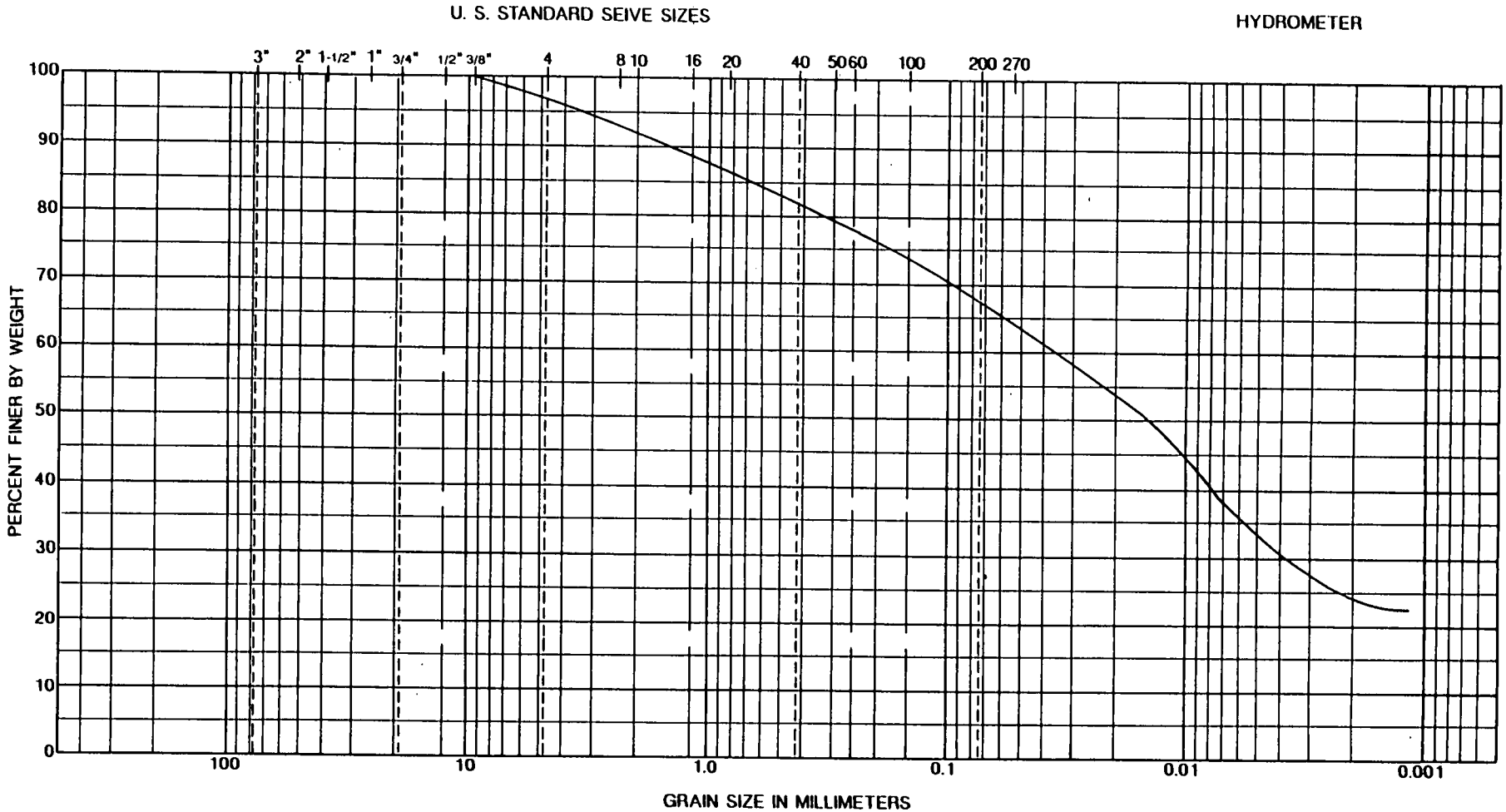

BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

SAMPLE NUMBER	ELEVATION OR DEPTH	DESCRIPTION OR CLASSIFICATION	NAT W %	LL	PL	PI
B-5	30.0-31.5	Sandy lean clay (CL)	12	33	14	9

PROJECT NO: 4144-88-462 DATE: 11-23-88

PROJECT: BOD.N. Facility Upgrade

LOCATION: Fernald, Ohio

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GRAIN SIZE DISTRIBUTION

26

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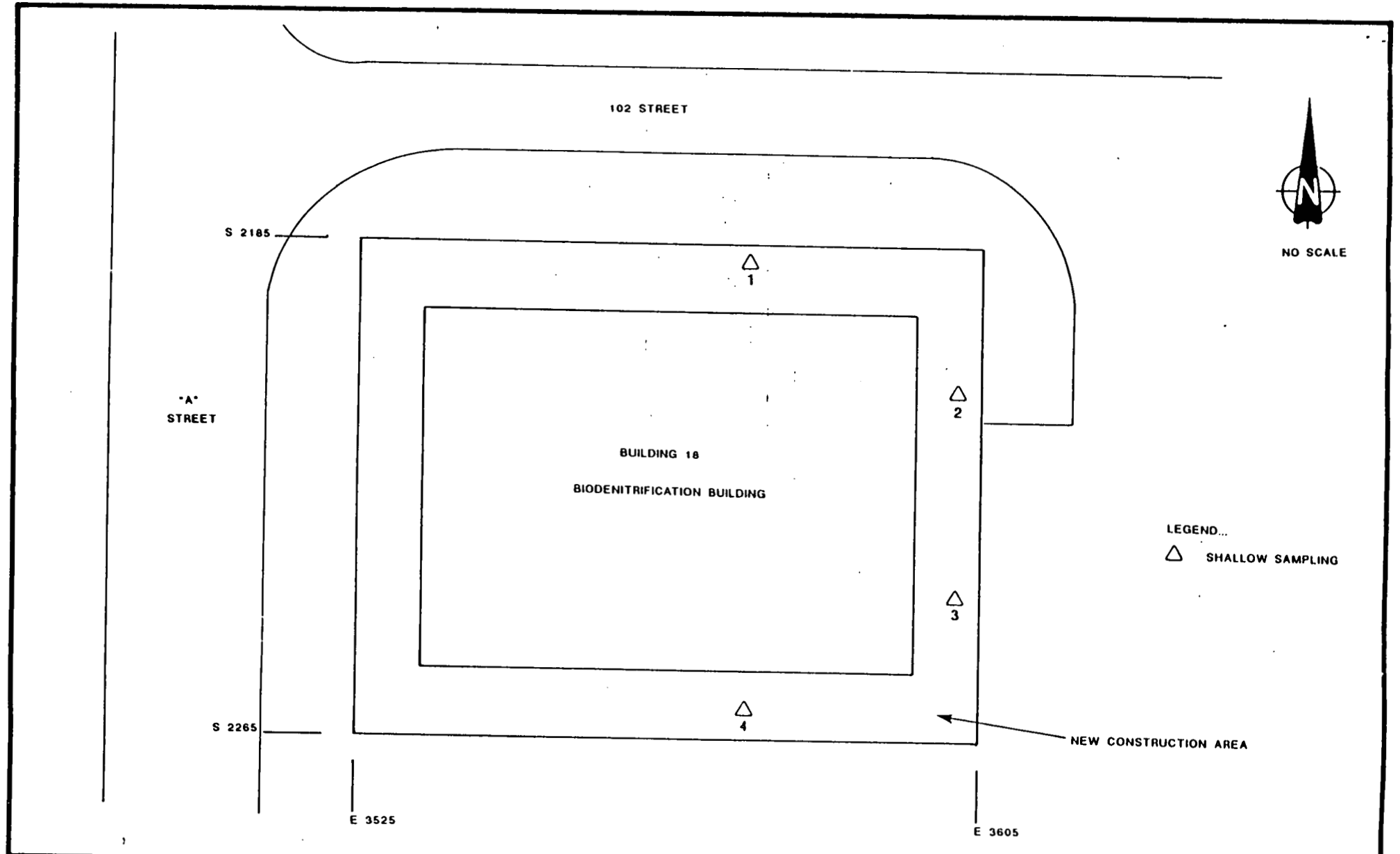
W48-02

APPENDIX B

SITE 2 - BDN BUILDING

INTRODUCTION

The proposed Biodenitrification (BDN) Building will be located within the production area at the southeast corner of the A Street and 102 Street intersection. The scope of work for this report was limited to shallow sampling of the subgrade soils at the locations shown on Figure 1B. A description of the method used for shallow sampling can be found in the Exploration Procedures section of Appendix A.



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Rust Engineering Company
Biodenitrification Facility Upgrade
FMPC Fernald, Ohio

BORING PLAN: SITE 2

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PROJ. NO. 4144-88-462 FIG. NO. 1B

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N21259

APPENDIX C

SITE 3 - BDN EFFLUENT TREATMENT SYSTEM

INTRODUCTION

The BDN Effluent Treatment System is located within the production area at the southeast corner of the A Street and 101 Street intersection. The scope of work for this report includes shallow sampling, review and presentation of previous geotechnical borings and general recommendations for foundation design based on review of the previous geotechnical borings.

Exact type and location of proposed structures for the BDN Effluent Treatment System site are unknown at this time since design is in the preliminary stages. The main structure will be a 20-ft. high building having plan dimensions of 30 by 30 ft. The building will not have a basement and will contain dewatering and water disinfection equipment. A 300,000 gallon water tank will also be constructed on the site and may be circular with a 60 ft. diameter.

EXPLORATION PROCEDURES

Eight (8) shallow samples were obtained at the locations shown on Figure 1C. Shallow sampling was performed using methods outlined in the Exploration Procedures section of Appendix A.

Seven(7) previous geotechnical borings were made at the site at the locations shown on Figure 1C. The borings were made in September, 1985 and April, 1986 for the previous S&ME Project Numbers 021-85-162 and 021-86-169, respectively.

Hollow-stem augers were used to advance the hole, while soil samples were obtained in the undisturbed material below the augered

depth using the Standard Method for Penetration Test and Split-Barrel Sampling of Soil (ASTM D 1586). Samples were obtained at 2.5-ft. intervals to 10 ft. below present grades and then at 5-ft. intervals to the depths explored.

SUBSURFACE CONDITIONS

The BDN Effluent Treatment System site is flat and covered with a 3-inch-thick gravel surface. There is generally about 2 to 3 ft. of very stiff cohesive fill beneath the gravel. The fill is underlain by 2 to 4 ft. of natural lean clay in a stiff to very stiff condition.

Brown and gray lakebed clay was encountered at a depth of about 10 ft. below grade at 4 of the 7 borings. The lakebed clay is 3 to 17 ft. thick and very soft to very stiff in consistency. This type of soil is sometimes moderately compressible. Very stiff to hard gray glacial till was encountered beneath the lakebed clay to the depth explored of 30 ft. Isolated granular layers were encountered in 2 of the borings and range in thickness from 2 to 5 ft.

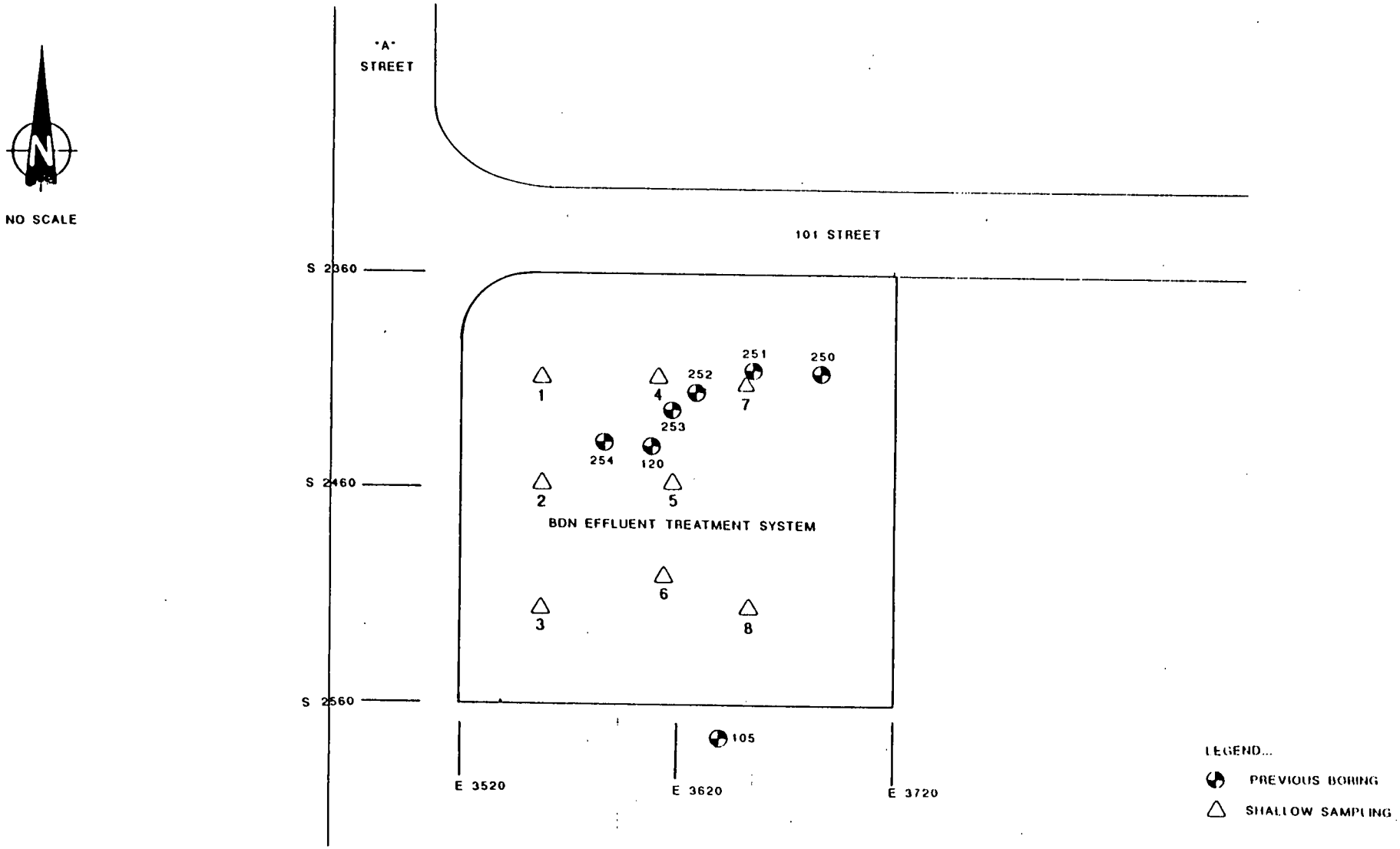
Groundwater was encountered in 6 of the 7 borings at the time of drilling. It is likely that the groundwater encountered is the result of seepage into the borehole from water trapped in the granular layers or perched atop the low-permeable lakebed clays.

GENERAL FOUNDATION RECOMMENDATIONS

Based on current geotechnical information, the site does not pose any unusual geotechnical problems except for the shallow fill and underlying lakebed clays. It is probable that the two-story structure may be supported on conventional continuous or isolated spread footings. The footings should be extended through the fill to bear in natural soil. Due to the underlying lakebed clays, net allowable bearing pressure may be on the order of 2000 to 3000 psf.

The 60 ft. diameter water tank may be supported on a ring footing, however, settlement limits may dictate the use of a continuous mat foundation due to the variable thickness and consistency of the lakebed clays.

A more detailed geotechnical analysis should be made once the type and location of structures has been finalized. Additional borings and laboratory testing may be required if proposed structures are not located near the existing borings.



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BORING PLAN: SITE 3

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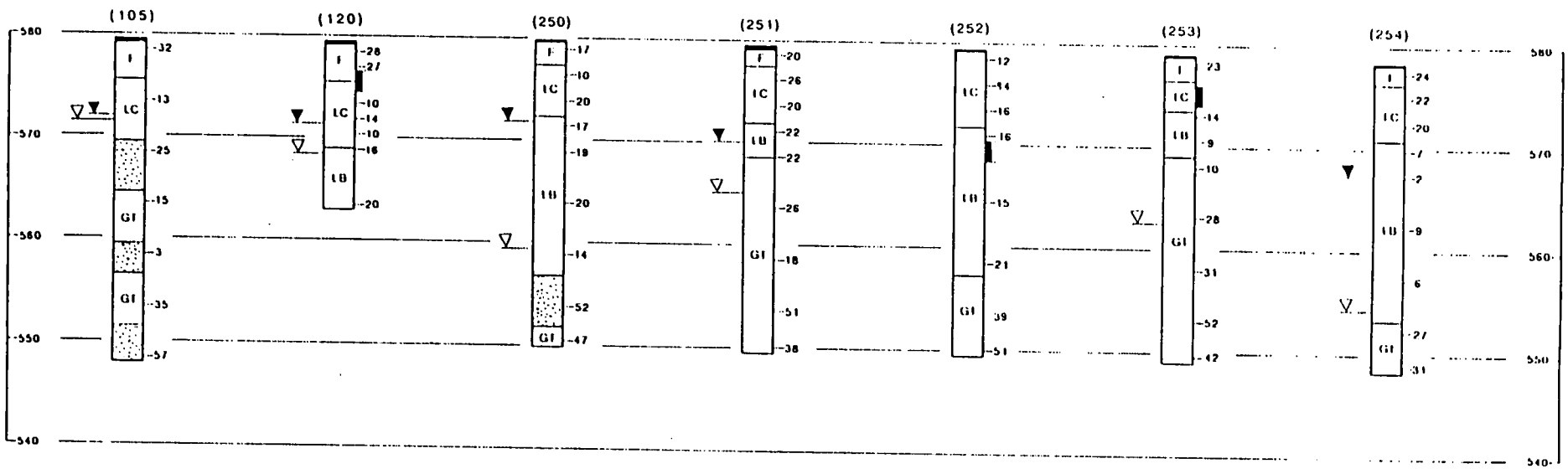
CINCINNATI, OHIO

PROJ. NO. 4144-88-462 FIG. NO. 1C

369

N21259



LEGEND...

- GRAVEL SURFACE (FILL)
- F FILL - SOIL
- LC LEAN CLAY
- SAND OR SILTY SAND
- LB LAKEBED CLAY
- GI GLACIAL TILL
- FINAL WATER LEVEL
- INITIAL WATER LEVEL
- N, STANDARD PENETRATION RESISTANCE VALUE
- SHELBY TUBE SAMPLE

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CINCINNATI, OHIO

Rust Engineering Company
Biodenitrification Facility Upgrade
FMPC Fernald, Ohio

SOIL BORING PROFILE

SCALE:	As Shown
DRAWN BY:	GCT
APPROVED BY:	RFR
PROJECT NO:	4144-88-462
DATE:	Dec 1988
FIGURE	2C

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	Penetration Resistance (1) (blows/ft.)	Relative Density
SAND and/or GRAVEL	0 to 4	Very Loose
	5 to 10	Loose
	11 to 30	Medium Dense
	31 to 50	Dense
	Over 50	Very Dense
		Consistency
SILTS and CLAY	0 to 2	Very soft
	3 to 4	Soft
	5 to 8	Medium Stiff
	9 to 15	Stiff
	16 to 30	Very Stiff
	21 to 50	Hard
	Over 50	Very Hard

(1) ASTM D 1586-74
A 2-inch outside-diameter by 1-3/8-inch inside-diameter split-barrel sampler is driven 18 inches with a 140-pound hammer falling 30 inches. The number of blows required for each 6 inches of penetration is recorded. The sum of the blows required for the final 12 inches of penetration is the Standard Penetration Resistance

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RECORD OF BORING NO. 2.29-2 (105)

Client: Lockwood Greene Engineers, Inc.

Project: NLO - Conceptual Design Program

Project No.: 021-85-162

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
579.4	0.0						
		Gravel Fill					
578.9	0.5						
		Brown silt and clay, sand, gravel Fill; damp-hard	1	0.0-1.5	SS	10-17-15	15
575.4	4.0						
		Brown and gray silt and clay, little fine sand; moist-stiff	2	5.0-6.5	SS	6-6-7	18
569.4	10.0						
		Brown silty fine sand; moist-medium dense	3	10.0-11.5	SS	10-12-13	18
564.4	15.0						
		Gray silty clay with sand and gravel; moist-stiff	4	15.0-16.5	SS	7-7-8	18
559.4	20.0						
		Brown sandy silty clay; wet-soft	5	20.0-21.5	SS	3-1-2	0
556.4	23.0						
		Gray silty clay with sand and gravel; damp-hard	6	25.0-26.5	SS	10-16-19	18
551.4	28.0						
		Brown fine to medium sand; moist-very dense	7	30.0-31.5	SS	24-27-30	18
547.9	31.5						
		Boring terminated @ 31.5'					

Dates Drilled: 9-25-85

Driller: F. Moore

Water Depth: Initial: 8.0'

1 Days after Completion: 7.5'

_____ Days after Completion: _____

Drilling Method: 8" O.D. Hollow Stem Augers

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

RECORD OF BORING NO. [illegible] (120)

369

Client: Lockwood Greene Engineers, Inc.

Project: [illegible] - Conceptual Design Program

Project No.: 021-85-162[illegible]

Location: S 2426.0 - E 3620.0

Page 1 of [illegible]

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
579.4	0.0						
		Gravel fill					
578.9	0.5						
		Brown silty clay fill; moist-very stiff	1	0.0-1.5	SS	12-14-14	18
			2	1.5-3.0	SS	12-13-14	18
575.4	4.0		3	3.0-5.0	ST		15
		Brown and gray silty clay trace fine sand; moist-stiff	4	5.0-6.5	SS	3-4-6	18
572.9	6.5						
		Brown clayey silt with fine sand; wet-stiff	5	6.5-8.0	SS	5-6-8	18
			6	8.0-9.5	SS	3-4-6	18
568.9	10.5		7	9.5-11.0	SS	5-7-9	18
		Gray varved silt and clay very moist-very stiff	8	15.0-16.5	SS	7-8-12	18
562.9	16.5						
		Boring terminated @ 16.5'					

Dates Drilled: 9/26/85

Driller: F. Moore

Water Depth: Initial: 8.0'

0 Days after Completion: 11.0'

7 Days after Completion: 7.7'

Drilling Method: 8" O.D. Hollow Stem Augers

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

RECORD OF BORING NO. 1

(250)

Client: The Rust Engineering Company

Page 1 of 1

Project: Drum Reconditioning

Project No.: 021-86-169 WEMCO E.P. NO. 00-85501-1050

Location: S 2413.0 - E 3684.5

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
579.7	0.0						
		Gravel					
579.5	0.25						
		Brown silty clay with sand, moist-very stiff (Fill)	1	0.0-1.5	SS	6-10-7	18
577.7	2.0						
		Dark brown lean clay, moist-stiff	2	2.5-4.0	SS	4-5-5	6
577.2	2.5						
		Brown lean clay, moist-very stiff	3	5.0-6.5	SS	7-11-9	18
572.2	7.5						
		Brown and gray interbedded silt with sand and fat clay, moist-stiff to very stiff (Varved)	4	7.5-9.0	SS	7-8-9	18
			5	10.0-11.5	SS	8-8-11	18
			6	15.0-16.5	SS	8-10-10	18
559.2	20.5						
		Gray lean clay with sand, moist to wet-stiff	7	20.0-21.5	SS	6-6-8	18
556.7	23.0						
		Gray uniformly graded fine sand, moist to wet-very dense	8	25.0-26.5	SS	24-25-27	18
551.7	28.0						
		Gray silty clay with sand, moist-hard	9	28.5-30.0	SS	14-22-25	18
549.7	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-18-86

Driller: L. Sanders

Water Depth: Initial: 20.5'

.1 Days after Completion: 8.0'

Days after Completion:

Drilling Method: 3¼" I.D. - Hollow Stem Augers

Sampling Method: ASTM D-1586

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

RECORD OF BORING NO. 2

(251)

Client: The Rust Engineering Company

Page 1 of 1

Project: Drum Reconditioning

Project No.: 021-86-169 WEMCO E.P. NO. 00-85501-1050

Location: S 2413.0 - E 3651.0

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
579.4	0.0						
		Gravel (with cobbles)					
578.9	0.5						
		Brown lean clay with sand, moist-very stiff (contains limestone fragments) (Fill)	1	0.0-1.5	SS	9-9-11	18
577.4	2.0						
		Brown lean clay, moist-very stiff	2	2.5-4.0	SS	10-14-12	12
			3	5.0-6.5	SS	8-9-11	18
571.9	7.5						
		Brown and gray interbedded silt with sand and fat clay, moist to very moist-stiff to very stiff (Varved)	4	7.5-9.0	SS	9-10-12	18
			5	10.0-11.5	SS	9-10-12	18
568.4	11.0						
		Gray silty clay with sand, moist-very stiff to very hard (1' sand seam @ 20.0')	6	15.0-16.5	SS	11-12-14	18
			7	20.0-21.5	SS	8-9-9	18
			8	25.0-26.5	SS	15-22-29	18
			9	28.5-30.0	SS	14-15-23	18
549.4	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-21-86

Driller: L. Sanders

Water Depth: Initial: 14.5'

.1 Days after Completion: 9.5'

____ Days after Completion: ____

Drilling Method: 3¼" I.D. - Hollow Stem Augers

Sampling Method: ASTM D-1586

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

RECORD OF BORING NO. 3

(252)

Client: The Rust Engineering Company

Project: Drum Reconditioning

Project No.: 021-86-169 WEMCO E.P. NO. 00-85501-1050

Location: S 2439.0 - E 3614.5

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
579.3	0.0						
		Gravel					
579.1	0.25						
		Brown lean clay, moist-stiff	1	0.0-1.5	SS	6-5-7	12
			2	2.5-4.0	SS	5-6-8	18
			3	5.0-6.5	SS	5-6-10	18
571.8	7.5						
		Gray and brown interbedded silt with sand and fat clay, moist to wet- stiff to very stiff (Varved)	4	7.5-9.0	SS	5-7-9	18
			1	9.0-11.0	ST		24
			5	15.0-16.5	SS	6-7-8	18
			6	20.0-21.5	SS	8-9-12	18
557.3	22.0						
		Gray silty clay with sand, moist-hard to very hard	7	25.0-26.5	SS	14-17-22	18
			8	28.5-30.0	SS	19-22-29	18
549.3	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-18-86

Driller: L. Sanders

Water Depth: Initial: None

_____ **Days after Completion:** _____

_____ **Days after Completion:** _____

Drilling Method: 3¼" I.D. - Hollow Stem Augers

Sampling Method: ASTM D-1586 & D-1587

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

RECORD OF BORING NO. 4

(253)

Client: The Rust Engineering Company

Project: Drum Reconditioning

Project No.: 021-86-169 WEMCO E.P. NO. 00-85501-1050

Location: S 2419.0 - E 3630.0

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
579.0	0.0						
		Gravel					
578.8	0.25						
		Brown lean clay, moist - very stiff (fill)	1	0.0-1.5	SS	11-11-12	18
576.5	2.5						
		Brown lean clay, moist	2	2.5-4.0	SS	11-12-15	18
			ST-1	3.0-5.0	ST		24
573.5	5.5						
		Gray and brown interbedded silt and fat clay, moist to very moist - stiff (varved) (also interbedded with thin till and sand layers)	3	5.0-6.5	SS	5-7-7	18
			4	7.5-9.0	SS	4-4-5	18
			5	10.0-11.5	SS	4-4-6	18
			6	15.0-16.5	SS	10-13-15	8
559.0	20.0						
		Gray silty clay with sand, moist - hard to very hard	7	20.0-21.5	SS	8-9-22	18
			8	25.0-26.5	SS	32-27-25	18
			9	28.5-30.0	SS	12-13-29	18
549.0	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-18-86

Driller: L. Sanders

Water Depth: Initial: 16.5'

_____ Days after Completion: _____

_____ Days after Completion: _____

Drilling Method: 3½" I.D. - Hollow Stem Augers

Sampling Method: ASTM D1586 & D1587

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

RECORD OF BORING NO. 5

369

(254)

Client: The Rust Engineering Company

Page 1 of 1

Project: Drum Reconditioning

Project No.: 021-86-169 WEMCO E.P. NO. 00-85501-1050

Location: S 2439.0 - E 3579.5

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
578.3	0.0						
		Gravel					
578.1	0.25						
		Brown lean clay with sand, moist-very stiff (Fill)	1	0.0-1.5	SS	11-14-10	18
576.3	2.0						
		Brown lean clay, moist-very stiff	2	2.5-4.0	SS	8-9-13	8
			3	5.0-6.5	SS	8-9-11	18
570.8	7.5						
		Brown and gray interbedded silt with sand and fat clay, moist to wet- very soft to medium stiff (Varved)	4	7.5-9.0	SS	3-3-4	18
			5	10.0-11.5	SS	WH-1-1	18
			6	15.0-16.5	SS	6-4-5	18
562.8	15.5						
		Gray well graded sand, wet					
562.3	16.0						
		Gray lean clay with sand, moist to wet- medium stiff	7	20.0-21.5	SS	3-3-3	18
553.3	25.0						
		Gray silty clay with sand, moist-very stiff	8	25.0-26.5	SS	8-13-14	18
			9	28.5-30.0	SS	12-14-17	18
548.3	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-18-86

Driller: L. Sanders

Water Depth: Initial: 24.0'

.1 Days after Completion: 11.0'

_____ Days after Completion: _____

41

Drilling Method: 3¼" I.D. - Hollow Stem Augers

Sampling Method: ASTM D-1586

SOIL & MATERIAL ENGINEERS, INC.
Cincinnati, Ohio

APPENDIX D

SITE 4 - CALCIUM REMOVAL SYSTEM

INTRODUCTION

The Calcium Removal System site is located within the production area near the northwest corner of the B Street and 101 Street intersection. The scope of work for this project consists of shallow sampling and review of existing geotechnical boring logs from previous S&ME Project Number 1221-87-178-2.0. Also included in the scope of work are general recommendations provided for foundation design for proposed structures.

At this point of the preliminary design, we understand that proposed structures will include a monorail and 2-ton jib crane, bucket elevator pad, and a 1000-gallon water tank. Location of these structures within the site area is unknown at this time.

EXPLORATION PROCEDURES

Two (2) shallow samples were obtained at the locations shown on Figure 1D. Shallow sampling was performed using methods outlined in the Exploration Procedures section of Appendix A.

Two (2) previous geotechnical borings were made at the site at the locations shown on Figure 1D. The borings were made in April, 1987 for the previous S&ME Project Number 1221-87-178-2.0.

Hollow stem augers were used to advance the hole, while soil samples were obtained in the undisturbed material below the augered depth using the Standard Method for Penetration Test and Split-Barrel Sampling of Soil (ASTM D 1586). Samples were obtained at 2.5-ft. intervals to 10 ft. below present grades and then at 5-ft. intervals to the depths explored.

Subsurface Conditions

The surface of the Calcium Removal System site is flat and covered with a very thin (less than 3 inches) layer of gravel. The surface materials are underlain by 2.5 to 7 ft. of stiff natural lean clay of low plasticity. At Boring 126, the lean clay is underlain by 3 ft. of natural well-graded sand which is loose in relative density.

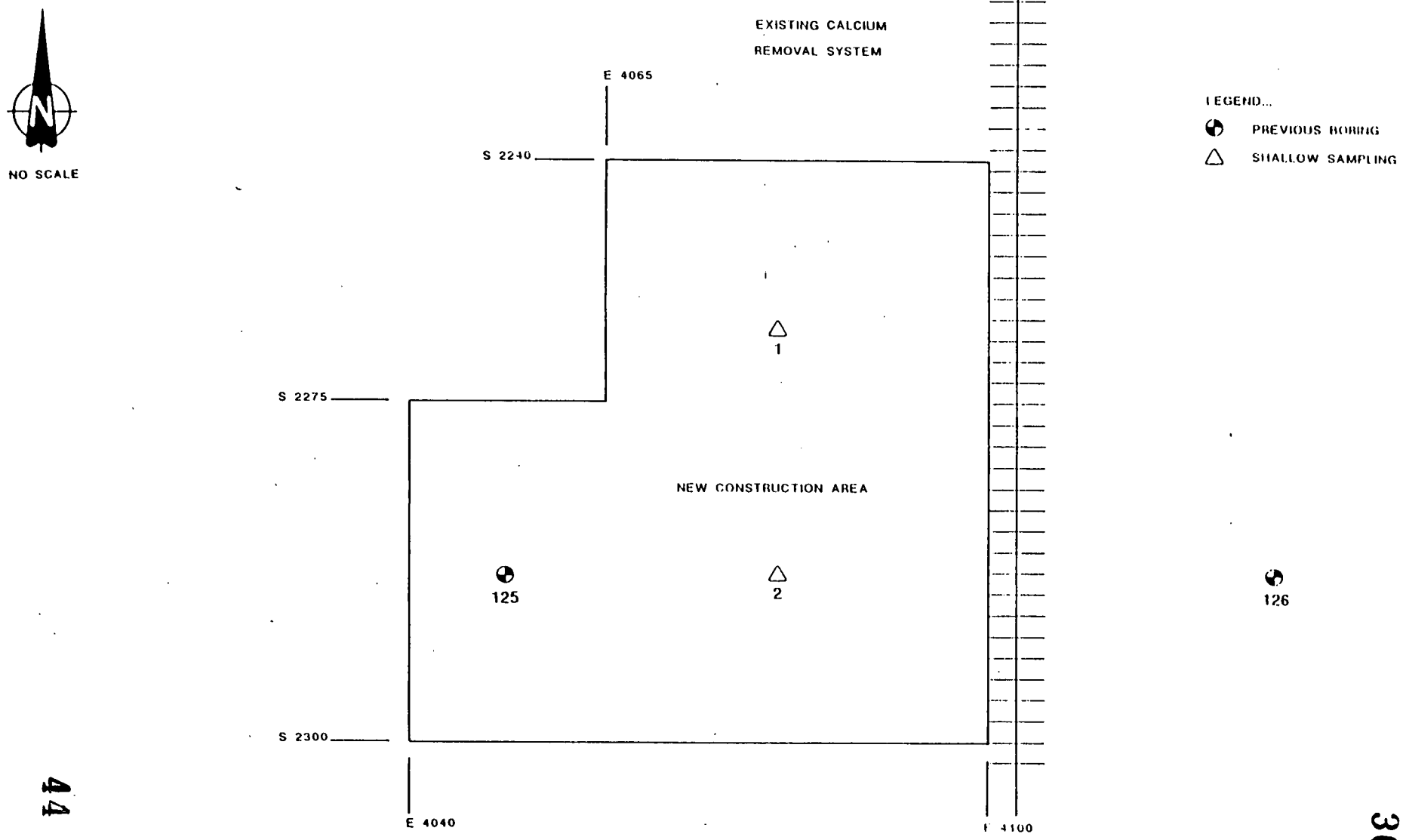
Underlying the above soils is a layer of soft to medium stiff lakebed clay. About 2.5 ft. of wet sandy silt was encountered below the lakebed clay in Boring 126. Stiff to hard glacial till was encountered below the silt and lakebed clay to the depth explored of 30 ft. below grade.

Groundwater was encountered at a depth of 24 ft. at Boring 125. We suspect that the groundwater encountered is the result of seepage into the borehole from water trapped in the granular layers or perched atop the low-permeable lakebed clays.

GENERAL FOUNDATION RECOMMENDATIONS

The structures described in the introduction will probably be supported on isolated spread footings. It is likely that the structures will be unhoused and not protected from freezing with heated buildings. Based upon current geotechnical information for the area conventional continuous or isolated spread footings, bearing at the frost depth level of 30 inches below finished grade, may be suitable. Low bearing capacities (1500 to 2500 psf) will most likely be needed to limit settlement of the underlying lakebed clays.

A more detailed geotechnical analysis should be made once the type and location of structures has been finalized. Additional borings and laboratory testing may be required if proposed structures are not located near the existing borings.



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BORING PLAN: SITE 4

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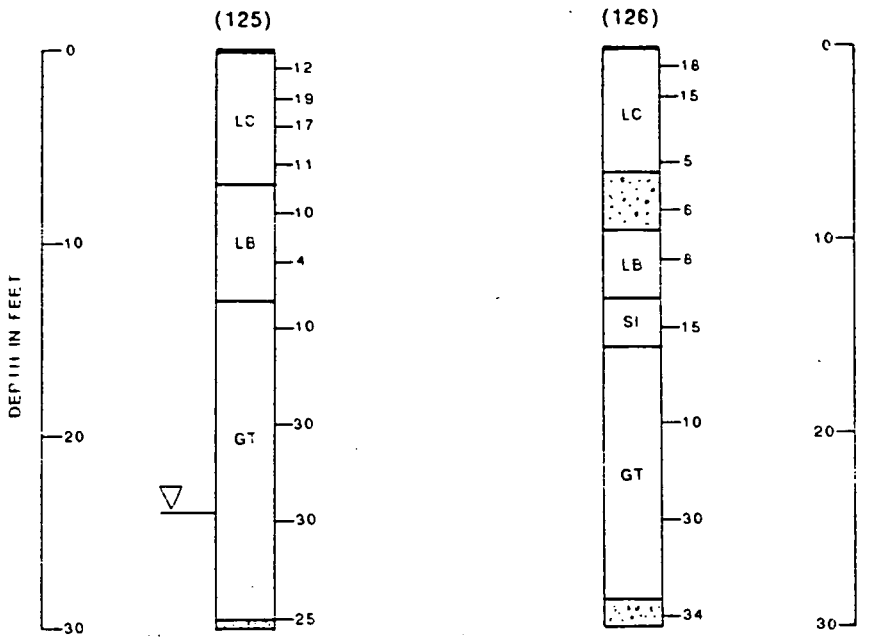
PROJ. NO. 4144-88-462 FIG. NO. 11

44

369

N21259



LEGEND...

- GRAVEL FILL
- LC — LEAN CLAY
- LB — LAKEBED CLAY
- SAND
- SI — SANDY SILT
- GT — GLACIAL TILL
- INITIAL WATER LEVEL
- N, STANDARD PENETRATION RESISTANCE VALUE

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FMPC Fernald, Ohio

SOIL BORING PROFILE (SITE 4) - CALCIUM REMOVAL SYSTEM

Westinghouse
Environmental Engineering
CINCINNATI, OHIO

PROJ. NO. 4144-88-462 FIG. NO. 2D

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	Penetration Resistance (1) (blows/ft.)	Relative Density
SAND and/or GRAVEL	0 to 4	Very Loose
	5 to 10	Loose
	11 to 30	Medium Dense
	31 to 50	Dense
	Over 50	Very Dense
		Consistency
SILTS and CLAY	0 to 2	Very soft
	3 to 4	Soft
	5 to 8	Medium Stiff
	9 to 15	Stiff
	16 to 30	Very Stiff
	21 to 50	Hard
	Over 50	Very Hard

(1) ASTM D 1586-74
A 2-inch outside-diameter by 1-3/8-inch inside-diameter split-barrel sampler is driven 18 inches with a 140-pound hammer falling 30 inches. The number of blows required for each 6 inches of penetration is recorded. The sum of the blows required for the final 12 inches of penetration is the Standard Penetration Resistance

Westinghouse
Environmental Engineering
225 Corporate Court
Fairfield, Ohio 45014
(513) 874-4111

RECORD OF BORING NO. 7 (125) 369

Client: The Rust Engineering Company Page: 1

Project: Fernald, Ohio (FMPC) - General Sump

Project No.: 1221-87-178-2.0

Rust W.O. No. 1063 - WMCO No. 00-86501

Location: S 2280.0 - E 4050.0

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recov. (in.
	0.0						
		Gravel					
	0.2						
		Brown and gray silty clay,	1	0.0-1.5	SS	4-5-7	5
		moist - stiff to very stiff	2	1.5-3.0	SS	7-9-10	6
			3	3.0-4.5	SS	5-7-10	10
			4	5.0-6.5	SS	4-5-6	13
	7.0						
		Brown lean to fat clay,	5	7.5-9.0	SS	4-5-5	15
		moist to wet - soft to	6	10.0-11.5	SS	2-2-2	10
		medium stiff					
	13.0						
		Gray sandy silty clay,	7	13.5-15.0	SS	4-4-6	14
		moist - stiff to very	8	18.5-20.0	SS	6-15-15	8
		stiff	9	23.5-25.0	SS	6-14-16	14
	29.5						
		Brown uniformly graded	10	28.5-30.0	SS	5-10-15	16
		fine sand, wet					
	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-9-87 Driller: O.Cornelius

Water Depth: Initial: 24'

Days after Completion:

Days after Completion:

Drilling Method: 3-1/4" I.D. Hollow Stem Auger

S&ME, IN

Cincinnati,

RECORD OF BORING NO. (126) 369

Client: The Rust Engineering Company Page: 1

Project: Fernald, Ohio (FMPC) - General Sump

Project No.: 1221-87-178-2.0

Rust W.O. No. 1063 - WMCO No. 00-86501

Location: S 2285.0 - E 4139.0

Elev. (ft.)	Depth (ft.)	Description	Sample No.	Sample Depth (ft.)	Sample Type	Blows per 6"	Recovery (in.)
	0.0						
		Gravel (fill)					
	0.1						
		Brown silty clay, moist - medium stiff to stiff	1	0.0-0.1	SS	12-10-8	6
			2	1.5-3.0	SS	6-7-8	12
					ST	3-5	
			3	5.0-6.5	SS	2-2-3	14
	6.5						
		Brown well graded sand, damp - loose	4	7.5-9.0	SS	4-3-3	10
	9.5						
		Brown interbedded silt and fat clay, moist to wet - medium stiff (varved)	5	10.0-11.5	SS	2-3-5	16
	13.0						
		Gray brown sandy silt, wet - stiff	6	13.5-15.0	SS	8-7-8	15
	15.5						
		Gray sandy silty clay, moist - stiff to very stiff	7	18.5-20.0	SS	3-4-6	15
			8	23.5-25.0	SS	11-13-17	0
	28.5						
		Brown uniformly graded fine sand, damp - dense	9	28.5-30.0	SS	15-17-17	17
	30.0						
		Boring terminated @ 30.0'					

Dates Drilled: 4-8-87 Driller: O.Cornelius

Water Depth: Initial: None

Days after Completion:

Days after Completion:

S&ME, INC.

Drilling Method: 3-1/4" I.D. Hollow Stem Auger Cincinnati, Ohio