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Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

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Report on

6/83

ASSESSMENT OF PERIMETER CONTAINMENT DIKE STABILITY PONDS 5, 7, 11, AND 12 CHEMICAL WASTE MANAGEMENT, INC. LIQUID DISPOSAL FACILITY VICKERY, OHIO

CONFIDENTIAL

Submitted to:

Chemical Waste Management, Inc.
3956 State Road 412
Vickery, Ohio 43464

DISTRIBUTION:

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June 1983

834-1358

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

June 30, 1983

834-1358.1
F/N 302.3

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attn: Mr. Gary R. Brown, District Engineer

RE: PERIMETER CONTAINMENT DIKE STABILITY
PONDS 5, 7, 11, AND 12
CHEMICAL WASTE MANAGEMENT, INC.
LIQUID DISPOSAL FACILITY
VICKERY, OHIO

Gentlemen:

We are pleased to present the attached report of the results of our perimeter containment dike stability assessment, as referenced above. This work was accomplished as per your authorization of Addendum 19, dated May 23, 1983.

The report includes the results of field exploration, laboratory testing, and dike stability analyses under static and seismically induced dynamic loading conditions. The analyses indicate the dikes to be stable under all conditions studied except for the potential for some minor surface slumping under seismic loading; we stress, however, that such minor slumping will not impair the ability of the dikes to safely contain the stored liquids.

Should there be any questions, please call.

Very truly yours,

GOLDER ASSOCIATES

Gary H. Collison

Gary H. Collison, P.E.
Principal

GHC:dap

Attachment

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1. INTRODUCTION

Golder Associates has been retained by Chemical Waste Management, Inc. (CWM) to undertake an assessment of the overall stability of the existing perimeter containment dikes for Ponds 5, 7, 11, and 12 at their liquid waste disposal facility near Vickery, Ohio. This stability study is part of an overall review and investigation of the geologic and hydrogeologic site conditions presently being conducted at the facility by Golder Associates.

This report presents the results of field drilling and laboratory testing programs carried out to determine the engineering properties of the existing dike fill and underlying foundation subsoil together with the results of total and effective stress stability analyses of the existing dikes under both static and seismically induced dynamic loading conditions.

2. BACKGROUND DATA

2.1 Site Description

The Chemical Waste Management, Inc. facility is located in Sandusky County, near Vickery, Ohio (ref. Figure 1). The facility comprises some 280 acres and is essentially bounded by the Ohio Turnpike to the north, State Route 512 and 410 to the east and south, and County Road 403 to the west. The surrounding land use is primarily agricultural. The site is quite flat and, apart from man-made features such as drainage ditches and fills, exhibits less than 4 ft. of relief.

The facility was used for the reclamation of waste oil products and is currently disposing acid waste products. A series of

lagoons, contained by perimeter dikes, have been constructed for temporary storage of these products (ref. Figure 2). This study is directed toward the containment dikes for Ponds 5, 7, 11 and 12.

Ponds 5 and 7 are roughly rectangular in shape, and are each some 800 to 900 ft. in length and 200 ft. in width. These ponds are contained by perimeter dikes on the extreme north and west sides only; earth fill operations have raised the ground surface to provide containment on the remaining sides. The maximum height of the dikes is approximately 15 ft., and occurs at the northwest corner of the ponds.

Ponds 11 and 12 are rectangular in shape, and are each roughly 860 to 960 ft. long and 500 to 600 ft. wide. The perimeter of these ponds is contained on all sides by dikes which are 15 to 25 ft. high.

Surface drainage at the site is poor due to the low relief. Drainage ditches have been constructed to the north of the ponds, in the vicinity of the former rail line, and to the west of Pond 12 (ref. Figure 2). Areas of seasonally standing surface water were noted immediately to the west of Pond 12, and to the east of Pond 7.

2.2 Site Geology

A review of previous subsurface investigations by Bowser-Morner, Inc.[1] indicates that the site is underlain by glacial deposits laid down during the Wisconsin period of glaciation.

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[1]Bowser-Morner Testing Laboratories, Inc., "Hydrogeologic Assessment, Northern Ohio Treatment Facility, Vickery, Ohio", dated May 3, 1983.

The overburden deposits comprise a sequence of lacustrine clay, unconsolidated till and dense basal till, respectively, and are typically about 40 to 50 ft. thick in the vicinity of the site.

The glacial deposits are underlain by relatively flat lying dolomite bedrock of the Bass Island Formation. The dolomite is reported to contain frequent beds of shale, gypsum and anhydrite. A detailed description of subsurface conditions is presented in Section 4 of this report.

2.3 History of Containment Dikes

Little detailed information is available regarding the history of the containment dikes. It is understood, however, that the dikes were constructed of compacted silty clay which was borrowed from within the base of the ponds (i.e. the ponds were partially incised into the ground). This is borne out by the results of recent soundings within Ponds 11 and 12 by Dames and Moore (Golder Associates letter regarding "Lagoons 4, 5, 7, 11 and 12 Dimensions, Chemical Waste Management, Vickery, Ohio" dated June 28, 1983) which indicates that the base of the ponds is some 9 to 10 ft. below the surrounding ground surface.

While the slopes of the perimeter dikes are relatively steep (typically 2 to 2-1/2 horizontal to 1 vertical) the dikes show no evidence of instability. However, it is understood that at one time in the past, a local slump occurred on the inside face of the dike near the northwest corner of Pond 12. As a result, the dikes were reportedly "widened" using compacted, locally available, silty clay. While no details of this "widening" are known, it is probable that it comprises the berms which presently exist along the north, west and south sides of Pond 12.

3. PROCEDURE

3.1 Review of Available Information and Site Inspection

Background information regarding subsurface conditions in the vicinity of the site was obtained primarily from the results of a previous subsurface investigation by Bowser-Morner, Inc. and a review of selected geologic references.

Information concerning the construction and operational history of the containment dikes was obtained through discussions with CWM mangement and operations personnel at the facility. Following this review, a detailed visual inspection of the condition of the dikes was made by a senior member of our engineering staff.

Typical cross-sections of the dikes were surveyed at selected locations by staff from Farnham, Wirries, and Berning, Civil Engineers and Surveyors, of Toledo, Ohio. This survey was confined to the crest and downstream portions of the dike.

3.2 Field Investigation Program

A subsurface investigation to determine the engineering properties of the dike fill and foundation subsoil was undertaken between April 19 and 27, 1983. During this period, 8 borings were drilled to depths ranging from 25.5 ft. to 50.5 ft. below the dike crest, at the locations shown on Figure 2.

The borings were advanced using a truck-mounted power auger. Representative samples of the overburden materials were obtained at 1.5 to 5.0 ft. intervals of depth using 2 in. diameter split spoon and 3 in. diameter thin wall (Shelby) tube samplers. Standard penetration tests were conducted

in conjunction with the split spoon sampling. The thin wall sampling tubes were hydraulically pushed into the soil to minimize sample disturbance. The in-situ undrained shear strength of the soil was determined at selected depths using a field vane shear apparatus.

Standpipe type piezometers were sealed into each boring following completion of the hole. A single piezometer was placed in each hole to ensure the quality of the installation. At borehole locations D-3, D-6, and D-8, a second shallow piezometer installation was placed in an unsampled boring drilled adjacent to the sampled boring. These unsampled piezometer installations are denoted as Boreholes D-3A, D-6A, and D-8A, respectively.

The borings were drilled under the supervision of a member of Golder Associates engineering staff, who located the boreholes in the field, directed the drilling and sampling operations, logged the borings and cared for the samples obtained. The elevations of the borings were determined relative to a benchmark established by surveyors from Farnham, Wirries, and Bernings. Details of the drilling, sampling and in-situ testing and of the piezometer installations are presented on the Record of Borehole sheets following the text of this report.

3.3 Laboratory Testing Program

The split spoon samples obtained during the investigation were placed in glass sample jars and the thin wall tube samples were tightly capped in order to minimize changes in moisture content.

Laboratory index (classification) testing including water content, Atterberg limits, grain size determination, and

bulk density was undertaken on selected samples by Bowser-Morner Testing Laboratories, Inc. of Toledo, Ohio.

The results of these analyses were provided by Bowser-Morner and are presented on the accompanying Record of Borehole sheets, and Figures 9, 13, 15, and 16.

Selected thin wall tube samples were shipped to Golder Associates laboratory for consolidated undrained triaxial shear strength testing ($\bar{R}$ tests). The results of the triaxial testing together with the results of appropriate accompanying index testing are shown on the Record of Borehole sheets and on Figures 10, 11, 12, and 14.

4. SUBSURFACE CONDITIONS

The following description of the existing dike fill and associated foundation subsoil conditions is based on the results of the recent borings drilled at the site under Golder Associates direction and the results of previous borings reported by Bowser-Morner Testing Laboratories, Inc.

The detailed stratigraphy encountered in each of the boreholes and the results of laboratory tests carried out on representative samples of the subsoils are presented on the attached Record of Borehole sheets and on Figures 8 to 16 inclusive. It should be noted that the stratigraphic boundaries indicated on the borehole logs and cross-sections are generally inferred from non-continuous sampling, observation of auger cuttings, and resistance to auger advance. These boundaries typically represent a transition from one soil type to another and do not necessarily indicate an exact plane of geological change. Further, the subsurface conditions are confirmed at the borehole locations only and may vary at other locations.

In summary, the dikes appear to comprise silty clay fill materials, overlying native deposits of lacustrine clay, and silty clay till. The glacial till was not fully penetrated by any of the borings drilled in the present investigation. However, the results of previous borings in the vicinity indicate that it is underlain by a thin basal deposit of very dense silt till and bedrock. Stratigraphic cross-sections in the vicinity of the dikes are presented on Figures 3 to 7, inclusive.

4.1 Fill Materials

Fill materials were encountered in all of the current borings. The depth of fill varied from about 16 to 25 ft. in Boreholes D-1 to D-6 (Ponds 11 and 12) and from 11 to 11.5 ft. in Boreholes D-7 and D-8 (Ponds 5 and 7). The fill comprises stiff to hard mottled brown to grey-brown silty clay with occasional traces of sand and gravel, and was found to be relatively uniform in composition at all of the sample locations.

A summary of the engineering parameters of the fill based on measured field and laboratory test results is given on Figure 8.

As indicated on Figure 8 (Plasticity Chart) the fill may be classified as an inorganic clay of low plasticity (CL material). The results of standard penetration tests carried out in the boreholes indicate that the N values range from about 6 to 16 blows/ft. near the top of the dikes to about 13 to 23 blows/ft. near the base of the fill and tend to increase linearly with depth. Similarly, the undrained shear strength of the fill, while variable, tends to increase linearly from about 1200 to 2500 lb/sq.ft. near the top of the dikes to about 1700 to 3200 lb/sq.ft. near the base of the fill. Based on the results of the in-situ vane testing,

a conservative, average undrained shear stength of the fill of 1500 lb/sq.ft. is suggested for analyses (see Figure 8).

The measured water content of the fill ranges from about 17 to 24 per cent and is generally near the plastic limit of the material. A comparison of the moisture-density determinations with the results of a laboratory standard Proctor compaction test carried out on a representative sample of the fill (Figure 9) indicates that while the field moisture content is generally above the optimum moisture content for compaction, the fill has been compacted to between 93 and 102 per cent of Proctor optimum dry density.

Finally, the results of a consolidated undrained triaxial compression test with pore pressure measurement ($\bar{R}$ test - see Figure 10) indicates that the fill behaves as an essentially cohesionless material ($c' = 0$) and that the effective angle of internal shearing resistance (ϕ') is 31 degrees.

4.2 Lacustrine Clay

Lacustrine clay was encountered immediately beneath the dike fill material at all of the current borehole locations. This stratum consists of grey to grey brown silty clay and exhibits distinct horizontal laminations of about 1/8 to 1/2 in. thickness, with occasional fine sand partings between the laminations. The upper 1 to 2 ft. of the deposit frequently contains a trace of organic matter in the form of fine root fibers; probably representative of the 'B' topsoil horizon which was not fully removed during site stripping operations at the time of construction.

The lacustrine deposit was fully penetrated only in Boreholes D-3, D-6, and D-8 of the current investigation where it was found to vary in thickness from about 14 to 27 ft. However,

the previous borings drilled by Boswer-Morner, Inc. suggest that the thickness of the deposit in the vicinity of the dikes ranges variably from about 10 to 30 ft.

As indicated on Figure 8 (Plasticity Chart) the lacustrine deposit can generally be classified as an inorganic clay of low plasticity (CL material). Based on the results of standard penetration testing and in-situ field vane tests, the upper portion of the deposit has been desiccated to form a relatively stiffer crust over the otherwise apparently near normally consolidated deposit. Within this crust, N values decreased from about 13 to 30 blows/ft. at about elevation 610 ft. to about 4 to 8 blows/ft. at about elevation 590 ft. Below about elevation 590 ft., the results of both the current investigation (Figure 8) and the previous Bowser-Morner investigation indicate that the N values increase and are consistently in excess of about 15 blows/ft. at elevation 570 ft.

Within the desiccated zone, the undrained shear strength of the deposit is consistently greater than about 1500 lb/sq.ft. near original ground surface. With depth, however, the shear strength decreases and is between 500 and 1000 lb/sq.ft. at about elevation 590 ft. Below this elevation, the shear strength increases (as indicated by the N value profile) but no numeric strength data is available. As indicated on Figure 8, it is suggested that for analysis purposes, a conservative, average undrained shear strength of 1250 lb/sq.ft. be assumed on the desiccated crust (elevation 595 to 610 ft.) and that a shear strength of 700 lb/sq.ft. be assumed within the near normally consolidated zone between elevation 585 and 595 ft.

Within the desiccated zone, the measured water content of the lacustrine clay (Figure 8) increases fairly uniformly from about 18 to 22 per cent (about the plastic limit) near

the top of the deposit to about 30 to 35 per cent (about the liquid limit) at about elevation 590 ft. This increase in water content is compatible with the measured decrease in shear strength over the same zone.

Finally, the results of a consolidated, drained triaxial compression test with pore pressure measurement ($\bar{R}$ test - see Figure 11) carried out on a representative sample of the desiccated silty clay indicates that the lacustrine deposit will behave as an essentially cohesionless material ($c' = 0$) and that the effective angle of internal shearing resistance (ϕ') is 33 degrees.

4.3 Silty Clay Till

Where completely penetrated (Boreholes D-3, D-6 and D-8) the lacustrine clay is underlain at a depth of between 32 and 45 ft. below the dike crest (i.e. at elevation 582 to 592 ft.) by a deposit consisting of silty clay with some sand and a trace of gravel. This deposit was encountered in all of the borings drilled during the course of the previous investigation by Bowser-Morner, Inc. where it was found to extend to depths of about 40 to 50 ft. below original ground surface (to about elevation 550 to 570 ft.).

While this deposit has a generally till-like gradation (Figure 17), it was not heavily preconsolidated by the glacial ice sheet and, as a result, is relatively soft. As indicated on Figure 8, N values in the upper portion of the till are generally similar to those in the lower, near normally consolidated portion of the lacustrine clay (4-8 blows/ft.) but increase with increasing depth. Similarly, below about elevation 590 ft. the measured water contents tend to decrease with increasing depth. The results of standard penetration testing carried out during the course of the previous investigation indicate that below about elevation 570 to 575 ft.,

the consistency of the till is generally very stiff to hard (shear strength in excess of about 2000 lb/sq.ft.).

4.4 Groundwater Conditions

The groundwater levels in the piezometers installed during the course of this investigation were measured periodically from the time of their installation until June 1983. The results of these measurements are summarized in Table 1. The most recent water levels (June 2, 1983) are plotted on the Record of Borehole sheets and on Figures 3 to 7 inclusive. On the basis of these readings, it appears that the water levels have stabilized in all of the piezometers and are typically at or below the base of the dike fill (Boreholes D-1, 2, 3A, 4, 7 and 8A) or at an elevation close to that of the adjacent natural ground surface outside the dike (Boreholes 5 and 6A).

Where adjacent piezometers were installed in the lower portion of the dike fill/upper desiccated portion of the silty clay and at depth in the lacustrine clay/till (Boreholes 3 and 3A, 6 and 6A, 8 and 8A), the water level in the deeper installation was some 2.5 to 6 ft. lower than the water level in the shallower installation. This suggests that, at these locations at least, there is a net downward hydraulic gradient through the overburden of about 0.1 to 0.2 ft./ft.

5. ASSESSMENT OF DIKE STABILITY

5.1 Description of Dikes

Typical surveyed cross-sections for representative areas of the perimeter containment dikes are presented on Figure 4 to 7, inclusive. It should be noted that these surveys were performed on the crest and outside faces of the dikes only,

since the nature of the liquids stored in the lagoons precluded a detailed survey of the inside faces. Therefore, the slope and nature of the upstream portion of the dikes was estimated from visual observations.

The dikes typically comprise a uniform cross-section, with 15 to 20 ft. crest width, and slopes between 2 and 2-1/2 horizontal to 1 vertical. The maximum height of the dikes is about 25 ft. at Pond 12, and 15 ft. at Pond 5. Portions of the Pond 11 and 12 dikes have a 5 to 10 ft. wide bench in the downstream slope at about mid-height (ref. Figure 4 to 7).

The outside slopes of the dikes are generally covered with a thick growth of grass and weeds. The inside slopes are protected with coarse rock fill of about 6 to 12 in. diameter. The thickness of this rock fill was observed to be about 18 to 24 in. The crests of the dikes are surfaced with granular material and are used as access roadways.

A detailed visual inspection of the outside face and toe of the dikes revealed no zones of surface cracking, erosion or slumping; excessively soft or saturated soils; or other indications of past or existing instability.

Similarly, the visible portions of the inside face of the dikes were also in good condition. However, a small part of the inside face of the western side of the Pond 12 dike has no rock fill surfacing and was the reported location of past surficial slumping. This area shows no present signs of distress.

The maximum operating fluid levels in the ponds, allowing 2 ft. of freeboard, are:

Pond	Maximum Pond Surface Elevation	Approx. Depth of Liquid
5	617.2 ft.	11.7 - 21.7 ft.
7	617.2 ft.	20.5 - 21.0 ft.
11	623.3 ft.	21.0 - 26.5 ft.
12	624.7 ft.	25.6 - 31.6 ft.

Based on the results of the current subsurface investigation the dikes appear to have been constructed as homogeneous sections and were built of locally available desiccated silty clay borrow material (i.e. no internal drain or filter layers were installed). Further, the stiff to hard consistency and the relatively high in-situ densities of the fill indicate that the material received adequate compactive effort during placement.

The low phreatic surface recorded in all of the piezometers installed in the lower portion of the dike fill and/or upper portion of the underlying desiccated lacustrine clay suggests that little to no mounding has occurred above the natural groundwater levels in the overburden. This could be due to some form of low permeability (lower than the embankment material permeability) "lining" which has developed along the inside of the pond, or to the desiccated lacustrine clay acting as an underdrain, or a combination of both. The desiccated materials could be more permeable than the overlying compacted fill because of micro-fissuring during the desiccation process. A low permeability "lining" could have been developed during construction by smearing or compaction against the dikes or it could be the result of a chemical precipitation from the pond fluid in contact with the clays.

5.2 "Typical" Dike Sections Used for Analyses

Based on the surveyed cross-section (Figure 4 to 7 inclusive), the perimeter containment dikes can be divided into three

basic types as shown on Figure 17. These may be summarized as follows:

Type I: - These dikes comprise the perimeter of Pond 11 and the southern portion of the west dike of Pond 12. The dikes are typically about 14 to 19 ft. high, have an outside slope of about 2 to 2-1/2 horizontal to 1 vertical and a crest width of about 16 to 22 ft.

Type II: - These dikes comprise most of the perimeter of Pond 12. They are typically about 17 to 23 ft. high, have an outside slope of about 1-3/4 to 2-1/2 horizontal to 1 vertical and a crest width of about 16 to 20 ft. They are characterized by a partial to full height berm some 10 ft. wide on the outside face of the dike.

Type III: - These dikes comprise the diked perimeter of Ponds 5 and 7. They are typically about 12 to 15 ft. high, have an outside slope of about 2 to 2-1/2 horizontal to 1 vertical and a crest width of about 14 to 24 ft.

For each of these basic dike configurations, an idealized, "worst case" geometry was selected for subsequent analyses as indicated on Figure 17.

5.3 Results of Total Stress Stability Analyses

As a first step in assessing the overall stability of the perimeter containment dikes, total stress (undrained condition) stability analyses were carried out for each of the three "typical" dike geometrics developed in Section 5.2 of this report. For these analyses, the conservative, minimum average undrained shear strength, c_u, profile shown on Figure 8 was assumed. Further, the total unit weights, γ, of the various soil units were determined from the results of the laboratory measurements and/or published data. In summary, the following engineering properties were used:

Compacted clay fill	c_u = 1500 lb/sq.ft. γ = 130 lb/cu.ft.
Desiccated crust (above elev. 595	c_u = 1250 lb/sq.ft. γ = 130 lb/cu.ft.
Normally consolidated clay (elevation 585 to 595)	c_u = 700 lb/sq.ft. γ = 115 lb/cu.ft.

The total stress stability analyses were carried out using the SARMA[1,2] method. This is a pseudo-static method of analysis which computes not only the static factor of safety against instability for an assumed potential failure surface but also the minimum (critical) horizontal ground acceleration required to induce movement along the surface (i.e. reduce the factor of safety to unity). For each of the three "typical" dike geometries, iterative analyses were carried out to determine the "critical" failure surface (i.e. the surface for which the factor of safety is lowest) for each of the following three conditions:

(i) failure entirely within the fill itself;
(ii) failure through the desiccated crust;
(iii) failure through the near normally consolidated clay.

The results of these analyses are summarized on Figure 18. As indicated on Figure 18, for the conservative, minimum average undrained shear strengths assumed, the "critical" failure surface generally passes through the near normally consolidated clay stratum (i.e. deep-seated rotational type failure). However, the factor of safety against

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[1] Sarma, S.K., 1983; Stability Analysis of Embankments and Slopes, Geotechnique, Vol. 23, No. 3.

[2] Sarma, S.K., 1979; Response and Stability of Earth Dams during Strong Earthquakes, Miscellaneous Paper GL-79-13, Vicksburg, Mississippi.

instability under static loading conditions is consistently in excess of 2.3 and the critical horizontal ground acceleration required to induce movement is consistently in excess of 0.4 g which is about 8 times the recommended design acceleration for the Vickery area*.

In summary, based on the results of the total stress stability analyses the perimeter containment dikes for Ponds 5, 7, 11, and 12 are stable under both static and seismically induced dynamic loading conditions.

5.4 Results of Effective Stress Stability Analyses

In addition to the total stress (undrained) analyses, the stability of each of the "typical" perimeter containment dike geometries developed in Section 5.2 was assessed using effective stress shear strength parameters. For these analyses, an assessment of the porewater pressure distribution within the dikes was required. As discussed in Section 4.4, within the borings drilled along the centerline of the dikes the piezometric water level in the lower portion of the fill and desiccated silty clay was at or below the fill/clay contact and/or the natural ground surface outside the dikes. Further, the results of concomitant studies suggest that outside the lagoon areas the "regional" groundwater level in the desiccated silty clay is generally at or close to ground surface.

As discussed in Section 5.1, the piezometric water level data further suggests that little to no mounding has occurred above the natural groundwater level in the overburden. While

* Vickery is located in Seismic Zone 1 as identified in "Engineering and Design Stability for Earth and Rockfill Dams", U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-1902, April 1970. For Zone 1, the seismic design coefficient is 0.05 g.

no quantitative information is available regarding the pore water pressure distribution within the inside slopes of the dikes, based on the above information and the reported maximum operating levels for the ponds (Section 5.1) an inferred upper phreatic surface or flow line was constructed for each of the three "typical" dike sections for purposes of the stability analyses (see Figure 19).

The effective stress stability analyses were carried out using the SARMA method (see Section 5.3). The analyses were based on the reported maximum pond operating levels (Section 5.1) and the phreatic surfaces shown on Figure 19; the effective stress shear strength parameters developed from the laboratory testing program (Figures 10 and 11); and the unit weights developed for the total stress analyses (Section 5.3). These are summarized as follows:

Compacted clay fill	$c' = 0$ $\phi' = 31^{\circ}$ $\gamma = 130$ lb/cu.ft.
Desiccated silty clay (above elevation 595)	$c' = 0$ $\phi' = 33^{\circ}$ $\gamma = 130$ lb/cu.ft.
Normally consolidated clay (elevation 585 to 595)	$c' = 0$ $\phi' = 33^{\circ}$ $\gamma = 115$ lb/cu.ft.

The results of the effective stress stability analyses are summarized on Figure 19. As indicated on Figure 19, under effective stress (drained) conditions the "critical" potential failure surface (i.e. the surface for which the factor of safety is lowest) is shallow and is restricted to the

outside face of the dikes. For this condition, the analyses degenerate to an "infinite slope" condition where the factor of safety (F.S.) may be expressed as:

$$F.S. = \frac{\tan\phi}{\tan\beta}$$

where ϕ = internal angle of shear resistance of the fill
= 31°

and β = the slope angle
= 23° - 28° (ref. Figure 17)

Thus, the minimum factor of safety against surficial slumping of the outer dike slopes is about 1.1 to 1.4 depending upon the section analyzed.

For larger potential failure surfaces which encroach into the inside face of the dikes (and could result in a loss of liquid if the ponds are at or near the maximum operating level) the minimum factor of safety under static loading conditions is about 2 and the critical acceleration required to cause failure (i.e. reduce the factor of safety to unity) is about 0.3 g.

Based on the results of the effective stress stability analyses, the existing Pond 5, 7, 11, and 12 dikes are stable under static loading conditions. Under the design seismic loading (0.05 g horizontal ground acceleration) some local surficial slumping of steeper portions of the exterior dike slopes may occur. However, such slumping will not impair the ability of the existing dikes to safely contain the stored liquids.

6. CONCLUSIONS

The results of the present study have confirmed that the existing perimeter containment dikes were constructed as homogeneous sections and were built of the locally available desiccated silty clay crust material, probably borrowed from within the base of the ponds themselves. Further, the clay fill was adequately compacted during construction.

While no internal drains or filters were incorporated into the dike sections, it appears that there has been little to no mounding above the natural groundwater levels in the overburden soils. Consequently, piezometric pressures within the dike fill are very low (at the dike centerline the upper phreatic surface is near or below the level of the surrounding groundwater levels).

The results of the total stress stability analyses indicated that for the undrained condition the "critical" failure surface passes through the foundation subsoil but that under static loading conditions the factor of safety against instability is consistently in excess of 2.3 for all of the dike sections considered. Further, the critical seismically induced horizontal ground acceleration required to cause instability is some 8 times the design acceleration for the site area.

The results of the effective stress stability analyses indicate that the existing dikes are stable under static loading conditions. Under seismic loading conditions some local surficial slumping of the steeper portions of the exterior slopes may occur. It is stressed, however, that such

slumping will extend only a few feet into the dike face and will not impair the ability of the dikes to safely contain the stored liquids.

GOLDER ASSOCIATES

for J.B. Davis, P. Eng.

for G.H. Collison, P. E.

JBD:GHC:lp

FORM G.A.-F.-4

RECORD OF WATER LEVEL READINGS

JOB No. 831 4089-3

BOREHOLE No.	OPEN HOLE, STANDPIPE, PIEZOMETER-A,B,C,etc.	DATE OF READING (DAY/MONTH/YEAR)										
		21/4/83	22/4/83	25/4/83	26/4/83	27/4/83	28/4/83	29/4/83	30/4/83	01/5/83	02/5/83	03/5/83
D-1	1" ø PVC Standpipe	606.5	606.4	606.4	606.2	606.4	606.1	606.1	606.3	606.3	606.4	606.6
D-2	1" ø PVC Standpipe	608.1	608.0	608.0	607.9	607.8	607.9	607.6	607.9	607.9	-	-
D-3	1" ø PVC Standpipe	579.1	581.1	-	590.7	593.2	596.4	598.1	599.7	601.1	602.3	602.9
D-3A	1" ø PVC Standpipe	607.5	Dry to 607.5	-	608.5	608.6	608.6	608.6	608.7	609.0	609.0	609.2
D-4	1" ø PVC Standpipe	606.1	608.0	-	607.1	607.3	607.4	602.4	607.3	608.0	609.0	609.4
D-5	1" ø PVC Standpipe	-	-	-	607.8	608.1	608.1	608.2	608.4	608.6	608.8	608.9
D-6	1" ø PVC Standpipe	-	-	-	578.5	579.0	579.8	580.4	580.8	581.5	583.2	585.1
D-6A	1" ø PVC Standpipe	-	-	-	Dry to 605.7	Dry to 605.7	606.3	606.9	607.0	607.5	607.9	608.2
D-7	1" ø PVC Standpipe	-	-	-	-	605.4	605.9	606.1	606.3	606.5	606.8	606.6
D-8	1" ø PVC Standpipe	-	-	-	-	-	605.3	604.4	604.3	604.4	604.1	604.2
D-8A	1" ø PVC Standpipe	-	-	-	-	-	Dry	Dry	Dry	Dry	Dry	605.3

TABLE 1

FORM G.A.-F.-4

RECORD OF WATER LEVEL READINGS

JOB No. 831 089-1

BOREHOLE No.	OPEN HOLE, STANDPIPE, PIEZOMETER-A,B,C,etc.	DATE OF READING (DAY/MONTH/YEAR)										
		10/5/83	11/5/83	12/5/83	13/5/83	25/5/83	01/6/83	02/6/83				
D-1	628.4'	606.7	606.6	606.6	608.5	606.6	606.5	606.4				
D-2	627.9'	608.1	608.1	608.0	508.0	608.0	607.9	607.9				
D-3	627.1'	605.3	605.7	605.6	605.4	607.3	607.1	607.2				
D-3A	627.0'	609.6	609.7	609.6	609.6	609.7	609.6	609.7				
D-4	626.0'	608.2	608.0	608.1	608.1	607.9	607.6	607.8				
D-5	625.4'	608.2	608.5	608.4	608.3	608.6	607.9	608.3				
D-6	626.4'	595.1	596.4	595.7	595.8	605.2	606.0	606.3				
D-6A	626.2'	610.0	610.2	610.0	609.9	611.4	611.6	612.0				
D-7	620.0'	606.2	606.1	606.1	606.1	606.3	606.1	606.0				
D8	620.0'	604.0	604.0	604.0	603.9	604.3	604.2	604.0				
D-8A	619.9'	605.7	605.9	605.8	605.7	607.1	607.5	607.6				

TABLE 1 (Cont.)

Golder Associates

LIST OF ABBREVIATIONS

The abbreviation commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 0.3 m (12 in.).

Standard Penetration Resistance, *N*:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 0.3 m (12 in.).

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*'N'* Blows/0.30m or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	*'Cu'* kPa	psf.
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer[1]
Q undrained triaxial[2]
R consolidated undrained triaxial[2]
S drained triaxial
U unconfined compression
V field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

Form G.A.-P.1

LIST OF SYMBOLS

I. GENERAL

$\pi = 3.1416$

e = base of natural logarithms 2.7183

$\log_e a$ or $\ln a$, natural logarithm of a

$\log_{10} a$ or $\log a$, logarithm of a to base 10

t	time
g	acceleration due to gravity
V	volume
W	weight
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	shear strain
ν	Poisson's ratio (μ is also used)
E	modulus of linear deformation (Young's modulus)
G	modulus of shear deformation
K	modulus of compressibility
η	coefficient of viscosity

III. SOIL PROPERTIES

(a) *Unit weight*

γ	unit weight of soil (bulk density)
γ_s	unit weight of solid particles
γ_w	unit weight of water
γ_d	unit dry weight of soil (dry density)
γ'	unit weight of submerged soil
G_s	specific gravity of solid particles $G_s = \gamma_s/\gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) *Consistency*

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_S	shrinkage limit
I_L	liquidity index $= (w - w_P)/I_P$
I_C	consistency index $= (w_L - w)/I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

h	hydraulic head or potential
q	rate of discharge
v	velocity of flow
i	hydraulic gradient
k	coefficient of permeability
j	seepage force per unit volume

(d) *Consolidation (one-dimensional)*

m_v	coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$
C_c	compression index $= -\Delta e/\Delta \log_{10} \sigma'$
c_v	coefficient of consolidation
T_v	time factor $= c_v t/d^2$ (d, drainage path)
U	degree of consolidation

(e) *Shear strength*

τ_f	shear strength	
c'	effective cohesion intercept	in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	effective angle of shearing resistance, or friction	
c_u	apparent cohesion*	in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$
ϕ_u	apparent angle of shearing resistance, or friction	
μ	coefficient of friction	
S_t	sensitivity	

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

Form G.A.-D-1 Project No. 831-1089-1

RECORD OF BOREHOLE D-1

LOCATION See Figure 2 BORING DATE APRIL 19, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 8.5 in. DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
628.4 / 0.0	DIKE CREST				
	STIFF TO VERY STIFF BROWN SILTY CLAY, TRACE SAND AND GRAVEL (DIKE FILL)	1	1	2" D.O.	11
			2	"	10
			3	"	8
			4	"	14
			5	"	15
			6	3" TW	PH
			7	2" D.O.	16
			8	"	15
			9	"	17
			10	3" T.W.	PH
603.4 / 25.0	HARD BROWN SILTY CLAY TRACE ROOTS		11	2" D.O.	26
601.9 / 26.5	VERY STIFF GREY BROWN SILTY CLAY DISTINCT HORIZONTAL LAMINATIONS, OCCAS. SAND PARTINGS (DESICCATED CRUST)	2A	12	"	16
			13	"	17
596.9 / 31.5	END OF HOLE				

ELEVATION SCALE: 630, 625, 620, 615, 610, 605, 600, 595, 590

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM. V. - ⊕ U. - O

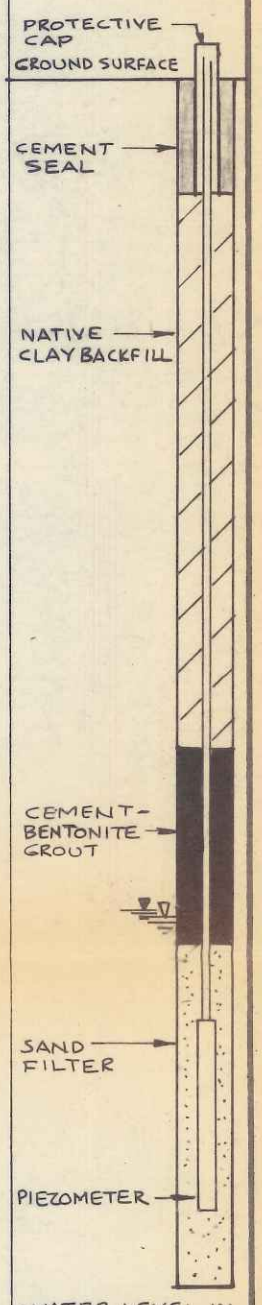
COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL 10 20 30 40

γ = 129.5 lb./cu.ft.

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL IN PIEZOMETER AT ELEV. 606.7 ft. ON MAY 10, 1983
ELEV. 606.4 ft. ON JUNE 2, 1983

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.
CHECKED JBD

Form G.A.-D-1

Project No. 331 089

RECORD OF BOREHOLE D-2

LOCATION See Figure 2 BORING DATE APRIL 20, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 8.5" DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT
627.9 / 0.0	DIKE CREST	
	STIFF TO VERY STIFF GREY BROWN SILTY CLAY, TRACE SAND AND GRAVEL (DIKE FILL)	1
607.9 / 20.0	VERY STIFF TO STIFF MOTTLED GREY BROWN SILTY CLAY DISTINCT HORIZONTAL LAMINATIONS, OCCAS. FINE SAND PARTINGS (DESICCATED CRUST)	2A
599.9 / 28.0	FIRM TO STIFF GREY BROWN SILTY CLAY LAMINATED, OCCAS. FINE SAND PARTINGS	2
597.4 / 30.5	END OF HOLE	

SAMPLE NUMBER	TYPE	BLOWS/FT.
1	2" D.O.	21
2	"	9
3	"	9
4	3" TW	-
5	2" D.O.	20
6	"	16
7	"	22
8	3" TW	-
9	2" D.O.	25
10	"	21
11	"	10

ELEVATION SCALE: 630, 625, 620, 615, 610, 605, 600, 595

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL 10 20 30 40

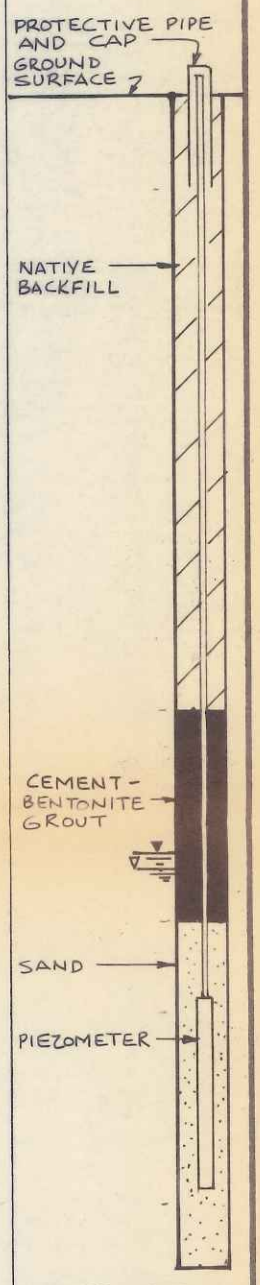
R TEST MH

γ = 130.9 lb/cu.ft.

MH

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL IN PIEZOMETER AT ELEV. 608.1 ft ON MAY 10, 1983. ELEV. 607.9 ft ON JUNE 2, 1983

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.

CHECKED JBD

Form G.A.-D-

Project No. 831-1089-1

RECORD OF BOREHOLE D-3

LOCATION See Figure 2 BORING DATE APRIL 20, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 8.5" DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
627.1 / 0.0	DIKE CREST				
	STIFF TO VERY STIFF GREY BROWN SILTY CLAY TRACE SAND AND GRAVEL (DIKE FILL)	1	1	2" D.O.	12
			2	"	24
			3	"	13
			4	3" T.W.	P.H.
			5	2" D.O.	15
610.6 / 16.5	STIFF DARK BROWN SILTY CLAY, TR. ORGANIC MATTER		6	"	13
609.1 / 18.0	STIFF GREY BROWN SILTY CLAY, DISTINCT HORIZONTAL LAMINATIONS OCCASIONAL FINESAND PARTINGS (DESICCATED CRUST)	2A	7	3" T.W.	P.H.
			8	2" D.O.	11
599.1 / 28.0	SOFT TO FIRM GREY SILTY CLAY, LAMINATED, OCCAS. FINE SAND PARTINGS (LACUSTRINE CLAY)	2	9	"	4
			10	3" TW	P.H.
			11	2" D.O.	4
581.8 / 45.3	STIFF TO VERY STIFF GREY SILTY CLAY WITH SAND, TRACE GRAVEL (TILL)	3	12	"	6
			13	"	18
576.6 / 50.5	END OF HOLE				

ELEVATION SCALE: 625, 620, 615, 610, 605, 600, 595, 590, 585, 580

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. lb/sq ft. NAT. V. - + Q. - ● REM. V. - ⊕ U. - O (500, 1000, 1500, 2000)

COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL (10, 20, 30, 40)

ADDITIONAL LAB. TESTING: MH; γ = 127.4 lb./cu.ft.

PIEZOMETER OR STANDPIPE INSTALLATION: PROTECTIVE PIPE; GROUND SURFACE; CEMENT-BENTONITE GROUT; SAND; PIEZOMETER

WATER LEVEL IN PIEZOMETER AT ELEV. 605.3 ON MAY 10, 1983 ELEV. 607.2 ft. ON JUNE 2, 1983

15 ⊕ 5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN DM

CHECKED JBD

Form G.A.-D-1

Project No. 83-1089

RECORD OF BOREHOLE D-3A

LOCATION See Figure | BORING DATE APRIL 21, 1983 | DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. | PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	SOIL PROFILE: ELEV'N. / DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS/	SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O	COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10	WATER CONTENT, PERCENT Wp W WL	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
POWER AUGER 8.5 in. DIAM. HOLLOW STEM	627.3 / 0.0	DIKE CREST					630						
		(DIKE FILL)		1			625						
							620						
							615						
	610.8 / 16.5	SILTY CLAY (DESICCATED CRUST)		2A			610						
	606.8 / 20.5	END OF HOLE					605						
							600						

UNSAMPLED

WATER LEVEL IN PIEZOMETER AT ELEV. 609.6 ON MARCH 10, 1983
ELEV. 609.7 ON JUNE 2, 1983

15 ◆ 5 (0, 10) Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.
CHECKED JBD

Form G.A.-D-1.

Project No. 83-089

RECORD OF BOREHOLE D-4

LOCATION See Figure 2 BORING DATE APRIL 21, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
	626.0 / 0.0	DIKE CREST				
POWER AUGER 6" DIAM. HOLLOW STEM		VERY STIFF TO STIFF GREY BROWN SILTY CLAY, OCCASIONAL TRACES OF SAND AND GRAVEL (DIKE FILL)	1	1	2" D.O.	18
				2	"	14
				3	"	9
				4	3" T.O.	PH
				5	2" D.O.	13
				6	"	18
	610.0 / 16.0	DARK BROWN SILTY CLAY, TR. ORGANIC MATERIAL				
	609.0 / 17.0	VERY STIFF MOTTLED GREY-BROWN SILTY CLAY DISTINCTLY LAMINATED (DESICCATED CRUST)	2A	7	"	23
				8	3" T.O.	PH
				9	2" D.O.	16
	603.0 / 23.0	FIRM GREY-BROWN SILTY CLAY, LAMINATED (LACUSTRINE CLAY)	2	10	"	6
	600.5 / 25.5	END OF HOLE				

ELEVATION SCALE: 630, 625, 620, 615, 610, 605, 600, 595

DYNAMIC PENETRATION RESISTANCE, BLOWS/

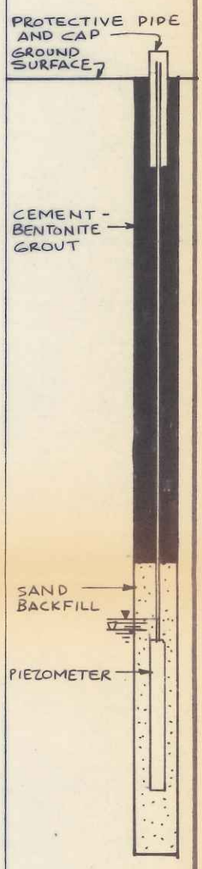
SHEAR STRENGTH Cu. lb/sq.ft. 500 1000 1500 2000 — NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL IN PIEZOMETER AT ELEV. 608.2 ft ON MAY 10, 1983. ELEV. 607.8 ft ON JUNE 2, 1983.

15 ◆ 0 5 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.

CHECKED JAD

Form G.A.-D-1.

Project No. 231-1089

RECORD OF BOREHOLE D-5

LOCATION See Figure 2 BORING DATE APRIL 22, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 6 in. DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
625.4 / 0.0	DIKE CREST				
	STIFF GREY BROWN SILTY CLAY, OCCAS. TRACES OF SAND AND GRAVEL (DIKE FILL)	1	1	2" D.O.	12
			2	"	10
			3	3" T.W.	PH
			4	2" D.O.	11
			5	3" T.W.	PH
			6	2" D.O.	13
604.4 / 21.0	STIFF TO VERY STIFF MOTTLED GREY BROWN SILTY CLAY, DISTINCT HORIZONTAL LAMINATIONS, OCCAS. FINE SAND PARTINGS (DESICCATED CRUST)	2A	7	3" T.W.	PH
			8	"	PH
597.4 / 28.0	FIRM TO STIFF GREY-BROWN SILTY CLAY, LAMINATED LACUSTRINE CLAY	2	9	2" D.O.	7
594.9 / 30.5	END OF HOLE				

ELEVATION SCALE: 630, 625, 620, 615, 610, 605, 600, 595, 590

DYNAMIC PENETRATION RESISTANCE, BLOWS/

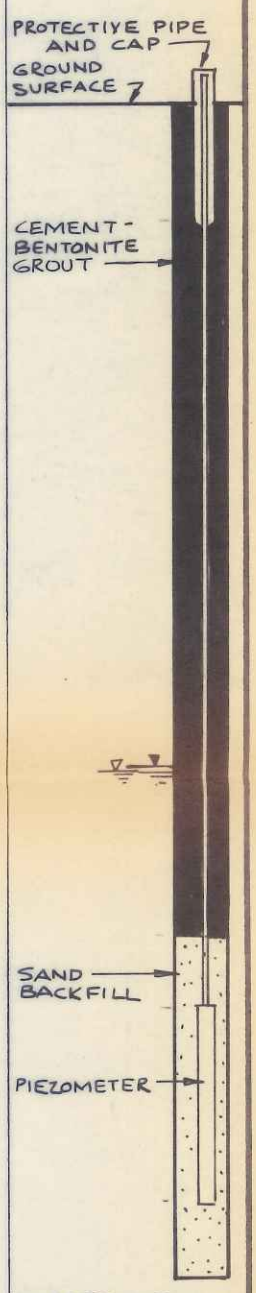
SHEAR STRENGTH Cu. lb/sq ft. NAT. V. - + Q. - ● REM. V. - ⊕ U. - O (500, 1000, 1500, 2000)

COEFFICIENT OF PERMEABILITY, k., CM./SEC. (1x10, 1x10, 1x10, 1x10)

WATER CONTENT, PERCENT Wp W WL (10, 20, 30, 40)

ADDITIONAL LAB. TESTING: γ = 127.6 lb./cu. ft.; R TEST; MH; γ = 125.4 lb./cu. ft.

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL IN PIEZOMETER AT ELEV. 608.2 ON MAY 10, 1982. ELEV. 608.3 ON JUNE 2, 1983.

15 ← 0 → 5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.

CHECKED JRD

Form G.A.-D-1

Project No. 83 089

RECORD OF BOREHOLE D-6

LOCATION See Figure 2 BORING DATE APRIL 22 TO 25, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 6" DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
626.4 / 0.0	DIKE CREST				
	VERY STIFF GREY BROWN SILTY CLAY TRACES OF SAND AND GRAVEL (DIKE FILL)	1	1	2" D.O.	15
			2	"	15
			3	3" TW	PH
			4	2" D.O.	18
			5	3" TW	PH
607.4 / 19.0	HARD DARK BROWN CLAYEY SILT, TR. ORG. MAT.		6	2" D.O.	30
606.4 / 20.0	VERY STIFF TO HARD GREY BROWN SILTY CLAY, DISTINCT HORIZONTAL LAMINATIONS, OCCAS. SAND PARTINGS (DESICCATED CRUST)	2A	7	3" TW	PH
			8	2" DO	20
			9	"	14
597.4 / 29.0	FIRM GREY-BROWN SILTY CLAY LAMINATED (LACUSTRINE CLAY)	2	10	"	6
592.4 / 34.0	FIRM TO STIFF GREY SILTY CLAY, SOME SAND, TRACE GRAVEL (TILL)	3	11	"	5
			12	3" TW	PH
			13	2" D.O.	8
			14	"	11
575.9 / 50.5	END OF HOLE				

ELEVATION SCALE: 625, 620, 615, 610, 605, 600, 595, 590, 585, 580

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. lb./sq. ft. NAT. V. - + Q. - ● REM. V. - ⊕ U. - O (500, 1000, 1500, 2000)

COEFFICIENT OF PERMEABILITY, k., CM./SEC. (1x10, 1x10, 1x10, 1x10)

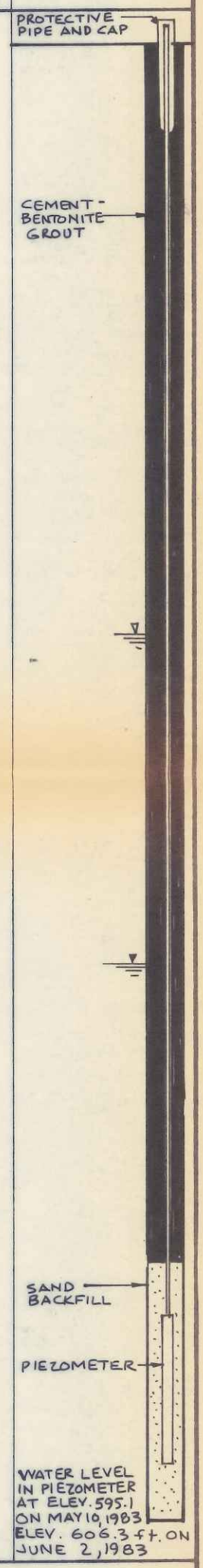
WATER CONTENT, PERCENT Wp W WL (10, 20, 30, 40)

2925

>3000 (COULD NOT TURN)

ADDITIONAL LAB. TESTING: MH, MH

PIEZOMETER OR STANDPIPE INSTALLATION



15 ⊕ 5 (0, 10) Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.

CHECKED JBS

Form G.A.-D-1.

Project No. 831-1089

RECORD OF BOREHOLE D-6a

LOCATION See Figure 2 BORING DATE APRIL 25, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD	SOIL PROFILE: ELEV'N. / DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS/	SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O	COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10	WATER CONTENT, PERCENT Wp W WL	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
POWER AUGER 6 in. DIAM. HOLLOW STEM	626.2 / 0.0	DIKE CREST					630						PROTECTIVE PIPE AND CAP GROUND SURFACE
		(DIKE FILL)		1	UNSAMPLED		625						
							620						CEMENT-BENTONITE GROUT
							615						
							610						SAND BACKFILL; PIEZOMETER
	607.2 / 19.0												
	606.2	SILTY CLAY		2A									
	20.0	END OF HOLE					605						
							600						

15 ← 0 → 5 ↓ 10 Percent axial strain at failure

WATER LEVEL IN PIEZOMETER AT ELEV. 610.0 ft. ON MAY 10, 1983 ELEV. 612.0 ft ON JUNE 2, 1983.

VERTICAL SCALE
1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.
CHECKED JBJ

Form G.A.-D-1

Project No. 831-1089

RECORD OF BOREHOLE D-7

LOCATION See Figure 2 BORING DATE APRIL 25 To 26, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 6" DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
620.0 / 00.0	DIKE CREST				
	VERY STIFF TO HARD GREY BROWN SILTY CLAY, OCCASIONAL TRACES OF SAND AND GRAVEL (DIKE FILL)	1	1	2" D.O.	28
			2	"	30
			3	3" T.O.	PH
608.5 / 11.5	VERY STIFF DARK BROWN SILTY CLAY, TR. ORGANIC MATERIAL		4	2" D.O.	17
607.0 / 13.0	VERY STIFF TO STIFF MOTTLED GREY BROWN SILTY CLAY DISTINCT HORIZONTAL LAMINATIONS, OCCAS. FINE SAND PARTINGS (DESICCATED CRUST)	2A	5	3" TO	PH
			6	2" D.O.	17
599.0 / 21.0	FIRM TO STIFF GREY BROWN SILTY CLAY, LAMINATED, OCCAS. FINE SAND PARTINGS (LACUSTRINE CLAY)	2	7	3" TO	PH
			8	2" DO	8
594.5 / 25.5	END OF HOLE				

ELEVATION SCALE: 625, 620, 615, 610, 605, 600, 595, 590

DYNAMIC PENETRATION RESISTANCE, BLOWS/ — 500, 1000, 1500, 2000

SHEAR STRENGTH Cu. lb/sq ft. — NAT. V. - + Q. - ● REM. V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k., CM./SEC. — 1x10, 1x10, 1x10, 1x10

WATER CONTENT, PERCENT — Wp, W, WL — 10, 20, 30, 40

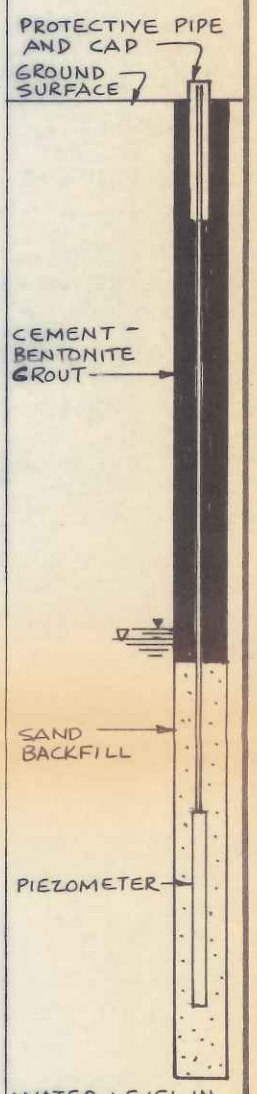
2700

γ = 134.3 lb./cu. ft.

MH

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL IN PIEZOMETER AT ELEV. 606.2 ON MAY 10, 1983
ELEV. 606.0 ft. ON JUNE 2, 1983.

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5 FEET

Golder Associates

DRAWN DM
CHECKED JBD

Form G.A.-D-1

Project No. 831-1009

RECORD OF BOREHOLE D-8

LOCATION See Figure 2 BORING DATE APRIL 26 TO 27, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 ins. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD: POWER AUGER, 6 in. DIAM. HOLLOW STEM

ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS/FT.
620.0 / 0.0	DIKE CREST				
	STIFF TO VERY STIFF GREY BROWN, SILTY CLAY (DIKE FILL)	1	1	2" D.O.	12
			2	"	19
			3	3" T.O.	PH
609.0 / 11.0	BROWN SILTY CLAY TRACE ORGANIC MATTER				
608.1 / 11.9			4	2" D.O.	15
	VERY STIFF TO HARD GREY BROWN SILTY CLAY, DISTINCT HORIZONTAL LAMINATIONS, OCCAS. FINE SAND PARTINGS (DESICCATED CRUST)	2A	5	3" T.O.	PH
			6	2" D.O.	15
			7	3" T.O.	PH
595.0 / 25.0	FIRM TO STIFF GREY-BROWN SILTY CLAY, LAMINATED, OCCAS. FINE SAND PARTINGS (LACUSTRINE CLAY)	2	8	2" D.O.	11
			9	"	8
588.0 / 32.0	STIFF TO VERY STIFF GREY SILTY CLAY WITH SAND, TRACE GRAVEL (TILL)	3	10	"	7
			11	3" T.O.	PH
			12	2" D.O.	18
574.5 / 45.5	END OF HOLE				

ELEVATION SCALE: 620, 615, 610, 605, 600, 595, 590, 585, 580, 575

DYNAMIC PENETRATION RESISTANCE, BLOWS/ (500, 1000, 1500, 2000)

SHEAR STRENGTH Cu. lb/sq.ft. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL (10, 20, 30, 40)

ADDITIONAL LAB. TESTING: MH, MH

3375

3150

PIEZOMETER OR STANDPIPE INSTALLATION: PROTECTIVE PIPE AND CAP; GROUND SURFACE; CEMENT-BENTONITE GROUT; SAND BACKFILL; PIEZOMETER

WATER LEVEL IN PIEZOMETER AT ELEV. 604.0 ft. ON MAY 10, 1983 AND JUNE 2, 1983

15 ✦ 5 (0, 10) Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5 FEET

Golder Associates

DRAWN D.M.

CHECKED JGD

Form G.A.-D-1.

Project No. 831-1089

RECORD OF BOREHOLE D-8A

LOCATION See Figure 2 BORING DATE APRIL 27, 1983 DATUM M.S.L.

SAMPLER HAMMER WEIGHT 140 lb. DROP 30 in. PENETRATION TEST HAMMER WEIGHT DROP

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FT.
	619.9 / 0.0	DIKE CREST				
POWER AUGER 6in. DIAM. HOLLOW STEM		DIKE FILL		1	UNSAMPLED	
	608.9 / 11.0	SILTY CLAY		2A		
	604.4 / 15.5	END OF HOLE				

ELEVATION SCALE: 625, 620, 615, 610, 605, 600

DYNAMIC PENETRATION RESISTANCE, BLOWS/

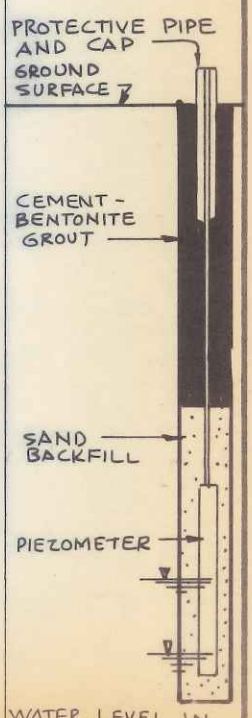
SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM. V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL IN PIEZOMETER AT ELEV. 605.7 ON MAY 10, 1983. ELEV. 607.6 ft ON JUNE 2, 1983

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5 FEET

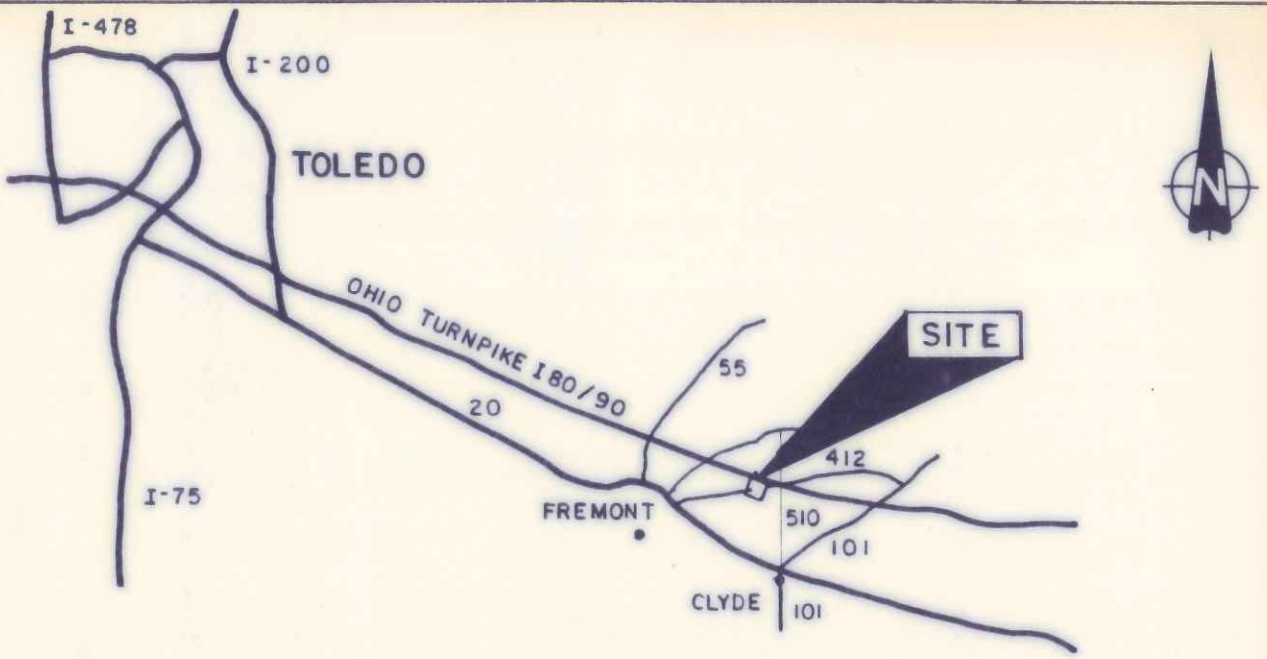
Golder Associates

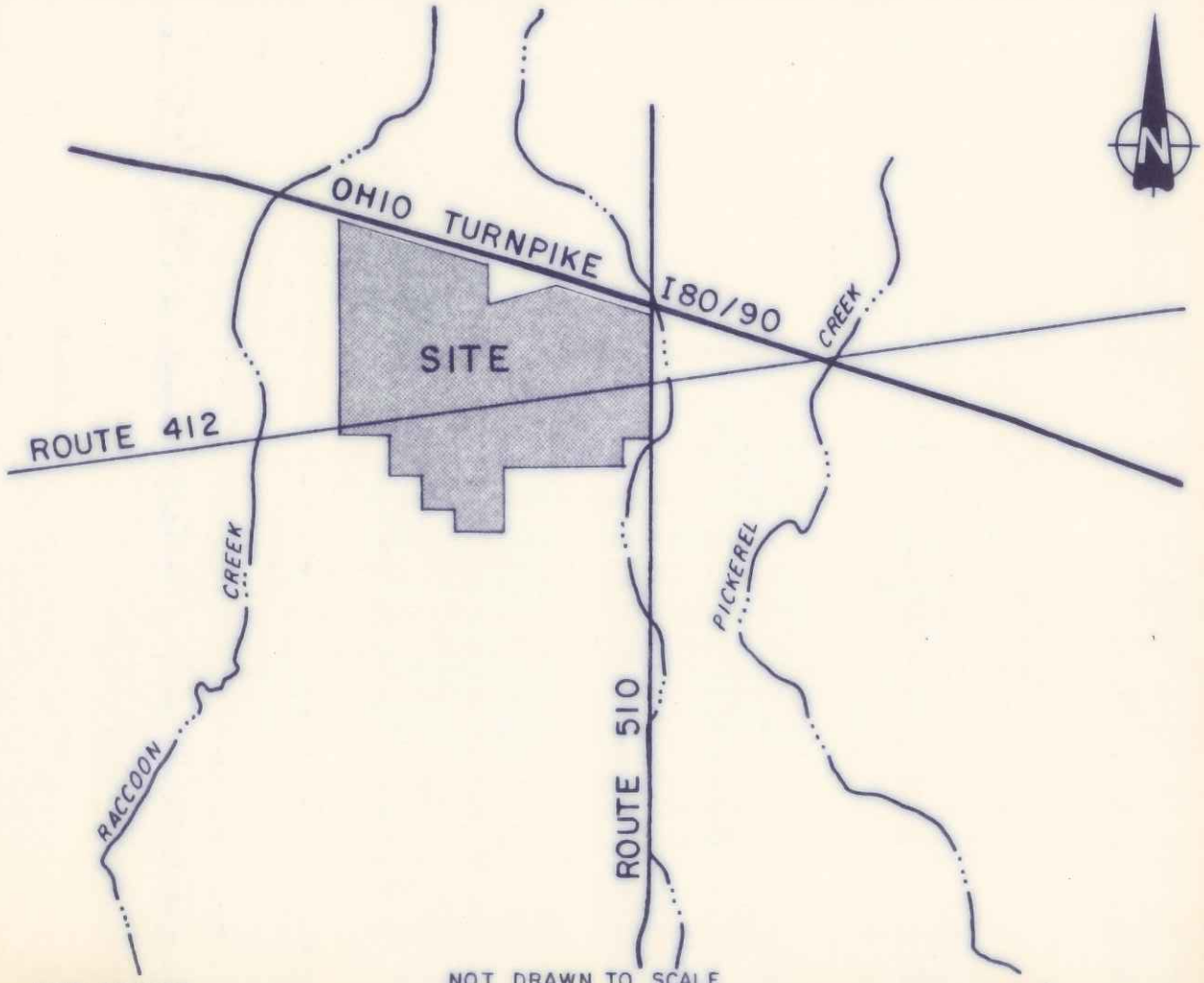
DRAWN D.M.

CHECKED JBD

LOCATION MAP

FIGURE 1





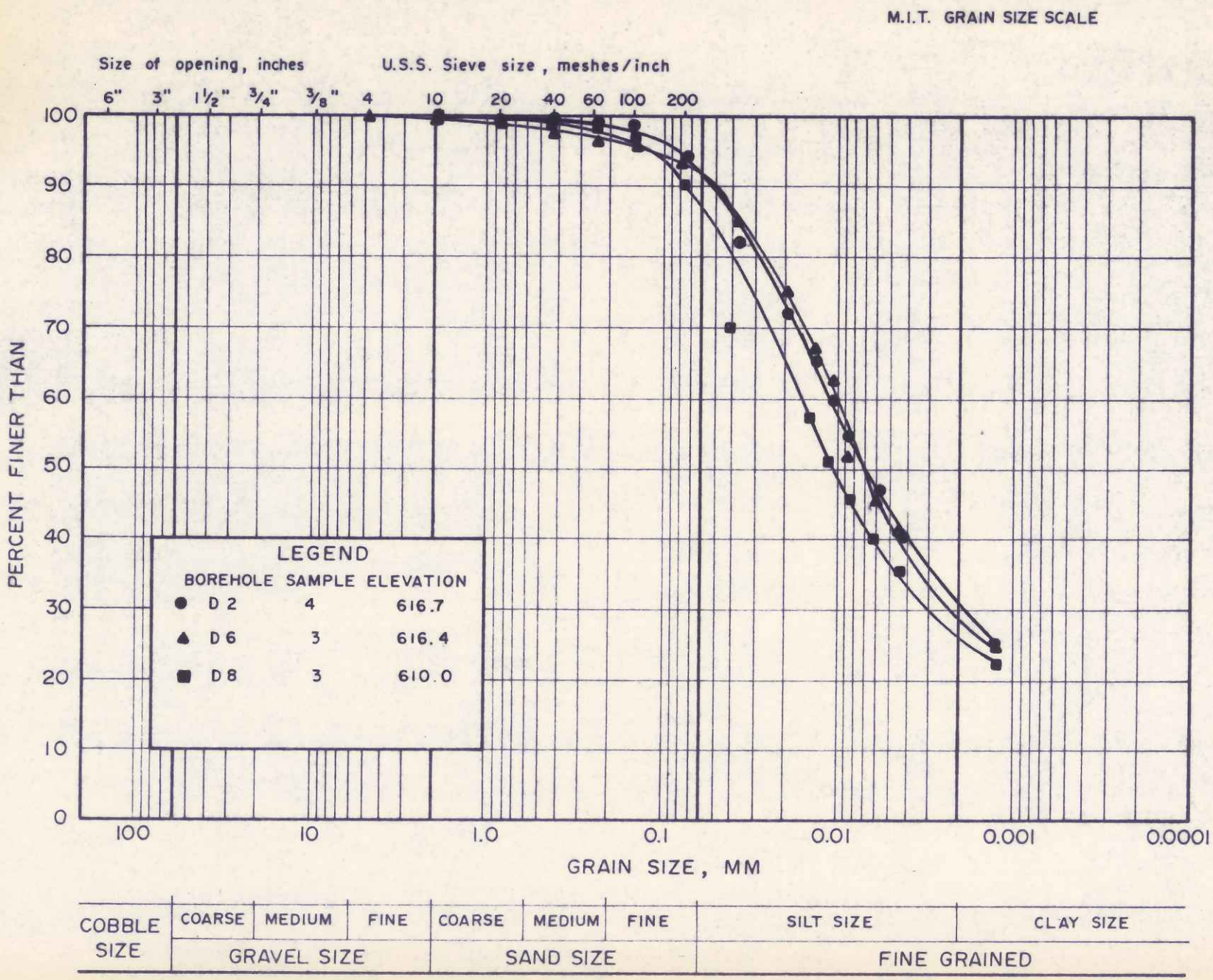
NOT DRAWN TO SCALE

Date JUNE 15, 1983
Project No. 831-1089-1

Golder Associates

Drawn D.M.
Chkd JED

Form G.A.-D-4

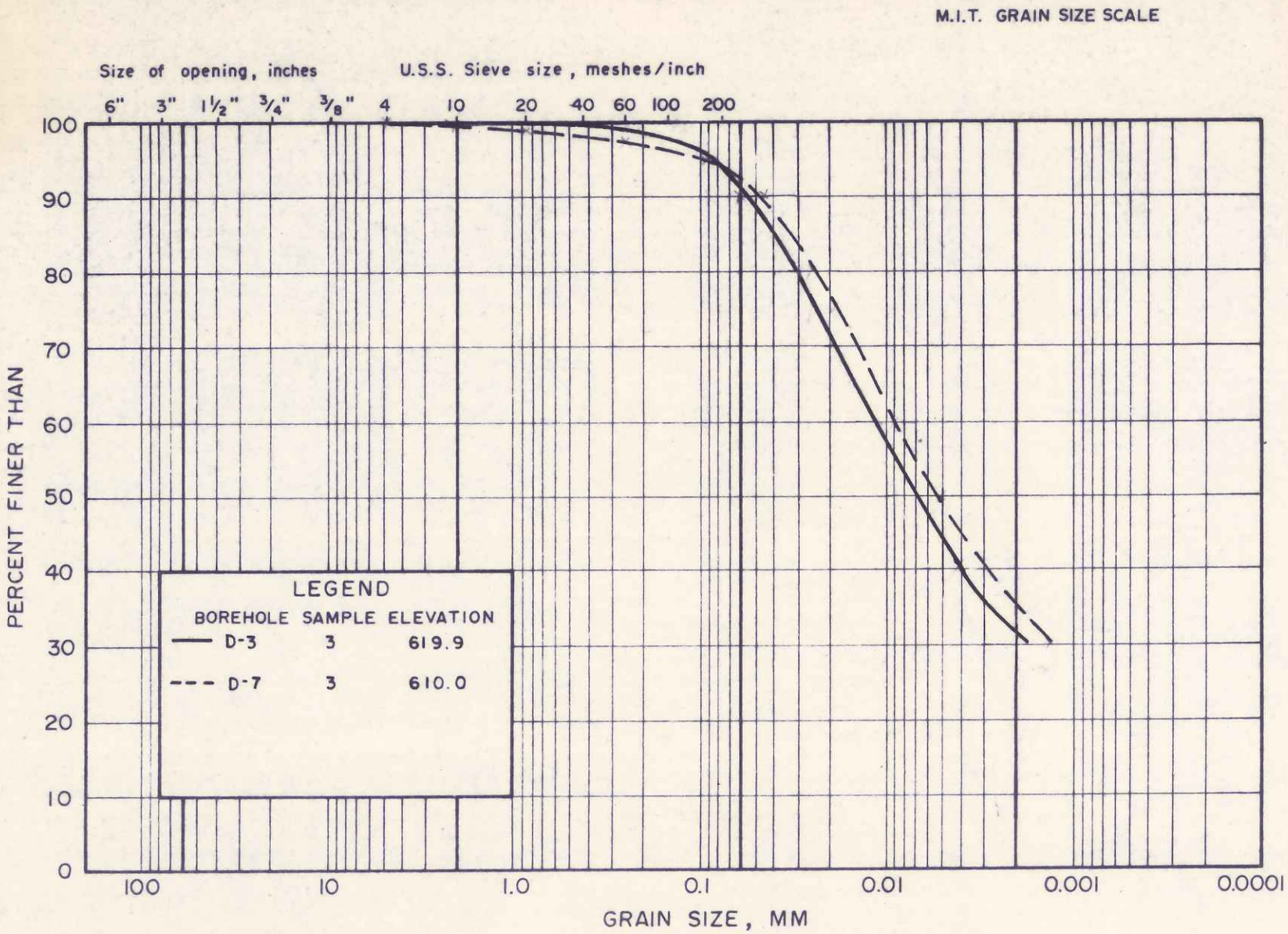


GRAIN SIZE DISTRIBUTION
DIKE FILL

FIGURE 12

Golder Associates

Form G.A.-D.-6



GRAIN SIZE DISTRIBUTION

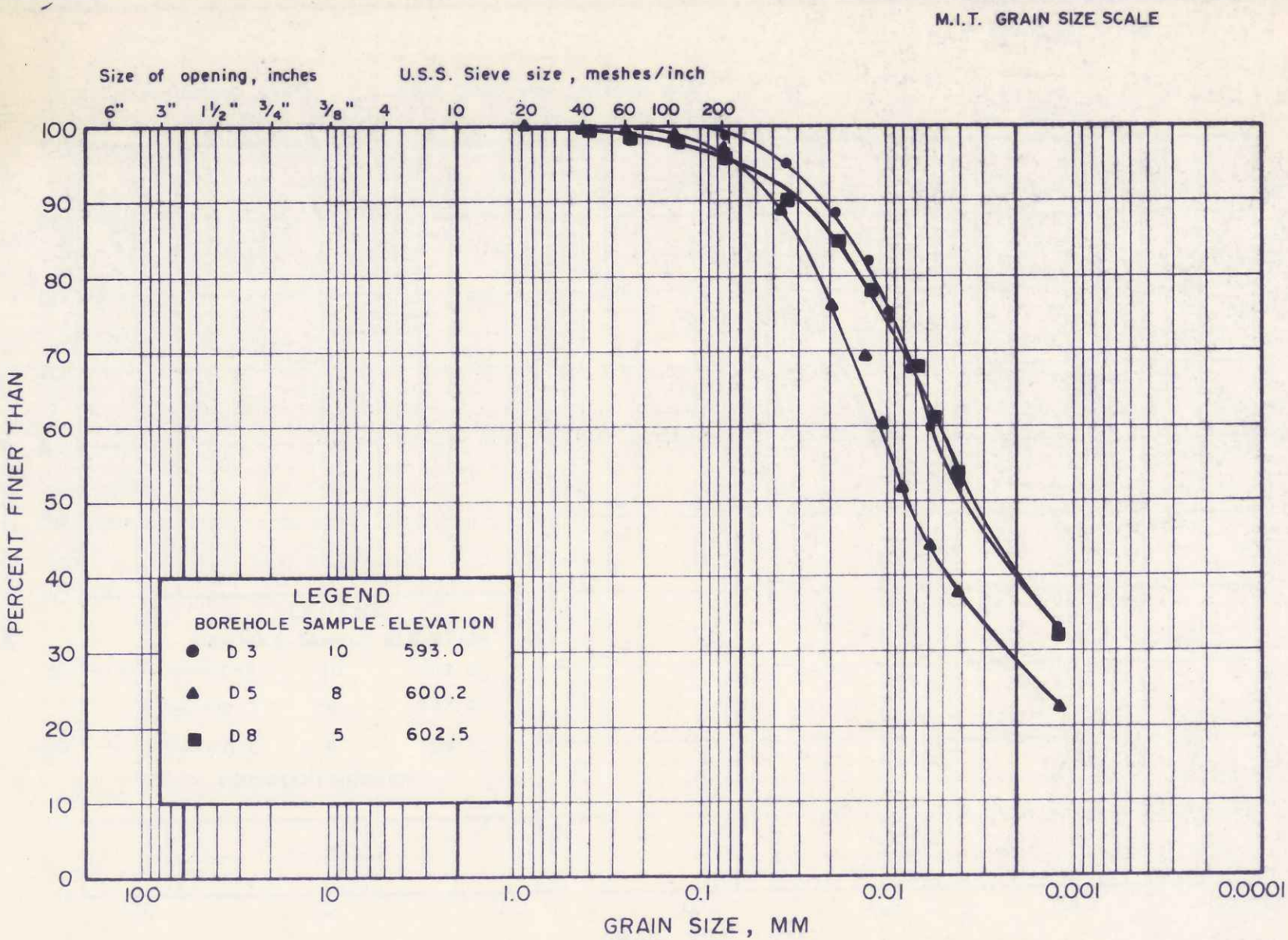
DIKE FILL - BOWSER MORNER

FIGURE 13

Golder Associates

Form G.A.-D.-6

831-1089-1



COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

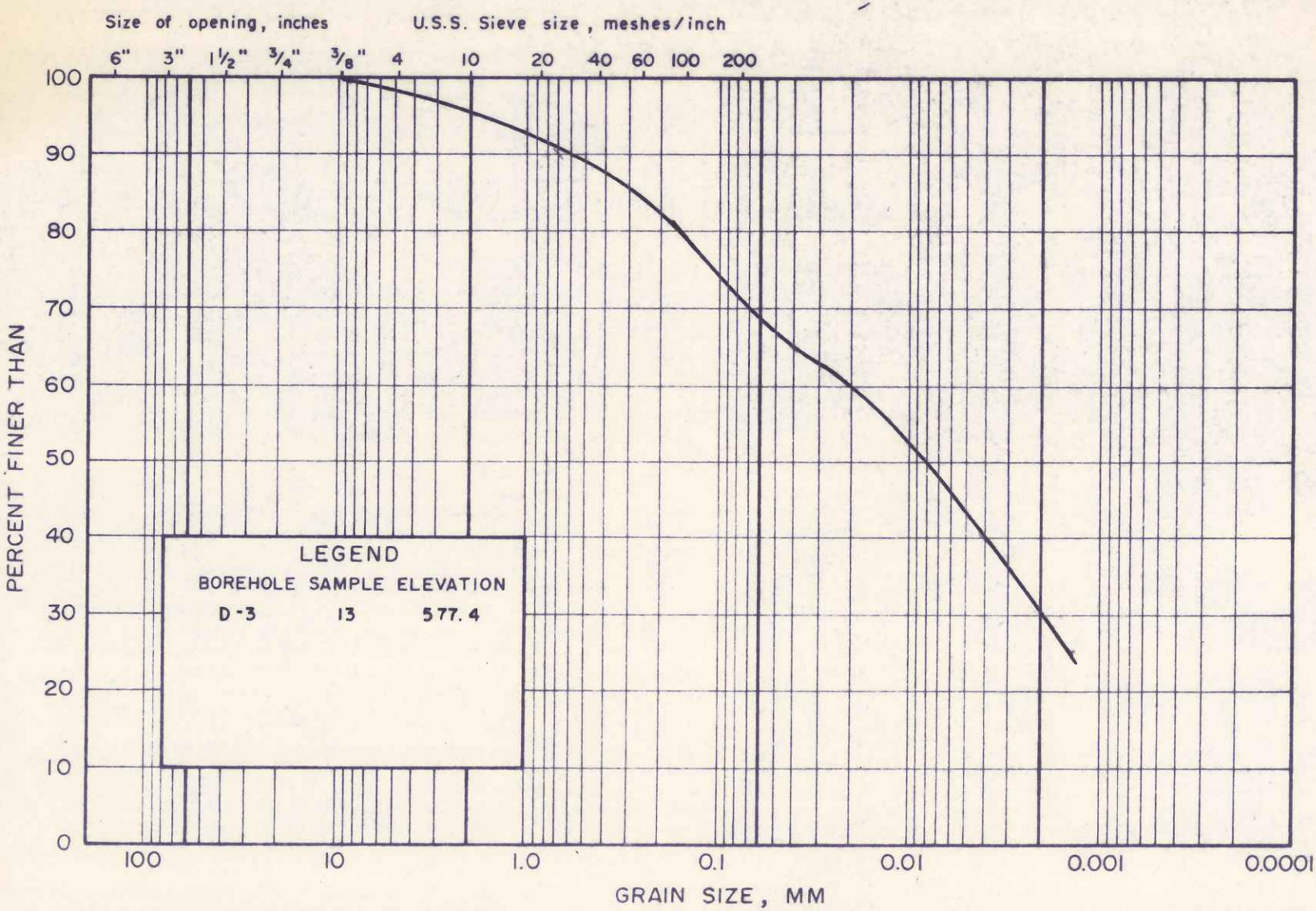
GRAIN SIZE DISTRIBUTION
LACUSTRINE CLAY

FIGURE **14**

Golder Associates

Form G.A.-D.-6

M.I.T. GRAIN SIZE SCALE

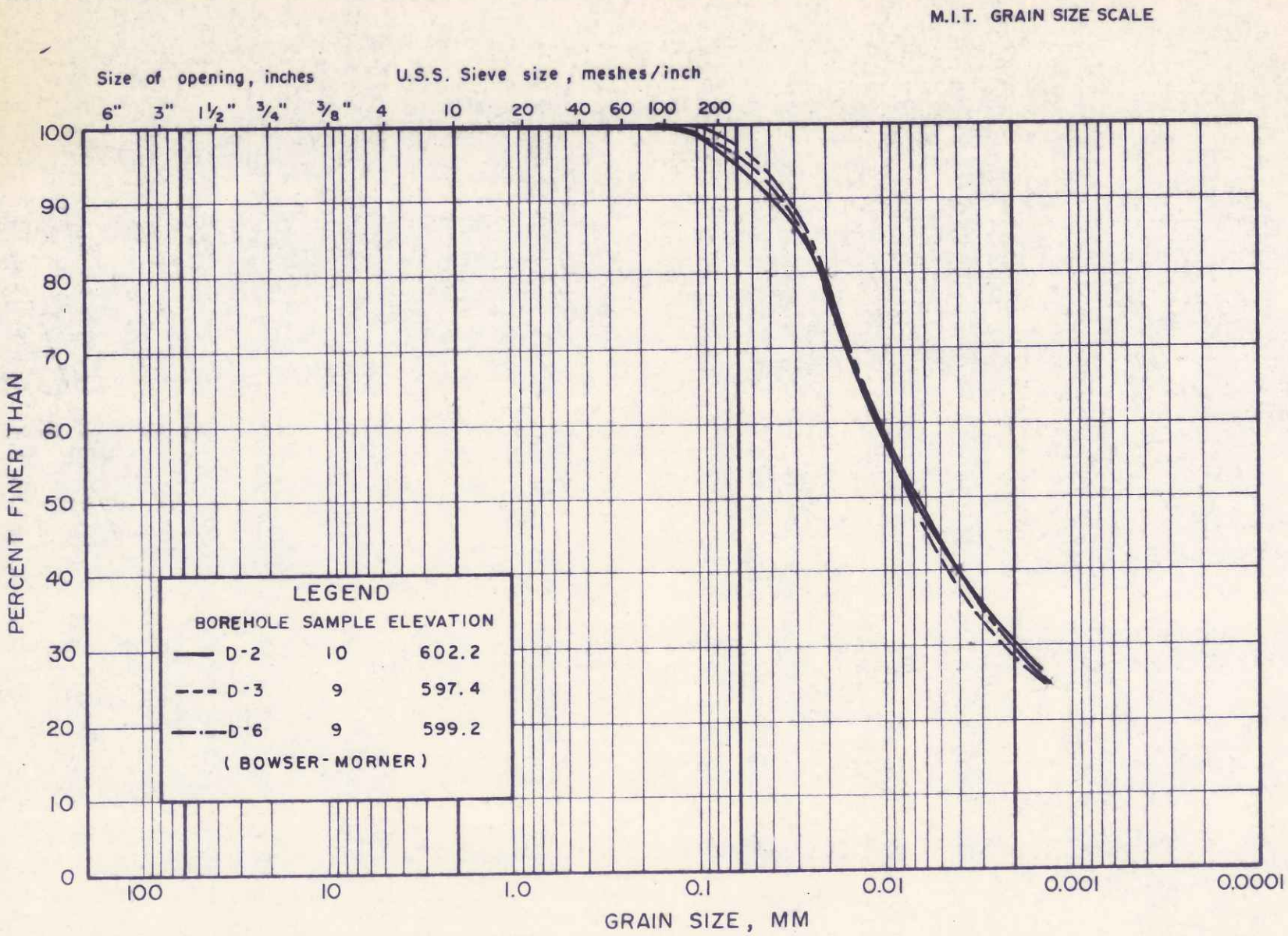


COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

Golder Associates

GRAIN SIZE DISTRIBUTION
SILTY CLAY (TILL) BOWSER-MORNER

FIGURE 16



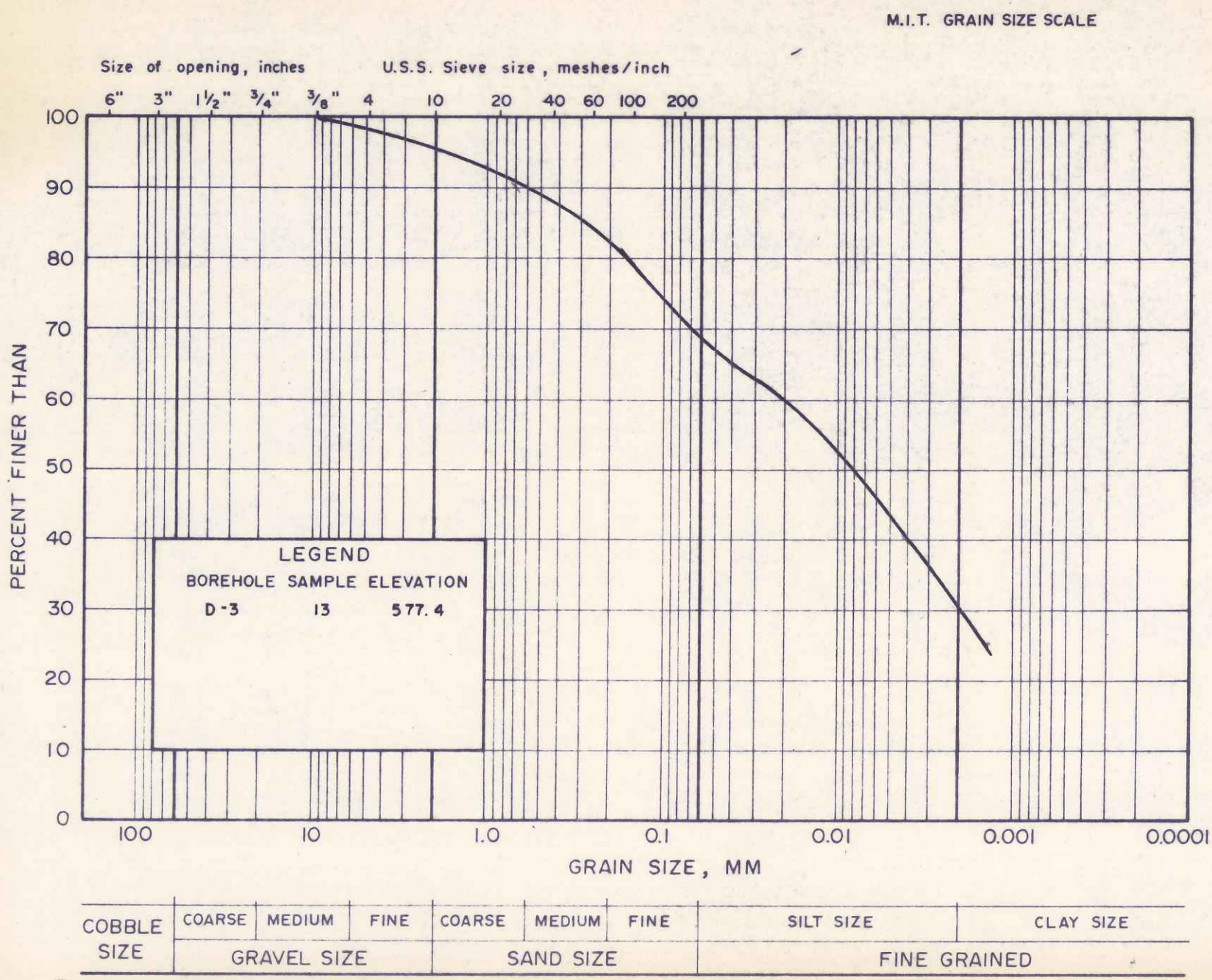
COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

GRAIN SIZE DISTRIBUTION
LACUSTRINE CLAY-BOWSER MORNER

FIGURE 15

Golder Associates

Form G.A.-D.-6



GRAIN SIZE DISTRIBUTION

SILTY CLAY (TILL) BOWSER-MORNER

FIGURE 16

Golder Associates

HYDROGEOLOGIC INVESTIGATION

Preliminary Data Summary
Northern Ohio Treatment Facility
Vickery, Ohio

3/83

PRELIMINARY
DATE

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attention: Mr. Gary Brown

Laboratory Job No. 33767

March 21, 1983

Report No. T-20135

BOWSER-MORNER
Testing Laboratories, Inc.

BOWSER-MORNER Testing Laboratories, Inc.

Founded 1911

TOLEDO DISTRICT • 122 S. St. Clair St. • P.O. Box 838 • Toledo, Ohio 43696 • 419/255-8200

March 21, 1983

PRELIMINARY

DATE

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attention: Mr. Gary Brown

RE: Hydrogeologic Investigation
Preliminary Data Summary
Northern Ohio Treatment Facility
Vickery, Ohio
Laboratory Job No. 33767

Gentlemen:

The following report consists of a series of appendices which contain accumulated data from the above referenced study of the site in Vickery, Ohio. The hydrogeologic study and site assessment was performed in accordance with the special terms and conditions set forth by the Hazardous Waste Facilities Approval Board in the Site Facility Permit issued December 19, 1981. The data contained in this report is the result of that study. This report is intended to be an addendum to a preliminary hydrogeologic analysis and site assessment which has been prepared for the site. The data contained in this report verifies the conclusions reached in the preliminary site assessment report.

It is planned to eventually assimilate this data into a final report which will describe the hydrogeologic conditions at the site and which will assess the site as a hazardous waste disposal facility. At the present time additional work is being recommended in order to be able to finalize the site assessment portion of the project.

If there are any questions or if we can be of further service, please contact us.

Respectfully submitted,
BOWSER-MORNER, INC.

J. Richard Hoppenjans

J. Richard Hoppenjans, P.E.
Chief Engineer

Julie K Kampa

Julie K. Kampa, Geologist

JRH:jl
1c-Donald McCombs
1c-Ron Shawl
1c-John A. Baker

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KENTUCKY DISTRICT • Route 8 West • P.O. Box 636 • Maysville, Kentucky 41056 • 606/564-5508

APPENDICES

Appendix A - Field and Laboratory Test Data

Appendix B - Injection Well Logs

Appendix C - Water Well Logs

Appendix D - Background Water Quality Data

Appendix E - Aquifer Pumping Test Data

Appendix F - Statistical Analysis of Monitoring Well Data

Appendix G - RCRA Monitoring Well Data

Appendix H - Example Analysis of Waste Streams

APPENDIX A

FIELD AND LABORATORY DATA

LOG OF BORING NO. 1

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 602' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Hard brown silt and clay, some sand, trace of organic, damp	1A	1.0- 2.5	15-16-17	33
5'		1C	4.0- 6.0		24"
6.0'	Very stiff brown and gray silt, some clay, traces of sand and gravel; moist	2A	6.0- 7.5	7- 8-15	23
8.5'	Stiff gray silt and clay, trace of sand, moist	3A	9.0-10.5	3- 6- 5	11
10'		2C	12.0-14.0		18"
	(Becomes soft with 3" wet brown silt and sand layer at 14.0')	4A	14.0-15.5	2- 2- 2	4
15'					
20'		5A	19.0-20.5	2- 2- 2	4
	(Becomes medium stiff at 24.0')	6A	24.0-25.5	2- 3- 3	6
25.0'	Stiff gray clay, some silt, traces of sand and gravel, damp				
30'		7A	29.0-30.5	3- 5- 6	11

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 43.0' (heavy)

COMPLETION DEPTH: 39.0'

DEPTH AFTER: 24 HRS. 7.3'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 1 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 602' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		3C	34.0-36.0		24"
36.0'	Hard gray silt, some clay, some sand, trace of gravel, moist	8A	36.0-37.5	6-18-29	47
40'		9A	39.0-40.5	66-34/2"	100+
44.0'	Hard gray shaley dolomite	10A	44.0	100/0"	100+
45'		1B	44.0-49.0		55"
50'					
		2B	49.0-59.0		90"
55'					
60'					

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 43.0' (heavy)

COMPLETION DEPTH: 39.0'

DEPTH AFTER: 24 HRS. 7.3'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 1 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 602' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'		3B	59.0-64.0		56"
	Bottom of boring at 64.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**	
TECHNICIAN:	TA and RF	INITIAL DEPTH: 43.0' (heavy)	X	A. SPLIT SPOON
		COMPLETION DEPTH: 39.0'	X	B. NX wire
JOB NO.:	33767 (j1)	DEPTH AFTER: 24 HRS. 7.3'	X	C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

ROCK CORE LOG

Job No. 33767

Boring No. 1

Date Logged 11-1-82

Core Top Elevation 558'

Observer JKK

Core Recovery 201"

Surface Elevation 602'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 44%

TOTAL Fracture Frequency (FF) 5+ per foot

Depth(ft)	Description	Sample	Recovery
44.0	Hard gray and white shale with gypsum, occasional voids with crystalline gypsum, occasional clastic zone.	1B RQD =	55" 32%
48.5	Hard gray and black shale, occasional voids lined with gypsum crystals.		
49.0		2B RQD = FF =	90" 46% 5/ft.
52.1	Hard gray and white shale with gypsum, occasional voids.		
59.0		3B RQD =	56" 53%
64.0	Bottom of boring.	FF =	5/ft.

LOG OF WELL NO. 1

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan.
DATE INSTALLED: 10-14-82

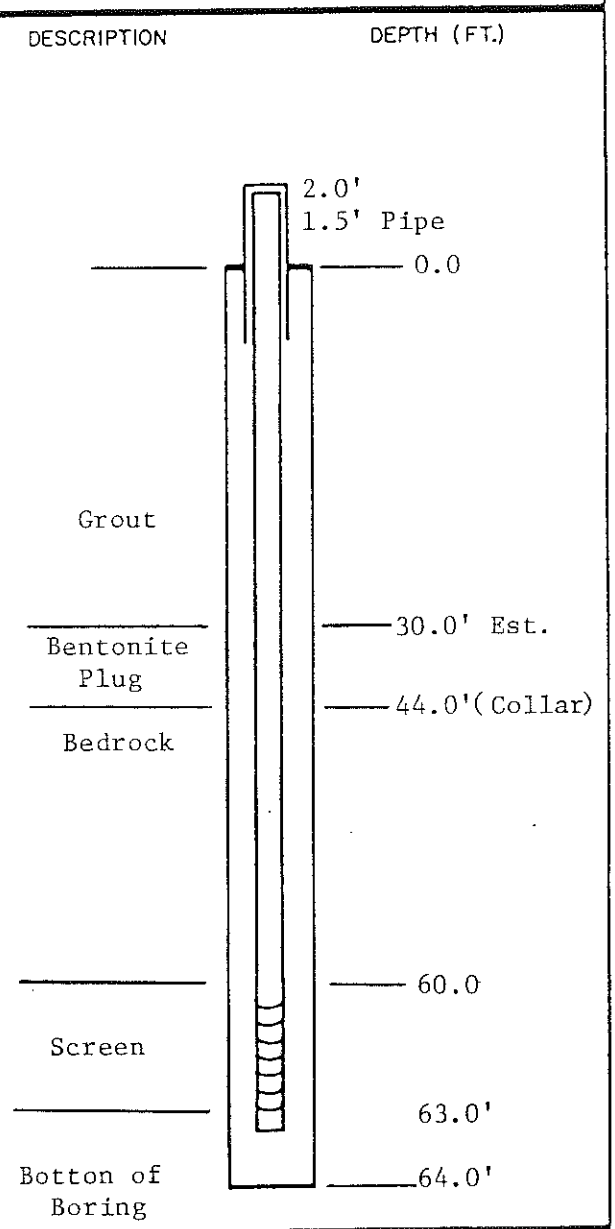
SURFACE ELEVATION: 601.3'
TOP OF PIPE ELEVATION: 603.04'

TYPE OF PIEZOMETER: 1 1/4" SCH 40 1 1/4" x 3' 0.010 slot.

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)
10-14-82	7.3	595.7
10-14-82	6.4 *	596.6
10-19-82 AM	8.5	594.5
10-19-82 PM	7.4	595.6
10-20-82	7.3	595.7
1-19-83	5.68	595.6
2-3-83	3.9	597.4

* After 6 hours.

INSTALLATION DESCRIPTION



TECHNICIAN TA-RF

JOB NO. 33767 (j1)

Guard pipe with locking cap installed.

LOG OF BORING NO. 2

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 10-12-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Topsoil				
0.5'	(FILL) Hard brown silt and clay, traces of sand, gravel and organic material, damp	1A	1.0- 2.5	12-21-14	35
3.0'	Very stiff brown and gray clay and silt, traces of sand and gravel, damp	2A	4.0- 5.5	6- 8-11	19
5'		1C	7.0- 9.0		24"
10'		3A	9.0-10.5	6-11-12	23
15.0'	(Becomes stiff at 14.0')	4A	14.0-15.5	6- 5-10	15
18.0'	Stiff brown and gray silt and clay, trace of silt, wet				
20'	Very stiff gray silt, some clay, traces of sand and gravel, damp	5A	19.0-20.5	7- 9-11	20
25'		6A	24.0-25.5	6- 9-11	20
30'	(Becomes stiff at 29.5')	7A	29.0-30.5	3- 6- 6	12

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH:

DEPTH AFTER: 24 HRS. 5.3'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* 9.0'(light); 48.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 2 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 10-12-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.0')	8A	34.0-35.5	7- 9-11	20
40'		9A	39.0-40.5	7-10-15	25
43.0'					
45'	Hard gray silt, some sand, some clay, trace of gravel, damp	10A	44.0-45.0	78-22/1"	100+
49.3'		11A	49.0-49.5	100/5"	100+
50'	Gray weathered limestone				
51.0'	Medium-hard gray shaley dolomite with gypsum	1B	50.0-59.0		108"
55'					
60'					

METHOD: Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**	
TECHNICIAN: TA and RF	INITIAL DEPTH: *	X	A. SPLIT SPOON
	COMPLETION DEPTH:	X	B. NX wire
JOB NO.: 33767 (j1)	DEPTH AFTER: 24 HRS. 5.3'	X	C. SHELBY TUBE

* 9.0'(light); 48.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 2 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 10-12-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'					
		2B	59.0-69.0		93"
65'					
		3B	69.0-70.0		12"
70'					
		4B	70.0-80.0		80"
80'					
85'		5B	80.0-90.0		120"
90'					
	Bottom of boring at 90.0'				

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH:

DEPTH AFTER 24 HRS. 5.3'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* 9.0'(light); 48.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

ROCK CORE LOG

Job No. 33767

Boring No. 2

Date Logged 11-1-82

Core Top Elevation 559'

Observer JKK

Core Recovery 413"

Surface Elevation 609'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 39%

TOTAL Fracture Frequency (FF) 5+ per foot

Depth(ft)	Description	Sample	Recovery
50	Hard gray and white shale with gypsum, occasional voids and weathered zones	1B RQD = FF =	108" 36% 5/ft.
59		2B RQD = FF =	93" 30% 5/ft.
59.5	Hard gray and black shale, occasional voids (especially upper part) and weathered zones		
62.2	Hard gray and white shale with gypsum, occasional voids and weathered zones.		
69.0		3B RQD = FF =	12" 41% 4/ft.
70.0		4B* RQD = FF =	80" 16% 8/ft.
78.5	Hard massive fine grained gray dolomite with gypsum in fillings, carbonaceous partings		
80.0		5B RQD = FF =	120" 63% 3/ft.
86.0	Hard gray and white shale with gypsum, occasional voids		

* Inner barrel came loose and ground core up.

ROCK CORE LOG

Job No. 33767

Boring No. 2 - continued

Date Logged 11-1-82

Core Top Elevation 559'

Observer JKK

Core Recovery 413"

Surface Elevation 609'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 39%

TOTAL Fracture Frequency (FF) 5+ per foot

Depth(ft)	Description	Sample	Recovery
89.0	Hard black shale		
	Bottom of boring at 90.0'		

LOG OF BORING NO. 3

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-18-83

SURFACE ELEVATION: 610' **DATE COMPLETED:** 1-18-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Stiff brown and gray clay and silt, traces of sand and gravel, moist	1A	1.0- 2.5	5- 6- 7	13
5'	(Becomes medium stiff at 4.0')	2A	4.0- 5.5	4- 4- 5	9
9.0'	Medium stiff gray clay and silt, traces of sand and gravel, with 1" brown silt seam, moist	3A	9.0-10.5	2- 3- 4	7
14.0'	Medium stiff gray silt, some clay, some sand, trace of gravel, wet	4A	14.0-15.5	3- 3- 3	6
20'		5A	19.0-20.5	2- 3- 4	7
25'		6A	24.0-25.5	3- 3- 4	7
30'	(Becomes moist at 29.0')	7A	29.0-30.5	3- 5- 8	13

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 19.0' (medium)

COMPLETION DEPTH: None

DEPTH AFTER: 0.75 HRS. 26.0'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 3 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-18-83

SURFACE ELEVATION: 610' **DATE COMPLETED:** 1-18-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.0-35.5	7-11-18	29
38.5'					
40'	Gray silt, some sand, some clay, trace of gravel, contains gypsum (Auger refusal at 40.5')	9A	39.0-40.0	50-50/3"	100+
	Bottom of boring at 40.5'				

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 19.0' (medium)

COMPLETION DEPTH: None

DEPTH AFTER: 0.75 HRS. 26.0'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 4

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-26-83

SURFACE ELEVATION: 611' **DATE COMPLETED:** 1-26-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Stiff brown and gray silt, some clay, some sand, trace of gravel, moist	1A	1.0- 2.5	4- 5- 6	11
5'	(Becomes soft at 4.0')	2A	4.0- 5.5	2- 1- 3	4
9.0'	Medium stiff gray silt, some clay, some sand, trace of gravel, moist	3A	9.0-10.5	2- 3- 5	8
10'					
15'	(Becomes stiff at 14.5')	4A	14.0-15.5	3- 7- 7	14
20'	(Becomes medium stiff at 19.0')	5A	19.0-20.5	3- 3- 6	9
25'		6A	24.0-25.5	3- 4- 4	8
30'	(Becomes very stiff at 29.5')	7A	29.0-30.5	6- 8-13	21

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 36.3' **

DEPTH AFTER: 0.5 HRS. 32.0'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* 4.0'(trace); 9.0'(heavy)

** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 4 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-26-83

SURFACE ELEVATION: 611' **DATE COMPLETED:** 1-26-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes hard at 34.5')	8A	34.0-35.5	10-16-19	35
38.5'	Gypsum and weathered shale	9A	39.0-39.5	100/2"	100+
	Bottom of boring at 39.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: *	X A. SPLIT SPOON
JOB NO.:	33767 (j1)	COMPLETION DEPTH: 36.3'**	B.
		DEPTH AFTER: 0.5 HRS. 32.0'	C. SHELBY TUBE

* 4.0'(trace); 9.0'(heavy)

** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 5

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-14-82

SURFACE ELEVATION: 616' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Very stiff brown clay, some silt, traces of sand and gravel, damp	1A	1.0- 2.5	6-12-13	25
5'		1C	4.0- 6.0		24"
6.0'	Very stiff brown and gray clay, some silt, some sand, trace of gravel, moist	2A	6.0- 7.5	17-28-29	57
	(Becomes stiff and gray at 8.0')	3A	9.0-10.5	4- 5- 7	12
10'					
		2C	13.0-15.0		24"
15'	(Becomes medium stiff at 15.0')	4A	15.0-16.5	3- 4- 5	9
20'		5A	19.0-20.5	3- 3- 4	7
25'		6A	24.0-25.5	3- 4- 5	9
		3C	27.5-29.5		0"
30'	(Becomes very stiff at 30.0')	7A	29.5-31.0	5- 9-10	19

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 4.0'

DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* 37.5'(light); 39.5'(medium)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 5 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-14-82

SURFACE ELEVATION: 616' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'					
		3B	58.0-68.0		118"
65'					
70'					
		4B	68.0-78.0		120"
75'					
		5B	78.0-80.5		30"
80'					
	Bottom of boring at 80.5'				

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 4.0'

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* 37.5'(light); 39.5'(medium)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 5 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-14-82

SURFACE ELEVATION: 616' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.0-35.5	10-13-16	29
37.5'	Hard gray sand, some gravel, some clay, some silt (contains gypsum), damp	9A	39.0-40.0	85-15/1"	100+
40' 40.5'	Medium to hard shale				
45'		1B	40.5-48.0		84"
48.5'	Medium to hard shaley dolomite				
50'					
55'		2B	48.0-58.0		120"
60'					

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 4.0'

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* 37.5'(light); 39.5'(medium)

BOWSER – MORNER
TESTING LABORATORIES, INC.

ROCK CORE LOG

Job No. 33767

Boring No. 5

Date Logged 11-1-82

Core Top Elevation 576'

Observer JKK

Core Recovery 472"

Surface Elevation 616'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 43%

TOTAL Fracture Frequency (FF) 3+ per foot

Depth(ft)	Description	Sample	Recovery
40.5	Hard black fine-grained dolomite	1B RQD =	84" 0
41.0	Hard black thin-bedded shale		
42.0	Soft gypsum and weathered black shale: highly fractured, some solutioning of gypsum		
48.0	Hard massive white, gray and black shales with some thin massive gypsum, appears clastic in part	2B RQD =	120" 30%
57.0 58.0	Begin finding open voids with crystalline gypsum	3B	118"
		RQD = FF =	51% 4/ft.
67.5	Carbonaceous partings		
68.0		4B RQD = FF =	120" 47% 3/ft.
78.0	Bottom of boring at 80.5'	5B RQD = FF =	30" 53% 4/ft.

LOG OF WELL NO. 5

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

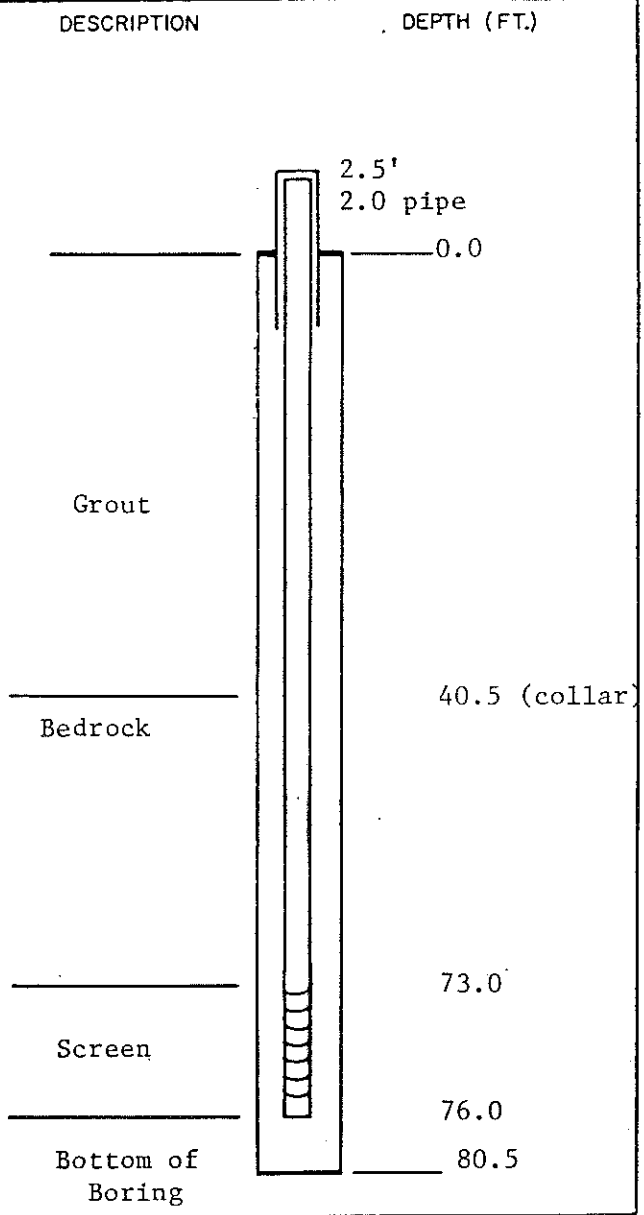
BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 10-15-82

SURFACE ELEVATION: 616.5
TOP OF PIPE ELEVATION: 619

TYPE OF PIEZOMETER: 1 1/4" PVC SCH 40 with 1 1/4" x 3' screen, 0.010 slot

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	Remarks
10-15-82	4.0		After coring
10-18-82	21.2	595.3	
	62.0		After air flush
	57.0		After 5 min.
	53.0		After 15 min.
	64.0		Flushed again
	61.0		After 10 min.
10-19-82	20.7	595.8	
10-20-82	21.2	595.3	
2-3-83	18.3	598.2	

INSTALLATION DESCRIPTION



TECHNICIAN TA and RF

JOB NO. 33767 (j1)

Could not get well to bottom, collar was hanging up at sand layer above core hole. Pulled auger after pipe locked up for sand cave-in before grouting. Guard pipe with locking cap installed.

LOG OF BORING NO. 6

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-19-83

SURFACE ELEVATION: 612' **DATE COMPLETED:** 1-19-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Stiff brown and gray clay, some silt, traces of sand and gravel, moist	1A	1.0- 2.5	3- 6- 8	14
5'	(Becomes very stiff at 4.5')	2A	4.0- 5.5	6-11- 7	18
9.0'	Medium stiff brown and gray silt and clay, trace of sand, moist	3A	9.0-10.5	3- 5- 5	10
10'					
14.0'	Soft gray clay, some silt, some sand, trace of gravel, moist	4A	14.0-15.5	2- 2- 3	5
15'					
20'	(Becomes medium stiff at 19.5')	5A	19.0-20.5	2- 3- 3	6
25'		6A	24.0-25.5	2- 3- 4	7
30'	(Becomes stiff at 29.5')	7A	29.0-30.5	4- 6- 7	13

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 9.0' (heavy)

COMPLETION DEPTH: 39.0' *

DEPTH AFTER: 2.0 HRS. 17.2'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 6 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-19-83

SURFACE ELEVATION: 612' **DATE COMPLETED:** 11-19-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35' 35.5'	(Becomes hard at 34.0')	8A	34.0-35.5	11-24-53	77
	Gray shale				
		9A	39.0-39.5	100/1"	100+
	Bottom of boring at 39.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**	
TECHNICIAN:	BK and CL	INITIAL DEPTH: 9.0' (heavy)	X	A. SPLIT SPOON
		COMPLETION DEPTH: 39.0' *		B.
JOB NO.:	383767 (j1)	DEPTH AFTER: 2.0 HRS. 17.2'		C. SHELBY TUBE

* Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 7

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-22-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 11-22-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Stiff brown and gray clay and silt, trace of sand, moist	1A	1.0- 2.5	4- 5- 7	12
		2A	4.0- 5.5	6-11-14	25
5'					
9.0'	Very stiff brown and gray clay, some silt, traces of sand and gravel, moist	3A	9.0-10.5	4- 8- 9	17
10'					
14.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	4A	14.0-15.5	3- 4- 6	10
15'					
		5A	19.0-20.5	3- 4- 6	10
20'					
25'	(Becomes stiff at 24.5')	6A	24.0-25.5	4- 5- 7	12
		7A	29.0-30.5	3- 6- 9	15
30'					

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 43.5 (medium)

COMPLETION DEPTH: 41.5'

DEPTH AFTER: 0.25 HRS. 38.5'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 7 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-22-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 11-22-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes hard at 35.0')	8A	34.0-35.5	5-12-19	31
40'		9A	39.0-40.5	12-24-39	63
42.5'	Weathered dolomite	10A	43.5-44.0	100/3"	100+
	Bottom of boring at 44.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: 43.5' (medium)	X A. SPLIT SPOON
JOB NO.:	33767 (j1)	COMPLETION DEPTH: 41.5'	B.
		DEPTH AFTER: 0.25 HRS. 38.5'	C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 8

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-23-82

SURFACE ELEVATION: 607' **DATE COMPLETED:** 11-23-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Very stiff brown and gray clay and silt, trace of sand, moist	1A	1.0- 2.5	5- 9-14	23
		2A	4.0- 5.5	5- 8-12	20
5'					
9.0'	Very stiff brown clay, some silt, some sand, trace of gravel, moist (With 1/2" brown sand seam at 10')	3A	9.0-10.5	5-10-19	29
10'					
14.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	4A	14.0-15.5	3- 3- 6	9
15'					
20'		5A	19.0-20.5	3- 4- 6	10
	(Becomes stiff at 24.5')				
25'		6A	24.0-25.5	4- 5- 8	13
30'		7A	29.0-30.5	3- 5- 6	11

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: None

COMPLETION DEPTH: None

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 8 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-23-82

SURFACE ELEVATION: 607' **DATE COMPLETED:** 11-23-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes hard at 34.5' with trace of rock fragments)	8A	34.0-35.5	6-15-22	37
40'		9A	39.0-40.5	9-19-43	62
	(Apparent rock at 40.5') (Auger refusal at 41.5')				
	Bottom of boring at 41.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: None	X A. SPLIT SPOON
JOB NO.:	33767 (jl)	COMPLETION DEPTH: None	B.
		DEPTH AFTER: ____ HRS. ____	C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 9

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 606' **DATE COMPLETED:** 10-11-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Very stiff gray and brown clay, some silt, trace of sand, moist	1A	1.0- 2.5	7- 8-11	19
5'	(Becomes medium stiff at 4.0')	2A	4.0- 5.5	3- 4- 6	10
9.0'	Medium stiff brown silt, some clay, trace of sand, moist	1C	9.0-11.0		24"
10'					
14.6'	Soft gray clay, some silt, some sand, trace of gravel, moist	3A	14.0-15.5	2- 2- 2	4
15'					
20'		2C	19.0-21.0		24"
	(Becomes stiff at 24.5')				
25'		4A	24.0-25.5	3- 5- 6	11
30'		3C	29.0-31.0		24"

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 34.0' **

DEPTH AFTER: 0.25 HRS. 14.2'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

X C. SHELBY TUBE

* 41.0'(medium); 43.0'(heavy)

** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 9 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 606' **DATE COMPLETED:** 10-11-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	5A	34.0-35.5	5- 8-13	21
40'		4C	39.0-41.0		0"
	(Becomes hard at 41.0')	6A	41.0-42.5	20-26-30	56
43.0'	Weathered dolomite and gypsum	7A	44.0-44.5	100/6"	100+
	Bottom of boring 44.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	BKand CL	INITIAL DEPTH: *	X A. SPLIT SPOON
JOB NO.:	33767 (j1)	COMPLETION DEPTH: 34.0'	B.
		DEPTH AFTER: 0.25 HRS. 14.2'	X C. SHELBY TUBE

* 41.0'(medium); 43.0'(heavy)
** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 10

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-16-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Hard gray and brown silt and clay, trace of sand, damp	1A	1.0- 2.5	9-14-22	36
5'	(Becomes stiff and moist at 4.5')	2A	4.5- 6.0	3- 5- 9	14
10'	(Becomes very stiff at 9.5')	3A	9.5-11.0	5- 7-10	17
15'		4A	14.5-16.0	5- 7- 8	15
19.5' 20'	Medium stiff gray clay, some silt, trace of sand, moist	5A	19.5-21.0	4- 4- 5	9
24.5' 25'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	6A	24.5-26.0	4- 4- 5	9
30'		7A	29.5-31.0	5- 7- 7	14

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 15.3'

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wireline

___ C. SHELBY TUBE

* 14.5'(trace); 49.5'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 10 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-16-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.5-36.0	5- 7- 8	15
40'		9A	39.5-41.0	10-20-22	42
	(With trace of limestone fragments from 42.0')				
45.0'		10A	44.5-45.5	40-60/3"	100+
	Hard gray silt, some clay, some sand, trace of gravel, moist				
49.5' 50'		11A	49.5-50.0	100/2"	100+
	Medium hard weathered gray shale with gypsum				
55'		1B	50.0-60.0		108"
	Bottom of boring at 60.0'				

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 15.3'

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wireline

___ C. SHELBY TUBE

* 14.5'(trace); 49.5'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

ROCK CORE LOG

Job No. 33767

Boring No. 10

Date Logged 12-1-82

Core Top Elevation 554'

Observer JKK

Core Recovery 108"

Surface Elevation 604'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 0%

TOTAL Fracture Frequency (FF) Too highly fractured to count.

Depth(ft)	Description	Sample	Recovery
50.0	Medium hard white and gray gypsum and anhydrite shaly dolomite	1B RQD = FF =	108" 0% infinite
51.3'	Hard black fissile shale with some interbedded gypsum and anhydrite, a few highly weathered zones		
	Bottom of boring at 60.0'		

LOG OF WELL NO. 10

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan

DATE INSTALLED:

SURFACE ELEVATION: 604.2

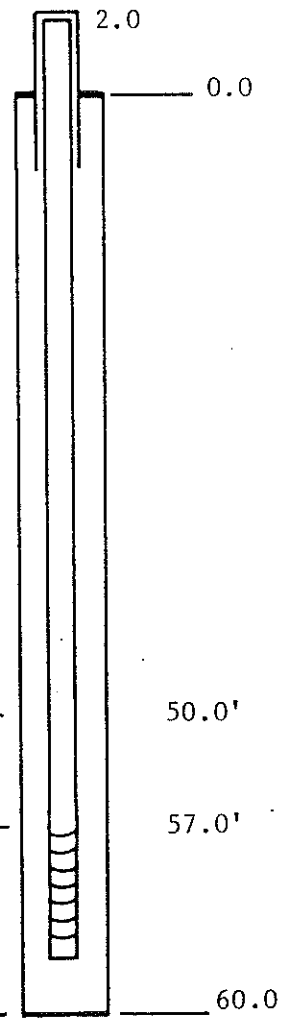
TOP OF PIPE ELEVATION: 605.98

TYPE OF PIEZOMETER: 1 1/4" SCH 40 PVC with 0.010 1 1/4" x 3" point

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
11-16-82	14.3	589.9	
1-19-83	12.3	591.9	
2-3-83	10.2	594.0	

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)
	2.0
	0.0
Grout	
Bedrock	50.0'
	57.0'
Screen	
Bottom of Boring	60.0



TECHNICIAN RG and TA

JOB NO. 33767

Guard pipe with locking cap installed.

LOG OF BORING NO. 11

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-6-82

SURFACE ELEVATION: 600' **DATE COMPLETED:** 10-6-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Very stiff gray and brown silt and clay, traces of sand, gravel and organic material, moist	1A	1.0- 2.5	5- 7-11	18
4.0'	Stiff brown and gray clay and silt, trace of sand, moist	2A	4.0- 5.5	4- 5- 8	13
5'					
	(Becomes soft at 9.0')	3A	9.0-10.5	2- 1- 3	4
10'					
15.0'		4A	14.0-15.5	3- 4- 6	10
	Medium stiff gray silt, some clay, some sand, trace of gravel, moist				
20'		5A	19.0-20.5	3- 4- 6	10
	(Becomes stiff at 24.5')	6A	24.0-25.5	3- 5- 8	13
25'					
30'		7A	29.0-30.5	4- 6- 8	14

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 41.5'

DEPTH AFTER: 19.0 HRS. 9.2'

TYPE SAMPLER:

X A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

* 14.0' & 19.0'(trace); 49.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

2815

LOG OF BORING NO. 11 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-6-82

SURFACE ELEVATION: 600' **DATE COMPLETED:** 10-6-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 35.0')	8A	34.0-35.5	4- 7-14	21
40'	(Becomes hard at 39.5')	9A	39.0-40.5	8-15-28	43
44.0' 45'	Hard gray silt, some sand, some gravel (gypsum), some clay, moist (With trace of cobbles from 42-43')	10A	44.0-45.5	30-45-55/4"	100+
48.0' 50'	Gray weathered shale, wet (Auger refusal at 51.0')	11A	49.0-49.5	100/5"	100+
	Bottom of boring at 51.0'				

METHOD: Hollow Auger

TECHNICIAN: BKand CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 41.5'

DEPTH AFTER: 19.0 HRS. 9.2'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* 14.0' & 19.0'(trace); 49.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF WELL NO. 11

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan
DATE INSTALLED: 10-8-82

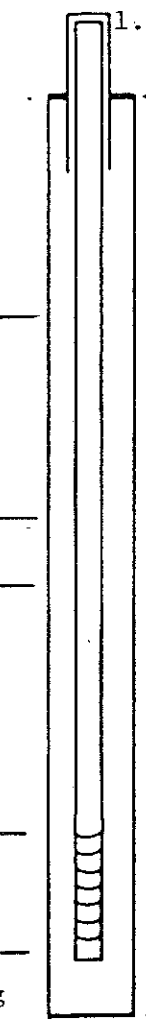
SURFACE ELEVATION: 600.9
TOP OF PIPE ELEVATION: 602.35

TYPE OF PIEZOMETER: 1 1/4" PVC, 3' well point

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	Remarks
10-8-82	9.2	591.8	
10-11-82	9.3	591.7	
10-13-82	12.0	588.9	
10-14-82	11.0	589.9	
11-18-82	9.7	591.3	
1-19-83	8.65	592.2	
2-3-83	7.3	593.6	

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)
	1.5'
	0.0
Grout	
	43.0'
Bentonite	
	45.0
Sand Filter	
	48.0
Screen	
	51.0
Bottom of Boring	51.0



Set well inside casing. Guard pipe set with flip top and lock. Placed cap on top of water pipe.

TECHNICIAN BK and CL

JOB NO. 33767 (j1)

LOG OF BORING NO. 12

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-12-82

SURFACE ELEVATION: 605' **DATE COMPLETED:** 10-12-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Very stiff gray and brown silt and clay, traces of sand and organic material, moist	1A	1.0- 2.5	4- 6-10	16
5'		1C	4.0- 6.0		22
9.0'	Soft brown clay and silt, trace of sand, moist	2A	9.0-10.5	2- 2- 3	5
10'					
14.0'	Soft gray clay, some silt, some sand, trace of gravel, moist	2C	14.0-16.0		24"
15'					
20'		3A	19.0-20.5	1- 2- 2	4
25'		3C	24.0-26.0		24"
30'	(Becomes medium stiff at 29.5')	4A	29.0-30.5	2- 3- 6	9

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 16.2'

DEPTH AFTER: 0.25 HRS. 16.2 **

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

X C. SHELBY TUBE

* 19.0'(trace); 42.0'(medium); 43.0'(heavy)

** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 12 -continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-12-82

SURFACE ELEVATION: 605' **DATE COMPLETED:** 10-12-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		4C	34.0-36.0		24"
40'	(Becomes hard at 39.5')	5A	39.0-40.5	11-21-35	56
	(With sand and gravel seam at 42.0')				
43.0'	Weathered dolomite	6A	44.0-44.5	100/3"	100+
	Bottom of boring at 44.5'				

METHOD: Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**	
TECHNICIAN: BK and CL	INITIAL DEPTH: *	X	A. SPLIT SPOON
JOB NO.: 33767 (jl)	COMPLETION DEPTH: 16.2'		B.
	DEPTH AFTER: 0.25 HRS. 16.2'**	X	C. SHELBY TUBE

* 19.0'(trace); 42.0'(medium); 43.0'(heavy)

** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 13

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-26-83

SURFACE ELEVATION: 606' **DATE COMPLETED:** 1-26-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Brown silt, some sand,				
0.3'	(FILL) Gray clay, some silt, traces of sand and gravel, moist	1A	1.0- 2,5	6-12-12	24
2.2'	Very stiff brown and gray clay, some silt, traces of sand and gravel, moist	2A	4.0- 5.5	5- 8-11	19
5'					
9.0'		3A	9.0-10.5	4- 7- 8	15
10'	Stiff brown and gray silt, some clay, some sand, trace of gravel, moist				
15'		4A	14.0-15.5	4- 4- 4	8
15.4'	Medium stiff gray silt, some clay, some sand, trace of gravel, moist				
19.0'		5A	19.0-20.5	2- 3- 4	7
20'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist				
25'		6A	24.0-25.5	3- 3- 4	7
30'	(Becomes stiff at 29.5')	7A	29.0-30.5	4- 6- 8	14

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 14.0' (heavy)

COMPLETION DEPTH: None

DEPTH AFTER: 0.25 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 13 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-26-83

SURFACE ELEVATION: 606' **DATE COMPLETED:** 1-26-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.0-35.5	6-10-13	23
40'		9A	39.0-40.5	11-20-29	49
41.0'	(With trace of rock fragments at 39.0 to 40.5')				
	Apparent rock (Auger refusal at 42.0')				
	Bottom of boring at 42.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**		**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: 14.0' (heavy)	X	A. SPLIT SPOON
		COMPLETION DEPTH: None		B.
JOB NO.:	33767 (jl)	DEPTH AFTER: 0.25 HRS. None		C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 14

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Very stiff brown silt and clay, traces of sand and organic material, moist	1A	1.0- 2.5	6-10-14	24
4.0'	Very stiff brown and gray silt and clay, trace of sand, moist	2A	4.0- 5.5	5-10-11	21
5'					
10'		1C	9.0-11.0		20"
11.0'	Soft gray clay, some silt, some sand, trace of gravel, moist				
15'		3A	14.0-15.5	1- 2- 3	5
20'		2C	19.0-21.0		24"
	(Becomes stiff at 24.0')				
25'		4A	24.0-25.5	5- 6- 8	14
30'		3C	29.0-31.0		24"

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 43.5' (trace)

COMPLETION DEPTH: None

DEPTH AFTER: 0.25 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 14 -continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	5A	34.0-35.5	6- 8-14	22
40'		4C	39.0-41.0		24"
43.5'	Gray weathered shale and gypsum	6A	44.0-44.5	100/5"	100+
	Bottom of boring at 44.5'				

METHOD: Hollow Auger

TECHNICIAN: BKand CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 43.5' (trace)

COMPLETION DEPTH: None

DEPTH AFTER: 0.25 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

____ B.

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 15

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-19-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Stiff brown and gray clay and silt, trace of sand, moist	1A	1.0- 2.5	4- 5- 7	12
5'		2A	4.0- 5.5	4- 5- 6	11
10'	(Becomes soft at 9.0')	3A	9.0-10.5	2- 2- 3	5
14.0'	Soft gray clay and silt, trace of sand, moist	4A	14.0-15.5	2- 2- 3	5
15'					
20'	(Becomes very soft at 19.0')	5A	19.0-20.5	1- 2- 1	3
24.0'	Soft gray clay, some silt, trace of sand, moist	6A	24.0-25.5	1- 1- 2	3
25'					
29.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	7A	29.0-30.5	2- 3- 4	7
30'					

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 42.0' (heavy)

COMPLETION DEPTH: 33.0'

DEPTH AFTER: 0.5 HRS. 18.0'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 15 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-19-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes hard at 35.5')	8A	34.0-35.5	7-13-20	33
40'	(With rock fragments at 40.0')	9A	39.0-40.5	12-25-55	80
41.5'		10A	41.5-42.5	70-30/2"	100+
	Hard gray silt, some clay, some sand, trace of gravel (with gypsum and limestone fragments), moist (Auger refusal at 42.5')				
	Bottom of boring at 42.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: 43.0' (heavy)	X A. SPLIT SPOON
		COMPLETION DEPTH: 33.0'	B.
JOB NO.:	33767 (jl)	DEPTH AFTER: 0.5 HRS. 18.0'	C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 16

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-26-83

SURFACE ELEVATION: 606' **DATE COMPLETED:** 1-27-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Gray clay, some silt, some sand, trace of gravel, moist				
1.5'	Very stiff brown and gray clay and silt, traces of sand and gravel, moist	1A	1.0- 2.5	6- 8-13	21
4.0'	Very stiff brown and gray silt, some clay, some sand, trace of gravel, moist	2A	4.0- 5.5	7-10-13	23
5'					
	(Becomes medium stiff at 9.0')	3A	9.0-10.5	3- 4- 4	8
10'					
15'		4A	14.0-15.5	2- 3- 3	6
19.0'	Soft gray clay and silt, traces of sand, and gravel, wet	5A	19.0-20.5	2- 2- 3	5
20'					
24.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	6A	24.0-25.5	2- 4- 6	10
25'					
30'	(Becomes stiff at 29.5')	7A	29.0-30.5	3- 5- 8	13

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 15.0'**

DEPTH AFTER: 0.5 HRS. 15.0'**

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* 14.0'(trace); 41.0'(heavy)

** Taken in augers

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 16 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-26-83

SURFACE ELEVATION: 606' **DATE COMPLETED:** 1-27-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.0-35.5	6- 9-16	25
40'		9A	39.0-40.5	19-34-40	74
42.0'	Apparent rock (Auger refusal at 44.0')				
	Bottom of boring at 44.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**		**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: *	X	A. SPLIT SPOON
JOB NO.:	33767 (j1)	COMPLETION DEPTH: 15.0'**		B.
		DEPTH AFTER: 0.5 HRS. 15.0'**		C. SHELBY TUBE

* 14.0'(trace); 41.0'(heavy)
** Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 17

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Very stiff gray and brown clay and silt, traces of sand and organic material, moist	1A	1.0- 2.5	6- 9-13	22
5'		2A	4.5- 6.0	6- 9- 8	17
6.5'	Medium stiff gray and brown silt and clay, trace of sand, moist				
10'		3A	9.5-11.0	2- 3- 3	6
14.5'	Soft gray clay, some silt, traces of sand and gravel, moist	4A	14.5-16.0	2- 2- 3	5
15'					
19.5'	Soft gray clay, some silt, some sand, trace of gravel, moist	5A	19.5-21.0	1- 2- 2	4
20'					
25'		6A	24.5-26.0	4- 4- 5	9
30'		7A	29.5-31.0	4- 5- 5	10

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 14.0'

DEPTH AFTER: 12 HRS: 15.8'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wireline

___ C. SHELBY TUBE

* 9.0'(light); 43.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 17 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes stiff at 34.5')	8A	34.5-36.0	6- 6- 7	13
39.5' 40'	Hard gray clay, some silt, some sand, trace of gravel, moist	9A	39.5-41.0	11-14-18	32
44.5' 45.0'	Hard gray silt, some clay, some sand, trace of gravel (with gypsum), moist	10A	44.5-45.0	100/4"	100+
	Medium hard gray shaley dolomite	1B	45.0-50.0		45"
50'					
55'		2B	50.0-60.0		114"
60'					

METHOD:	Hollow Auger	WATER OBSERVATIONS	TYPE SAMPLER:
TECHNICIAN:	RG and TA	INITIAL DEPTH: *	X A. SPLIT SPOON
JOB NO.:	33767 (j1)	COMPLETION DEPTH: 14.0'	X B. NX wireline
		DEPTH AFTER: 12 HRS. 15.8'	C. SHELBY TUBE

* 9.0'(light); 43.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 17 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'					
65'		3B	60.0-70.0		100"
70'					
75'		4B	70.0-80.0		120"
80'					
85'		5B	80.0-90.0		120"
90'					

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 14.0'

DEPTH AFTER: 12 HRS. 15.8'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wireline

___ C. SHELBY TUBE

* 9.0'(light); 43.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 17 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
90'					
95'		6B	90.0-100.0		120"
100'					
105'		7B	100.0-110		120"
110'					
115'		8B	110.0-120		118"
120'					

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 14.0'

DEPTH AFTER: 12 HRS. 15.8'

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wireline

___ C. SHELBY TUBE

* 9.0'(light); 43.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 17 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-16-82

SURFACE ELEVATION: 604' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
120'		9B	120.0-125		60"
	Bottom of boring at 125.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	RG and TA	INITIAL DEPTH: *	X A. SPLIT SPOON
JOB NO.:	33767 (jl)	COMPLETION DEPTH: 14.0'	X B. NX wireline
		DEPTH AFTER: 12 HRS. 15.8'	C. SHELBY TUBE

* 9.0'(light); 43.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

ROCK CORE LOG

Job No. 33767

Boring No. 17

Date Logged 12-1-82

Core Top Elevation 559'

Observer JKK

Core Recovery 917"

Surface Elevation 604'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 33% (from 50 to 125 feet)

TOTAL Fracture Frequency (FF) from 85 to 125' only, 7.5 fractures/ft.

Depth(ft)	Description	Sample	Recovery
45.0	Medium hard gray and white shale, gypsum and anhydrite, some highly weathered zones	1B RQD =	45" 0%
50.0	Hard gray fine grained dolomite with occasional interbeds of gypsum and anhydrite	2B RQD =	114" 14%
52.5	(0.5'± thick weathered zone)		
55.0	Hard black fissile shale, occasional interbeds of gypsum and anhydrite and weathered zones		
56.0'	(1 foot weathered zone)		
60.0'		3B RQD =	100" 16%
62.0	Hard weathered black fissile shale with occasional interbeds of gypsum and anhydrite		
70.0'		4B RQD = FF =	120" 6% 10/ft.
80.0		5B RQD =	120" 35%

ROCK CORE LOG

Job No. 33767

Boring No. ~~17 - continued~~

Date Logged 12-1-82

Core Top Elevation 559'

Observer JKK

Core Recovery 917"

Surface Elevation 604'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 33% (from 50 to 125 feet)

TOTAL Fracture Frequency (FF) from 85 to 125' only 7.5 fractures/ft.

Depth(ft)	Description	Sample	Recovery
84.0	Hard massive gray and white dolomite with shale partings, occasional thin gypsum		
90.0		6B RQD = FF =	120" 55% 5/ft.
99.0	Hard gray and brown dolomite with gypsum partings		
100.0		7B RQD = FF =	120" 63% 4/ft.
101.3	(2' zone of dark brown gypsum spheres)		
103.0	Hard gray fine-grained massive dolomite with occasional shale partings		
109.5	Alternating thin hard black fissile shale, gray dolomites and soft white gypsum with some weathered zones		
110.0		8B RQD = FF =	118" 44% 5/ft.
116.0	(Begin 2' zone of very small dark brown gypsum spheres)		

ROCK CORE LOG

Job No. 33767

Boring No. 17 - continued

Date Logged 12-1-82

Core Top Elevation 559'

Observer JKK

Core Recovery 917"

Surface Elevation 604'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 33% (from 50 to 125 feet)

TOTAL Fracture Frequency (FF) from 85 to 125' only 7.5 fractures/ft.

Depth(ft)	Description	Sample	Recovery
120.0		9B RQD = FF =	60" 26% 8/ft.
	Bottom of boring at 125.0'		

BOWSER-MORNER
Testing Laboratories, Inc.

LOG OF BORING NO. 18

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-12-82

SURFACE ELEVATION: 607' **DATE COMPLETED:** 10-13-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Crushed stone				
1.0'	Very stiff brown and gray silt and clay, traces of sand, gravel and organic material, moist (Becomes stiff at 4.5')	1A	1.0- 2.5	3- 7-10	17
5'		2A	4.0- 5.5	3- 5- 6	11
10'		3A	9.0-10.5	2- 2- 3	5
14.0'	Very soft gray clay, some silt, trace of sand, (with 1/2" brown silt seams throughout sample), moist	4A	14.0-15.5	1- 1- 2	3
15'					
19.0'	Very soft gray clay, traces of silt and sand, wet	5A	19.0-20.5	1- 1- 2	3
20'					
24.0'	Soft gray clay, some silt, traces of sand and gravel, wet	6A	24.0-25.5	2- 1- 3	4
25'					
	(Becomes moist at 29.0')				
30'		7A	29.0-30.5	1- 2- 2	4

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 24.0' (heavy)

COMPLETION DEPTH: 22.0' *

DEPTH AFTER: 15.5 HRS. 12.2'**

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

** Taken in augers at 19.0'

* Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 18 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-12-82

SURFACE ELEVATION: 607' **DATE COMPLETED:** 10-13-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
34.0' 35'	Very stiff gray clay and silt, some sand, trace of gravel, moist	8A	34.0-35.5	4- 7- 11	18
40'	(Becomes hard at 39.5')	9A	39.0-40.5	11-22-39	61
44.0' 45.0'	Hard gray silt, some clay, some sand, traces of gravel and gypsum, moist	10A	44.0-45.0	70-30/1"	100+
	Weathered dolomite (Auger refusal at 46.0')				
	Bottom of boring at 46.0'				

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 24.0' (heavy)

COMPLETION DEPTH: 22.0'*

DEPTH AFTER: 15.5 HRS. 12.2'**

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

**Taken in augers at 19.0'

* Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 19

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-19-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 10-20-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Very stiff brown and gray clay and silt, traces of sand and organic material, moist	1A	1.0- 2.5	4- 9- 9	18
5'		2A	4.0- 5.5	9-13-14	27
		1C	7.0- 9.0		24"
9.0'					
10'	Medium stiff brown silt and clay, trace of sand, wet	3A	9.0-10.5	3- 4- 5	9
		4A	14.0-15.5	3- 3- 3	6
15.0'					
	Medium stiff gray silt and clay, trace of sand, moist				
19.0'					
20'	Soft gray clay, some silt, some sand, trace of gravel, moist	5A	19.0-20.5	0- 1- 3	4
25'		6A	24.0-25.5	2- 3- 5	8
		2C	27.0-29.0		24"
30'		7A	29.0-30.5	0- 4- 5	9

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 7.0'

COMPLETION DEPTH: 5.5'

DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 19 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-19-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 10-20-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.0-35.5	5- 6- 8	14
40'		9A	39.0-40.5	3- 5- 8	13
44.0'					
45'	Hard gray silt, some clay, traces of sand and gravel, moist	10A	44.0-45.5	12-21-35	56
50.0'		11A	49.0-49.5	100/3"	100+
	Medium hard broken brown shaley dolomite	1B	50.0-53.0		33"
55'		2B	53.0-58.0		54"
60'					

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 7.0'

COMPLETION DEPTH: 5.5'

DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 19 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-19-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 10-20-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'					
		3B	58.0-68.0		117"
65'					
		4B	68.0-70.0		24"
	Bottom of boring at 70.0'				

METHOD: Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN: TA and RF	INITIAL DEPTH: 7.0'	X A. SPLIT SPOON
JOB NO.: 33767 (jl)	COMPLETION DEPTH: 5.5'	X B. NX wire
	DEPTH AFTER: ____ HRS. ____	X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

ROCK CORE LOG

Job No. 33767

Boring No. 19

Date Logged 11-1-82

Core Top Elevation 561'

Observer JKK

Core Recovery 228"

Surface Elevation 611'

Age(s)/Formation(s) Upper Silurian/Tymochtee

TOTAL Rock Quality Designation (RQD) 29%

TOTAL Fracture Frequency (FF) Not calculated

Depth(ft)	Description	Sample	Recovery
50.0	Hard weathered black shale with gypsum along bedding planes	1B RQD =	33" 0%
52.5	Soft massive white gypsum with shale partings		
53.0		2B RQD =	54" 27%
53.5	Hard black shale, occasional gypsum, occasional weathered zones		
58.0'	Hard interbedded black and white shale and gypsum, appears clastic in zones, small scale faults with offset	3B RQD = FF =	117" 32% 6/ft.
68.0		4B RQD = FF =	24" 58% 2/ft.
	Bottom of boring at 70.0'		

LOG OF BORING NO. 20

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-24-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-24-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Medium stiff brown clay and silt, trace of sand, moist	1A	1.0- 2.5	2- 4- 5	9
4.0'	Medium stiff brown and gray clay and silt, trace of sand, moist	2A	4.0- 5.5	3- 3- 5	8
5'					
10'		3A	9.0-10.5	3- 4- 5	9
12.0'	Medium stiff gray clay, some silt, trace of sand, moist				
15'		4A	14.0-15.5	2- 3- 3	6
19.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist				
20'		5A	19.0-20.5	2- 3- 4	7
	(With trace of gravel at 24.0')				
25'		6A	24.0-25.5	2- 4- 4	8
30'		7A	29.0-30.5	11-22-30	52

METHOD: Hollow Auger

TECHNICIAN: BK and DU

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 9.0' (heavy)

COMPLETION DEPTH: 20.0'

DEPTH AFTER: 1.75 HRS. 0.4'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 20 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-24-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-24-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'	(Becomes stiff at 30.5')				
35'	(Becomes hard at 35.0')	8A	34.0-35.5	11-22-30	52
40'		9A	39.0-40.5	12-28-41	69
41.0'	Apparent rock (Auger Refusal at 41.5')				
	Bottom of boring at 41.5'				

METHOD: Hollow Auger

TECHNICIAN: BK and DU

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 9.0' (heavy)

COMPLETION DEPTH: 20.0'

DEPTH AFTER: 1.75 HRS. 0.4'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 21

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-19-82

SURFACE ELEVATION: 612' **DATE COMPLETED:** 11-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Very stiff gray and brown silt and clay, traces of sand and organic material, moist	1A	1.0- 2.5	8-10-12	22
5'		2A	4.5- 6.0	4- 4- 5	9
10' 9.5'	Medium stiff gray clay and silt, trace of sand with intermittent 1/16"-1/8"wet fine sand seams from 10.5'), moist	3A	9.5-11.0	2- 3- 4	7
15' 14.5'	Medium stiff gray clay, some silt, traces of sand and gravel, moist	4A	14.5-16.0	2- 3- 3	6
19.5' 20'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	5A	19.5-21.0	3- 4- 4	8
25'	(Becomes stiff at 24.5')	6A	24.5-26.0	4- 5- 7	12
30'		7A	29.5-31.0	4- 6- 8	14

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 10.5' (light)

COMPLETION DEPTH: None

DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 21 -continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-19-82

SURFACE ELEVATION: 612' **DATE COMPLETED:** 11-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.5-36.0	10-14-16	30
37.0'	Gray weathered dolomitic shale (Auger refusal at 38.0')				
	Bottom of boring at 38.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	RG and TA	INITIAL DEPTH: 10.5' (light)	X A. SPLIT SPOON
JOB NO.:	33767 (jl)	COMPLETION DEPTH: None	B.
		DEPTH AFTER: ____ HRS. ____	C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 22

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 10-11-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Very stiff brown and gray silt and clay, traces of sand and organic material, moist	1A	1.0- 2.5	7- 8-13	21
5'		1C	4.0- 6.0		24"
9.0'					
10'	Soft gray clay and silt, trace of sand (with 1/2" brown silt seams throughout sample), moist	2A	9.0-10.5	1- 2- 2	4
14.0'					
15'	Soft gray clay, some silt, some sand, trace of gravel, moist	2C	14.0-16.0		24"
20'		3A	19.0-20.5	1- 2- 3	5
25'		3C	24.0-26.0		24"
30'	(Becomes stiff at 29.5')	4A	29.0-30.5	3- 5- 6	11

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 11.0' (heavy)

COMPLETION DEPTH: 19.8'

DEPTH AFTER: 1.0 HRS. 18.5'

TYPE SAMPLER:

X A. SPLIT SPOON

____ B.

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 22 -continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-11-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 10-11-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(With cobbles at 34.5 to 35.0')	4C	34.0-34.5		6"
	(Becomes hard at 35.0')	5A	34.5-36.0	7-34-10	44
40'		6A	39.0-40.5	15-25-75/5"	100+
41.0'	Weathered dolomite, wet				
		7A	44.0-45.5	100/9"	100+
	Bottom of boring at 45.0'				

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 11.0' (heavy)

COMPLETION DEPTH: 19.8'

DEPTH AFTER: 1.0 HRS. 18.5'

TYPE SAMPLER:

X A. SPLIT SPOON

____ B.

X C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

2B15

LOG OF BORING NO. 23

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 618' **DATE COMPLETED:** 11-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Stiff brown and gray silt and clay, traces of sand, gravel and organic material, moist	1A	1.0- 2.5	7- 8-11	19
3.5'	(FILL) Medium stiff gray and brown clay and silt, trace of sand, moist	2A	4.5- 6.0	3- 4- 5	9
5' 6.5'	(FILL) Medium stiff dark gray clay and silt, traces of sand and organic material, moist	3A	9.5-11.0	2- 3- 4	7
10' 11.0'	Very stiff gray and brown clay and silt, trace of sand, moist	4A	14.5-16.0	7-14-15	29
15' 20.0'	(With 6-8" wet black organic matter at 19.5')	5A	19.5-21.0	4- 4- 4	8
24.5'	Medium stiff gray and brown clay and silt, trace of sand with 1/16" fine sand seams, moist	6A	24.5-26.0	0- 3- 2	5
25' 29.5'	Soft gray clay, some silt, with intermittent 1/16-1/8" gray fine to coarse sand seams, moist				
30'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	7A	29.5-30.0	3- 3- 3	6

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 19.5' (light)

COMPLETION DEPTH: 24.4'

DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:

X A. SPLIT SPOON

_____ B.

_____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 23 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 618' **DATE COMPLETED:** 11-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.5-36.0	2- 4- 3	7
40'		9A	39.5-41.0	3- 4- 4	8
45'	(Becomes hard at 44.5')	10A	44.5-46.5	8-13-19	32
50'		11A	49.5-51.0	8-16-18	34
53.0'	Medium-hard gray weathered gypsiferous shale	12A	54.5-55.0	110/6"	110+
	Bottom of boring at 55.0'				

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 19.5' (light)

COMPLETION DEPTH: 24.4'

DEPTH AFTER: _____ HRS. _____

TYPE SAMPLER:

X A. SPLIT SPOON

_____ B.

_____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 24

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 605' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Very stiff gray and brown clay and silt, trace of sand, moist	1A	1.0- 2.5	6- 8-12	20
4.5'	Very stiff gray and brown silt, some clay, trace of sand, moist	2A	4.5- 6.0	7-11-14	25
5'					
10'	(Becomes medium stiff at 9.5')	3A	9.5-11.0	3- 4- 5	9
10.5'	Medium stiff gray clay, some silt, traces of sand and gravel, moist				
15'		4A	14.5-16.0	1- 3- 5	8
20'		5A	19.5-21.0	2- 4- 5	9
24.5'	Stiff gray clay, some silt, some sand, trace of gravel, moist	6A	24.5-26.0	4- 5- 6	11
25'					
30'		7A	29.5-31.0	4- 5- 7	12

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 4.5' (trace)

COMPLETION DEPTH: None

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 24 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 605' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.5-36.0	6- 8-11	19
40'		9A	39.5-41.0	7-10-14	24
42.5'	Hard gray silt, some clay, some sand, trace of gravel, contains gypsum, moist				
45.0'	Gray weathered shale with gypsum	10A	44.5-45.5	50-50/3"	100+
	Bottom of boring at 45.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	RG and TA	INITIAL DEPTH: 4.5' (trace)	X A. SPLIT SPOON
JOB NO.:	33767 (jl)	COMPLETION DEPTH: None	B.
		DEPTH AFTER: ____ HRS. ____	C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 25

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 10-13-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Brown silt, trace of sand, moist				
0.5'	Medium stiff brown and gray silt and clay, traces of sand and gravel, moist	1A	1.0- 2.5	2- 4- 6	10
4.0'	Stiff brown and gray silt and clay, traces of sand and organic material, moist	2A	4.0- 5.5	3- 5- 8	13
5'					
7.0'	Stiff gray and brown clay and silt, trace of sand, moist	1C	7.0- 9.0		20"
10'		3A	9.0-10.5	2- 7- 8	15
14.0'	Stiff gray silt, some clay, some sand, trace of gravel, moist	4A	14.0-15.5	3- 5- 7	12
15'					
		2C	17.0-19.0		24"
	(Becomes medium stiff at 19.5')	5A	19.0-20.5	2- 3- 5	8
20'					
	(Becomes stiff at 24.5')	6A	24.0-25.5	3- 5- 6	11
25'					
		3C	27.0-29.0		24"
30'		7A	29.0-30.5	3- 6- 7	13

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 17.0' (heavy)

COMPLETION DEPTH: 30.7' *

DEPTH AFTER: 0.25 HRS. 22.4 *

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

X C. SHELBY TUBE

* Taken in augers.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 25 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-13-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 10-13-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.0-35.5	4- 5- 7	12
40'	(Becomes very stiff at 39.5')	9A	39.0-40.5	5-10-15	25
45'	(Becomes hard at 44.0')	10A	44.0-45.5	20-26-47	73
47.5'	Weathered dolomite and gypsum, wet	11A	49.0-49.5	100/1"	100+
	Bottom of boring at 49.5'				

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 17.0' (heavy)

COMPLETION DEPTH: 30.7'*

DEPTH AFTER 0.25 HRS. 22.4'*

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

X C. SHELBY TUBE

* Taken in augers.

BOWSER - MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 26

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-27-83

SURFACE ELEVATION: 613' **DATE COMPLETED:** 1-27-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0' 1.0'	(FILL) Brown silt, some sand, some clay, traces of gravel and organic material, moist	1A	1.0- 2.5	6- 5-12	17
4.0'	(FILL) Very stiff gray and brown clay, some silt, some sand, trace of gravel, moist	2A	4.0- 5.5	17- 4- 2	6
5'	(FILL) Medium stiff brown silt, some sand, traces of gravel and organic material, moist (Becomes very stiff at 8.5')	3A	9.0-10.5	7- 8-13	21
10.0'	Stiff brown and gray clay and silt, traces of sand, gravel and organic material, moist	4A	14.0-15.5	4- 6- 7	13
15'		5A	19.0-20.5	5- 7- 8	15
20' 19.7'	Stiff gray clay and silt, some sand, moist	6A	24.0-25.5	3- 4- 7	11
25.0'	Stiff gray silt, some clay, some sand, trace of gravel, moist	7A	29.0-30.5	5- 7- 8	15
30'					

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 24.0' (trace)

COMPLETION DEPTH: None

DEPTH AFTER: 0.25 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 26 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 1-27-83

SURFACE ELEVATION: 613' **DATE COMPLETED:** 1-27-83

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.0-35.5	5- 6- 9	15
40'	(Becomes very stiff at 39.5')	9A	39.0-40.5	5- 8-10	18
45'		10A	44.0-45.5	5-10-18	28
49.0' 50'		11A	49.0-49.5	100/6"	100+
50.5'	Hard gray silt, some sand, some clay, trace of gravel, moist				
	Apparent rock (Auger refusal at 51.5')				
	Bottom of boring at 51.5'				

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 24.0' (trace)

COMPLETION DEPTH: None

DEPTH AFTER: 0.25 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 27

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-11-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-15-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Hard dark brown silt and clay, traces of sand and organic material, moist	1A	1.0- 2.5	9-16-18	34
2.0'	Hard gray and brown clay and silt, traces of sand and gravel, moist (Becomes medium stiff at 4.5')	2A	4.5- 6.0	4- 4- 4	8
5'					
10'		3A	9.5-11.0	3- 4- 4	8
10.5'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist				
15'		4A	14.5-16.0	4- 4- 4	8
20'		5A	19.5-21.0	3- 4- 5	9
25'		6A	24.5-26.0	4- 4- 5	9
30'		7A	29.5-31.0	4- 5- 5	10

METHOD: Hollow Auger

TECHNICIAN: RG and RA

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 42.5'

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* 4.5'(trace); 29.5'(medium)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 27 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-11-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-15-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.5-36.0	4- 8- 9	17
40'		9A	39.5-41.0	26-28-31	59
42.0'	Gray shaley dolomite with gypsum.	10A	43.0-43.5	100/2"	100+
	Bottom of boring at 43.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	RG and TA	INITIAL DEPTH: *	X A. SPLIT SPOON
JOB NO.:	33767 (j1)	COMPLETION DEPTH: 42.5'	B.
		DEPTH AFTER: ____ HRS. ____	C. SHELBY TUBE

* 4.5'(trace); 29.5'(medium)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 28

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-10-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 11-11-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
0.5'	Hard gray and brown clay and silt, trace of sand, moist	1A	1.0- 2.5	15-23-25	48
5'	(Becomes very stiff at 4.5')	2A	4.5- 6.0	5- 8-12	20
10'	(With trace of 1/16" fine sand lenses at 9.0')	3A	9.5-11.0	5- 7-10	17
14.5' 15'	Stiff gray clay, some silt, some sand, trace of gravel, moist	4A	14.5-16.0	4- 4- 7	11
20'		5A	19.5-21.0	4- 5- 6	11
25'		6A	24.5-26.0	4- 5- 6	11
30'	(Becomes medium stiff at 29.5')	7A	29.5-31.0	2- 5- 5	10

METHOD: Hollow Auger

TECHNICIAN: RG and TA

JOB NO.: 33767 (j10

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 23.0'

DEPTH AFTER: 16.25 HRS. 18.0'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* 4.5'(light); 44.5'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 28 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-10-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 11-11-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.5-36.0	6- 8- 9	17
40'	(Becomes hard at 40.0')	9A	39.5-41.0	8-17-19	36
44.5'	Gray weathered shale with gypsum and 1" sand seam, wet)	10A	44.5-45.0	100/5"	100+
	Bottom of boring at 45.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**		**TYPE SAMPLER:**
TECHNICIAN:	RG and TA	INITIAL DEPTH: *	X	A. SPLIT SPOON
JOB NO.:	33767 (jl)	COMPLETION DEPTH: 23.0'		B.
		DEPTH AFTER: 16.25 HRS. 18.0'		C. SHELBY TUBE

* 4.5'(light); 44.5'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 29

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-18-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 10-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.5'	Very stiff brown silt, some clay, some sand, damp	1A	1.0- 2.5	7-10-19	29
5'		1C	4.0- 6.0		18"
6.0'	Hard gray and brown silt, some clay, some sand, trace of gravel, damp	2A	6.0- 7.5	17-19-13	32
10'		3A	9.0-10.5	5- 6-11	17
14.0'	Stiff gray silt and clay, some sand, trace of gravel, moist	4A	14.0-15.5	3- 6- 6	12
15'					
20'		5A	19.0-20.5	3- 4- 6	10
		2C	23.0-25.0		24"
25'		6A	25.0-26.5	4- 5- 6	11
30'		7A	29.0-30.5	3- 5- 6	11

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: 42.5' (heavy)

COMPLETION DEPTH: 13.0' *

DEPTH AFTER: 5 min. HRS. 11.0' **

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* After coring

** Taken in augers at 44' depth before coring.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 29 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-18-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 10-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.0-35.5	3- 3- 5	8
39.5'		9A	39.0-40.5	10-60-30/3"	90+
40'	Hard brown silt, some clay, some sand, trace of gravel, damp				
42.5'	Gray fractured dolomite				
45'		1B	44.0-48.0		48"
50'		2B	48.0-58.0		120"
55'					
60'					

METHOD: Hollow Auger

TECHNICIAN: TA and RF

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 42.5' (heavy)

COMPLETION DEPTH: 13.0' *

DEPTH AFTER: 5 min. HRS. 11.0'**

TYPE SAMPLER:

X A. SPLIT SPOON

X B. NX wire

X C. SHELBY TUBE

* After coring

** Taken in augers at 44' depth before coring.

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 29 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-18-82

SURFACE ELEVATION: 611' **DATE COMPLETED:** 10-19-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
60'		3B	58.0-64.0		64"
	Bottom of boring at 64.0'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**	
TECHNICIAN:	TA and RF	INITIAL DEPTH: 42.5' (heavy)	X	A. SPLIT SPOON
		COMPLETION DEPTH: 13.0' *	X	B. NX wire
JOB NO.:	33767 (jl)	DEPTH AFTER: 5 min HRS. 11.0'**	X	C. SHELBY TUBE

* After coring

** Taken in augers at 44' depth before coring.

BOWSER – MORNER
TESTING LABORATORIES, INC.

ROCK CORE LOG

Job No. 33767

Boring No. 29

Date Logged 10-29-82

Core Top Elevation 567'

Observer JKK

Core Recovery 232"

Surface Elevation 611'

Age(s)/Formation(s) Silurian/Tymochtee member of Bass Islands Formation

TOTAL Rock Quality Designation (RQD) 40%

TOTAL Fracture Frequency (FF) 5 per foot

Depth(ft)	Description	Sample	Recovery
44.0'	Hard black shale with massive gypsum in fractures and voids	1B RQD = FF =	48" 60% 3/ft.
47.2	Soft massive buff shaley gypsum		
48.0		2B RQD = FF =	120" 55% 4.5/ft.
49.0	Hard black shale with massive gypsum veins		
50.7	Soft massive white gypsum interbedded with black shale, appears clastic in part		
54.2 57.5	Becomes hard Hard fine grained buff dolomite with thin gypsum laminae		
58.0		3B RQD = FF =	64" 0% 7/ft.
58.7	Begin finding open voids parallel with bedding lined with crystalline gypsum		
63.3	Hard massive black shale with flow structures Bottom of boring at 64.0'		

BOWSER-MORNER
Testing Laboratories, Inc.

LOG OF WELL NO. 29

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan.
DATE INSTALLED: 10-19-82

SURFACE ELEVATION: 610.3
TOP OF PIPE ELEVATION: 612.68

TYPE OF PIEZOMETER: 1 1/4" SCH 40 PVC with 1 1/4" x 3', 0.010 slot screen

DATE	WATER SURFACE DEPTH (FT.)	WATER SURFACE ELEV. (FT.)	
10-19-82	Flushed after setting.		
10-20-82	19.3	591.0	
1-19-83	16.25	594.0	
2-03-83	15.5	594.8	

INSTALLATION DESCRIPTION

DESCRIPTION	DEPTH (FT.)
	2.0'
	0.0'
Grout	
	44.0' (collar)
Bedrock	
	60.5
Screen	
	63.5
	64.0
Bottom of Boring	

Guardpipe with locking cap installed

TECHNICIAN TA and RF

JOB NO. 33767 (j1)

LOG OF BORING NO. 30

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Very stiff brown clay and silt, trace of sand, moist	1A	1.0- 2.5	5- 7-10	17
4.0'	Stiff brown and gray clay and silt, traces of sand and gravel, moist	2A	4.0- 5.5	4- 6- 7	13
5'					
10'		3A	9.0-10.5	4- 7- 6	13
14.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	4A	14.0-15.5	3- 3- 4	7
15'					
20'		5A	19.0-20.5	2- 3- 4	7
25'		6A	24.0-25.5	3- 4- 4	8
30'	(Becomes stiff at 30.0')	7A	29.0-30.5	3- 4- 7	11

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: 43.0' (heavy)

COMPLETION DEPTH: 24.6'

DEPTH AFTER: 1.0 HRS. 10.8'

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 30 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 610' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'		8A	34.0-35.5	4- 8-15	23
40'	(Becomes hard at 39.5')	9A	39.0-40.5	10-18-37	55
42.0'	Weathered shale with gypsum (Auger refusal at 43.5')	10A	43.0-43.5	100/1"	100+
	Bottom of boring at 43.5'				

METHOD:	Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**
TECHNICIAN:	BK and CL	INITIAL DEPTH: 43.0' (heavy)	X A. SPLIT SPOON
		COMPLETION DEPTH: 24.6'	___ B.
JOB NO.:	33767 (j1)	DEPTH AFTER: 1.0 HRS. 10.8'	___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 31

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-14-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	(FILL) Brown silt, some clay, some sand, moist				
1.0'	Very stiff brown and gray silt and clay, trace of sand, moist	1A	1.0- 2.5	4- 8- 8	16
4.0'	Very stiff brown silt and clay, trace of sand, moist	2A	4.0- 5.5	6- 8- 8	16
9.0'	Medium stiff gray silt and clay, trace of sand, moist	3A	9.0-10.5	3- 3- 3	6
15.0'	Medium stiff gray clay, some silt, some sand, trace of gravel, moist	4A	14.0-15.5	3- 3- 4	7
		5A	19.0-20.5	3- 3- 5	8
		6A	24.0-25.5	3- 4- 6	10
		7A	29.0-30.5	4- 4- 6	10

5' 10' 20' 25' 30'

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: None

COMPLETION DEPTH: None

DEPTH AFTER: 0.75 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

____ B.

____ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 31 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 10-14-82

SURFACE ELEVATION: 609' **DATE COMPLETED:** 10-14-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 34.5')	8A	34.0-35.5	5- 7-11	18
43.0'	Weathered dolomite				
40'		9A	39.0-40.5	5- 9-19	28
		10A	44.0-44.5	100/3"	100+
	Bottom of boring at 44.5'				

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (j1)

WATER OBSERVATIONS

INITIAL DEPTH: None

COMPLETION DEPTH: None

DEPTH AFTER: 0.75 HRS. None

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 32

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 606' **DATE COMPLETED:** 11-18-82

STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
0.0'	Topsoil				
1.0'	Stiff brown and gray clay and silt, trace of sand, moist	1A	1.0- 2.5	6- 6- 9	15
5'		2A	4.0- 5.5	4- 6- 9	15
9.0'	Stiff brown clay and silt, trace of sand, moist (With 2" brown sand and gravel seam at 9.8')	3A	9.0-10.5	2- 7- 5	12
10'					
14.0'	Soft gray clay, some silt, some sand, trace of gravel, moist	4A	14.0-15.5	1- 2- 3	5
15'					
20'	(Becomes medium stiff at 19.0')	5A	19.0-20.5	3- 4- 4	8
25'		6A	24.0-25.5	3- 3- 5	8
30'	(Becomes stiff at 29.5')	7A	29.0-30.5	4- 5- 7	12

METHOD: Hollow Auger

TECHNICIAN: BK and CL

JOB NO.: 33767 (jl)

WATER OBSERVATIONS

INITIAL DEPTH: *

COMPLETION DEPTH: 30.0'

DEPTH AFTER: ____ HRS. ____

TYPE SAMPLER:

X A. SPLIT SPOON

___ B.

___ C. SHELBY TUBE

* 9.0'(medium); 19.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

LOG OF BORING NO. 32 - continued

NORTHERN OHIO TREATMENT FACILITY - VICKERY, OHIO

BORING LOCATION: As shown on boring location plan **DATE STARTED:** 11-18-82

SURFACE ELEVATION: 606' **DATE COMPLETED:** 11-18-82

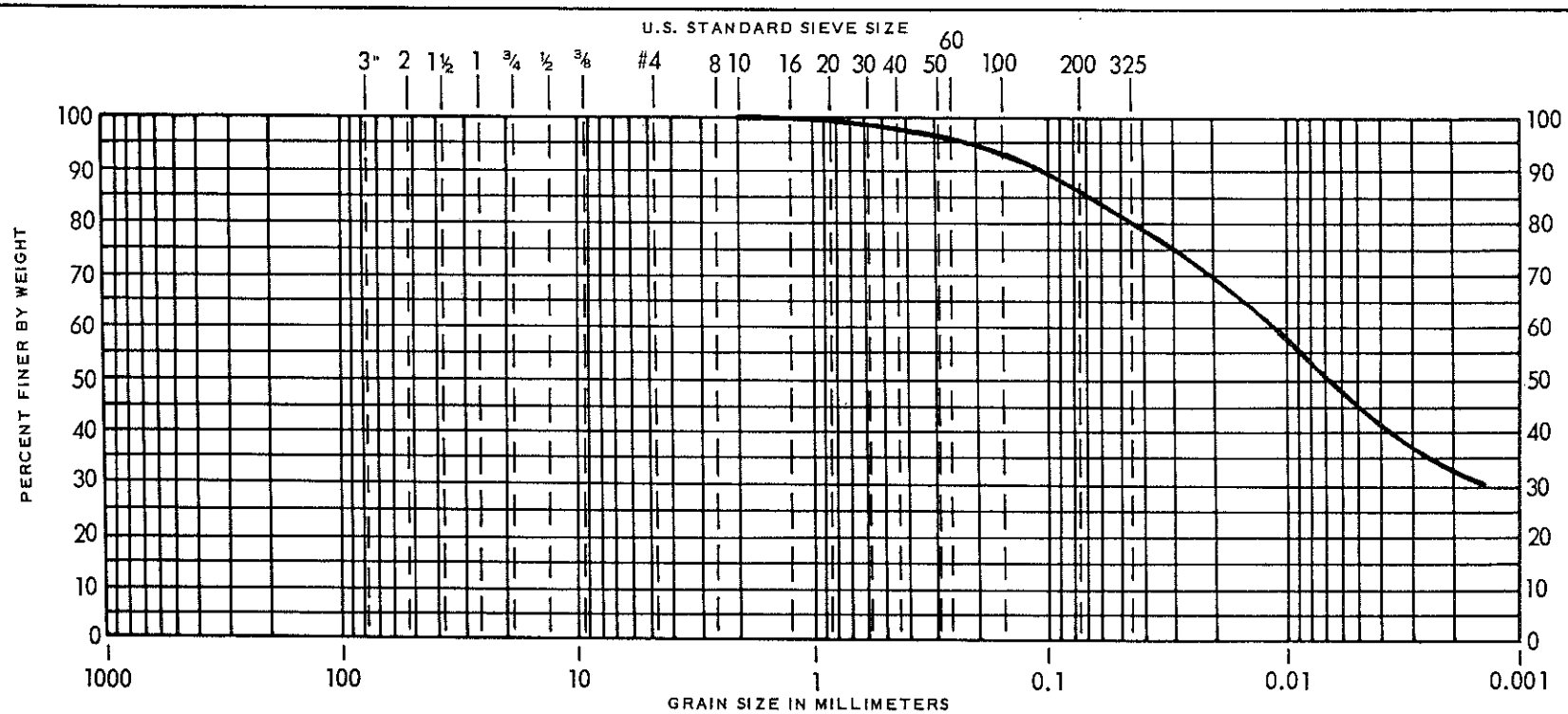
STRATUM	DESCRIPTION OF MATERIAL	SAMPLE NO. & TYPE	SAMPLE DEPTH	BLOWS PER 6" ON SAMPLER	"N" BLOWS /FT. OR CORE REC.
30'					
35'	(Becomes very stiff at 35.0')	8A	34.0-35.5	6- 7- 9	16
40'		9A	39.0-40.5	5-10-17	27
42.0'	Apparent rock (Auger refusal at 42.5')				
	Bottom of boring at 42.5'				

METHOD: Hollow Auger	**WATER OBSERVATIONS**	**TYPE SAMPLER:**	
TECHNICIAN: BK and CL	**INITIAL DEPTH:** *	X	A. SPLIT SPOON
JOB NO.: 33767 (jl)	**COMPLETION DEPTH:** 30.0'		B.
	DEPTH AFTER: ____ **HRS.** ____		C. SHELBY TUBE

* 9.0'(medium); 19.0'(heavy)

BOWSER – MORNER
TESTING LABORATORIES, INC.

SOIL CLASSIFICATION SHEET



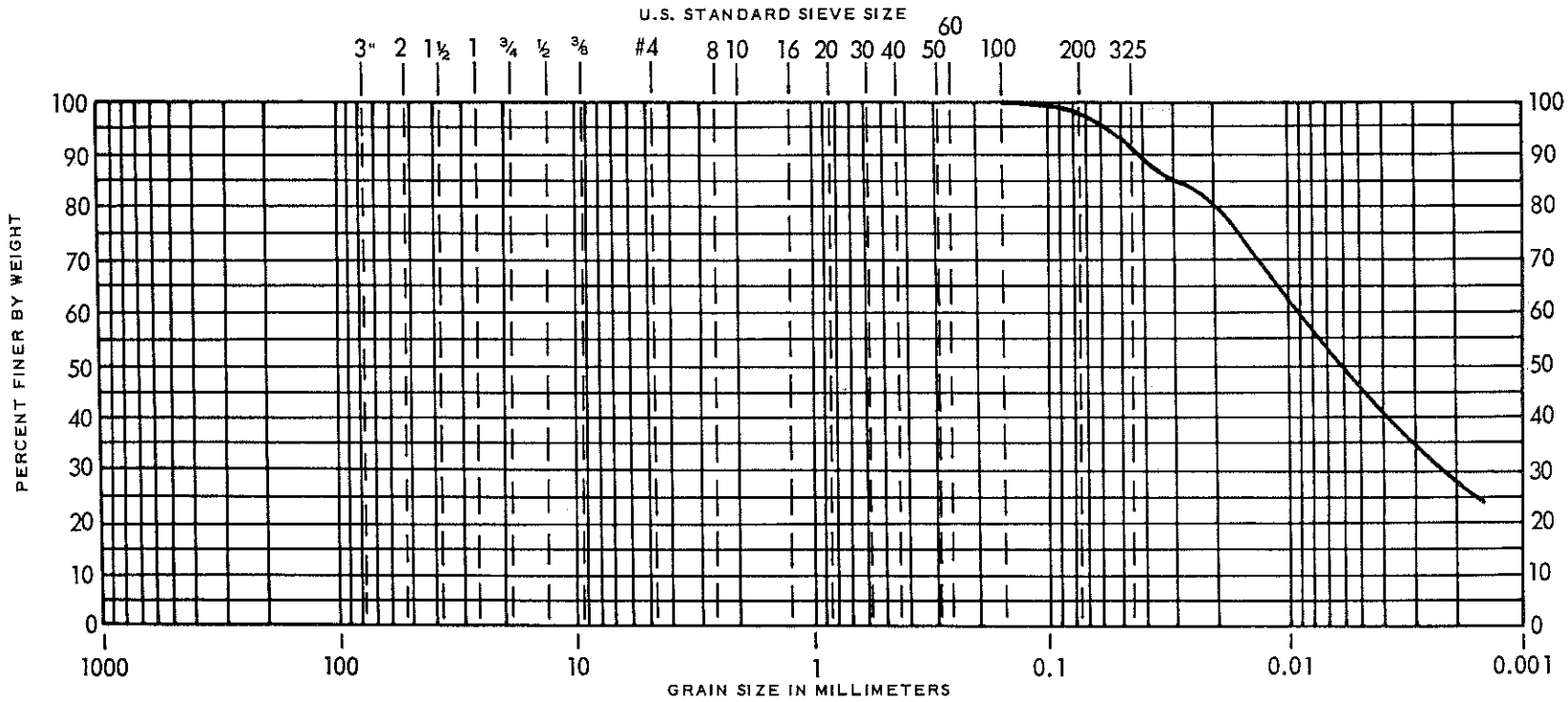
COBBLES	GRAVEL 0%		SAND 14%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	41%	45%

PROJECT	33767	NATURAL % MOISTURE	14.4
		LIQUID LIMIT	--
BORING NO.	1	PLASTIC LIMIT	--
SAMPLE NO.	1A	PLASTICITY INDEX	--
DEPTH	1.0-2.5'	COLOR	Brown
CLASSIFICATION		REMARKS	

BOWSER-MORNER
TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET

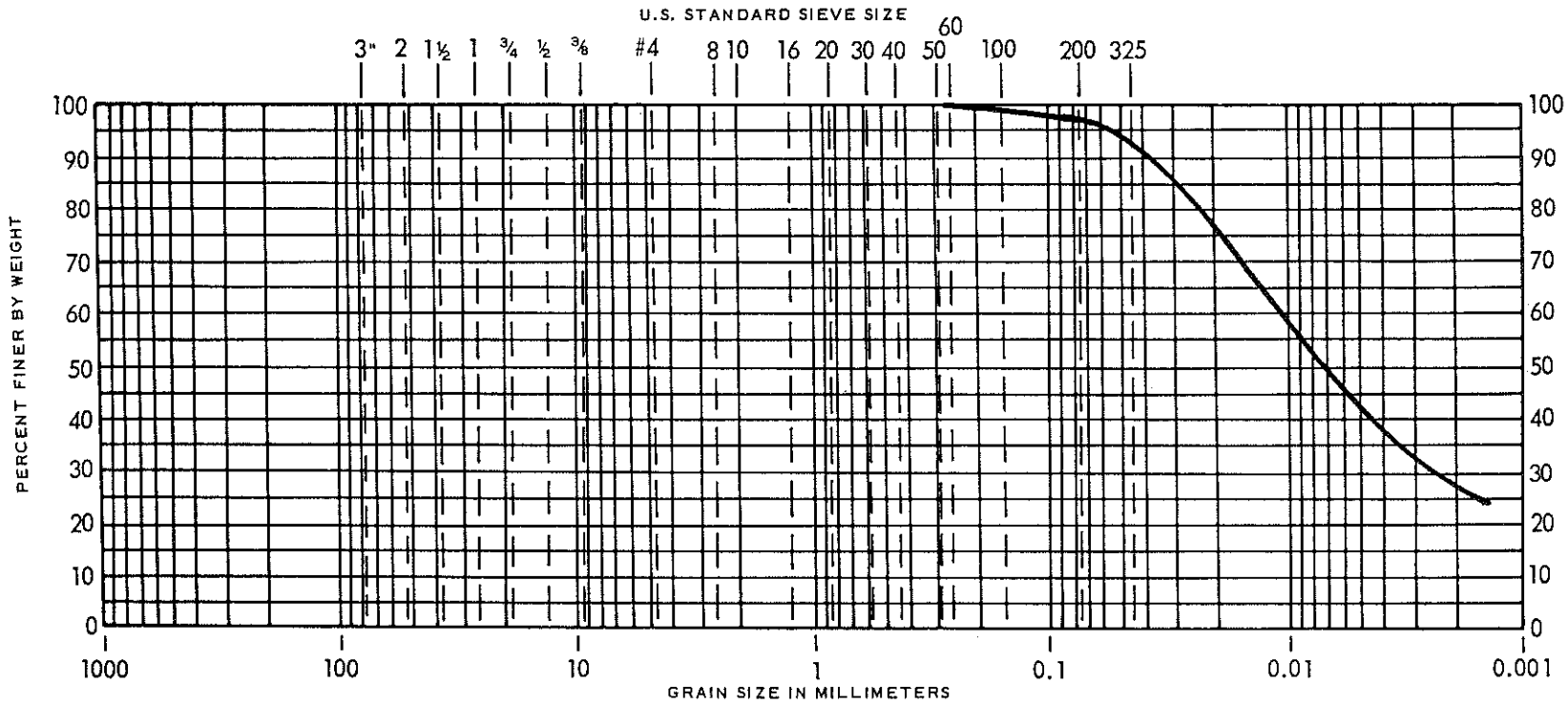


COBBLES	GRAVEL 0%		SAND 2%			SILT 52%	CLAY 46%
	COARSE	FINE	COARSE	MEDIUM	FINE		

PROJECT	33767	NATURAL % MOISTURE	27.7	BOWSER-MORNER
		LIQUID LIMIT	28	TESTING LABORATORIES, INC.
BORING NO.	1	PLASTIC LIMIT	18	
SAMPLE NO.	2C	PLASTICITY INDEX	10	
DEPTH	12.0-14.0'	COLOR	Gray	
CLASSIFICATION	Silty clay, "CL"	REMARKS	U.S.C.S.	
	A-4(9)		A.A.S.H.T.O. M145-73	

2A-34R

SOIL CLASSIFICATION SHEET

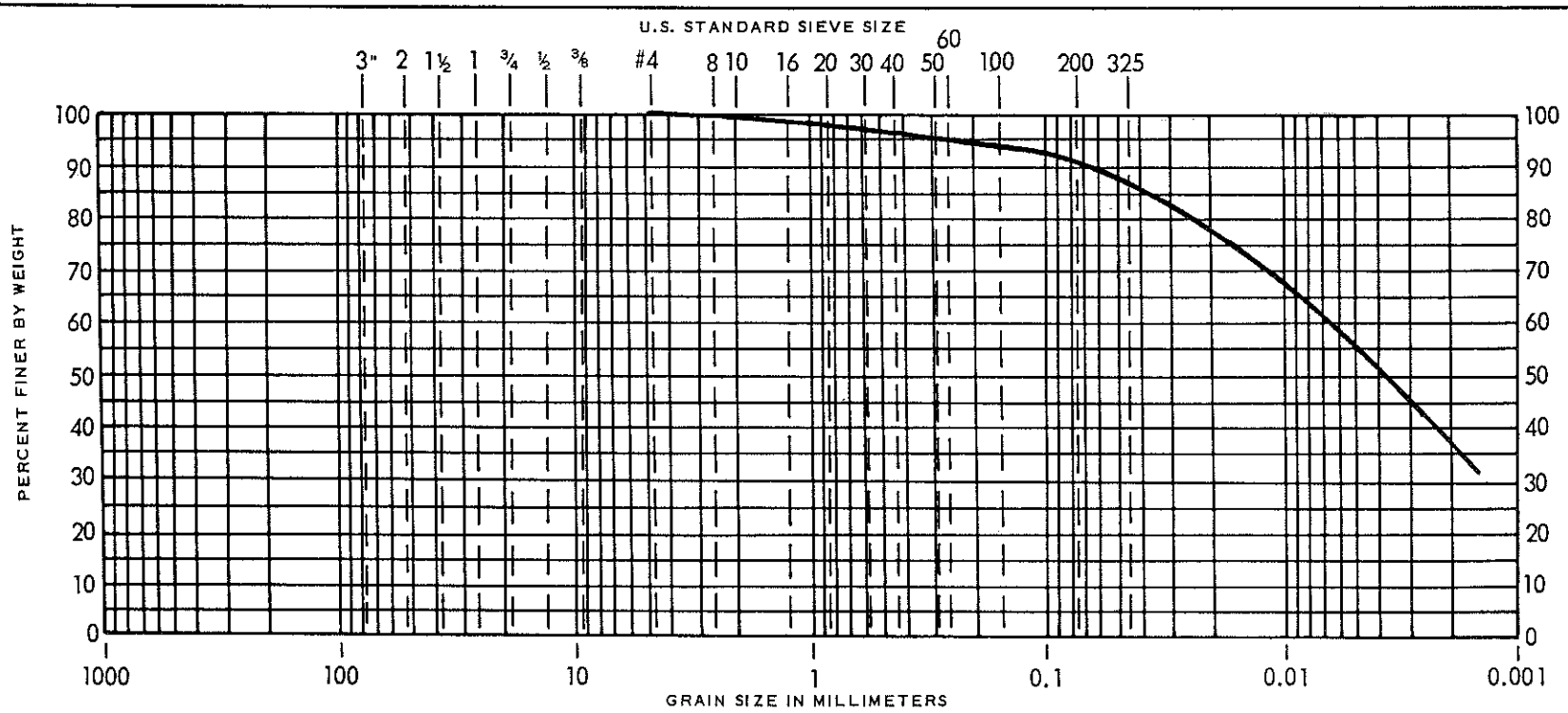


COBBLES	GRAVEL 0%		SAND 3%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	54%	43%

PROJECT	33767	NATURAL % MOISTURE	29.2	BOWSER-MORNER
		LIQUID LIMIT	--	TESTING LABORATORIES, INC.
BORING NO.	1	PLASTIC LIMIT	--	
SAMPLE NO.	5A	PLASTICITY INDEX	--	
DEPTH	19.0-20.5'	COLOR	Gray	
CLASSIFICATION		REMARKS		

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 0%		SAND 9%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	36%	55%

PROJECT	33767	NATURAL % MOISTURE	26.0
BORING NO.	2	LIQUID LIMIT	--
SAMPLE NO.	3A	PLASTIC LIMIT	--
DEPTH	9.0-10.5	PLASTICITY INDEX	--
CLASSIFICATION		COLOR	Brown
		REMARKS	

BOWSER-MORNER
TESTING LABORATORIES, INC.

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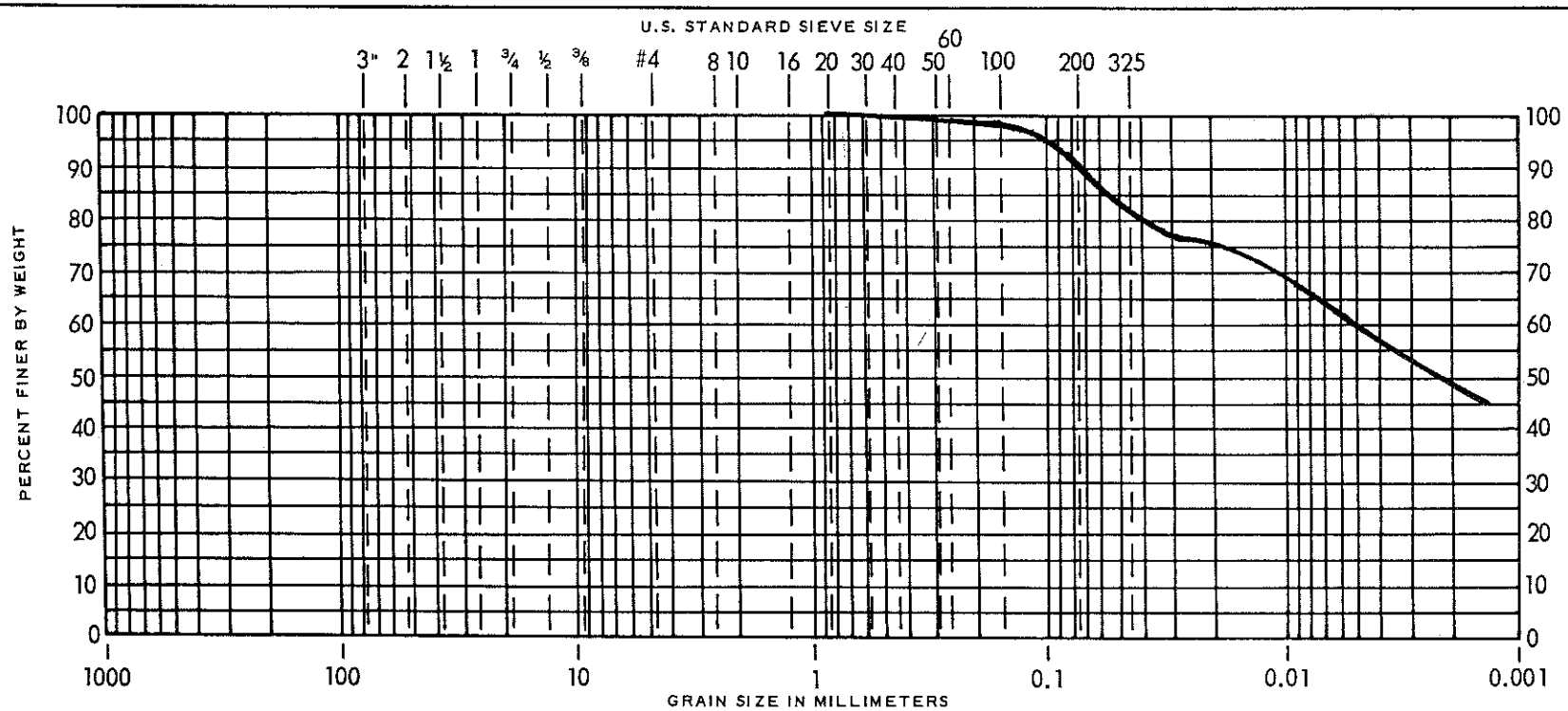
SOIL CLASSIFICATION SHEET

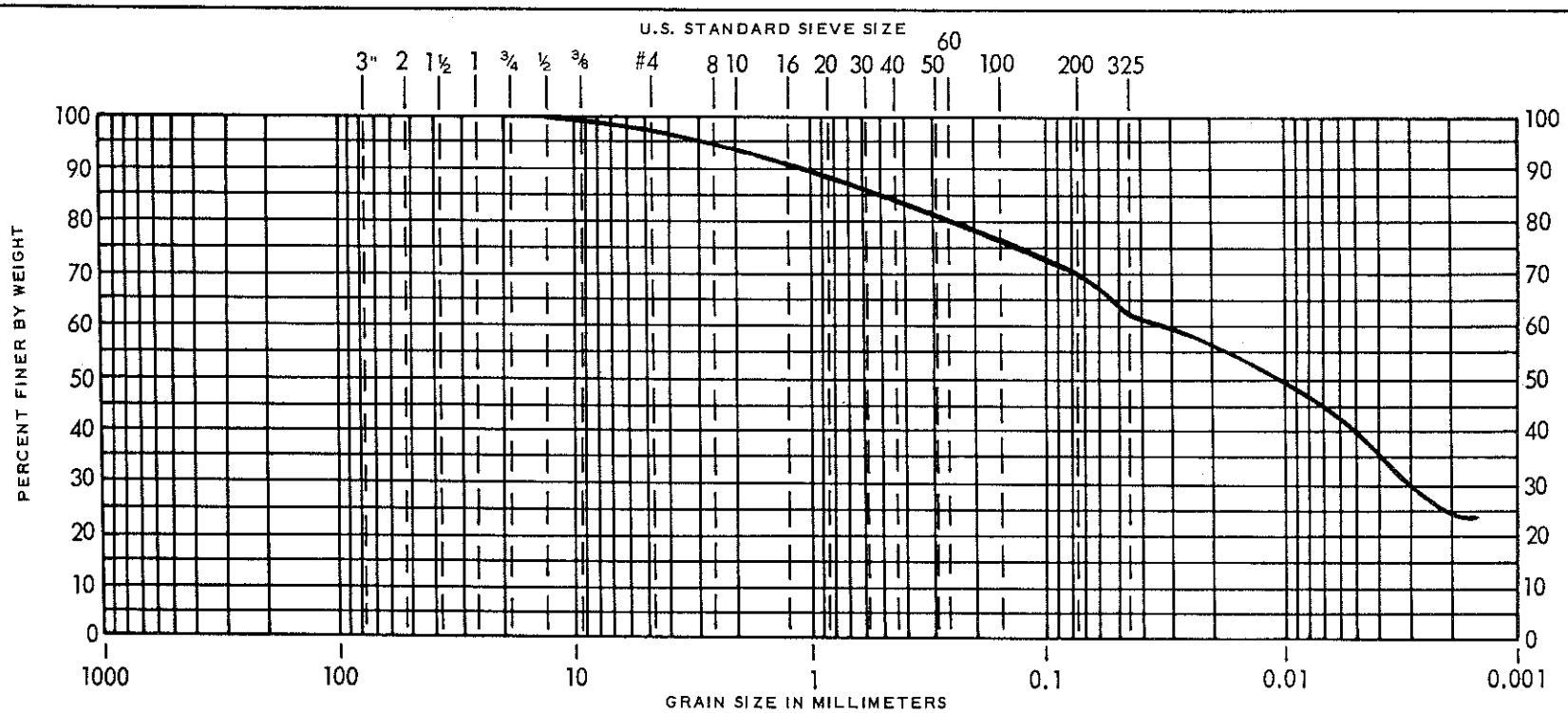


COBBLES	GRAVEL 0%		SAND 9%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	31%	60%

PROJECT	33767	NATURAL % MOISTURE	17.6	BOWSER-MORNER
		LIQUID LIMIT	--	TESTING LABORATORIES, INC.
BORING NO.	5	PLASTIC LIMIT	--	
SAMPLE NO.	1A	PLASTICITY INDEX	--	
DEPTH	1.0-2.5'	COLOR	Brown	
CLASSIFICATION		REMARKS		

2A-34R

SOIL CLASSIFICATION SHEET

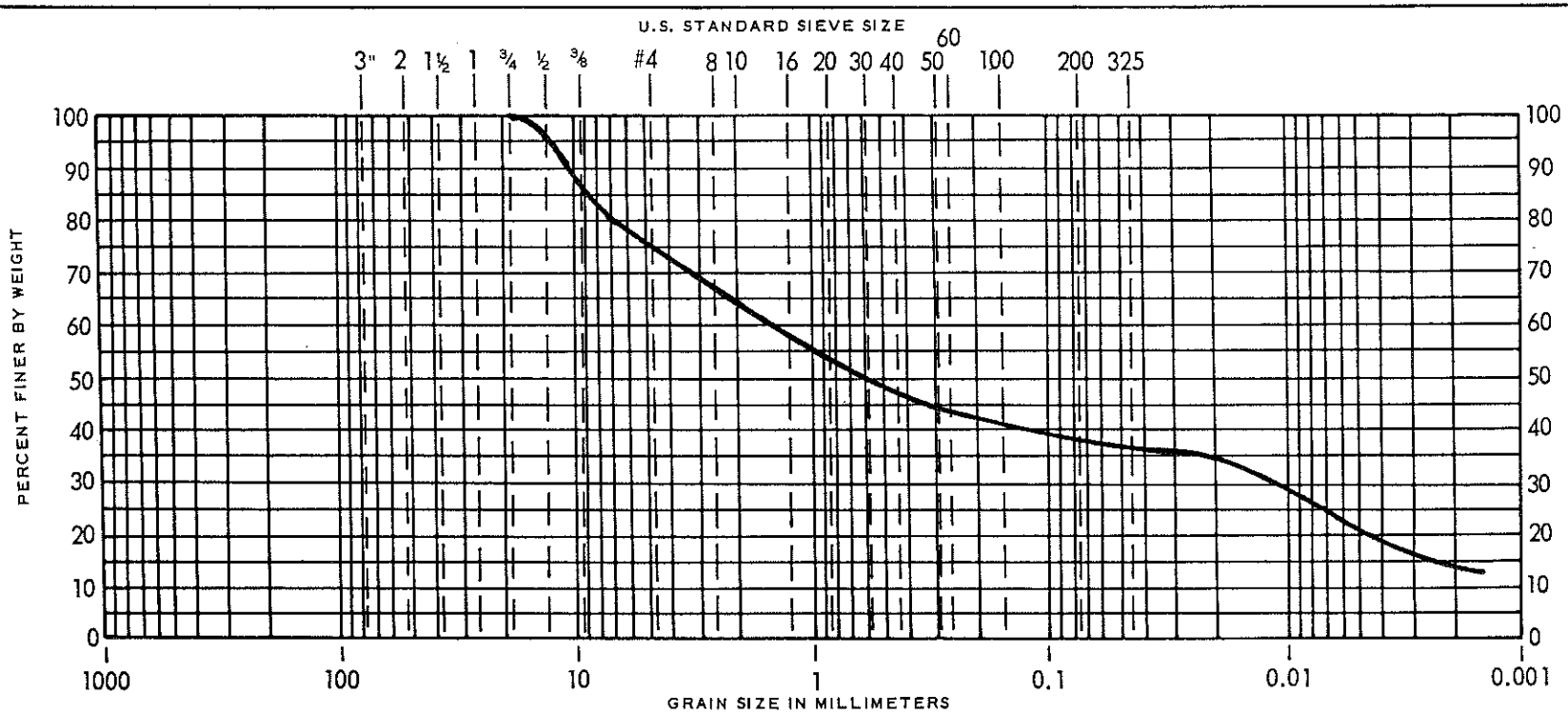


COBBLES	GRAVEL 3%		SAND 27%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	30%	40%

PROJECT	33767	NATURAL % MOISTURE	19.4	BOWSER-MORNER
		LIQUID LIMIT	--	TESTING LABORATORIES, INC.
BORING NO.	5	PLASTIC LIMIT	--	
SAMPLE NO.	3C	PLASTICITY INDEX	--	
DEPTH	27.5-29.5'	COLOR	Gray	

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 25%		SAND 37%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	17%	21%

PROJECT	33767	NATURAL % MOISTURE	12.4
		LIQUID LIMIT	--
BORING NO.	5	PLASTIC LIMIT	--
SAMPLE NO.	9A	PLASTICITY INDEX	--
DEPTH	39.0-40.0'	COLOR	Gray
CLASSIFICATION		REMARKS	Sample contained considerable gypsum.

BOWSER-MORNER
TESTING LABORATORIES, INC.

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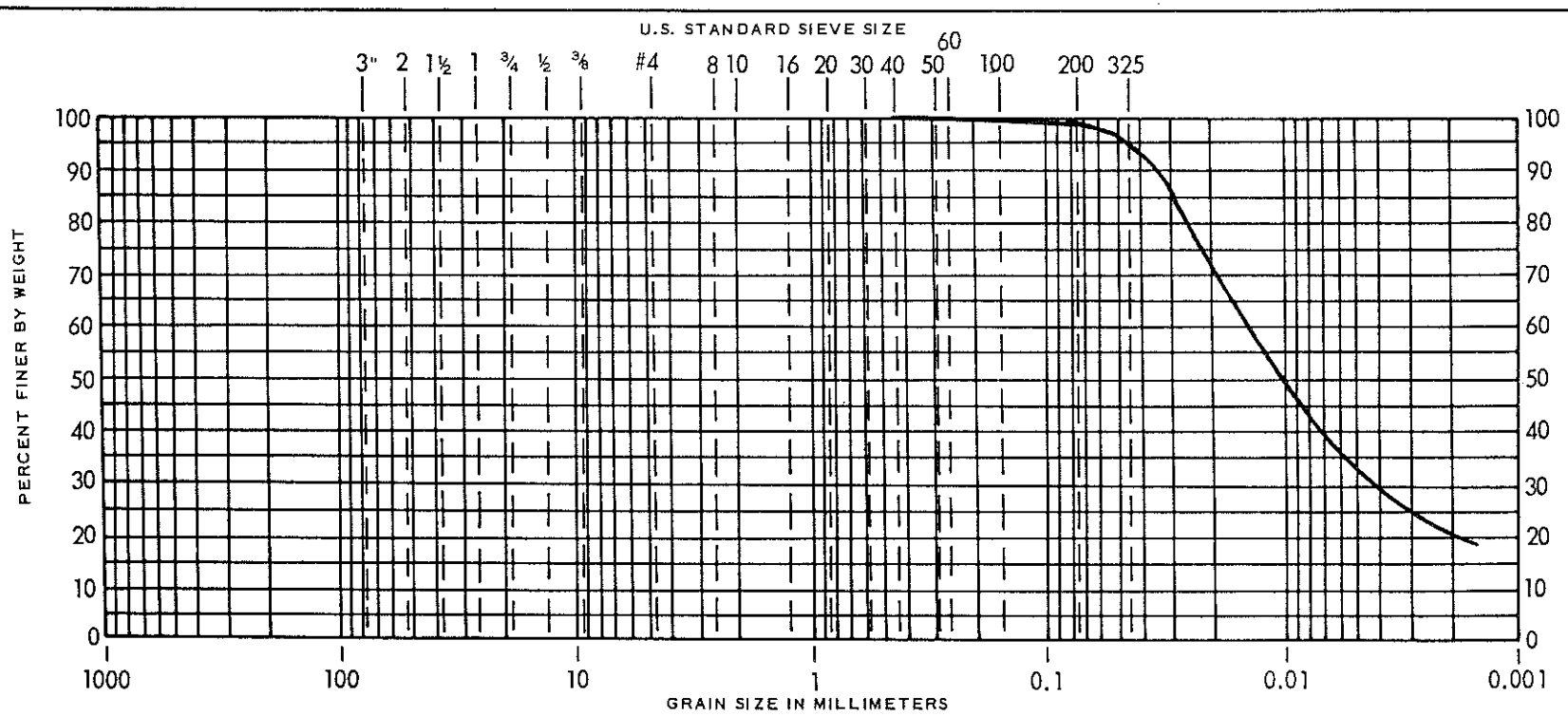
SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 0%		SAND 1%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	66%	33%

PROJECT	33767	NATURAL % MOISTURE	26.2
		LIQUID LIMIT	--
BORING NO.	9	PLASTIC LIMIT	--
SAMPLE NO.	1C	PLASTICITY INDEX	--
DEPTH	9.0-11.0'	COLOR	Brown

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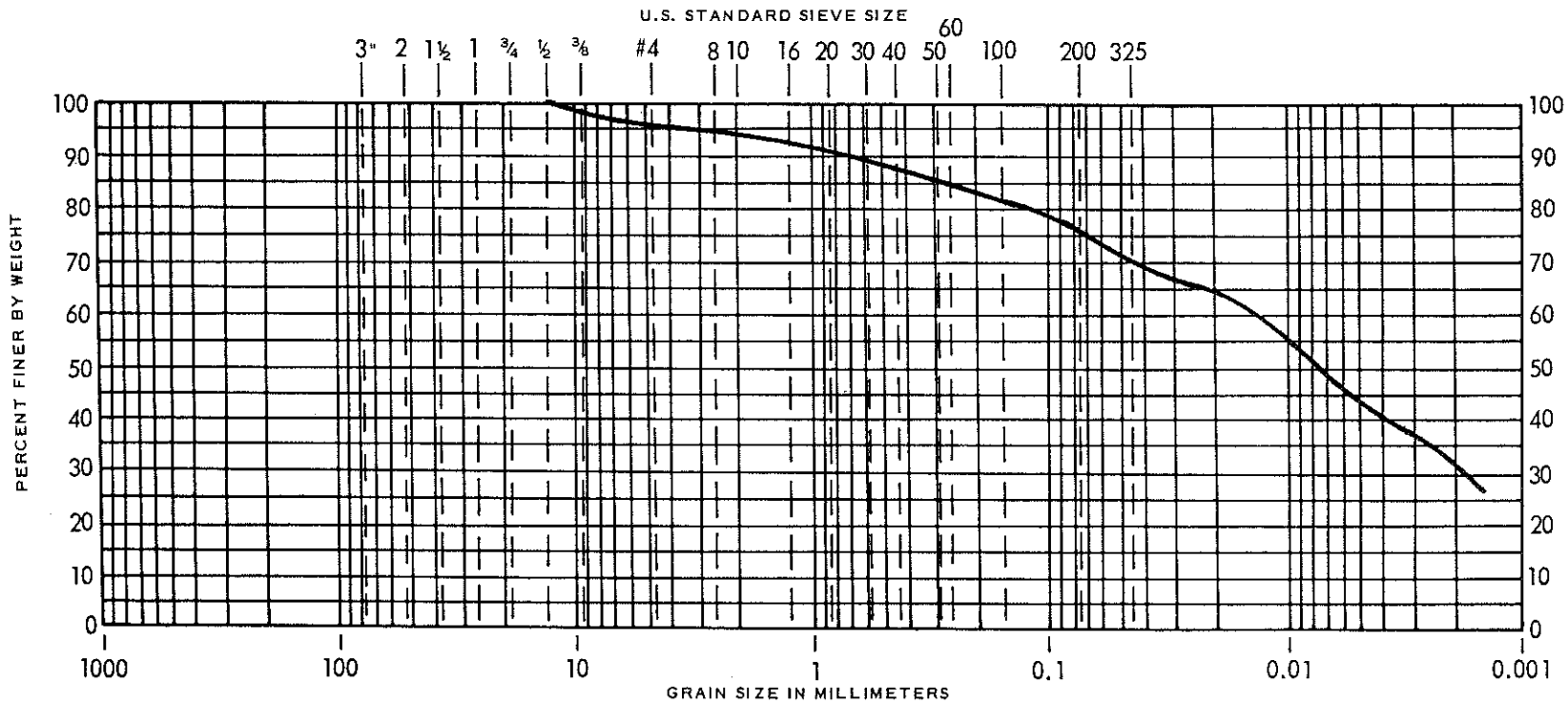
TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



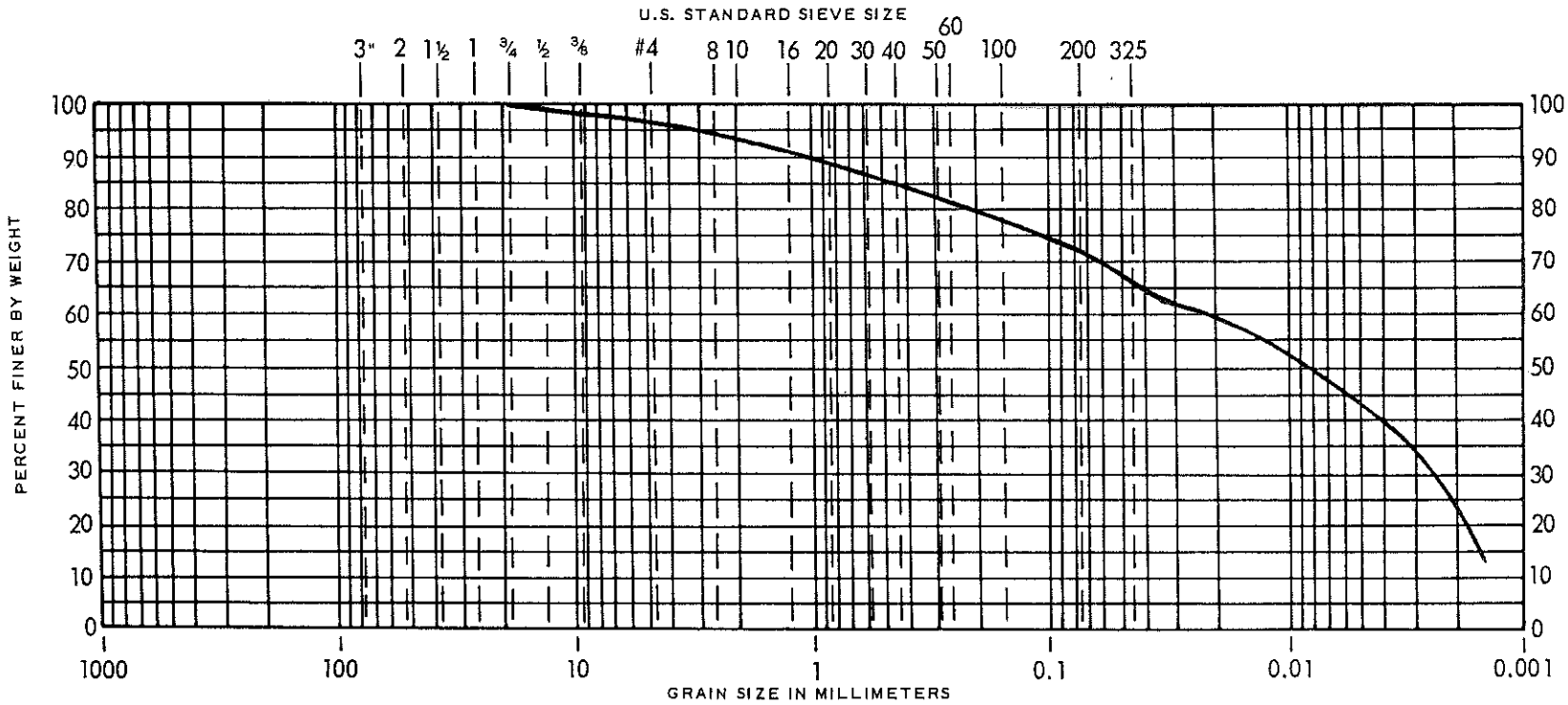
COBBLES	GRAVEL 4%		SAND 20%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	32%	44%

PROJECT	33767	NATURAL % MOISTURE	28.2
		LIQUID LIMIT	--
BORING NO.	9	PLASTIC LIMIT	--
SAMPLE NO.	3A	PLASTICITY INDEX	--
DEPTH	14.0-15.5'	COLOR	Gray

BOWSER-MORNER
TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET

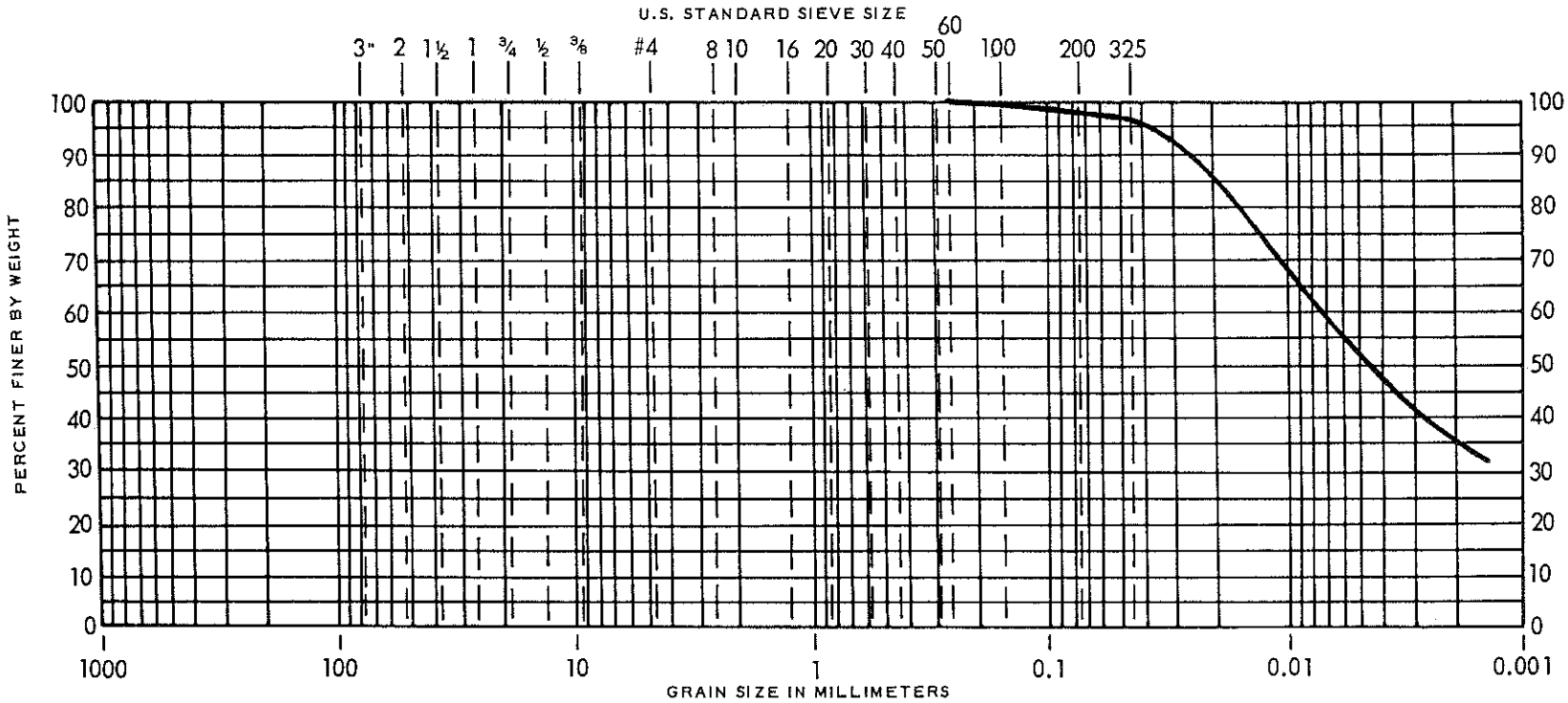


COBBLES	GRAVEL 3%		SAND 25%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	29%	43%

PROJECT	33767	NATURAL % MOISTURE	17.6	BOWSER-MORNER
		LIQUID LIMIT	--	TESTING LABORATORIES, INC.
BORING NO.	9	PLASTIC LIMIT	--	
SAMPLE NO.	3C	PLASTICITY INDEX	--	
DEPTH	29.0-31.0'	COLOR	Gray	

2A-34R

SOIL CLASSIFICATION SHEET



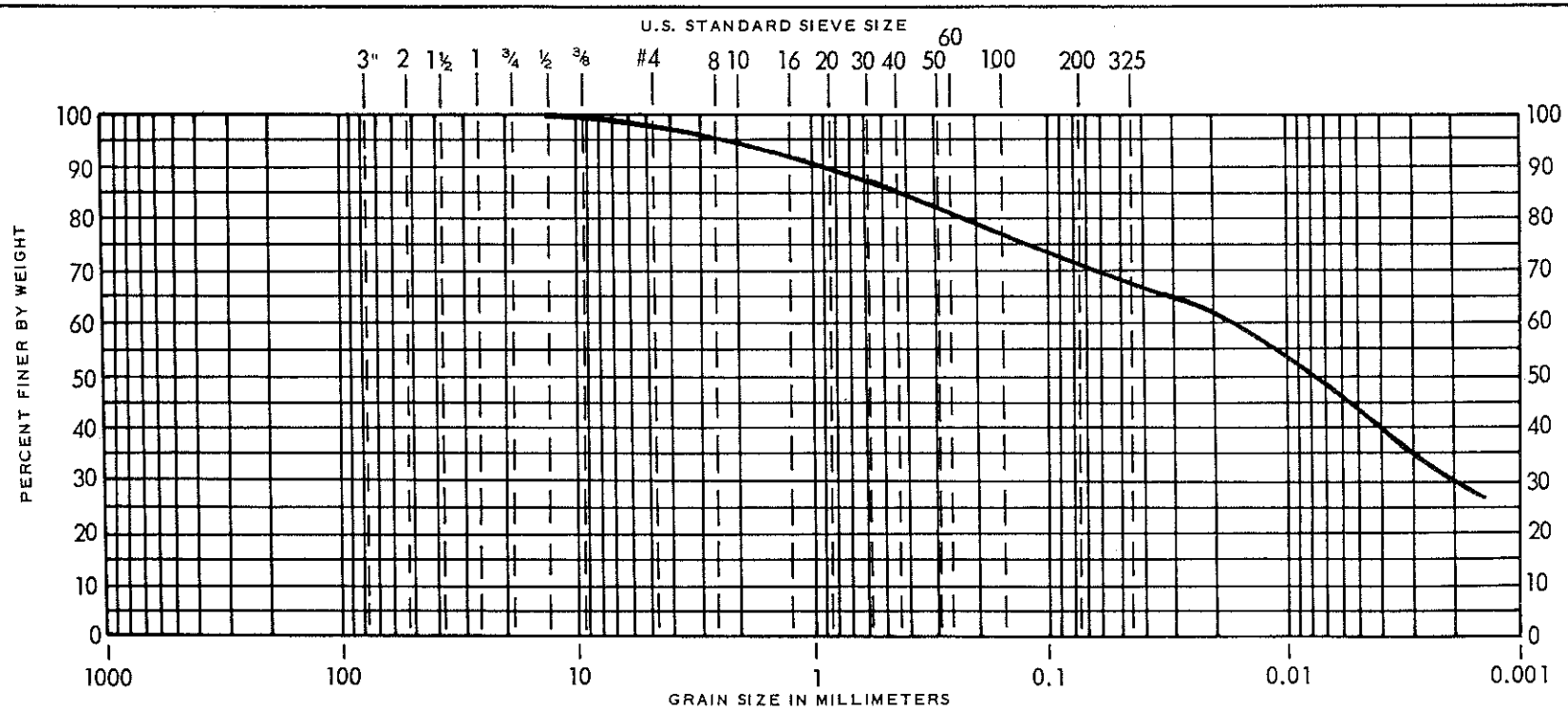
COBBLES	GRAVEL 0%		SAND 2%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	45%	52%

PROJECT	33767	NATURAL % MOISTURE	25.3
		LIQUID LIMIT	--
BORING NO.	11	PLASTIC LIMIT	--
SAMPLE NO.	3A	PLASTICITY INDEX	--
DEPTH	9.0-10.5'	COLOR	Brown
CLASSIFICATION		REMARKS	

BOWSER-MORNER
TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 2%		SAND 27%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	27%	44%

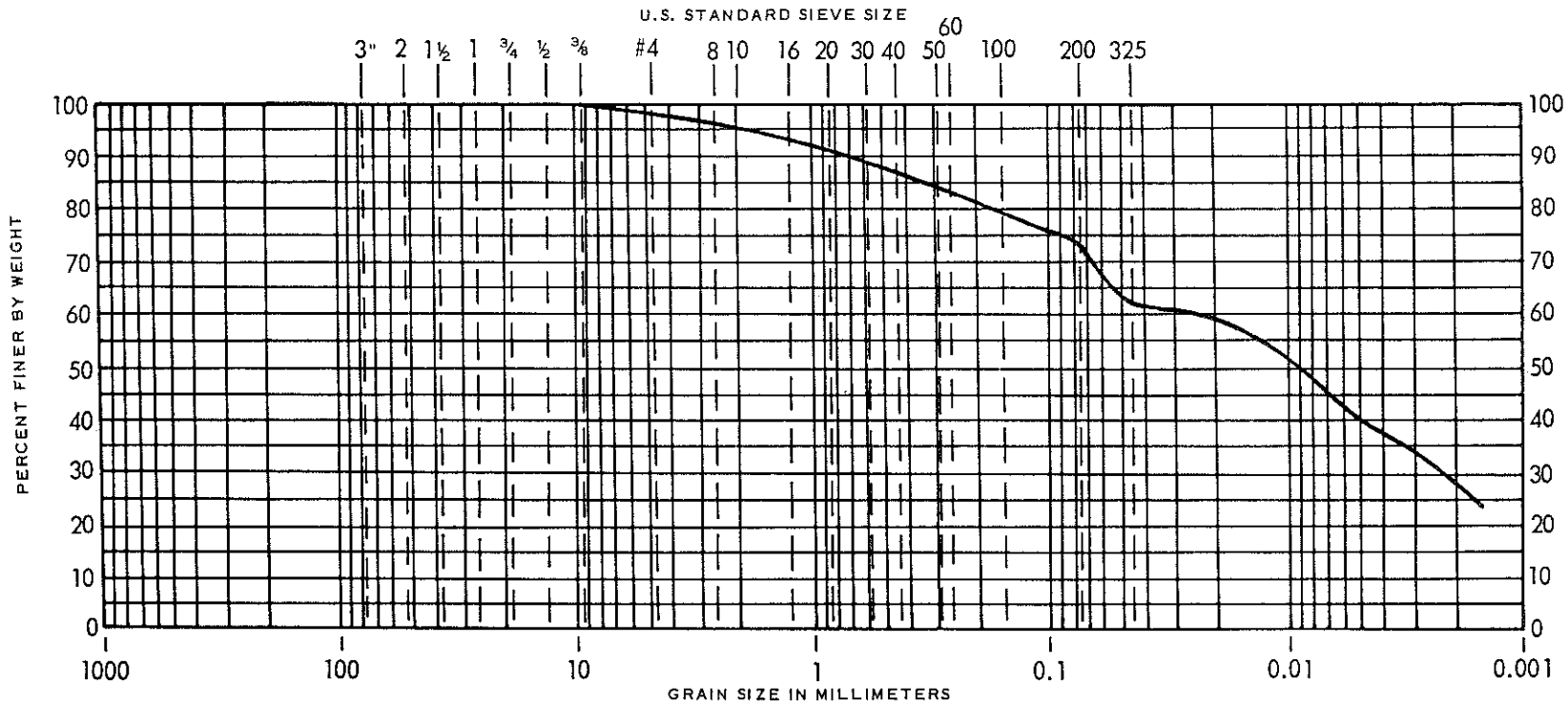
PROJECT	33767	NATURAL % MOISTURE	18.5
		LIQUID LIMIT	--
BORING NO.	11	PLASTIC LIMIT	--
SAMPLE NO.	6A	PLASTICITY INDEX	--
DEPTH	24.0-25.5'	COLOR	Gray
CLASSIFICATION		REMARKS	

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



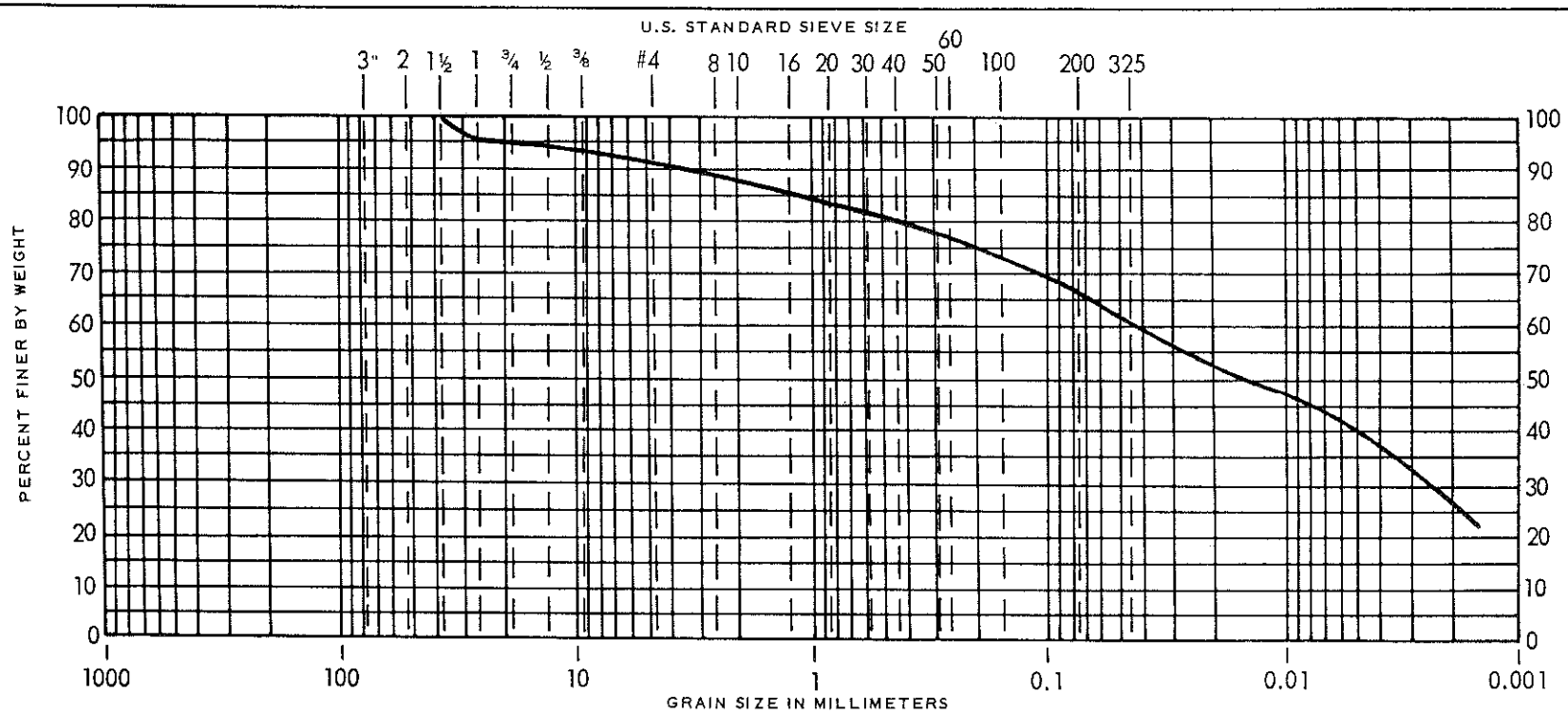
PROJECT	33767	NATURAL % MOISTURE	20.2
		LIQUID LIMIT	26
BORING NO.	12	PLASTIC LIMIT	17
SAMPLE NO.	2C	PLASTICITY INDEX	9
DEPTH	14.0-16.0'	COLOR	Gray
CLASSIFICATION	Sandy clay, "CL"	REMARKS	U.S.C.S.
	A-4(4)		A.A.S.H.T.O. M145-73

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET

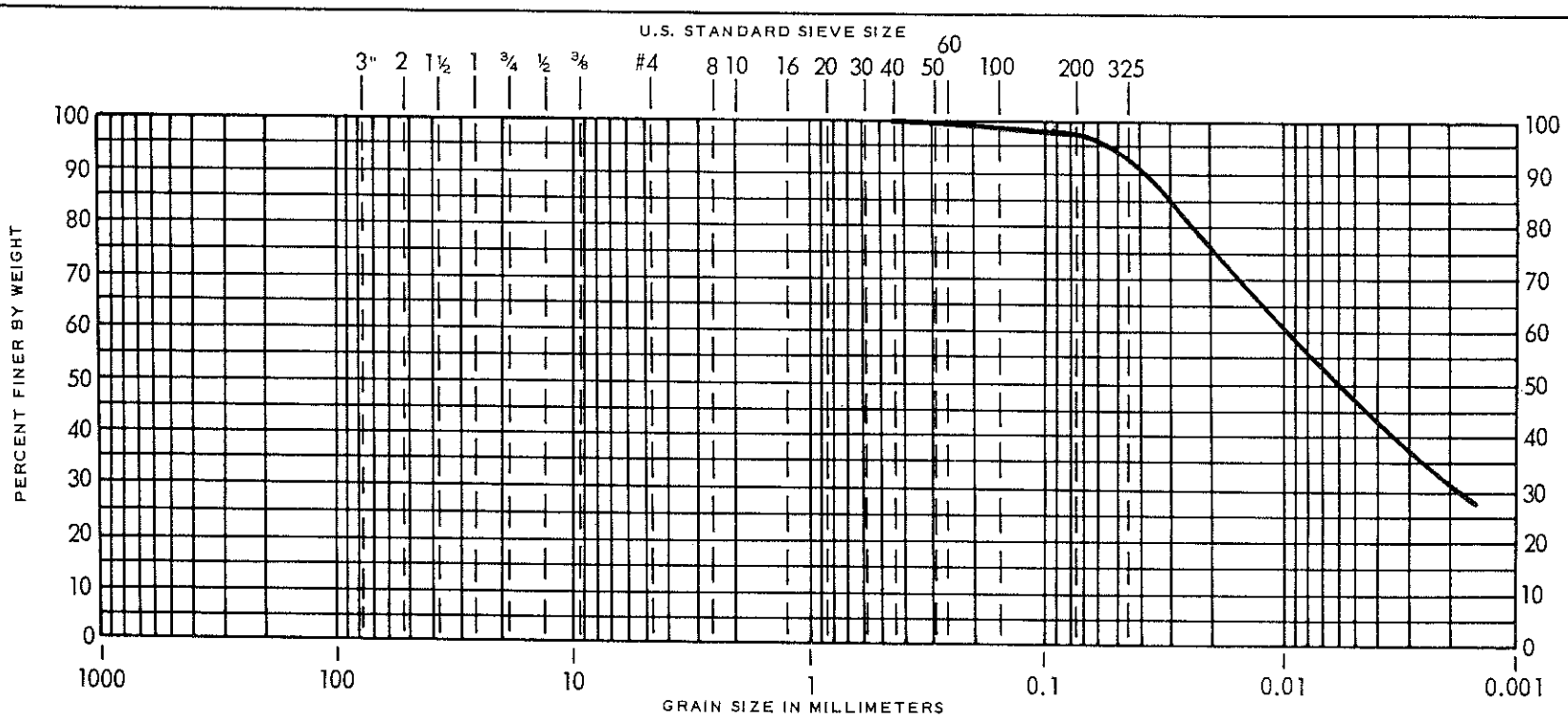


COBBLES	GRAVEL 8%		SAND 25%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	27%	40%

PROJECT	33767	NATURAL % MOISTURE	15.6	BOWSER-MORNER
		LIQUID LIMIT	--	TESTING LABORATORIES, INC.
BORING NO.	12	PLASTIC LIMIT	--	
SAMPLE NO.	4C	PLASTICITY INDEX	--	
DEPTH	34.0-36.0'	COLOR	Gray	

2A-34R

SOIL CLASSIFICATION SHEET



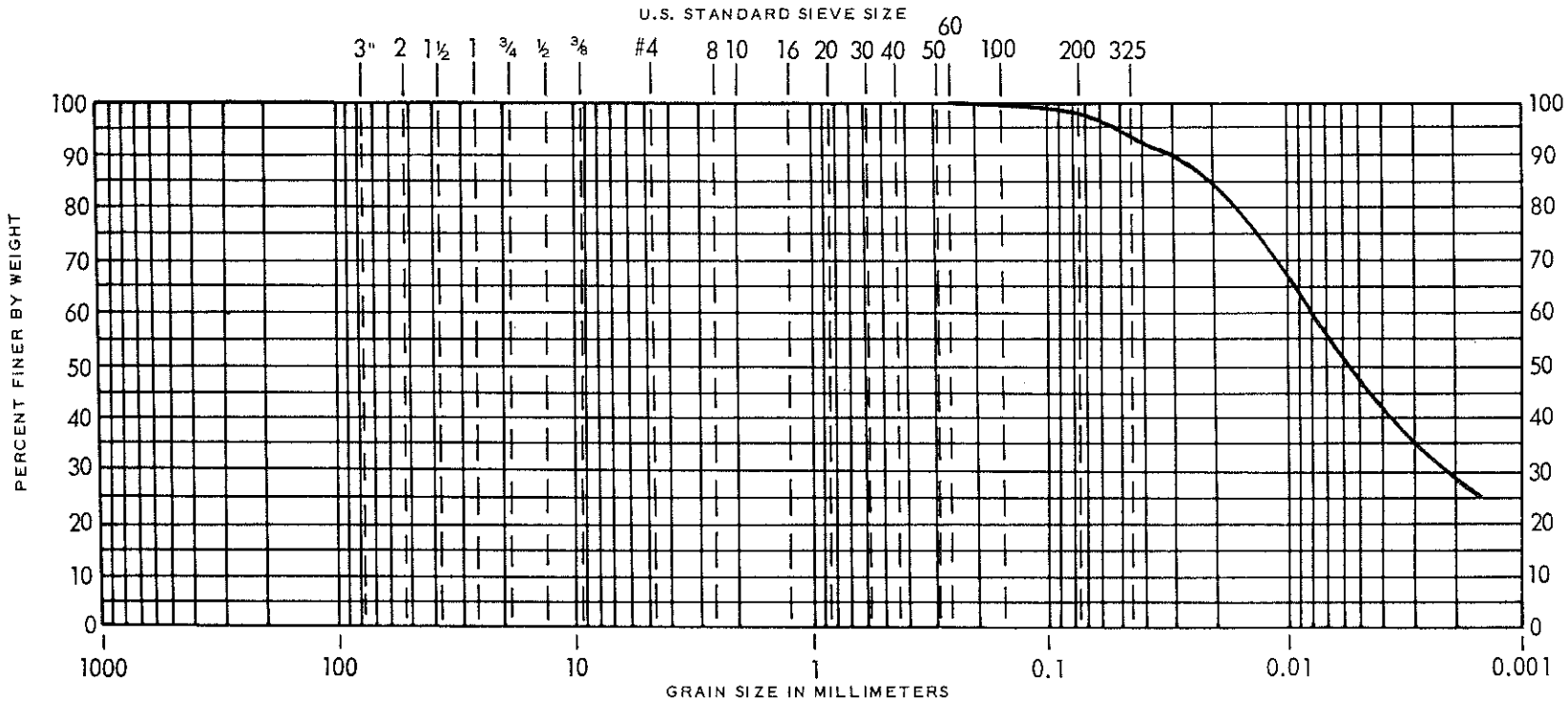
COBBLES	GRAVEL 0%		SAND 3%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	50%	47%

PROJECT	33767	NATURAL % MOISTURE	25.6
BORING NO.	14	LIQUID LIMIT	--
SAMPLE NO.	2A	PLASTIC LIMIT	--
DEPTH	4.0–5.5'	PLASTICITY INDEX	--
CLASSIFICATION		COLOR	Brown
		REMARKS	

BOWSER-MORNER
TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



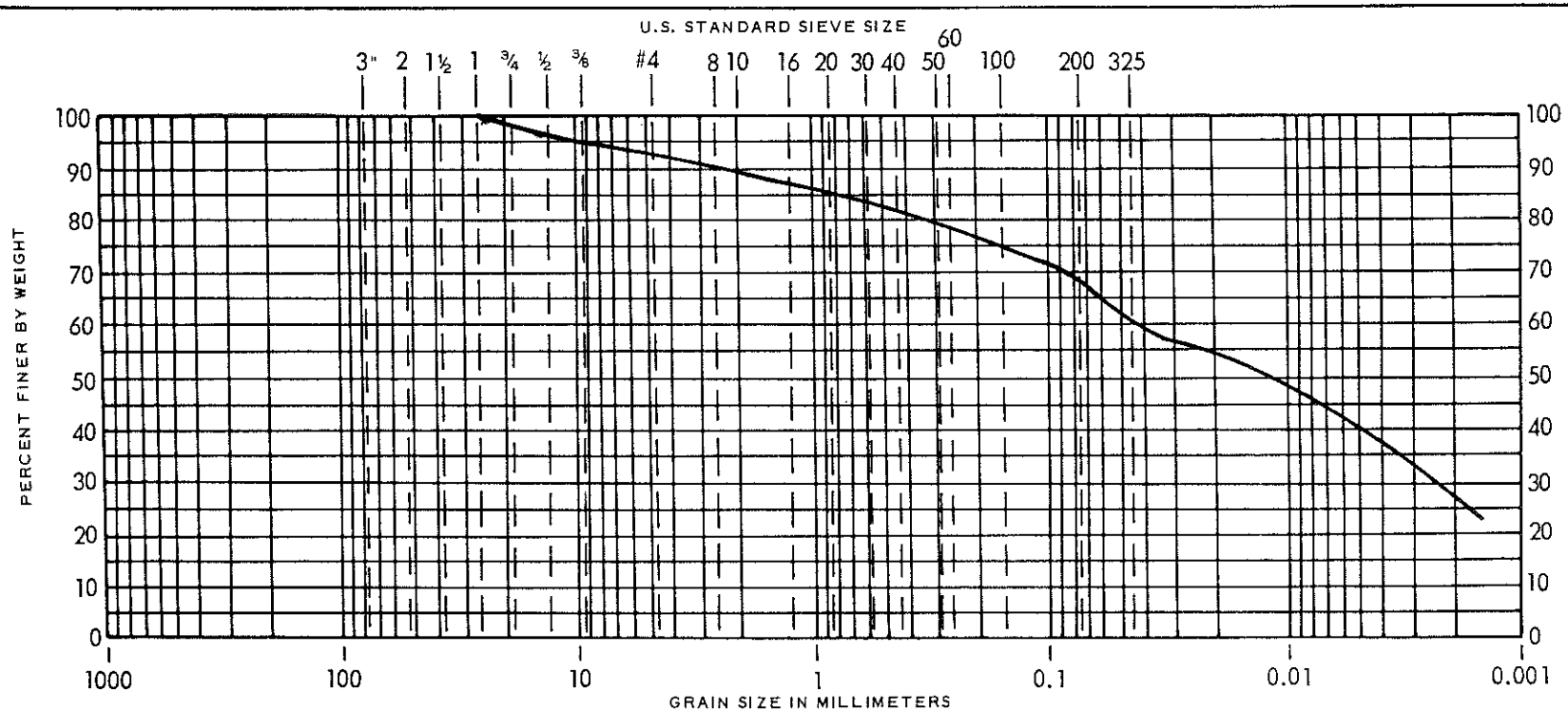
COBBLES	GRAVEL 0%		SAND 2%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	50%	48%

PROJECT	33767	NATURAL % MOISTURE	27.3
		LIQUID LIMIT	--
BORING NO.	14	PLASTIC LIMIT	--
SAMPLE NO.	1C	PLASTICITY INDEX	--
DEPTH	9.0-11.0'	COLOR	Brown

BOWSER-MORNER
TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET

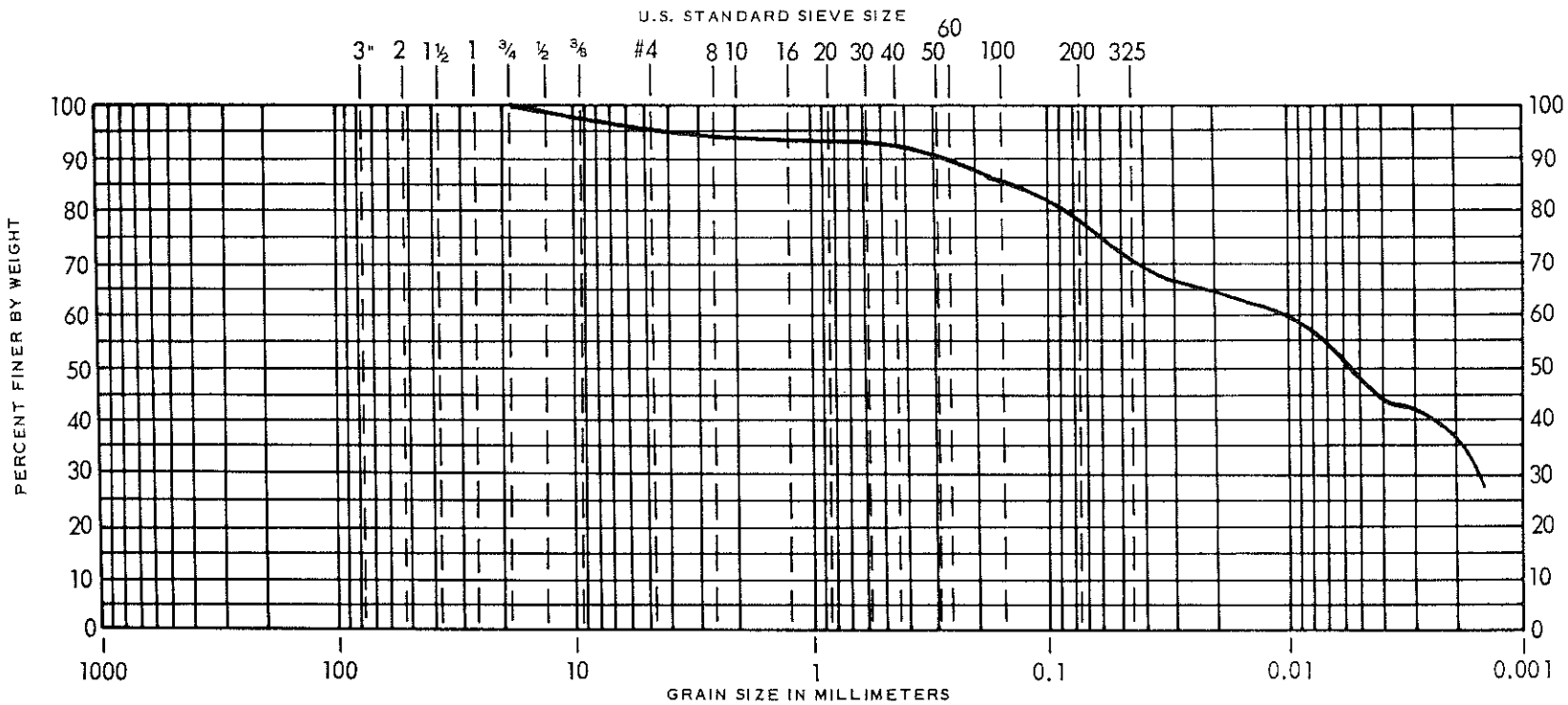


COBBLES	GRAVEL 8%		SAND 24%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	28%	40%

PROJECT	33767	NATURAL % MOISTURE	18.3	BOWSER-MORNER
		LIQUID LIMIT	25	TESTING LABORATORIES, INC.
BORING NO.	14	PLASTIC LIMIT	16	
SAMPLE NO.	2C	PLASTICITY INDEX	9	
DEPTH	19.0-21.0'	COLOR	Gray	
CLASSIFICATION	Sandy clay, "CL"	REMARKS	U.S.C.S.	
	A-4(4)		A.A.S.H.T.O. M145-73	

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 5%		SAND 17%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	30%	48%

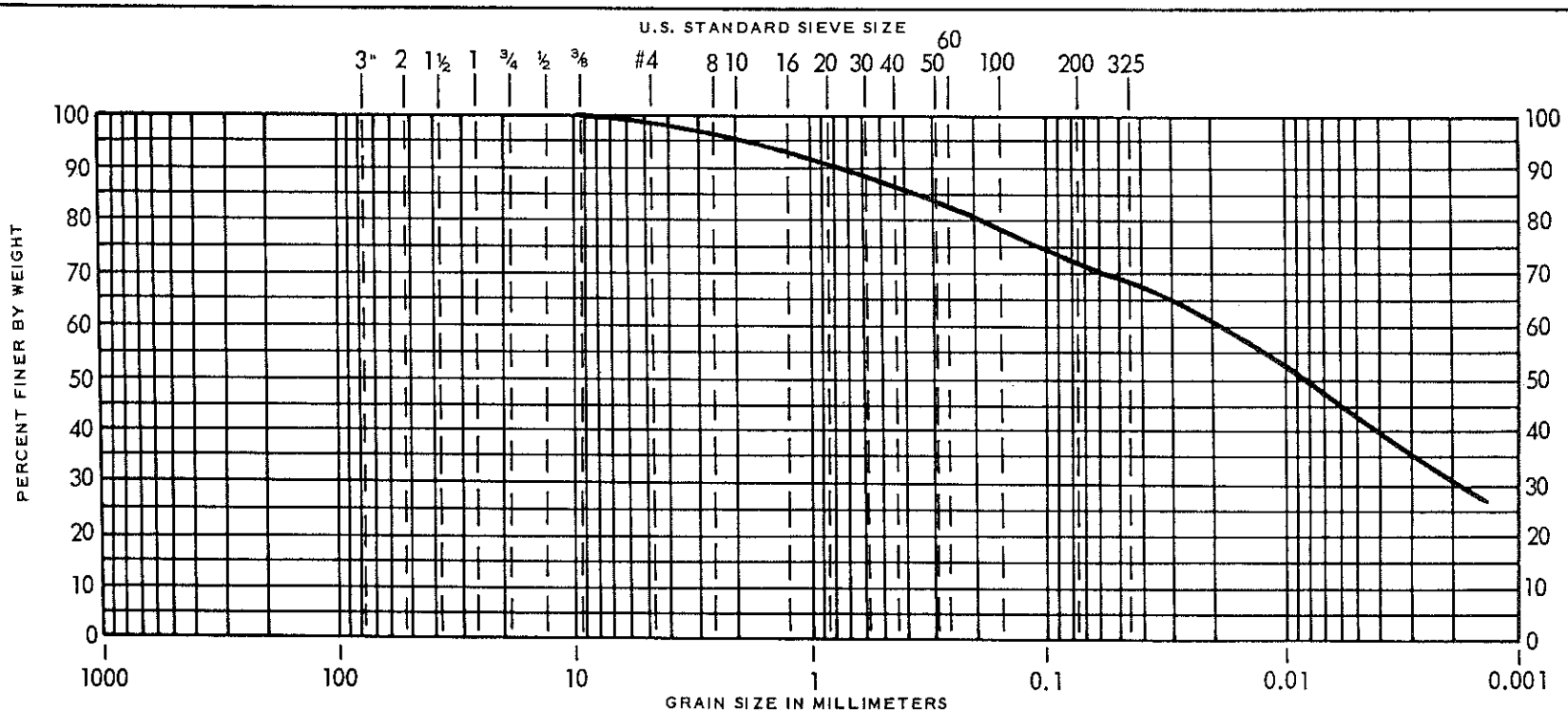
PROJECT	33767	NATURAL % MOISTURE	15.2
		LIQUID LIMIT	29
BORING NO.	14	PLASTIC LIMIT	17
SAMPLE NO.	4C	PLASTICITY INDEX	12
DEPTH	39.0-41.0'	COLOR	Gray
CLASSIFICATION	Lean clay, "CL"	REMARKS	U.S.C.S.
	A-6(7)		A.A.S.H.T.O. M145-73

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 2%		SAND 26%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	29%	43%

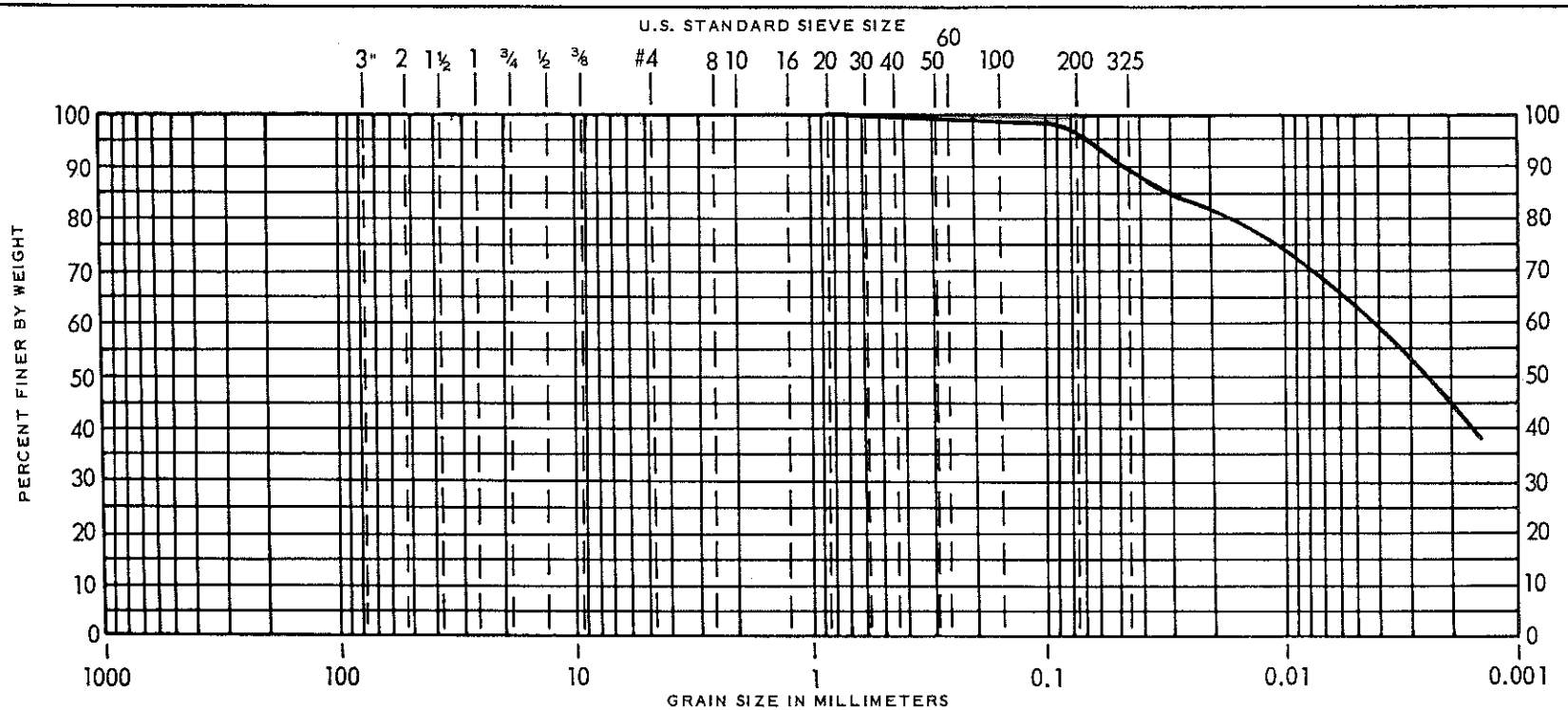
PROJECT	33767	NATURAL % MOISTURE	17.9
BORING NO.	18	LIQUID LIMIT	--
SAMPLE NO.	8A	PLASTIC LIMIT	--
DEPTH	34.0-35.5'	PLASTICITY INDEX	--
CLASSIFICATION		COLOR	Gray
		REMARKS	

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 0%		SAND 3%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	34%	63%

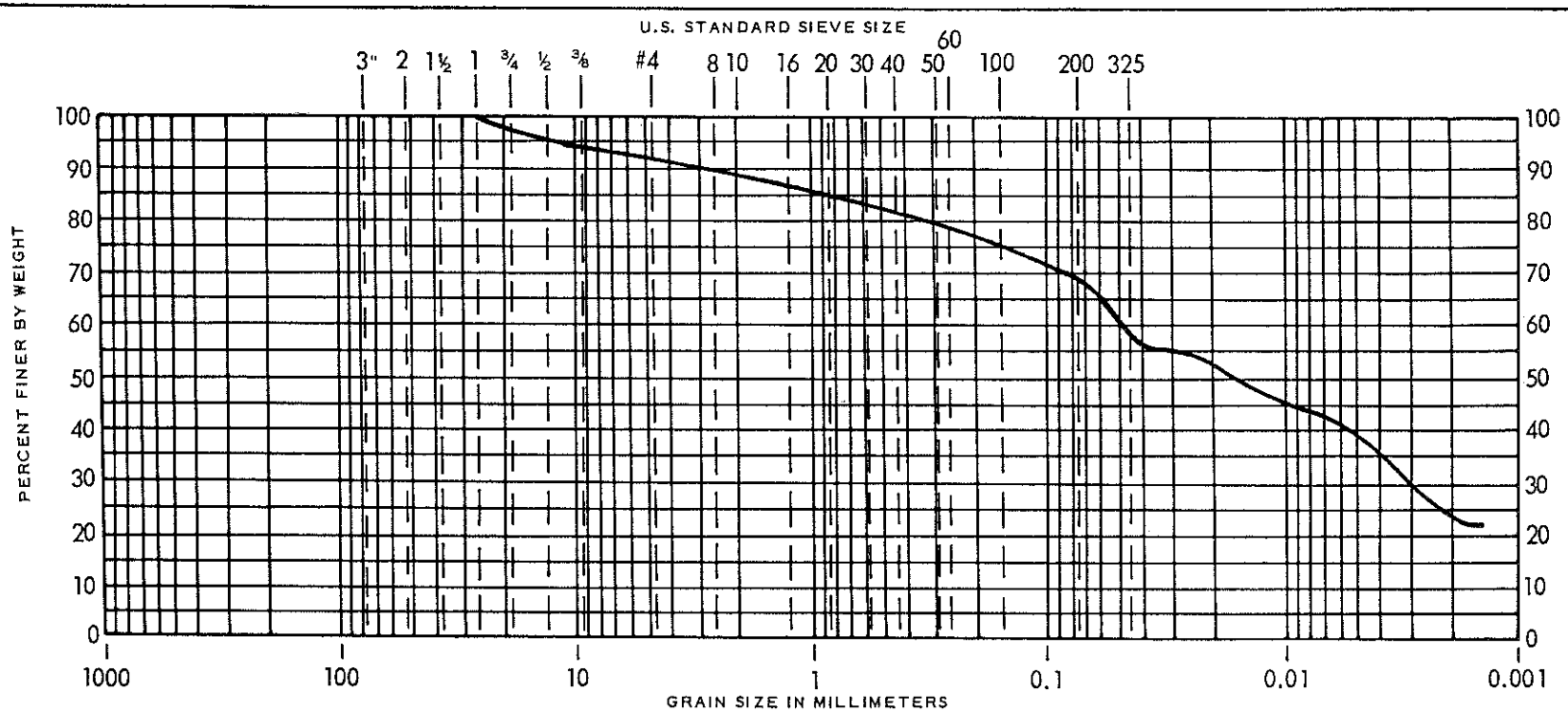
PROJECT	33767	NATURAL % MOISTURE	28.9
		LIQUID LIMIT	42
BORING NO.	19	PLASTIC LIMIT	24
SAMPLE NO.	1C	PLASTICITY INDEX	18
DEPTH	7.0-9.0'	COLOR	Gray/Brown
CLASSIFICATION	Silty clay, "CL"	REMARKS	U.S.C.S.
	A-7-6(20)		A.A.S.H.T.O. M145-73

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET

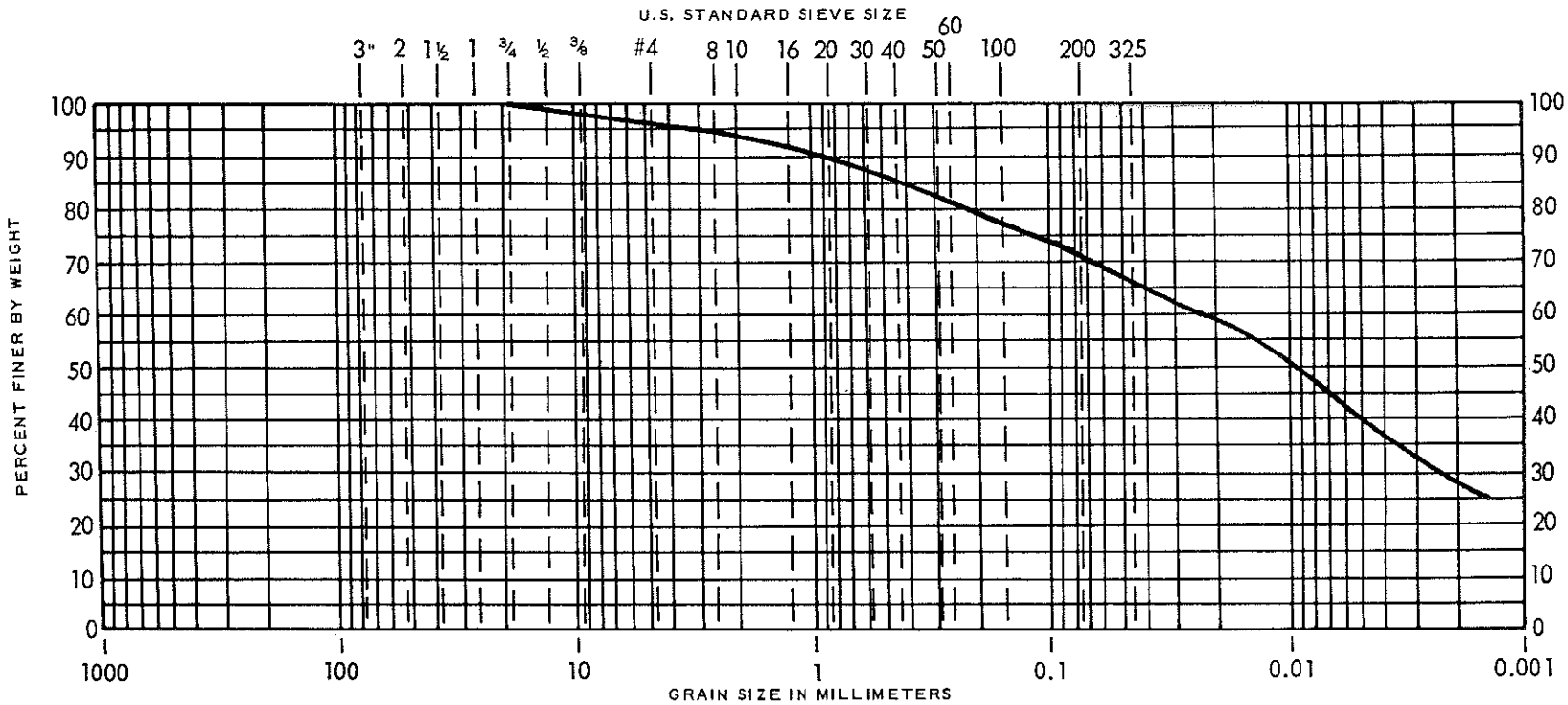


COBBLES	GRAVEL 8%		SAND 23%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	29%	40%

PROJECT	33767	NATURAL % MOISTURE	17.3	BOWSER-MORNER
BORING NO.	19	LIQUID LIMIT	25	TESTING LABORATORIES, INC.
SAMPLE NO.	2C	PLASTIC LIMIT	17	
DEPTH	27.0-29.0'	PLASTICITY INDEX	8	
CLASSIFICATION	Sandy clay, "CL"	COLOR	Gray	
	A-4(3)	REMARKS	U.S.C.S.	
			A.A.S.H.T.O. M145-73	

2A-34R

SOIL CLASSIFICATION SHEET

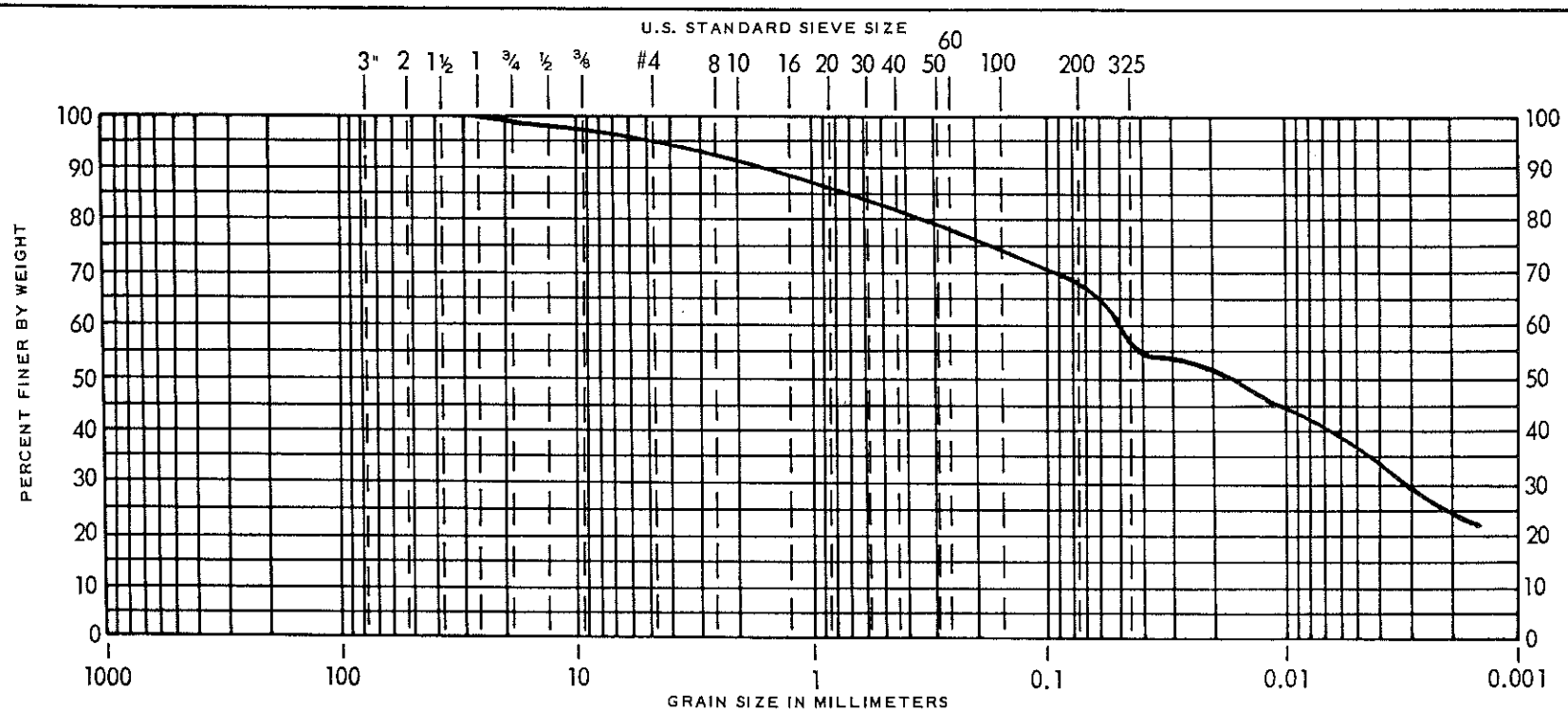


COBBLES	GRAVEL 4%		SAND 25%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	31%	40%

PROJECT	33767	NATURAL % MOISTURE	16.3	BOWSER-MORNER
BORING NO.	19	LIQUID LIMIT	--	TESTING LABORATORIES, INC.
SAMPLE NO.	10A	PLASTIC LIMIT	--	
DEPTH	44.0-45.5'	PLASTICITY INDEX	--	
CLASSIFICATION		COLOR	Gray	
		REMARKS		

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 5%		SAND 27%			SILT	CLAY
0%	COARSE	FINE	COARSE	MEDIUM	FINE	31%	37%

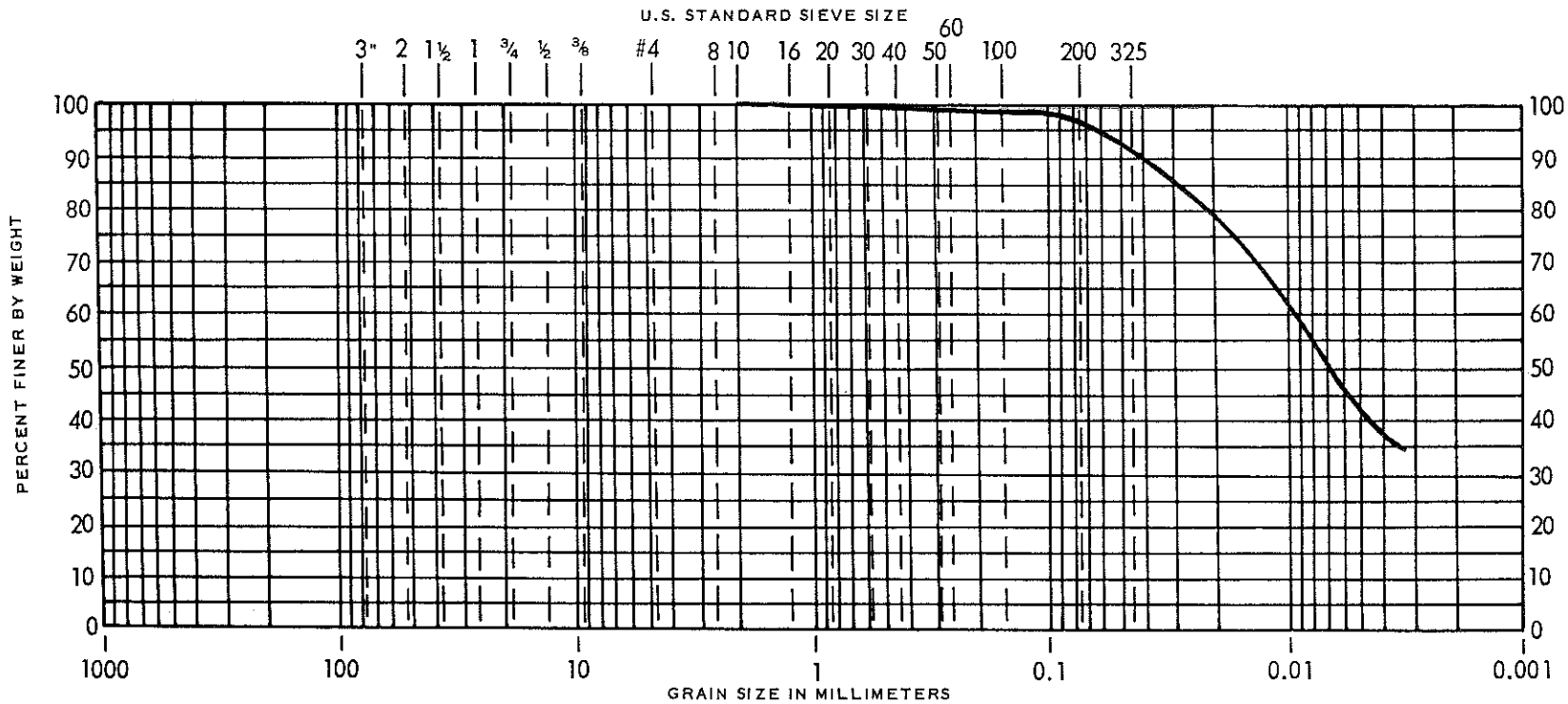
PROJECT	33767	NATURAL % MOISTURE	19.4
		LIQUID LIMIT	--
BORING NO.	22	PLASTIC LIMIT	--
SAMPLE NO.	3C	PLASTICITY INDEX	--
DEPTH	24.0-26.0'	COLOR	Gray

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

SOIL CLASSIFICATION SHEET



COBBLES	GRAVEL 0%		SAND 3%			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	55%	42%

PROJECT	33767	NATURAL % MOISTURE	--
		LIQUID LIMIT	32
BORING NO.	25	PLASTIC LIMIT	21
SAMPLE NO.	1C	PLASTICITY INDEX	11
DEPTH	7.0-9.0'	COLOR	Gray and brown mottled
CLASSIFICATION	Silty clay, "CL"	REMARKS	U.S.C.S.
	A-6(11)		A.A.S.H.T.O. M145-73

BOWSER-MORNER

TESTING LABORATORIES, INC.

2A-34R

Constant Head
Permeability Test

Project:	33767
Boring No:	1
Sample No:	2C
Depth Interval of Sample:	12.0'-14.0'
Depth Interval of Test Specimen:	12.4'-12.6'
Material Description:	Gray silt and clay, trace sand

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.077
Diameter:	2.796
Weight, lbs.,	
Initial:	0.919
Moisture Content, %:	
Initial:	28.1
Final:	27.5
Wet Unit Weight, pcf,	
Initial:	124.5
Final:	123.9
Dry Unit Weight, pcf,	
Initial:	97.2
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	7.0×10^{-9}

Constant Head
Permeability Test

Project:	33767
Boring No:	5
Sample No:	3C
Depth Interval of Sample:	27.5'-29.5'
Depth Interval of Test Specimen:	28.0'-28.2'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.000
Diameter:	2.766
Weight, lbs.,	
Initial:	0.961
Moisture Content, %:	
Initial:	18.8
Final:	18.0
Wet Unit Weight, pcf,	
Initial:	138.1
Final:	137.1
Dry Unit Weight, pcf,	
Initial:	116.2
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	1.5×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	9
Sample No:	1C
Depth Interval of Sample:	9.0'-11.0'
Depth Interval of Test Specimen:	10.0'-10.2'
Material Description:	Gray silt, some clay, trace sand

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.229
Diameter:	2.848
Weight, lbs.,	
Initial:	0.993
Moisture Content, %:	
Initial:	27.0
Final:	28.4
Wet Unit Weight, pcf,	
Initial:	120.9
Final:	122.2
Dry Unit Weight, pcf,	
Initial:	95.1
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	6.1×10^{-9}

Constant Head
Permeability Test

Project:	33767
Boring No:	9
Sample No:	3C
Depth Interval of Sample:	29.0'-31.0'
Depth Interval of Test Specimen:	30.0'-30.2'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.000
Diameter:	2.787
Weight, lbs.,	
Initial:	0.948
Moisture Content, %:	
Initial:	18.0
Final:	18.1
Wet Unit Weight, pcf,	
Initial:	134.2
Final:	134.2
Dry Unit Weight, pcf,	
Initial:	113.7
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	1.6×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	12
Sample No:	2C
Depth Interval of Sample:	14.0'-16.0'
Depth Interval of Test Specimen:	14.2'-14.4'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.025
Diameter:	2.803
Weight, lbs.,	
Initial:	0.916
Moisture Content, %:	
Initial:	23.2
Final:	22.6
Wet Unit Weight, pcf,	
Initial:	126.7
Final:	126.1
Dry Unit Weight, pcf,	
Initial:	102.8
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	2.6×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	12
Sample No:	4C
Depth Interval of Sample:	34.0'-36.0'
Depth Interval of Test Specimen:	35.0'-35.2'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.086
Diameter:	2.809
Weight, lbs.,	
Initial:	1.019
Moisture Content, %:	
Initial:	17.7
Final:	17.8
Wet Unit Weight, pcf,	
Initial:	136.1
Final:	136.3
Dry Unit Weight, pcf,	
Initial:	115.7
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	1.6×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	14
Sample No:	1C
Depth Interval of Sample:	9.0'-11.0'
Depth Interval of Test Specimen:	10.3'-10.5'
Material Description:	Gray clay and silt, trace sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.000
Diameter:	2.828
Weight, lbs.,	
Initial:	0.894
Moisture Content, %:	
Initial:	29.9
Final:	30.8
Wet Unit Weight, pcf,	
Initial:	123.0
Final:	123.8
Dry Unit Weight, pcf,	
Initial:	94.7
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	3.5×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	14
Sample No:	2C
Depth Interval of Sample:	19.0'-21.0'
Depth Interval of Test Specimen:	20.4'-20.2'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.000
Diameter:	2.780
Weight, lbs.,	
Initial:	0.923
Moisture Content, %:	
Initial:	19.5
Final:	18.9
Wet Unit Weight, pcf,	
Initial:	131.4
Final:	130.7
Dry Unit Weight, pcf,	
Initial:	110.0
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	2.2×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	14
Sample No:	4C
Depth Interval of Sample:	39.0'-41.0'
Depth Interval of Test Specimen:	40.4'-40.6'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.116
Diameter:	2.855
Weight, lbs.,	
Initial:	1.044
Moisture Content, %:	
Initial:	12.1
Final:	16.2
Wet Unit Weight, pcf,	
Initial:	133.2
Final:	138.1
Dry Unit Weight, pcf,	
Initial:	118.8
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	8.4×10^{-9}

Constant Head
Permeability Test

Project:	33767
Boring No:	19
Sample No:	1C
Depth Interval of Sample:	7.0'-9.0'
Depth Interval of Test Specimen:	8.3'-8.5'
Material Description:	Gray clay, some silt, trace sand

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.050
Diameter:	2.811
Weight, lbs.,	
Initial:	0.888
Moisture Content, %:	
Initial:	15.6
Final:	25.8
Wet Unit Weight, pcf,	
Initial:	120.6
Final:	131.2
Dry Unit Weight, pcf,	
Initial:	104.3
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	1.5×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	19
Sample No:	2C
Depth Interval of Sample:	27.0'-29.0'
Depth Interval of Test Specimen:	28.0'-28.2'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.000
Diameter:	2.826
Weight, lbs.,	
Initial:	0.959
Moisture Content, %:	
Initial:	19.1
Final:	18.3
Wet Unit Weight, pcf,	
Initial:	132.1
Final:	131.2
Dry Unit Weight, pcf,	
Initial:	110.9
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	3.1×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	22
Sample No:	3C
Depth Interval of Sample:	24.0'-26.0'
Depth Interval of Test Specimen:	25.0'-25.2'
Material Description:	Gray clay, some silt, some sand, trace gravel

SPECIMEN DATA:

Dimensions, inches,	
Height:	2.150
Diameter:	2.784
Weight, lbs.,	
Initial:	0.991
Moisture Content, %:	
Initial:	27.5
Final:	24.6
Wet Unit Weight, pcf,	
Initial:	130.8
Final:	127.9
Dry Unit Weight, pcf,	
Initial:	102.6
Back Pressure Saturation, psi,	
Pressures:	10.0
Permability, cm/sec,	
k:	2.4×10^{-8}

Constant Head
Permeability Test

Project:	33767
Boring No:	25
Sample No:	1C
Depth Interval of Sample:	7.0'-9.0'
Depth Interval of Test Specimen:	8.0'-8.2'
Material Description:	24"

SPECIMEN DATA:

Orientation of Flow:	Horizontal
Dimensions, inches,	
Height:	
Diameter:	2.254
	2.814
Weight, lbs.,	
Initial:	1.014
Moisture Content, %	
Initial:	23.4
Final:	24.4
Dry Unit Weight, pcf,	
Initial	125.0
Final:	126.0
Dry Unit Weight, pcf,	
Initial:	101.3
Back Pressure Saturation, psi,	
Pressures:	45.0
Permeability, cm/sec,	
k:	8.6×10^{-8}

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Fill:							
2	1A	1.0- 2.5					17.3			
13	1A	1.0- 2.5					29.4			
23	1A	1.0- 2.5					25.4			
	2A	4.5- 6.0					29.3			
	3A	9.5-11.0					26.4			
26	1A	1.0- 2.5					20.0			
	2A	4.0- 5.5					54.8			
	3A	9.0-10.5					28.7			
			Lucustrine deposits: Brown and/or Gray silty clay or clay ey silt with varying amounts of sand and occasional traces of gravel.							
1	1A	1.0- 2.5					14.4			CL
	1C	4.0- 6.0					Not Taken			
	2A	6.0- 7.5					24.7			
	3A	9.0-10.5					27.2			
	2C	12.0-14.0					27.7	97.2		CL
	4A	14.0-15.5					29.8			
	5A	19.0-20.5					29.2			ML-CL
	6A	24.0-25.5					21.3			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Lacustrine deposits (Continued)							
2	2A	4.0- 5.5					22.9			
	1C	7.0- 9.0					Not Taken			
	3A	9.0-10.5					26.0			CL
	4A	14.0-15.5					25.1			
3	1A	1.0- 2.5					26.6			
	2A	4.0- 5.5					28.1			
	3A	9.0-10.5					26.0			
5	1A	1.0- 2.5					17.6			CL
	1C	4.0- 6.0					Not Taken			
6	1A	1.0- 2.5					26.5			
	2A	4.0- 5.5					27.8			
	3A	9.0-10.5					25.5			
7	1A	1.0- 2.5					23.2			
	2A	4.0- 5.5					23.0			
	3A	9.0-10.5					22.6			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Lacustrine deposits (Continued)							
8	1A	1.0- 2.5					25.0			
	2A	4.0- 5.5					22.2			
9	1A	1.0- 2.5					18.3			
	2A	4.0- 5.5					24.2			
	1C	9.0-11.0					26.2	95.1		ML
10	1A	1.0- 2.5					20.2			
	2A	4.5- 6.0					22.3			
	3A	9.5-11.0					24.7			
	4A	14.5-16.0					25.4			
	5A	19.5-21.0					16.3			
11	1A	1.0- 2.5					21.3			
	2A	4.0- 5.5					26.6			
	3A	9.0-10.5					25.3			ML-CL
	4A	14.0-15.5					28.6			
12	1A	1.0- 2.5					19.9			
	1C	4.0- 6.0					Not Taken			
	2A	9.0-10.5					24.6			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plasticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classification
			Lacustrine deposits (Continued)							
13	2A	4.0- 5.5					26.1			
	3A	9.0-10.5					23.9			
	4A	14.0-15.5					25.0			
14	1A	1.0- 2.5					12.6			
	2A	4.0- 5.5					25.6			ML-CL
	1C	9.0-11.0					27.3	94.7		ML-CL
15	1A	1.0- 2.5					18.7			
	2A	4.0- 5.5					26.2			
	3A	9.0-10.5					31.7			
	4A	14.0-15.5					29.6			
	5A	19.0-20.5					26.8			
	6A	24.0-25.5					46.0			
16	1A	1.0- 2.5					27.0			
	2A	4.0- 5.5					23.1			
	3A	9.0-10.5					25.3			
	4A	14.0-15.5					29.5			
	5A	19.0-20.5					29.7			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Lacustrine deposits (Continued)							
17	1A	1.0- 2.5					25.3			
	2A	4.5- 6.0					25.9			
	3A	9.5-11.0					28.6			
	4A	14.5-16.0					41.6			
18	1A	1.0- 2.5					22.0			
	2A	4.0- 5.5					25.5			
	3A	9.0-10.5					28.4			
	4A	14.0-15.5					31.9			
	5A	19.0-20.5					27.8			
19	1A	1.0- 2.5					22.2			
	2A	4.0- 5.5					21.9			
	1C	7.0- 9.0					28.9	104.3		CL
	3A	9.0-10.5					34.9			
	4A	14.0-15.5					31.6			
20	1A	1.0- 2.5					22.1			
	2A	4.0- 5.5					26.6			
	3A	9.0-10.5					26.8			
	4A	14.0-15.5					31.1			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Lacustrine deposits (Continued)							
21	1A	1.0- 2.5					22.7			
	2A	4.5- 6.0					23.8			
	3A	9.5-11.0					25.0			
22	1A	1.0- 2.5					17.2			
	1C	4.0- 6.0					Not Taken			
	2A	9.0-10.5					28.0			
23	4A	14.5-16.0					25.0			
24	1A	1.0- 2.5					25.1			
	2A	4.5- 6.0					24.0			
	3A	9.5-11.0					28.7			
	4A	14.5-16.0					37.5			
	5A	19.5-21.0					36.1			
25	1A	1.0- 2.5					19.5			
	2A	4.0- 5.5					28.3			
	1C	7.0- 9.0					23.4	101.3		CL
	3A	9.0-10.5					19.8			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Lacustrine deposits (Continued)							
26	4A	14.0-15.5					26.3			
	5A	19.0-20.5					24.8			
	6A	24.0-25.5					30.5			
27	1A	1.0- 2.5					20.8			
	2A	4.5- 6.0					29.0			
	3A	9.5-11.0					21.1			
28	1A	1.0- 2.5					20.3			
	2A	4.5- 6.0					24.5			
	3A	9.5-11.0					28.8			
29	1A	1.0- 2.5					17.1			
	1C	4.0- 6.0					Not Taken			
30	1A	1.0- 2.5					21.0			
	2A	4.0- 5.5					21.9			
	3A	9.0-10.5					22.6			
31	1A	1.0- 2.5					19.5			
	2A	4.0- 5.5					22.6			
	3A	9.0-10.5					27.1			
	4A	14.0-15.5					26.2			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plasticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classification
			Lacustrine deposits (Continued)							
32	1A	1.0- 2.5					28.4			
	2A	4.0- 5.5					26.3			
	3A	9.0-10.5					29.7			
			Glacial Till Brown and/or Gray, silty clay or clay-ey silt, some sand, trace of gravel:							
1	7A	29.0-30.5					18.8			
	3C	34.0-36.0					Not Taken			
2	5A	19.0-20.5					26.1			
	6A	24.0-25.5					17.9			
	7A	29.0-30.5					19.4			
	8A	34.0-35.5					19.7			
	9A	39.0-40.5					17.0			
3	4A	14.0-15.5					20.8			
	5A	19.0-20.5					18.2			
	6A	24.0-25.5					19.7			
	7A	29.0-30.5					19.6			
	8A	34.0-35.5					16.8			
4	1A	1.0- 2.5					21.4			
	2A	4.0- 5.5					19.2			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
4	3A	9.0-10.5					17.3			
	4A	14.0-15.5					17.6			
	5A	19.0-20.5					18.9			
	6A	24.0-25.5					19.9			
	7A	29.0-30.5					20.0			
	8A	34.0-35.5					16.4			
5	2A	6.0- 7.5					14.7			
	3A	9.0-10.5					17.0			
	2C	13.0-15.0					Not Taken			
	4A	15.0-16.5					18.5			
	5A	19.0-20.5					19.8			
	6A	24.0-25.5					19.2			
	3C	27.5-29.5					18.8	116.2		CL
	7A	29.8-31.0					No Sample			
	8A	34.0-35.5					17.9			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
6	4A	14.0-15.5					26.8			
	5A	19.0-20.5					18.7			
	6A	24.0-25.5					20.3			
	7A	29.0-30.5					16.0			
	8A	34.0-35.5					14.4			
7	4A	14.0-15.5					16.3			
	5A	19.0-20.5					18.6			
	6A	24.0-25.5					17.8			
	7A	29.0-30.5					19.8			
	8A	34.0-35.5					16.8			
	9A	39.0-40.5					14.9			
8	3A	9.0-10.5					13.0			
	4A	14.0-15.5					18.9			
	5A	19.0-20.5					19.1			
	6A	24.0-25.5					18.5			
	7A	29.0-30.5					19.2			
	8A	34.0-35.5					17.9			
	9A	39.0-40.5					15.4			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
9	3A	14.0-15.5					28.2			CL
	2C	19.0-21.0					Not Taken			
	4A	24.0-25.5					18.0			
	3C	29.0-31.0					17.6	113.7		CL
	5A	34.0-35.5					17.3			
	4C	39.0-41.0					Not Taken			
	6A	41.0-42.5					14.1			
10	5A	19.5-21.0					16.3			
	6A	24.5-26.0					18.2			
	7A	29.5-31.0					18.4			
	8A	34.5-36.0					18.3			
	9A	39.5-41.0					16.7			
11	5A	19.0-20.5					18.5			
	6A	24.0-25.5					18.5			CL
	7A	29.0-30.5					18.8			
	8A	34.0-35.5					18.0			
	9A	39.0-40.5					15.5			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
12	2C	14.0-16.0					20.2	102.8		CL
	3A	19.0-20.5					34.9			
	3C	24.0-26.0					Not Taken			
	4A	29.0-30.5					19.0			
	4C	34.0-36.0					15.6	115.7		CL
	5A	39.0-40.5					14.8			
13	5A	19.0-20.5					38.3			
	6A	24.0-25.5					20.4			
	7A	29.0-30.5					19.8			
	8A	34.0-35.5					18.2			
	9A	39.0-40.5					15.6			
14	3A	14.0-15.5					28.1			
	2C	19.0-21.0					18.3	110.0		CL
	4A	24.0-25.5					18.3			
	3C	29.0-31.0					Not Taken			
	5A	34.0-35.5					16.8			
	4C	39.0-41.0					15.2	118.8		CL

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
15	7A	29.0-30.5					20.1			
	8A	34.0-35.5					18.4			
	9A	39.0-40.5					15.4			
16	6A	24.0-25.5					26.8			
	7A	29.0-30.5					19.0			
	8A	34.0-35.5					18.9			
	9A	39.0-40.5					15.2			
17	5A	19.5-21.0					19.1			
	6A	24.5-26.0					20.6			
	7A	29.5-31.0					19.4			
	8A	34.5-36.0					18.8			
	9A	39.5-41.0					15.2			
18	6A	24.0-25.5					32.9			
	7A	29.0-30.5					20.0			
	8A	34.0-35.5					17.9			CL
	9A	39.0-40.5					15.7			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
19	5A	19.0-20.5					20.0			
	6A	24.0-25.5					23.2			
	2C	27.0-29.0					17.3	110.9		CL
	7A	29.0-30.5					20.0			
	8A	34.0-35.5					19.1			
	9A	39.0-40.5					17.7			
20	5A	19.0-20.5					19.7			
	6A	24.0-25.5					20.2			
	7A	29.0-30.5					19.9			
	8A	34.0-35.5					17.5			
	9A	39.0-40.5					17.1			
21	4A	14.5-16.0					21.9			
	5A	19.5-21.0					19.6			
	6A	24.5-26.0					19.1			
	7A	29.5-31.0					18.8			
	8A	34.5-36.0					13.8			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
22	2C	14.0-16.0					Not Taken			
	3A	19.0-20.5					18.6			
	3C	24.0-26.0					19.4	102.6		CL
	4A	29.0-30.5					19.4			
	4C	34.0-34.5					Not Taken			
	5A	34.5-36.0					17.2			
	6A	39.0-40.5					16.6			
23	5A	19.5-21.0					25.3			
	6A	24.5-26.0					21.0			
	7A	29.5-30.0					21.0			
	8A	34.5-36.0					20.9			
	9A	39.5-41.0					19.1			
	10A	44.5-46.0					17.2			
	11A	49.5-51.0					18.7			
24	6A	24.5-26.0					20.5			
	7A	29.5-31.0					21.5			
	8A	34.5-36.0					17.9			
	9A	39.5-41.0					18.4			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
25	3A	9.0-10.5					19.8			
	4A	14.0-15.5					16.1			
	2C	17.0-19.0					Not Taken			
	5A	19.0-20.5					18.3			
	6A	24.0-25.5					18.0			
	3C	27.0-29.0					Not Taken			
	7A	29.0-30.5					19.0			
	8A	34.0-35.5					18.7			
	9A	39.0-40.5					16.3			
	10A	44.0-45.5					16.0			
26	7A	29.0-30.5					18.4			
	8A	34.0-35.5					18.3			
	9A	39.0-40.5					18.3			
	10A	44.0-45.5					17.0			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
27	4A	14.5-16.0					19.0			
	5A	19.5-21.0					19.4			
	6A	24.5-26.0					14.3			
	7A	29.5-31.0					19.8			
	8A	34.8-36.0					18.8			
	9A	39.5-41.0					17.5			
28	4A	14.5-16.0					20.5			
	5A	19.5-21.0					19.1			
	6A	24.5-26.0					19.7			
	7A	29.5-31.0					19.1			
	8A	34.5-36.0					18.9			
	9A	39.5-41.0					15.5			
29	2A	6.0- 7.5					15.7			
	3A	9.0-10.5					17.5			
	4A	14.0-15.5					17.3			
	5A	19.0-20.5					19.2			
	2C	23.0-25.0					Not Taken			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Glacial Till deposits (Continued)							
29	6A	25.0-26.5					18.8			
	7A	29.0-30.5					17.3			
	8A	34.0-35.5					18.7			
30	4A	14.0-15.5					16.8			
	5A	19.0-20.5					21.0			
	6A	24.0-25.5					18.5			
	7A	29.0-30.5					17.9			
	8A	34.0-35.5					18.2			
	9A	39.0-40.5					15.6			
31	5A	19.0-20.5					18.5			
	6A	24.0-25.5					19.1			
	7A	29.0-30.5					19.2			
	8A	34.0-35.5					19.5			
32	4A	14.0-15.5					24.7			
	5A	19.0-20.5					25.6			
	6A	24.0-25.5					19.3			
	7A	29.0-30.5					19.1			
	8A	34.0-35.5					20.2			
	9A	39.0-40.5					15.9			

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plasticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classification
			Glacial Till Grey silt, some sand, some clay, trace gravel, usually contains gypsum.							
1	8A	36.0-37.5					14.3			
	9A	39.0-40.5					8.6			
2	10A	44.0-45.0					8.6			
	11A	49.0-49.5					*			
3	9A	39.0-40.5					Rock			
5	9A	39.0-40.0					12.4			SM-SC
10	10A	44.5-45.5					9.1			
11	10A	44.0-45.5					10.2			
15	10A	41.5-42.5					12.0			
17	10A	44.5-45.0					Rock			
18	10A	44.0-45.0					14.5			
19	10A	44.0-45.5					16.3			CL
	11A	49.0-49.5					---			
24	10A	44.5-45.5					14.1			
26	11A	49.0-49.5					7.9			
29	9A	39.0-40.5					9.6			

* Saturated

LABORATORY SUMMARY SHEET

Boring No.	Sample No.	Depth (Feet)	Material	Liquid Limits	Plastic Limits	Plas-ticity Index	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	U.S.C.S. Soil Classi-fication
			Tymochtee Formation							
1	10A	44.0-					No Sample			
2	11A	49.0-49.5					*			
4	9A	39.0-39.5					Rock			
6	9A	39.0-39.5					No Sample			
7	10A	43.5-44.0					24.8			
9	7A	44.0-44.5					Rock			
10	11A	49.5-50.0					Rock			
11	11A	49.0-49.5					*			
12	6A	44.0-44.5					Rock			
14	6A	44.0-44.5					9.1			
22	7A	44.0-45.5					*			
23	12A	54.5-55.0					16.9			
25	11A	49.0-49.5					Rock			
27	10A	43.0-43.5					Rock			
28	10A	44.5-45.0					Rock			
30	10A	43.0-43.5					8.2			
31	9A	39.0-40.5					16.8			
	10A	44.0-44.5					Rock			

* Saturated

APPENDIX B

INJECTION WELL LOGS

Schl.GR, Sch.P

Ohio Division Of Geological Survey

[redacted] S- 2745

Permit No. 210
Permit Issued 2-24-72
Quadrangle Clyde
Twp. Quarter

County Sandusky Township Riley
Section 26 Lot Tract
Measured 250' NL & 2123' EL of Sec. 26
20 Acres

PE - Strat Test - R.T.

Land Owner Ohio Liquid Disposal Well No. 1 Date Commenced 3-1-72
Operator Ohio Liquid Disposal, Inc. Well No. Date Completed 3-16-72
Elevation Bar S.L. Total Depth 2933' Plugged Back
Formation Drld. To. Prod. Form. Prod. Nat.
I.P.
Init. Rock Press.
Casing Record 8" 643'. 5½" 2809' Abandoned 7-23-80

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
X= 1,867,877				Conasauga	2481	2606	
Y= 621,400				Rome	2606	2748	
				Shady	2748	2810	
Overburden	0	65		Mt. Simon	2810	2932	
				Granite	2932	2933	TD
PLUGGING REPORT 12-22-80							
Big lime	65	605					
Trenton	1667	1828					
Black river	1828	2312					
Gull river	2312	2363					
Glenwood	2363	2366					
Knox	2366	2481					

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
	0	2315		NSR 11-2-72			
				Csg. 8-5/8"-643';5½"-2809'			
				B.Lm.	65	604	
				Tren.	1666	1828	
				B.Riv.	1828	2323	
				Glen.	2362	2366	
				L.Copper Ridge	2366	2481	
				Maynardsville	2481	2606	
				Rome	2606	2748	
				Shady	2748	2810	
				Mt.Simon	2810	2931	
				TD 2932			

[redacted]

SCHL:GRN,Cal,D,CB,L I.W.D.W. #19

BIRD:3DV

Permit No. 235
Permit Issued 9-5-79
Quadrangle Clyde
Twp. Quarter

County SANDUSKY Township RILEY

Section 26 Lot Tract

Measured 124.20' NL & 2377.95' EL of Sec. 26

20 acres Mt. Simon - IWDW - R.T.

Land Owner Ohio Liquid Disposal, Inc. Well No. 1A Date Commenced 9-10-79

Operator Ohio Liquid Disposal, Inc. Well No. Date Completed 9-27-79

Elevation Bar 606.11' 616.11'KB Total Depth 2980' Plugged Back

Formation Drld. To Pre-Cambrian Prod. Form. Mt. Simon Prod. Nat.

A/W 1M gal 15% HCl 10-18-79; A/W 4M gal 15% HCl 10-23-79 I.P.

Init. Rock Press.

Casing Record 16" 43' 125sks, 10 3/4" 632' 500sks, 7" 2342' Abandoned

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
Date: COMPLETION 3-12-80				X= 1,867,600			
Big lime	50	600	wtr	Y= 621,450			
Clinton	600	700		Rome	2594	2656	
Brassfield	700	743		Rome	2656	2746	wtr
Queenston	743	840		Shady	2746	2808	
Reedsville	840	1672		Mt. Simon	2808	2936	
Trenton	1672	1820		Granite	2936	2980	TD
Black river	1820	2307	s/gas 1850'	COMPLETION 8-6-80			
Gull river	2307	2360		Added treatment information.			
Glenwood	2360	2366					
Copper ridge	2366	2450					
Maynardville	2450	2594	wtr				

[redacted] S-3405

SCHL:GR,Cal,D,L,I,CB
BIRD:3DV,Tr

OHIO DIVISION OF GEOLOGICAL SURVEY #12

Permit No. 224
Permit Issued 1-28-76

County SANDUSKY Township RILEY Quadrangle Clyde
Section 26 Lot Tract Twp. Quarter
Measured 232' NL & 2635' EL of Sec. 26
25 Acres PG - IWDW - R.T.
Land Owner Ohio Liquid Disposal, Inc. Well No. 2 Date Commenced 6-17-76
Operator Ohio Liquid Disposal, Inc. Well No. Date Completed 11-23-76
Elevation Bar 607'G 615'DF 616'KB (618'KB) Total Depth 2961' Plugged Back
Formation Drld. To Pre-Cambrian Prod. Form. Prod. Nat.
A/W 5M gal. I.P.
Init. Rock Press. IWDW
Casing Record 10 3/4" 629'500sks, 7" 2371', 3½" 2800' Abandoned

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
Date: COMPLETION 3-20-78				X= 1,867,397			
Glacial deposits	0	60		Y= 621,418			
Big Lime	60	600		Glenwood	2360	2370	
Shale	600	690		Glenwood	2370	2380	
Dolomite	690	700		Knox	2380	2440	
Shale	700	710		Sandstone	2440	2590	
Dolomite	710	720		Rome	2590	2820	
Shale	720	880		Mt. Simon	2820	2930	
Dolomite	880	910		Basement	2930	2961	
Limestone	910	960					
Trenton	960	1560					
Black, Gull river	1560	2360					

[redacted] S-3416

SCHL:GR,Cal,D,CB,L,I
BIRD:GR,Cal,D,3DV,Tr * DIVISION OF GEOLOGICAL SURVEY #13

Permit No. 225
Permit Issued 1-28-76

County SANDUSKY Township RILEY Quadrangle Clyde

NE¼ Section 26 Lot Tract Twp. Quarter

Measured 1270' NL & 1878'EL of NE¼ Sec. 26

25 Acres PG - IWDW - R.T.

Land Owner Ohio Liquid Disposal, Inc. Well No. 3 Date Commenced 7-1-76

Operator Ohio Liquid Disposal, Inc. Well No. Date Completed 11-22-76

Elevation Bar (608.8' SL) 607' 618'KB Total Depth 2960' Plugged Back

Formation Drld. To Pre-Cambrian Prod. Form. Prod. Nat.

A/W 5M gal. 15% HCL I.P.

Init. Rock Press. I.W.D.W.

Casing Record 10 3/4" 663', 7" 2369', 3½" 2800' Abandoned

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
Date COMPLETION 3-30-78				X= 1,868,122			
Glacial deposits	0	67		Y= 620,380			
Big Lime	67	665		Dolomite	2500	2570	
Shale	665	1700		Sandstone	2570	2600	
Trenton	1700	1820		Dolomite	2600	2700	
Black, Gull river	1820	2360		Sandstone	2700	2720	
Glenwood	2360	2370		Dolomite	2720	2740	
Glenwood	2370	2400		Sandstone	2740	2750	
Knox	2400	2440		Dolomite	2750	2820	
Sandstone	2440	2450		Mt. Simon	2820	2890	
Dolomite	2450	2460		Basement	2890	2900	
Sandstone	2460	2500		*DIA-LOG COMPANY - Casing Profile Calipher log			

[redacted] [redacted] S-3417

BIRD:GR,Cal,D,CCL,I,3DV,Tr #14

OHIO DIVISION OF GEOLOGICAL SURVEY

Permit No. 226
Permit Issued 1-28-76
Quadrangle Clyde
Twp. Quarter

County SANDUSKY Township RILEY

NE¼ Section 26 Lot Tract

Measured 1165' NL & 935' EL of NE¼ Sec.26

25 Acres PG - IWDW - R.T.

Land Owner Ohio Liquid Disposal, Inc. Well No. 4 Date Commenced 7-15-76

Operator Ohio Liquid Disposal, Inc. Well No. Date Completed 11-24-76

Elevation Bar 609.1' SL 618'KB Total Depth 2905' Plugged Back

Formation Drld. To Pre-Cambrian Prod. Form. Prod. Nat.

A/W 5M gal. 15% HCL I.P.

Init. Rock Press. I.W.D.W.

Casing Record 10 3/4" 637' 500sks, 7" 2388', 3½" 2823' Abandoned

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
Date: COMPLETION 3-30-78				X= 1,869,065			
Glacial deposits	0	67		Y= 620,485			
Big Lime	67	665		Sandstone	2481	2509	
Shale	665	1680		Shale	2509	2519	
Trenton	1680	1830		Dolomite	2519	2520	
Limestone	1830	2370		Shale	2520	2529	
Glenwood	2370	2420		Sandstone	2529	2694	
Knox	2420	2426		Dolomite	2694	2711	
Sandstone	2426	2432		Sandstone	2711	2712	
Dolomite	2432	2435		Dolomite	2712	2797	
Sandstone	2435	2446		Mt. Simon	2797	2905	
Dolomite	2446	2481		Basement	2905	2910	

I.W.D.W.

Permit No. 237
Permit Issued 6-11-80
Quadrangle Clyde

County SANDUSKY Township RILEY
Section 26 Lot Tract Twp. Quarter
Measured 53.53' NL & 612.11' WL of Sec. 26
"Mt. Simon" - IWDW- R.T.

Land Owner Ohio Liquid Disposal, Inc. Well No. 5 Date Commenced
Operator Ohio Liquid Disposal, Inc. Well No. Date Completed
Elevation Bar 512' Total Depth Plugged Back
Formation Drld. To Prod. Form. Prod. Nat.
I.P.
Init. Rock Press.
Casing Record Abandoned

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
				X=1,865,375 Y= 621,520			

Compl

I.W.D.W.

11-17-81

Permit No. 238

Permit Issued 6-11-80

County SANDUSKY Township RILEY Quadrangle Clyde

Section 23 Lot Tract Twp. Quarter

Measured 546.98' SL & 3219.84' EL of Sec. 23

"Mt. Simon" - IWDW- R.T.

Land Owner Ohio Liquid Disposal, INc. Well No. 6 Date Commenced

Operator Ohio Liquid Disposal, INc. Well No. Date Completed

Elevation Bar 605' Total Depth Plugged Back

Formation Data To Prod. Form. Prod. Nat.

I.P.

Init. Rock Press.

Casing Record Abandoned

Formation	Top	Bottom	Remarks	Formation	Top	Bottom	Remarks
				X=1,866,780 Y= 622,100			

FEB 1982
RECEIVED
TOLEDO

APPENDIX C

WATER WELL LOGS

NOTE: Well log numbering is not necessarily consecutive. All well logs collected were re-numbered at the lower right hand corner with numbers that were assigned by ODNR during their logging procedures.

Additional information such as elevations of the ground surface, identification numbers, and miscellaneous comments is often added to the original copies by BOWSER-MORNER, INC. personnel to facilitate analysis. Examples of such additions are shown on the next page.

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

No. 11
602224
87i

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP #3

OWNER O. L. D' Inc. ADDRESS 504 Liberty Fremont, O

LOCATION OF PROPERTY St Rt 412 & 510

CONSTRUCTION DETAILS

Casing diameter 6" plastic Length of casing 47½

Type of screen — Length of screen —

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 5-6-81

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 50 gpm Duration of test 1 hrs

Drawdown 10' ft Date 5-6-81

Static level (depth to water) 10' ft

Quality (clear, cloudy, taste, odor) Black Sulfur

Pump installed by

WELL LOG*

607

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	15 ft
Blue Clay	15	45
Blue Limestone - Erosion	45	60

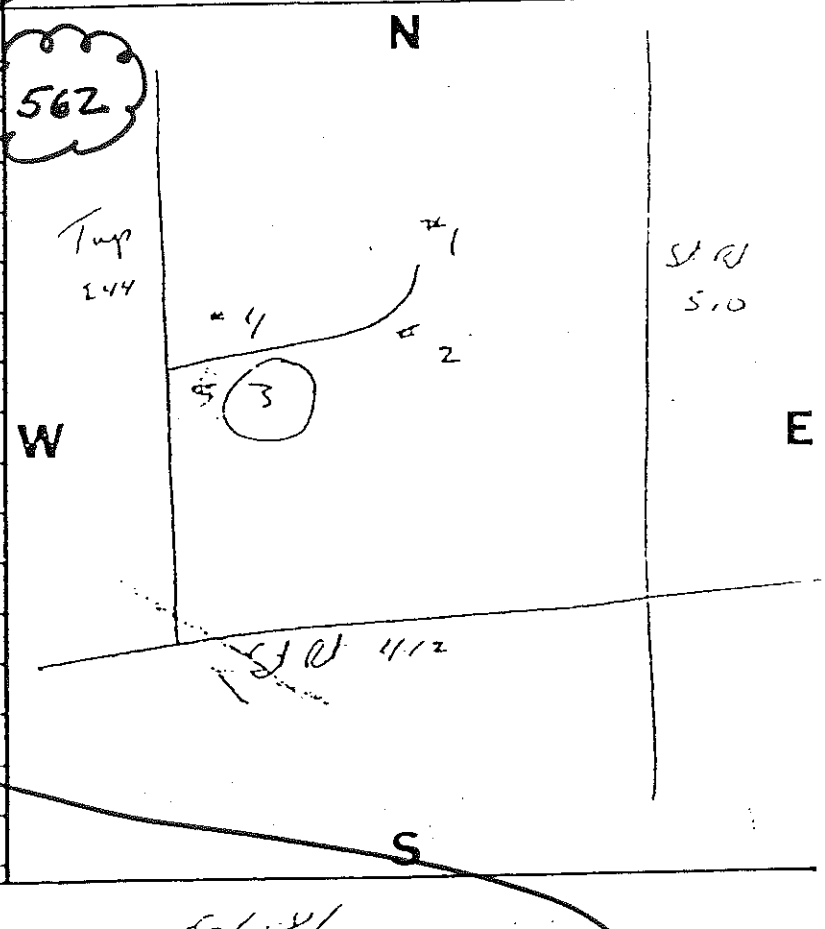
562

Monitor Well #11

DATA ADDED by BOWSER MORNER

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM TIBBOLES WELL DRILLING, INC.
ADDRESS 8377 No. St. Rt. 18
RR 3 Bellevue, Ohio 44811

DATE 5-6-81

SIGNED W. F. Tibbles

87i

*If additional space is needed to complete well log, use next consecutive numbered form.

LOCATED WELL LOG AND DRILLING REPORT

23 ?
location uncertain

NO. 71620

County Sandusky Township Riley Section of Township

Owner Arnold Staschke Address Vickery O

Location of property 1st house N of 12 on 510

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 4 1/4 Length of casing 47	Pumping rate G.P.M.
Type of screen Length of screen	Duration of test hrs.
Type of pump	Drawdown ft. Date 9-10-99
Capacity of pump	Developed capacity
Depth of pump setting	Static level - depth to water 11 ft.
Date of completion	Pump installed by

WELL LOG		
Formation	From	To
clay	0	36
hardpan		44
gravel		46
ls.		58

SKETCH SHOWING LOCATION

N.

W. E.

S.

Drilling Firm Pennsylvania Drilling Co. Date 2-19-60

Address Copied by RS

23
NOT LOCATED

23 2
location uncertain

LOCATED WELL LOG AND DRILLING REPORT

NO. 71620

County Sandusky Township Riley Section of Township

Owner Arnold Staschke Address Vickery O

Location of property 1st house N of 12 on 510

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 4 1/4 Length of casing 47	Pumping rate G.P.M.
Type of screen Length of screen	Duration of test hrs.
Type of pump	Drawdown ft. Date 9-10-99
Capacity of pump	Developed capacity
Depth of pump setting	Static level - depth to water 11 ft.
Date of completion	Pump installed by

WELL LOG			SKETCH SHOWING LOCATION
Formation	From	To	N.
clay	0	36	
hardpan		44	
gravel		46	
ls.		58	W. E.
			S.

Drilling Firm Permanter Drilling Co. Date 2-19-60

Address Copied by RS

23
NOT LOCATED

E)

LOCATED

WELL LOG AND DRILLING REPORT

NO. 24

County Sandusky Township Riley Section of Township 26

Owner Bates + Rogers Const. Co. Address Chicago, Ill.

Location of property Road jct 510 + 12 (northwest corner)

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 6 Length of casing 43	Pumping rate 45 G.P.M.
Type of screen ____ Length of screen ____	Duration of test ____ hrs.
Type of pump ____	Drawdown 2 ft. Date 1-9-59
Capacity of pump ____	Developed capacity ____
Depth of pump setting ____	Static level - depth to water 8 ft.
Date of completion ____	Pump installed by ____

610'

WELL LOG	From	To
Formation		
yel. clay	0	14
bl. clay		32
tough bl. clay		40½ 570
gr. Ls. soft layers.		78
br. Ls.		80
water 50', 60', 70'		
(House burned down)		
Probably plugged		

SKETCH SHOWING LOCATION

N.

W. E.

S.

Drilling Firm Dunbar Drilling Date 2-17-60

Address ____ Copied by RS

24

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 405085 Eckart

County [illegible] Township Riley Section of Township

Owner [illegible] Address 615 [illegible]

Location of property St. Rt. #412 - 2 mi. East of Berlin [illegible]

CONSTRUCTION DETAILS

Casing diameter [illegible] Length of casing 47'

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate G.P.M. Duration of test hrs.

Drawdown ft. Date

Static level-depth to water 16' ft.

Quality (clear, cloudy, taste, odor)

Pump installed by

WELL LOG*

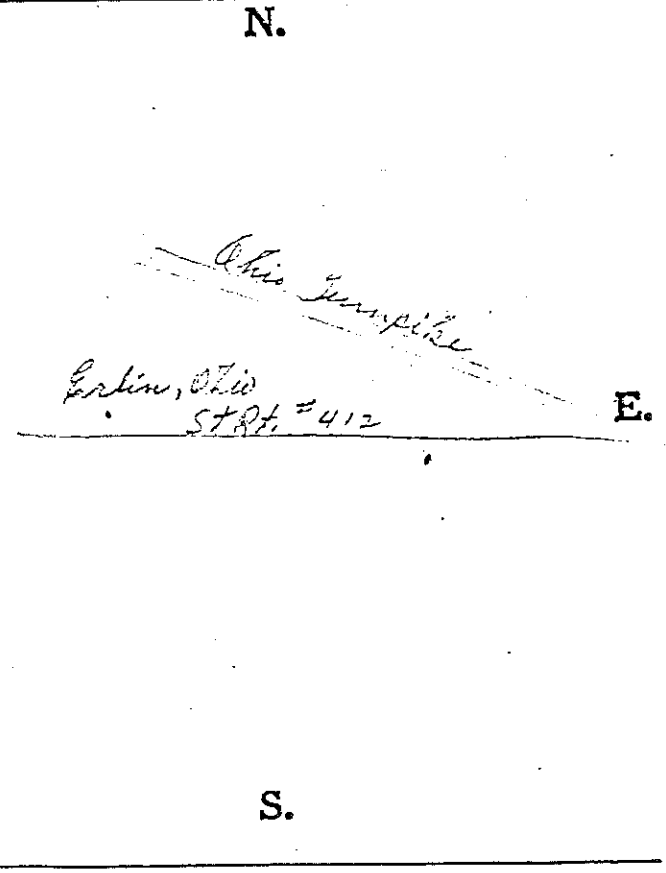
610

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	9' Ft.
Shale	9'	42'
Hard pan	42'	47'
Limestone	47'	50'
OEPA well # 3		
Don Eckart house		

563

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm [illegible] Date [illegible]

Address [illegible] Signed [illegible]

[illegible] Sandusky, Ohio

*If additional space is needed to complete well log, use next consecutive numbered form.

WELL LOG AND DRILLING REPORT

ORIGINAL

PLEASE USE PENCIL
OR TYPEWRITER
DO NOT USE INK.

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

Nº 318483

County Sandusky Township Riley Section of Township 22

Owner Wayne Fiber (Builder) Address Fremont, Ohio

Location of property East of Fremont on Co. Rd. #238

CONSTRUCTION DETAILS

Casing diameter 4 1/4" Length of casing 52'

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST

Pumping Rate G.P.M. Duration of test hrs.

Drawdown 28' ft. Date

Static level-depth to water 12' 593 ft.

Quality (clear, cloudy, taste, odor) Sulphur

Pump installed by

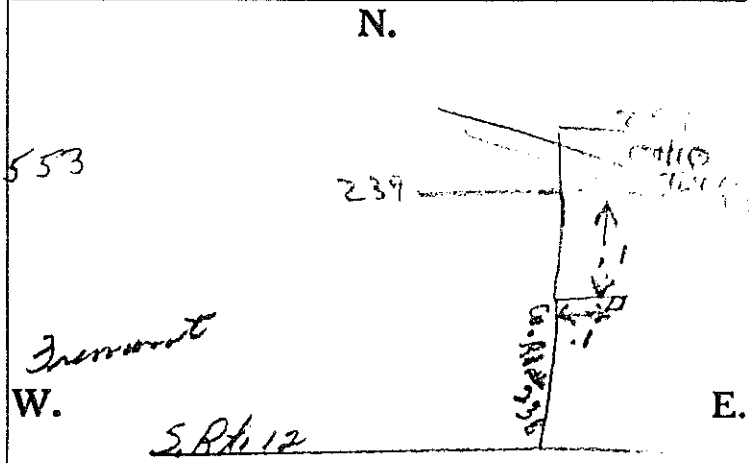
WELL LOG

605

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	7 Ft.
Blue Clay	7	45
Sand	45	52
Limestone	52	86

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm M & G Well Drilling Date May 2 / 65

Address 717 O'Donnell St. Signed Arnold F. Green

Upper Sandusky, Ohio

68

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 244877

County Sandusky Township Riley Section of Township 23

Owner M. Gillett Address R.R. 1 Victory, O.

Location of property 5 mi. North of Clyde on State 510

CONSTRUCTION DETAILS

Casing diameter 4½ Length of casing 71½

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 10-10-60

BAILING OR PUMPING TEST

Pumping rate 10 G.P.M. Duration of test 1 hrs.

Drawdown 70 ft. Date 10-10-60

Developed capacity 10 GPM

Static level—depth to water ft.

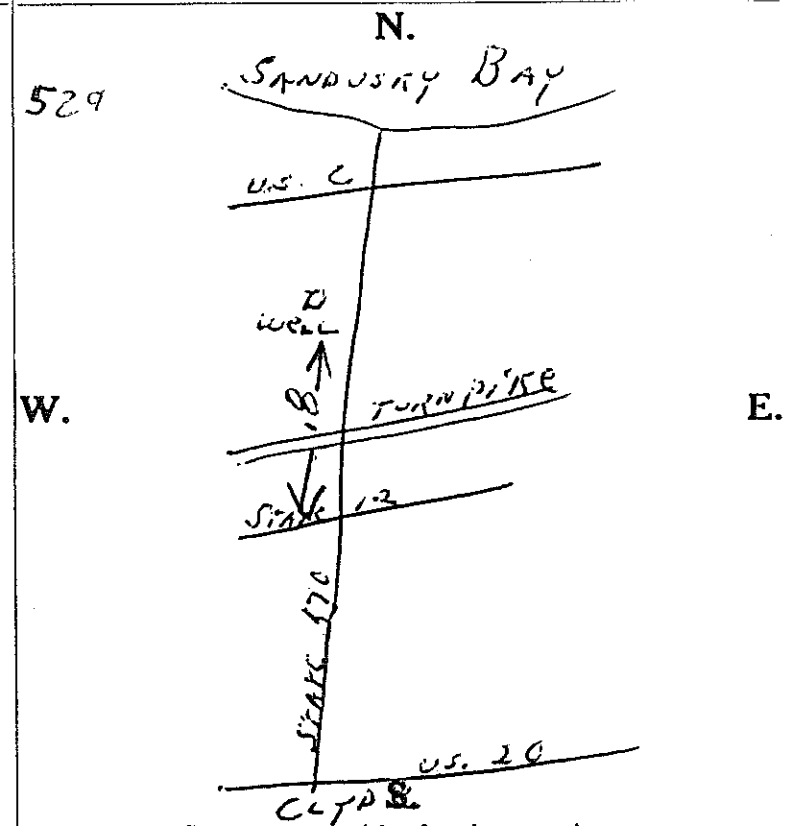
Pump installed by —

WELL LOG 600'

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	50 Ft.
Shale & Clay	50	71½
Limestone	71½	115

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Robertson's Date 10-10-60

Address Bellevue, O. Signed H. P. Robertson

69

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 266815

County SANDUSKY Township TOWNSEND Section of Township 23

Owner C. R. GRIFFAW Address R. D. VICTORY, O.

Location of property 1 mi. NORTH of CLYDE on ST. RT. 510

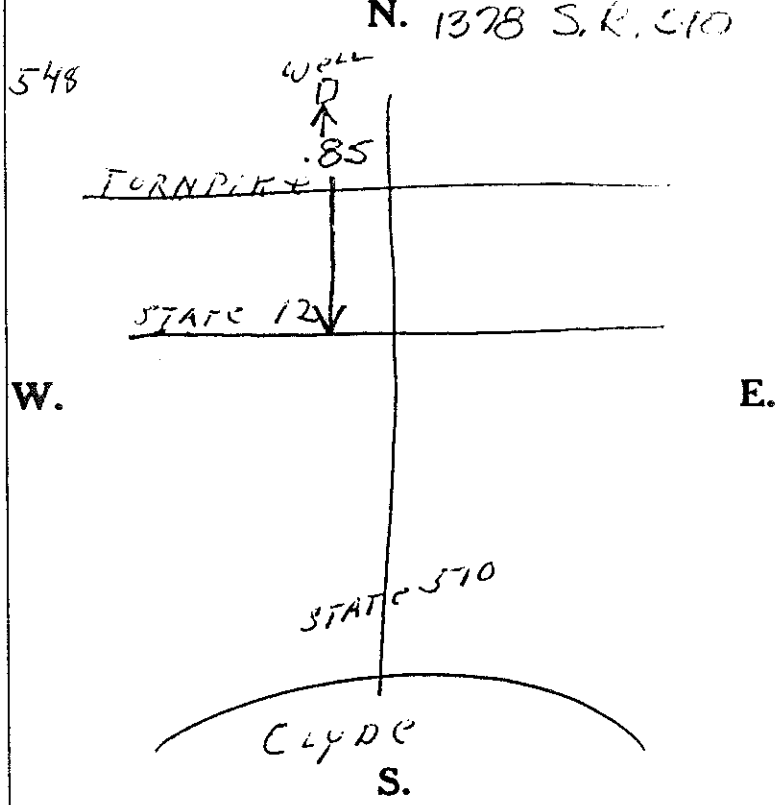
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 4 Length of casing 57	Pumping rate 10 G.P.M. Duration of test 1 hrs.
Type of screen — Length of screen —	Drawdown 40 ft. Date 7-1-62
Type of pump Sub	Developed capacity 10 GPM
Capacity of pump 10 GPM	Static level—depth to water 19 Feet ft.
Depth of pump setting 60 Feet	Pump installed by Robertson's
Date of completion 7-1-62	

WELL LOG 600

Formations Sandstone, shale, limestone, gravel and clay	From	To
Top Soil	0 Feet	3 Ft.
HARDPAN	3	52
LIMESTONE	52	62

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Robertson Date

Address Bellevue, O. Signed

70

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 272052

County Sandusky Township Riley Section of Township 23 24

Owner Maynard Wetosky Address R4 Fremont Ohio

Location of property N-E of Erlin Ohio

CONSTRUCTION DETAILS

Casing diameter 4 1/4 Length of casing 46'

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST

Pumping rate 2.3 G.P.M. Duration of test 1 hrs.

Drawdown 14 ft. Date 1-3-62

Developed capacity

Static level—depth to water 10 ft.

Pump installed by

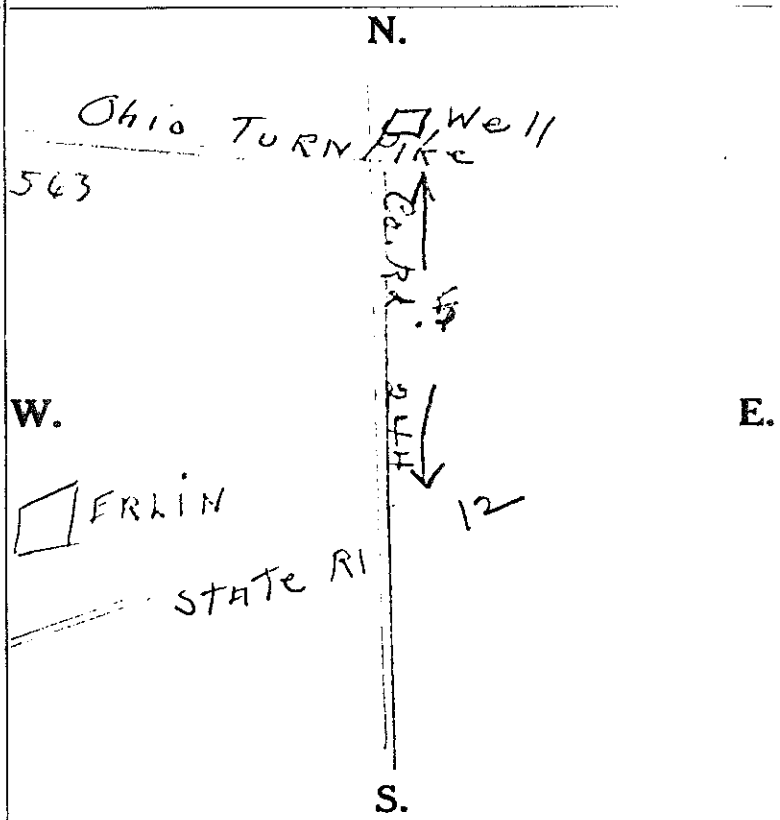
WELL LOG

605

Formations Sandstone, shale, limestone, gravel and clay	From	To
	0 Feet	Ft.
Clay		18
Sand	18	35
Hard Pan	35	42
Rock	42	82

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm C & O Drilling Co Date 1-3-62

Address R1 Fremont Ohio Signed C. J. Oblon

71

WE . LOG AND DRILLING REPOR

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

OK

No. 199092

County Sandusky Township Riley Section of Township #24

Owner John W. Sims Address Erlin Ohio R.7 Hl.

Location of property On St. Rt. #510 - North off St. Rt. #12

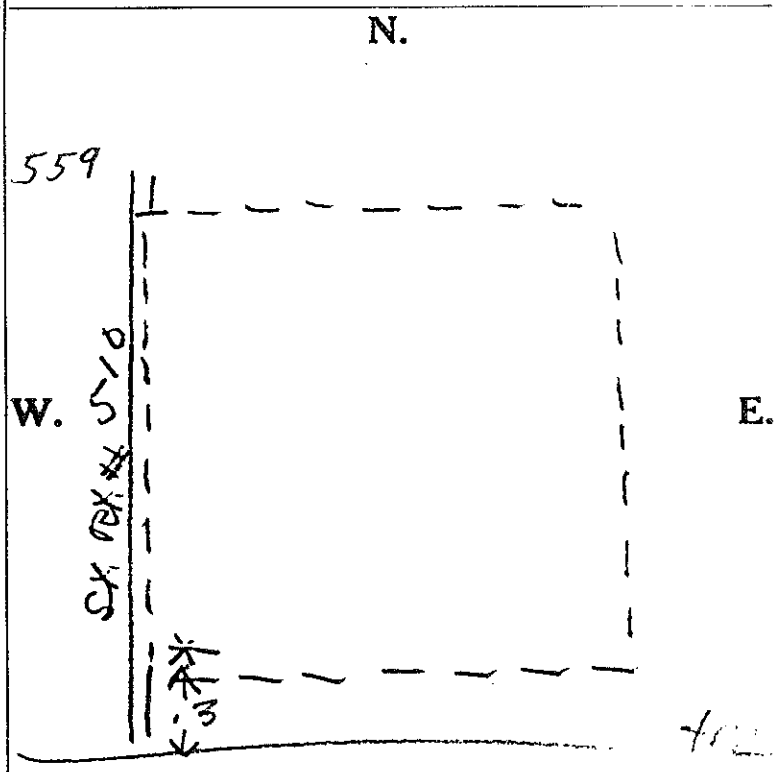
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 4 1/4 Length of casing 47	Pumping rate 6 G.P.M. Duration of test ... hrs.
Type of screen ... Length of screen ...	Drawdown ... ft. Date ...
Type of pump ...	Developed capacity ...
Capacity of pump ...	Static level—depth to water 12 ft.
Depth of pump setting ...	Pump installed by ...
Date of completion ...	

WELL LOG 605

Formations Sandstone, shale, limestone, gravel and clay	From	To
	0 Feet	1 Ft.
Top soil	1	12
Yellow Clay	12	46
Blue "	46	48
Rock		
Water at 47-48		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm FORREST JONES Date Mar-58

Address Tamaroa Ohio Signed Forrest Jones

(78)

PLEASE USE PENCIL OR TYPEWRITER

DO NOT USE INK.

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

№ 354498
83

County SANDUSKY Township RILEY Section of Township

Owner GERALD W. GNEPPER Address R.R.4, FREMONT OHIO

Location of property 3 RD House North of P.P. on S.R. 232, Fremont Ohio

CONSTRUCTION DETAILS

Casing diameter 6 1/4 Length of casing 130'

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST

Pumping Rate G.P.M. Duration of test hrs.

Drawdown ft. Date

Static level-depth to water ft.

Quality (clear, cloudy, taste, odor) CLEAR SULPHUR ODOR

Pump installed by

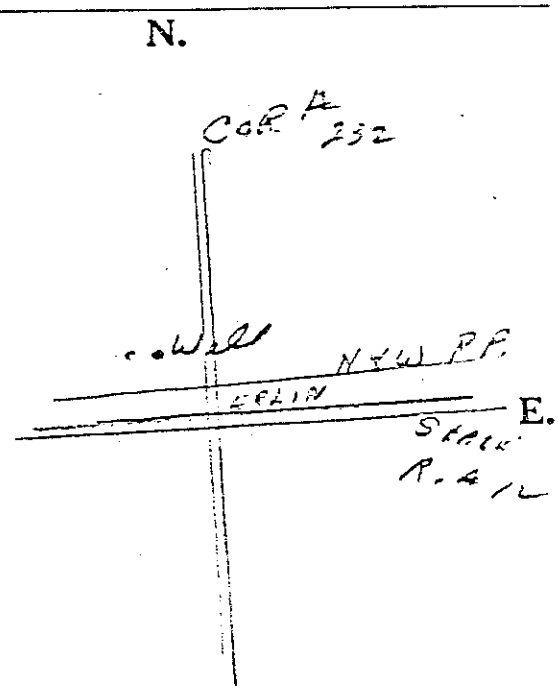
WELL LOG*

605

Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	84 Ft.
SAND	84	88
SHALE	88	97
LIMESTONE	97	152
Water at 152 ft		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm [illegible] Date [illegible]

Address Signed W. R. [illegible]

*If additional space is needed to complete well log, use next consecutive numbered form.

83

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

84?

No. 195709

County Sandusky Township Green Rock Section of Township

Owner Paul Widman Address Fremont, Ohio R.F.

Location of property 3 mi. East + 1 mi. North of Fremont, O.

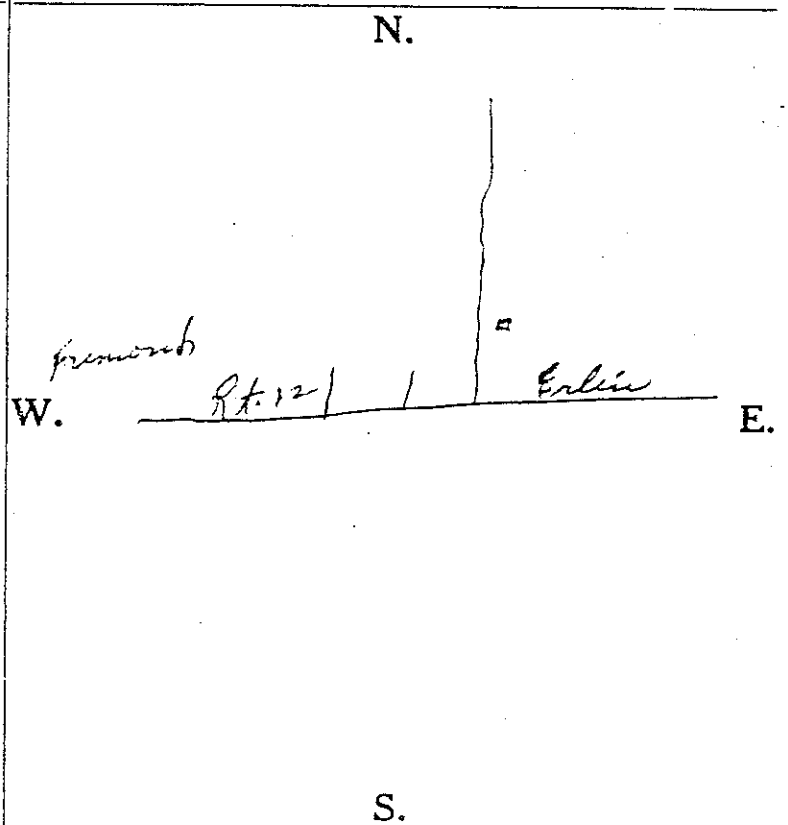
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 4 1/4 Length of casing 18'	Pumping rate ..... G.P.M. Duration of test ..... hrs.
Type of screen ..... Length of screen	Drawdown none ft. Date .....
Type of pump	Developed capacity .....
Capacity of pump	Static level—depth to water 3 ft.
Depth of pump setting	Pump installed by .....
Date of completion	

WELL LOG 6107

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	3 Ft.
B. Shale	3	66
Gravel	66	74
B. shale	74	97
sand & Gravel	97	108
Limestone	108	110

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Gingerich & Green Date 3/28/57

Address 317 W. Hicks st. Signed Arnold F. Green

Upper Sandusky, O.

C - 12

84

County Permit No. _____ 1.1

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

ORIGINAL

554273

OK

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP Well # 1 Pl.

OWNER OHIO Liquid Disposal Inc. ADDRESS 504 Liberty St. Fremont, O

LOCATION OF PROPERTY St Rt 412 ½ mi. W of St Rt 510

CONSTRUCTION DETAILS

Casing diameter 6" Plastic Length of casing 46'

Type of screen — Length of screen —

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 7-2-79

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 25 gpm Duration of test 1 hrs

Drawdown 20 ft Date 7-2-79

Static level (depth to water) 14 ft

Quality (clear, cloudy, taste, odor) Black Sulfur

Pump installed by

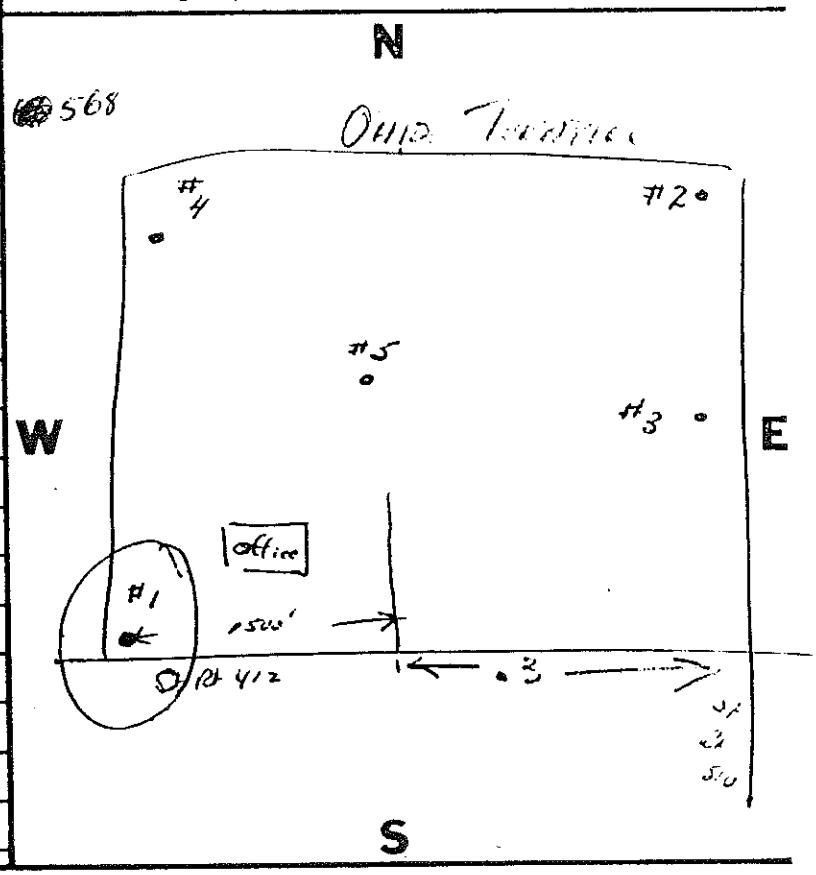
WELL LOG*

610

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	14 ft
Blue Clay	14	42
Limestone	42	50
This is a observation well		#6N
Top of casing elevation 608.55		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM

ADDRESS

DATE 7-2-79

SIGNED Wm Tibbs

*If additional space is needed to complete well log, use next consecutive numbered form.

87 a 5/6

County Permit No. _____

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

ORIGINAL

554274

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP Well #2 .26

OWNER Ohio Liquid Disposal Inc ADDRESS 504 Liberty St Fremont, O

LOCATION OF PROPERTY 3956 St Rt 412 Wickery, O

CONSTRUCTION DETAILS

Casing diameter 6" Plastic Length of casing 48'

Type of screen — Length of screen _____

Type of pump _____

Capacity of pump _____

Depth of pump setting _____

Date of completion 7-2-79

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 25 gpm Duration of test 1 hrs

Drawdown 1.5 ft Date 7-2-79

Static level (depth to water) 14 ft

Quality (clear, cloudy, taste, odor) Appears Good

Pump installed by _____

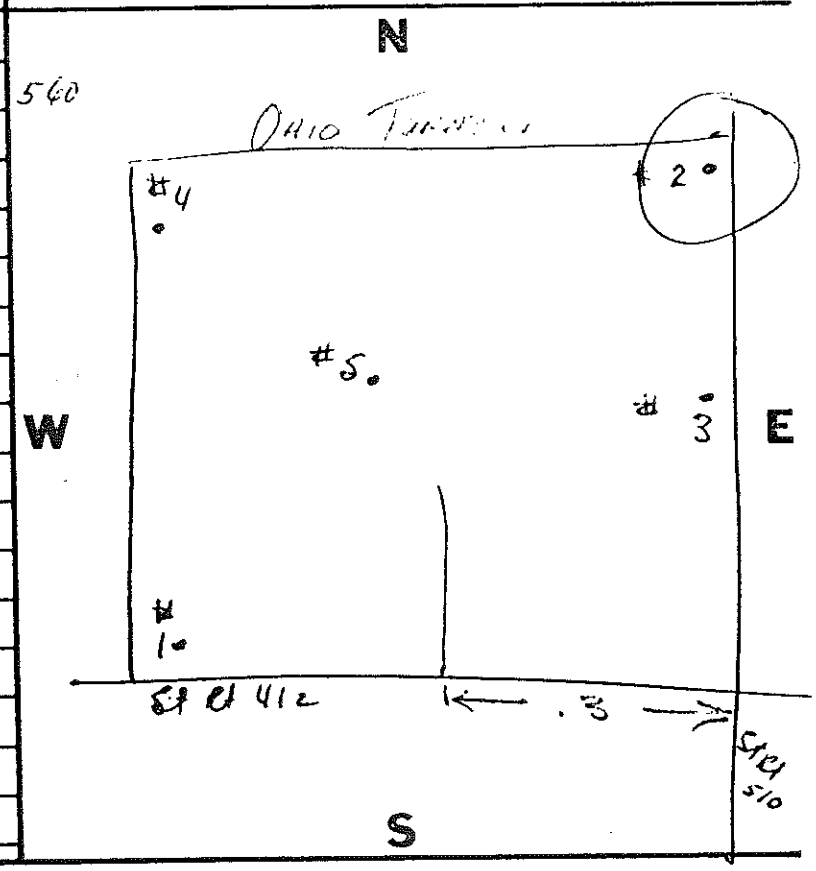
WELL LOG*

605

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	14 ft
Blue Clay	14	45
Limestone	45	50
This is a observation well		#4N
OEPA #1		
Top of casing 606.87		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM _____ DATE 7-2-79

ADDRESS _____ SIGNED W Fitts

*If additional space is needed to complete well log, use next consecutive numbered form.

County Permit No. _____

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

554275
OK

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP Well # 3 .26

OWNER Ohio Liquid Disposal Inc ADDRESS 504 Liberty St Fremont, O

LOCATION OF PROPERTY 3956 St Rt 412 Wickey, O

CONSTRUCTION DETAILS

Casing diameter 6" Plastic Length of casing 45½'

pe of screen _____ Length of screen _____

Type of pump _____

ıpacity of pump _____

Depth of pump setting _____

ıte of completion 7-3-79

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 15 gpm Duration of test 1 hrs

Drawdown 40 ft Date 7-3-79

Static level (depth to water) 14 ft

Quality (clear, cloudy, taste, odor) Appears Good

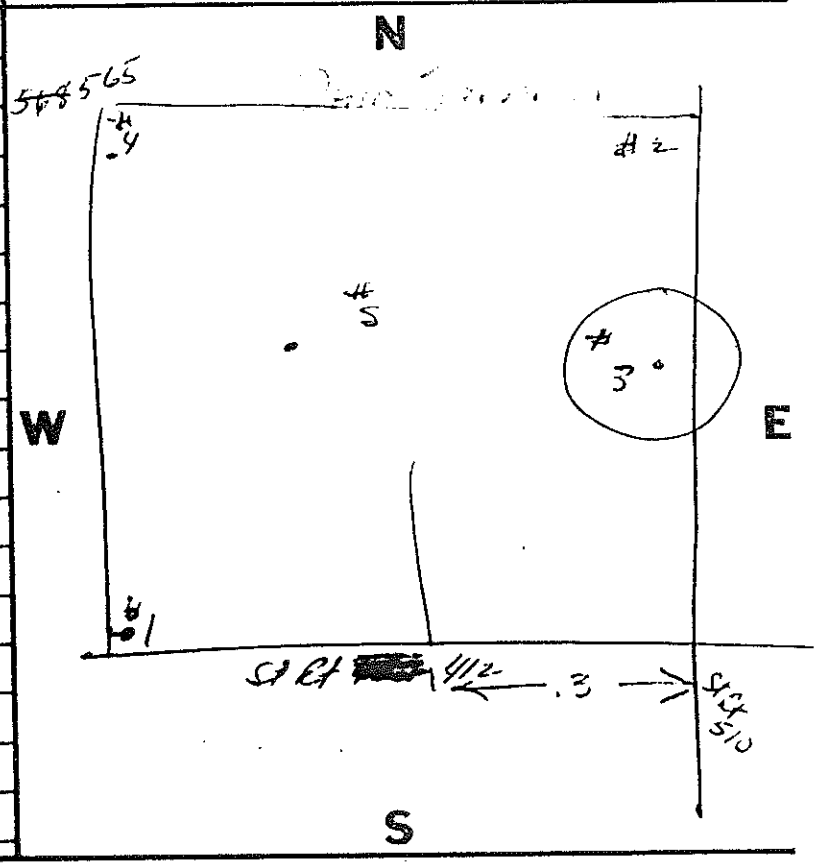
Pump installed by _____

WELL LOG* 607

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	14 ft
Blue Clay	14	42½
Limestone	42½	55'
This is a observation well		#7
Top of casing elevation 607.91		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM _____ DATE 7-3-79

ADDRESS _____ SIGNED W Tibbals

*If additional space is needed to complete well log, use next consecutive numbered form.

County Permit No. _____

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

ORIGINAL

554276

OK

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP Well #4 Zo

OWNER Ohio Liquid Disposal Inc ADDRESS 504 Liberty St Fremont, O

LOCATION OF PROPERTY 3956 St Rt 412 Vickery, O

CONSTRUCTION DETAILS

Casing diameter 6" Plastic Length of casing 48'

Type of screen — Length of screen _____

Type of pump _____

Capacity of pump _____

Depth of pump setting _____

Date of completion 7-3-79

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 25 gpm Duration of test 1 hrs

Drawdown 10 ft Date 7-3-79

Static level (depth to water) 12 ft

Quality (clear, cloudy, taste, odor) Appears Good

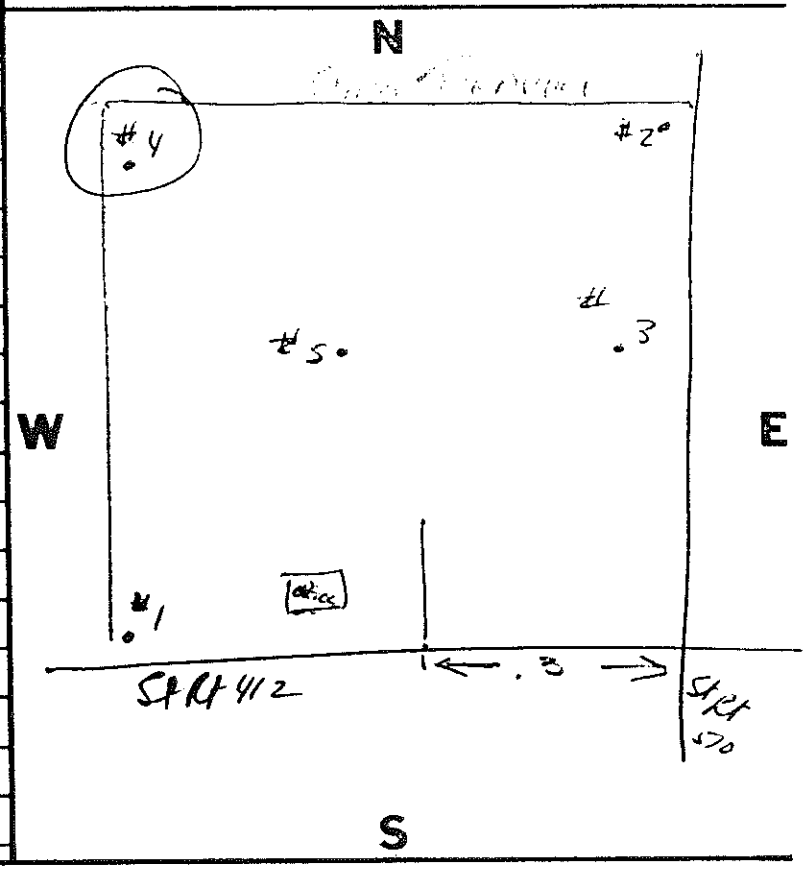
Pump installed by _____

WELL LOG* 605

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	14 ft
Blue Clay	14	45
Limestone	45	50
This is a observation well #3N		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM _____ DATE 7-3-79

ADDRESS _____ SIGNED [signature]

*If additional space is needed to complete well log, use next consecutive numbered form.

County Permit No. _____

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

ORIGINAL

554277

OK

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP Well #5 26

OWNER Ohio Liquid Disposal Inc ADDRESS 504 Liberty St Fremont, O

LOCATION OF PROPERTY 3956 St Rt 412 Vickery, O

CONSTRUCTION DETAILS

Casing diameter 6" Plastic Length of casing 56½

Type of screen _____ Length of screen _____

Type of pump _____

Capacity of pump _____

Depth of pump setting _____

Date of completion 7-6-79

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 75 gpm Duration of test 1 hrs

Drawdown 150 ft Date 7-6-79

Static level (depth to water) 10 ft

Quality (clear, cloudy, taste, odor) Black Sulfur

Pump installed by _____

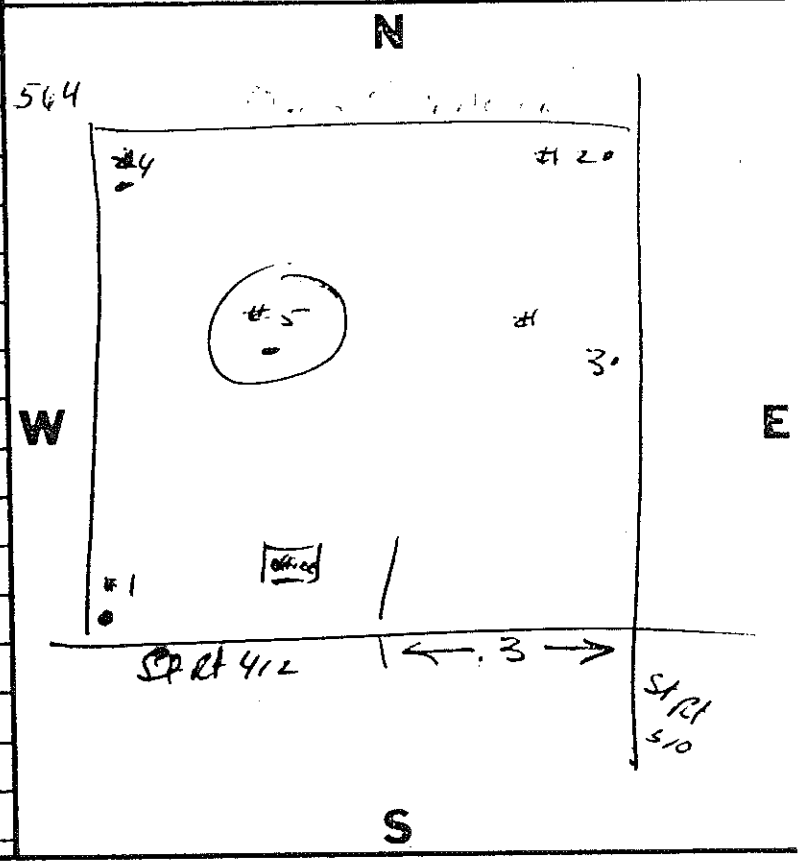
WELL LOG*

610

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	14 ft
Blue Clay	14	46
Limestone	46	200
This is a observation well.		#1
Sulfur		
Gas was encountered in last		
25' of hole		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM _____ DATE 7-6-79

ADDRESS _____ SIGNED [signature]

*If additional space is needed to complete well log, use next consecutive numbered form.

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

602222
878

COUNTY Sandusky TOWNSHIP Riley ~~SECTION OF TOWNSHIP~~ #1

OWNER O.L.D. Inc ADDRESS 504 Liberty St Fremont O 43420

LOCATION OF PROPERTY St Rt 412 - P 510

CONSTRUCTION DETAILS

Casing diameter 6" plastic Length of casing 43'

Type of screen — Length of screen —

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 5-1-81

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 30 gpm Duration of test 1 hrs

Drawdown 5' ft Date 5-1-81

Static level (depth to water) 5' ft

Quality (clear, cloudy, taste, odor) Black Sulfur

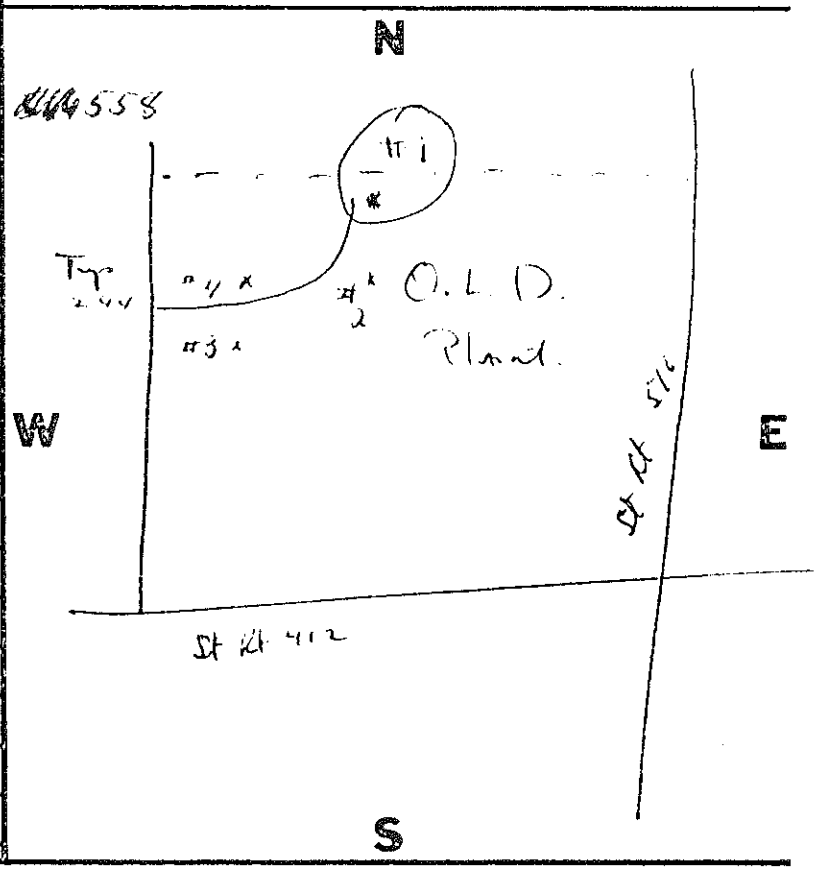
Pump installed by

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	15 ft
Bl Clay & Gravel	15	44½
Blue Limestone & Gypsum	44½	60
Monitor well #13		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM TIBBOLD WELL DRILLING, INC.

ADDRESS R.R.3 Bellevue, Ohio 44811

DATE 5-1-81

SIGNED [signature]

*If additional space is needed to complete well log, use next consecutive numbered form.

87f

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WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER NECESSARY – SELF-TRANSCRIBING

602223
87 9

COUNTY Sandusky TOWNSHIP Riley ~~SECTION OF TOWNSHIP~~ #2

OWNER O.L.D. Inc ADDRESS 504 Liberty St. Fremont O

LOCATION OF PROPERTY St Rt 412 & 510

CONSTRUCTION DETAILS

Casing diameter 6" plastic Length of casing 48'

Type of screen — Length of screen —

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 5-1-81

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 28 gpm Duration of test 1 hrs

Drawdown 30 ft Date 5-1-81

Static level (depth to water) 6' ft

Quality (clear, cloudy, taste, odor) Black Sulfur

Pump installed by

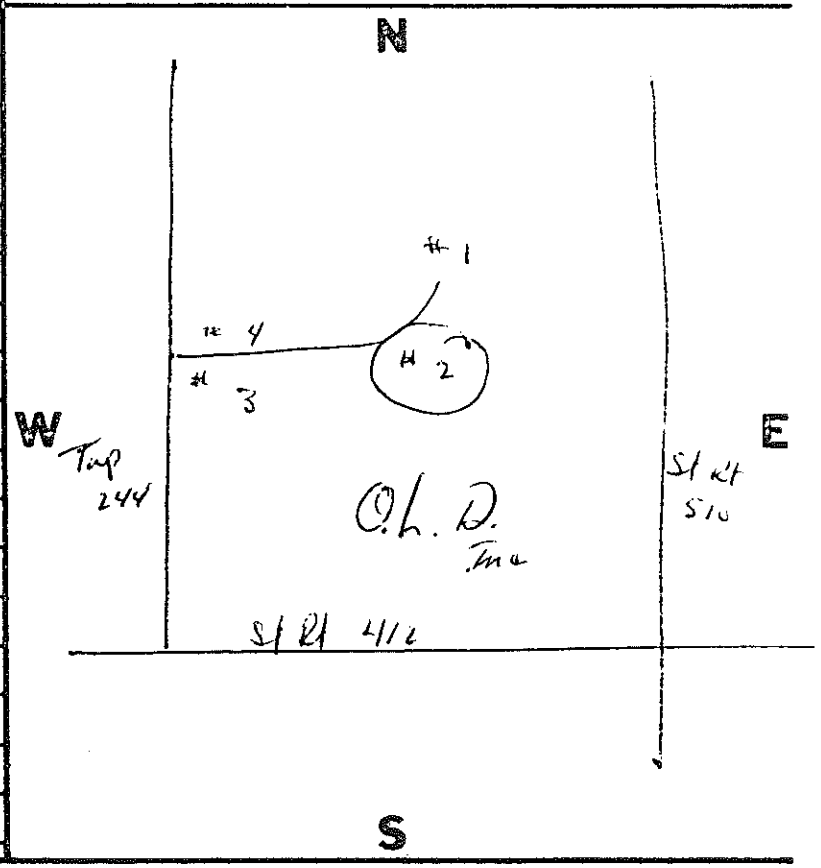
WELL LOG*

604

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	15 ft
Blue Clay & Gravel	15	45
Blue limestone & Gypsum	45	75
Not a monitor well		
Industrial water supply		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM TIBBOLES WELL DRILLING, INC.
ADDRESS 8377 No. St. Rt. 18 RR3 Bellevue, Ohio 44811

DATE 5-1-81
SIGNED W. Tibbles

*If additional space is needed to complete well log, use next consecutive numbered form.

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WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

602225
87h

COUNTY Sandusky TOWNSHIP Riley ~~SECTION OF TOWNSHIP~~ #4

OWNER O. L. D. Inc. ADDRESS 5004 Liberty Fremont O

LOCATION OF PROPERTY St Rt 412 n 510

CONSTRUCTION DETAILS

Casing diameter 6" plastic Length of casing [illegible]

Type of screen — Length of screen —

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 5-6-81

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 30 gpm Duration of test 1 hrs

Drawdown 30 ft Date 5-6-81

Static level (depth to water) 8 ft

Quality (clear, cloudy, taste, odor) Black Sulfur

Pump installed by

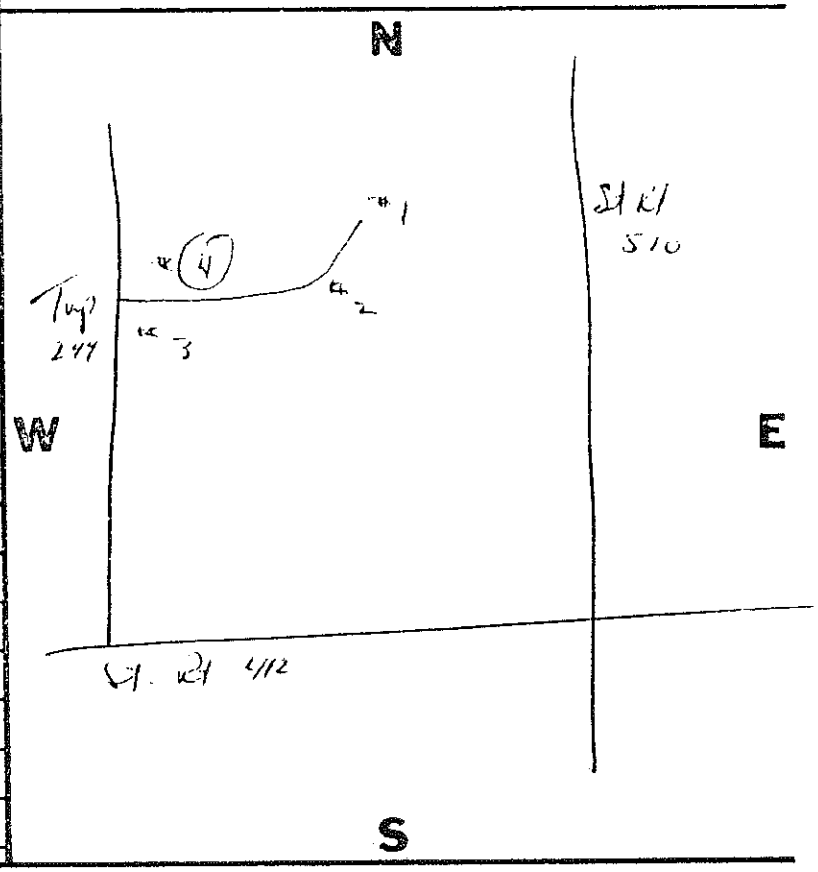
WELL LOG*

610

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	15 ft
Blue Clay	15	113½
Blue Limestone, Gypsum	113½	60
Monitor well #12		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM TIBBOLES WELL DRILLING, INC.
~~8377 No. St. Rt. 18~~

ADDRESS RR3 Bellevue, Ohio 44811

DATE 5-6-81

SIGNED [illegible]

*If additional space is needed to complete well log, use next consecutive numbered form.

87h

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WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

No. 11
602224
87i

COUNTY Sandusky TOWNSHIP Riley SECTION OF TOWNSHIP #3

OWNER O. L. D. Inc. ADDRESS 504 Liberty Fremont, O

LOCATION OF PROPERTY St Rt 412 & 510

CONSTRUCTION DETAILS

Casing diameter 6" plastic Length of casing 47½

Type of screen — Length of screen —

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 5-6-81

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 50 gpm Duration of test 1 hrs

Drawdown 10 ft Date 5-6-81

Static level (depth to water) 10' ft

Quality (clear, cloudy, taste, odor) Black Sulfur

Pump installed by

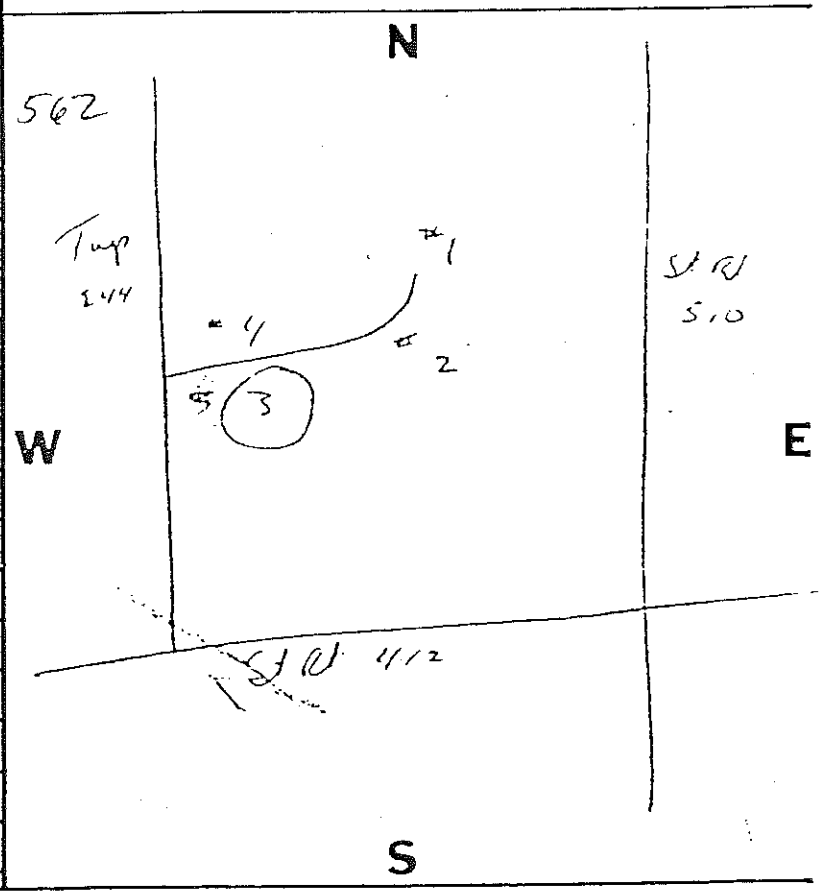
WELL LOG*

607

Formations: sandstone, shale, limestone, gravel, clay	From	To
Yellow Clay	0 ft	15 ft
Blue Clay	15	45
Fine Limestone, Green	45	60
Monitor Well #11		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM TIBBOLES WELL DRILLING, INC.
ADDRESS 8377 No. St. Rt. 18
RR 3 Bellevue, Ohio 44811

DATE 5-6-81
SIGNED W. H. Tibbles

*If additional space is needed to complete well log, use next consecutive numbered form.

87i

CUSTOMER'S COPY

ORIGINAL

WELL LOG AND DRILLING REPORT

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

425054

OK

County Sandusky Township Riley Section of Township 26

Owner Don's Oil Service Address Clyde Ohio

Location of property St. Rt. 412 Clyde Ohio

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 45'

Type of screen None Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion —

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate 25 G.P.M. Duration of test 1/2 hrs

Drawdown 2 ft. Date 5-23-72

Static level-depth to water 8 ft.

Quality (clear, cloudy, taste, odor) Cloudy No Sulphur Taste or Odor

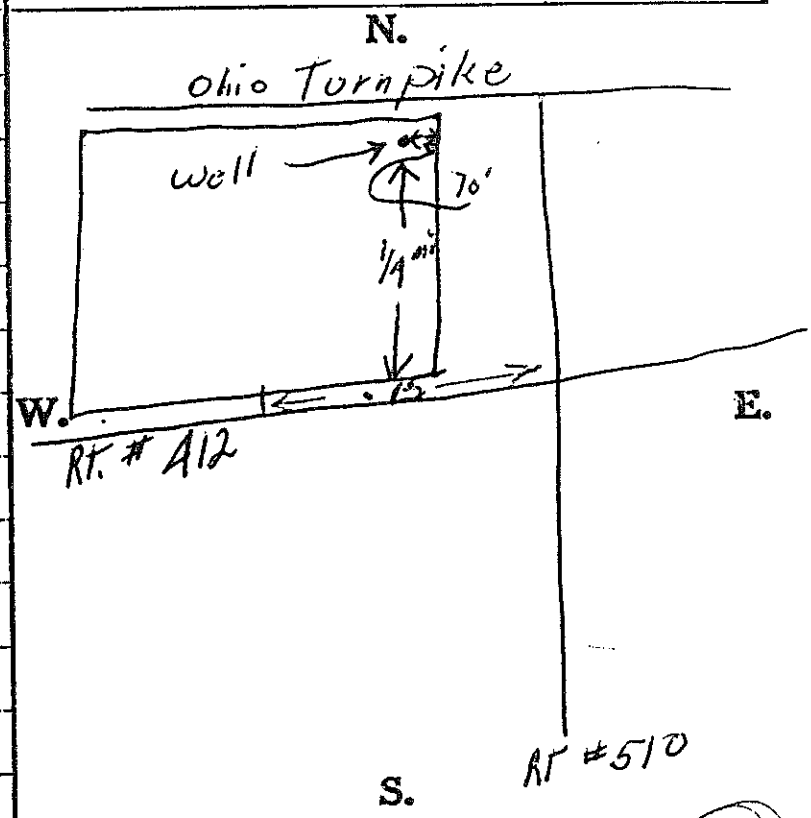
Pump installed by —

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Top Soil	0 Feet	5 Ft.
Clay	5	40
Sandstone + Clay	40	45'
Bed Rock	45'	55'
Well	55'	
Monitoring well # 4 ?		
OEPA #1		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Whittaker + Son Date 5-24-72

Address 920 Garrison St Fremont, Ohio Signed John Whittaker

*If additional space is needed to complete well log, use next consecutive numbered form.

LOCATED CNL

Division of Water
1500 Dublin Road
Columbus, Ohio

No. 182754
89

County Sandusky Township Riley Section of Township

Owner Arnold Staschke Address Rural Rt. Fremont

Location of property On State Rte 12 - ½ Mile N of Eden

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 4" Length of casing 43'6"	Pumping rate ..... G.P.M. Duration of test ..... hrs.
Type of screen ..... Length of screen	Drawdown 6 ft. Date May 3
Type of pump	Developed capacity .....
Capacity of pump	Static level—depth to water 18 ft.
Depth of pump setting	Pump installed by .....
Date of completion May 3, 56	

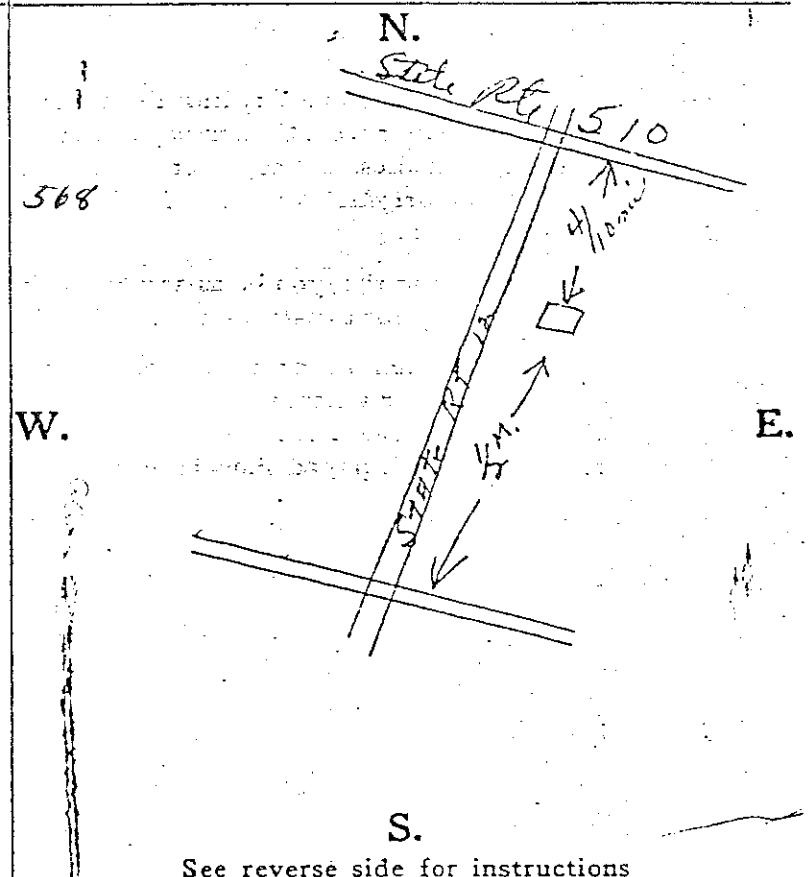
WELL LOG 610

Formations Sandstone, shale, limestone, gravel and clay	From	To
Sand.	0 Feet	18 Ft.
Clay	18	32
Sand.	32	37
gray Clay & Gravel	37	42
Limestone 42 ft.	42	56
Water 50'		

OEPA #6
Fersteuberger well
6-75

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Hartman Bros. Date Aug. 2-2-56

Address 622 Arthur Ave. Fremont, Ohio Signed [illegible]

C - 23

89

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 199085

County [illegible] Township [illegible] Section of Township 26

Owner [illegible] Address [illegible]

Location of property [illegible]

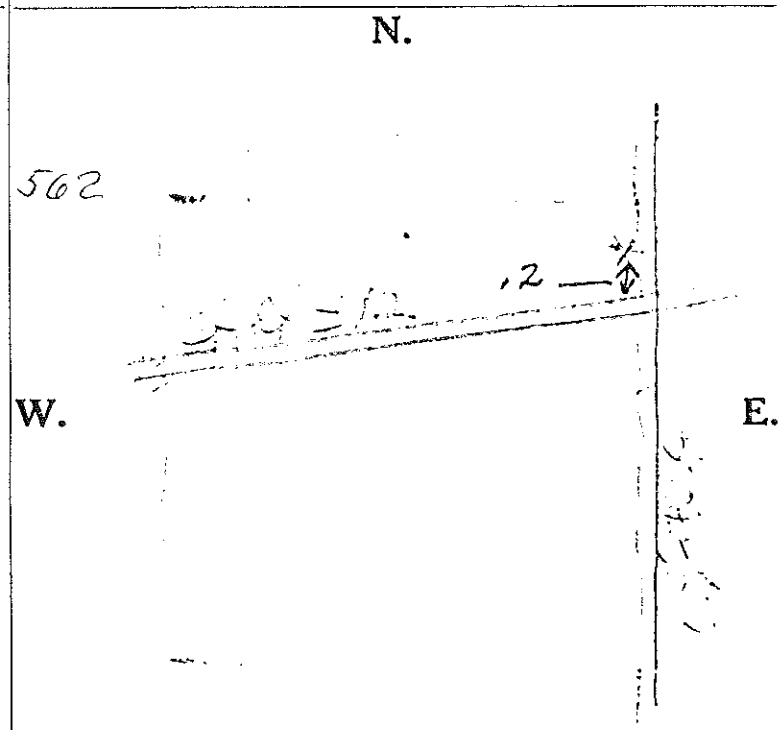
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 6 Length of casing 44'	Pumping rate 7 G.P.M. Duration of test ..... hrs.
Type of screen ..... Length of screen	Drawdown ..... ft. Date .....
Type of pump	Developed capacity .....
Capacity of pump	Static level—depth to water 10 595 ft.
Depth of pump setting	Pump installed by .....
Date of completion	

WELL LOG 605

Formations Sandstone, shale, limestone, gravel and clay	From	To
Topsoil	0 Feet	1 Ft.
Yellow Clay	1	12
Blue "	12	43
Rock	43	54
[illegible]		
OEPA #4		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm [illegible] Date 57

Address [illegible] Signed [illegible]

WELL LOG AND DRILLING REPORT

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 417706

County Sandusky Township Riley Section of Township 25

Owner Albert McGee Address Clyde, Ohio

Location of property St Rt 412 - ½ mi. East of St Rt 510

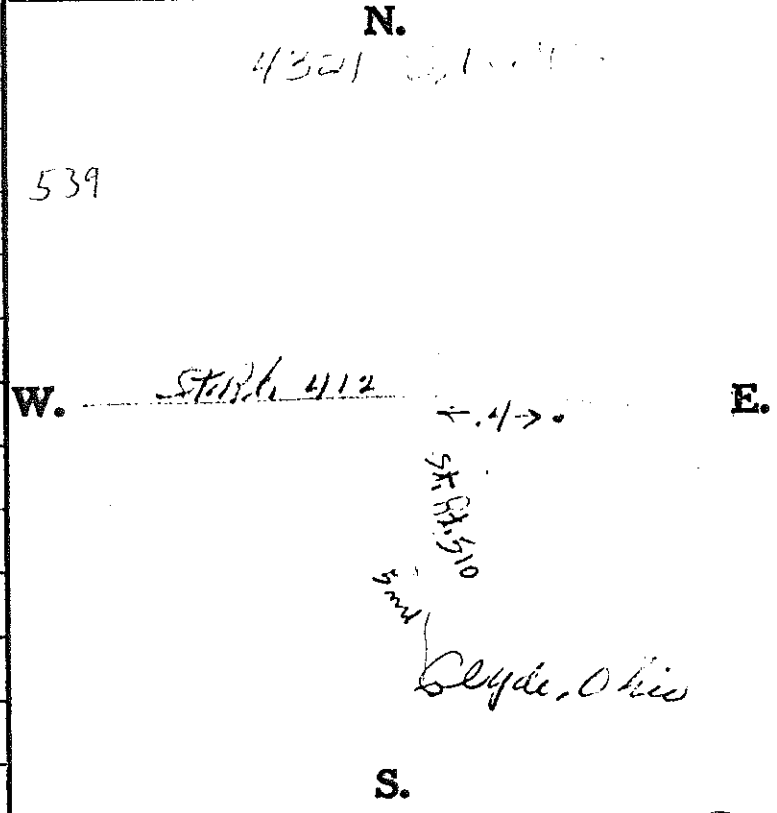
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST (Specify one by circling)
Casing diameter 4½" Length of casing 66'	Test Rate ..... G.P.M. Duration of test ..... hrs.
Type of screen ..... Length of screen	Drawdown None ft. Date .....
Type of pump	Static level-depth to water 15' ft.
Capacity of pump	Quality (clear, cloudy, taste, odor) .....
Depth of pump setting	
Date of completion	Pump installed by .....

WELL LOG* 605

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	6 Ft.
Shale	6'	51'
Sand	51	66'
Limestone	66'	100'

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

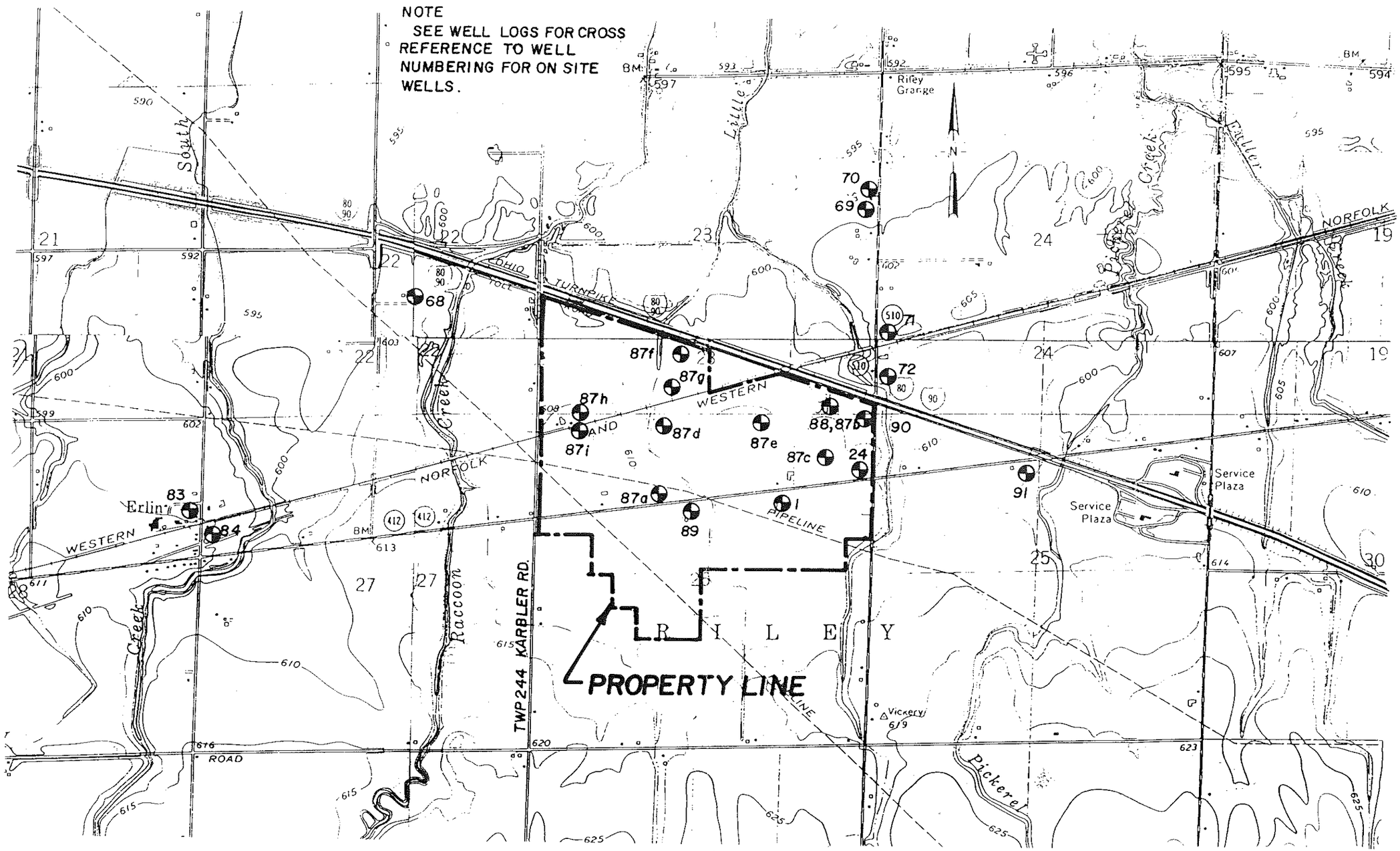


Drilling Firm Carl F. Green (Well Drilling) Date 4 Mar 1971

Address 712 - O'Donnell St. Signed Carl F. Green

Upper Sandusky, Ohio

*If additional space is needed to complete well log, use next consecutive numbered form.



WELL LOCATION PLAN

JOB NO. 33767
DATE: 2-4-83

APPENDIX D

BACKGROUND WATER QUALITY DATA

NOTE: The information contained in this appendix was collected from various sources. The references are listed below.

The water quality data on Poorman's Spring given on pages D-13 and D-14 was run by the lab at the Northern Ohio Treatment Facility. The form used is a standardized form normally used for reporting of waste stream analysis work. These two sets of data are not waste streams.

Hoover, J.A. (1982), "Groundwater Resources of Sandusky County, Ohio." Unpublished, University of Toledo Masters' Thesis.

Ohio Department of Natural Resources, Division of Water (1970), "Groundwater for Planning in Northwest Ohio - A Study of the Carbonate Rock Aquifers: Ohio Water Plan Inventory Report; Number 22, Columbus, Ohio."

Schaefer, E.J. and Waltron, W.C. (1956), Report to the Ohio Turnpike Commission on Developing a New Groundwater Supply for Service Plaza 5: June, 1956.

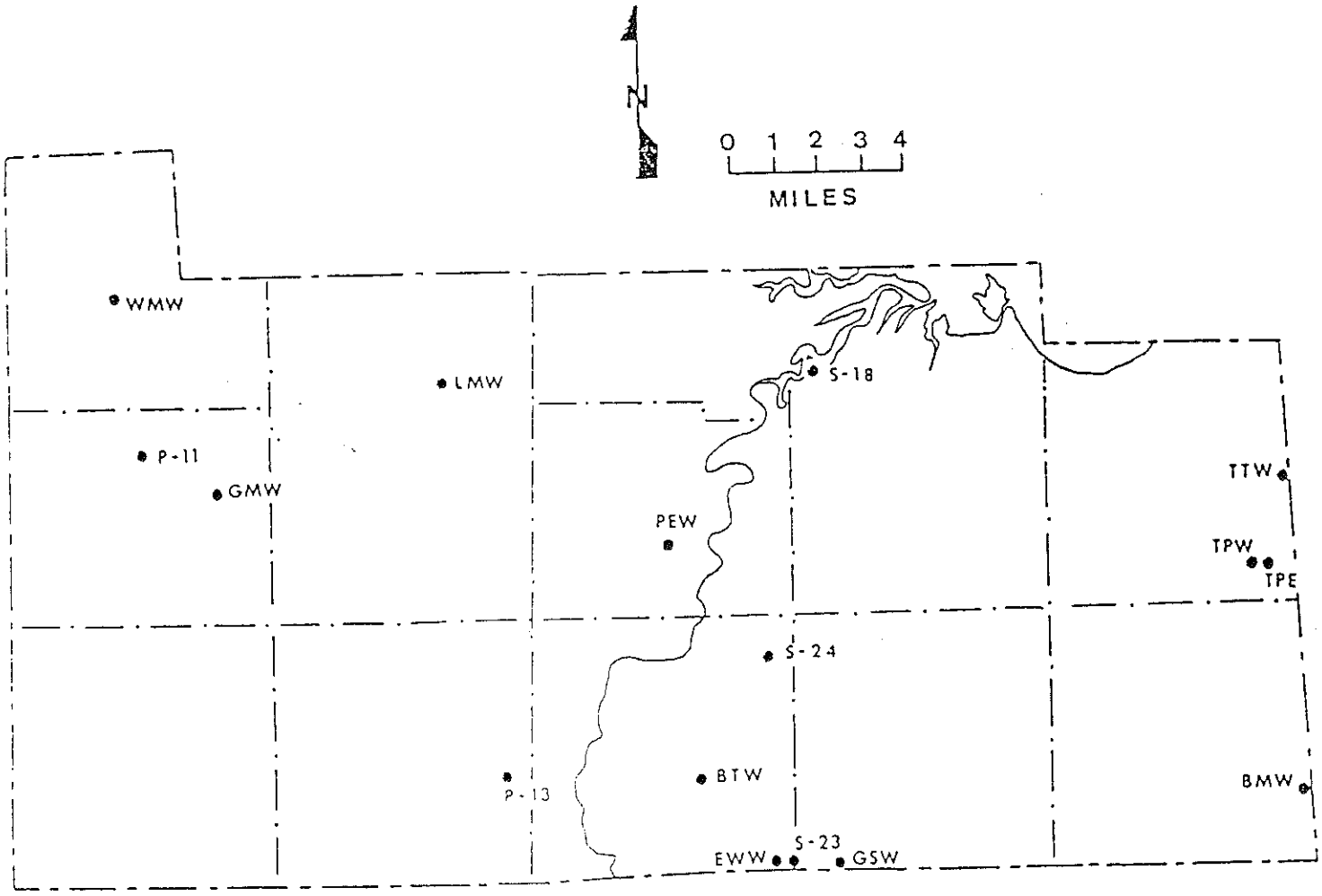


FIGURE 18. Location of wells analyzed for ground-water quality in Sandusky County, Ohio.

from Hoover 1982

TABLE 11. Ground-water quality from 16 wells in Sandusky County, Ohio. All values in mg/1, except pH (data from Ohio Department of Natural Resources, Division of Water, 1956, 1966, and 1970).

Well	Date	Location and well depth	Tot. dissolved solids	Carbonate hardness	pH	SO_4	Cl	F	Fe	Mn	H_2S
TPE	1956	Turnpike well east, NW ,NW ,Sec. 16, T5N, R17E, Townsend Twp., 150 ft (45.7 m)	2386	1622	---	571	25	---	13	---	---
TPW	1956	Turnpike well west, NE ,NE ,Sec. 15, T5N, R17E, Townsend Twp., 150 ft (45.7 m)	2582	1680	---	672	37	---	14	---	---
LMW	8/62	Lindsey, municipal well, 315 ft (96 m)	490	370	7.4	76	0	0.9	0.1	0.1	---
WMW	10/62	Woodville, municipal well, 225 ft (68.6 m)	575	420	7.9	101	17	0.3	0.05	0.05	---
GMW	4/63	Gibsonburg, municipal well, 301 ft (91.7 m)	495	390	8.2	101	8	0.6	0.0	0.0	---
BTW	5/63	SW ,SW ,Sec. 22,T4N, R15E, Ballville Twp., 73 ft (22.2 m)	1380	853	7.2	796	18	0.7	0.8	0.06	---
EWW	1/65	SE ,SE ,Sec. 36, T4N, R15E, Ballville Twp., 180 ft (54.8 m)	1680	1250	7.0	1030	7	1.0	19	0.1	---

from Hoover 1982

TABLE 11. (continued)

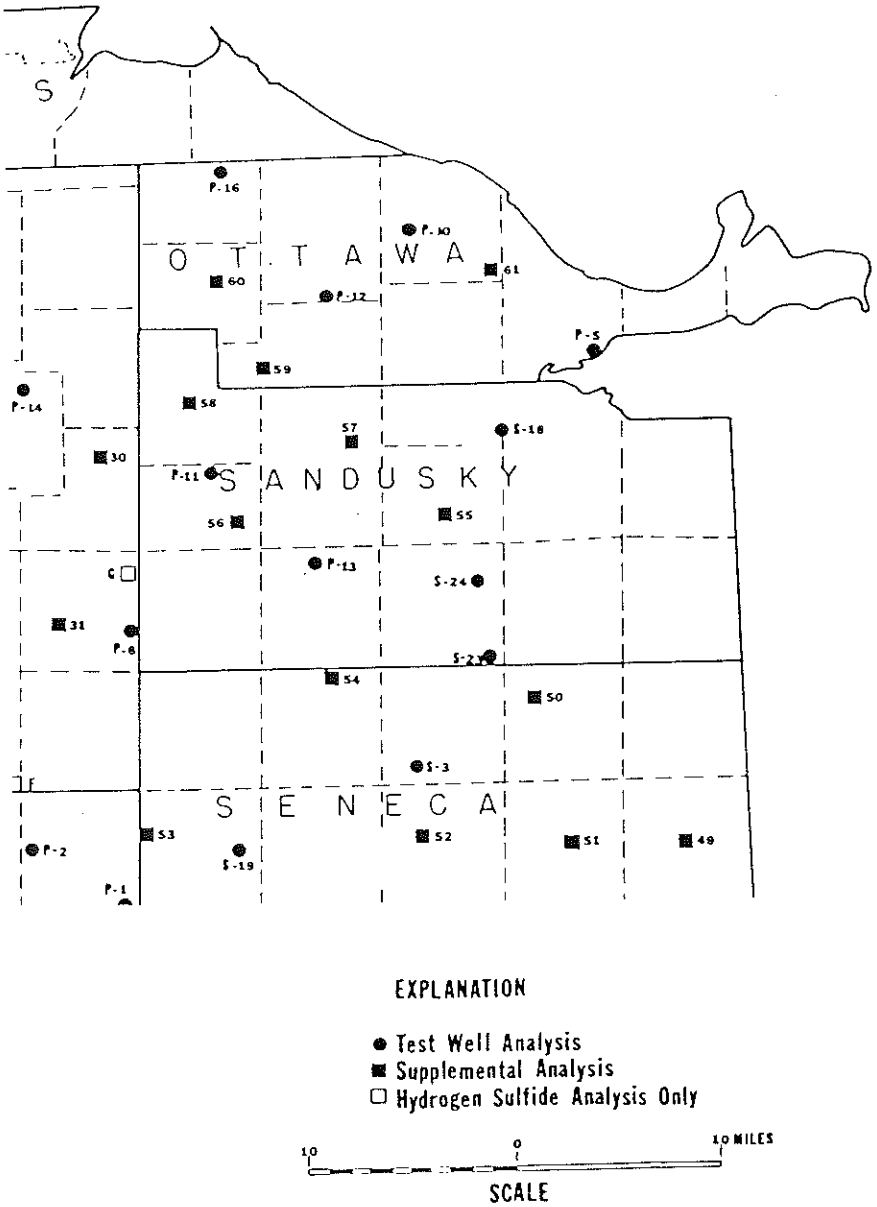
Well	Date	Location and well depth	Tot. dissolved solids	Carbonate hardness	pH	SO_4	Cl	F	Fe	Mn	H_2S
PEW	11/65	Peter Echrich & Sons, Fremont, 380 ft (115.7 m)	542	461	7.4	128	9	1.2	1.0	1.0	---
GSW	1966	Green Springs, municipal well west, 96 ft (29.3m)	1900	1360	---	1080	7	1.2	4.5	---	---
BMW	1966	Bellevue, municipal well (auxillary), 212 ft (64.6 m)	696	497	---	244	29	0.3	5.0	---	---
TTW	1966	NE ,NE ,Sec. 24, T5N, R17E, Townsend Twp., 99 ft (30.2 m)	2130	1560	---	1220	12	1.2	0.8	---	---
P-11	8/69	NW ,NW ,Sec. 15, T5N, R13E, Madison Twp., 250 ft (76.2 m)	408	345	7.6	71	10	0.6	0.7	0.7	1.8
S-24	10/69	NE ,SW ,Sec. 12, T4N, R15E, Ballville Twp., 92 ft (28 m)	1570	1080	7.3	876	12	1.5	1.3	1.3	0.2
S-18	10/69	NW ,NW ,Sec. 6, T5N, R16E, Riley Twp., 280 ft (85.3 m)	2590	1850	7.2	1520	39	1.5	0.4	0.4	1.2

from Hoover 1982

TABLE 11. (continued)

Well	Date	Location and well depth	Tot. dissolved solids	Carbonate hardness	pH	SO_4	Cl	F	Fe	Mn	H_2S
S-23	11/69	SW ,SE ,Sec. 36, T4N R15E, Ballville Twp., 108 ft (32.9 m)	1700	1230	7.2	878	5	1.0	2.2	2.2	0.3
P-13	11/69	NE ,SW ,Sec. 24, T4N, R14E, Jackson Twp., 280 ft (85.3 m)	523	447	7.3	116	8	1.6	0.8	0.8	0.8

from Hoover 1982



Well Location Map after ODNR (1970)

TABLE 8A (Continued)

WATER ANALYSES OF TEST WELLS

Well number	County	Date analyzed (month, year)	Depth of well (feet)	Water-bearing units	Milligrams per liter: Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C.)	Hardness $CaCO_3$: Total	Hardness $CaCO_3$: Noncarbonate	Hydrogen Sulfide (H_2S)	pH	Remarks
M-32	Defiance	4-68	580	D R	7.7	6.8	.07	69	56	94	15	389	116	120	2.2	.1	676	403	76	69.	7.5	Sample turbid
M-33	Paulding	8-69	385	D R	14	12	.05	98	53	69	8.7	426	93	115	2.3	.7	682	463	114	27.	7.4	Sample turbid
M-35	Henry	5-70	340	R T	13	.74	.08	130	47	160	2.2	86	740	11	1.2	.1	1170	518	448	---	7.7	Not pumped. H_2S present
M-36	Henry	7-69	220	R	20	.18	0	159	56	102	2.8	144	620	53	1.3	0	1140	628	510	3.7	7.8	Plugged back from 265'
M-37	Henry	6-69	300	D R	11	.42	.03	283	133	72	5.6	240	1050	107	1.9	.1	1900	1250	1060	29.	7.4	
M-38	Wood	10-69	500	R T	8.2	.32	.08	552	180	62	3.8	180	1910	48	1.7	0	3110	2120	1970	6.1	7.3	Double-cased to 410'
M-39	Lucas	6-69	250	D	8.6	.22	.03	67	27	38	2.7	247	152	6.0	2.3	0	452	278	76	5.1	7.6	
M-40	Lucas	8-69	335	D	11	---	---	114	33	13	2.2	330	180	4.5	1.8	.1	580	420	150	7.5	7.5	
M-41	Auglaize	5-70	260	L	16	2.2	.05	141	47	56	3.6	264	381	24	1.2	2.7	810	546	329	0	7.9	Not pumped
M-42	Mercer	4-69	280	G L	16	2.9	.04	189	100	39	4.3	430	566	8.0	1.2	0	1230	884	531	1.5	7.2	
P-1	Hancock	12-69	220	L	17	---	---	186	90	72	3.4	188	734	14	.8	0	1310	835	680	0	7.7	Not pumped
P-2	Hancock	12-69	220	L	18	---	---	295	86	84	3.8	132	1080	20	1.6	.3	1760	1090	982	.3	7.5	
P-3	Wood	11-69	230	L	9.7	1.6	.05	227	95	91	6.0	150	888	63	2.1	0	1590	958	835	---	7.8	Not pumped
P-4	Hancock	5-70	230	L	10	16	.05	132	57	96	3.6	146	560	30	1.3	.1	996	564	445	0	7.4	Not pumped. Sample turbid
P-5	Ottawa	10-69	350	T G L	13	.30	0	577	130	21	3.6	284	1620	36	1.4	0	2720	1980	1740	5.1	7.2	Double-cased to 180'
P-6	Hancock	6-69	420	R T G L	11	.57	.02	236	79	92	4.2	180	885	20	1.3	0	1410	915	767	6.7	7.1	
P-8	Wood	11-69	260	L	16	.36	.02	94	31	7.1	1.6	370	50	8.7	.7	.1	399	362	59	0	7.4	
P-9	Wood	11-69	235	G L	22	3.1	.05	480	136	23	4.1	305	1410	18	1.6	0	2420	1760	1510	0	7.2	
P-10	Ottawa	9-69	300	G L	12	.90	0	400	146	22	3.2	198	1290	47	1.7	.03	2270	1600	1440	3.9	7.2	Double-cased to 120'
P-11	Sandusky	8-69	250	L	14	.73	0	87	31	8.8	1.9	332	71	10	.6	0	408	345	72	1.8	7.6	
P-12	Ottawa	9-69	360	G L	8.9	.79	0	104	55	42	2.4	190	375	18	1.4	.03	782	486	330	14	7.1	
P-13	Sandusky	11-69	280	L	15	.79	0	105	45	7.5	1.8	398	116	8.0	1.6	0	533	447	121	.8	7.3	
P-14	Wood	8-69	250	L	11	1.3	.03	67	23	24	1.7	186	136	12	1.0	.1	390	262	109	1.7	7.7	
P-16	Ottawa	8-69	360	L	9.2	.25	.01	108	32	5.0	1.4	354	114	1.0	1.9	0	465	401	111	2.2	7.4	
P-18	Wood	5-69	300	G L	16	.41	.03	203	116	63	4.8	258	840	25	1.0	0	1540	984	773	20.	7.1	
S-1	Crawford	4-70	285	D R	13	.12	0	248	74	24	5.3	362	642	6.0	1.5	0	1240	924	628	7.5	7.1	
S-3	Seneca	11-69	360	G L	16	.86	.04	103	49	14	2.0	345	181	6.0	1.5	0	600	459	176	.3	7.5	
S-4	Marion	5-70	320	R T G	15	.34	0	146	38	9.7	2.5	371	217	1.0	1.6	0	644	520	216	.9	7.7	
S-5	Wyandot	3-70	320	T G L	9.4	.35	.08	553	146	33	3.8	304	1670	55	1.8	1.6	2790	1980	1730	5.4	6.8	
S-6	Wyandot	3-70	300	T G L	12	1.3	.08	247	70	49	3.4	230	760	20	1.8	0	1340	905	716	0	7.8	

Water-bearing units: D - Devonian System; R - Raisin River Formation; T - Tymochtee Formation; G - Greenfield Formation; L - Lockport Group

* analysis relevant to this study
from ODNR 1970

TABLE 8A (Continued)

WATER ANALYSES OF TEST WELLS

Well number	County	Date analyzed (month, year)	Depth of well (feet)	Water-bearing units	Milligrams per liter: Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids (residue at 180°C.)	Hardness $CaCO_3$: Total	Hardness $CaCO_3$: Noncarbonate	Hydrogen Sulfide (H_2S)	pH	Remarks
S-7	Wyandot	5-70	290	T G L	15	4.5	.02	240	83	41	4.0	246	780	14	1.6	.1	1270	941	740	.8	7.4	
S-8	Hardin	4-70	330	G L	8.9	1.4	0	179	78	55	4.4	285	580	34	1.7	.2	1180	768	534	.7	7.4	
S-9	Wyandot	2-70	220	G L	17	2.4	.01	533	93	67	5.8	188	1590	23	2.0	.7	2600	1710	1560	1.5	7.0	
S-10	Wyandot	2-70	200	G L	18	3.5	.05	429	91	48	6.4	246	1260	18	1.8	0	2160	1440	1240	1.4	6.8	
S-11	Wyandot	2-70	180	G L	10	---	---	420	195	368	24	230	1250	780	1.3	0	3440	1850	1660	0	7.4	Not pumped
S-12	Crawford	3-70	330	D R	14	.64	0	94	22	3.6	1.8	338	53	1.0	1.1	.1	363	325	48	0	7.1	
S-13	Crawford	2-70	340	D R	10	3.4	1.2	641	141	47	6.8	376	1800	62	1.8	.1	3060	2180	1870	40	7.3	Not pumped. Sample turbid.
S-14	Wyandot	2-70	120	R	17	1.2	0	193	64	6.3	2.7	324	436	1.5	1.6	.1	962	745	479	.2	7.0	Plugged back from 200'
S-15	Hardin	4-70	250	R T G L	15	3.4	.04	150	53	21	2.2	480	239	4.3	1.4	0	735	592	199	.7	7.5	
S-16	Seneca	1-70	310	G L	13	2.3	.08	250	58	65	3.8	170	780	15	.9	0	1410	863	748	.7	7.1	
S-17	Seneca	2-70	395	T G L	14	.88	.03	156	56	12	4.1	386	302	7.0	1.4	0	775	620	303	1.1	6.9	
* S-18	Sandusky	10-69	340	T G L	12	.37	.02	484	156	24	3.9	267	1520	39	1.5	.2	2590	1850	1630	1.2	7.2	Double-cased to 180'
S-19	Seneca	1-70	375	L	13	1.6	.07	215	60	64	4.6	152	716	16	.9	.2	1300	784	660	0	7.2	
* S-23	Sandusky	11-69	108	T G	19	2.2	.05	375	71	15	2.6	416	878	5.0	1.0	0	1700	1230	887	.3	7.2	
* S-24	Sandusky	10-69	163	T G	16	1.3	.03	282	91	35	2.8	232	876	12	1.5	.1	1570	1080	888	.2	7.3	

Water-bearing units: D - Devonian System; R - Raisin River Formation; T - Tymochtee Formation; G - Greenfield Formation; L - Lockport Group

* analysis relevant to this study
from ODNR 1970

TABLE 8B (Continued)

WATER ANALYSES OF SUPPLEMENTAL WELLS

Number	County	Location	Date analyzed (month, year)	Depth of well (feet)	Water-bearing units	Milligrams per liter: Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C.)	Hardness $CaCO_3$: Total	Hardness $CaCO_3$: Noncarbonate	Hydrogen Sulfide (H_2S) [b]	pH	Remarks
51	Seneca	Republic	9-62	123	R	.40	0	114	50	9.0	335	225a	1.0	.6	.4	685	490	215	0	7.6	c
52	Seneca	Tiffin	5-62	150	L	.98	.11	102	36	16	354	134	8.0	1.3	.2	507	403	113	0	6.8	
53	Seneca	Fostoria, 1 mi S	5-63	153	L	2.9	.04	115	34	18	352	136	28	.2	.3	541	427	139	0	8.0	
54	Seneca	Bettsville	5-66	230	G L	.40	0	116	31	8.0	461	28	19	1.6	0	500	414	36	.2	8.1	c
55	Sandusky	Fremont	11-65	389	G L	1.0	.18	109	46	7.0	410	128	9.0	1.2	.4	542	461	125	0	7.4	
56	Sandusky	Gibsonburg	4-63	301	L	0	0	102	33	5.0	348	101a	8.0	.6	0	495	390	105	0	8.2	c
57	Sandusky	Lindsey	8-62	315	G L	.10	0	100	29	5.0	366	76a	0	.9	.4	490	370	70	0	7.4	c
58	Sandusky	Woodville	10-62	225	L	.05	0	104	39	8.0	378	101a	17	.3	0	575	420	110	0	7.9	c
59	Ottawa	Elmore	1-68	375	L	.20	0	236	72	22	340	591	28	1.6	.7	1186	878	599	0	7.7	c
60	Ottawa	Genoa	6-69	350	L	.10	0	138	21	7.0	381	91	17	.7	0	585	432	120	.5	7.2	c
61	Ottawa	Oak Harbor, 3 mi E	8-54	137	T G	.05	----	544	177	26	246	1831	46	1.8	0	3018	2090	1884	3.9	7.2	
A	Putnam	Ottoville	10-69	450	G L	----	----	---	---	----	---	-----	----	---	---	----	----	----	0.2	---	Double-cased to 160'
B	Allen	Delphos	2-70	450	R T G L														9.2		North well field
C	Auglaize	St. Marys	2-70	270	L														0		New well field
D	Hardin	Kenton	11-69	358	T G L														0		
E	Wood	Cygnet	10-69	170	G L														4.1		
F	Wood	Bloomdale	10-69	181	L														1.2		
G	Wood	Bradner	9-69	315	L														0		

a -- SO_4 calculated
b -- H_2S analyzed, 1969-70
c -- Analysis by Ohio Department of Health

Water-bearing units: R - Raisin River Formation; T - Tymochtee Formation; G - Greenfield Formation; L - Lockport Group

* analysis relevant to this study
from ODNR 1970

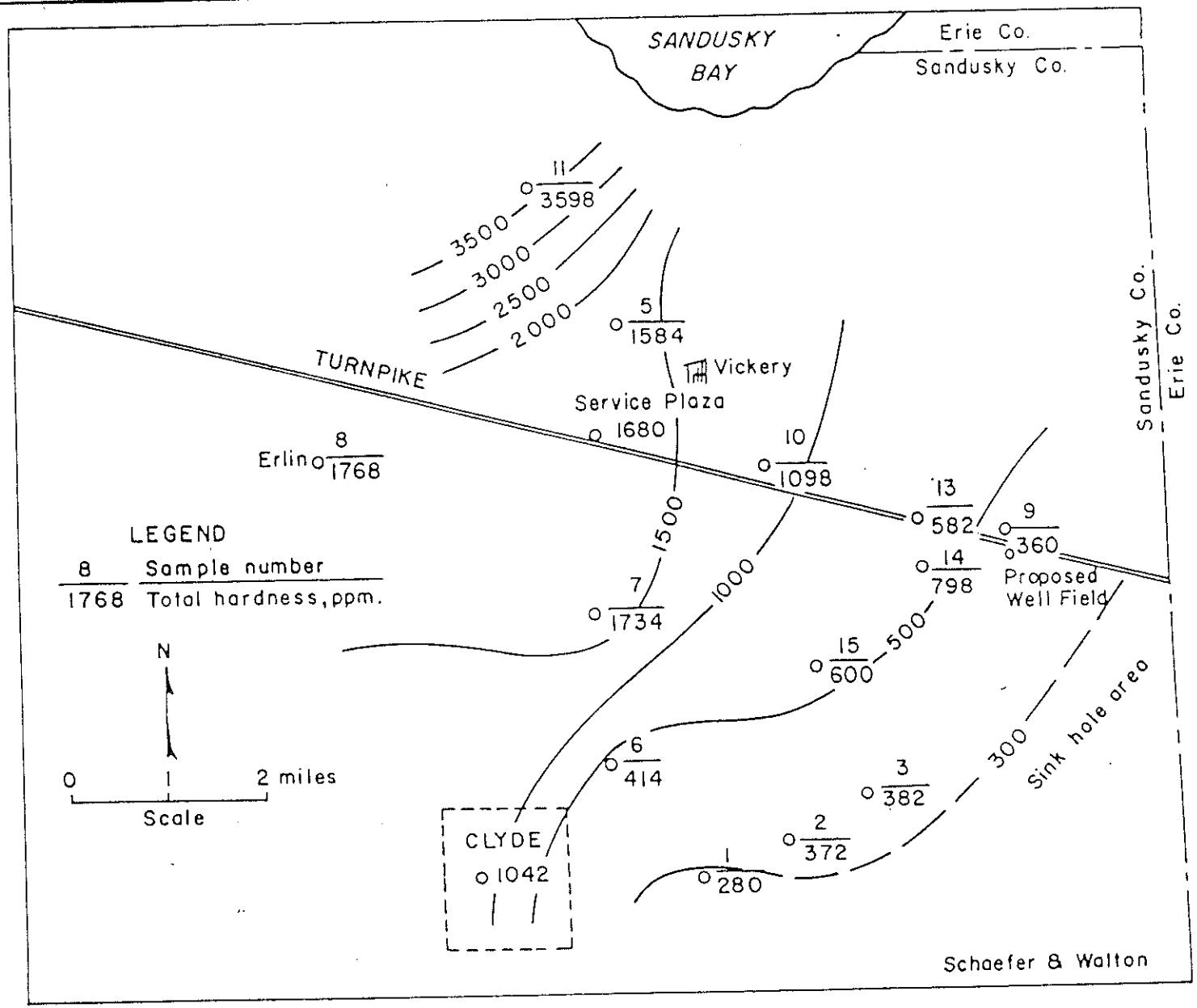


FIGURE 5.- MAP SHOWING TOTAL HARDNESS OF GROUND WATER.

from Schaefer and Walton (1956)

from Schaefer and Walton (1956)

Table 1

Chemical quality of the ground water

pumped at the Service Plaza

	Parts per million	
	East well	West well
Calculated carbon dioxide as Co_2	33.0	32.0
Phenol alkalinity as $CaCo_3$	0	0
Total alkalinity as $CaCo_3$	252.	240.
Total hardness as $CaCo_3$	1622.	1680.
Carbonate hardness as $CaCo_3$	252.	240.
Noncarbonate hardness as $CaCo_3$	1370.	1440.
Calcium hardness as $CaCo_3$	1312.	1424.
Calcium as Ca	524.8	569.6
Magnesium hardness as $CaCo_3$	310.	256.
Magnesium as Mg	89.3	73.7
Chlorides as Cl	25.	37.
Total iron as Fe	13.	14.
Sulfates as SO_4	571.	672.
Dissolved silica as SiO_2	18.	21.
Corrosion factor	minus 36	minus 56
Total solids	2386.	2582.
Volatile solids	347.	466.
Fixed solids	2039.	2116.
pH value	7.19	7.17

Table 2

Chemical quality of the ground waters in the area under investigation

Parts per million

Sample No.	1	2	3	5	6	7	8	9	10	11	13	14	15
Total alkalinity as $CaCo_3$	230	254	292	266	198	228	226	254	258	222	206	260	350
Total hardness as $CaCo_3$	280	372	382	1584	414	1734	1768	360	1098	3598	582	798	600
Carbonate hardness as $CaCo_3$	230	254	292	266	198	228	226	254	258	222	206	260	350
Noncarbonate hardness as $CaCo_3$	50	118	90	1318	216	1506	1542	106	840	3376	376	538	250
Total solids	340	610	482	2332	710	2518	2622	462	1546	8124	866	1138	820

from Schaelfer and Walton (1956)

OHIO LIQUID DISPOSAL, INC.
CUSTOMER SAMPLE REPORT

NW# L10-50 DATE RECV'D: 10/21/80

CUSTOMER: Spring water DATE RUN: 10/22/80

SAMPLE CODE: DISCHARGED TO:

SAMPLE IDENTIFICATION: Sulfur spring draining into Raccoon Creek ½ mile South of SR 412 off Twp. Rd. 233

COLOR: clear, strong sulfide odor

TEST RESULTS

PH	7.17	AP	PHENOL	0.013 mg/l	[illegible]
TOTAL AL or AC			CL	19 mg/l	AP
SS	10 mg/l	AP	SO4	1149 mg/l	AP
DS			COND.	1850 µmhos/cm²	AP
TS	2655 mg/l	AP	SpGr		
ASH			Total Fe:	0.04 mg/l	[illegible]
COD	36 mg/l	[illegible]	" Cr:	< 0.03	"
O&G (F)	3 mg/l	[illegible]	" Ni:	< 0.03	"
FLASH			" Cd:	< 0.006	"
REACTION/POND 5:			" Zn:	0.008	"
			" Ca:	528	"
OTHER TESTS:			" Mg:	92	"

Sampling Temp: 10.5°C; Dissolved O_2: 1.3 mg/l

REMARKS:

TS and Fe not as high as artesian aquifer farther north

Form 202

ANALYST: BB

BOWSER-MORNER
Testing Laboratories, Inc.

OHIO LIQUID DISPOSAL, INC.
CUSTOMER SAMPLE REPORT

NW# L-2-37 DATE RECV'D: 02/24/81

CUSTOMER: ~~Stream~~ Raccoon Creek Spring DATE RUN: 2-26-81

SAMPLE CODE: Adelbert Poorman Spring DISCHARGED TO:

SAMPLE IDENTIFICATION: Subsurface Water.

COLOR: Clear, lt suspended solids, strong sulfide odor

TEST RESULTS

PH	7.23	AP	PHENOL	0.003	mg/l
TOTAL AL or AC			CL	22	mg/l
SS	40 mg/l		SO_4	1484	mg/l
DS			COND	1650	µmhos/cm²
TS	2495 mg/l		SpGr		
ASH			Total Fe:	0.13	mg/l
COD	8 mg/l		" Cr:	< 0.03	mg/l
O&G (F)	7 mg/l		" Ni:	< 0.03	mg/l
FLASH	questionable.		" Cd:	< 0.006	mg/l
REACTION/POND 5:			" Zn:	< 0.003	mg/l
			TOC:	N.A.	mg/l

OTHER TESTS: Sampling Temperature: 9.0°C Dissolved Oxygen: 3.0 mg/l

REMARKS:

Form 202

ANALYST: BB

BOWSER-MORNER
Testing Laboratories, Inc.

APPENDIX E

AQUIFER PUMPING TEST DATA

AQUIFER PUMPING TEST

LOCATION: North of Clyde, Ohio DATE OF TEST: 12/9/82 TIME: 8:00 AM

BOREHOLE #1 Pumping TOTAL DEPTH 75 ft.

CLIENT (NAME): Chemical Waste Management LENGTH OF STANDPIPE: 1'10.5"

TECHNICIAN: Richard Hosfeld DISTANCE FROM PUMPING WELL: N/A

TIME AFTER PUMPING STARTED (MINUTES) Interval	Actual	PUMPING RATE (GPM)	DEPTH TO WATER (FROM TOP OF PIPE)	DRAWDOWN (FT)
0	9:00 AM	0	14.96	0
1	3	11 gpm	22.50	7.54
2	4		22.70	7.74
3	5		22.70	7.74
5	7		22.80	7.84
7	9		22.83	7.87
10	11		22.85	7.89
15	15		22.87	7.91
20	20		22.92	7.96
25	25		22.92	7.96
30	30		22.98	8.02
40	40		22.96	8.00
50	50		23.00	8.04
60	60	$\frac{55 \text{ gallons}}{4'55''} \cong 11$ gpm	23.04	8.08
75	75		23.08	8.12
100	100		22.96	8.00
160	120	$\frac{55 \text{ gallons}}{4'55''} \cong 11$ gpm	23.04	8.08

BOWSER MORNER

AQUIFER PUMPING TEST -- CONTINUED

TIME AFTER PUMPING STARTED (MINUTES) Interval	Actual	PUMPING RATE (GPM)	DEPTH TO WATER (FROM TOP OF PIPE)	DRAWDOWN (FT)
220	180		23.40	8.44
280	255	$\frac{55 \text{ gallons}}{4'55''} \cong 11$ gpm	24.08	9.12
340	301		24.63	9.67
400	360	$\frac{55 \text{ gallons}}{5'} \cong 11$ gpm	24.96	10.00
460	422		24.96	10.00
520	476		24.96	10.00
580	480	0 gpm	17.33	7.63

/mjj(#29, Tracks #17 & #18)

BOWSER MORNER

AQUIFER PUMPING TEST

LOCATION: North of Clyde, Ohio DATE OF TEST: 12/9/82 TIME: 8:00 AM

BOREHOLE #2 Observation TOTAL DEPTH 60 ft.

CLIENT (NAME): Chemical Waste Management LENGTH OF STANDPIPE: 1'5"

TECHNICIAN: Richard Hosfeld DISTANCE FROM PUMPING WELL: 24.73 feet

TIME AFTER PUMPING STARTED (MINUTES) Interval	Actual	PUMPING RATE (GPM)	DEPTH TO WATER (FROM TOP OF PIPE)	DRAWDOWN (FT)
0		0	14.47	0
1	2	11 gpm	14.55	0.08
2	3		14.65	0.18
3	4		14.73	0.26
5	6		14.80	0.33
7	8		15.30	0.83
10	11		15.40	0.93
15	15		15.45	0.98
20	20		15.13	0.66
25	25		15.00	0.53
30	30		15.00	0.53
40	40		15.00	0.53
50	50		15.00	0.53
60	60	11 gpm	15.00	0.53
75	75		15.00	0.53
100	100		15.00	0.53
160	123	11 gpm	15.00	0.53

BOWSER MORNER

AQUIFER PUMPING TEST -- CONTINUED

TIME AFTER PUMPING STARTED (MINUTES)		PUMPING RATE (GPM)	DEPTH TO WATER (FROM TOP OF PIPE)	DRAWDOWN (FT)
Interval	Actual			
220	181		15.78	1.31
280	257	11 gpm	16.78	2.31
340	304		17.05	2.58
400	360	11 gpm	17.05	2.58
460	420		17.05	2.58
520	475		17.05	2.58
580	481	0 gpm	16.95	

/mjj(#29, Tracks #19 & #20)

BOWSER MORNER

APPENDIX F

STATISTICAL ANALYSIS OF MONITORING WELL DATA

NOTE: The following pages contain the means and standard deviations of seven constituents. The data was compiled annually for the period of record available as of October, 1982. All values, with the exception of pH and phenols, are in milligrams per liter (mg/l). Phenols were not consistently recorded in mg/l, and for many samples it was uncertain whether the units were recorded in parts per million (ppm) or parts per billion (ppb). No effort was made to correct the raw data before the values were entered into the computer. The statistical data for phenols, therefore, is incorrect and is unreliable. Also, many values for parameters were recorded as "less than" some number. These values were entered into the computer at a concentration level equal to the limiting value and, therefore, may suggest the presence of a greater concentration than actually exists.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=1 YEAR=78						
PH	36	7.0172	0.3136	6.5500	7.9000	0.0983
CL	18	1730.0000	1411.4599	144.0000	5671.0000	1992219.0588
PHENOL	5	0.2044	0.4448	0.0010	1.0000	0.1978
ZN	32	35.2556	199.0382	0.0060	1126.0000	39616.1862
SULFATES	19	1835.3158	122.8613	1408.0000	2009.0000	15094.8947
IRON	36	7.3981	33.4273	0.0300	202.0000	1117.3817
CROMIUM	36	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=1 YEAR=79						
PH	24	7.0137	0.1741	6.6000	7.3600	0.0303
CL	24	2205.2917	2187.1695	1001.0000	9161.0000	4783710.3025
PHENOL	11	3.7424	10.8025	0.0020	36.0000	116.6948
ZN	24	0.0398	0.0456	0.0040	0.2040	0.0021
SULFATES	23	1830.9130	45.8485	1744.0000	1897.0000	2102.0830
IRON	24	0.8295	1.1909	0.0300	5.7500	1.4183
CROMIUM	24	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=1N YEAR=79						
PH	24	7.2608	0.3344	6.3800	7.8800	0.1118
CL	22	561.0455	184.0746	141.0000	877.0000	33883.4740
PHENOL	20	9.8121	29.0213	0.0000	100.0000	842.2351
ZN	24	0.0118	0.0187	0.0020	0.0870	0.0003
SULFATES	24	1735.2083	344.0121	156.0000	1897.0000	118344.3460
IRON	24	0.2793	0.3057	0.0140	1.4200	0.0934
CROMIUM	24	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=1N YEAR=80						
PH	45	7.1938	0.1799	6.6200	7.8700	0.0324
CL	45	748.3556	164.3924	274.0000	1153.0000	27024.8707
PHENOL	45	2.2350	14.9052	0.0000	100.0000	222.1649
ZN	45	0.0098	0.0094	0.0030	0.0590	0.0001
SULFATES	45	1779.1556	96.3681	1429.0000	1976.0000	9286.8162
IRON	45	0.6049	0.5675	0.0500	3.2800	0.3221
CROMIUM	45	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=1N YEAR=81						
PH	31	7.1523	0.1096	6.9000	7.3500	0.0120
CL	31	1588.4516	923.6365	701.0000	4810.0000	853104.3892
PHENOL	31	0.0017	0.0020	0.0010	0.0100	0.0000
ZN	30	0.0114	0.0106	0.0040	0.0530	0.0001
SULFATES	31	1726.9032	277.9364	296.0000	2120.0000	77248.6237
IRON	30	1.7027	2.5168	0.3500	9.4200	6.3343
CROMIUM	30	0.0290	0.0071	0.0200	0.0600	0.0001
WELL=1N YEAR=82						
PH	15	7.1907	0.3232	6.7000	8.2100	0.1045
CL	15	1539.5333	580.6465	443.0000	2720.0000	337150.4095
PHENOL	15	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	15	0.0542	0.0607	0.0030	0.2200	0.0037
SULFATES	15	1670.2000	379.5419	320.0000	1910.0000	144052.0286
IRON	15	1.5873	2.2903	0.1300	7.7600	5.2454
CROMIUM	15	0.0267	0.0082	0.0100	0.0400	0.0001

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=2 YEAR=77						
PH	40	7.1132	0.3495	6.6000	8.4100	0.1221
CL	11	183.5455	38.3832	143.0000	280.0000	1473.2727
PHENOL	3	0.0073	0.0046	0.0020	0.0100	0.0000
ZN	41	0.2592	0.3634	0.0060	2.1000	0.1320
SULFATES	12	1854.5833	74.0006	1728.0000	2017.0000	5476.0833
IRON	40	2.0357	2.0734	0.0200	9.6500	4.2991
CROMIUM	41	0.0296	0.0072	0.0200	0.0700	0.0001
WELL=2 YEAR=78						
PH	49	7.3216	0.1574	6.9100	7.6700	0.0248
CL	22	224.6818	31.0213	183.0000	305.0000	962.3225
PHENOL	8	0.0064	0.0081	0.0010	0.0220	0.0001
ZN	49	0.1966	0.4687	0.0050	2.2300	0.2197
SULFATES	22	1871.0000	48.0506	1769.0000	1973.0000	2308.8571
IRON	49	1.2172	0.8710	0.0220	4.4700	0.7587
CROMIUM	49	0.0431	0.0570	0.0200	0.4000	0.0032
WELL=2 YEAR=79						
PH	50	7.2934	0.2470	6.4900	7.8800	0.0610
CL	48	226.2917	69.1711	63.0000	430.0000	4784.6365
PHENOL	31	3.7279	17.8962	0.0010	100.0000	320.2741
ZN	50	0.0234	0.0446	0.0040	0.3250	0.0020
SULFATES	49	1846.9796	58.6567	1699.0000	1962.0000	3440.6037
IRON	49	1.6509	1.1246	0.0800	5.0200	1.2648
CROMIUM	50	0.0304	0.0028	0.0300	0.0500	0.0000
WELL=2 YEAR=80						
PH	48	7.2496	0.1144	6.8200	7.4300	0.0131
CL	48	202.8750	32.4494	100.0000	277.0000	1052.9628
PHENOL	46	2.1904	14.7418	0.0010	100.0000	217.3193
ZN	48	0.0376	0.0269	0.0100	0.1200	0.0007
SULFATES	48	1867.6042	75.9644	1520.0000	2063.0000	5770.5847
IRON	48	1.5200	1.3059	0.1360	5.3000	1.7055
CROMIUM	48	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=2 YEAR=81						
PH	15	7.1807	0.1327	6.9000	7.4000	0.0176
CL	15	383.6667	222.6582	250.0000	1130.0000	49576.6667
PHENOL	15	0.0010	0.0000	0.0010	0.0010	0.0000
ZN	14	0.0703	0.0464	0.0090	0.1870	0.0022
SULFATES	15	1867.9333	25.6305	1820.0000	1910.0000	656.9238
IRON	14	1.8664	0.9471	0.4700	3.2500	0.8969
CROMIUM	14	0.0243	0.0085	0.0100	0.0400	0.0001
WELL=2 YEAR=82						
PH	16	7.3131	0.0857	7.1800	7.4800	0.0073
CL	16	352.6875	254.3868	245.0000	1300.0000	64712.6292
PHENOL	16	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	16	0.1302	0.1742	0.0200	0.5700	0.0303
SULFATES	16	1869.3125	115.5720	1750.0000	2290.0000	13356.8958
IRON	16	1.3294	0.4236	0.5000	2.4200	0.1794
CROMIUM	16	0.0212	0.0034	0.0200	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=3 YEAR=76						
PH	5	10.0080	0.6290	9.2300	10.7000	0.3957
CL	2	84.0000	12.7279	75.0000	93.0000	162.0000
PHENOL	0	.	.	.	.	.
ZN	1	0.0250	.	0.0250	0.0250	.
SULFATES	3	747.3333	388.5027	299.0000	985.0000	150934.3333
IRON	5	92.1800	202.8278	0.0400	455.0000	41139.1203
CROMIUM	5	0.0420	0.0110	0.0300	0.0500	0.0001
WELL=3 YEAR=78						
PH	38	9.4832	0.6560	7.0700	10.1000	0.4303
CL	20	167.9500	245.7512	20.0000	1201.0000	60393.6289
PHENOL	5	0.1124	0.2073	0.0010	0.4800	0.0430
ZN	9	5.7270	6.5441	0.0240	18.6000	42.8252
SULFATES	20	1423.8000	148.0685	1114.0000	1593.0000	21924.2737
IRON	38	0.4014	1.1507	0.0300	6.9700	1.3241
CROMIUM	38	0.0276	0.0085	0.0200	0.0700	0.0001
WELL=3 YEAR=79						
PH	25	9.0272	0.4611	7.7600	9.6200	0.2126
CL	24	128.7917	131.2982	19.0000	684.0000	17239.2156
PHENOL	9	0.0922	0.1703	0.0040	0.5400	0.0290
ZN	0	.	.	.	.	.
SULFATES	22	1390.0909	88.7334	1244.0000	1727.0000	7873.6104
IRON	25	0.0633	0.0656	0.0050	0.2900	0.0043
CROMIUM	25	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=3A YEAR=78						
PH	47	7.4253	0.3681	7.0200	9.5600	0.1355
CL	22	21.1000	14.1816	7.0000	44.0000	201.1190
PHENOL	4	0.0045	0.0040	0.0010	0.0100	0.0000
ZN	47	0.0558	0.0972	0.0090	0.6570	0.0095
SULFATES	22	250.0000	421.6535	67.0000	1623.0000	177791.7143
IRON	46	0.2433	0.3403	0.0200	1.7800	0.1158
CROMIUM	47	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=3A YEAR=79						
PH	49	7.4249	0.2848	6.3800	8.3200	0.0811
CL	49	43.6531	153.9473	7.0000	1095.0000	23699.7730
PHENOL	31	3.7578	17.8925	0.0020	100.0000	320.1425
ZN	49	0.0311	0.0405	0.0030	0.2800	0.0016
SULFATES	48	141.0625	63.8690	59.0000	388.0000	4079.2513
IRON	49	0.7156	0.9599	0.0200	2.7300	0.9214
CROMIUM	49	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=3A YEAR=76						
PH	37	7.4089	0.2398	7.0200	8.0000	0.0575
CL	9	9.6111	8.1078	1.0000	30.0000	65.7361
PHENOL	0	.	.	.	.	.
ZN	13	0.0692	0.0404	0.0200	0.1550	0.0016
SULFATES	10	83.4000	24.7665	44.0000	121.0000	613.3778
IRON	33	0.6176	1.1124	0.0200	5.6000	1.2375
CROMIUM	34	0.0378	0.0114	0.0200	0.0500	0.0001
WELL=3A YEAR=77						
PH	38	7.1882	0.2437	6.7000	8.1500	0.0594
CL	10	6.8600	2.2677	3.0000	9.0000	5.1427
PHENOL	2	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	38	0.0335	0.0194	0.0070	0.0960	0.0004
SULFATES	10	120.8000	32.4681	88.0000	202.0000	1054.1778
IRON	38	0.1415	0.1714	0.0200	0.7580	0.0294
CROMIUM	38	0.0284	0.0031	0.0250	0.0400	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=3 A YEAR=80						
PH	50	7.3088	0.1313	6.9600	7.5700	0.0172
CL	50	13.4400	12.5229	8.0000	99.0000	156.8229
PHENOL	48	2.0995	14.4314	0.0010	100.0000	208.2658
ZN	50	0.0117	0.0120	0.0030	0.0300	0.0001
SULFATES	50	132.7600	44.1013	45.0000	274.0000	1944.9208
IRON	50	0.0737	0.1115	0.0300	0.6200	0.0124
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=3 A YEAR=81						
PH	11	7.2945	0.1621	7.1100	7.6500	0.0263
CL	11	18.1818	9.3789	5.0000	42.0000	87.9636
PHENOL	11	0.0010	0.0000	0.0010	0.0010	0.0000
ZN	11	0.0154	0.0114	0.0030	0.0390	0.0001
SULFATES	11	136.6364	46.4549	19.0000	210.0000	2158.0545
IRON	11	0.9627	1.1535	0.0300	4.1200	1.3305
CROMIUM	11	0.0291	0.0030	0.0200	0.0300	0.0000
WELL=3 A YEAR=82						
PH	6	7.2583	0.1007	7.1700	7.4500	0.0101
CL	6	11.7833	4.3037	6.0000	18.0000	18.5217
PHENOL	6	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	6	0.0340	0.0472	0.0100	0.1300	0.0022
SULFATES	6	148.3333	46.7062	78.0000	220.0000	2181.4667
IRON	6	1.0317	0.5920	0.1200	1.6300	0.3505
CROMIUM	6	0.0217	0.0041	0.0200	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=3N YEAR=79						
PH	25	7.1116	0.2093	6.5100	7.4900	0.0438
CL	25	570.5600	531.1973	28.0000	1848.0000	282170.5900
PHENOL	21	5.3035	21.7260	0.0020	100.0000	472.0174
ZN	25	0.0138	0.0322	0.0030	0.1620	0.0010
SULFATES	25	1686.6400	230.9661	1437.0000	2459.0000	53345.3233
IRON	25	0.7189	0.6090	0.0300	2.9500	0.3709
CROMIUM	25	0.0319	0.0018	0.0300	0.0370	0.0000
WELL=3N YEAR=80						
PH	65	7.0769	0.1032	6.7800	7.3400	0.0106
CL	65	105.7538	149.4828	52.0000	935.0000	22345.0947
PHENOL	61	1.6524	12.8020	0.0010	100.0000	163.8920
ZN	65	0.0085	0.0064	0.0030	0.0270	0.0000
SULFATES	65	1473.5538	130.3121	1206.0000	2061.0000	16981.2510
IRON	65	0.0596	0.0577	0.0300	0.3100	0.0033
CROMIUM	65	0.0296	0.0033	0.0030	0.0300	0.0000
WELL=3N YEAR=81						
PH	42	7.0843	0.1275	6.8300	7.3500	0.0163
CL	42	276.5714	261.8330	84.0000	1230.0000	68556.4948
PHENOL	42	0.0011	0.0006	0.0010	0.0040	0.0000
ZN	41	0.0220	0.0306	0.0030	0.1940	0.0009
SULFATES	42	1491.7619	57.1510	1380.0000	1652.0000	3266.2346
IRON	41	0.1688	0.1883	0.0300	0.6600	0.0355
CROMIUM	41	0.0283	0.0038	0.0200	0.0300	0.0000
WELL=3N YEAR=82						
PH	17	7.1482	0.1310	6.9600	7.3800	0.0172
CL	17	435.0588	245.0810	330.0000	1380.0000	60064.6838
PHENOL	17	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	17	0.0211	0.0145	0.0080	0.0700	0.0002
SULFATES	17	1519.7647	19.9985	1490.0000	1570.0000	399.9412
IRON	17	0.1076	0.0434	0.0300	0.2200	0.0019
CROMIUM	17	0.0212	0.0033	0.0200	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=4 YEAR=74						
PH	11	7.9545	0.1128	7.7000	8.1000	0.0127
CL	2	77.5000	60.1041	35.0000	120.0000	3612.5000
PHENOL	0	.	.	.	.	.
ZN	0	.	.	.	.	.
SULFATES	2	1619.5000	314.6625	1397.0000	1842.0000	99012.5000
IRON	0	.	.	.	.	.
CROMIUM	0	.	.	.	.	.
WELL=4 YEAR=75						
PH	36	7.7706	0.3770	6.6900	8.5200	0.1421
CL	10	33.0000	5.0990	28.0000	46.0000	26.0000
PHENOL	0	.	.	.	.	.
ZN	0	.	.	.	.	.
SULFATES	12	1773.3333	124.2434	1567.0000	1989.0000	15436.4242
IRON	0	.	.	.	.	.
CROMIUM	0	.	.	.	.	.
WELL=4 YEAR=76						
PH	51	7.5147	0.3627	6.2000	8.2400	0.1315
CL	12	31.5000	5.3172	27.0000	43.0000	28.2727
PHENOL	0	.	.	.	.	.
ZN	16	3.4594	1.1539	1.7000	6.5000	1.3314
SULFATES	12	1852.8333	183.5399	1317.0000	1995.0000	33686.8788
IRON	39	0.7713	0.4597	0.0400	1.8200	0.2114
CROMIUM	37	0.0368	0.0132	0.0050	0.0500	0.0002
WELL=4 YEAR=77						
PH	39	7.3892	0.3019	6.7500	7.9700	0.0912
CL	11	32.0909	9.3537	26.0000	60.0000	87.4909
PHENOL	2	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	18	3.9606	1.3952	1.6600	5.6000	1.9467
SULFATES	11	1927.1818	136.4389	1573.0000	2067.0000	18615.5636
IRON	40	0.8503	0.5674	0.0600	1.9500	0.3220
CROMIUM	40	0.0285	0.0030	0.0250	0.0400	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=4 YEAR=78						
PH	48	7.5294	0.2108	7.1300	7.9700	0.0444
CL	23	32.4783	9.6430	22.0000	65.0000	92.9881
PHENOL	5	0.0130	0.0174	0.0010	0.0430	0.0003
ZN	17	124.4376	497.4972	1.5600	2055.0000	247503.5124
SULFATES	22	1957.0909	55.7494	1868.0000	2102.0000	3107.9913
IRON	48	0.8110	0.4712	0.1400	1.5400	0.2220
CROMIUM	48	0.0269	0.0051	0.0200	0.0400	0.0000
WELL=4 YEAR=79						
PH	25	7.7008	0.1772	7.2900	8.0900	0.0314
CL	25	34.4800	10.1658	8.0000	50.0000	103.3433
PHENOL	11	0.5612	0.9243	0.0010	2.0000	0.8544
ZN	0	.	.	.	.	.
SULFATES	22	1899.7727	92.1422	1538.0000	2021.0000	8490.1840
IRON	25	0.3293	0.3064	0.0300	1.2400	0.0939
CROMIUM	25	0.0436	0.0680	0.0300	0.3700	0.0046

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=4N YEAR=79						
PH	25	6.9648	0.2451	6.2100	7.4800	0.0601
CL	25	467.4000	181.6409	69.0000	803.0000	32993.4167
PHENOL	21	5.3013	21.7265	0.0020	100.0000	472.0418
ZN	25	0.0075	0.0072	0.0030	0.0280	0.0001
SULFATES	25	488.8000	201.5757	354.0000	1370.0000	40632.7500
IRON	25	0.2381	0.2141	0.0300	0.7610	0.0458
CROMIUM	25	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=4N YEAR=80						
PH	50	6.7974	0.1210	6.3900	7.0500	0.0146
CL	50	609.9000	144.5674	337.0000	1044.0000	20899.7245
PHENOL	48	2.0998	14.4314	0.0010	100.0000	208.2643
ZN	50	0.0080	0.0067	0.0030	0.0300	0.0000
SULFATES	50	440.5600	228.2087	193.0000	1513.0000	52079.2310
IRON	50	0.3471	0.4532	0.0300	3.3500	0.2054
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=4N YEAR=81						
PH	51	6.9080	0.1402	6.6200	7.2000	0.0196
CL	50	482.7400	260.0024	76.0000	800.0000	67601.2576
PHENOL	51	0.0011	0.0006	0.0010	0.0050	0.0000
ZN	50	0.0337	0.1402	0.0010	1.0000	0.0197
SULFATES	50	909.6600	603.0432	348.0000	1884.0000	363661.0453
IRON	49	0.9500	0.8259	0.0400	2.7600	0.6821
CROMIUM	49	0.0269	0.0047	0.0200	0.0300	0.0000
WELL=4N YEAR=82						
PH	32	7.3109	0.1335	7.0100	7.6900	0.0178
CL	32	63.0313	83.9134	21.0000	510.0000	7041.4506
PHENOL	32	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	32	0.0381	0.0574	0.0100	0.2600	0.0033
SULFATES	32	1916.4063	101.9196	1740.0000	2340.0000	10387.6038
IRON	32	0.3150	0.2554	0.0400	1.3200	0.0652
CROMIUM	32	0.0216	0.0051	0.0100	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=5 YEAR=74						
PH	20	7.9250	0.2511	7.3000	8.2000	0.0630
CL	5	50.0000	33.5932	33.0000	110.0000	1128.5000
PHENOL	0	.	.	.	.	.
ZN	0	.	.	.	.	.
SULFATES	5	1437.8000	727.8473	150.0000	1892.0000	529761.7000
IRON	0	.	.	.	.	.
CROMIUM	0	.	.	.	.	.
WELL=5 YEAR=75						
PH	37	7.2968	0.2633	6.6700	7.8800	0.0693
CL	11	33.8182	11.6689	1.0000	43.0000	136.1636
PHENOL	0	.	.	.	.	.
ZN	0	.	.	.	.	.
SULFATES	12	1515.4167	489.8954	69.0000	1817.0000	239997.5379
IRON	0	.	.	.	.	.
CROMIUM	0	.	.	.	.	.
WELL=5 YEAR=76						
PH	52	7.2162	0.3125	6.1400	7.9000	0.0977
CL	12	42.4167	13.4127	25.0000	66.0000	179.9015
PHENOL	0	.	.	.	.	.
ZN	15	0.2829	0.2369	0.0900	0.9600	0.0561
SULFATES	12	1794.6667	89.9043	1569.0000	1887.0000	8082.7879
IRON	38	2.9047	1.7125	1.1900	7.4000	2.9327
CROMIUM	39	0.0383	0.0159	0.0100	0.1000	0.0003
WELL=5 YEAR=77						
PH	44	7.1480	0.1889	6.6600	7.8200	0.0357
CL	11	50.6364	23.2563	29.0000	98.0000	540.8545
PHENOL	3	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	43	0.1661	0.1264	0.0210	0.6880	0.0160
SULFATES	11	1746.5455	90.6337	1588.0000	1840.0000	8214.4727
IRON	40	2.0650	0.4058	0.7600	3.4800	0.1647
CROMIUM	44	0.0285	0.0023	0.0250	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=5 YEAR=78						
PH	48	7.2177	0.1542	6.6500	7.5600	0.0238
CL	23	63.5217	29.8692	29.0000	156.0000	892.1700
PHENOL	6	0.0117	0.0192	0.0010	0.0500	0.0004
ZN	48	0.1641	0.2994	0.0270	1.6700	0.0896
SULFATES	23	1837.9565	189.6304	1706.0000	2679.0000	35959.6798
IRON	46	1.9654	0.6276	0.1800	3.8700	0.3939
CROMIUM	48	0.0265	0.0048	0.0200	0.0300	0.0000
WELL=5 YEAR=79						
PH	50	7.2296	0.2142	6.3600	7.7700	0.0459
CL	49	55.2449	32.6200	18.0000	221.0000	1064.0638
PHENOL	32	3.5477	17.6272	0.0020	100.0000	310.7187
ZN	35	0.0863	0.2882	0.0030	1.7200	0.0831
SULFATES	49	1774.3061	94.9768	1413.0000	1933.0000	9020.5918
IRON	50	1.8202	0.6642	0.0400	3.2000	0.4412
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=5 YEAR=80						
PH	50	7.0872	0.0930	6.7400	7.2800	0.0086
CL	50	47.1200	10.4874	30.0000	67.0000	109.9853
PHENOL	48	2.0993	14.4314	0.0010	100.0000	208.2665
ZN	50	0.0530	0.1190	0.0090	0.8400	0.0142
SULFATES	50	1841.0600	47.4279	1651.0000	1948.0000	2249.4045
IRON	50	2.0326	1.2233	0.0400	9.1500	1.4965
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=5 YEAR=81						
PH	34	7.1109	0.0899	6.9500	7.3300	0.0081
CL	34	48.7059	13.8379	31.0000	90.0000	191.4866
PHENOL	34	0.0011	0.0003	0.0010	0.0030	0.0000
ZN	33	0.0478	0.0371	0.0110	0.1550	0.0014
SULFATES	34	1780.0882	220.4144	629.0000	1924.0000	48582.5071
IRON	33	2.6327	0.6834	0.1900	3.6400	0.4671
CROMIUM	33	0.0276	0.0044	0.0200	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=5 YEAR=82						
PH	16	7.2306	0.0990	7.1000	7.4500	0.0098
CL	16	43.0000	6.1319	33.0000	51.0000	37.6000
PHENOL	16	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	16	0.0974	0.1155	0.0100	0.4500	0.0133
SULFATES	16	1809.1250	63.5860	1700.0000	1960.0000	4043.1833
IRON	16	2.6987	0.8966	1.5000	5.5100	0.8039
CROMIUM	16	0.0219	0.0066	0.0100	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=6 YEAR=76						
PH	32	8.0478	0.3954	7.4200	9.1200	0.1563
CL	5	434.8000	244.1848	1.0000	587.0000	59626.2000
PHENOL	0	.	.	.	.	.
ZN	13	2.5085	1.6792	0.5500	5.0100	2.8198
SULFATES	7	1242.8571	746.9753	77.0000	1853.0000	557972.1429
IRON	30	0.4364	0.5389	0.0200	2.6300	0.2905
CROMIUM	30	0.0362	0.0108	0.0200	0.0500	0.0001
WELL=6 YEAR=77						
PH	38	8.0487	0.3793	7.2500	8.9300	0.1438
CL	10	557.3000	37.5472	491.0000	627.0000	1409.7889
PHENOL	4	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	38	2.0393	1.0430	0.0320	4.6200	1.0878
SULFATES	10	1790.3000	59.3147	1668.0000	1879.0000	3518.2333
IRON	38	0.2201	0.2138	0.0200	0.8300	0.0457
CROMIUM	38	0.0287	0.0035	0.0250	0.0440	0.0000
WELL=6 YEAR=78						
PH	49	8.1486	0.4546	6.4500	9.1800	0.2067
CL	26	494.8080	210.5981	0.0070	642.0000	44351.5644
PHENOL	2	0.1905	0.2680	0.0010	0.3800	0.0718
ZN	19	1.7953	2.1777	0.0250	9.5800	4.7424
SULFATES	25	1804.3200	60.9650	1671.0000	2000.0000	3716.7267
IRON	49	0.2947	0.3010	0.0300	1.4500	0.0906
CROMIUM	49	0.0267	0.0047	0.0200	0.0300	0.0000
WELL=6 YEAR=79						
PH	25	8.0600	0.2186	7.6000	8.6300	0.0478
CL	25	667.4400	381.6381	91.0000	1865.0000	145647.6733
PHENOL	9	0.6751	0.9937	0.0020	2.0000	0.9875
ZN	0	.	.	.	.	.
SULFATES	24	1669.3750	386.6178	529.0000	2399.0000	149473.2880
IRON	25	0.1138	0.0663	0.0200	0.3100	0.0044
CROMIUM	25	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=6A YEAR=76						
PH	37	7.4351	0.2303	7.1000	7.9200	0.0530
CL	9	34.4444	15.5251	5.0000	50.0000	241.0278
PHENOL	0	.	.	.	.	.
ZN	13	0.1986	0.3123	0.0200	1.1700	0.0975
SULFATES	10	278.7000	565.3532	65.0000	1887.0000	319624.2333
IRON	35	0.6446	0.8288	0.0200	3.2200	0.6868
CROMIUM	35	0.0373	0.0111	0.0200	0.0500	0.0001
WELL=6A YEAR=77						
PH	38	7.3974	0.2478	7.0200	7.9000	0.0614
CL	10	50.5000	14.8941	24.0000	72.0000	221.8333
PHENOL	2	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	38	0.0783	0.2557	0.0050	1.5600	0.0654
SULFATES	10	106.4000	28.4183	48.0000	146.0000	807.6000
IRON	38	0.2452	0.3616	0.0200	1.8400	0.1307
CROMIUM	38	0.0288	0.0022	0.0250	0.0300	0.0000
WELL=6A YEAR=78						
PH	47	7.4711	0.2492	7.0600	8.0100	0.0621
CL	23	65.7391	118.4273	10.0000	605.0000	14025.0198
PHENOL	6	0.0013	0.0008	0.0010	0.0030	0.0000
ZN	46	0.1487	0.3582	0.0050	1.5600	0.1283
SULFATES	23	166.0435	296.6276	57.0000	1515.0000	87987.9526
IRON	45	0.2898	0.4501	0.0300	1.7500	0.2026
CROMIUM	46	0.0278	0.0042	0.0200	0.0300	0.0000
WELL=6A YEAR=79						
PH	49	7.5047	0.3256	6.1900	8.3100	0.1060
CL	49	49.7551	31.1960	10.0000	218.0000	973.1888
PHENOL	31	3.5323	17.9279	0.0020	100.0000	321.4081
ZN	49	0.0204	0.0194	0.0030	0.1010	0.0004
SULFATES	48	117.1875	51.2552	54.0000	276.0000	2627.0918
IRON	48	0.9278	1.2328	0.0300	5.0000	1.5199
CROMIUM	49	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=6A YEAR=80						
PH	50	7.3784	0.1721	6.5100	7.8300	0.0296
CL	50	46.4800	17.8099	13.0000	100.0000	317.1935
PHENOL	48	2.0995	14.4314	0.0010	100.0000	208.2659
ZN	50	0.0039	0.0024	0.0030	0.0130	0.0000
SULFATES	50	161.7600	99.1757	39.0000	630.0000	9835.8188
IRON	50	2.4276	16.2474	0.0300	115.0000	263.9793
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=6A YEAR=81						
PH	2	7.2950	0.0495	7.2600	7.3300	0.0024
CL	1	84.0000	.	84.0000	84.0000	.
PHENOL	2	0.0030	0.0028	0.0010	0.0050	0.0000
ZN	2	0.0045	0.0021	0.0030	0.0060	0.0000
SULFATES	2	203.5000	44.5477	172.0000	235.0000	1984.5000
IRON	2	0.1500	0.1697	0.0300	0.2700	0.0288
CROMIUM	2	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=6N YEAR=79						
PH	25	7.4784	0.3452	6.3800	8.1600	0.1192
CL	25	1180.0800	148.3158	744.0000	1678.0000	21997.5767
PHENOL	21	5.2573	21.7366	0.0030	100.0000	472.4802
ZN	25	0.0088	0.0086	0.0030	0.0350	0.0001
SULFATES	25	1807.1600	74.0139	1600.0000	1968.0000	5478.0567
IRON	25	0.0760	0.0887	0.0300	0.4000	0.0079
CROMIUM	25	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=6N YEAR=80						
PH	50	7.2274	0.0946	6.9700	7.5800	0.0089
CL	50	1162.8800	103.3837	892.0000	1486.0000	10688.1894
PHENOL	46	2.1935	14.7413	0.0010	100.0000	217.3054
ZN	50	0.0055	0.0040	0.0010	0.0250	0.0000
SULFATES	50	1832.5400	61.0935	1518.0000	1946.0000	3732.4167
IRON	50	0.0606	0.0556	0.0300	0.3300	0.0031
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=6N YEAR=81						
PH	34	7.2606	0.1311	7.0400	7.7000	0.0172
CL	34	1344.2647	212.6751	1048.0000	1840.0000	45230.6854
PHENOL	34	0.0025	0.0081	0.0010	0.0480	0.0001
ZN	33	0.0142	0.0157	0.0010	0.0870	0.0002
SULFATES	34	1822.0588	33.1077	1760.0000	1907.0000	1096.1176
IRON	33	0.0588	0.0465	0.0300	0.2500	0.0022
CROMIUM	33	0.0279	0.0048	0.0200	0.0400	0.0000
WELL=6N YEAR=82						
PH	17	7.2994	0.1641	7.1500	7.8000	0.0269
CL	17	1431.1765	168.5186	1090.0000	1740.0000	28398.5294
PHENOL	17	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	17	0.0245	0.0103	0.0100	0.0500	0.0001
SULFATES	17	1823.8824	53.9524	1770.0000	1980.0000	2910.8603
IRON	17	0.1018	0.0265	0.0700	0.1600	0.0007
CROMIUM	17	0.0241	0.0071	0.0100	0.0400	0.0001

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=7 YEAR=76						
PH	1	7.9800	.	7.9800	7.9800	.
CL	1	516.0000	.	516.0000	516.0000	.
PHENOL	0	.	.	.	.	.
ZN	0	.	.	.	.	.
SULFATES	1	1698.0000	.	1698.0000	1698.0000	.
IRON	1	0.0500	.	0.0500	0.0500	.
CROMIUM	1	0.0500	.	0.0500	0.0500	.
WELL=7 YEAR=79						
PH	25	7.2848	0.2575	6.2700	7.7500	0.0663
CL	25	209.4000	80.1613	109.0000	414.0000	6425.8333
PHENOL	21	5.2569	21.7367	0.0020	100.0000	472.4849
ZN	25	0.0045	0.0022	0.0030	0.0110	0.0000
SULFATES	25	1835.6000	83.6516	1537.0000	1935.0000	6997.5833
IRON	25	0.1345	0.1536	0.0300	0.6800	0.0236
CROMIUM	25	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=7 YEAR=80						
PH	50	7.2732	0.0934	7.0200	7.5500	0.0087
CL	50	93.6600	57.6140	55.0000	372.0000	3319.3718
PHENOL	48	2.0975	14.4317	0.0010	100.0000	208.2740
ZN	49	0.0063	0.0045	0.0030	0.0270	0.0000
SULFATES	50	1772.7800	119.8190	1466.0000	2237.0000	14356.5833
IRON	49	0.1761	0.1247	0.0300	0.5800	0.0156
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=7 YEAR=81						
PH	35	7.2969	0.1175	7.0500	7.5500	0.0138
CL	35	74.0571	25.7076	35.0000	136.0000	660.8790
PHENOL	35	0.0010	0.0000	0.0010	0.0010	0.0000
ZN	34	0.0129	0.0086	0.0030	0.0420	0.0001
SULFATES	35	1767.8000	79.7152	1493.0000	1876.0000	6354.5176
IRON	34	0.3909	0.2642	0.0600	1.2400	0.0698
CROMIUM	34	0.0279	0.0041	0.0200	0.0300	0.0000
WELL=7 YEAR=82						
PH	16	7.3000	0.0692	7.1400	7.4200	0.0048
CL	16	93.1875	124.1613	15.0000	450.0000	15416.0292
PHENOL	16	0.0106	0.0025	0.0100	0.0200	0.0000
ZN	16	0.0197	0.0080	0.0030	0.0300	0.0001
SULFATES	16	1791.8750	54.1872	1630.0000	1880.0000	2936.2500
IRON	16	0.1531	0.0903	0.0300	0.3600	0.0082
CROMIUM	16	0.0212	0.0034	0.0200	0.0300	0.0000

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=8 YEAR=79						
PH	16	7.3550	0.1924	7.0700	7.7800	0.0370
CL	16	26.1250	1.7464	23.0000	30.0000	3.0500
PHENOL	12	8.6068	28.7846	0.0020	100.0000	828.5537
ZN	16	6.0766	2.1655	0.9050	8.9500	4.6892
SULFATES	16	1842.3125	57.6931	1733.0000	1938.0000	3328.4958
IRON	16	2.2181	0.3583	1.8000	2.8900	0.1283
CROMIUM	16	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=8 YEAR=80						
PH	50	7.3072	0.1278	6.9500	7.6500	0.0163
CL	50	25.6800	2.7586	17.0000	32.0000	7.6098
PHENOL	48	2.0994	14.4314	0.0010	100.0000	208.2661
ZN	49	4.8549	1.7165	1.7700	9.9000	2.9464
SULFATES	50	1845.8200	56.6492	1583.0000	1991.0000	3209.1302
IRON	50	2.2024	1.0088	0.0300	4.8000	1.0177
CROMIUM	50	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=8 YEAR=81						
PH	33	7.2488	0.1212	7.0600	7.4800	0.0147
CL	33	42.6364	35.2206	24.0000	232.0000	1240.4886
PHENOL	33	0.0012	0.0014	0.0010	0.0090	0.0000
ZN	32	4.9513	1.6390	0.0030	8.8500	2.6864
SULFATES	33	1783.1515	41.5189	1620.0000	1870.0000	1723.8201
IRON	32	2.5794	2.4997	0.0500	9.3300	6.2483
CROMIUM	32	0.0606	0.1806	0.0200	1.0500	0.0326
WELL=8 YEAR=82						
PH	15	7.1800	0.1043	7.0200	7.4000	0.0109
CL	15	41.8667	39.6806	10.0000	180.0000	1574.5524
PHENOL	15	0.0100	0.0000	0.0100	0.0100	0.0000
ZN	15	2.1533	3.3596	0.1700	13.1000	11.2872
SULFATES	15	1797.0667	14.5576	1770.0000	1830.0000	211.9238
IRON	15	1.8520	1.7774	0.4000	7.9600	3.1592
CROMIUM	15	0.0213	0.0035	0.0200	0.0300	0.0000

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=11 MONTH=1					
PH	7.3300	0.1414	7.2300	7.4300	0.0200
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	607.5000	67.1751	560.0000	655.0000	4512.5000
SULFATES	2030.0000	0.0000	2030.0000	2030.0000	0.0000
ZN	0.0145	0.0078	0.0090	0.0200	0.0001
CROMIUM	0.0300	0.0000	0.0300	0.0300	0.0000
WELL=11 MONTH=2					
PH	7.3500	.	7.3500	7.3500	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	590.0000	.	590.0000	590.0000	.
SULFATES	2040.0000	.	2040.0000	2040.0000	.
ZN	0.0270	.	0.0270	0.0270	.
CROMIUM	0.0200	.	0.0200	0.0200	.
WELL=11 MONTH=3					
PH	7.3850	0.0919	7.3200	7.4500	0.0084
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	555.0000	77.7817	500.0000	610.0000	6050.0000
SULFATES	2060.0000	14.1421	2050.0000	2070.0000	200.0000
ZN	0.0110	0.0127	0.0020	0.0200	0.0002
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=11 MONTH=4					
PH	7.3250	0.0354	7.3000	7.3500	0.0012
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	610.0000	28.2843	590.0000	630.0000	800.0000
SULFATES	2045.0000	7.0711	2040.0000	2050.0000	50.0000
ZN	0.0250	0.0071	0.0200	0.0300	0.0001
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=11 MONTH=5					
PH	7.3200	.	7.3200	7.3200	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	2610.0000	.	2610.0000	2610.0000	.
SULFATES	2070.0000	.	2070.0000	2070.0000	.
ZN	0.0030	.	0.0030	0.0030	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=11 MONTH=6					
PH	7.4400	0.0283	7.4200	7.4600	0.0008
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	615.0000	21.2132	600.0000	630.0000	450.0000
SULFATES	2040.0000	28.2843	2020.0000	2060.0000	800.0000
ZN	0.0100	0.0000	0.0100	0.0100	0.0000
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=11 MONTH=7					
PH	7.4267	0.0208	7.4100	7.4500	0.0004
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	554.6667	43.8786	520.0000	604.0000	1925.3333
SULFATES	2032.3333	10.7858	2020.0000	2040.0000	116.3333
ZN	0.0133	0.0058	0.0100	0.0200	0.0000
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=11 MONTH=8					
PH	7.2400	.	7.2400	7.2400	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	610.0000	.	610.0000	610.0000	.
SULFATES	2061.0000	.	2061.0000	2061.0000	.
ZN	0.0100	.	0.0100	0.0100	.
CROMIUM	0.0200	.	0.0200	0.0200	.

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=11 MONTH=9					
PH	7.1350	0.2333	6.9700	7.3000	0.0544
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	596.5000	19.0919	583.0000	610.0000	364.5000
SULFATES	2055.0000	7.0711	2050.0000	2060.0000	50.0000
ZN	0.0100	0.0000	0.0100	0.0100	0.0000
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=11 MONTH=10					
PH	7.3900	.	7.3900	7.3900	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	609.0000	.	609.0000	609.0000	.
SULFATES	2040.0000	.	2040.0000	2040.0000	.
ZN	0.0200	.	0.0200	0.0200	.
CROMIUM	0.0200	.	0.0200	0.0200	.

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=12 MONTH=1					
PH	7.2800	.	7.2800	7.2800	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	1410.0000	.	1410.0000	1410.0000	.
SULFATES	1870.0000	.	1870.0000	1870.0000	.
ZN	0.0340	.	0.0340	0.0340	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=12 MONTH=2					
PH	7.1900	.	7.1900	7.1900	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	910.0000	.	910.0000	910.0000	.
SULFATES	1890.0000	.	1890.0000	1890.0000	.
ZN	0.0240	.	0.0240	0.0240	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=12 MONTH=3					
PH	7.0750	0.1768	6.9500	7.2000	0.0312
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	765.0000	148.4924	660.0000	870.0000	22050.0000
SULFATES	1950.0000	141.4214	1850.0000	2050.0000	20000.0000
ZN	0.0160	0.0057	0.0120	0.0200	0.0000
CROMIUM	0.0250	0.0071	0.0200	0.0300	0.0001
WELL=12 MONTH=4					
PH	6.8900	0.0141	6.8800	6.9000	0.0002
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	488.0000	31.1127	466.0000	510.0000	968.0000
SULFATES	1935.0000	7.0711	1930.0000	1940.0000	50.0000
ZN	0.0200	0.0141	0.0100	0.0300	0.0002
CROMIUM	0.0250	0.0071	0.0200	0.0300	0.0001

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=12 MONTH=6					
PH	7.0500	0.0990	6.9800	7.1200	0.0098
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	508.0000	31.1127	486.0000	530.0000	968.0000
SULFATES	1971.0000	57.9828	1930.0000	2012.0000	3362.0000
ZN	0.0250	0.0071	0.0200	0.0300	0.0001
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=12 MONTH=7					
PH	7.1333	0.2485	6.9800	7.4200	0.0617
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	518.3333	7.6376	510.0000	525.0000	58.3333
SULFATES	1948.3333	27.5379	1920.0000	1975.0000	758.3333
ZN	0.0233	0.0153	0.0100	0.0400	0.0002
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=12 MONTH=8					
PH	6.9200	.	6.9200	6.9200	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	490.0000	.	490.0000	490.0000	.
SULFATES	1980.0000	.	1980.0000	1980.0000	.
ZN	0.0300	.	0.0300	0.0300	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=12 MONTH=9					
PH	6.9533	0.0351	6.9200	6.9900	0.0012
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	507.3333	6.4291	500.0000	512.0000	41.3333
SULFATES	1956.6667	15.2753	1940.0000	1970.0000	233.3333
ZN	0.0200	0.0173	0.0100	0.0400	0.0003
CROMIUM	0.0167	0.0058	0.0100	0.0200	0.0000

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=12 MONTH=10					
PH	6.9800	.	6.9800	6.9800	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	510.0000	.	510.0000	510.0000	.
SULFATES	1970.0000	.	1970.0000	1970.0000	.
ZN	0.0200	.	0.0200	0.0200	.
CROMIUM	0.0200	.	0.0200	0.0200	.

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=13 MONTH=1					
PH	7.6000	.	7.6000	7.6000	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	620.0000	.	620.0000	620.0000	.
SULFATES	1890.0000	.	1890.0000	1890.0000	.
ZN	0.0340	.	0.0340	0.0340	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=13 MONTH=2					
PH	7.2300	.	7.2300	7.2300	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	610.0000	.	610.0000	610.0000	.
SULFATES	1880.0000	.	1880.0000	1880.0000	.
ZN	0.0320	.	0.0320	0.0320	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=13 MONTH=3					
PH	7.3600	0.0566	7.3200	7.4000	0.0032
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	670.0000	98.9949	600.0000	740.0000	9800.0000
SULFATES	2015.0000	233.3452	1850.0000	2180.0000	54450.0000
ZN	0.0380	0.0028	0.0360	0.0400	0.0000
CROMIUM	0.0250	0.0071	0.0200	0.0300	0.0001
WELL=13 MONTH=4					
PH	7.6300	0.3394	7.3900	7.8700	0.1152
PHENOLS	0.0200	0.0141	0.0100	0.0300	0.0002
CL	1275.0000	940.4520	610.0000	1940.0000	884450.0000
SULFATES	1900.0000	14.1421	1890.0000	1910.0000	200.0000
ZN	0.0300	0.0000	0.0300	0.0300	0.0000
CROMIUM	0.0250	0.0071	0.0200	0.0300	0.0001

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=13 MONTH=6					
PH	7.4200	0.0000	7.4200	7.4200	0.0000
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	615.0000	77.7817	560.0000	670.0000	6050.0000
SULFATES	1922.5000	45.9619	1890.0000	1955.0000	2112.5000
ZN	0.0300	0.0000	0.0300	0.0300	0.0000
CROMIUM	0.0150	0.0071	0.0100	0.0200	0.0000
WELL=13 MONTH=7					
PH	7.4267	0.2419	7.2400	7.7000	0.0585
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	588.3333	7.6376	580.0000	595.0000	58.3333
SULFATES	1889.6667	19.5021	1870.0000	1909.0000	380.3333
ZN	0.0333	0.0058	0.0300	0.0400	0.0000
CROMIUM	0.0200	0.0000	0.0200	0.0200	0.0000
WELL=13 MONTH=8					
PH	7.2300	.	7.2300	7.2300	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	570.0000	.	570.0000	570.0000	.
SULFATES	1920.0000	.	1920.0000	1920.0000	.
ZN	0.0040	.	0.0040	0.0040	.
CROMIUM	0.0300	.	0.0300	0.0300	.
WELL=13 MONTH=9					
PH	7.2267	0.0808	7.1400	7.3000	0.0065
PHENOLS	0.0100	0.0000	0.0100	0.0100	0.0000
CL	588.0000	7.2111	580.0000	594.0000	52.0000
SULFATES	1883.3333	5.7735	1880.0000	1890.0000	33.3333
ZN	0.0300	0.0173	0.0200	0.0500	0.0003
CROMIUM	0.0167	0.0058	0.0100	0.0200	0.0000

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	VARIANCE
WELL=13 MONTH=10					
PH	7.2800	.	7.2800	7.2800	.
PHENOLS	0.0100	.	0.0100	0.0100	.
CL	580.0000	.	580.0000	580.0000	.
SULFATES	1910.0000	.	1910.0000	1910.0000	.
ZN	0.0300	.	0.0300	0.0300	.
CROMIUM	0.0200	.	0.0200	0.0200	.

APPENDIX G

RCRA MONITORING DATA

TABLE 1

1st Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	1N	2	3N	4N	5
Date Sampled	3-3-82	2-24-82	2-24-82	2-24-82	3-3-82
TOH_1, mg/l	< 0.010	< 0.010	0.054	0.031	0.048
TOH_2, mg/l	0.034	< 0.010	0.010	0.045	< 0.010
TOH_3, mg/l	0.050	< 0.010	0.042	0.059	0.016
TOH_4, mg/l	0.055	0.015	0.094	0.016	0.120
Chloride, mg/l	2300	308	390	66.5	45.2
Sulfate, mg/l	1670	1820	1430	1940	1790
Nitrate N, mg/l	0.20	0.12	0.70	0.12	0.05
Fluoride, mg/l	2.0	1.7	0.7	0.8	2.0
Ammonia N, mg/l	2.68	1.26	0.28	0.86	0.91
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	400	910	220	1040	3940
Manganese, ug/l	< 5	30	40	160	50
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	30	20	40	70	30
Cadmium, ug/l	3	< 2	< 2	< 2	< 2
Chromium, ug/l	< 5	< 5	< 5	< 5	< 5
Lead, ug/l	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	6	10	< 5	< 5	< 5
Silver, ug/l	50	< 3	< 3	< 3	40
T. Coliform, Col/100 ml	< 1	< 1	< 1	< 1	< 1
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	30.3	30.4	75.6	23.5	38.8
TOC_2, mg/l	30.3	30.2	75.3	23.8	39.3
TOC_3, mg/l	30.8	30.5	75.6	23.5	39.1
TOC_4, mg/l	30.2	31.1	75.8	23.9	39.0
pH, units	7.18	7.25	7.12	7.16	7.21
pH, units	7.18	7.33	7.16	7.21	7.27
pH, units	7.18	7.38	7.18	7.23	7.31
pH, units	7.20	7.38	7.19	7.25	7.31
Conductivity, umhos/cm	4980	2300	2180	1820	2030
nductivity, umhos/cm	5100	2310	2220	1850	2100
conductivity, umhos/cm	5070	2380	2300	1900	2140
Conductivity, umhos/cm	5150	2400	2330	1960	2180
Phenol, mg/l	< 0.001	< 0.001	< 0.001	0.002	< 0.001

TABLE 1 (Cont'd)

1st Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	6N	7	8	11	12	13
Date Sampled	3-3-82	2-24-82	2-24-82	2-24-82	3-3-82	3-3-82
TOH_1, mg/l	0.081	0.015	0.010	0.031	0.016	0.068
TOH_2, mg/l	0.210	0.010	0.010	0.023	0.048	0.051
TOH_3, mg/l	0.240	0.010	0.010	0.035	0.030	0.019
TOH_4, mg/l	0.130	0.010	0.011	0.019	0.061	0.120
Chloride, mg/l	1610	35.9	34.6	697	926	765
Sulfate, mg/l	1760	1670	1730	1960	1840	1870
Nitrate N, mg/l	< 0.05	0.11	0.47	0.11	0.06	1.28
Fluoride, mg/l	1.2	1.2	1.5	1.3	0.64	1.8
Ammonia N, mg/l	1.90	0.23	1.76	1.76	1.87	0.26
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	140	170	2650	190	310	120
Manganese, ug/l	30	30	110	190	330	40
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	30	30	30	60	30	40
Cadmium, ug/l	10	< 2	< 2	< 2	9	6
Chromium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Lead, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	< 5	< 5	< 5	< 5	5	< 5
Silver, ug/l	50	< 3	< 3	< 3	< 3	< 3
T. Coliform, Col/100 ml	< 1	< 1	—	< 1	< 1	< 1
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	28.8	24.6	50.4	24.2	57.3	20.4
TOC_2, mg/l	28.2	24.3	51.4	23.2	57.5	20.6
TOC_3, mg/l	28.3	24.1	54.7	25.4	56.3	21.1
TOC_4, mg/l	28.7	24.9	52.5	25.2	56.0	21.2
pH, units	7.18	7.25	7.12	7.34	7.20	7.43
pH, units	7.18	7.32	7.18	7.35	7.21	7.40
pH, units	7.19	7.33	7.20	7.35	7.20	7.39
pH, units	7.18	7.35	7.20	7.37	7.19	7.40
Conductivity, umhos/cm	4280	1700	1950	2800	3290	2900
Conductivity, umhos/cm	4400	1720	1980	2900	3360	2950
Conductivity, umhos/cm	4490	1780	1990	2960	3480	3010
nductivity, umhos/cm	4600	1800	2010	3050	3500	3100
Phenol, mg/l	< 0.001	< 0.001	< 0.004	< 0.001	< 0.001	< 0.001

TABLE 1 (Cont'd)

CHEMICAL WASTE MANAGEMENT

Radiological Parameters

All in pCi/l

Well No.	1N	6N	12	13
Gross Alpha	< 9.9	< 7.0	< 5.0	< 5.0
Gross Beta	38.0 ± 10.0	30.0 ± 6.0	20.0 ± 5.0	19.0 ± 5.0
Radium 266	3.05 ± 0.22	1.85 ± 0.019	0.67 ± 0.09	1.15 ± 0.012
Radium 228	1.86 ± 1.49	NN	NN	NN

NN - Analysis not needed

TABLE 2

2nd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	1N	2	3N	4N	5	6N
Date Sampled	5-12-82	5-5-82	5-5-82	5-5-82	5-12-82	5-12-82
TOH_1, mg/l	0.031	0.010	< 0.010	1.130	0.071	0.054
TOH_2, mg/l	0.058	0.010	< 0.010	0.660	0.042	0.052
TOH_3, mg/l	0.046	0.010	0.010	1.330	0.062	0.130
TOH_4, mg/l	0.086	0.010	0.015	0.830	0.064	0.072
Chloride, mg/l	2180	280	376	50.7	38.2	1630
Sulfate, mg/l	1810	1870	1510	2190	1770	1870
Nitrate N, mg/l	0.19	0.05	0.016	0.12	0.13	0.18
Fluoride, mg/l	1.9	2.2	1.0	1.1	1.7	1.4
Ammonia N, mg/l	2.50	1.16	0.07	0.05	0.82	1.70
T. Cyanide, mg/l	0.25	0.25	0.25	0.25	0.25	0.25
Iron, ug/l	547	1030	68	91	2250	165
Manganese, ug/l	44	23	18	36	54	50
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	10	4	18	14	26	35
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	17	11	10	8	< 5	17
Lead, ug/l	20	< 5	< 5	< 5	8	5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	< 5	6	< 5	7	< 5	< 5
Silver, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
T. Coliform, Col/100 ml	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	28	31	72	22	42	30
TOC_2, mg/l	28	31	70	21	41	30
TOC_3, mg/l	29	30	70	23	41	30
TOC_4, mg/l	28	30	70	23	41	30
pH, units	7.20	7.33	7.30	7.21	7.25	7.41
pH, units	7.20	7.36	7.30	7.22	7.24	7.39
pH, units	7.19	7.38	7.30	7.21	7.24	7.42
pH, units	7.18	7.40	7.31	7.22	7.22	7.40
Conductivity, umhos/cm	5900	2500	2490	2060	2290	5100
nductivity, umhos/cm	5920	2350	2400	2100	2300	5100
Conductivity, umhos/cm	5700	2530	2510	2120	2250	4840
Conductivity, umhos/cm	5800	2530	2520	2160	2290	4980
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

TABLE 2 (Cont'd)

2nd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	7	8	11	12	13	3A
Date Sampled	5-5-82	5-5-82	5-5-82	5-12-82	5-12-82	5-5-82
TOH_1, mg/l	< 0.010	< 0.010	< 0.010	0.111	0.012	< 0.010
TOH_2, mg/l	< 0.010	0.012	< 0.010	0.164	0.017	< 0.010
TOH_3, mg/l	< 0.010	< 0.010	< 0.010	0.096	0.044	< 0.010
TOH_4, mg/l	< 0.010	0.011	< 0.010	0.182	0.072	0.012
Chloride, mg/l	28.9	31.7	584	549	640	13.4
Sulfate, mg/l	1910	1600	2290	1950	1960	118
Nitrate N, mg/l	0.18	0.14	0.10	0.15	0.14	0.17
Fluoride, mg/l	1.3	1.9	1.7	0.7	2.0	0.3
Ammonia N, mg/l	0.09	0.73	1.91	0.86	0.04	0.08
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	138	1240	252	237	202	63
Manganese, ug/l	35	60	153	278	59	42
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	19	23	32	47	53	28
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	3	6	12	11	7	< 5
Lead, ug/l	14	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Silver, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
T. Coliform, Col/100 ml	5.1*	< 2.2	< 2.2	< 2.2	< 2.2	—
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	24	39	23	61	21	77
TOC_2, mg/l	24	40	25	61	21	78
TOC_3, mg/l	29	40	26	58	22	76
TOC_4, mg/l	25	44	26	57	22	76
pH, units	7.36	7.15	7.32	6.97	7.39	7.25
pH, units	7.38	7.15	7.32	6.95	7.39	7.25
pH, units	7.39	7.16	7.34	6.95	7.42	7.36
pH, units	7.40	7.18	7.35	6.93	7.38	7.28
Conductivity, umhos/cm	2000	2050	3300	3500	3480	580
Conductivity, umhos/cm	2010	1990	3350	3450	3400	570
nductivity, umhos/cm	2040	2060	3400	3460	3500	580
Conductivity, umhos/cm	1950	1900	3380	3400	3500	570
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

*Parameter exceeds MCL's

TABLE 2 (Cont'd)

CHEMICAL WASTE MANAGEMENT

Radiological Parameters

All in pCi/l

Well No.	Gross Alpha	Gross Beta	Radium 226
1N	<5.2	16.8 ± 4.6	2.34 ± 0.18
2	<7.9	18.4 ± 8.0	1.83 ± 0.21
3N	<6.9	<8	0.33 ± 0.08
4N	<5.9	<7.9	0.26 ± 0.07
5	<12.1	10.7 ± 7.2	1.68 ± 0.09
6N	<11.2	16.8 ± 7.5	3.03 ± 0.11
7	<9.0	10.0 ± 6.9	1.02 ± 0.07
8	<9.3	10.5 ± 7.9	1.94 ± 0.19
11	<4.7	15.7 ± 7.4	NN
12	<10.3	9.8 ± 7.0	0.05 ± 0.01
13	<10.3	15.7 ± 7.4	1.17 ± 0.22
3A	13.7 ± 5.1	33.6 ± 3.1	0.92 ± 0.10

NN - Analysis not needed

TABLE 3

3rd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	1N	2	3N	4N	5	6N
Date Sampled	8-12-82	8-12-82	8-12-82	8-12-82	8-10-82	8-10-82
TOH_1, mg/l	0.057	0.010	0.022	0.095	< 0.010	0.509
TOH_2, mg/l	0.051	0.010	0.026	0.059	< 0.010	0.178
TOH_3, mg/l	0.021	0.017	0.023	0.099	< 0.010	0.159
TOH_4, mg/l	0.011	0.010	0.019	0.087	0.022	0.261
Chloride, mg/l	1390	279	336	31.5	17.7	1420
Sulfate, mg/l	1520	1660	1300	1750	1620	1670
Nitrate N, mg/l	0.14	< 0.05	0.09	0.95	0.10	< 0.05
Fluoride, mg/l	1.4	1.6	0.7	0.8	1.3	1.0
Ammonia N, mg/l	2.73	—	—	—	1.21	2.31
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	891	1610	52	40	4070	631
Manganese, ug/l	116	32	110	21	122	130
Arsenic, ug/l	< 5	7	< 5	< 5	6	< 5
Barium, ug/l	38	7	51	8	33	56
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	1	< 5	28	1	1	9
Lead, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Selenium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Silver, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
T. Coliform, Col/100 ml	< 2.2	2.2*	< 2.2	< 2.2	< 2.2	< 2.2
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	1.5	34	81	22	3.3	4.8
TOC_2, mg/l	1.8	34	81	23	3.0	5.5
TOC_3, mg/l	1.7	34	80	23	3.3	5.0
TOC_4, mg/l	1.9	34	80	23	5.0	4.6
pH, units	7.12	7.21	6.96	7.37	7.18	7.15
pH, units	7.15	7.31	7.00	7.38	7.17	7.16
pH, units	7.20	7.37	6.96	7.40	7.15	7.14
pH, units	7.20	7.36	7.00	7.38	7.16	7.15
Conductivity, umhos/cm	5000	2620	2790	2180	2060	5050
Conductivity, umhos/cm	5180	2580	2600	2170	2100	5200
Conductivity, umhos/cm	5180	2590	2610	2180	2180	5250
Conductivity, umhos/cm	5200	2600	2600	2190	2190	5300
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Depth to Water, m	—	—	4.2	4.2	—	4.1

*Parameter exceeds MCL's

NOTE: Ammonia nitrogen tests not run by lab in error for wells 2, 3N, 4N, 7 & 8

TABLE 3 (Cont'd)

3rd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	7	8	11	12	13
Date Sampled	8-10-82	8-10-82	8-10-82	8-10-82	8-10-82
TOH_1, mg/l	0.660**	0.029	0.027	0.044	0.039
TOH_2, mg/l	0.640	0.020	0.024	0.019	0.022
TOH_3, mg/l	0.540	0.021	0.027	< 0.010	0.033
TOH_4, mg/l	0.630	0.032	0.028	0.012	0.018
Chloride, mg/l	128	30	549	452	542
Sulfate, mg/l	1600	1570	1870	1830	1760
Nitrate N, mg/l	< 0.05	< 0.05	< 0.05	0.09	0.14
Fluoride, mg/l	1.3	1.4	1.2	0.4	1.3
Ammonia N, mg/l	—	—	—	1.29	0.52
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	91	1630	400	635	113
Manganese, ug/l	14	90	173	420	40
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	10	50	30	22	7
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	8	< 5	< 5	6	< 5
Lead, ug/l	< 5	5	5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Selenium, ug/l	< 5	5	< 5	< 5	< 5
Silver, ug/l	< 5	5	< 5	< 5	< 5
T. Coliform, Col/100 ml	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	30	42	30	11	2.4
TOC_2, mg/l	30	42	30	11	2.5
TOC_3, mg/l	30	42	30	11	2.3
TOC_4, mg/l	31	42	30	10	2.2
pH, units	7.14	7.07	7.39	6.92	7.22
pH, units	7.09	7.01	7.43	6.92	7.23
pH, units	7.07	7.04	7.42	6.91	7.23
pH, units	7.07	7.06	7.41	6.92	7.21
Conductivity, umhos/cm	2310	2020	3390	3380	3350
Conductivity, umhos/cm	2310	2070	3390	3440	3450
Conductivity, umhos/cm	2320	2090	3400	3500	3490
Conductivity, umhos/cm	2300	2090	3410	3500	3500
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	4.7	—	4.6	4.1	5.5

*Readings taken following well disinfection with chlorine

TABLE 3 (Cont'd)

CHEMICAL WASTE MANAGEMENT

Radiological Parameters

All in pCi/l

Well No.	Gross Alpha	Gross Beta	Radium 226
1N	11.7 ± 11.7	28.1 ± 13.2	3.15 ± 0.19
2	<8.2	9.5 ± 7.6	1.77 ± 0.11
3N	<6.2	<8.8	0.68 ± 0.05
4N	<7.9	<9.0	0.40 ± 0.05
5	<5.8	7.8 ± 7.4	1.60 ± 0.12
6N	<7.7	15.5 ± 10.8	2.01 ± 0.8
7	<8.2	12.3 ± 7.7	1.36 ± 0.10
8	<7.6	12.6 ± 7.7	1.11 ± 0.06
11	<8.5	<9.1	1.43 ± 0.07
12	<6.4	8.6 ± 7.5	0.44 ± 0.05
13	<6.7	14.1 ± 7.9	1.55 ± 0.07

TABLE 4

4th Quarter 1982

CHEMICAL WASTE MANAGEMENT
GROUNDWATER ANALYSES

Lab No.	2806-82	2807-82	2808-82	2809-82
Well No.	2	3N	4N	7
Date Sampled	11/3/82	11/3/82	11/3/82	11/3/82
Time Sampled	09:30	09:45	10:00	10:45
TOH_1, mg/l	0.029	0.022	0.007	0.058
TOH_2, mg/l	0.028	0.020	0.006	0.061
TOH_3, mg/l	0.025	0.024	0.006	0.059
TOH_4, mg/l	0.027	0.022	0.008	0.061
Chloride, mg/l	270	490	56	35
Sulfate, mg/l	1960	1760	1900	1900
Nitrate N, mg/l	< 0.05	0.44	< 0.05	< 0.05
Fluoride, mg/l	1.56	0.79	0.84	1.19
Ammonia N, mg/l	1.13	0.28	0.89	0.59
T. Cyanide, mg/l	0.03	0.02	0.02	0.03
Iron, ug/l	284	< 10	470	<10
Manganese, ug/l	12	16	190	92
Arsenic, ug/l	< 4	< 4	< 4	< 4
Barium, ug/l	22	56	12	21
Cadmium, ug/l	4	4	4	< 0.5
Chromium, ug/l	<10	<10	<10	12
Lead, ug/l	<10	<10	<10	<10
Mercury, ug/l	< 0.2	< 0.2	< 0.2	< 0.2
Selenium, ug/l	< 3	< 3	< 3	< 3
Silver, ug/l	<10	<10	<10	<10
T. Coliform Bacteria, #/100 ml	>16*	16*	9.2*	>16*
Endrin, ug/l	< 0.04	< 0.04	< 0.04	< 0.04
Lindane, ug/l	< 0.04	< 0.04	< 0.04	< 0.04
Methoxychlor, ug/l	< 0.2	< 0.2	< 0.2	< 0.2
Toxaphene, ug/l	< 1.0	< 1.0	< 1.0	< 1.0
2,4-D, ug/l	< 0.8	< 0.4	< 1.0	< 0.8
2,4,5-TP Silvex, ug/l	< 0.2	< 0.4	< 0.4	< 0.3
TOC_1, mg/l	54	107	40	45
TOC_2, mg/l	53	108	39	45
TOC_3, mg/l	53	111	39	45
TOC_4, mg/l	53	107	39	45
pH, units	7.34	7.00	7.32	7.32
pH, units	7.58	7.08	7.40	7.40
pH, units	7.58	7.02	7.32	7.32
pH, units	7.54	7.08	7.32	7.32
Conductivity, umhos/cm	2800	3300	2150	2150
Conductivity, umhos/cm	2800	3300	2160	2160
Conductivity, umhos/cm	2800	3320	2180	2180
Conductivity, umhos/cm	2800	3310	2180	2180
Phenol, mg/l	<0.001	<0.001	<0.011	<0.001
Depth, m	—	4.0	4.6	4.9

Note: Depth not measurable in wells with flooded above grade pump suction (2, 5 & 8)

TABLE 4 (Cont'd)

4th Quarter 1982

CHEMICAL WASTE MANAGEMENT
GROUNDWATER ANALYSES

Lab No.	2810-82	2811-82	2908-82	2909-82
Well No.	8	11	5	6N
Date Sampled	11/3/82	11/3/82	11/10/82	11/10/82
Time Sampled	10:30	10:45	09:30	09:30
TOH_1, mg/l	0.060	0.013	0.021	-
TOH_2, mg/l	0.064	0.008	0.020	-
TOH_3, mg/l	0.062	0.010	0.022	-
TOH_4, mg/l	0.061	0.011	0.020	-
Chloride, mg/l	30	540	51	1550
Sulfate, mg/l	1840	2400	2100	1900
Nitrate N, mg/l	<0.05	<0.05	0.20	0.22
Fluoride, mg/l	1.42	1.18	1.31	0.96
Ammonia N, mg/l	0.79	1.61	0.67	1.62
T. Cyanide, mg/l	0.01	0.01	<0.01	0.07
Iron, ug/l	230	<10	2880	<10
Manganese, ug/l	32	100	44	24
Arsenic, ug/l	<4	<4	<4	<4
Barium, ug/l	20	40	8	21
Cadmium, ug/l	<4	4	0.5	<0.5
Chromium, ug/l	16	<10	<10	<10
Lead, ug/l	<10	<10	<5	<10
Mercury, ug/l	<0.2	0.4	0.3	<0.2
Selenium, ug/l	<3	<3	<3	<3
Silver, ug/l	<10	<10	<10	<10
T. Coliform Bacteria, #/100 ml	<2.2	<2.2	<2.2	5.1*
Endrin, ug/l	<0.04	<0.04	<0.04	<0.04
Lindane, ug/l	<0.04	<0.04	<0.04	<0.04
Methoxychlor, ug/l	<0.2	<0.2	<0.2	<0.2
Toxaphene, ug/l	<1.0	<1.0	<1.0	<1.0
2,4-D, ug/l	<0.4	<0.4	<0.4	<0.4
2,4,5-TP Silvex, ug/l	<0.2	<0.2	<0.2	<0.8
TOC_1, mg/l	61	41	4.9	5.8
TOC_2, mg/l	61	42	5.6	5.8
TOC_3, mg/l	62	43	5.4	5.8
TOC_4, mg/l	62	42	5.4	4.8
pH, units	7.21	7.43	7.19	7.15
pH, units	7.27	7.38	7.20	7.12
pH, units	7.27	7.34	7.20	7.14
pH, units	7.25	7.34	7.20	7.15
Conductivity, umhos/cm	2200	3500	2500	6000
Conductivity, umhos/cm	2200	3500	2510	5950
Conductivity, umhos/cm	2200	3520	2500	5950
Conductivity, umhos/cm	2200	3510	2500	5950
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Depth, m	—	5.0	—	3.9

TABLE 4 (Cont'd)

4th Quarter 1982

CHEMICAL WASTE MANAGEMENT
GROUNDWATER ANALYSES

Lab No.	2910-82	2911-82
Well No.	12	13
Date Sampled	11/10/82	11/10/82
Time Sampled	09:30	09:30
TOH_1, mg/l	0.028	-
TOH_2, mg/l	0.027	-
TOH_3, mg/l	0.029	-
TOH_4, mg/l	0.027	-
Chloride, mg/l	590	540
Sulfate, mg/l	1900	1760
Nitrate N, mg/l	0.22	1.69
Fluoride, mg/l	0.45	1.28
Ammonia N, mg/l	0.99	0.16
T. Cyanide, mg/l	<0.01	0.01
Iron, ug/l	260	180
Manganese, ug/l	430	40
Arsenic, ug/l	<4	<4
Barium, ug/l	26	21
Cadmium, ug/l	<0.5	0.7
Chromium, ug/l	<10	<10
Lead, ug/l	<10	<10
Mercury, ug/l	<0.2	<0.2
Selenium, ug/l	<3	<3
Silver, ug/l	<10	<10
T. Coliform Bacteria, #/100 ml	>16*	<2.2
Endrin, ug/l	<0.04	<0.04
Lindane, ug/l	<0.04	<0.04
Methoxychlor, ug/l	<0.2	<0.2
Toxaphene, ug/l	<<1.0	<1.0
2,4-D, ug/l	<0.4	<0.4
2,4,5-TP Silvex, ug/l	<0.2	<0.2
TOC_1, mg/l	8.3	9.2
TOC_2, mg/l	8.4	9.2
TOC_3, mg/l	8.3	9.5
TOC_4, mg/l	9.5	9.5
pH, units	6.97	7.32
pH, units	6.95	7.31
pH, units	6.98	7.31
pH, units	6.98	7.31
Conductivity, umhos/cm	4300	3800
Conductivity, umhos/cm	4300	3800
Conductivity, umhos/cm	4300	3800
Conductivity, umhos/cm	4300	3800
Phenol, mg/l	<0.001	<0.001

CHEMICAL WASTE MANAGEMENT

TABLE 5

Summary of Values of Drinking Water Parameters which Exceed Appendix III Maximum Levels (1982)

Parameter	Standard	Sampling Period	Well No.	Concentration
Total Coliform	1 Col./100 ml	2nd Qtr.*	7	5.1 Col./100 ml
		3rd Qtr.*	2	2.2 "
		4th Qtr.*	2	> 16 "
		4th Qtr.	3	16 "
		4th Qtr.	4	9.2 "
		4th Qtr.	6N	5.1 "
		4th Qtr.	7	> 16 "
		4th Qtr.	12	> 16 "

NOTE: During these three quarters, the laboratory used had a detection limit of 2.2 Col./100 ml. Wells showing concentrations higher than the detection limit are reported here.

APPENDIX H

EXAMPLE ANALYSIS OF WASTE STREAMS

NOTE: The data contained in this appendix is intended to indicate the types and concentrations of various constituents found in the Northern Ohio Treatment Facility waste streams. This data is not intended to be comprehensive and does not indicate statistical variations. The data is reported on standardized forms and does not indicate any particular customer's waste stream. The data was run in the on-site laboratory.

OHIO LIQUID DISPOSAL, INC.
CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 5 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Pond 7

SAMPLE IDENTIFICATION: Grab sample from transfer pump

COLOR: _____

TEST RESULTS

PH	1.40		PHENOL	167	mg/l
TOTAL AL or AC	280	meq/l	CL	1610	mg/l
SS	470	mg/l	SO_4	5760	mg/l
DS			COND	22 000	µmhos/cm^2
TS	16 060	mg/l	SpGr	1.000	
ASH	7730	mg/l	Total Fe:	1180	mg/l
COD	8900	mg/l	" Cr:	23	mg/l
O&G(F)	313	mg/l	" Ni:	13	mg/l
FLASH			" Cd:	1.04	mg/l
REACTION/POND 5:			" Zn:	230	mg/l
			TOC:	2332	mg/l

OTHER TESTS: _____

REMARKS: _____

Form 202

ANALYST: CK

BOWSER-MORNER
Testing Laboratories, Inc.

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 7 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Pond 11

SAMPLE IDENTIFICATION: Grab sample from transfer pump

COLOR: _____

TEST RESULTS

PH	0.10		PHENOL	57	mg/l
TOTAL AL or AC	2300	meq/l	CL	12 000	mg/l
SS	100	mg/l	SO_4	97900	mg/l
DS			COND.	184 000	µmhos/cm^2
TS	145 600	mg/l	SpGr	1.105	
ASH	46 190	mg/l	Total Fe:	8270	mg/l
COD	33 000	mg/l	" Cr:	180	mg/l
O&G (F)	68	mg/l	" Ni:	190	mg/l
FLASH			" Cd:	3.48	mg/l
REACTION/POND 5:			" Zn:	1360	mg/l
			TOC:	9982	mg/l

OTHER TESTS: _____

REMARKS: _____

Form 202

ANALYST: CR

BOWSER-MORNER
Testing Laboratories, Inc.

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 11 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Pond 12

SAMPLE IDENTIFICATION: Grab sample by well crew from filter building

COLOR: _____

TEST RESULTS

PH	0.25		PHENOL	167	mg/l
TOTAL AL or AC	1680	meq/l	CL	10 300	mg/l
SS, Filtered:	37.2	mg/l	SO_4	77 400	mg/l
DS Non-filtered:	45.2	"	COND	155 000	µmhos/cm^2
TS	120 600	mg/l	SpGr	1.085	
ASH	45 950	mg/l	Total Fe:	88 00	mg/l
COD	26 000	mg/l	" Cr:	190	mg/l
O&G(F)	28.4	mg/l	" Ni:	100	mg/l
FLASH			" Cd:	3.08	mg/l
REACTION/POND 5:			" Zn:	1240	mg/l
			TOC:	8319	mg/l

OTHER TESTS: _____

REMARKS: _____

Form 202

ANALYST: CL

BOWSER-MORNER
Testing Laboratories, Inc.

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 12 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Deepwell injection

SAMPLE IDENTIFICATION: Grab sample by well crew from filter building

COLOR: _____

TEST RESULTS

PH	0.40		PHENOL	101	mg/l
TOTAL AL or AC	1460	meq/l	CL	7700	mg/l
SS Filtered	44.8 *	mg/l	SO_4	62100	mg/l
DS Unfiltered	23.6		COND	130000	µmhos/cm^2
TS	99810	mg/l	SpGr	1.070	
ASH	38400	mg/l	Total Fe:	8270	mg/l
COD	19000	mg/l	" Cr:	160	mg/l
O&G (F)	23.2	mg/l	" Ni:	78	mg/l
FLASH			" Cd:	2.13	mg/l
REACTION/POND 5:			" Zn:	1010	mg/l
			TOC:	6876	mg/l

OTHER TESTS: report = 6880 mg/L Nov '82

REMARKS: * Small amount of filter-aid present in this sample

Form 202

ANALYST: CL

BOWSER-MORNER
Testing Laboratories, Inc.

HYDROGEOLOGIC INVESTIGATION

Preliminary Results and Site Assessment
Northern Ohio Treatment Facility
Vickery, Ohio

PRELIMINARY
DATE

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attention: Mr. Gary Brown

Laboratory Job No. 33767

Report No. T-20134

March 21, 1983

BOWSER-MORNER
Testing Laboratories, Inc.

BOWSER-MORNER Testing Laboratories, Inc.

Founded 1911

TOLEDO DISTRICT • 122 S. St. Clair St. • P.O. Box 838 • Toledo, Ohio 43696 • 419/255-8200

March 21, 1983

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attention: Mr. Gary Brown

PRELIMINARY

RE: Hydrogeologic Investigation
Preliminary Results and
Site Assessment
Northern Ohio Treatment Facility
Vickery, Ohio
Laboratory Job No. 33767
Report No. T-20134

Gentlemen:

The following report summarizes the preliminary results of the hydrogeologic investigation and site assessment at the above referenced site in Vickery, Ohio. The purpose of this work was to perform a hydrogeologic study and site assessment in accordance with the special terms and conditions set forth by the Hazardous Waste Facilities Approval Board in the Site Permit issued December, 1981. This work has essentially been completed; however, this study has identified a problem with the existing groundwater monitoring well system which must be resolved through additional work. This preliminary report outlines the results of our study and makes recommendations concerning additional work.

A separate report has been prepared to present a large volume of accumulated data. The report has been prepared as a series of appendices and contains the following information:

Appendix A - Field and Laboratory Data

Appendix B - Injection Well Logs

Appendix C - Water Well Logs

Appendix D - Background Water Quality Data

Appendix E - Aquifer Pumping Test Data

Appendix F - Statistical Analysis of Monitoring Well Data

Appendix G - RCRA Monitoring Data

Appendix H - Example Analysis of Waste Streams

CORPORATE ADDRESS • 420 Davis Ave. • P.O. Box 51 • Dayton, Ohio 45401 • 513/253-8805
KENTUCKY DISTRICT • Route 8 West • P.O. Box 636 • Maysville, Kentucky 41056 • 606/564-5508

It should be noted that this study shows that the Northern Ohio Treatment Facility site is well suited for the management of hazardous waste materials and that the existing groundwater quality meets federal drinking water quality standards. At this time there is no evidence of any hazardous constituents having entered the groundwater at the site.

It is planned eventually to prepare and submit a detailed report concerning the hydrogeologic investigation and site assessment of the Northern Ohio Treatment Facility. This final report is planned to be issued after the completion of the recommended additional work.

If there are any questions or if we can be of further service, please contact us.

Respectfully submitted,

BOWSER-MORNER, INC.

J. Richard Hoppenjans

J. Richard Hoppenjans, P.E.
Chief Engineer

Julie K Kampa

Julie K. Kampa, Geologist

JRH:jl
lc-Donald McCombs
lc-Ron Shawl
lc-John A. Baker

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INTRODUCTION

A hydrogeologic investigation and a statistical analysis of accumulated groundwater quality data has been performed for the Northern Ohio Treatment Facility. The hydrogeologic investigation was based upon a comprehensive soil boring and rock coring program, integrated with data available in published and unpublished literature. Extensive water quality data was available for on-site wells which dates back to as early as 1972. In addition to on-site data, background water qualtiy data was obtained from the Ohio Department of Natural Resources, the Turnpike Commission, and other published reports. The available water quality data was evaluated by statistical regression analysis.

Site Facilities

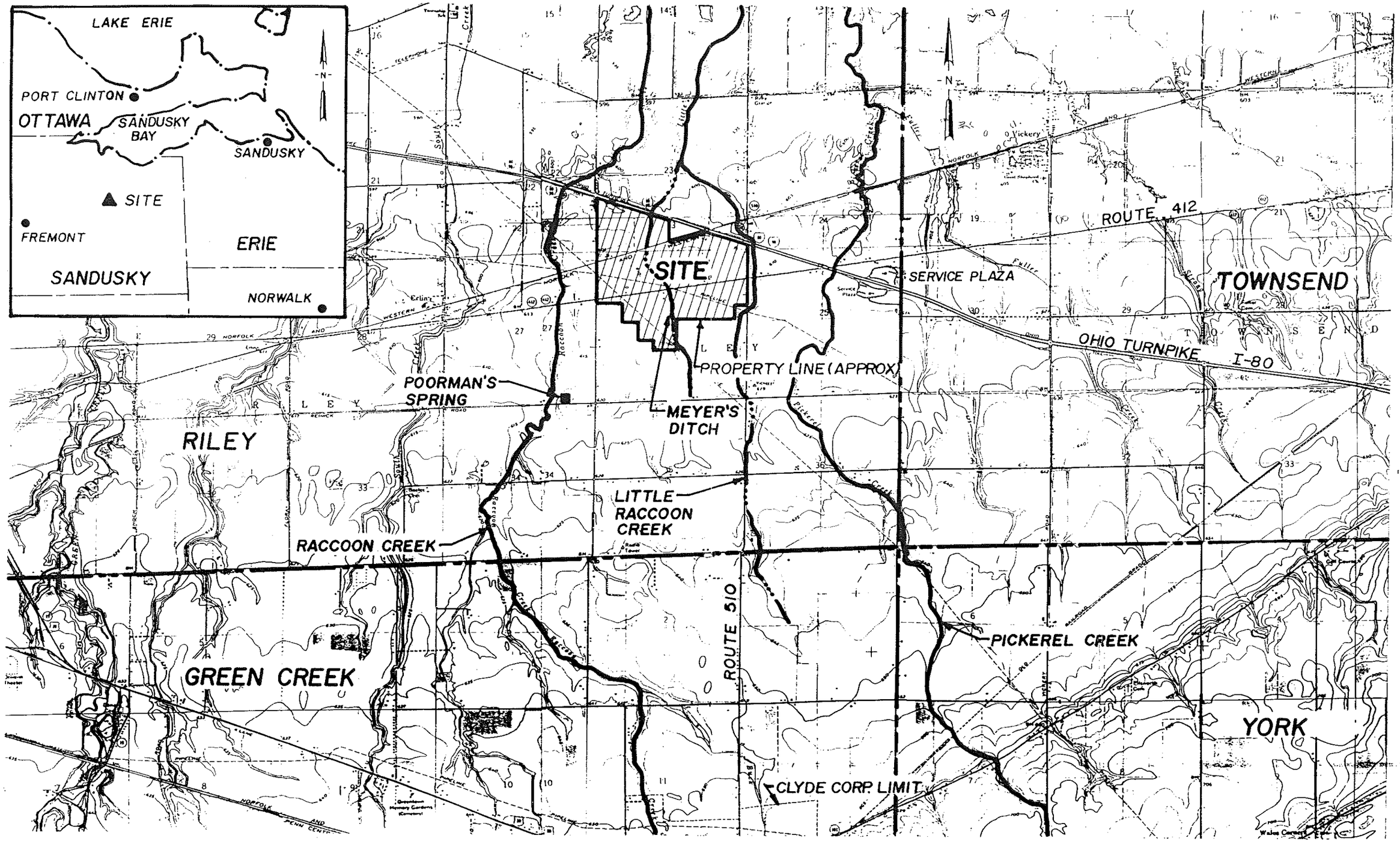
The location of the Ohio Northern Treatment Facility is shown on Figure 1. The groundwater flows to the north/northwest and eventually empties into Sandusky Bay. As can be seen in Figure 1, there are no significant population centers between the site and Sandusky Bay. The location of Poorman's Spring and the Ohio Turnpike service plaza is also shown. These areas will be discussed later.

As part of the study, a Facilities Location Plan was developed and a summary of the facility history was created. Much of this information was obtained verbally from on-site personnel. The Facilities Location Plan (Sheet 1) is included with this report, and Table 1 provides the summary of the facility history. This information provides locations and approximate dates when various facilities were begun and closed at the site. Surface water runoff is controlled at the site by a series of dikes, ditches, and a sluice gate on Charles E. Meyer ditch. Because of the extremely flat grade, however, surface runoff oftentimes ponds on the site at various locations. Shown on the Facilities Location Plan is the location of all of the current soil borings, the injection wells, and existing groundwater monitoring wells.

The majority of the on-site facilities consist of above-grade lagoons in which the waste materials are stored prior to final processing and injection into the deep well system. Impermeable on-site soils were used to construct compacted clay dikes around each lagoon excavation. Closure of the lagoons has been accomplished by landfarming (no longer done at the site), and/or landfilling sludges left in the lagoon. The landfilling is done by mixing the sludge with soil available in the dikes, borrow soil materials brought from off-site, and other admixtures such as lime. The final stabilized mixture is compacted into the previous lagoon excavation and capped with soil materials.

Site Geology and Soil Profile

Bedrock at the site was found to be composed of the Tymochtee dolomite and is located from 40 to 50 feet below the existing surface elevation. The current investigation included a detailed examination of rock cores to a total maximum depth of about 130 feet. The rock profile was not investi-



SCALE: 1" = 3125'

NOTE:
TAKEN FROM USGS CLYDE, VICKERY, FREMONT EAST AND WIGHTMANS GROVE QUADRANGLES.

SITE LOCATION MAP

JOB NO. 33767
DATE: 2-4-83

FIG. 1

BOWSER-MORNER, INC.

TABLE 1

SUMMARY OF FACILITY HISTORY

FACILITY	DATE OF CONSTRUCTION	DATE PUT IN OPERATION	DATE TAKEN OUT OF OPERATION	DATE OF CLOSURE	CURRENT STATUS
Pond 1	1961	1961	1979	1979	Closed
Pond 2	1962	1962	1979	1979	Closed
Pond 3	1962	1962	1980	1980	Closed
Pond 4	1963	1963	1982	**	25% Closed
Pond 5	1968	1968			Active
Pond 6	1966	1966 *	1980	1980	Closed
Pond 7	1968	1968			Active
Pond 8	1968	1968			Combined with #7
Pond 9	1969	1969	1981	**	75% Closed
Pond 10	1971	1971	1982	1982	Closed
Pond 11	1973	1973			Active
Pond 12	1973	1973			Active
Injection Well 1 ***	3/72	1976	1979	1980	Closed
Injection Well 1A	9/79	1980			Active
Injection Well 2	6/76	1977			Active
Injection Well 3	7/76	1977			Active
Injection Well 4	7/76	1977			Active
Injection Well 5	1981	1982			Active
Injection Well 6	11/81	1982			Active
Oil Recovery	1977	1977			Active
Sludge Farm	1978	1978	1978	1978	Closed

* Pond 6 was split into Pond 6 East and Pond 6 West in 1976.

** Pond 4 and Pond 9 are scheduled to be closed in the spring of 1983. However, Chemical Waste Management plans to ask for a two-year extension on the closing period for Pond 4.

*** Drillers logs for the injection wells are contained in Appendix B.

from the injection wells. The Tymochtee found here is a mixture of shale, dolomite, gypsum, and anhydrite.

The overlying soil deposits at the site are of glacial origin and two general types of deposits are found at the site. The deposits have measured laboratory permeabilities in the range of 10^{-8} to 10^{-9} cm./sec. The upper portion of the soil profile is a clayey lacustrine deposit approximately 10 to 20 feet thick. The remaining portion of the soil profile, approximately 30 feet in thickness, is glacial till. While both of these deposits are virtually impermeable, the uppper lacustrine deposit is horizontally layered with some fine sand and silt partings. One horizontal permeability test in this material was attempted which indicated a permeability of approximately 10^{-7} cm./sec. Horizontal flow of fluids in the soil profile will, therefore, be more likely than vertical flow.

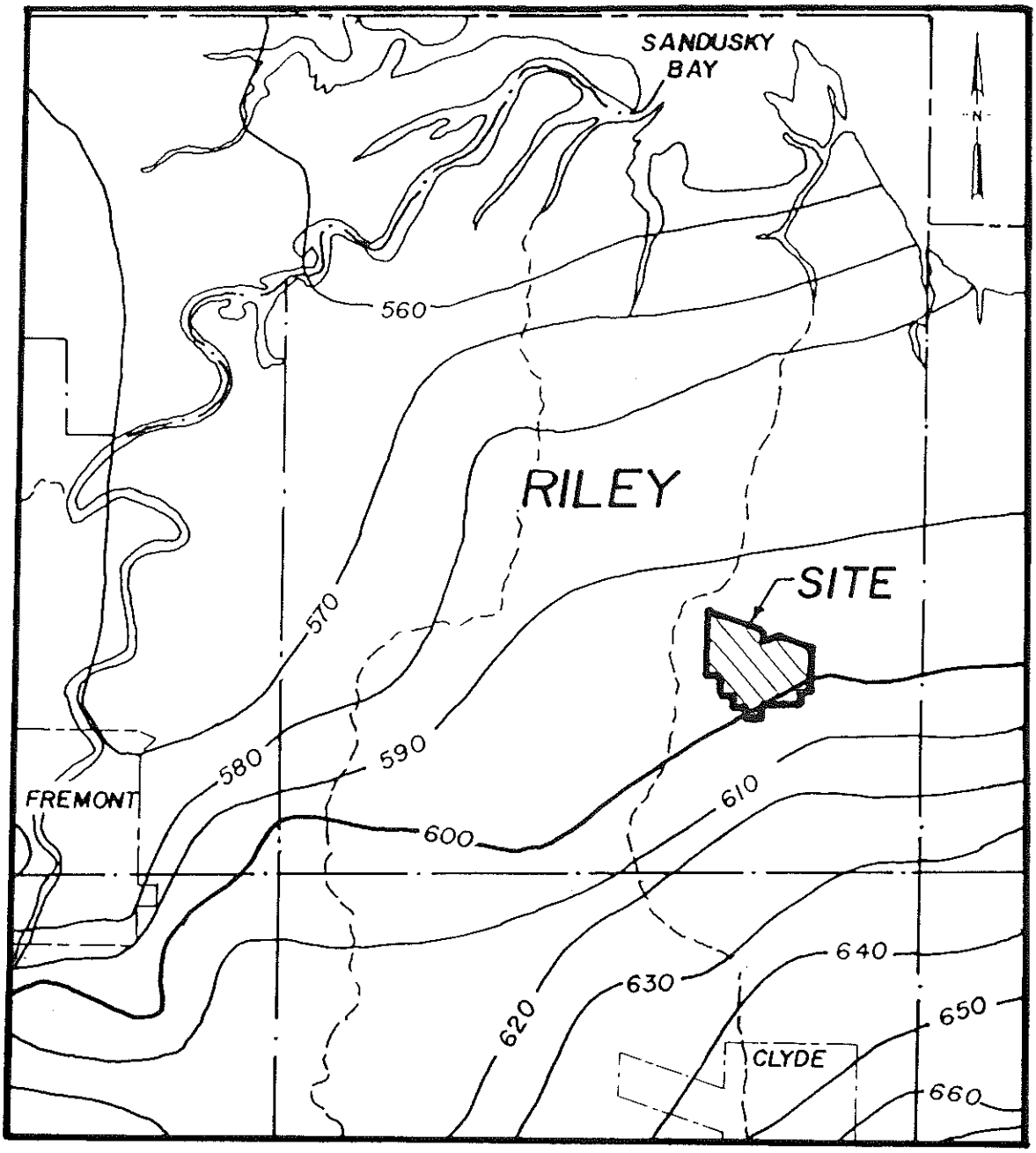
No aquifers or significant pockets of free water were found in the soil profile. In addition, no natural connections were found between the existing surface and the bedrock aquifer. Cation exchange testing was performed on selected soil samples which show high CEC values, approximately 25 or more, and pHs generally above 7.8. The natural soil conditions, therefore, are suited to the attenuation of heavy metals. This, coupled with the naturally impermeable soil conditions, indicate that the site is good to excellent for the containment of the wastes.

Site Groundwater

This study identified the general characteristics and the quality of the existing groundwater underlying the site. Figure 2 shows the levels of groundwater in the regional area around the site. The regional rate of flow across the site, based upon a pump test and on published literature, appears to be approximately one foot per year. Utilizing the on-site piezometers and groundwater monitoring well records, Figure 3 was developed which shows the on-site groundwater contours. As can be seen in Figure 3, a cone of depression exists at the site, indicating that the pumping being done from the two production wells at the site is sufficient to develop a relatively large cone of depression.

By reviewing existing literature and the groundwater quality records available from the site, general background water quality parameters for the area have been developed. Of particular interest is the study done for the Ohio Turkpike Commission for the service plaza located just to the east of the site. The existing groundwater contains high amounts of sulfate which renders the water practically unusable for human drinking purposes. The source of the sulfate is gypsum and anhydrite in the Tymochtee dolomite. Previous studies have placed the base of the potable water zone at or about elevation 600. At this site, the ground surface elevation is approximately elevation 600 and the groundwater is found only in the bedrock aquifer located approxmately 40 feet below the surface (elevation 560±). The water is used locally mainly for agricultural and livestock purposes.

The data available shows the following ranges of concentration for background water quality. Of particular interest is the sulfate and chloride levels.



POTENTIOMETRIC SURFACE MAP OF THE BEDROCK AQUIFER

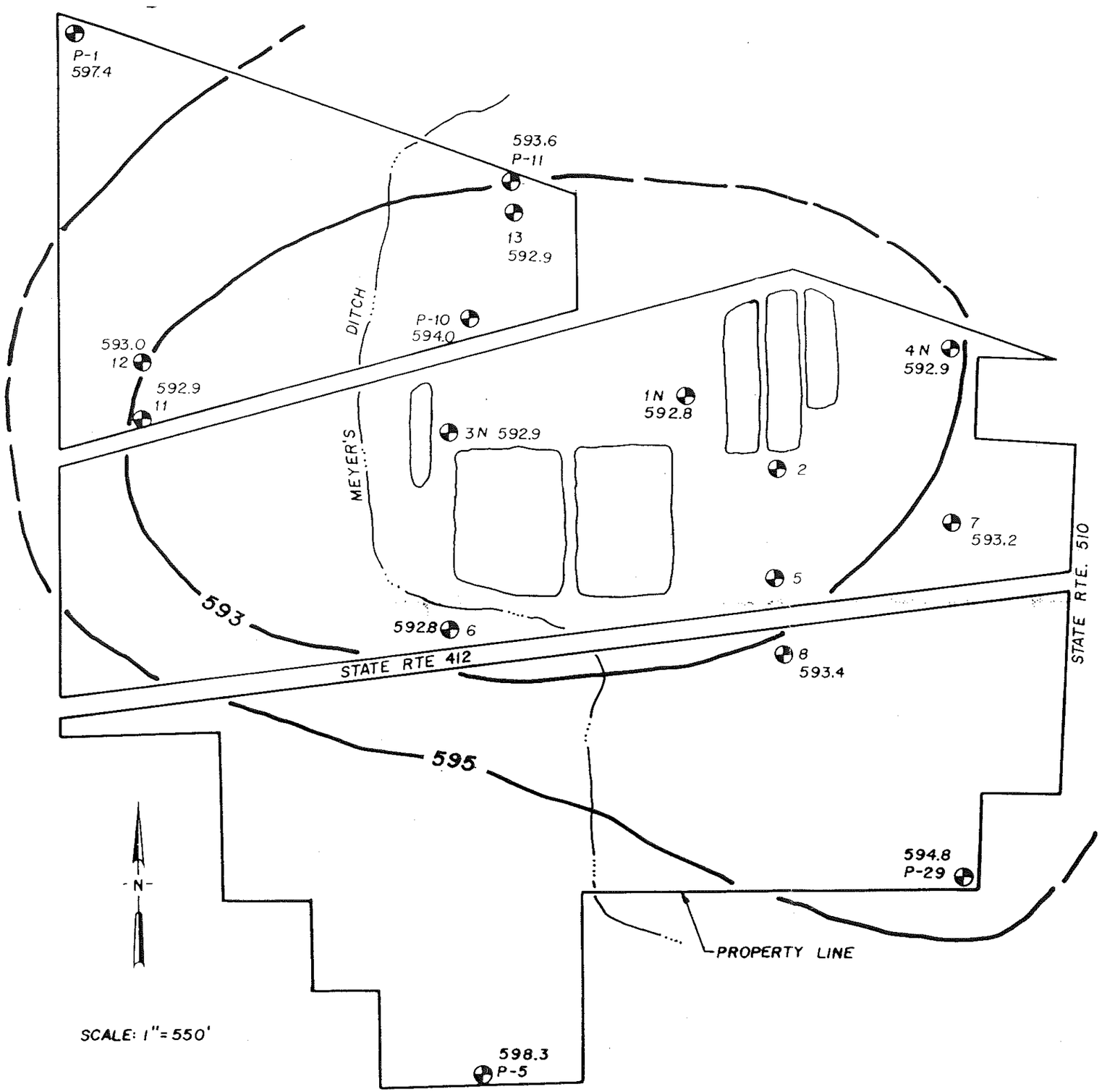
AFTER HOOVER (1982)

— 610 — GROUND WATER SURFACE CONTOUR LINE

SCALE: 1" = 8250' (APPROX.)
JOB NO. 33767
DATE: 2-16-83

FIG. 2

BOWSER-MORNER, INC.



13 MONITORING WELL

P-1 PIEZOMETER

592.8 WATER LEVEL ELEVATION

SITE GROUND WATER CONTOUR MAP

WATER LEVEL READINGS TAKEN ON 2-3-83

JOB NO. 33767
DATE: 2-18-83

FIG.3

Parameter	Range mg/l
Iron (Fe)	.02 - 19
Calcium (Ca)	109 - 577
Magnesium (Mg)	71 - 177
Sodium (Na)	7 - 35
Sulfate (SO_4)	128 - 1831
Chloride (Cl)	5 - 46
Total Solids (TS)	340 - 8124
Total Hardness	280 - 3598
pH	7.0 - 7.4 (not mg/l)

Also of note relative to the background data is the water quality testing which has been done on Poorman's Spring located just to the southwest of the site. This spring likely represents upstream groundwater quality data, and is the only upstream data available for various metals. A summary of this data is as follows.

Parameter	Concentration * (mg/l)
Iron (Fe)	0.04 - 0.13
Chrome Cr)	< 0.03
Nickel (Ni)	< 0.03
Cadmium (Cd)	< 0.006
Zinc (Zn)	< 0.003 - 0.008
Calcium (Ca)	528
Magnesium (Mg)	92
Phenol	0.003 - 0.013
Chloride (Cl)	19 to 22
Sulfate (SO_4)	1148 to 1484
Conductivity	1650 to 1850 (umhos/cm^2)
pH	7.17 to 7.23 (not mg/l)
Total Solids	2495 to 2655

* Based on two samples; 1980 and 1981.

Groundwater Data Analysis

Groundwater monitoring data is available for the site beginning in 1972. In general, it appears that the quality of the data has been steadily improving, with the most consistent data apparently starting in approximately 1979. Table 2 provides data concerning monitoring well construction and sampling dates for all of the on-site monitoring wells. The water quality data has been accumulated from the files of the Northern Ohio Treatment Facility and from Ohio EPA, and has been studied statistically by regression analysis. It should be noted in any analysis of the available data that many of the parameters that have been analyzed have been found with concentrations near or less than the detection level of the equipment and/or test method. There are numerous data points, therefore, with values listed as "less than." In performing statistical analysis on such data, it is obvious that the analysis will be biased. In addition, a review of the actual raw data shows that there are irreconcilable discrepancies in some test values, indicating either operator or testing error, and/or inaccurate recording of the data. This was particularly true for phenol and as a consequence, statistical analysis of phenol was omitted in some instances. Finally, as indicated above, it appears that the quality of the groundwater testing has improved with time. This would make older historical records more suspect than recent records. Such considerations plus the knowledge of the major constituents of the waste streams allowed the selection of chemical parameter indicators which were used for the statistical analysis. Generally speaking, the statistical analysis was performed for pH, phenols, sulfates, chlorides, zinc, and chrome.

Table 3 shows the summary of the regression analysis which was performed on several parameters. The regression analysis for pH does not show strong trends. Furthermore, the absolute values of the pH remain fairly constant in a given well and were, at all times, in the general neutral range.

The regression analysis for chloride showed strong and consistent trends for most of the wells. The changes and trends in the chloride levels from well to well, however, are very complex. Generally speaking, it appears that downstream wells have increasing levels of chloride and the absolute values of the concentration of chloride in the groundwater under the site are higher than background quantities. A detailed review of the data, however, has not developed a consistent trend for all downstream or all upstream wells. Virtually every well on the property has had significant spikes of chloride concentration over the years at various different times. None of these spikes appear to be specifically related to another well or time period, with the possible exception of the installation of monitoring wells in 1979. During this period (both before and just after) significant variations in concentration occurred in many of the monitoring wells. A review of Sheets 2, 3, and 4 attached to this report show evidence of the complex variations in the chloride levels.

The regression analysis for sulfates does not show strong and consistent trends, except for well 4N. Examination of the data, however, shows that there is a significant difference between upstream and downstream sulfate levels. In general, sulfate concentrations at any given

TABLE 2

MONITOR WELL CONSTRUCTION SUMMARY

CWM No.	OEPA No.	Depth (feet)	Casing	Year Drilled	CWM Dates Sampled	Date Abandoned	ODNR Log Number	Mean Sea Level Elev. 1983 Survey TOC	TOC	Remarks
1	--	--	3" galvanized steel	1978	4/79 - 6/79	6/79 - Filled with cement	--	606.33	606.2	--
1N	--	200	6" PVC cased to 60'	1979	7/79 - present	--	554277	609.17	607.4	--
1A	--	18.5	6" PVC perforated	1979	6 Months	1980	--	609.95	608.4	--
2	--	150	4" galvanized steel	1976	2/76 - present Gap 12/80-6/81			Buried under drive		Used for washing trucks
3	--	--	3" galvanized steel	1976	6/76 - 9/76	6/79 - Filled with cement	--	605.76	604.8	--
3N	--	50	6" PVC cased to 48'	1979	7/79 - present	--	554276	606.75	605.3	--
3A	--	14'or18'?	4" PVC perforated	1976	4/76 - present Gap 1/82-3/82	--	--	606.37	604.7	--
4	1	55	6" galvanized steel	1972	CWM 8/74-6/79 OEPA '72-6/79	June, 1979	425054	609.43	608.2	Hand pump
4N	1	50	6" PVC cased to 48'	1979	CWM 7/79-present OEPA 7/79-present	--	554274	608.84	608.0	--
5	2	56'or51'?	4" galvanized steel cased to 50'	Unknown	CWM 7/74-present OEPA '72-present	--	--	Location Uncertain		Lab well
6	--	--	3" galvanized steel	1976	4/76 - 6/79	6/79 - Filled with cement	--	609.36	608.4	
6N	--	50	6" PVC cased to 46'	1979	7/79 - present	--	554273	610.65	608.5	--
6A	--	12'or18'?	4" PVC perforated	1976	4/76 - 1/81 Gap 12/76-2/77		--	608.67	608.67	Mower broke casing off 1982
7	--	55	6" PVC cased to 45.5'	1979	7/79 - present	--	554275	610.26	608.1	--
8	3	50	4" galvanized steel cased to 47'	1979	CWM 9/79-present OEPA '72-present	--	405085	612.88	611.8	Eckhart home empty since 1981

Table 2 continued -

CWM No.	OEPA No.	Depth (feet)	Casing	Year Drilled	CWM Dates Sampled	Date Abandoned	ODNR Log Number	Mean Sea Level Elev. 1983 Survey TOC	TOG	Remarks
--	4	54	4" galvanized steel cased to 44.5'	1957	OEPA '74-'80	--	199085	--	605±	Emery house
--	5	77	Galvanized steel	Unknown	OEPA '72-'74	1974, pump broke	--	--	605±	Hand pump
--	6	56	4 1/4" cased to 43.5'	1956	OEPA '75-'79	1979	182754	--	610±	Gertensberger home
11	--	60	6" PVC cased to 47.5'	1981	1/82-present	--	602224	609.79	608.4	--
12	--	65	6" PVC cased to 47'	1981	1/82-present	--	602225	608.38	606.1	--
13	--	60	6" PVC cased to 48'	1981	1/82-present	--	602222	605.27	603.7	--
Ind. Well	--	75	6" PVC cased to 48'	1981	--	--	602223	606.43	604.7	Not a monitor well

LEGEND

CWM - Chemical Waste Management

OEPA - Ohio Environmental Protection Agency

TOC - Top of Casing

TOG - Top of Ground

TABLE 3

SUMMARY OF REGRESSION ANALYSIS

CHEMICAL PARAMETERS

Well No.	pH		CHLORIDES		SULFATES		ZINC		CHROMIUM	
	m	r	m	r	m	r	m	r	m	r
2	-0.003	-0.07	30.5	0.81	-0.14	-0.03	-0.12	-0.70	-0.003	-0.80
5	-0.006	-0.23	-0.65	-0.19	3.96	0.25	-0.03	-0.84	-0.002	-0.74
1N	-0.025	-0.71	377	0.92	-25	-0.71	0.01	0.67	-0.001	-0.90
3N	0.012	0.47	-23.7	-0.15	-48	-0.64	0.0035	0.71	-0.003	-0.93
4N	0.116	0.68	-134	-0.73	475	0.90	0.012	0.93	-0.003	-0.92
6N	-0.051	-0.59	93	0.93	4	0.48	0.0056	0.87	-0.002	-0.92
7	0.009	0.77	-37	-0.77	-14	-0.57	0.005	0.97	-0.003	-0.88

m = slope of regression line in mg/liter/year of record

r = correlation coefficient

time increase slightly to the northwest, parallel to regional groundwater flow. This same downgradient increase was observed by Schaefer and Walton in their report to the Ohio Turnpike Commission, and is a function of bedrock mineralogy and time. There is no indication that any additional sulfate concentrations are reaching the wells.

The regression analysis for zinc showed some definite trends and a reasonable correlation factor in most of the wells. Because of the galvanized steel casings or abandoned steel well casings located near certain wells, the concentrations of zinc may be affected by previous construction in the area. Furthermore, all of the zinc concentrations are extremely low and generally within the concentration level of testing done at Poorman's Spring. It is not felt that this site is in anyway influencing zinc levels with the possible exception of effects caused by the well casings.

The analysis of chromium indicates a strong trend for decreasing chromium values in the groundwater. Background information from Poorman's Spring indicates that the natural levels present are less than 0.03 mg/l. The on-site concentrations are below or around that value. The chrome at these concentrations could be present in the groundwater.

Site Assessment

The overlying soil profile is composed of uniformly clay-rich deposits with low permeability. The underlying bedrock aquifer is very highly mineralized and is naturally of low quality. Because the clay-rich soils prevent migration of waste constituents into the groundwater, and because the existing groundwater is already of low quality, it appears that the site represents a relatively good geological location for management of hazardous wastes. Furthermore, the site is generally far removed from dense population centers, further limiting possible negative effects.

The high levels of chlorides indicate that some groundwater quality change is occurring across the site. However, parameters other than choride do not provide any indication of groundwater quality degredation. In fact, all parameters tested are below the federal drinking water standards, except for coliform levels. High chloride levels are found near the center of the site, with intermediate chloride levels downgradient of the site. The waste liquids at the site are high in chlorides content and, therefore, it may be logical to conclude that the changing chloride levels in the groundwater are the results of liquids escaping from the site. This study, however, has not identified any mechanism through which such escape of liquids could be occurring.

Natural sources for the chloride have been considered. The Tymochtee dolomite, although an evaporative deposit, is not known to contain salt deposits. Furthermore, based on existing knowledge of the location of high chloride brine and because of the careful construction of the injection wells, it does not seem likely that the chloride level is the result of contamination from deep salty brines. Surface sources for the chlorides also have been considered. For example, road salt utilized on the turnpike and local roads could be adding to the chloride level in the groundwater. Sodium chloride has also been used on-site as a dust suppressant. Chloride

contamination could also be the result of normal drilling and reworking of the deep wells. (In order to prevent escape of waste fluids which have been injected into the deep well, salt brine is used to "kill" the well prior to reworking. Reworking of the deep wells can occur as often as 6 to 12 times per year. During this process, salt and acid brine is often spilled on the ground surface around the deep wells.) This source of chlorides has been identified as the most likely source of the elevated levels.

By carefully researching the construction records relative to monitoring well installation on the site, it has been determined that the existing monitoring well system may be providing a conduit through which high chloride runoff, such as salt brine, may be entering the local groundwater. Information on the construction of the monitoring wells indicates that the monitoring wells have not been adequately sealed, leaving a highly permeable annular space around the outside of the casing. Indeed, some of the groundwater monitoring records would indicate that high chloride levels appeared immediately after installing new monitoring wells in 1979 in an area where chloride levels had historically been low.

The combination of leaking monitoring wells and the spillage of salt and/or acid brines at the various deep well locations could explain the apparent erratic and complex chloride concentration data. For example, monitoring wells numbered 11, 12 and 13 all show elevated chloride levels. The groundwater flow, however, is towards the lagoons. If the lagoons were leaking, then these wells should not show elevated levels. Furthermore, the chloride level spikes do not occur in all affected wells at the same time or with the same trends. The sporatic nature of the deep well reworking and possible salt spillage would help to explain the lack of consistent trends.

The combination of imperfectly sealed wells and surface salt and/or chloride spillage also helps to explain the chloride level data in wells numbered 1N and 2. Well 2 has been used more or less continuously and, therefore, has purged the well of chlorides which may be entering through the well bore. The chloride levels in this well have tended to be less variable and of lower overall concentration than well 1N, which is relatively close by. Well numbered "1N" on the other hand, is not pumped regularly and is located in a diked area where chloride spillage could easily be concentrated.

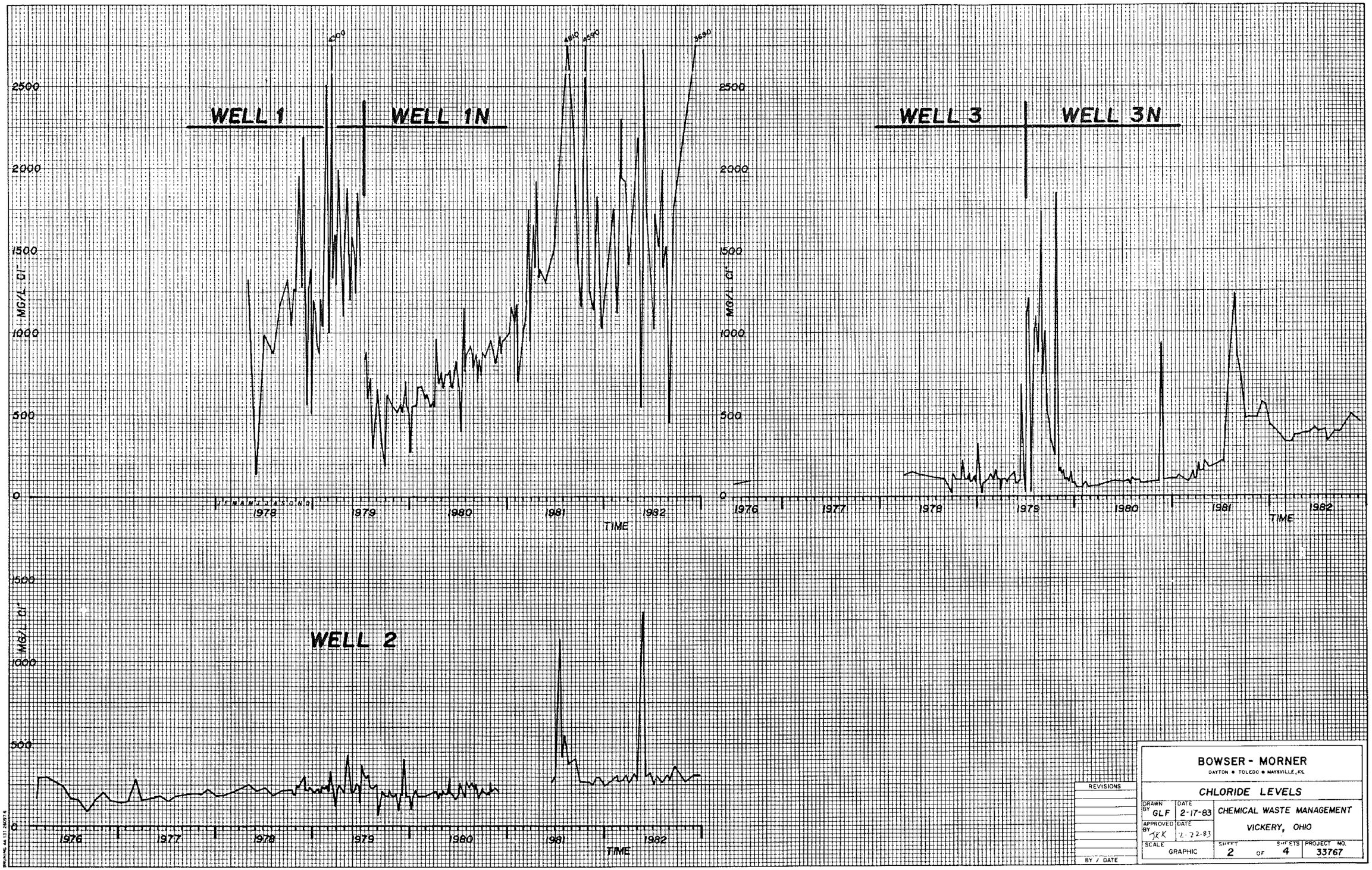
CONCLUSIONS AND RECOMMENDATIONS

The study has shown that the site is hydrogeologically suited for management of hazardous wastes by methods which use landfarming, landfilling, and lagoon systems. The area is underlain by naturally impermeable soil which is preventing the migration of waste constituents into the underlying aquifer. In addition, the existing groundwater quality is poor and moves across the site at a very slow rate. Finally, the normal operational pumping at the site has developed a cone of depression which further limits movement of site groundwater. The combination of all these factors minimizes the possibility of negative impacts on the groundwater.

The study has identified a problem with the existing monitoring well system. In order to better define the nature of this problem and to correct the situation, additional work must be performed at the site. It is recommended that four new monitoring wells be established at the site at the locations shown on Figure 4. These wells should have minimum 4 inch inside diameter casing and be equipped with permanent submersible pumps. These wells should be immediately monitored for chloride levels and new RCRA quarterly monitoring established. In order to assess the condition of the existing wells, each should be checked with fluorescent dye to determine the integrity of the casing and the well seal. Should the seals prove to be improper, the wells will need to be properly sealed and/or abandoned.

Groundwater quality analysis from the new wells should confirm the results of this study. In general, the proposed downstream wells are removed from the areas where previous well installations may have contaminated the groundwater. Wells numbered 16 and 17 have been located to show that high chloride levels present in wells 11, 12, and 13 are not migrating downstream. Furthermore, their location will indicate the extent of the contamination if, for some reason, migration has taken place. Wells numbered 15, 16, and 17 will be downstream monitoring wells and well No. 14 will be the upstream monitoring well (for natural water gradient conditions). Considering the pumping being done at the site, all four new wells will be upstream of the waste management facilities.

The actions recommended above should resolve the questions of high chloride levels. Because normal pumping at the site is purging the groundwater system, there does not appear to be any need for emergency action. Furthermore, no hazardous constituents have been found in the groundwater, even though priority pollutants analysis has been performed twice at the site. The existing groundwater meets drinking water standards. Finally, the natural groundwater flow velocity at the site is slow (one foot per year) and, therefore, any possible contamination should not escape the property boundaries for several years.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WELL 3
WELL 3N
WELL 2
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1000
500
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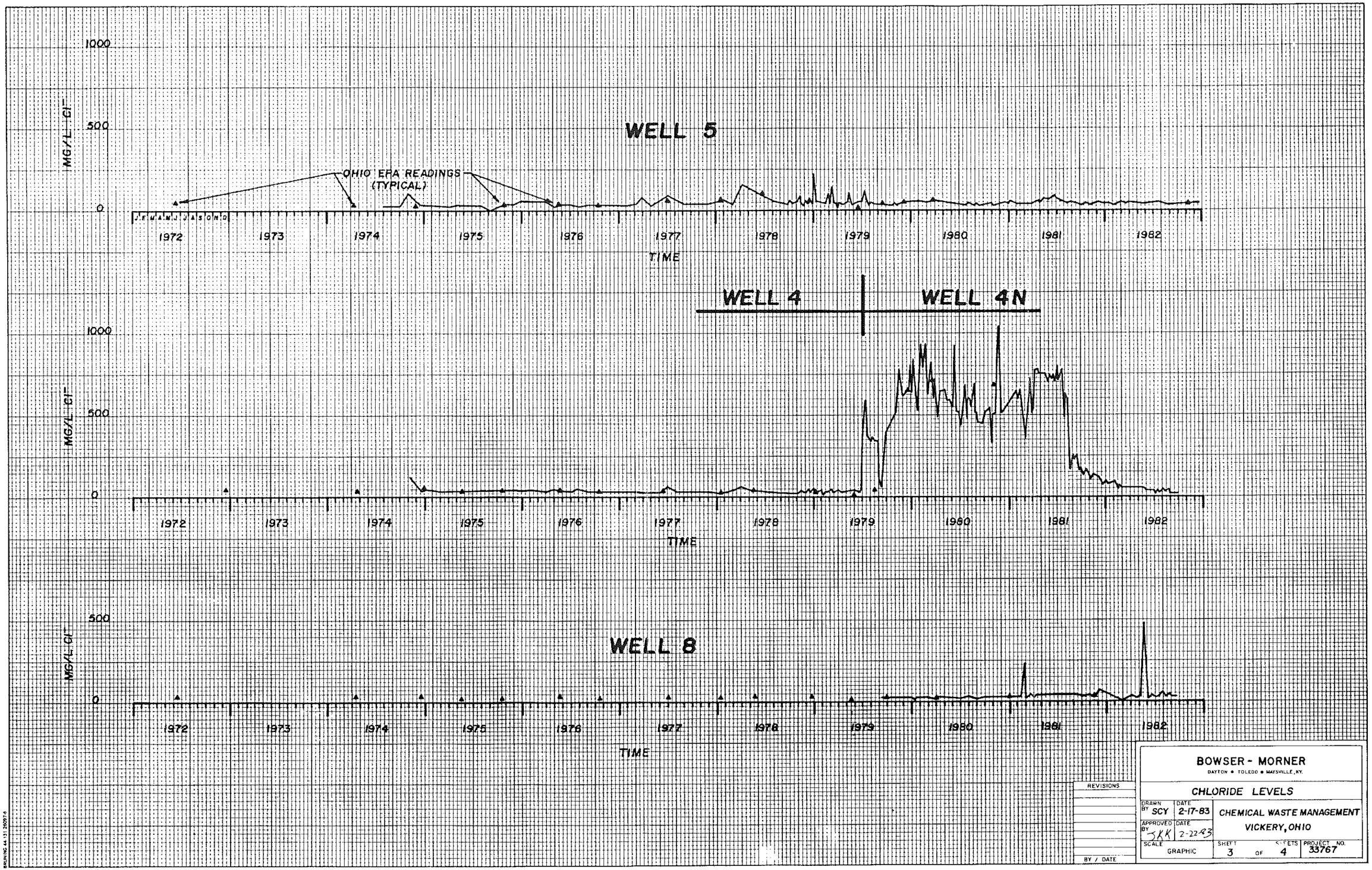
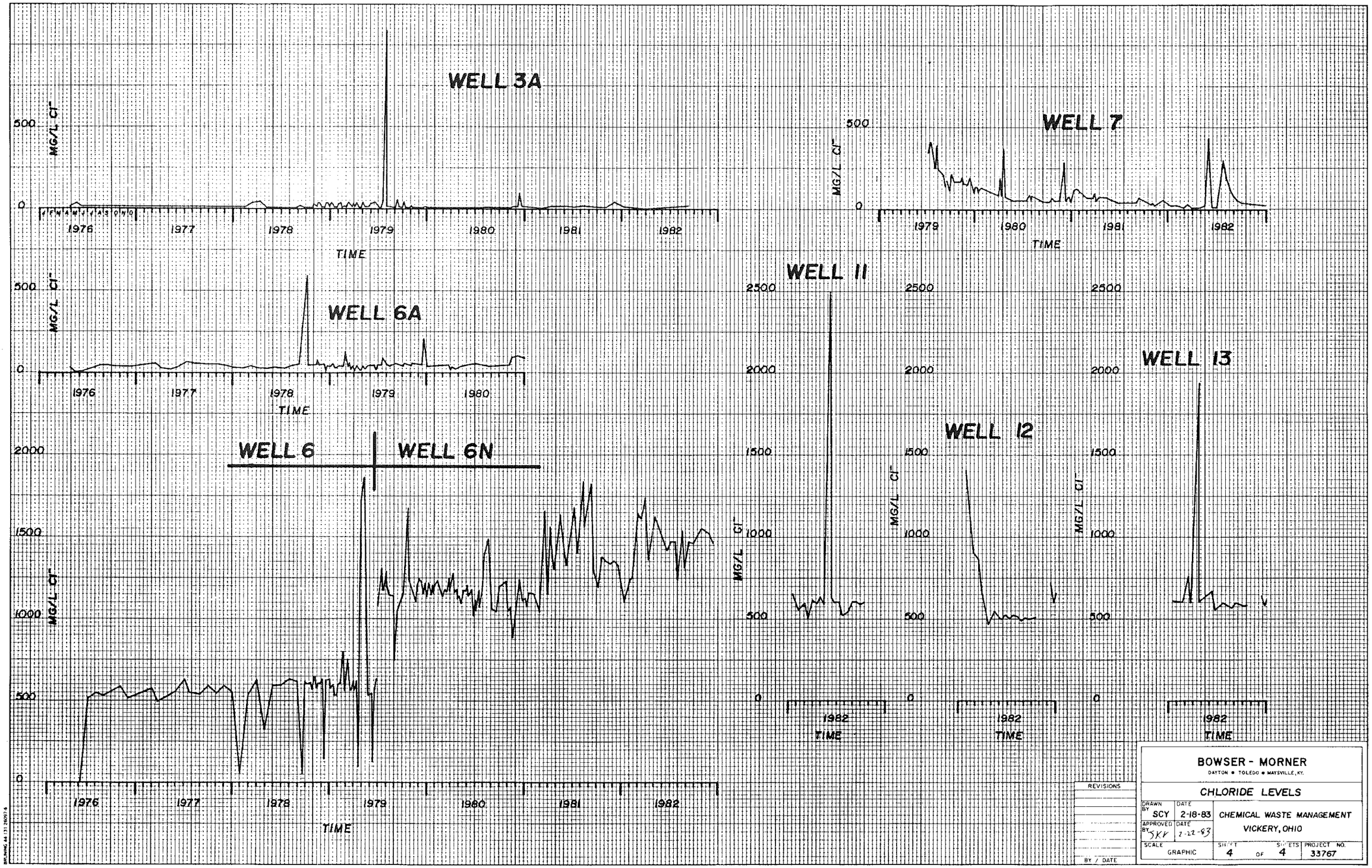
1978
1979
1980
1981
1982
TIME
J F M A M J J A S O N D
1200
1910
1990
3690
REVISIONS
BY / DATE
BOWSER - MORNER
DAYTON • TOLEDO • MAYSVILLE, KY.
CHLORIDE LEVELS
DRAWN BY GLF
DATE 2-17-83
APPROVED BY JKK
DATE 2-22-83
CHEMICAL WASTE MANAGEMENT
VICKERY, OHIO
SCALE GRAPHIC
SHEET 2 OF 4 SHEETS
PROJECT NO. 33767


WELL 5
OHIO EPA READINGS (TYPICAL)
MG/L Cl⁻
1000
500
0
J F M A M J J A S O N D
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
TIME
WELL 4
WELL 4N
WELL 8
REVISIONS
BY / DATE
BOWSER - MORNER
DAYTON • TOLEDO • MAYSVILLE, KY.
CHLORIDE LEVELS
DRAWN BY SCY
DATE 2-17-83
APPROVED BY SKK
DATE 2-22-83
CHEMICAL WASTE MANAGEMENT
VICKERY, OHIO
SCALE GRAPHIC
SHEET 3 OF 4 SHEETS
PROJECT NO. 33767



BOWSER - MORNER
DAYTON • TOLEDO • MAYSVILLE, KY.

CHLORIDE LEVELS

DRAWN BY SCY	DATE 2-18-83	CHEMICAL WASTE MANAGEMENT VICKERY, OHIO
APPROVED BY SKV	DATE 2-22-83	
SCALE GRAPHIC	SHEET 4 OF SHEETS 4	PROJECT NO. 33767

REVISIONS

BY / DATE

BRUNING 44 131 26097-6

HYDROGEOLOGIC INVESTIGATION

Preliminary Data Summary
Northern Ohio Treatment Facility
Vickery, Ohio

RELEASED
DATE 2/13/95
RIN # 1199-94
INITIALS J.P.

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attention: Mr. Gary Brown

PRELIMINARY
DATE
CONFIDENTIAL

Laboratory Job No. 33767

March 14, 1983

BOWSER-MORNER
Testing Laboratories, Inc.

BOWSER-MORNER Testing Laboratories, Inc.

Founded 1911

TOLEDO DISTRICT • 122 S. St. Clair St. • P.O. Box 838 • Toledo, Ohio 43696 • 419/255-8200

March 14, 1983

RELEASED
DATE 2/13/95
BY #1192-94
INITIALS J.P.
PRELIMINARY
DATE
CONFIDENTIAL

Chemical Waste Management, Inc.
3956 State Route 412
Vickery, Ohio 43464

Attention: Mr. Gary Brown

RE: Hydrogeologic Investigation
Preliminary Data Summary
Northern Ohio Treatment Facility
Vickery, Ohio
Laboratory Job No. 33767

Gentlemen:

The following report consists of a series of appendices which contain accumulated data from the above referenced study of the site in Vickery, Ohio. The hydrogeologic study and site assessment was performed in accordance with the special terms and conditions set forth by the Hazardous Waste Facilities Approval Board in the Site Facility Permit issued December 19, 1981. The data contained in this report is the result of that study. This report is intended to be an addendum to a preliminary hydrogeologic analysis and site assessment which has been prepared for the site. The data contained in this report verifies the conclusions reached in the preliminary site assessment report.

It is planned to eventually assimilate this data into a final report which will describe the hydrogeologic conditions at the site and which will assess the site as a hazardous waste disposal facility. At the present time additional work is being recommended in order to be able to finalize the site assessment portion of the project.

If there are any questions or if we can be of further service, please contact us.

Respectfully submitted,
BOWSER-MORNER, INC.

J. Richard Hoppenjans

J. Richard Hoppenjans, P.E.
Chief Engineer

Julie K Kampa

Julie K. Kampa, Geologist

JRH:jl
1c-Donald McCombs
1c-Ron Shawl
1c-John A. Baker

NOTE:

For appendices not included herein, please refer to the preliminary report issued February 22, 1983, Report No. T-20032.

At the time of final submittal, all the appendices will be included.

APPENDIX D

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# L10-50 DATE RECV'D: 10/21/80

CUSTOMER: Spring water DATE RUN: 10/22/80

SAMPLE CODE: DISCHARGED TO:

SAMPLE IDENTIFICATION: Sulfur spring draining into Raccoon Creek ½ mile south of SR 412 off Twp. Rd. 233

COLOR: clear, strong sulfide odor

TEST RESULTS

PH	7.17	AP	PHENOL	0.013 mg/l	[illegible]
TOTAL AL or AC			CL	19 mg/l	[illegible]
SS	10 mg/l	AP	SO4	1148 mg/l	[illegible]
DS			COND.	1850 µmhos/cm²	AP
TS	2655 mg/l	[illegible]	SpGr		
ASH			Total Fe:	0.04 mg/l	[illegible]
COD	36 mg/l	[illegible]	" Cr:	< 0.03	"
O&G (F)	3 mg/l	[illegible]	" Ni:	< [illegible]	"
FLASH			" Cd:	< [illegible]	"
REACTION/POND 5:			" Zn:	[illegible]	"
			" Ca:	528	"
OTHER TESTS:			" Mg:	92	"

Sampling Temp: 10.5°C; Dissolved O_2: 1.3 mg/l

REMARKS:

TS and Fe not as high as artesian aquifer further north

Form 202

ANALYST: BB

BOWSER-MORNER
Testing Laboratories, Inc.

OHIO LIQUID DISPOSAL, INC.
CUSTOMER SAMPLE REPORT

NW# L-2-37 DATE RECV'D: 02/24/81

CUSTOMER: ~~Stream~~ Raccoon Creek Spring DATE RUN: 2-26-81

SAMPLE CODE: Additional Poorman Spring DISCHARGED TO:

SAMPLE IDENTIFICATION: Subsurface Water.

COLOR: Clear, lt suspended solids, strong sulfide odor

TEST RESULTS

PH	7.23	AP	PHENOL	0.003	mg/l
TOTAL AL or AC			CL	22	mg/l
SS	40 mg/l		SO_4	1484	mg/l
DS			COND	1650	µmhos/cm²
TS	2495 mg/l		SpGr		
ASH			Total Fe:	0.13	mg/l
COD	8 mg/l		" Cr:	< 0.03	mg/l
O&G (F)	7 mg/l		" Ni:	< 0.03	mg/l
FLASH	quantionable.		" Cd:	< 0.006	mg/l
REACTION/POND 5:			" Zn:	< 0.003	mg/l
			TOC:	N.A.	mg/l

OTHER TESTS: Sampling Temperature: 9.0°C Dissolved Oxygen: 3.0 mg/l

REMARKS:

Form 202 ANALYST: BB

BOWSER-MORNER
Testing Laboratories, Inc.

APPENDIX G

TABLE 1

1st Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	1N	2	3N	4N	5
Date Sampled	3-3-82	2-24-82	2-24-82	2-24-82	3-3-82
TOH_1, mg/l	< 0.010	< 0.010	0.054	0.031	0.048
TOH_2, mg/l	0.034	< 0.010	0.010	0.045	< 0.010
TOH_3, mg/l	0.050	< 0.010	0.042	0.059	0.016
TOH_4, mg/l	0.055	0.015	0.094	0.016	0.120
Chloride, mg/l	2300	308	390	66.5	45.2
Sulfate, mg/l	1670	1820	1430	1940	1790
Nitrate N, mg/l	0.20	0.12	0.70	0.12	0.05
Fluoride, mg/l	2.0	1.7	0.7	0.8	2.0
Ammonia N, mg/l	2.68	1.26	0.28	0.86	0.91
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	400	910	220	1040	3940
Manganese, ug/l	< 5	30	40	160	50
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	30	20	40	70	30
Cadmium, ug/l	3	< 2	< 2	< 2	< 2
Chromium, ug/l	< 5	< 5	< 5	< 5	< 5
Lead, ug/l	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	6	10	< 5	< 5	< 5
Silver, ug/l	50	< 3	< 3	< 3	40
T. Coliform, Col/100 ml	< 1	< 1	< 1	< 1	< 1
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	30.3	30.4	75.6	23.5	38.8
TOC_2, mg/l	30.3	30.2	75.3	23.8	39.3
TOC_3, mg/l	30.8	30.5	75.6	23.5	39.1
TOC_4, mg/l	30.2	31.1	75.8	23.9	39.0
pH, units	7.18	7.25	7.12	7.16	7.21
pH, units	7.18	7.33	7.16	7.21	7.27
pH, units	7.18	7.38	7.18	7.23	7.31
pH, units	7.20	7.38	7.19	7.25	7.31
Conductivity, umhos/cm	4980	2300	2180	1820	2030
Conductivity, umhos/cm	5100	2310	2220	1850	2100
Conductivity, umhos/cm	5070	2380	2300	1900	2140
Conductivity, umhos/cm	5150	2400	2330	1960	2180
Phenol, mg/l	< 0.001	< 0.001	< 0.001	0.002	< 0.001

TABLE 1 (Cont'd)

1st Quarter 1982

CHEMICAL WASTE MANAGEMENT

- GROUNDWATER ANALYSES

Well No.	6N	7	8	11	12	13
Date Sampled	3-3-82	2-24-82	2-24-82	2-24-82	3-3-82	3-3-82
TOH_1, mg/l	0.081	0.015	0.010	0.031	0.016	0.068
TOH_2, mg/l	0.210	0.010	0.010	0.023	0.048	0.051
TOH_3, mg/l	0.240	0.010	0.010	0.035	0.030	0.019
TOH_4, mg/l	0.130	0.010	0.011	0.019	0.061	0.120
Chloride, mg/l	1610 ✓	35.9 ✓	34.6 ✓	697 ✓	926 ✓	765 ✓
Sulfate, mg/l	1760	1670	1730	1960	1840	1870
Nitrate N, mg/l	< 0.05	0.11	0.47	0.11	0.06	1.28
Fluoride, mg/l	1.2	1.2	1.5	1.3	0.64	1.8
Ammonia N, mg/l	1.90	0.23	1.76	1.76	1.87	0.26
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	140	170	2650	190	310	120
Manganese, ug/l	30	30	110	190	330	40
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	30	30	30	60	30	40
Cadmium, ug/l	10	< 2	< 2	< 2	9	6
Chromium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Lead, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	< 5	< 5	< 5	< 5	5	< 5
Silver, ug/l	50	< 3	< 3	< 3	< 3	< 3
T. Coliform, Col/100 ml	< 1	< 1	—	< 1	< 1	< 1
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	28.8	24.6	50.4	24.2	57.3	20.4
TOC_2, mg/l	28.2	24.3	51.4	23.2	57.5	20.6
TOC_3, mg/l	28.3	24.1	54.7	25.4	56.3	21.1
TOC_4, mg/l	28.7	24.9	52.5	25.2	56.0	21.2
pH, units	7.18	7.25	7.12	7.34	7.20	7.43
pH, units	7.18	7.32	7.18	7.35	7.21	7.40
pH, units	7.19	7.33	7.20	7.35	7.20	7.39
pH, units	7.18	7.35	7.20	7.37	7.19	7.40
Conductivity, umhos/cm	4280	1700	1950	2800	3290	2900
Conductivity, umhos/cm	4400	1720	1980	2900	3360	2950
Conductivity, umhos/cm	4490	1780	1990	2960	3480	3010
Conductivity, umhos/cm	4600	1800	2010	3050	3500	3100
Phenol, mg/l	< 0.001	< 0.001	< 0.004	< 0.001	< 0.001	< 0.001

TABLE 1 (Cont'd)

CHEMICAL WASTE MANAGEMENT

Radiological Parameters

All in pCi/l

Well No.	1N	6N	12	13
Gross Alpha	< 9.9	< 7.0	< 5.0	< 5.0
Gross Beta	38.0 ± 10.0	30.0 ± 6.0	20.0 ± 5.0	19.0 ± 5.0
Radium 266	3.05 ± 0.22	1.85 ± 0.019	0.67 ± 0.09	1.15 ± 0.012
Radium 228	1.86 ± 1.49	NN	NN	NN

NN - Analysis not needed

TABLE 2

2nd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	1N	2	3N	4N	5	6N
Date Sampled	5-12-82	5-5-82	5-5-82	5-5-82	5-12-82	5-12-82
TOH_1, mg/l	0.031	0.010	< 0.010	1.130	0.071	0.054
TOH_2, mg/l	0.058	0.010	< 0.010	0.660	0.042	0.052
TOH_3, mg/l	0.046	0.010	0.010	1.330	0.062	0.130
TOH_4, mg/l	0.086	0.010	0.015	0.830	0.064	0.072
Chloride, mg/l	2180	280	376	50.7	38.2	1630
Sulfate, mg/l	1810	1870	1510	2190	1770	1870
Nitrate N, mg/l	0.19	0.05	0.016	0.12	0.13	0.18
Fluoride, mg/l	1.9	2.2	1.0	1.1	1.7	1.4
Ammonia N, mg/l	2.50	1.16	0.07	0.05	0.82	1.70
T. Cyanide, mg/l	0.25	0.25	0.25	0.25	0.25	0.25
Iron, ug/l	547	1030	68	91	2250	165
Manganese, ug/l	44	23	18	36	54	50
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	10	4	18	14	26	35
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	17	11	10	8	< 5	17
Lead, ug/l	20	< 5	< 5	< 5	8	5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	< 5	6	< 5	7	< 5	< 5
Silver, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
T. Coliform, Col/100 ml	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	28	31	72	22	42	30
TOC_2, mg/l	28	31	70	21	41	30
TOC_3, mg/l	29	30	70	23	41	30
TOC_4, mg/l	28	30	70	23	41	30
pH, units	7.20	7.33	7.30	7.21	7.25	7.41
pH, units	7.20	7.36	7.30	7.22	7.24	7.39
pH, units	7.19	7.38	7.30	7.21	7.24	7.42
pH, units	7.18	7.40	7.31	7.22	7.22	7.40
Conductivity, umhos/cm	5900	2500	2490	2060	2290	5100
Conductivity, umhos/cm	5920	2350	2400	2100	2300	5100
Conductivity, umhos/cm	5700	2530	2510	2120	2250	4840
Conductivity, umhos/cm	5800	2530	2520	2160	2290	4980
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

TABLE 2 (Cont.'d)

2nd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	7	8	11	12	13	3A
Date Sampled	5-5-82	5-5-82	5-5-82	5-12-82	5-12-82	5-5-82
TOH_1, mg/l	< 0.010	< 0.010	< 0.010	0.111	0.012	< 0.010
TOH_2, mg/l	< 0.010	0.012	< 0.010	0.164	0.017	< 0.010
TOH_3, mg/l	< 0.010	< 0.010	< 0.010	0.096	0.044	< 0.010
TOH_4, mg/l	< 0.010	0.011	< 0.010	0.182	0.072	0.012
Chloride, mg/l	28.9 ✓	31.7 ✓	584 ✓	549 ✓	640 ✓	13.4 ✓
Sulfate, mg/l	1910	1600	2290	1950	1960	118
Nitrate N, mg/l	0.18	0.14	0.10	0.15	0.14	0.17
Fluoride, mg/l	1.3	1.9	1.7	0.7	2.0	0.3
Ammonia N, mg/l	0.09	0.73	1.91	0.86	0.04	0.08
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	138	1240	252	237	202	63
Manganese, ug/l	35	60	153	278	59	42
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	19	23	32	47	53	28
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	3	6	12	11	7	< 5
Lead, ug/l	14	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Selenium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Silver, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
T. Coliform, Col/100 ml	5.1*	< 2.2	< 2.2	< 2.2	< 2.2	—
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	24	39	23	61	21	77
TOC_2, mg/l	24	40	25	61	21	78
TOC_3, mg/l	29	40	26	58	22	76
TOC_4, mg/l	25	44	26	57	22	76
pH, units	7.36	7.15	7.32	6.97	7.39	7.25
pH, units	7.38	7.15	7.32	6.95	7.39	7.25
pH, units	7.39	7.16	7.34	6.95	7.42	7.36
pH, units	7.40	7.18	7.35	6.93	7.38	7.28
Conductivity, umhos/cm	2000	2050	3300	3500	3480	580
Conductivity, umhos/cm	2010	1990	3350	3450	3400	570
Conductivity, umhos/cm	2040	2060	3400	3460	3500	580
Conductivity, umhos/cm	1950	1900	3380	3400	3500	570
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

*Parameter exceeds MCL's

TABLE 2 (Cont'd)

CHEMICAL WASTE MANAGEMENT

Radiological Parameters

All in pCi/l

Well No.	Gross Alpha	Gross Beta	Radium 226
1N	<5.2	16.8 ± 4.6	2.34 ± 0.18
2	<7.9	18.4 ± 8.0	1.83 ± 0.21
3N	<6.9	<8	0.33 ± 0.08
4N	<5.9	<7.9	0.26 ± 0.07
5	<12.1	10.7 ± 7.2	1.68 ± 0.09
6N	<11.2	16.8 ± 7.5	3.03 ± 0.11
7	<9.0	10.0 ± 6.9	1.02 ± 0.07
8	<9.3	10.5 ± 7.9	1.94 ± 0.19
11	<4.7	15.7 ± 7.4	NN
12	<10.3	9.8 ± 7.0	0.05 ± 0.01
13	<10.3	15.7 ± 7.4	1.17 ± 0.22
3A	13.7 ± 5.1	33.6 ± 3.1	0.92 ± 0.10

NN - Analysis not needed

TABLE 3

3rd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	1N	2	3N	4N	5	6N
Date Sampled	8-12-82	8-12-82	8-12-82	8-12-82	8-10-82	8-10-82
TOH_1, mg/l	0.057	0.010	0.022	0.095	< 0.010	0.509
TOH_2, mg/l	0.051	0.010	0.026	0.059	< 0.010	0.178
TOH_3, mg/l	0.021	0.017	0.023	0.099	< 0.010	0.159
TOH_4, mg/l	0.011	0.010	0.019	0.087	0.022	0.261
Chloride, mg/l	1390	279	336	31.5	17.7	1420
Sulfate, mg/l	1520	1660	1300	1750	1620	1670
Nitrate N, mg/l	0.14	< 0.05	0.09	0.95	0.10	< 0.05
Fluoride, mg/l	1.4	1.6	0.7	0.8	1.3	1.0
Ammonia N, mg/l	2.73	—	—	—	1.21	2.31
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	891	1610	52	40	4070	631
Manganese, ug/l	116	32	110	21	122	130
Arsenic, ug/l	< 5	7	< 5	< 5	6	< 5
Barium, ug/l	38	7	51	8	33	56
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	1	< 5	28	1	1	9
Lead, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Mercury, ug/l	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Selenium, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
Silver, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
T. Coliform, Col/100 ml	< 2.2	2.2*	< 2.2	< 2.2	< 2.2	< 2.2
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	1.5	34	81	22	3.3	4.8
TOC_2, mg/l	1.8	34	81	23	3.0	5.5
TOC_3, mg/l	1.7	34	80	23	3.3	5.0
TOC_4, mg/l	1.9	34	80	23	5.0	4.6
pH, units	7.12	7.21	6.96	7.37	7.18	7.15
pH, units	7.15	7.31	7.00	7.38	7.17	7.16
pH, units	7.20	7.37	6.96	7.40	7.15	7.14
pH, units	7.20	7.36	7.00	7.38	7.16	7.15
Conductivity, umhos/cm	5000	2620	2790	2180	2060	5050
Conductivity, umhos/cm	5180	2580	2600	2170	2100	5200
Conductivity, umhos/cm	5180	2590	2610	2180	2180	5250
Conductivity, umhos/cm	5200	2600	2600	2190	2190	5300
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Depth to Water, m	—	—	4.2	4.2	—	4.1

*Parameter exceeds MCL's

NOTE: Ammonia nitrogen tests not run by lab in error for wells 2, 3N, 4N, 7 & 8

TABLE 3 (Cont'd)

3rd Quarter 1982

CHEMICAL WASTE MANAGEMENT

GROUNDWATER ANALYSES

Well No.	7	8	11	12	13
Date Sampled	8-10-82	8-10-82	8-10-82	8-10-82	8-10-82
TOH_1, mg/l	0.660**	0.029	0.027	0.044	0.039
TOH_2, mg/l	0.640	0.020	0.024	0.019	0.022
TOH_3, mg/l	0.540	0.021	0.027	< 0.010	0.033
TOH_4, mg/l	0.630	0.032	0.028	0.012	0.018
Chloride, mg/l	128 ✓	30 ✓	549 ✓	452 ✓	542
Sulfate, mg/l	1600	1570	1870	1830	1760
Nitrate N, mg/l	< 0.05	< 0.05	< 0.05	0.09	0.14
Fluoride, mg/l	1.3	1.4	1.2	0.4	1.3
Ammonia N, mg/l	—	—	—	1.29	0.52
T. Cyanide, mg/l	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Iron, ug/l	91	1630	400	635	113
Manganese, ug/l	14	90	173	420	40
Arsenic, ug/l	< 5	< 5	< 5	< 5	< 5
Barium, ug/l	10	50	30	22	7
Cadmium, ug/l	< 5	< 5	< 5	< 5	< 5
Chromium, ug/l	8	< 5	< 5	6	< 5
Lead, ug/l	< 5	5	5	< 5	< 5
Mercury, ug/l	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Selenium, ug/l	< 5	5	< 5	< 5	< 5
Silver, ug/l	< 5	5	< 5	< 5	< 5
T. Coliform, Col/100 ml	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
Endrin, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Lindane, ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Methoxychlor, ug/l	< 10	< 10	< 10	< 10	< 10
Toxaphene, ug/l	< 5	< 5	< 5	< 5	< 5
2,4-D, ug/l	< 100	< 100	< 100	< 100	< 100
2,4,5-TP Silvex, ug/l	< 10	< 10	< 10	< 10	< 10
TOC_1, mg/l	30	42	30	11	2.4
TOC_2, mg/l	30	42	30	11	2.5
TOC_3, mg/l	30	42	30	11	2.3
TOC_4, mg/l	31	42	30	10	2.2
pH, units	7.14	7.07	7.39	6.92	7.22
pH, units	7.09	7.01	7.43	6.92	7.23
pH, units	7.07	7.04	7.42	6.91	7.23
pH, units	7.07	7.06	7.41	6.92	7.21
Conductivity, umhos/cm	2310	2020	3390	3380	3350
Conductivity, umhos/cm	2310	2070	3390	3440	3450
Conductivity, umhos/cm	2320	2090	3400	3500	3490
Conductivity, umhos/cm	2300	2090	3410	3500	3500
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	4.7	—	4.6	4.1	5.5

*Readings taken following well disinfection with chlorine

TABLE 3 (Cont'd)

CHEMICAL WASTE MANAGEMENT

Radiological Parameters

All in pCi/l

Well No.	Gross Alpha	Gross Beta	Radium 226
1N	11.7 ± 11.7	28.1 ± 13.2	3.15 ± 0.19
2	<8.2	9.5 ± 7.6	1.77 ± 0.11
3N	<6.2	<8.8	0.68 ± 0.05
4N	<7.9	<9.0	0.40 ± 0.05
5	<5.8	7.8 ± 7.4	1.60 ± 0.12
6N	<7.7	15.5 ± 10.8	2.01 ± 0.8
7	<8.2	12.3 ± 7.7	1.36 ± 0.10
8	<7.6	12.6 ± 7.7	1.11 ± 0.06
11	<8.5	<9.1	1.43 ± 0.07
12	<6.4	8.6 ± 7.5	0.44 ± 0.05
13	<6.7	14.1 ± 7.9	1.55 ± 0.07

TABLE 4

4th Quarter 1982

CHEMICAL WASTE MANAGEMENT
GROUNDWATER ANALYSES

Lab No.	2806-82	2807-82	2808-82	2809-82
Well No.	2	3N	4N	7
Date Sampled	11/3/82	11/3/82	11/3/82	11/3/82
Time Sampled	09:30	09:45	10:00	10:45
TOH_1, mg/l	0.029	0.022	0.007	0.058
TOH_2, mg/l	0.028	0.020	0.006	0.061
TOH_3, mg/l	0.025	0.024	0.006	0.059
TOH_4, mg/l	0.027	0.022	0.008	0.061
Chloride, mg/l	270	490	56	35
Sulfate, mg/l	1960	1760	1900	1900
Nitrate N, mg/l	< 0.05	0.44	< 0.05	< 0.05
Fluoride, mg/l	1.56	0.79	0.84	1.19
Ammonia N, mg/l	1.13	0.28	0.89	0.59
T. Cyanide, mg/l	0.03	0.02	0.02	0.03
Iron, ug/l	284	< 10	470	<10
Manganese, ug/l	12	16	190	92
Arsenic, ug/l	< 4	< 4	< 4	< 4
Barium, ug/l	22	56	12	21
Cadmium, ug/l	4	4	4	< 0.5
Chromium, ug/l	<10	<10	<10	12
Lead, ug/l	<10	<10	<10	<10
Mercury, ug/l	< 0.2	< 0.2	< 0.2	< 0.2
Selenium, ug/l	< 3	< 3	< 3	< 3
Silver, ug/l	<10	<10	<10	<10
T. Coliform Bacteria, #/100 ml	>16*	16*	9.2*	>16*
Endrin, ug/l	< 0.04	< 0.04	< 0.04	< 0.04
Lindane, ug/l	< 0.04	< 0.04	< 0.04	< 0.04
Methoxychlor, ug/l	< 0.2	< 0.2	< 0.2	< 0.2
Toxaphene, ug/l	< 1.0	< 1.0	< 1.0	< 1.0
2,4-D, ug/l	< 0.8	< 0.4	< 1.0	< 0.8
2,4,5-TP Silvex, ug/l	< 0.2	< 0.4	< 0.4	< 0.3
TOC_1, mg/l	54	107	40	45
TOC_2, mg/l	53	108	39	45
TOC_3, mg/l	53	111	39	45
TOC_4, mg/l	53	107	39	45
pH, units	7.34	7.00	7.32	7.32
pH, units	7.58	7.08	7.40	7.40
pH, units	7.58	7.02	7.32	7.32
pH, units	7.54	7.08	7.32	7.32
Conductivity, umhos/cm	2800	3300	2150	2150
Conductivity, umhos/cm	2800	3300	2160	2160
Conductivity, umhos/cm	2800	3320	2180	2180
Conductivity, umhos/cm	2800	3310	2180	2180
Phenol, mg/l	<0.001	<0.001	<0.011	<0.001
Depth, m	—	4.0	4.6	4.9

Note: Depth not measurable in wells with flooded above grade pump suction (2, 5 & 8)

TABLE 4 (Cont'd)

4th Quarter 1982

CHEMICAL WASTE MANAGEMENT
GROUNDWATER ANALYSES

Lab No.	2810-82	2811-82	2908-82	2909-82
Well No.	8	11	5	6N
Date Sampled	11/3/82	11/3/82	11/10/82	11/10/82
Time Sampled	10:30	10:45	09:30	09:30
TOH_1, mg/l	0.060	0.013	0.021	-
TOH_2, mg/l	0.064	0.008	0.020	-
TOH_3, mg/l	0.062	0.010	0.022	-
TOH_4, mg/l	0.061	0.011	0.020	-
Chloride, mg/l	30 ✓	540 ✓	51 ✓	1550 ✓
Sulfate, mg/l	1840	2400	2100	1900
Nitrate N, mg/l	<0.05	<0.05	0.20	0.22
Fluoride, mg/l	1.42	1.18	1.31	0.96
Ammonia N, mg/l	0.79	1.61	0.67	1.62
T. Cyanide, mg/l	0.01	0.01	<0.01	0.07
Iron, ug/l	230	<10	2880	<10
Manganese, ug/l	32	100	44	24
Arsenic, ug/l	<4	<4	<4	<4
Barium, ug/l	20	40	8	21
Cadmium, ug/l	<4	4	0.5	<0.5
Chromium, ug/l	16	<10	<10	<10
Lead, ug/l	<10	<10	<5	<10
Mercury, ug/l	<0.2	0.4	0.3	<0.2
Selenium, ug/l	<3	<3	<3	<3
Silver, ug/l	<10	<10	<10	<10
T. Coliform Bacteria, #/100 ml	<2.2	<2.2	<2.2	5.1*
Endrin, ug/l	<0.04	<0.04	<0.04	<0.04
Lindane, ug/l	<0.04	<0.04	<0.04	<0.04
Methoxychlor, ug/l	<0.2	<0.2	<0.2	<0.2
Toxaphene, ug/l	<1.0	<1.0	<1.0	<1.0
2,4-D, ug/l	<0.4	<0.4	<0.4	<0.4
2,4,5-TP Silvex, ug/l	<0.2	<0.2	<0.2	<0.8
TOC_1, mg/l	61	41	4.9	5.8
TOC_2, mg/l	61	42	5.6	5.8
TOC_3, mg/l	62	43	5.4	5.8
TOC_4, mg/l	62	42	5.4	4.8
pH, units	7.21	7.43	7.19	7.15
pH, units	7.27	7.38	7.20	7.12
pH, units	7.27	7.34	7.20	7.14
pH, units	7.25	7.34	7.20	7.15
Conductivity, umhos/cm	2200	3500	2500	6000
Conductivity, umhos/cm	2200	3500	2510	5950
Conductivity, umhos/cm	2200	3520	2500	5950
Conductivity, umhos/cm	2200	3510	2500	5950
Phenol, mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Depth, m	—	5.0	—	3.9

TABLE 4 (Cont'd)

4th Quarter 1982

CHEMICAL WASTE MANAGEMENT
GROUNDWATER ANALYSES

Lab No.	2910-82	2911-82
Well No.	12	13
Date Sampled	11/10/82	11/10/82
Time Sampled	09:30	09:30
TOH_1, mg/l	0.028	-
TOH_2, mg/l	0.027	-
TOH_3, mg/l	0.029	-
TOH_4, mg/l	0.027	-
Chloride, mg/l	590	540
Sulfate, mg/l	1900	1760
Nitrate N, mg/l	0.22	1.69
Fluoride, mg/l	0.45	1.28
Ammonia N, mg/l	0.99	0.16
T. Cyanide, mg/l	<0.01	0.01
Iron, ug/l	260	180
Manganese, ug/l	430	40
Arsenic, ug/l	<4	<4
Barium, ug/l	26	21
Cadmium, ug/l	<0.5	0.7
Chromium, ug/l	<10	<10
Lead, ug/l	<10	<10
Mercury, ug/l	<0.2	<0.2
Selenium, ug/l	<3	<3
Silver, ug/l	<10	<10
T. Coliform Bacteria, #/100 ml	>16*	<2.2
Endrin, ug/l	<0.04	<0.04
Lindane, ug/l	<0.04	<0.04
Methoxychlor, ug/l	<0.2	<0.2
Toxaphene, ug/l	<<1.0	<1.0
2,4-D, ug/l	<0.4	<0.4
2,4,5-TP Silvex, ug/l	<0.2	<0.2
TOC_1, mg/l	8.3	9.2
TOC_2, mg/l	8.4	9.2
TOC_3, mg/l	8.3	9.5
TOC_4, mg/l	9.5	9.5
pH, units	6.97	7.32
pH, units	6.95	7.31
pH, units	6.98	7.31
pH, units	6.98	7.31
Conductivity, umhos/cm	4300	3800
Conductivity, umhos/cm	4300	3800
Conductivity, umhos/cm	4300	3800
Conductivity, umhos/cm	4300	3800
Phenol, mg/l	<0.001	<0.001

CHEMICAL WASTE MANAGEMENT

TABLE 5

Summary of Values of Drinking Water Parameters which Exceed Appendix III Maximum Levels (1982)

Parameter	Standard	Sampling Period	Well No.	Concentration
Total Coliform	1 Col./100 ml	2nd Qtr.*	7	5.1 Col./100 ml
		3rd Qtr.*	2	2.2 "
		4th Qtr.*	2	> 16 "
		4th Qtr.	3	16 "
		4th Qtr.	4	9.2 "
		4th Qtr.	6N	5.1 "
		4th Qtr.	7	> 16 "
		4th Qtr.	12	> 16 "

NOTE: During these three quarters, the laboratory used had a detection limit of 2.2 Col./100 ml. Wells showing concentrations higher than the detection limit are reported here.

APPENDIX H

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 5 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Pond 7

SAMPLE IDENTIFICATION: Grab sample from transfer pump

COLOR: _____

TEST RESULTS

PH	1.40		PHENOL	167	mg/l
TOTAL AL or AC	280	meq/l	CL	1610	mg/l
SS	470	mg/l	SO4	5760	mg/l
DS			COND	22 000	µmhos/cm²
TS	16 060	mg/l	SpGr	1.000	
ASH	7730	mg/l	Total Fe:	1180	mg/l
COD	8900	mg/l	" Cr:	23	mg/l
O&G(F)	313	mg/l	" Ni:	13	mg/l
FLASH			" Cd:	1.04	mg/l
REACTION/POND 5:			" Zn:	230	mg/l
			TOC:	2332	mg/l

OTHER TESTS: _____

REMARKS: _____

Form 202

ANALYST: CK

BOWSER-MORNER
Testing Laboratories, Inc.

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 7 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Pond 11

SAMPLE IDENTIFICATION: Grab sample from transfer pump

COLOR: _____

TEST RESULTS

PH	0.10		PHENOL	57	mg/l
TOTAL AL or AC	2300	meq/l	CL	12 000	mg/l
SS	100	mg/l	SO4	97 900	mg/l
DS			COND.	184 000	µmhos/cm^2
TS	148 600	mg/l	SpGr	1.105	
ASH	46 190	mg/l	Total Fe:	8270	mg/l
COD	33 000	mg/l	" Cr:	180	mg/l
O&G (F)	68	mg/l	" Ni:	190	mg/l
FLASH			" Cd:	3.48	mg/l
REACTION/POND 5:			" Zn:	1360	mg/l
			TOC:	9987	mg/l

OTHER TESTS: _____

REMARKS: _____

Form 202

ANALYST: GR

OHIO LIQUID DISPOSAL, INC.
CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 11 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Pond 12

SAMPLE IDENTIFICATION: Grab sample by well crew from filter building

COLOR: _____

TEST RESULTS

PH	0.25		PHENOL	167	mg/l
TOTAL AL or AC	1680	meq/l	CL	10 300	mg/l
SS Filtered:	372	mg/l	SO_4	77 400	mg/l
DS Non-filtered:	45.2	"	COND	155 000	µmhos/cm^2
TS	120 600	mg/l	SpGr	1.085	
ASH	45 950	mg/l	Total Fe:	88 00	mg/l
COD	26 000	mg/l	" Cr:	190	mg/l
O&G (F)	28.4	mg/l	" Ni:	100	mg/l
FLASH			" Cd:	3.08	mg/l
REACTION/POND 5:			" Zn:	1240	mg/l
			TOC:	8319	mg/l

OTHER TESTS: _____

REMARKS: _____

Form 202

ANALYST: CL

OHIO LIQUID DISPOSAL, INC.

CUSTOMER SAMPLE REPORT

NW# _____ DATE RECV'D: 11-23-82

CUSTOMER: OLD Pond # 12 DATE RUN: 11-24-82

SAMPLE CODE: _____ DISCHARGED TO: Deepwell injecti

SAMPLE IDENTIFICATION: Grab sample by well crew from filter building

COLOR: _____

TEST RESULTS

PH	0.40		PHENOL	101	mg/l
TOTAL AL or AC	1460	meq/l	CL	7700	mg/l
SS, Filtered	44.8 *	mg/l	SO_4	62100	mg/l
DS Unfiltered:	23.6		COND.	130 000	µmhos/cm^2
TS	99 810	mg/l	SpGr	1.070	
ASH	38 400	mg/l	Total Fe:	8270	mg/l
COD	19 000	mg/l	" Cr:	160	mg/l
O&G (F)	23.2	mg/l	" Ni:	78	mg/l
FLASH			" Cd:	2.13	mg/l
REACTION/POND 5:			" Zn:	1010	mg/l
			TOC:	6876	mg/l

OTHER TESTS: report = 6880 mg/L Nov '82

REMARKS: * Small amount of filter-aid present in this sample

Form 202

ANALYST: CL

BOWSER-MORNER
Testing Laboratories, Inc.

MEMORANDUM

Hydrogeologic Investigation Preliminary Results
Northern Ohio Treatment Facility - Vickery, Ohio

G.R.O.W.S.
1513 Bordentown Road
Morrisville, Pennsylvania 19067

Attention: Mr. Gary Brown

PRELIMINARY
DATE _____
CONFIDENTIAL

RELEASED
DATE 2/13/95
RIN # 1199-94
INITIALS J.-B.

Laboratory Job No. 33767

March 7, 1983

BOWSER-MORNER
Testing Laboratories, Inc.

BOWSER-MORNER Testing Laboratories, Inc.

Founded 1911

TOLEDO DISTRICT • 122 S. St. Clair St. • P.O. Box 838 • Toledo, Ohio 43696 • 419/255-8200

M E M O R A N D U M

PRELIMINARY

DATE _____

CONFIDENTIAL

RELEASED DATE 2/13/95 RIN # 1199-94 INITIALS J.P.

TO: Gary Brown

FROM: J. Richard Hoppenjans

REF: Hydrogeologic Investigation Preliminary Results
Northern Ohio Treatment Facility
Laboratory Job No. 33767

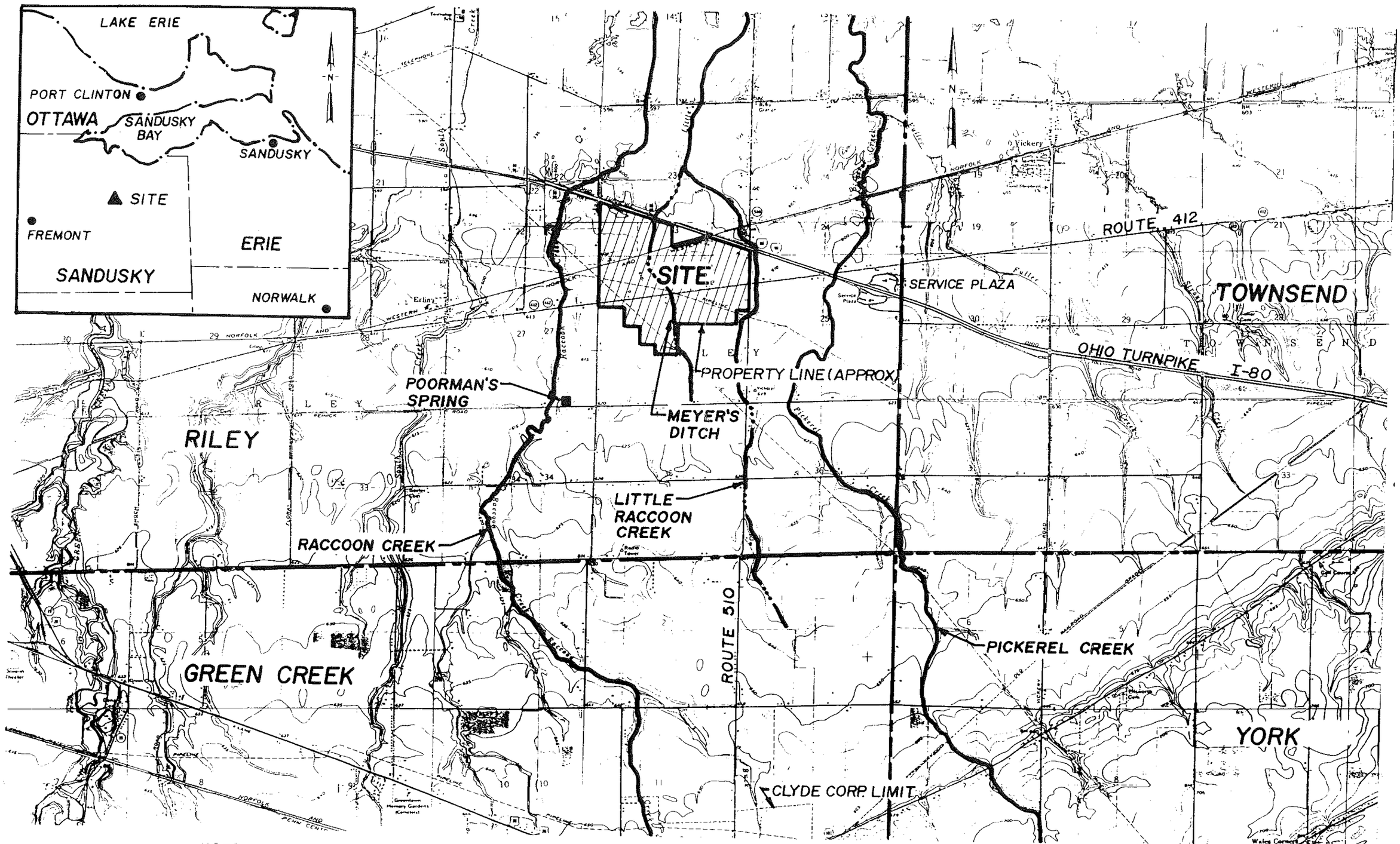
DATE: March 7, 1983

A hydrogeologic investigation and a statistical analysis of accumulated groundwater quality data has been performed for the Northern Ohio Treament Facility. The hydrogeologic investigation was based upon a comprehensive soil boring and rock coring program, integrated with data available in published and unpublished literature. Extensive water quality data was available for on-site wells which dates back to as early as 1972. In addition to the data available from the Ohio Northern Treatment Facility, background water qualtiy data was obtained from the ODNR, the Turnpike Commission, and other published reports. The available water quality data was evaluated utilizing both the Student "T" Test procedure specified by RCRA and by statistical regression analysis.

Site Facilities

The location of the Ohio Northern Treatment Facility is shown on Figure 1. The groundwater flows to the north/northwest and eventually empties into Sandusky Bay. As can be seen in Figure 1, there are no significant population centers between the site and Sandusky Bay. The location of Poorman's Spring and the Ohio Turnpike service plaza is also shown. These areas will be discussed later.

As part of the study, a Facilities Location Plan was developed and a summary of the facility history was created. Much of this information was obtained verbally from on-site personnel. The Facilities Location Plan (Sheet 1) is attached to this Memo, and Table 1 provides the summary of the facility history. This information provides locations and approximate dates when various facilities were begun and closed at the site. Note that landfarming and sludge landfilling are disposal methods used at the site. Surface water runoff is controlled at the site by a series of dikes, ditches, and a sluice gate on Charles E. Meyer ditch. Because of the extremely flat grade, however, surface runoff oftentimes ponds on the site at various locations. As will be seen later, it is possible that runoff from the landfilling and the sludge farming area may have allowed waste constituents to migrate to monitoring well locations. Also shown on the Facilities Location Plan is the location of all of the current soil borings, the injection wells, and existing groundwater monitoring wells.



SCALE: 1" = 3125'

NOTE:
TAKEN FROM USGS CLYDE, VICKERY, FREMONT EAST AND WIGHTMANS GROVE QUADRANGLES.

SITE LOCATION MAP

JOB NO. 33767
DATE: 2-4-83

FIG. 1

BOWSER-MORNER, INC.

TABLE 1

SUMMARY OF FACILITY HISTORY

FACILITY	DATE OF CONSTRUCTION	DATE PUT IN OPERATION	DATE TAKEN OUT OF OPERATION	DATE OF CLOSURE	CURRENT STATUS
Pond 1	1961	1961	1979	1979	Closed
Pond 2	1962	1962	1979	1979	Closed
Pond 3	1962	1962	1980	1980	Closed
Pond 4	1963	1963	1982	**	25% Closed
Pond 5	1968	1968			Active
Pond 6	1966	1966 *	1980	1980	Closed
Pond 7	1968	1968			Active
Pond 8	1968	1968			Combined with #7
Pond 9	1969	1969	1981	**	75% Closed
Pond 10	1971	1971	1982	1982	Closed
Pond 11	1973	1973			Active
Pond 12	1973	1973			Active
Injection Well 1 ***	3/72	1976	1979	1980	Closed
Injection Well 1A	9/79	1980			Active
Injection Well 2	6/76	1977			Active
Injection Well 3	7/76	1977			Active
Injection Well 4	7/76	1977			Active
Injection Well 5	1981	1982			Active
Injection Well 6	11/81	1982			Active
Oil Recovery	1977	1977			Active
Sludge Farm	1978	1978	1978	1978	Closed

* Pond 6 was split into Pond 6 East and Pond 6 West in 1976.

** Pond 4 and Pond 9 are scheduled to be closed in the spring of 1983. However, Chemical Waste Management plans to ask for a two-year extension on the closing period for Pond 4.

*** Drillers logs for the injection wells are contained in Appendix B.

Site Geology and Soil Profile

Bedrock at the site was found to be composed of the Tymochtee dolomite and is located from 40 to 50 feet below the existing surface elevation. The current investigation included a detailed examination of rock cores to a total maximum depth of about 130 feet. The rock profile was not investigated below this depth, except by examination of the well records available from the injection wells. The Tymochtee found here is a mixture of shale, dolomite, gypsum, and anhydrite.

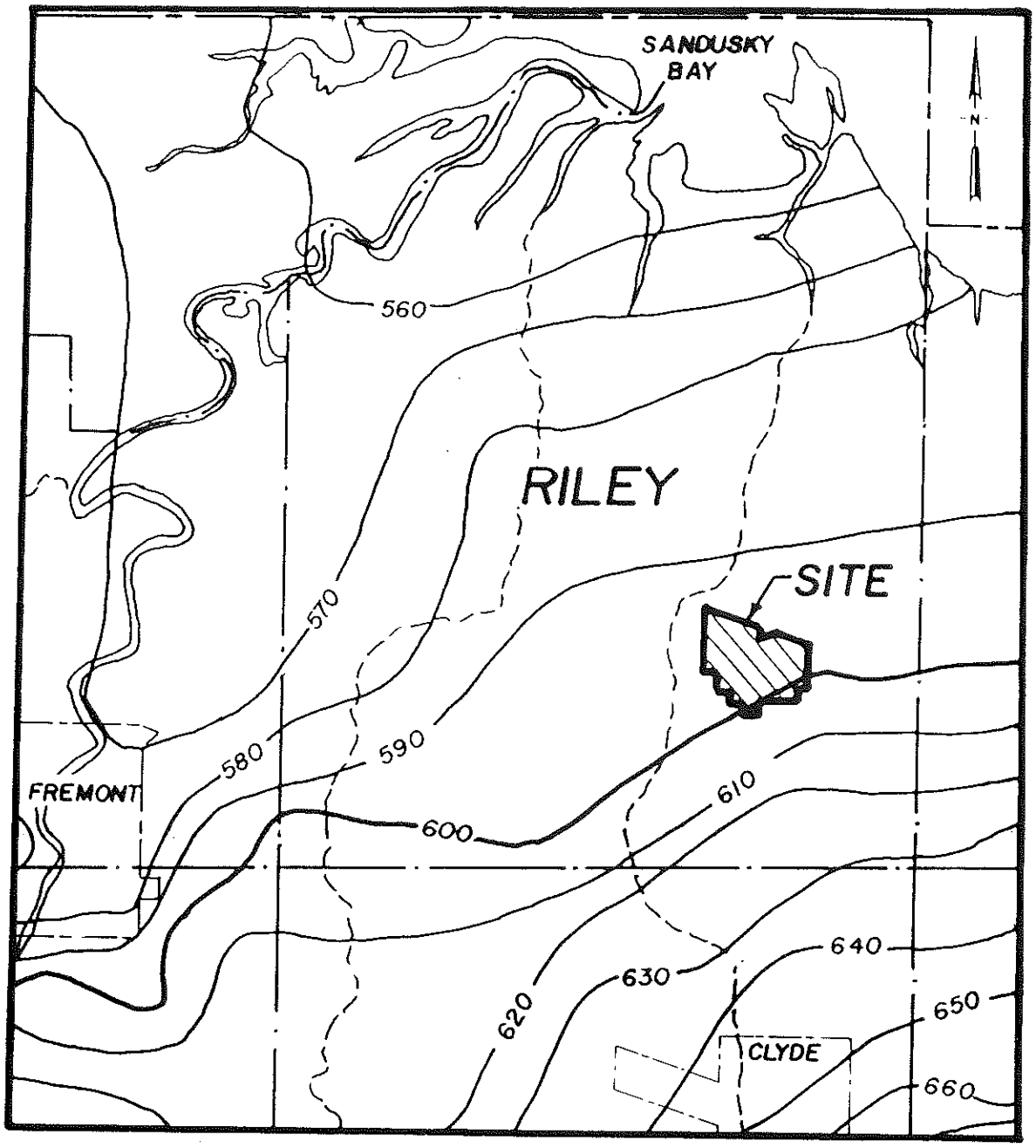
The overlying soil deposits at the site are of glacial origin and two general types of deposits are found at the site. The deposits have measured laboratory permeabilities in the range of 10^{-8} to 10^{-9} cm./sec. The upper portion of the soil profile is a clayey lacustrine deposit approximately 10 to 20 feet thick. The remaining portion of the soil profile, approximately 30 feet in thickness, is glacial till. While both of these deposits are virtually impermeable, the uppper lacustrine deposit is horizontally layered with some fine sand and silt partings. One horizontal permeability test in this material was attempted which indicated a permeability of approximately 10^{-7} cm./sec., approximately ten times or more the vertical permeability. The implication in this information is that horizontal flow of fluids in the soil profile will be more prevalent than vertical flow.

No aquifers or significant pockets of free water were found in the soil profile. In addition, no natural connections exist between the existing surface and the bedrock aquifer. Cation exchange testing was performed on selected soil samples which show high CEC values, approximately 25 or more, and pHs generally above 7.8. The natural soil conditions, therefore, are suited to the attenuation of heavy metals. This, coupled with the naturally impermeable soil conditions, indicate that the site is good to excellent for the containment of the types of waste being handled.

Site Groundwater

This study identified the general characteristics and the quality of the existing groundwater underlying the site. Figure 2 shows the levels of groundwater in the regional area around the site. As can be seen, the groundwater flowing under the site goes directly to Sandusky Bay. The rate of flow across the site, based upon the pump test and on published literature, appears to be approximately one foot per year. Utilizing the on-site piezometers and groundwater monitoring well records, Figure 3 was developed which shows the on-site groundwater contours. As can be seen in Figure 3, a cone of depression exists at the site, indicating that the pumping being done from the two production wells at the site is sufficient to develop a relatively large cone of depression.

By reviewing existing literature and the groundwater quality records available from the site, general background quality parameters for the area



POTENTIOMETRIC SURFACE MAP OF THE BEDROCK AQUIFER

AFTER HOOVER (1982)

— 610 — GROUND WATER SURFACE CONTOUR LINE

SCALE: 1" = 8250' (APPROX.)
JOB NO. 33767
DATE: 2-16-83

FIG. 2

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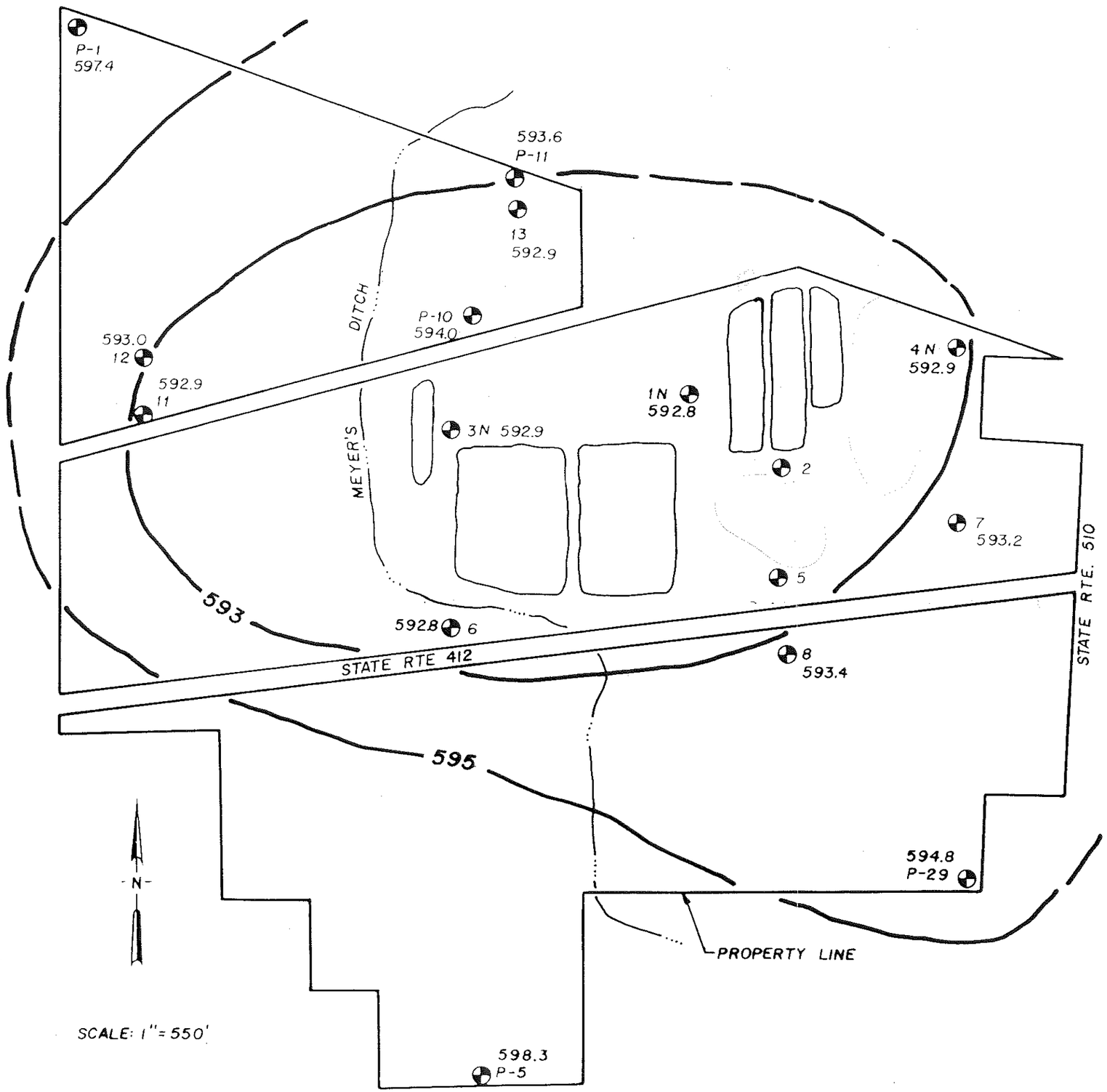


13 MONITORING WELL

P-1 PIEZOMETER

592.8 WATER LEVEL ELEVATION

SITE GROUND WATER CONTOUR MAP

WATER LEVEL READINGS TAKEN ON 2-3-83

JOB NO. 33767
DATE: 2-18-83

FIG.3

BOWSER-MORNER, INC.

have been developed. Of particular interest is the study done for the Ohio Turkpike Commission for the service plaza located just to the east of the site. The existing groundwater contains high amounts of sulfate which renders the water practically unusable for human drinking purposes. The source of the sulfate is gypsum and anhydrite in the Tymochtee dolomite. Previous studies have placed the base of the potable water zone at or about around elevation 600, which in this area is approximately the ground surface elevation. The water is used locally mainly for agricultural and livestock purposes. The data available was utilized to develop a range of background concentrations. Of particular interest is the sulfate and chloride levels. The sulfate levels range from 128 to 1831 milligrams per liter, and the chloride levels range from 5 to 46 milligrams per liter. Also of note in the background data is the water quality testing which has been done on Poorman's Spring located just to the southwest of the site. This spring which likely represents upstream groundwater quality data, and is the only upstream data available for various metals.

Groundwater Data Analysis

Groundwater monitoring data is available for the site beginning in 1972. In general, it appears that the quality of the data has been steadily improving, with the most consistent data apparently starting in approximately 1979. Table 2 provids data concerning monitoring well construction and sampling dates for all of the on-site monitoring wells. The water quality data has been accumulated from the files of the Ohio Northern Treatment Facility and from Ohio EPA, and has been studied statistically. Both the "T" test and regression analysis has been performed. It should be noted in any analysis of the available data that many of the parameters that have been analyzed have been found with concentrations near or less than the detection level of the equipment and/or test method. There are numerous data points, therefore, with values listed as "less than." In performing statistical analysis on such data, it is obvious that the analysis will be biased. In addition, a review of the actual raw data shows that there are unreconcilable discrepancies in some test values, indicating either operator or testing error, and/or inaccurate recording of the data. This was particualrly true for phenol and as a consequence, statistical analysis of phenol was omitted in some instances. Finally, as indicated above, it appears that the quality of the groundwater testing has improved with time. This would make older historical records more suspect than recent records. Such considerations plus the knowledge of the major constituents of the waste streams allowed the selection of chemical parameter indicators which were used for the statistical analysis. Generally speaking, the statistical analysis was performed for pH, phenols, sulfates, chlorides, zinc, and chrome.

Table 3 shows the summary of the regression analysis which as performed on several parameters. The regression analysis for pH does not show strong trends. Furthermore, the absolute values of the pH remain fairly constant

TABLE 2

MONITOR WELL CONSTRUCTION SUMMARY

CWM No.	OEPA No.	Depth (feet)	Casing	Year Drilled	CWM Dates Sampled	Date Abandoned	ODNR Log Number	Mean Sea Level Elev. 1983 Survey TOC	TOC	Remarks
1	--	--	3" galvanized steel	1978	4/79 - 6/79	6/79 - Filled with cement	--	606.33	606.2	--
1N	--	200	6" PVC cased to 60'	1979	7/79 - present	--	554277	609.17	607.4	--
1A	--	18.5	6" PVC perforated	1979	6 Months	1980	--	609.95	608.4	--
2	--	150	4" galvanized steel	1976	2/76 - present Gap 12/80-6/81			Buried under drive		Used for washing trucks
3	--	--	3" galvanized steel	1976	6/76 - 9/76	6/79 - Filled with cement	--	605.76	604.8	--
3N	--	50	6" PVC cased to 48'	1979	7/79 - present	--	554276	606.75	605.3	--
3A	--	14'or18'?	4" PVC perforated	1976	4/76 - present Gap 1/82-3/82	--	--	606.37	604.7	--
4	1	55	6" galvanized steel	1972	CWM 8/74-6/79 OEPA '72-6/79	June, 1979	425054	609.43	608.2	Hand pump
4N	1	50	6" PVC cased to 48'	1979	CWM 7/79-present OEPA 7/79-present	--	554274	608.84	608.0	--
5	2	56'or51'?	4" galvanized steel cased to 50'	Unknown	CWM 7/74-present OEPA '72-present	--	--	Location Uncertain		Lab well
6	--	--	3" galvanized steel	1976	4/76 - 6/79	6/79 - Filled with cement	--	609.36	608.4	
6N	--	50	6" PVC cased to 46'	1979	7/79 - present	--	554273	610.65	608.5	--
6A	--	12'or18'?	4" PVC perforated	1976	4/76 - 1/81 Gap 12/76-2/77		--	608.67	608.67	Mower broke casing off 1982
7	--	55	6" PVC cased to 45.5'	1979	7/79 - present	--	554275	610.26	608.1	--
8	3	50	4" galvanized steel cased to 47'	1979	CWM 9/79-present OEPA '72-present	--	405085	612.88	611.8	Eckhart home empty since 1981

Table 2 continued -

CWM No.	OEPA No.	Depth (feet)	Casing	Year Drilled	CWM Dates Sampled	Date Abandoned	ODNR Log Number	Mean Sea Level Elev. 1983 Survey TOC	TOG	Remarks
--	4	54	4" galvanized steel cased to 44.5'	1957	OEPA '74-'80	--	199085	--	605±	Emery house
--	5	77	Galvanized steel	Unknown	OEPA '72-'74	1974, pump broke	--	--	605±	Hand pump
--	6	56	4 1/4" cased to 43.5'	1956	OEPA '75-'79	1979	182754	--	610±	Gertensberger home
11	--	60	6" PVC cased to 47.5'	1981	1/82-present	--	602224	609.79	608.4	--
12	--	65	6" PVC cased to 47'	1981	1/82-present	--	602225	608.38	606.1	--
13	--	60	6" PVC cased to 48'	1981	1/82-present	--	602222	605.27	603.7	--
Ind. Well	--	75	6" PVC cased to 48'	1981	--	--	602223	606.43	604.7	Not a monitor well

LEGEND

CWM - Chemical Waste Management

OEPA - Ohio Environmental Protection Agency

TOC - Top of Casing

TOG - Top of Ground

TABLE 3

SUMMARY OF REGRESSION ANALYSIS

CHEMICAL PARAMETERS

Well No.	pH		CHLORIDES		SULFATES		ZINC		CHROMIUM	
	m	r	m	r	m	r	m	r	m	r
2	-0.003	-0.07	30.5	0.81	-0.14	-0.03	-0.12	-0.70	-0.003	-0.80
5	-0.006	-0.23	-0.65	-0.19	3.96	0.25	-0.03	-0.84	-0.002	-0.74
1N	-0.025	-0.71	377	0.92	-25	-0.71	0.01	0.67	-0.001	-0.90
3N	0.012	0.47	-23.7	-0.15	-48	-0.64	0.0035	0.71	-0.003	-0.93
4N	0.116	0.68	-134	-0.73	475	0.90	0.012	0.93	-0.003	-0.92
6N	-0.051	-0.59	93	0.93	4	0.48	0.0056	0.87	-0.002	-0.92
7	0.009	0.77	-37	-0.77	-14	-0.57	0.005	0.97	-0.003	-0.88

m = slope of regression line in mg/liter/year of record

r = correlation coefficient

in a given well and were, at all times, in the general neutral range. Table 4 shows the "T" tests relative to pH. An inspection of this table will show that for 1982, pH values, upstream and downstream, were not statistically different.

The regression analysis for chloride showed strong and consistent trends for most of the wells. The changes and trends in the chloride levels from well to well, however, are very complex. Generally speaking, it appears that downstream wells have increasing levels of chloride and the absolute values of the concentration of chloride in the groundwater under the site are significantly higher than background quantities. T test scores also indicate statistically significant variations between upstream and downstream concentrations of chloride. A detailed review of the data, however, has not developed a consistent trend for all downstream or all upstream wells. Virtually every well on the property has had significant spikes of chloride concentration over the years at various different times. None of these spikes appear to be specifically related to another well or time period, with the possible exception of the installation of monitoring wells in 1979. During this period (both before and just after) significant variations in concentration occurred in many of the monitoring wells. A review of Sheets 2, 3, and 4 attached to this report show evidence of the complex variations in the chloride levels.

The regression analysis for sulfates does not show strong and consistent trends, except for well 4N. Table 5 shows the T scores for the sulfate concentrations. It can be seen in this table that there is a significant difference between upstream and downstream water quality, as represented by a comparison to base well No. 5. In general, sulfate concentrations at any given time increase slightly to the northwest, parallel to regional groundwater flow. This same downgradient increase was observed by Schaefer and Walton in their report to the Ohio Turnpike Commission, and is a function of bedrock mineralogy and time. There is no indication that any additional sulfate concentrations are reaching the wells. Table 5 also compares water quality data between Ohio EPA and the on-site laboratory, and indicates that there is not a statistical difference. This was done for three different years, as shown in the table.

The regression analysis for zinc showed some definite trends and a reasonable correlation factor in most of the wells. Because of the galvanized steel casings or abandoned steel well casings located near certain wells, the concentrations of zinc may be affected by previous construction in the area. Furthermore, all of the zinc concentrations are extremely low and generally within the concentration level of testing done at Poorman's Spring. It is not felt that this site is in anyway influencing zinc levels with the possible exception of affects caused by the well casings.

The analysis of chromium indicates a strong trend for decreasing chromium values in the groundwater. Table 6 shows the T test results for chro-

TABLE 4

STUDENT T TEST FOR pH

Base Well (1)	Comparison Well (2)	Time Interval	Mean ($\overline{X}_I$)	Std. Dev. ($\hat{S}_I$)	Obs. (N_I)	T-Score (TØ)	Deg. Free (DF)	t Value 1%	PASS ?	t Value 5%	PASS ?	Significant Difference ?
1N		1979	7.261	0.334	24							
	2		7.293	0.247	50	0.43	72	2.65	Yes	2.00	Yes	No
	3N		7.112	0.209	25	1.84	47	2.68	Yes	2.01	Yes	No
	4N		6.965	0.245	25	3.47	47	2.68	No	2.01	No	Yes
	5		7.23	0.214	50	0.48	72	2.65	Yes	2.00	Yes	No
	6N		7.478	0.345	25	2.19	47	2.68	Yes	2.01	No	Probably
	7		7.285	0.258	25	0.28	47	2.68	Yes	2.01	Yes	No
	12		Not Existing									
	13		Not Existing									
1N		1982	7.191	0.323	15							
	2		7.313	0.086	16	1.42	29	2.76	Yes	2.04	Yes	No
	3N		7.148	0.131	17	0.48	30	2.75	Yes	2.04	Yes	No
	4N		7.311	0.134	32	1.76	45	2.70	Yes	2.02	Yes	No
	5		7.23	0.099	16	0.45	29	2.76	Yes	2.04	Yes	No
	6N		7.299	0.164	17	1.18	30	2.75	Yes	2.04	Yes	No
	7		7.300	0.069	16	1.28	29	2.76	Yes	2.04	Yes	No
	12		7.041	0.155	16	1.60	29	2.76	Yes	2.04	Yes	No
	13		7.382	0.193	16	1.95	29	2.76	Yes	2.04	Yes	No

TABLE 5

STUDENT T TEST FOR SULFATES

Base Well (1)	Comparison Well (2)	Time Interval	Mean ($\bar{X}_1$)	Std. Dev. (S_1)	Obs. (N_1)	T-Score (TØ)	Deg. Free (DF)	t Value 1%	PASS ?	t Value 5%	PASS ?	Significant Difference ?
5		1979	1774	95	49							
	1N		1735	344	24	0.73	71	2.65	Yes	2.00	Yes	No
	2		1847	59	49	4.52	96	2.64	No	1.99	No	Yes
	3N		1687	231	25	2.25	72	2.65	Yes	2.00	No	Probably
	4N		489	202	25	36.69	72	2.65	No	2.00	No	Yes
	6N		1807	74	25	1.50	72	2.65	Yes	2.00	Yes	No
	7		1835	84	25	2.68	72	2.65	No	2.00	No	Yes
	12			Not Existing								
	13			Not Existing								
5		1982	1809	64	16							
	1N		1670	380	15	1.39	29	2.76	Yes	2.04	Yes	No
	2		1869	116	16	1.75	30	2.75	Yes	2.04	Yes	No
	3N		1520	20	17	17.18	31	2.75	No	2.04	No	Yes
	4N		1916	102	32	3.75	46	2.70	No	2.02	No	Yes
	6N		1824	54	17	0.71	31	2.75	Yes	2.04	Yes	No
	7		1792	54	16	0.79	30	2.75	Yes	2.04	Yes	No
	12		1946	50	16	6.53	30	2.75	No	2.04	No	Yes
	13		1912	75	16	4.05	30	2.75	No	2.04	No	Yes
5		1975	1515	490	12							
	OEPA (2)		1825	78	2	0.83	12	3.06	Yes	2.18	Yes	No
5		1977	1747	91	11							
	OEPA (2)		1900	0	1	1.53	10	3.17	Yes	2.23	Yes	No
5		1980	1841	47	50							
	OEPA (2)		1835	21	2	0.18	50	2.68	Yes	2.01	Yes	No

TABLE 6

STUDENT T TEST FOR CHROME

Base Well (1)	Comparison Well (2)	Time Interval	Mean ($\overline{X}_r$)	Std. Dev. ($\hat{S}_r$)	Obs. (N_r)	T-Score (TØ)	Deg. Free (DF)	t Value 1%	PASS ?	t Value 5%	PASS ?	Significant Difference ?
1N		1982	0.0267	0.0082	15							
	2		0.0212	0.0034	16	2.39	29	2.76	Yes	2.04	No	Probably
	3N		0.0212	0.0033	17	2.46	30	2.75	Yes	2.04	No	Probably
	4N		0.0216	0.0051	32	2.22	40	2.70	Yes	2.02	No	Probably
	5		0.0219	0.0066	29	1.74	29	2.76	Yes	2.04	Yes	No
	6N		0.0241	0.0071	17	0.93	30	2.75	Yes	2.04	Yes	No
	7		0.0212	0.0034	16	2.39	29	2.76	Yes	2.04	Yes	Probably
	12		0.0225	0.0058	16	1.60	29	2.76	Yes	2.04	Yes	No
	13		0.0219	0.0066	16	1.74	29	2.76	Yes	2.04	Yes	No
5		1982	0.0219	0.0066	16							
	1N		0.0267	0.0082	15	1.80	29	2.76	Yes	2.04	Yes	No
	2		0.0212	0.0034	16	0.38	30	2.75	Yes	2.04	Yes	No
	3N		0.0212	0.0033	25	0.45	39	2.70	Yes	2.02	Yes	No
	4N		0.0216	0.0051	32	0.17	46	2.69	Yes	2.01	Yes	No
	6N		0.0241	0.0071	17	0.92	31	2.75	Yes	2.04	Yes	No
	7		0.0212	0.0034	16	0.38	30	2.75	Yes	2.04	Yes	No
	12		0.0225	0.0058	10	0.24	24	2.80	Yes	2.06	Yes	No
	13		0.0219	0.0066	10	0.00	24	2.80	Yes	2.06	Yes	No

mium and as indicated there is no statistical difference between upstream and downstream levels. Background information from Poorman's Spring indicates that the natural levels present are less than 0.03 mg/l. The on-site concentrations are below or around that value. The chrome at these concentrations could be present in the groundwater.

Site Assessment

The overlying soil profile is composed of uniformly clay-rich deposits with low permeability. The underlying bedrock aquifer is very highly mineralized and is naturally of low quality. Because the clay-rich soils prevent migration of waste constituents into the groundwater, and because the existing groundwater is already of low quality, it appears that the site represents a relatively good geological location for management of hazardous wastes. Furthermore, the site is generally far removed from dense population centers, further limiting possible negative effects.

The high levels of chlorides indicate that some groundwater quality change is occurring across the site. However, parameters other than choride do not provide any indication of groundwater quality degredation. In fact, all parameters tested are below the federal drinking water standards, except for coliform levels. High chloride levels are found near the center of the site, with intermediate chloride levels downgradient of the site. The waste liquids at the site are high in chlorides content and, therefore, it may be logical to conclude that the changing chloride levels in the groundwater are the results of liquids escaping from the site. This study, however, has not identified any definitive machanism through which such escape of liquids could be occurring.

Natural sources for the chloride has been considered. The Tymochtee dolomite, although an evaporative deposit, is not known to contain salt deposits. Furthermore, based on existing knowledge of the location of high chloride brine, and because of the careful construction of the injection wells, it does not seem likely that the chloride level is the result of contamination from deep salty brines. Surface sources for the chlorides also have been considered. For example, road salt utilized on the turnpike and local roads could conceivably be adding to the chloride level in the groundwater. As with the liquid in the lagoons, the mechanism of transfer from the existing ground surface to the rock surface (some 40 to 50 feet through clay-rich soil) has not been identified.

By carefully researching the construction records relative to monitoring well installation on the site, it has been determined that the existing monitoring well system may be providing a conduit through which high chloride runoff, such as road salt, may be entering the local groundwater. Information on the construction of the monitoring wells indicates that the monitoring wells may not have been adequately sealed, leaving a highly permeable annular space around the outside of the casing. Indeed,

some of the groundwater monitoring records would indicate that high chloride levels appeared immediately after installing new monitoring wells in 1979 in an area where chloride levels had historically been low.

Another possible source for chloride migration is through soils affected by the storage of the liquids in open lagoons. The liquids stored at the site are high in chlorides and heavy metals, and also are highly acidic. The on-site natural soils tend to contain carbonaceous materials which could, theoretically, be attacked by the highly acidic liquids. In fact, there is some evidence to suggest that the stored liquid does react with the natural soil. This reaction, however, appears to be definitely limited (6 to 9 feet). The data would suggest that waste liquids are not escaping the lagoon system. Furthermore, migration of chlorides through the soil profile should be detected either in the local stream, the on-site shallow monitoring wells, or the on-site borrow pits, which are monitored regularly. This is because the upper lacustrine soil material is horizontally bedded and has a higher horizontal permeability than the measured vertical permeability. Chlorides migrating through the soil profile, therefore, should be showing up in the shallow monitoring zones. Current data would suggest that high levels of chlorides are not being encountered at these locations.

The results of this study, therefore, indicate that some changes (chlorides) in the groundwater regime have taken place over a period of years. As indicated above, the mechanism causing this change has not been identified and, therefore, additional investigation is indicated and apparently required by RCRA. It is felt that careful additional testing can identify the sources of the chlorides, and once identified, the situation can be corrected.

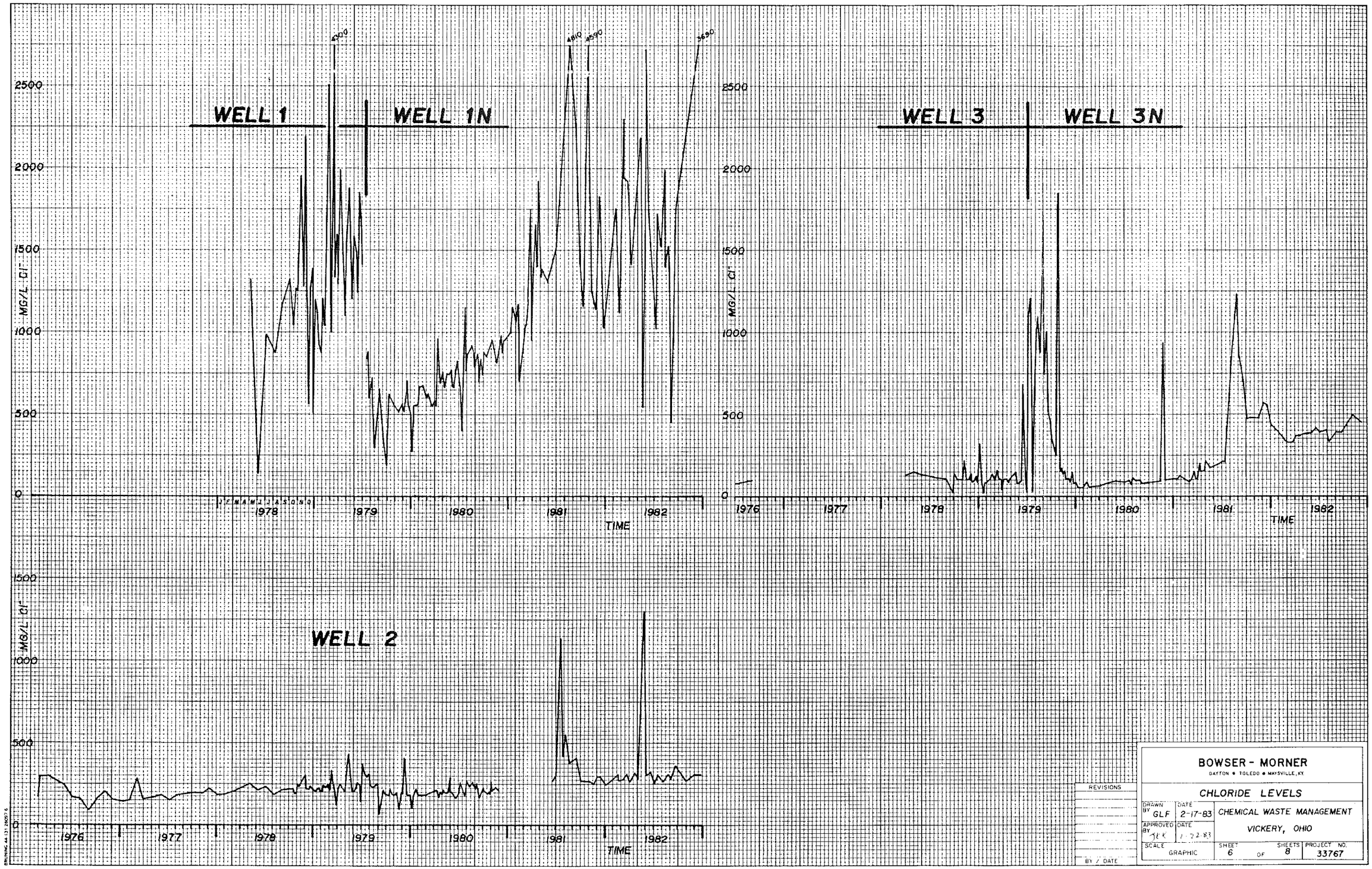
While it is obvious that action must be taken, the existing data would indicate that there is no immediate emergency. In fact, the data indicates that a cone of depression has been developed on the site by the pumping necessary for normal operation at the site. This pumping is purging the groundwater system, thereby helping to contain and remove the high chloride groundwater. Considering this cone of depression and the slow rate of water movement across the site, it would appear that there is sufficient time to perform additional testing and to implement appropriate action.

Respectfully submitted,
BOWSER-MORNER, INC.

J. Richard Hoppenjans

J. Richard Hoppenjans, P.E.
Chief Engineer

JRH:jl
12-WMI, Mr. Gary Brown
Attachments



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CHLORIDE LEVELS

DRAWN BY GLF	DATE 2-17-83	CHEMICAL WASTE MANAGEMENT
APPROVED BY JEK	DATE 1-22-83	VICKERY, OHIO
SCALE GRAPHIC	SHEET 6 OF 8	PROJECT NO. 33767

REVISIONS

BY / DATE

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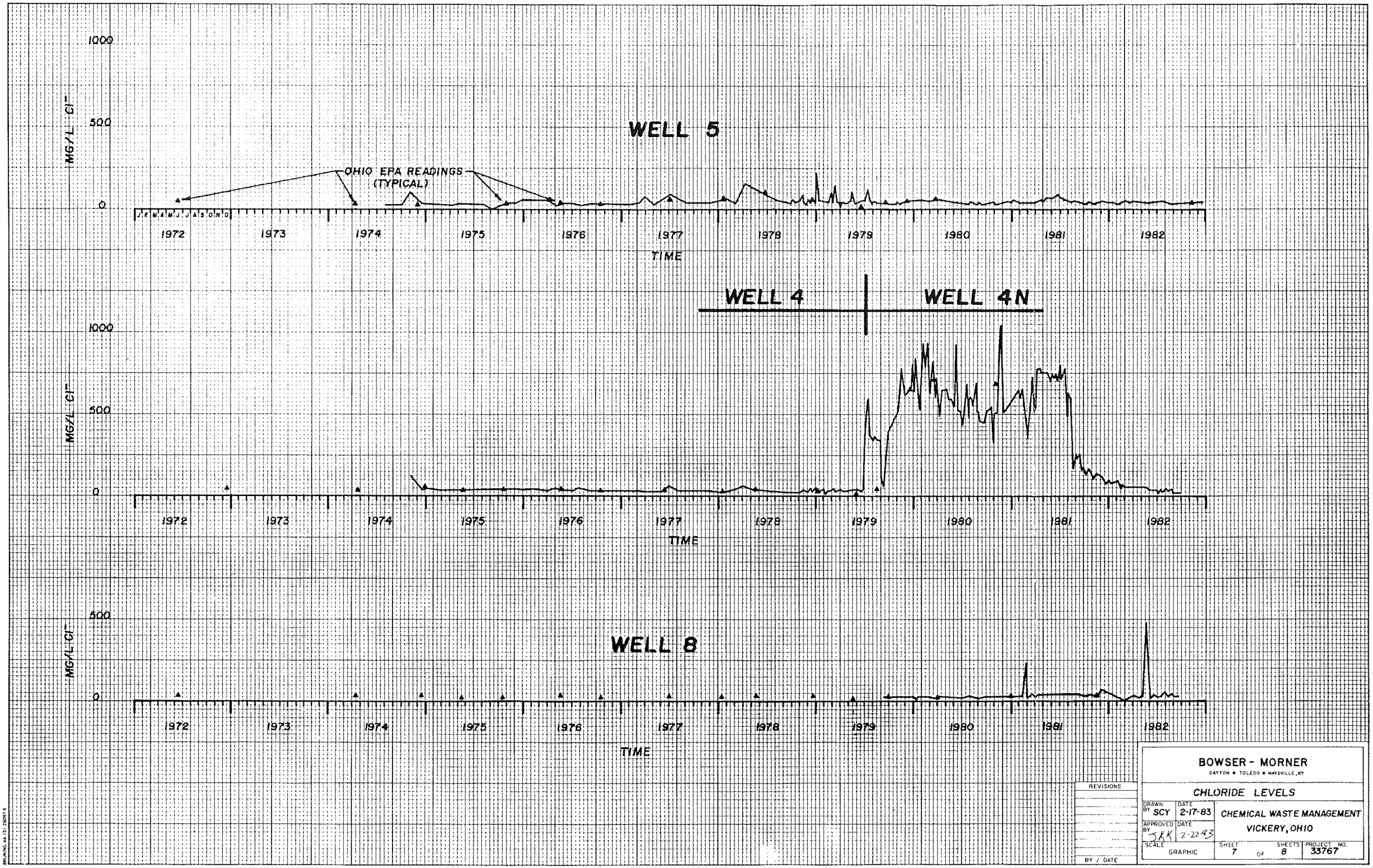

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CHLORIDE LEVELS

DRAWN BY SCY	DATE 2-17-83	CHEMICAL WASTE MANAGEMENT VICKERY, OHIO
APPROVED BY SKK	DATE 2-22-83	
SCALE GRAPHIC	SHEET 7 OF SHEETS 8	PROJECT NO. 33767

REVISIONS

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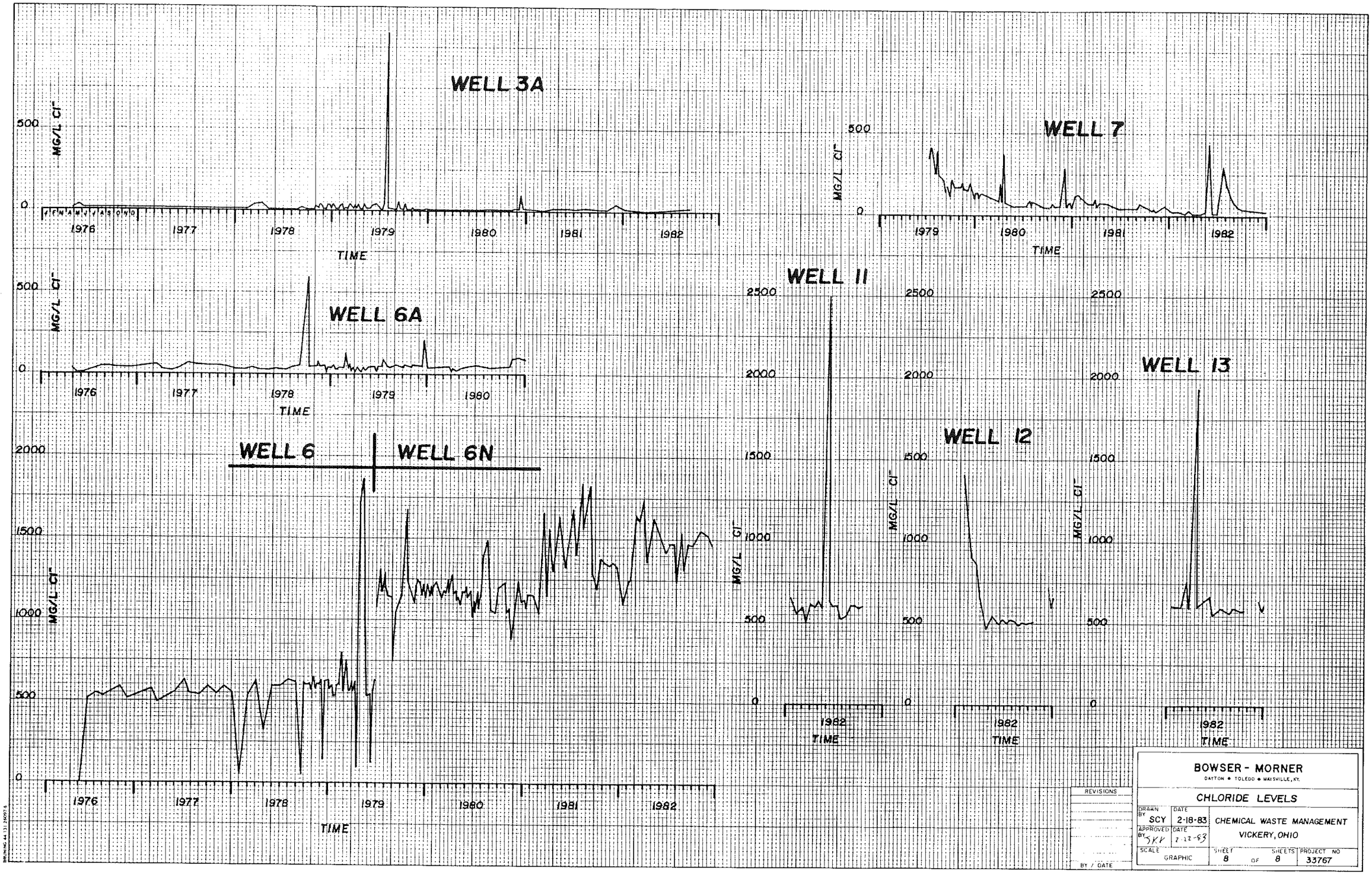

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CHLORIDE LEVELS

DRAWN BY SCY	DATE 2-18-83	CHEMICAL WASTE MANAGEMENT VICKERY, OHIO
APPROVED BY SKK	DATE 2-22-83	
SCALE GRAPHIC	SHEET 8 OF SHEETS 8	PROJECT NO 33767

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