GEOLOGY AND GROUND WATER HYDROGEOLOGY INVESTIGATION

for

KOPPERS COMPANY, INC.
WOOD TREATING PLANT
SUPERIOR, WISCONSIN

by

WOODWARD-CLYDE CONSULTANTS
11 EAST ADAMS STREET
CHICAGO, ILLINOIS

DECEMBER 19, 1985
85C3134-2

GEOLOGY AND GROUND WATER HYDROGEOLOGY INVESTIGATION

for

KOPPERS COMPANY, INC.
WOOD TREATING PLANT
SUPERIOR, WISCONSIN

by

WOODWARD-CLYDE CONSULTANTS
11 EAST ADAMS STREET
CHICAGO, ILLINOIS

DECEMBER 19, 1985
85C3134-2

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

1.0 INTRODUCTION

Koppers Company, Inc. operates a wood treating plant located near Superior, Wisconsin (Fig. 1). The Superior plant has been in operation since the mid 1920's. The plant product lines include pressure-creosoted railroad cross ties, bridge timbers, switch ties and crossing panels. The railroad products are treated with creosote as a preservative. According to company records, pentachlorophenol in petroleum oil was used at the plant from approximately 1955 to 1980.

Two types of permitted hazardous waste facilities exist at the site; two surface impoundments and a container storage facility.

1.1 Purpose

The objective of this study is to define the general subsurface geology and ground water hydrology of the site and vicinity. These data will be used to facilitate compliance with USEPA RCRA and state regulations for ground water monitoring.

A meeting was held August 27, 1985 with the Wisconsin Department of Natural Resources (DNR), the USEPA, Koppers Company, Inc. and Woodward-Clyde Consultants (WCC). At that meeting, existing data from previous investigations were reviewed and data gaps identified. The following issues were unresolved.

- Is there a laterally extensive sand horizon beneath the site?
- What is the general subsurface stratigraphy beneath the site?
- What is a clear definition of the ground water hydrology in the vicinity of the site?
- What is the local ground water flow?
- What is the uppermost aquifer unit (sand or fractured clay)?
- What wells will be used as upgradient and downgradient monitoring wells?

The purpose of the current investigation is to provide data that will facilitate resolution of these issues.

1.2 Previous Investigations

Previous investigations have been conducted to characterize ground water conditions, water quality and to define the general hydrogeology beneath the site.

Wells R-1D, R-2D, R-3D and R-4 were installed by Koppers in December 1981 as part of the RCRA interim status ground water monitoring program. In order to develop additional data on ground water conditions, wells R-1, R-2 and R-3 were installed in August 1982.

In June and July 1984, a series of wells were installed by GAI Consultants around the perimeter of the surface impoundments (Lagoons). The purpose of these wells was to assess the presence and characteristics of the natural clay liner, the stability of the dikes surrounding the two existing surface impoundments, the vertical extent of any pollution and the lateral extent of any sand horizons. Eleven L-series wells were installed by GAI. Locations of R- and L-series wells are shown on Figure 2. Boring logs and well construction details for the R- and L-series wells are presented in Attachment 1.

2.0 CURRENT INVESTIGATION

2.1 Scope of Work

A hydrogeologic investigation was conducted at the Koppers Co. Superior, Wisconsin facility September 25, 1985 through October 5, 1985. The field work was supervised by WCC. A total of ten soil borings, of which five were converted to observation wells, were drilled and constructed by Twin City Testing Company. The soil borings were drilled to a maximum depth of 60 ft or 5 ft below the sand unit suspected of being present beneath portions of the site. Soil borings were labeled B-1 through B-5 and observation wells were labeled W-1, W-2, W-3, W-4A and W-4B. Figure 2 presents a topographic map of the Superior site with the locations of soil borings and observation wells.

All borings were drilled using an ATV mounted CME 750 rotary drill rig. Borings were advanced using either a 6 inch O.D. hollow stem auger or a 3 inch O.D. roller bit with fresh water. The borings extended 5 ft below the bottom of the sand layer or to a maximum depth of 60 ft. Samples were taken using a split spoon sampler driven by a SPT hammer. All borings were logged by an WCC geologist. Split spoon samples were generally taken at the following intervals with the lower 6 inches of sample retained in glass jars for soils analysis.

Boring Depth	Sampling Interval
0 - 3 ft	Continuous
5 - 20 ft	5 ft
20 - 60 ft	2.5 ft

Upon completion of the hole, soil borings were grouted to the surface with cement-bentonite grout delivered through a tremie pipe.

Observation wells were constructed of 2 in diameter, Schedule 40 PVC riser, flush coupled, threaded joints, with Teflon tape on the threads. The PVC screen consisted of No. 10 slot size (0.01 in.) manufactured screen in 5 ft lengths. To the extent possible, only the sandy portion was screened.

The annular space around the screen was filled with a clean, washed, concrete aggregate sand from the bottom of the boring to a minimum of 1 ft above the top of the screen. A bentonite pellet seal, not less than 2 ft thick, was placed above the sand pack in all wells except W-2, where the bentonite seal was inadvertantly limited to 0.7 ft. The remainder of the annular space was filled to above the ground surface with a cement-bentonite grout, (approximate grout mix: 12 gal. water, 5 lb powdered bentonite, 1 sack (94 lb) Portland cement). A steel protective casing with a locking cap was set in the grout at the ground surface. A general well construction diagram is presented in Figure 3. Boring and well logs are displayed in Attachment 2.

Well development of the W-series observation wells consisted of peristaltic pumping and hand bailing operations. A minimum of three well volumes of groundwater were removed per well during development operations. Upon completion of the well development operation rapid recharge of ground water was observed in all newly installed monitoring wells.

3.0 REGIONAL GEOLOGY

3.1 Historical Geology

The geological section beneath the Superior site vicinity consists of a thick section of Quaternary age sediments overlying Precambrain bedrock. A northwest to southeast cross-section presents the general subsurface geology in the vicinity of Koppers Superior facility. Information collected from local water well logs was used to construct the cross section (Figure 4).

The top of bedrock underlying the Superior, Wisconsin area is reported in local water well logs to be between 170 ft to 210 ft below the surface. The bedrock consists of flat-lying quartz sandstone. The uppermost bedrock unit, the Superior Sandstone, is reported to be in excess of 250 ft thick. The sandstone is part of the Bayfield Group of Precambrian age. The sand was originally deposited in an offshore marine environment more than 600 million years ago.

Unconformably overlying the Precambrian sandstone are Pleistocene deposits. The Pleistocene section consists of the Copper Falls and Miller Creek formations. The Copper Falls is found 100 ft to 140 ft below the surface with an average thickness of 40 ft. The Miller Creek formation overlies the Copper Falls and consists of those materials from the ground surface to a depth of 100 ft to 140 ft.

The geological history of the Superior region through most of Pleistocene time is not known in detail. More detailed information is available for the last part of the Wisconsin Glaciation which began approximately 20,000 years before present (YBP). Five major glacial advances modified the topography and deposited sediments (Wright and others, 1970; Wright, 1972; Clayton and Moran, 1982; and Clayton, 1984). The depositional suite includes lake deposits, near-shore features such as delta, dune and beach deposits and fluvial deposits.

3.2 Pleistocene Stratigraphy

The Pleistocene series consists of, from bottom to top, the Copper Falls and Miller Creek Formations. The Copper Falls Formation contains reddish to brownish sandy sediment. The majority of the Copper Falls consits of sandy till. However, a large

amount of other material, specifically sand and gravel deposits by preglacial melt water streams are found interbedded with the till deposits. The United States Department of Agriculture classifies the Copper Falls Formation as a sandy loam (Clayton, 1984). Analyses throughout the Superior region indicate that the Copper Falls Formation typically consists of between 40 and 80 percent sand, 15 and 50 percent silt, 2 and 20 percent clay and several percent pebbles, cobbles and boulders (Clayton, 1984). The upper Copper Falls Formation is reported as overly compacted and is commonly referred to as "hard-pan" in water well drillers logs. The base of the Copper Falls consists of a sand and gravel deposit. The origin of deposition is probably fluvial; however, it may be glacially reworked Precambrain units. The Copper Falls Formation is readily distinquished from the overlying Miller Creek Formation, which is more clayey and somewhat redder.

The Miller Creek Formation overlies the Copper Falls Formation. The Miller Creek consists of two members, the Hanson Creek Member (lower) and the Douglas Member (upper). The Miller Creek consists of red clay with a thin unit of blue clay found interbedded within the red clay at various locations. The Miller Creek includes till, clayey, glacial-lacustrine deposits and offshore, stream and shoreline sand. The Miller Creek Formation is reported to be between 11,500 and 9,500 years old (Clayton, 1984).

The Hanson Creek Member is a till and contains between 45 and 70 percent clay, 20 and 45 percent silt, 3 and 20 percent sand and a few percent or less of pebbles, cobbles and boulders (Clayton, 1984). A blue-green clay unit has been identified in well water logs and is considered to be the upper portion of the Hanson Creek. The Hanson Creek was deposited as glacial till. The blue-green clay is considered a lake bed deposit that was exposed when lake levels decreased and the clay was subject to drying.

The Douglas Member is reported to be a dull reddish brown clay till which contains between 45 and 85 percent clay, 10 and 40 percent silt, and 3 and 20 percent sand and a few percent of less or pebbles, cobbles and boulders, (Clayton, 1984).

4.0 REGIONAL WATER USE

4.1 Surface Water

The major source of surface water in the Superior region is Lake Superior, which provides the primary source of drinking water for the Minnesota and northwestern Wisconsin region. The lake is also used for transportation, commerce and recreation.

In the vicinity of Koppers Superior site swampy terrain, rivers and streams occupy the topography (Figure 1). The major drainage for surface water is the Nemadji River and Crawford Creek to the west of the site and Bluff Creek to the east. Both drainages flow north into Lake Superior and have limited use other than fishing or boating. Drinking water in the immediate vicinity of the site is obtained via water wells and not from surface water.

4.2 Ground Water

The major water bearing unit underlying the Superior region is the Precambrian age Superior Sandstone. This sandstone is the major aquifer underlying the Koppers site and the vicinity. The top of the sandstone is reported in local water well logs to be approximately 170 ft to 210 ft below the surface. Regional water levels obtained from wells screened in the sandstone are generally between 40 ft and 70 ft below the surface.

A water-bearing unit was reported in one well log 38 to 44 ft below the surface with the well terminating at 44 ft deep. The well screened in this aquifer indicated that the water surface is 20 ft below the surface. Figure 5 presents a stratigraphic column of the various hydrostratigraphic units underlying the site and vicinity. The data for the stratigraphic column and water levels were obtained from 99 water wells in the vicinity of Koppers site. Table 1 presents tabulated information from the water well logs.

The water wells in the area are primarly for residential use. Approximately 10 percent of the wells are for industrial use.

5.0 SITE GEOLOGY

5.1 Previous Investigations

Previous investigations of the site, conducted by GAI Consultants in 1984, describe the subsurface geology as lake bed deposits composed of red-brown clay containing discontinuous layers of silt and sand.

A recent regional study of the area by Clayton (1984) reported the clay sequence to be part of the Douglas till. The till was described as a red-brown clay deposited during the end of the Wisconsin Glacial Stage. The till is reported to typically contain between 45 and 85 percent clay, 10 and 40 percent silt, 3 and 20 percent sand and a few percent or less of pebbles, cobbles and boulders (Clayton, 1984).

5.2 Data Presentation

Ten soil borings were drilled to variable depths, each terminating in the red-brown clay. The borings ranged in depth from 30 ft to 60 ft. Figure 2 presents the location of the soil borings. Section 2.0 describes the boring procedure. Figures 6 through 9 present cross sections of the subsurface geology at the Superior site. The cross sections were constructed from boring logs. The locations for the cross-sections are shown on Figure 2. Samples taken during drilling were analyzed for moisture content and grain size distribution. Table 2 presents data for moisture content, sand, silt and clay content for selected sample intervals from each boring.

The following characteristics were observed in the underlying deposits. The upper 0-5 ft. consist of fill deposits and top soil. Underlying the fill deposits a red-brown highly plastic, unlaminated clay, with thin vertical, hairline fractures in-filled with a greenish-gray clay-like material is present. The fractured clay continued to a maximum depth of 18 ft., but was generally less than 15 ft. thick. N values for the clay were typically two (2 blows per foot). Moisture content ranged between 25 and 60 percent. Organic material such as decomposed wood was found intermittently throughout the unit.

Below the fractured clay, a similar red-brown highly plastic, unlaminated clay was present ranging from 15 to greater than 60 ft. below the surface. Fractures and the gray clay infillings were absent. N values were approximately two. The moisture content was

generally around 50 percent. Very little organic matter was detected. Where sand, silt or gravel layers were not detected, the clay continued to the bottom of all borings.

All soil borings, except B-2 and B-4, encountered variable amounts of sand, silt and gravel deposits within the unfractured clay. Soil borings B-2 and B-4 encountered only trace amounts of these deposits. The sand was multicolored, subangular, and generally poorly sorted, with some samples exhibiting layers or bedding. The sand found between 35 ft and 45 ft depths exhibited a fining up sequence with gravel on the bottom grading to coarse to medium sand with fine sand and silt on top. The sandy units had a variable range in thickness from 1 inch to 10 ft. N values for the sand units were approximately 40 to 50.

Below and between the sandy units the red-brown highly plastic, unlaminated, unfractured clay was observed. The bottom of the clay unit was not detected.

5.3 Interpretations

The site geology differs from regional reports in the area. The literature reports that the underlying strata is a glacial till deposit (Clayton, 1984). Previous investigations by GAI Consultants suggest this clay is a lake bed deposit.

The absence of bedding, laminations or varves suggests the clay unit may be a till deposit. However, the data on Table 2 indicates moisture content values between 18 and 70 percent. These very high moisture content values suggest that the clay was deposited in a subaqueous environment. The low N values are not typical of glacial till deposits, but rather soft lake bottom sediments. The absence of varves, laminations or bedding may be explained by deposition below a floating, year-round ice cover. When the deposition occurred, the deposits were under water and ice. The ice cover provided a constant depositional environment without seasonal variation in depositional rate. Evidence of higher lake levels include the presence of Pleistocene shoreline sediments. These sediments are found at a maximum elevation approximately 600 ft above the current lake level and a maximum of 530 ft above the site ground surface elevation (Clayton, 1984).

The apparently discontinuous deposits of sand, silt and gravel were not reported in the literature. However, the published investigations represent a regional, not a local

study. During the site specific investigation, sand units were identified at several depth intervals. A fining up sequence was recorded at several sample locations. The sequence is indicative of stream deposits. The variable deposits of silt, sand and gravel are characteristic of glacial outwash and melt water stream deposits and may represent buried ice bottom esker deposits during periods of grounding of the ice mass.

The origin of the fractured clay was described by GAI Consultants as dessication fractures produced by the drying of exposed surfaces, or possible stress release joints from the release of the load produced by the glacial ice.

The observed vertical fractures extend a maximum of 18 ft below the surface. It seems unlikely that these soils have experienced dessication to depths of 15 ft to 18 ft based on the recent past and present climatic history. Stress release joints may be more plausable as a source of these fractures. However, unloading stress release joints would generally be orientated in a horizontal direction, not vertical as observed in the current investigation.

Stress release fracturing from removal of the oriented load due to a moving ice mass would tend to be vertical with a preferred direction perpendicular to the direction of ice motion. Available data do not indicate the presence of a preferred fracture orientation.

The origin of these fractures is not conclusive with the available data and may warrant further investigation.

6.0 SITE GROUND WATER HYDROLOGY

6.1 Previous Investigations

Previous ground water investigations at the Superior site (GAI Consultants, 1985) indicated a trend of decreasing water levels with increasing depth. This trend is indicative of a vertically downward flow component, typical of ground water recharge areas. The investigation also indicated that the surface impoundments were hydraulically interconnected with the underlying deposits of sand and gravel. GAI identified the sand and gravel deposits as being the shallowest zone of material exhibiting aquifer characteristics. The sand and gravel deposits were observed in the northwestern region of the site at depths between 30 ft and 38 ft below the surface. The lateral extent of the deposits was unknown. A ground water contour map produced by GAI Consultants is shown in Figure 10. Ground water flow is in a northerly direction.

A recent regional study of the geochemistry and movement of ground water through clayey till in the Superior, Wisconsin region was conducted by Bradbury and others (1985). The study concluded that original pore water has remained in a portion of the till profile since deposition of the till 9,500 to 10,000 years ago. The study also indicates that the clayey till deposits may have a potential for providing long term isolation of soluble waste from the biosphere.

6.2 Data Presentation

Ground water characteristics at the Superior site were interpreted through data obtained from water level measurements, ground water contours and laboratory analysis of samples. Water level measurements were collected from 20 observation wells on November 6, 1985 by Koppers personnel. A ground water contour map was constructed from water level measurements obtained from the deep wells listed in Table 2.

A trend of decreasing head with depth was observed in observation wells throughout the site. A vertical downward gradient was calculated and found to range from approximately 0.008 ft/ft to 0.7 ft/ft, with a average gradient of 0.3 ft/ft.

An average ground water velocity can be calculated using the following equation:

$\bar{v} = \frac{k\,i}{n}$ where

$\bar{v}$ = average velocity
k = hydraulic conductivity
i = gradient
n = porosity

Hydraulic conductivity values for the fractured and unfractured clay were reported to be 2 to 3 x 10^{-8} cm/sec (GAI Consultants, 1985). A typical porosity value for a clay is 40 to 45 percent (Todd, 1980). The horizontal gradient from Figure 11 is approximately 4 x 10^{-2} ft/ft.

The sand samples were not analyzed for hydraulic conductivity values. However, grain size analysis was conducted on selected sand samples. Grain size distribution is related to porosity. Porosity values for a typical medium grained sand are reported to be approximately 40 percent (Todd, 1980). The grain size distribution is consistent with reported porosity values. Typical hydraulic conductivity values for a sand was reported to be approximately 5 x 10^{-2} cm/sec (Todd, 1980). The horizontal gradient from Figure 11, is 4 x 10^{-2} ft/ft.

Using these measured values or values obtained from the literature, the horizontal velocity calculated for the clay deposits was approximately 2.7 x 10^{-9} cm/sec or 0.002 ft/year and the vertical velocity was 2.0 x 10^{-8} or 0.02 ft/year. The sand and gravel deposits had a calculated velocity of 5 x 10^{-3} cm/sec or 5200 ft/year. These values suggest that the sand unit is is to be considered the uppermost aquifer due to its high velocity potential and ability to transmit water to wells and springs.

6.3 Interpretations

The presence of saturated surface conditions as shown in Figure 1 is indicative of a high water table, close to the ground surface. The high water table is produced by a combination of low permeability underlying clay, precipitation and residual meltwater.

Figure 11 and 12 present a ground water contour map of the Superior site utilizing water level information from deep wells (Table 3). A ground water high or mounding is observed underlying the surface impoundments and spray irrigation fields. The mounding

effect suggests that the underlying hydrostratigraphic unit and the overlying surface areas may be hydraulically interconnected. A ground water divide is interpreted to exist in a north-south oriented direction. Flow is directed toward the east and west (Figure 11 and 12). The ground water flow pattern ressembles the surface water drainage pattern. Ground water is flowing beneath the surface impoundments to the the west toward Crawford Creek and to the east toward Bluff Creek.

A trend of decreasing head with depth was observed in observation wells throughout the site (Table 3). The downward vertical gradient is typical of a ground water recharge area.

The sand, silt and gravel deposits screened at variable depths are considered the uppermost aquifer. The lateral extent of the hydrostratigraphic unit is not known. The thickest portion (10 ft) was recorded in the south-central portion of the site.

In Figure 11 and 12, data from Wells R-2D and R-3D were not used in the contour interpretation. The annular space around the well casing in the R-series wells was reported to be backfilled with cuttings. Therefore, Wells R-2D and R-3D were not installed according to the specifications listed in Section 2.1.

A ground water contour map was not constructed for the medium wells listed in Table 3, due to the paucity of data.

A ground water contour map was not constructed for the shallow wells listed in Table 3 due to inconsistent water level readings, the distribution of wells around the ground water mound and the fact that the R-series wells may have been installed without exterior grout.

7.0 CONCLUSIONS

The general subsurface stratigraphy beneath the site consists of thick lacustrine clay deposits (Douglas Member Red Clay) interbedded with laterally semicontinuous to discontinuous deposits of silt, sand and gravel. The upper portion of the clay contains fractures to an approximate depth of 15 ft below the surface. The sand was found at variable depths in greater than trace amounts at all borings except B-2 and B-4. The thickness of the sand varied from 1 in. to 10 ft. The thickest sand deposits are located in the southern and central sections of the plant. It is unknown at this time if all identified sands are interconnected. However, the sand unit at elevation 630 ft. appears more continuous than sands observed higher in the section.

The ground water hydrology beneath the site exhibits a ground water high or mounding effect under the surface impoundments and spray irrigation field area. The flow pattern suggest a north-south oriented ground water divide. The directions of ground water flow is to the west toward Crawford Creek and to the east toward Bluff Creek. A vertical downward flow component was interpreted from the observed trend of decreasing head with depth in observation wells throughout the site. A vertical gradient was calculated to range from approximately 0.008 to 0.7 ft/ft with an average of 0.3 ft/ft. Horizontal ground water velocities were calculated to be 0.002 ft/year for the clay and 5200 ft/year for the sand. The high velocity values for the sand suggest that the sand is to be considered the uppermost aquifer beneath the site.

The uppermost aquifer beneath the site is considered to be the sand unit present at approximate elevation 630 ft. That sand unit appears to be more laterally extensive than the sands reported at higher elevations. The reported permeability and calculated velocity values suggest that the uppermost aquifer is capable of transmitting water to wells and springs. This sand unit, with its physical characteristics, such as high permeability and high ground water velocity values, provides an excellent opportunity to monitor the ground water conditions beneath the Superior site.

Upgradient and downgradient monitoring wells were selected following the review of available data. The flow pattern presented in Figure 11 and 12 suggest that no wells

exist in an upgradient position due to the mounding effect and ground water flow directions. However, Wells R-1 and W-4B appear sufficently outside the influence of the waste management units to be used as background wells for monitoring the surface impoundments. Wells W-1, W-2, W-3 and L-4D and L-5D will be used to monitor downgradient ground water flow from the waste managment units.

REFERENCES

Bradbury, K.R., Desaulnier, D.S., Connell, D.E., Hennings, R.G., 1985, Groundwater Movement through Clayey Till, Northwestern Wisconsin, USA: International Association of Hydrogeologist, Memoires, Volume XVII, Part 1 Proceedings, 405-416.

Bradbury, K.R., 1984, Major Ion and Istope Geochemistry of Ground Water in Clayey Till, Northwestern Wisconsin, USA: Canadian/American Conference on Hydrogeology, 284-289.

Clayton, Lee, 1984, Pleistocene Geology of the Superior Region, Wisconsin: Wisconsin Geological and Natural History Survey, Information Circular No. 46.

Clayton, Lee, and Moron, S.R., 1982, Chronology of Late Wisconsinian Glaciation in Middle North America: Quaternary Science Reviews, V.1. p. 55-82.

GAI Consultants, 1985, Surface Impoundments Exploration Liner Integrity and Dike Stability, RCRA Part B Permit Application Existing Lagoons Wood Treatment Plant Koppers Company, Inc., Superior WI, by GAI Consultants, Pittsburgh, PA., 22 p.

Goebel, J.E. and others, 1983, Quaternary Geology Minneapolis 4^{o} x 6^{o} Quad, U.S. Department of the Interior, United States Geological Survey, 1:1,000,000.

Mickelson, D.M., Clayton, L., Bakery, R.W., Node, W.N., Schneider, A.F., 1984, Pleistocene Stratigraphic Units of Wisconsin: Wisconsin Geological and Natural History Survey, Misc. Paper 84-1.

Need, E.A., Unpublished Thesis, 1980, Till Stratigraphy and Glacial History of Wisconsin Lake Superior Shoreline: Wisconsin Point to Bark River: M.S. Thesis University of Wisconsin, Madison, 140 p

Thomas, R.L., and Dell, C.I., 1978, Sediments of Lake Superior: Journal of Great Lakes Reserach, Dec. 1978 pp. 264-275.

Todd, D.K., 1980, Groundwater Hydrology: Second Edition, John Wiley and Sons, USA and Canada, 535.

USGS, 1983, Superior Quadrangle, Wisconsin-Minnesota, 7.5 Minute Series: United States Geological Survey, 1:24,000.

Winter, T.C., 1973, Hydrogeology of Glacial Drift Mesobi Iron Range: Northeastern Minnesota, USGS Water-Supply Paper 2029-A.

Wright, H.E., Jr., 1972, Quaternary History of Minnesota, in Sims, P.K. and Morey, G.B., eds., Geology of Minnesota, a centenial volume: Minnesota Geological Survey, p. 515-578.

Wright, H.E., Jr., Mattson, L.A. and Thomas, J.A., 1970, Geology of the Cloquet Quadrangle: Carlotn County, Minnesota; Minnesota Geological Survey Geologic Map Series GM-3, 30p.

Woodward-Clyde Consultants, 1985, Exposure Information Report for the Koppers Company, Inc., Hazardous Waste Management Facility, Superior, WI, by Woodward-Clyde Consultants, Chicago, Il., p.50.

TABLE 1

WATER WELL INFORMATION

Well No.	Location Sec	R	T	Date Drilled	Owner	Type of Well	Water Level (Feet)	Depth (Feet)
1	31	13W	49N	1942	R. Lozen	R	45	178
2		13W	49N	1942	City of Superior	C	45	108
3	20	13W	48N	1943	E. Johnson	R	60	116
4	16	13W	48N	1955	L. Van Grongam	R	72	190
5	21	13W	48N	1960	N. Ross	R	65	155
6	19	13W	48N	1945	C. Granquist	R	65	160
7	29	13W	48N	1941	F. Paulson	R	72	121
8	30	13W	48N	1943	L. Otten	R	50	104
9	30	13W	48N	1950	L. Brown	R	40	105
10	30	13W	48N	1970	R. Johnson & Sons	C	90	250
11		13W	49N	1958	J. Kurrilla	R	60	165
12	30	13W	48N	1943	O. Dahlin	R	70	103
13	10	14W	48N	1954	P. Strouge	R	NA	173
14	1	14W	48N	1955	L. Superior Fur Farm	C	40	145
15		14W	48N	1957	H.Olson	R	60	240
16	1	14W	48N	1945	C. Palm	R	57	145
17	2	14W	48N	1964	E. Craft	R	65	172
18	2	14W	48N	1962	M. Fossnes	R	65	218
19	2	14W	48N	1948	F. Gren	R	126	187
20	2	14W	48N	1960	E. Bak	R	105	265
21	3	14W	48N	1954	P. Hudacek	R	50	168
22	3	14W	48N	1954	Twin Port Dairy Coop	C	59	216
23	3	14W	48N	1945	L. Wick	R	35	167
24	3	14W	48N	1970	R. Johnson	R	50	123
25	3	14W	48N	1944	C. Damilson	R	50	200
26	3	14W	48N	1977	J. Plesko	R	25	275
27	3	14W	48N	1977	T. Rep	R	35	289
28	1	14W	48N	1953	Koppers Inc	C	100	500

TABLE 1

WATER WELL INFORMATION

Well No.	Location Sec	R	T	Date Drilled	Owner	Type of Well	Water Level (Feet)	Depth (Feet)
29		14W	48N	1950	D. Albright	R	45	128
30	10	14W	48N	1958	D. Elison	R	58	134
31	10	14W	48N	1980	L. Long	R	75	145
32		14W	48N	1952	L. Podorich	R	40	175
33	12	14W	48N	1940	S. Dragich	R	22	240
34	10	15W	48N	1939	J.Miestke	R	39	173
35	4	14W	48N	1977	M. Hilger	R	20	200
36	7	13W	48N	1970	B. Erickson	R	90	190
37	8	13W	48N	1973	A. Hartke	R	40	202
38	9	13W	48N	1946	R. Paaso	R	58	97
39	9	13W	48N	1946	C. Hazart	R	58	100
40	9	13W	48N	1964	Tomco Wood Products	C	75	107
41	9	13W	48N	1960	E. Hattla	R	65	124
42	9	13W	48N	1952	C. Holdley	R	50	164
43	9	13W	48N	1953	D. Bolton	R	60	168
44	9	13W	48N	1944	R. Warblow	R	55	235
45	9	13W	48N	1967	L. Grube	R	60	168
46	9	13W	48N	1974	D. Salo	R	75	225
47	9	13W	48N	1944	C. Bing	R	50	220
48	7	13W	48N	1942	B. Lintula	R	65	139
49	9	13W	48N	1941	O. Anderson	R	58	87
50	9	13W	48N	1956	G. Pelitte	R	60	174
51	9	13W	48N	1940	J. Butler	R	70	350
52	22	14W	48N	1942	A. Kimmk	R	30	160
53	26	14W	48N	1940	G. Albright	R	70	155
54	26	14W	48N	1970	R. Lindberg	R	35	150
55	26	14W	48N	1958	A. Kronberg	R	30	214

TABLE 1

WATER WELL INFORMATION

Well No.	Location Sec	R	T	Date Drilled	Owner	Type of Well	Water Level (Feet)	Depth (Feet)
56	26	14W	48N	1948	J. Kronlong	R	54	157
57	25	14W	48N	1944	P. Danielson	R	24	161
58	25	14W	48N	1958	L. Spring	R	40	166
59	34	14W	48N	1943	B. Southwick	R	70	198
60	34	14W	48N	1964	D. Ninedorf	R	80	170
61	34	14W	48N	1978	R. Larson	R	125	190
62	34	14W	48N	1973	D. Van Duymbrock	R	105	220
63	34	14W	48N	1972	C. Heytons	R	60	207
64	35	14W	48N	1955	H. Gilden	R	72	154
65	36	14W	48N	1969	J. Sampson	R	60	154
66	36	14W	48N	1952	C. Spring	R	70	160
67	34	14W	48N	1941	T. Nelson	R	68	145
68	36	14W	48N	1953	Lake Head Pipeline Co	C	NA	179
69		15W	48N	1979	G. Wallace	R	75	130
70	22	14W	48N	1942	S. Landala	R	*0.2	120
71	13	14W	48N	1952	W. Keene	R	45	175
72	13	14W	48N	1946	Koppers Co	C	58	200
73	13	14W	48N	1954	Koppers Co	C	20	44
74	14	14W	48N	1946	H. Weinstein	R	39	190
75		14W	48N	1970	Greenwood Cemetery	C	45	148
76	14	14W	48N	1978	B. Porter	R	32	340
77	14	14W	48N	1944	F. Schmidt	R	45	144
78	15	14W	48N	1950	S.M. Grengs Co	C	60	222
79	15	14W	48N	1952	D. Southerland	R	73	202
80	13	14W	48N	1943	Duluth Masales Iron Range	C	45	205

* Water level above surface

TABLE 1

WATER WELL INFORMATION

Well No.	Location Sec	R	T	Date Drilled	Owner	Type of Well	Water Level (Feet)	Depth (Feet)
81	24	14W	48N	1945	R. Perrson	R	48	170
82	24	14W	48N	1955	V. Johnson	R	NA	190
83	24	14W	48N	1943	A. Tenner	R	55	151
84	22	14W	48N	1955	D. Potter	R	45	190
85	23	14W	48N	1947	N. Gustafson	R	30	161
86	22	14W	48N	1943	W. Amen	R	60	225
87	22	14W	48N	1943	C. Strand	R	50	179
88	22	14W	48N	1943	L. Tyson	R	50	164
89	22	14W	48N	1973	B. Westman	R	35	168
90	16	13W	48N	1942	E. Connell	R	70	269
91	22	14W	48N	1937	C. Campbell	R	40	185
92	22	14W	48N	1937	C. Campbell	R	65	185
93	11	14W	48N	1936	A. Olson	R	45	205
94	5	13W	48N	1936	City of Superior	C	50	235
95	6	13W	48N	1936	City of Superior	C	55	165
96	9	13W	48N	1940	C. Peterson	R	104	216
97	10	14W	48N	1980	L. Long	R	75	145
98	9	13W	48N	1937	H. Samalasky	R	75	225
99	1	14W	48N	1957	St. Alonnsis Church	C	8	85.5

R = Residential Well

C = Commercial Well

NA = Not Available

TABLE 2

GRAIN SIZE ANALYSIS AND MOISTURE CONTENT

Boring No.	Sample Depth	USCS	Moisture Content	Sand Content	Silt Content	Clay Content
W-1	4.5-6	CH	42.0%	.5%	15.0%	84.0%
	19.5-21	CH	63.34%	0.0%	12.0%	88.0%
	27-28.5	CH	50.37%	2.0%	28.0%	70.0%
	42-45	SP	NA	99.0%	1.0%	0.0%
	44.5-46	CH	35.64%	4.0%	25.0%	71.0%
W-2	19.5-21	CH	60.24%	1.0%	12.0%	87.0%
	27-28.5	CH	64.01%	1.0%	12.0%	87.0%
	39.5-41	CL/CH	17.74%	30.0%	46.0%	24.0%
	44.5-46	CH	30.60%	2.0%	34.0%	64.0%
W-3	4.5-6	CH	45.45%	0.0%	14.0%	86.0%
	27-28.5	CH	70.19%	0.0%	13.0%	87.0%
	37-38.5	CH	57.19%	3.0%	8.0%	89.0%
	42-43.5	CH	61.69%	2.0%	8.0%	90.0%
W-4B	4.5-6	CH	36.84%	2.0%	23.0%	75.0%
	17-18.5	CH	60.26%	2.0%	9.0%	89.0%
	22-23.5	CH	52.23%	12.0%	18.0%	70.0%
	24.5-26	SP/SM	NA	90.0%	10.0%	0.0%
	29.5-31	CH	46.33%	13.0%	11.0%	76.0%
	34.5-36	CL	21.11%	25.0%	56.0%	19.0%
	37-38.5	CL	23.50%	22.0%	39.0%	39.0%
	42-43.5	CH	57.13%	2.0%	8.0%	90.0%
B-1	4.5-6	CH	48.46%	5.0%	19.0%	76.0%
	19.5-21	CH	73.97%	0.0%	8.0%	92.0%
	44.5-46	CL	20.54%	29.0%	56.0%	15.0%
	47-48.5	SW/SM	NA	87.0%	13.0%	0.0%
	55-56.5	CH	52.79%	5.0%	9.0%	86.0%

TABLE 2

GRAIN SIZE ANALYSIS AND MOISTURE CONTENT

Boring No.	Sample Depth	USCS	Moisture Content	Sand Content	Silt Content	Clay Content
B-2	9.5-11	CH	48.06%	1.0%	8.0%	91.0%
	19.5-21	CH	68.46%	0.0%	8.0%	92.0%
	32-33.5	CH	51.68%	2.0%	26.0%	72.0%
	44.5-46	CH	51.89%	4.0%	12.0%	84.0%
	50.5-52	CH	55.23%	8.0%	8.0%	84.0%
B-3	*19.5-21	SP	NA	94.0%	6.0%	0.0%
	19.5-21	SP	NA	94.0%	6.0%	0.0%
	37-38.5	SM	NA	64.0%	36.0%	0.0%
	39.5-41	SM	NA	83.0%	17.0%	0.0%
	44.5-46	CH	37.35%	5.0%	12.0%	83.0%
B-4	9.5-11	CH	50.79%	0.0%	13.0%	87.0%
	19.5-21	CH	68.08%	2.0%	14.0%	84.0%
	29.5-31	CH	57.96%	2.0%	26.0%	78.0%
	44.5-46	CH	48.70%	2.0%	29.0%	69.0%
B-5	9.5-11	CH	49.10%	0.0%	16.0%	84.0%
	19.5-21	CH	48.42%	0.0%	19.0%	81.0%
	32-33.5	SC	18.78%	46.6%	41.0%	13.0%
	39.5-41	CH	38.63%	4.6%	27.0%	69.0%
	49.5-51	CH	67.55%	4.0%	11.0%	85.0%
	58-60	CH	57.82%	8.0%	12.0%	80.0%

* Sample taken from upper 6 in. of sampler

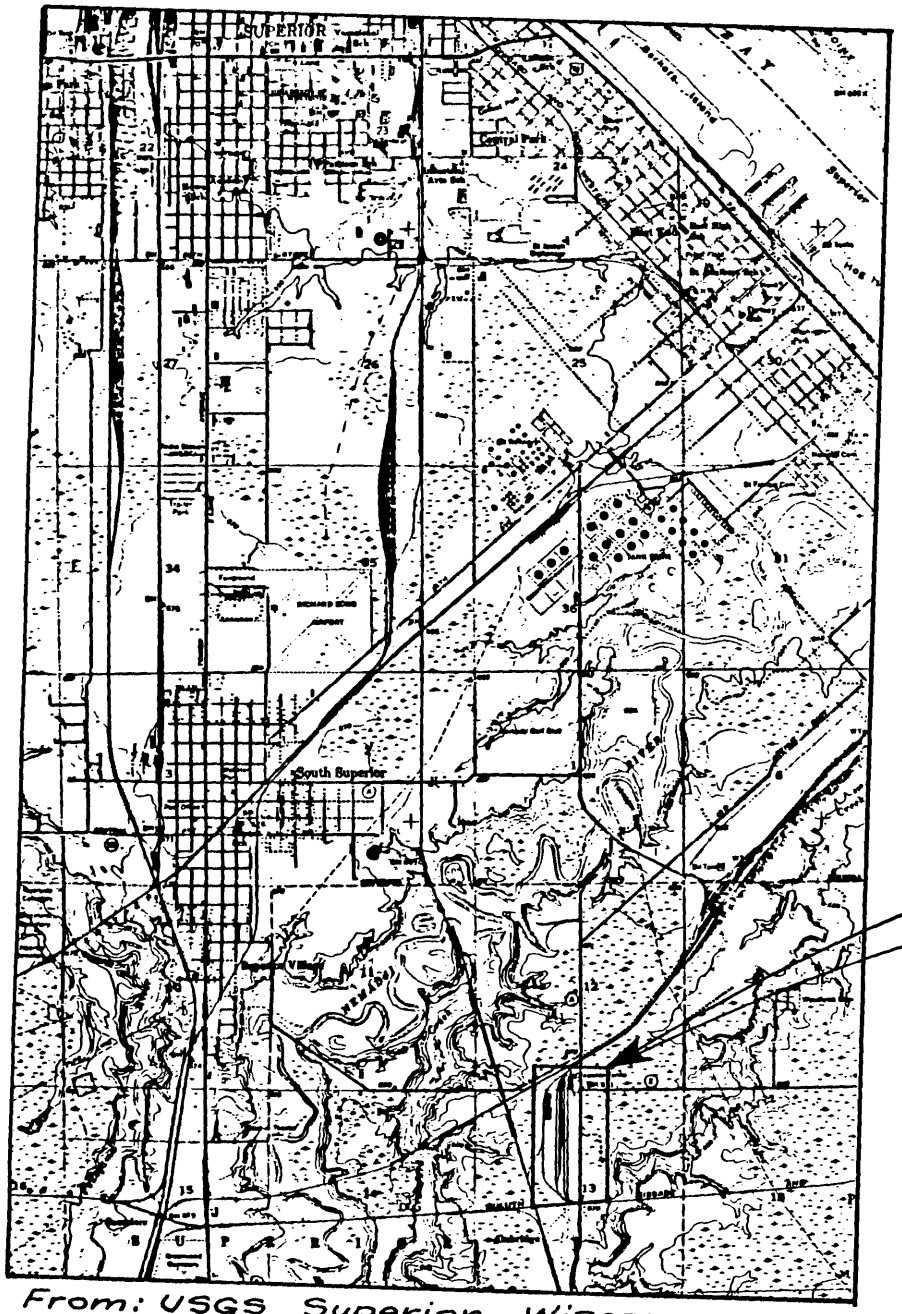
OBSERVATION WELL INFORMATION

TABLE 3

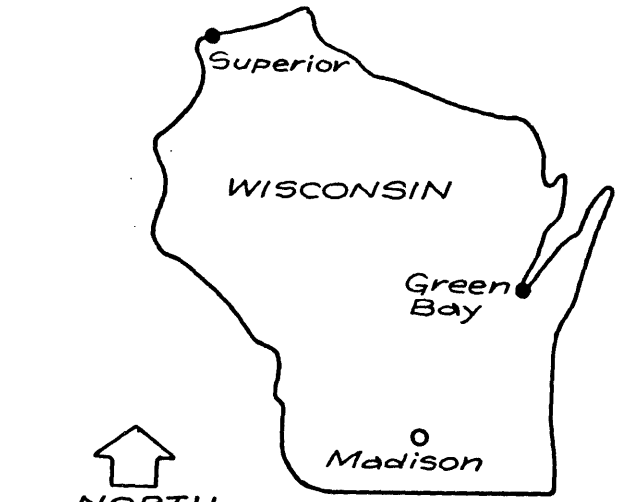
WATER LEVEL MEASUREMENTS TAKEN ON NOVEMBER 6, 1985

WELL NUMBER	CASING ELEVATION (feet)	WATER LEVEL (feet)	WATER ELEVATION (feet)	SCREENED INTERVAL (feet)
DEEP WELLS				
L-4D	677.24	11.75	665.49	25 to 35
L-5D	677.82	21.45	656.37	37 to 47
R-2D	673.37	7.98	665.39	20 to 35
R-3D	673.51	7.01	666.5	30 to 45
W-1 W1C	674.05	15.81	658.24	41 to 44
W-2 W2C	672.65	18.32	654.33	38 to 43
W-3 W3C	674.29	19.89	654.4	36 to 41
W-4B W4C	677.23	17.72	659.51	36 to 41
MEDIUM WELLS				
L-3M	677.22	7.63	669.59	15 to 25
L-4M	677.64	8.96	668.68	15 to 25
L-5M	677.75	5.75	672	15 to 25
R-1D	674.49	*	*	8 to 23
W-4A W4B	677.69	14.24	663.45	20 to 30
SHALLOW WELLS				
L-1T	676.72	*	*	5 to 15
L-1S	678.59	5.66	672.93	2 to 12
L-2S	678.58	5.72	672.86	2 to 12
L-3S	678.14	8.41	669.73	2 to 12
L-4S	678.82	5.86	672.96	2 to 12
L-5S	678.41	5.77	672.64	5 to 15
R-1	674.94	2.97	671.97	5 to 20
R-2	674.17	3.97	670.2	5 to 10
R-3	674.08	4.31	669.77	5 to 20
R-4	675.56	*	*	to

* DENOTES THAT WATER LEVEL MEASUREMENTS ARE UNAVAIABLE FOR THIS DATE



From: USGS Superior, Wisconsin
7.5 Minute Quadrangle



NORTH

0 1/2 1

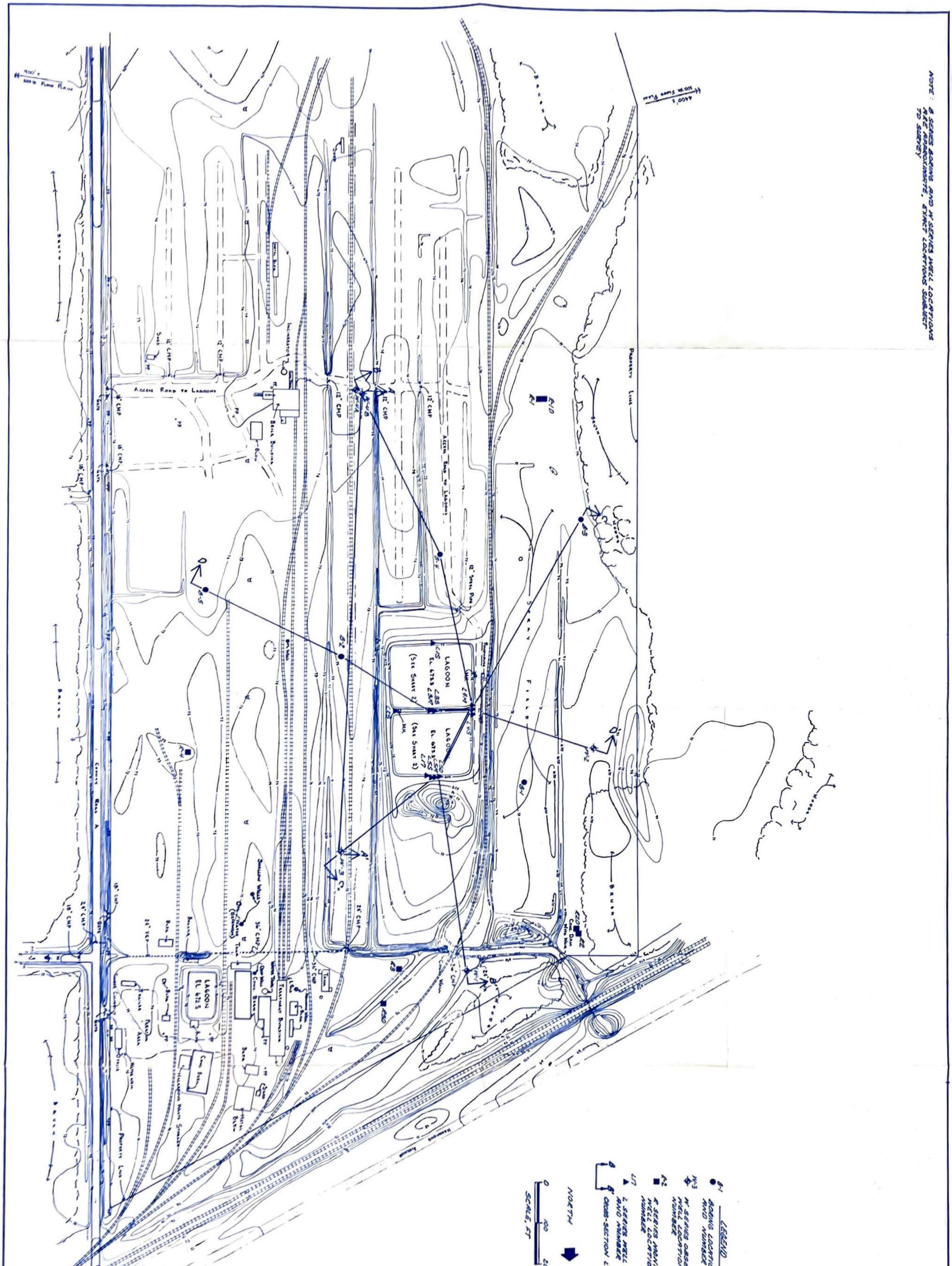
SCALE, MILES

SITE LOCATION

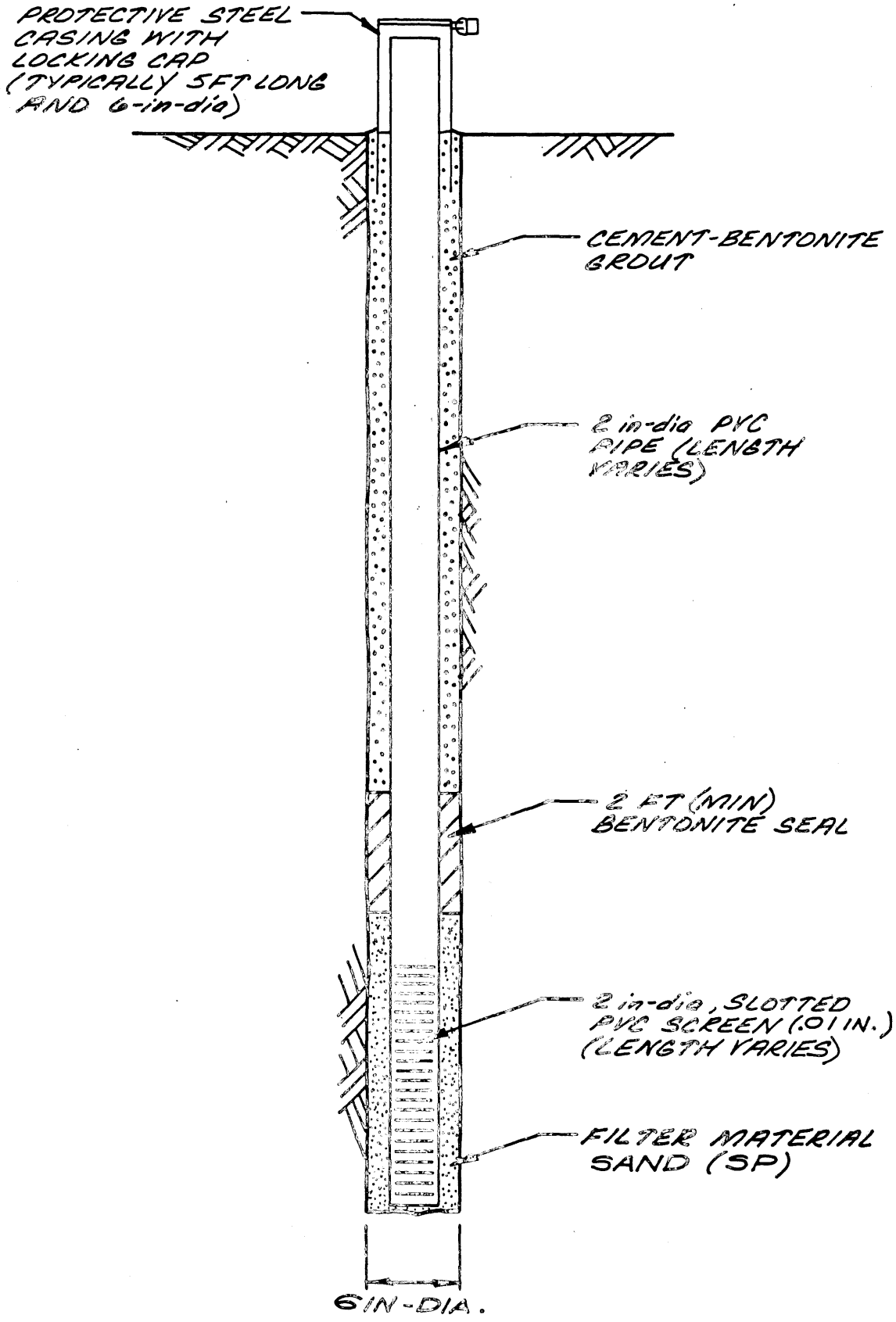
SITE LOCATION MAP

FIGURE 1.

WCC,85C3134-2 DECEMBER 1985



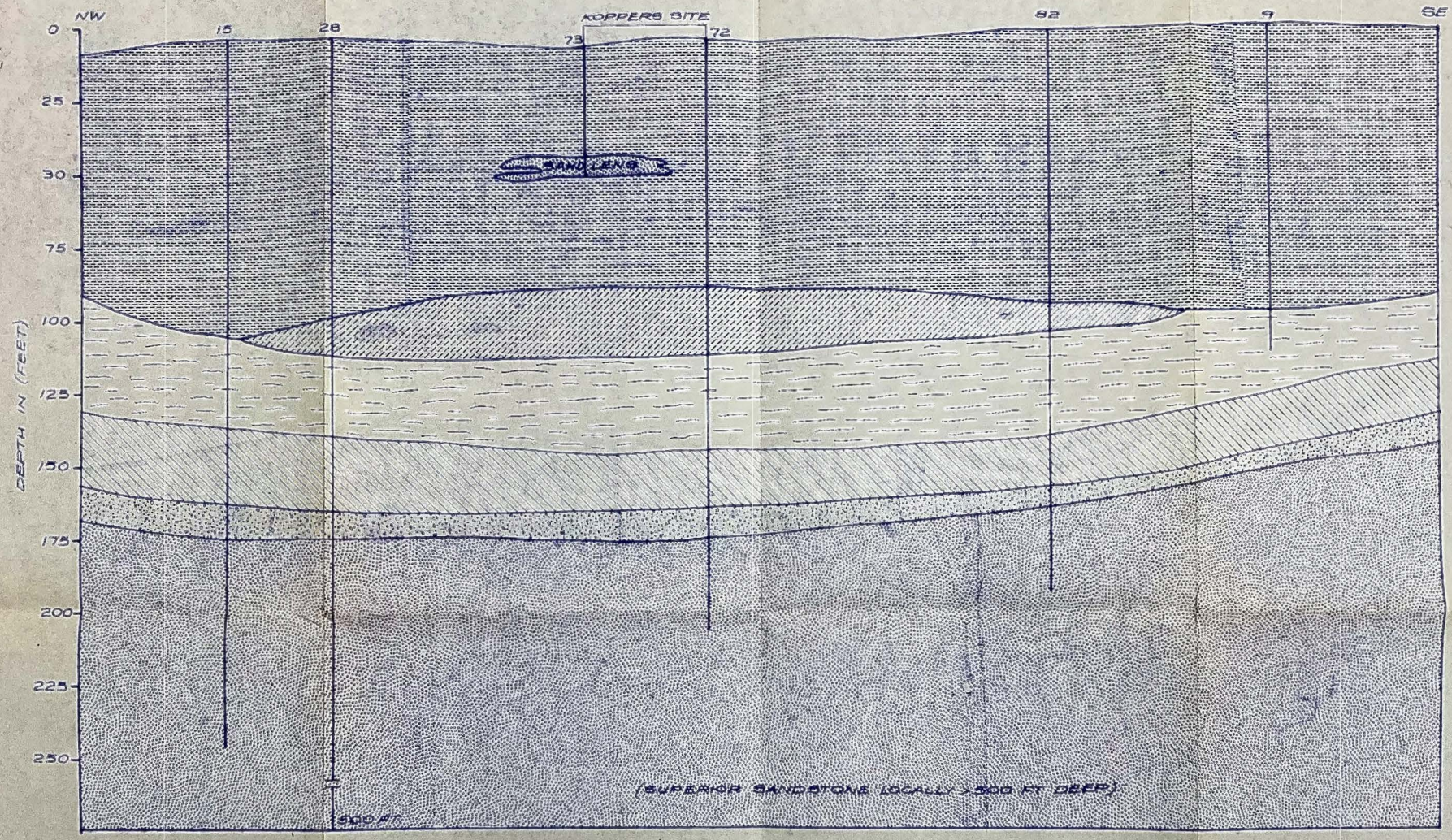
JOB NO. 85C3134-2	KOPPERS COMPANY, INC SUPERIOR, WISCONSIN WOOD TREATING FACILITY	BORING AND WELL LOCATION MAP	DESIGNED BY / DATE DRAWN BY LO CHECKED BY RGB DATE SCALE AS SHOWN	TOPOGRAPHIC MAP PREPARED BY SERWAY ENGINEERING CO., DULUTH, MINNESOTA FIELD DATA OBTAINED JUNE, 1984
SHEET 1 OF 1 Figure 2			MARK / DATE / REVISION	



GENERAL WELL CONSTRUCTION DIAGRAM

85C3134-2

Fig. 3



QUATERNARY	PLEISTOCENE	MILLER CREEK	DOUGLAS	RED CLAY
			HANSON CREEK	BLUE CLAY
				RED CLAY
		COPPER FALLS	UNNAM. MEMB.	HARD-PAN
				FLUVIAL SAND AND GRAVEL
PRECAMBRIAN	BAYFIELD	SUPERIOR SAND		SANDSTONE

NOTE: 1. DATA FOR THE CROSS SECTION WAS OBTAINED FROM DRILLERS LOGS FROM WATER WELLS INSTALLED BETWEEN 1940 TO 1970

2. WELL LOCATIONS ARE APPROXIMATE

GENERAL NORTHWEST - SOUTHEAST
CROSS SECTION OF THE SUPERIOR WISCONSIN AREA

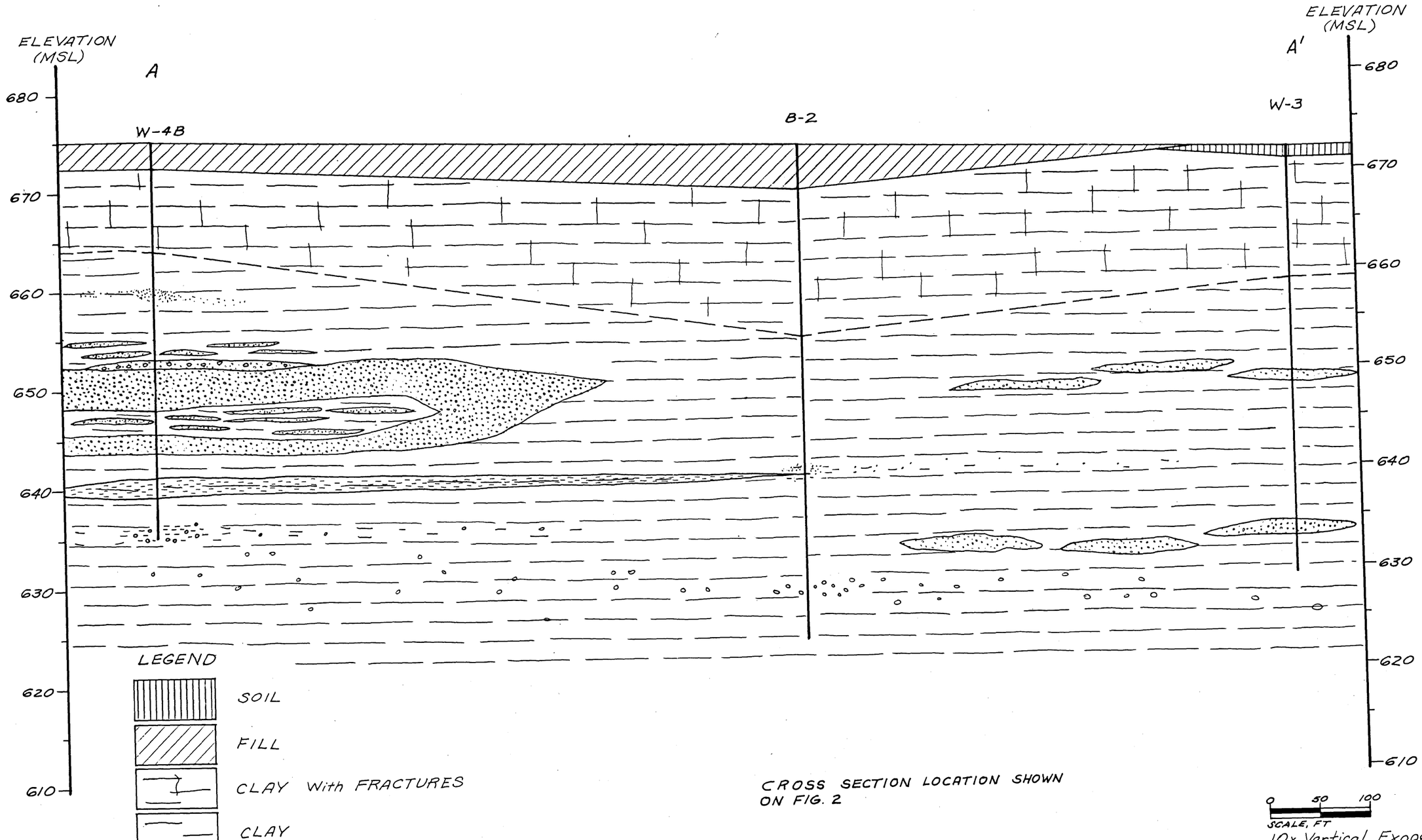
FIGURE 4

					RANGE OF THICKNESS	LITHOLOGY	HYDROGEOLOGIC UNITS
QUATERNARY	PLEISTOCENE		MILLER CREEK FORMATION	DOUGLAS MEMBER	50 - 100 FT.	RED BROWN CLAY, CLAYEY GLACIAL FLUVIAL GLACIAL LACUSTRINE AND OFF SHORE SEDIMENTS AND ASSOCIATED SANDY OFF SHORE, DEPOSITS AND SHORELINE SAND	AQUITARD VERY LOW PERMEABILITY VALUES, MOST WATER HAS BEEN IN PLACE SINCE THE LAST GLACIAL PERIOD
				HANSON CREEK MEMBER	5 - 20 FT.	BLUE / GREEN CLAY, DRIED LAKE BED DEPOSITS	
					20 - 50 FT.	RED-BROWN, DULL, SILTY-CLAY WITH CALCAREOUS FRACTION, SMALL PERCENT COBBLE AND PEBBLES, GLACIAL TILL DEPOSITS.	
			COPPER FALLS FORMATION	UNNAMED MEMBERS	20 - 40 FT.	SANDY CLAY , OVERLY COMPACTED, VERY HARD, GLACIAL TILL DEPOSITS	
					10 - 15 FT.	REDDISH TO BROWNISH SANDY SEDIMENT WITH COBBLES AND BOULDERS. FLUVIAL DEPOSITS OR POSSIBLY GLACIALLY REWORKED PRECAMBRIAN UNITS	AQUIFER MAJOR AQUIFER IN THE SUPERIOR AREA. SUPPLIES MOST LOCAL WELLS.
PRECAMBRIAN			BAYFIELD GROUP	SUPERIOR SAND	250 FT. +	QUARTZ SANDSTONE BEACH AND OFF SHORE DEPOSITS	

GENERAL STATIGRAPHY AND HYDROGEOLOGIC UNITS
OF THE SUPERIOR AREA

WCC 85C3134-2

FIGURE 5



CROSS-SECTION A-A'

FIGURE 6

B

B'

W-4B

B-4

L-4D

L-5D

W-1

ELEVATION (MSL)

675
670
665
660
655
650
645
640
635
630

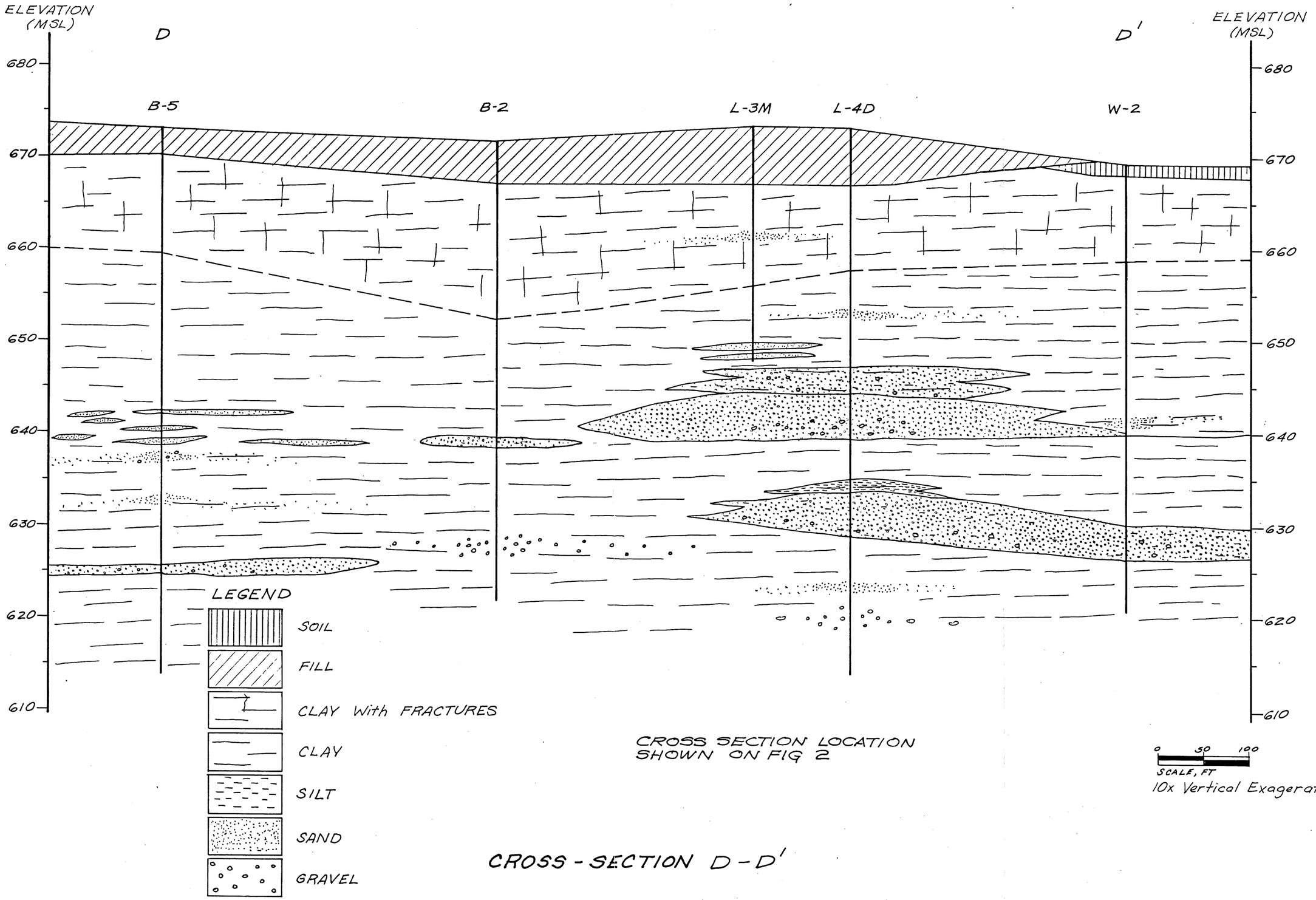
SOIL
FILL
CLAY With FRACTURES
CLAY
SILT
SAND
GRAVEL

0 50 100
SCALE, FT
10x Vertical Exageration

CROSS SECTION LOCATION SHOWN ON FIG. 2

CROSS-SECTION B-B'

FIGURE 7



CROSS-SECTION D-D'

FIGURE 9

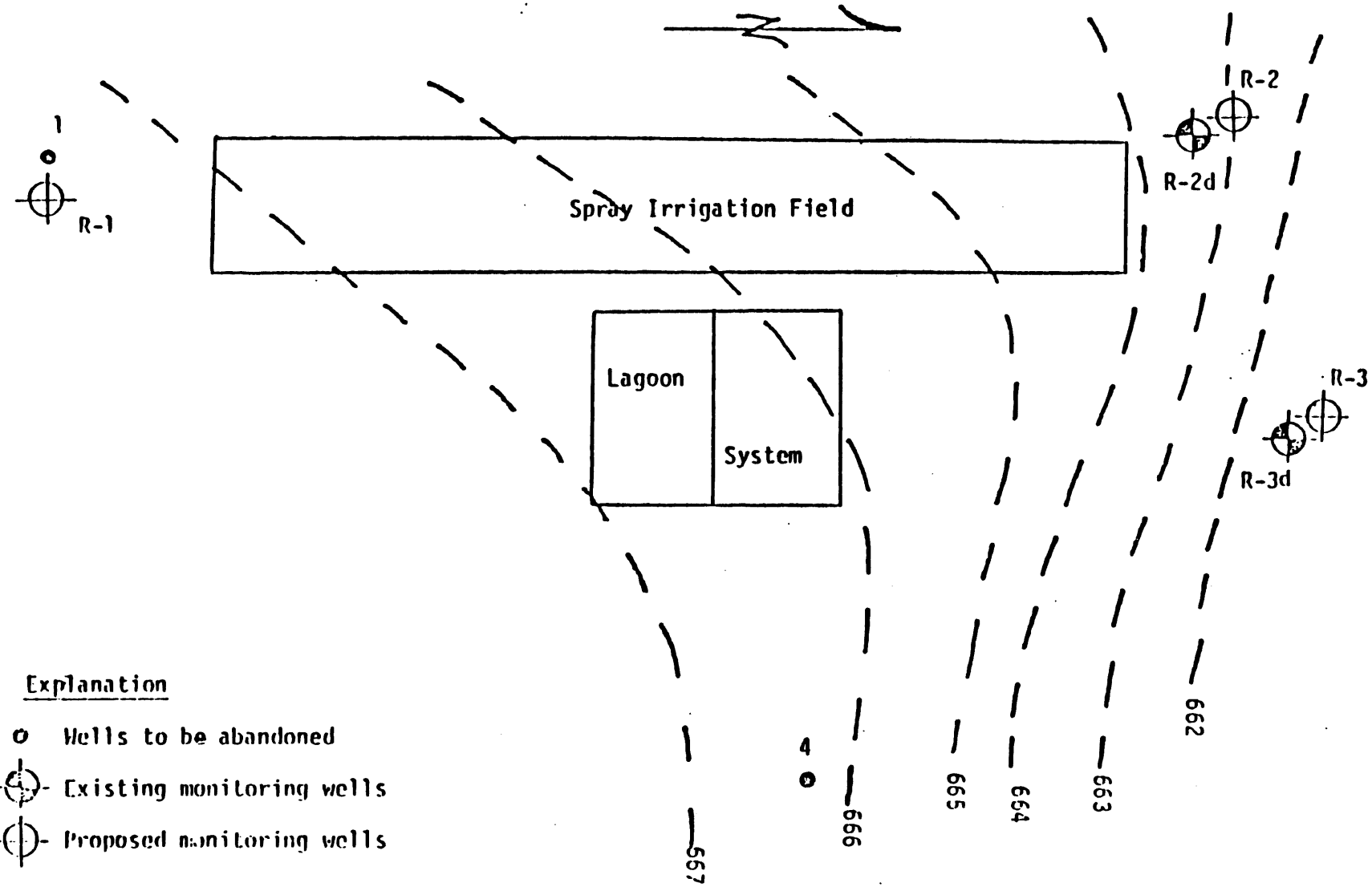


Fig..2
Koppers Company, Inc., Superior WI, Plant map showing location of existing and proposed monitoring wells, and contours of water levels as of 3/1/82.

* * From the Febuary 5, 1985 GAI Consultants report.

Figure 10

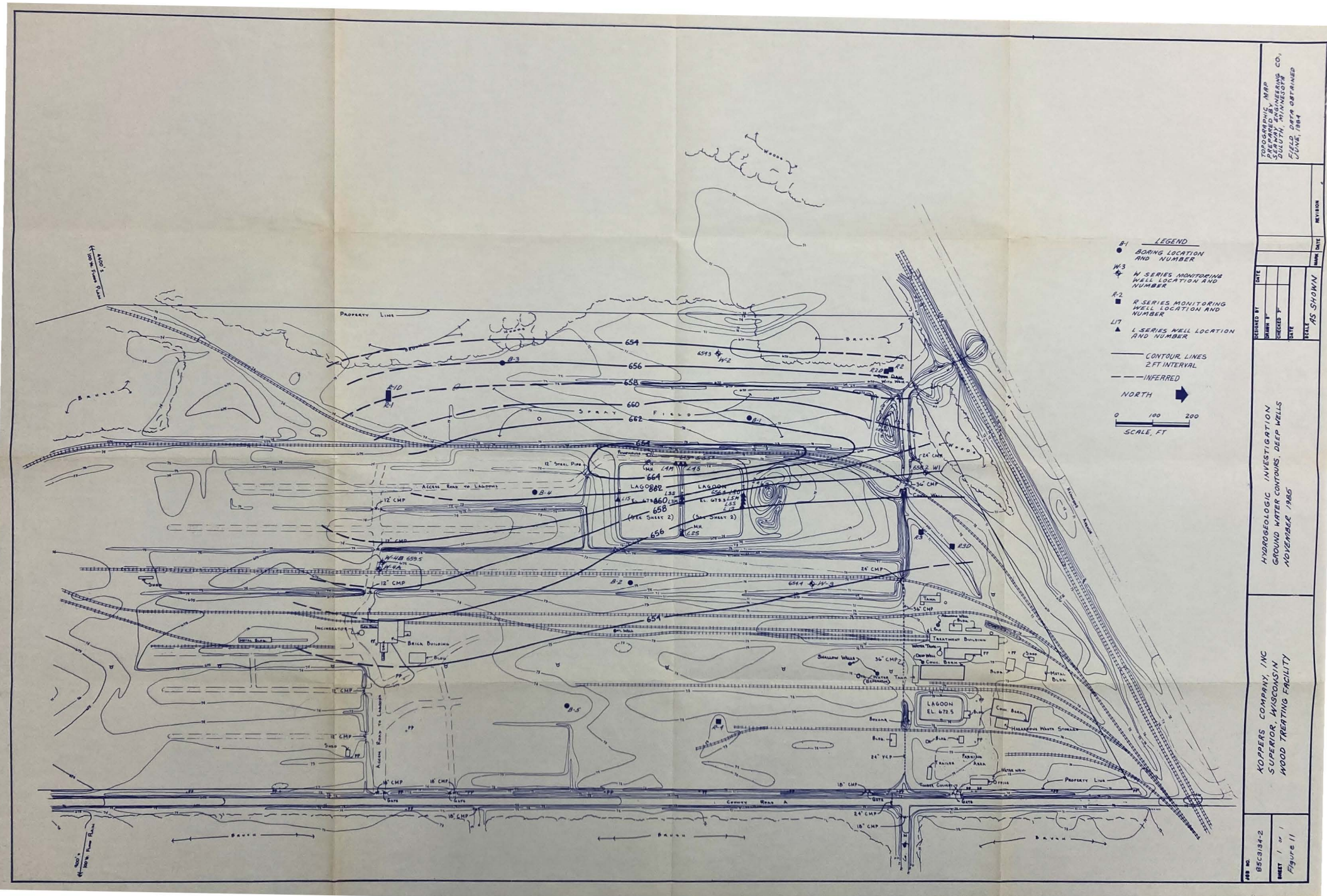
GAI Ground Water Contour Map

654
656
658
660
662
B-3
W-2
654.3
R2D
R2
R1D
R1
B-1
SPRAY IRRIGATION FIELD
L4S L4M L4D
655.5
W-1
658.2
B-4
L5S
L3S
L5M
L5D
656
L1S
L3M
L1T
LAGOONS
LAGOONS
L2S
R3
R3D
W-4B
659.5
W-4A
B-2
W-3
654.4
LEGEND
B-1 BORING LOCATION AND NUMBER
W-4 W-SERIES MONITORING WELL LOCATION
R-4 R-SERIES MONITORING WELL LOCATION
L-2 L-SERIES WELL LOCATION
660 CONTOUR LINES 2-FT INTERVAL
INFERRED
N
0 100 200
Scale, FT
B-5
R4

GROUND WATER CONTOUR MAP, DEEP WELLS

NOVEMBER 6, 1985

Fig. 12


LEGEND
B-1 BORING LOCATION AND NUMBER
W-3 W SERIES MONITORING WELL LOCATION AND NUMBER
R-2 R SERIES MONITORING WELL LOCATION AND NUMBER
L17 L SERIES WELL LOCATION AND NUMBER
CONTOUR LINES 2 FT INTERVAL
INFERRED
NORTH
0 100 200
SCALE, FT
PROPERTY LINE
SPRAY FIELD
ACCESS ROAD TO LAGOONS
LAGOON EL 672.5
LAGOON EL 673.5
TREATMENT BUILDING
BRICK BUILDING
INCINERATOR
HAZARDOUS WASTE STORAGE
TRAILER AREA
OFFICE
PROPERTY LINE
COUNTY ROAD A
TOPOGRAPHIC MAP PREPARED BY LAKE SURVEYING CO. DULUTH, MINNESOTA FIELD DATA OBTAINED JUNE, 1984
DESIGNED BY
DRAWN BY
CHECKED BY
DATE
SCALE AS SHOWN
NAME DATE REVISION
KOPPERS COMPANY, INC
SUPERIOR, WISCONSIN
WOOD TREATING FACILITY
HYDROGEOLOGIC INVESTIGATION
GROUND WATER CONTOURS, DEEP WELLS
NOVEMBER 1985
ABB NO. 85C8134-2
SHEET 1 OF 1
Figure 11

ATTACHMENT 1

R-Series and L-Series Boring Logs

CONSULTANTS INC

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS — PROJECT NO. 84-250

ELEVATION ~675 GWL 0 HRS DRY — BORING NO. L1S

19 HRS 10.0

DATE 6/18/84 FIELD ENGINEER C. PARKE — PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS::
1	2	3	4	5	6	7	8	9	10
	1 1	OS-1			V. STIFF	RED-BRN	CLAY	CH	*2.75 FILL MOIST
1.5	2 3								
3.0	3 5	OS-2							*2.5
	2 4	OS-3		4.0					*3.0
4.5	2 5			4.8		DK. GRAY	SILTY CLAY - SOME WOOD FRAGS		
6.0	3 5	OS-4				RED-BRN	CLAY		*2.0
	3 4	OS-5							*2.5
7.5	2 6								
9.0	3 5	OS-6							*2.25
	2 3	OS-7							*2.5
10.5	2 4								
12.0	3 4	OS-8							*2.0
							BOTTOM OF BORING AT 12.0'		
							SCREEN 2.0 - 12.0		

REMARKS::: CME MODEL 45 ; 6"Φ Hollow STEM AUGERS USED TO ADVANCE BORING

LAKEHEAD TESTING LABORATORY — PROJECT NO. 84-250

BORING NO. L1S

: POCKET PENETROMETER READINGS

::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS PROJECT NO. 84-250

ELEVATION ~675 GWL 0 HRS DRY BORING NO. L 2S

17 HRS 10.0

DATE 6/18/84 FIELD ENGINEER C. PARKE PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS**
1	2	3	4	5	6	7	8	9	10
	1 1	OS-1			STIFF	RED-BRN	CLAY FILL	CH	*1.5 MOIST
1.5	1 3								
3.0	1 2	OS-2							
	1 1	OS-3			MED. STIFF				*.75 WET
4.5	1 2								
6.0	2 5	OS-4			V. STIFF				*2.75 MOIST
	2 4	OS-5					DECOMPOSED WOOD FRAGS 5.8-6.0		*3.0
7.5	3 7								
9.0	3 5	OS-6							*3.25
	2 3	OS-7							*2.5
10.5	2 4								
12.0	3 4	OS-8					BOTTOM OF BORING AT 12.0' SCREEN 2.0-12.0		*2.25

REMARKS***: CME MODEL 45; 6" Ø HOLLOW STEM AUGERS USED TO ADVANCE BORING

LAKEHEAD TESTING LABORATORY PROJECT NO. 84-250

BORING NO. L 2S

* POCKET PENETROMETER READINGS

*** METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS DRY BORING NO. L 3S
HRS 8.85
DATE 6/18/84 FIELD ENGINEER C. PARKE PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS::
1	2	3	4	5	6	7	8	9	10
						RED-BRN	CLAY	CH	
2.0									
	0.8/2.0	AST-1							
4.0									
10.0									
	2.0/2.0	AST-2							
12.0							BOTTOM OF BORING 12.0'		
							SCREEN 2.0 - 12.0'		

REMARKS::: CME MODEL 45; 6" ⌀ Hollow Stem Augers used to advance boring between sample intervals; Lakehead Testing Laboratory PROJECT NO. 84-250

:: POCKET PENETROMETER READINGS BORING NO. L-3S

::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS — PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS 14.5 Inside Auger — BORING NO. L 3M
24 HRS 11.8
DATE 6/15/84 FIELD ENGINEER C. PARKE — PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS:*
1	2	3	4	5	6	7	8	9	10
	1 1	OS-1			STIFF	RED-BRN	CLAY FILL	CH	MOIST
1.5	1 1								
3.0	1 2	OS-2							
	1 2	OS-3							*1.25 STOP 6/15
4.5	1 4								
6.0	2 4	OS-4							*1.75
	1 2	OS-5		6.5					*2.25
7.5	2 4				V. STIFF				
9.0	2 4	OS-6							*2.3
	2 2	OS-7							*2.25
10.5	4 4								
12.0	4 5	OS-8					-TR. FINE SAND		1.2' RECOVERY
	2 2	OS-9			STIFF				*1.5
13.5	2 3								
15.0	3 4	OS-10							
	1 2	OS-11							
16.5	2 3								
18.0	3 4	OS-12							
	2 3	OS-13							
19.5	1 3			20.0					
21.0	2 3	OS-14		21.0		RED BR-GRN	CLAY MOTTLED -TR ORGANICS		*1.3
	2 2	OS-15				RED-BRN	CLAY		*1.5
22.5	2 3			23.0					WET
24.0	3 3	OS-16		23.5		GRAY			*1.75
	2 6	OS-17		25.0		RED-BRN	-SANDY 24.0-24.2		*1.25
25.5	4			25.4		BRN	FINE SAND -TR. GRAVEL	SP	
				25.5		RED-BRN	CLAY	CH	
							BOTTOM OF BORING 25.5		
							SCREEN 14.8-24.8		

REMARKS:::: CME MODEL 45; 6" ⌀ HOLLOW STEM AUGERS USED TO ADVANCE BORING

LAKEHEAD TESTING LABORATORY — PROJECT NO. 84-250

BORING NO. L-3M

* POCKET PENETROMETER READINGS
:::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS — PROJECT NO. 84-250

ELEVATION ~675 GWL 0 HRS DRY — BORING NO. L 4S

110 HRS 3.8

DATE 6/14/84 FIELD ENGINEER C. DARKE — PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						RED-BRN	CLAY	CH	MOIST
12.0							BOTTOM OF BORING 12.0'		
							SCREEN 12.0 → 2.0'		

REMARKS:::: CME MODEL 55; 6"Ø Hollow Stem Augers used to advance boring

LAKEHEAD TESTING LABORATORY — PROJECT NO. 84-250

BORING NO. L 4S

* POCKET PENETROMETER READINGS

:::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS — PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS 21.0 Inside Auger — BORING NO. L 4M
HRS
DATE 6/14/84 FIELD ENGINEER C. PARKE — PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS::
1	2	3	4	5	6	7	8	9	10
						RED-BRN	CLAY	CH	MOIST
6.0									
	1.6/2.0	Δ ST-1							
8.0									
15.0									
	1.9/2.0	Δ ST-2							
17.0									▽
23.0									
	1.9/2.0	Δ ST-3				↓	↓	↓	
25.0							BOTTOM OF BORING AT 25.0'		
							SCREEN 15.0 - 25.0'		

REMARKS::: CME MODEL 55 ; 6" Ø HOLLOW STEM AUGERS USED TO ADVANCE BORING BETWEEN SAMPLE INTERVALS; LAKEHEAD TESTING LABORATORY

PROJECT NO. 84-250
BORING NO. L 4M

:: POCKET PENETROMETER READINGS
::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KODDERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS 15.9 Inside auger BORING NO. L 4D
HRS
DATE 6/13/84 FIELD ENGINEER C. DARKE PAGE NO. 1 OF 2

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS::
1	2	3	4	5	6	7	8	9	10
	1 1	OS-1			STIFF	RED-	CLAY FILL	CH	*1.25 MOIST
1.5	1 2					BRN.			
3.0	2 2	OS-2							
	2 3	OS-3							
4.5	2 4								
6.0	3 5	OS-4					-TR. WOOD FRAGS 6.0		
	3 4	OS-5		6.5					*2.5
7.5	3 6				STIFF	RED-	CLAY		
9.0	4 5	OS-6				BRN			
	3 4	OS-7			V. STIFF				*3.5
10.5	3 6								
12.0	4 6	OS-8							*2.5
	3 3	OS-9							WET
13.5	3 4								
15.0	3 5	OS-10							*2.25
	2 2	OS-11			STIFF		GWL 11:00 6/13 INSIDE AUGER		*1.75
16.5	1 4								
18.0	3 3	OS-12							*1.25
	2 3	OS-13							
19.5	2 3								
21.0	5 4	OS-14		20.5			-TR. FINE SAND		
	1 2	OS-15		22.3			- SOME FINE SAND	CL	
22.5	2 3					RED-BRN.	CLAY	CH	
24.0	2 3	OS-16		24.0					
	1 2	OS-17				RED-BRN GRAY	CLAY - MOTTLED -TR. ROOTS	CH	
25.5	1 2								
27.0	2 5	OS-18		26.5 27.0	MED. STIFF		- SOME SILT		*0.75
	2 4	OS-19		27.5		BRN.	FINE SAND - SOME CLAY - TR. GRAVEL	SC	
28.5	3 3			29.0			SILT - TR. CLAY	ML	
30.0	7 13	OS-20			MED. DENSE		SILTY SAND - TR. FINE GRAVEL	SM	

REMARKS:::: CME MODEL 55, 6"Ø HOLLOW STEM AUGERS USED TO ADVANCE BORING

LAKE HEAD TESTING LABORATORY PROJECT NO. 84-250

BORING NO. L-4D

* POCKET PENETROMETER READINGS
:::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREASOTE LAGOONS PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS BORING NO. L 4D
HRS
DATE 6/13/84 FIELD ENGINEER C. PARKE PAGE NO. 2 OF 2

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
		OS-21				BRN	FINE SILTY SAND	SM	NO RECOVERY
31.5	10								USED H2O TO FLUSH
33.0	17 20	OS-22			DENSE				AUGER
	2 5	OS-23			MED DENSE				
34.5	1 11			34.3					
36.0	2 3	OS-24			MED. STIFF	RED-BRN	CLAY	CH	*.75
	2 2	OS-25							
37.5	2 3								
39.0	2 6	OS-26		38.5		DK. BRN	CLAYEY SILT	ML-CL	
	1 5	OS-27		39.5			CLAYEY SILT - SOME FINE SAND		
40.5	4 8			40.5			FINE SAND - SOME SILT	SM	SAND IN AUGER
42.0	12 23	OS-28			DENSE				USED H2O TO FLUSH
	20 52	OS-29			V. DENSE				NO RECOVERY
43.5	10 39						SAND - SOME FINE GRAVEL	- WASH?	
45.0	7 12	OS-30		44.9	MED DENSE				
	3 5	OS-31			V. STIFF	RED-BRN	CLAY	CH	*2.5
46.5	2 9								STOP 46.5 6/13/84
48.0	3 4	OS-32			STIFF				*1.25
	2 2	OS-33			MED. STIFF				*.75
49.5	1 3								
51.0	2 3	OS-34			SOFT				*.30
	WOT	OS-35					- TR. FINE SAND		*.25
52.5	WOT 2								
54.0	2 3	OS-36					- TR. FINE GRAVEL		
	WOT	OS-37							*.50
55.5	WOT 2								
57.0	1 4	OS-38							
	WOT 2	OS-39							
58.5	WOT 3								
60.0	2 2	OS-40							

REMARKS::: BOTTOM OF BORING 60.0' - 6/14/84 PIEZOMETER TIP AT 35.0'
TOP OF SCREEN 25.0'

PROJECT NO. 84-250
BORING NO. L 4D

* POCKET PENETROMETER READINGS
::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS DRY BORING NO. L 5S
HRS
DATE 6/21/84 FIELD ENGINEER C. PARKE PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	2 1	OS-1			STIFF	RED BRN	CLAY FILL	CH	MOIST
1.5	1 2								
3.0	2 3	OS-2							* 1.0
	1 2	OS-3							* 2.0
4.5	1 5								
6.0	3 5	OS-4		5.7	V. STIFF	DK GRAY	SILTY CLAY	CL	
	1 3	OS-5		6.2	STIFF	RED BRN	CLAY	CH	* 1.75
7.5	2 4			7.5			1- SLIGHT odor 7.5'		
9.0	2 4	OS-6					CONTAMINATION IN		
	2 3	OS-7					FRACTURES		* 2.25
10.5	2 3								
12.0	3 4	OS-8					- STRONG odor		* 1.75
	2 2	OS-9							* 1.25
13.5	1 3						- SLIGHT odor		
15.0	2 3	OS-10		15.0			NO FRACTURES		* 1.0
	1 1	OS-11			MED. STIFF		NO odor		* .75
16.5	2 2								
18.0	2 3	OS-12							
							BOTTOM OF BORING AT 18.0'		
							SCREEN 5.0 - 15.0'		

REMARKS:::: CME MODEL 45 ; 6" Ø Hollow STEM AUGERS USED TO ADVANCE BORING

LAKEHEAD TESTING LABORATORY PROJECT NO. 84-250

BORING NO. L 5S

* POCKET PENETROMETER READINGS
:::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN - CREOSOTE LAGOONS — PROJECT NO. 84-250

ELEVATION ~675 GWL 0 HRS 12.0 inside AUGER — BORING NO. L 5M

HRS 24.0 S

DATE 6/20/84 FIELD ENGINEER C. PARKE — PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS**
1	2	3	4	5	6	7	8	9	10
						RED-BRN	CLAY AUGERED	CH	MOIST
6.5	1	OS-1			STIFF		6.5		*1.75
8.0	3 5								
	1 3	OS-2			V. STIFF				*2.25
9.5 10.0	4								
	1.9 /	Δ ST-1							
12.0	/ 2.0								
	2 2	OS-3			STIFF				*1.0
13.5 14.0	3								
	2.0 /	Δ ST-2							
16.0	/ 2.0								
	1 2	OS-4			MED. STIFF				*0.75
17.5	3								
20.0									
	2.0 /	Δ ST-3							
22.0	/ 2.0								
							AUGERED		
25.0							BOTTOM OF BORING AT 25.0		
							SCREEN 15.0 - 25.0'		

REMARKS***: CME MODEL 45; 6" Ø Hollow STEM AUGERS USED TO ADVANCE BORING BETWEEN SAMPLE INTERVALS; LAKEHEAD TESTING LABORATORY

PROJECT NO. 84-250

BORING NO. L 5M

* POCKET PENETROMETER READINGS

*** METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN CREOSOTE LAGOONS — PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS 29.0 Inside Auger — BORING NO. L-5D
18 HRS 30.7
DATE 6/19/84 FIELD ENGINEER C. PARKE — PAGE NO. 1 OF 2

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS**
1	2	3	4	5	6	7	8	9	10
	1	OS-1			STIFF	RED-BRN.	CLAY FILL	CH	*1.25 MOIST
1.5	1 2								
3.0	2 3	OS-2							*2.0
	1 2	OS-3							
4.5	3 3			5.0					
6.0	3 5	OS-4		6.0	V. STIFF	GRAY-BRN.	CLAY - SOME WOOD CHIPS		*2.5
	2 3	OS-5			STIFF	RED-BRN.	CLAY ?		*1.75
7.5	4								
9.0	3 4	OS-6		8.5			CONTAMINATION IN		*2.0
	3	OS-7					FRACTURES 8.5-15.3'		
10.5	4								
12.0	2 3	OS-8							
	2 2	OS-9							*1.5
13.5	2								
15.0	2 2	OS-10							*1.25
	1	OS-11		15.3		RED-BRN.	NO FRACTURES		*1.0
16.5	WOT 3			17.0	STIFF		CLAY		
18.0	1 2	OS-12							WET
	1	OS-13			MED. STIFF	REDDISH BRN	CLAY -		*.5
19.5	2								
21.0	1 2	OS-14							
	1	OS-15			SOFT				*.3
22.5	2								
24.0	1 1	OS-16							
	1	OS-17							
25.5	2								
27.0	1 1	OS-18							
	1	OS-19							
28.5	WOT 1								
30.0	1 1	OS-20							*.25

REMARKS*** CME MODEL 55 ; 6" Ø HOLLOW STEM AUGERS USED TO ADVANCE BORING

LAKE HEAD TESTING LABORATORY — PROJECT NO. 84-250

BORING NO. L-5D

* POCKET PENETROMETER READINGS
*** METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIOR WISCONSIN CREOSOTE LAGOONS PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS BORING NO. L-5D
HRS
DATE 6/19/84 FIELD ENGINEER C. PARKE PAGE NO. 2 OF 2

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS::
1	2	3	4	5	6	7	8	9	10
	1 1	OS-21			SOFT	REDDISH BRN	CLAY	CH	*.5 WE-
31.5	WOT 1								
33.0	1 2	OS-22							*.3
	1 1	OS-23							
34.5	WOT 2								
36.0	1 2	OS-24							
	WOT 1	OS-25							*.25
37.5	5 2			37.5	MED. DENSE	DK. BRN	FINE SILTY SAND -TR. GRAVEL	SM	
39.0	4 9	OS-26					-TR. CLAY		
	3 6	OS-27		39.5		BRN	SAND - SOME GRAVEL - TR. SILT	SW	
40.5	10 12								
42.0	18 23	OS-28			DENSE		SAND AND GRAVEL	SP	~1 1/2' SAND INSIDE
	32 44	OS-29			V. DENSE				AUGER
43.5	23 34						SAND - SOME GRAVEL - TR. SILT		
45.0	27 29	OS-30							~5.0' SAND INSIDE
	14 19	OS-31		46.3	DENSE				AUGER USED H2O
46.5	3 19				V. STIFF	RED-BRN	CLAY	CH	TO FLUSH
48.0	5 6	OS-32							*2.25 STOP 6/19
	2 3	OS-33			STIFF				*1.75
49.5	2 4								
51.0	2 3	OS-34							*1.25
	2 3	OS-35					SCREEN 37.0-47.0		*1.0
52.5	1 4								
54.0	2 2	OS-36			MED. STIFF				*.5
	WOT 2	OS-37							
55.5	WAT 2								
57.0	2 3	OS-38							
	WOT 1	OS-39			SOFT				*.25
58.5	WAT 2								
60.0	2 3	OS-40					BOTTOM OF BORING AT 60.0'		

REMARKS::::

PROJECT NO. 84-250
BORING NO. L 5D

:: POCKET PENETROMETER READINGS
:::: METHOD OF ADVANCING AND CLEANING BORING

PROJECT KOPPERS - SUPERIDE WISCONSIN - Additional Drilling PROJECT NO. 84-250
ELEVATION ~675 GWL 0 HRS DRY BORING NO. L-17
HRS
DATE 7/24/84 FIELD ENGINEER C.D PARKE PAGE NO. 1 OF 1

DEPTH FEET	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	CASING BLOWS	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS::
1	2	3	4	5	6	7	8	9	10
	1 1	OS-1			MED. STIFF	REDDISH BRN	CLAY FILL	CH	*.75 TSF MOIST
1.5	1 1								
3.0	1 2	OS-2							
	2 2	OS-3			STIFF				*1.25
4.5	2 2								
6.0	3 5	OS-4			V. STIFF		- FEW FRACTURES		*2.25
	3 4	OS-5					- SOME GRAY-MOTTLED		*2.5
7.5	3 5						TO 8.0'		
9.0	3 4	OS-6					- SOME FRACTURES		*2.5
	3 3	OS-7					- FEW FRACTURES		*2.0
10.5	1 3								
12.0	3 4	OS-8		12.0					*2.25
	2 3	OS-9			STIFF		- UNFRACTURED STICKY		*1.0
13.5	1 4								
15.0	2 3	OS-10							
							BOTTOM OF BORING AT 15.0		
							PIEZOMETER SCREEN 15.0-5.0		
							DENSITY SAND 15.0-4.0		
							BENTONITE Pellets 4.0-2.5		
							GROUT 2.5 - 0.0		

REMARKS::: LOCATED BETWEEN BORINGS L-5 AND L-6, 6"ø Hollow STEM AUGERS, CME Model 45, LAKEHEAD TESTING LABORATORIES PROJECT NO. 84-250

:: POCKET PENETROMETER READINGS BORING NO. L-17

::: METHOD OF ADVANCING AND CLEANING BORING

MONITORING WELL LOG

PROJECT Superior — WELL NO. R-1

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 8/31/82

GROUND ELEVATION

TOP OF WELL 674.29

DEPTH OF WELL (ft) 20

GROUND WATER DEPTH (ft):

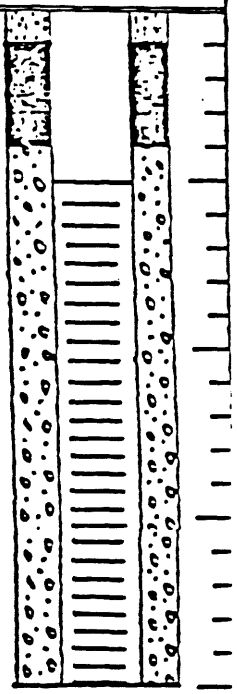
AT COMPLETION

AFTER HOURS

CASING MATERIAL 2" PVC — SCREEN 2" PVC

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Topsoil	
5		Reddish brown CLAY	
10			
15			
20			



MONITORING WELL LOG

PROJECT Superior — WELL NO. R-1d

DRILLING METHOD Hollow Stem Auger — GEOLOGIST

DRILLER Lakehead Testing — DATE 12/15/81

GROUND ELEVATION

TOP OF WELL 674.57

DEPTH OF WELL (ft) 23

GROUND WATER DEPTH (ft):

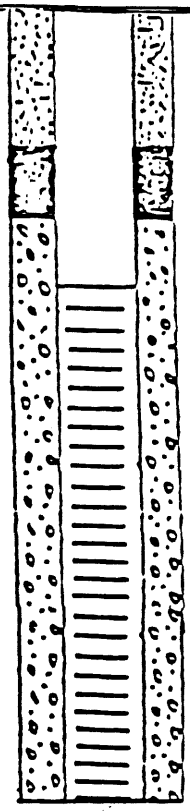
AT COMPLETION

AFTER HOURS

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

CASING MATERIAL 2" PVC — SCREEN 2" PVC

STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Topsoil	
5		Reddish brown CLAY	
10			
15			
20			
25			
30			



MONITORING WELL LOG

PROJECT Superior — WELL NO. R-2

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 8/31/82

GROUND ELEVATION

TOP OF WELL 673.60

DEPTH OF WELL (ft) 20

GROUND WATER DEPTH (ft):

AT COMPLETION

AFTER HOURS

CASING MATERIAL 2" PVC — SCREEN 2" PVC

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Reddish brown CLAY	
5			
10			
15			

MONITORING WELL LOG

PROJECT Superior — WELL NO. R-2d

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 12/15/81

GROUND ELEVATION

TOP OF WELL 673.08

DEPTH OF WELL (ft) 35'

GROUND WATER DEPTH (ft):

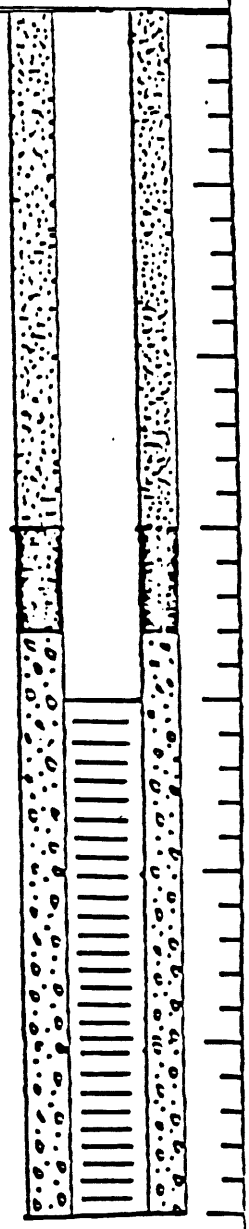
AT COMPLETION

AFTER HOURS

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

CASING MATERIAL 2" PVC — SCREEN 2" PVC

STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Reddish brown CLAY	



MONITORING WELL LOG

PROJECT Superior — WELL NO. R-3

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 8/31/82

GROUND ELEVATION

TOR OF WELL 673.60

DEPTH OF WELL (ft) 20

GROUND WATER DEPTH (ft):

AT COMPLETION

AFTER HOURS

CASING MATERIAL 2" PVC — SCREEN 2" PVC

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

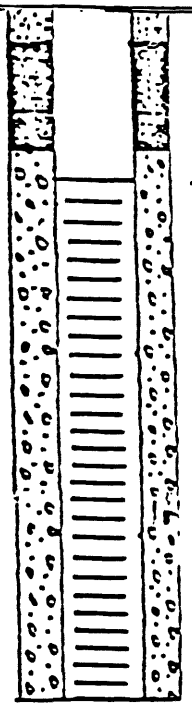
STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Reddish brown CLAY	

5

10

15

20



MONITORING WELL LOG

PROJECT Superior — WELL NO. R-3d

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 12/15/81

GROUND ELEVATION

TOP OF WELL 673.26

DEPTH OF WELL (ft) 45

GROUND WATER DEPTH (ft):

AT COMPLETION

AFTER HOURS

CASING MATERIAL 2" PVC — SCREEN 2" PVC

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Topsoil	
		Reddish brown CLAY	

5 10 15 20 25 30 35 40

MONITORING WELL LOG (Cont.)

PROJECT Superior — WELL NO. R-3d

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 12/15/81

GROUND ELEVATION

TOP OF WELL

DEPTH OF WELL (ft)

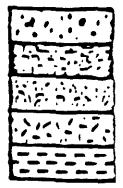
GROUND WATER DEPTH (ft):

AT COMPLETION

AFTER HOURS

CASING MATERIAL — SCREEN

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN



STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		(Cont.)	
45		Reddish brown clay	
50		Brown fine SAND, some silty clay	

MONITORING WELL LOG

PROJECT Superior — WELL NO. R-4

DRILLING METHOD HSA — GEOLOGIST

DRILLER Lakehead Testing — DATE 12/16/81

GROUND ELEVATION

TOP OF WELL 675.33

DEPTH OF WELL (ft) 34.5

GROUND WATER DEPTH (ft):

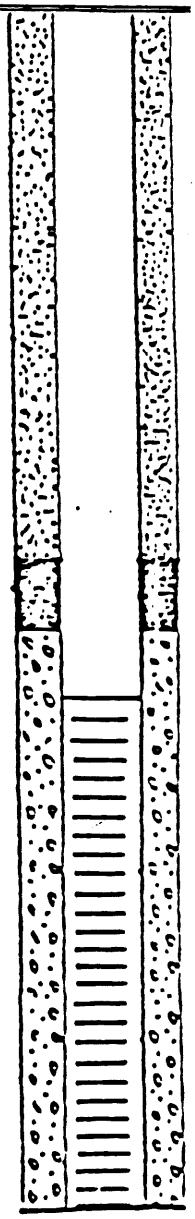
AT COMPLETION

AFTER HOURS

CASING MATERIAL 2" PVC — SCREEN 2" PVC

GRAVEL PACK
BENTONITE
BACK FILL
CONCRETE
SCREEN

STRATA DEPTH	SAMPLE DEPTH	DESCRIPTION	CONSTRUCTION
		Fill	
		Reddish brown CLAY	



ATTACHMENT 2

B-Series and W-Series Boring Logs

BORING LOG

SHEET 1 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 2 Oct 85

B-1

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY Billman/Colangelo DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	6/12	1 1	Soft brown to black organic rich topsoil	CH	Boring advanced w/ 6-in diameter HSA
	S	6/12	1 1	firm red brown highly plastic clay. w/rootlets		start drilling 3:50
	S	6/12	1 3			background ova 2-3 ppm
						borehole ovm-nd
						remove respirators
5	S	18/18	1 2 3	hairline vertical fracture, root holes and some gray clay filling fractures		
				Becoming soft with less fractures and roots		Boring continued with 3-in dia,. roller bit and freshwater
10	S	18/18	1 1 2			
15	S	18/18	1 1 1	Becoming soft to very soft		
20	S	18	1 0 1			
	S	18	1 0 1			
			1 01			

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 2 Oct 85

B-1

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY Billman/Colangelo DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	1 0 1	Same: very soft to soft, red-brown, highly plastic clay	CH	
	S	18/18	1 0 0			
				SAME		
30	S	18/18	1 0 0			
	S	18/18	1 0 1			
35	S	18/18	1 0 1	SAME		No Sample Taken
	S	18/18	0 0 1			
40	S	18/18	1 1 1	SAME		
	S	18/18	1 0 1			
45	S	18/18	1 3 7	Loose to medium dense, gray brown clayey silt w/ 1" ~~thick fine~~ sand ~~at bottom~~ of sampler and trace organics	ML	
					SP	
	S	18	9 12 15	Med dense brown poorly graded very fine to fine sand	SW	
				Medium dense multicolored well graded, fine to coarse sand with trace gravel		
50						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 3 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 2 Oct 85

B-1

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY Billman/Colangelo DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
50	S	10/10	9 9 11	3" of silt at bottom of sampler fining up sequence	SW w/ SP	
	S	18/18	5 7 9	stiff to very stiff, red brown, highly plastic clay	CH	
55	S	18/18	3 3 4	Becoming firm		Finish drilling 7:00 pm Bottom of boring 56.5 ft Boring grouted following day

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 1 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 4 Oct 85

B-2

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY _____ DRILLED BY _____

WATER ENTERS _____

SURFACE ELEVATION _____ ELEVATION DATUM _____

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	6/18	19 14 5	Sand, cinder, gravel fill	FILL	Boring advanced with 6" diameter HSA. Begin drilling at 4:30 pm. Background ovm 1-2 ppm Borehole ovm=ND above background
5	S	18/18	1 3 5	Firm to stiff red-brown highly plastic clay fractured with grey clay in-fillings	CH	Switched to rotary wash drilling at 9 ft with 3" diameter bit and freshwater
10	S	18/18	2 2 2	Becoming soft to firm		
15	S	18/18	1 1 1	Becoming very soft to soft		
20	S	18/18	1 1 1	Fractures absent less grey clay particles		
	S	18/18	1 1 1	No grey clay particles Soft		
25						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO. _____

BORING LOG

SHEET 2 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 4 Oct 85

B-2

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY _____ DRILLED BY _____

WATER ENTERS _____

SURFACE ELEVATION _____ ELEVATION DATUM _____

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	1 1 1	Same: very soft to soft, red brown highly plastic clay	CH	
	S	18/18	1 2 1			Sampler Settled 0.5 ft when weight was static
30	S	18/18	1 0 1	Soft very soft		
	S	18/18	0 1	Trace of grey clay particles small patch of silt and fine sand near bottom		
35	S	18/18	1 0 2			
	S	18/18	1 1 1			
40	S	18/18	1 0 1	gray clay particles ¼" diameter		
	S	18/18	1 3 2	firm clay at bottom of sampler trace pebbles		
45	S	18/18	1 2 3	abundent gray clay particles		
	S	18/18	1 2 2	trace gray clay particles		
50						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO. _____

BORING LOG

SHEET 3 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 4 Oct 85

RIG CME-750 ATV

B-2

PROJECT LOCATION Superior, WI

LOGGED BY _____ DRILLED BY _____

WATER ENTERS _____

SURFACE ELEVATION _____ ELEVATION DATUM _____

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
50	S	18/18	1 1 2	Same: Soft, red-brown, highly plastic clay	CH	Finish drilling 6:45
						Bottom of boring 52 ft
55						Boring grouted upon completion

WOODWARD-CLYDE CONSULTANTS

FIGURE NO. _____

BORING LOG

SHEET 1 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 28 Sept 85

B-3

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	8/12	2 2	Vegetation		Boring advanced by 6-in dia. HSA
	S	8/12	1 4	Firm, red brown, highly plastic clay with vertical fractures and roots	CH	Background OVM 1-11-2 ppm start drilling 08:30
	S	12/12	3 4			
				Becoming firm to stiff with root holes (no roots), many vertical fractures, gray clay along some root holes		Borehole OVM 1 ppm remove respirators
5	S	18/18	3 3 5			
				without rootholes - fractures present		
10	S	18/18	1 3 4			
				becoming free of fractures		
15	S	18/18	2 3 4	¼" thick fine to med. sand in bottom of sampler	W/SP	
	S	18/18	3 3 3	1" thick sand layers at 16.5 and 17.0'		ATD
				very loose, red-brown, fine sand with some silt	SP	
20	S	18/18	3 2 2			
				with 1" highly plastic clay in bottom of sampler	W/CH	
	S	18/18	1 2 4	firm, red brown highly plastic clay with 2" gray sand in bottom sampler	CH	
				loose , brown fine to medium sand with some coarse sand and fine gravel	SW	
25						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 28 Sept 85

B-3

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	1 2 3	Same: Loose, brown, fine to medium sand with coarse sand to fine gravel	SW	sand moving into casing-8 ft sand in augers prior to attempting 27' sample
				becoming medium dense		sand in at 17 ft prior to roller core switch to 2 15/16" dia tricone roller bit and water
30	S	0/18	7 11 11			
	S	3/18	3 3 4	loose, gray-brown, clayey silt with some sand and organic fragments	ML	
35	S	15/18	2 3 4	Firm red brown highly plastic clay, thinly laminated with gray clay and some sand and trace gravel becoming gray and silty at about 35.6 ft	CH	
	S	18/18	7 20 31	Loose gray, clayey silt	ML	
				Dense, gray brown, fine silty sand becoming medium to coarse sand and fine gravel at about 38.3 ft	SM	
40	S	12/18	11 10 16	more coarse sand and fine gravel red-brown highly plastic clay at bottom of sampler	SW	
					CH	
	S	8/18	8 12 14	very stiff, red-brown, highly plastic clay (dry)		
45	S	18/18	4 4 6	Becoming stiff		Finish drilling 12:45
						Bottom of boring 46 ft
						Boring grouted upon completion
50						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 1 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 26 Sept 85

B-4

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	3/18	13 50/.2'	coarse gravel	FILL	boring advanced with 6-in diam. HSA start 4:05
				gray, crushed granite fill		
				firm to stiff, red-brown, highly plastic clay with roots	CH	background OVM = 0.7 ppm
5	S	12/18	3 7 8			OVM in borehole 0.7 ppm remove respirators
				becoming firm with trace vertical fractures and less roots		
10	S	18/18	2 3 4			
				becoming soft to firm, free of fractures and roots		
15	S	18/18	1 2 2			
				becoming very soft		
20	S	18/18	1 0 1			samples wet but no free water in hole
	S	18/18	1 0 1			
25						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 26 Sept 85

B-4

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	1 0 1	very soft to soft red brown, highly plastic clay, with ¼" pebble of rounded granite	CH	
	S	18/18	1 0 1			
30	S	18/18	1 1 1	SAME		
	S	18/18	1 0 2			
35	S	18/18	1 1 2	SAME		
	S	18/18	1 1 2			
40	S	18/18	1 1 2	with 1" thick silty clay lens with trace sand at 39.5 ft		
	S	18/18	2 2 2	with a few scattered sand grains		
45	S	18/18	2 1 2	no sand detected		6:29 bottom of boring 46 ft bottom grouted upon completion

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 1 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 28-30 Sept 85

B-5

PROJECT LOCATION Superior, WI

RIG CME-750 ATC

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	12/18	7 11 16	Brown to black gravel and clay fill	FILL	Boring advanced with 6-in dia. HSA
						start drilling 5:40 background OVM = ppm (perched water?)
				stiff, red brown highly plastic clay with vertical hairline fractures	CH	
5	S	18/18	3 4 6			borehole OVM 1 ppm remove respirato
				becoming firm with some root holes and gray clay along some fractures		
10	S	18/18	2 2 3			
				becoming free of fractures and root holes		
15	S	18/18	2 2 3			
20	S	18/18	2 2 3	SAME		stop drilling 6:15 resume 10-1-85 @ 8:00
	S	18/18	2 2 3			
25						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 28-30 Sept 85

B-5

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	2 2 4	Firm, red brown, highly plastic clay	CH	
	S	18/18	2 2 2	SAME		
30	S	18/18	3 4 5	firm, red brown highly plastic clay with 1" medium sand stringer, at bottom of sample. thin gravel layer		
	S	6/18	5 11 6	loose clay soft with 3" thick coarse sand layer at bottom of sample and medium gravel	W/SW	
					SW	
35	S	18/18	3 7 13	very soft highly plastic clay with trace sand ¼" gravel layer	CH	
	S	12/18	3 5 9	becoming stiff to very stiff with some ¼" pebbles and fractures with gray clay filling		
40	S	18/18	3 6 7	with trace fine gravel		
	S	18/18	3 5 7			
45	S	8/18	3 6 8			
	S	18/18	5 15 42	sampler pushed rock		detected (chatter) by driller
				coarse sand (?) or gravel (?)	SW	

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 3 OF 3

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 28-30 Sept 85

B-5

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
50	S	24/24	2 3 2 2	soft, red-brown, highly plastic clay	CH	
	S	24/24	2 2 2 2	SAME		
55	S	24/24	1 2 2 3			
	S	24/24	2 2 3 3	SAME		Finish drilling 3:00
60						bottom of boring 60 ft boring grouted upon completion
						80 gal water 94 lb bags cement 26 lb bentonite

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 1 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 3 Oct 85

W-1

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY Billman/Colangel DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION 670.9 ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	12/18	1 1 2	Soft, brown to black, highly plastic clay fill w/organics and linders	FILL	Boring advanced with 6-in dia HSA
						Begin drilling 11:00
				Firm red/Brown stiff highly plastic clay with Rootlets fractures infilled with gray clay	CH	Background OVM=1.5-2 ppm
5	S	10/18	2 2 3			Borehole ovm ND above background. Remove respirators
10	S	24/24	2 1 3 3	Root holes and trace roots,		
15	S	18/18	1 2 2	Less fractures		
				Soft to very soft clay free of fractures		
20	S	18/18	1 1 4			
	S	18/18	1 1 1	Clay becoming moist		

BORING LOG

SHEET 2 OF 2

PROJECT NAME Koppers Wood Treating Plan

PROJECT NO. 85C3134-2

DATE 3 Oct 85

W-1

PROJECT LOCATION Superior, WI

RIG CME-750 ATV

LOGGED BY Billman/Colangelo DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION 670.9 ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	1 1 2		CH	
	S	18/18	1 1 1	SAME		
30	S	18/18	1 1 1			
	S	18/18	1 1 2	Trace of organics		
35	S	18/18	1 1 2			
	S	18/18	1 1 2	Clay becoming dry		
40	S	18/18	1 1 2	1/8" diameter gray dry clay spots found in clay		
42	S	18/18	2 5 6	Medium dense, fining up sequence multi colored fine to coarse sand w/trace fine gravel 4" of red brown plastic clay at bottom	SW	ATD Water rises to 18.7 ft
44						sand enters auger, drill out w/3-in di roller bit and fres water (25 gal)
45	S	6/18	2 4 3	Firm red brown highly plastic clay, trace of dry gray clay particles	CH	
	S	/18	1 2 3	some clay particles & pebbles		BoB 48½

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

MONITORING WELL INSTALLATION REPORT

Well No. W-1

Project Koppers Wood Treating Plant Location

Project No. 85C3134-2 Installed By Twin City Testing Date 3 Oct 85 Time 3:00pm to 7:00p

Method of Installation Boring backfilled to 44.5 with sand. Set pvc screen and riser pipe to 44.5 ft. Added sand filter pack to 35 ft and peltonite seal to 31.8 ft. Remainder of annulus filled with cement-bentonite grout (tremmied). Well developed by removing about 3 well volumes of water with a peristaltic DC operated pump.

LOG OF BORING AND MONITORING WELL

BORING

Depth in ft.	Description	Symbol
	See Boring Log W-1	

Type of Well Groundwater Observation Well

Ground Elev. Top of Riser Elev.

Protective Casing 3.1 ft

Vented Cap

L_1: 3'
L_2: 31.8
L_3: 3.2
L_4: 9.5
L_5: 44.5
L_6: 3.1
L_7: 48.5

I.D. of Riser Pipe 1 7/8"

Type of Pipe Schedule 40 PVC

Type of Backfill Around Riser Cement-bentonite grout

Depth Top of Seal Elev. 31.8

Type of Seal Material Peltonite

Depth Top of Filter Elev. 35

Type of Filter Material medium grain sand (SP)

Size of Openings 0.01"

Diameter of Piezometer Tip 2 3/8"

Depth Bottom of Piez. Elev. 44.5

Depth Bottom of Boring Elev. 48.5

Diameter of Boring 6"

Remarks Protective casing 5.3 ft Riser pipe, five 10 ft. sections of riser at 9' 10", 1 screen at 3.1 ft. All threads wrapped with teflon tape. cement bentonite slurry composed of 4, 94 lbbags of cement, 50 gallons of water and 10 lbs of bentonite.

BORING LOG

SHEET 1 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 27 Sept 85

W-2

PROJECT LOCATION Superior, WI

RIG CME 750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION 670.6 ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	12/18	1 1 6	Topsoil		Boring advanced w/ 6-in dia. HSA
	S	18/18	1 3 3	Firm, red brown highly plastic clay w/vertical fractures and roots	CH	Background ovm = 1ppm start drilling 11:15
	S	18/18	2 3 3		CH	
5	S	12/18	1 3 4	Black shiny oily material along some fractures		No ovm readings above background in bore-hole, remove respirators
				Becoming free of visual fractures and any indications of contamination		
10	S	18/18	2 2 3			
15	S	18/18	2 2 3			
				Becoming soft		
20	S	18/18	2 1 2			
	S	18/18	1 1 1			
25						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 27 Sept 85

W-2

PROJECT LOCATION Superior, WI

RIG CME 750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	1 1 2	SAME	CH	
	S	18/18	0 1 1			weight of drill steel pushes sample 8"
30	S	18/18	1 1 2	Trace sand grains		Break 12:45 - 1:30
	S	18/18	1 0 1	Clay becoming very soft		
35	S	18/18	1 1 1	Clay becoming soft		
	S	18/18	1 1 2			ATD
40	S	18/18	5 6 10	Medium dense, red brown, very finesilty sand w/some small gray silty zones	SM	
	S	12/18	6 7 10	Becoming clean and fine to coarse(grading down) stiff to very stiff, red brown, highly plastic clay with multiangle hairline fractures (Laminated)	SP CH	
45	S	18/18	4 6 10	Breaks along irregular fracture planes some gray clay in fractures		sample is dry
	S	18/18	3 3 4	Becoming firm to stiff		4:40 pm Bottom of boring 48.5 ft

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

MONITORING WELL INSTALLATION REPORT

Well No. W-2

Project Koppers - Superior Wisconsin Location

Project No. 85C3134-2 Installed By Twin City Testing Date 27 Sept 85 Time

Method of Installation Added sand to 43 ft. 5 ft pvc screen, 40 ft riser pipe to 43 ft. Added sand filter pack to 36.3 ft, peltonite seal to 35.6 ft. Remainder of boring grouted with cement-bentonite grout (tremmied). Locking protective casing grouted in place. Well developed by removing at least 3 well volume of water with a peristaltic pump.

LOG OF BORING AND MONITORING WELL

BORING

Depth in ft.	Description	Symbol
	See Boring Log W-2	

Type of Well Groundwater observation well

Ground Elev. Top of Riser Elev.

Protective casing

Vented Cap

L_1: 2'
L_2: 35.6
L_3: 0.6
L_4: 6.7
L_5: 40
L_6: 5
L_7: 48.5

I.D. of Riser Pipe 1 7/8"

Type of Pipe Schedule 40 pvc

Type of Backfill Around Riser cement-bentonite grout

Depth Top of Seal Elev. 35.6

Type of Seal Material Peltonite

Depth Top of Filter Elev. 36.3

Type of Filter Material medium grain sand

Size of Openings 0.01"

Diameter of Piezometer Tip 2 3/8"

Depth Bottom of Piez. Elev. 43

Depth Bottom of Boring Elev. 48.5

Diameter of Boring 6"

Remarks Material used:

4 bags cement (94 lb bags)

50 gal water

10 lbs bentonite

PVC threads wrapped with teflon tape

BORING LOG

SHEET 1 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 4 Oct 85

W-3

PROJECT LOCATION Superior, Wisconsin

RIG CME-750 ATV

LOGGED BY R. Colangelo DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION 671.3 ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	8/18	1 1 1	Top soil black cinders	fill	Boring advanced with 6 in diameter HSA
				Firm red brown highly plastic clay, fractured infilled with gray clay	CH	Begin drilling at 9:00
						Background ovm 2.3 ppm
				rootlets, gray dried clay particles (¼ diameter)		
5	S	16/18	1 3 2			Borehole ovm ND above background remove respirators
				Rootlets and clay particles absent		
10	S	0/18	1 1 2			No recovery
				Becoming soft; fractures absent, moist		
15	S	18/18	1 1 1			
20	S	18/18	1 0 1	Soft to very soft clay		
	S	18/18	1 1 1	Thin silty find sand lenses ½" thick		

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 4 Oct 85

W-3

PROJECT LOCATION Superior, Wisconsin

RIG CME750 ATV

LOGGED BY R. Colangelo DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION 671.3 ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	18/18	10 1	Same, very soft to soft, red brown highly plastic clay	CH	
	S	18/18	1 2 1			
30	S	18/18	1 1 1	SAME		
	S	18/18	1 1 1			
35	S	18/18	1 1 1			
				with/stiff gray clay particles		
	S	18/18	1 2	fine sand at tip of sampler multicolored medium to coarse with gravel	SW	ATD 34.5 10:15 27.2 10:26 23 10:39 17.6 11:30
	S	10/8	2 4 4	firm red brown highly plastic clay with ¼" diameter dry grey clay particles with small particles	CH	
40	S	18/18	1 1 2			BOB 43.5
45						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

MONITORING WELL INSTALLATION REPORT

Well No. W-3

Project Koppers Wood Treating Plant Location Superior, Wisconsin

Project No. 85C3134-2 Installed By Twin City Testing Date 4 Oct 85 Time 12:00pm-3:00pm

Method of Installation Boring backfilled to 41 ft with SP. sand. Set PVC screen and riser pipe to 41 ft. Added sand filter pack to 30.5 ft. Peltonite seal was set at 27.5 ft. Remainder of anulus filled with cement bentonite grout (tremmied). Well developed using a peristaltic pump, removing more than three volumes of water.

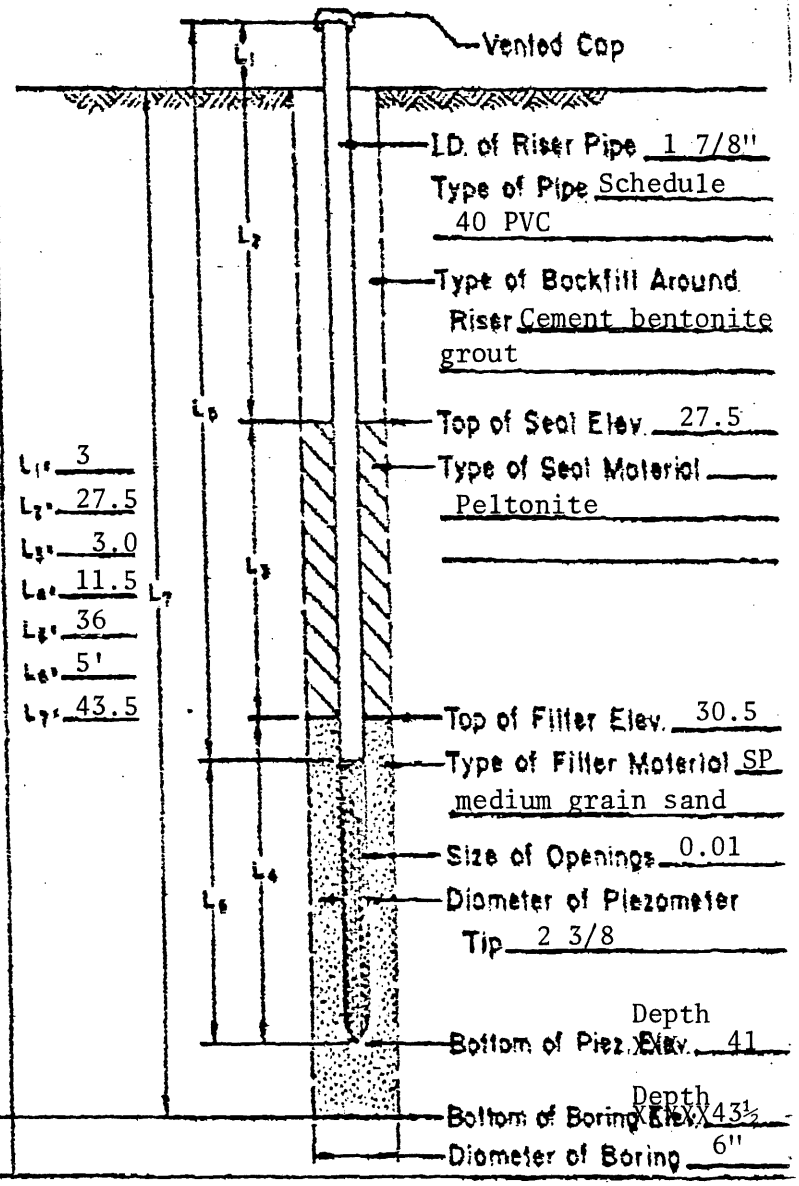
LOG OF BORING AND MONITORING WELL

BORING

Depth in ft.	Description	Symbol
	See Boring log W-3	

Type of Well: Groundwater Observation Well

Ground Elev. _____ Top of Riser Elev. _____



L1: 3
L2: 27.5
L3: 3.0
L4: 11.5
L5: 36
L6: 5'
L7: 43.5

I.D. of Riser Pipe 1 7/8"

Type of Pipe Schedule 40 PVC

Type of Backfill Around Riser Cement bentonite grout

Top of Seal Elev. 27.5

Type of Seal Material Peltonite

Top of Filter Elev. 30.5

Type of Filter Material SP medium grain sand

Size of Openings 0.01

Diameter of Piezometer Tip 2 3/8

Depth Elev. Bottom of Piez. 41

Depth Elev. Bottom of Boring 43½

Diameter of Boring 6"

Remarks Protective casing 5.3 ft, riser pipe 1 at 9'10" (5 used) 1, 5 ft screen at 4'10". 5 threads wrapped with teflon tape. 4, 94 lb bags of cement, 10 lbs of bentonite and 60 gal of water for slurry mixture.

MONITORING WELL INSTALLATION REPORT

Well No. W-4A

Project Koppers Wood Treating Plant Location Superior, Wisconsin

Project No. 85C3134-2 Installed By Twin City Testing Date 26 Sept 85 Time

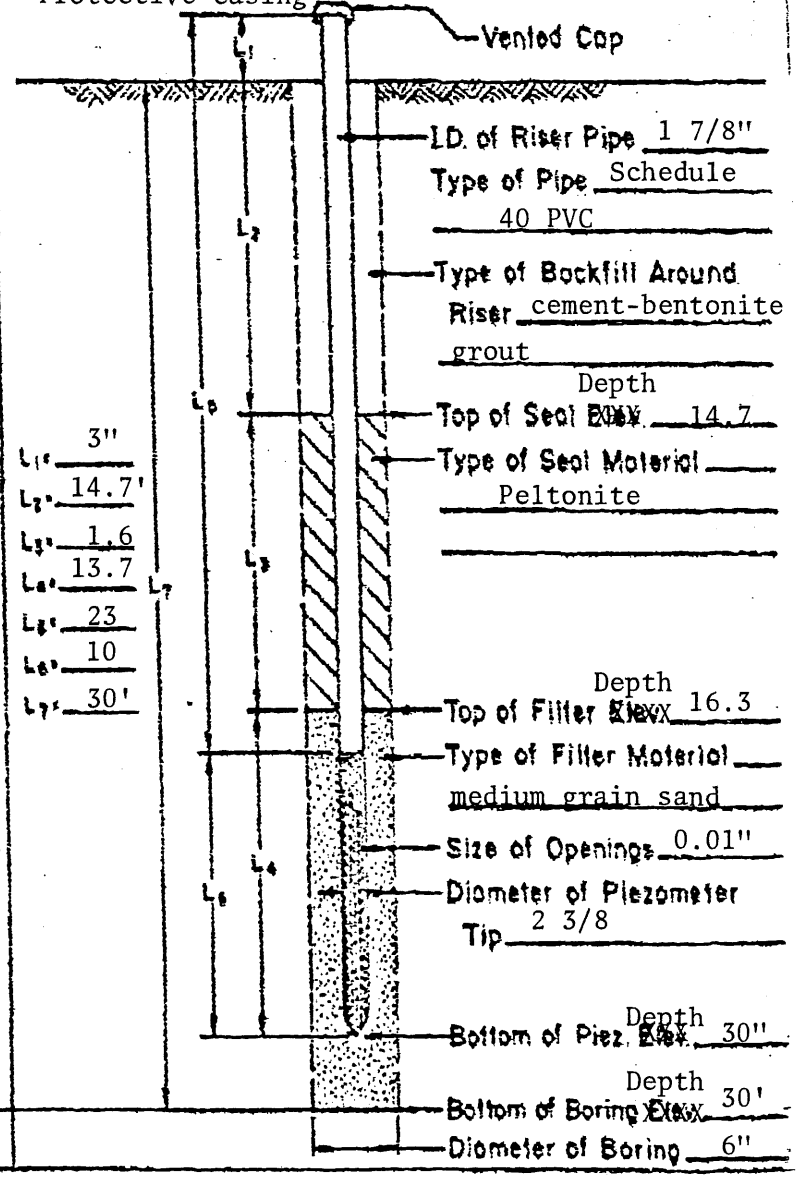
Method of Installation Set 10 ft pvc screen, 23 ft riser pipe to 30 ft. Pulled augers out; added sand, peltonite, grout (tremmie). Locking protective casing grouted in place. Well developed by removing 2 well volumes of water with a Koppers stainless steel bailer.

LOG OF BORING AND MONITORING WELL

BORING

Depth in ft.	Description	Symbol
	Boring advanced with CME-750 and 6-in dia HSA to 30 ft.	
	See Boring log W-4B for description of materials encountered	

Type of Well Groundwater Observation Well



Remarks Grout material:
20 gal water
2 94-lb bags cement
10 lb. bentonite

PVC threads wrapped with teflon tap

BORING LOG

SHEET 1 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

DATE 25 Sept 85

W-4B

PROJECT LOCATION Superior, Wisconsin

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
0	S	3/24	13 15 9 4	Dark brown, sandy clay fill w. rock fragments	Fill	Boring advanced w/ 6-in dia, HSA
				1" organic layer (old topsoil)		Background OVM 1.8-2.2 ppm, sampler pushing rock
	S	24/24	3 5 6 6	Stiff, red brown, highly plastic clay w/ fine vertical fractures	CH	Take off respirators ovm 2.8 ppm in bore-hole
5	S	18/18	3 4 7			some blocky structure
	S	18/18	2 4 6	with greenish gray clay along some fractures		
10	S	0/18	3 5 5	Sampler pushing rock fragment		
	S	18/18	2 3 3	Firm red-brown, highly plastic clay (free of fractures) w/ piece of wood sample break along horizontal planes		
15	S	18/18	2 3 3	Trace water on sampler sand grains		
	S	19/18	2 2 2	with fine verical fractures and root and root holes with green clay infilling		
20	S	18/18	3 3 4	Sand	W/ SP	
				Sand becoming interbedded with 1" thick fine sand layers (sp)		free water in hole @ 16 ft
	S	18/18	3 2 3	loose, brown and black fine sand with some coarse sand to fine gravel	SP	
				firm, red brown, highly plastic clay becoming sandy	CH	10:30am - shutdown work

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

BORING LOG

SHEET 2 OF 2

PROJECT NAME Koppers Wood Treating Plant

PROJECT NO. 85C3134-2

W-4B

PROJECT LOCATION Superior,Wisconsin

DATE 25 Sept 85

RIG CME-750 ATV

LOGGED BY B. Billman DRILLED BY Twin City Testing

WATER ENTERS

SURFACE ELEVATION ELEVATION DATUM

DEPTH	SAMPLE TYPE	SAMPLE REC	SAMPLE RESIST	DESCRIPTION	U.S.C.	SPECIAL NOTES AND FIELD OBSERVATIONS
25	S	3/18	4 7 12	Same: Medium dense, red brown, clayey, fine sand	SC	Resume drilling @ 12:30
	S	5/24	3 5 6 7	stiff, red brown, highly plastic clay w/ 1" thick sand layers	CH w/ SP	Sand entering augers to 17 ft-switch to 2 15/16" dia tricone roller bit and water to clean out augers
30	S	18/18	3 3 4	firm, red brown, highly plastic clay w/ fractures and a few ¼ in diameter pebbles free of sand		Photo 5,6 Till
	S	18/18	2 3 4	1 to 2 in thick piece of decomposed wood		
35	S	18/18	8 8 12	medium dense, red brown very clayey silt with trace sand and roots, 1" sand at base of sampler	ML	
	S	18/18	2 4 6	medium dense, brown & black, fine grain sand	SP	
				firm to stiff, red-brown, highly plastic silty sandy clay	CH	
40	S	4/18	8 10 12	very stiff, red-brown, finely fractured high plastic silt with trace fine gravel clay roots decomposed black organic matter	M	Photo 8,7
	S	18/18	3 5 6	Becoming stiff		
45	S	18/18	2 2 2	Becoming firm		
						Bottom or boring 46 ft set well W-4B to 41 ft W-4A set to 30 ft
50						

WOODWARD-CLYDE CONSULTANTS

FIGURE NO.

MONITORING WELL INSTALLATION REPORT

Well No. W-4B

Project Koppers Wood Treating Plant Location Superior, WI

Project No. 85C3134-2 Installed By Twin City Testing Date 26 Sept 85 Time

Method of Installation Borehole filled with sand to 41 ft. Remove augers and set 5 ft pvc screen, 35 ft riser pipe to 41 ft. Sand filter pack placed to 32 ft. Peltonite seal placed to 30.5 ft. Remainder of borehole grouted with cement-bentonite (tremmied). Locking protective casing set. Well developed by removing at least 2 well volumes with a Koppers stainless steel bailer.

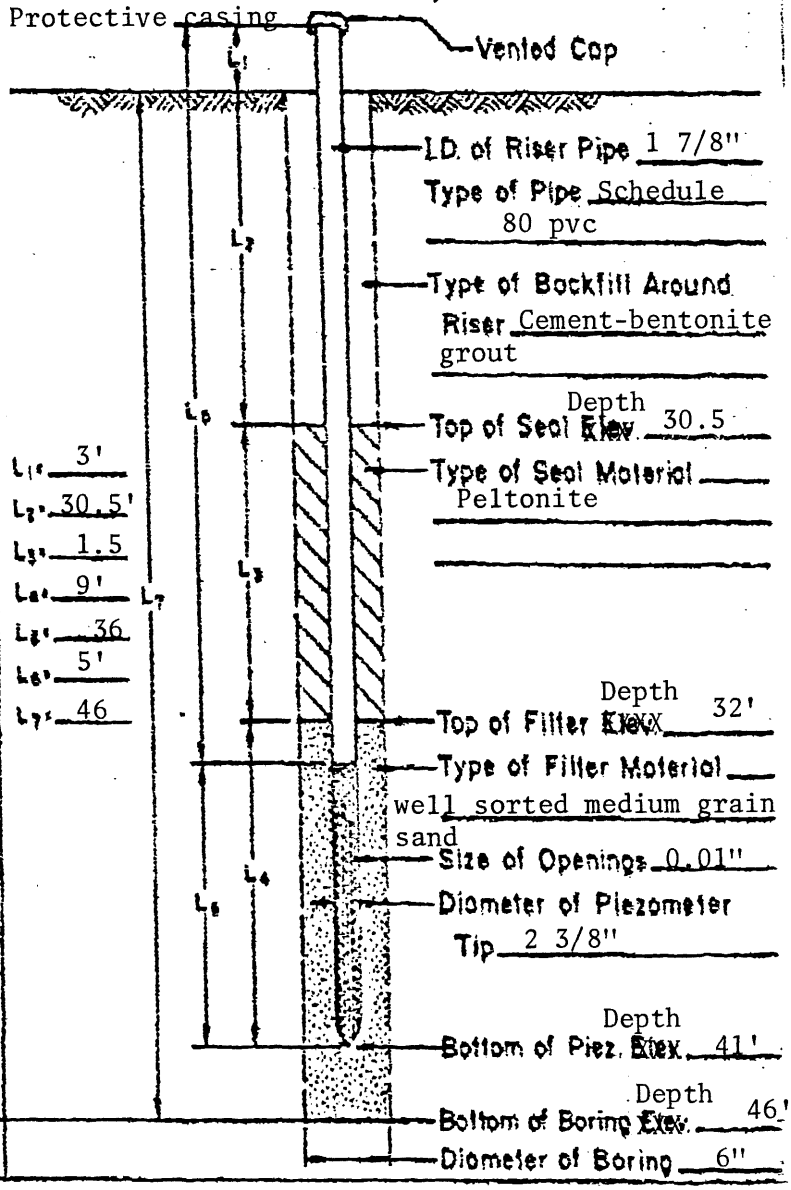
LOG OF BORING AND MONITORING WELL

BORING

Depth in ft.	Description	Symbol
	See Boring log W-4B	

Type of Well Groundwater Observation Well

Ground Elev. Top of Riser Elev.



Remarks Materials used for grout

45 gallons water

4 94-lb bags cement

10 lbs bentonite

Threads on pvc pipe wrapped with teflon tape