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Village of Whitefish Bay

Site Investigation Report

Former Whitefish Bay Landfill
Milwaukee, Wisconsin

5/92

STS

PRIVILEGED AND CONFIDENTIAL

May 20, 1992

Mr. William Pagels
Village Attorney
Village of Whitefish Bay
5300 Marlborough Drive
Whitefish Bay, WI 53217

RE: Site Investigation Report for the Former Whitefish Bay Landfill, 5201 West Good Hope Road, Milwaukee, Wisconsin -- STS Proposal No. 82149XF

Dear Mr. Pagels:

At the request of the Whitefish Bay Village Board, we have prepared the Site Investigation report updating the work performed at the Whitefish Bay Ash Landfill site located at 5201 West Good Hope Road. The report presents the results of our soil vapor investigation and groundwater monitoring survey. Wehave also presented remedial alternatives and a conceptual design for the recommended alternative, groundwater extraction followed by treatment for discharge to Lincoln Creek or other surface water systems.

Five (5) copies of this report are included for your use. Thank you for the opportunity to work on this project. We look forward to continued service to the Village.

Yours sincerely,

STS CONSULTANTS, LTD.

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KRH/ed-m11/82149XF
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Report

PROJECT

SITE INVESTIGATION REPORT
FOR THE FORMER WHITEFISH BAY LANDFILL
5201 WEST GOOD HOPE ROAD
MILWAUKEE, WISCONSIN

CLIENT

MR. WILLIAM PAGELS
VILLAGE ATTORNEY
VILLAGE OF WHITEFISH BAY
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Project No.

82149XF

Date

MAY 20, 1992

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SITE INVESTIGATION REPORT
FOR THE FORMER WHITEFISH BAY LANDFILL
5201 WEST GOOD HOPE ROAD
MILWAUKEE, WISCONSIN

1.0 INTRODUCTION

1.1 Site Description

The Village of Whitefish Bay (WFB) owns approximately eleven acres south of Good Hope road and east of 53rd Street extended in the City of Milwaukee, Wisconsin. The site was used by the Village for disposal of incinerator ash and some yard waste and was closed during the 1970s. The major portion of the property lies west of Lincoln Creek with a smaller parcel located on the east side of the Creek. A detailed legal description is included in the Appendix. The site is east of a new condominium development, north of Webster Middle School and west of several small commercial facilities along Good Hope Road. To the north are several industrial plants. Surrounding areas are predominantly residential. Figure 1 shows the Site Location and Figure 2 is a Vicinity Diagram identifying adjacent properties.

The site is presently undeveloped although the Village and a local developer are interested in expanding the adjacent condominium development onto portions of this property. It has revegetated with small trees, scrub vegetation and grasses. The site was regraded in 1980 to meet Wisconsin Department of Natural Resources (WDNR) requirements for closure. A grading plan is included in Appendix D. The topography decreases slightly in slope to the east and southeast with a noticeable mound in the southern one-third of the property.

Access to the property from the north is limited by a chain link fence and locked gate. However, the site is accessible from the south and from the west. There is evidence that the property is used for occasionally jogging and as a play area for children.

1.2 Project Objectives and Scope

STS Consultants, Ltd. (STS) was retained by the Village of Whitefish Bay to provide geotechnical and environmental investigative services on the property after a preliminary assessment identified chlorinated solvents on-site. A Phase II environmental assessment was conducted and the results were submitted to WFB on January 11, 1989. The report was subsequently submitted to the WDNR for review on February 2, 1989.

Work on the site continued through the subsequent years. These efforts included further evaluation of the major areas of soil contamination, continued monitoring of the groundwater, investigation of various potential sources of chlorinated solvents on-site and identification and evaluation of remedial alternatives. The objective of the continuing work was to identify the most cost-effective remediation alternative which was also compatible with nearby development and WFB's long term goals for the property.

The specific work scope items to accomplish this objective were as follows:

Phase III - Further Assessment of Site Conditions

- Installation of seven (7) additional soil borings (B-17 to B-23) with two (2) converted to groundwater monitoring wells (BW-18, BW-22).
- Additional sampling round on six (6) monitoring wells.
- Soil vapor survey at over 70 locations in the suspected on-site source areas.
- Permeability tests in wells to evaluate hydraulic conductivity.
- Water level readings to confirm shallow groundwater flow direction.

Phase IV - Evaluation of Remedial Alternatives

- Identify possible remediation alternatives.
- Review applicable case studies.
- Assess advantages and disadvantages of alternatives.

- Recommend specific alternative and develop conceptual remedial design for this option.
- Document all results into a report for submittal to WDNR.

1.3 Report Organization

This Site Investigation report has been organized into five (5) major sections and a comprehensive Appendix. The conceptual design for the recommended alternative is included in the last section of the report. The following is a summary of each report section and what information is contained therein:

1.0 Introduction - Contains a basic site description and information regarding project objectives and report organization.

2.0 Technical Background - Presents information on the regional and local geology and hydrogeology, as well as a brief summary of work reported to date.

3.0 Results and Analyses - Includes data generated since the last report and evaluation of that information.

4.0 Evaluation of Remedial Alternatives - Identifies various remedial options and presents an evaluation of their technical implementability, effectiveness and relative cost.

5.0 Conceptual Design Action - Describes the recommended alternative in detail and provides a conceptual design for implementation.

Appendix -

The Appendix includes Figures and Tables, detailed descriptions of procedures, boring logs, well diagrams and analytical data sheets.

2.0 TECHNICAL BACKGROUND

2.1 Regional Topography and Hydrogeology

The site is located in an area of gently rolling topography at approximate USGS elevation +700 MSL. The Milwaukee River, the predominant geomorphic feature in the vicinity of the site, is located approximately 2-1/2 miles east of the site. The topographic relief between the Milwaukee River and the site is approximately 120 feet. Lake Michigan is located approximately 4-1/2 miles east of the site.

The site lies in the southern portion of the Lake Michigan basin hydrologic province. The Lake Michigan basin consists of several subbasins whose main stem streams discharge directly into Lake Michigan and into Green Bay (Skinner and Borman, 1973). The Milwaukee River flows south to where it joins the Menomonee River and ultimately Lake Michigan about 9 miles southeast of the site.

Surface water over the majority of the site flows mainly to the east towards Lincoln Creek, a recharge stream. Lincoln Creek joins the Milwaukee River about 3 miles southeast of the site.

2.2 Regional Geology

The General Soil Map in the "Soil Survey of Milwaukee and Waukesha Counties, Wisconsin" (SCS, 1971) shows the site as underlain by the Ozaukee-Morley-Mequon association of soils. These soils have formed in glaciated uplands where the soils formed in a thin layer of loess (wind deposits) over glacial deposits. The Ozaukee and Morley soils are greatly sloping and occupy ridges and side slopes of glacial moraines. The Mequon soils are also gently sloping and are found in drainageways or old lake basins. The soils mapped on-site include Clayey land, Ashkum silty clay loam and Mequon silt loam. Clayey land is a miscellaneous land type soil that consists of fill areas and of cut or borrow areas. The Ashkum silty clay loam and Mequon silt loam are reported to have moderately slow permeability.

Unconsolidated Pleistocene deposits underlie the surficial soil deposits. These deposits are part of the terminal moraines from the Lake Michigan glacier (Alden, 1918) of Wisconsin Age. They consist of till and stratified sand and gravel deposits. The Pleistocene deposits are underlain by Silurian Dolomite. This formation includes the Cayugan, Niagaran and Alexandrian series. The depth to bedrock is anticipated to be 15 to 30 meters (Mudrey, et al, 1982).

The Silurian Dolomite is in turn underlain by the Ordovician Maquoketa Formation which consists of shale, dolomite shale and dolomite. This formation is considered a regional confining bed. The Maquoketa Formation overlies the Galena Dolomite, Decorah and Platteville Formation. These are underlain by sandstones of Cambrian and Ordovician ages.

2.3 Regional Hydrogeology

The two (2) major aquifers regionally are the Niagara Dolomite Aquifer of Silurian age, and the sandstone aquifer, which consists of sandstones of Cambrian and Ordovician ages (Green and Hutchinson, 1965). The Niagara aquifer is generally unconfined and was historically used for shallow wells. The sandstone aquifer is a high yield groundwater aquifer used as a water source for some deeper wells in the area. In the site area, the sandstone aquifer is confined by the Maquoketa shale. Presently and for many years, the site area has been supplied by a municipal water system which obtains its water from Lake Michigan.

2.4 Site History and Proposed Usage

This property was purchased by WFB in 1960 for use as an ash disposal site. Prior to that time the site and adjacent property west to 55th Street was owned by Mr. Albert Deshur and Mr. Norman Nadler, who operated a dump site on portions of the entire property. The exact areas filled prior to WFB ownership are not clearly defined at this time. WFB operated the site for disposal of incinerator ash, large debris and yard wastes from 1962 to 1972. The Village staff manned the site and controlled the placement and governing of materials disposed of there. The site was closed in 1972 after less than half of the parcel was used for ash disposal. The WFB staff only disposed of limited amounts of yard waste on the southern portions of the property. The remainder of the southern portion of the site was used to stockpile clean soil materials for cover. After closure, some of this stockpile was used to grade the site. Access was controlled from the north, however, the south end of the property (adjacent to the newly constructed Hustis Road) was not fenced.

WFB has not used the property for any purpose since 1972. The site has generally revegetated. There is no observable seepage nor noticeable odors on the property at the present time. Presently, the site is zoned for single/multifamily residential development and there is interest on the part of the adjacent property owner to expand the new condominium development onto the WFB property. The Village is interested in pursuing this matter since current plans include no specific use for the property under Village ownership.

2.5 Summary of Work Reported to Date

Work on this project was initiated in 1988 in order to evaluate the historical use of the property and establish whether physical or environmental limitations had occurred which should be disclosed prior to sale. Subsequently, solvent impacts were detected in the soil and groundwater in the southern portion of the site. WFB notified WDNR of this finding in their letter dated January 12, 1989 and subsequently submitted a Phase II Environmental Reconnaissance report for WDNR review.

The following is the executive summary from the Phase II Environmental Reconnaissance report written in January, 1989.

> "A Phase II Environmental Reconnaissance was conducted on an eleven acre incinerator ash/demolition landfill owned by the Village of Whitefish Bay and located on the north side of Milwaukee. The objective of this study was to determine if past measurement of contamination might be indicative of more environmental impairment on the property. To evaluate the site, STS Consultants advanced seven (7) additional soil borings and located three (3) wells on the southern portion of the property. Soil samples were tested for leachable metals and

volatile organic compounds, and water samples were analyzed for volatile organic compounds.

The soil/fill did not contain leachable metals which exceeded hazardous waste criteria. However, some fill did contain solvents above the hazardous waste criteria concentrations and soils were also found to contain elevated concentrations of various solvents. Groundwater was found to flow to the west with on-site and downgradient groundwater quality exceeding NR140 Enforcement Standards for tetrachloroethene, trichloroethene and dichloroethene.

The Village is advised to notify Wisconsin DNR that the groundwater enforcement standards have been exceeded and to begin development of a remediation program. It is recommended that further investigation to identify on-site sources and soil permeability for groundwater extraction be undertaken to meet the Wisconsin DNR requirements."

3.0 RESULTS AND ANALYSES

3.1 Containment Migration Pathways and Receptor Assessment

Contaminants can migrate from the site through the air, surface water, groundwater, and to a limited extent through the soil. Based on the results of the site investigation, leachate seeps have not been observed which could impact nearby surface waters (Lincoln Creek). No obvious odors or elevated ambient PID readings were detected during the subsurface investigation at the site. During walkover of the landfill cover, no obvious odors were detected. Therefore, the results of the site investigation indicates that air and surface water pathways are of minimal concern at the site.

Affected groundwater is believed to flow to the southwest. At present, there are no private drinking water wells immediately downgradient of the site. Drinking water in the area is obtained from a municipal water system supplied by Lake Michigan. Potential contaminant receptors along this flow path would include any new groundwater users who might install wells in the area. Given the municipal water supply, this scenario is unlikely and illegal. Direct contact with the groundwater on or directly downgradient is minimized because the depth to groundwater is 10 to 20 feet below ground surface and there is no nearby surface water discharge area. Further, no utility lines, which can be potential sources of off-site migration, transect the site. The installation of the groundwater extraction and treatment system, which is discussed in Section 5.0, should mitigate the potential for future off-site migration of contaminants and will reduce long term potential for future exposure pathways.

Because affected soils are greater than 3 feet below ground surface, there is no direct exposure to contaminated soil at the present time. Therefore, physical contact or ingestion of affected soil is not considered a viable exposure pathway of concern. Future development on portions of the site with high solvent impacts will be prohibited by deed restrictions.

In summary, there are no completed exposure pathways emanating from the site; therefore, there are no direct receptors. The installation of the remedial system (see Section 5.0) and placement of deed restrictions should mitigate the potential for future off-site migration of contaminants and limit the potential for future off-site receptors.

3.2 Soil Vapor Study

3.2.1 Objectives and Approach

In order to evaluate the extent of contamination in the soil, a soil vapor study was undertaken. In this portion of the study, the areas surrounding borings where solvents were previously confirmed were evaluated. A grid based sampling pattern was proposed with 50 foot spacing between grid points at two (2) locations on the site. A fifty-nine (59) sampling locations were identified and are illustrated on Figure 7, Appendix B. The locations were centered in two (2) areas where high levels of solvents were confirmed in the previous borings.

Drilled borings were advanced at each designated node on the grid. Samples were collected from depth of 5 to 6 feet and 6 to 7 feet below ground surface at each location. These samples were allowed to warm and were then screened using the PID. The procedures for both drilling and screening are included in Appendix D. Each PID reading is presented on a summary table, Table 1, Appendix C, and were subsequently plotted on Figure 8, Appendix B, to allow assessment of the extent of contamination.

3.2.2 Results of the Vapor Survey

The vapor survey data indicated that there were essentially three (3) areas of solvent contamination on the site. These were:

1. A 50 foot by 25 foot area surrounding Boring B-15 in the central portion of the property.

2. A 25 foot by 50 foot plume surrounding Boring B-21 in the southern mid-section of the property.
3. An approximately 100,000 square foot area in the southwest portion of the property.

Figure 7, Appendix B, illustrates these areas of impacts with the color gradation of the levels detected. This interpretation was based on the PID screening results. However, where selected samples from the borings were analyzed for Volatile Organic Compounds (VOCs), there was correlation between high VOCs and high PID values.

The northernmost hot spot, near B-15 was a relatively small area, with very high levels of borings. Soil vapor levels of 200 to 300 ppm were measured in these samples. Another smaller hot spot was located near B-21. PID results were lower here (ranging from 20 to 125 ppm), indicating a lesser level of solvent impact.

The most widespread and concentrated levels of VOC contamination occur in the southwest portion of the site. Levels exceeding 300 ppm were evident in an approximate 10,000 square feet area roughly bounded by Borings B-22, B-10 and B-12. This area, shown as yellow in Figure 7, Appendix B, is surrounded by areas of decreasing soil gas concentrations. About 100,000 square feet of surface area indicates levels above 20 ppm.

3.3 Soil Conditions

3.3.1 Objectives and Approach

Additional borings were advanced during this phase of the investigation to confirm soil gas readings and verify the extent of contamination established by the soil vapor study. All samples were screened and selected samples were submitted for analyses of VOCs using Method 8010/8020. Specific procedures for obtaining soil samples are included in Appendix A.

3.3.2 Subsurface Conditions

The entire site contains variable amounts of fill materials. Most are clay and silty type materials although sands and gravels were identified in various areas. Table 3, Appendix C, shows the depth of fill in the boring/well locations. As can be seen, fill depths ranged from 4.5 to 13 feet depending upon location. In general, there is silty clay beneath the fill. This silty clay layer overlies a layer of fine to coarse sand and gravel that is the shallow water bearing unit. A cross-section illustrating site soil conditions is presented in Figure 6, Appendix B. This cross-section illustrates the variable thickness of the fill as well as the underlying silty clay and sands. The cross-section also shows the declining elevation of the water table from east at Lincoln Creek to west at B-22. It should also be noted that B-22 was extended to the bedrock in order to establish if there were dense non-aqueous phase compounds and to evaluate soil conditions with depth. The detailed boring log for B-22 is included in Appendix D, which indicates that a sand layer with increasing fines and density exists below 33 feet. The sand layer is underlain by silty clay at 42 feet below ground surface. Bedrock was encountered at 67 feet below ground surface beneath the dense clay tills.

3.3.3 Soil Chemical Characteristics

The concentrations of VOCs were quantified in twelve (12) samples with eight (8) tested during the initial studies and four (4) additional samples tested during this site investigation. As stated in the procedures, samples were selected to confirm PID screening results and provide basic information regarding the extent of contamination. Table 2, Appendix C, summarizes the soil results.

In general, there is good correlation between high PID values and high total VOC concentrations, however, there is not a linear relationship between the screening and laboratory data. Basically, we have concluded that PID screening data above 100 ppm consistently indicate very high VOCs. The correlation for readings between 10 and 100 ppm is not as close and care should be taken in the interpretation.

The results confirm essentially the same combination of VOCs which were found during previous work on the site. The VOCs appear to be a mixture of chlorinated solvents, predominantly trichloroethylene and tetrachloroethylene and common petroleum based solvents included toluene, ethylbenzene and xylene. Benzene was not detected which indicates that the constituents are not common fuel materials but may be associated with industrial solvent uses such as Varnish Makers and Petroleum (VM&P) Naphtha.

The PID screening data indicated that the depth of impacts was also variable across the site. Impacts were at greater depths than 22 feet at B-21, extended to 18 feet at B-11 and to 22 feet at B-22. In general, however, it appeared that there was a general reduction in concentration levels once the water bearing sand layer was encountered. In addition, there was also a consistent pattern of low PID readings (less than 1) in the surface soils to depths of 3 to 5 feet below ground surface even at locations where the underlying soil contamination was extremely high. This may be due to either natural venting or more likely fill placement which occurred during site leveling operations.

One additional TCLP analysis was performed to evaluate the potential handling methods for the on-site soils. A single sample was taken adjacent to B-11 from a depth of approximately 5 feet to 6.5 feet below grade. The sample was tested for TCLP extraction of VOCs and metals. The results indicated no detectable levels of VOCs in the extract and extractable metals well below hazardous limits. The results are included in Appendix D.

3.3.4 Quantities of Impacted Soil

In order to assess the potential remedial alternatives for this site, the quantity of solvent impacted soil was estimated based upon the soil vapor study and the soil boring results. The depths estimated for removal are summarized as follows:

	Depth	Lateral Extent to 50 ppm, Ft^2	Volume, Yd^3	Lateral Extent to 10 ppm Ft^3	Volume, Yd^3
Area 1	10 feet	64,300	23,815	963	33,690
Area 2	15 feet	3,300	1,833	6,600	3,666
Area 3	12 feet	4,100	1,822	8,200	3,644
		TOTAL	27,470		41,000

These quantities are extremely high and significantly limit cost-effective remediation options for this site. Further discussion of remedial alternatives is included in Section 4.0.

3.4 Groundwater Conditions

3.4.1 Shallow Groundwater Flow Directions and Rate

The local groundwater flow direction is to the southwest as illustrated on Figure 4. Water levels measured on March 27, 1992 are presented on Table 3 and they are consistent with the groundwater flow direction established during the Phase II reconnaissance. Based upon the boring logs and groundwater elevation measurements, it appears that the groundwater discharges from Lincoln Creek through a course sand layer that underlies the site. This layer presently drops in relative elevation to the ground surface so that the shallow groundwater aquifer ranges from 12 feet below ground surface at BW-16 to almost 30 feet below ground surface at BW-22.

A preliminary estimate of in-situ soil permeability was performed on-site. The results indicate that there was a high recharge rate with the shallow sand aquifer throughout the site. It should be recognized that any groundwater extraction system should be designed with sufficient capacity to contain the suspected plume.

3.4.2 Groundwater Quality

Three (3) rounds of groundwater sampling have been performed on selected wells on the site. The data is summarized in Table 4, Appendix B. The water quality results were compared to the State of Wisconsin groundwater standards as published in the Wisconsin Administrative Code NR 140 (NR140). There are two (2) concentration levels presented in NR140. The first level, Enforcement Standards (ES), is generally equivalent to the primary drinking water standards or maximum contaminant levels developed by the USEPA. An ES exceedance will require a response which usually involves remediation. The next level of comparison in NR140 is the Preventive Action Limit (PAL). The PAL is set at 10% or 20% of the ES and it also requires reporting to WDNR and subsequent action.

Table 4 includes the PAL and ES levels for comparison. On the WFB site, there were both PAL and ES exceedances in six (6) of the seven (7) wells tested. The following table summarizes the exceedances detected during Round 3 only (4/19/89).

TABLE 3.1
GROUNDWATER STANDARD EXCEEDANCES
ROUND 3 (All units in µg/l)

Parameter	B-4	B-9	B-10	B-11	B-18	B-22	ES
1,1 Dichloroethene	2.3*	0.3*	35.6	26	0.4*	82.3	7
1,2 Dichloroethene	229	146	10400	9130	106	22200	100
Trichloroethene	264	10.5*	3400	69	9.4	1180	5
Tetrachloroethene	110	--	477	11.8	--	36.4	1
1,1 Dichloroethane	--	--	--	--	--	165*	850
1,1,1 Trichloroethane	--	--	--	--	--	16.8	200
Benzene	--	--	--	48.4*	--	--	5
Vinyl Chloride	--	--	3400	825	--	2490	0.2
1,2 Dichloroethane	--	--	--	--	--	132	5

NOTES: -- Means no exceedance
* PAL exceedance - all others ES exceedance

In general, the water quality on-site is above applicable standards. Concentrations in wells where multiple rounds of sampling was completed, show some variability but no distinct trends of either increasing or decreasing concentrations. It is interesting that benzene was detected in the water although not in the soil samples. However, there may be residual benzene in the soils which could not be detected because of the high detection levels in some of the analyses. The results also show generally the same parameters were detected in most rounds except at B-10 where a very high level of vinyl chloride was detected only in Round 3. This value would need confirmation if it was to influence the ultimate remedy selection.

3.5 Quality Assurance/Quality Control

Throughout the sampling and analysis program, STS followed specific quality assurance/quality control (QA/QC) procedures. Screening equipment was calibrated daily in the field and sampling was performed in accordance with current STS and WDNR guidelines. Field and sampling QA/QC is discussed in the Procedures section in Appendix A.

The subcontract analytical laboratory, Radian Corporation, conducted chemical analytical testing in accordance with their standard quality assurance. This is documented in their Laboratory Quality Assurance Data Package, which is included in Appendix D. In addition, STS analyzed several trip blanks to document laboratory quality assurance.

3.6 Summary of Results

The site investigation confirmed the on-site groundwater impacts and allowed definition of the extent of soil contamination on the WFB property. The soil impacts appear to be concentrated in three (3) areas and to average depths of 10 feet to 13 feet below ground surface. The quantity of solvent impacted soil is estimated to be 41,000 cubic yards.

Groundwater is also impacted above current standards by chlorinated compounds and benzene. The groundwater flow is southwest and the water appears to discharge from Lincoln Creek through a subsurface sand layer which exists from 12 to 30 feet below ground surface. No completed exposure pathways were identified since there are no drinking water wells directly downgradient of the site and since the impacted soils are generally 3 to 5 feet below current ground surface.

4.0 ALTERNATIVES EVALUATION

4.1 Identification of Alternatives

Based upon the results of the investigation, various remedial alternatives were identified for this site. These alternatives considered both source and groundwater control. Table 6 presents the list of the alternatives and an initial screening of these alternatives in terms of effectiveness, implementability and cost. Other alternatives including off-site incineration, in-situ vitrification and solidification/stabilization were not considered implementable or were extremely cost prohibitive so they were not considered further.

4.2 Analyses of Alternatives

The alternatives were further reviewed for feasibility of application on this site. Brief discussions of the alternatives and more detail on the evaluation criteria are presented in the following paragraphs.

4.2.1 Source Control Alternatives

4.2.1.1 Excavation and Off-Site Disposal - This alternative consisted of excavation of contaminated fill and removal to a landfill site for disposal. If the mass of soil impacted above 10 ppm is removed, a total quantity of 41,000 cubic yards would require excavation. This quantity could be reduced to 27,500 cubic yards if soils above 50 ppm were removed. In either case, the cost for off-site landfilling would be high. In addition, even though the TCLP test indicated that these materials were non-hazardous, landfill acceptance may be difficult to obtain for large quantities of materials containing chlorinated solvents.

4.2.1.2 Excavation and On-site Treatment - This alternative consists of excavating impacted soils and aerating them on a one (1) acre pad constructed on the property. Runoff water would be collected and either discharged or recirculated. This approach could take up to ten (10) years to complete assuming lift thicknesses of 1 to 2 feet and a two (2) to three (3) month time to treat the soils. Air emissions and soil testing would be needed during operation and closure confirmation would be needed upon completion. Given the site's proximity to a new residential development, this alternative does not appear to be implementable. In addition, the effectiveness is presently unknown given the high percent of fine grained clays in the fill soils.

4.2.1.3 Site Vapor Extraction - This technology would consist of placing closely spaced extraction and air injection wells to evacuate the volatile constituents from the soil. Given the heterogeneous, fine grained fill soils which predominate the solvent impacted areas, the well spacing would need to be very close and the extracted vapors may tend to form preferential flow paths in the heterogeneous fill. Extensive pilot testing would be needed to evaluate this alternative. The time to treat would be difficult to estimate and ultimate effectiveness is unknown.

4.2.1.4 NR180 Capping - The placement of a cover on the site is a containment option for source control. This alternative entails placement of a 2 foot clay layer and 6 inches of topsoil in conformance with NR180 requirements. This covering option was essentially completed with the grading performed in 1980. Since solvent contamination of the source area is generally present below depths of 3 to 5 feet, the additional capping will not provide a substantial reduction to human exposures. This option would actually reduce the effectiveness of clean-up if groundwater extraction is selected since it would reduce the amount of contaminant flushing associated with infiltration.

4.2.1.5 Modified Capping with Passive Bioremediation - This alternative would involve utilization of the existing landfill cap and then placement of inlet ports at various locations to provide oxygen to enhance bioremediation. These inlet ports would generally consist of slotted PVC pipe which extend through the most contaminated soil zones to a solid PVC riser then through the surface to gooseneck type air inlets. Existing wells could also be modified to provide air inlets if desired. This alternative may provide some additional source remediation. It would allow water infiltration which would be beneficial if the alternative is combined with groundwater extraction.

4.2.1.6 Deed Restrictions - The final source control alternative involves a deed restriction to prohibit building on the solvent impacted portion of the site as long as it remains contaminated. This alternative can be easily implemented with low costs. It must be used in conjunction with groundwater extraction and treatment. The approach will allow infiltration of precipitation to continue flushing of the solvents into the groundwater for treatment.

4.2.2 Groundwater Control Alternatives -

4.2.2.1 Groundwater Monitoring Only - This alternative involves establishing a quarterly monitoring program at two (2) to three (3) downgradient locations. This program would be implemented after source removal and would continue until water quality reached either upgradient water quality or applicable state standards, whichever comes first.

4.2.2.2 Groundwater Extraction, Treatment and Discharge to the Sanitary Sewer - This system involves extraction of groundwater using three (3) vertical extraction wells manifolded to a treatment building. Water would be treated using a diffused aeration system. Discharge would be to the sanitary sewer. Long term monitoring of the effluent will be established by the Milwaukee Metropolitan Sewerage District (MMSD). This alternative may be acceptable for a short time, but will not be implementable on a long term basis since the MMSD has recently decided not to accept new long term discharges of contaminated groundwater into the sewerage system.

4.2.2.3 Groundwater Extraction, Treatment and Discharge to the Storm Sewer - This alternative is essentially the same as that described previously except that the effluent will be directed to Lincoln Creek or the nearby storm sewer. The WDNR has developed general surface water discharge permits which can be applied to contaminated groundwater extraction systems so a WPDES permit should be obtainable with appropriate application. The extraction system will remove contaminated groundwater downgradient of the solvent source and essentially eliminate its migration off-site. Treatment effectiveness will be carefully monitored. This alternative would be effective in removing contamination and can be implemented on the site for a moderate cost.

4.3 Selection of Recommended Alternative

On the basis of the technical data, the potential exposure pathways and the evaluation of implementability, effectiveness and cost, the recommended continued alternatives for this site includes deed restrictions for source control along with groundwater extraction, treatment and storm sewer discharge. This continued alternative provides long term protection of human health and the environment, is a treatment technique, and can be implemented quickly and effectively. A conceptual design for the recommended alternative is presented in Section 5.0.

5.0 CONCEPTUAL DESIGN FOR RECOMMENDED ALTERNATIVE

5.1 Detailed Description of Alternative

The recommended remedial alternative consists of two (2) parts: 1) Deed Restrictions and 2) groundwater extraction, treatment and discharge to surface water.

The Deed Restriction will be recorded with the title. This restriction would apply to the source area located on the southern portion of the property for as long as it remained contaminated. Development of the northern portion of the parcel would not be prohibited assuming appropriate WDNR approval for building on a landfill would be obtained. The purpose of the Deed Restriction is to prohibit intrusion into the contaminated soil area and provide a location for the groundwater extraction and treatment system. Specific language of the Deed Restriction should be developed by the Village Attorney and approved by the Board of Trustees.

The groundwater extraction and treatment system has two (2) major components: 1) the extraction wells and piping system, and 2) the treatment building and discharge line. The basic layout of these components is illustrated on Figure 11.

5.1.1 Extraction System

The extraction system, based on preliminary investigation and design, is assumed to consist of three (3) 35 foot deep, 4 to 6 inch diameter vertical wells. These wells will be constructed with a screen to intersect the groundwater at the sand seam. The wells will not extend into the underlying clay. Each well will be equipped with a 25 gpm submersible pump. The pumps are expected to operate continuously. The final drawdown will be established during system start-up. Pumps will be selected to have variable capacity which can be adjusted to meet site conditions. It should also be noted, that the hydraulic conductivities measured on the site will be confirmed during design using in-field permeability testing. A separate pump test has not been specified because of the large volumes of water which will need to be handled. Instead, the system start-up will include a staged operating approach to allow pump operation modifications needed to achieve the necessary groundwater recoveries. Spacing of the wells has been based upon the field permeability results, the soil type encountered and basic hydrogeologic principles. The exact spacing will be determined during final design. The discharge from the wells will be pumped to a common 1-1/2 inch header pipe which discharges into the treatment unit. The well discharge and header pipe will be installed below frost depth.

5.1.2 Groundwater Treatment System

All extracted groundwater will be discharged into a treatment unit housed in a permanent building. The building location is assumed to be near Lincoln Creek. Although the exact size and location will be determined during final design, preliminarily the prefabricated metal building is sized at approximately 20 feet by 15 feet in size. The building will contain a proprietary shallow tray treatment unit, heater, ventilation system, lighting, sampling and control panel. Effluent from the treatment system will be discharged through a buried 1-1/2 inch effluent line directly to Lincoln Creek (assuming the appropriate permits can be obtained - see Section 5.3).

The proprietary treatment unit proposed for this system is a totally enclosed Shallow Tray Aeration System. The unit is a low profile diffused aeration system. A double tray unit constructed of stainless steel and capable of handling flow up to 80 gpm will be used. The treatment unit is approximately 5 feet by 12 feet wide and 6 feet 6 inches high. Air is supplied by an attached blower and the vapors will be vented through a 12 inch pipe through the roof of the building. The system is self contained requiring only an electrical power source. Figure 11 presents the basic operational features of the treatment unit.

5.2 Capital cost Estimate

An estimate of the capital costs for this system has been proposed and is summarized below.

A. System Components

- (3) 4" diameter extraction wells, 35 feet deep

- 200' of 1 1/2" header piping
- (3) 25 gpm submersible pumps
- On-site treatment unit
- Building to enclose treatment unit
- Electric service
- 500' of 1 1/2" discharge piping to Lincoln Creek

B. Capital Costs

Component	Quantity	Unit	Unit Cost	Total
Wells	3	EA	$5,000	$15,000
Header Pipe	200	LF	$12	$2,400
Submersible Pumps	3	EA	$2,000	$6,000
Discharge Piping	500	LF	$12	$6,000
Treatment Unit	1	LS	$27,900	$27,900
Treatment Building	1	LS	$16,000	$16,000
Electric Service	1	LS	$6,000	$6,000
	SUBTOTAL			$79,300
	25% Contingency			$19,825
	Engineering			$25,000
	Permitting			$8,000
	TOTAL CAPITAL COST ESTIMATE			$132,125

NOTES:

1. Electrical service is assumed to exist at or near the property line in the vicinity of the proposed treatment building location.
2. The treatment system consists of a single self contained proprietary aeration unit. The unit will contain all necessary equipment, motors, blowers, trays, etc. to treat the groundwater for discharge to Lincoln Creek. The unit is to be mounted on a concrete pad.
3. The building is intended to be a single prefabricated metal building including insulation, heating unit, vent fan, interior lights, switches, outlets, and one man door. The building will be lowered and mounted in place over the installed treatment unit.
4. Treatment unit discharge will be pumped to Lincoln Creek.

As noted, a 25% contingency for engineering design and costs have been included with the Capital Cost Estimate. These numbers are comparison estimates. Final costs will be developed after bids are received.

5.3 Environmental Permitting

Several environmental permits will be needed to construct this system. These permits are separate from normal construction permits which will be obtained by the contractor. The environmental permits include the following:

1. Wisconsin Pollution Elimination Discharge System (WPDES) Permit required for storm sewer discharge.
2. Application to treat or dispose of contaminated soil.

Application will be made for a general WPDES permit. This permit application will present information on anticipated groundwater quality as well as the efficiency of the treatment unit. At this time, direct discharge to Lincoln Creek is anticipated. However, if storm sewer discharge along Hustis Road provides a better alternative, this approach will be pursued.

The other environmental permit will be the Application to Treat and Dispose of Contaminated soil. This permit will be submitted to the WDNR case worker and forwarded to the Bureau of Air Management for review and approval. Based on present available information, no additional air permits will be required.

5.4 Operation Costs

System operation costs will include both monitoring and actual operation of individual system components. Major component costs are electric and operator time for checking equipment. The system will be automated and components have been selected to require only minimal service. The effluent monitoring will result in the greater expense. Depending upon the frequency of testing ultimately required by the WDNR, the operation costs can vary. The following table provides an assumed frequency and a three year duration for monitoring.

Operation and Maintenance Costs (Annual)

Component	Quantity	Unit	Unit Cost	Total
Electrical Service	50000	kwhr	$0.07	$3,500
Misc. Equipment	1	LS	$1,000.00	$1,000
Operator	50	Hr	$60.00	$3,000
			SUBTOTAL	$7,500

Monitoring Costs

1. Engineering Services		128 hours $9,000
2. Laboratory Services		
a. Permitting analytical data required for WPDES permit		$1,495
b. In place system monitoring		$7,842
	SUBTOTAL	$18,337
	25% Contingency	$4,484
	TOTAL	$22,821

NOTES:

1) Monitoring costs were estimated assuming the following sampling frequency:

Frequency	Period
Weekly	1st month of operation
Bi-Monthly	2rd & 3rd months of operation
Monthly	Thru 1st year of operation
Quarterly	2nd thru 3rd year of operation

2) Estimate assumes three years of sampling

5.5 Groundwater Monitoring and Closure of System

Groundwater monitoring has been proposed only after the influent pumped groundwater quality for solvents is at levels which meet the current State of Wisconsin groundwater standards or is equivalent to upgradient water quality, whichever is greater. Since upgradient water at BW-16 contained no detected VOCs, it is likely that the groundwater standards as specified in NR140 will apply. Once the influent to the treatment unit achieves the solvent concentration levels, then the extraction system will be shut down and groundwater monitoring for VOCs will be performed at the downgradient well locations. If the VOC standards are met for four (4) consecutive quarters, then final closure will be assumed and the system closure report will be submitted to the WDNR. At this point, the time to achieve closure is unknown. It is assumed that this remediation approach will take an extended period of time.

PROCEDURES

Introduction

The subsurface exploration program consisted of advancing soil borings, installing groundwater monitoring wells and advancing shallow soil gas probes. Initially, soil borings were advanced at various locations on-site to determine the vertical and to some degree the lateral extent of contamination. Groundwater monitoring wells were installed in several boring locations to monitor the water levels and to test the quality of water flowing beneath the site. Soil gas probes were conducted in two (2) grids, spaced at 50 foot centers, around borings which exhibited unusually high concentrations of solvents. The soil gas probes were completed to define the lateral extent and degree of the contamination in the specified areas.

Soil Borings

Soil Borings were advanced to intersect the groundwater table and/or drilled into natural soil. One boring, B-22, was advanced to bedrock. All borings that were not converted to groundwater monitoring wells were backfilled with soil cuttings in 1986 and 1988.

The borings on the site were completed on various dates. Borings B-1 through B-9 were completed from 11/6/86 to 11/11/86, borings B-10 to B-16 were completed from 9/13/88 to 9/16/88, borings B-17 to B-22 were completed from 4/18/89 to 4/20/89 and B-23 was completed on 7/6/89. An all-terrain (ATV) drill rig was used to advance the borings. Borings B-1 through B-9 were geotechnical borings advanced using solid stem auger. Casing was used in several of the borings to keep the borehole open while drilling and sampling. Four and one-quarter inch ID hollow stem augers were used to advance the remainder of the borings.

Soil samples were collected at 2.5 foot intervals using split-barrel samplers for borings B-10 to B-23 (see Appendix D - Standard Method for Penetration Test and Split-Barrel Sampling of Soils - ASTM D-1586). Since B-1 through B-9 were completed as geotechnical borings, samples were collected at 2.5 foot intervals using split-barrel samplers to a depth of 10 feet. Below 10 feet, samples were collected at 5 foot intervals. If clayey soil was encountered during sampling, shelby tube samplers were used (see Appendix D - Standard Practice for Thin-Walled Tube Sampling of Soils) otherwise the split-barrel sampler was used.

Soil augers and downhole drilling equipment were cleaned using a high pressure hot water washer, prior to drilling and between soil borings (B-10 through B-23) to minimize the potential of cross contamination. Furthermore, the split-barrel sampler was scrubbed with a brush to remove remaining soil and washed using water and trisodium phosphate (TSP) soap between samples, then rinsed with clean water.

Soil Screening

The drillers screened the soil samples with a HNu Model 101 Photoionization Detector (PID) equipped with a 10.2 eV lamp. This instrument is capable of detecting certain Volatile Organic Compounds (VOCs), including many of volatile components characteristic of petroleum products and common solvents, with ionization potentials less than or equal to 10.2 eV. The PID operates on the principal of photoionization in which incoming gas molecules are subjected to ultraviolet radiation and transformed ion pairs. The charged ions create a current between two (2) electrodes and this current is transformed into a meter reading.

Because organic compounds have varying ionization potentials, the response of the PID depends upon the compounds being ionized. Accordingly, when a variety of compounds are present in the head space, the meter reading does not necessarily indicate the concentrations of any specific VOC. Prior to soil screening, the PID was calibrated to a benzene standard (isobutylene) per the manufacturer's specifications.

As each sample was collected during drilling operations, it was placed in a clean, unused 8 ounce glass jars and sealed with a screw-on type lid. The samples were placed in refrigerated storage in the STS laboratory until ready for laboratory PID screening and soil classification. Laboratory PID screening of the recovered soil samples was accomplished by first allowing the samples to warm to room temperature (approximately 70°F). The samples were shaken vigorously for several seconds, this procedure breaks up the soils and increase the surface area of the soil particles exposed to the air inside the jar. The tip of the PID probe was inserted about 1 inch into the jar through the aluminum foil cover. The highest value read off the PID meter during the first few seconds after inserting the probe tip, is recorded as the PID reading for the soil sample.

Soil Classification

The STS drilling crew conducted a preliminary classification of recovered soil samples during drilling. The soil samples were transported to the STS laboratory in coolers. The soil samples in the STS laboratory were classified by an engineer on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS). A copy of the classification system and STS General Notes is included in Appendix D. The estimate group symbols according to the USCS are indicated in parenthesis following the soil description of the boring logs. Boring logs with soil descriptions, methods of sampling, sample depth, PID readings, boring dates, etc. are included in Appendix D. Additional information regarding the preparation of the final boring logs from field and laboratory data is described in the sheet entitled "Field and Laboratory Procedures" which is also included in Appendix D.

The soil stratification indicated on the logs was selected by the engineer on the basis of the field log information and sample observations. Stratification lines should be considered as approximate. The transition between soil types in-situ may be gradual in both the horizontal and vertical directions.

The engineer reviewing the soil samples also completed olfactory and visual observations in an attempt to detect the presence of obvious chemical or petroleum products in the samples. Any observations by the engineer are included in the soil descriptions on the boring logs.

Soil Sample Analysis

The soil samples submitted for analysis were selected based on PID screening results, samples collected at the soil/water interface (groundwater table) and visual and olfactory observations. The analytical testing was conducted at Radian Laboratories in West Milwaukee, Wisconsin. The samples were submitted for VOCs by EPA Method 8010/8020.

Monitoring Well Installation

A total of eight (8) wells are present on the site, five (5) of which were installed as geotechnical wells while the remaining four (4) were installed as environmental wells. The geotechnical wells, W-4, W-6, W-9, W-10 and W-11 were installed in 1986. W-10 was replaced with W-10R after a contractor damaged W-10 during construction on an adjacent site. Wells W-4, W-6 and W-9 were installed as 20 foot wells by the following procedure. The screened portion of the wells consisted of 5 foot lengths of 2 inch ID machine slotted Schedule 40 PVC with a bottom cap. The screen was threaded to 10 foot lengths of Schedule 40 solid PVC pipe. Pea gravel was placed in the annulus between the PVC screen and the borehole walls from the bottom of the screen to approximately 3 feet below the ground surface. A 2 foot bentonite seal was placed over the pea gravel and 1 foot of concrete was used to anchor the steel protector pipe. Well W-10 was installed with a slight variation to the previously mentioned procedures. The W-10R well was installed as a 28.3 foot deep well. Instead of placing pea gravel around the screened portion of the well, a washed silica sand was placed from the bottom of the well to approximately 20 feet below the ground surface. The annular space seal around the solid PVC riser pipe was pea gravel, placed to within 3 feet of the ground surface. A 3 foot bentonite seal was placed around the riser pipe and the well was covered with a sturdy plastic flush mounted protective cover.

Wells W-16 and W-18 were installed as environmental wells in which 5 or 10 feet sections of 2 inch ID, Schedule 40 machine slotted PVC well screen was used. A 5 feet section was used in W-16 and a 10 foot section was used in W-18. The screen was threaded onto 10 feet sections of solid PVC riser pipe. Commercially prepared washed silica sand was placed in the annular space around the screened portion of the wells. An 8 feet sand pack was placed in W-16 (around the 5 feet screen) and 14 feet of sand was placed in W-18 (around the 10 feet screen). A bentonite seal was placed above the sand to within 1 foot of the ground surface. W-16 was installed with a flush mounted steel protector pipe, whereas W-18 had a stickup steel protector pipe.

Monitoring well W-22 was installed as an environmental well. The boring was drilled to a terminal depth of 69 feet and the well was installed to 32.9 feet below the ground surface. The boring was backfilled with a bentonite slurry from 32.9 feet to 69 feet. A 10 foot section of 2 inch ID, Schedule 40 PVC screen was threaded to solid PVC riser pipe. Sand was placed around the screen portion from the bottom of the well to approximately 4 feet above the screen. A 17.7 foot bentonite seal was placed above the sand in the annular space of the boring. A stickup steel protector pipe was set in a 2 foot concrete seal.

All of the stickup wells have master locks for additional protection. The flush mounted wells use screw-in type PVC covers fitted with small padlocks.

A rough elevation survey was conducted on the site to estimate boring and water elevations. The elevations were determined using a benchmark located on the rim of the fire hydrant located on Hustis Street.

The depth to groundwater in the wells was measured using an electronic water level indicator manufactured by Slope Indicator, Inc. The water levels were measured on several occasions. Table 3 in Appendix C presents the results of the most recent round of water levels.

Groundwater Sampling and Analysis

The monitoring wells were developed by surge and purge methods using a Teflon bailer or by pumping with a pump on the drilling rig. Approximately 10 well volumes of water were removed from the wells for development, unless the wells could bail dry. If the wells bailed dry, they were bailed dry twice.

Prior to collection of groundwater samples, the wells were again purged, removing approximately four (4) well volumes of water for quick recharging wells or bailed dry twice for wells that bailed dry. Teflon bailers were used to collect samples and clean nylon rope was used for each well location.

Reusable equipment, such as bailers, were decontaminated between well locations using TSP and distilled water wash and then rinsed twice with distilled water. Bailers were wrapped with aluminum foil between well locations to prevent possible airborne contaminants from being introduced into the groundwater.

Groundwater samples were collected from the wells on various occasions. A total of three (3) rounds of water samples were collected from the wells and submitted to Radian Corporation laboratories for analytical testing for VOCs by EPA Method 8010/8020. Two (2) of the sampling rounds were conducted prior to completion of the Phase II report which was submitted in January, 1989. The analytical data sheets are included in that report. Table 4 in Appendix C presents the results of the analytical testing. The analytical data sheets for the third round of water samples collected in April, 1989 are included in Appendix D.

Soil Gas Probes

Because analytical test results on the soil and water samples indicated that contamination was present at various locations on the site, a soil gas survey was conducted to attempt to define the lateral extent of the impairment. The soil gas survey was conducted in two (2) grid locations surrounding the two (2) borings on the site with the highest total of VOCs (borings B-1 through B-17). The first grid system was centered around W-11 and B-5 near the southwest corner of the site. A total of thirty-four (34) probes were conducted in this area. The probes were advanced to depths ranging from 5.0 to 7.0 feet. One (1) to two (2) soil samples from each location were collected in 8 ounce glass jars. The soil in the jars was screened with a PID as described in the soil screening portion of the Procedures section. The samples were broken up as much as possible to acquire the most surface area and to allow for a more accurate head space measurement. The boreholes were also screened with a PID prior to backfilling with soil cuttings.

The grid system covered an area which included Borings B-5, B-10 and B-11. Borings B-20, B-21 and B-22 were drilled after the soil gas survey was completed to define the vertical extent of impairment in the select areas.

The second grid was centered around B-15 near the northcentral portion of the site. Twenty-five (25) probes were conducted in this area, for a total of fifty-nine (59) probes on the Whitefish Bay Landfill site. The probes were advanced to a terminal depth of 7.0 feet. Soil samples were collected in clean glass jars from 5 to 6 feet and 6 to 7 feet. As mentioned for the first grid system, the head space in the soil sample jars was screened with a PID to obtain a semi-quantitative value of impacts in the soil. The boreholes in this grid area were also screened with a PID prior to backfilling.

Boring B-23 was also advanced after the soil gas survey was completed. This boring was placed between the two (2) grid locations to show the impairment found in each of the grid areas was from two (2) distinct sources.

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KRH/ed-m11/82149XF/tables

AppendiX A

1. Procedures

PROCEDURES

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Wells W-16 and W-18 were installed as environmental wells in which 5 or 10 feet sections of 2 inch ID, Schedule 40 machine slotted PVC well screen was used. A 5 feet section was used in W-16 and a 10 foot section was used in W-18. The screen was threaded onto 10 feet sections of solid PVC riser pipe. Commercially prepared washed silica sand was placed in the annular space around the screened portion of the wells. An 8 feet sand pack was placed in W-16 (around the 5 feet screen) and 14 feet of sand was placed in W-18 (around the 10 feet screen). A bentonite seal was placed above the sand to within 1 foot of the ground surface. W-16 was installed with a flush mounted steel protector pipe, whereas W-18 had a stickup steel protector pipe.

Monitoring well W-22 was installed as an environmental well. The boring was drilled to a terminal depth of 69 feet and the well was installed to 32.9 feet below the ground surface. The boring was backfilled with a bentonite slurry from 32.9 feet to 69 feet. A 10 foot section of 2 inch ID, Schedule 40 PVC screen was threaded to solid PVC riser pipe. Sand was placed around the screen portion from the bottom of the well to approximately 4 feet above the screen. A 17.7 foot bentonite seal was placed above the sand in the annular space of the boring. A stickup steel protector pipe was set in a 2 foot concrete seal.

All of the stickup wells have master locks for additional protection. The flush mounted wells use screw-in type PVC covers fitted with small padlocks.

A rough elevation survey was conducted on the site to estimate boring and water elevations. The elevations were determined using a benchmark located on the rim of the fire hydrant located on Hustis Street.

The depth to groundwater in the wells was measured using an electronic water level indicator manufactured by Slope Indicator, Inc. The water levels were measured on several occasions. Table 3 in Appendix C presents the results of the most recent round of water levels.

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The monitoring wells were developed by surge and purge methods using a Teflon bailer or by pumping with a pump on the drilling rig. Approximately 10 well volumes of water were removed from the wells for development, unless the wells could bail dry. If the wells bailed dry, they were bailed dry twice.

Prior to collection of groundwater samples, the wells were again purged, removing approximately four (4) well volumes of water for quick recharging wells or bailed dry twice for wells that bailed dry. Teflon bailers were used to collect samples and clean nylon rope was used for each well location.

Reusable equipment, such as bailers, were decontaminated between well locations using TSP and distilled water wash and then rinsed twice with distilled water. Bailers were wrapped with aluminum foil between well locations to prevent possible airborne contaminants from being introduced into the groundwater.

Groundwater samples were collected from the wells on various occasions. A total of three (3) rounds of water samples were collected from the wells and submitted to Radian Corporation laboratories for analytical testing for VOCs by EPA Method 8010/8020. Two (2) of the sampling rounds were conducted prior to completion of the Phase II report which was submitted in January, 1989. The analytical data sheets are included in that report. Table 4 in Appendix C presents the results of the analytical testing. The analytical data sheets for the third round of water samples collected in April, 1989 are included in Appendix D.

Soil Gas Probes

Because analytical test results on the soil and water samples indicated that contamination was present at various locations on the site, a soil gas survey was conducted to attempt to define the lateral extent of the impairment. The soil gas survey was conducted in two (2) grid locations surrounding the two (2) borings on the site with the highest total of VOCs (borings B-1 through B-17). The first grid system was centered around W-11 and B-5 near the southwest corner of the site. A total of thirty-four (34) probes were conducted in this area. The probes were advanced to depths ranging from 5.0 to 7.0 feet. One (1) to two (2) soil samples from each location were collected in 8 ounce glass jars. The soil in the jars was screened with a PID as described in the soil screening portion of the Procedures section. The samples were broken up as much as possible to acquire the most surface area and to allow for a more accurate head space measurement. The boreholes were also screened with a PID prior to backfilling with soil cuttings.

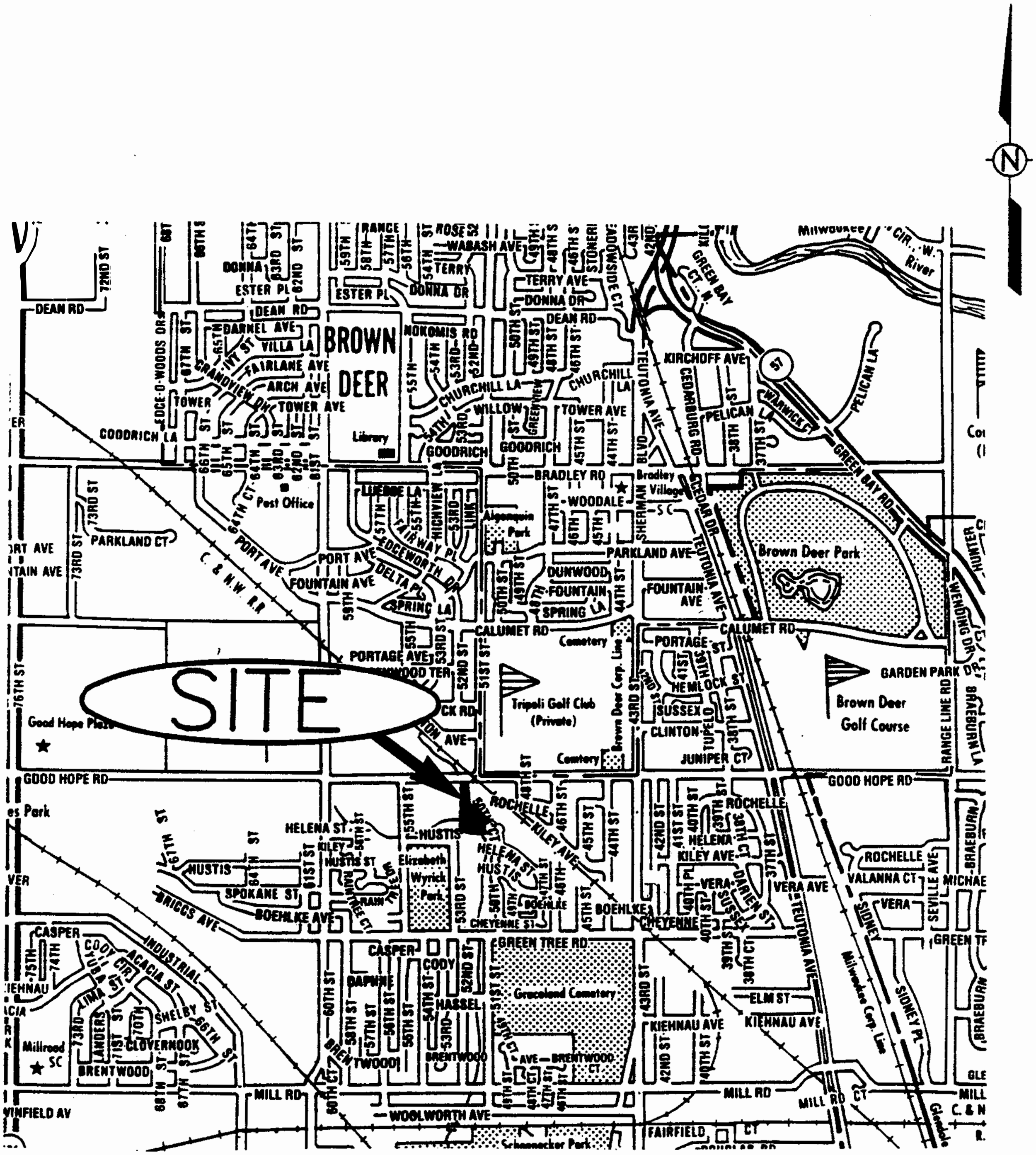
The grid system covered an area which included Borings B-5, B-10 and B-11. Borings B-20, B-21 and B-22 were drilled after the soil gas survey was completed to define the vertical extent of impairment in the select areas.

The second grid was centered around B-15 near the northcentral portion of the site. Twenty-five (25) probes were conducted in this area, for a total of fifty-nine (59) probes on the Whitefish Bay Landfill site. The probes were advanced to a terminal depth of 7.0 feet. Soil samples were collected in clean glass jars from 5 to 6 feet and 6 to 7 feet. As mentioned for the first grid system, the head space in the soil sample jars was screened with a PID to obtain a semi-quantitative value of impacts in the soil. The boreholes in this grid area were also screened with a PID prior to backfilling.

Boring B-23 was also advanced after the soil gas survey was completed. This boring was placed between the two (2) grid locations to show the impairment found in each of the grid areas was from two (2) distinct sources.

Appendix B - Illustrations/Diagrams

1. Site Location Diagram
2. Vicinity Diagram
3. Boring Location Diagram
4. Well Location Diagram
5. Topographic Map of Area
6. Geologic Cross Section
7. Soil Gas Grid Section
8. Soil Gas Concentration Diagram
9. Conceptual Design Groundwater Extraction
10. Grading Plan
11. Shallow Tray Aeration Unit
12. Section-Treatment Unit



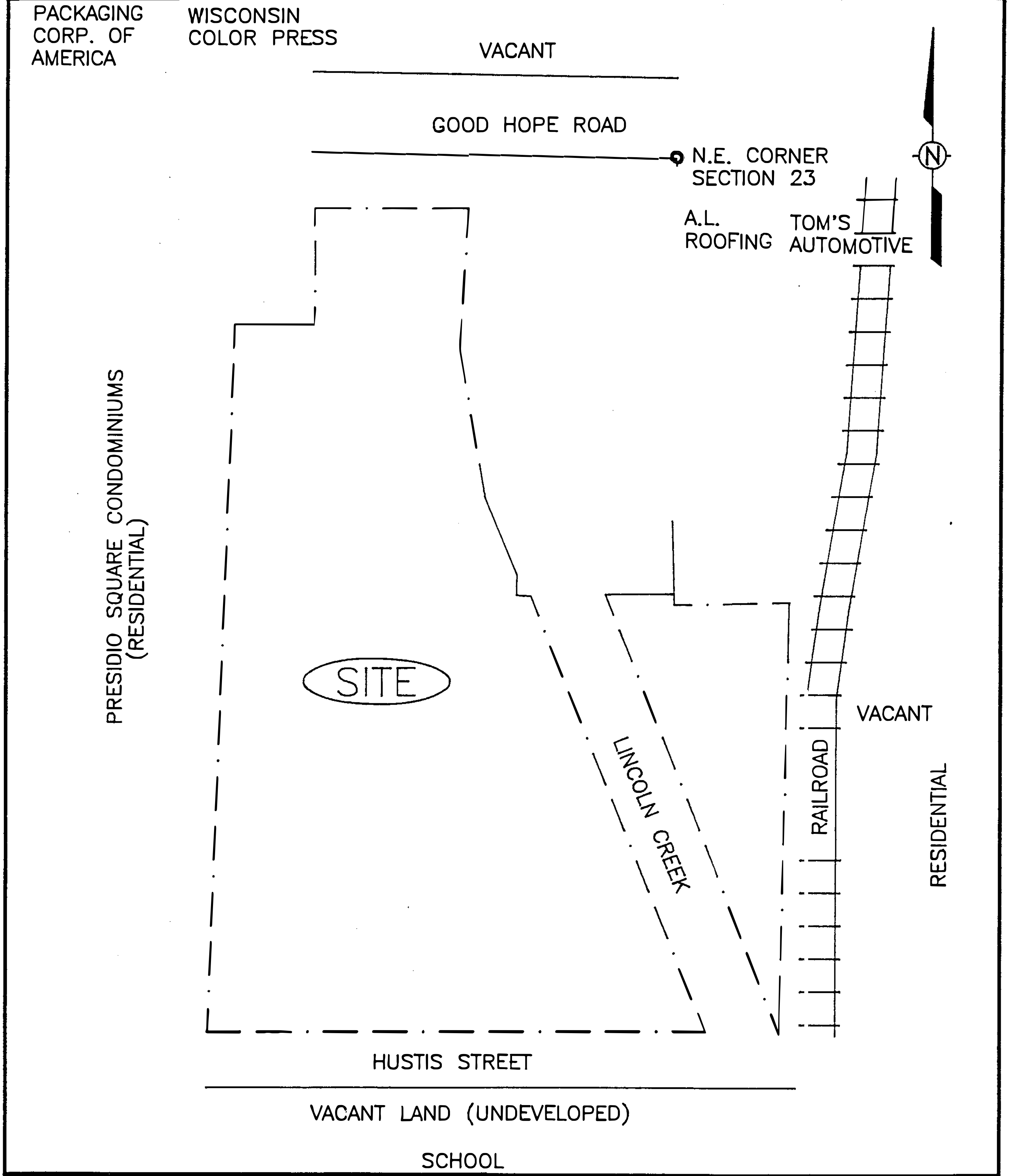
SOURCE: GREATER MILWAUKEE STREET GUIDE

STS Consultants, Ltd.

PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
SITE LOCATION DIAGRAM

DRAWN BY	T.J.J.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92
SCALE	FIGURE NO. 1	
CADFILE 149-1.DWG	STS PROJECT NO. 82149XF	
PLOT DATE 4/24/92		

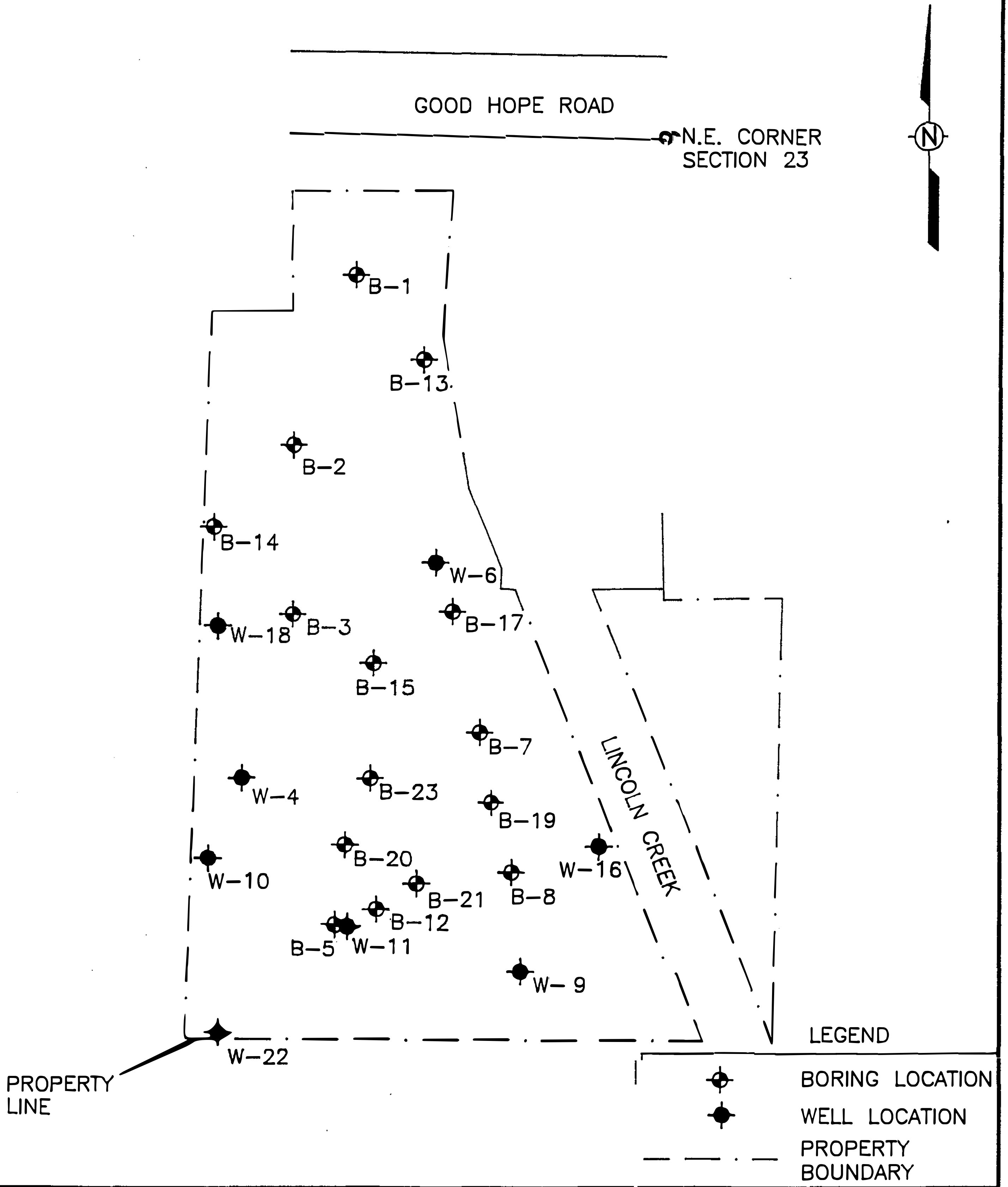


STS Consultants, Ltd.

PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
VICINITY DIAGRAM

DRAWN BY	J.M.I.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92
SCALE 1" =200'	FIGURE NO. 2	
CADFILE 821492-1.DWG PLOT DATE 4/24/92	STS PROJECT NO. 82149XF	



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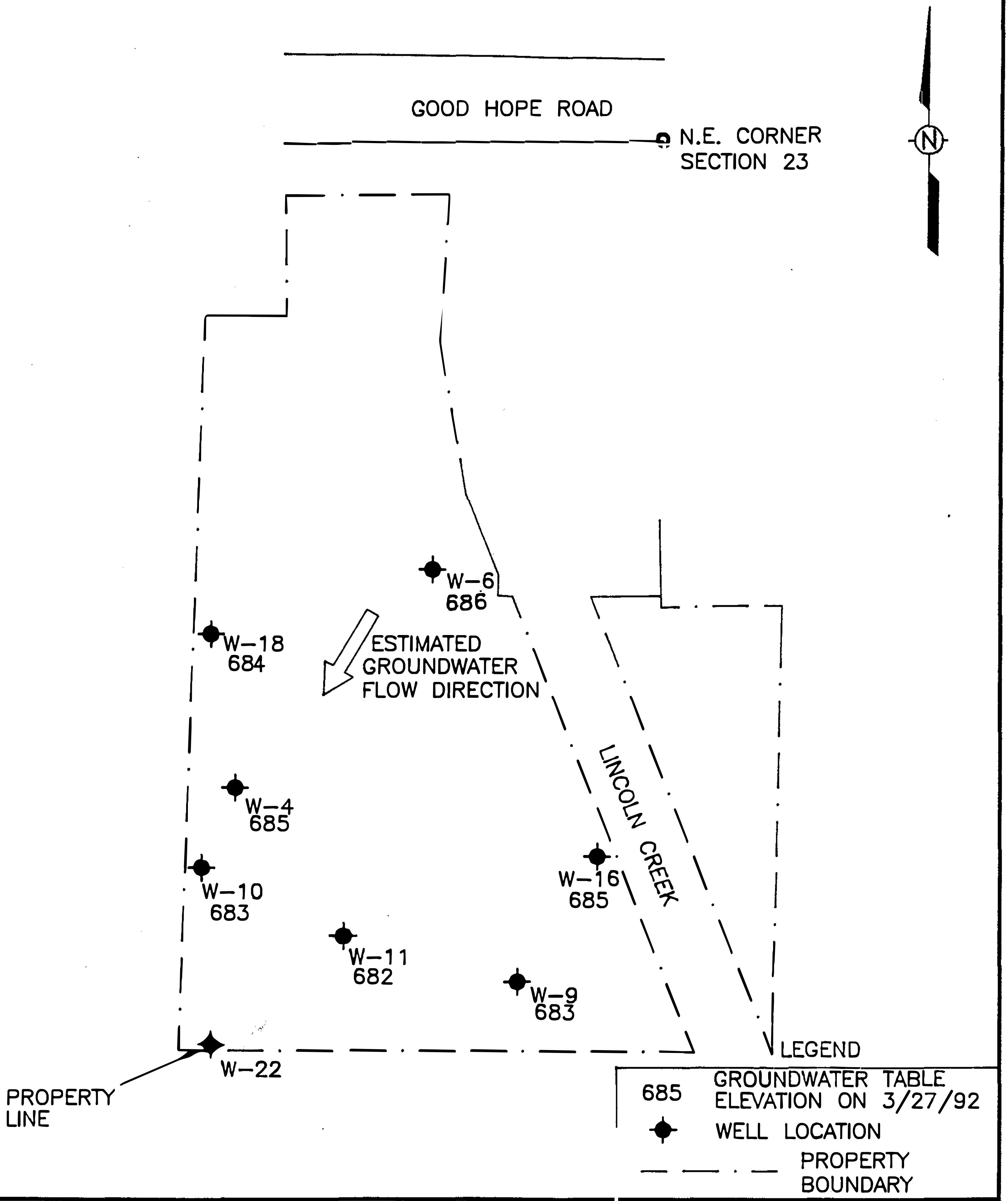
PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
BORING LOCATION DIAGRAM

DRAWN BY	J.M.I.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

SCALE 1"=200'	FIGURE NO. 3
CADFILE 821492-1.DWG PLOT DATE 4/24/92	STS PROJECT NO. 82149XF



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PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
WELL LOCATION DIAGRAM

DRAWN BY	J.M.I.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

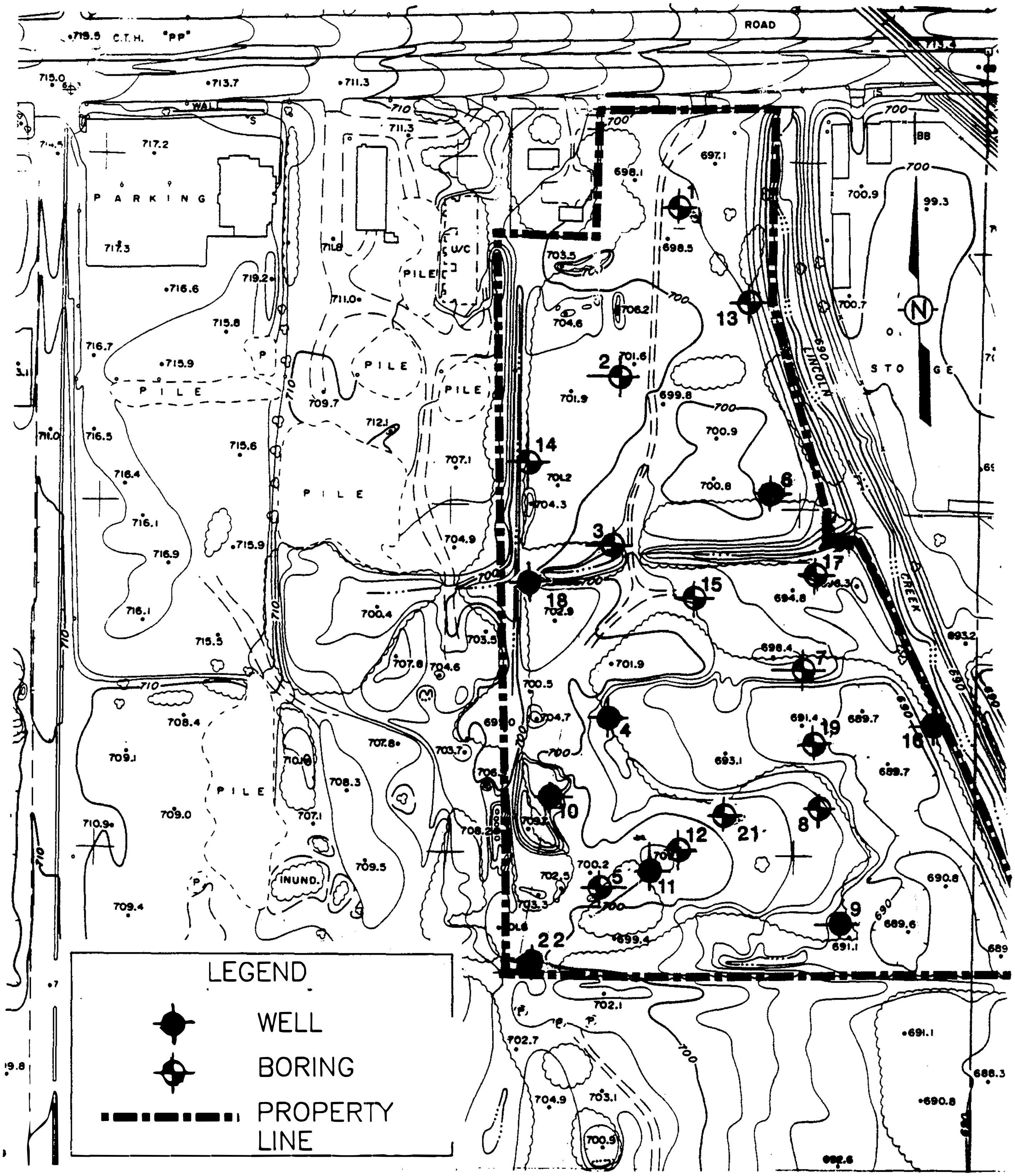
SCALE 1"=200'

FIGURE NO. 4

CADFILE 821492-1.DWG

PLOT DATE 4/24/92

STS PROJECT NO. 82149XF



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WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
TOPOGRAPHIC MAP OF AREA

DRAWN BY	T.J.J.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

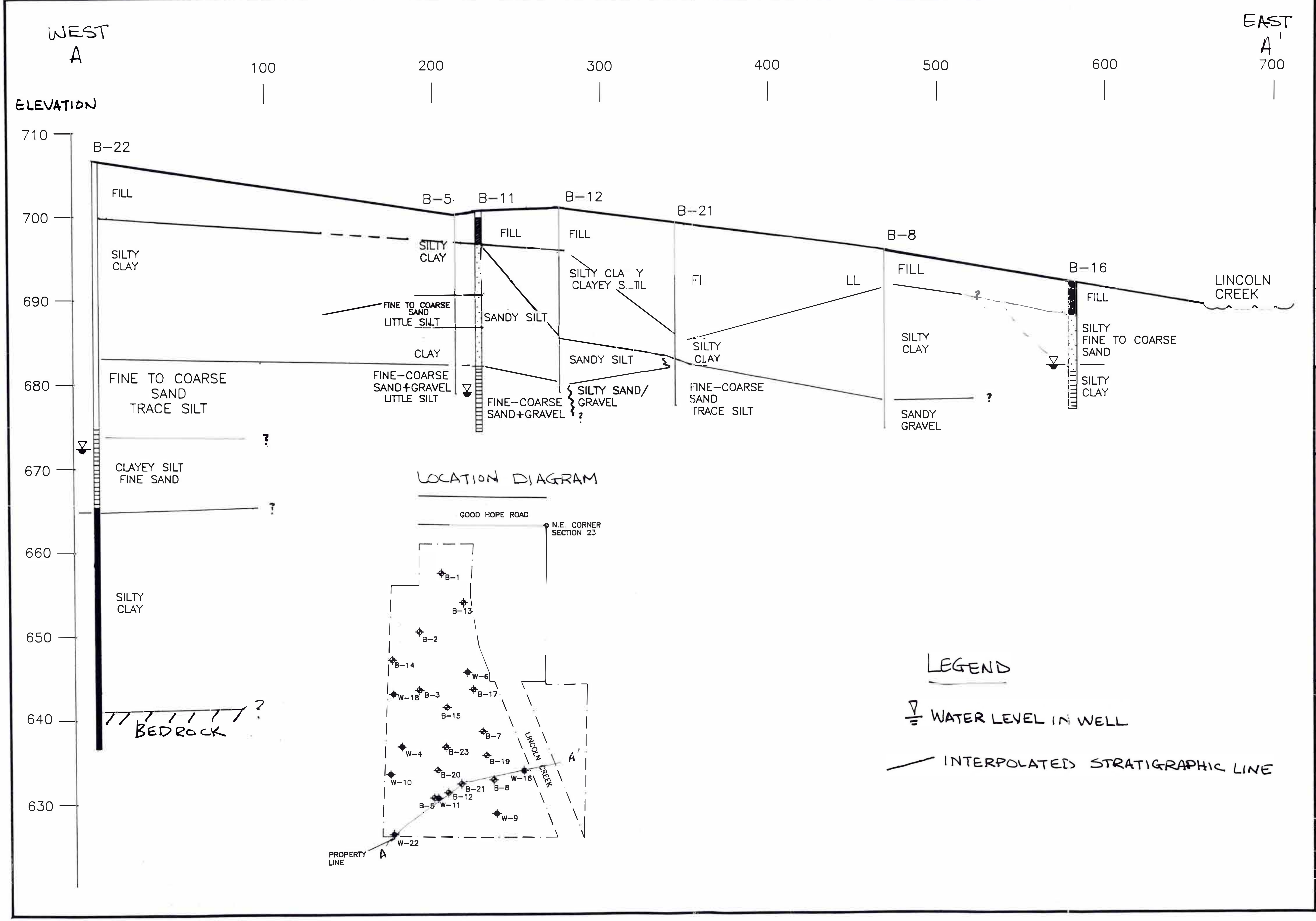
SCALE 1" = 200'

FIGURE NO. 5

CADFILE 149-1.DWG

PLOT DATE 4/24/92

STS PROJECT NO. 82149XF



REVISION

DATE | BY

AUTOCAD FILE
149–6.DWG

DRAWN BY J.M.I./C.R.H.

DATE 4/24/92

CHK. BY T.D.S.

APPROVED BY K.R.H.

WHITEFISH BAY LANDFILL
GEOLOGIC CROSS SECTION
MILWAUKEE, WISCONSIN

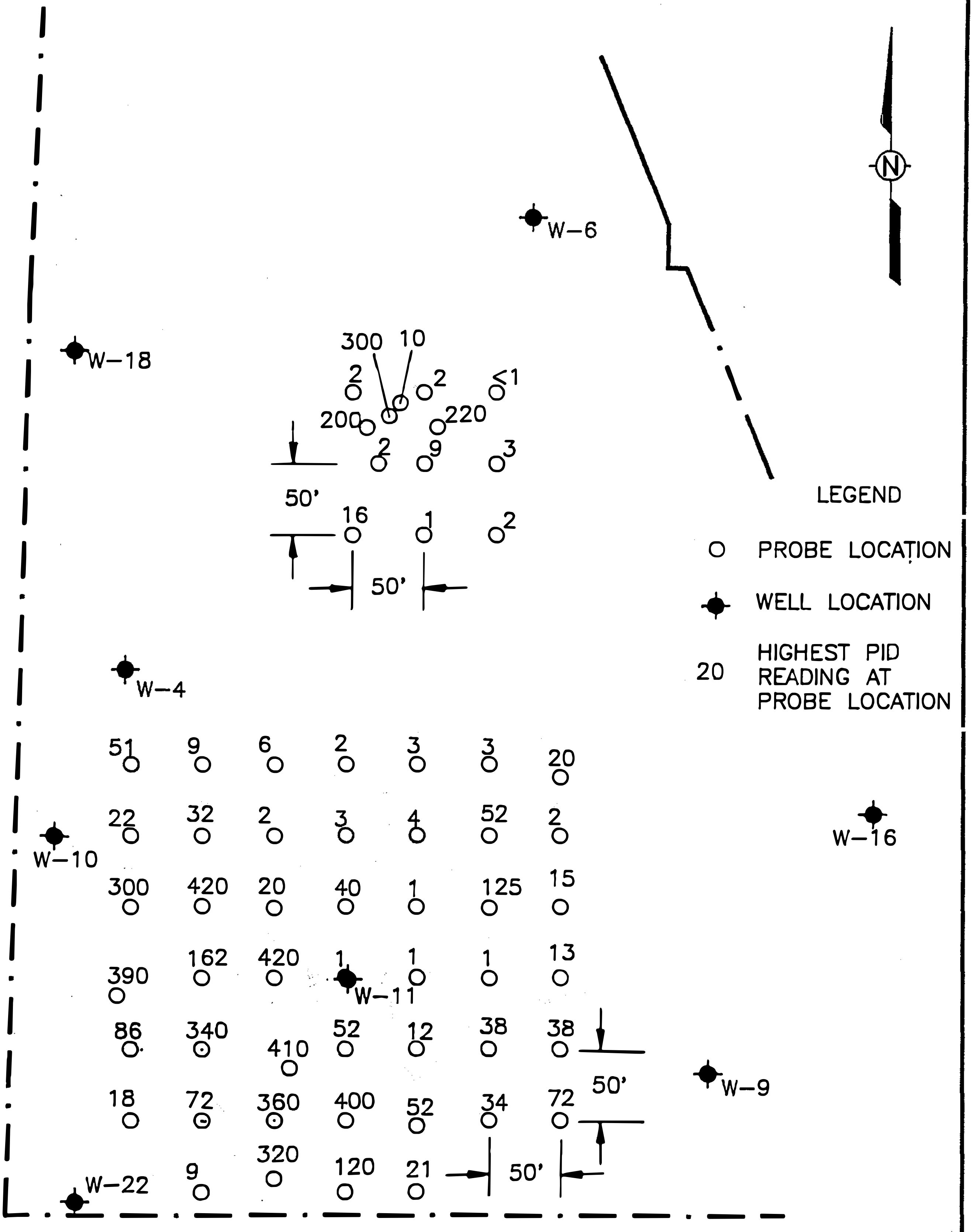
STS Consultants, Ltd.
Consulting Engineers

STS PROJECT NUMBER
82149XF

STS PROJECT FILE
82149XF

SCALE
AS SHOWN

SHEET NUMBER
6



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PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
SOIL GAS GRID LOCATIONS

DRAWN BY	J.M.I.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

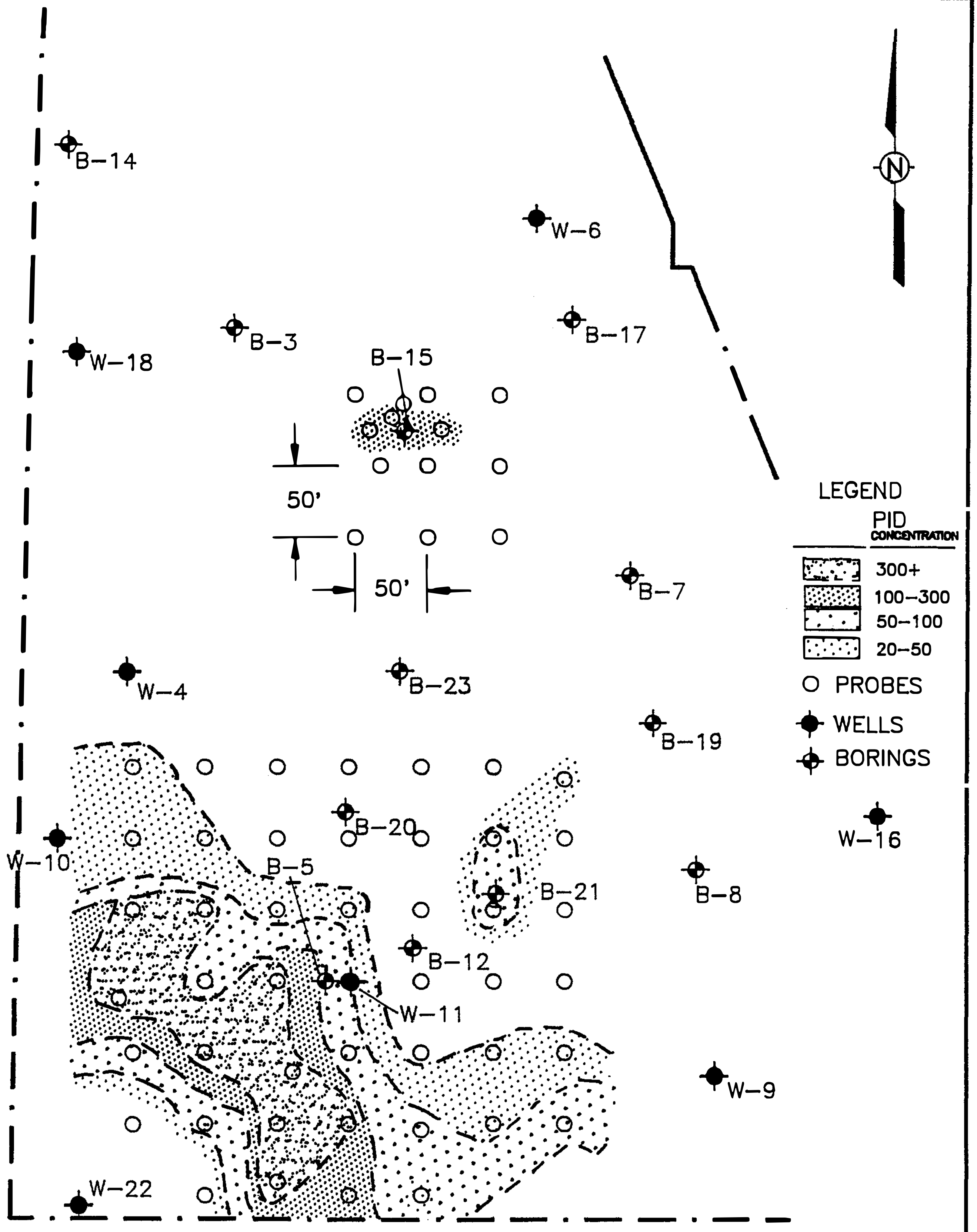
SCALE 1"=100'

FIGURE NO. 7

CADFILE 821492-7.DWG

PLOT DATE 4/24/92

STS PROJECT NO. 82149XF



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PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
SOIL GAS CONCENTRATIONS

DRAWN BY	J.M.I.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

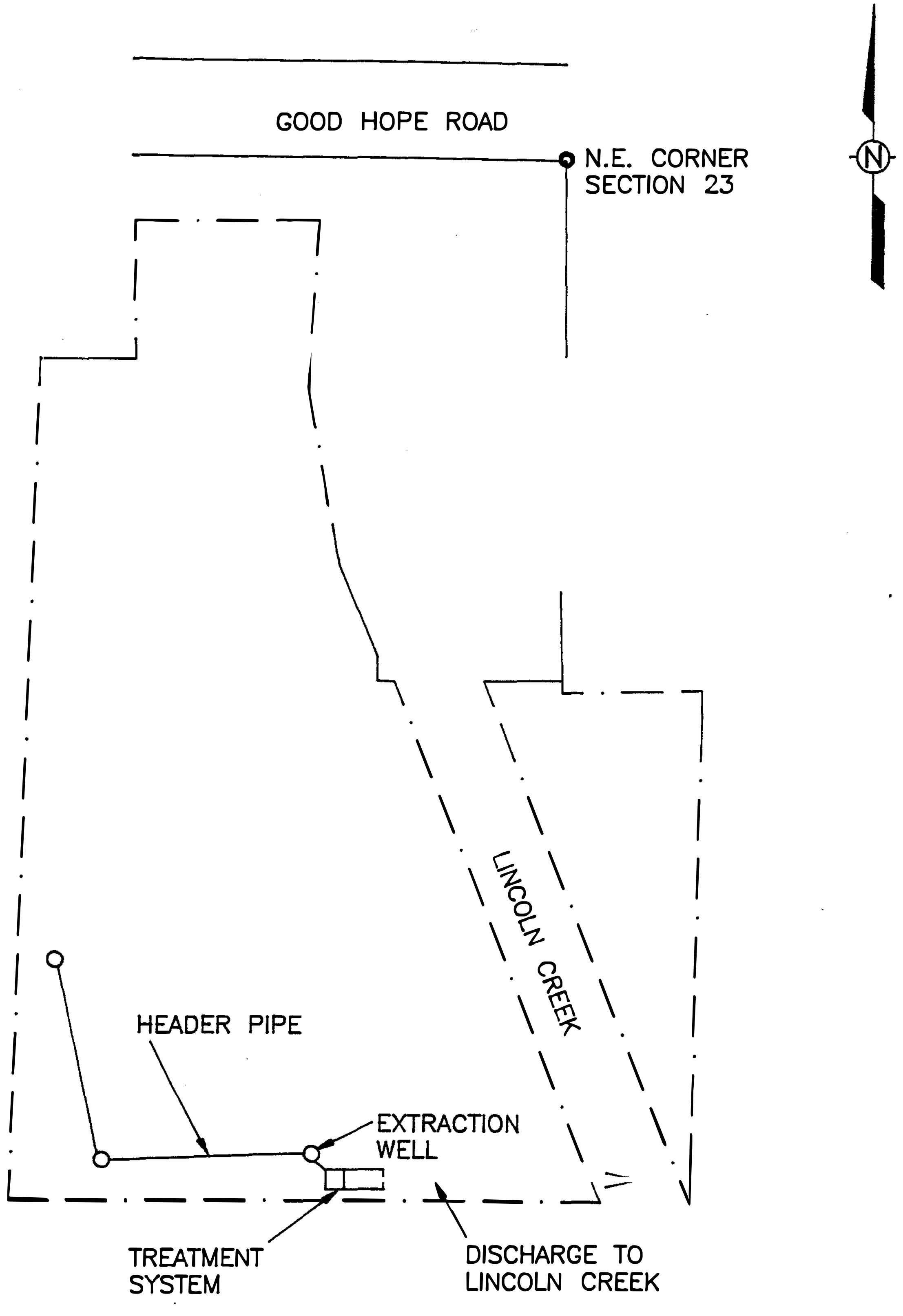
SCALE 1"=100'

FIGURE NO. 8

CADFILE 821492-8.DWG

PLOT DATE 4/24/92

STS PROJECT NO. 82149XF



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PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
PROPOSED GROUNDWATER EXTRACTION SYSTEM

DRAWN BY	J.M.I.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

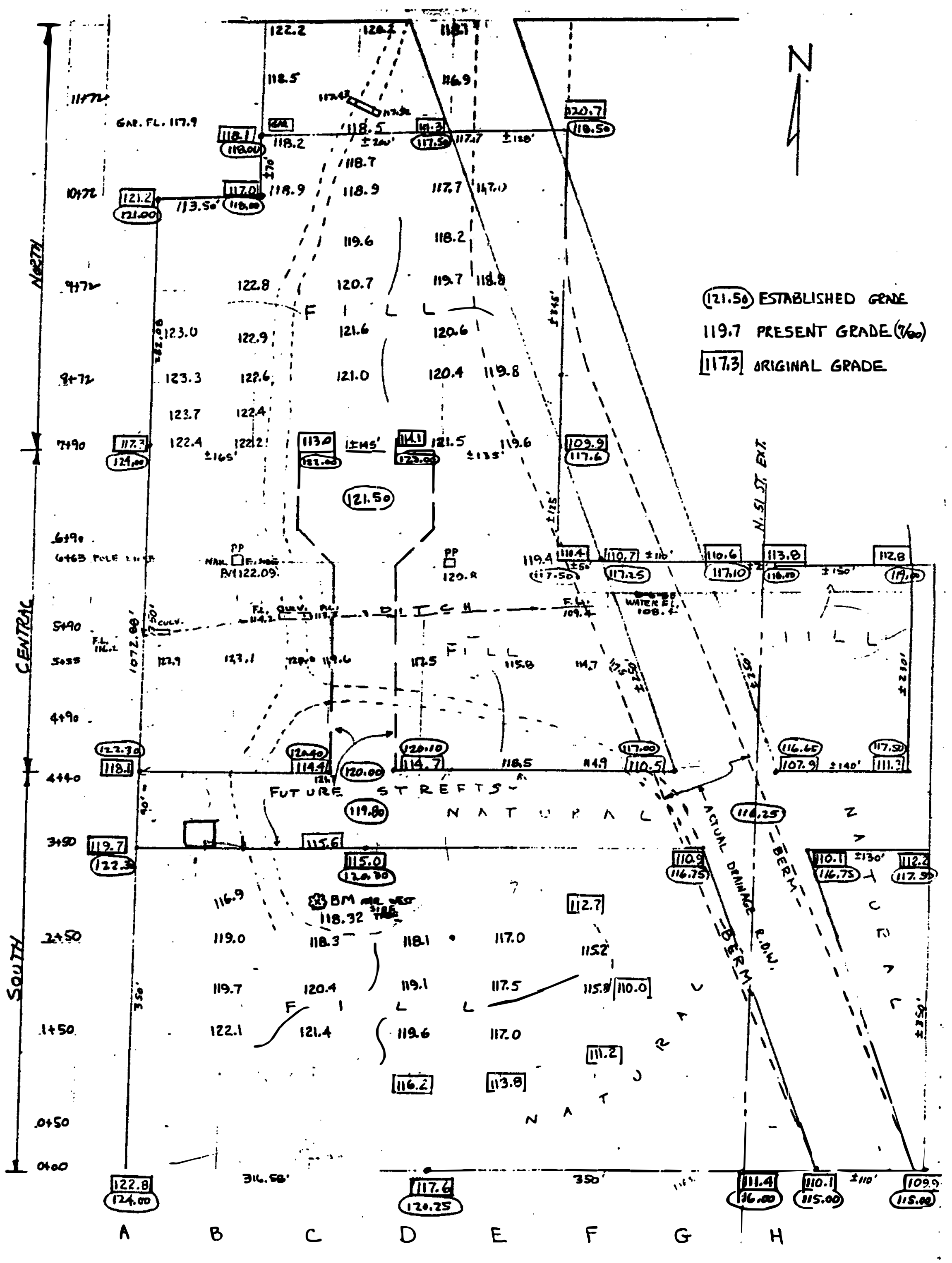
SCALE 1" = 200'

FIGURE NO. 9

CADFILE 821492-1.DWG

PLOT DATE 4/24/92

STS PROJECT NO. 82149XF



SOURCE: DAVE WEISS, WHITEFISH BAY ENGINEER

STS Consultants, Ltd.

PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
GRADING PLAN

DRAWN BY	T.J.J.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

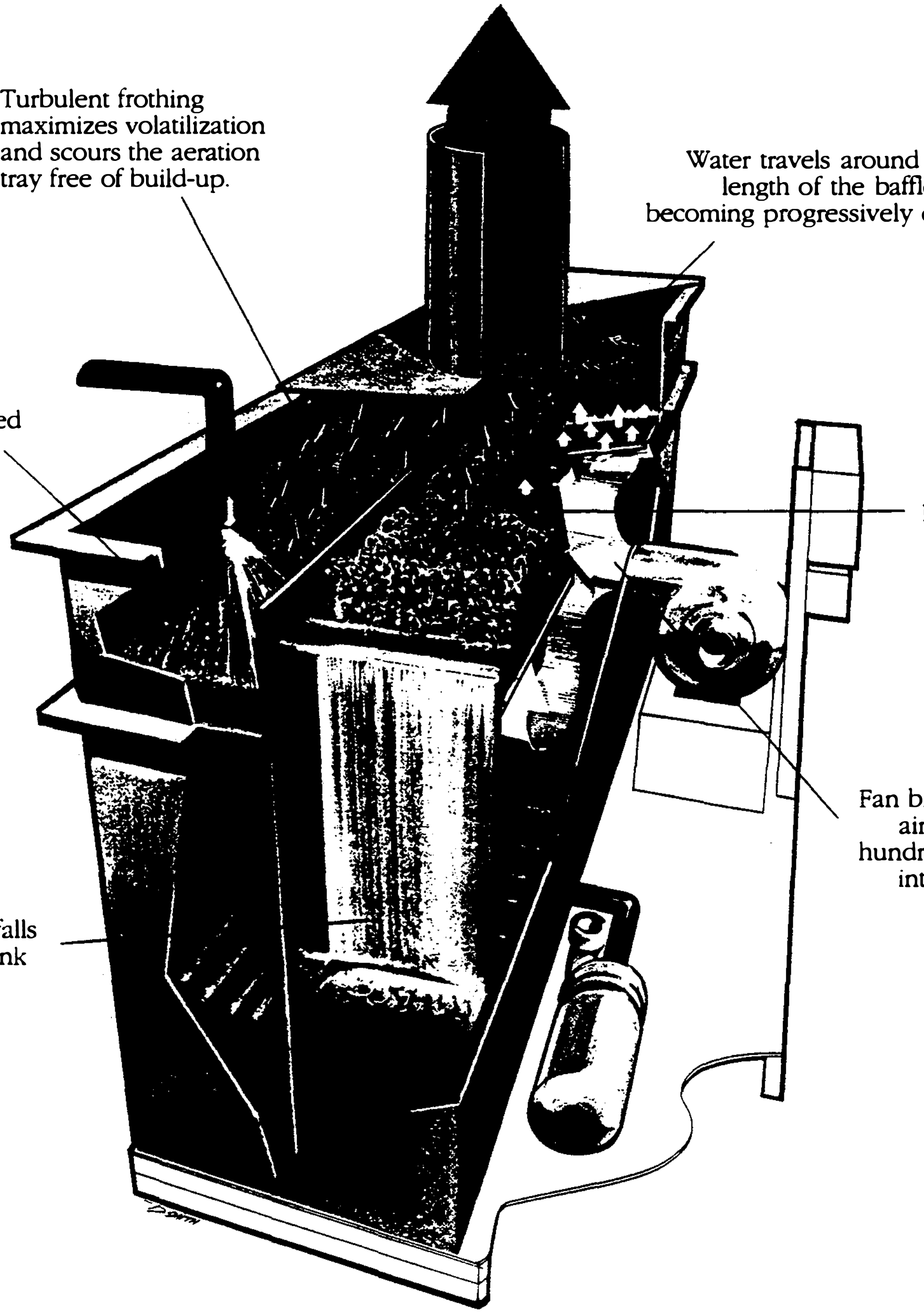
SCALE 1" =80'

FIGURE NO. 10

CADFILE 149-1.DWG

PLOT DATE 4/24/92

STS PROJECT NO. 82149XF



Turbulent frothing maximizes volatilization and scours the aeration tray free of build-up.

Water travels around the full length of the baffled tray, becoming progressively cleaner.

Contaminated water inlet.

3/16" holes resist fouling, providing years of trouble-free operation.

Fan blows filtered air up through hundreds of holes into the water.

Treated water falls into holding tank

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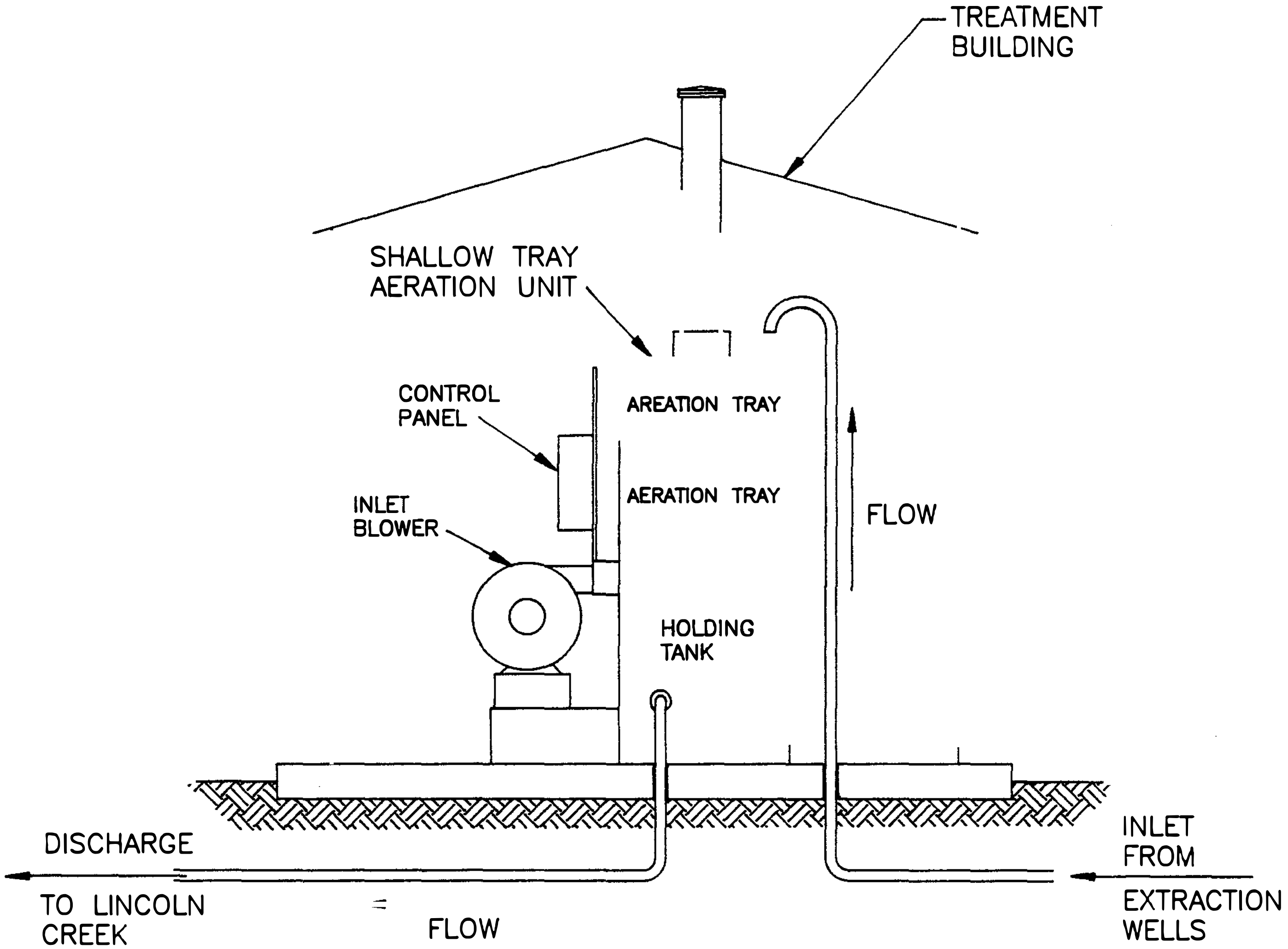
PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
SHALLOW TRAY AERATION UNIT
(ILLUSTRATIVE EXAMPLE)

DRAWN BY	T.J.J.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

SCALE N.T.S.
FIGURE NO. 11
CADFILE 149-1.DWG
PLOT DATE 4/24/92
STS PROJECT NO. 82149XF



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PROJECT/CLIENT

WHITEFISH BAY LANDFILL
MILWAUKEE, WISCONSIN
SECTION – TREATMENT UNIT

DRAWN BY	T.J.J.	4/24/92
CHECKED BY	A.J.G.	4/24/92
APPROVED BY	K.R.H.	4/24/92

SCALE N.T.S.
FIGURE NO. 12
CADFILE 149-12.DWG
STS PROJECT NO. 82149XF
PLOT DATE 4/24/92

Appendix C - Data

1. Results Soil Gas
2. Analytical Results Table - Soil
3. Boring/Well Information Summary
4. Analytical Results Table - Water
5. Remedial Alternative Evaluation Summary

TABLE 1

Whitefish Bay Landfill
Soil Gas Probe Results
March, 1989

Probe/ Sample No.	HNu Result	Probe/ Sample No.	HNu Result	Probe/ Sample No.	HNu Result
B1-S1	1	B24-S1	420	B44-S1	52
B2-S1	40	B24-S2	290	B44-S2	10
B3-S1	20	B25-S1	24	B45-S1	13
B4-S1	420	B25-S2	32	B45-S2	8
B5-S1	2	B26-S1	1	B46-S1	6
B6-S1	3	B26-S2	2	B46-S2	15
B7-S1	<1	B27-S1	1	B47-S1	2
B8-S1	1	B27-S2	2	B47-S2	<1
B9-S1	1	B28-S1	9	B48-S1	180
B10-S1	1	B28-S2	4	B48-S2	300
B11-S1	50	B29-S1	1	B49-S1	22
B11-S2	140	B29-S2	<1	B49-S2	12
B12-S1	305	B30-S1	2	B50-S1	51
B12-S2	220	B30-S2	<1	B50-S2	20
B13-S1	72	B31-S1	3	B51-S1	7
B13-S2	60	B31-S2	<1	B51-S2	13
B14-S1	340	B32-S1	<1	B52-S1	9
B14-S2	360	B32-S2	<1	B52-S2	4
B15-S1	400	B33-S1	16	B53-S1	6
B15-S2	310	B34-S1	2	B53-S2	6
B16-S1	34	B34-S2	1	B54-S1	2
B16-S2	15	B37-S1	62	B54-S2	<1
B17-S1	72	B37-S2	86	B55-S1	2
B17-S2	30	B38-S1	9	B55-S2	3
B18-S1	35	B38-S2	18	B56-S1	20
B18-S2	38	B39-S1	4	B56-S2	16
B19-S1	38	B39-S2	9	B57-S1	18
B19-S2	31	B40-S1	4	B57-S2	200
B20-S1	12	B40-S2	320	B58-S1	20
B20-S2	3	B41-S1	120	B58-S2	300
B21-S1	25	B41-S2	60	B59-S1	18
B21-S2	52	B42-S1	21	B59-S2	220
B22-S1	12	B42-S2	18	B60-S1	8
B22-S2	125	B43-S1	410	B60-S2	10
B23-S1	52	B43-S2	390	B61-S1	390
B23-S2	19			B61-S2	220

TABLE 3

BORING/WELL INFORMATION SUMMARY
WATER ELEVATIONS TAKEN ON 3/27/92
(All Measurements are in Feet)

				Sand		
Boring/ Well No.	Estimated Elevation	Fill Depth	Fill Bottom	Depth Range	Elevation Range	Water Surface
4	696	4.5	691.5	4.5-9.5 13-18	686.5-691.5 678-683	685
6	701	10-13	688-691	16-18	683-685	686
9	692	--	692	13-21.5	670.5-679	683
10	704	8	696	24.5-31.5	672.5-679.5	683
11	700.5	9.5	691	11-12 18-26.5	688.5-689.5 674-682.5	682
16	692	4.5	687.5	5.5-10	686.5-682	684
18	700	10	690	18-26.5	680-673.5	685
22*	704	7	697	23-67	681-637	NA

*Well is damaged and water level information could not be taken at this time.

KRH/ed-m11/82149XF/tables

TABLE 2 - WHITEFISH BAY LANDFILL
ANALYTICAL RESULTS - SOIL

SAMPLE LOCATION (1)

Parameter	Units	B-10(3) S-4 7.5-8.5	B-11(3) S-4 7.5-8'	B-11(3) S-6 12.5-14'	B-l2(3) S-4' 7.5-9'	B-15(3) S-4' 12.5-15'	B-15(3) S-3' 5-6.5'	B-5(2) S-3' 5-6.5'	B-5(2) S-6' 15-16.5'	B-18 S-3 5-6.5'	B-20 S-7 15-16.5'	B-21 S-7 15-16.5'	B-22 S-7 15-16.5'
1 , 2 Dichloroethene	ug/kg	17	784,000	<800	17	10	30	<5	23	<0.47	127	<31	<31
Trichloroethene	ug/kg	15,500	4,800,000	10,600	358	146	122	150	16,000	12.6	2,160	5,840	10,100
Tetrachloroethene	ug/kg	46	11,500,000	122,000	4,450	3,110	3,090	3,700	8,700	41.9	115	129,000	22,500
Benzene	ug/kg	<2	<35,000	<800	<2	<2	<2	<5	<5	<0.28	<0.028	<18	<19
Toluene	ug/kg	16	1,500,000	7,300	26	160	127	<5	1500	23.6	15.5	9,080	2670
Ethylbenzene	ug/kg	<2	1,580,000	10,000	28	1,710	1,730	<5	2,200	53.6	23.6	31,700	14,500
Xylene	ug/kg	10	9,150,000	56,600	222	2,176	2,437	-	0	45.4	57.2	190,000	66,000
Chloroform	ug/kg	<2	<35	<800	3	12	30	89	24	<2.2	<0.22	<140	<140
Methylene Chloride	ug/kg	<2	<35	<800	<2	<2	<2	790	2,500	<5.9	<0.59	<390	<390
PID Value	ppm	17	370	160	65	235	100	110	25	25	40	430	410
Total VOC's	ug/kg	15,589	29,314,000	206,500	5,087	7,314	7,536	4,729	30,924	177.1	2498	365,570	115,770

Notes:
(1) Sample location is boring number, sample number and depth of sample.
(2) Test results from 1986 study.
(3) test results included in 1989 report.

EXCEEDANCES

▨ PAL

▨ ES & PAL

TABLE 4

ANALYTICAL RESULTS FOR THREE ROUNDS OF TESTING OF WELLS ON WHITEFISH BAY LANDFILL

DATE: 5/22/89 JOB: 82149XF C.R.H. CAD/WFB1.DWG DONE BY: A.J.G. CHECKED BY K.R.H.

		B-4			B-9			B-10				
	UNITS	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ENFORCEMENT STANDARD	PREVENTIVE ACTION-LIMIT
1,1 DICHLOROETHENE	UG/L	3.6	<1	2.3	<1	NS	0.3	46	54	35.6	7.0	0.024
1.2 DICHLOROETHANE	UG/L	1.3	<1	229	3	NS	136	<1	<1	10400	100.0	20.0
TRICHLOROETHANE	UG/L	425	341	264	1.5	NS	0.5	2630	877	3400	5.0	0.18
TETRACHLOROETHANE	UG/L	400	223	110	3.7	NS	<1	138	34	477	1.0	0.1
1,1 DICHLOROETHANE	UG/L	<1	<1	6	<1	NS	<1	23	31	18.8	850.0	85.0
1,1 TRICHLOROETHANE	UG/L	<1	<1	<1	<1	NS	<1	30	<1	<1	200.0	40.0
BROMODICHLOROMETHANE	UG/L	<1	<1	<1	<1	NS	<1	2	<1	<1	179.0	36.0
DIBROMODICHLOROMETHANE	UG/L	<1	<1	<1	<1	NS	<1	<1	<1	<1	215.0	43.0
TOLUENE	UG/L	<1	<1	<1	<1	NS	<1	24	3.4	11.5	343.0	68.6
METHYLENE CHLORIDE	UG/L	<1	<1	<1	<1	NS	<1	8.2	<1	<1	150.0	15.0
1,2 DICHLOROPROPANE	UG/L	<1	<1	<1	<1	NS	<1	1	<1	<1	5.0	0.5
TOTAL XYLENES	UG/L	<1	<1	<1	<1	NS	<1	10	<1	<1	620.0	124.0
BENZENE	UG/L	<1	<1	<1	<1	NS	0.1	<1	3.9	<1	5.0	0.067
VINYL CHLORIDE	UG/L	<1	<1	<1	<1	NS	<1	<1	<1	3400	0.2	0.0015
ETHYLBENZENE	UG/L	<1	<1	<1	<1	NS	<1	<1	<1	3.5	1360.0	272.0
1,2 DICHLOROETHANE	UG/L	<1	<1	<1	<1	NS	<1	<1	<1	<1	5.0	0.05
TOTAL VOC's	UG/L	829.9	564	611.3	8.2	--	136.9	2912.2	1003.3	17746.4	–	–

EXCEEDANCES

░ PAL

▒ ES & PAL

ANALYTICAL RESULTS FOR THREE ROUNDS OF TESTING OF WELLS ON WHITEFISH BAY LANDFILL

DATE: 5/22/89 JOB: 82149XF DONE BY: A.J.G. CHECKED BY K.R.H.

C.R.H. CAD/WFB1.DWG

		B-11			B-16			B-18				
	UNITS	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ENFORCEMENT STANDARD	PREVENTIVE ACTION-LIMIT
1,1 DICHLOROETHENE	UG/L	18.7	20.8	26	<1	NS	NS	NS	NS	0.4	7.0	0.024
1.2 DICHLOROETHANE	UG/L	9.1	20.6	9130	<1	NS	NS	NS	NS	106	100.0	20.0
TRICHLOROETHANE	UG/L	<1	11.9	69	<1	NS	NS	NS	NS	9.4	5.0	0.18
TETRACHLOROETHANE	UG/L	15.6	9.0	11.8	<1	NS	NS	NS	NS	<1	1.0	0.1
1,1 DICHLOROETHANE	UG/L	19.4	<1	30.2	<1	NS	NS	NS	NS	<1	850.0	85.0
1,1 TRICHLOROETHANE	UG/L	27.9	42.6	48.4	<1	NS	NS	NS	NS	4.8	200.0	40.0
BROMODICHLOROMETHANE	UG/L	5	<1	<1	<1	NS	NS	NS	NS	<1	179.0	36.0
DIBROMODICHLOROMETHANE	UG/L	10.1	<1	<1	<1	NS	NS	NS	NS	<1	215.0	43.0
TOLUENE	UG/L	3.6	<1	2.2	<1	NS	NS	NS	NS	<1	343.0	68.6
METHYLENE CHLORIDE	UG/L	<1	<1	<1	<1	NS	NS	NS	NS	<1	150.0	15.0
1,2 DICHLOROPROPANE	UG/L	<1	<1	<1	<1	NS	NS	NS	NS	<1	5.0	0.5
TOTAL XYLENES	UG/L	<1	<1	<1	<1	NS	NS	NS	NS	<1	620.0	124.0
BENZENE	UG/L	<1	<1	3.6	<1	NS	NS	NS	NS	<1	5.0	0.067
VINYL CHLORIDE	UG/L	<1	<1	825	<1	NS	NS	NS	NS	<1	0.2	0.0015
ETHYLBENZENE	UG/L	<1	<1	0.7	<1	NS	NS	NS	NS	<1	1360.0	272.0
1,2 DICHLOROETHANE	UG/L	<1	<1	<1	<1	NS	NS	NS	NS	<1	5.0	0.05
TOTAL VOC's	UG/L	109.4	104.9	10146.9	<1	–	–	–	–	120.6	–	–

EXCEEDANCES

░ PAL

░ ES & PAL

ANALYTICAL RESULTS FOR THREE ROUNDS OF TESTING OF WELLS ON WHITEFISH BAY LANDFILL

DATE: 5/22/89 JOB: 82149XF DONE BY: A.J.G. CHECKED BY K.R.H.

C.R.H. CAD/WFB1.DWG

B-22

	UNITS	ROUND 1 10/5/88	ROUND 2 11/10/88	ROUND 3 4/19/89	ENFORCEMENT STANDARD	PREVENTIVE ACTION-LIMIT
1,1 DICHLOROETHENE	UG/L	NS	NS	82.3	7.0	0.024
1.2 DICHLOROETHANE	UG/L	NS	NS	22200	100.0	20.0
TRICHLOROETHANE	UG/L	NS	NS	1180	5.0	0.18
TETRACHLOROETHANE	UG/L	NS	NS	36.4	1.0	0.1
1,1 DICHLOROETHANE	UG/L	NS	NS	165	850.0	85.0
1,1 TRICHLOROETHANE	UG/L	NS	NS	<1	200.0	40.0
BROMODICHLOROMETHANE	UG/L	NS	NS	<1	179.0	36.0
DIBROMODICHLOROMETHANE	UG/L	NS	NS	<1	215.0	43.0
TOLUENE	UG/L	NS	NS	25.3	343.0	68.6
METHYLENE CHLORIDE	UG/L	NS	NS	<1	150.0	15.0
1,2 DICHLOROPROPANE	UG/L	NS	NS	<1	5.0	0.5
TOTAL XYLENES	UG/L	NS	NS	41.3	620.0	124.0
BENZENE	UG/L	NS	NS	16.8	5.0	0.067
VINYL CHLORIDE	UG/L	NS	NS	2490	0.2	0.0015
ETHYLBENZENE	UG/L	NS	NS	24.7	1360.0	272.0
1,2 DICHLOROETHANE	UG/L	NS	NS	132	5.0	0.05
TOTAL VOC's	UG/L	–	–	26393.8	–	–

TABLE 5

REMEDIAL ALTERNATIVE EVALUATION SUMMARY

Source Control Alternative	Implementability	Effectiveness	Cost	Comments
Excavation and Off-Site Disposal	Maybe	Effective	Very High	Could have problems with chlorinated solvent acceptance in a landfill.
Excavation and On-Site Treatment	Maybe	Likely but unknown	Moderate	Time and proximity to residential development reduces effectiveness of alternative.
In-Situ Vapor Extraction	Marginal	Limited	Moderate	Variable soil type and clay fills reduce effectiveness.
NR180 Capping	Yes	Limited	Moderate	Contamination is already present at depth; cover essentially already in-place from previous grading work.
Modified Capping with Passive Bioremediation	Yes	Some	Low to Moderate	Essentially leave site alone with modification of existing wells to provide an inlet.
Deed Restrictions	Yes	Limited	Low	Eliminates future exposure pathways. Should be used with groundwater extraction alternative.
Groundwater Control Alternatives				
Groundwater Monitoring Only	Yes	None	Low	Provides information - must be used in conjunction with source control alternative.
Groundwater Extraction/Treatment to Sanitary Sewer	Marginal	Effective	Moderate	MMSD's current policy restricts long term groundwater disposal.
Groundwater Extraction/Treatment to Storm Sewer	Yes	Effective	Moderate	WDNR issues general permit for contaminated groundwater. Water should be treatable to meet WPDES requirements.

Appendix D - General

1. Legal Description

2. Drilling Information Sheets
    a. USCS
    b. ASTM D-1587
    c. ASTM D-1586
    d. Field and Laboratory Procedures
    e. Standard Boring Log Procedures
    f. STS General Notes

3. Boring Logs
    B-1 to B-23

4. Well Installation Diagrams
    a. B-4, B-9
    b. B-6
    c. B-10
    d. B-11
    e. B-16
    f. B-18
    g. B-22

5. Analytical Data Sheets
    a. Water, April 1989
    b. Soil, April 1989

6. Quality Assurance Document

7. Correspondence/Data Regarding TCLP Testing

ISSUED THROUGH THE OFFICE OF:

TITLE INSURANCE COMPANY OF MINNESOTA

TITLE INSURANCE COMPANY OF MINNESOTA

A Stock Company of Minneapolis, Minnesota

ENDORSEMENT NO. 1

To be attached to and become a part of Title Commitment No. A-57953T of Title Insurance Company of Minnesota.

RE:5201 W. Good Hope
   Village of Whitefish Bay

The effective is extended to May 21, 1986 at 8:00 A.M.

The legal description is hereby amended to read as follows:

Parcel I
That part of the Northwest One-quarter (1/4) and Northeast One-quarter (1/4) of Section Twenty-three (23), Township Eight (8) North, Range Twenty-one (21) East, in the City of Milwaukee, Milwaukee County, Wisconsin, bounded and described as follows: Commencing at a point in the North line of the Northwest 1/4 of said Section, said line also being the centerline of West Good Hope Road, 553.08 feet West of the Northeast corner of said Northwest 1/4; thence South 1 degrees 26 minutes 00 degrees West 80.02 feet to a point in the Southerly line of West Good Hope Road, said point being the point of beginning; thence continuing South 1 degrees 26 minutes 00 seconds West, 179.98 feet; thence West 113.50 feet; thence South 1 degrees 26 minutes 00 seconds West, 1072.88 feet measured (1072+ feet recorded), to a point in the South line of the North 1/2 of said Northwest 1/4; thence South 89 degrees 58 minutes 30 seconds East along said South line 666.58 feet to a point in the East line of said Northwest 1/4; thence North 1 degrees 26 minutes 00 seconds East along said East line 2.33 feet; thence South 89 degrees 55 minutes 16 seconds East, 79.41 feet; thence North 22 degrees 29 minutes 17 seconds West, 717.57 feet; thence South 89 degrees 56 minutes 10 seconds West, 13.37 feet; thence North 1 degrees 26 minutes 00 seconds East, 30.47 feet; thence North 22 degrees 29 minutes 17 seconds West, 130.11 feet to a point in a curved line; thence Northeasterly along the arc of a curve to the right (having a radius of 550.00 feet and a long chord of 227.96 feet which bears North 10 degrees 31 minutes 38 seconds West) an arc distance of 229.63 feet; thence North 1 degrees 26 minutes 00 degrees East, 212.84 feet to a point in the Southerly right of way line of West Good Hope Road; thence West along said Southerly line 228.05 feet to the point of beginning.

Parcel II
That part of the Northwest One-quarter (1/4) and Northeast One-quarter (1/4) of Section Twenty-three (23), Township Eight (8) North, Range Twenty-one (21) East, in the City of Milwaukee, Milwaukee County, Wisconsin, bounded and described as follows: Commencing at the Northeast corner of said Northwest 1/4; thence South 1 degrees 26 minutes 00 seconds West along the East line of said Northwest 1/4, 667.50 feet to the point of beginning; thence continuing South 1 degrees 26 minutes 00 seconds West along said East line 11.29 feet;

ISSUED THROUGH THE OFFICE OF:

TITLE INSURANCE
COMPANY
OF MINNESOTA

thence South 89 degrees 55 minutes 16 seconds East, 179.46 feet; thence South 1 degrees 26 minutes 00 seconds West, 633.28 feet; thence North 22 degrees 29 minutes 17 seconds West, 697.54 feet; thence North 89 degrees 56 minutes 10 seconds East, 103.47 feet to the point of beginning.

5201 W. Good Hope Road   Tax Key No. 121-9996-122-3
7027-7027-R-N. 50th Street   Tax Key No. 122-9998-210-4

Item No's. 11, 12 and 13 under Schedule B - Section 2 are hereby eliminated.

Any questions regarding this endorsement, please contact:
ALICE MORROW/cak

Nothing herein contained shall be construed as extending or changing the effective date of said Commmitment, unless otherwise expressly stated.

This Endorsement shall not be valid or binding until signed by an officer or agent.

Signed and sealed this 2nd day of June, 1986

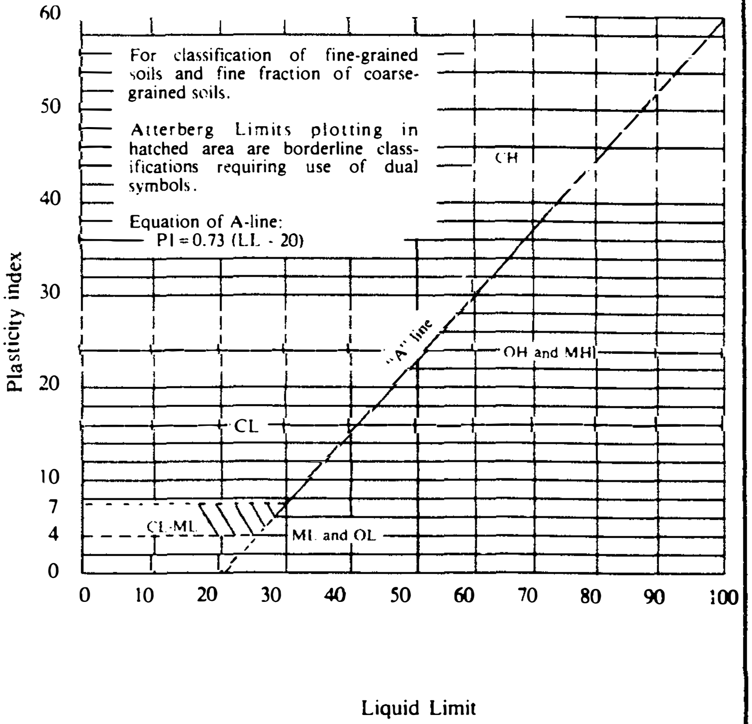
TITLE INSURANCE COMPANY OF MINNESOTA

Signed:
By Alice Morrow
Officer or Validating Agent

Orig + 4cc Mr. Michael Harrigan

STS Soil Classification System

UNIFIED SOIL CLASSIFICATION

Major Divisions			Group symbols	Typical names	Laboratory classification criteria		
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)	Gravels (More than half of coarse fraction larger than No. 4 sieve size)	Clean gravels (Little of no fines)	GW	Well-grades gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 per cent .... GW, GP, SW, SP More than 12 per cent .... GM, GC, SM, SC 5 to 12 per cent .... *Borderline* cases requiring dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} x D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM d u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{10})^2}{D_{10} x D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM d u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	 For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols. Equation of A-line: PI = 0.73 (LL - 20) 		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt	Peat and other highly organic soils	Plasticity Chart		

AMERICAN SOCIETY FOR TESTING AND MATERIALS

Standard Practice for
THIN-WALLED TUBE SAMPLING OF SOILS[1]

This standard is issued under the fixed designation D 1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of the last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (€) indicates an editorial change since the last revision or reapproval.

This practice has been approved for use by agencies of the Department of Defense and for listing in the DOD Index os Specifications and Standards.

1. Scope

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of structural properties. Thin-walled tubes used in piston, plug, or rotary-type samplers, such as the Denison or Pitcher, must comply with the portions of this practice which describe the thin-walled tubes (5.3).

NOTE 1—This practice does not apply to liners used within the above samplers.

2. Applicable Documents

2.1 ASTM Standards:

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D3550 Practice for Ring-Lined Barrel Sampling of Soils[2]

D4220 Practice for Preserving and Transporting Soil Samples[2]

3. Summary of Practice

3.1 A relatively undisturbed sample is obtained by pressing a thin-walled metal tube into the in-situ soil, removing the soil-filled tube, and sealing the ends to prevent the soil from being disturbed or losing moisture.

4. Significance and Use

4.1 This practice, or Practice D3550, is used when it is necessary to obtain a relatively undisturbed specimen suitable for laboratory tests of structural properties or other tests that might be influenced by soil disturbance.

5. Apparatus

5.1 Drilling Equipment—Any drilling equipment may be used that provides a reasonably clean hole; that does not disturb the soil to be sampled; and that does not hinder the penetration of the thin-walled sampler. Open borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.5 times the outside diameter of the thin-walled tube.

5.2 Sampler Insertion Equipment, shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

5.3 Thin-Walled Tubes, should be manufactured as shown in Fig. 1. They should have an outside diameter of 2 to 5 in. and be made of metal having adequate strength for use in the soil and formation intended. Tubes shall be clean and free of all surface irregularities including projecting weld seams.

5.3.1 Length of Tubes—See Table 1 and 6.4.

5.3.2 Tolerances, shall be within the limits shown in Table 2.

5.3.3 Inside Clearance Ratio, should be 1% or as specified by the engineer or geologist for the soil and formation to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled. See Fig. 1 for definition of inside clearance ratio.

5.3.4 Corrosion Protection—Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective coating. Tubes which will contain samples for more than 72 h shall be coated. The type of coating to be used may vary depending upon the material to be sampled. Coatings may include a light coat of lubricating oil, lacquer, epoxy, Teflon, and others. Type of coating must be specified by the engineer or geologist if storage will exceed 72 h. Plating of the tubes or alternate base metals may be specified by the engineer or geologist.

5.4 Sampler Head, serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube, comprises the thin-walled tube sampler. The sampler head shall contain a suitable check valve and a venting area to the outside equal to or greater than the area through the check valve. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.

6. Procedure

6.1 Clean out the borehole to sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above ground water level during the sampling operation.

6.2 Bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted. Remove loose material from the center of a casing or hollow stem auger as carefully as possible to avoid disturbance of the material to be sampled.

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[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigation.

Current edition approved Aug. 17, 1983. Published October 1983. Originally published as D 1587-58T. Last previous edition D 1587-74.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

NOTE 2—Roller bits are available in downward-jetting and diffused-jet configurations. Downward-jetting configuration rock bits are not acceptable. Diffuse-jet configurations are generally acceptable.

6.3 Place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler without rotation by a continuous relatively rapid motion.

6.4 Determine the length of advance by the resistance and condition of the formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays.

NOTE 3—Weight of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 1.

6.5 When the formation is too hard for push-type insertion, the tube may be driven or Practice D3550 may be used. Other methods, as directed by the engineer or geologist, may be used. If driving methods are used, the data regarding weight and fall of the hammer and penetration achieved must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."

6.6 In no case shall a length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3 in. for sludge-end cuttings.

NOTE 4—The tube may be rotated to shear bottom of the sample after pressing is complete.

6.7 Withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample.

7. Preparation for Shipment

7.1 Upon removal of the tube, measure the length of sample in the tube. Remove the disturbed material in the upper end of the tube and measure the length again. Seal the upper end of the tube. Remove at least 1 in. of material from the lower end of the tube. Use this material for soil description in accordance with Practice D2488. Measure the overall sample length. Seal the lower end of the tube. Alternatively, after measurement, the tube may be sealed without removal of soil from the ends of the tube if so directed by the engineer or geologist.

NOTE 5—Field extrusion and packaging of extruded samples under the specific direction of a geotechnical engineer or geologist is permitted.

NOTE 6—Tubes sealed over the ends as opposed to those sealed with expanding packers should contain end padding in end voids in order to prevent drainage or movement of the sample within the tube.

7.2 Prepare and immediately affix labels or apply markings as necessary to identify the sample. Assure that the markings or labels are adequate to survive transportation and storage.

8. Report

8.1 The appropriate information is required as follows:

8.1.1 Name and location of the project,

8.1.2 Boring number and precise location on project,

8.1.3 Surface elevation or reference to a datum,

8.1.4 Date and time of boring—start and finish,

8.1.5 Depth to top of sample and number of samples,

8.1.6 Description of sampler: size, type of metal, type of coating,

8.1.7 Method of sampler insertion: push or drive,

8.1.8 Method of drilling, size of hole, casing, and drilling fluid used,

8.1.9 Depth to groundwater level: date and time measured,

8.1.10 Any possible current or tidal effect on water level,

8.1.11 Soil description in accordance with Practice D2488,

8.1.12 Length of sampler advance, and

8.1.13 Recovery: length of sample obtained.

9. Precision and Bias

9.1 This practice does not produce numerical data; therefore, a precision and bias statement is not applicable.

TABLE 1 Suitable Thin-Walled Steel Sample Tubes[A]

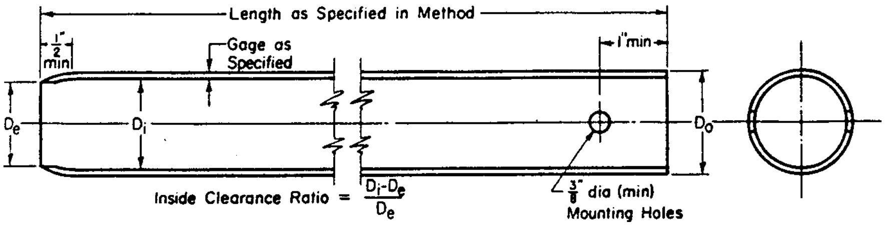
Outside diameter:			
in.	2	3	5
mm	50.8	76.2	127
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.066	0.120
mm	1.24	1.68	3.05
Tube length:			
in.	36	38	54
m	0.91	0.91	1.45
Clearance ratio, %	1	1	1

[A] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

TABLE 2 Dimensional Tolerances for Thin-Walled Tubes

Nominal Tube Diameters from Table 1[A] Tolerances, in.			
Size Outside Diameter	2	3	5
Outside diameter	+0.007	+0.010	+0.015
	−0.000	−0.000	−0.000
Inside diameter	+0.000	+0.000	+0.000
	−0.007	−0.010	−0.015
Wall thickness	±0.007	±0.010	±0.015
Ovality	0.015	0.020	0.030
Straightness	0.030/ft	0.030/ft	0.030/ft

[A] Intermediate or larger diameters should be proportional. Tolerances shown are essentially standard commercial manufacturing tolerances for seamless steel mechanical tubing. Specify only two of the first three tolerances; that is, O.D. and I.D., or O.D. or O.D. and Wall, or I.D. and Wall.



NOTE 1—Minimum of two mounting holes on opposite sides for 2 to 3½ in. sampler.
NOTE 2—Minimum of four mounting holes spaced at 90° for samplers 4 in. and larger.
NOTE 3—Tube held with hardened screws.
NOTE 4—Two-inch outside-diameter tubes are specified with an 18-gage wall thickness to comply with area ratio criteria accepted for "undisturbed samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-gage tubes are generally readily available.

Metric Equivalents

in.	mm
³/₈	6.77
½	12.7
1	25.4
2	50.8
3½	88.9
4	101.6

FIG. 1 Thin-Walled Tube for Sampling

AMERICAN SOCIETY FOR TESTING AND MATERIALS

Standard Method for
PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS[1]

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of the last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (€) indicates an editorial change since the last revision or reapproval.

This method has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

1. Scope

1.1 This method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Applicable Documents

2.1 ASTM Standards:

D2487 Test Method for Classification of Soils for Engineering Purposes[2]

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D4220 Practice for Preserving and Transporting Soil Samples[2]

3. Descriptions of Terms Specific to This Standard

3.1 anvil—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.2 cathead—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.3 drill rods—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.4 drive-weight assembly—a device consisting of the hammer, hammer fall guide, the anvil, and any hammer drop system.

3.5 hammer—that portion of the drive-weight assembly consisting of the 140 ± 2 lb (63.5 ± 1 kg) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.6 hammer drop system—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.7 hammer fall guide—that part of the drive-weight assembly used to guide the fall of the hammer.

3.8 N-value—the blowcount representation of the penetration resistance of the soil. The N-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.9 ΔN—the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.10 number of rope turns—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.11 sampling rods—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.12 SPT—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or N-value, and the engineering behavior of earthworks and foundation are available.

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[1] This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D1586—58T. Last previous edition D1586—67 (1974).

[2] Annual Book of ASTM Standards, Vol 04.08.

5. Apparatus

5.1 Drilling Equipment—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be suitable for advancing a borehole in some subsurface conditions.

5.1.1 Drag, Chopping, and Fishtail Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharging bits are permitted.

5.1.2 Roller-Cone Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 Hollow-Stem Continuous Flight Augers, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 Solid, Continuous Flight, Bucket and Hand Augers, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.

5.2 Sampling Rods—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1⅝ in. (41.2 mm) and an inside diameter of 1⅛ in. (28.5 mm).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the N-values to depths of at least 100 ft (30 m).

5.3 Split-Barrel Sampler—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1⅜ in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

NOTE 2—Both theory and available test data suggest that N-values may increase between 10 to 30% when liners are used.

5.4 Drive-Weight Assembly:

5.4.1 Hammer and Anvil—The hammer shall weigh 140 ± 2 lb (63.5 ± 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 Hammer Drop System—Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of the sampler while re-engaging and lifting the hammer.

5.5 Accessory Equipment—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 m) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance", or the "N-value". If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either of the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2¼ rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¾ of 2¼ rope turns, depending upon whether or not the rope comes off the top (1¾ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¾ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

8. Report

8.1 Drilling information shall be recorded in the field and shall include the following:

8.1.1 Name and location of job,

8.1.2 Names of crew,

8.1.3 Type and make of drilling machine,

8.1.4 Weather conditions,

8.1.5 Date and time of start and finish of boring,

8.1.6 Boring number and location (station and coordinates, if available and applicable),

8.1.7 Surface elevation, if available,

8.1.8 Method of advancing and cleaning the boring,

8.1.9 Method of keeping boring open,

8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,

8.1.11 Location of strata changes,

8.1.12 Size of casing, depth of cased portion of boring,

8.1.13 Equipment and method of driving sampler,

8.1.14 Type of sampler and length and inside diameter of barrel (note use of liners),

8.1.15 Size, type, and section length of the sampling rods, and

8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in the field and shall include the following:

8.2.1 Sample depth and, if utilized, the sample number,

8.2.2 Description of soil,

8.2.3 Strata changes within sample,

8.2.4 Sampler penetration and recovery lengths, and

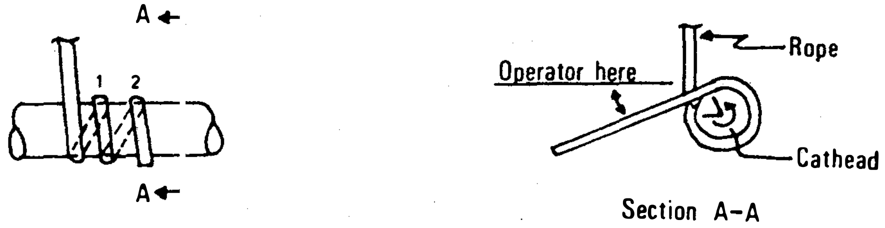
8.2.5 Number of blows per 6-in. (0.15-m) or partial increment.

9. Precision and Bias

9.1 Variations in N-values of 100% or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, N-values in the same soil can be reproduced with a coefficient of variation of about 10%.

9.2 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems.

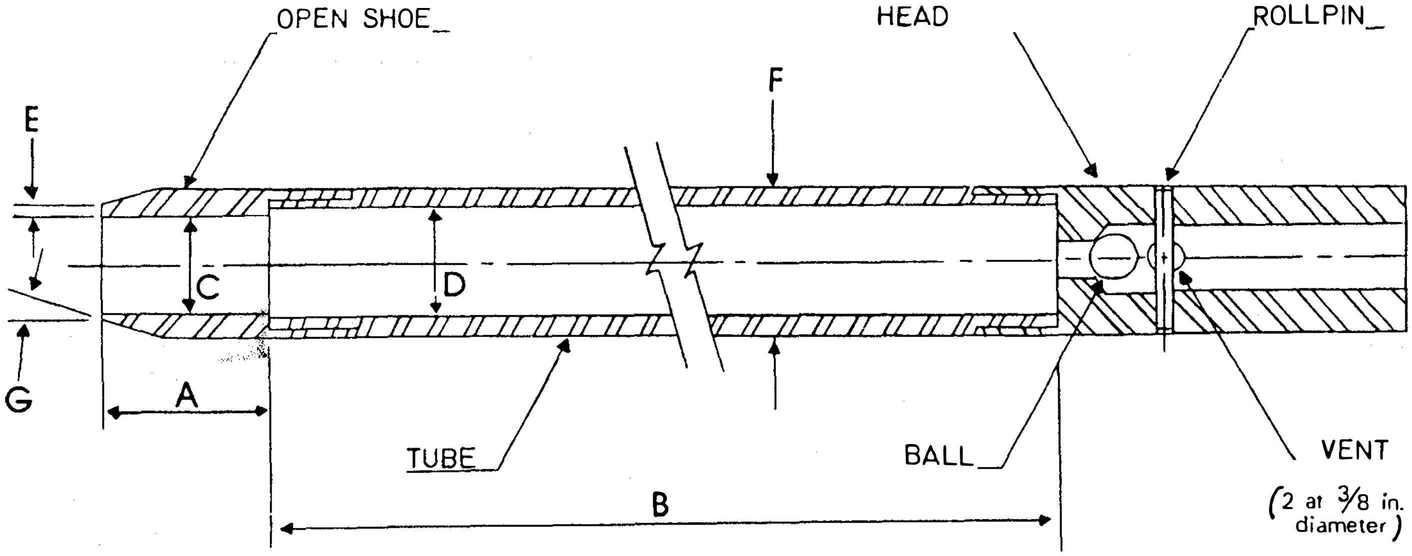
9.3 The variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is currently under development.



(a) counterclockwise rotation
approximately 1¾ turns

(b) clockwise rotation
approximately 2¼ turns

FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 − 0.00 in. (38.1 ± 1.3 − 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 − 0.00 in. (50.8 ± 1.3 − 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

SUBSURFACE EXPLORATION PROCEDURES

Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer. When the sampler is driven to the desired sample depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the bore hole in preparation for obtaining the next sample.

Power Auger Drilling (PA)

In this type of drilling procedure, continuous flight augers are used to advance the bore holes. They are turned and hydraulically advanced by a truck or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open bore holes.

Hollow Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers having open stems are used to advance the bore holes. The open stem allows the sampling tool to be used without removing the augers from the bore hole. Hollow stem augers thus provide support to the sides of the bore hole during the sampling operations.

Rotary Drilling (RB)

In employing rotary drilling methods, various cutting bits are used to advance the bore holes. In this process, surface casing and/or drilling fluids are used to maintain open bore holes.

Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in sturdy containers in sequential order.

SAMPLING PROCEDURES

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) — (ASTM Standard D-1586-84)

In the split-barrel sampling procedure, a 2 inch O.D., split barrel sampler is driven into the soil a distance of 18 inches by means of a 140 pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) — (ASTM Standard D-1587-83)

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undistributed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-ft. sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-ft. maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-ft. interval.

LABORATORY PROCEDURES

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf), by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

Dry Density (γ_D)

The dry density is the quantity used as a measure of the amount of solids in a unit volume of soil aggregate. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and classified on the basis of their texture and plasticity in accordance with United Soil Classification System (USCS). The soil descriptions on the boring logs are in conformance with this system and the estimated group symbols according to this system are included in parentheses following the soil descriptions on the boring logs. Included on a separate sheet entitled "General Notes" is a brief explanation of this system of soil classification.

STS Standard Boring Log Procedures

STS CONSULTANTS, LTD.

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soil engineers, and differences between the field logs and the final logs may exist.

The engineer preparing the report reviews the field and laboratory logs, classifications and test data, and using judgment and experience in interpreting this data, may make further changes.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then destroyed unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.

It is common practice in the geotechnical engineering profession that field logs and laboratory data sheets not included in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors and subcontractors submitting bids or proposals on work might have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs are retained in our office for review by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have been and typically are made in the preparation of our final reports, to the contractor or subcontractors, before the firm submits its bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

The descriptive terms and symbols used on the logs are described on the attached sheet, entitled: "General Notes".

STS CONSULTANTS, LTD.

DRILLING & SAMPLING SYMBOLS:

SS : Split Spoon-1 3/8" I.D., 2" O.D.
Unless otherwise noted
ST : Shelby Tube-2" O.D.,
Unless otherwise noted
PA : Power Auger
DB : Diamond Bit-NX, BX, AX
AS : Auger Sample
JS : Jar Sample
VS : Vane Shear
OS : Osterberg Sampler-3" Shelby Tube
HS : Hollow Stem Auger
WS : Wash Sample
FT : Fish Tail
RB : Rock Bit
BS : Bulk Sample
PM : Pressuremeter Test, In-Situ
GS : Giddings Sampler

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL : Water Level
WS : While Sampling
WD : While Drilling
AB : After Boring
WCI : Wet Cave In
DCI : Dry Cave In
BCR : Before Casing Removal
ACR : After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be sought.

GRADATION DESCRIPTION & TERMINOLOGY:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component Of Sample	Size Range
Boulders	Over 8 in. (200 mm)
Cobbles	8 inches to 3 inches (200 mm to 75 mm)
Gravel	3 inches to #4 sieve (75 mm to 4.76 mm)
Sand	#4 to #200 sieve (4.76 mm to 0.074 mm)
Silt	Passing #200 sieve (0.074 mm to 0.005 mm)
Clay	Smaller than 0.005 mm

Description Of Components Also Present in Sample	Percent Of Dry Weight
Trace	1-9
Little	10-19
Some	20-34
And	35-50

CONSISTENCY OF COHESIVE SOILS:

Unconfined Compressive Strength, Qu, tsf	Consistency
0.25	Very Soft
0.25-0.49	Soft
0.50-0.99	Medium (Firm)
1.00-1.99	Stiff
2.00-3.99	Very Stiff
4.00-8.00	Hard
>8.00	Very Hard

RELATIVE DENSITY OF GRANULAR SOILS:

N-Blows per ft.	Relative Density
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense
>80	Extremely Dense

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

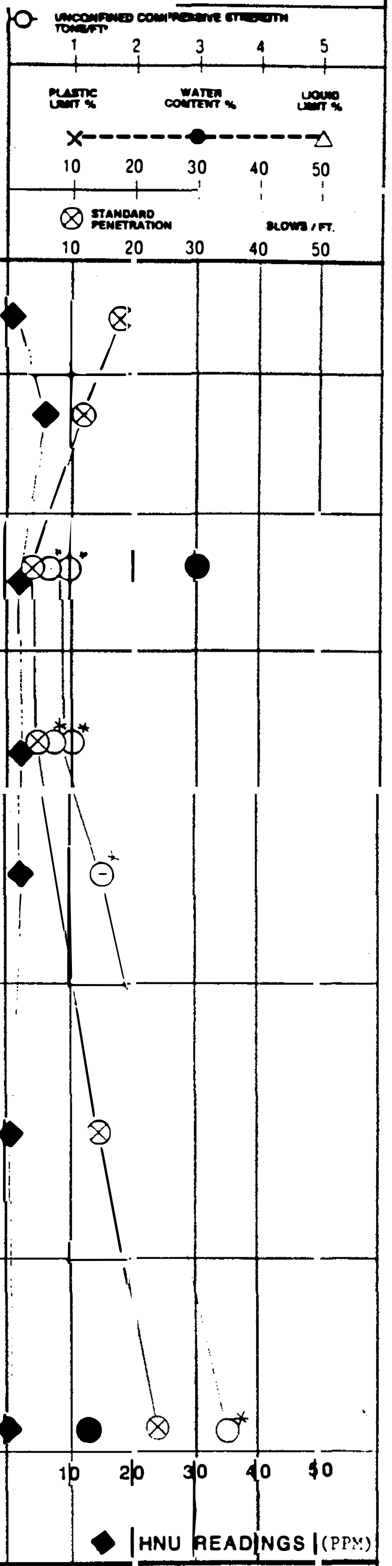
PROJECT NAME
Landfill

SITE LOCATION
Milwaukee, WI

LOG OF BORING NUMBER
B-1

ARCHITECT—ENGINEER

DEPTH	ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	UNIT DRY WT. LBS./FT³
		1	SS			Silty clay fill, some sand and gravel, trace topsoil, roots and glass-brown, grey and slightly black (CL-Fill)	
			PA				
		2	SS			Miscellaneous fill-glass, bricks, roots, fibrous material -dark grey-moist-medium dense (Misc Fill)	
5ft			PA				
		3	SS			Silty clay fill, trace glass, rusty metal-roots-dark grey-medium (CL-Fill)	
			PA				
		4	SS			Slightly organic silty clay, trace sand-bluish grey and slightly brown-medium (CL-OL)	
			PA				
10ft		5	ST			Clayey silt, little sand and gravel-greyish brown-stiff (ML-CL)	
			RB				
						Sandy clayey silt, trace gravel-grey-wet-medium dense (ML)	
15ft		6	SS				
			RB				
						Silty clay with irregular sand pockets and seams-brownish grey-very stiff (CL)	
20ft		7	SS				
21.5ft						END OF BORING Installed 11 feet of NX casing	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL

WL 5' WS		BORING STARTED 11-6-86		STS OFFICE Milwaukee	
WL	BCR ARC	BORING COMPLETED 11-6-86		DRAWN BY ER	SHEET NO. 1 OF 1
WL 5.5' AB		RIG CME 55	FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL-3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

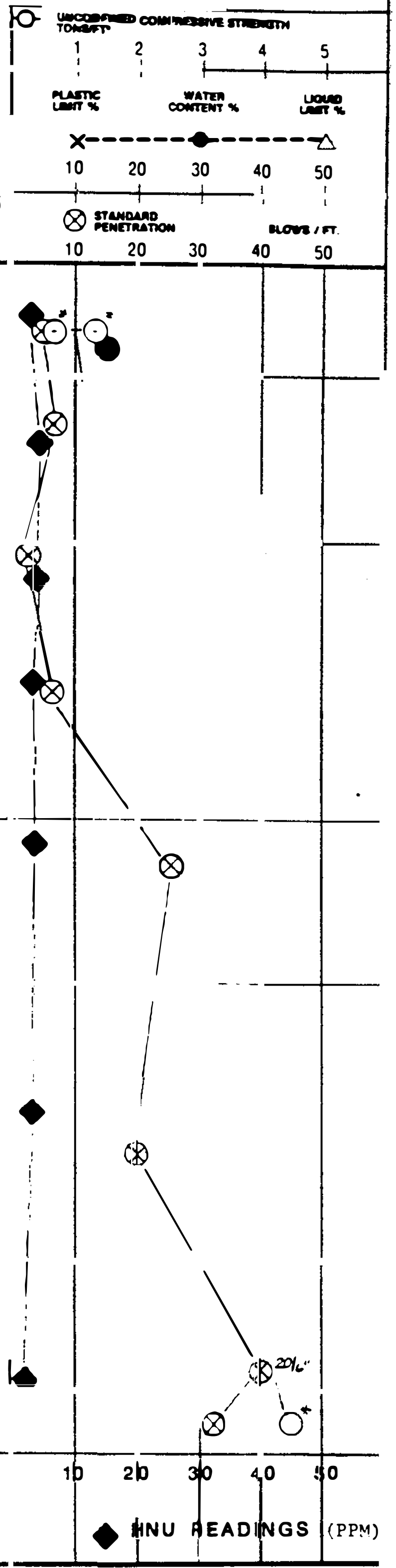
PROJECT NAME
Landfill

SITE LOCATION
Milwaukee, WI

LOG OF BORING NUMBER
B-2

ARCHITECT—ENGINEER

DEPTH	ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
☒						SURFACE ELEVATION	
		1	SS			Silty clay fill, little sand and gravel, trace roots-brown-medium to stiff (CL-Fill)	
			PA				
		2	SS			Sand and gravel fill, little silt, trace glass-grey-wet-loose (SM-GM-Fill)	
5ft			PA				
		3	SS				
			PA			Miscellaneous fill: Bricks, clay, metal, cinders, glass, roots-red, brown, dark grey to black-moist-very loose to loose (Misc Fill)	
		4	SS				
			PA				
10ft		5	SS			Very silty fine to coarse sand and gravel-brown-wet-medium dense (SM-GM)	
			PA				
15ft						Silty fine to medium sand with silt seams-brown to rusty brown-wet-medium dense (SM)	
		6	SS				
			PA				
						Clayey silt, little to some sand and gravel-brownish grey-dense (ML-CL)	
20ft		7	SS				
		7A	SS			Silty clay, with irregular fine sand seams-brownish grey-hard (CL)	
21.5ft						END OF BORING	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 8.5' WS		BORING STARTED	11-6-86	STS OFFICE	Milwaukee	
WL	BCR ARC	BORING COMPLETED	11-6-86	DRAWN BY ER	SHEET NO 1	OF 1
WL 9' AB		RIG CME 55	FOREMAN JW	APP'D BY ABW	STS JOB NO.	82149

BL 3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

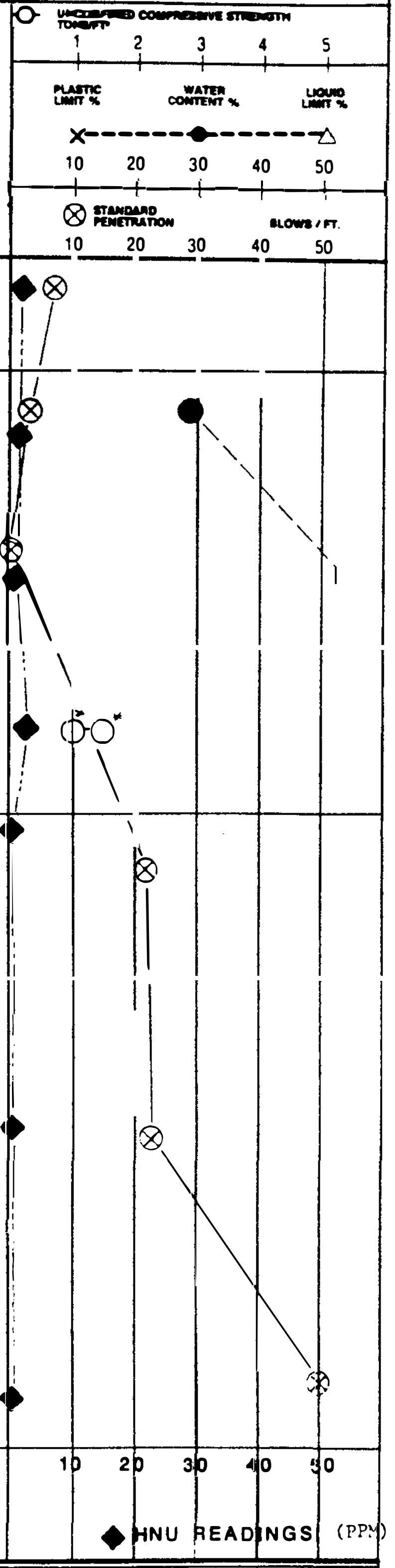
LOG OF BORING NUMBER
B-3 (Offset 13' North - 10' East)

PROJECT NAME
Landfill

ARCHITECT—ENGINEER

SITE LOCATION
Milwaukee, WI

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	UNIT DRY WT. LBS./FT³
	1	SS			Miscellaneous fill: Clay, topsoil, sand and gravel fill-brown to black-moist-loose (Misc Fill)	
		PA				
	2	SS			Topsoil fill, trace metal, roots and glass-black-moist very loose (OL-Fill)	
5ft		PA				
	3	SS				
		PA				
	4	ST			Silty clay fill, trace sand, gravel, metal and wood-greyish brown-stiff (CL-Fill)	
10ft		PA				
	5	SS			Silty fine to coarse sand and gravel-brown-wet-medium dense (SM-GM)	
		PA				
15ft					Very silty fine to coarse sand and gravel-grey-wet-medium dense to very dense (SM-GM)	
	6	SS				
		PA				
20ft	7	SS				
21.5ft					END OF BORING	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL

WL 6.5' WS		BORING STARTED 11-6-86		STS OFFICE Milwaukee	
WL	BCR ARC	BORING COMPLETED 11-6-86		DRAWN BY ER	SHEET NO. 1 OF 1
WL 5.5' AB		RIG CME 55	FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL.3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

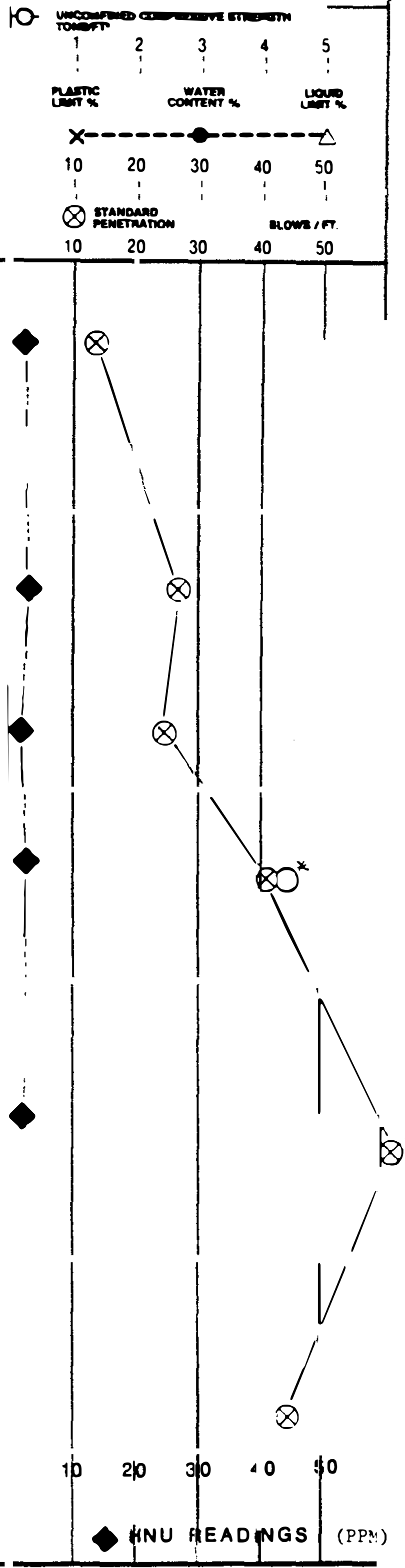
PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-4 (Offset 8' East)

ARCHITECT—ENGINEER

SITE LOCATION
Milwaukee, WI

DEPTH	ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	UNIT DRY WT. LBS./FT³
		1	SS			Miscellaneous Fill: Clay, topsoil, sand and gravel fill-brown and black (Misc Fill)	
			PA				
		2	ST				
5ft			PA				
		3	SS			Very silty fine to coarse sand and gravel-brown-wet-medium dense (SM-GM)	
			PA				
		4	SS				
			PA				
10ft		5	SS			Silty clay with irregular silt seams-brownish grey -hard (CL)	
			RB				
						Fine to coarse sand, trace silt, little gravel-greyish brown-wet-very dense (SP)	
15ft		6	SS				
			RB				
						Fine to coarse sand and gravel, trace silt-grey-wet-dense (SP to GP)	
20ft		7	SS				
21.5ft						END OF BORING Installed 11 feet of NX casing	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL

WL	6' WS	BORING STARTED	11-10-86	STS OFFICE	Milwaukee
WL	BCR ARC	BORING COMPLETED	11-10-86	DRAWN BY ER	SHEET NO. 1 OF 1
WL		RIG CME 55	FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL.3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

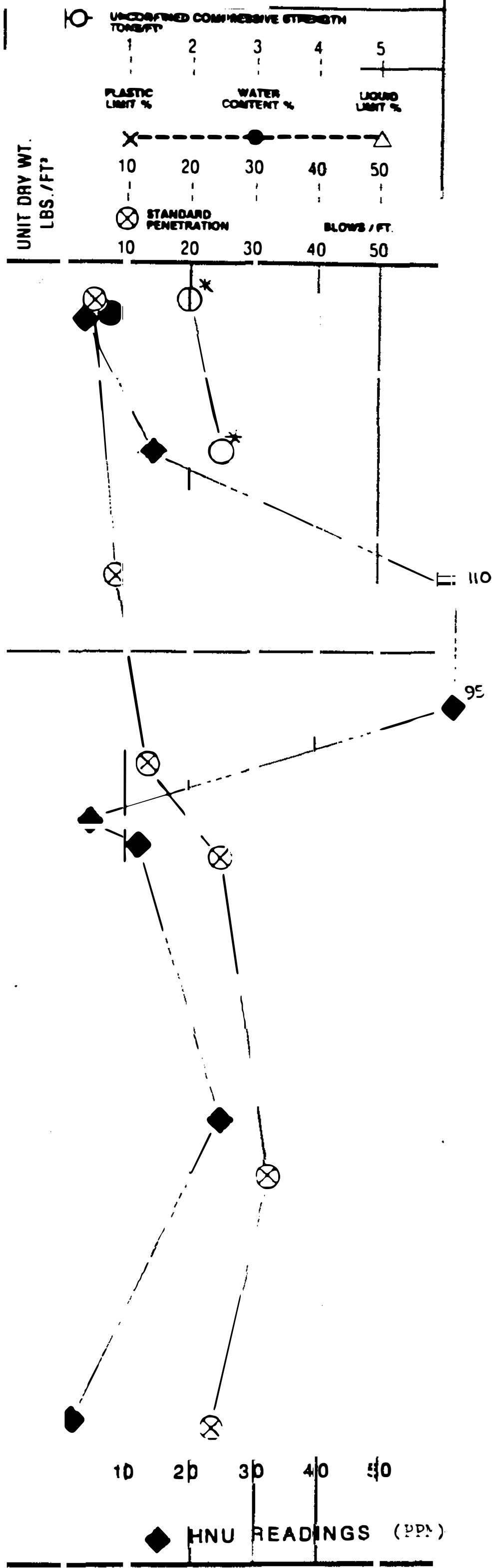
PROJECT NAME
Landfill

SITE LOCATION
Milwaukee, WI

LOG OF BORING NUMBER
B-5 (Offset 45' West)

ARCHITECT—ENGINEER

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	UNIT DRY WT. LBS./FT³
	1	SS			Silty clay, trace sand and gravel-brown-very stiff (CL)	
		PA				
	2	ST			Silty clay, little sand and gravel-mottled brown and grey-very stiff (CL)	
5ft		PA				
	3	SS			Silty clayey sand, trace gravel-yellowish brown-wet-loose (SC)	
		PA				
	4	SS			Clayey silt, some sand, trace gravel-brown-medium dense -moist (ML-CL)	
		PA				
10ft		SS				
	5A	SS			Fine to coarse sand, little silt and gravel-brown-medium dense-wet (SM)	
		PA				
					Layered silty clay, silt and sand-brownish grey-hard-dense-wet (CL-ML-SM)	
15ft	6	SS				
		PA				
					Fine to coarse sand and gravel, little silt-brownish grey-wet-medium dense (SM-GM)	
20ft	7	SS				
21.5ft					END OF BORING	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL

WL 10' WS	BORING STARTED 11-11-86	STS OFFICE Milwaukee	
WL BCR ARC	BORING COMPLETED 11-11-86	DRAWN BY ER	SHEET NO. 1 OF 1
WL	RIG CME 55 FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL-3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

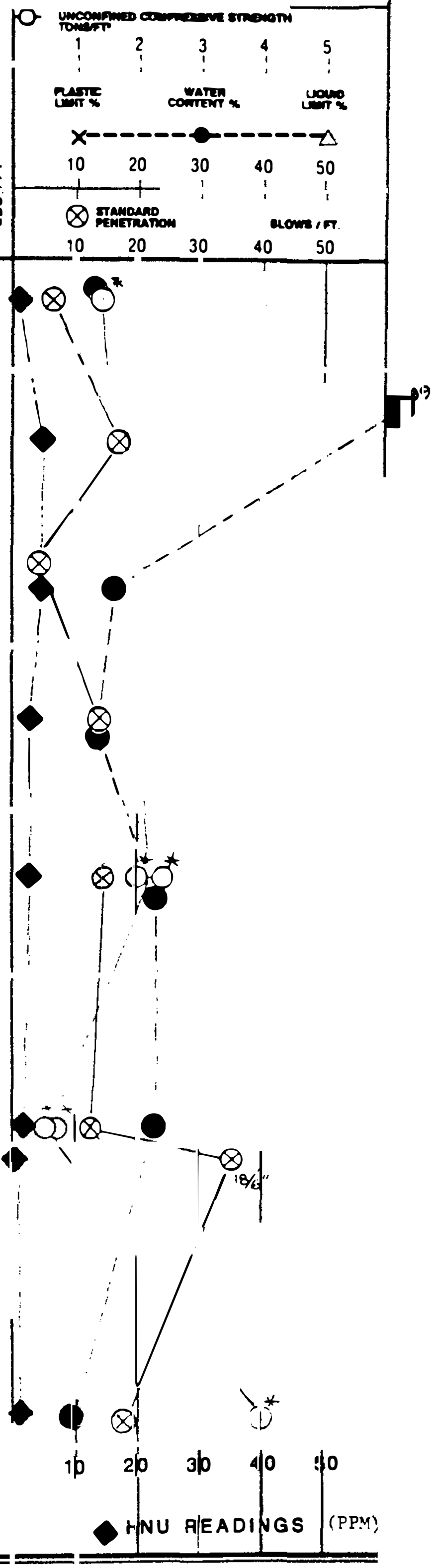
LOG OF BORING NUMBER
B-6

PROJECT NAME
Landfill

ARCHITECT—ENGINEER

SITE LOCATION
Milwaukee, WI

DEPTH	ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	UNIT DRY WT. LBS./FT³
		1	SS			Silty clay fill, little sand, gravel and topsoil-brown-stiff (CL-Fill)	
			PA				
		2	SS			Topsoil fill, little partially decayed vegetation-black-loose to medium dense (OL-Fill)	
			PA				
		3	SS				
			PA				
		4	SS			Silty clay fill, some sand, gravel and broken concrete-brown and grey (CL-Fill)	
10ft			PA				
		5	SS			Slightly organic silty clay, trace sand-dark grey and slightly black (CL-OL-Possible Fill)	
			PA				
						Clayey silt-brownish grey and greyish brown-wet-medium (ML-CL)	
15ft							
		6	SS				
		6A	SS			Fine to coarse sand and gravel-brown-wet-dense (SM-GM)	
			PA				
						Layers of silty clay, little sand and gravel (CL) and clayey silt (ML-CL)-brownish grey-hard	
20ft							
		7	SS				
21.5ft						END OF BORING	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 16' WS		BORING STARTED 11-10-86		STS OFFICE Milwaukee	
WL	BCR ARC	BORING COMPLETED 11-10-86		DRAWN BY ER	SHEET NO. 1 OF 1
WL		RIG CME 55	FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL 3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

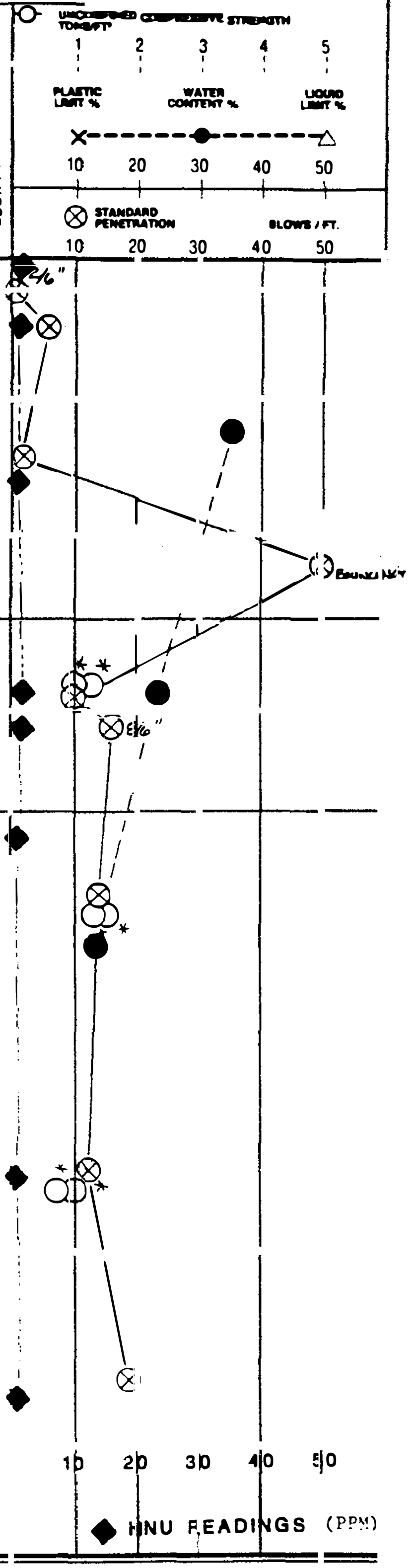
PROJECT NAME
Landfill

SITE LOCATION
Milwaukee, WI

LOG OF BORING NUMBER
B-7

ARCHITECT—ENGINEER

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
☒					SURFACE ELEVATION	
	1	SS			Silty clay fill, trace sand, gravel and roots-brown (CL-Fill)	
	1A	SS			Clayey silt fill, little sand and gravel-brown (ML-CL-Fill)	
		PA				
	2	SS			Silty clay fill, some partially decayed vegetation and wood, trace plastic-brown and black (CL-OL-Fill)	
5ft		PA				
	3	SS			Concrete obstruction-no sample recovery	
		PA			Silty clay, trace sand and gravel-mottled rusty brown and grey-stiff (CL)	
	4	SS				
	4A	SS			Silty fine to coarse sand and gravel-brown-moist-medium dense (SM-GM)	
10ft		PA				
	5	SS			Silty clay, little sand and gravel-brown to grey-stiff to medium (CL-ML)	
		PA				
15ft	6	SS				
		PA				
20ft					Silty fine to coarse sand and gravel-brownish grey-wet medium dense (SM-GM) (Limited recovery-pushed stone)	
	7	SS				
21.5ft					END OF BORING	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL

WL 18.5' WD	BORING STARTED 11-10-86	STS OFFICE Milwaukee	
WL BCR ARC	BORING COMPLETED 11-10-86	DRAWN BY ER	SHEET NO. 1 OF 1
WL 16'AB	RIG CME 55 FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL 3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

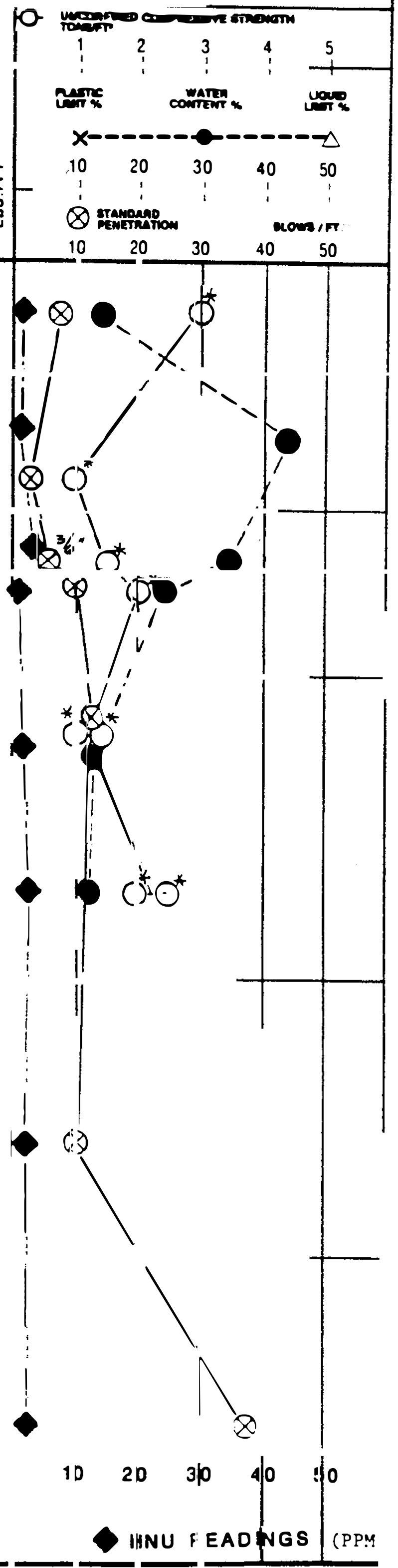
PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-8

ARCHITECT—ENGINEER

SITE LOCATION
Milwaukee, WI

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL SURFACE ELEVATION
	1	SS	Silty clay fill, trace sand and gravel-brownish grey-very stiff (CL-Fill)
		PA	
	2	SS	Silty clay and topsoil fill, little partially decayed wood-brown and black-stiff (CL-OL-Fill)
		PA	
5ft	3	SS	Silty clayey topsoil, trace sand and roots-dark grey to black (CL-OL)
	3A	SS	Silty clay-grey and rusty brown with topsoil filled seams-black-stiff (CL & OL)
		PA	
	4	SS	Silty clay, little to some sand and gravel-greyish brown-stiff to very stiff (CL-ML)
10ft		PA	
	5	ST	
		RB	
15ft	6	SS	Silty clay, little sand, trace gravel-grey-moist (CL)
		RB	
			Sandy gravel, trace silt-grey-wet-dense (GP)
20ft	7	SS	
21.5ft			END OF BORING



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL

WL 16.5' WD		BORING STARTED 11-11-86		STS OFFICE Milwaukee	
WL	BCR ACR	BORING COMPLETED 11-11-86		DRAWN BY ER	SHEET NO. 1 OF 1
WL 14.9' AB		RIG CME 55	FOREMAN JW	APP'D BY ABW	STS JOB NO. 82149

BL.3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

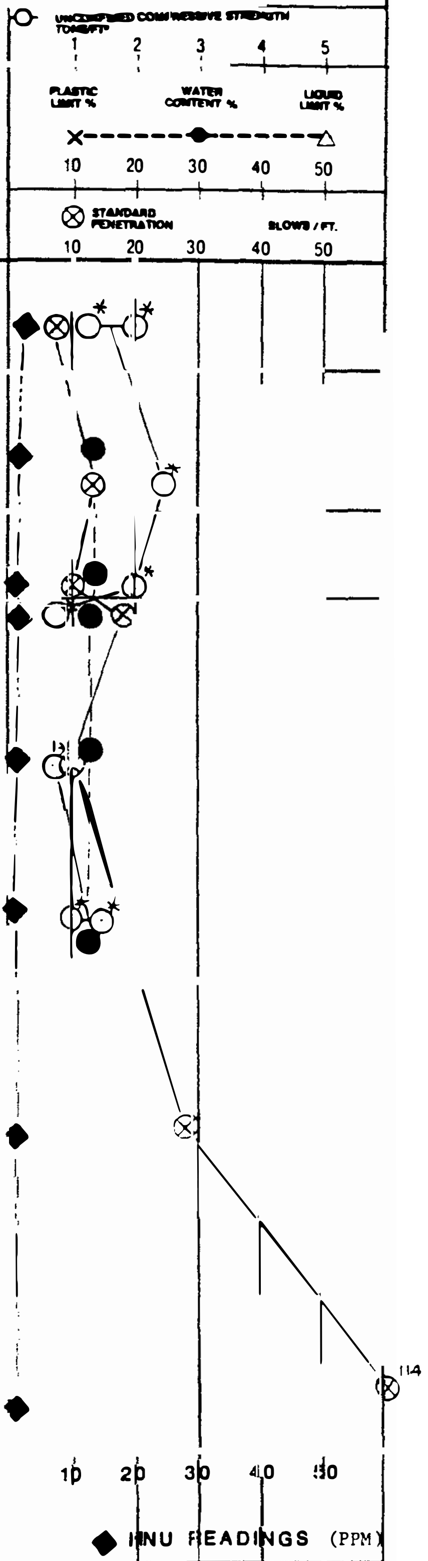
PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-9 (Offset 18' West)

ARCHITECT—ENGINEER

SITE LOCATION
Milwaukee, WI

DEPTH	ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	UNIT DRY WT. LBS./FT³
		1	SS			Silty clay, trace sand, roots and topsoil-brown and grey-stiff (CL)	
			PA				
		2	SS			Silty clay, little sand and gravel-brown-very stiff (CL-ML)	
5ft			PA				
		3	SS			Silty clay with fine sand seams-brownish grey-very stiff (CL)	
		3A	SS				
			PA				
		4	SS				
10ft			PA				
		5	ST			Silty clay, little sand and gravel-brownish grey-medium to stiff (CL)	
			PA				
15ft						Silty fine to coarse sand and gravel-brownish grey-wet-medium dense to extremely dense (SM-GM)	
		6	ST				
20ft			PA				
		7	SS				
21.5ft						END OF BORING	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL

WL 12' WD
WL BCR ARC
WL

BORING STARTED 11-11-86
BORING COMPLETED 11-11-86
RIG CME 55 FOREMAN JW

STS OFFICE Milwaukee
DRAWN BY ER
APP'D BY ABW
SHEET NO. 1 OF 1
STS JOB NO. 82149

BL.3-1183

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

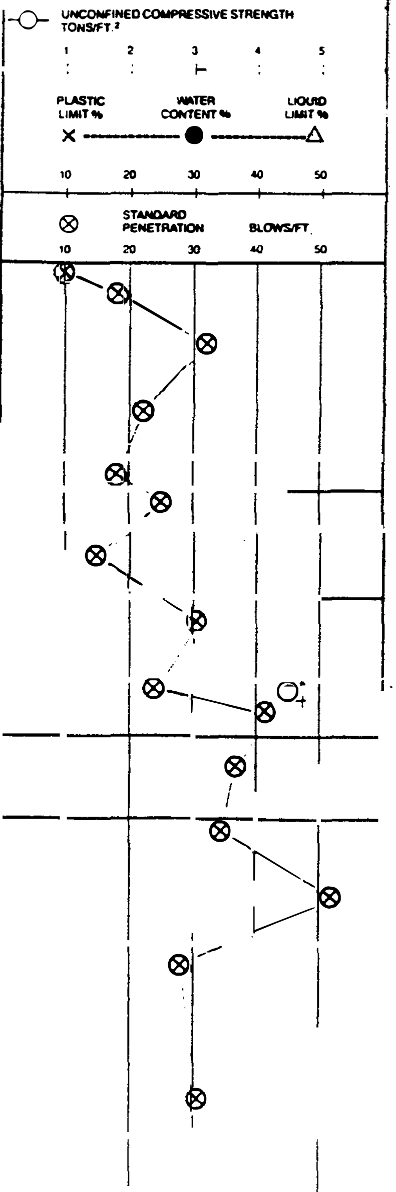
PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-10

ARCHITECT-ENGINEER

SITE LOCATION
Milwaukee, Wisconsin

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. results (ppm.)
1		SS 1A	SS	Fill: Sandy silt and silty fine sand, trace clay inclusions, 2 inch root mass at surface, trace gravel - brown-moist-medium dense (SM -ML)	0 0
			HS		
		2	SS		1
5.0			HS		
		3	SS		0
			HS		
		4	SS	"A"	1
		4A	SS	Silty fine sand, trace gravel - brown-moist-medium dense (SM)	1
10.0					
		5	SS	Sandy silt, trace gravel, trace coarse sand, trace clay - brown-moist-medium dense (ML)	1
			HS		
		6	SS	Silty fine sand, with occasional thin to 1 inch lenses of sandy and clayey silt - brown-moist-medium dense (SM)	1
15.0			HS		
		7	SS	Clayey silt, trace sand - brown changing to gray brown at 15.7 feet - moist - hard (ML-CL)	2
		7A	SS		4
			HS		
		8	SS	Silt, trace clay, trace to little fine sand - gray - moist-dense (ML)	5
20.0			HS		
		9	SS	Clayey silt, trace fine sand - gray - moist - hard (ML-CL)	3
			HS		
		10	SS		17
25.0			HS		
		11	SS	Fine to coarse sand, trace silt, little to some gravel - gray - wet-medium (SW)	2
			HS		
30.0					
		12	SS		0
31.5					



END OF BORING

"A"-- Fill: Silty fine sand, little gravel, trace black discoloration - brown-moist-medium dense (SM)

Boring advanced to 30.0 feet by hollow-stem auger.
Observation well installed at 27 feet.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 21.0 WS — WS OR WO	BORING STARTED 9-13-88	STS OFFICE Milwaukee	
WL BCR — ACR	BORING COMPLETED 9-14-88	DRAWN BY CH	SHEET NO. 1 OF 1
WL	RIG FOREMAN CME-55/DK	APP'D BY TWW	STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

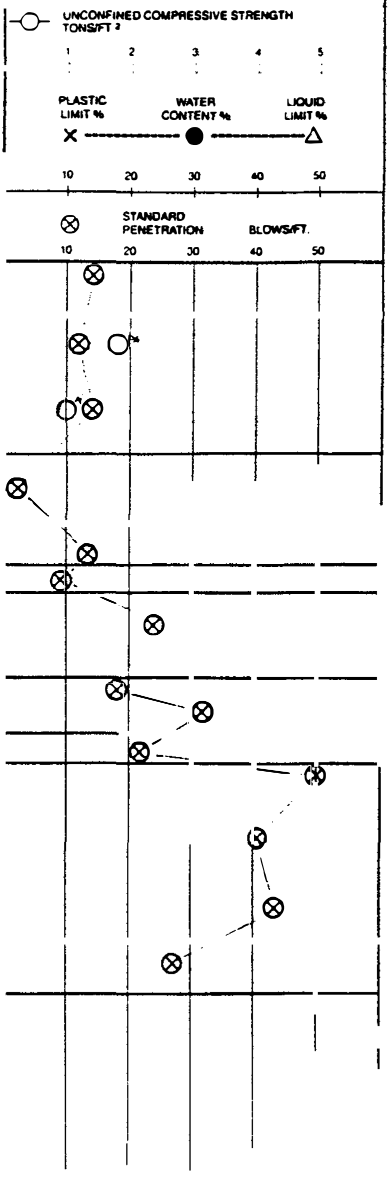
OWNER Village of Whitefish Bay

LOG OF BORING NUMBER B-11

PROJECT NAME Landfill

ARCHITECT-ENGINEER

SITE LOCATION Milwaukee, Wisconsin



DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. results (ppm.)
		1	SS	Fill: sandy silt, trace clay, trace roots - dark brown-moist (ML)	0
			HS		
		2	SS	Fill: mixture of silty clay and topsoil, trace gravel-brown, grey and black-moist-stiff (CL & OL)	2
5.0			HS	Note: solvent odor below 5 feet	
		3	SS		95
			HS		
		4	SS	"A"	370
			HS		
10.0		5	SS	Sandy silt, trace clay, trace gravel-solvent odor-brown-moist-medium dense (ML)	390
		5A	SS	"B"	390
			HS		
		6	SS	Sandy silt, grey with black staining - septic odor-wet medium dense (ML)	160
15.0			HS		
		7	SS	Sandy silt to silty fine sand - mottled grey and black-wet-medium dense (ML to SM)	3
		7A	SS		10
			HS		
		8	SS	"C"	18
		8A	SS		4
20.0			HS	Fine to coarse sand, some gravel, trace silt - grey-moist becoming wet at 20 feet - dense (SP to SW)	
		9	SS		1
			HS		
		10	SS		0
			HS		
25.0		11	SS	Fine to coarse sand and gravel, trace to little silt - grey-wet-medium dense (SP tc GP)	1
26.5					

END OF BORING

"A" -- Fill: partially decayed paper (fibrous clayey silt texture) - black and grey-strong solvent odor-moist-very loose

"B" -- Silty fine to medium sand, trace gravel, 1-inch silt seam at 11.5 feet - solvent odor-dark grey-moist-medium dense (SM)

"C" -- Sandy silt, trace clay, trace gravel - grey-moist-medium dense (ML)

Boring advanced to 22.5 feet by hollow-stem auger.
Boring advanced from 22.5 to 25 feet by cutting bit and circulating water.
Observation well installed to 25.7 feet.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 21.5 feet WS OR WD WD
WL BCR ACR
WL
BORING STARTED 9-13-88
BORING COMPLETED -13-88
RIG FOREMAN CME-55/DK
STS OFFICE Milwaukee
DRAWN BY CH
APP'D BY WW
SHEET NO. 1 OF 1
STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER Village of Whitefish Bay

LOG OF BORING NUMBER B-12

PROJECT NAME Landfill

ARCHITECT-ENGINEER

SITE LOCATION Milwaukee, Wisconsin

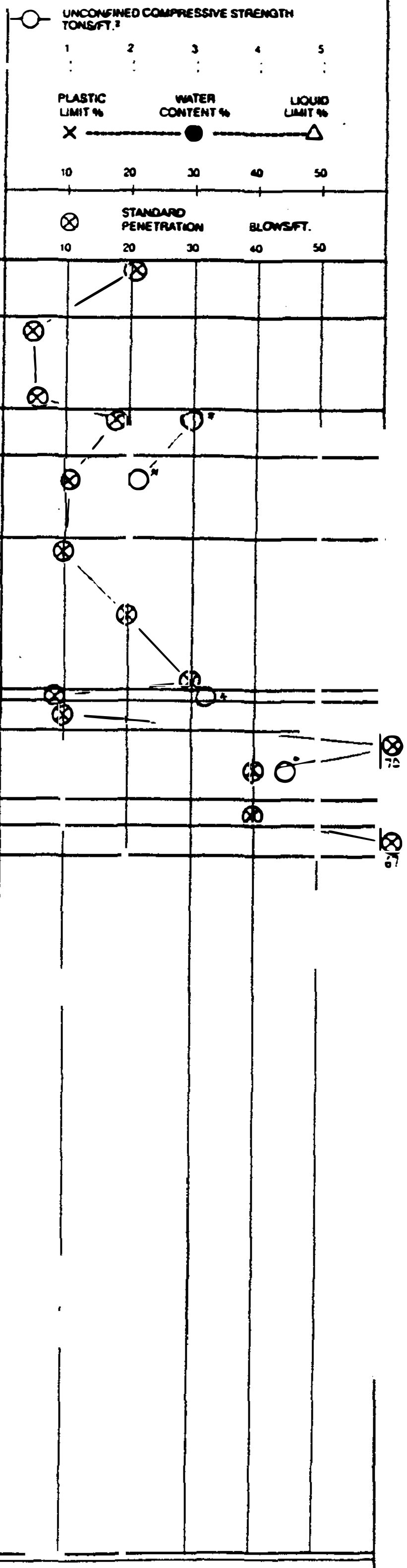
DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. results (ppm.)
		1	SS			Fill: very silty sand, with pockets of sandy silt, trace clay, trace gravel, trace roots	0
			HS				
		2	SS			Fill: silt and sand, some wood fragments and organic debris - black-moist-loose	1
5.0			HS				
		3	SS			2 inch organic clayey silt topsoil over silty clay, trace sand, trace roots - brown-moist (OL & CL)	28
		3A	SS				
			HS				
		4	SS			Clayey silt, trace gravel, little to some sand - brown-moist-very stiff (ML & CL)	65
10.0			HS				
		5	SS			Silty fine to coarse sand, little to some gravel - moist-medium dense (SM)	8
			HS				
		6	SS				9
15.0			HS				
		7	SS				10
		7A	SS			"A"	50
		7B	SS			Sandy silt, trace gravel - grey-wet-medium dense (ML)	30
			HS				
		8	SS			Silt, trace clay, little sand, trace gravel - grey-moist-dense (ML)	8
		8A	SS				20
20.0			HS				
		9	SS			"B"	7
21.5		9A	SS			Silty sandy gravel - grey-wet-very dense (GM)	3

END OF BORING

"A" -- Silty clay, some sand and fine gravel - grey-moist-very stiff (CL)

"B" -- Very silty clay, with lenses to silt and clayey silt, trace gravel - grey-moist-dense (CL)

Boring advanced to 20.0 feet by hollow-stem auger.



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 16.0 feet WS WS OR WD

WL BCR ACR

WL

BORING STARTED 9-14-88

BORING COMPLETED 9-14-88

RIG FOREMAN CME-55/DK

STS OFFICE Milwaukee

DRAWN BY CH

SHEET NO. 1 OF 1

APP'D BY TWW

STS JOB NO. 82149XF

STS Consultants Ltd.

OWNER Village of Whitefish Bay

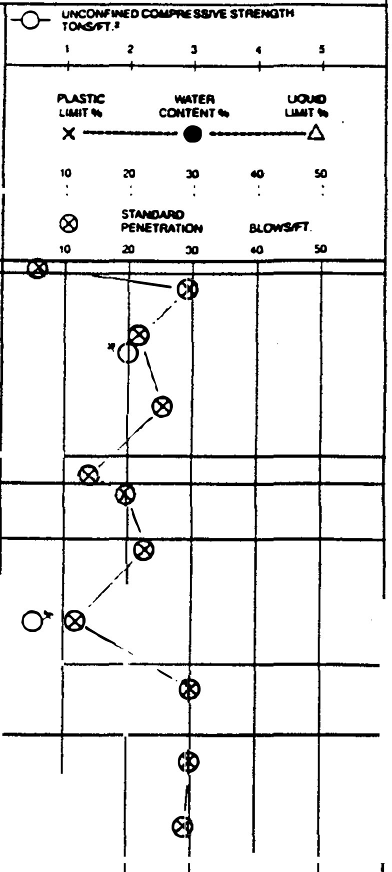
LOG OF BORING NUMBER B-13

PROJECT NAME Landfill

ARCHITECT-ENGINEER

SITE LOCATION Milwaukee, Wisconsin

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. results (ppm.)
	1	SS	"A"	0
	1A	SS	Fill: mixture of silty clay, clayey silt and silt, little sand, little concrete fragments below 5 feet - brown-moist-medium dense	0
		HS		
	2	SS		
5.0		HS		
	3	SS		0
		HS		
	4	SS	"B"	0
	4A	SS	Sandy silt, with lenses of silty fine sand - brown-moist-medium dense (ML & SM)	0
10.0		HS		
	5	SS	Very silty clay, trace sand, trace gravel, with occasional lenses of sandy silt - brown changing to grey at 12.5 feet-moist-medium to stiff (CL)	0
		HS		
	6	SS		0
15.0		HS		
	7	SS	Silty fine sand, trace coarse sand to fine gravel - greyish brown-wet-dense (SM)	0
		HS		
	8	SS	Silt, trace clay, trace gravel, little fine sand - greyish brown-moist-medium dense to dense (ML)	0
20.0		HS		
21.5	9	SS		0



END OF BORING

"A" -- Fill: organic clayey silt topsoil, trace sand, trace roots - dark brown-moist-loose (OL)

"B" -- Fill: silty fine to medium sand, trace gravel, with pockets of silty clay - brown-moist-medium dense (SM)

Boring advanced to 20.0 feet by hollow-stem auger.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 21.5 feet WS (WS OR WD)	BORING STARTED 9-16-88	STS OFFICE Milwaukee	
WL BCR ACR	BORING COMPLETED 9-16-88	DRAWN BY CH	SHEET NO. 1 OF 1
WL CI @ 16.1 AB	RIG FOREMAN CME-55/DK	APP'D BY TWW	STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER Village of Whitefish Bay

LOG OF BORING NUMBER B-14

PROJECT NAME Landfill

ARCHITECT-ENGINEER

SITE LOCATION Milwaukee, Wisconsin

DESCRIPTION OF MATERIAL

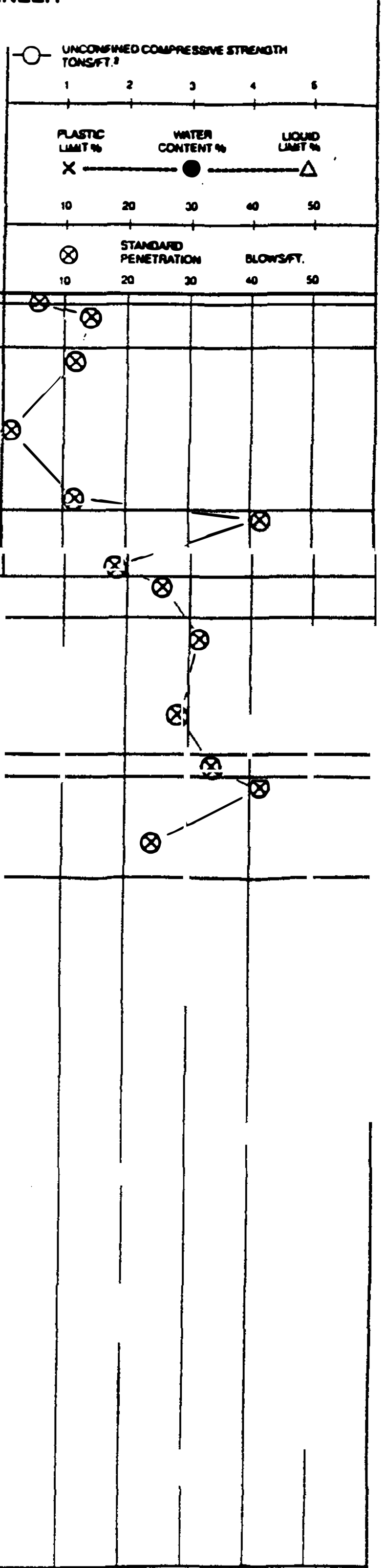
SURFACE ELEVATION

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	P.I.D. results (ppm.)
		1	SS	"A"	0
		1A	SS	Fill: sandy silt, trace clay pockets, trace gravel - yellowish brown-moist-medium dense (ML)	
			HS		
		2	SS	Fill: silt, sand, clay, glass, decayed roots and grass - black-moist-medium dense (ML)	11
5.0					17
		3	SS		
		4	SS		12
		4A	SS	Fill: silty fine to medium sand, little gravel, trace metal fragments - brown-moist-dense (SM)	12
10.0		5	SS	Silty fine sand - brown-moist-medium dense (SM)	1
		5A	SS	Sandy silt - brown-wet-dense (ML)	0
		6	SS	Silty very fine to fine sand - brown-moist-medium dense to dense (SM)	0
15.0					
		7	SS		0
		8	SS	Sandy clayey silt, trace gravel - grey-moist (ML-CL)	0
		8A	SS	Fine to coarse sand, little to some gravel, trace thin clay lenses - grey brown-moist-medium dense to dense (SP)	0
20.0					
21.0		9	SS		0

END OF BORING

"A" -- Fill: sandy silt, trace organic matter, 1-inch root mass at surface - dark brown-moist-loose (ML)

Boring advanced to 20.0 feet by hollow-stem auger.



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 21.5 feet WS

WS OR WD

WL BCR ACR

WL

BORING STARTED 9-15-88

BORING COMPLETED 9-15-88

RIG FOREMAN CME-55/DK

STS OFFICE Milwaukee

DRAWN BY CH

SHEET NO. 1 OF 1

APP'D BY TWW

STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER Village of Whitefish Bay

LOG OF BORING NUMBER B-15

PROJECT NAME Landfill

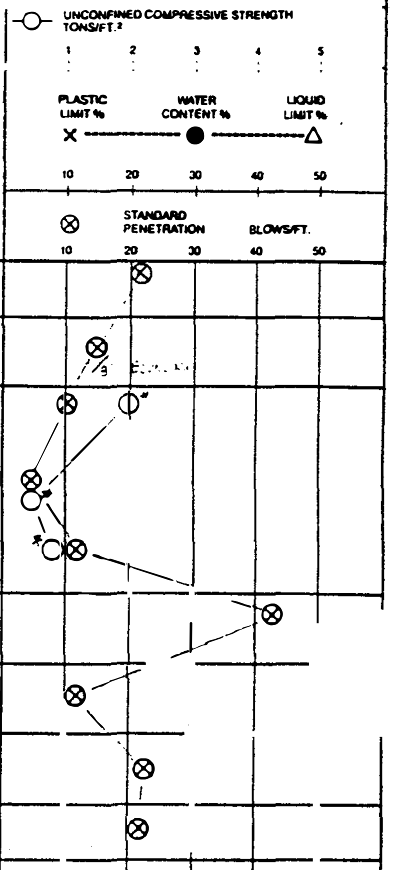
ARCHITECT-ENGINEER

SITE LOCATION Milwaukee, Wisconsin

DESCRIPTION OF MATERIAL

SURFACE ELEVATION

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	P.I.D. results (ppm.)
		1	SS	Fill: silty sand, trace slag, trace roots - dark brown-moist-medium dense	0
			HS		
		2	SS	Fill: silt, clay, decayed wood and organic matter - black-moist Note: Tree root obstruction	0
5.0		3	SS	Silty clay, trace fine sand, solvent odor - grey-moist-medium stiff to stiff (CL)	100
		4	SS		220
10.0		5	SS		230
		6	SS	Silty fine to medium sand, frequent lenses of sandy silty clay, trace gravel - grey-brown-moist (SM)	230
15.0		7	SS	Sandy silt, trace clay, trace gravel - grey-moist medium dense (ML)	50
		8	SS	Silty fine to coarse sand, some gravel, with occasional lense of sandy clayey silt - grey-wet-medium dense (SM)	5
20.0		9	SS	Silty fine to coarse sand, trace gravel - 3-inch silt seam at tip of sample - grey-wet-medium dense (SM)	2
21.5					



END OF BORING

Boring advanced to 20.0 feet by hollow-stem auger.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 17.5 feet	WS OR WD WS	BORING STARTED 9-15-88		STS OFFICE Milwaukee	
WL 18.0	BCR 16.0 ACR	BORING COMPLETED 9-15-88		DRAWN BY CH	SHEET NO. 1 OF 1
WL		RIG FOREMAN CME-55/DK		APP'D BY TWW	STS JOB NO. 82149XF

BL-3-0687

STS Consultants Ltd.

OWNER	Village of Whitefish Bay
LOG OF BORING NUMBER	B-16
PROJECT NAME	Landfill
ARCHITECT-ENGINEER	
SITE LOCATION	Milwaukee, Wisconsin

DESCRIPTION OF MATERIAL

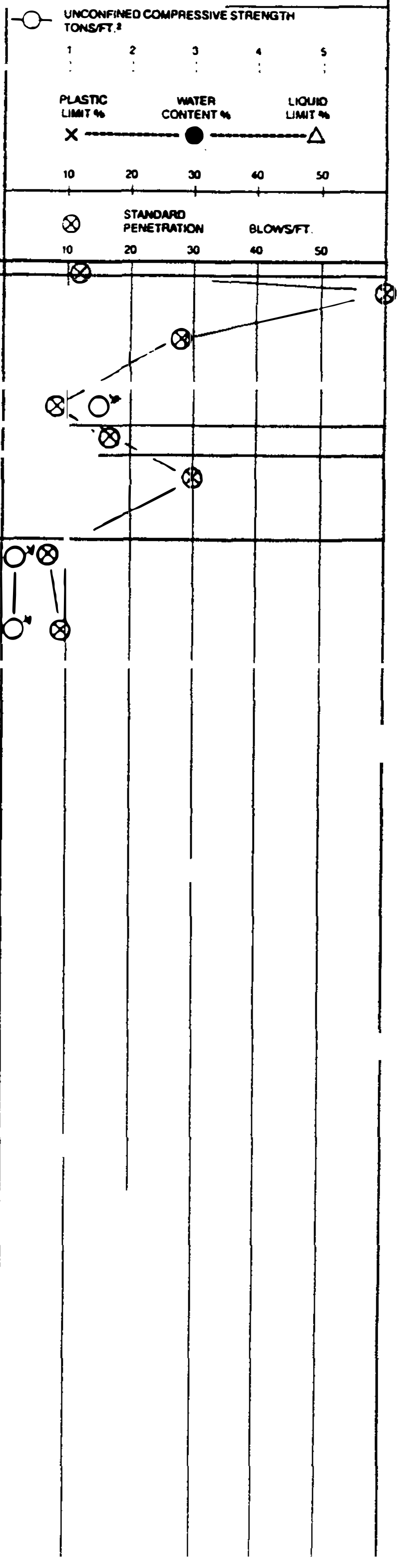
DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	SURFACE ELEVATION	P.I.D. results (ppm.)
		1	SS		"A"	0
		1A	SS		Fill: silty sand and gravel, some clayey silt inclusions below 2 feet - brown-moist-medium dense to dense	0
			HS			
		2	SS			0
5.0					"B"	0
		3	SS			
		3A	SS		Silty fine to medium sand - brown-moist-medium dense (SM)	0
		4	SS		Silty fine to coarse sand and gravel - yellowish brown-wet-dense (SM to GM)	0
10.0						
		5	SS		Silty clay, trace to little gravel, trace sand - grey-damp-firm (CL)	0
		6	SS			0
14.5						

END OF BORING

"A" -- Fill: sandy silt topsoil, trace gravel, trace roots - dark brown-moist-medium dense (ML)

"B" -- Silty clay, trace gravel, with clayey topsoil at interface - greyish brown-moist-stiff (CL)

Boring advanced to 13.0 feet by hollow-stem auger.



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 8.0 feet	WS OR WD WS	BORING STARTED 9-16-88	STS OFFICE Milwaukee
WL	BCR ACR	BORING COMPLETED 9-16-88	DRAWN BY CH | SHEET NO. 1 OF 1
WL		RIG FOREMAN CME-55/DK	APP'D BY TWW | STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

PROJECT NAME
Landfill

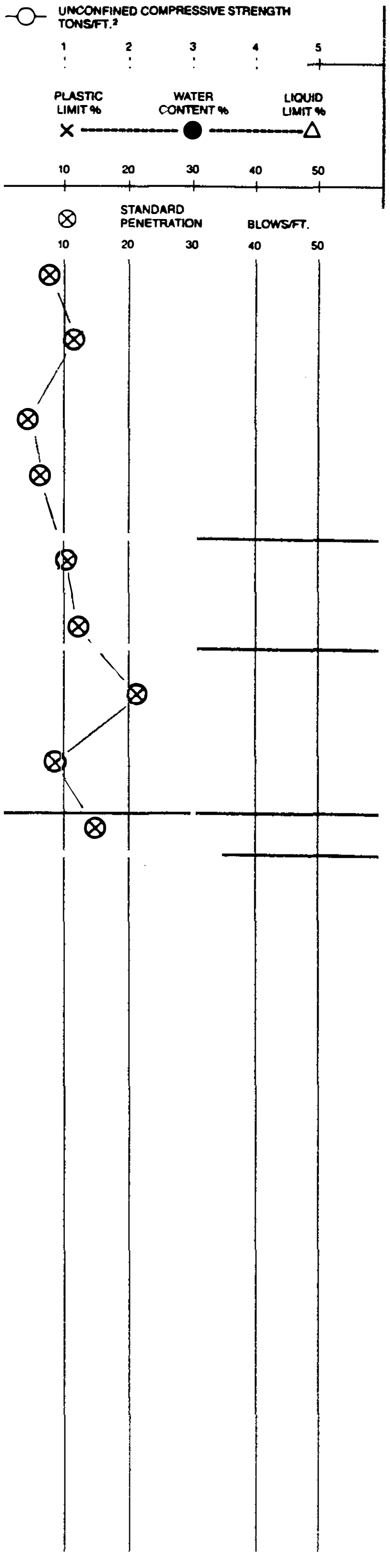
LOG OF BORING NUMBER
B-17

ARCHITECT-ENGINEER

SITE LOCATION
5200 W. Good Hope Road, Milwaukee, Wisconsin

SURFACE ELEVATION

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	P.I.D. Results (ppm.)
		1	SS			Fill: silty clay, trace gravel, glass, wood, cinders, plastic, nails- brown and gray mix-moist-stiff (CL Fill)	<1
			HS				
		2	SS				<1
5.0			HS				
		3	SS				<1
			HS				
		4	SS				<1
10.0			HS				
		5	SS			Clayey silt, trace fine to coarse sand - gray, slightly brown mottled-moist to wet-stiff/medium dense (CL-ML)	<1
			HS				
		6	SS				<1
15.0			HS			Clayey to silty fine to coarse sand, trace gravel - gray-wet-medium dense (SC-SM)	
		7	SS				<1
			HS				
		8	SS				<1
20.0			HS				
21.5		9	SS			Fine to coarse sand, little silt, trace gravel - gray-wet-medium dense (SM)	<1



END OF BORING

Boring advanced to 20 feet by hollow-stem auger.

Borehole backfilled with bentonite grout.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU. THE TRANSITION MAY BE GRADUAL.

WL 12.5' WS	WS OR WD	BORING STARTED 4-20-89	STS OFFICE Milwaukee
WL	BCR ACR	BORING COMPLETED 4-20-89	DRAWN BY CRH · SHEET NO. 1 OF 1
WL		RIG FOREMAN CME-55 BZ	APP'D BY MDF · STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER Village of Whitefish Bay

LOG OF BORING NUMBER B-18

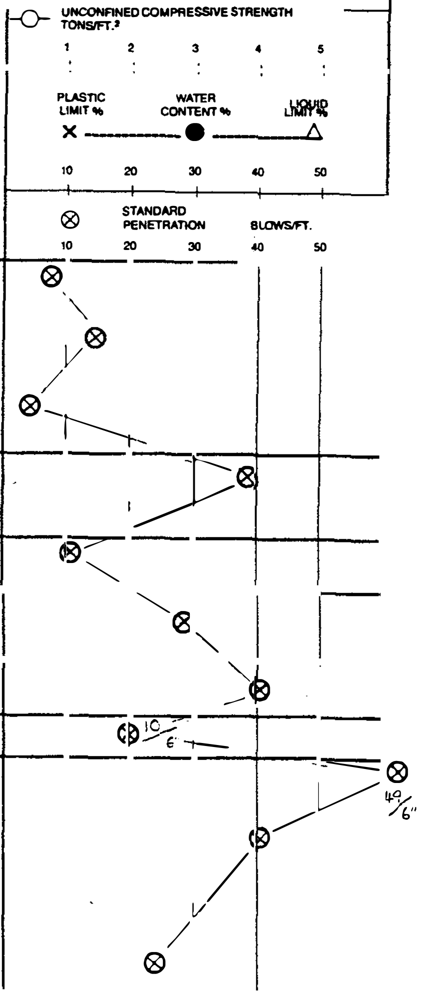
PROJECT NAME Landfill

ARCHITECT-ENGINEER

SITE LOCATION 5200 W. Good Hope Road, Milwaukee, Wisconsin

SURFACE ELEVATION 699.8

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	P.I.D. Results (ppm.)
		1	SS	Fill: silty clay, trace fine to coarse sand, trace gravel, wood - brown and black mix-moist-firm to stiff	<1
			HS		
		2	SS	(chemical odor below 4 feet) (CL Fill)	<1
5.0			HS		
		3	SS		25
			HS		
		4	SS	Fill: silty fine to coarse sand, trace gravel, metal-gray-wet-dense (SM Fill)	3
10.0			HS		
		5	SS	Silty clay to clayey silt, trace fine to coarse sand - brown-moist-stiff (CL-ML)	4
			HS		
		6	SS	Clayey to silty fine to coarse sand, trace gravel - gray--moist-medium dense (SC-SM)	2
15.0			HS		
		7	SS	Fine sandy silt, trace clay - gray-moist-dense (ML)	2
			HS	Silty clay, trace fine to coarse sand - gray-moist-stiff (CL)	2
		8	SS	Fine to coarse sand, trace silt, trace gravel - gray-moist to wet-medium dense to dense (SP-SM)	2
20.0			HS		
		9	SS		<1
			HS		
25.0					
26.5		10	SS		<1



END OF BORING

Boring advanced to 25 feet by hollow-stem auger.

Groundwater monitoring well installed to 26.3 feet on 4-20-89 (see diagram for details)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 20.0' WS	WS OR WD	BORING STARTED 4-20-89	STS OFFICE Milwaukee		
WL	BCR ACR	BORING COMPLETED 4-20-89	DRAWN BY CRH	SHEET NO. 1	OF 1
WL		RIG FOREMAN CME-55 BZ	APP'D BY MDF	STS JOB NO. 82149XF	

BL:3-0687

STS Consultants Ltd.

OWNER Village of Whitefish Bay

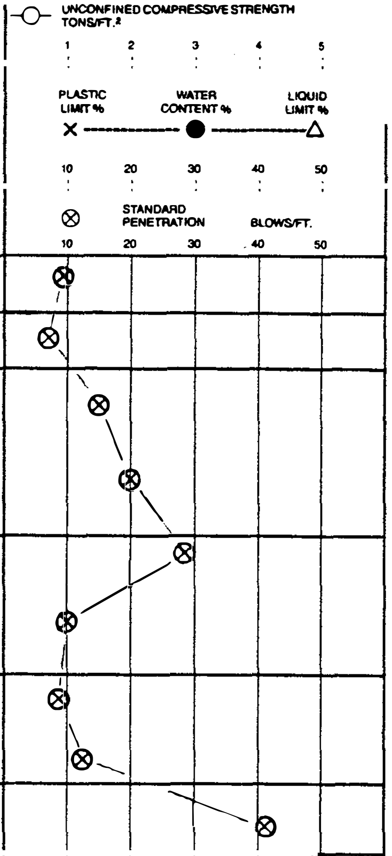
PROJECT NAME Landfill

LOG OF BORING NUMBER B-19

ARCHITECT–ENGINEER

SITE LOCATION 5200 W. Good Hope Road, Milwaukee, Wisconsin

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. Results (ppm.)
		1	SS			Fill: silty clay, trace fine to coarse sand - gray-moist-stiff (CL Fill)	1
			HS				
		2	SS			Fill: clayey to silty fine to coarse sand, trace gravel, wood - black-moist-loose (SC-SM Fill)	2
5.0			HS			Fill: clayey to silty fine to coarse sand, trace gravel, cinders - gray and brown mix-moist-medium dense	
		3	SS				8
			HS			(chemical odor) (SC-SM Fill)	
		4	SS				10
10.0			HS				
		5	SS			Silty clay, trace to little fine to coarse sand, trace gravel - gray-moist-stiff (CL)	3
			HS				
		6	SS				1
15.0			HS				
		7	SS			Clayey fine to coarse sand, trace gravel - gray-moist-medium dense (SC)	1
			HS				
		8	SS				<1
20.0			HS			Fine to coarse sand, trace silt, trace gravel - gray-wet-dense (SP-SM)	
		9	SS				<1



END OF BORING

Boring advanced to 20 feet by hollow-stem auger.

Borehole backfilled with bentonite grout.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 17.5' WS WS OR WD	BORING STARTED 4-18-89	STS OFFICE Milwaukee	
WL BCR ACR	BORING COMPLETED 4-18-89	DRAWN BY CRH	SHEET NO. 1 OF 1
WL 14.5' AB	RIG FOREMAN CME-55 BZ	APP'D BY MDF	STS JOB NO 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

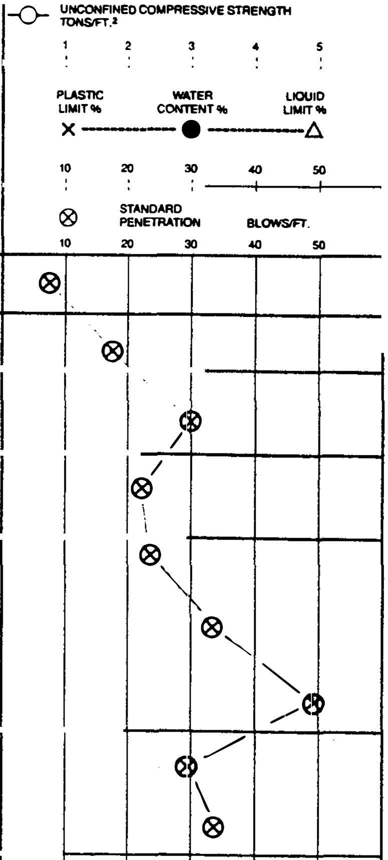
PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-20

ARCHITECT-ENGINEER

SITE LOCATION
5200 W. Good Hope Road, Milwaukee, Wisconsin

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. Results (ppm.)
	1	SS	"A"	<1
		HS		
	2	SS	Fill: silty clay, trace fine to coarse sand, trace gravel - brown and dark brown mix-moist-stiff (CL Fill)	<1
5.0		HS		
	3	SS	Clayey to silty fine to coarse sand, trace gravel - brown-moist-dense (SC-SM) (chemical odor)	6
		HS		
	4	SS	Fine sand, trace silt, trace medium to corase sand, trace gravel - brown-moist-medium dense (SP-SM) (chemical odor)	9
10.0		HS		
	5	SS	Clayey to silty fine to coarse sand, trace gravel - gray-moist-dense (SC-SM) (chemical odor)	18
		HS		
	6	SS		20
15.0		HS		
	7	SS		40
		HS		
	8	SS	Fine to coarse sand, trace silt, trace gravel - gray-wet-dense (SP-SM) (chemical odor)	20
20.0		HS		
21.5	9	SS		5



END OF BORING

"A" - Fill: mixed silty clay and clayey fine to coarse sand, trace gravel, cinders - brown and black mix-moist-firm/loose (CL/SC Fill)

Boring advanced to 20 feet by hollow-stem auger.

Borehole backfilled with bentonite grout.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 17.5' WS — WS OR WD	BORING STARTED 4-18-89	STS OFFICE Milwaukee	
WL — BCR — ACR	BORING COMPLETED 4-18-89	DRAWN BY CRH	SHEET NO. 1 OF 1
WL 13.7' AB	RIG FOREMAN CME-55 BZ	APP'D BY MDF	STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

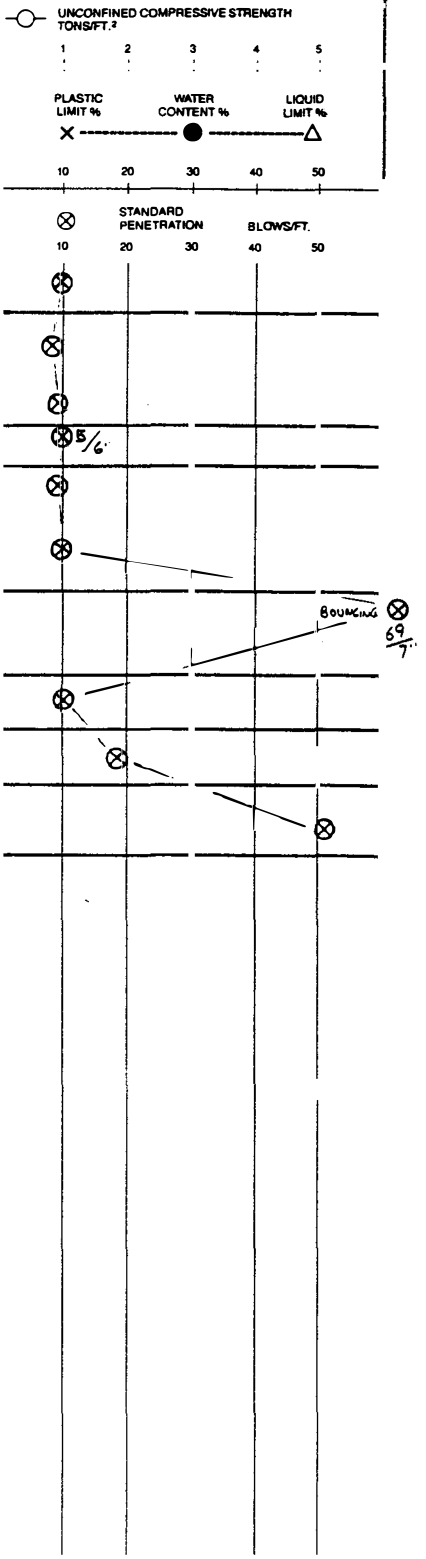
PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-21

ARCHITECT-ENGINEER

SITE LOCATION
5200 W. Good Hope Road, Milwaukee, Wisconsin

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	P.I.D. Results (ppm.)
						SURFACE ELEVATION	
		1	SS			Fill: mixed silty clay and clayey fine to coarse sand, trace gravel-gray mix-moist-firm/medium dense (CL/SC Fill)	5
			HS				
		2	SS			Fill: clayey to silty fine to coarse sand, trace gravel, wood, topsoil pockets - gray brown and black mix-moist-loose (SC-SM Fill (chemical odor)	12
5.0			HS				
		3	SS				8
						Fill: silty clay, trace fine to coarse sand - green gray-moist-firm (chemical odor) (CL Fill)	30
			HS				
		4	SS			Fill: silty clay, little fine to coarse sand, trace gravel, metal, plastic - brown-moist-firm (CL Fill) (chemical odor)	180
10.0			HS				
		5	SS				400
			HS				
		6	SS			Fill: silty clay, trace fine to coarse sand, trace gravel - gray-moist-firm (CL Fill) (chemical odor)	410
15.0			HS				
		7	SS			"A"	430
			HS				
		8	SS			Silty fine sand - gray-moist to wet-medium dense (SM) (chemical odor)	290
20.0			HS			Fine to coarse sand, trace silt, trace gravel - gray-wet-dense (chemical odor) (SP-SM)	
21.5		9	SS				58



END OF BORING

"A" - Silty clay, trace to little fine to coarse sand, trace gravel, trace roots - gray brown mottled-moist-firm (CL) (chemical odor)

Boring advanced to 20 feet by hollow-stem auger.

Borehole backfilled with bentonite grout.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 17.5' WS WS OR WD

WL BCR ACR

WL

BORING STARTED 4-18-89

BORING COMPLETED 4-18-89

RIG FOREMAN CME-55 BZ

STS OFFICE Milwaukee

DRAWN BY CRH

SHEET NO. 1 OF 1

APP'D BY MDF

STS JOB NO 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

PROJECT NAME
Landfill

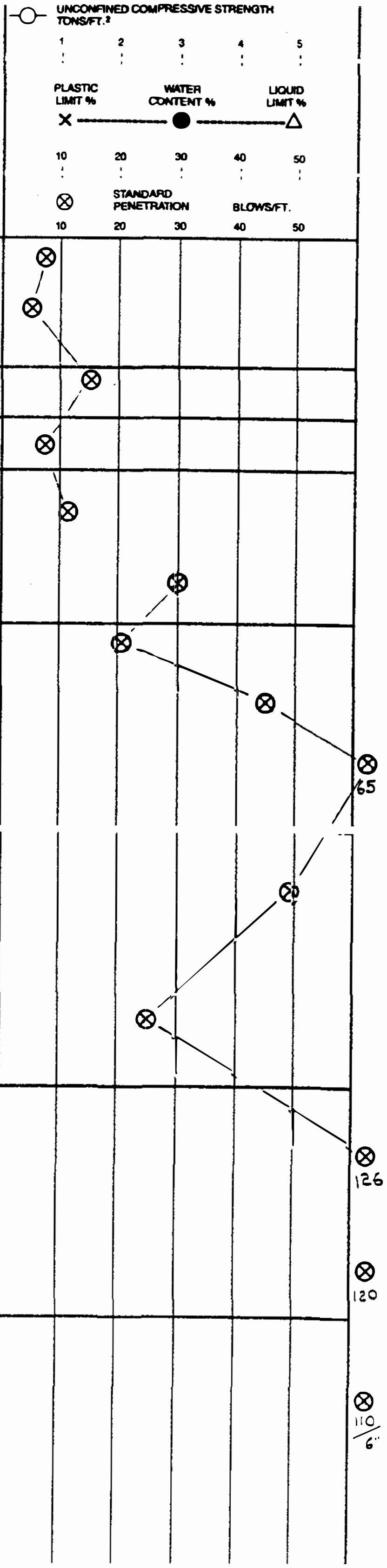
LOG OF BORING NUMBER
B-22 1 of 2

ARCHITECT-ENGINEER

SITE LOCATION
5200 W. Good Hope Road, Milwaukee, Wisconsin

SURFACE ELEVATION 703.9

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	P.I.D. Results (ppm.)
		1	SS	Fill: Clayey fine to coarse sand, trace gravel - brown-moist-loose (SC Fill)	1
			HS		
		2	SS		<1
5.0			HS		
		3	SS	Fill: silty clay, trace fine to coarse sand, trace (CL Fill) gravel - brown and gray mix-moist-stiff (chemical odor)	50
			HS		
		4	SS	Clayey silt, trace fine sand - brown slightly gray mottled-firm (chemical odor) (CL-ML)	90
10.0			HS	Silty clay, trace fine to coarse sand, trace gravel - brown-moist-stiff to very stiff (CL) (chemical odor)	
		5	SS		400
			HS		
		6	SS		400
15.0			HS		
		7	SS	Silty clay, trace fine to coarse sand, trace gravel - gray-moist-very stiff to hard (chemical odor) (CL)	410
			HS		
		8	SS		100
20.0			HS		
		9	SS		45
			RB		
25.0				Fine to coarse sand, trace silt, trace gravel - gray-wet-medium dense to dense (SP-SM) (chemical odor to 27 feet)	
		10	SS		8
			RB		
30.0					
		11	SS		<1
			RB	Clayey to silty fine sand, trace gravel - gray-moist-extremely dense (SC-SM)	
35.0					
		12	SS		1
			RB		
40.0					
		13	SS		<1
			RB	Silty clay, little fine to coarse sand, trace gravel - gray-moist-hard (CL)	
45.0					
		14	SS	(Note: probable boulder encountered from 42 to 43 feet.)	1
			RB		
50.0					



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

STS JOB NO. 82149XF SHEET NO 1 OF 2

BL:4-0687

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

PROJECT NAME
Landfill

LOG OF BORING NUMBER
B-22 2 of 2

ARCHITECT-ENGINEER

SITE LOCATION
5200 W. Good Hope Road, Milwaukee, Wisconsin

—○— UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} 1 2 3 4 5

PLASTIC LIMIT % × WATER CONTENT % ● -------- △ LIQUID LIMIT % 10 20 30 40 50

⊗ STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	P.I.D. Results (ppm.)	STANDARD PENETRATION BLOWS/FT.
				SURFACE ELEVATION 703.9		
51.5		15	SS	(continued from page 2)	1	⊗ 93
			RB	Silty clay, little fine to coarse sand, trace gravel - gray-moist-hard		
55.0		16	SS		<1	⊗ 82
			RB			
60.0		17	SS		<1	⊗ 84
			RB			
65.0		18	SS		<1	⊗ 74
			RB	Limestone bedrock		
69.0			RB			

END OF BORING

Boring advanced to 20 feet by hollow-stem auger.

20 feet of HW casing installed.

Boring advanced from 20 feet to 69 feet by rotary bit and bentonite drilling fluid.

Groundwater monitoring well installed to 32.9 feet on 4-19-89 in blind drilled hole adjacent to sampled borehole (see diagram for details).

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL	WS OR WD	BORING STARTED 4-19-89	STS OFFICE Milwaukee	
WL BCR	ACR	BORING COMPLETED 4-19-89	DRAWN BY CRH	SHEET NO. 2 OF 2
WL		RIG FOREMAN CME-55 BZ	APP'D BY MDF	STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

OWNER
Village of Whitefish Bay

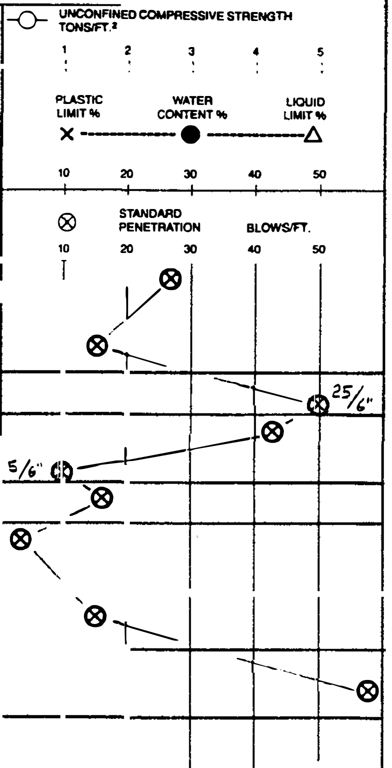
LOG OF BORING NUMBER
B-23

PROJECT NAME
Landfill

ARCHITECT-ENGINEER

SITE LOCATION
5200 West Good Hope Road
Milwaukee, Wisconsin

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION	P.I.D. (Results ppm)
		1	SS			Fill: fine to coarse sand, trace silt, trace gravel, concrete slab at 1.3 to 1.8 feet-light gray-moist-loose (SP-SM Fill)	<1
			HS				
		2	SS				<1
5.0			HS			Fill: silty clay, little fine to coarse sand, trace gravel-grayish brown and dark gray mixed-moist-stiff (CL Fill)	<1
		3	SS				
		3A	SS			Clayey to silty fine to coarse sand, trace gravel-brown-moist-medium dense	<1
			HS				<1
		4	SS				
		4A	SS			Clayey to silty fine sand, tarce medium to coarse sand, trace gravel-grayish brown-moist to wet-medium dense (SC-SM)	<1
10.0			HS				
		5	SS			Silty fine sand, trace clay, trace medium to coarse sand-gray-wet-loose (SM)	<1
		6	SS			Fine to coarse sand, little clay and silt, trace gravel-gray-wet-medium dense (SM-SC)	<1
15.0			HS			Fine to coarse sand, little silt, trace gravel-gray-damp-very dense (SM)	
16.5		7	SS				<1



END OF BORING

Boring advanced to 15.0 feet by hollow stem auger.

Borehole backfilled with bentonite grout.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WL 10.0' WS — WS ORWD

WL — BCR — ACR

WL Dry AB

BORING STARTED 7-06-89

BORING COMPLETED 7-06-89

RIG FOREMAN CME-55/DK

STS OFFICE Milwaukee

DRAWN BY CH

APP'D BY MDF

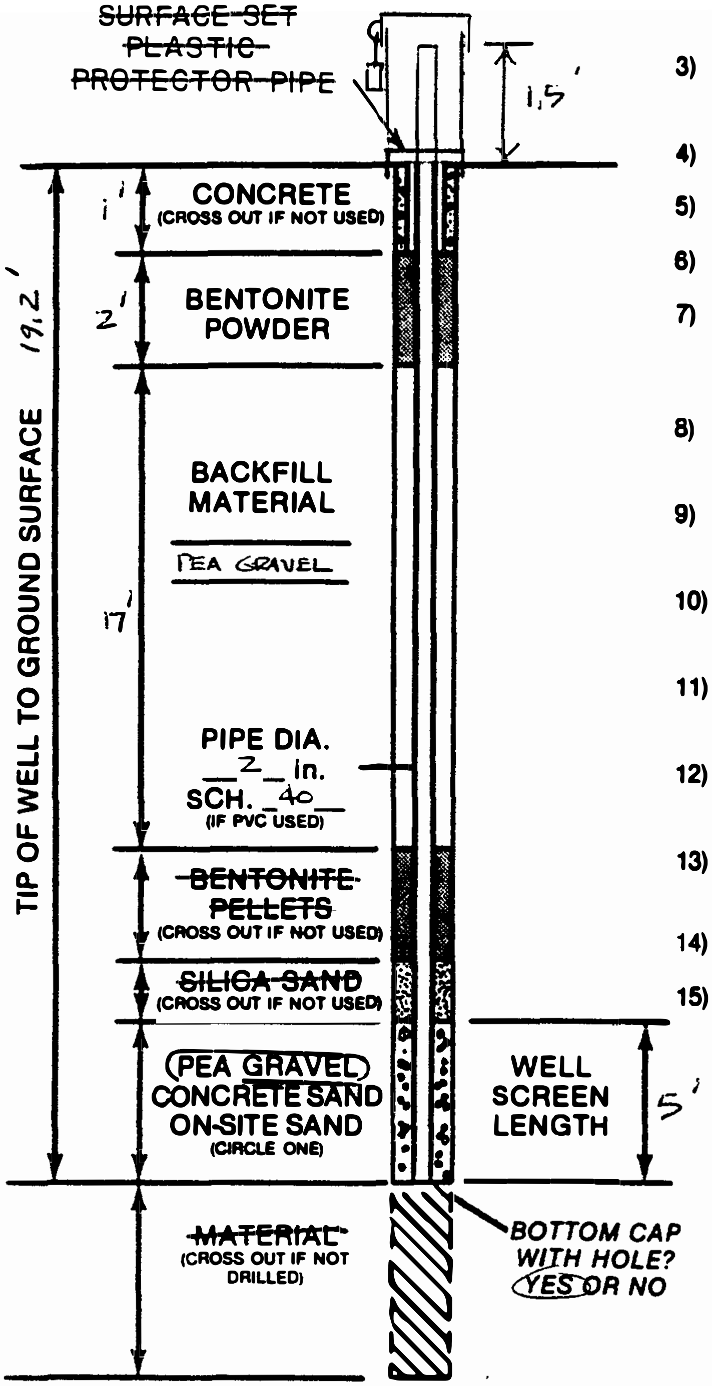
SHEET NO. 1 OF 1

STS JOB NO. 82149XF

BL:3-0687

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
[✓ PVC], GALVANIZED, STAINLESS, OTHER ________

2) TYPE OF PIPE JOINTS?
BELLED, COUPLINGS, THREADED, OTHER ______

3) TYPE OF WELL SCREEN
[✓ PVC], GALVANIZED, STAINLESS, OTHER ________

4) SCREEN SIZE 0.010"

5) INSTALLED PROTECTOR PIPE W/LOCK? [✓ YES] OR NO

6) WAS SOLVENT USED? YES OR [✓ NO]

7) WAS DRILLING MUD USED? No
SOLID AUGER, HOLLOW STEM AUGER,
[✓ WATER], REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR NO.

9) HOW WAS WELL DEVELOPED? WAS NOT.
BAILING, PUMPING, SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., 30 min., OTHER ——

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER ——

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, TURBID, OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR NO

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
________ Ft. or DRY

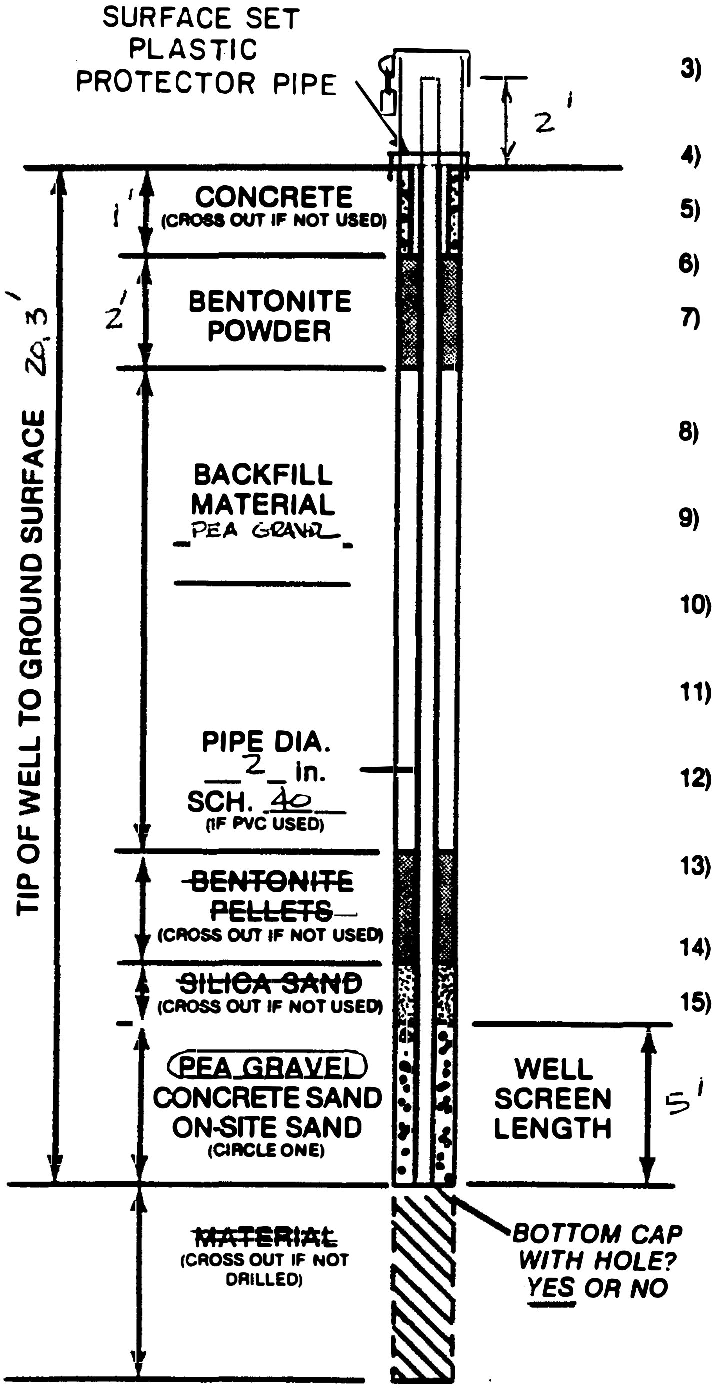
2) OTHER MEASUREMENTS:

DATE 11-10-86 13.4 Ft. FROM T, ST. PIPE
DATE 11-28-86 13.9 Ft. FROM T, ST. PIPE
DATE 9-14-88 17.5 Ft. FROM T, ST. PIPE
DATE ________, ________ Ft. FROM T, ST. PIPE

Well No. B-4, B-9 DATE INSTALLED 11-10-86 DRILL RIG CME 55
DRILLER J.W. DRILL CREW D.K.
JOB/CLIENT VILLAGE OF WHITEFISH BAY STS JOB No. 82149
W: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, GALVANIZED, STAINLESS, OTHER ________

2) TYPE OF PIPE JOINTS?
BELLED, COUPLINGS, [✓ THREADED], OTHER ______

3) TYPE OF WELL SCREEN
[✓ PVC], GALVANIZED, STAINLESS, OTHER ________

4) SCREEN SIZE 0.010"

5) INSTALLED PROTECTOR PIPE W/LOCK? [✓ YES] OR NO

6) WAS SOLVENT USED? YES OR [✓ NO]

7) WAS DRILLING MUD USED? No
[✓ SOLID AUGER], HOLLOW STEM AUGER,
~~WATER~~, ~~REVERT~~, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR [✓ NO]

9) HOW WAS WELL DEVELOPED? WAS NOT
BAILING, PUMPING, SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., 30 min., OTHER ________

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER ________

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, TURBID, OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR NO

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
________ Ft. or DRY

2) OTHER MEASUREMENTS:

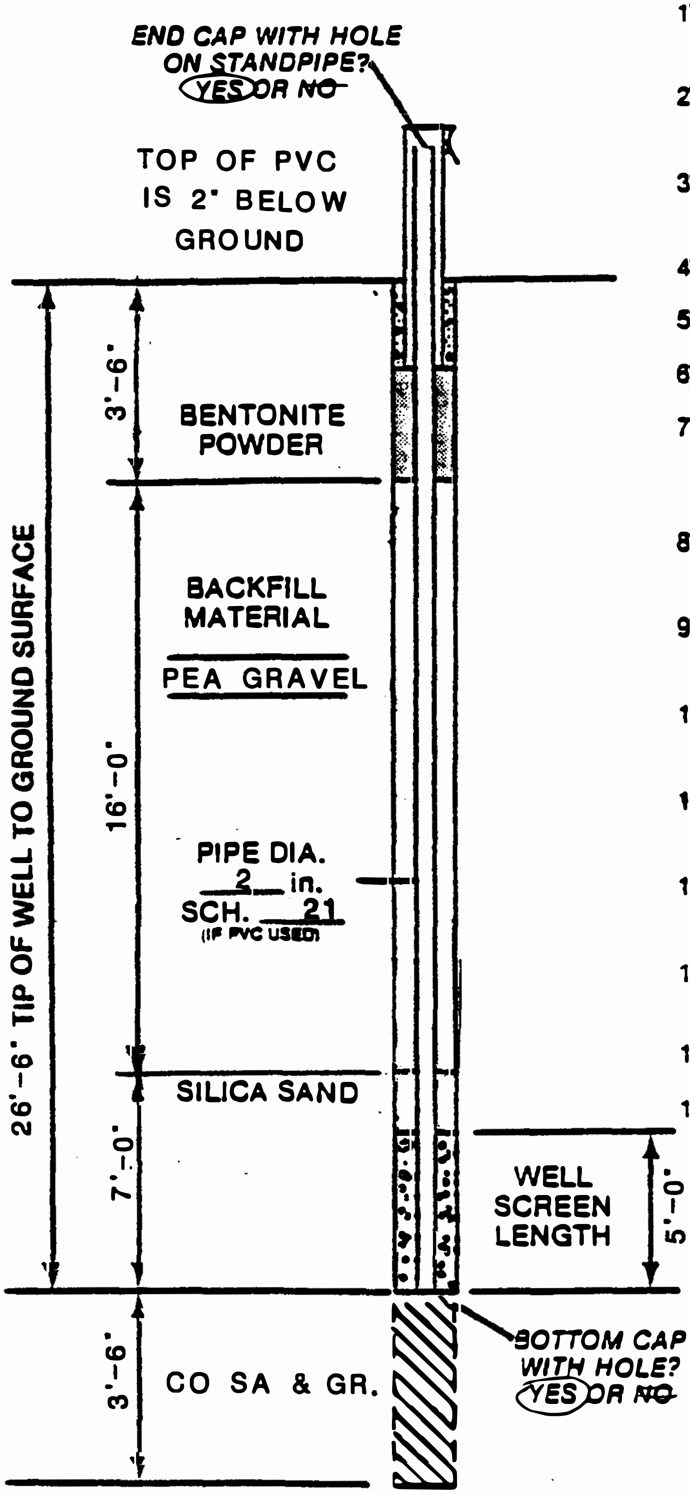
DATE 11-10-86, 17.5 Ft. FROM T, ST. PIPE
DATE 11-28-86, 17.5 Ft. FROM T, ST. PIPE
DATE 9-14-88 DRY Ft. FROM T, ST. PIPE
DATE Ft. FROM T, ST. PIPE

Well No. B-6 DATE INSTALLED 11-10-86 DRILL RIG CME 55
DRILLER JW DRILL CREW DK
JOB/CLIENT VILLAGE OF WHITEFISH BAY STS JOB No. 82149

W: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
[✓ PVC], GALVANIZED, STAINLESS, OTHER ______

2) TYPE OF PIPE JOINTS?
BELLED, COUPLINGS, [✓ THREADED], OTHER ______

3) TYPE OF WELL SCREEN
[✓ PVC], GALVANIZED, STAINLESS, OTHER ______

4) SCREEN SIZE .020

5) INSTALLED PROTECTOR PIPE W/LOCK? YES OR [✓ NO]

6) WAS SOLVENT USED? YES OR [✓ NO]

7) WAS DRILLING MUD USED? NO
SOLID AUGER [✓ HOLLOW STEM AUGER],
WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR [✓ NO]

9) HOW WAS WELL DEVELOPED?
[✓ BAILING], PUMPING, SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., 30 min., OTHER ______
ON 2 DAYS

11) APPROXIMATE WATER VOLUME REMOVED OR ~~ADDED~~?
[✓ 5 gal.], 10 gal., 15 gal., OTHER ______

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, TURBID, [✓ OPAQUE]

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, TURBID, [✓ OPAQUE]

14) DID THE WATER SMELL? YES OR [✓ NO]

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
26' Ft. or DRY

2) OTHER MEASUREMENTS:

DATE 9-15 17'-9" Ft. FROM T. ST. PIPE
DATE 9-16, 21'-3" Ft. FROM T. ST. PIPE
DATE ______, ______ Ft. FROM T. ST. PIPE
DATE ______, ______ Ft. FROM T. ST. PIPE

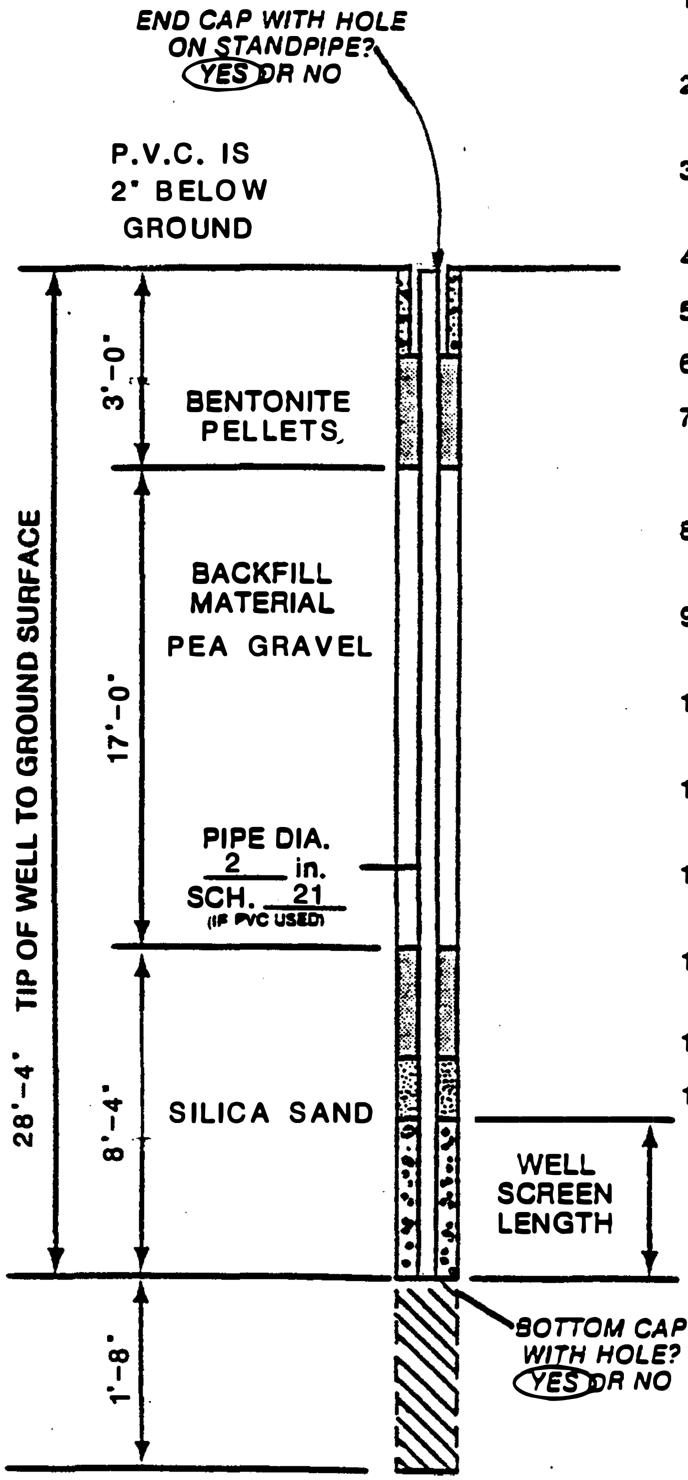
Well No. B-10 DATE INSTALLED 9-14-88 DRILL RIG CME 55

DRILLER AK DRILL CREW JW

JOB/CLIENT WHITEFISH BAY STS JOB No. 82149XF

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



END CAP WITH HOLE ON STANDPIPE? [✓ YES] OR NO

P.V.C. IS 2" BELOW GROUND

PEA GRAVEL

PIPE DIA. 2 in.
SCH. 21 (IF PVC USED)

BOTTOM CAP WITH HOLE? [✓ YES] OR NO

1) TYPE OF PIPE?
[✓ PVC] GALVANIZED, STAINLESS, OTHER ________

2) TYPE OF PIPE JOINTS?
BELLED, COUPLINGS, [✓ THREADED] OTHER ______

3) TYPE OF WELL SCREEN
[✓ PVC] GALVANIZED, STAINLESS, OTHER ________

4) SCREEN SIZE 0.010"

5) INSTALLED PROTECTOR PIPE W/LOCK? ~~YES~~ OR [✓ NO]

6) WAS SOLVENT USED? ~~YES~~ OR [✓ NO]

7) WAS DRILLING MUD USED? NO
[✓ SOLID AUGER] HOLLOW STEM AUGER,
[✓ WATER] REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR [✓ NO]

9) HOW WAS WELL DEVELOPED?
[✓ BAILING] PUMPING, SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
~~5 min.~~, [✓ 15 min.] ~~30 min.~~, ~~OTHER~~ ________

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
[✓ 5 gal.] ~~10 gal.~~, ~~15 gal.~~, ~~OTHER~~ ________

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, [✓ TURBID] OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, [✓ TURBID] OPAQUE

14) DID THE WATER SMELL? ~~YES~~ OR [✓ NO]

15) WATER LEVEL SUMMARY
24'-10" BEFORE BAILING
1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
25'-1" Ft. or DRY

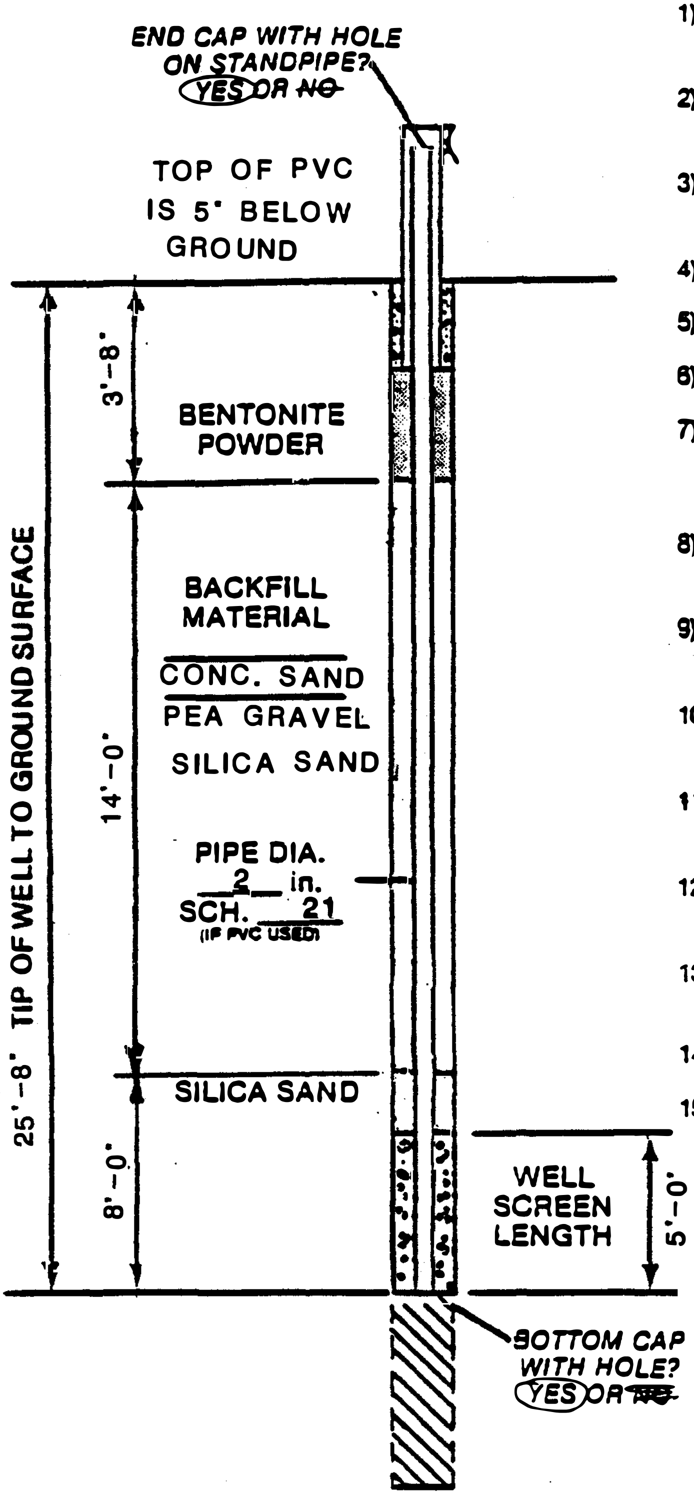
2) OTHER MEASUREMENTS:
DATE ________, ________ Ft. FROM T, ST. PIPE
DATE ________, ________ Ft. FROM T, ST. PIPE
DATE ________, ________ Ft. FROM T, ST. PIPE
DATE ________, ________ Ft. FROM T, ST. PIPE

REPLACEMENT WELL
Well No. B-10R DATE INSTALLED 10-14-88 DRILL RIG B-47
DRILLER A.K. DRILL CREW M.B.
JOB/CLIENT WHITEFIS HBAY STS JOB No. 82149XF

1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



END CAP WITH HOLE ON STANDPIPE? [✓ YES] OR ~~NO~~

TOP OF PVC IS 5" BELOW GROUND

BACKFILL MATERIAL: CONC. SAND, PEA GRAVEL, SILICA SAND

PIPE DIA. 2 in.

SCH. 21 (IF PVC USED)

BOTTOM CAP WITH HOLE? [✓ YES] OR ~~NO~~

1) TYPE OF PIPE?
[✓ PVC,] GALVANIZED, STAINLESS, OTHER ______

2) TYPE OF PIPE JOINTS?
BELLED, COUPLINGS, [✓ THREADED,] OTHER ______

3) TYPE OF WELL SCREEN
[✓ PVC,] GALVANIZED, STAINLESS, OTHER ______

4) SCREEN SIZE .02 0

5) INSTALLED PROTECTOR PIPE W/LOCK? YES OR [✓ NO]

6) WAS SOLVENT USED? YES OR [✓ NO]

7) WAS DRILLING MUD USED? NO
SOLID AUGER [✓ HOLLOW STEM AUGER,]
WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR [✓ NO]

9) HOW WAS WELL DEVELOPED?
[✓ BAILING,] PUMPING, SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., 30 min., OTHER 45 MIN. ON TWO DAYS

11) APPROXIMATE WATER VOLUME REMOVED OR ~~ADDED~~?
5 gal., 10 gal., [✓ 15 gal.,] OTHER ______

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, TURBID, [✓ OPAQUE]

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, TURBID, [✓ OPAQUE]

14) DID THE WATER SMELL? YES OR [✓ NO]

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
______ Ft. or DRY

2) OTHER MEASUREMENTS:

DATE AM 9-15, 22'-2" Ft. FROM T. ST. PIPE
DATE PM 9-15 22'-8" Ft. FROM T. ST. PIPE
DATE 9-16 , 21'-11" Ft. FROM T. ST. PIPE
DATE ______ , ______ Ft. FROM T. ST. PIPE

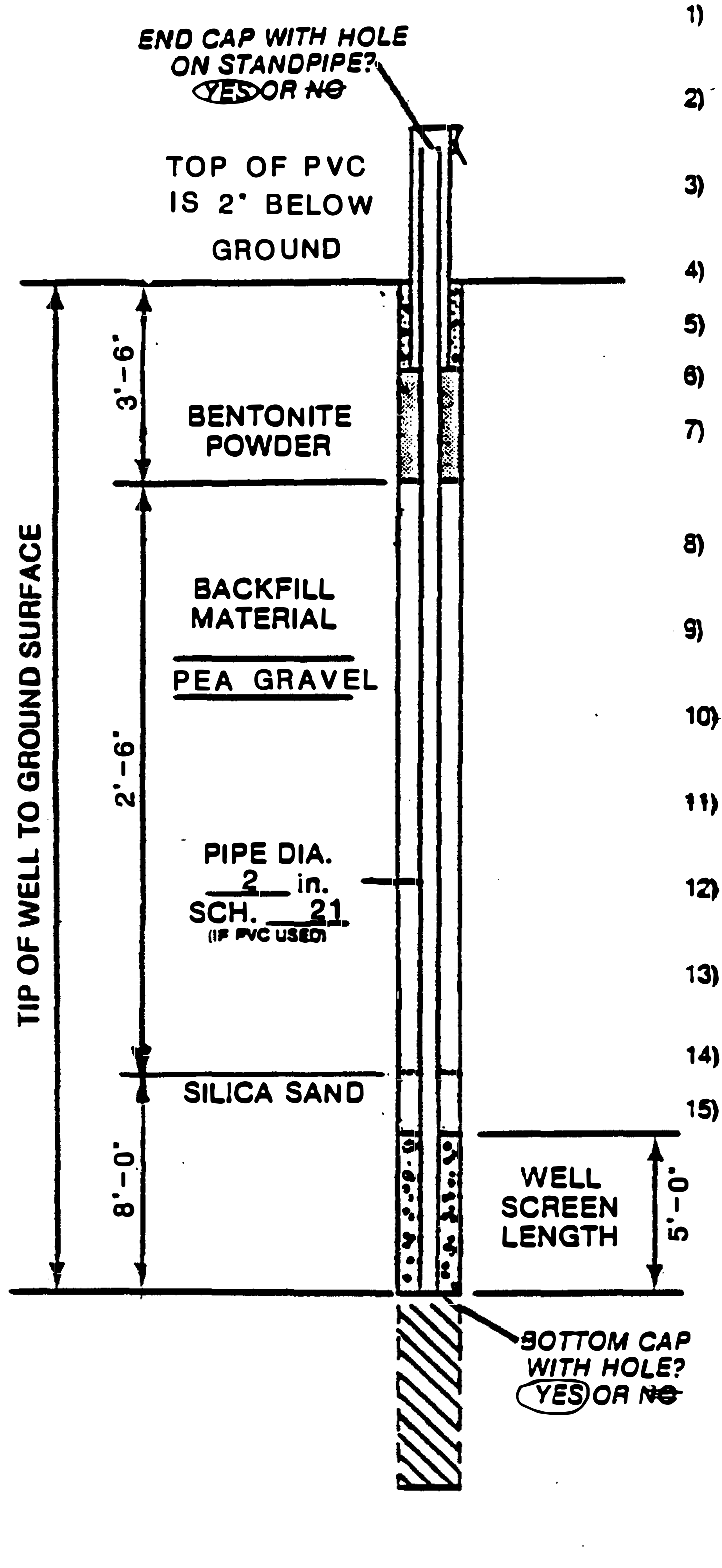
Well No. B-11 DATE INSTALLED 9-15-88 DRILL RIG CME 55

DRILLER AK DRILL CREW JW

JOB/CLIENT WHITEFISH BAY STS JOB No. 82149XF

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
[✓ PVC,] GALVANIZED, STAINLESS, OTHER ________

2) TYPE OF PIPE JOINTS?
BELLED, COUPLINGS, [✓ THREADED] OTHER ________

3) TYPE OF WELL SCREEN
[✓ PVC,] GALVANIZED, STAINLESS, OTHER ________

4) SCREEN SIZE .020

5) INSTALLED PROTECTOR PIPE W/LOCK? YES OR [✓ NO]

6) WAS SOLVENT USED? YES OR [✓ NO]

7) WAS DRILLING MUD USED? NO
SOLID AUGER [✓ HOLLOW STEM AUGER,]
WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR [✓ NO]

9) HOW WAS WELL DEVELOPED?
[✓ BAILING,] PUMPING, SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., 30 min., OTHER ________

11) APPROXIMATE WATER VOLUME REMOVED OR ~~ADDED~~?
5 gal., 10 gal., 15 gal., OTHER 3 GAL

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, TURBID, OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR NO

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
________ Ft. or DRY

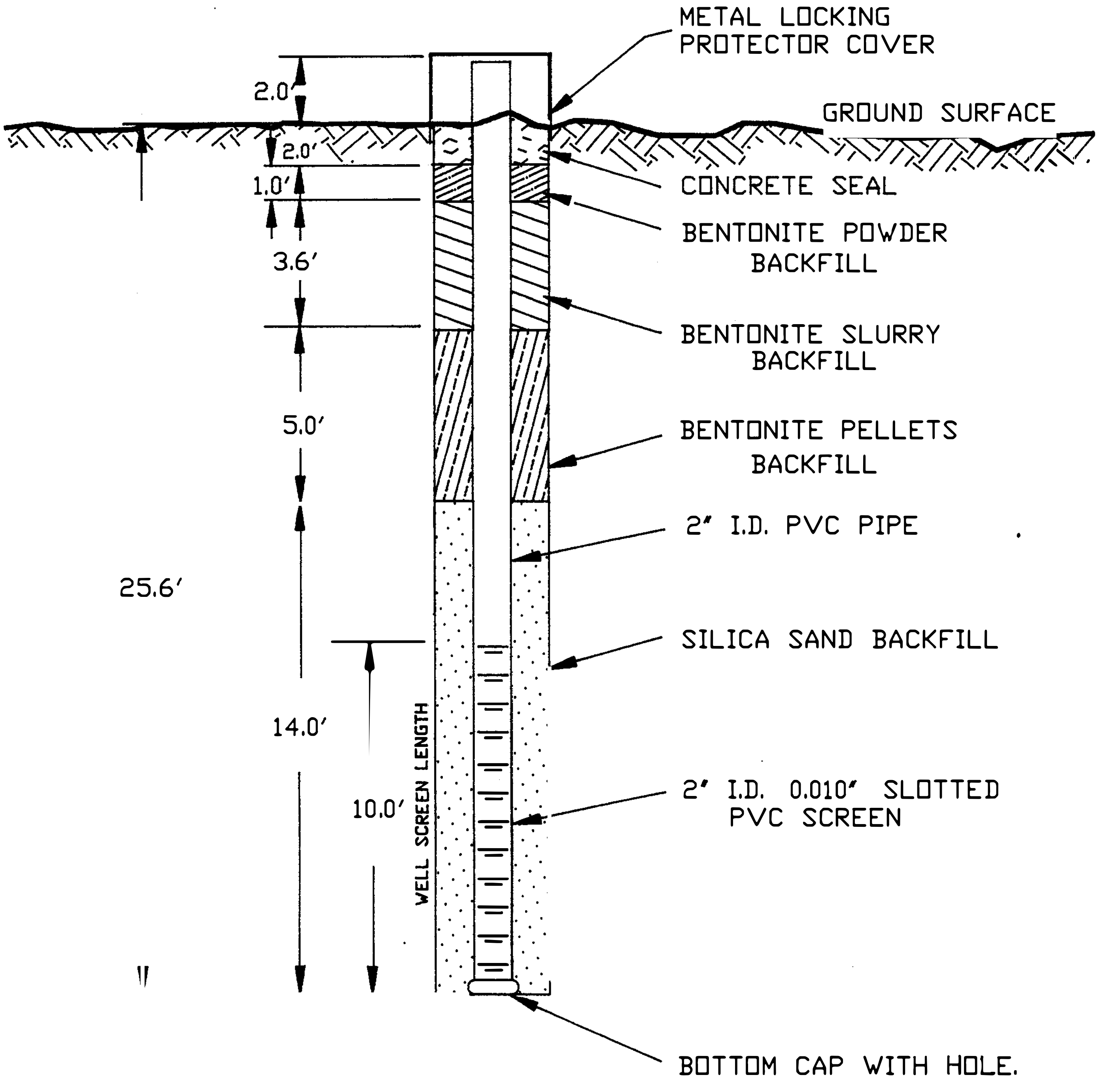
2) OTHER MEASUREMENTS:

DATE 9-16 , 8'-9" Ft. FROM T, ST. PIPE
DATE ________ , ________ Ft. FROM T, ST. PIPE
DATE ________ , ________ Ft. FROM T, ST. PIPE
DATE ________ , ________ Ft. FROM T, ST. PIPE

Well No. B-16 DATE INSTALLED 9-16-88 DRILL RIG CME 55

DRILLER AK DRILL CREW JW

JOB/CLIENT WHITEFISH BAY STS JOB No. 82149XF



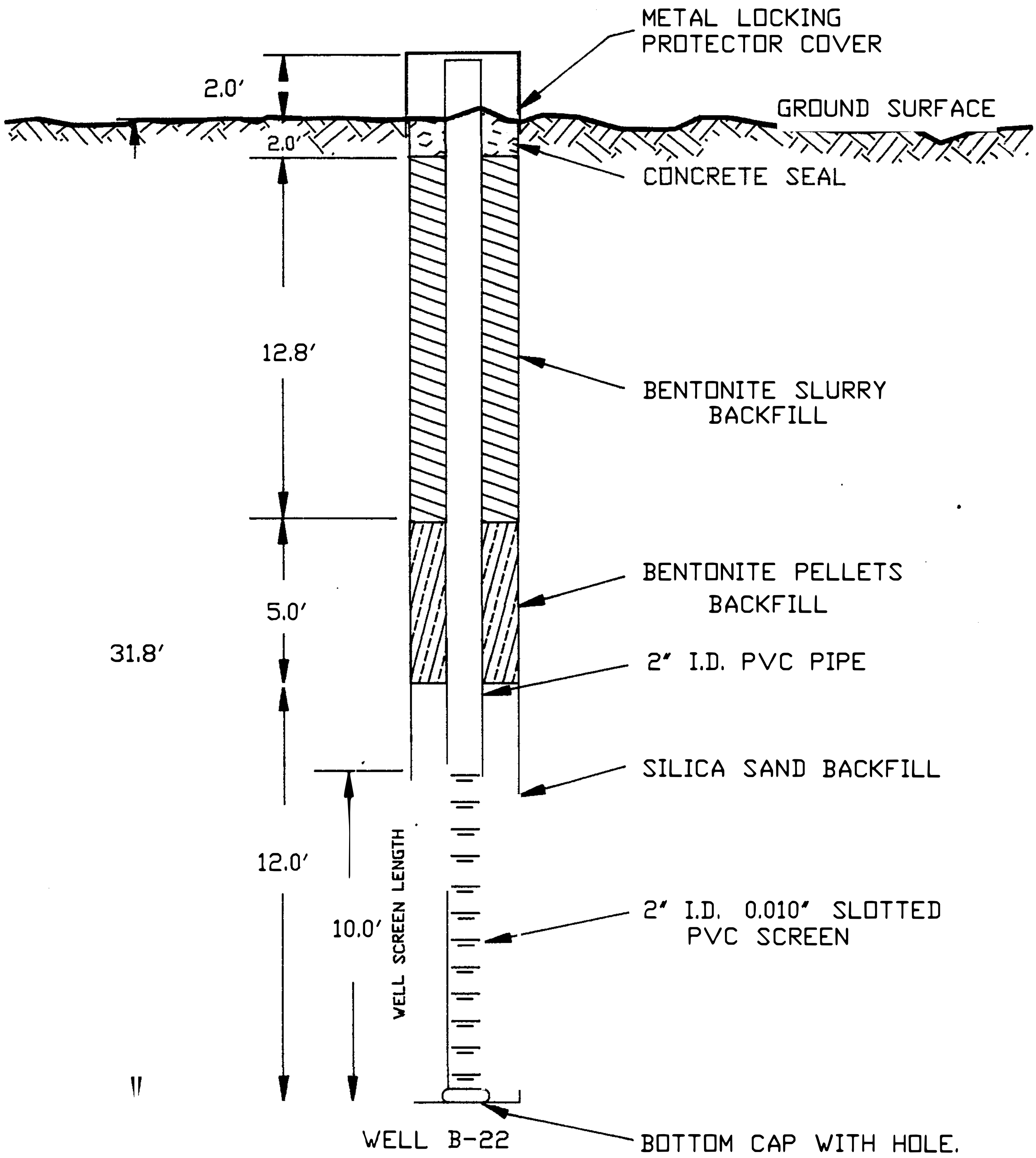
WELL B-18

STS Consultants, Ltd.

WHITEFISH BAY LANDFILL FIG. #2

MONITORING WELL DIAGRAM 82149XF

DATE INSTALLED	DRW'N BY	CHK'D BY	SCALE
4-20-89	C.R.H.	M.D.F.	N.T.S.



WELL B-22

STS Consultants, Ltd.

WHITEFISH BAY LANDFILL

MONITORING WELL DIAGRAM

FIG. #3

82149XF

DATE INSTALLED	DRW'N BY	CHK'D BY	SCALE
4-20-89	C.R.H.	M.D.F.	N.T.S.

-Page 1 RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89 05/16/89 09:43:31

REPORT TO STS CONSULTANTS, LTD.
11425 W. LAKE PARK DR.
MILWAUKEE, WI 53224

ATTEN MR. MIKE FREDE

PREPARED BY Radian Corporation
Milwaukee Office
5103 West Beloit Road
Milwaukee, WI 53214
ATTEN Charles S. Applegate
PHONE (414)643-2768

CERTIFIED BY

CONTACT C_APPLEGATE

CLIENT STS SAMPLES 7
COMPANY STS CONSULTANTS, LTD.
FACILITY 11425 W. LAKE PARK DR.
MILWAUKEE, WI 53224

State of Wisconsin - Certified Laboratory
No. 241293910

WORK ID STS CUSTODY RECORD NO 3577
TAKEN 04/21/89 BY ANDI GREGG
TRANS 04/21/89 BY ANDI GREGG
TYPE WATER
P.O. # 82149XF
INVOICE under separate cover

Radian Project No. 207-027-13-01

SAMPLE IDENTIFICATION

01	B4 WATER
02	B9 WATER
03	B10 WATER
04	B11 WATER
05	B18 WATER
06	B22 WATER
07	BLANK

TEST CODES and NAMES used on this report

8010	HALOGENATED VOLITILE ORGN.
8020B	AROMATIC VOLITILE ORGANICS

MAY 17 1989

Received: 04/21/89
Results by Sample

SAMPLE ID B4 WATER
FRACTION 01A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/19/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

Round 3

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/02/89 FACTOR 1.00 UNITS ug/l

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	ND	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	2.3	0.040	1.00
75-34-3	1,1-Dichloroethane	6.0	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	229.0	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	ND	0.34	1.00
71-55-6	1,1,1-Trichloroethane	ND	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	264	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	110.0	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	101.0 % Recovery
Mixture	2-Bromo-1-chloropropane	92.9 % Recovery

Received: 04/21/89

RADIAN CORP. REPORT
Results by Sample

Work Order # M9-04-049

SAMPLE ID B4 WATER

FRACTION 01A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/19/89 Category

Round
3

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
INSTRMT TRACOR

INJECTD 05/02/89 FILE #
FACTOR 1.00 UNITS ug/l

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	0.030	1.00
108-88-3	Toluene	ND	0.37	1.00
100-41-4	Ethylbenzene	ND	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	ND	1.3	1.00
Mixture	o,p-Xylene	ND	1.1	1.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 87.8% recovery

[redacted] [redacted]

Received: 04/21/89

RADIAN CORP. REPORT
Results by Sample

Work Order # M9-04-049

SAMPLE ID B9 WATER

FRACTION 02A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/19/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM
INSTRMT TRACOR INJECTD 05/02/89
FILE #
FACTOR 1.00
VERIFIED MM
UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	ND	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	.3	0.040	1.00
75-34-3	1,1-Dichloroethane	ND	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	136.0	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	ND	0.34	1.00
71-55-6	1,1,1-Trichloroethane	ND	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	.5	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	ND	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	111.8 % Recovery
Mixture	2-Bromo-1-chloropropane	104.0 % Recovery

[redacted] [redacted]

Page 5 RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89 Results by Sample

SAMPLE ID B9 WATER

FRACTION 02A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/19/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
INSTRMT TRACOR

INJECTD 05/02/89 FILE #
FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	.1	0.030	1.00
108-88-3	Toluene	ND	0.37	1.00
100-41-4	Ethylbenzene	ND	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	ND	1.3	1.00
Mixture	o,p-Xylene	ND	1.1	1.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 124.0% recovery

[redacted]

Page 6 RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89 Results by Sample

SAMPLE ID B10 WATER FRACTION 03A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/19/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	3400.0	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	35.6	0.040	1.00
75-34-3	1,1-Dichloroethane	18.8	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	10400	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	ND	0.34	1.00
71-55-6	1,1,1-Trichloroethane	ND	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	3400	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	477.0	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	81.4 % Recovery
Mixture	2-Bromo-1-chloropropane	93.4 % Recovery

[redacted] [redacted] [redacted]

Page 7 RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89 Results by Sample

SAMPLE ID B10 WATER
FRACTION 03A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/19/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
FILE #
INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	0.030	1.00
108-88-3	Toluene	11.5	0.37	1.00
100-41-4	Ethylbenzene	3.5	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	ND	1.3	1.00
Mixture	o,p-Xylene	ND	1.1	1.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 105.8% recovery

[redacted] [redacted] [redacted] [redacted]

RADIAN CORP. REPORT Work Order # M9-04-049

Received: 04/21/89 Results by Sample

SAMPLE ID B11 WATER

FRACTION 04A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.

Date & Time Collected 04/19/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM

INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	825.0	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	26.0	0.040	1.00
75-34-3	1,1-Dichloroethane	30.2	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	9130	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	ND	0.34	1.00
71-55-6	1,1,1-Trichloroethane	48.4	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	69.0	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	11.8	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	113.5 % Recovery
Mixture	2-Bromo-1-chloropropane	106.6 % Recovery

[redacted] [redacted] [redacted] [redacted]

RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89
Results by Sample

SAMPLE ID B11 WATER
FRACTION 04A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/19/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
INSTRMT TRACOR
INJECTD 05/03/89
FILE #
FACTOR 1.00 UNITS ug/l

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	3.6	0.030	1.00
108-88-3	Toluene	2.2	0.37	1.00
100-41-4	Ethylbenzene	.7	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	ND	1.3	1.00
Mixture	o,p-Xylene	ND	1.1	1.00

Round 3

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 89.0% recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Received: 04/21/89 RADIAN CORP. REPORT Work Order # M9-04-049
Results by Sample

SAMPLE ID B18 WATER FRACTION 05A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/21/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	ND	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	.4	0.040	1.00
75-34-3	1,1-Dichloroethane	4.8	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	106.0	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	ND	0.34	1.00
71-55-6	1,1,1-Trichloroethane	ND	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	9.4	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	ND	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	93.9 % Recovery
Mixture	2-Bromo-1-chloropropane	102 % Recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Page 11 RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89 Results by Sample

SAMPLE ID B18 WATER FRACTION 05A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/21/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM FILE #
INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	0.030	1.00
108-88-3	Toluene	ND	0.37	1.00
100-41-4	Ethylbenzene	ND	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	ND	1.3	1.00
Mixture	o,p-Xylene	ND	1.1	1.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 114.3% recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Page 12 RADIAN CORP. REPORT Work Order # M9-04-049
Received: 04/21/89 Results by Sample

SAMPLE ID B22 WATER FRACTION 06A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/21/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	2490	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	82.3	0.040	1.00
75-34-3	1,1-Dichloroethane	165.0	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	22200	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	132.0	0.34	1.00
71-55-6	1,1,1-Trichloroethane	ND	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	1180	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	36.4	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	80.8 % Recovery
Mixture	2-Bromo-1-chloropropane	105.0 % Recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Received: 04/21/89

RADIAN CORP. REPORT
Results by Sample

Work Order # M9-04-049

SAMPLE ID B22 WATER

FRACTION 06A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/21/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
INSTRMT TRACOR

INJECTD 05/03/89

FILE #
FACTOR 1.00 UNITS ug/l

Round 3

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	16.8	0.030	1.00
108-88-3	Toluene	25.3	0.37	1.00
100-41-4	Ethylbenzene	24.7	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	4.2	1.3	1.00
Mixture	o,p-Xylene	37.1	1.1	1.00

41.3

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 96.7% recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

SAMPLE ID BLANK FRACTION 07A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected not specified Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/03/89 FACTOR 1.00 UNITS ug/l

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.6	1.00
74-83-9	Bromomethane	ND	15	1.00
75-71-8	Dichlorodifluoromethane	ND	100	1.00
75-01-4	Vinyl Chloride	ND	3.2	1.00
75-00-3	Chloroethane	ND	2.2	1.00
75-09-2	Methylene Chloride	ND	0.63	1.00
75-69-4	Trichlorofluoromethane	ND	1.1	1.00
75-35-4	1,1-Dichloroethene	ND	0.040	1.00
75-34-3	1,1-Dichloroethane	ND	0.77	1.00
156-60-5	trans-1,2-Dichloroethene	ND	0.050	1.00
67-66-3	Chloroform	ND	0.23	1.00
107-06-2	1,2-Dichloroethane	ND	0.34	1.00
71-55-6	1,1,1-Trichloroethane	ND	0.15	1.00
56-23-5	Carbon Tetrachloride	ND	0.21	1.00
75-27-4	Bromodichloromethane	ND	0.49	1.00
78-87-5	1,2-Dichloropropane	ND	0.29	1.00
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	1.00
79-01-6	Trichloroethene	ND	0.050	1.00
124-48-1	Dibromochloromethane	ND	2.8	1.00
79-00-5	1,1,2-Trichloroethane	ND	1.0	1.00
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	1.00
100-75-8	2-Chloroethylvinyl Ether	ND	2.8	1.00
75-25-2	Bromoform	ND	46	1.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	1.00
127-18-4	Tetrachloroethene	ND	0.49	1.00

	SURROGATES	
74-97-5	Bromochloromethane	115.2 % Recovery
Mixture	2-Bromo-1-chloropropane	107.6 % Recovery

SAMPLE ID BLANK

FRACTION 07A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected not specified Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
INSTRMT TRACOR

INJECTD 05/03/89
FILE #
FACTOR 1.00 UNITS ug/l

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	0.030	1.00
108-88-3	Toluene	ND	0.37	1.00
100-41-4	Ethylbenzene	ND	0.52	1.00
108-90-7	Chlorobenzene	ND	0.65	1.00
106-46-7	1,4-Dichlorobenzene	ND	2.5	1.00
541-73-1	1,3-Dichlorobenzene	ND	1.0	1.00
95-50-1	1,2-Dichlorobenzene	ND	1.6	1.00
108-38-3	m-Xylene	ND	1.3	1.00
Mixture	o,p-Xylene	ND	1.1	1.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 109.4% recovery

TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.

Method not available.

TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS

Method not available.

-Page 1
Received: 04/27/89

RADIAN CORP. REPORT
05/23/89 15:55:21

Work Order # M9-04-060

REPORT TO STS CONSULTANTS, LTD.
11425 W. LAKE PARK DR.
MILWAUKEE, WI 53224

ATTEN MR. MIKE FREDE

PREPARED BY Radian Corporation
Milwaukee Office
5103 West Beloit Road
Milwaukee, WI 53214
ATTEN Charles S. Applegate
PHONE (414)643-2768

James R.
CERTIFIED BY

CONTACT C_APPLEGATE

CLIENT STS
SAMPLES 4
COMPANY STS CONSULTANTS, LTD.
FACILITY 11425 W. LAKE PARK DR.
MILWAUKEE, WI 53224

State of Wisconsin - Certified Laboratory
No. 241293910

WORK ID 3649
TAKEN 4/27/89
TRANS CUST. (JOS. WEAM)
TYPE SOIL & WATER
P.O. # 82149XF
INVOICE under separate cover

Radian Project No. 207-027-13-01

SAMPLE IDENTIFICATION	
01	B-18:S-3
02	B-20:S-7
03	B-21:S-7
04	B-22:S-7

TEST CODES and NAMES used on this report	
8010	HALOGENATED VOLITILE ORGN.
8020B	AROMATIC VOLITILE ORGANICS

Received: 04/27/89
Results by Sample

SAMPLE ID B-18:S-3 FRACTION 01A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/27/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/22/89 FACTOR 9.43 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	62	9.43
74-83-9	Bromomethane	ND	140	9.43
75-71-8	Dichlorodifluoromethane	ND	940	9.43
75-01-4	Vinyl Chloride	ND	30	9.43
75-00-3	Chloroethane	ND	21	9.43
75-09-2	Methylene Chloride	ND	5.9	9.43
75-69-4	Trichlorofluoromethane	ND	10	9.43
75-35-4	1,1-Dichloroethene	ND	0.38	9.43
75-34-3	1,1-Dichloroethane	ND	7.3	9.43
156-60-5	trans-1,2-Dichloroethene	ND	0.47	9.43
67-66-3	Chloroform	ND	2.2	9.43
107-06-2	1,2-Dichloroethane	ND	3.2	9.43
71-55-6	1,1,1-Trichloroethane	ND	1.4	9.43
56-23-5	Carbon Tetrachloride	ND	2.0	9.43
75-27-4	Bromodichloromethane	ND	4.6	9.43
78-87-5	1,2-Dichloropropane	ND	2.7	9.43
10061-02-6	trans-1,3-Dichloropropene	ND	11	9.43
79-01-6	Trichloroethene	12.6	0.47	9.43
124-48-1	Dibromochloromethane	ND	26	9.43
79-00-5	1,1,2-Trichloroethane	ND	9.4	9.43
10061-01-5	cis-1,3-Dichloropropene	ND	15	9.43
100-75-8	2-Chloroethylvinyl Ether	ND	26	9.43
75-25-2	Bromoform	ND	430	9.43
79-34-5	1,1,2,2-Tetrachloroethane	ND	9.4	9.43
127-18-4	Tetrachloroethene	41.9	4.6	9.43

soil.

SURROGATES

74-97-5	Bromochloromethane	99.1 % Recovery
Mixture	2-Bromo-1-chloropropane	88.8 % Recovery

[redacted]

Received: 04/27/89
Results by Sample

SAMPLE ID B-18:S-3 FRACTION 01A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/27/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM FILE #
INSTRMT TRACOR INJECTD 05/22/89 FACTOR 9.43 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	0.28	9.43
108-88-3	Toluene	23.6	3.5	9.43
100-41-4	Ethylbenzene	53.6	4.9	9.43
108-90-7	Chlorobenzene	ND	6.1	9.43
106-46-7	1,4-Dichlorobenzene	ND	24	9.43
541-73-1	1,3-Dichlorobenzene	ND	9.4	9.43
95-50-1	1,2-Dichlorobenzene	ND	15	9.43
108-38-3	m-Xylene	24.5	12	9.43
Mixture	o,p-Xylene	20.9	10	9.43

PID =25

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 94.0% recovery

[redacted]

RADIAN CORP. REPORT Work Order # M9-04-060
Received: 04/27/89 Results by Sample

SAMPLE ID B-20:S-7 FRACTION 02A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/27/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/22/89 FACTOR 0.94 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	6.2	0.94
74-83-9	Bromomethane	ND	14	0.94
75-71-8	Dichlorodifluoromethane	ND	94	0.94
75-01-4	Vinyl Chloride	ND	3.0	0.94
75-00-3	Chloroethane	ND	2.1	0.94
75-09-2	Methylene Chloride	ND	0.59	0.94
75-69-4	Trichlorofluoromethane	ND	1.0	0.94
75-35-4	1,1-Dichloroethene	ND	0.038	0.94
75-34-3	1,1-Dichloroethane	ND	0.72	0.94
156-60-5	trans-1,2-Dichloroethene	127.0	0.047	0.94
67-66-3	Chloroform	ND	0.22	0.94
107-06-2	1,2-Dichloroethane	ND	0.32	0.94
71-55-6	1,1,1-Trichloroethane	1.8	0.14	0.94
56-23-5	Carbon Tetrachloride	ND	0.20	0.94
75-27-4	Bromodichloromethane	ND	0.46	0.94
78-87-5	1,2-Dichloropropane	ND	0.27	0.94
10061-02-6	trans-1,3-Dichloropropene	ND	1.1	0.94
79-01-6	Trichloroethene	2160	0.047	0.94
124-48-1	Dibromochloromethane	ND	2.6	0.94
79-00-5	1,1,2-Trichloroethane	ND	0.94	0.94
10061-01-5	cis-1,3-Dichloropropene	ND	1.5	0.94
100-75-8	2-Chloroethylvinyl Ether	ND	2.6	0.94
75-25-2	Bromoform	ND	43	0.94
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.94	0.94
127-18-4	Tetrachloroethene	115.0	0.46	0.94

PID = 40

SURROGATES

74-97-5	Bromochloromethane	95.8 % Recovery
Mixture	2-Bromo-1-chloropropane	100.5 % Recovery

TOTAL P.01

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Received: 04/27/89
Results by Sample

SAMPLE ID B-20:S-7
FRACTION 02A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/27/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
FILE #
INSTRMT TRACOR INJECTD 05/22/89 FACTOR 0.94 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	0.028	0.94
108-88-3	Toluene	15.5	0.35	0.94
100-41-4	Ethylbenzene	23.6	0.49	0.94
108-90-7	Chlorobenzene	ND	0.61	[illegible].94
106-46-7	1,4-Dichlorobenzene	ND	2.4	0.94
541-73-1	1,3-Dichlorobenzene	ND	0.94	0.94
95-50-1	1,2-Dichlorobenzene	ND	1.5	0.94
108-38-3	m-Xylene	26.8	1.2	0.94
Mixture	o,p-Xylene	30.4	1.0	0.94

57.2

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 102.0% recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Received: 04/27/89 Results by Sample

SAMPLE ID 8-21:S-7 FRACTION 03A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/27/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/22/89 FACTOR 612.00 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	4000	612.00
74-83-9	Bromomethane	ND	9100	612.00
75-71-8	Dichlorodifluoromethane	ND	61000	612.00
75-01-4	Vinyl Chloride	ND	2000	612.00
75-00-3	Chloroethane	ND	1300	612.00
75-09-2	Methylene Chloride	ND	390	612.00
75-69-4	Trichlorofluoromethane	ND	670	612.00
75-35-4	1,1-Dichloroethene	ND	24	612.00
75-34-3	1,1-Dichloroethane	ND	47[illegible]	612.00
156-60-5	trans-1,2-Dichloroethene	ND	31	612.00
67-66-3	Chloroform	ND	140	612.0[illegible]
107-06-2	1,2-Dichloroethane	ND	210	612.00
71-55-6	1,1,1-Trichloroethane	ND	92	612.00
56-23-5	Carbon Tetrachloride	ND	130	612.[illegible]0
75-27-4	Bromodichloromethane	ND	300	612.00
78-87-5	1,2-Dichloropropane	ND	180	612.00
10061-02-6	trans-1,3-Dichloropropene	ND	730	612.00
79-01-6	Trichloroethene	5840	31	612.00
124-48-1	Dibromochloromethane	ND	1700	612.00
79-00-5	1,1,2-Trichloroethane	ND	610	612.00
10061-01-5	cis-1,3-Dichloropropene	ND	980	612.00
100-75-8	2-Chloroethylvinyl Ether	ND	1700	612.00
75-25-2	Bromoform	ND	28000	612.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	610	612.00
127-18-4	Tetrachloroethene	129000	300	612.00

PID = 43[illegible]

SURROGATES

74-97-5	Bromochloromethane	92.4 % Recovery
Mixture	2-Bromo-1-chloropropane	108.3 % Recovery

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Received: 04/27/89 Results by Sample

SAMPLE ID B-21:S-7 FRACTION 03A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS

Date & Time Collected 04/27/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM FILE #

INSTRMT TRACOR INJECTD 05/22/89 FACTOR 612.00 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	18	612.00
108-88-3	Toluene	9080	230	612.00
100-41-4	Ethylbenzene	31700	320	612.00
108-90-7	Chlorobenzene	ND	400	612.00
106-46-7	1,4-Dichlorobenzene	ND	1500	612.00
541-73-1	1,3-Dichlorobenzene	ND	610	612.00
95-50-1	1,2-Dichlorobenzene	ND	980	612.00
108-38-3	m-Xylene	99000	800	612.00
Mixture	o,p-Xylene	91000 19000	670	612.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 106.9% recovery

Page 8 RADIAN CORP. REPORT Work Order # M9-04-060
Received: 04/27/89 Results by Sample

SAMPLE ID B-22:S-7 FRACTION 04A TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.
Date & Time Collected 04/27/89 Category

ORGANIC ANALYSIS DATA SHEET - PURGEABLE HALOCARBONS

ANALYST MM FILE # VERIFIED MM
INSTRMT TRACOR INJECTD 05/22/89 FACTOR 624.00 UNITS ug/kg

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
74-87-3	Chloromethane	ND	4100	624.00
74-83-9	Bromomethane	ND	9300	624.00
75-71-8	Dichlorodifluoromethane	ND	62000	624.00
75-01-4	Vinyl Chloride	ND	2000	624.00
75-00-3	Chloroethane	ND	1400	624.00
75-09-2	Methylene Chloride	ND	390	624.00
75-69-4	Trichlorofluoromethane	ND	690	624.00
75-35-4	1,1-Dichloroethene	ND	25	624.00
75-34-3	1,1-Dichloroethane	ND	480	624.00
156-60-5	trans-1,2-Dichloroethene	ND	31	624.00
67-66-3	Chloroform	ND	140	624.00
107-06-2	1,2-Dichloroethane	ND	210	624.00
71-55-6	1,1,1-Trichloroethane	ND	94	624.00
56-23-5	Carbon Tetrachloride	ND	130	624.00
75-27-4	Bromodichloromethane	ND	310	624.00
78-87-5	1,2-Dichloropropane	ND	180	624.00
10061-02-6	trans-1,3-Dichloropropene	ND	750	624.00
79-01-6	Trichloroethene	10100	31	624.00
124-48-1	Dibromochloromethane	ND	1700	624.00
79-00-5	1,1,2-Trichloroethane	ND	620	624.00
10061-01-5	cis-1,3-Dichloropropene	ND	1000	624.00
100-75-8	2-Chloroethylvinyl Ether	ND	1700	624.00
75-25-2	Bromoform	ND	29000	624.00
79-34-5	1,1,2,2-Tetrachloroethane	ND	620	624.00
127-18-4	Tetrachloroethene	22500	310	624.00

PID= 410

SURROGATES

74-97-5	Bromochloromethane	99.6 %	Recovery
Mixture	2-Bromo-1-chloropropane	106.7 %	Recovery

Received: 04/27/89

RADIAN CORP. REPORT
Results by Sample

Work Order # M9-04-[illegible]60

SAMPLE ID B-22:S-7

FRACTION 04A TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS
Date & Time Collected 04/27/89 Category

ORGANICS ANALYSIS DATA SHEET - PURGEABLE AROMATICS

VERIFIED MM

ANALYST MM
INSTRMT TRACOR

INJECTD 05/22/89
FILE #
FACTOR 624.00 UNITS ug/kg

P. p. 410

CAS#	COMPOUND	RESULT	DET LIMIT	FACTOR
71-43-2	Benzene	ND	19	624.00
108-88-3	Toluene	2670	230	624.00
100-41-4	Ethylbenzene	14500	320	624.00
108-90-7	Chlorobenzene	ND	410	624.00
106-46-7	1,4-Dichlorobenzene	ND	1600	624.00
541-73-1	1,3-Dichlorobenzene	ND	620	624.00
95-50-1	1,2-Dichlorobenzene	ND	1000	624.00
108-38-3	m-Xylene	37200	810	624.00
Mixture	o,p-Xylene	28800 66000	690	624.00

SURROGATE

98-08-8 a,a,a-Trifluorobenzene 100.4% recovery

TEST CODE 8010 NAME HALOGENATED VOLITILE ORGN.

Method not available.

TEST CODE 8020B NAME AROMATIC VOLITILE ORGANICS

Method not available.

20th★★★ Anniversary

RADIAN
CORPORATION

5101 West Beloit Rd.
Milwaukee, WI 53214

September 1, 1989

Ms. Kathy Huibregtse
STS Consultants Ltd.
11425 West Lake Park Drive
Milwaukee, Wisconsin 53224

Dear Ms. Huibregtse:

Subject: Laboratory Quality Assurance

As requested, we are submitting a data package that details the quality control and quality assurance associated with your project number 82149XF. Volatile organic compounds were analysed in compliance with SW846 protocol for Methods 8010 and 8020.

Our standard quality assurance is documented in our Laboratory Quality Assurance Program Plan. I have provided copies of the appropriate sections of this document. The full document is available at our laboratory for your review should you need additional information. All volatile organic analyses are subject to the following quality assurance procedures:

- Calibration verification;
- Analysis of surrogate spiked samples;
- Method blank analysis;
- Analysis of matrix spike and matrix spike duplicates;
- Analysis of QC check samples;
- Retention time window checks; and
- Surrogate spiked blank analysis.

The data package includes the analyst's commentary on the analysis, taken from the GC run log.

Please call me at 414/643-2764 if you have any questions or concerns about this data package.

Best Regards,

Charles S Applegate

Charles S. Applegate
Laboratory Group Leader

Attachments

STS ORDER 82149XF
RECEIVED 4/27/89

Sample # M904049-01A
- This sample did not require dilution 5 mls purged
Every thing look good

M904049-02A
- This sample did not require dilution 5 mls purged
Every thing looks good

M904049-03A.
- First Run was 5 mls purged
T 12 DCETENE way off scale
TCETENE way off scale
> ran clean out after this sample no carryover observed
- Second run - 20 ul sample injected into 5 mls di H2O
T 12 DCETENE - now on scale
TCETENE - now on scale

M904049-04A
- First run was 5 mls purged.
T 12 DCETENE way off scale
> ran clean out after this sample no carryover observed
- Second run 20 ul of Sample injected into 5 mls DI H2O
T 12 DCETENE now on scale

M904049-05A
- this sample required no dilution 5 mls purged
Every thing looks good

M904049-06A
- First run was 5 mls purged
T 12 DCETENE way off scale
TCETENE way off scale
> ran clean out after this sample no carryover observed
- Second run - 10 ul of Sample injected into 5 mls DI H2O
T 12 DCETENE and TCETENE now on scale

then I ran Viny chloride STD's to quantify Vinyl chloride found in Samples 03A, 04A, 05A.

The blank ran with M904049 - BCM = 99.5%
2B1 = 96.7%
aaaTFT = 116 %
and 1.9 ug/l T12 DCETENE

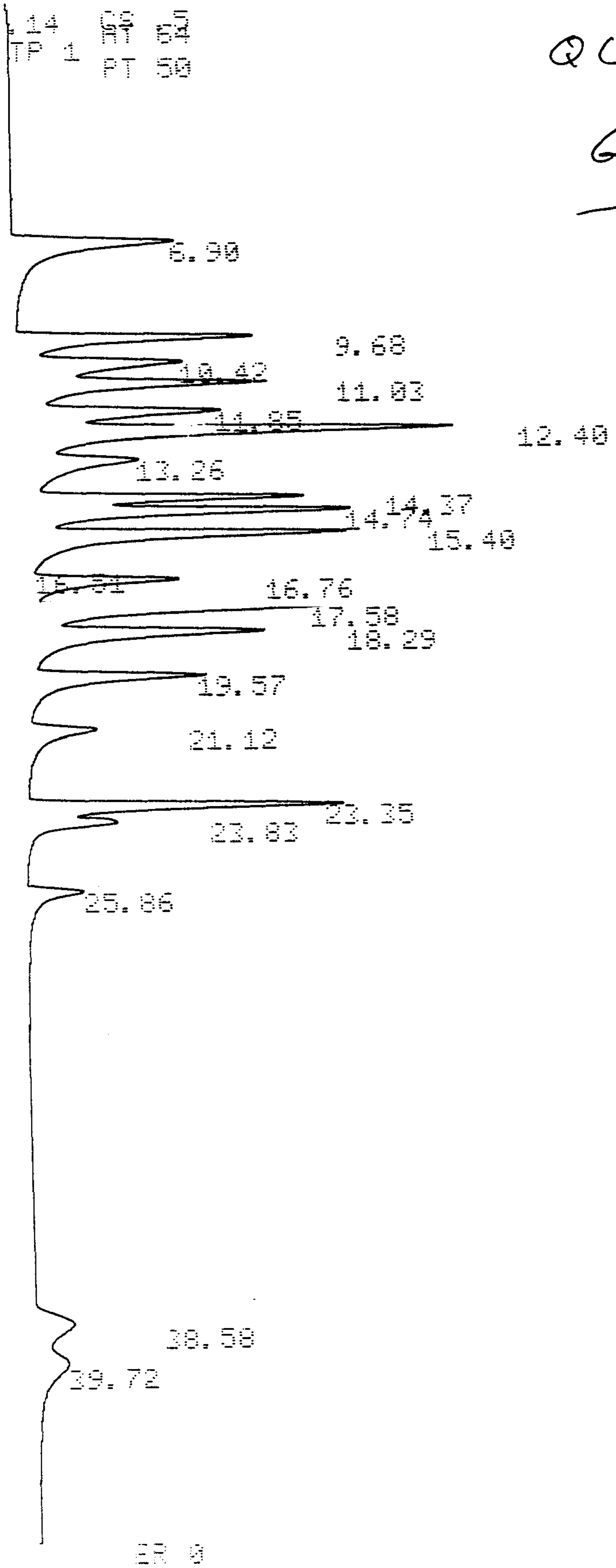
Second Source QC check - all components > 82% Rec and < 128% Rec ave = 104.6%
all componetits at ≃ 20 ug/l

[illegible] 259.052 [illegible]

CHANNEL A INJECT 05/03/89 09:22:08

QC Check STD

GC8904-06A



```
FILE  1.        METHOD  5.       RUN 469       INDEX  16

ANALYST: MILANOWSKI        QC Check STD  GC 8904-06A

NAME                     NG           RT          AREA BC        RF

 1                        0.           0.14         309 01
METHYLENEC    96.5%    92.66 ✓          6.9  96  426531 01       4603.184 ✓
11DCETENE     93.3%   116.172 ✓         9.68 1245 388860 02      3347.278 ✓
SG STD BCM    96.1%   194.112 2432    10.42 253 362196 02     ~~1865.312~~ 1489
11DCETANE    111.5%   ~~126.037~~ 100.4   11.03 90  473085 02     ~~3753.544~~ 4713
T12DCETENE   112.4%   123.117 ✓       11.85 1095 381526 02      3098.89 ✓
CHLOROFORM   101.3%    ~~97.291~~ 1269   12.4 125.25 798157 02     ~~8203.011~~ 6292
12DCETANE    113.9%   114.514 ✓       13.26 1005 363038 02      3170.25 ✓
111TCETANE   108.9%   ~~147.135~~ 121.7   14.37 111.75 388553 02     ~~2640.792~~ 3192
CARBONTET    101.1%   ~~226.715~~ 137.1   14.74 1356 547096 02     ~~2413.144~~ 3990
BDCMTANE     102.6%    ~~85.417~~ 2246   15.4 219  665492 02     ~~2704.885~~ 2963
 12                       0.          16.51        2981 02
12DCPPANE     99.6%   ~~155.439~~ 96.3    16.76 96.25 298297 02    ~~1919.864~~ 3097
TCETENE      108.8%   ~~342.625~~ 136.2   17.58 125.25 515697 02   ~~1505.135~~ 3785
DBCMTANE     123.1%   ~~123.08~~ 436.5    18.29 354.75 550521 02   ~~4472.071~~ 1261
SG STD 2B1   107.7%   ~~239.395~~ 323     19.57 300 383838 02     ~~1602.267~~ 1188
BROMOFORM    126.3%   ~~134.307~~ 532.5   21.12 421.5 185307 03    ~~1379.727~~ 348
TETCETENE    106.5%   ~~102.082~~ 144.6   23.35 1355 445449 02     ~~4363.639~~ 3081
 19                       0.          23.83      179963 03          392
CHLOROBENZ    98.9%   ~~154.243~~ 1120    25.86 113.25 121817 01     ~~789.773~~ 1088
13DCBENZ      91.5%   ~~122.779~~ 129     38.58 141 162118 02      ~~1320.465~~ 1257
12DCBENZ      83.9%   ~~209.064~~ 107.6   39.72 128.25 193337 03     921.262 1797

TOTALS                 2906.981                 7834168


8020 8010 CNFRM                 05/03/89 09:22:08       CH= "B"   PS=  1.

FILE  2.       METHOD  5.       RUN 508       INDEX  17

ANALYST: MILANOWSKI

NAME                     NG           RT          AREA BC        RF

 1 Methylene C  91.1%     0. 87.4      6.77 96      2973 01       34
11DCETENE    128.5%   159.836 ✓        9.6  1245 203186 01       1271.215 ✓
T12DCETENE   110.0%   120.461 ✓       11.75 1095 466715 01       3874.407 ✓
 4                        0.          14.24         808 01
 5                        0.          15.42        1726 01
TCETENE      112.9%   141.388 ✓       17.51 125.25 360575 02     2550.252 ✓
BENZENE      118.0%    ~~90.035~~ ✓ 92.1  17.97 78  479994 03    ~~4066.300~~ ✓ 5213
 8                        0.          19.46        2320 01
TETCETENE    118.4%   149.919 ✓       23.25 135.25 361448 02     2410.955 ✓
SG STD AAA    97.8%   347.033 ✓       23.78 355 523889 02       1538.439 ✓
TOLUENE      106.2%    82.063 ✓       24.56 77.25 402041 03      4899.175 ✓
CHLOROBENZ    93.7%   106.075 ✓       25.75 113.25 575854 01     5428.744 ✓
ETHYLBENZ    100.7%    80.064 ✓       27.91 79.5 318974 01       3983.988 ✓
M-XYLENE      82.6%    61.913 ✓       32.86 75.0 228463 02       3690.065 ✓
O,P-XYLENE   124.0%   124.58 ✓        33.98 100.5 513363 03      4120.75 ✓
13DCBENZ      96.5%   136.039 ✓       38.38 141 399703 02        2938.15 ✓
12DCBENZ      96.7%   124.023 ✓       39.56 128.25 255430 03     2059.537 ✓

TOTALS                 [illegible]                 [illegible]
```

Sample # M904060 - 01A

purged .53 gms of sample

Every thing Looks good

M904060 - 02A

First purge 5.31gms, TCETENE offscale

Second purge .63gms TCE Now on scale

M904060 - 03A

First purge - 10ul of a MeOH EXTRACTION (~~[illegible]~~ 10.21gms / 12.5ml MeC

or the equivalant of .008168gms purged.

Every thing on scale - very high - but good - no 2nd purge requ

M904060 - 04A

FisT purge - 10ul of a MeOH ExTRACTion (10.01gms / 12.5ml MeOH)

or the equivalent of .008008 gms purged

Every thing on scale - good no second purge required.

The blank run with M904060 - BCM 100%

2BI 100%

aaaTFT 98.1%

and. Toluene 1.7ug/l

all others N.D.

Second Source calib check STD. - all components ≈ 20 ug/l

all components > 72% and < 115%

ave % Rec = 91.6%

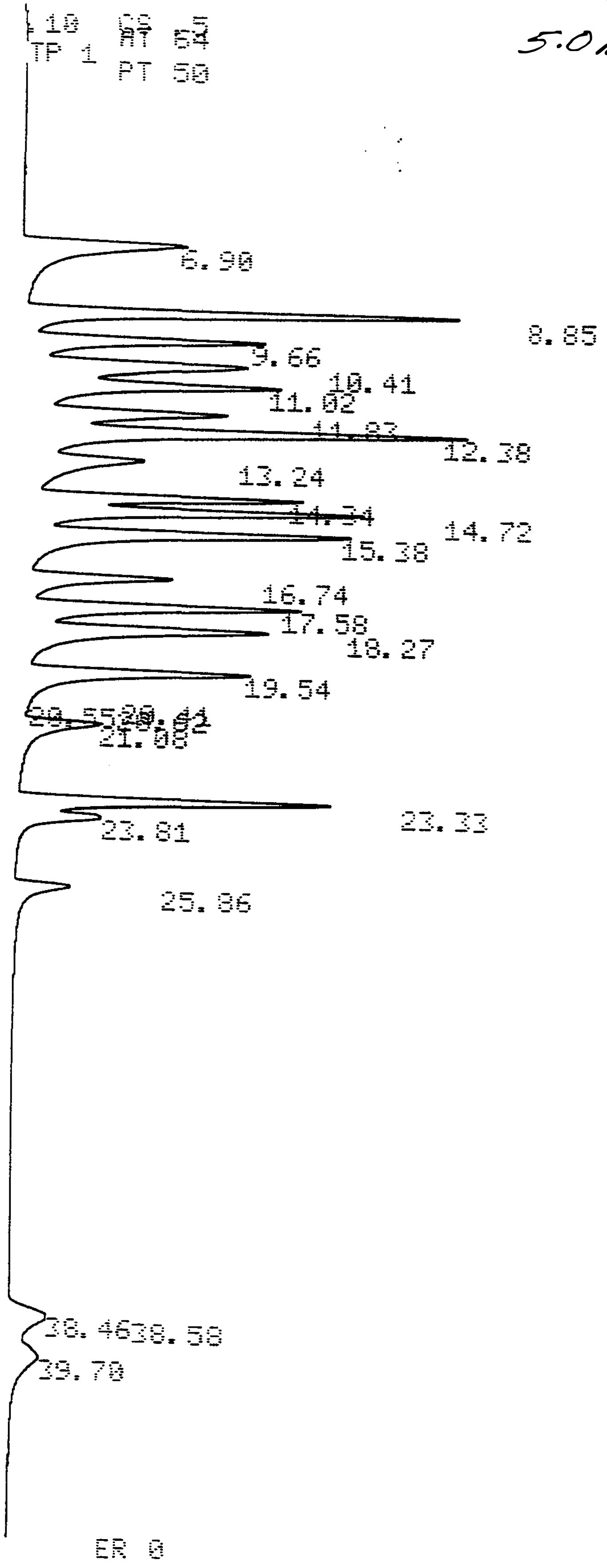
also included is spk and spk Dup info for a sample that was run between ord M904049 and ord M904060

also included is Memo on M904049

CHANNEL A INJECT 05/22/89 11:13:20

CHECK STD FOR M904060

5.0 mls GC8904-17D



3010

05/22/89 11:13:20 CH= "A" PS= 1.

2. METHOD 5. RUN 560 INDEX 4

```
E        %Rec    NG                  RT                 AREA BC         RF

                 0.                  0.1                   93 01
YLENEC   81.2%   77.946              6.9  96.0      422412 01      5419.29 ✓
TANE     90.0%   124.225             8.85 138       600942 02      4837.529 ✓
CETENE   90.4%   112.516             9.66 124.5     391699 02      3481.274 ✓
TN ACM   85.9%   ~~192.993~~ 217     10.41 253      493097 02      ~~2490.477~~  2268
ETANE    90.9%   ~~99.478~~ 81.8     11.02 90       506457 02      ~~5091.146~~  6192
CETENE   91.0%   99.646              11.83 109.5    373210 02      3745.359 ✓
ROFORM   84.0%   ~~80.202~~ 105.2    12.38 125.25   797446 02      ~~9949.969~~  7577
ETANE    94.8%   95.265              13.24 100.5    356259 02      3739.663 ✓
CFTANE   99.1%   110.785             14.34 111.75   376067 02      3394.566 ✓
RBONTET  85.0%   ~~193.385~~ 115.2   14.72 135.6    541501 02      ~~2801.278~~  4200
TANE     77.8%   ~~64.882~~ 170.3    15.38 219      657993 02      ~~10141.38~~  3864
PPANE    74.8%   ~~125.271~~ 223     16.74 96.75    283465 02      ~~2262.901~~  3919
TFNF     80.0%   ~~265.766~~ 1000    17.58 125.25   465699 02      ~~1752.29~~  4659
TANF     80.3%   ~~419.098~~ 285     18.27 354.25   544286 02      ~~4921.042~~  1910
IN 2A1   74.4%   ~~219.966~~ 223     19.54 300      446715 02      ~~2617.39~~  2002
                 0.                  20.41                7808 02
                 0.                  20.55                3104 02
                 0.                  20.62                8223 02
OFORM    82.0%   ~~95.859~~ 346      21.08 421.5    199165 03      ~~2095.172~~  576
CETFNF   76.7%   ~~79.302~~ 103.7    23.33 135.25   426199 02      ~~5360.995~~  4109
                 0.                  23.81              168129 03
ROBENZ   72.6%   ~~125.643~~ 82.2    25.86 113.25   113903 01      ~~906.272~~  1386
CBFNZ    80.5%   ~~65.789~~ 113.5    38.46 141       61996 02      ~~943.493~~  149755 : 1320
                 0.                  38.58               87759 02
BENZ     81.7%   ~~209.447~~ 104.8   39.7 128.25    168996 03      ~~807.948~~  1613

TALS             2554.481                          8502623


  8010 CNFRM                 05/22/89 11:13:20     CH= "B"   PS=  1.

LE  2.       METHOD  5.      RUN 606      INDEX   4

  YST: MILANOW


                                     RT           AREA BC        RF

L               96.5%    0.     92.6   6.78 96.0       2334 01       25.2
ETENE           109.7%   136.605        9.58 124.5   139456 01      1020.87 ✓
[redacted]CETENE 94.1%   103.019       11.74 109.5   327242 01      3176.521 ✓
                92.7%    116.107       17.49 125.25  256927 02      2212.804 ✓
ZENE            103.5%   80.761        17.96 78.0    344662 03      4267.679 ✓
[redacted]               0.            19.44           1528 01
CETENE          91.7%    124.013       23.23 125.25  255383 02      2059.324 ✓
 STD BBA        101.5%   ~~329.225~~ 360  23.76 355  486805 02      ~~1455.05~~   1351
[redacted]ENE   99.0%    76.513        24.54 72.25   319316 03      4173.356 ✓
ROBENZ          90.2%    ~~93.116~~ 102.1  25.73 113.25 428820 01   ~~4326.446~~  4200
YLBENZ          92.5%    73.877        27.9 79.9     238518 01      3228.583 ✓
LENE            73.9%    55.42         32.84 75.0    172760 02      3117.286 ✓
XYLENE          115.0%   115.576       33.97 100.5   388258 03      3359.331 ✓
ENZ             93.9%    ~~120.205~~ 132.3  38.34 141  157221 02    ~~2316.88~~  2246
INZ             94.2%    ~~117.6~~ 120.8    39.5 128.25 [illegible]2478 03  ~~1536.718~~  1594

                1566.117                     1351703
```

RADIAN
CORPORATION

MATRIX SPIKE RECOVERIES FOR

EPA 601 and EPA 602 COMPOUNDS M904060 & M904049

PROJECT:

DATE
ANALYST

ORD NO.	Spk	ug/l	Expected ug/l	Found ug/l		Found ug/l		Found ug/l			
FRAC NO.	Level	in	in	in	% Rec	in	% Rec	in	% Rec		
601 COMPOUNDS	ug/l	09A	09A Spk	09A Spk		09A Spk Dup		09A Spk Dup Dup			
CHLOROMETHANE	—	N.D.	N.S.								
BROMOMETHANE	—	↓	↓								
DICHLORODIFLUOROMETHANE	—	↓	↓								
VINYLCHLORIDE	—	↓	↓								
CHLOROETHANE	—	↓	↓								
METHYLENE CHLORIDE	19.2	↓	19.2	15.5	80.7	20.3	105.7	16.6	86.5		
TRICHLOROFLUOROMETHANE	27.6	↓	27.6	22.1	80.1	35.8	129.7	27.7	100.4		
1,1-DICHLOROETHENE	24.9	↓	24.9	22.5	90.4	28.6	114.9	22.8	91.6		
1,1-DICHLOROETHANE	18.0	4.6	22.6	18.5	81.9	22.1	97.8	20.1	88.9		
T-1,2-DICHLOROETHENE	21.9	9.6	31.5	22.9	72.7	27.0	85.7	23.8	75.6		
CHLOROFORM	25.1	N.D.	25.1	21.3	84.9	26.5	105.6	22.9	91.2		
1,2-DICHLOROETHANE	20.1	↓	20.1	15.2	75.6	20.6	102.5	16.8	83.6		
1,1,1-TRICHLOROETHANE	22.4	.8	23.2	20.0	86.2	25.3	109.1	22.4	96.6		
CARBONTETRACHLORIDE	27.1	N.D.	27.1	24.0	88.6	30.4	112.2	27.0	99.6		
BROMODICHLOROMETHANE	43.8	↓	43.8	37.3	85.2	49.4	112.8	39.8	90.9		
1,2-DICHLOROPROPANE	19.4	↓	19.4	15.7	80.9	20.2	104.1	17.5	90.2		
T-1,3-DICHLOROPROPENE	—	↓									
TRICHLOROETHENE	25.1	10.5	35.6	30.8	86.5	36.2	101.7	33.4	93.8		
CIS-1,3-DICHLOROPROPENE	—	N.D.	N.S								
1,1,2-TRICHLOROETHANE	—	↓	↓								
DIBROMOCHLOROMETHANE	71.0	↓	71.0	84.7	119.3	105.9	149.2	89.1	125		
2-CHLORORETHYLVINYLETHER	—	↓	N.S.								
BROMOFORM	84.3	↓	84.3	117.8	139.7	143.5	170.2	121.0	143.5		
TETRACHLOROETHENE	27.15	↓	27.15	22.1	81.4	31.3	115.3	26.5	97.6		
1,1,2,2-TETRACHLOROETHANE	—	↓	N.S								
Sg STD BCM %RECOVERY				90.6%		91.6%		101.2%			
Sg STD 2BI % Rec				93.3%		92.0%		100.3%			
602 COMPOUNDS											
BENZENE	15.6	9.1	24.7	16.3	66.0	18.5	74.9	16.8	68.0		
TOLUENE	15.5	1.7	17.2	14.9	86.6	17.6	102.3	16.1	93.6		
CHLOROBENZENE	22.7	N.D.	22.7	16.9	74.4	22.6	99.6	18.6	81.9		
ETHYLBENZENE	15.9	↓	15.9	12.4	78.0	15.7	98.7	13.6	85.5		
1,3-DICHLOROBENZENE	28.2	↓	28.2	21.6	76.6	29.2	103.9	25.2	89.4		
1,2-DICHLOROBENZENE	25.7	↓	25.7	21.7	84.4	25.3	98.4	24.8	96.5		
1,4-DICHLOROBENZENE	—	↓									
m-XYLENE	15.0	13.0	28.0	10.0	35.7	11.8	42.1	10.9	38.9		
o,p-XYLENE	20.1	31.0	51.1	19.4	38.0	24.0	47.0	21.3	41.7		
Sg STD a a a-TFT %REC				[illegible]		[illegible]		110.8%			

RADIAN CORPORATION

TELEPHONE CALL RECORD

☐ Incoming Call
☐ Outgoing Call

Project No. 207-027-13-01

Project Name

Date 5-4-89

Time 08:00

Distribution
M. Milanowski
J. Wostkiewicz

Person Calling ANDI GREG

Activity STS

Person Called CHUCK APPLEGATE

Activity

General Subject

M9-04-049

TOPICS DISCUSSED AND ACTION TAKEN

ANDI CALLED TO CHANGE THE SAMPLE IDENTIFICATION FOR VOA ANALYSIS. HER FIELD LOGS INDICATE THAT THE SAMPLE IDENTIFICATION THAT SHE GAVE YOU YESTERDAY SHOULD BE REVERSED. THE SAMPLE SHE IDENTIFIED AS #22 SHOULD BE #18. THE SAMPLE IDENTIFIED AS #18 SHOUD BE #22

PLEASE INCLUDE THIS MEMO IN THE SAMPLE FILE

BOTH SAMPLES WERE NOT IDENTIFIED ON THE SAMPLE LABELS WHEN RECEIVED.

Signature: Chuck Applegate

9-85-21364

SECTION 3

QUALITY ASSURANCE OBJECTIVES

3.0 INTRODUCTION

The objectives of the quality assurance efforts for the laboratory activities are two fold. First, they provide the mechanism for ongoing control and evaluation of measurement data quality on a routine basis. Second, quality control data can ultimately be used to define data quality for the various measurement parameters, in terms of precision and accuracy.

3.1 Laboratory Methods

Most of the laboratory methods identified in this manual were published by EPA in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW846, Third Edition, revised November 1986. Additional methods identified in this manual were published in "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater" (EPA-600/4-85 054), and "Standard Methods for the Examination of Water and Wastewater" (American Public Health Administration). The standard analytical methods performed at the Milwaukee laboratory are listed in Table 3-1.

3.1 Accuracy and Precision

The QC objectives for accuracy and precision for organic parameters are listed in Table 3-2 to 3-3. Accuracy and precision objectives for metal and inorganic parameters are listed in Tables 3-4 and 3-5. Accuracy values include components of both random error (i.e., variability due to imprecision) and systematic error (i.e., bias), and thus reflect the total error for a given measurement, expressed as a percentage of the true value. Accuracy is typically measured by determining the percent recovery of known target analytes that are spiked into a field sample (a matrix spike) or reagent water (a method spike) before extraction, if applicable, at known concentrations. The accuracy limits in these Tables apply to spiking levels at five times the method detection limits or higher. The individual methods provide equations for acceptance criteria at lower spiking levels. The precision values in these Tables represent variability for replicate measurements of the same parameter, and are expressed in terms of relative percent difference (RPD) for duplicate measurements. Typically, RPD calculations are calculated from matrix spike/matrix spike duplicate (MSD) recoveries, or duplicate analyses if MSDs are not performed. The RPD calculation is described in Section 10. The objectives in Tables 3-2 to 3-5 are based primarily on performance data from method validation studies. These are not intended to represent data validation criteria, per se; rather they represent the performance capability of the methods.

3.3 Data Representativeness

Data representativeness is a function of sampling strategy, which is outside the scope of this document. Data comparability will be achieved by following approved, standard analytical procedures, where such exist, and by reporting results in standard units of measure, as suggested by the American Chemical Society's publication "Principles of Environmental Analysis".

3.4 Data Completeness

Completeness is expressed as the percentage of the amount of valid data obtained compared to the amount of data expected to be obtained under normal conditions. Ultimately, the goal is to obtain valid data for all analyses. Conditions which prevent complete data capture, such as significant sample matrix difficiulities, or sample loss, should be reported to the client in a timely fashion to determine whether remedial action should be taken.

3.5 Method Detection Limits

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Method detection limits (MDLs) for organic analyses performed in the Milwaukee laboratory are listed in Tables 3-6 and 3-7. Most MDLs for water matrices are taken directly from the SW846 8000 series methods. The laboratory performs annual MDL studies to demonstrate that it can meet or exceed these recommended MDLs. The EPA procedure used for establishing MDLs is described in Appendix B to Part 136 "Definition and Procedure for the Determination of the Method Detection Limit - Revision 1.11", 40 CFR 136, 1984. This procedure consists of analyzing seven (7) aliquots of a standard spiked at 3 to 5 times the MDL which is taken thru all the sample processing steps of the analytical method. The MDL is defined as three times the standard deviation of the mean value for the seven analyses. In the few cases where the experimentally determined MDLs are higher than recommended method detection limits, the method recommended MDL is shown in parentheses.

Method detection limits for metal analyses are listed in Table 3-8. The listed MDL's are taken from the indicated methods. The laboratory performs annual method detection limit (MDL) studies to demonstrate that it can meet or exceed the recommended MDLs. The EPA procedure used for this determination is the same as described above for organic parameters.

Method detection limits for water analysis parameters are listed in Table 3-9. Again these MDLs are taken from the appropriate method recommendations and are verified annually using EPA protocol.

Table 3-2. QC Acceptance Criteria For Method SW8010

Parameter	Accuracy[a] (Percent Recovery)	Precision (RPD) (%)
Chloromethane	D-193	50
Bromomethane	D-144	50
Vinyl Chloride	28-163	50
Chloroethane	46-137	50
Methylene Chloride	25-162	50
Trichlorofluoromethane	21-156	50
1,1-Dichloroethene	28-167	50
1,1-Dichloeoethane	47-132	50
trans-1,2-Dichloroethene	38-155	50
Chloroform	49-133	50
1,2-Dichloroethane	51-147	50
1,1,1-Trichloroethane	41-138	50
Carbon tetrachloride	43-143	50
Bromodichloromethane	42-172	50
1,2-Dichloropropane	44-156	50
cis-1,3-Dichloropropene	22-178	50
Trichloroethene	35-146	50
Dibromochloromethane	24-191	50
1,1,2-Trichloroethane	39-136	50
trans-1,2-Dichloropropene	22-178	50
2-Chloroethylvinyl ether	14-186	50
Bromoform	13-159	50
Tetrachloroethene	26-162	50
1,1,2,2-Tetrachloroethane	8-184	50
Chlorobenzene	38-150	50
1,3-Dichlorobenzene	7-187	50
1,2-Dichlorobenzene	D-208	50
1,4-Dichlorobenzene	42-143	50
Surrogate		
Bromochloromethane	40-140	NA
2-Bromo-1-chloromethane	40-140	NA

---

a= SW846 3rd Ed.
D= Detected
NA= Not Applicable

TABLE 3-3. QC ACCEPTANCE CRITERIA FOR METHOD SW8020

Parameter	Accuracy[a] (Percent Recovery)	Precision (RPD) (%)
Benzene	39-150	50
Chlorobenzene	55-135	50
1,4-Dichlorobenzene	42-143	50
1,3-Dichlorobenzene	50-141	50
1,2-Dichlorobenzene	37-154	50
Ethylbenzene	32-160	50
Toluene	46-148	50
Surrogate		
a,a,a-Trifluorotoluene	40-140	NA

a = SW846 3rd ed.
NA = Not Applicable

5.3 Organic Analytical Procedures and Calibration

SW8010

Halogenated Volatile Organics

Halogenated volatile organics in water and soil samples are analyzed using Method 8010. This method is a purge and trap (Method 5030) gas chromatographic methods. An inert gas is bubbled through a water matrix to transfer the volatile halocarbons from the liquid to the vapor phase. Halocarbons are removed from the inert gas by passing it through a sorbent trap which is then backflushed onto a gas chromatographic column with an electrolytic conductivity detector to separate and quantify the compounds of interest. Medium level soil samples are analyzed by extraction of 5 grams of the sample with 5 mls of methanol and diluting a minimum of 1:50 in reagent water. Low level soil samples may be analyzed by weighing 5 grams of sample directly into the purge and trap device.

The methods provide for the use of a second gas chromatographic column of dissimilar phase to resolve compounds of interest from interferences that may occur. When second column analysis is performed, retention times on both columns must match and quantitation between the two columns must be within a factor of three, or the chromatographic peaks are considered interferences.

Calibration--

Calibration standards at five concentration levels are prepared in reagent water by dilution of stock standards. The average calibration factor is acceptable if the RSD for the calibration factors at each level does not exceed 20 percent, otherwise linear regression is used. Daily calibration checks are acceptable if the daily response falls within the method defined recovery windows, see Table 3-2, Section 3.

SW8020

Aromatic Volatile Organics

Aromatic volatile organics in water and soil samples are analyzed using Method 8020. This Method, also known as BTX, since the compounds of interest include benzene, toluene, and xylene, are purge and trap gas chromatographic methods. An inert gas is bubbled through a water matrix to transfer the volatile aromatic hydrocarbons from the liquid to the vapor phase. The aromatics are removed from the inert gas by passing it through a sorbent trap which is then backflushed onto a gas chromatographic column with a photoionization detector to separate and quantify the compounds of interest. Soil samples are analyzed via extraction with methanol and diluted a minimum of 1:50 in reagent water. Low level soils may be analyzed by weighing 5 grams of sample directly into the purge and trap device.

The methods provide for a second chromatographic column of dissimilar phase to resolve compounds of interest from interferences that may occur. When second column analysis is performed, retention times on both columns must match and quantitation between the two columns must agree within a factor of two, or the chromatographic peaks will be considered interferences.

Calibration--

Calibration standards at five concentration levels are prepared in reagent water by dilution of stock standards. The average calibration factor is used if the RSD for the calibration factors at each level does not exceed 20 percent otherwise, linear regression is used. Daily calibration checks are acceptable if the daily response falls within the method defined recovery windows, see Table 3-3, Section 3.

- Sampling apparatus should be thoroughly cleaned between each sampling to prevent cross-contamination of the samples; and
- At least one sample of rinsate after apparatus cleaning should be submitted for analysis of key parameters.

In addition to these general sampling QC requirements, additional QC procedures should be performed as part of the analytical methods. These are discussed below.

7.2 Laboratory QC

7.2.1 SW846 GC Methods

Analytical quality control procedures for GC analyses are described generally in Method 8000 of SW846, 3rd ed.; and include the following:

- Initial demonstration of capability;
- Routine determination of method detection limits(MDL);
- Calibration verification;
- Analysis of surrogate spiked samples;
- Reagent (method) blank analysis;
- Analysis of matrix spike/matrix spike duplicates;
- Analysis of QC check samples;
- Retention time window checks; and
- Surrogate spiked blank.

These procedures are described below.

Initial Demonstration of Capability -- Before analyzing samples by a method, the laboratory must demonstrate the ability to generate accuracy and precision. This is done by analyzing four aliquots of a QC check sample (QCCS) by the same procedure used to analyze samples. The laboratory should calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. The mean recovery and standard deviation for each analyte should be compared with the corresponding acceptance criteria published in the SW846 method. If the experimental accuracy and precision data are acceptable, analyses may proceed; if not, remedial action must be taken to improve system performance.

Method Detection Limits -- The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Method detection limits (MDLs) for organic analyses performed in the Milwaukee laboratory are listed in Tables 3-6 and 3-7. Most MDLs for water matrices are taken directly from the SW846 8000 series methods. The laboratory performs annual MDL studies to demonstrate that it can meet or exceed these recommended MDLs. The EPA procedure used for establishing MDLs is described in Appendix B to Part 136 "Definition and Procedure for the Determination of the Method Detection Limit - Revision 1.11", 40 CFR 136, 1984. This procedure consists of analyzing seven (7) aliquots of a standard spiked at 3 to 5 times the MDL which is taken thru all the sample processing steps of the analytical method. The MDL is defined as three times the standard deviation of the mean value for the seven analyses. In the few cases where the experimentally determined MDLs are higher than recommended method detection limits, the method recommended MDL is shown in parentheses.

Surrogate Spikes -- A surrogate standard is a chemically inert compound not expected to occur in an environmental sample. The use of surrogate compounds may be project dependent, and limited by the ability to select a suitable surrogate for a particular parameter class. Recommended surrogate compounds and method recovery acceptance limits for GC methods are shown in Section 3, Tables 3-2 and 3-3. If the surrogate spike recovery in any sample is not within limits:

- Check for errors in calculations, surrogate solutions and standards. Check instrument performance.

- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem.

- Reextract and reanalyze the sample if none of the above are a problem, or flag the data as "estimated concentration".

Reagent (Method) Blank Analysis. -- Before processing any samples, the analyst should demonstrate through the analysis of a reagent water method blank that all glassware and reagents are interference-free. Each time a set of samples is extracted or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps. Lack of contamination is demonstrated if all target analytes with the exception of common laboratory reagents are present at less than their MDLs.

QC Check Sample Analysis. -- QC check samples may be obtained from EPA or prepared from suitable reference materials, but must be prepared independently of calibration standards. The QCCS should contain the analyte(s) of interest at a concentration in the mid-calibration range. A QCCS must be analyzed if matrix spike recoveries are unacceptable to verify that the analytical system is in a state of control.

Matrix Spike/Matrix Spike Duplicate Analysis (MS/MSD). -- SW846 protocol recommends analysis of matrix spike and matrix spike duplicate samples for each analytical batch or matrix type (5 percent minimum frequency). The method recovery limits and relative percent difference (RPD) acceptance criteria are shown in Section 3, Tables 3-2 to 3-5. When matrix spike results fall outside limits published in the respective methods, a QCCS must be analyzed to demonstrate analytical control. If spike recoveries are outside normal limits due to matrix problems, the data should be flagged.

Retention Time Windows -- The laboratory will calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. To establish windows, make three injections of all single component standard mixtures and multiresponse products (e.g., PCBs) throughout the course of a 72-hr period. Calculate the standard deviation of the three absolute retention times for each single component standard. For multiresponse products, choose one major peak from the envelope. If the standard deviation for a particular standard is zero, substitute the standard deviation of a close eluting, similar compound to develop a valid retention time window.

The laboratory will establish daily retention time windows for each analyte. Use the absolute retention time for each daily calibration standard as the midpoint of the window for that day. The daily retention time window equals the midpoint ± three times the standard deviation determined above. All succeeding standards in an analysis sequence must fall within the daily retention time window established by the first standard of the sequence.

Surrogate Spiked Blank -- A blank water sample will be spiked with a surrogate compound and carried through the entire analytical process. The percent recovery results will be used for calculating control chart limits.

7.2.3 EPA 200 Series and SW846 Metals Methods

Metals Analysis by Atomic Absorption -- The quality control procedures associated with metals analyses are described in SW846 Method 7000 and EPA 200 series for atomic absorption, and include:

- Calibration;
- Analysis of QC check samples;
- Method blank analysis; and
- Analysis of matrix spike/matrix spike duplicates

These procedures are described below.

PURGEABLE HALOCARBONS

METHODS

EPA	STANDARD METHODS	* SW846
601	-	5030 8010

*Comments: This SOP covers analysis by SW846 Method 8010 only. Use EPA 601 as a reference document only.

PRESERVATION

Preservative: 0.008% $Na_2S_2O_3$ IF CHLORINE IS PRESENT
Temperature: 4°C

CONTAINERS

GLASS, TEFLON-LINED SEPTUM
40 ml VOA VIAL

MAXIMUM HOLDING TIME

Days: 14

REQUIRED QA

SEE PAGE 2 OF THIS SOP.

MINIMUM RECORDS REQUIREMENT

ANALYSIS START DATE
ORDER NUMBER
SAMPLE DESCRIPTION
FRACTION NUMBER
PROJECT NUMBER
ANALYST

SAMPLE ALIQUOT, DEVIATIONS FROM METHOD 601 SPECIFICATIONS, FINAL RESULT (SAVE CHROMATOGRAM AND PRINT-OUT), ADDTIONAL ENTRIES REQUIRED FOR GC RUN LOG

SPECIAL HANDLING INSTRUCTIONS

REPORTING REQUIREMENTS

REPORT ug/l OR mg/l FOR EACH COMPOUND MEASURED
REPORT NO MORE THAN 3 SIGNIFICANT FIGURES

EPA - "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020 USEPA, March 1983.

STANDARD METHODS - "Standard Methods for the Examination of Water and Wastewater", 15th Edition.

SW846 - "Test Methods for Evaluating Soild Waste Physical/Chemical Methods", Third Edition.

INTERNAL QUALITY CONTROL PROCEDURES

Parameter	Analytical Method	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Volatile Organic Compounds	8010/8020	Multipoint calibration min. 5 points	Initially	Correlation coefficient >/= 0.995	Repeat calibration
		Daily calibration	Daily before use	Single point RF within ±15%	Recalibrate
		QC check sample	10%;one per batch	±20% error	1.Repeat QC check sample analysis 2.Evaluate system
		Method blank	One per batch	None	Used to assess contamination
		Matrix spike	5%	Established criteria in method	1.Analyze QCCS for analytes that failed test;if passes: 2.Flag data;if QCCS fails: 3.Evaluate system;recalibrate; and reanalyze samples out-of control condition.
		Matrix spike duplicate	5%	RPD<50%	Flag data
		Surrogate spikes	Every sample, standard,blank	±50%	1.Check for calculation errors 2.Recalculate data and/or reanalyze extract 3.Reextract and reanalyze or flag data.
		Control chart (surrogate in blank)	Daily	± 3s (update chart monthly)	1.Identify and resolve problem. 2.Repeat all analyses since last in-control point

SOP NO. A902
REV. NO. 2
DATE 1/89
Page 1 of 1

PURGEABLE AROMATICS

METHODS

EPA	STANDARD METHODS	* SW846
602	-	5030 8020

*Comments: This SOP covers analysis by SW846 Method 8020 only. Use EPA 602 as a reference document only.

PRESERVATION

Preservative: $0.008\%\ Na_2 S_2 O_3$

(IF CHLORINE IS PRESENT)

Temperature: $4^{o}C$

CONTAINERS

GLASS, TEFLON-LINED SEPTUM

MAXIMUM HOLDING TIME

Days: 7 DAYS

REQUIRED QA

See Page 2 of SOP A901

MINIMUM RECORDS REQUIREMENT

ANALYSIS START DATE
ORDER NUMBER
SAMPLE DESCRIPTION
FRACTION NUMBER
PROJECT NUMBER
ANALYST

SAMPLE ALIQUOT, DEVIATIONS FROM METHOD 8020 SPECIFICATIONS, FINAL RESULT, (SAVE CHROMATOGRAPH AND PRINT-OUT), SEE GC RUN LOG FOR ADDTIONAL INFORMATION

SPECIAL HANDLING INSTRUCTIONS

REPORTING REQUIREMENTS

REPORT ug/l OR mg/l FOR EACH COMPOUND MEASURED. REPORT NO MORE THAN 3 SIGNIFICANT FIGURES.

EPA - "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020 USEPA, March 1983.

STANDARD METHODS - "Standard Methods for the Examination of Water and Wastewater", 15th Edition.

SW846 - "Test Methods for Evaluating Soild Waste Physical/Chemical Methods", Third Edition.

October 4, 1990

Mr. William H. Pagels
Village of Whitefish Bay, Attorney
740 North Plankington Avenue
Milwaukee, WI 53203

PRIVILEGED AND CONFIDENTIAL

RE: Village of Whitefish Bay Landfill-Good Hope Road (STS Job No. 82149XF)

Dear Mr. Pagels:

Enclosed are the results of the extraction tests for the sample collected recently form the landfill site. These are submitted for your information in view of the potential liabilities and therefore, the potential litigation related to the site. The data indicate that this material is not hazardous using the new Toxic Characteristic Leading Procedure (TCLP) for both inorganic metals and organic compounds. Since the sample was collected in the area found to be highly impacted in our previous studies, this result indicates that hazardous waste issues are not likely to further complicate the remediation. The laboratory report and chain of custody sheet, as well as the sample collection location diagram are attached for your information. Please contact us if you have any questions.

Yours Sincerely,

STS CONSULTANTS, LTD.

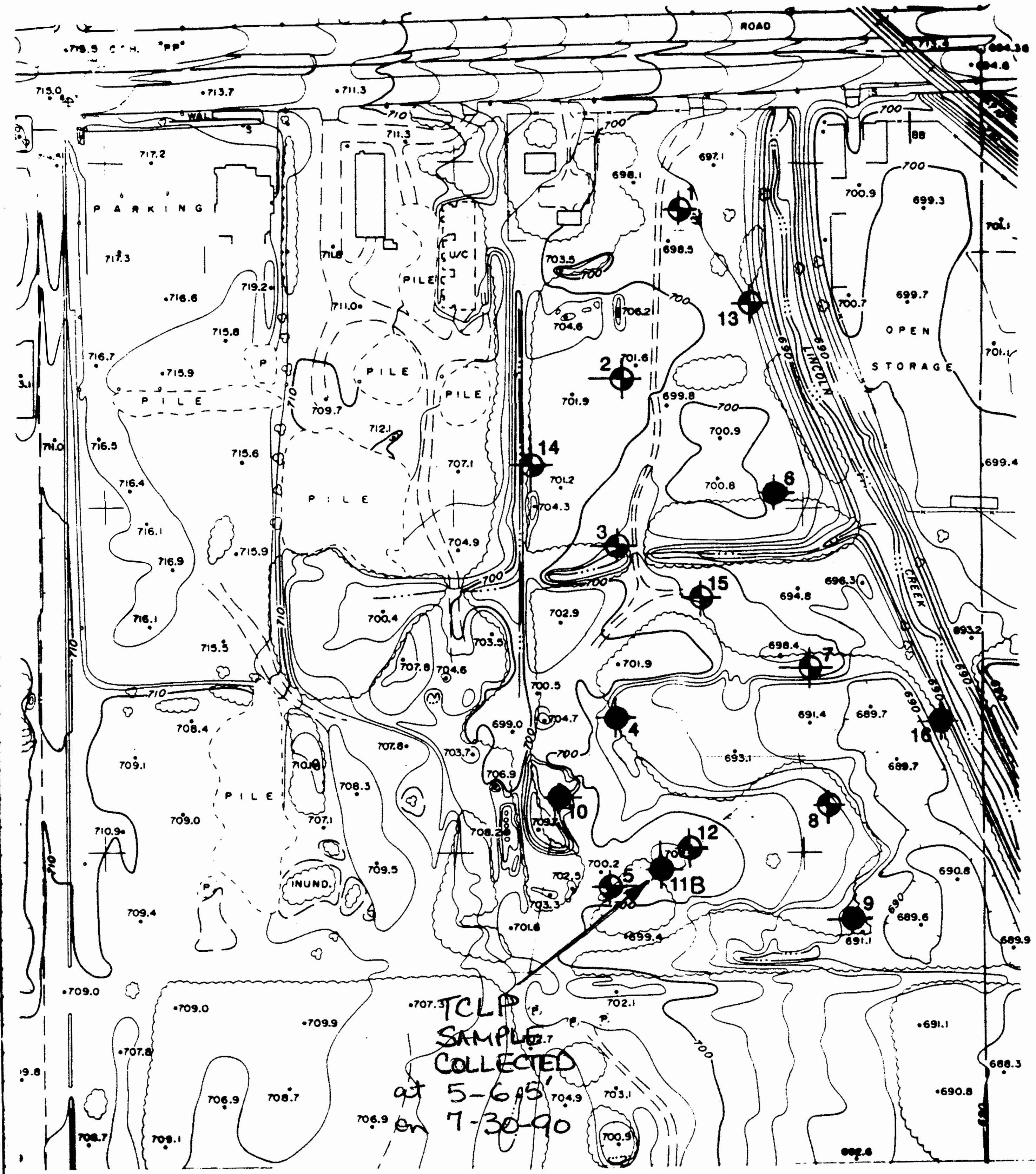
Kathryn R Huibregtse

Kathryn R. Huibregtse, P.E.
Principal Engineer

Thomas W Wolf /KRH

Thomas W. Wolf, P.E.
Principal Engineer

KRH/K011/29
Enclosures



TCLP SAMPLE COLLECTED at 5-6.5' on 7-30-90

STS Consultants Ltd.
FIGURE SHEET

PROJECT
WFB LANDFILL

FIGURE NO.

TITLE
SOIL BORING LOCATION DIAGRAM

JOB NO.
82149-XF

DATE 10-4-90

DRAWN BY
TWW

APPROVED BY
KRH

SCALE
1"=200'

ENVIROSCAN

August 21, 1990

STS Consultants
11425 W. Lake Park Dr.
Milwaukee, WI 53224

Attn: Kathy Hubregtse

Re: Project 82149XF

Please find enclosed the analytical results for the sample received August 1 of this year for TCLP extraction and analysis.

The TCLP extractions, both normal and zero headspace, were done in accordance with the most recent version of TCLP documentation. The metals were determined using EPA method 200.7 (ICP-AES). The volatile organic compounds were determined using EPA method 624 (GC-MS). The pesticides and herbicides were determined using EPA method 608 (GC-ECD) and SW-846 method 8150 (GC-ECD), respectively, while the remaining semi-volatile organics were analyzed in accordance with EPA method 625 (GC-MS).

The chain of custody document is enclosed. If you have any questions about the results, please call. Thank you for using Enviroscan, Inc. for your analytical needs.

Sincerely,

Enviroscan, Inc.

James B Edwards

James B. Edwards
Analytical Chemist

303 West Military Road Rothschild, WI 54474 (715) 359-7226

ANALYTICAL REPORT
ENVIROSCAN

STS Consultants
11425 W. Lake Park Dr.
Milwaukee, WI 53224

CUST NUMBER: 82149XF
SAMPLED BY: Client
DATE REC'D: 08/01/90
REPORT DATE: 08/21/90
APPROVED BY: JBE

Attn: Kathy Hubregtse

TCLP ORGANIC COMPOUNDS

	Units	Detection Limit	B-11B
Benzene	µg/l	50.	X
Carbon Tetrachloride	µg/l	50.	X
Chlorobenzene	µg/l	50.	X
Chloroform	µg/l	50.	X
1,2-Dichloroethane	µg/l	50.	X
1,1-Dichloroethylene	µg/l	50.	X
1,4-Dichlorobenzene	µg/l	50.	X
Methyl Ethyl Ketone	µg/l	500.	X
Tetrachloroethylene	µg/l	50.	X
Trichloroethylene	µg/l	50.	X
Vinyl Chloride	µg/l	50.	X
m- and p-Cresol	µg/l	200.	X
o-Cresol	µg/l	200.	X
2,4-Dinitrotoluene	µg/l	100.	X
Hexachlorobenzene	µg/l	100.	X
Hexachlorobutadiene	µg/l	100.	X
Hexachloroethane	µg/l	100.	X
Nitrobenzene	µg/l	100.	X
Pentachlorophenol	µg/l	1000.	X
2,4,5-Trichlorophenol	µg/l	200.	X
2,4,6-Trichlorophenol	µg/l	200.	X
Pyridine	µg/l	1000.	X
2,4-D	µg/l	0.5	X
2,4,5-TP (Silvex)	µg/l	0.05	X
Chlordane	µg/l	0.3	X
Endrin	µg/l	0.03	X
Heptachlor	µg/l	0.02	X
Heptachlor Epoxide	µg/l	0.02	X
Lindane(BHC)	µg/l	0.02	X
Methoxychlor	µg/l	0.3	X
Toxaphene	µg/l	0.3	X
Analytical No.:			36806

X = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

ENVIROSCAN

ANALYTICAL REPORT

STS Consultants
11425 W. Lake Park Dr.
Milwaukee, WI 53224

CUST NUMBER: 82149XF
SAMPLED BY: Client
DATE REC'D: 08/01/90
REPORT DATE: 08/21/90
APPROVED BY: JBE

Attn: Kathy Hubregtse

TCLP METALS

	Units	Detection Limit	B-11B
Silver	mg/l	0.004	0.011
Arsenic	mg/l	0.053	0.079
Barium	mg/l	0.002	0.768
Cadmium	mg/l	0.004	X
Chromium	mg/l	0.005	0.008
Mercury	mg/l	0.039	X
Lead	mg/l	0.045	X
Selenium	mg/l	0.089	X
Analytical No.:			36806

X = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

nviroscan Inc., 303 West Military Rd., Rothschild, WI 54474 1/800/338-SCAN Wisconsin Lab Certification No. 737053130

STS CHAIN OF CUSTODY RECORD

NO. 3994 RECORD NO.______ THROUGH______

Contact person Kathy Huibreatse
Phone No. 1-414-359-3830
Project No. 82149XF PO No.
STS Office Milwaukee

SPECIAL HANDLING REQUEST

☐ RUSH ☐ VERBAL ☒ OTHER

Laboratory Enviroscan
Contact Person Mary Christie
Phone No. 1-800-338-7226
Results Due 2 weeks

Sample I D	Date	Time	Grab	Composite	No. of Containers	Sample Type (Water, soil air, sludge, etc.)	Preservation		Field Data				Analysis Request	Comments on Samples (Include Major Contaminants)
									PID/FID		PH	Spec. Cond.		
							Y	N	Ambient	Sample				
B-11B: sample 1	7-30	Am	X		1	Soil		X					TCLP	

Collected by : Joe Weaver Date 7-30 Time Am
Delivery by : UPS Date 8-1 Time Am
Received by : Date Time
Relinquished by : Date Time
Received by : Date Time
Relinquished by : Date Time
Received by : Date Time
Relinquished by : Date Time
Received for lab by: J Backhuber Date 8/1/90 Time 10:44AM
Relinquished by : Date Time

Laboratory Comments Only : Seals Intact Upon Receipt ☒ YES ☐ NO ☐ N/A

Final disposition :

Comments (Weather Conditions, Precautions, Hazards) : 15.8°C

1936806

~~[illegible]~~

Distribution: Original and Green - Laboratory Yellow - As needed Pink - Transporter Goldenrod - STS Project File

Instruction to Laboratory: Forward completed original to STS with analytical results. Retain green copy.

3/88