Harding Lawson Associates

Engineers, Geologists
& Geophysicists

HLA

REMEDIAL INVESTIGATION
GIBSON SITE
NIAGARA FALLS, NEW YORK

HLA Job No. 17497,001.12

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DIVISION OF SOLID AND
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A Report Prepared for:

Olin Corporation
P. O. Box 248
Lower River Road
Charleston, Tennessee 37310

REMEDIAL INVESTIGATION
GIBSON SITE
NIAGARA FALLS, NEW YORK

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by

Steven R. Neely, P.E.
Associate Engineer

James W. Tremblay, P.E.
N.Y. Special Permit No. 00138

Quality Control Reviewer:

Frank C. Boerger
Professional Engineer 35030

Harding Lawson Associates
6220 Westpark Drive, Suite 100
Houston, Texas 77057
Telephone: (713) 789-8050

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I EXECUTIVE SUMMARY

A Remedial Investigation (RI) was conducted at the Gibson Site in Niagara Falls, New York. The overall objective of the investigation was to assess the type and degree of contamination from previous disposal at the site and, thereby, provide a data base which Olin can use for planning site remediation activities.

Olin wastes that were disposed of at the Gibson Site were reported to be in the form of approximately 403 buried drums of hexachlorobenzene (HCB), and 101 truck loads of hexachlorocyclohexane (benzenehexachloride or BHC) cake primarily of the α and β isomers. In March 1985, the State of New York and Olin mutually agreed to a stipulation which provides for a site specific study and appropriate remedial action.

The remedial investigation consisted of four phases that included a metal detection survey, soil borings and analysis, ground-water monitoring, and collection of ground-water samples for chemical analysis. The metal detection survey, soil boring program, installation of monitoring wells, and chemical analysis of the soil samples were completed in May, June, and July 1985. The last ground-water sampling was completed in June 1986.

The most significant area of buried metal identified was located on the north side of the site. This area, approximately 2600 square feet in size, is probably the location of the 403 buried drums. The borings disclosed a top layer of fill material at the site which varies in composition from cake waste, flayash, lime grit, construction debris, and mixed natural soils. The cake, or soils contaminated with cake, was found primarily in an area of approximately 27,400 square feet on the north side of the site in the same general area of the buried drums. The cake waste is up to 6 feet thick, and has a volume of roughly 8,500 cubic yards, including the associated overburden which averages 1 foot in thickness. Underlying all of the fill material, including the cake, is a stratum of red-brown clay which forms an aquiclude across the site. Bedrock was encountered at a depth of approximately 20 feet.

2

22.75 - 25'

deeper

Ground water was encountered generally less than 5 feet below the ground surface. The water table slopes towards the east and northeast, following both the ground surface and the surface of the aquiclude. The permeability of the saturated zone above the aquiclude is 1.69 x 10^{-5} cm/sec as measured by field permeability tests. Permeability of the aquiclude, measured by laboratory permeability tests, averages 6 x 10^{-8} cm/sec. Ground-water movement across the site is, therefore, slow and restricted in this upper saturated zone.

Of the 27 soil samples chemically analyzed, seven samples showed detectable levels of BHC contamination. One of the samples which indicated contamination was from the south side of the site and the rest were from the north side of the site where the cake and buried drums are located. The maximum level of contamination in the ground water was 140 parts per billion (ppb) β-BHC, with all other analyses indicating at or below 18 ppb BHC. Chemical analyses of ground-water samples for other priority pollutants indicated concentrations generally below the limits of detection. The results of the analysis for heavy metals were also below the limits of detection except for trace concentrations of copper, lead, mercury, nickel, and silver. Zinc had the highest concentration at 22.7 ppb.

Further study planned at the Gibson Site by Olin includes a field exploration program to investigate the contents of the buried drums. Although planning is underway, no specific start date has been established.

II INTRODUCTION AND BACKGROUND

A. General Background

This report presents the results of Harding Lawson Associates' (HLA) investigation of the Gibson Site (also referred to as the Pine and Tuscarora Site) at the intersection of Niagara Falls Boulevard and Tuscarora Road in Niagara Falls, New York, for Olin Corporation (Olin). HLA has performed the work under Olin's Contract No. C5-NF-0000-02216 dated April 30, 1985.

The overall objective of this investigation is to assess the type and degree of contamination from previous disposal of waste at the site and, thereby, provide a data base which Olin can use for planning site remediation activities. Specific objectives include:

- Detecting/locating any buried metal, i.e. drums, including buried pipelines, to identify areas to avoid during the boring program.
- Conducting an on-site boring program to collect soil samples for physical and chemical analyses, to visually note the presence and locations of any buried waste materials, to help determine what wastes are buried on site, and to characterize natural soil types, underlying strata, depth to bedrock and other geologic characteristics of the site.
- Conducting an on-site ground-water monitoring program including installation of seven wells, collection of ground-water samples for chemical analysis, and measurement of ground-water elevation and gradient, and creek elevation.

- Performing a site analytical protocol to analyze soil and ground-water samples to chemically characterize type and extent of waste, and soil and ground-water contamination.

The work for this investigation has been performed in conformance with the work plan developed by Olin and the State of New York, Department of Law (NYDOL). A copy of the work plan is presented in Appendix A.

The metal detection survey, soil boring program, installation of the ground-water monitoring wells, and chemical analyses of the soil samples were completed in May, June, and July 1985. The ground-water monitoring program was conducted over the following twelve months. The program involved collection of water samples for chemical analysis and measurement of water levels at each monitoring well. The water samples for chemical analysis were collected monthly for the first four months and quarterly thereafter. The monitoring well water levels were measured monthly. The last ground-water sampling and water elevation measurements were completed in June 1986.

The Gibson Site, approximately four acres in size, is located along the dividing line between the city of Niagara Falls and the Town of Niagara. The site is bounded by Niagara Falls Boulevard (formerly Pine Avenue) on the south, on the west by Tuscarora Road, and on the east and north by a bend of Cayuga Creek. Plate 1 presents a vicinity map showing the location of the site and Plate 2 presents a site survey by Wendel Engineers P.C.

B. Site History

According to documents supplied by Olin, the eastern portion of the Gibson Site was originally low lying marsh lands. Later, the site was filled to existing grade with various materials, including building demolition debris, chemical wastes, and soil. The disposal of Olin chemical waste reportedly took place in 1957. Olin wastes that were disposed of at the Gibson Site were reported to be in the form of approximately 403 buried drums (90 tons est.) of hexachlorobenzene (HCB), and 101 truck loads (100 tons est.) of hexachlorocyclohexane (benzenehexachloride or BHC) cake primarily of the α and β isomers.*

Both HCB and BHC are considered to be toxic and both have a low solubility in water. In 1981, chemical analyses were performed for

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* The manufacturing process for BHC produces a mixture of isomeric forms, predominately α, β, and γ. Later process steps further increase the level of the more potent γ isomer a residual of the other forms, predominately α and β. This residual is termed "α-β cake". Olin did not manufacture the 99+ percent γ - BHC product called Lindane.

the New York State Department of Environmental Conservation (NYDEC) on samples of soil from the site, and sediment and water samples from the adjacent Cayuga Creek. These tests indicated levels of contamination up to 7.7 percent by weight of BHC in some soil samples. Analyses of creek water and sediment samples did not indicate the presence of related contaminants.

C. Olin Litigation

In December 1983, the NYDOL brought suit against Olin and the Gibson Site property owners (New York vs. Olin, et.al. CIV 83-1400) to have the site investigated and remediated. In March 1985, the State of New York and Olin mutually agreed to a stipulation which provides for a site specific study and appropriate remedial action.

D. Four Phase Investigative Program

In May 1985, Olin contracted Harding Lawson Associates (HLA) to perform a Remedial Investigation (RI) of the Gibson Site in accordance with the agreed upon work plan between Olin and NYDOL. A copy of the work plan is presented in Appendix A. The investigation consisted of the following four phases, each developed to provide specific data on the types and extent of contamination for use by Olin in developing remediation plans.

Phase 1	Metal Detection - To confirm, from the ground surface, the location of underground utilities and to locate areas where drums were possibly buried so that they could be avoided during the soil boring program.
Phase 2	Soil Borings - To define geologic conditions across the site, delineate the lateral and vertical extent of the waste, and collect samples for chemical analysis.
Phase 3	Ground Water - To collect ground-water samples for chemical analysis, and determine ground-water levels, gradients and flow rates. Also to monitor creek elevation and its relationship to ground water.
Phase 4	Ground-Water Sampling - Sampling and analysis of ground water monthly for four months then quarterly for the balance of the study period to evaluate seasonal effects on the chemistry and hydrology of the site.

The remaining sectons of this report describe in detail the phases of the investigation and present the findings based on the interpretation of the data and information collected.

III ENVIRONMENTAL SETTING

A. Site Topography

The present-day topography is relatively flat with approximately 4 feet of relief across the site. The site gently slopes toward the northeast and Cayuga Creek. Plate 3 presents a topographic map showing ground-surface elevation contours. This topographic information was developed by Wendel Engineers P.C., Buffalo, New York, and is referenced to National Geodetic Survey, Mean Sea Level (MSL) Datum. Wendel Engineers' complete site survey is presented on Plate 2.

B. Regional Geology

The uppermost bedrock unit at the site is Lockport dolomite, which in turn is underlain by an alternating sequence of shales, limestones, and sandstones. The Lockport dolomite is approximately 150 feet thick and forms a resistant gently-dipping surface. Locally, this bedrock is overlain by relatively thin (5 to 25 feet thick) unconsolidated glacial deposits which range in texture from gravel to clay depending upon location.

C. Regional Hydrogeology

The two primary zones of potable ground water in the Niagara Falls area are the surficial glacial deposits and the underlying Lockport dolomite. Of these, the greater volume is yielded by the

Lockport dolomite. Ground water occurs along vertical and horizontal fractures in the dolomite. At the Gibson Site the Lockport dolomite is 23 to 26 feet below existing grade.

Where unconsolidated sands and gravels overlie the Lockport dolomite they contain and transmit ground water. Generally, the unconsolidated aquifer is limited in areal extent due to the variable nature of the surficial materials. Where permeable sands and gravels are in direct contact with the dolomite, they enhance recharge of the dolomite. Where poorly permeable formations such as clay and silt overlie the dolomite, the rate of ground-water movement to the underlying dolomite is reduced by several orders of magnitude.

The Niagara Falls area lies within the Niagara River drainage basin. Several tributaries, including Cayuga Creek which borders the Gibson Site on the north and east, feed into the Niagara River which is approximately one mile downstream from the site.

D. Adjacent Land Use

The Gibson Site, shown on Plates 1 and 2, is located in a commercial/residential area of Niagara County. The site is bounded by Tuscarora Road on the west, Niagara Falls Boulevard on the south, and Cayuga Creek on the north and east. Small commercial businesses are located along Niagara Falls Boulevard, which is the more heavily traveled of the two streets. Single family residences border Tuscarora Road. The site itself consists of two adjacent parcels of land. An 80-foot-wide right-of-way (ROW) owned by Niagara Mohawk Power Corporation divides the site roughly in half. A private home on approximately one acre of land is located north of the ROW. The landowners on the south side do not live on-site but operate a used car business there.

IV FIELD ACTIVITIES

A. Metal Detection Survey

Prior to drilling on the Gibson Site, a metal detection survey was conducted in May 1985. The objective of the survey was to locate buried metal within the study area and to identify the underground utilities so that drilling operations could avoid these areas.

The instrument used for the buried metal detection survey was a Fisher M-Scope, Model TW-5 metal detector. This instrument senses buried metal by the transmission of a radio field, and detects field distortions caused by the presence of buried metal. This instrument does not indicate exact size or depth of the objects. Areas of buried metal delineated by this survey (shown on Plate 5) were avoided during the subsequent drilling phase.

A 50-foot by 50-foot control grid was staked by Wendel Engineers for performing the metal detection survey and subsequent soil borings. The grid system was oriented parallel to the Niagara Mohawk Power Corporation ROW as shown on Plate 4. Coordinates in the north-south direction were given letter designations A through H, and coordinates in the east-west direction were numbered one through seven. Traverses (sweeps approximately 3.5 feet wide) were made side by side in the east-west direction within the grid system. To assure complete coverage within the grid, stringlines were staked three feet apart to define each traverse boundry. Areas that indicated a presence of metal were traversed several times to define the general shape and extent of the buried metal. These areas were then marked on the ground with spray paint and located on the site plan with respect to the control grid. In this manner, large areas of buried metal could be distinguished from point sources (single objects) and pipelines. Pipeline locations were verified by traverses perpendicular to the pipeline alignment.

Plate 5 shows the areas where buried metal was detected. The largest area, approximately 2600 square feet, was detected in the northeastern portion of the site. It is probable that this is the primary location of the reported 403 buried drums. Other smaller areas containing buried metal were also identified on the northern portion of the site. Eight of these areas are located roughly north of the primary location and could represent individual drums, groups of a few drums, or unrelated scrap metal. The remaining three areas identified on the north side of the site do not appear to have any connection to the primary location.

On the southern portion of the site, 28 areas of buried metal were identified ranging in size from apparent single objects to a ground surface area of 400 square feet. Based on existing site plans, the larger areas identified are either underground utilities or part of the now abandoned septic system for the buildings. Many of the buried metal objects identified south of the Niagara Mohawk Power Corporation ROW are most likely miscellaneous automobile parts from past land use as a retail car and parts lot.

B. Soil Borings

The soil boring program was designed with the following objectives:

- To visually identify the presence of the buried waste and assess its areal and vertical distribution on site.
- To visually characterize buried wastes and all soil types.
- To initially screen samples for organic content using an organic vapor monitor (OVM).
- To collect samples of the soil and waste for analysis.
- To define the subsurface soil stratigraphy across the site.

A total of 48 borings were drilled at the site at the locations shown on Plate 4. Logs of the borings are presented in Appendix B. Initially, four deep borings were drilled to bedrock (Borings D1, E1, H3 and H7) to define the general subsurface soil stratigraphy across the site. The remaining 44 borings were drilled to the clay aquiclude identified by the deep borings. General coverage was accomplished by drilling on the 50-foot by 50-foot grid system, across the entire site except for the exclusion areas. Borings were drilled slightly off the grid coordinates where necessary to avoid buried metal or hard construction debris. The X and Y series borings were drilled to define the margins and thickness of the waste along the northern boundary of the Niagara Mohawk Power Corporation ROW. Table 1 presents a summary of boring numbers, termination depths, etc. for the borings.

The borings were drilled by Buffalo Drilling Company using a Mobile B-47 Rig and hollow-stem augering methods. Continuous samples were taken with a split-spoon sampler one foot into native soil where waste was encountered, or one foot into the aquiclude in areas where no waste was encountered. The four deep borings to bedrock were also continuously sampled using a split-spoon sampler.

All split-spoon samples were visually inspected, classified and logged in the field by a geologist. Samples were then sealed in clean glass jars with Teflon-lined lids, and labeled with boring location and depth of sample. The sampler was decontaminated after each sampling following decontamination procedures outlined in the work plan. A Shelby tube sampler was used to collect the six selected samples for laboratory permeability testing. The Shelby tube samples were sealed with wax on both ends, labeled as to boring location and sample depth, and shipped to the HLA Houston laboratory for testing.

All split-spoon sample containers were sealed with evidence tape, and all samples were handled following chain-of-custody procedures outlined in the work plan. During shipment and storage the samples were maintained at 4°C using coolers with ice packs.

At the completion of each boring, a bentonite seal (approximately 1-foot-thick) was placed in the bottom of each borehole. The borehole was then backfilled with the drill cuttings to a depth of two feet below grade, sealed with cement-bentonite grout to about 6 inches below the ground surface, and then packed with clean sand fill. Excess cuttings were drummed and retained on-site for later disposal by Olin (at a permitted hazardous waste disposal facility) after the completion of the required chemical analyses. The deep borings to bedrock (Borings D1, E1, H3 and H7) were grouted from the bottom up with a cement-bentonite grout using a tremie pipe. The upper 6 inches was packed with clean sand fill similarly as the other borings.

Geologic cross-sections of the site, as shown on Plates 6 through 9, were constructed from the boring logs. Most of the site is covered with a top layer of fill material which varies in composition from reworked natural sand, silt, and clay to waste material consisting of flyash, lime grit, and the BHC cake. "Cake", as used here, is defined as the concentrated waste, generally a loose light-gray or white powder. The fill layer ranges in thickness from "not-present"

"Y" LINE?

in four borings to 9 feet of flyash in Boring Y1. The BHC cake material appears only in borings north of the Niagara Mohawk Power Corporation ROW and is often found mixed with the other fill material. The cake is thickest in the northeast portion of the site and thins towards the west. An isopach map showing the approximate thickness of the cake material is presented on Plate 10.

Below the fill material are silt and clay strata. The most important of these is a stiff red-brown clay (Unified Soil Classification Symbol CH) which comprises the aquiclude. Plate 11 is a contour map showing the elevation of the top of the aquiclude. The clay is continuous as depicted by the Subsurface Profiles shown on Plates 6 through 9.

Isolated sand and silty sand pockets up to 1.8 feet in thickness were identified in the borings, but there are no continuous sand or sand/gravel layers traceable between the borings. Four of the borings (corner borings) were drilled to bedrock, which appears to be relatively flat-lying throughout the site (rock surface elevation is between 548 and 551 feet, MSL).

C. Ground-Water Monitoring Wells

At the completion of the soil boring phase, seven locations were chosen for installation of ground-water monitoring wells. The locations of the monitoring wells are shown on Plate 4. Preliminary ground-water level data from the soil borings indicated a hydraulic gradient generally from the west toward the east and northeast. Therefore, two monitoring wells (MW1 and MW2) were located on the upgradient (west) side of the site. Four wells (MW3, MW4, MW5, and MW6) were located on the downgradient (east) side. Well MW7 is located on the margin of the cake waste on the north side.

The location and depth of each well was determined by Olin's on-site representative in conjunction with NYDOL and NYDEC representatives. Accessibility and the presence of buried metal affected the final location of each monitoring well.

The objectives of the ground-water phase of the investigation were:

- to determine ground-water elevations, gradients and velocity, and their seasonal trends, and;
- to collect ground-water samples for chemical analysis to characterize ambient ground-water quality and assess any effect of buried waste on the ambient ground-water quality.

The monitoring wells were installed as outlined in the work plan by advancing a 10-inch hollow-stem auger no more than one foot into the red-brown clay aquiclude. The well was completed by placing a five-foot long, two-inch-diameter stainless steel well-screen (0.010-inch openings) in the borehole and attaching a 2-inch-diameter galvanized steel riser pipe to approximately 2 feet above grade. The annular space was backfilled with clean sand to just above the top of the well-screen. A one-foot-thick bentonite seal was placed on top of the sand pack and the remainder of the annulus was grouted with cement-bentonite grout to preclude any surface water from entering the well. A 4-inch-diameter protective steel pipe with a locking cap was cemented in place over the riser pipe. At monitoring wells MW1 and MW3, at-grade protective steel boxes were cemented in place at the request of the landowner. Details of each well are shown adjacent to the boring log for that well (Appendix B) and typical monitoring well details are shown on Plate 12.

Each well was developed as outlined in the work plan. Initially, the monitoring wells were developed using compressed air; however, the recharge to four of the wells (MW3, MW4, MW5, and MW6) was so slow that these wells had to be bailed by hand to evacuate enough ground water for proper development. MW1 and MW2 were developed entirely by compressed air and MW7 was dry at the time of installation. After removal of three well volumes of water, bailing continued until water was visually observed to be silt free. Additional bailing was conducted until three consecutive similar conductivity readings were obtained in a three minute period, indicating sufficient development. Development water flushed from the wells was drummed and retained on-site for later disposal by Olin at a permitted hazardous waste disposal facility.

Water levels in the wells were measured monthly for one year using a calibrated electrical probe lowered down the well. In addition, the water surface elevation of Cayuga Creek was measured at Niagara Falls Boulevard and Porter Road. Table 2 presents the groundwater level and creek elevation data collected from July 1985 through June 1986. Hydrographs depicting seasonal flucuations for MW-1 through MW-7 are presented on Plate 13. Plate 14 presents hydrographs for Cayuga Creek at Niagara Falls Boulevard and Porter Road.

Samples for chemical analysis were collected by hand-bailing using procedures outlined in the work plan to assure that a minimum amount of air contacted the samples and to prevent cross-contamination. Prior to sampling, all wells were flushed by removing three times the volume of the well casing, or once to dryness where recharge was slow. The water samples were decanted into glass containers with Teflon-lined lids. The water samples were stored and maintained at 4°C during shipment to the analytical laboratory. All chain-of-custody, handling and transportation procedures outlined in the work plan (Appendix A) were followed.

Field permeability tests were conducted on wells MW1 and MW5 on August 22, 1985, and on wells MW3 and MW6 on September 27, 1985, during scheduled visits to the site to collect water samples and measure water levels. The results of these tests are presented in Table 3. The measured permeability of the zone of ground-water flow above the aquiclude was 1.7×10^{-5} cm/sec, or less. The tests were conducted by pumping the wells until dry and measuring the recovery of the water level in the well. Field practice and data analysis followed "Pumping Test Analyses for Low Yield Formations," by David S. Schafer in The Johnson Driller's Journal, November/December 1980, Vol. 52, No. 6. Laboratory permeability tests were performed on six undisturbed (Shelby tube) samples of the aquiclude as discussed in Section V.A.

Sufficient data has been collected between July 1985 and June 1986 to characterize the hydrogeologic regime at the site. Plates 15 through 27 present water table elevation contour maps for the site from July 1985 to June 1986. The water levels in the monitoring wells generally declined from July through September 1985.

Over the same period, Cayuga Creek was also low. This tracks the general trend during the hot summer months when evapotranspiration occurs at a greater rate resulting in a lower net recharge. From September 1985 through April 1986, water levels in all of the monitoring wells increased by 1.5 feet (MW3 and MW6) to 3 feet (MW1). In general, water levels in the monitoring wells rose rapidly from September through December 1985 when evapotranspiration is typically less, resulting in greater net recharge to the subsurface. Cayuga Creek similarly rose over the same period (see Plate 14). A small decrease in water levels in the monitoring wells occurred during February 1986 which was probably caused by a thick frost layer at the ground surface that reduced recharge to the subsurface. Snow melt in March and April combined with other precipitation, maintained the high water levels. From April through June 1986, increased evapotranspiration again produced a decline in the water table elevation.

The change in water table elevation across the site ranges between 6 to 6.5 feet. This gradient slopes downward towards the northeast and east (Cayuga Creek) and parallels and correlates with the relief of the underlying clay aquiclude surface. The water table gradient is observed to increase adjacent to Cayuga Creek.

The ground water is perched on the aquiclude, i.e., water seepage downward to the Lockport dolomite is blocked by the underlying red-brown clay aquiclude. Ground water, therefore, moves downgradient toward Cayuga Creek and enters the creek along seepage zones in the bank. During runoff events when Cayuga Creek rises, some water likely migrates into the seepage zone above the aquiclude. However, runoff events are normally of short duration and have only temporary impact on ground-water gradients.

D. Air Sampling

Six ambient air samples were collected for analysis of airborne BHC and HCB particulates during the boring program in accordance with the State approved Health and Safety Plan for the investigation. A copy of the Health and Safety Plan is presented in Appendix C. One sample set (one upwind and one downwind sample) were collected on June 22, 1985 prior to any drilling. Two other sample sets were also collected upwind and downwind on July 2 and July 10, during drilling. Table 5 shows the time intervals over which the samples were collected. An MSA Model 5 portable vacuum pump attached to a 0.45 micron glass fiber filter was used to collect the samples. Ambient air was drawn, at a flow rate of 2 liters/minute, through the column.

On each day that the samples were collected (with the exception of the first day) one pump was set up on the upwind side of the site and another on the downwind side. On the first day, only one pump was available so downwind sampling took place immediately after upwind sampling. In this manner, any pollutants which originated off site, measured upwind, can be differentiated from those originating on site (downwind minus upwind). For each sample a blank column (one through which no air had been pumped) was analyzed for BHC and HCB. The results of the chemical analysis are discussed in the following section on Laboratory Analyses.

At the completion of each sampling, the glass fiber filter canister was removed, immediately capped, and labeled with site-specific information including sample designation, location (upwind/downwind), time, and date. All chain-of-custody and shipping procedures were followed in accordance with the work plan.

V LABORATORY ANALYSES

Laboratory analyses of samples from the Gibson Site consisted of permeability testing of the clay aquiclude material and chemical analysis of the air, soil, and ground-water samples. The permeability testing was performed by HLA in its Houston Laboratory and the chemical analyses were performed by O'Brien & Gere in their laboratory facilities in Syracuse, New York. All samples were handled and transported to the laboratories in accordance with the chain-of-custody procedures in the work plan and Department of Transportation shipping procedures. The following report sections describe the testing and present the results of analyses.

A. Laboratory Soil Permeability

Six Shelby tube soil samples were taken from the red-brown clay aquiclude, and shipped to HLA's Houston, Texas, laboratory for permeability testing. Laboratory permeability tests were performed on each sample in accordance with Appendix VII of the U.S. Army Corps of Engineers Manual EM 1110-2-1906, 30 November, 1970, Laboratory Soils Testing. The measured permeabilities are presented in Table 4. The average permeability for the six samples was 6×10^{-8} cm/sec. This value verifies the relatively impermeable nature of the red-brown clay aquiclude.

B. Chemical Analysis - Air Samples

The glass fiber filters (air particulate samples) from the air sampling program were analyzed for BHC and HCB using gas chromatography. The test method used is described in Appendix D. The samples were prepared for testing in a clean laboratory and samples were extracted from the filter according to NIOSH Method S-290 dated April, 1977. Sample volume was reduced by distillation and then analyzed using gas chromatography with electron capture. The results of the chemical analysis of the air samples are presented on Table 5. No detectable levels of BHC and HCB were found in the air samples collected.

C. Chemical Analysis - Soil Samples

At the time of sample collection, all samples were characterized visually and screened with an organic vapor monitor (HNU Model PI 101). This information was used as the basis for selection of 21 initial samples for chemical analysis.

Representatives from NYDEC, NYDOL, Olin, O'Brien & Gere, and HLA, met on July 19, 1985, at O'Brien & Gere's office in Syracuse, New York, to split the samples selected for analysis. Of the 21 samples initially chosen, 10 were tested for the priorty pollutants list (Appendix 6 of the work plan) and 11 were tested for BHC and HCB only. An additional 8 samples (6 from the original 21 samples and 2 substitute samples) were later analyzed for the priority pollutants list for a total of 18 priority pollutants and 5 BHC/HCB only analyses. Still later, an additional four samples from borings within the Niagara Mohawk Power Corporation ROW were analyzed for BHC and HCB; bringing the total number of soil samples analyzed to 18 priority pollutant and 9 BHC/HCB only analyses. All samples analyzed and the test results are listed in Table 6. The testing for purgeable, base/neutral, pesticide, and acid priority pollutants followed the July, 1985, version of the USEPA Contract Laboratory Program (CLP) protocols. Testing for mercury (Hg) followed Method 7471 and formaldehyde followed NIOSH Method P & CAM125 described in Appendix D.

Of the 27 samples analyzed, seven [C3 (2'-4'), X1 (2'-4'), MW4A (8'-10'), A4 (2'-4'), C3 (2'-4'B), C3 (4'-6'), and Y3 (0-2'B)] contained detectable amounts of BHC isomers. It should be noted that sample MW4A (8'-10') contained only alpha BHC, and samples C3 (2'-4' B) and Y3 (0-2'B) contained only beta BHC, and that the measured concentrations were barely above the detection limits. The high concentration of BHC found in sample A4 (2'-4') is as expected, since this sample was visually determined to be exclusively cake material.

D. Chemical Analysis - Water Samples

Ground-water samples for chemical analysis were collected during the months of August through November, 1985 and February, May, and June 1986. The samples were analyzed for BHC and HCB, formaldehyde, and mercury. In addition, the October and November samples were analyzed for a full list of priority pollutants and heavy metals. Table 7 and Appendix E present the results of the chemical analyses.

Upon receipt of the water samples at O'Brien and Gere's laboratory, all samples except those analyzed for volatile organic compounds, were filtered in accordance with the work plan to remove any suspended solids and, properly preserved. All samples were tested within the limits of the holding times listed in 44 CFR 43260. Analyses were performed using the July, 1985, version of the USEPA Contract Laboratory Program (CLP) protocals. Testing for mercury (Hg) and formaldehyde followed Method 7470 and NIOSH Method P & CAM125, respectively, described in Appendix D.

VI ANALYSIS OF DATA

A. Site Soils

The study area is covered with a layer of material characterized as fill. This fill material consists of cake waste (suspected BHC/HCB), flyash, lime grit, or loose, mixed natural silt, clay, sand, and gravel. Outside of the area where cake was encountered, no soil contamination was found except at Boring X1, which showed high concentrations of BHC within the fill material.

The cake material is found only ?? north of the Niagara Mohawk Power Corporation ROW, where it was originally reported to have been dumped. The cake has a maximum thickness of 6 feet at its eastern extent, thinning towards the west. Plate 10 presents an isopach map depicting the thickness of the cake. For safety reasons, the area where the metal detection survey indicated the likelihood of buried drums was not drilled; therefore, the presence or thickness of cake is estimated to be approximately the thickness of the surrounding cake. The cake is covered by a layer of fill soil (overburden) approximately 1-foot-thick. ?? A preliminary volume of the cake waste was computed based on the isopach map of waste thickness presented on Plate 10. Based on planimetric map measurements and observed thickness, there is approximately 5,000 cubic yards of cake waste, and 3,500 cubic yards of overburden covering the cake waste.

B. Ground Water

As indicated by the boring program, the primary geologic control of ground-water movement is a red-brown natural clay layer which appears to be undisturbed and continuous across the site forming an aquiclude to the vertical movement of water. This aquiclude is present below all of the fill or waste found at the site. The depth of the aquiclude ranges from 0.5 to 12 ft. (Table I), with an average depth of 6 feet.

The ground-water monitoring program concentrated on the uppermost ground-water flow zone from the ground surface down to the aquiclude. Ground-water data shows that the flow direction in this uppermost flow zone is towards the northeast and east. From the water table elevation contour maps, a relatively uniform water gradient occurs that increases in the vicinity of the Cayuga Creek bank. The gradients away from the creek bank are slightly affected by seasonal variations. The fluctuation of water levels with season in the monitoring wells occurs uniformly, maintaining a constant gradient. Near the creek bank, gradients are normally strong toward Cayuga Creek.

The field permeability tests within this upper flow zone indicate low permeability values (less than 1.7×10^{-5} cm/sec). Three of the four tests (MW1, MW3 and MW5) had water level recovery rates too slow for analysis with even "low yield methods." The water level recovery in Well MW6 was sufficiently rapid to be analyzed. The calculated transmissivity is 2.15 gallons per day per foot of formation and the corresponding permeability value is 1.69 x 10^{-5} cm/sec. Values for the other wells were far less. The MW6 permeability value can be considered as a maximum for the site. Well MW7, which was pumped dry during development in July 1985, showed no recovery and remained dry until January 1986. Since January, MW7 has had a water level.

Monthly ground-water flow velocities across the site and in the vicinity of the Cayuga Creek bank on the east side of the site are presented in Table 8. Average flow velocities calculated are 1.9 x 10^{-6} cm/sec and 8.6 x 10^{-6} cm/sec, respectively. These velocities were calculated using the observed water gradients, a hydraulic conductivity of 1.7 x 10^{-5} cm/sec, and an assumed porosity of 25 percent for the soils. based on what?

Chemical analysis of the ground water shows the BHC-isomers (α, β, δ, γ) to be present at detectable limits, with β-BHC showing the highest concentrations. A maximum concentration of 140 ppb β-BHC was reported in MW2 for the August 1985 sampling (see Table 7). Subsequent samplings show that the concentration dropped to values less than 0.1 ppb β-BHC at the same well. Of the other priority pollutants analyzed, most were below the limits of detection.

Trichloroethene and t-1, 2-Dichloroethene are exceptions to this with measured concentrations in MW4 of 4 ppb and 5 ppb, respectively, for the October sampling. Formaldehyde was initially detected in all of the wells and dropped below detection limits in subsequent analyses.

Chemical analysis of the ground water for heavy metals show most concentration levels below the limits of detection. Exceptions to this include zinc and to a lessor degree copper, lead, mercury, nickel and silver. Zinc concentrations ranged from a low of 0.22 ppm at MW3 in October to 22.7 ppm at MW4 in November.

A seasonal variation in ground-water concentrations of BHC-isomers is apparent. Without exception, the concentrations of BHC-isomers decreased from the initial sampling and analysis in August 1985 to the sampling in June 1986. These decreases generally resulted in the reduction in BHC-isomer concentrations by one order of magnitude. MW2 and MW5 showed greater reductions. The concentrations of mercury and formaldehyde detected in the ground water generally followed this same seasonal trend.

VII CONCLUSIONS

A. Metal Detection Survey

One large area of approximately 2,600 square feet was identified on the north side of the site (north of the powerline ROW). This is probably the location of the majority of the reported 403 buried drums. Several other smaller areas were identified on the north side of the site which could represent either individual drums or groups of a few drums, or other buried metal debris. Several areas were identified on the south side of the site. The larger areas are identified as either underground utilities or part of the abandoned septic system associated with the buildings located there. The smaller areas are more likely buried metal debris from the used car operation.

B. Soil Boring Program

The borings disclosed five types of fill material on the site: cake waste, flyash, lime grit, construction rubble and mixed natural soils. Of these fill materials, the α-β BHC cake is considered the primary material of concern and was found only north of the powerline ROW, concentrated in the northeast portion of the site. This is the same general area where the 403 drums of HCB are reported to have been buried. The cake, or soils contaminated with cake, was found primarily in an area of approximately 27,400 square feet. It varies in thickness from 0 to 6 feet, and has a volume of roughly 8,500 cubic yards, including the associated overburden which averages 1 foot in thickness. Underlying all of the fill material, including the cake, is a stratum of red-brown clay which forms an aquiclude across the site. This aquiclude was generally encountered at a depth of about 6 feet. It is considered to be continuous over the entire site and slopes toward Cayuga Creek, directing ground-water flow. Bedrock was encountered at a depth of approximately 25 feet.

C. Ground-Water Levels

Ground water was encountered generally less than 5 feet below the ground surface. The water table slopes toward the east and northeast, following both the ground surface and the surface of the aquiclude. This water table is perched on the aquiclude in the site vicinity. The perched aquifer is local and isolated to the study area.

The lateral permeability of the saturated zone above the aquiclude is 1.69×10^{-5} cm/sec. The vertical permeability of the aquiclude, measured by the laboratory permeability tests, averages 6×10^{-8} cm/sec. Ground-water movement across the site is, therefore, slow and restricted with a calculated average velocity of 1.9×10^{-6} cm/sec across the site increasing to 8.6×10^{-6} cm/sec in the vicinity of Cayuga Creek on the east side of the site.

D. Air Samples

Three sets of air samples were obtained during drilling as part of the Health and Safety Plan. These samples were chemically analyzed for BHC and HCB, and no detectable levels of these pollutants were found in any of the air samples. The results of the organic vapor monitoring done in the work area during drilling indicate organic vapor levels generally less than 2 ppm (referenced to benzene). Slightly higher readings, up to 6 ppm, were measured in the area of Boring H3.

E. Soil Samples

Of the 27 soil samples chemically analyzed, 16 were from the north side of the site and 11 were from the south side. Only 7 samples showed detectable levels of contamination (three of these samples were from the same boring). Contamination consisted solely of BHC. Only one of the samples which indicated contamination was from the south side of the site (Sample MW4A 8' to 10') and it had only a trace level (barely over detectable limits); the rest being from the north side of the site where the cake was encountered. Five of the 27 soil samples analyzed indicated detectable levels of formaldehyde, but in no distinct pattern of occurrence. The formaldehyde concentrations are questionable considering that it is easily biodegraded and subsequently has a short life in the environment.

F. Ground-Water Samples

Chemical analysis of the ground water shows BHC to be present at a maximum concentration of 140 ppb in MW2 (August Sampling) located upgradient adjacent to the motel. Subsequent samplings shows this concentration to drop below 0.1 ppb. BHC concentrations in the remaining wells were much less. BHC concentrations were found to decrease from their higher initial levels. Of the remaining priority pollutants analyzed, most were below the limits of detection. Formaldehyde was initially detected in all of the wells and dropped below detection limits in subsequent samplings. Heavy metal concentrations were generally below the limits of detection with the exception of zinc and to lessor degrees copper, lead, mercury, nickel, and silver.

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TABLE 1. SUMMARY OF SOIL BORING DATA

Boring	Surface Elevation (feet)(1)	Depth of Boring (feet)	Depth of Aquiclude (feet)	Thickness of Aquiclude If Penetrated (feet)	Intervals Chosen for Chemical Analysis (feet)	Material Description	Indication of Contamination(2)
A4	570.0	7.0	5.5	-	2-4	"cake"	Yes
B2	571.0	10.0	6.0	-	4-6	Black Fill ?	No
B3	570.8	8.0	7.0	-	4-6	Black Fill	No
B4	570.8	7.0	7.0	-	-	-	
B5A	570.7	12.0	9.0	-	-	-	
C1	571.8	7.0	4.5	-	-	-	
C2	572.2	10.0	8.5	-	-	-	
C3	571.9	6.2	6.2+	-	0-2 2-4 4-6	"cake" "cake" "cake"	Yes Yes Yes
C4	571.3	10.0	8.5	-	-	-	
D1	573.5	25.6	6.0	4.0	-	-	
D2	572.1	6.0	5.0	-	-	-	
D3	572.5	10.0	10.0+	-	-	-	

(1) Referenced to Mean Sea Level (MSL)
(2) Based on results of the analytical testing

TABLE 1. SUMMARY OF SOIL BORING DATA (cont)

Boring	Surface Elevation[1] (feet)	Depth of Boring (feet)	Depth of Aquiclude (feet)	Thickness of Aquiclude If Penetrated (feet)	Intervals Chosen for Chemical Analysis (feet)	Material Description	Indication of Contamination[2]
D4	572.5	10.0	8.0	-	6-8	Clayey Silt	No
D5	572.2	10.0	8.0	-	4-6	Flyash	No
E1	574.0	22.75	6.0	14.0	-	-	
E2	574.1	8.0	6.5	-	4-6	Clayey Silt/Silty Sand	No
				-	6-8	Clay Aquiclude	No
E3	572.9	5.5	4.5	-	-	-	
E4	572.3	5.5	4.0	-	0-2	Sandy Silt	No
E5	572.5	14.0	12.0	1.5	0-2	Silty Sand	No
					2-4	Silty Sand	No
					6-8	Clayey Silt	No
E6	572.0	7.5	6.0	-	2-4	Clay Fill	No
F2	574.2	8.0	5.5	-	-	-	
F3	573.6	7.4	5.0	-	-	-	
F4	573.2	7.0	6.0	-	6-7	Clay Aquiclude	No

(1) Referenced to Mean Sea Level (MSL)
(2) Based on results of the analytical testing

TABLE 1. SUMMARY OF SOIL BORING DATA (cont)

Boring	Surface Elevation[1] (feet)	Depth of Boring (feet)	Depth of Aquiclude (feet)	Thickness of Aquiclude If Penetrated (feet)	Intervals Chosen for Chemical Analysis (feet)	Material Description	Indication of Contamination[2]
F5	572.7	7.6	5.0	-	-	-	
F6	572.4	6.0	2.0	-	-	-	
F7	572.2	12.0	11.0	-	6-8	Silty Clay	No
G2	574.2	8.0	5.5	-	-	-	
G3	573.8	8.0	6.0	-	-	-	
G4	573.5	7.5	6.0	-	-	-	
G5	573.2	8.0	5.5	-	-	-	
G6A	573.2	7.5	6.0	-	-	-	
H3	574.0	24.6	6.0	13.0	-	-	
H4	574.0	8.0	6.0	-	-	-	
H5	573.5	8.0	5.5	-	-	-	
H7	573.3	23.0	11.0	6.5	10-12	Clayey Silt	No

(1) Referenced to Mean Sea Level (MSL)
(2) Based on results of the analytical testing

TABLE 1. SUMMARY OF SOIL BORING DATA (cont)

Boring	Surface Elevation(1) (feet)	Depth of Boring (feet)	Depth of Aquiclude (feet)	Thickness of Aquiclude If Penetrated (feet)	Intervals Chosen for Chemical Analysis (feet)	Material Description	Indication of Contamination(2)
X1	572.9	8.0	5.5	-	2-4	Sandy Clay	Yes
X2	572.4	6.0	4.5	-	-	-	
X3	573.8	6.0	4.0	-	-	-	
Y1	572.0	10.0	10.0+	-	2-4	Flyash/Silty Sand	No
Y2	572.0	8.0	8.0	-	-	-	
Y3	572.1	10.0	7.0	-	0-2	Flyash/Silty Clay/ "cake"	Yes
					2-4	Flyash/Silty Clay	No
					4-6	Flyash/Silty Clay	No
Y4	572.5	6.0	6.0+	-	0-2	Flyash/"cake"	No ?
					2-4	Flyash	No
					4-6	Flyash/Silt	No
Y5A	573.0	2.0	0.5	-	-	-	
MW1	574.0	6.5	5.0	-	-	-	
MW2	574.0	6.5	5.5	-	-	-	

(1) Referenced to Mean Sea Level (MSL)
(2) Based on results of the analytical testing

TABLE 1. SUMMARY OF SOIL BORING DATA (cont)

Boring	Surface Elevation[1] (feet)	Depth of Boring (feet)	Depth of Aquiclude (feet)	Thickness of Aquiclude If Penetrated (feet)	Intervals Chosen for Chemical Analysis (feet)	Material Description	Indication of Contamination[2]
MW3	573.2	10.0	7.5	-	-	-	
MW4A	572.3	12.0	11.0	-	8-10	Clayey Silt	Yes
MW5A	572.1	11.2	11.2+	-	-	-	
MW6	572.2	10.2	9.5	-	-	-	
MW7	573.2	7.8	6.5	-	-	-	

(1) Referenced to Mean Sea Level (MSL)
(2) Based on results of the analytical testing

TABLE 2. SUMMARY OF MONITORING WELL DATA

Monitoring Well	Elevation (feet)[1]			Parameters	SAMPLE PERIOD												
					1985						1986						
	Ground	TOP[2]	TD[3]		7/11	8/21 8/22	9/25 9/27	10/24 10/25	11/21 11/22	12/19	1/23	2/20 2/21	3/20	4/24	5/22	6/5 6/6	6/26
MW1	574.0	574.45	568.37	Depth to Water (feet)	N/R[6]	4.52	4.54	2.81	1.94	2.03	1.64	2.21	1.52	1.61	1.91	2.80	3.79
				Elevation of Water (feet)	570.5[7]	569.93	569.91	571.64	572.51	572.42	572.81	572.24	572.93	572.84	572.54	571.65	570.66
				Average pH	N/R	6.48	6.68	7.68	7.47			6.50			7.10	7.80	
				Avg. Conduct. (μmhos/cm)	500	1075	1000	455	533			472			467	525	
				Average Temperature (°C)	15.2	NR	17	13	9			4			11	14	
MW2	574.0	575.56[4]	563.56	Depth to Water	N/R	9.82		10.85	3.61	3.54	3.28	3.19	3.25	3.42	3.39	4.08	4.95
		576.00[5]		Elevation of Water (feet)	570.5[7]	566.18	Pipe	565.15	571.95	572.02	572.28	572.37	572.31	572.14	572.17	571.48	570.61
				Average pH	N/R	6.51	Broken[8]	6.48	6.50			6.22			7.10	6.80	
				Avg. Conduct. (μmhos/cm)	393	925		834	805			710			788	826	
				Average Temperature (°C)	20.3	NR		14	9			4			11	14	
MW3	573.2	573.42	565.01	Depth to Water (feet)	N/R	5.82	5.60	5.02	4.32	4.71	4.32	4.98	4.06	3.95	4.53	468	5.03
				Elevation of Water (feet)	567.2[7]	567.60	567.82	568.40	569.10	568.71	569.10	568.44	569.36	569.47	568.69	568.74	568.39
				Average pH	N/R	6.73	7.27	6.60	7.03			6.44			7.20	7.00	
				Avg. Conduct. (μmhos/cm)	320	708	703	678	877			675			783	727	
				Average Temperature (°C)	19.1	N/R	15	13	19			5			12	14	
MW4	572.3	575.15	561.55	Depth of Water (feet)	N/R	8.05	7.98	7.11	5.97	5.90	5.79	6.32	5.97	5.39	5.79	606	6.43
				Elevation of Water (feet)	586.8[7]	567.10	567.17	568.46	569.18	569.25	569.36	568.83	569.18	569.76	569.36	569.09	568.72
				Average pH	N/R	6.19	6.62	6.36	6.53			6.16			6.80	6.70	
				Avg. Conduct. (μmhos/cm)	1985	3737	3775	3072	3212			2858			2767	3208	
				Average Temperature (°C)	18.6	N/R	15	14	9			5			10	13	

(1) Referenced to Mean Sea Level (MSL)
(2) Top of Pipe
(3) Total Depth
(4) T.O.P. Elevation after 10/24/85
(5) T.O.P. Elevation before 10/24/85
(6) N/R = No data
(7) Obtained from July, 1985 Water Table Map
(8) Well destroyed by vehicular traffic, new well installed on 10/25/85

TABLE 2. SUMMARY OF MONITORING WELL DATA (CONT.)

Monitoring Well	Elevation (feet)(1) Ground	TOP(2)	TD(3)	Parameters	SAMPLE PERIOD 1985 7/11	8/21 8/22	9/25 9/27	10/24 10/25	11/21 11/22	12/19	1986 1/23	2/20 2/21	3/20	4/24	5/22	6/5 6/6	6/26
MW5	572.1	575.57	560.49	Depth to Water (feet)	N/R	9.07	9.14	8.53	7.44	7.21	7.54	7.21	7.14	6.40	6.48	6.20	6.33
				Elevation of Water (feet)	568.1(7)	566.50	566.43	567.04	568.13	568.36	568.03	568.36	568.43	569.17	569.09	569.36	569.24
				Averag pH	N/R	5.56	6.26	6.36	6.40			6.06			6.80	6.3	
				Avg. Conduct. (μmhos/cm)	813	2012	2045	1922	1928			1712			1883	0925	
				Average Temperature (°C)	20.0	N/R	15	13	9			5			11	04	
MW6	572.2	575.24	563.24	Depth to Water (feet)	N/R	10.16	10.00	9.73	9.26	9.51	8.67	9.80	8.97	8.57	9.15	9.69	9.85
				Elevation of Water (feet)	568.7(7)	565.03	565.24	565.51	565.98	565.73	566.57	565.44	566.27	566.67	566.09	565.55	565.39
				Average pH	N/R	9.84	8.10	10.83	11.67			10.15			10.40	00.0	
				Avg. Conduct. (μmhos/cm)	288	472	300	402	1213			313.33			1142	383	
				Average Temperature (°C)	22.8	N/R	14	13	9			6			10	04	
MW7	573.2	575.82	561.55	Depth to Water (feet)	Dry	Dry	Dry	Dry	Dry	Dry	6.55	6.97	6.40	6.45	7.65	8.00	8.65
				Elevation of Water (feet)							569.27	568.85	569.42	569.37	568.17	567.80	567.07
				Average pH								7.00			7.20	7.2	
				Avg. Conduct. (μmhos/cm)								637			762	900	
				Average Temperature (°C)								4			11	04	
CAYUGA CREEK STAGE																	
Niagara Falls Boulevard (Headwall El. 575.7)				Elevation of Water (feet)	N/R	563.41	563.19	563.59	564.10	565.15	564.26	563.81	563.99	557.69	563.89	563.95	564.09
Porter Road (Headwall El. 583.5)				Elevation of Water (feet)	N/R	567.06	567.29	567.74	567.78	568.02	568.81	568.61	568.65	567.99	567.91	567.70	567.47

(1) Referenced to Mean Sea Level (MSL)
(2) Top of Pipe
(3) Total Depth
(4) T.O.P. Elevation after 10/24/85
(5) T.O.P. Elevation before 10/24/85
(6) N/R = No data
(7) Obtained from July, 1985 Water Table Map
(8) Well destroyed by vehicular traffic, new well installed on 10/25/85

TABLE 3. FIELD PERMEABILITY TEST RESULTS

Monitoring Well	Depth of Well (ft)	Screened Interval (ft)	Date Tested	Permeability (cm/sec)
MW1	6.5	1.5 - 6.5	8/21/85	$<1.7 \times 10^{-5}$
MW3	8.9	3.9 - 8.9	9/26/85	$<1.7 \times 10^{-5}$
MW5	11.5	6.5 - 11.5	8/21/85	$<1.7 \times 10^{-5}$
MW6	10.5	4.25 - 9.25	9/26/85	1.7×10^{-5}

TABLE 4. LABORATORY PERMEABILITY TEST RESULTS

Boring	Sample Interval (ft)	Description	Initial Moisture (%)	Initial Dry Density (gm/cc)	Initial Saturation (%)	Permeability (cm/sec)
F3	6 - 8	Brown Clay	18.8	112.2	96	3.3×10^{-8}
B5A	10 - 12	Brown Clay	36.4	85.7	99	8.8×10^{-8}
Y3	8 - 10	Gray Clay	30.7	87.1	85	13.4×10^{-8}
C2	8 - 10	Brown Clay	30.3	85.0	82	3.3×10^{-8}
C1	6 - 7	Brown Clay	21.1	104	95	2.5×10^{-8}
F5	6 - 7	Brown Clay	23.3	103.6	96	4.4×10^{-8}

TABLE 5. ANALYTICAL TEST RESULTS - AIR SAMPLES

Contaminants	6/22/85 Upwind 9:50-12:40	6/22/85 Upwind Blank	6/22/85 Downwind 12:55-15:40	6/22/85 Downwind Blank	7/2/85 Upwind 12:40-14:40	7/2/85 Upwind Blank	7/2/85 Downwind 12:42-14:42	7/10/85 Downwind Blank	7/10/85 Upwind 14:20-17:21	7/10/85 Upwind Blank	7/10/85 Downwind 14:25-17:25	7/10/85 Downwind Blank
Hexachlorocyclohexane- (α-BHC)	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Hexachlorocyclohexane- (β-BHC)	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Hexachlorocyclohexane- (γ-BHC)	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Hexachlorocyclohexane- (δ-BHC)	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41

Notes:

Results reported as total μg/cubic meter.

TABLE 6. ANALYTICAL TEST RESULTS-SOIL SAMPLES

Sample Type	H7-10-12A Clayey Silt	E5-6-8 Clayey Silt	E4-6-7 Sandy Silt	E6-2-4 Clay	E2-4-6 Clayey Silt	C3-2-4 Cake	B3-4-6B Black Fill	X1-2-4 Sandy Clay	MW4-8-10 Clayey Silt	D5-4-6 Fly-ash	E5-0-2 Silty Sand	E5-2-4A Silty Sand	A4-2-4 Cake	E2-6-8 Clay	D4-6-8 Clayey Silt	C3-2-4B Cake	C3-4-6 Cake	B2-4-6 Black Fill	Y1-2-4 Fill	Y3-2-4 Clay	Y4-2-4 Fly-ash	E4-0-2 Sandy Silt	F7-6-8A Silty Clay
BENZENE	(12	(13	(12	(12	(12	INSUF	(12	(11	(15	INSUF						(17	(17	(17	(16	(18	(18	(12	(18
CHLOROBENZENE	(612	(660	(600	(630	(600	INSUF	(600	(550	(750	INSUF						(17	(17	(17	(16	(18	(18	(12	(18
DICHLOROBENZENE	(612	(660	(600	(630	(600	(775	(600	(550	(750	(775						(830	(1200	(5340	(1275	(2975	(1555	(565	(875
TRICHLOROBENZENE	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775						(830	(1200	(5340	(1275	(2975	(1555	(565	(875
TETRACHLOROBENZENE	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775						(830	(1200	(810	(790	(875	(865	(565	(875
PENTACHLOROBENZENE	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775						(830	(1200	(810	(790	(875	(865	(565	(875
HEXACHLOROBENZENE	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775	(740	(750	(5300	(625	(650	(830	(1200	(5340	(1265	(2975	(1555	(565	(875
PENTACHLORONITROBENZENE	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775						(830	(850	(810	(790	(875	(865	(565	(875
TETRACHLOROETHYLENE	(12	(13	(12	(12	(12	(15	(12	(11	(15	(15						(17	(17	(17	(16	(18	(18	(12	(18
HEXACHLOROCYCLOHEXANE (α-BHC)	(612	(665	(600	(630	(610	(780	(600	263476	841	(775	(735	(750	20×10^7	(625	(650	(850	6275	(810	(800	(875	(865	(565	(875
HEXACHLOROCYCLOHEXANE (β-BHC)	(612	(665	(600	(630	(610	15550	(600	92216	(750	(775	(735	(750	44×10^6	(625	(650	945	9665	(810	(790	(875	(865	(565	(875
HEXACHLOROCYCLOHEXANE (γ-BHC)	(612	(665	(600	(630	(610	(780	(600	8782	(750	(775	(735	(750	23×10^6	(625	(650	(850	(850	(810	(800	(875	(865	(565	(875
HEXACHLOROCYCLOHEXANE (δ-BHC)	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775	(735	(750	14×10^6	(625	(650	(850	(850	(810	(800	(875	(865	(565	(875
HEPTACHLOR	(612	(665	(600	(630	(610	(780	(600	(5500	(750	(775						(830	(850	(810	(800	(875	(865	(565	(875
PHENYLMETHYLETHER-(ANISOLE)	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775						(830	(850	(810	(800	(875	(865	(565	(875
TRICHLOROANISOLE	(612	(665	(600	(630	(610	(780	(600	(550	(750	(775						(830	(850	(810	(790	(875	(865	(565	(875
CHLORINATED BIPHENYLS	(860	(925	(850	(880	(850	(780	(850	(7685	(1050	(1100						(1655	(1695	(1620	(1580	(1750	(1725	(1130	(1745
PHENOL	(1530	(1655	(1500	(1570	(1520	(1950	(1510	(1375	(1880	(1930						(665	(1200	(5340	(1265	(2975	(1555	(565	(875
DICHLOROPHENOLS	(1530	(1655	(1500	(1570	(1520	(1950	(1510	(1375	(1880	(1930						(665	(1200	(534	(1265	(2975	(1555	(565	(875
TRICHLOROPHENOLS	(1530	(1655	(1500	(1570	(1520	(1950	(1510	(1375	(1880	(1930						(665	(1200	(534	(1265	(2975	(1555	(565	(875
FORMALDEHYDE	(1250	(1325	(1500	(1570	(1520	(1550	(1210	(1100	(1100	(1545						2480	(1500	26000	(1580	5600	(1725	6000	1700
MERCURY	440	1110	420	1230	(120	420	170	970	390	290						496	339	INSUF	316	175	173	225	698
% SOLIDS	81.66	75.55	82.91	79.64	82.58	64.32	82.79	91.09	66.57	64.78	67.9	66.96	94.81	80.15	77.18	60.43	58.99	61.70	63.28	57.15	57.95	88.73	57.30

All results reported as PPB and on a dry weight basis. "(" means "less than" INSUF = "insufficient sample"

In detect levels

TABLE 6. ANALYTICAL TEST RESULTS-SOIL SAMPLES (cont)

Sample	Y3-0-2B	Y3-4-6	Y4-0-2	Y4-4-6A
Hexachlorobenzene	< 20	< 20	< 20	< 20
Hexachlorocyclohexane (α-BHC)	< 20	< 20	< 20	< 20
Hexachlorocyclohexane (β-BHC)	40	< 20	< 20	< 20
Hexachlorocyclohexane (γ-BHC)	< 20	< 20	< 20	< 20
Hexachlorocyclohexane (δ-BHC)	< 20	< 20	< 20	< 20

All results reported as PPB and on a dry weight basis.

"<" means "less than"

TABLE 7. ANALYTICAL TEST RESULTS - WATER SAMPLES

		MONITORING WELL(1)						
Contaminant	Date	MW1 (Upgradient)	MW2 (Upgradient)	MW3 (Downgradient)	MW4 (Downgradient)	MW5 (Downgradient)	MW6 (Downgradient)	MW7 (Downgradient)
HCB	8/22/85	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
	9/27/85	<0.01	-	<0.01	<0.01	<0.01	<0.01	-
	10/25/85	<0.1	<0.5	<1.0	<1.0	<1.0	<1.0	-
	11/22/85	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1	-
	2/20/86	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1
	5/22/86	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1
	6/6/86	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	-
αBHC	8/22/85	2.3	16.0	9.5	1.2	2.2	2.1	-
	9/27/85	0.99	-	3.3	0.55	0.70	6.5	-
	10/25/85	0.7	0.1	8.7	1.1	4.0	2.5	-
	11/22/85	1.2	2.5	1.9	0.7	0.5	<0.1	-
	2/20/86	0.28	<0.1	0.98	0.23	0.13	<0.1	10.3
	5/22/86	1.3	1.8	<0.1	0.3	0.3	<0.1	5.1
	6/6/86	0.5	<0.1	0.5	0.3	0.1	<0.1	-
βBHC	8/22/85	10.0	140.0	8.8	1.3	1.4	18.0	-
	9/27/85	1.8	-	1.1	0.23	0.2	6.1	-
	10/25/85	1.3	<0.1	2.1	0.2	0.6	5.2	-
	11/22/85	1.5	<0.1	0.9	0.1	0.1	7.5	-
	2/20/86	2.3	<0.1	2.4	0.38	0.30	1.3	12.6
	5/22/86	1.5	0.8	<0.1	0.1	0.1	4.4	3.2
	6/6/86	2.1	<0.1	0.8	0.2	<0.1	7.6	-

Notes:

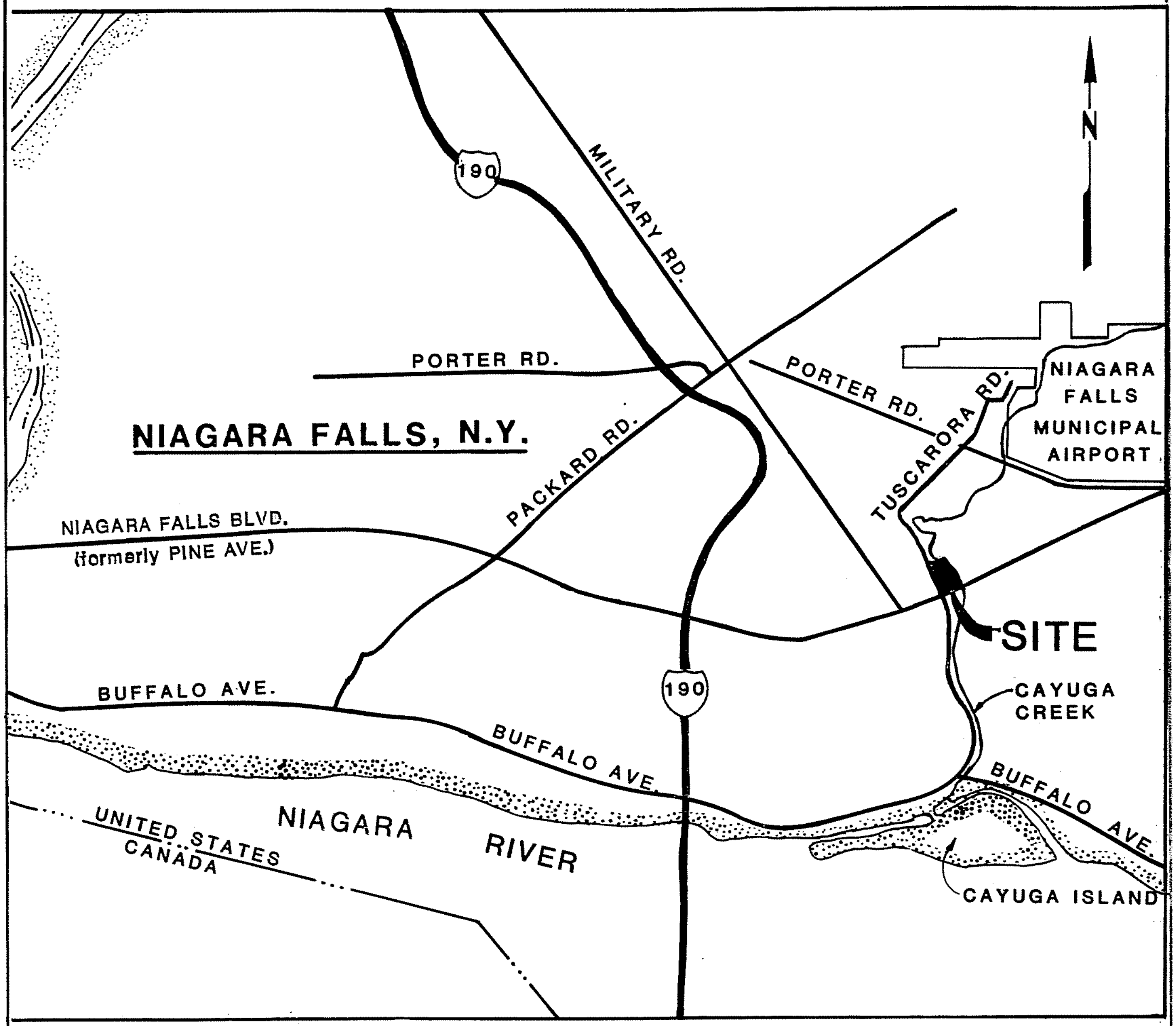
(1) Concentrations reported in parts per billion (ppb) except for Formaldehyde which is reported in parts per million (ppm).
"-" Denotes riser pipe broken in the case of MW2 and the well was dry, or insufficient sample, in the case of MW7.
"*" Denotes that no data is available for this date.

TABLE 7. ANALYTICAL TEST RESULTS - WATER SAMPLES (CONT)

		MONITORING WELL(1)						
Contaminant	Date	MW1 (Upgradient)	MW2 (Upgradient)	MW3 (Downgradient)	MW4 (Downgradient)	MW5 (Downgradient)	MW6 (Downgradient)	MW7 (Downgradient)
δBHC	8/22/85	0.75	0.62	0.02	0.12	0.02	<0.01	-
	9/27/85	0.21	-	0.03	0.02	0.3	<0.01	-
	10/25/85	<0.01	<0.01	<0.5	<0.1	<0.1	<0.01	-
	11/25/85	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	-
	2/20/86	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	0.18
	5/22/86	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	0.1
	6/6/86	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	-
γBHC	8/22/85	1.5	0.20	0.12	0.01	0.04	0.02	-
	9/27/85	0.40	-	0.02	<0.01	<0.01	<0.01	-
	10/25/85	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
	11/22/85	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
	2/20/86	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.32
	5/22/86	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
	6/6/86	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Hg	8/22/85	0.6	0.5	1.4	0.6	2.4	2.9	-
	9/27/85	2.1	-	0.9	2.4	3.5	1.2	-
	10/25/85	<0.5	1.1	<0.5	<0.5	<0.05	<0.05	-
	11/22/85	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	-
	2/20/86	<0.5	<0.5	4.3	<0.5	<0.05	<0.05	0.5
	5/22/86	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5
	6/6/86	<0.5	<0.5	<0.5	6.2	<0.5	<0.5	<0.5
Formaldehyde(1)	8/22/85	*	*	*	*	*	*	-
	9/27/85	*	-	*	*	*	*	-
	10/25/85	<0.5	0.1	0.18	0.24	<0.24	<0.25	-
	11/22/85	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
	2/20/86	0.47	0.47	0.40	1.1	2.2	3.5	0.6
	5/22/86	<0.2	<0.1	<0.1	0.3	0.2	<0.01	0.2
	6/6/86	0.4	<0.1	0.3	<0.1	0.2	<0.1	0.1

Notes:

(1) Concentrations reported in parts per billion (ppb) except for Formaldehyde which is reported in parts per million (ppm).
"-" Denotes riser pipe broken in the case of MW2 and the well was dry, or insufficient sample, in the case of MW7.
"*" Denotes that no data is available for this date.



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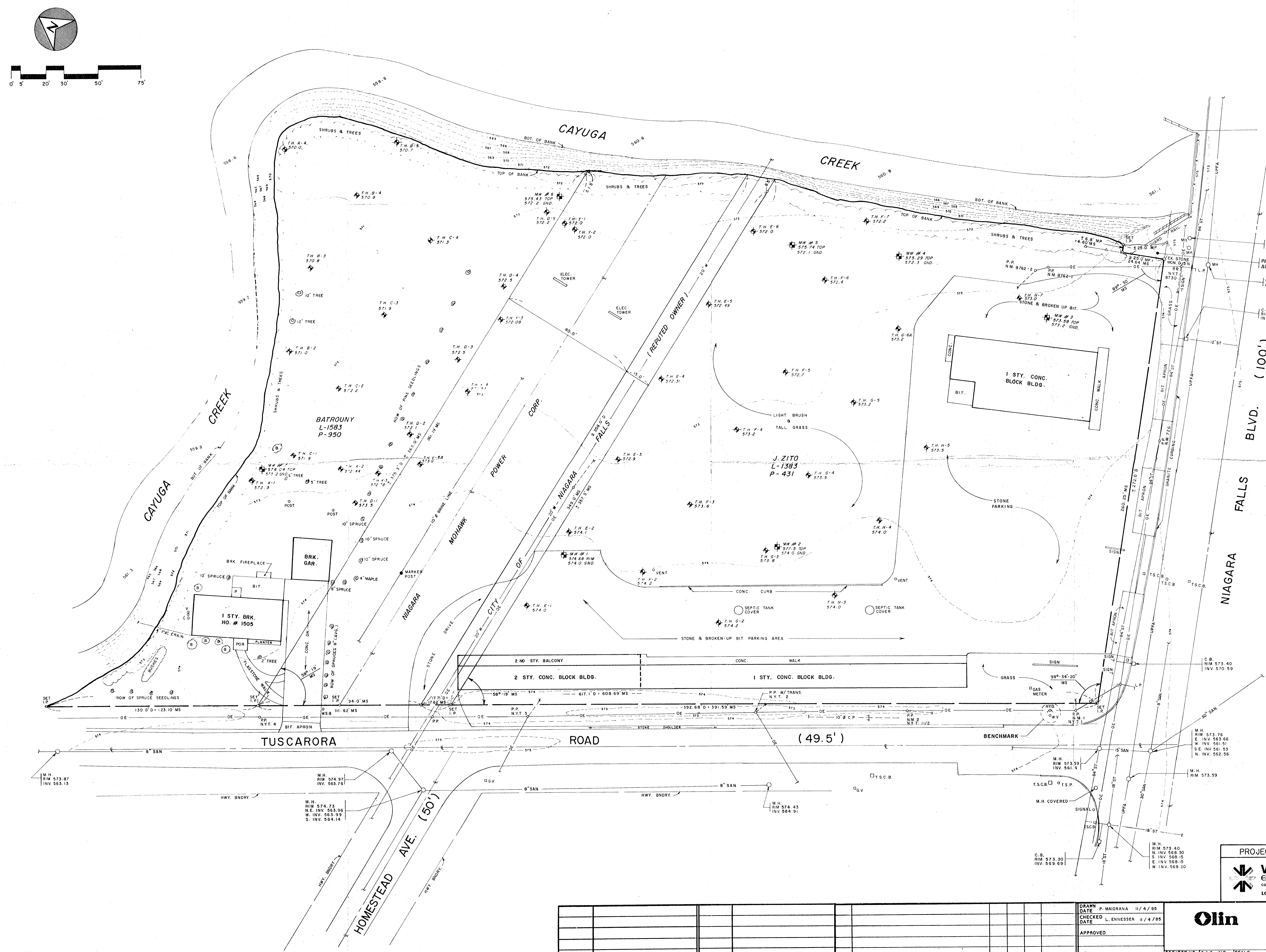
& Geophysicists

VICINITY MAP
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	RC	3/20/86	DH	7/22/86



LEGEND

T.H.	TEST HOLE
M W	MONITORING WELL
M.H.	MANHOLE
C.B.	CATCH BASIN
T.S.C.B.	TRAFFIC SIGNAL CONTROL BOX
T.S.P.	TRAFFIC SIGNAL POLE
P.P.	POWER POLE
G.V.	GAS VALVE
W.V.	WATER VALVE
— OE —	OVERHEAD ELECTRIC
— SAN —	SANITARY SEWER
— ST —	STORM SEWER
— UPFA —	UNDERGROUND POLICE & FIRE ALARM
— W —	WATER LINE

NOTE: ELEVATIONS GIVEN AT MONITORING WELLS ARE TOP OF 2"Ø PVC PIPE AND NOT 4"Ø METAL PROTECTION PIPE.

B.M. - NORTHWEST FLANGE BOLT OF HYDRANT AT NORTHEST CORNER OF TUSCARORA ROAD & NIAGARA FALLS BLVD. ELEV. 576.69

PROJECT No. 2287 - 43

WENDEL
ENGINEERS P.C.
consulting engineers/planners/surveyors
LOCKPORT N.Y. - BUFFALO N.Y.

STATE OF NEW YORK
Peter J. Welsby
No. 049414
LICENSED LAND SURVEYOR

Peter J. Welsby

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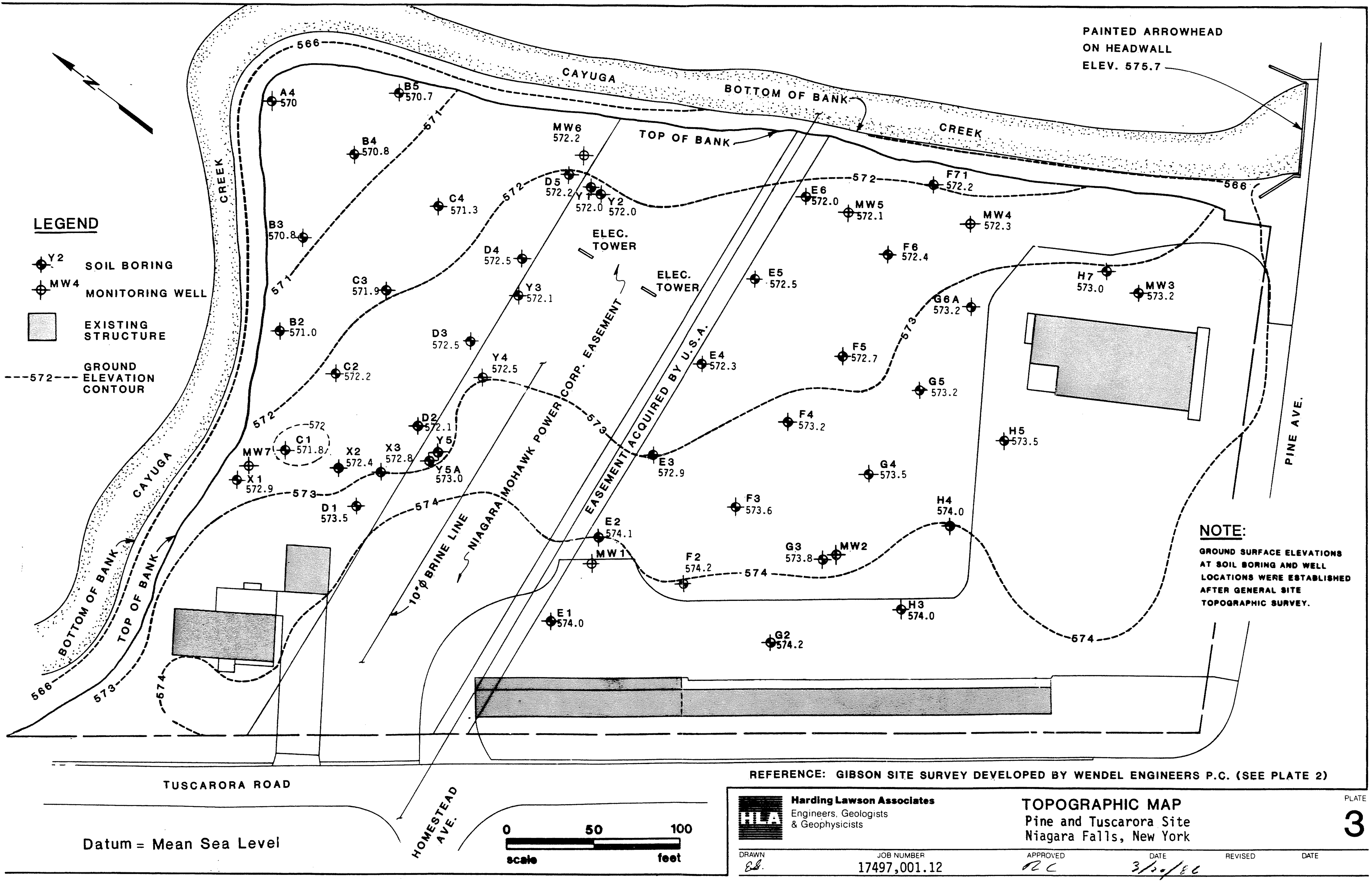
DWG NO	REFERENCE DWG	DWG NO	REFERENCE DWG	REV.	DESCRIPTION	DRAWN	DATE	CHKD.	APPR.

DRAWN DATE P. MAIORANA 11/4/85
CHECKED DATE L. ENNESSER 11/4/85
APPROVED

Olin

GIBSON SITE SURVEY
NIAGARA FALLS, NEW YORK

PROJECT NO.	C.A.R. NO.	SCALE	DRAWING NUMBER	PLATE	REV.
		1" = 20'		2	



NOTE:

GROUND SURFACE ELEVATIONS AT SOIL BORING AND WELL LOCATIONS WERE ESTABLISHED AFTER GENERAL SITE TOPOGRAPHIC SURVEY.

REFERENCE: GIBSON SITE SURVEY DEVELOPED BY WENDEL ENGINEERS P.C. (SEE PLATE 2)

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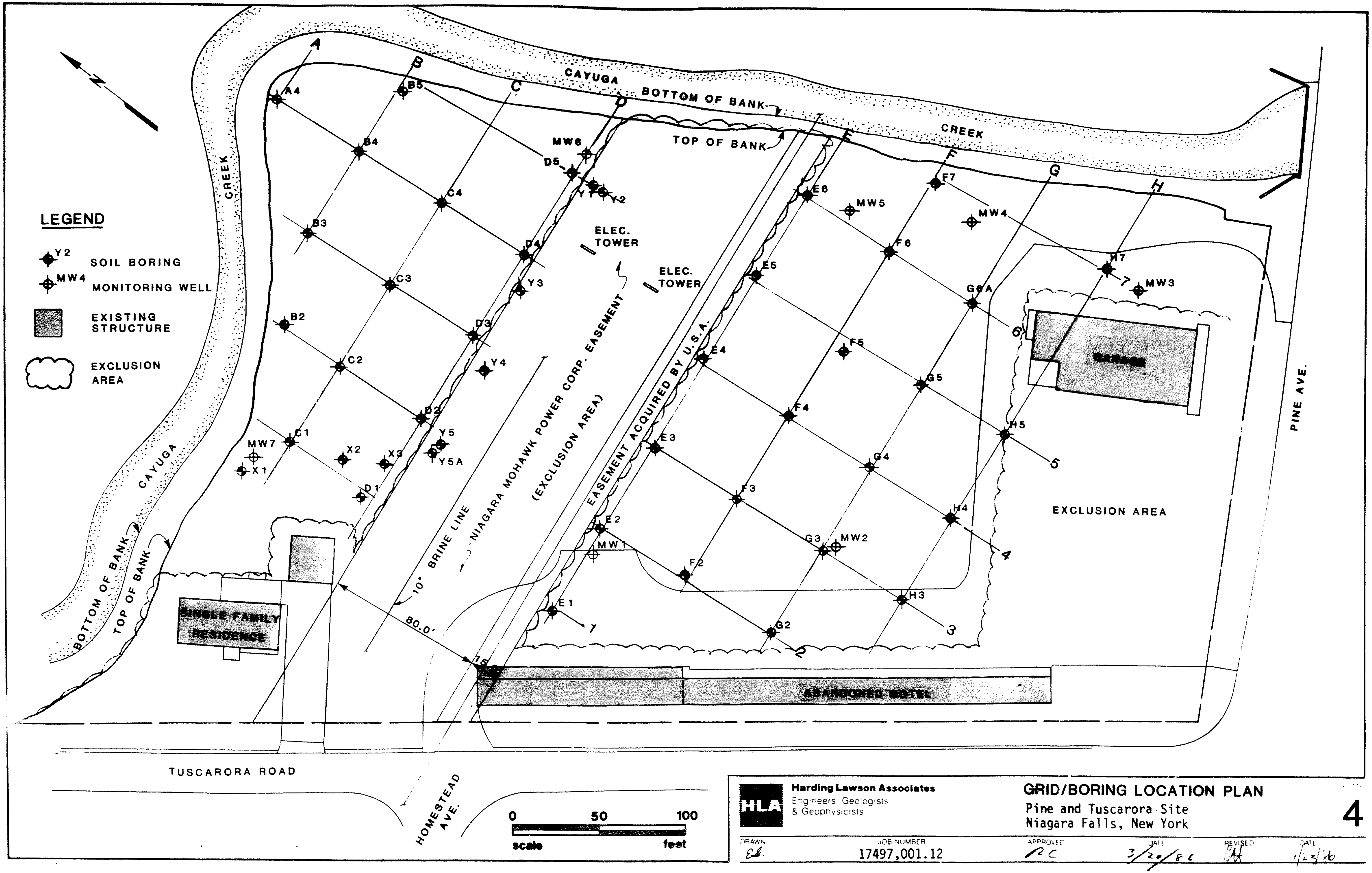
& Geophysicists

TOPOGRAPHIC MAP
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12	RC	3/10/86		



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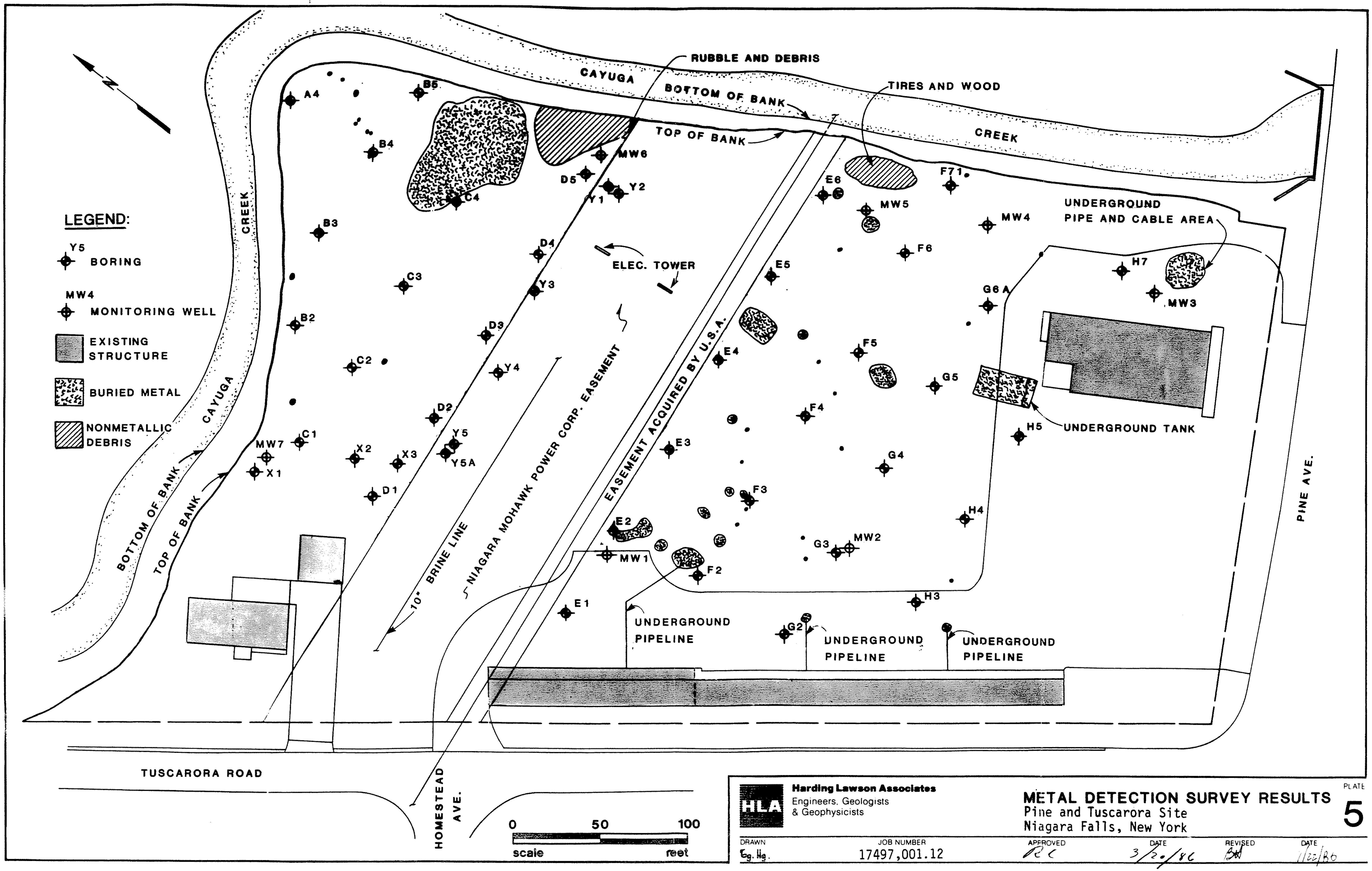
& Geophysicists

GRID/BORING LOCATION PLAN

Pine and Tuscarora Site
Niagara Falls, New York

4

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
EB	17497,001.12	RC	3/20/86	JH	1/23/86



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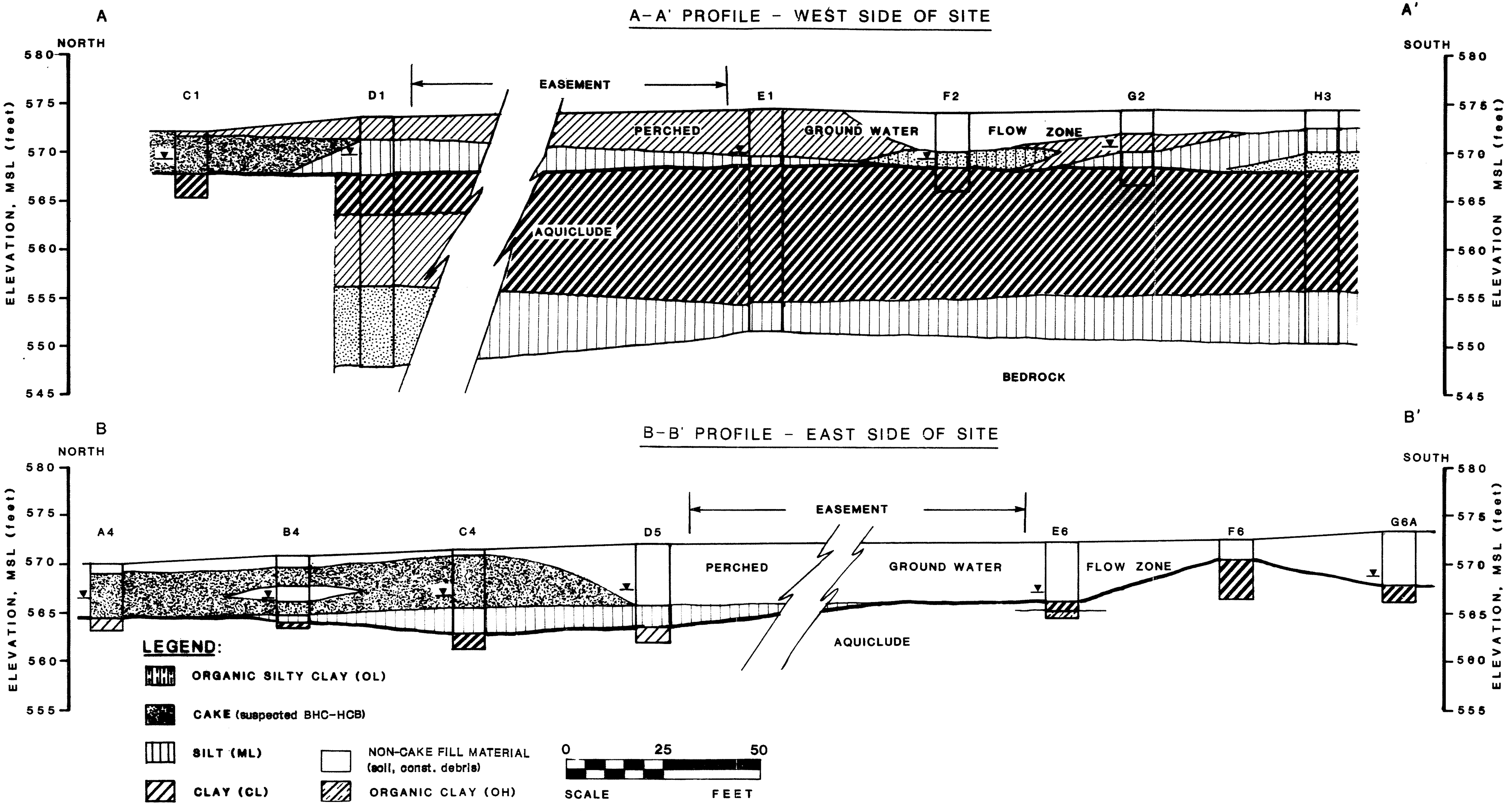
METAL DETECTION SURVEY RESULTS
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
5

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
Eg. Hg.	17497,001.12	RC	3/20/86	BH	1/22/86



NOTE:
Refer to Plate 2 for Boring Location

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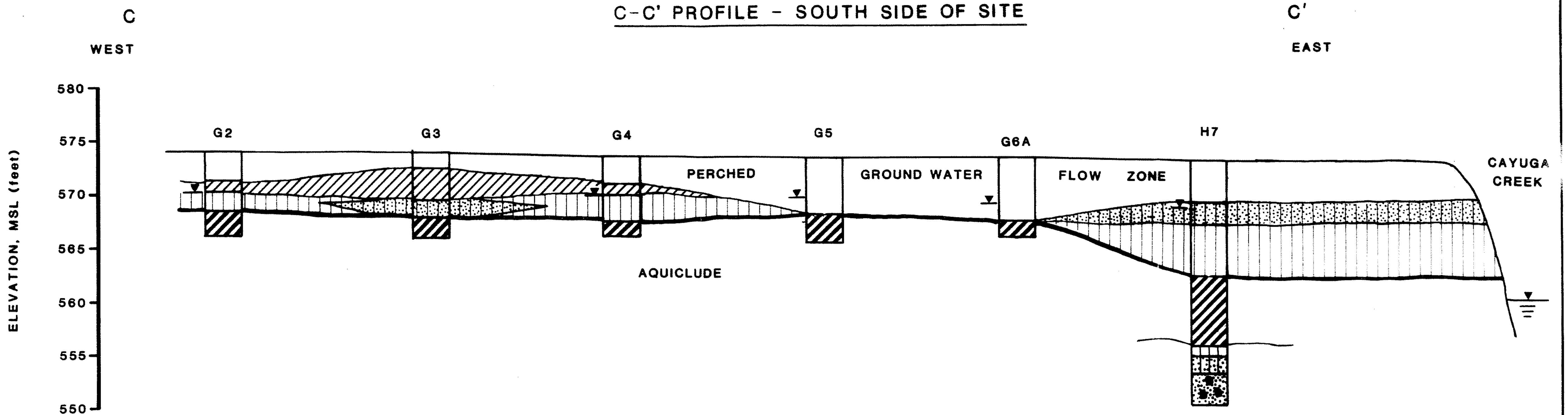
SUBSURFACE PROFILES A-A' & B-B'

Pine and Tuscarora Site
Niagara Falls, New York

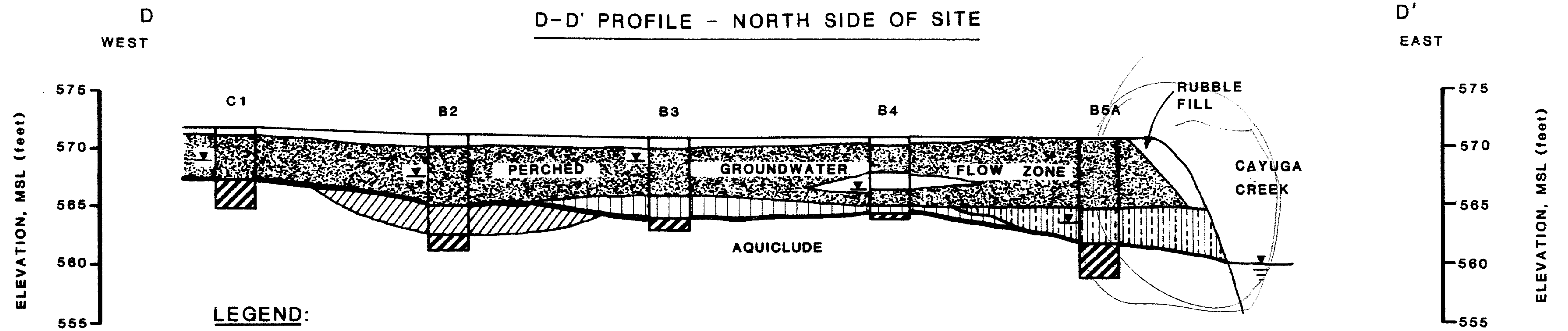
PLATE
6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12	RC	3/20/86	RH	7/23/86

C-C' PROFILE - SOUTH SIDE OF SITE



D-D' PROFILE - NORTH SIDE OF SITE



LEGEND:

- ▥ ORGANIC SILTY CLAY (OL)
- ▒ CAKE (suspected BHC-HCB)
- ▥ SILT (ML)
- ▨ CLAY (CL)
- ▨ CLAY (CH)
- ▒ SAND (SW)
- ▦ SILTY SAND (SM)
- ☐ NON-CAKE FILL MATERIAL (soil, const. debris)
- ▼ WATER LEVEL
- ▒ GRAVEL (GW)

0 25 50

SCALE FEET

HORIZONTAL

NOTE: Refer to Plate 2 for Boring Location

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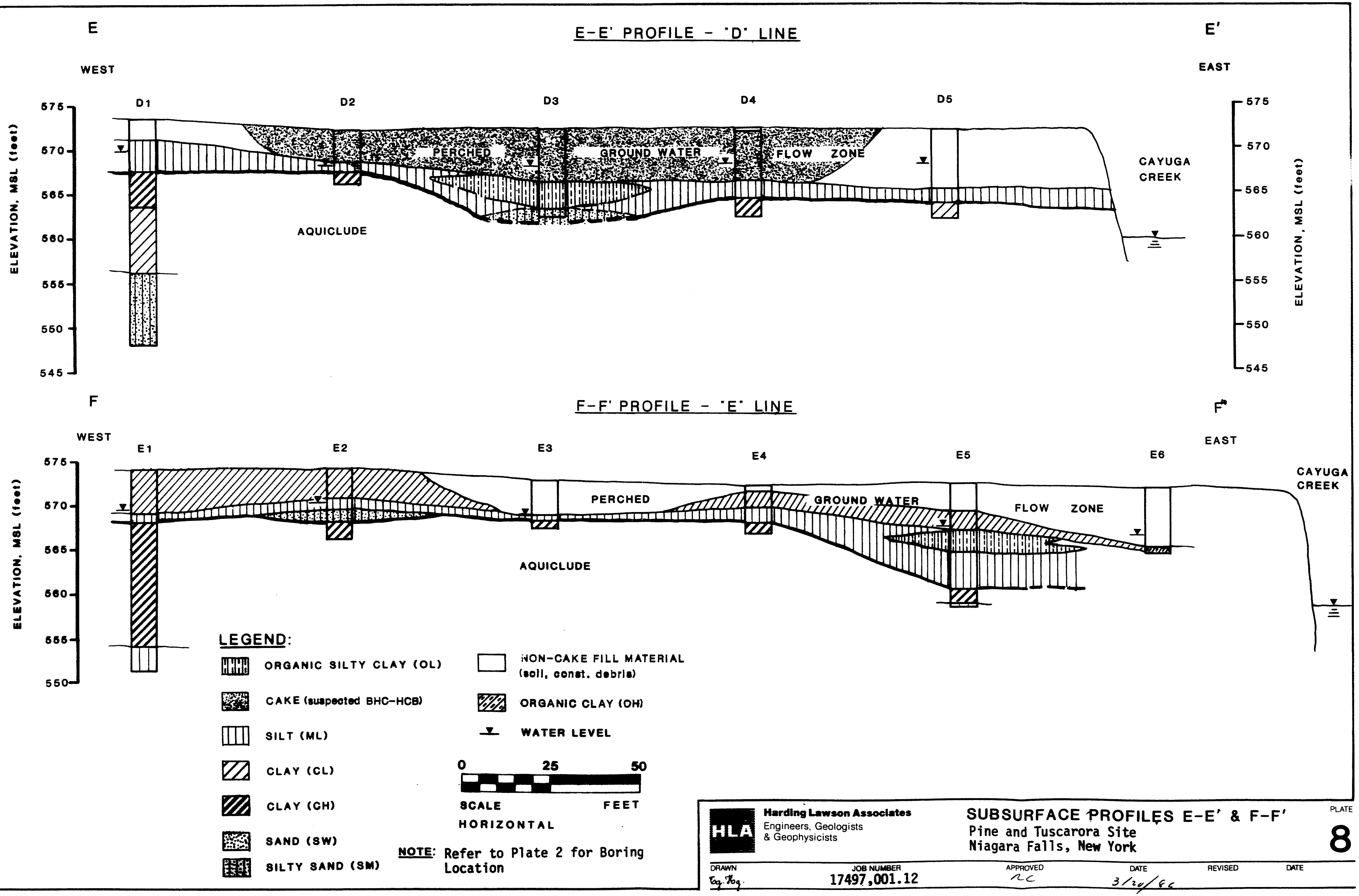
SUBSURFACE PROFILES C-C' & D-D'
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
HM	17497,001.12	RC	3/20/86		



NOTE: Refer to Plate 2 for Boring Location

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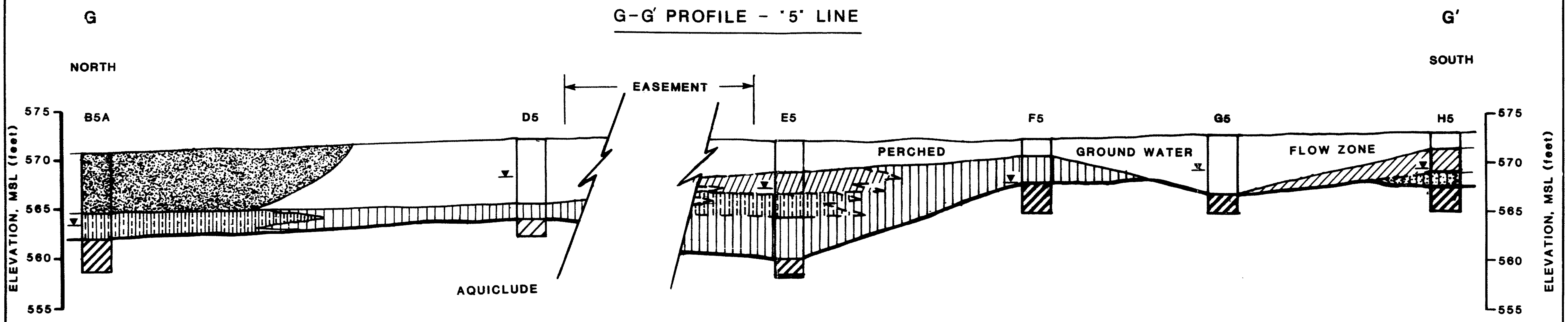
SUBSURFACE PROFILES E-E' & F-F'
Pine and Tuscarora Site
Niagara Falls, New York

PLATE 8

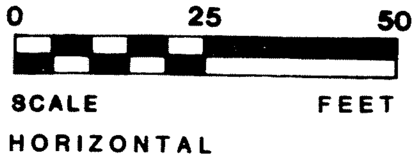
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
Eg. Hog.	17497,001.12	RC	3/20/86		

G-G' PROFILE - '5' LINE



LEGEND:

- ▥ ORGANIC SILTY CLAY (OL)
- ▩ CAKE (suspected BHC-HCB)
- ▥ SILT (ML)
- ▨ CLAY (CL)
- ▨ CLAY (CH)
- ▒ SAND (SW)
- ▦ SILTY SAND (SM)
- ☐ NON-CAKE FILL MATERIAL (soil, const. debris)
- ▼ WATER LEVEL



NOTE: Refer to Plate 2 for Boring Location

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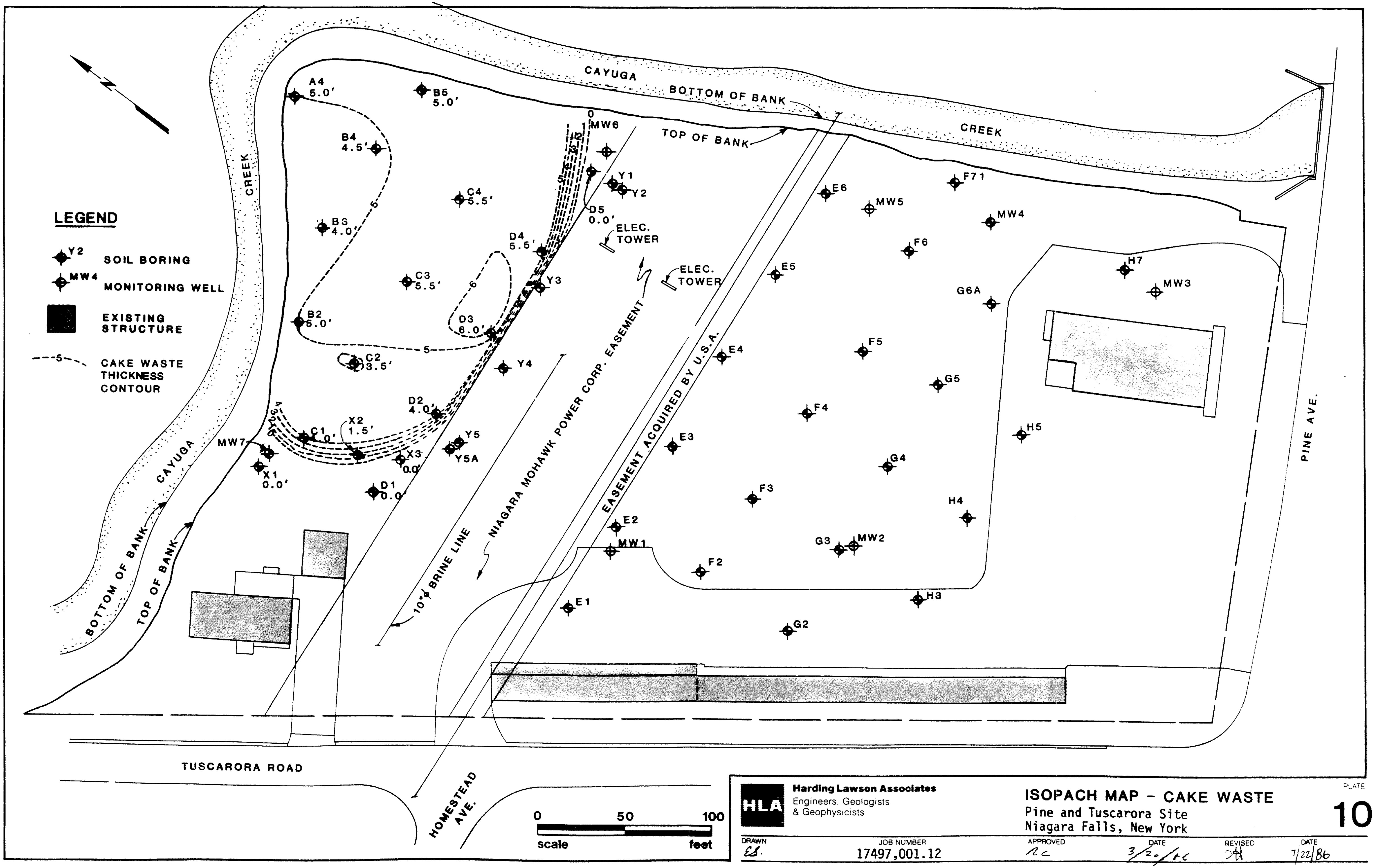
SUBSURFACE PROFILE G-G'

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12		3/20/86		7/23/86



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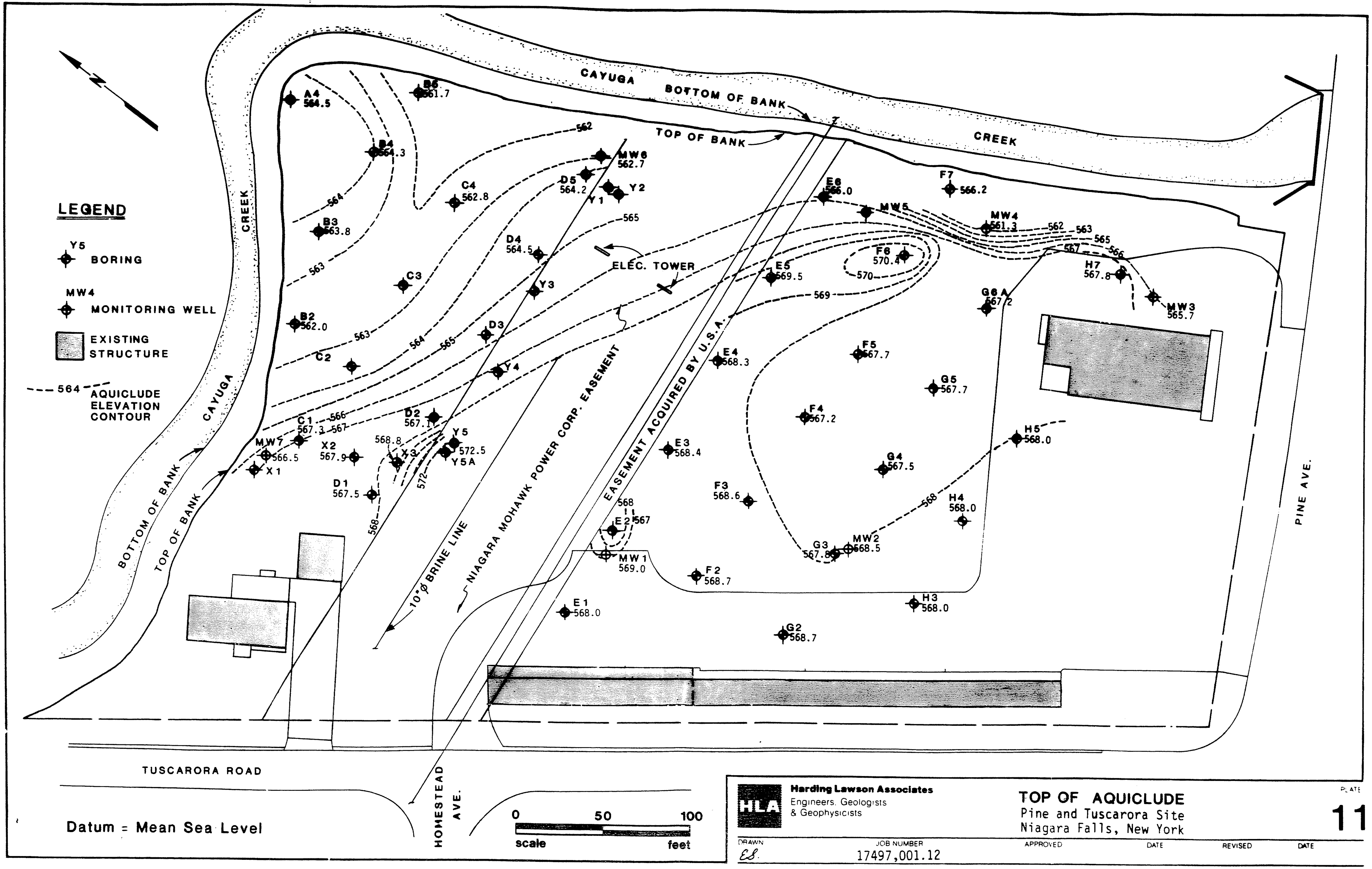
ISOPACH MAP - CAKE WASTE

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
10

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES	17497,001.12	RC	3/20/86	DH	7/22/86



Datum = Mean Sea Level

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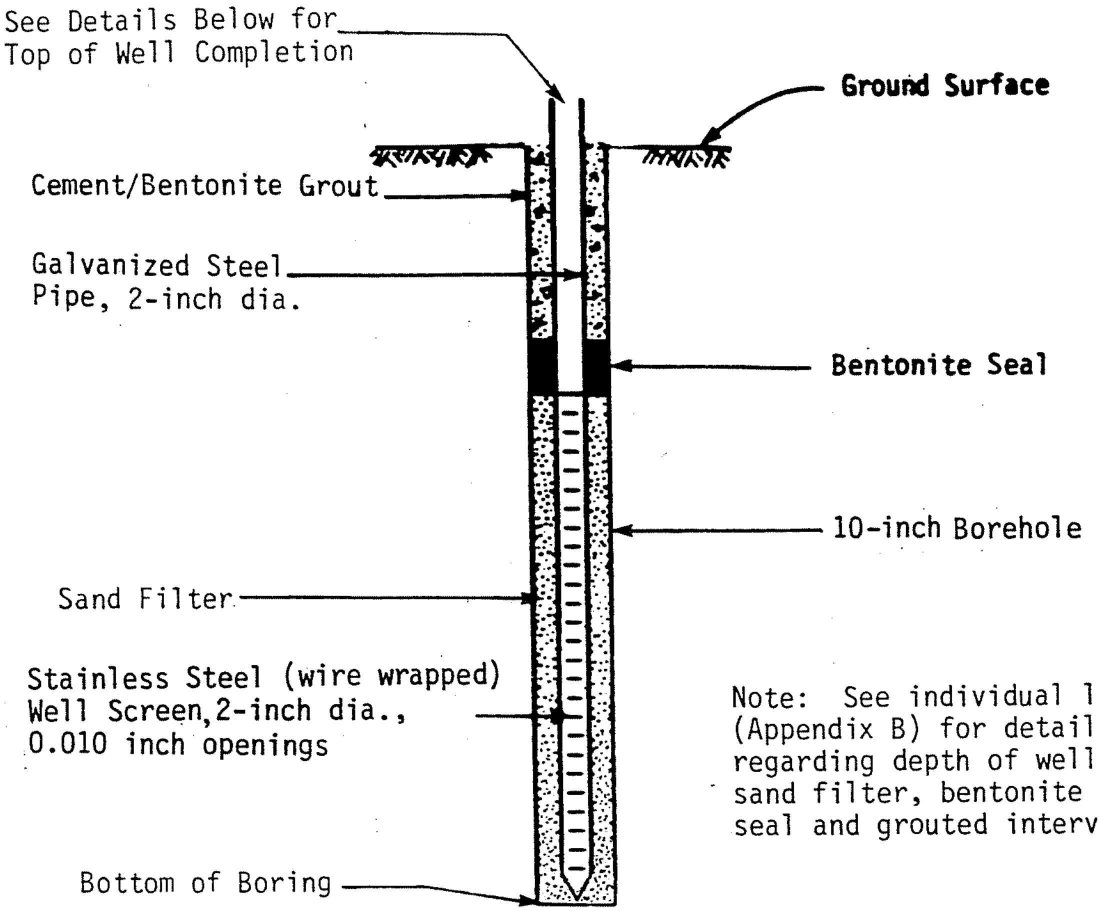
TOP OF AQUICLUDE

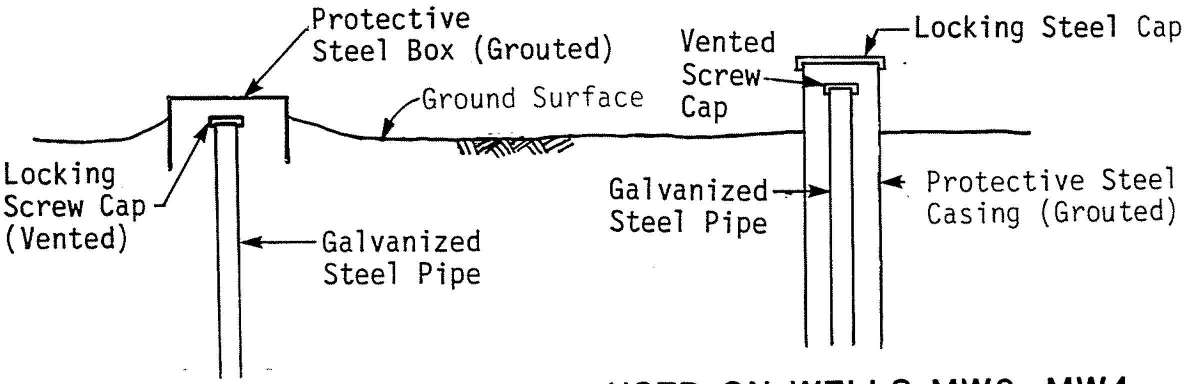
Pine and Tuscarora Site
Niagara Falls, New York

PLATE 11

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES	17497,001.12				



Note: See individual logs (Appendix B) for details regarding depth of well, sand filter, bentonite seal and grouted interval.



USED ON WELLS MW1 & MW3

USED ON WELLS MW2, MW4, MW5, MW6, & MW7

NOT TO SCALE

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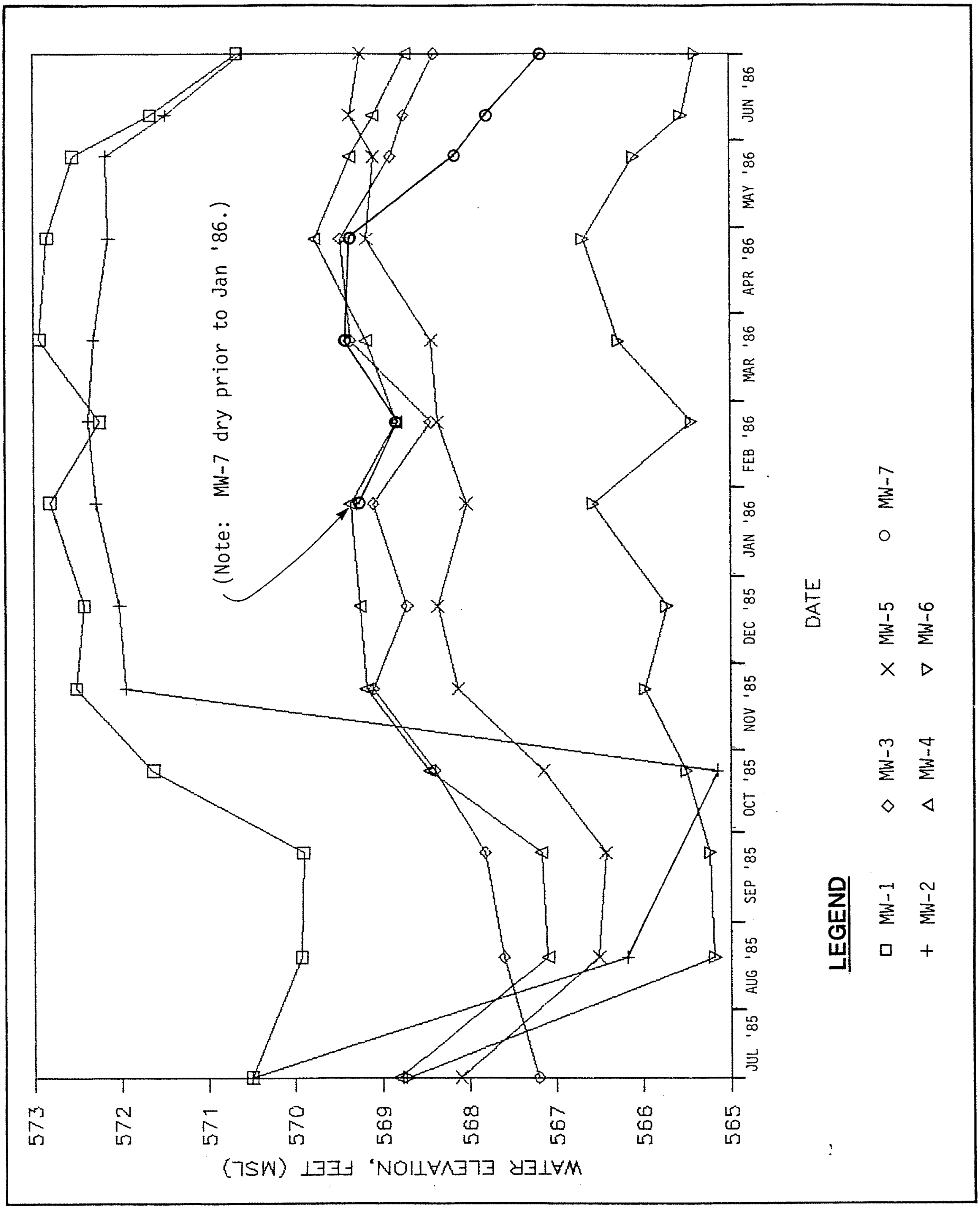
TYPICAL MONITORING WELL DETAIL

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
12

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	BH	7/22/86		



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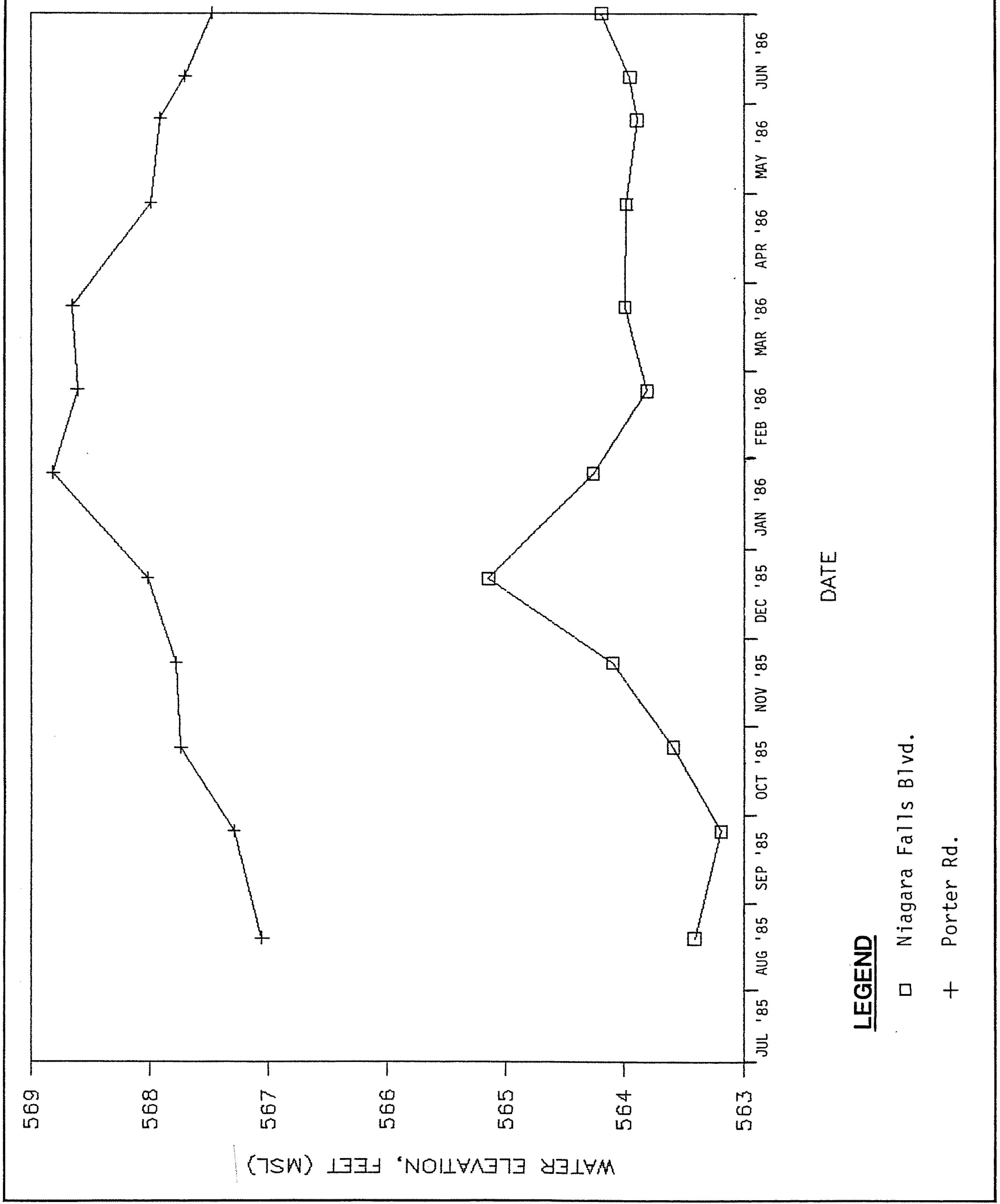
GROUND-WATER HYDROGRAPHS

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
13

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MK	17497,001.12	BH	7/23/86		



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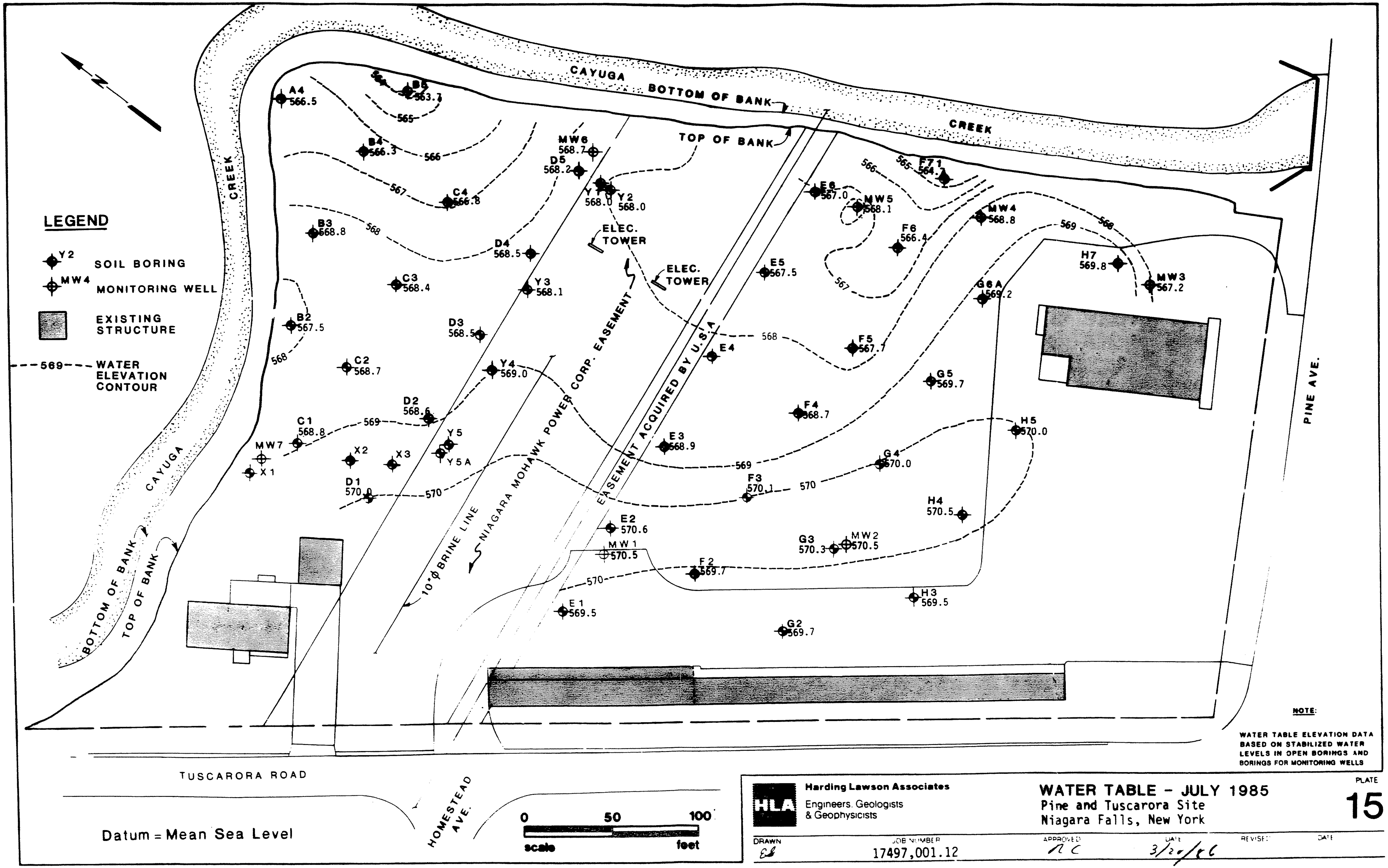
CAYUGA CREEK HYDROGRAPHS

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
14

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MK	17497,001.12	BH	7/23/86		



Datum = Mean Sea Level

NOTE:

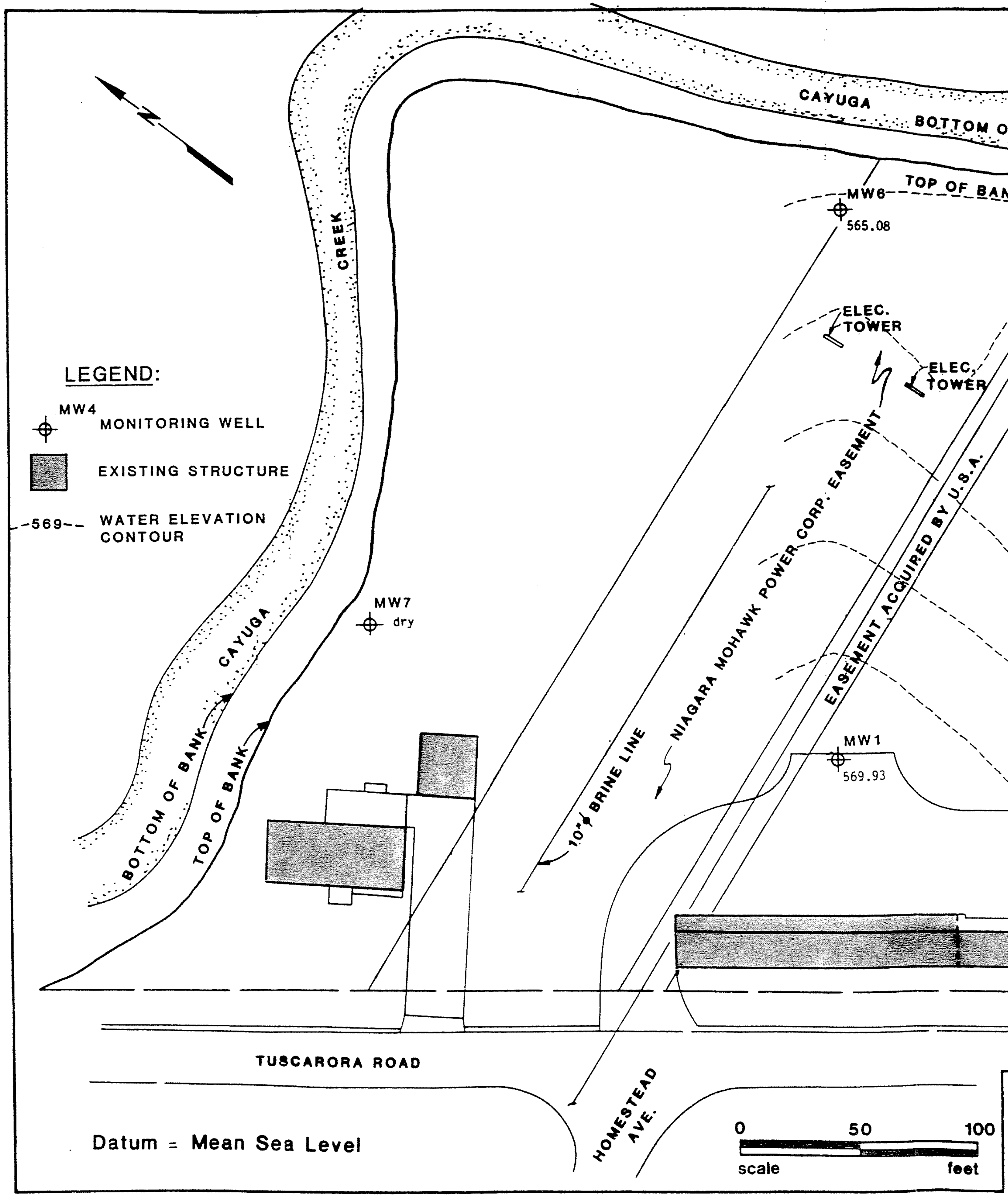
WATER TABLE ELEVATION DATA BASED ON STABILIZED WATER LEVELS IN OPEN BORINGS AND BORINGS FOR MONITORING WELLS

HLA **Harding Lawson Associates**
Engineers, Geologists & Geophysicists

WATER TABLE - JULY 1985
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
15

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
EL	17497,001.12	RC	3/20/86		



Datum = Mean Sea Level

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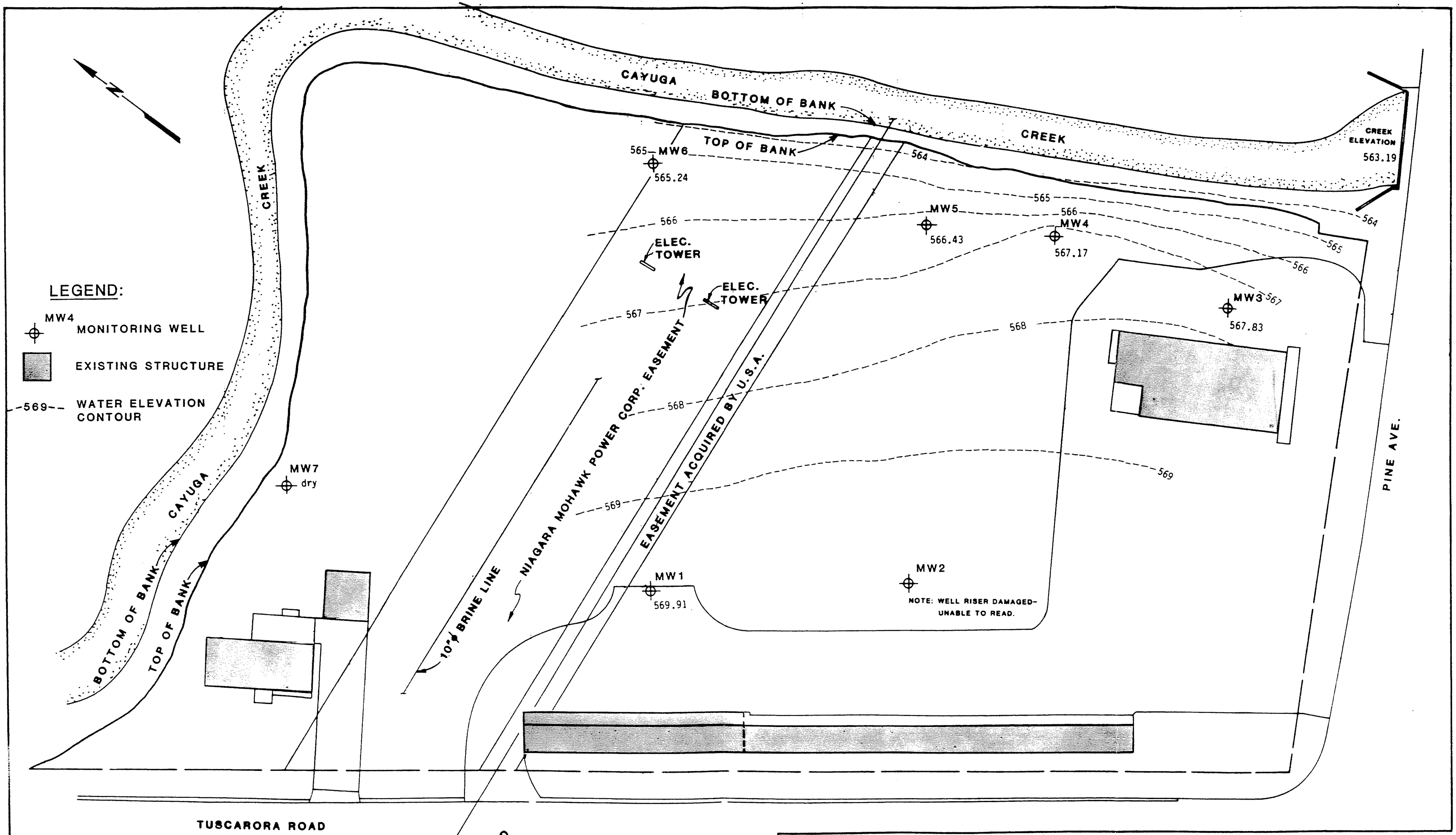
& Geophysicists

WATER TABLE - AUGUST, 1985

Pine and Tuscarora Site
Niagara Falls, New York

PLATE 16

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12	BH	7/22/86		



Datum = Mean Sea Level

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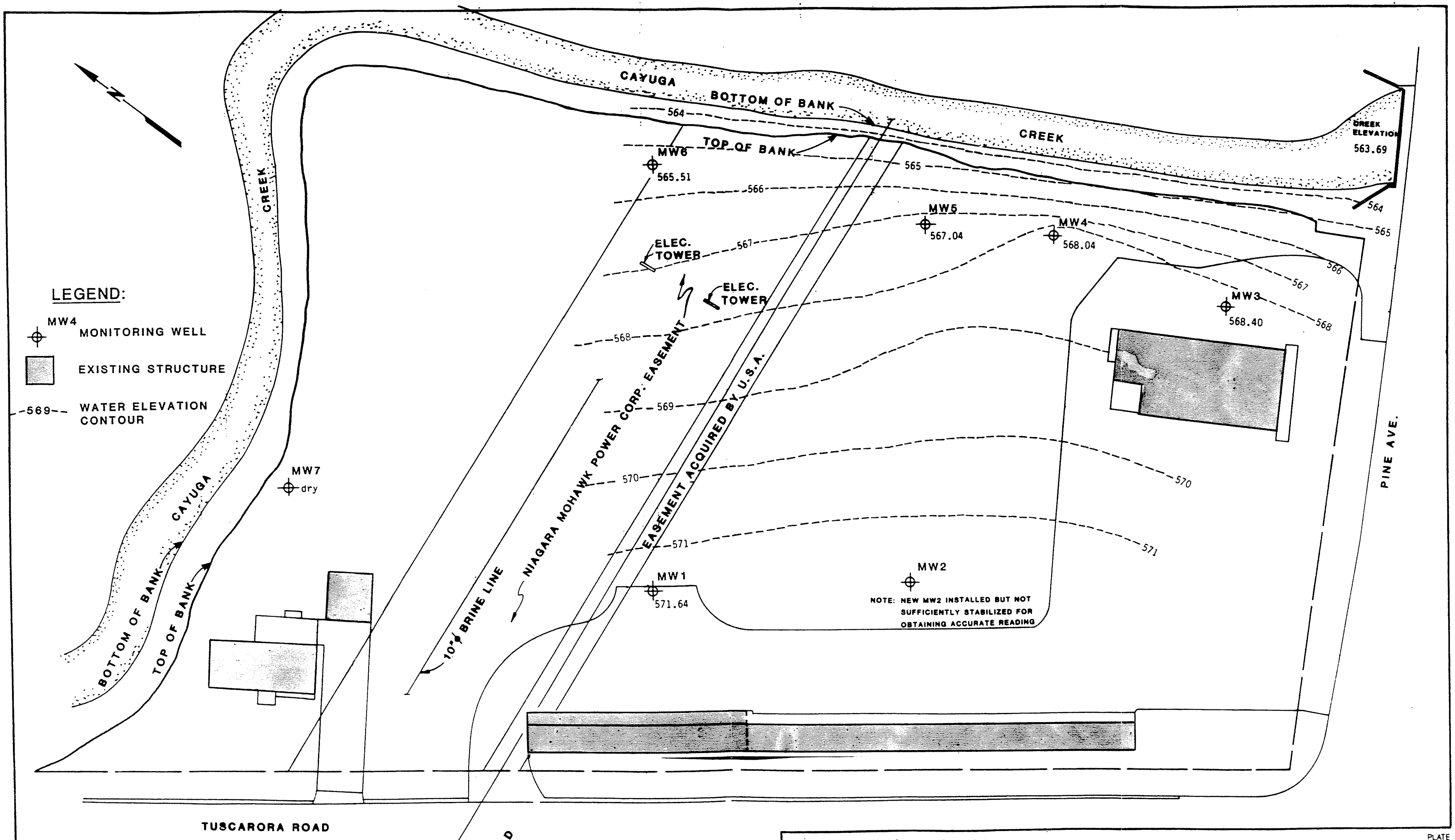
& Geophysicists

WATER TABLE - SEPTEMBER, 1985

Pine and Tuscarora Site
Niagara Falls, New York

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12		7/22/86		

PLATE
17



Datum = Mean Sea Level

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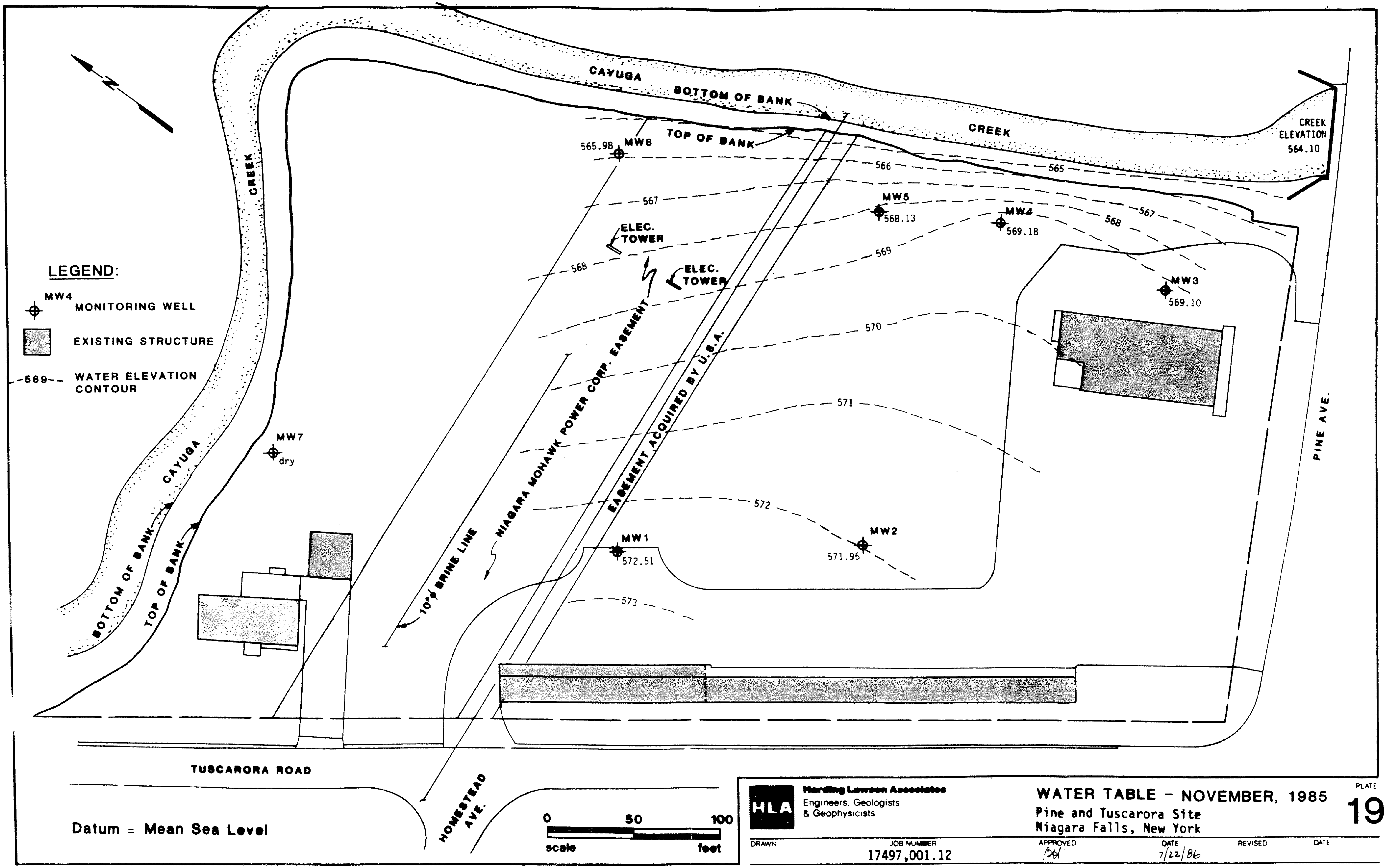
& Geophysicists

WATER TABLE - OCTOBER, 1985
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
18

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12	JH	7/22/86		



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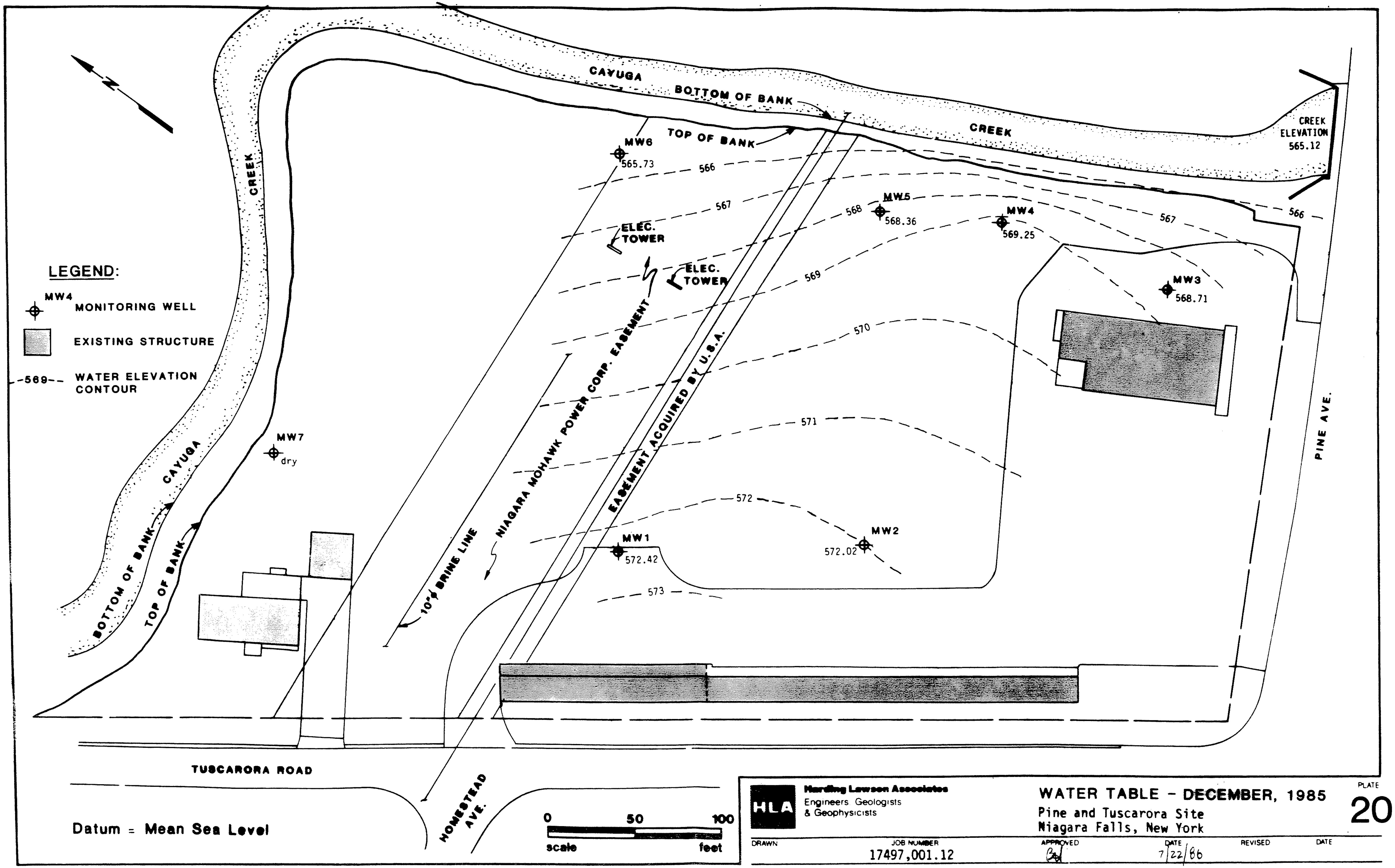
WATER TABLE - NOVEMBER, 1985

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
19

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	DH	7/22/86		



Harding Lawson Associates
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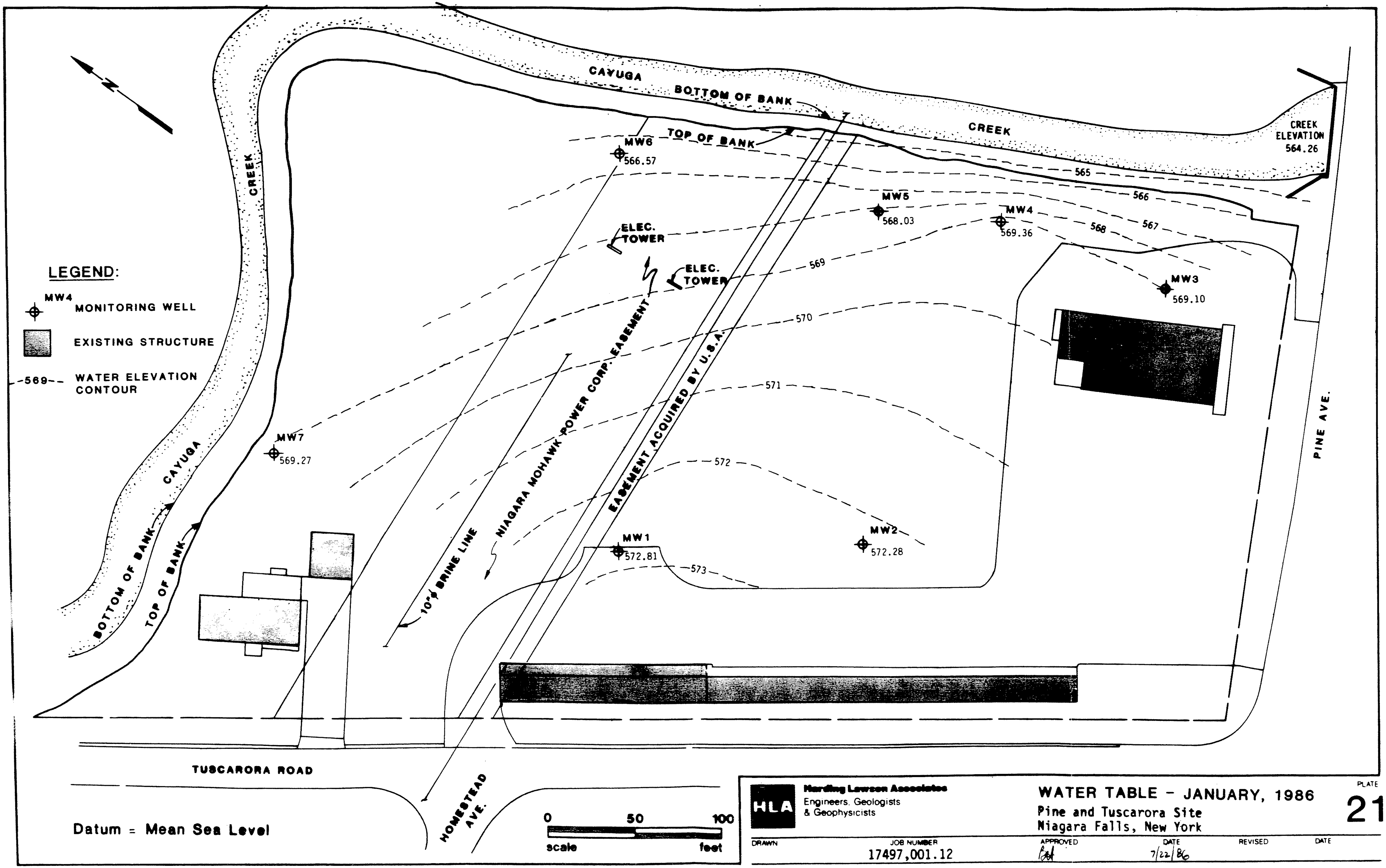
& Geophysicists

WATER TABLE - DECEMBER, 1985

Pine and Tuscarora Site
Niagara Falls, New York

PLATE 20

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12		7/22/86		



Datum = Mean Sea Level

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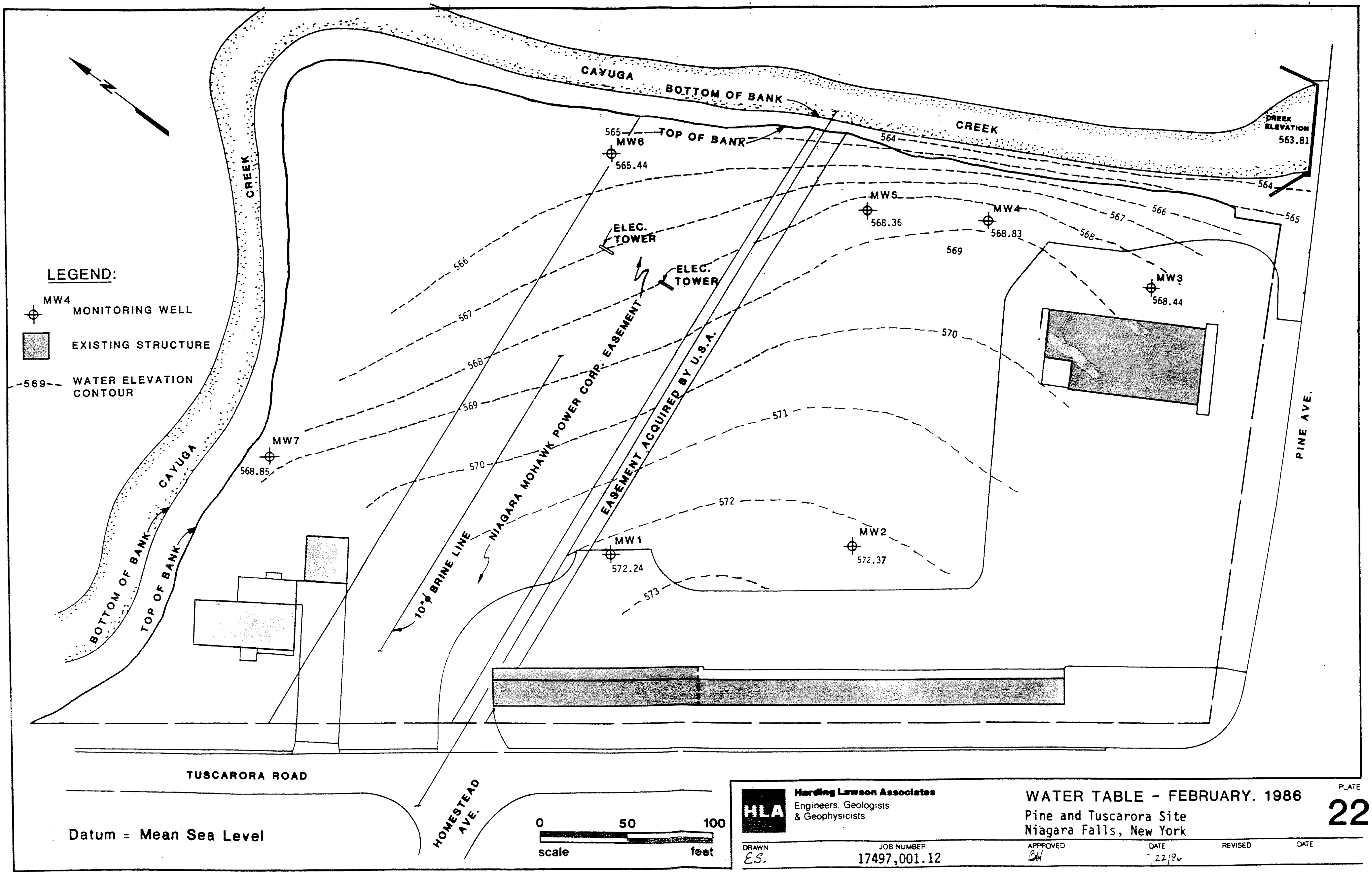
& Geophysicists

WATER TABLE - JANUARY, 1986

Pine and Tuscarora Site
Niagara Falls, New York

PLATE 21

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	Bd	7/22/86		



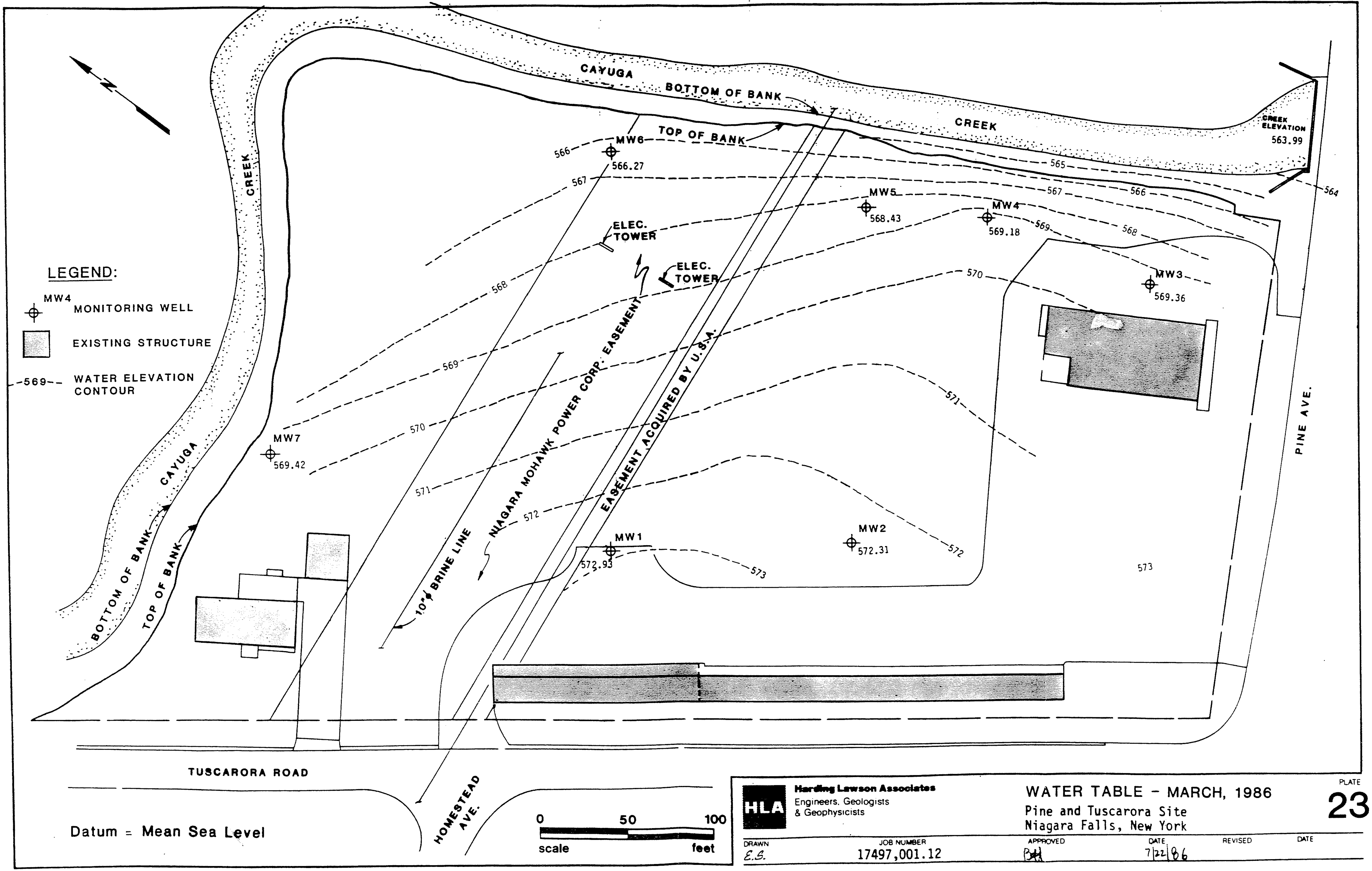
Harding Lawson Associates
Engineers, Geologists
& Geophysicists

WATER TABLE - FEBRUARY. 1986

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
22

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12	BH	7/22/86		



Datum = Mean Sea Level

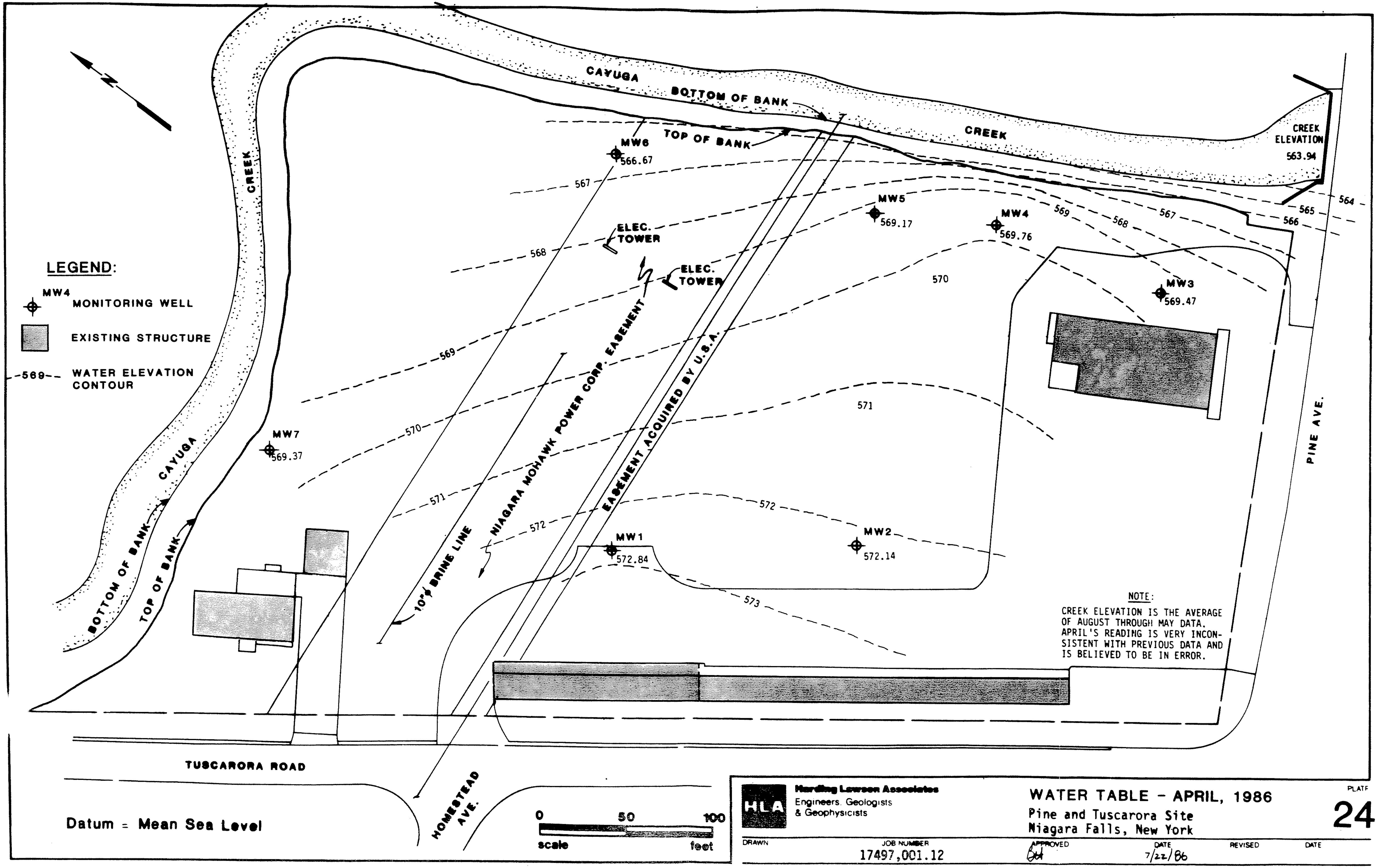
Harding Lawson Associates
Engineers, Geologists
& Geophysicists

WATER TABLE - MARCH, 1986

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
23

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
E.S.	17497,001.12	BH	7/22/86		



NOTE:
CREEK ELEVATION IS THE AVERAGE OF AUGUST THROUGH MAY DATA. APRIL'S READING IS VERY INCONSISTENT WITH PREVIOUS DATA AND IS BELIEVED TO BE IN ERROR.

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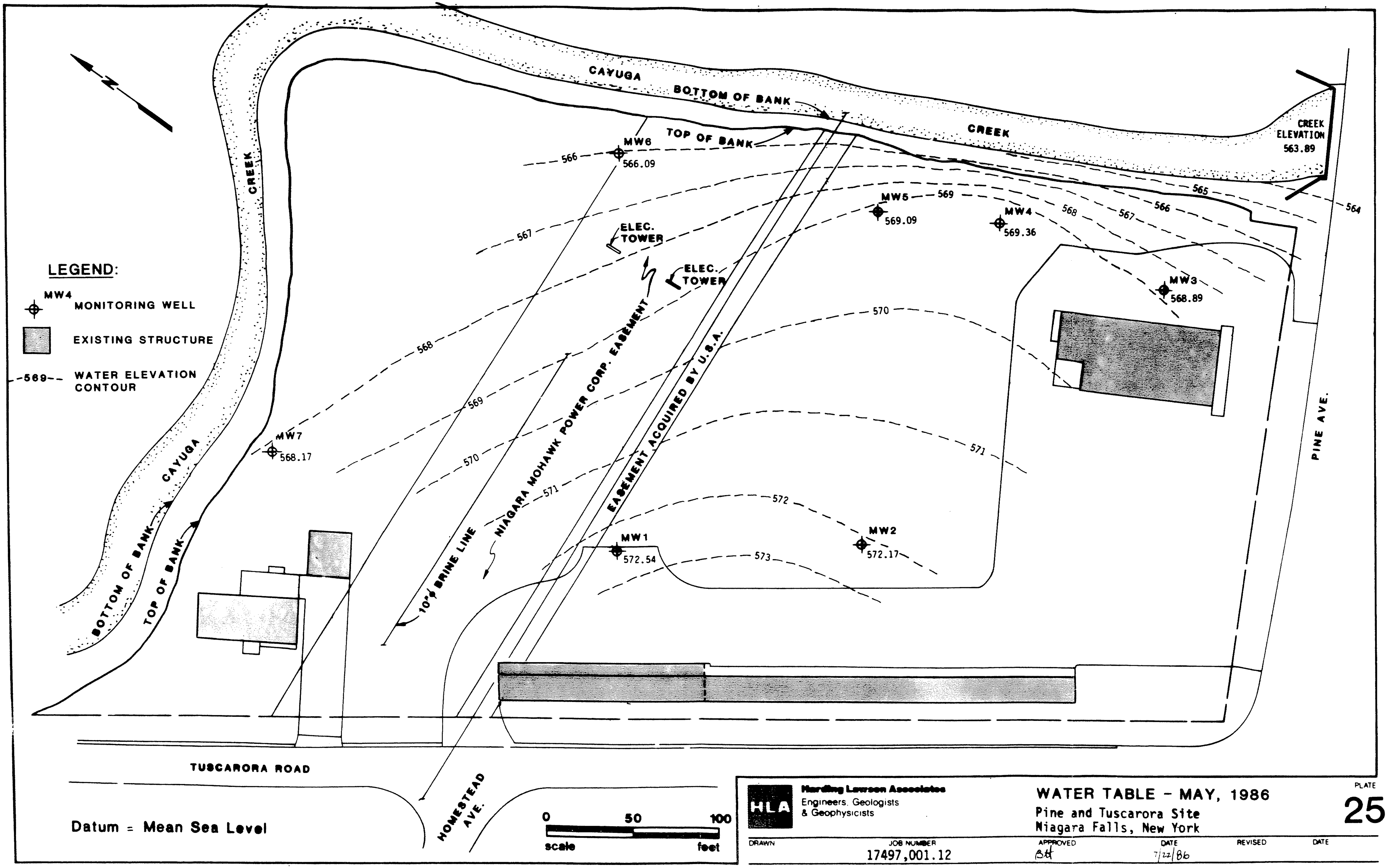
WATER TABLE - APRIL, 1986
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
24

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	BH	7/22/86		



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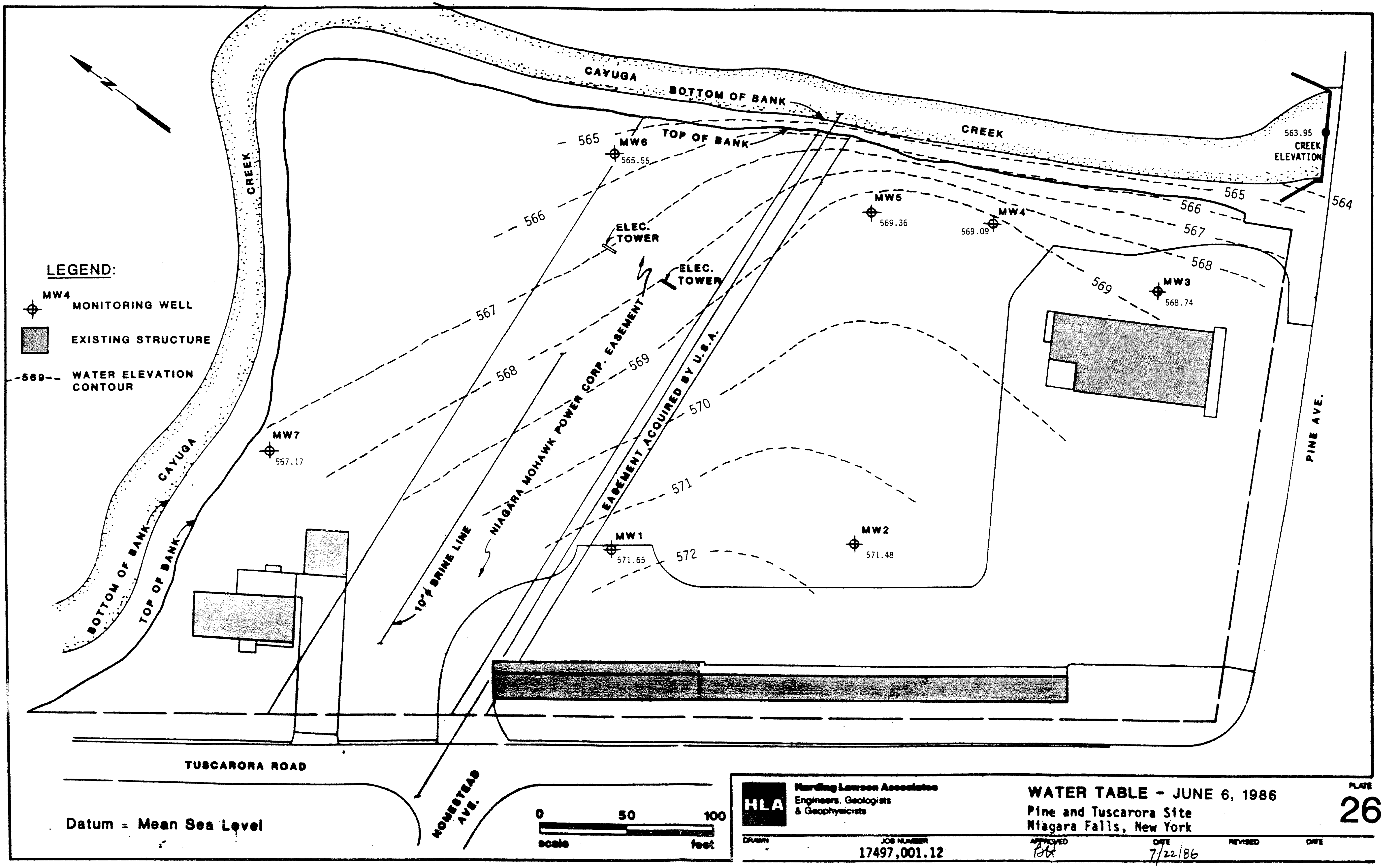
WATER TABLE - MAY, 1986

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
25

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	BH	7/22/86		



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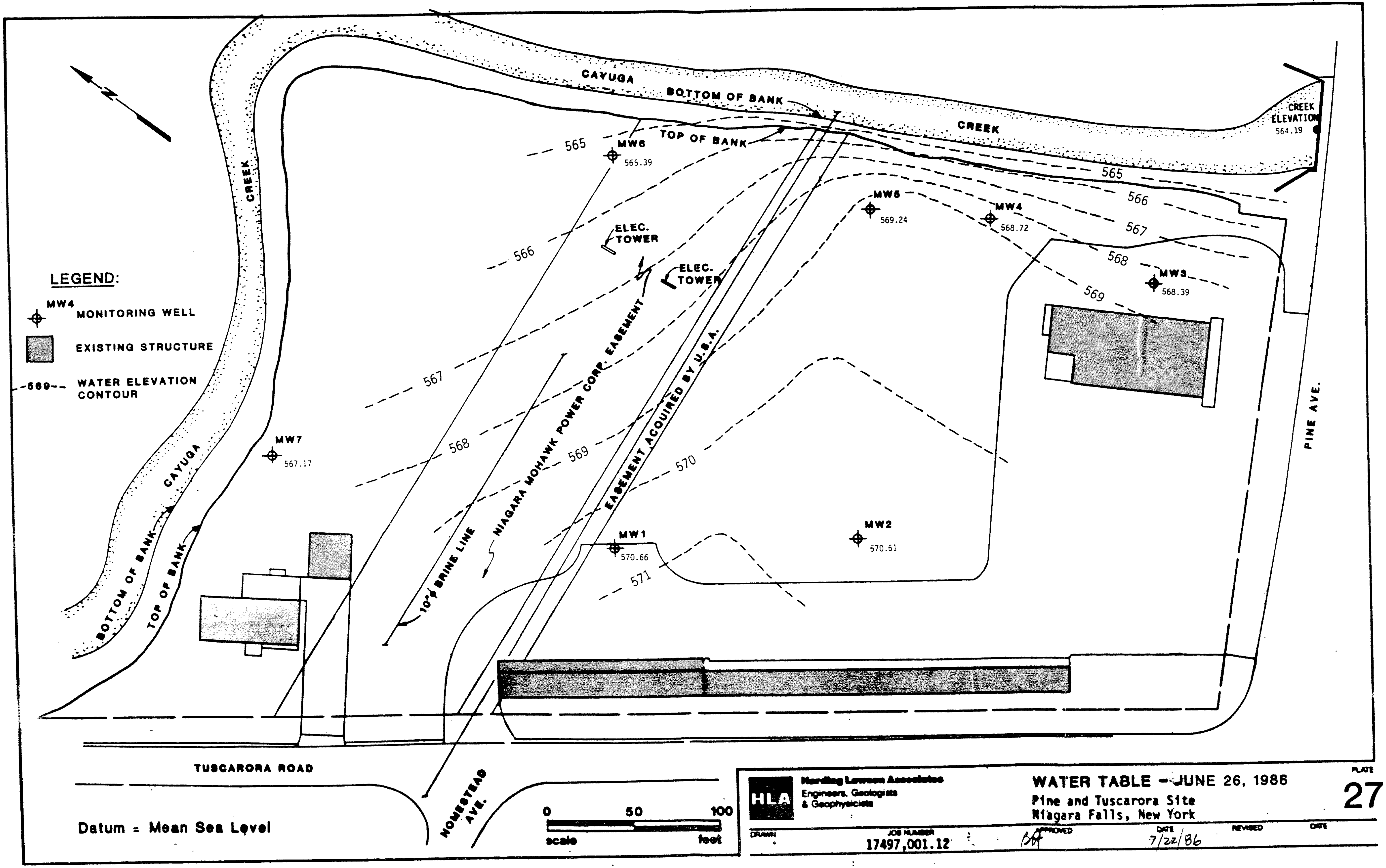
WATER TABLE - JUNE 6, 1986
Pine and Tuscarora Site
Niagara Falls, New York

PLATE **26**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12		7/22/86		



HLA Harding Lawson Associates
Engineers, Geologists & Geophysicists

WATER TABLE — JUNE 26, 1986

Pine and Tuscarora Site
Niagara Falls, New York

PLATE 27

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	BH	7/22/86		

APPENDIX A

WORK PLAN

PINE/TUSCARORA INVESTIGATION PLAN

I. REMEDIAL INVESTIGATION

A. GROUND SURVEY

A preliminary site map will be prepared from existing information (scale 1 = 20') which will provide an overall site description. Buildings, power lines, buried pipelines, and other physical or geopolitical landmarks will be noted. This map will serve as the working, field base map. The borehole grid will be laid out on this preliminary map. In addition, as field work progresses, various appropriate notes may be made for incorporation in a final site map.

B. BURIED METAL DETECTION

1) Purpose

    a) To detect location of any buried metal drums.

    b) To define buried metal obstructions on-site as potential avoidance areas for drilling operations.

2) Instrumentation

    a) Function

        1) Fisher M-Scope Model TW-5 metal detector

        2) Senses buried metal by transmission of radio field and detecting field distortions caused by metal presence.

        3) Functions by traverse over ground surface.

        4) Traverses cover 4-foot width, with series of traverses across site to cover entire site area.

    b) Limitations/capabilities

        1) Will detect presence/absence of buried metal

2) Will not detect shape of buried metal

3) Will not be affected by presence of on-site automobiles.

4) Can be marginally affected by presence of powerlines, correctable by calibration.

5) Can detect metal several inches in size.

6) Depth of detection up to 20 feet depending on soil conditions.

7) Operation of unit is described in attachment.

3) Field Procedures

a) Area of concern for metal detection is entire site except those areas to the south and west of the Batrouny residence, motel and garage have been excluded because they contained structures or were at grade elevation at the time of disposal. (Area to the east of the garage is included in metal detection survey). See Appendix 2.

b) Clear site of parked automobiles to facilitate traverse of metal detector.

1) Tow truck will move autos to south end of site to allow room for drilling and metal detection traverse.

c) Linear traverse lines will be laid out by pegged cord

1) Line will allow 3-foot wide traverse corridors across width of site.

2) This corridor width will allow small overlap between adjacent traverses.

3) When buried metal is detected, marker stakes will be placed to define the location and extent of buried metal, immediately after detection.

4) Buried metal pipelines will be defined in like manner.

5) Where buried pipelines are evident, a secondary traverse will be made to verify its presence along the pipeline length.

6) This secondary traverse may cross initial traverse pattern diagonally.

7) Secondary traverses will be done for all buried metal pipelines.

8) Secondary traverses will also be made to verify the aerial perimeter of any other detected metal.

9) All pipeline and buried metal locations will then be plotted on baseline map of the study area and will be included in any reports on the study.

4) Results

a) Metal detection investigation will have established the perimeter of any buried metal.

b) Metal detection will define buried pipelines.

c) This will identify an area for avoidance by drilling apparatus, i.e., avoidance area will be the area underneath the powerline plus an area 10 feet wide centered on the buried pipelines.

C. BORING PROGRAM

1) Purpose

   a) To visually note presence of any buried waste materials and determine the area and depth of their occurrence on-site.

   b) To identify as best as possible the buried waste materials.

   c) To collect soil samples for analysis.

2) Field Layout

   a) The study area will be divided into a grid by wooden field stakes.

   b) Grid points will be 50 feet apart.

   c) Study area is the total site minus the agreed upon exclusion areas noted on base map (Appendix 2).

      1) These exclusion areas include the strip of land defined as the powerline R.O.W. (detected in buried metal detection program) and is noted in attached letter, dated January 4, 1982. (Appendix 3)

      2) Study area is bounded on east by Cayuga Creek, on north by Cayuga Creek and the Batrouny property line, on west by a line parallel to and 10 feet from the east side of Batrouny house and motel, and on south by a line 10 feet from and parallel to rear of the garage; however the area to the east of the garage shall be sampled according to Section I.C.(2)(e)(1).

    3) If waste is encountered in the course of study at the edge of the study area, the study area shall be expanded in order to determine the extent of buried waste.

d) All grid points will be numbered by row and column to identify any samples collected at each point. Grid point numbers will be marked on stakes and on field maps.

e) There will be a total of about 35 (±) borings.

    1) Initial grid at 50-foot centers is shown on sketch (Appendix 2) and involves 25 (±) borings, including one boring east and south of the garage.

    2) An additional 10 (±) borings may be sited in the field to define the extent of any burial zones detected by the initial 25 borings. If additional study is necessary to define the waste areas in the R.O.W., small test pits may be utilized if borings are not feasible. For the purpose of Plan A, "small" means the width of a standard backhoe blade. Soils from test pits will be treated in the same manner as auger cuttings as provided at 3(c)(4).

    3) The additional 10 borings will be sited by judgement of the Olin field engineer, consistent with Section II, based upon visual inspection and aerial distribution of any buried waste as noted in core samples from the 25 initial borings.

f) All samples taken during the study will be numbered according to grid location and depth below grade to provide consistent reference to any sample locations.

3) Boring and Sampling Procedures

a) Continuous core samples will be taken.

1) Where buried waste is encountered, samples will be collected to one foot into virgin soil.

2) Boring will be terminated when no buried waste is found one foot into any aquiclude encountered below fill. For the purposes of this study, an aquiclude is a poorly permeable formation or bed that impedes groundwater movement.

3) Should a soil boring be terminated in a clay stratum less than three feet thick, an impervious grout plug will be tremied into the bottom of the boring to create an impervious grout seal. If the clay stratum is greater than three feet thick, a sufficient quantity of bentonite pellets shall be placed down the boring to provide a seal against downward migration.

4) Presence/absence of waste to be determined by onsite visual inspection and, concurrent with boring, scanning of samples with an organic vapor meter (OVM) by the inspection field engineer, consistent with Section II.

5) Four soil borings at the corners of the study area shall be completed to bedrock, provided that the borings can be located in non-waste areas. These borings may be omitted if reliable geological information regarding bedrock elevation and stratigraphy across the site is otherwise available.

6) A log of all cores will be kept by the field geologist identified numbered by grid location and depth of core sample as well as core sample description. The log will include information such as names of the boring crew, date, location, initial water table, soil descriptions, blowcounts, and presence/absence of waste. The field log will be considered preliminary information subject to refinement by consultation with other professionals, laboratory analyses and tests, etc.

7) If concrete is encountered at very shallow depths, small test pits will be necessary in this area. Samples will be appropriately collected to yield the same information as borings.

b) Drilling and core sampling methods

1) Drilling and sampling will be done by hollow stem auger and split spoon core sampler.

2) The split spoon sampler will be cleaned between advances by wire brushing and washing/flushing in a bucket of water, washed with detergent, rinsed with distilled water, solvent rinsed, then air dried. Spent solvents and rinse water will be stored and disposed of in accordance with applicable regulations.

c) Auger cuttings and completed boreholes

1) Seven selected boreholes will be converted to groundwater monitoring wells. Excess auger cuttings and excess groundwater from development will be stored and disposed of in accordance with applicable regulations.

2) Auger cuttings (from borings not converted to monitoring wells) will be poured back down the boreholes to a depth of two feet below grade with the remainder of the boreholes packed with impervious grout. A six-inch space between grout and surface level shall be left and clean fill deposited to surface level.

3) Should a soil boring be terminated in a clay stratum less than three feet thick, an impervious grout plug will be tremied into the bottom of the boring to create an impervious grout seal. If the clay stratum is greater than three feet thick, a sufficient quantity of bentonite pellets shall be placed down the boring to provide a seal against downward migration.

4) Soil from test pits may be replaced to within six inches of grade and clean fill then deposited to grade.

d) Samples for laboratory permeability

1) Special sampling procedures will be used to collect samples for laboratory permeability measurements as described below.

2) Six selected samples will be collected in the field based upon judgment by Olin field geologist, consistent with Section II.

3) Samples will be collected by Shelby Tube, a method similar to split spoon, but consisting of a solid metal tube driven into soil, sealed with wax upon withdrawal and sent to laboratory in that form for permeability tests.

4) This method preserves the sample in an undisturbed state with natural moisture content and texture for accurate permeability tests.

5) This method can replace split spoon tests for the six specific samples at any grid point or depth.

6) The State may have representatives on hand when Shelby tubes are opened.

7) After permeability testing, the soil contained in the Shelby tubes should be preserved for possible chemical analysis.

4) Handling Core Samples

a) Each core sample will be removed from the split spoon and stored in a clean glass jar with Teflon lined lid, and cover-sealed with a paper label.

b) Each jar will be marked with sample number consisting of grid point and depth of core, sampler, time and date of collection.

c) Sample will be visually inspected and logged in the field.

1) For soil, texture and soil classification will be noted.

2) For any waste, description of waste will be noted, i.e., color, organic vapor level and texture.

d) Twenty samples selected by the field engineer, consistent with Section II will be analyzed as detailed in analytical protocol outline.

1) Selection will be made after reviewing boring logs and visual inspection at laboratory. The field engineer(s) who supervised the taking of the samples shall participate in the sample selection.

2) Selection will be done so as to include samples of any and all different wastes found on the site, and shall also include seven soil samples taken from the intervals selected for well screen placement.

3) If the analysis of the 13 non-well borehole samples is no longer sufficient to define and characterize the waste areas, up to seven additional samples shall be analyzed to sufficiently characterize the waste areas.

e) All samples will have chain-of-custody label attached to bottle and will be handled according to chain-of-custody procedures described below.

f) All samples will be shipped to analytical laboratory as per U.S. Department of Transportation (USDOT) procedures governing the shipping of potentially hazardous substances (49 CFR 272.101).

g) All samples will be maintained at 4°C during shipment, as specified in 49 FR 43260. (Appendix 4)

h) All samples will be stored appropriately at the laboratory for the maximum recommended periods as provided for in the appendices, so that additional future analyses can be performed if found necessary.

5) Chain-of-Custody Procedures

a) Purpose: To establish a chain of responsibility for possession and integrity of sample at each point of transfer and exchange from collection to analysis.

b) Labels will be attached to each sample bottle and will identify location, sample number, date and time of collection, collector(s). The chain-of-custody document will identify the handlers (including commercial shipper), receiver at analytical laboratory and all other handlers at laboratory, up to time of analysis. All such receivers and handlers will sign the chain-of-custody document. The bill of lading from the commercial shipper may be substituted for the shipper's signature. Analysts will sign laboratory report sheets and/or notebooks.

c) Chain-of-custody labels will be returned to Olin field engineer upon analysis of sample for cross-check in field log book.

d) All sample containers will have a paper label which will be broken only immediately prior to analysis.

e) Each sample received by laboratory will be logged in by sample number, date of receipt, and date of analysis and analytical results.

f) All analytical results will be signed by appropriate personnel at laboratory.

D. GROUNDWATER PROGRAM

1) Purpose: To collect samples of groundwater for analysis, measure water table depth and gradient.

2) Seven selected boreholes will be converted to groundwater monitoring wells.

   a) The locations of wells will be selected to allow distribution across the site for vertical and horizontal groundwater table measurement and sample collection.

Location of wells will be made by the field geologist consistent with Section II.

b) The boreholes will be converted as follows:

   1) As the borehole is completed, soil samples will be taken by split spoon sampler and hollow stem auger, detailed in previous section. The borehole will not be backfilled.

   2) A galvanized steel well casing will be lowered into the hollow stem auger to bottom of the hole.

   3) The hollow stem auger will then be removed from the hole around the well casing, leaving the well casing in place.

   4) Auger cuttings will be retained and disposed of as specified in I.C.3.c.(1).

   5) <u>No well will be located in waste areas</u>.

   6) If groundwater table is below the expected 10-foot depth below grade, the selected boreholes may be drilled deeper so as to allow for collection of groundwater samples. These borings will extend down to but not through the aquiclude.

   7) Selection of wells to be drilled deeper and depth of drilling will be at the judgment of the Olin field geologist consistent with Section II, and will be logged in his field log book.

   8) Wells will be installed at the surface of any aquiclude, e.g., native clay stratum that is encountered below the fill. This aquiclude will be

defined in the field by the Olin field geologist consistent with Section II.

3) Well Construction

a) The portion of the well casing below water table will be screened to allow in-flow of groundwater.

b) Screen will extend one foot above water table to safely allow for any seasonal fluctuations of water table levels. It will extend below water table to the aquiclude defined above.

c) Screen will be five foot lengths of .010-inch slot stainless steel, casing will be galvanized steel, two inches in diameter, with flush joint couplings and lockable vented caps. Pipe dope and/or lubricants will not be used.

d) The annular space (between casing and hole wall) will be backfilled with clean gravel or coarse sand (3-10 Tyler mesh) fill approximately one foot above the top of the well screen to minimize suspended sediments reaching the well.

e) At the top of the gravel pack a one-foot thick impervious bentonite plug will be set, and from there to above ground level, an impervious bentonite grout mixture will be set. This will ensure that no surface run-off directly enters the well and that only groundwater is sampled.

f) The top of the casing will extend two to three feet above ground level unless otherwise specified by the property owners in the site access agreements.

g) A protective four-inch casing will be placed around the two-inch well casing above ground level. A concrete collar will be poured around the four-inch casing for further protection. Each well will be clearly labeled and noted on the site map.

h) All well caps will be lockable and kept locked. The Olin field geologist will retain the keys. Spare keys will be kept on file at the office of the geologist.

i) Keys must be signed out and in, and only used by the signer. Purpose of key sign-out must be stated. The State will have access to the keys upon 24 hours notice. Access to the wells will normally be for the purpose of taking samples or making water table measurements. Access to the wells shall be restricted, where practicable, to times that do not interfere with Olin's field program.

4) Upon completion of the boring program and well installation, the site will be surveyed and maps will be prepared by a licensed surveyor. Said survey maps shall detail physical and legal property boundaries, surface contours, locations of buildings and structures, buried pipelines and powerline R.O.W.'s, well and boring locations and elevations of wells to the nearest .01 foot in relation to mean sea level. A contour map of virgin soil elevations and waste locations shall also be prepared.

5) Well Development

a) Wells will be blown with compressed air until clear water is produced, and then pumped to remove three well volumes. After three well volumes are removed and three consecutive identical conductance readings are obtained during a three minute interval, the wells will be considered developed.

6) Water Table Measurement

a) The top of each well casing will be marked and measured, referenced to USGS datum. A marker on Pine Avenue bridge and an upstream point from which the relative elevation of creek water in Cayuga Creek can be measured will also be marked and measured, referenced to USGS datum.

b) Well top elevations will serve as reference points for water table measurement in each well.

c) Water table levels will be measured to the nearest .01 foot from casing top by one of several methods: (1) a weighted measured tape which will sound when it touches water level; or (2) an electric probe on a measured line which will light a small bulb or move a chart needle at surface when the probe hits water (conducting a small current).

d) All well depths, pipe top elevations and creek level elevations will be recorded by an Olin field technician, to .01 foot at 30 to 35-day intervals for one year after the first measurement is taken. At least a 48-hour notice will be provided to the State prior to the measuring date.

e) Data will be used to plot groundwater table gradient and the relation of water table to creek level. Separate high and low water contours will be plotted if differences are significant.

6) Groundwater Sampling

a) Water will be flushed from wells by a peristaltic pump with silicone rubber interior tubing. Precautions will be taken to insure removal of the entire column of stagnant well casing water. All down hole tubing will be of inert plastic and will be well dedicated. Pump will be repeatedly rinsed with distilled water between wells. Inert plastic will be disposed of after each sampling.

b) All wells will be flushed prior to sampling by extracting three times the volume of well casing (at first sampling, after five times the volume), or once to dryness if recharge is slow; and sampled after three identical specific conductance readings are obtained within a three minute interval.

c) All flushed water will be retained and properly disposed of in accordance with regulatory requirements.

d) Samples will be collected monthly for first three months and quarterly thereafter. First sampling will be done at least two weeks after well development and in any event as soon as practicable after the analytical results of the soil sampling are complete. Groundwater samples will be collected by hand bailing to insure that no air contacts the samples thereby potentially volatilizing any chemical constituents of the sample.

e) If well recovery (fill-up after water withdrawal) is slow, sampling of all wells shall occur over one day under rising head conditions.

f) Caps will be locked after completion of each sampling.

g) Samples will be collected in glass bottles with Teflon-lined lids, and sealed with a paper seal.

h) Groundwater sampling procedures will follow the principles delineated in 1) "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities" (USEPA SW-611) Dec. 1980 and/or "Handbook for Sampling and Sample Preservation of Water and Wastewater", (EPA-600/4-82-029) September 1982.

8) Handling of Groundwater Samples

a) Samples will be maintained at 4°C during shipment to the laboratory according to procedures detailed in soils sampling section of Boring Program. Sealed insulated coolers with "cooler paks" will be used for storing and transporting samples to the analytical laboratory.

b) Chain-of-custody procedures, as detailed in Boring Program will also apply to all groundwater samples.

9) Field measurement for lateral permeability. Well pump down recovery rate tests will be conducted in four wells to determine the permeability of the saturated aquifer in accordance with procedures in Appendix 5.

II. COOPERATION WITH THE STATE

A) The field engineer(s) and geologist(s) shall confer with the State's on-site representative who shall have the right to advise concerning the propriety and correctness of field decisions. All field personnel shall make good faith attempts to resolve disputes concerning methodology, boring location, sample collection and other matters requiring in-field judgment. If dispute resolution fails, and it subsequently is determined that action taken was erroneous, necessary corrective action shall be taken by Olin. Both parties shall maintain the right to request the immediate cessation of any procedure, work or action, which it considers to be unsafe or a health hazard to those on the site or its environs.

B) Soil samples collected by Olin shall be sufficiently large to allow for the splitting of samples with the State. The State shall be provided split samples upon its request. Selection by the State of soil samples need not be made until analytical results from the water samples have been provided to the State. The State shall be allowed splits of water samples at the time of sampling.

III. ANALYTICAL PROTOCOL

A. SOILS

1) Sample parameters and procedures

   a) Analysis one time on 20 samples, two replicates for each sample.

   b) Analyze for HCB and BHC in all samples.

   c) At the time of collection all core samples will be examined visually and with an OVM to detect samples which are suspected to be other material than BHC and HCB.

   d) Of these visually and organic vapor examined core samples, select up to 10 representative samples for each suspected waste and analyze for the list of potential Olin contaminants in Appendix 6 or paragraph 4(e) of the Consent Decree.

   e) Measure moisture content of soil samples to facilitate chemical analysis reporting on a dry basis.

2) Sampling handling and analysis

   a) Portions for analysis from each core will be taken from the core center to eliminate the potential of core surface contamination.

   b) Volatile priority pollutants in soils will be analyzed according to the attached procedure - Method 8240 in USEPA SW-846. (Appendix 7).

   c) Base/neutral pesticide and acidic samples will be prepared for organic analysis by extraction method and analyzed by GC/MS using Method 8250 as detailed in USEPA SW-846 . (Appendix 8).

d) Inorganic constituents will be analyzed by USEPA SW-846, 1982.

e) BHC and HCB will be analyzed by GC/MS Method 8250 as detailed in USEPA SW-846. (Appendix 8).

f) Soils permeability tests will be done on specially collected Shelby tube samples, as per ASTM Method D-2434.68.

B. GROUNDWATER

1) Sample parameters and procedures

a) Samples will be collected from each of the seven monitoring wells.

b) Sample frequency will be once monthly for the first three months and quarterly thereafter for nine months.

2) Sample handling and analysis

a) All samples are to be analyzed for HCB and BHC plus any other materials of Olin manufacture which were detected in soils analyses. Samples for analysis shall not be collected until the contaminants in the soil samples have been identified.

b) All samples except volatile organic samples will be filtered to remove any suspended solids and preserved with proper preservative as per "Sampling and Analytical Procedures for Screening Industrial Effluents for Priority Pollutants", USEPA, 1977. This will be done immediately upon receipt of samples at the contractor's laboratory.

c) After samples are received at the contractor's laboratory, analyses will be done as soon as practical and within the holding times listed in 44 FR 43260.

d) Up to a maximum of five (5) groundwater samples will be analyzed for priority pollutants per "Sampling and Analytical Procedures for Screening Industrial Effluents for Priority Pollutants", USEPA, 1977, or "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", USEPA, 1982, or "Methods for Chemical Analysis of Water and Waste", USEPA, 1979. The ten (10) non-priority pollutant compounds present in greatest concentration shall also be identified.

e) BHC and HCB will be analyzed by GC/MS in selected ion mode as detailed under soils analysis outline.

C. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

1) The standard reference for QA/QC procedures during laboratory analysis of samples will be EPA-600 24-79-019, "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", March, 1979.

2) QA/QC for GC/MS laboratory procedures

a) Instrument calibration will be done daily. Precision will be determined by analysis of replicate analysis of same sample.

b) The GC/MS system detection capability will be determined by analysis of standard mixtures, for each type of GC/MS analysis. Standard mixtures will be provided from commercial sources.

c) Additional check is provided by analysis of quality control samples containing four to six compounds after every 10 samples.

d) QA audit samples are analyzed by laboratory, at 5% rate (i.e., one in 20 field samples) for each type of analysis.

e) Non-priority pollutant solvents are utilized in the laboratory for cleaning purposes.

3) QC for trace elements

a) Standards, blanks and duplicates are analyzed for continuous quality control.

b) To check sample digestion, 10% of priority pollutant samples are digested in duplicate. Digestion procedures as per "Sampling and Analysis Procedures for Screening Industrial Effluents for Priority Pollutants". USEPA-April, 1977.

c) After daily instrument calibration, a quality control standard is analyzed to determine recovery.

4) QC practice for inorganic analysis

a) Calibration solutions will be prepared for verification of linear response to standard concentration.

b) Valid analysis of National Bureau of Standards QC sample.

c) Precision verification will be made through duplicate analyses.

d) A standard spike will be run to evaluate recovery and insure absence of matrix interferences.

DLC/GBB/wsr
01/WR9
2/19/85

Original - 11/11/83

APPENDIX I

Metal Detection

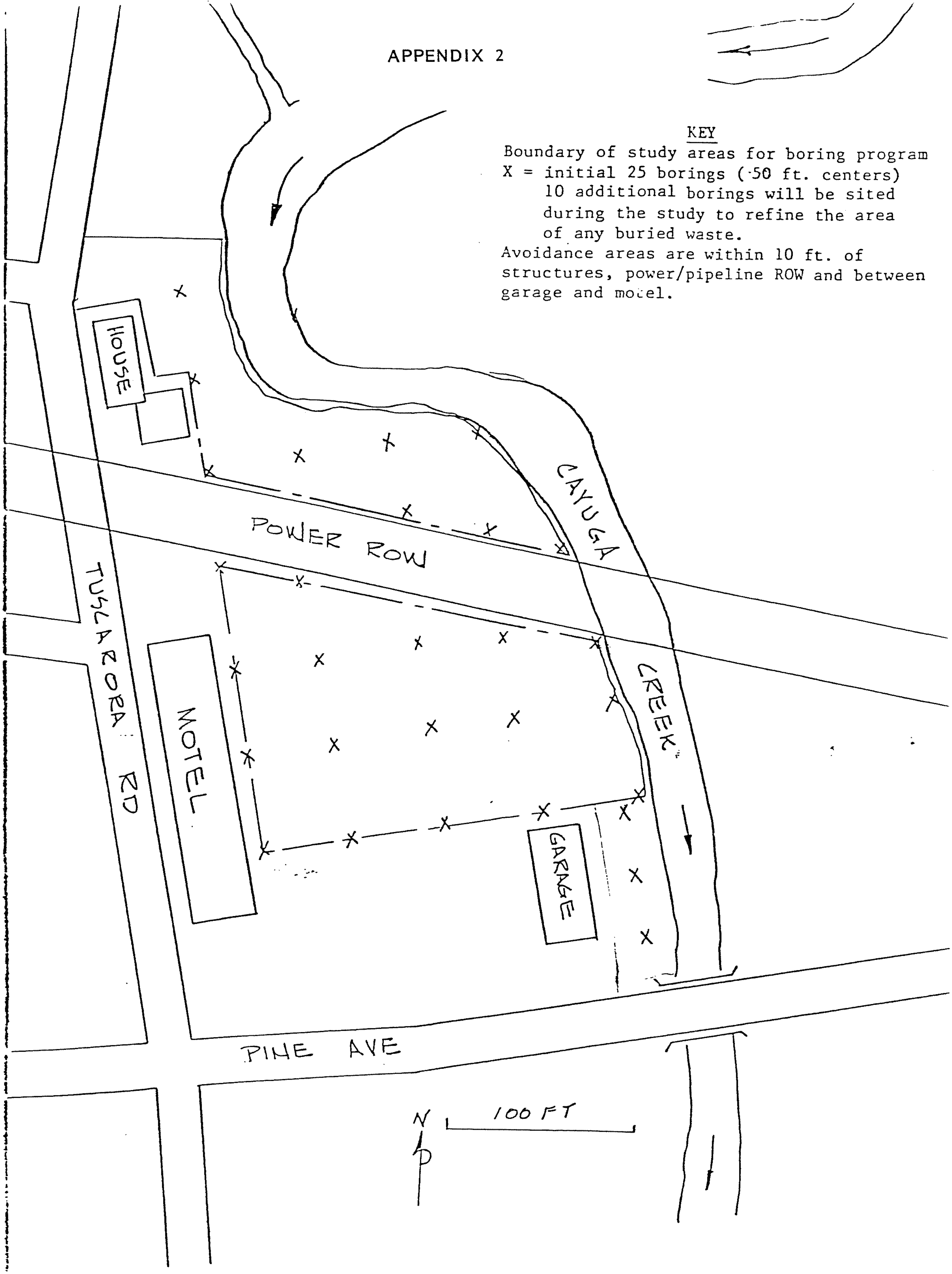
The Fisher TW-5 pipe and cable locator consists of a radio frequency transmitter and receiver. The transmitter outputs a radio signal at 82 kilohertz, frequency modulated at 270 cycles to eliminate outside frequency interference. The signal is transmitted from a loop which yields a perfectly circular field. The receiver unit is mounted on the opposite end of four-foot long handle and, when calibrated using adjustment screws, is parallel to the radio field lines and thus does not detect the signal.

When the radio field lines encounter a metal object, the field lines are distorted and receiver detects the change.

One of the most important features of the unit is that it can be calibrated for various soil conditions (i.e., wet, dry, etc.). As long as the soil conditions are fairly homogeneous, the unit will detect only anomolies such as buried metal.

Shallow groundwater with high totaled dissolved solids may interfere with metal detection if the metal is below the water table. Since this rarely occurs, the interference is not considered a major problem. In fact, in some cases, highly corroded drums have contributed iron or their contents to the groundwater to form locally high TDS waters which can be detected and distinguished from natural waters.

APPENDIX 2



KEY

Boundary of study areas for boring program
X = initial 25 borings (50 ft. centers)
10 additional borings will be sited during the study to refine the area of any buried waste.
Avoidance areas are within 10 ft. of structures, power/pipeline ROW and between garage and motel.

New York State Department of Environmental Conservation
600 Delaware Avenue
Buffalo, New York 14202

Robert F. Flack
Commissioner

RECEIVED
JAN 11 1982
V. NORWOOD

January 4, 1982

Daniel M. Darragh, Esq.
Hodgson, Russ, Andrews, Woods & Goodyear
1800 One M & T Plaza
Buffalo, New York 14203

Dear Mr. Darragh: Re: CHARLES GIBSON SITE

Pursuant to our agreement at the meeting between the Department of Environmental Conservation, Hazardous Waste Compliance Team and Olin, the following is a summary of our information concerning the dates when building occurred at the Charles Gibson Site:

The motel was apparently built in two stages. The City of Niagara Falls tax records indicate that the one-story section was built in 1950, and the 1951 aerial photograph verifies this. The current two-story structure first appears in the 1958 aerial photograph. The house in which the Batrounys currently reside was built in 1957. City tax records indicate that the former restaurant was built in 1956.

The Niagara Mohawk power line right-of-way is noted on the property deeds prior to 1950. Niagara Mohawk records indicate that the northern towers were installed in 1955 and that the southern towers had been installed at an earlier date.

There is a twenty-inch high pressure water line which is located on a right-of-way parallel and adjacent to the power line right-of-way, to the south of it. The water line was built by Malcolm Pirnie, Inc. which filed and recorded the survey for construction in 1947.

APPENDIX 3

A brine line was installed in the center of the Niagara Mohawk right-of-way in 1969 and 1970 by Buckeye Pipelines Company and Hooker. Hooker owns the brine line easement, purchasing it from Niagara Mohawk. You should note that Niagara Mohawk has indicated that it would be willing to allow Olin free access to the right-of-way without the company having to post bond.

Other than the information set forth herein, we are unaware of any other utility lines having been installed at the site. There are, however, several sewer and water lines along Pine Avenue which may be partially on site property. City and town sewer and water line charts do not include individual connections.

I trust that this information will be helpful to you. Feel free to contact me should any questions arise.

Very truly yours,

Barbara B. Guibord

Barbara B. Guibord
Assistant Counsel

BBG:jar

cc: John Greenthal, Director (Albany)
Vance Bryant, Geologist "
Kevin Walter, Assoc. Sanitary Engineer (Albany)
Myron Sokolowski, Olin
Verrill Norwood, Olin
Compliance Team (Buffalo)
Ronald Tramontano, Dept. Health (Albany

APPENDIX 4

TABLE II.—REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter No./name	Container [1]	Preservation [2,3]	Maximum holding time [4]
Table IA—Bacterial Tests:			
1–4. Coliform, fecal and total	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$ [5]	6 hours.
5. Fecal streptococci	P, G	do	Do.
Table IB—Inorganic Tests:			
1. Acidity	P, G	Cool, 4°C	14 days.
2. Alkalinity	P, G	do	Do.
4. Ammonia	P, G	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
9. Biochemical oxygen demand	P, G	Cool, 4°C	48 hours.
11. Bromide	P, G	None required	28 days.
14. Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours.
15. Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
16. Chloride	P, G	None required	Do.
17. Chlorine, total residual	P, G	do	Analyze immediately.
21. Color	P, G	Cool, 4°C	48 hours.
23–24. Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to $pH>12$, 0.6g ascorbic acid [5]	14 days.[6]
25. Fluoride	P	None required	28 days.
27. Hardness	P, G	HNO_3 to $pH<2$, H_2SO_4 to $pH<2$	6 months.
28. Hydrogen ion (pH)	P, G	None required	Analyze immediately.
31, 43. Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
Metals:[7]			
18. Chromium VI	P, G	Cool, 4°C	24 hours.
35. Mercury	P, G	HNO_3 to $pH<2$	28 days.
3, 5–8, 10, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70–72, 74, 75. Metals, except chromium VI and mercury.	P, G	do	6 months.
38. Nitrate	P, G	Cool, 4°C	48 hours.
39. Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
40. Nitrite	P, G	Cool, 4°C	48 hours.
41. Oil and grease	G	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
42. Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to $pH<2$	Do.
44. Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours.
46. Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately.
47. Winkler	do	Fix on site and store in dark	8 hours.
48. Phenols	G only	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
49. Phosphorus (elemental)	G	Cool, 4°C	48 hours.
50. Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to $pH<2$	28 days.
53. Residue, total	P, G	Cool, 4°C	7 days.
54. Residue, Filterable	P, G	do	7days
55. Residue, Nonfilterable (TSS)	P, G	do	7 days.
56. Residue, Settleable	P, G	do	48 hours.
57. Residue, volatile	P, G	do	7 days.
61. Silica	P	do	28 days.
64. Specific conductance	P, G	do	Do.
65. Sulfate	P, G	do	Do.
66. Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to $pH>9$.	7 days.
67. Sulfite	P, G	None required	Analyze immediately.
68. Surfactants	P, G	Cool, 4°C	48 hours.
69. Temperature	P, G	None required	Analyze.
73. Turbidity	P, G	Cool, 4°C	48 hours.
Table IC—Organic Tests:[8]			
13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 66, 88, 89, 92–95, 97. Purgeable Halocarbons.	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$.[5]	14 days.
6, 57, 90. Purgeable aromatic hydrocarbons	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], HC1 to pH2[9]	Do.
3, 4. Acrolein and acrylonitrile	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]; Adjust pH to 4–5 [10]	Do.
23, 30, 44, 49, 53, 67, 70, 71, 83, 85, 96. Phenols [11]	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction.
7, 38. Benzidines [11]	do	do	7 days until extraction.[12]
14, 17, 48, 50–52. Phthalate esters [11]	do	Cool, 4°C	7 days until extraction; 40 days after extraction.
72–74. Nitrosamines [11,14]	do	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$[5]	Do.
76–82. PCBs [11] acrylonitrile	do	Cool, 4°C	Do.
54, 55, 65, 69. Nitroaromatics and isophorone [11]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5] store in dark	Do.
1, 2, 5, 8–12, 32, 33, 58, 59, 64, 68, 84, 86. Polynuclear aromatic hydrocarbons.[11]	do	do	Do.
15, 16, 21, 31, 75. Haloethers [11]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	Do.
29, 35–37, 60–63, 91. Chlorinated hydrocarbons [11]	do	Cool, 4°C	Do.
87. TCDD [11]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	Do.
Table ID—Pesticides Tests:			
1–70. Pesticides [11]	do	Cool, 4°C, pH 5–9 [15]	Do.
Table IE—Radiological Tests:			
1–5. Alpha, beta and radium	P, G	HNO_3 to $pH<2$	6 months.

APPENDIX 5

In-situ Field Permeability Testing

Drawdown/recovery method

Field measurements

- Measure water table level
- Pump standing water out of well casing until dry or until at least one volume has been evacuated, indicating stabilized inflow/outflow conditions.
- Pull pump from well
- Measure and record water table level as well recovers at 15 second intervals of measurement to 1 minute as recovery rate slows.
- Continue recording water table level vs. time for 20-30 minutes, as the water table level approaches its initial level.

Calculations

- Plot water table level (linear scale) vs. time (log scale).
- For part of the drawdown curve conforming to a straight line, measure the drawdown (DS) over one log cycle.
- Calculate aquifer Transmissivity (T) by $T = \frac{264\ Q}{DS}$

  Where Q is the pump rate during the field measurements.
- Aquifer permeability = T - m, the saturated aquifer thickness.

APPENDIX 6

Benzene
Chlorobenzene
Dichlorobenzene
Trichlorobenzene
Tetrachlorobenzene
Pentachlorobenzene
Hexachlorobenzene
Pentachloronitrobenzene
Tetrachloroethylene
Hexachlorocyclohexane - α-isomer
Hexachlorocyclohexane - β-isomer
Hexachlorocyclohexane - γ-isomer
Hexachlorocyclohexane - δ-isomer
Heptachlorocyclohexane
Phenylmethylether (anisole)
Trichloroanisole
Chlorinated Biphenyls
Phenol
Dichlorophenols
Trichlorophenols
Formaldehyde
Mercury

78/WR8
1/07/85

APPENDIX 7

METHOD 8240

GC/MS METHOD FOR VOLATILE ORGANICS

1.0 Scope and Application

1.1 Method 8240 is used to determine volatile organic compounds in a variety of solid waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including groundwater, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments.

1.2 The detection limit of Method 8240 for an individual compound is approximately 1 µg/g (wet weight) in waste samples. For samples containing more than 1 mg/g of total volatile material, the detection limit is proportionately higher.

1.3 Method 8240 is based upon a purge-and-trap, gas chromatographic/mass spectrometric (GC/MS) procedure. This method is restricted to use by or under the supervision of analysts experienced in the use of purge-and-trap systems and gas chromatograph/mass spectrometers and skilled in the interpretation of mass spectra and their use as a quantitative tool.

2.0 Summary of Method

2.1 The volatile compounds are introduced to the gas chromatograph by direct injection, the Headspace Method (Method 5020), or the Purge-and-Trap Method (Method 5030). Method 5030 should be used for groundwater analysis. The components are separated via the gas chromatograph and detected using a mass spectrometer which is used to provide both qualitative and quantitative information. The chromatographic conditions as well as typical mass spectrometer operating parameters are given.

2.2 If the above sample introduction techniques are not applicable, a portion of the sample can be dispersed in methanol or polyethylene glycol (PEG) to dissolve the volatile organic constituents. A portion of the methanolic or PEG solution is combined with water in a specially designed purging chamber. An inert gas is then bubbled through the solution at ambient temperature and the volatile comnponents are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is heated to elute the components, which are detected with a mass spectrometer.

2.3 An aliquot of each sample must be spiked with an appropriate standard to determine percent recovery and detection limits for that sample.

2.4 Table 1 lists detection limits that can be obtained in wastewaters in the absence of interferences. Detection limits for a typical waste sample would be significantly higher.

TABLE 1. CHROMATOGRAPHIC CONDITIONS AND METHOD DETECTION LIMITS

Parameter	Retention time (min) Column 1[a]	Method detection limit (µg/l)
Chloromethane	2.3	ND
Bromomethane	3.1	ND
Vinyl chloride	3.8	ND
Chloroethane	4.6	ND
Methylene chloride	6.4	2.8
Trichlorofluoromethane	8.3	ND
1,1-Dichloroethene	9.0	2.8
1,1-Dichloroethane	10.1	4.7
trans-1,2-Dichloroethene	10.8	1.6
Chloroform	11.4	1.6
1,2-Dichloroethane	12.1	2.8
1,1,1-Trichloroethane	13.4	3.8
Carbon tetrachloride	13.7	2.8
Bromodichloromethane	14.3	2.2
1,2-Dichloropropane	15.7	6.0
trans-1,3-Dichloropropene	15.9	5.0
Trichloroethene	16.5	1.9
Benzene	17.0	4.4
Dibromochloromethane	17.1	3.1
1,1,2-Trichloroethane	17.2	5.0
cis-1,3-Dichloropropene	17.2	ND
2-Chloroethylvinyl ether	18.6	ND
Bromoform	19.8	4.7
1,1,2,2-Tetrachloroethane	22.1	6.9
Tetrachloroethene	22.2	4.1
Toluene	23.5	6.0
Chlorobenzene	24.6	6.0
Ethyl benzene	26.4	7.2
1,3-Dichlorobenzene	33.9	ND
1,2-Dichlorobenzene	35.0	ND
1,4-Dichlorobenzene	35.4	ND

ND = not determined.

[a] Column conditions: Carbopack B (60/80 mesh) coated with 1% SP-1000 packed in a 6-ft by 2-mm I.D. glass column with helium carrier gas at a flow rate of 30 ml/min. Column temperature is isothermal at 45° C for 3 min, then programmed at 8° C per minute to 220° and held for 15 min.

3.0 Interferences

3.1 Interferences coextracted from the samples will vary considerably from source to source, depending upon the particular waste or extract being tested. The analytical system, however, should be checked to ensure freedom from interferences under the conditions of the analysis by running method blanks. Method blanks are run by analyzing organic-free water in the normal manner. The use of non-TFE plastic tubing, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.

3.2 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride) through the septum seal into the sample during shipment and storage. A field blank prepared from organic-free water and carried through the sampling and handling protocol can serve as a check on such contamination.

3.3 Cross contamination can occur whenever high-level and low-level samples are sequentially analyzed. To reduce cross contamination, the purging device and sample syringe should be rinsed out twice, between samples, with organic-free water. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of organic-free water to check for cross contamination. For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds, or high organohalide levels, it may be necessary to wash out the purging device with a soap solution, rinse with distilled water, and then dry in a 105° C oven between analyses.

3.4 Low molecular weight impurities in PEG can be volatilized during the purging procedure. Thus, the PEG employed in this method must be purified before use as described in Section 5.2.

4.0 Apparatus and Materials

4.1 Sampling equipment

4.1.1 Vial: 25-ml capacity or larger, equipped with a screw cap (Pierce #13075 or equivalent). Detergent wash, rinse with tap and distilled water, and dry for 1 hr at 105° C before use.

4.1.2 Septum: Teflon-faced silicone (Pierce #12722 or equivalent). Detergent wash, rinse with tap and distilled water and dry at 105° C for 1 hr before use.

4.2 Purge-and-trap device: The purge-and-trap device consists of three separate pieces of equipment: the purging chamber, trap, and the desorber. Several complete devices are now commercially available.

4.2.1 The purging chamber must be designed to accept 5-ml or 25-ml samples with a water column at least 3 cm deep. The gaseous head space between the water column and the trap must have a total volume of less than 15 ml. The purge gas must pass through the water column as finely divided bubbles with a diameter of less than 3 mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. The purging chamber, illustrated in Figure 1, meets these design criteria.

4.2.2 The trap must be at least 25 cm long and have an inside diameter of at least 2.5 mm. The trap must be packed to contain the following minimum lengths-of-adsorbents: 1.0 cm of methyl-silicone-coated packing (Section 5.3.2), 15 cm of 2,6-diphenylene oxide polymer (Section 5.3.1), and 8 cm of silica gel (Section 5.3.3). The minimum specifications for the trap are illustrated in Figure 2.

4.2.3 The desorber must be capable of rapidly heating the trap to 180° C within 30 sec. The polymer section of the trap should not be heated higher than 180° C and the remaining sections should not exceed 220° C. The desorber design, illustrated in Figure 2, meets these criteria.

4.2.4 The purge-and-trap device may be assembled as a separate unit or be coupled to a gas chromatograph as illustrated in Figures 3 and 4.

4.3 Gas chromatograph/mass spectrometer system

4.3.1 Gas chromatograph: An analytical system complete with a temperature-programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases.

4.3.2 Column: 2-m x 2-mm I.D. stainless steel or glass, packed with 1% SP-1000 on 60/80 mesh Carbopack B or equivalent.

4.3.3 Mass spectrometer: Capable of scanning from 40 to 250 amu every 3 sec or less, utilizing 70 volts (nominal) electron energy in the electron impact ionization mode and producing a mass spectrum which meets all the criteria in Table 1 when 50 ng of 4-bromofluorobenzene (BFB) is injected through the GC inlet or introduced in the purge-and-trap mode.

4.3.4 GC/MS interface: Any GC-to-MS interface that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria (see Section 9) may be used. GC-to-MS interfaces constructed of all glass or glass-lined materials are recommended. Glass can be deactivated by silanizing with dichlorodimethylsilane. The interface must be capable of transporting at least 10 ng of the components of interest from the GC to the MS.

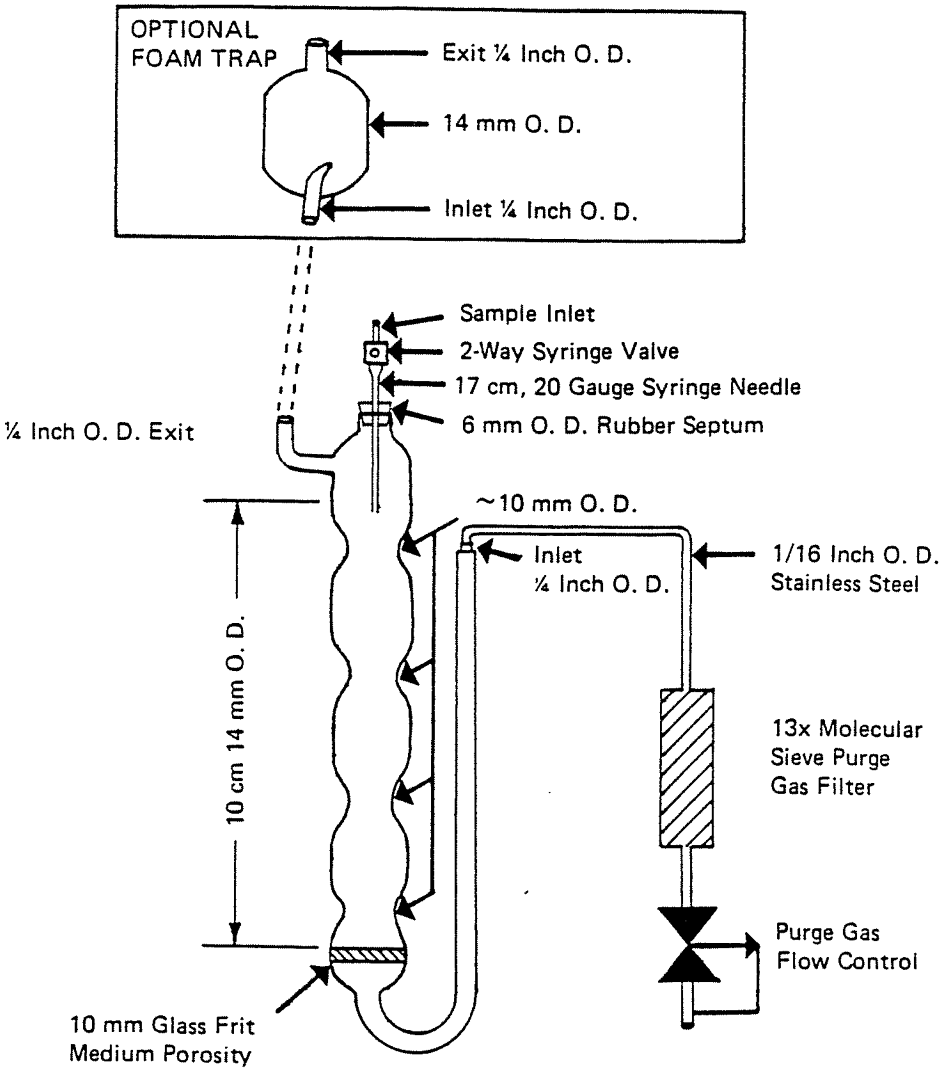


Figure 1. Purging chamber.

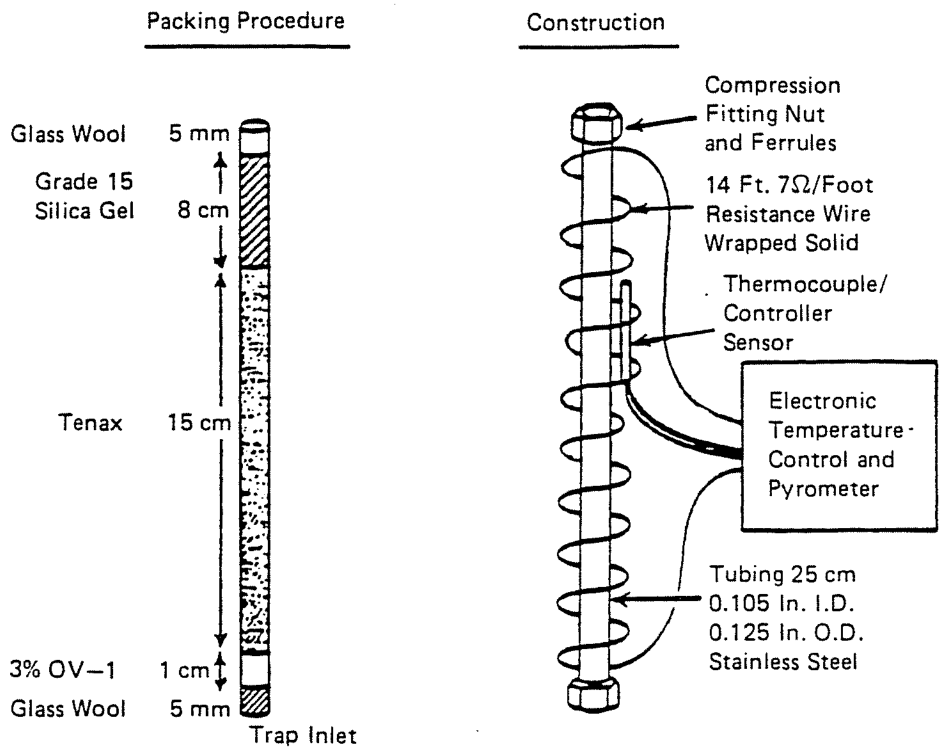


Figure 2. Trap packings and construction to include desorb capability.

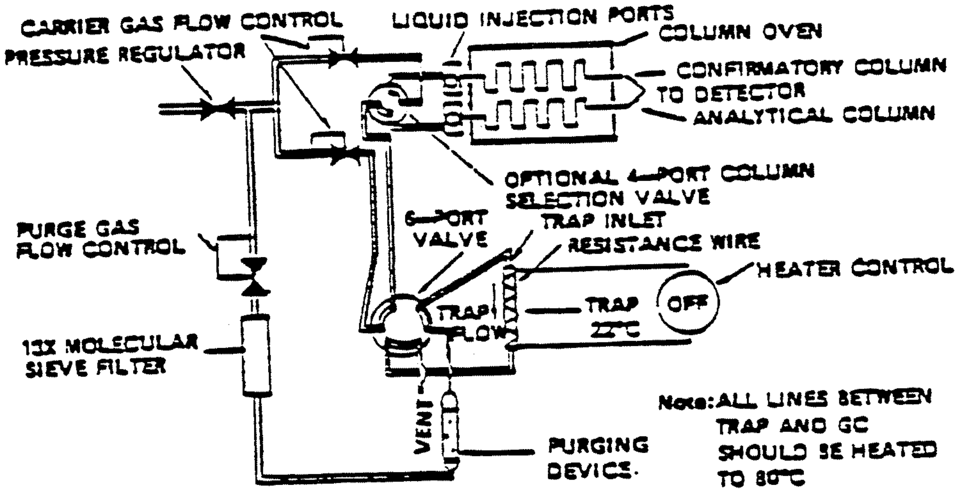


FIGURE 3. Schematic of purge and trap device – purge mode

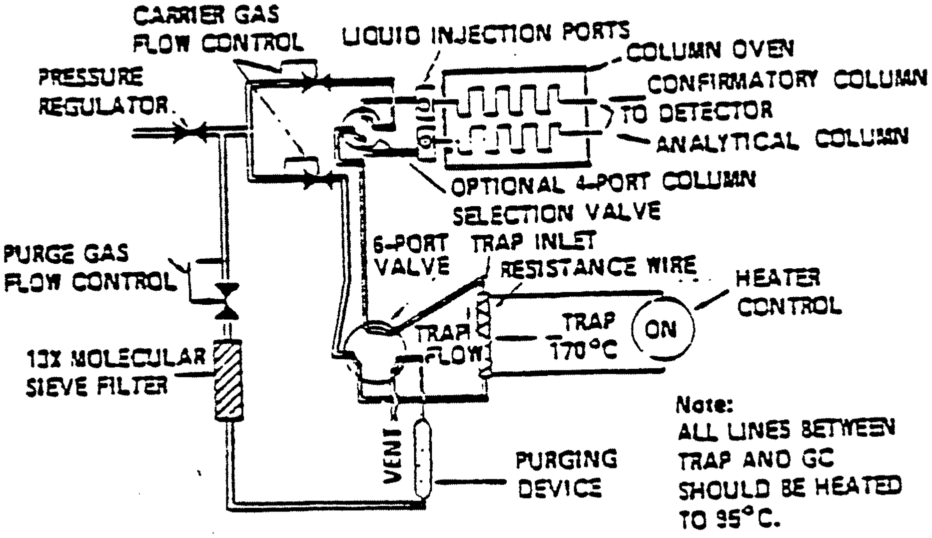


Figure 4. Schematic of purge and trap device - desorb mode

4.3.5 Data system: A computer system must be interfaced to the mass spectrometer that allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that allows searching any GC/MS data file for ions of a specific mass and plotting such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundance in any EICP between specified time or scan number limits. Hardware and software must be available to transform the data into a compatible format. These generally consist of a 9-inch, 800-bpi tape drive and the associated software.

4.4 Sample transfer implements: Implements are required to transfer portions of solid, semisolid, and liquid wastes from sample containers to laboratory glassware. The transfer must be accomplished rapidly to avoid loss of volatile components during the transfer step. Liquids may be transferred using a hypodermic syringe with a wide-bore needle or no needle attached. Samples should be introduced into the syringe by (1) removing the plunger from the syringe, (2) pouring the sample into the barrel, and (3) replacing the barrel and inverting the syringe to remove any air trapped in the syringe. Do not draw the sample up into the syringe. Solids may be transferred using a conventional laboratory spatula, spoon, or coring device. A coring device that is suitable for handling some samples can be made by using a glass tubing saw to cut away the closed end of the barrel of a glass hypodermic syringe.

TABLE 2. BFB KEY ION ABUNDANCE CRITERIA

Mass	Ion abundance criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base Peak, 100% Relative Abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 100% of mass 174
177	5 to 9% of mass 176

4.5 Syringes: 5-ml and 25-ml glass hypodermic, equipped with 20-gauge needle, at least 15 cm in length.

4.6 Micro syringes: 10-µl, 25-µl, 100-µl, 250-µl, and 1000-µl. These syringes should be equipped with 20-gauge needles having a length sufficient to extend from the sample inlet to within 1 cm of the glass frit in the purging device (see Figure 1). The needle length required will depend upon the dimensions of the purging device employed.

4.7 Centrifuge tubes: 50-ml round-bottom glass centrifuge tubes with Teflon-lined screw caps. The tubes must be marked before use to show an approximate 20-ml graduation.

4.8 Centrifuge: Capable of accommodating 50-ml glass tubes.

4.9 Syringe valve: 2-way, with Luer ends (2 each) (Hamilton #86725 valve equipped with one Hamilton #35033 Luer fitting, or equivalent).

4.10 Syringe: 5-ml, gas-tight with shut-off valve.

4.11 Bottle: 15-ml, screw-cap, Teflon cap liner.

4.12 Balance: Analytical, capable of accurately weighing 0.0001 g.

4.13 Rotary evaporator: equipped with Teflon-coated seals (Buchi Rotavapor R-110, or equivalent).

4.14 Vacuum pump: mechanical, two-stage.

5.0 Reagents

5.1 Reagent water: Reagent water is defined as a water in which an interferent is not observed at the method detection limit of the compounds of interest.

5.1.1 Reagent water may be generated by passing tap water through a carbon filter bed containing about 500 g of activated carbon (Calgon Corp., Filtrasorb-300, or equivalent).

5.1.2 A water purification system (Millipore Super-Q or equivalent) may be used to generate reagent water.

5.1.3 Reagent water may also be prepared by boiling water for 15 min. Subsequently, while maintaining the temperature at 90° C, bubble a contaminant-free inert gas through the water for 1 hr. While still hot, transfer the water to a narrow-mouth screw-cap bottle and seal with a Teflon-lined septum and cap.

5.1.4 Reagent water may also be purchased under the name "HPLC water" from several manufacturers (Burdick and Jackson, Baker and Waters, Inc.).

5.2 Reagent PEG: Reagent PEG is defined as PEG having a nominal average molecular weight of 400, and in which interferents are not observed at the method detection limit for compounds of interest.

5.2.1 Reagent PEG is prepared by purification of commercial PEG having a nominal average molecular weight of 400. The PEG is placed in a round-bottom flask equipped with a standard taper joint, and the flask is affixed to a rotary evaporator. The flask is immersed in a water bath at 90-100° C and vacuum is maintained at less than 10 mm Hg for at least 1 hr using a two-stage mechanical pump. The vacuum system is equipped with an all-glass trap, which is maintained in a dry ice/methanol bath.

5.2.2 In order to demonstrate that all interfering volatiles have been removed from the PEG, a reagent water/PEG blank must be analyzed.

5.3 Trap materials

5.3.1 2,6-Diphenylene oxide polymer: 60/80-mesh Tenax, chromatographic grade or equivalent.

5.3.2 Methyl silicone packing: 3 percent OV-1 on 60/80 mesh Chromosorb-W or equivalent.

5.3.3 Silica gel, Davison Chemical (35/60 mesh), grade-15 or equivalent.

5.3.4 Prepared trapping columns may be purchased from several chromatography suppliers.

5.4 Methanol: Distilled-in-glass quality or equivalent.

5.5 Calibration standards; stock solutions (2 mg/ml): Stock solutions of calibration standards may be prepared from pure standard materials or purchased as certified solutions. Prepare stock standard solutions of individual compounds in methanol using assayed liquids or gases as appropriate. Because of the toxicity of some of the organohalides, primary dilutions of these materials should be prepared in a hood. A NIOSH/MESA-approved toxic gas respirator should be worn by analysts when handling high concentrations of these materials.

5.5.1 Place about 9.8 ml of methanol in a 10-ml ground-glass-stoppered volumetric flask. Allow the flask to stand, unstoppered, for about 10 min or until all alcohol-wetted surfaces have dried. Weigh the flask to the nearest 0.1 mg.

5.5.2 Add the assayed reference material as described below.

5.5.2.1 Liquids: Using a 100-µl syringe, immediately add 2 drops of assayed reference material to the flask, then reweigh. The liquid must fall directly into the alcohol without contacting the neck of the flask.

5.5.2.2 Gases: To prepare standards for any compounds that boil below 30° C (e.g., bromomethane, chloroethane, chloromethane, or vinyl chloride), fill a 5-ml valved gas-tight syringe with a reference standard to the 5.0-ml mark. Lower the needle to 5 mm above the methanol meniscus. Slowly introduce the reference standard above the surface of the liquid. The heavy gas rapidly dissolves in the methanol.

5.5.3 Reweigh, dilute to volume, stopper, then mix by gently inverting the flask several times. Calculate the concentration in µg/µl per microliter from the net gain in weight. When compound purity is assayed to be 96% or greater, the weight may be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

5.5.4 Transfer the stock standard solution into a Teflon-sealed screw-cap bottle. Store, with minimal headspace, at -10 to -20° C and protect from light.

5.5.5 Prepare fresh standards weekly for gases or for reactive compounds such as 2-chloroethylvinyl ether. All other standards must be replaced after one month, or sooner if comparison with check standards indicates a problem.

5.6 Calibration standards; secondary dilution solutions: Using stock solutions described in Section 5.5, prepare secondary dilution standards in methanol that contain the compounds of interest, either singly or mixed together. The secondary dilution standards should be prepared at concentrations such that the methanol or aqueous PEG calibration solutions prepared as described in Section 6.3.2 will bracket the working range of the analytical system. Secondary dilution standards should be stored with minimal headspace and should be checked frequently for signs of evaporation, especially just prior to preparing calibration standards from them.

5.7 Surrogate standards: Surrogate standards may be added to samples and calibration solutions to assess the effect of the sample matrix on recovery efficiency. The compounds employed for this purpose are 1,2-dibromotetrafluoroethane, bis(perfluoroisopropyl) ketone, fluorobenzene, and m-bromobenzotrifluoride. Prepare methanolic solutions of the surrogate standards using the procedures described in Sections 5.5 and 5.6. The concentrations prepared and the amount of solution added to each sample should be those required to give an amount of each surrogate in the purging device that is equal to the amount of each internal standard added, assuming a 100% recovery of the surrogate standards.

5.8 Internal standards: In this method, internal standards are employed during analysis of all samples and during all calibration procedures. The analyst must select one or more internal standards that are similar in analytical behavior to the compounds of interest. The analyst must further demonstrate that the measurement of the internal standard is not affected by method or matrix interferences. Because of these limitations, no internal standard can be suggested that is applicable to all samples. However, for general use, D_4-1,2-dichloroethane, D_6-benzene, and D_5-ethylbenzene are recommended as internal standards covering a wide boiling point range.

5.9 4-Bromofluorobenzene (BFB): BFB is added to the internal standard solution or analyzed alone to permit the mass spectrometer tuning for each GC/MS run to be checked.

5.10 Internal standard solution: Using the procedures described in Sections 5.5 and 5.6, prepare a methanolic solution containing each internal standard at a concentration of 12.5 µg/ml.

5.11 Sodium monohydrogen phosphate: 2.0 µ in distilled water.

5.12 n-Nonane and n-dodecane, 98+% purity.

5.13 N-Hexadecane, distilled-in-glass (Burdick and Jackson, or equivalent).

6.0 Sample Collection, Handling, and Preservation

6.1 All samples must be collected using a sampling plan that addresses the considerations discussed in Section One of this manual.

6.2 All samples must be stored in Teflon-lined screw cap vials. Sample containers should be filled as completely as possible so as to minimize headspace or void space. Vials containing liquid sample should be stored in an inverted position.

6.3 All samples must be iced or refrigerated from the time of collection to the time of analysis, and should be protected from light.

7.0 Procedure

7.1 Calibration

7.1.1 Assemble a purge-and-trap device that meets the specifications in Section 4.2 and connect the device to a GC/MS system. Condition the trap overnight at 180° C by backflushing with an inert gas flow of at least 20 ml/min. Prior to use, condition the trap daily for 10 min while backflushing at 180° C.

7.1.2 Operate the gas chromatograph using the conditions described in Section 7.3.5 and operate the mass spectrometer using the conditions described in Section 7.3.2.

7.1.3 Calibration procedure

7.1.3.1 Conduct calibration procedures using a minimum of three concentration levels for each calibration standard. One of the concentration levels should be at a concentration near but above the method detection limit. The remaining two concentration levels should correspond to the expected range of concentrations found in real samples or should define the working range of the GC/MS system.

7.1.3.2 Prepare the final solutions containing the required concentrations of calibration standards, including surrogate standards, directly in the purging device. To the purging device, add 5.0 ml of reagent water or reagent water/PEG solution. This solution is prepared by taking 4.0 ml of reagent water or reagent PEG and diluting to 100 ml with reagent water. The reagent water/PEG solution is added to the purging device using a 5-ml glass syringe fitted with a 15-cm 20-gauge needle. The needle is inserted through the sample inlet shown in Figure 1. The internal diameter of the 14-gauge needle that forms the sample inlet will permit insertion of a 20-gauge needle. Next, using a 10-µl or 25-µl micro-syringe equipped with a long needle (see Section 4.6), take a volume of the secondary dilution solution containing appropriate concentrations of the calibration standards (see Section 5.6). Add the aliquot of calibration solution directly to the reagent water or reagent water/PEG solution in the purging device by inserting the needle through the sample inlet. When discharging the contents of the micro-syringe be sure that the end of the syringe needle is well beneath the surface of the reagent water or water/PEG solution. Similarly, add 20 µl of the internal standard solution (see Section 5.10). Close the 2-way syringe valve at the sample inlet.

7.1.3.3 Carry out the purge and analysis procedure as described in Section 7.3.4. Tabulate the area response of the primary characteristic ion against concentration for each compound including the internal standards. Calculate response factors (RF) for each compound as follows:

$$RF = (A_s C_{is})/A_{is} C_s)$$

where:

A_s = Area of the primary characteristic ion for the compound to be measured

A_{is} = Area of the primary characteristic ion of the internal standard

C_{is} = Concentration of the internal standard

C_s = Concentration of the compound to be measured.

The internal standard selected for the calculation of the RF of a compound and subsequent quantification of the compound is generally the internal standard that has a retention time closest to that of the compound. It is assumed that a linear calibration plot will be obtained over the range of concentrations used. If the RF value over the working range is a constant (less than 10% relative standard deviation), the RF can be assumed to be invariant, and the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios, A_s/A_{is}, versus RF.

7.1.3.4 The RF must be verified on each working day. The concentrations selected should be near the midpoint of the working range. The response factors obtained for the calibration standards analyzed immediately before and after a set of samples must be within ±20% of the response factor used for quantification of the sample concentrations.

7.2 Daily GC/MS performance tests

7.2.1 At the beginning of each day that analyses are to be performed, the GC/MS system must be checked to see that acceptable performance criteria are achieved for BFB (see Table 2).

7.2.2 The BFB performance test requires the following instrumental parameters:

Electron Energy:	70 volts (nominal)
Mass Range:	40 to 250 amu
Scan Time:	to give approximately 6 scans per peak but not to exceed 3 sec per scan.

7.2.3 Bleed BFB vapor into the mass spectrometer and tune the instrument to achieve all the key ion criteria for the mass spectrum of BFB given in Table 1. A solution containing 20 ng of BFB may be injected onto the gas chromatographic column in order to check the key ion criteria.

7.2.4 The peak intensity of D_6-benzene is used to monitor the mass spectrometer sensitivity. The peak intensity for D_6-benzene observed during each sample analysis must be between 0.7 and 1.4 times the D_6-benzene peak intensity observed during the applicable calibration runs. For example, if the peak intensity of D_6-benzene observed during calibration was 355,000 area counts, then each subsequent sample or blank must give a D_6-benzene peak intensity of between 250,000 and 500,000 area counts. If the D_6-benzene peak intensity is outside the specified range, the sample must be reanalyzed. If the peak intensity is again outside the specified range, the analyst must investigate the cause of the variability in sensitivity and correct the problem.

7.3 Sample extraction and analysis

7.3.1 The analytical procedure involves extracting the non-aqueous sample with methanol or polyethylene glycol (PEG) and analyzing a portion of the extract by a purge-and-trap GC/MS procedure. The amount of the extract to be taken for the GC/MS analysis is based on the estimated total volatile content (TVC) of the sample. The TVC is estimated by extracting the sample with n-hexadecane and analyzing the n-hexadecane extract by gas chromatography.

7.3.2 The estimated TVC is based on the total area response relative to that of n-nonane for all components eluting prior to the retention time of n-dodecane. The response factor for n-nonane and the retention time of n-dodecane are determined by analyzing a 2-µl aliquot of an n-hexadecane solution containing 0.20 mg/ml of n-nonane and n-dodecane.

7.3.2.1 The GC analyses are conducted using a flame ionization detector and a 3-m x 2-mm I.D. glass column packed with 10% OV-101 on 100-200 mesh Chromosorb W-HP. The column temperature is programmed from 80° C to 280° C at 8°/min and held at 280° for 10 min.

7.3.2.2 Determine the area response for n-nonane and divide by 0.2 to obtain the area response factor. Record the retention time of n-dodecane.

7.3.2.3 Add 1.0 g of sample to 20 ml of n-hexadecane and 2 ml of 2.0 M Na_2HPO_4 contained in a 50-ml glass centrifuge tube and cap securely with a Teflon-lined screw cap. Shake the mixture vigorously for one minute. If the sample does not disperse during the shaking process, sonify the mixture in an ultrasonic bath for 30 min. Allow the mixture to stand until a clear supernatant is obtained. Centrifuge if necessary to facilitate phase separation.

7.3.2.4 Analyze a 2-µl aliquot of the n-hexadecane supernatant using the conditions described in Section 7.3.2.1. Determine the total area response of all components eluting prior to the retention time of n-dodecane and subtract the corresponding area of an n-hexadecane blank. Using the area response factor determined for n-nonane in Section 7.3.2.2, calculate the TVC as follows:

$$\text{TVC} = \frac{\text{TAR}_{\text{sample}} - \text{TAR}_{\text{blank}}}{\text{n-Nonane Area Response Factor}} \times 20$$

where:

TVC = total volatile content of the sample in mg/g

$\text{TAR}_{\text{sample}}$ = total area response obtained for the sample

$\text{TAR}_{\text{blank}}$ = total area response obtained for a blank.

7.3.3 The transfer of an aliquot of the sample for extraction with methanol or PEG should be made as quickly as possible to minimize loss of volatiles from the sample.

7.3.3.1 To a 50-ml glass centrifuge tube with Teflon-lined cap, add 40 ml of reagent methanol or PEG. Weigh the capped centrifuge tube and methanol or PEG on an analytical balance.

7.3.3.2 Using an appropriate implement (see Section 4.4), transfer approximately 2 g of sample to the methanol or PEG in the centrifuge tube in such a fashion that the sample is dissolved in or submerged in the methanol or PEG as quickly as possible. Take care not to touch the sample-transfer implement to the methanol or PEG. Recap the centrifuge tube immediately and weigh on an analytical balance to determine an accurate sample weight.

7.3.3.3 Disperse the sample by vigorous agitation for 1 min. The mixture may be agitated manually or with the aid of a vortex-mixer. If the sample does not disperse during this process, sonify the mixture in an ultrasonic bath for 30 min. Allow the mixture to stand until a clear supernatant is obtained as the sample extract. Centrifuge if necessary to facilitate phase separation.

7.3.3.4 The sample extract may be stored for future analytical needs. If this is desired, transfer the solution to a 10-ml screw cap vial with Teflon cap liner. Store at -10 to -20° C, and protect from light.

7.3.4 Reagent water, internal standard solution, and the sample extract are added to a purging chamber that is connected to the purge-and-trap device and that has been flushed with helium during a 7-min trap reconditioning step (see Section 7.3.4.4). The additions are made using an appropriately sized syringe equipped with a 15-cm 20-gauge needle. Open the syringe valve of the sample inlet (shown in Figure 1) and insert the needle through the valve.

7.3.4.1 Add 5.0 ml of reagent water or aqueous sample to which 20.0 µl of the internal standard solution has been added (see Section 5.10) to the purging chamber. Insert the needle of the syringe well below the surface of the water for the addition of the internal standard solution. If the sample is aqueous go to Section 7.3.5.

7.3.4.2 Add an aliquot of the sample extract from Section 7.3.3.4. The total quantity of volatile components injected should not exceed approximately 10 µg. If the total volatile content (TVC) of the sample as determined in Section 7.3.1.4 is 1.0 mg/g or less, use a 200-µl aliquot of the sample extract. If the TVC is greater than 1.0 mg/g, use an aliquot of the sample extract that contains approximately 10 µg of total volatile components; the volume (in µl) of the aliquot to be taken can be calculated by dividing 200 by the TVC. If the TVC is greater than 20 mg/g, take a 500-µl aliquot of the sample extract and dilute to 10 ml with PEG. In this case calculate the aliquot volume (in µl) of the undiluted extract to be taken by dividing 4,000 by the TVC. If the TVC is less than 1.0 mg/g and greater sensitivity is desired, use a large purging chamber containing 25 ml of reagent water and use a 1.0-ml aliquot of the sample extract.

7.3.4.3 Close the 2-way syringe valve at the sample inlet.

7.3.5 The sample in the purging chamber is purged with helium to transfer the volatile components to the trap. The trap is then heated to desorb the volatile components which are swept by the helium carrier gas onto the GC column for analysis.

7.3.5.1 Adjust the gas (helium) flow rate to 40 ± 3 ml/min. Set the purging device to purge, and purge the sample for 11.0 ± 0.1 min at ambient temperature.

7.3.5.2 At the conclusion of the purge time, adjust the device to the desorb mode, and begin the GC/MS analysis and data acquisition using the following GC operating conditions:

Column: 6-ft x 2-mm I.D. glass column of 1% SP-1000 on Carbo-pack B (60-80 mesh).

Temperature: Isothermal at 45° C for 3 min, then increased at 8° C/min to 220° C, and maintained at 220° C for 15 min.

Concurrently, introduce the trapped materials to the GC column by rapidly heating the trap to 180° C while backflushing the trap with helium at a flow rate of 30 ml/min for 4 min. If this rapid heating requirement cannot be met, the GC column must be used as a secondary trap by cooling it to 30° C or lower during the 4-min desorb step and starting the GC program after the desorb step.

7.3.5.3 Return the purge-and-trap device to the purge mode and continue acquiring GC/MS data.

7.3.5.4 Allow the trap to cool for 8 min. Replace the purging chamber with a clean purging chamber. The purging chamber is cleaned after each use by sequential washing with acetone, methanol, detergent solution and distilled water, and then dried at 105° C.

7.3.5.5 Close the syringe valve on the purging chamber after 15 sec to begin gas flow through the trap. Purge the trap at ambient temperature for 4 min. Recondition the trap by heating it to 180° C. Do not allow the trap temperature to exceed 180° C, since the sorption/desorption is adversely affected when the trap is heated to higher temperatures. After heating the trap for approximately 7 min, turn off the trap heater. When cool, the trap is ready for the next sample.

7.3.6 If the response for any ion exceeds the working range of the system, repeat the analysis using a correspondingly smaller aliquot of the sample extract described in Section 7.3.2.3.

7.4 Qualitative identification

7.4.1 Obtain an EICP for the primary characteristic ion and at least two other characteristic ions for each compound when practical. The following criteria must be met to make a qualitative identification.

7.4.1.1 The characteristic ions of each compound of interest must maximize in the same or within one scan of each other.

7.4.1.2 The retention time must fall within ±30 sec of the retention time of the authentic compound.

7.4.1.3 The relative peak heights of the characteristic ions in the EICP's must fall within ±20% of the relative intensities of these ions in a reference mass spectrum. Reference spectra may be generated from the standards analyzed by the analyst or from a reference library. All reference spectra generated from standards must be obtained from an appropriately tuned mass spectrometer.

7.5 Quantitative determination

7.5.1 When a compound has been identified, the quantification of that compound will be based on the integrated abundance from the EICP of the primary characteristic ion. In general, the primary characteristic ion selected should be a relatively intense ion, as interference-free as possible, and as close as possible in mass to the characteristic ion of the internal standard used. Generally, the base peak of the mass spectrum is used.

8.0 Quality Control

8.1 Each laboratory that uses this method is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and the analysis of spiked samples as a continuing check on performance. The laboratory is required to maintain performance records to define the quality of the data that are generated. Ongoing performance checks must be compared with established performance criteria to determine if the results of analyses are within the accuracy and precision limits expected of the method.

8.1.1 Before performing any analyses, the analyst must demonstrate the ability to generate acceptable accuracy and precision with this method. This ability is established as described in Section 8.2.

8.1.2 The laboratory must spike all samples including check samples with surrogate standards to monitor continuing laboratory performance. This procedure is described in Section 8.4.

8.1.3 Before processing any samples, the analyst should daily demonstrate, through the analysis of an organic-free water method blank, that the entire analytical system is interference-free. The blank samples should be carried through all stages of the sample preparation and measurement steps.

8.2 To establish the ability to generate acceptable accuracy and precision, the analyst must perform the following operations using a representative sample as a check sample.

8.2.1 Analyze four aliquots of the unspiked check sample according to the method in Section 7.3.

8.2.2 For each compound to be measured, select a spike concentration representative of twice the level found in the unspiked check sample or a level equal to 10 times the expected detection limit, whichever is greater. Prepare a spiking solution by dissolving the compounds in methanol at the appropriate levels.

8.2.3 Spike a minimum of four aliquots of the check sample with the spiking solution to achieve the selected spike concentrations. Spike the samples by adding the spiking solution to the PEG used for the extraction. Analyze the spiked aliquots according to the method in Section 7.3.

8.2.4 Calculate the average percent recovery, R, and the standard deviation of the percent recovery, s, for all compounds and surrogate standards. Background corrections must be made before R and s calculations are performed. The average percent recovery must be greater than 20 for all compounds to be measured and greater than 60 for all surrogate compounds. The percent relative standard deviation of the percent recovery, s/R x 100, must be less than 20 for all compounds to be measured and all surrogate compounds.

8.3 The analyst must calculate method performance criteria for each of the surrogate standards.

8.3.1 Calculate upper and lower control limits for method performance for each surrogate standard, using the values for R and s calculated in Section 8.2.4:

Upper Control Limit (UCL) = R + 3s
Lower Control Limit (LCL) = R - 3s

The UCL and LCL can be used to construct control charts that are useful in observing trends in performance.

8.3.2 For each surrogate standard, the laboratory must maintain a record of the R and s values obtained for each surrogate standard in each waste sample analyzed. An accuracy statement should be prepared from these data and updated regularly.

8.4 The laboratory is required to spike all samples with the surrogate standards to monitor spike recoveries. The spiking level used should be that which will give an amount in the purge apparatus that is equal to the amount of the internal standard assuming a 100% recovery of the surrogate standards. If the recovery for any surrogate standard does not fall within the control limits for method performance, the results reported for that sample must be qualified as being outside of control limits. The laboratory must monitor the frequency of data so qualified to ensure that it remains at or below 5%. Four surrogate standards, namely 1,2-dibromodifluoroethane, bis(perfluoroisopropyl) ether, fluorobenzene, and m-bromobenzotrifluoride, are recommended for general use to monitor recovery of volatile compounds varying in volatility and polarity.

8.5 Each day, the analyst must demonstrate through the analysis of a process blank that all glassware and reagent interferences are under control.

8.6 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Field replicates may be analyzed to monitor the precision of the sampling technique. Whenever possible, the laboratory should perform analysis of standard reference materials and participate in relevant performance evaluation studies.

8.7 Standard quality assurance practices should be used with this method. Field replicates should be collected to validate the precision of the sampling technique. Laboratory replicates should be analyzed to validate the precision of the analysis. Fortified samples should be carried through all stages of sample preparation and measurement; they should be analyzed to validate the sensitivity and accuracy of the analysis. If the fortified waste samples do not indicate sufficient sensitivity to detect less than or equal to 1 µg/g of sample, then the sensitivity of the instrument should be increased or the extract subjected to additional cleanup. Detection limits to be used for groundwater samples are indicated in Table 1. Where doubt exists over the identification of a peak on the chromatograph, confirmatory techniques such as mass spectroscopy should be used.

8.8 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 value is above zero. The MDL concentrations listed in Table 1 were obtained using reagent water. Similar results were achieved using representative wastewaters. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

8.9 In a single laboratory, using reagent water and wastewaters spiked at or near background levels, the average recoveries presented in Table 3 were obtained. The standard deviation of the measurement in percent recovery is also included in Table 3.

TABLE 3. ACCURACY AND PRECISION FOR PURGEABLE ORGANICS

Parameter	Reagent Water		Wastewater	
	Average percent recovery	Standard deviation (%)	Average percent recovery	Standard deviation (%)
Benzene	99	9	98	10
Bromodichloromethane	102	12	103	10
Bromoform	104	14	105	16
Bromomethane	100	20	88	23
Carbon tetrachloride	102	16	104	15
Chlorobenzene	100	7	102	9
Chloroethane	97	22	103	31
2-Chloroethyl vinyl ether	101	13	95	17
Chloroform	101	10	101	12
Chloromethane	99	19	99	24
Dibromochloromethane	103	11	104	14
1,1-Dichloroethane	101	10	104	15
1,2-Dichloroethane	100	8	102	10
1,1-Dichloroethene	102	17	99	15
trans-1,2-Dichloroethene	99	12	101	10
1,2-Dichloropropane	102	8	103	12
cis-1,3-Dichloropropene	105	15	102	19
trans-1,3-Dichloropropene	104	11	100	18
Ethyl benzene	100	8	103	10
Methylene chloride	96	16	89	28
1,1,2,2-Tetrachloroethane	102	9	104	14
Tetrachloroethene	101	9	100	11
Toluene	101	9	98	14
1,1,1-Trichloroethane	101	11	102	16
1,1,2-Trichloroethane	101	10	104	15
Trichloroethene	101	9	100	12
Trichlorofluoromethane	103	11	107	19
Vinyl chloride	100	13	98	25

Samples were spiked between 10 and 1000 µg/l.

TABLE 4. (CONT.)

Parameter	Reagent water: Average percent recovery	Reagent water: Standard deviation (%)	Wastewater: Average percent recovery	Wastewater: Standard deviation (%)
Hexachlorobenzene	79	20	71	22
Hexachlorobutadiene	46	25	48	28
Hexachlorocyclopentadiene	27	25	12	12
Hexachloroethane	46	21	52	26
Indeno (1,2,3-cd) pyrene	65	37	81	43
Isophorone	75	33	77	42
Naphthalene	67	32	75	35
Nitrobenzene	72	31	82	54
N-Nitrosodi-n-propylamine	68	39	76	45
N-Nitrosodiphenylamine	84	24	86	31
PCB-1221	77	11	--	--
PCB-1254	80	13	--	--
Phenanthrene	84	14	76	22
Pyrene	86	15	80	23
1,2,4-Trichlorobenzene	64	16	69	26

Spiked between 5 and 2400 µg/l.

TABLE 5. ACCURACY AND PRECISION FOR ACID EXTRACTABLES

Parameter	Reagent water: Average percent recovery	Reagent water: Standard deviation (%)	Wastewater: Average percent recovery	Wastewater: Standard deviation (%)
4-Chloro-3-methylphenol	79	18	75	21
2-Chlorophenol	70	23	71	25
2,4-Dichlorophenol	74	24	80	21
2,4-Dimethylphenol	64	25	58	26
2,4-Dinitrophenol	78	21	108	56
2-Methyl-4,6-dinitrophenol	83	18	90	35
4-Nitrophenol	41	20	43	16
2-Nitrophenol	75	25	75	27
Pentachlorophenol	86	20	66	36
Phenol	36	14	36	21
2,4,6-Trichlorophenol	77	20	81	20

Spikes ranged from 10 to 1500 µg/l.

APPENDIX 8

METHOD 8250

GC/MS METHOD FOR SEMIVOLATILE ORGANICS: PACKED COLUMN TECHNIQUE

1.0 Scope and Application

1.1 Method 8250 is used to determine the concentration of semivolatile organic compounds (see Tables 1 and 2) in a variety of solid waste matrices.

1.2 This method is applicable to nearly all types of samples, regardless of water content, including groundwater, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments.

1.3 Method 8250 can be used to quantify most neutral, acidic, and basic organic compunds that are soluble in methylene chloride and capable of being eluted without derivatization as sharp peaks from a gas chromatographic column. Such compounds include polynuclear aromatic hydrocarbons, chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters, nitrosamines, haloethers, aldehydes, ethers, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, and phenols, including nitrophenols.

1.4 The detection limit of Method 8250 for determining an individual compound is approximately 1 µg/g (wet weight) in waste samples. For samples that contain more than 1 mg/g of total solvent extractable material, the detection limit is proportionately higher.

1.5 Method 8250 is based upon a solvent extraction, gas chromatographic/mass spectrometric (GC/MS) procedure.

1.6 This method is restricted to use by or under the supervision of analysts experienced in the use of gas chromatograph/mass spectrometers and skilled in the interpretation of mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 Summary of Method

2.1 Prior to using this method, the waste samples should be prepared for chromatography (if necessary) using the appropriate sample preparation method - i.e., separatory funnel liquid-liquid extraction (Method 3510), acid base extraction (Method 3530), sonication (Method 3550), or soxhlet extraction (Method 3540). For groundwater samples Method 3530 should be used. If emulsions are a problem, continuous extraction techniques should be used. This method describes chromatographic conditions which allow for the separation of the compounds in the extract.

TABLE 1. CHROMATOGRAPHIC CONDITIONS, METHOD DETECTION LIMITS, AND CHARACTERISTIC IONS FOR BASE/NEUTRAL EXTRACTABLES

Parameter	Retention time (min)	Method detection limit (μg/l)	Characteristic ions: Electron impact Primary	Electron impact Secondary		Chemical ionization (methane)		
1,3-Dichlorobenzene	7.4	1.9	146	148	113	146	148	150
1,4-Dichlorobenzene	7.8	4.4	146	148	113	146	148	150
Hexachloroethane	8.4	1.6	117	201	199	199	201	203
Bis(2-chloroethyl) ether	8.4	5.7	93	63	95	63	107	109
1,2-Dichlorobenzene	8.4	1.9	146	148	113	146	148	150
Bis(2-chloroisopropyl) ether	9.3	5.7	45	77	79	77	135	137
N-Nitrosodi-n-propyl amine			130	42	101			
Nitrobenzene	11.1	1.9	77	123	65	124	152	164
Hexachlorobutadiene	11.4	0.9	225	223	227	223	225	227
1,2,4-Trichlorobenzene	11.6	1.9	180	182	145	181	183	209
Isophorone	11.9	2.2	82	95	138	139	167	178
Naphthalene	12.1	1.6	128	129	127	129	157	169
Bis(2-chloroethoxy) methane	12.2	5.3	93	95	123	65	107	137
Hexachlorocyclopentadiene	13.9		237	235	272	235	237	239
2-Chloronaphthalene	15.9	1.9	162	164	127	163	191	203
Acenaphthylene	17.4	3.5	152	151	153	152	153	181
Acenaphthene	17.8	1.9	154	153	152	154	155	183
Dimethyl phthalate	18.3	1.6	163	194	164	151	163	164
2,6-Dinitrotoluene	18.7	1.9	165	89	121	183	211	223
Fluorene	19.5	1.9	166	165	167	166	167	195
4-Chlorophenyl phenyl ether	19.5	4.2	204	206	141			
2,4-Dinitrotoluene	19.8	5.7	165	63	182	183	211	223
Diethylphthalate	20.1	22	149	177	150	177	223	251
N-Nitrosodiphenylamine	20.5	1.9	169	168	167	169	170	198
Hexachlorobenzene	21.0	1.9	284	142	249	284	286	288
α-BHC	21.1		183	181	109			
4-Bromophenyl phenyl ether	21.2	1.9	248	250	141	249	251	277
γ-BHC	22.4		183	181	109			

TABLE 1. (CONT.)

Parameter	Retention time (min)	Method detection limit (µg/l)	Characteristic ions					
			Electron impact			Chemical ionization (methane)		
			Primary	Secondary				
Phenanthrene	22.8	5.4	178	179	176	178	179	207
Anthracene	22.8	1.9	178	179	176	178	179	207
β-BHC	23.4	4.2	181	183	109			
Heptachlor	23.4	1.9	100	272	274			
δ-BHC	23.7	3.1	183	109	181			
Aldrin	24.0	1.9	66	263	220			
Dibutyl phthalate	24.7	2.5	149	150	104	149	205	279
Heptachlor epoxide	25.6	2.2	353	355	351			
Endosulfan I	26.4	--	237	339	341			
Fluoranthene	26.5	2.2	202	101	100	203	231	243
Dieldrin	27.2	2.5	79	263	279			
4,4'-DDE	27.2	5.6	246	248	176			
Pyrene	27.3	1.9	202	101	100	203	231	243
Endrin	27.9	--	81	263	82			
Endosulfan II	28.6	--	237	339	341			
4,4'-DDD	28.6	2.8	235	237	165			
Benzidine	28.8	44	184	92	185	185	213	225
4,4'-DDT	29.3	4.7	235	237	165			
Endosulfan sulfate	29.8	5.6	272	387	422			
Endrin aldehyde	--	--	67	345	250			
Butyl benzyl phthalate	29.9	2.5	149	91	206	149	299	327
Bis(2-ethylhexyl) phthalate	30.6	2.5	149	167	279	149		
Chrysene	31.5	2.5	228	226	229	228	229	257
Benzo(a)anthracene	31.5	7.8	228	229	226	228	229	257
3,3'-Dichlorobenzidine	32.2	16.5	252	254	126			
Di-n-octyl phthalate	32.5	2.5	149					
Benzo(b)fluoranthene	34.9	4.8	252	253	125	252	253	281
Benzo(k)fluoranthene	34.9	2.5	252	253	125	252	253	281
Benzo(a)pyrene	36.4	2.5	252	253	125	252	253	281

TABLE 1. (CONT.)

Parameter	Retention time (min)	Method detection limit (μg/l)	Characteristic ions					
			Electron impact			Chemical ionization (methane)		
			Primary	Secondary				
Indeno(1,2,3-c,d)pyrene	42.7	3.7	276	138	277	276	277	305
Dibenzo(a,h)anthracene	43.2	2.5	278	139	279	278	279	307
Benzo(ghi)perylene	45.1	4.1	276	138	277	276	277	305
N-Nitrosodimethyl amine	--	--	42	74	44			
Chlordane[a]	19 to 30	--	373	375	377			
Toxaphene[a]	25 to 34	--	159	231	233			
PCB 1016[a]	18 to 30	--	224	260	294			
PCB 1221[a]	15 to 30	30	190	224	260			
PCB 1232[a]	15 to 32	--	190	224	260			
PCB 1242[a]	15 to 32	--	224	260	294			
PCB 1248[a]	12 to 34	--	294	330	362			
PCB 1254[a]	22 to 34	36	294	330	362			
PCB 1260[a]	23 to 32	--	330	362	394			

[a] These compounds are mixtures of various isomers (See Figures 2 to 12).

Gas chromatographic conditions: Glass column 1.8 m long x 2 mm I.D. packed with Supelcoport (100/120) coated with 3% SP-2250. Carrier gas: helium at a flow rate of 30 ml/min. Temperature: Isothermal at 50° C for 4 min, then 8° per min to 270° C. Hold at 270° C for 30 min.

TABLE 2. CHROMATOGRAPHIC CONDITIONS, METHOD DETECTION LIMITS, AND CHARACTERISTIC IONS FOR ACID EXTRACTABLES

Parameter	Retention time (min)	Method detection limit (µg/l)	Characteristic ions					
			Electron impact			Chemical ionization (methane)		
			Primary	Secondary				
2-Chlorophenol	5.9	3.3	128	64	130	129	131	157
2-Nitrophenol	6.5	3.6	139	65	109	140	168	122
Phenol	8.0	1.5	94	65	66	95	123	135
2,4-Dimethylphenol	9.4	2.7	122	107	121	123	151	163
2,4-Dichlorophenol	9.8	2.7	162	164	98	163	165	167
2,4,6-Trichlorophenol	11.8	2.7	196	198	200	197	199	201
4-Chloro-3-methylphenol	13.2	3.0	142	107	144	143	171	183
2,4-Dinotrophenol	15.9	42	184	63	154	185	213	225
2-Methyl-4,6-dinitrophenol	16.2	24	198	182	77	199	227	239
Pentachlorophenol	17.5	3.6	266	264	268	267	265	269
4-Nitrophenol	20.3	2.4	65	139	109	140	168	122

Chromatographic conditions: Glass column 1.8 m long x 2 mm I.D. packed with Supelcoport (100/120) coated with 1% SP-1240 DA. Carrier gas: helium at a flow rate of 30 ml/min. Column temperature, isothermal at 70° C for 2 min, then 8° per min to 200° C.

3.0 Interferences

3.1 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines causing misinterpretation of chromatograms. All these materials must be demonstrated to be free from interferences under the conditions of the analysis by running method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be required.

3.2 Interferences coextracted from the samples will vary considerably from source to source, depending upon the diversity of the industrial complex or waste being sampled.

3.2.1 Glassware must be scrupulously cleaned. Clean all glassware as soon as possible after use by rinsing with the last solvent used in it. Heating in a muffle furnace at 450° C for 5 to 15 hr is recommended whenever feasible. Alternatively, detergent washes, water rinses, acetone rinses, and oven drying may be used. Cleaned glassware should be sealed and stored in a clean environment to prevent any accumulation of dust or other contaminants.

3.2.2 The use of high purity reagents and solvents helps to minimize interference problems.

4.0 Apparatus

4.1 Sampling equipment: Glass screw-cap vials or jars of at least 100-ml capacity. Screw caps must be Teflon lined.

4.2 Glassware

4.2.1 Beaker: 400-ml.

4.2.2 Centrifuge tubes: approximately 200-ml capacity, glass with screw cap (Corning #1261 or equivalent). Screw caps must be fitted with Teflon liners.

4.2.3 Concentrator tube, Kuderna-Danish: 25-ml, graduated (Kontes K 570050-2526 or equivalent). Calibration must be checked at the volumes employed in the test. Ground-glass stopper is used to prevent evaporation of extracts.

4.2.4 Evaporative flask: Kuderna-Danish 250-ml (Kontes K-570001-0250 or equivalent). Attach to concentrator tube with springs.

4.2.5 Snyder column, Kuderna-Danish: Three-ball macro (Kontes K-503000-0121 or equivalent).

4.2.6 Snyder column, Kuderna-Danish: Two-ball micro (Kontes K-569001-0219 or equivalent).

4.3 Filter assembly

4.3.1 Syringe: 10-ml gas-tight with Teflon Luerlock (Hamilton 1010TLL or equivalent).

4.3.2 Filter holder: 13-mm Swinny (Millipore XX30-012 or equivalent)

4.3.3 Prefilters: glass fiber (Millipore AP-20-010 or equivalent).

4.3.4 Membrane filter: 0.2-µm Teflon (Millipore FGLP-013 or equivalent)

4.4 Micro syringe: 100-µl (Hamilton #84858 or equivalent).

4.5 Weighing pans, micro: approximately 1-cm diameter aluminum foil. Purchase or fabricate from aluminum foil.

4.6 Boiling chips: Approximately 10-40 mesh carborundum (A.H. Thomas #1590-D30 or equivalent). Heat to 450° C for 5-10 hr or extract with methylene chloride.

4.7 Water bath: Heated, capable of temperature control (±2° C). The bath should be used in a hood.

4.8 Balance: Analytical, capable of accurately weighing 0.0001 g.

4.9 Microbalance: Capable of accurately weighing to 0.001 mg (Mettler model ME-30 or equivalent).

4.10 Homogenizer, high speed: Brinkmann Polytron model PT 10ST with Teflon bearings, or equivalent.

4.11 Centrifuge: Capable of accommodating 200-ml glass centrifuge tubes.

4.12 pH Meter and electrodes: Capable of accurately measuring pH to ±0.1 pH unit.

4.13 Spatula: Having a metal blade 1-2 cm in width.

4.14 Heat lamp: 250-watt reflector-type bulb (GE #250R-40/4 or equivalent) in a heat-resistant fixture whose height above the sample may be conveniently adjusted.

4.15 Gas chromatograph/mass spectrometer data system

4.15.1 Gas chromatograph: An analytical system complete with a temperature-programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases.

4.15.2 Column for base-neutral compounds: 2-m x 2-mm I.D. stainless steel or glass, packed with 3% SP-2250-DB on 100/120 mesh Supelcoport B or equivalent.

4.15.3 Column for acidic compounds: 2-m x 2-mm I.D. glass packed with 1% SP 1240-DA on 100/120 mesh Supelcoport.

4.15.4 Mass spectrometer: Capable of scanning from 35 to 450 amu every 3 sec or less, utilizing 70 volts (nominal) electron energy in the electron impact ionization mode and producing a mass spectrum which meets all the criteria in Table 3 when 50 ng of decafluorotriphenylphosphine (DFTPP) is injected through the GC inlet.

TABLE 3. DFTPP KEY IONS AND ION ABUNDANCE CRITERIA[a]

Mass	Ion abundance criteria
51	30-60% of mass 198
68	Less than 2% of mass 69
70	Less than 2% of mass 69
127	40-60% of mass 198
197	Less than 1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	Greater than 1% of mass 198
441	Present but less than mass 443
442	Greater than 40% of mass 198
443	17-23% of mass 442

[a] J.W. Eichelberger, L.E. Harris, and W.L. Budde. 1975. Reference compound to calibrate ion abundance measurement in gas chromatography-mass spectrometry. Analytical Chemistry 47:995.

4.15.4 GC/MS interface: Any GC-to-MS interface that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria (see Sections 7.2.1-7.2.4) may be used. GC-to-MS interfaces constructed of all glass or glass-lined materials are recommended. Glass can be deactivated by silanizing with dichlorodimethylsilane. The interface must be capable of transporting at least 10 ng of the components of interest from the GC to the MS.

4.15.5 Data system: A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundance in any EICP between specified time or scan number limits.

4.16 Gel permeation chromatography system

4.16.1 Chromatographic column: 600-mm x 25-mm I.D. glass column fitted for upward flow operation.

4.16.2 Bio-beads S-X8: 80 g per column.

4.16.3 Pump: Capable of constant flow of 0.1 to 5 ml/min at up to 100 psi.

4.16.4 Injector: With 5-ml loop.

4.16.5 Ultraviolet detector: 254 mm.

4.16.6 Strip chart recorder.

5.0 Reagents

5.1 Reagent water: Reagent water is defined as a water in which an interferent is not observed at the method detection limit of each compound of interest.

5.2 Potassium phosphate, tribasic (K_3PO_4): Granular (ACS).

5.3 Phosphoric acid (H_3PO_4): 85% aqueous solution (ACS).

5.4 Sodium sulfate, anhydrous (Na_2SO_4): Powder (ACS).

5.5 Methylene chloride: Distilled-in-glass quality (Burdick and Jackson, or equivalent).

5.6 D_{10}-Phenanthrene.

5.7 Decafluorotriphenylphosphine (DFTPP).

5.8 Retention time standards: D_3-Phenol, D_8-naphthalene, D_{10}-Phenanthrene, D_{12}-chrysene, and D_{12}-benzo(a)pyrene. D_{12}-perylene may be used in place of D_{12}-benzo(a)pyrene.

5.9 Column performance standards: D_3-phenol, D_5-aniline, D_5-nitrobenzene, and D_3-2,4-dinitrophenol.

5.10 Surrogate standards: Decafluorobiphenyl, 2-fluoroaniline, and pentafluorophenol.

5.11 GPC calibration solution: Methylene chloride containing 100 mg corn oil, 20 mg di-n-octyl phthalate, 3 mg coronene, and 2 mg sulfur per 100 ml.

6.0 Sample Collection, Preservation, and Handling

6.1 Grab samples must be collected in glass containers having Teflon-lined screw caps. Sampling equipment must be free of oil and other potential sources of contamination.

6.2 The samples must be iced or refrigerated at 4° C from the time of collection until extraction.

6.3 All samples must be extracted within 14 days of collection and completely analyzed within 40 days of extraction.

7.0 Procedure

7.1 Calibration

7.1.1 An internal standard calibration procedure is used. To use this approach, the analyst must select one or more internal standards that are similar in analytical behavior to the compounds of interest. The analyst must further demonstrate that measurement of the internal standard is not affected by method or matrix interferences. D_{10}-phenanthrene is recommended for this purpose for general use. Use the base peak ion as the primary ion for quantification of the standards. If interferences are noted, use the next most intense ion as the secondary ion. The internal standard is added to all calibration standards and all sample extracts analyzed by GC/MS. Retention time standards, column performance standards, and a mass spectrometer tuning standard are included in the internal standard solution used.

7.1.1.1 A set of five or more retention time standards is selected that will permit all components of interest in a chromatogram to have retention times of 0.85 to 1.20 relative to at least one of the retention time standards. The retention time standards should be similar in analytical behavior to the compounds of interest and their measurement should not be affected by method or matrix interferences. The following retention time standards are recommended for general use: D_3-phenol, D_8-naphthalene, D_{12}-chrysene, and D_{12}-benzo(a)pyrene. D_{15}-perylene may be substituted for D_{12}-benzo(a)pyrene. D_{10}-phenanthrene serves as a retention time standard as well as an internal standard.

7.1.1.2 Representative acidic, basic, and polar netural compounds are added with the internal standard to assess the column performance of the GC/MS system. The measurement of the column performance standards should not be affected by method or matrix interferences. The following column performance standards are recommended for general use: D_5-phenol, D_5-aniline, D_5-nitrobenzene, and D_3-2,4-dinitrophenol. These compounds can also serve as retention time standards if appropriate and the retention time standards recommended in Section 7.1.1.1 can serve as column performance standards if appropriate.

7.1.1.3 Decafluorotriphenylphosphine (DFTPP) is added to the internal standard solution to permit the mass spectrometer tuning for each GC/MS run to be checked.

7.1.1.4 Prepare the internal standard solution by dissolving, in 50.0 ml of methylene chloride, 10.0 mg of each standard compound specified in Sections 7.1.1.1, 7.1.1.2, and 7.1.1.3. The resulting solution will contain each standard at a concentration of 200 µg/ml.

7.1.2 Prepare calibration standards at a minimum of three concentration levels for each compound of interest. Each ml of each calibration standard or standard mixture should be mixed with 250 µl of the internal standard solution. One of the calibration standards should be at a concentration near, but above, the method detection limit, 1 to 10 µg/ml, and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the GC/MS system.

7.1.3 Analyze 1 µl of each calibration standard and tabulate the area of the primary characteristic ion against concentration for each compound including standard compound. Calculate response factors (RF) for each compound as follows:

$$RF = (A_s C_{is})/(A_{is} C_s)$$

where:

A_s = Response for the parameter to be measured.

A_{is} = Response for the internal standards.

C_{is} = Concentration of the internal standard in µg/l.

C_s = Concentration of the compound to be measured in µg/l.

if the RF value over the working range is constant (less than 20% relative standard deviation), the RF can be assumed to be invariant and the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios, A_s/A_{is}, against RF.

7.1.4 The RF must be verified on each working day by the measurement of two or more calibration standards, including one at the beginning of the day and one at the end of the day. The response factors obtained for the calibration standards analyzed immediately before and after a set of samples must be within ±20% of the response factor used for quantification of the sample concentrations.

7.2 Daily GC/MS performance tests

7.2.1 At the beginning of each day that analyses are to be performed, the GC/MS system must be checked to see that acceptable performance criteria are achieved for DFTPP.

7.2.2 The DFTPP performance test requires the following instrumental parameters:

Electron energy: 70 volts (nominal)

Mass Range: 40 to 450 amu

Scan Time: 1 sec per scan

7.2.3 Inject a solution containing 50 µg/ml of DFTPP into the GC/MS system or bleed DFTPP vapor directly into the mass spectrometer and tune the instrument to achieve all the key ion criteria for the mass spectrum of DFTPP given in Table 1.

7.2.4 DFTPP is included in the internal standard solution added to all samples and calibration solutions. If any key ion abundance observed for DFTPP during the analysis of a sample differs by more than 10% from that observed during the analysis of the calibration solution, then the analysis in question is considered invalid. The instrument must be retuned or the sample and/or calibration solution reanalyzed until the above condition is met.

7.3 Sample extraction

7.3.1 The extraction procedure involves homogenization of the sample with methylene chloride, neutralization to pH 7, and the addition of anhydrous sodium sulfate to remove the water. The amount of acid or base required for the neutralization is determined by titration of the sample. Aqueous samples are extracted using Method 3510 while organic liquids may be analyzed neat or diluted with CH_2 and analyzed. Solids and semisolids are extracted by Method 3540 and 3550 or by the extraction described in Steps 7.3.1 through 7.4.3.

7.3.1.1 Thoroughly mix the sample to enable a representative sample to be obtained. Weight 3.0 g (wet weight) of sample into a 400-ml beaker. Add 75 ml methylene chloride and 150 ml water.

7.3.1.2 Homogenize the mixture for a total of 1 min using a high-speed homogenizer. Use a metal spatula to dislodge any material that adheres to the beaker or to the homogenizer before or during the homogenization to ensure thorough dispersion of the sample.

7.3.1.3 Adjust the pH of the mixture to 7.0 ± 0.2 by titration with 0.4 M H_3PO_4 or 0.4 M K_3PO_4 using a pH meter to measure the pH. Record the volume of acid or base required.

7.3.2 The extraction with methylene chloride is performed using a fresh portion of the sample. Weigh 3.0 g (wet weight) of sample into a 200-ml centrifuge tube. Spike the sample with surrogate standards as described in Section 8.4. Add 150 ml of methylene chloride followed by 1.0 ml of 4 M phosphate buffer pH 7.0, and an amount of 4 M H_3PO_4 or 4 M K_3PO_4 equal to one tenth of the pH 7 acid or base volume requirement determined in Section 7.3.1.3. For example, if the acid requirement in Section 7.3.1.3 was 2.0 ml of 0.4 M H_3PO_4, the amount of 4 M H_3PO_4 needed would be 0.2 ml.

7.3.3 Homogenize the mixture for a total of 30 sec using a high-speed homogenizer at full speed. Cool the mixture in an ice bath or cold water bath, if necessary, to maintain a temperature of 20-30° C. Use a metal spatula to help dislodge any material that adheres to the centrifuge tube or homogenizer during the homogenization to obtain as thorough a dispersion of the sample as possible. Some samples, especially those that contain much water, may not disperse well in this step but will disperse after sodium sulfate is added. Add an amount of anhydrous sodium sulfate powder equal to 15.0 g plus 3.0 g per ml of the 4 M H_3PO_4 or 4 M K_3PO_4 added in Section 7.3.2. Homogenize the mixture again for a total of 30 sec using a high-speed homogenizer at full speed. Use a metal spatula to dislodge any material that adheres to the centrifuge tube or homogenizer during the homogenization to ensure thorough dispersion. (NOTE: This step may cause rapid deterioration of the Teflon bearing in the homogenizer. The bearing must be replaced whenever the rotor shaft becomes loose to prevent damage to stainless steel parts.) Allow the mixture to stand until a clear supernatant is obtained. Centrifuge if necessary to facilitate the phase separation. Filter the supernatant required for Sections 7.3.4, 7.3.5, and 7.3.7 (at least 2 ml) through a 0.2-µm Teflon filter.

7.3.4 Estimate the total solvent extractable content (TSEC) of the sample by determining the residue weight of an aliquot of the supernatant from Section 7.3.3. Transfer 0.1 ml of the supernatant to a tared aluminum weighing dish, place the weighing dish under a heat lamp at a distance of 8 cm from the lamp for 1 min to allow the solvent to evaporate, and weigh on a microbalance. If the residue weight of the 0.1-ml aliquot is less than 0.05 mg, concentrate 25 ml of the supernatant to 1.0 ml and obtain a residue weight on 0.1 ml of the concentrate. For the concentration step, use a 25-ml evaporator tube fitted with a micro Snyder column; add two boiling chips and heat in a water bath at 60-65° C. Calculate the TSEC as milligrams of residue per gram of sample using Equation 1 if concentration was not required or Equation 2 if concentration was required.

$$\frac{\text{mg of residue}}{\text{g of sample}} = \frac{\text{residue weight (mg) of 0.1 ml of supernatant}}{0.002} \qquad \text{(Eq. 1)}$$

$$\frac{\text{mg of residue}}{\text{g of sample}} = \frac{\text{residue weight (mg) of 0.1 ml of conc. supernatant}}{0.05} \qquad \text{(Eq. 2)}$$

7.3.5 If the TSEC of the sample (as determined in Section 7.3) is less than 50 mg/g, concentrate an aliquot of the supernatant that contains a total of only 10 to 20 mg of residual material. For example, if the TSEC is 44 mg/g, use a 20-ml aliquot of the supernatant, which will contain 17.6 mg of residual material, or if the TSEC is 16 mg/g, use a 50-ml aliquot of the supernatant, which will contain 16.0 mg of residual material. If the TSEC is less than 10 mg/g, use 100 ml of the supernatant. Perform the concentration by transferring the aliquot of the supernatant to a K-D flask fitted into a 25-ml concentrator tube. Add two boiling chips, attach a three-ball macro Snyder column to the K-D flask, and concentrate the extract using a water bath at 60 to 65° C. Place the K-D apparatus in the water bath so that the concentrator tube is about half immersed in the water and the entire rounded surface of the flask is bathed with water vapor. Adjust the vertical position of the apparatus and the water temperature as required to complete the concentration in 15 to 20 min. At the proper rate of distillation, the balls of the column actively chatter but the chambers do not flood. When the liquid has reached an apparent volume of 5 to 6 ml, remove the K-D apparatus from the water bath and allow the solvent to drain for at least 5 min while cooling. Remove the Snyder column and rinse the flask and its lower joint into the concentrator tube with the methylene chloride to bring the volume to 10.0 ml. Mix the contents of the concentrator tube by inserting a stopper and inverting several times.

7.3.6 Analyze the concentrate from Section 7.3.5 or, if the TSEC of the sample is 50 mg/g or more, analyze the supernatant from Section 7.3 using gas chromatography. Use a 30-m x 0.25-mm bonded-phase silicone-coated fused-silica capillary column under the chromatographic conditions described in Section 7.5. Estimate the concentration factor or dilution factor required to give the optimum concentration for the subsequent GC/MS analysis. In general, the optimum concentration will be one in which the average peak height of the five largest peaks or the height of an unresolved envelope of peaks is the same as that of an internal standard at a concentration of 50-100 µg/ml.

7.3.7 If the optimum concentration determined in Section 7.3.6 is 20 mg of residual material per ml or less, proceed to Section 7.3.8. If the optimum concentration is greater than 20 mg of residual material per ml and if the TSEC is greater than 50 mg/g, apply the GPC cleanup procedure described in Section 7.4. For the GPC cleanup, concentrate 90 ml of the supernatant from Section 7.3.3 or a portion of the supernatant that contains a total of 600 mg of residual material (whichever is the smaller volume). Use the concentration procedure described in Section 7.3.5 and concentrate to a final volume of 15.0 ml. Stop the concentration prior to reaching 15.0 ml if any oily or semisolid material separates out and dilute as necessary (up to a maximum final volume equal to the volume of supernatant used) to redissolve the material. (Disregard the presence of small amounts of inorganic salts that may settle out.)

7.3.8 Concentrate further or dilute as necessary an aliquot of the concentrate from Section 7.3.5 or an aliquot of the supernatant from Section 7.3.3, or if GPC cleanup was necessary, an aliquot of the concentrate from Section 7.4.3 to obtain 1.0 ml of a solution having the optimum concentration, as described in Section 7.3.6, for the GC/MS analysis. If the aliquot needs to be diluted, dilute it to a volume of 1.0 ml with methylene chloride. If the aliquot needs to be concentrated, concentrate it to 1.0 ml as decribed in Section 7.3.4. Do not let the volume in the concentrator tube go below 0.6 ml at any time. Stop the concentration prior to reaching 1.0 ml if any oily or semisolid material separates out and dilute as necessary (up to a maximum final volume of 10 ml) to redissolve the material. (Disregard the presence of small amounts of inorganic salts that may settle out). Add 250 µl of the internal standard solution, containing 50 µg each of the internal standard, retention time standards, column performance standards, and DFTPP, to 1.0 ml of the final concentrate and save for GC/MS analysis as described in Section 7.5. Calculate the concentration in the original sample that is represented by the internal standard using Equation 3 if an aliquot of the concentrate from Section 7.3.5 was used in Section 7.3.8, Equation 4 if an aliquot of the supernatant from Section 7.3.3 was used in Section 7.3.8 or Equation 5 if an aliquot of the GPC concentrate from Section 7.4.3 was used in Section 7.3.8.

$$\frac{\mu g\text{ of Int. Std.}}{g\text{ of sample}} = \frac{50}{3} \times \frac{150}{V_{s(7.3.5)}} \times \frac{10}{V_{c\ (7.3.8)}} \times \frac{\text{Final Vol. (ml)}}{1} \qquad \text{(Eq. 3)}$$

$$\frac{\mu g\text{ of Int. Std.}}{g\text{ of sample}} = \frac{50}{3} \times \frac{150}{V_{s(7.3.8)}} \times \frac{\text{Final Vol. (ml)}}{1} \qquad \text{(Eq. 4)}$$

$$\frac{\mu g\text{ of Int. Std.}}{g\text{ of sample}} = \frac{50}{3} \times \frac{150}{V_{s(7.3.7)}} \times \frac{V_F}{V_{GPC\ (7.3.7)}} \times \frac{\text{Final Vol. (ml)}}{1} \qquad \text{(Eq. 5)}$$

where:

V_S = Volume of supernatant from Section 7.3.3 used in Sections 7.3.5, 7.3.8, 7.3.7

$V_{C(7.3.8)}$ = Volume of concentrate from Section 7.3.5 used in Section 7.3.8

$V_{F\ (7.3.7)}$ = Final volume of concentrate in Section 7.3.7

V_{GPC} = Volume of GPC concentrate from Section 7.4.3 used in Section 7.3.8

Use this calculated value for the quantification of individual compounds as described in Section 7.7.2.

7.4 Cleanup using gel permeation chromatography

7.4.1 Prepare a 600-mm x 25-mm I.D. gel permeation chromatography (GPC) column by slurry packing using 80 g of Bio-Beads S-X8 that have been swelled in methylene chloride for at least 4 hr. Prior to initial use, rinse the column with methylene chloride at 1 ml/min for 16 hr to remove any traces of contaminants. Calibrate the system by injecting 5 ml of the GPC calibration solution, eluting with methylene chloride at 5 ml/min for 50 min and observing the resultant UV detector trace. The column may be used indefinitely as long as no darkening or pressure increases occur and a column efficiency of at least 500 theoretical plates is achieved. The pressure should not be permitted to exceed 50 psi. Recalibrate the system daily.

7.4.2 Inject a 5-ml aliquot of the concentrate from Section 7.3.7 onto the GPC column and elute with methylene chloride at 5 ml/min for 50 min. Discard the first fraction that elutes up to a retention time represented by the minimum between the corn oil peak and the di-n-octyl phthalate peak in the calibration run. Collect the next fraction eluting up to a retention time represented by the minimum between the coronene peak and the sulfur peak in the calibration run. Apply the above GPC separation to a second 5-ml aliquot of the concentrate from Section 7.3.7 and combine the fractions collected.

7.4.3 Concentrate the combined GPC fractions to 10.0 ml as described in Section 7.3.5. Estimate the TSEC of the concentrate as described in Section 7.3.4. Estimate the TSVC of the concentrate as described in Section 7.3.6.

7.5 Gas chromatography/mass spectrometry

7.5.1 Analyze the 1-ml concentrate from Method 3510, 3540, or 3550, or Section 7.3.8 by GC/MS using the appropriate column (see Section 4.15). The recommended GC operating conditions to be used are as follows:

Conditions for base neutral analysis (3% SP-2250-DB)

Initial column temperature hold: 50° C for 4 min

Column temperature program: 50-300° C at 8 degrees/min

Final column temperature hold: 300^0 C for 20 min.

Conditions for acid analysis (1% SP-1240-DA)

Initial column temperature: 70° C for 2 min

Column temperature program: 70-200° C at 8 degrees/min

Final column temperature hold: 200° C for 20 min

Injector temperature: 300° C

Transfer line temperature: 300° C

Sample volume: 1-2 µl

Carrier gas: Helium at 30 ml/min

7.5.2 If the response for any ion exceeds the working range of the GC/MS system, dilute the extract and reanalyze.

7.5.3 Perform all qualitative and quantitative measurements as described in Sections 7.6 and 7.7. When the extracts are not being used for analyses, store them at 4° C protected from light in screw-cap vials equipped with unpierced Teflon-lined septa.

7.6 Qualitative identification. Obtain an EICP for the primary characteristic ion and at least two other characteristic ions for each compound when practical. The following criteria must be met to make a qualitative identification.

7.6.1 The characteristic ions for each compound of interest must maximize in the same or within one scan of each other.

7.6.2 The retention time must fall within ± 15 sec (based on the relative retention time) of the retention time of the authentic compound.

7.6.3 The relative peak heights of the characteristic ions in the EICP's must fall within ±20% of the relative intensities of these ions in a reference mass spectrum.

7.7 Quantitative determination

7.7.1 When a compound has been identified, the quantification of that compound will be based on the integrated abundance from the EICP of the primary characteristic ion. In general, the primary characteristic ion selected should be a relatively intense ion as interference-free as possible, and as close as possible in mass to the characteristic ion of the internal standard used.

7.7.2 Use the internal standard technique for performing the quantification. Calculate the concentration of each individual compound of interest in the sample using Equation 6.

$$\text{Concentration, } \mu g/g = \frac{\mu g \text{ of Int. Std.}}{g \text{ of sample}} \times \frac{A_s}{A_{is}} \times \frac{1}{RF} \qquad \text{(Eq. 6)}$$

where:

$\frac{\mu g \text{ of Int. Std.}}{g \text{ of sample}}$ = internal standard concentration factor calculated in Section 7.3.8

A_s = Area of the primary characteristic ion of the compound being quantified

A_{is} = Area of the primary characteristic ion of the internal standard

RF = Response factor of the compound being quantified (determined in Section 7.1.3).

7.7.3 Report results in µg/g without correction for recovery data. When duplicate and spiked samples are analyzed, report all data obtained with the sample results.

7.7.4 If the surrogate standard recovery falls outside the control limits in Section 8.3, the data for all compounds in that sample must be labeled as suspect.

8.0 Quality Control

8.1 Each laboratory that uses this method is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and the analysis of spiked samples as a continuing check on performance. The laboratory is required to maintain performance records to define the quality of data that is generated. Ongoing performance checks must be compared with established performance criteria to determine if the results of analyses are within the accuracy and precision limits expected of the method.

8.1.1 Before performing any analyses, the analyst must demonstrate the ability to generate acceptable accuracy and precision with this method. This ability is established as described in Section 8.2.

8.1.2 The laboratory must spike all samples including check samples with surrogate standards to monitor continuing laboratory performance. This procedure is described in Section 8.4.

8.2 To establish the ability to generate acceptable accuracy and precision, the analyst must perform the following operations using a representative sample as a check sample.

8.2.1 Analyze four aliquots of the unspiked check sample according to the method beginning in Section 7.3.

8.2.2 For each compound to be measured, select a spike concentration representative of twice the level found in the unspiked check sample or a level equal to 10 times the expected detection limit, whichever is greater. Prepare a spiking solution by dissolving the compounds in methylene chloride at the appropriate levels.

8.2.3 Spike a minimum of four aliquots of the check sample with the spiking solution to achieve the selected spike concentrations. Spike the samples after they have been transferred to centrifuge tubes for extraction. Analyze the spiked aliquots according to the method described beginning in Section 7.3.

8.2.4 Calculate the average percent recovery (R) and the standard deviation of the percent recovery (s) for all compounds and surrogate standards. Background corrections must be made before R and s calculations are performed. The average percent recovery must be greater than 20 for all compounds to be measured and greater than 60 for all surrogate compounds. The percent relative standard deviation of the percent recovery (s/R x 100) must be less than 20 for all compounds to be measured and all surrogate compounds.

8.3 The analyst must calculate method performance criteria for each of the surrogate standards.

8.3.1 Calculate upper and lower control limits for method performance for each surrogate standard, using the values for R and s calculated in Section 8.2.4:

Upper Control Limit (UCL) = R + 3s
Lower Control Limit (LCL) = R - 3s

The UCL and LCL can be used to construct control charts that are useful in observing trends in performance.

8.3.2 For each surrogate standard, the laboratory must maintain a record of the R and s values obtained for each surrogate standard in each waste sample analyzed. An accuracy statement should be prepared from these data and updated regularly.

8.4 The laboratory is required to spike all samples with the surrogate standard to monitor spike recoveries. The spiking level used should be that which will give a concentration in the final extract used for GC/MS analysis that is equal to the concentration of the internal standard assuming a 100% recovery of the surrogate standards. For unknown samples, the spiking level is determined by performing the extraction steps in Section 7.3 on a separate aliquot of the sample and calculating the amount of internal standard per gram of sample as described in Section 7.3.8. If the recovery for any surrogate standard does not fall within the control limits for method performance, the results reported for that sample must be qualified as being outside of control limits. The laboratory must monitor the frequency of data so qualified to ensure that it remains at or below 5%. Three surrogate standards, namely decafluorobiphenyl, 2-fluoroaniline, and pentafluorophenol, are recommended for general use to monitor recovery of neutral, basic, and acidic compounds, respectively.

8.5 Before processing any samples, the analyst must demonstrate through the analysis of a process blank that all glassware and reagent interferences are under control. Each time a set of samples is extracted or there is a change in reagents, a process blank should be analyzed to determine the level of laboratory contamination.

8.6 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Field replicates may be analyzed to monitor the precision of the sample technique. Whenever possible, the laboratory should perform analysis of standard reference materials and participate in relevant performance evaluation studies.

8.7 The features that must be monitored for each GC/MS analysis run for quality control purposes and for which performance criteria must be met are as follows:

- Relative ion abundances of the mass spectrometer tuning compound DFTPP.
- Response factors of column performance standards and retention time standards.
- Relative retention time of column performance standards and retention time standards.
- Peak area intensity of the internal standard, e.g., D_{10}-phenanthrene.

8.8 Standard quality assurance practices should be used with this method. Field replicates should be collected to validate the precision of the sampling technique. Laboratory replicates should be analyzed to validate the precision of the analysis. Fortified samples should be carried through all stages of sample preparation and measurement; they should be analyzed to validate the sensitivity and accuracy of the analysis. If the fortified waste samples do not indicate sufficient sensitivity to detect less than or equal to 1 µg/g of sample, then the sensitivity of the instrument should be increased or the extract subjected to additional cleanup. Detection limits to be used for groundwater samples are indicated in Tables 1 and 2. Where doubt exists over the identification of a peak on the chromatograph, confirmatory techniques such as mass spectroscopy should be used.

8.9 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 value is above zero. The MDL concentrations listed in Tables 1 and 2 were obtained using reagent water. Similar results were achieved using representative wastewaters. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

8.10 In a single laboratory, using reagent water and wastewaters spiked at or near background levels, the average recoveries presented in Tables 4 and 5 were obtained. The standard deviation of the measurement in percent recovery is also included in Tables 4 and 5.

TABLE 4. ACCURACY AND PRECISION FOR BASE/NEUTRAL EXTRACTABLES

	Reagent water		Wastewater	
Parameter	Average percent recovery	Standard deviation (%)	Average percent recovery	Standard deviation (%)
Acenaphthene	77	23	83	29
Acenaphthylene	78	22	82	23
Aldrin	72	6	--	--
Anthracene	84	14	76	22
Benzo(a)anthracene	83	19	75	28
Benzo(b)fluoranthene	96	68	41	21
Benzo(k)fluoranthene	96	68	47	27
Benzo(ghi)perylene	80	45	68	40
Benzo(a)pyrene	90	22	43	21
Benzidine	87	61	63	55
Butyl benzyl phthalate	47	32	74	43
β-BHC	69	25	--	--
δ-BHC	56	18	--	--
Bis (2-chloroethoxy) methane	84	33	82	74
Bis (2-chloroethyl) ether	56	36	72	37
Bis (2-chloroisopropyl) ether	71	33	71	39
Bis (2-ethylhexyl) phthalate	129	50	82	63
4-Bromophenyl phenyl ether	80	17	75	20
2-Chloronaphthalene	73	24	79	27
4-Chlorophenyl phenyl ether	45	11	--	--
Chrysene	83	19	75	28
4,4'-DDD	80	9	--	--
4,4'-DDE	69	20	--	--
4,4'-DDT	63	15	--	--
Dibenzo(a,h)anthracene	82	39	70	40
Di-n-butyl phthalate	70	25	93	51
1,2-Dichlorobenzene	59	27	62	28
1,3-Dichlorobenzene	55	28	54	24
1,4-Dichlorobenzene	61	31	63	35
3,3-Dichlorobenzidine	184	174	143	145
Diethylphthalate	42	28	48	28
Dimethyl phthalate	25	33	35	36
2,4-Dinitrotoluene	83	32	79	34
2,6-Dinitrotoluene	79	18	79	25
Di-n-octylphthalate	97	37	89	62
Endosulfan sulfate	79	29	--	--
Fluoranthene	89	19	80	26
Fluorene	77	16	80	20
Heptachlor	69	6	--	--
Heptachlor epoxide	82	7	--	--

APPENDIX B

LOGS OF BORINGS

MAJOR DIVISIONS					TYPICAL NAMES
COARSE - GRAINED SOILS MORE THAN HALF IS LARGER THAN NO 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN No 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL-GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE - GRAINED SOILS MORE THAN HALF IS SMALLER THAN NO 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS 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

UNIFIED SOIL CLASSIFICATION SYSTEM

■	"Undisturbed" Sample
☒	Bulk or Classification Sample
▩	Cake (Suspected BHC-HCB)
▒	Fly Ash
▨	Construction Debris
▼	Observed Water Level in Boring
Perm.	Laboratory Permeability

LEGEND FOR ADDITIONAL SYMBOLS USED ON LOGS

Harding Lawson Associates
Engineers Geologists
& Geophysicists

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B1

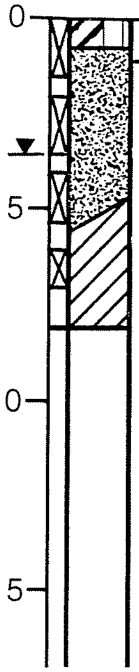
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
CS	17497,001.12	KH	10/11/85	BH	7/22/86

LOG OF BORING A4

Equipment Hollow-Stem Auger

Elevation - Date 6/7/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
12	5.0(A) 9.0(B)	1.0
26	16.5	1.0
14	12.6	1.0
14	5.5	1.0



INTERMIXED BROWN CLAY AND CLAYEY SILT
stiff, dry
Fill

WHITE CAKE
medium dense, moist, gray below 4 feet

RED-BROWN SILTY CLAY (CL)
stiff, moist, with roots

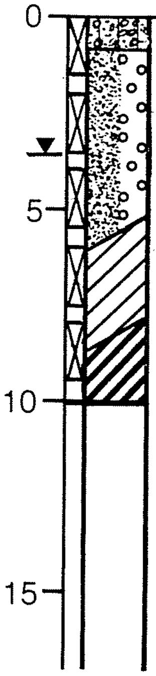
End of Boring - 7 feet

LOG OF BORING B2

Equipment Hollow-Stem Auger

Elevation - Date 7/2/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
16	0.9(A) 1.0(B)	0.9
25	1.0	0.9
7	3.2	0.9
6	1.6	0.7
8	5.7	0.8



BROWN SILTY GRAVELLY SAND
loose, dry

GRAY CAKE AND LIME GRIT
medium dense, moist
loose, saturated below 4 feet
gravelly 4.5 to 5 feet
intermixed with black fill at 5.5 feet
Fill

GRAY SILTY CLAY (CL)
stiff, saturated

RED-BROWN CLAY (CH)
stiff, saturated, with some silt

End of Boring - 10 feet

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

LOGS OF BORINGS A4 and B2
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B2

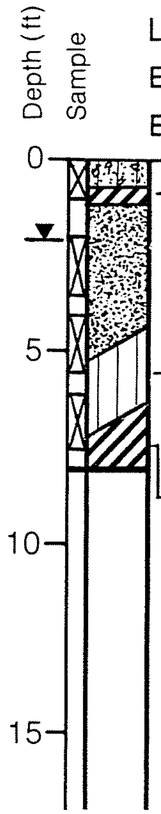
DRAWN ES.
JOB NUMBER 17497,001.12
APPROVED
DATE 10/10/85
REVISED
DATE

LOG OF BORING B3

Equipment Hollow-Stem Auger

Elevation - Date 6/27/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
24	4.9(A) 4.2(B)	1.0
38	4.8	0.9
21	7.6(A) 5.3(B)	0.8
10	42(A) 36(B)	1.0



SILTY SANDY GRAVEL
medium dense, dry
RED-BROWN CLAY
very stiff, moist
GRAY CAKE
very dense, saturated
intermixed with black fill 4.5
to 4.8 feet
BROWN AND GRAY CLAYEY SILT (ML)
medium dense, saturated
RED-BROWN CLAY (CH)
very stiff, very moist
End of Boring - 8 feet

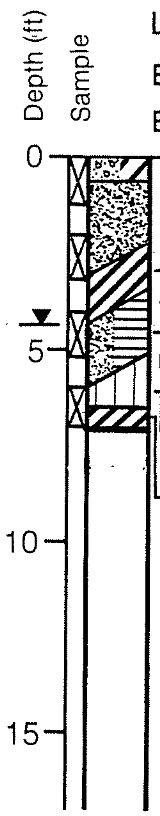
Fill

LOG OF BORING B4

Equipment Hollow-Stem Auger

Elevation - Date 6/27/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
20	6.1	1.0
45	15.5(A) 5.6(B)	1.0
10	4.3	0.9
17	5.4(A) 3.2(B)	1.1



BROWN SANDY GRAVEL AND CLAY
medium dense, dry
WHITE CAKE
hard, moist
RED-BROWN AND GRAY CLAY
very stiff, moist
GRAY CAKE AND BLACK GLASS
medium dense, saturated
RED-BROWN CLAYEY SILT (ML)
medium dense, saturated
RED-BROWN CLAY (CH)
very stiff, saturated
End of Boring - 7 feet

Fill

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

LOGS OF BORINGS B3 and B4
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B3

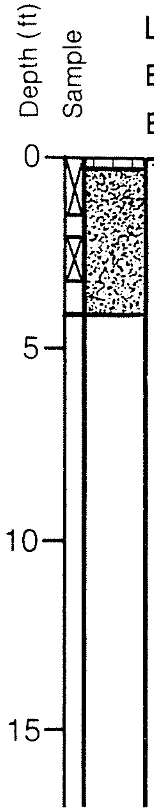
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	KH	10/10/85		

LOG OF BORING B5

Equipment Hollow-Stem Auger

Elevation - Date 7/3/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
45	2.3(A) 31(B)	0.8
77	92	0.8



CLAYEY SILT
dense, slightly moist

WHITE CAKE
very dense, moist
obstruction at 3.9 feet
End of Boring - 4 feet

Fill

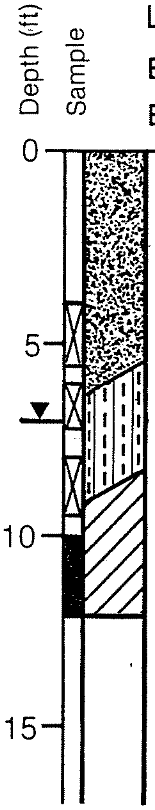
LOG OF BORING B5A

Equipment Hollow-Stem Auger

Elevation - Date 7/3/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
31	12.3(A) 3.6(B)	0.8
5	6.9	0.7
5	16.6(A) 2.2(B)	0.7

Perm.
8.8×10^{-8} cm/sec



Note: Drilled to 4 feet without sampling.

Fill

WHITE CAKE
dense, moist, intermixed with black fill 5 to 5.25 feet

ORGANIC DARK GRAY SILTY CLAY (OL)
soft, moist, with roots in upper 4 inches
sandy 8.4 to 8.7 feet

BROWN CLAY WITH SILT (CL)
very soft, saturated

End of Boring - 12 feet

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

LOGS OF BORINGS B5 and B5A
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B4

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
Eg. Kg.	17497,001.12	KH	10/10/85		

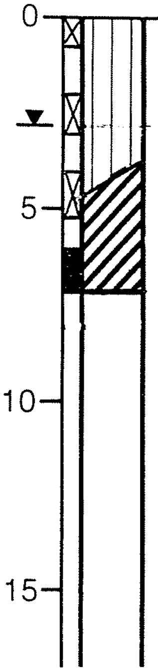
LOG OF BORING C1

Equipment Hollow-Stem Auger

Elevation - Date 7/2/85

Pocket Penetrometer (ksf)	Blows/foot	PID Headspace (ppm)	PID Background (ppm)
	8	2.6	1.3
	7	2.8(A) 1.8(B)	1.3
	15	7.6	1.3
4.5			

Perm.
$2.5\text{x}10^{-8}$ cm/sec



BROWN SANDY CLAYEY SILT
loose, dry, trace gravel, with white and gray cake below 0.5 feet
Fill

RED-BROWN CLAY (CH)
hard, moist, blocky, with few silt pockets
End of Boring - 7 feet

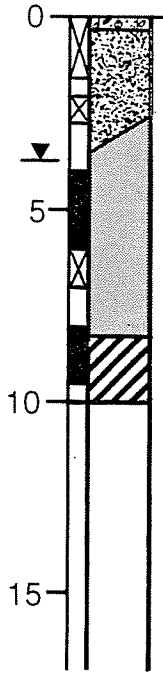
LOG OF BORING C2

Equipment Hollow-Stem Auger

Elevation - Date 6/28/85

Pocket Penetrometer (ksf)	Blows/foot	PID Headspace (ppm)	PID Background (ppm)
	21	5.0(A) 4.0(B)	0.9
	12	4.5	1.0
-		5.3	
	29	3.2	1.0
1.5			

Perm.
$3.3\text{x}10^{-8}$ cm/sec



SILTY SAND AND GRAVEL
medium dense, dry, with roots
WHITE CAKE
medium dense, moist
WHITE AND SPECKLED FLY ASH
medium dense, layered, saturated
Fill

BROWN CLAY (CH)
stiff, saturated
End of Boring - 10 feet

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

LOGS OF BORINGS C1 and C2

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B5

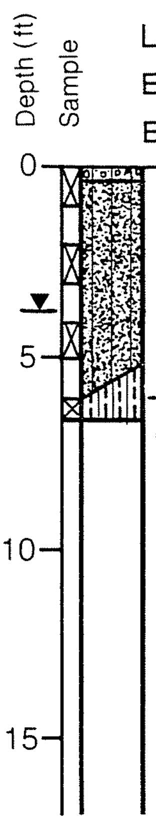
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KHH	10/10/85		

LOG OF BORING C3

Equipment Hollow-Stem Auger

Elevation - Date 6/28/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
10	5.7(A) 6.0(B)	1.3
10	5.5	1.6
6	3.7	1.6
-	11.4	1.5



GRAVELLY SILT AND SAND
stiff, dry
WHITE CAKE WITH SOME SILT
loose to medium dense, dry to 2 feet
moist 2 to 3.75 feet
gray and saturated below 3.75 feet
Fill

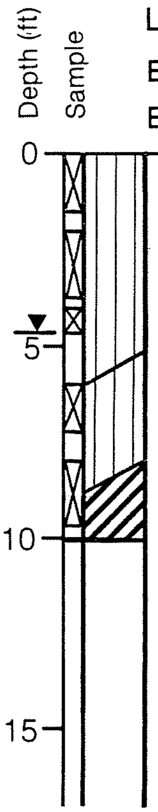
DARK BROWN ORGANIC CLAY (OL)
soft, saturated
wood encountered at 6.2 feet
End of Boring - 6.2 feet

LOG OF BORING C4

Equipment Hollow-Stem Auger

Elevation - Date 6/27/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
13	5.1(A) 5.8(B)	1.0
15	5.4(A) 4.8(B)	1.0
7	10.2	1.0
10	1.0	0.8
13	3.2	1.0



LIGHT GRAY SILT
medium dense, dry to 3 feet
intermixed with white cake 0.3 to 5.8 feet
intermixed with black glassy fill 2.0 to 3.8 feet
Fill
GRAY CLAYEY SILT (ML)
medium dense, saturated

RED-BROWN CLAY (CH)
stiff, saturated
End of Boring - 10 feet

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LOGS OF BORINGS C3 and C4
Pine and Tuscarora Site
Niagara Falls, New York

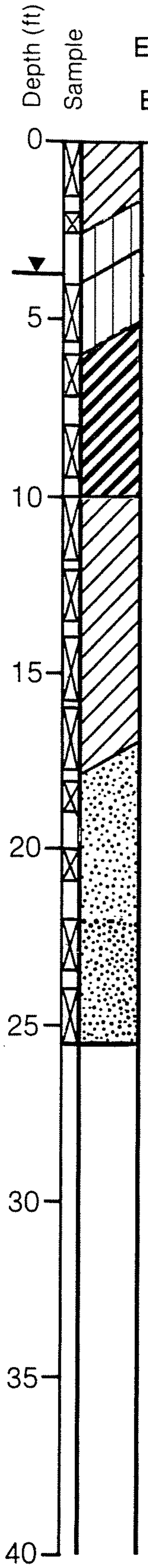
PLATE
B6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KHH	10/10/85		

Equipment Hollow-Stem Auger D1

Elevation - Date 7/2/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
10	2.3	1.3
16	4.4	1.2
5	4.1	1.3
26	2.4	1.3
22	2.4	1.3
7	2.9	1.4
5	3.4	1.3
3	3.2	1.3
6	3.7	1.3
2	15.3	1.3
13	6.2	1.2
41	2.5	1.2
43	3.2	1.0



LIGHT BROWN AND BROWN SILTY CLAY
stiff, moist, dry in top 6 inches
Fill

LIGHT BROWN CLAYEY SILT (ML)
medium dense, moist

LIGHT BROWN AND GRAY SANDY SILT (ML)
loose, saturated

RED-BROWN CLAY (CH)
very stiff, moist, with few sandy silt pockets

BROWN SILTY CLAY (CL)
medium stiff, saturated
very silty with trace of sand from 12.8 to 13.3 feet

BROWN SILTY GRAVELLY SAND (SW)
loose to 20 feet, saturated

medium dense 20 to 23 feet

gravel is mainly black metamorphic rock

dense below 23 feet
very gravelly 23 to 23.6 feet

End of Boring 25.6 feet

Bedrock encountered at 25.6 feet.

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LOG OF BORING D1

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B7

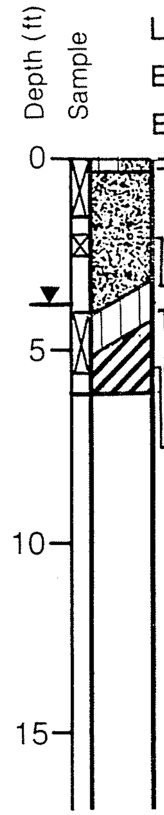
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
Cg. Hg.	17497,001.12		10/10/85		

LOG OF BORING D2

Equipment Hollow-Stem Auger

Elevation - Date 6/28/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
16	4.3	1.2
16	4.1	1.0
3	2.7(A) 4.7(B)	1.2



INTERMIXED SANDY SILT AND WHITE CAKE
loose, dry with roots

Fill

WHITE CAKE
medium dense, moist 1.5 to 3.7 feet

DARK GRAY CLAYEY SILT (ML)
loose, saturated, trace sand

RED-BROWN CLAY (CH)
stiff, very moist

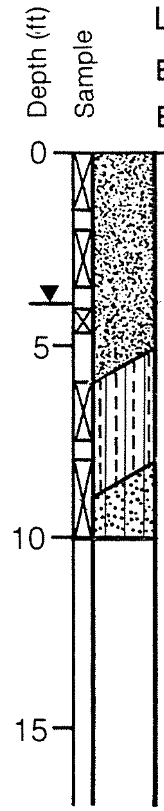
End of Boring - 6 feet

LOG OF BORING D3

Equipment Hollow-Stem Auger

Elevation - Date 6/28/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
8	6.7(A) 3.0(B)	1.6
9	4.7	1.2
7	4.3	1.4
7	13.6(A) 5.4(B)	1.3
5	3.0(A) 1.6(B)	1.3



WHITE CAKE
loose, moist, mixed with gravel to 0.35 feet
gray and saturated below 4 feet

Fill

DARK GRAY ORGANIC CLAYEY SILT (OL)
loose, saturated, with roots
gray and less silty 7 to 7.3 feet

LIGHT BROWN SILTY SAND (SM)
loose, saturated, trace clay

End of Boring - 10 feet

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LOGS OF BORINGS D2 and D3

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B8

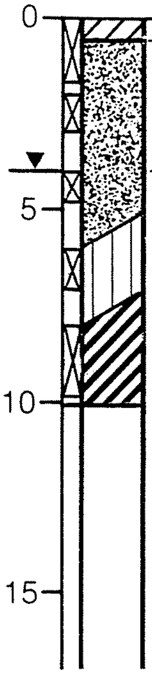
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
Gy. Hg.	17497,001.12	KH	10/11/85		

LOG OF BORING D4

Equipment Hollow-Stem Auger

Elevation - Date 6/27/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
16	8.0(A) 3.2(B)	1.2
6	5.2	1.3
7	6.7	1.2
6	5.9	1.2
13	4.5(A) 3.6(B)	1.1



BROWN TOPSOIL AND SILTY CLAY
stiff, dry

WHITE CAKE
loose, moist
saturated below 4 feet

Fill

DARK GRAY CLAYEY SILT (ML)
loose, saturated

GRAY CLAY (CH)
stiff, saturated
red-brown, very stiff below 9 feet

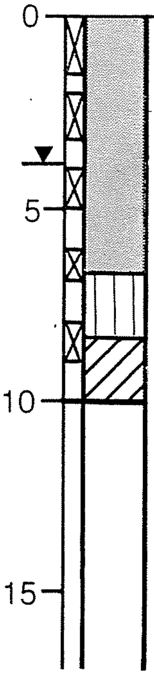
End of Boring - 10 feet

LOG OF BORING D5

Equipment Hollow-Stem Auger

Elevation - Date 7/10/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
8	0.4	0.3
7	0.4	0.3
7	0.6	0.3
4	0.4(A) 0.4(B)	0.4
5	0.4(A) 0.4(B)	0.4



FLY ASH
loose, moist
brown clayey silt to 1.5 inches
clayey 1.1 to 1.3 feet

DARK GRAY CLAYEY SILT (ML)
loose, saturated, with wood fibers

RED-BROWN SILTY CLAY (CL)
soft, saturated

End of Boring - 10 feet

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LOGS OF BORINGS D4 and D5

Pine and Tuscarora Site
Niagara Falls, New York

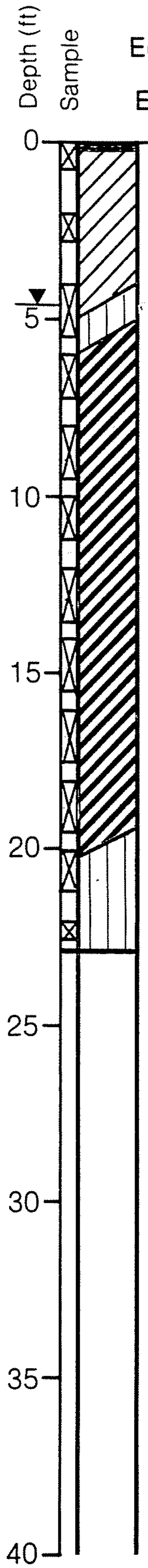
PLATE
B9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12		10/10/85		

Equipment Hollow-Stem Auger **E1**

Elevation - Date 6/25/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
19	0.2	0.2
10	0.3	0.2
6	1.5(A) 0.7(B)	0.3
26,	4.0	0.4
26	7.2	0.4
11	0.2	0.2
3	0.2	0.2
1	0.4	0.2
3	0.2	0.2
WH*	1.3	0.2
12	1.7	0.2
35/3"	60	0.1



3-Inch Paving (Asphalt)

GREEN GRAY SILTY CLAY (CL)
stiff, dry, moist 2 to 4.7 feet

GREEN GRAY SANDY SILT (ML)
loose, saturated

RED-BROWN CLAY (CH)
very stiff, saturated, with trace silt

with iron nodules 8 to 9.5 feet

stiff 10 to 12 feet

soft below 12 feet

CLAYEY SANDY SILT (ML)
medium dense, saturated, trace gravel

End of Boring - 22.75 feet

Bedrock encountered at 22.75 feet.

WH* - Weight of Hammer

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LOG OF BORING E1

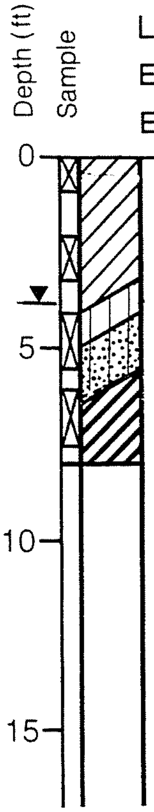
Pine and Tuscarora Site
Niagara Falls, New York

PLATE **B10**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
Tg. Hg.	17497,001.12	KH	10/10/85		

LOG OF BORING E2
Equipment Hollow-Stem Auger
Elevation - Date 6/27/85

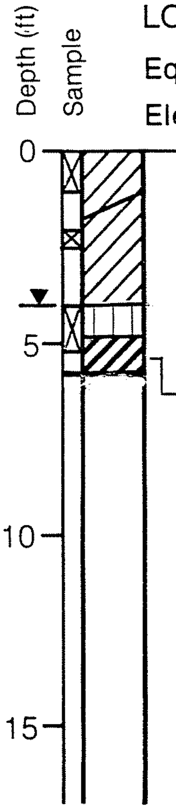
Blows/foot	PID Headspace (ppm)	PID Background (ppm)
22	2.6	1.6
13	1.4	1.2
6	18	1.3
41	34	1.1



BROWN AND GRAY SILTY CLAY (CL)
very stiff, moist, gravelly to 0.5 feet
GRAY CLAYEY SILT (ML)
loose, saturated
GRAY SILTY SAND WITH CLAY (SM)
loose, saturated
RED-BROWN CLAY (CH)
very stiff, saturated
End of Boring - 8 feet

LOG OF BORING E3
Equipment Hollow-Stem Auger
Elevation - Date 6/26/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
21	5.6	0.6
17	5.1	0.8
15	22(A) 44(B)	0.8



LIGHT BROWN SILTY CLAY
very stiff, moist
BROWN SANDY CLAY
very stiff, moist, trace gravel
DARK BROWN SANDY SILT (ML)
medium dense, saturated
RED-BROWN CLAY (CH)
stiff, moist
End of Boring - 5.5 feet

Fill

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LOGS OF BORINGS E2 and E3
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B11

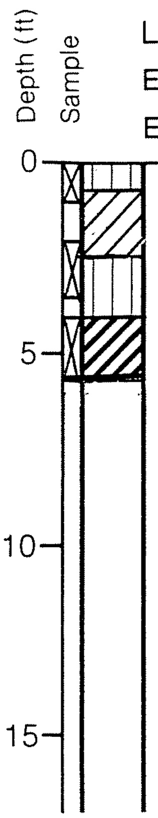
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/11/85		

LOG OF BORING E4

Equipment Hollow-Stem Auger

Elevation - Date 6/26/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
18	9.0(A) 16.0(B)	0.8
10	46	1.2
22	8.0	0.8



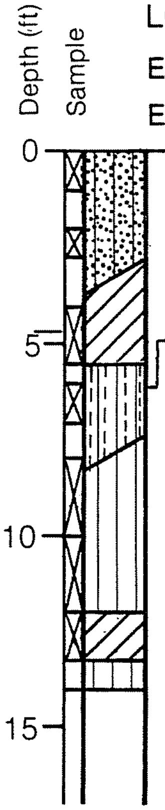
BROWN SANDY SILT Fill
medium dense, dry, trace gravel
RED-BROWN AND GRAY SILTY CLAY (CL)
stiff, moist
GRAY-GREEN CLAYEY SILT (ML)
medium dense, moist
RED-BROWN CLAY (CH)
very stiff, moist
End of Boring - 5.5 feet

LOG OF BORING E5

Equipment Hollow-Stem Auger

Elevation - Date 6/26/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
18	10.8	1.0
10	12.3(A) 9.4(B)	1.2
7	34	0.9
4	28	1.0
5	31(A) 8.8(B)	0.8
4	11.7	1.0
2	5.2(A) 4.6(B)	1.0



LIGHT GRAY SILTY SAND
medium dense, dry, trace gravel
Fill
BROWN SILTY CLAY (CL)
medium stiff, moist
DARK GRAY ORGANIC CLAYEY SILT (OL)
loose, saturated, with roots
and trace gravel
DARK GRAY CLAYEY SILT (ML)
loose, saturated
sandy 9.5 to 10 feet
RED-BROWN CLAY WITH SOME SILT (CL)
soft, saturated
DARK GRAY CLAYEY SANDY SILT (ML)
loose, saturated, with small
teeth
End of Boring - 14 feet

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LOGS OF BORINGS E4 AND E5

Pine and Tuscarora Site
Niagara Falls, New York

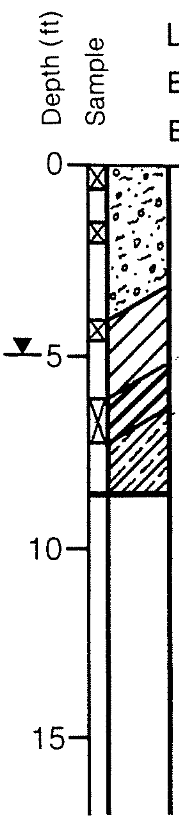
PLATE
B12

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES	17497,001.12	KJH	10/11/85		

LOG OF BORING E6

Equipment Hollow-Stem Auger
Elevation - Date 6/27/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
12	1.6	1.0
3	1.6	1.2
4	5.9	1.4
5	43(A) 8.0(B)	1.4



CLAYEY CONSTRUCTION DEBRIS AND GRAVEL
loose, dry to 2 feet

BROWN SILTY CLAY
soft, moist

RED-BROWN CLAY
soft, saturated

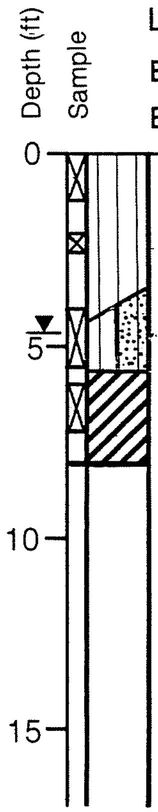
BROWN ORGANIC CLAY (OH)
soft, saturated
End of Boring - 7.5 feet

Fill

LOG OF BORING F2

Equipment Hollow-Stem Auger
Elevation - Date 7/1/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
15	4.0(A) 1.7(B)	1.0
13	42	1.3
6	14.6(A) 16.3(B)	1.7
38	13.6	1.6



BROWN GRAVELLY SILT
medium dense, dry

Fill

GRAY AND LIGHT BROWN INTERLAYERED SANDY SILT (ML) AND SILTY SAND (SM)
loose, saturated

RED-BROWN CLAY (CH)
hard, moist, with few silt pockets
End of Boring - 8 feet

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LOGS OF BORINGS E6 AND F2

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B13

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	HH	10/11/85		

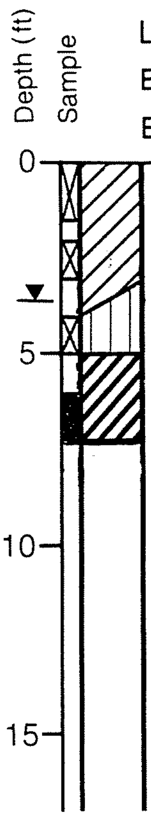
LOG OF BORING F3

Equipment Hollow-Stem Auger

Elevation - Date 7/1/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
21	0.8	0.7
20	0.9 6.0(A)	0.9
10	42(B)	1.0

Perm.
$3.3x10^{-8}$ cm/sec



BROWN SILTY CLAY (CL)
very stiff, dry, moist below 2 feet

GRAY SANDY SILT (ML)
medium dense, saturated

RED-BROWN CLAY (CH)
very stiff, moist

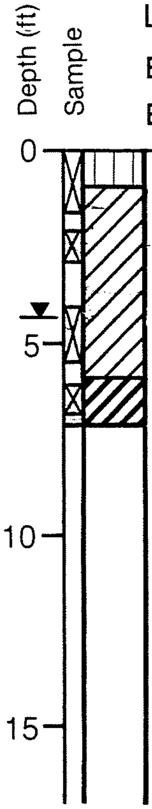
End of Boring - 7.4 feet

LOG OF BORING F4

Equipment Hollow-Stem Auger

Elevation - Date 6/26/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
13	7.1	1.2
17	17	1.2
6	64	1.2
	87	1.4



LIGHT BROWN SANDY CLAYEY SILT
medium dense, moist Fill

BROWN AND GRAY SILTY CLAY (CL)
stiff, moist
silty, medium stiff, and saturated below 4 feet

RED-BROWN CLAY (CH)
very stiff, moist

End of Boring - 7 feet

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LOGS OF BORINGS F3 AND F4

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B14

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/11/85		

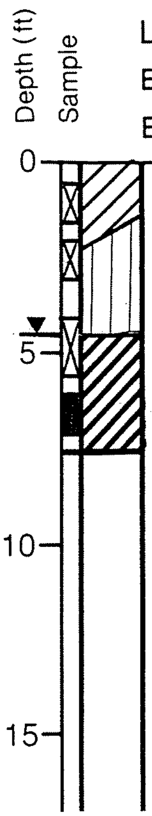
LOG OF BORING F5

Equipment Hollow-Stem Auger

Elevation - Date 6/29/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
11	3.3	1.0
6	17	1.0
15	12.2(A) 10.1(B)	1.0

Perm.
4.4x10^{-8} cm/sec



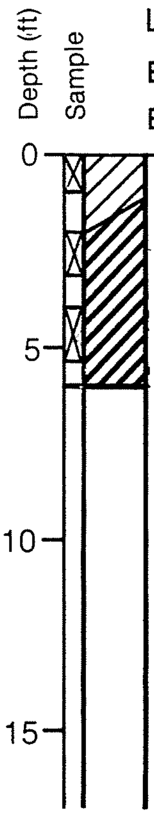
BROWN SILTY CLAY Fill
stiff, moist, trace of gravel
BROWN CLAYEY SILT (ML)
medium dense, moist
loose to 3 feet
saturated sand seam 4.7 to 4.8 feet
RED-BROWN CLAY (CH)
very stiff, saturated
End of Boring - 7.6 feet

LOG OF BORING F6

Equipment Hollow-Stem Auger

Elevation - Date 6/29/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
19	2.1	1.3
13	2.2	1.3
6	3.4(A) 3.1(B)	1.3



RED-BROWN AND DARK BROWN GRAVELLY SILTY CLAY Fill
very stiff, moist
RED-BROWN AND DARK GRAY CLAY (CH)
stiff, moist, trace silt

End of Boring - 6 feet

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LOGS OF BORINGS F5 AND F6

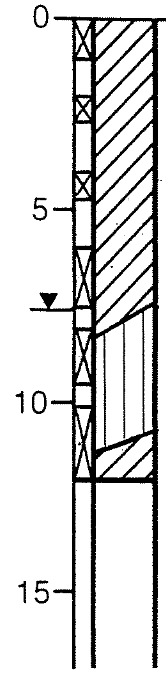
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B15

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	KH	10/11/85		

LOG OF BORING F7
Equipment Hollow-Stem Auger
Elevation - Date 7/1/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
19	5.9(A) 2.4(B)	1.2
15	5.1	1.2
3	10.3(A) 3.5(B)	1.3
8	6.8(A) 4.1(B)	1.3
4	6.4	1.3
4	7.4(A) 3.9(B)	1.3



RED-BROWN SILTY CLAY
stiff, moist, with white grit below 4.3 feet
medium stiff below 3 feet

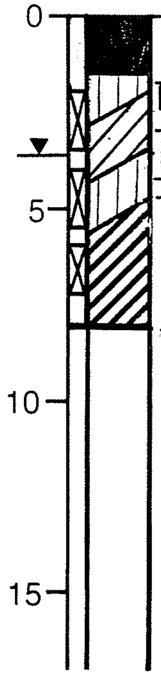
Fill

DARK GRAY ORGANIC SILTY CLAY (OL)
soft, saturated, with roots and wood fragments

RED-BROWN AND GRAY CLAY (CL)
soft, saturated
End of Boring - 12 feet

LOG OF BORING G2
Equipment Hollow-Stem Auger
Elevation - Date 7/1/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
9	3.6(A) 1.9(B)	1.8
6	2.2(A) 1.7(B)	1.4
38	42	1.6



ASPHALT PAVING AND STABILIZED BASE

Fill

VERY DARK GRAY CLAYEY SILT
loose, moist

LIGHT GRAY AND BROWN SILTY CLAY (CL)
stiff, moist

LIGHT GRAY CLAYEY SILT (ML)
loose, saturated
sandy 5.4 to 5.9 feet

RED-BROWN CLAY (CH)
hard, moist, with very few silt pockets
End of Boring - 8 feet

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LOGS OF BORINGS F7 AND G2

Pine and Tuscarora Site
Niagara Falls, New York

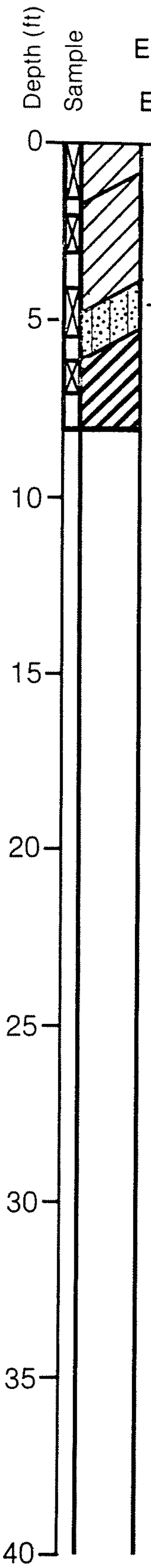
PLATE
B16

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/10/85		

Equipment Hollow-Stem Auger **G3**

Elevation - Date 7/1/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
14	1.6	1.0
19	2.5	1.1
7	6.7(A) 1.4(B)	1.0
34	2.6	1.0



BROWN SILTY CLAY Fill
stiff, moist, with
roots and trace gravel
BROWN AND GRAY SILTY CLAY (CL)
very stiff, moist
very silty 4 to 4.5 feet
LIGHT BROWN SILTY SAND (SM)
loose, saturated
RED-BROWN CLAY (CH)
hard, moist, with few silt
pockets
End of Boring - 8 feet

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LOG OF BORING G3

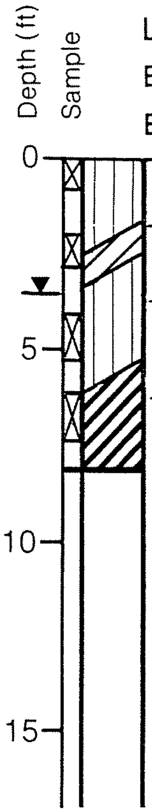
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B17

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/11/85		

LOG OF BORING G4
Equipment Hollow-Stem Auger
Elevation - Date 6/26/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
22	20	2.0
14	31	2.0
4	39(A) 21(B)	2.0
34	23	1.6



LIGHT BROWN CLAYEY SILT
medium dense, dry, trace of gravel and sand
Fill

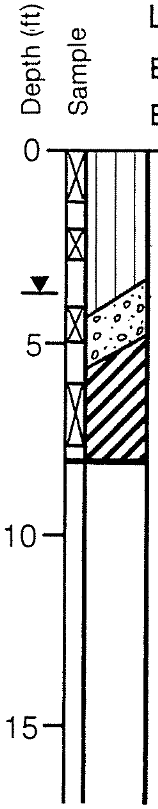
BROWN SILTY CLAY (CL)
stiff, moist, with sand

BROWN CLAYEY SILT (ML)
loose, saturated
sandy below 5 feet

RED-BROWN CLAY (CH)
hard, moist
End of Boring - 7.5 feet

LOG OF BORING G5
Equipment Hollow-Stem Auger
Elevation - Date 6/29/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
20	3.0	0.8
8	6.3	0.9
3	23(A) 20(B)	1.0
30	2.7	1.1



BROWN CLAYEY SILT
medium dense, dry to moist, trace gravel
loose below 2 feet
Fill

LIGHT BROWN SANDY GRAVEL
loose, saturated, with asphalt below 4.6 feet

RED-BROWN CLAY (CH)
very stiff, saturated
End of Boring - 8 feet

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

LOGS OF BORINGS G4 AND G5

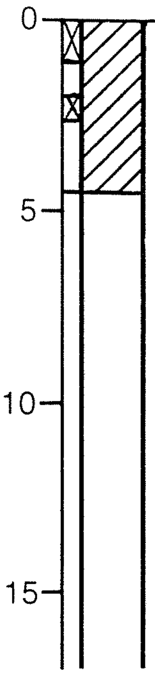
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B18

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES	17497,001.12	KH	10/11/85		

LOG OF BORING G6
Equipment Hollow-Stem Auger
Elevation - Date 6/29/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
27	14.3	1.0
-	33	1.1

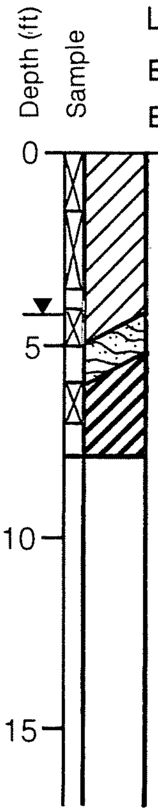


GRAVELLY SILTY CLAY
very stiff, moist, with white grit 2 to 2.2 feet
Refusal (concrete) encountered at 4.5 feet
End of Boring - 4.5 feet
(Gravel in hole was limestone, concrete, and black slag)

Fill

LOG OF BORING G6A
Equipment Hollow-Stem Auger
Elevation - Date 6/29/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
15	7.4	0.9
15	1.9(A) 1.1(B)	1.0
26	38(A) 21(B)	1.0
16	37	1.0



BROWN SILTY CLAY
stiff, moist, with sand pockets 3.5 to 4.8 feet

very stiff below 4 feet
BLACK SAND WITH WOOD
loose, saturated
RED-BROWN CLAY (CH)
very stiff, saturated
End of Boring - 7.5 feet

Fill

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Engineers, Geologists
& Geophysicists

LOGS OF BORINGS G6 AND G6A

Pine and Tuscarora Site
Niagara Falls, New York

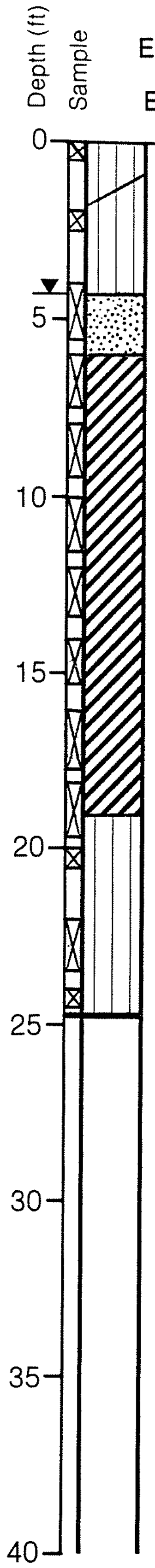
PLATE
B19

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/10/85		

Equipment Hollow-Stem Auger H3

Elevation - Date 6/24/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
18	8.2	6.0
8	7.6	4.0
6	7.6	4.0
34	22	4.2
39	8.8	2.0
10	21	3.0
5	7.5	2.4
1	7.3	2.4
1	7.4	2.0
2	7.4	2.0
26	8.3	1.0
97	10.3	0.5
-	6.8	0.5



DARK BROWN CLAYEY SILT
medium dense, dry

Fill

DARK BROWN CLAYEY SILT (ML)
loose, moist

BROWN SILTY CLAYEY SAND (SW)
loose, saturated

RED-BROWN CLAY (CH)
hard, saturated

stiff 10 to 12 feet

silty from 11 to 11.5 feet

medium stiff 12 to 13.5 feet
very soft below 13.5 feet

BROWN SANDY CLAYEY SILT (ML)
hard, saturated, trace gravel
loose 19 to 20 feet
medium dense 20 to 21 feet

End of Boring - 24.6 feet

Bedrock encountered at 24.6 feet.

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LOG OF BORING H3

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B20

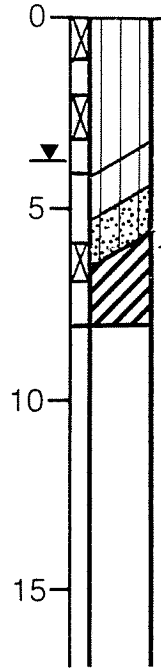
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/10/85		

LOG OF BORING H4

Equipment Hollow-Stem Auger

Elevation - Date 6/26/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
20	9.1(A) 9.3(B)	0.8
16	8.1	2.0
12	95(A) 43(B)	2.0
32	95	1.6



GRAVEL AND CLAYEY SILT
medium dense, dry, trace sand
Fill

BROWN CLAYEY SILT (ML)
medium dense, saturated

BROWN SILTY SAND (SM)
medium dense, saturated, with trace clay

RED-BROWN CLAY (CH)
very stiff, moist

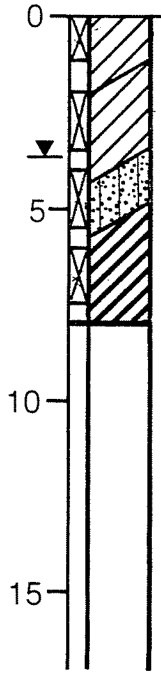
End of Boring - 8 feet

LOG OF BORING H5

Equipment Hollow-Stem Auger

Elevation - Date 7/ 1 /85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
19	4.4(A) 4.7(B)	1.2
14	3.7	1.0
7	20(A) 6.5(B)	1.1
40	32	1.1



DARK BROWN SILTY CLAY
very stiff, moist
Fill

LIGHT BROWN AND GRAY SILTY CLAY (CL)
stiff, moist

LIGHT BROWN SILTY SAND (SM)
loose, saturated, trace clay

RED-BROWN CLAY (CH)
hard, moist

End of Boring - 8 feet

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LOGS OF BORINGS H4 AND H5

Pine and Tuscarora Site
Niagara Falls, New York

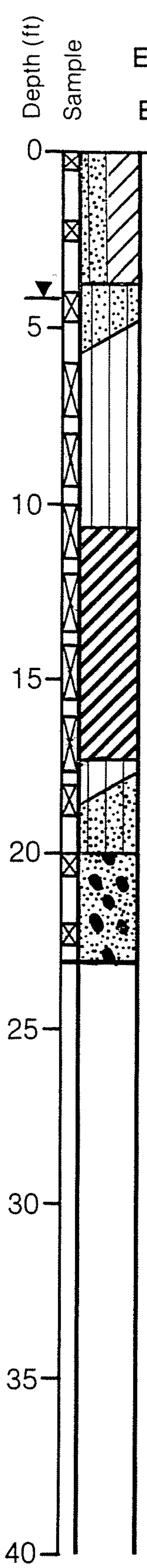
PLATE
B21

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES	17497,001.12	KYH	10/11/85		

Equipment Hollow-Stem Auger **H7**

Elevation - Date 6/25/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
51	1.6	1.6
17	1.2	1.0
15	1.0	0.2
3	3.4	1.0
3	0.8	0.6
6	6.0(A) 1.2(B)	0.7
4	3.7	0.3
1	0.9	0.3
WH*	0.4(A) 0.3(B)	0.3
45	1.1	0.2
67	31	0.3
-	3.4	0.3



GRAVEL, SILTY SAND AND CLAY

Fill

DARK GRAY SILTY SAND (SM)
medium dense, saturated

GREEN-BROWN CLAYEY SILT (ML)
soft, saturated

RED-BROWN CLAY (CH)
medium stiff, saturated

soft below 14 feet

RED-BROWN CLAYEY SILT (ML)
soft, saturated, trace sand

SILTY SAND (SM)
dense, saturated

SANDY GRAVEL WITH TRACE SILT (GW)
(gravel composed of dolomite)
very dense, saturated
End of Boring - 23 feet

Bedrock encountered at 23 feet.

WH* - Weight of Hammer

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& Geophysicists

LOG OF BORING H7

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B22

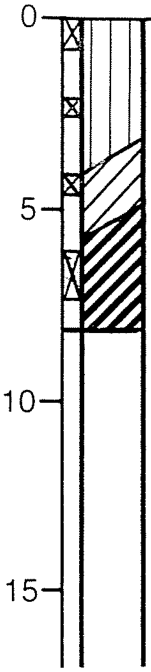
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
EB.	17497,001.12	KJH	10/11/85		

LOG OF BORING X1

Equipment Hollow-Stem Auger

Elevation - Date 7/3/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
6	2.0	1.0
8	2.0	1.0
13	23	0.9
20	3.6	1.0



LIGHT BROWN AND GRAY CLAYEY SILT
loose, moist, trace gravel
Fill

BROWN SILTY CLAY (CL)
stiff, moist

RED-BROWN CLAY (CH)
very stiff, moist

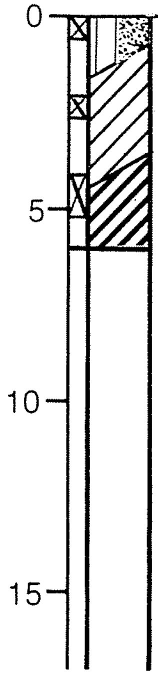
End of Boring - 8 feet

LOG OF BORING X2

Equipment Hollow-Stem Auger

Elevation - Date 7/3/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
5	4.3	1.4
10	2.5	1.0
21	6.1	1.0



CLAYEY SILT WITH SOME CAKE Fill
loose, dry
LIGHT BROWN SILTY CLAY (CL)
stiff, moist

RED-BROWN CLAY (CH)
very stiff, moist, with few
silt pockets
End of Boring - 6 feet

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LOGS OF BORINGS X1 AND X2

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B23

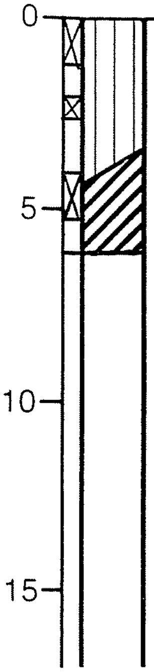
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/11/85		

LOG OF BORING X3

Equipment Hollow-Stem Auger

Elevation - Date 7/3/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
10	3.8(A) 2.7(B)	1.2
12	3.2	1.2
16	36	1.2



GRAVELLY CLAYEY SILT
medium dense, moist, with trace cake (or fly ash) Fill

RED-BROWN CLAY (CH)
very stiff, moist

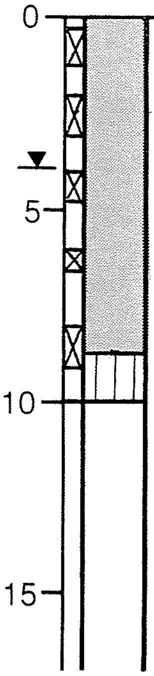
End of Boring - 6 feet

LOG OF BORING Y1

Equipment Hollow-Stem Auger

Elevation - Date 7/9/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
14	0.5(A) 0.5(B)	0.5
8	0.4	0.4
7	1.0(A) 0.9(B)	0.4
5	20	0.3
5	5.8(A) 2.0(B)	0.4



MIXED Fill AND FLY ASH WITH SILTY SAND
medium dense, moist
loose below 2 feet
saturated below 4 feet
wood 4.5 to 4.7 feet
Fill

BROWN CLAYEY SILT (ML)
loose, saturated, trace sand
End of Boring - 10 feet

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LOGS OF BORINGS X3 AND Y1

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B24

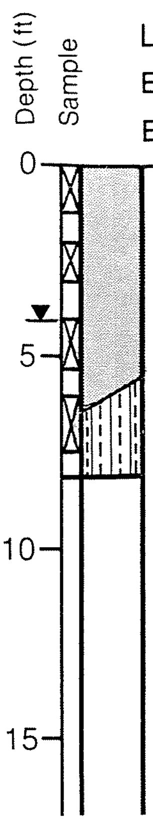
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/11/85		

LOG OF BORING Y2

Equipment Hollow-Stem Auger

Elevation - Date 7/9/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
24	9.7	0.4
7	3.8	0.4
13	3.1	0.4
5	3.1	0.4



MIXED FLY ASH, AND BROWN SILTY SAND
medium dense, moist
loose 2 to 3.5 feet

Fill

DARK GRAY ORGANIC SILTY CLAY (OL)
soft, saturated
End of Boring - 8 feet

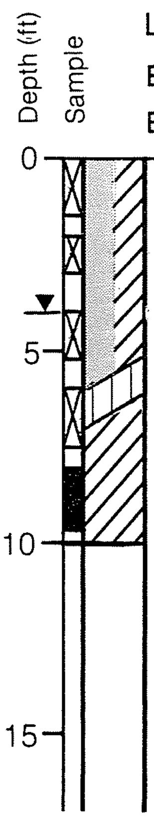
LOG OF BORING Y3

Equipment Hollow-Stem Auger

Elevation - Date 7/9/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
10	2.3(A) 1.2(B)	1.0
8	1.8	0.9
14	1.7	0.7
6	2.9(A) 2.8(B)	0.8

Perm.
13.4x10^{-8} cm/sec



FLY ASH WITH BROWN SILTY CLAY
medium dense with some white cake 1 to 2 feet

Fill

DARK GRAY CLAYEY SILT (ML)
loose, saturated, with wood fibers
GRAY SILTY CLAY (CL)
very stiff, saturated
End of Boring - 10 feet

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LOGS OF BORINGS Y2 AND Y3

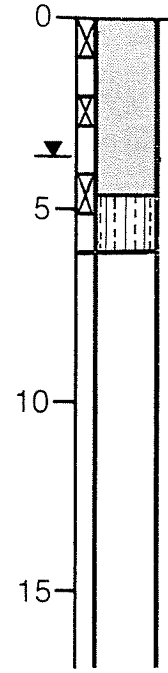
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B25

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	KH	10/11/85		

LOG OF BORING Y4
Equipment Hollow-Stem Auger
Elevation - Date 7/9/85

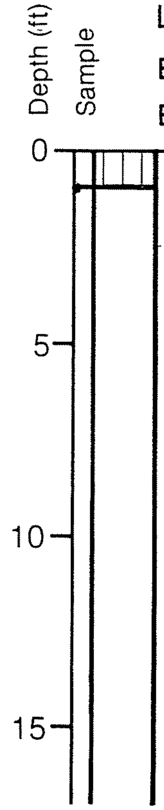
Blows/foot	PID Headspace (ppm)	PID Background (ppm)
5	1.1	0.8
5	0.8	0.7
2	7.8(A) 7.3(B)	0.8



FLY ASH
loose, moist, with some white cake 1 to 2 feet Fill

DARK GRAY ORGANIC CLAYEY SILT (OL)
loose, saturated
End of Boring - 6 feet

LOG OF BORING Y5
Equipment Hollow-Stem Auger
Elevation - Date 7/9/85



BROWN CLAYEY SILT Fill
loose, dry
(refusal encountered at 0.75 feet)
End of Boring - 0.75 feet

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LOGS OF BORINGS Y4 AND Y5

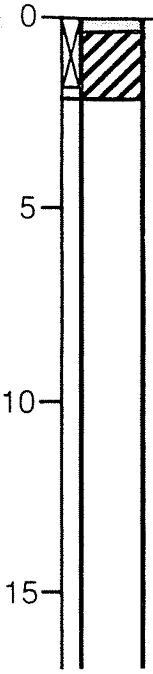
Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B26

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	KJH	10/11/85		

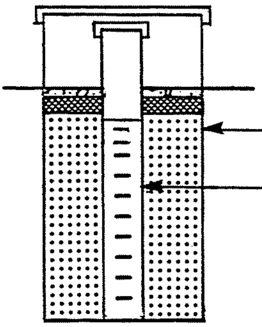
LOG OF BORING Y5A
Equipment Hollow-Stem Auger
Elevation - Date 7/9/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)	Depth (ft)
17	1.7	0.9	0



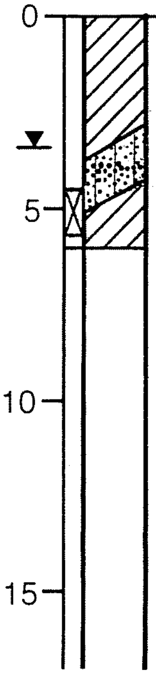
DARK BROWN TOPSOIL AND FLY ASH Fill
RED-BROWN AND BROWN CLAY (CH)
very stiff, moist
End of Boring - 2 feet

MONITORING WELL DETAIL *



LOG OF BORING MW1
Equipment Hollow-Stem Auger
Elevation - Date 7/5/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)	Depth (ft)
	0.6(A)		
17	0.7(B)	0.6	5



BROWN AND GRAY SILTY CLAY (CL)
saturated below 3.5 feet

BROWN SILTY SAND (SM)
loose, saturated, with trace clay
RED-BROWN SILTY CLAY (CL)
very stiff, moist
End of Boring - 6.5 feet

Note: Augered without sampling to 4.5 feet. Classification based on auger cuttings and nearby boring(s).

* For Detail refer to plate 12

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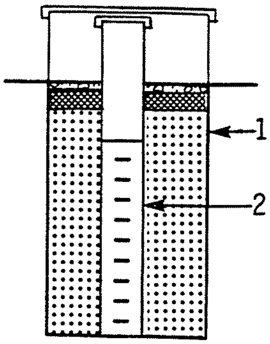
LOGS OF BORINGS Y5A AND MW1
Pine and Tuscarora Site
Niagara Falls, New York

PLATE B27

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	KJH	10/10/85	BH	7/22/86

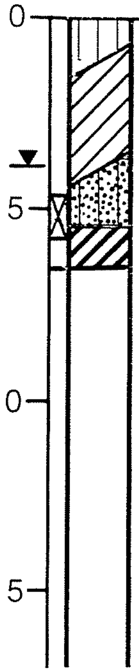
MONITORING WELL *
DETAIL



LOG OF BORING MW2

Equipment Hollow-Stem Auger
Elevation - Date 7/4/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)	Depth (ft)
	2.3(A)		
20	2.6(B)	1.3	5



SANDY GRAVELLY SILT Fill

BROWN AND GRAY SILTY CLAY (CL)

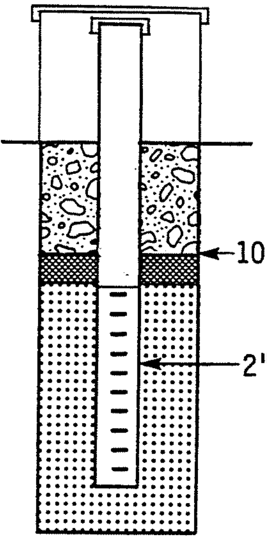
LIGHT BROWN SILTY SAND (SM)
medium dense, saturated

RED-BROWN CLAY (CH)
very stiff, moist, with few silt pockets

End of Boring - 6.5 feet

Note: Augered without sampling to 4.5 feet. Classification based on auger cuttings and nearby boring(s)

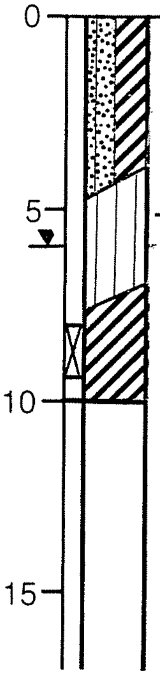
MONITORING WELL *
DETAIL



LOG OF BORING MW3

Equipment Hollow-Stem Auger
Elevation - Date 7/5/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)	Depth (ft)
15	0.9	0.8	



GRAVEL, SILTY SAND AND CLAY

Fill

GRAY SANDY CLAYEY SILT (ML)

RED-BROWN CLAY (CH)
stiff, saturated

End of Boring - 10 feet

Note: Augered without sampling to 8 feet. Classification based on auger cuttings and nearby boring(s).

* For Detail refer to plate 12

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LOGS OF BORINGS MW2 AND MW3

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B28

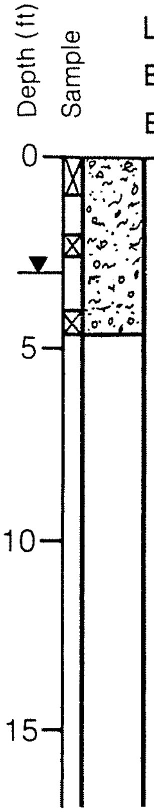
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	KJH	10/11/85	BH	7/22/86

LOG OF BORING MW4

Equipment Hollow-Stem Auger

Elevation - Date 7/6/85

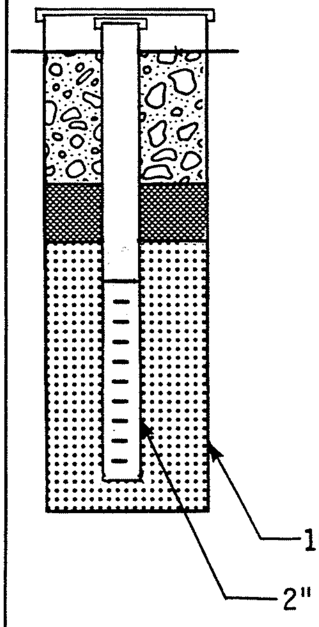
Blows/foot	PID Headspace (ppm)	PID Background (ppm)
24	0.7	0.6
14	6.4	0.5
-	0.5	0.5



GRAY AND BROWN GRAVELLY CLAYEY SAND AND CONSTRUCTION DEBRIS
medium dense, moist
refusal (concrete) encountered at 4.7 feet
End of Boring - 4.7 feet

Fill

MONITORING WELL** DETAIL

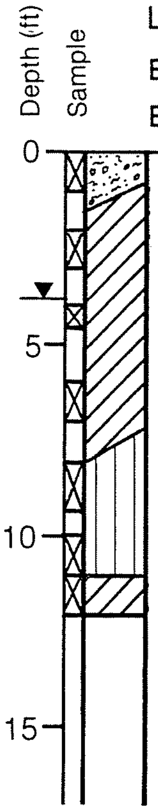


LOG OF BORING MW4A

Equipment Hollow-Stem Auger

Elevation - Date 7/6/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
22	0.7(A) 0.6(B)	0.6
7	1.3	0.4
7	0.5	0.4
11	3.9(A) 0.8(B)	0.4
8	0.4	0.4
2	0.8	0.5
WH*	0.7	0.5



CONSTRUCTION DEBRIS
RED-BROWN AND GRAY CLAY WITH SILT POCKETS
stiff, moist

brickbat 5.7 to 6 feet
white lime grit and charcoal 6.6 to 6.9 feet

Fill

DARK GRAY CLAYEY SILT (ML)
loose, saturated, with wood fibers and roots

RED-BROWN SILTY CLAY (CL)
very soft, saturated
End of Boring - 12 feet

WH* - Weight of Hammer

**For Detail refer to plate 12

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

LOGS OF BORINGS MW4 AND MW4A
Pine and Tuscarora Site
Niagara Falls, New York

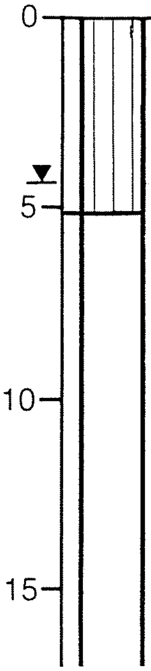
PLATE B29

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES	17497,001.12	DH	10/10/85	DH	7/24/86

LOG OF BORING MW5

Equipment Hollow-Stem Auger
Elevation - Date 7/8/85

PID Headspace (ppm)	PID Background (ppm)	Depth (ft)
0.3	0.5	5



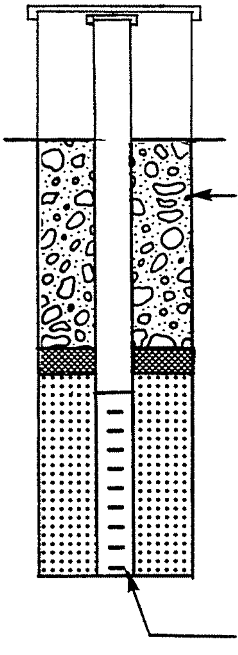
BROWN SANDY CLAYEY SILT
with trace gravel

Fill

refusal (concrete) encountered at 5.2 feet
End of Boring - 5.2 feet

Note: Augered without sampling. Classification based on auger cuttings.

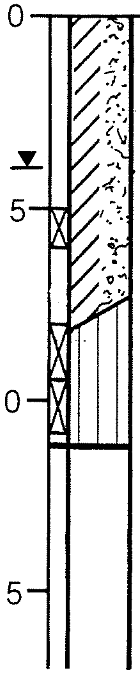
MONITORING WELL DETAIL *



LOG OF BORING MW5A

Equipment Hollow-Stem Auger
Elevation - Date 7/8/85

Blows/foot	PID Headspace (ppm)	PID Background (ppm)
13	0.4	0.4
	0.5(A)	
9	0.5(B)	0.5
4	0.7	0.4



BROWN SANDY CLAY AND SILT WITH CONSTRUCTION DEBRIS

Fill

concrete 5.5 to 5.7 feet

DARK GRAY CLAYEY SILT (ML)
loose, saturated, with wood fibers
brown and gray below 10 feet
End of Boring 11.2 feet

Note: Augered without sampling to 5 feet. Classification based on auger cuttings and nearby boring(s).

* For Detail refer to Plate 12

Harding Lawson Associates
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& Geophysicists

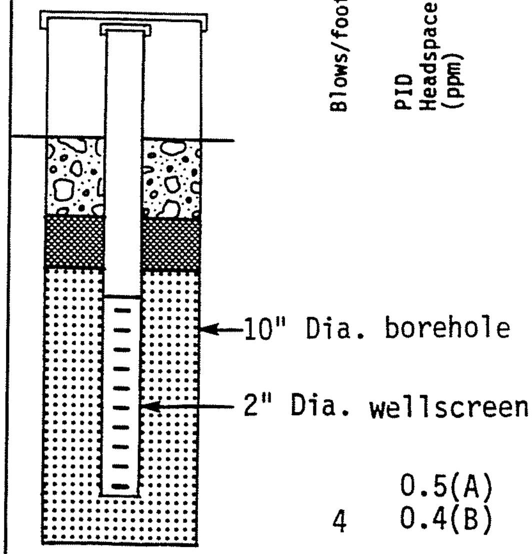
LOGS OF BORINGS MW5 AND MW5A

Pine and Tuscarora Site
Niagara Falls, New York

PLATE B30

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
ES.	17497,001.12	KH	10/11/85	BH	7/22/86

MONITORING WELL*

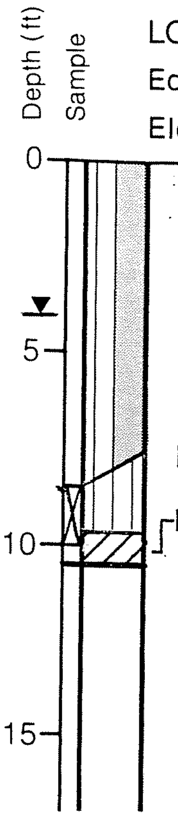


Blows/foot	PID Headspace (ppm)	PID Background (ppm)
	0.5(A)	
4	0.4(B)	0.3

LOG OF BORING MW6

Equipment Hollow-Stem Auger

Elevation - Date 7/10/85



BROWN CLAYEY SILT WITH CONCRETE, GRAVEL, AND PARTIALLY CEMENTED FLY ASH

Fill

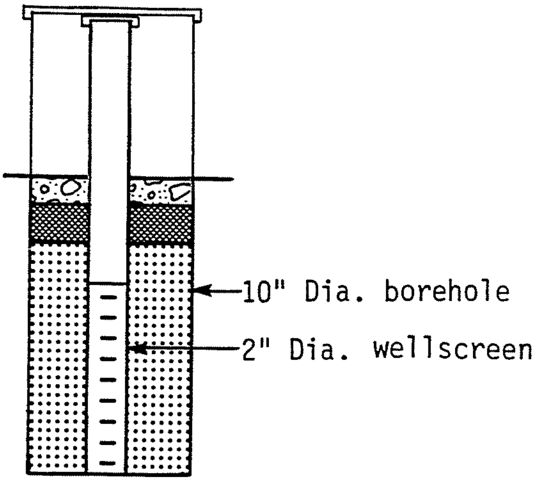
DARK GRAY CLAYEY SILT (ML)
loose, saturated

RED-BROWN SILTY CLAY (CL)
soft, saturated

End of Boring - 10.5 feet

Note: Augered without sampling to 8 feet. Classification based on auger cuttings and nearby boring(s).

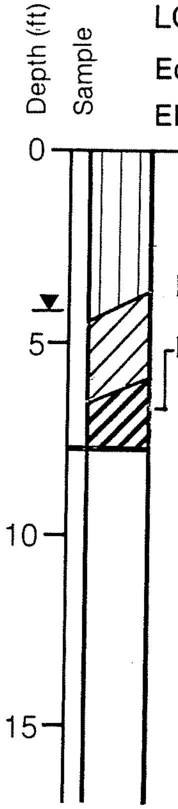
MONITORING WELL*
DETAIL



LOG OF BORING MW 7

Equipment Hollow-Stem Auger

Elevation - Date 7/8/85



LIGHT BROWN AND GRAY CLAYEY SILT
with trace gravel

Fill

BROWN SILTY CLAY (CL)

RED-BROWN CLAY (CH)

End of Boring - 7.8 feet

Note: Augered without sampling. Classification based on auger cuttings.

* For Detail refer to plate 12

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LOGS OF BORINGS MW6 AND MW7

Pine and Tuscarora Site
Niagara Falls, New York

PLATE
B31

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	17497,001.12	[illegible]	10/11/85	BH	7/22/86

APPENDIX C

HEALTH AND SAFETY PLAN

PINE/TUSCARORA SITE
FIELD INVESTIGATION
HEALTH AND SAFETY PLAN

May 13, 1985

Harding Lawson Associates

JOB SAFETY PLAN

Part 1 - Site Information

1. Site: Pine/Tuscarora Site 2. Job No.: 17497,001.12
3. Location: Niagra Falls, N.Y.
4. Plan Prepared By: Steve Neely (P.M.) Date: 5/9/85
5. Plan Approved By: Tony Wood (Safety Officer) Date: 5/13/85
6. Plan Revised: 6/6/85 7. Approved: Tony Wood
8. Facility Description: The 4 acre site is relatively flat and was originally marsh lands that were filled in with waste materials.
9. Status (active, inactive, unknown): Inactive (Residential & Commercial property)
10. Unusual Features (dike integrity, powerlines, etc.): Niagara Mohawk powerline and parallel underground water and brine pipelines cross site. (see Attachment 1)
11. History (injuries, exposures, complaints): 403 drums HCB plus 101 truckloads BHC reported by Olin to have been buried between 1955 - 1957. No known injuries, exposures, or complaints.
12. Surroundings (location with respect to residences, businesses, natural features): Residential and small business nearby. (see Attachment 1)
13. Site Sketch (attach sketch showing salient features) (See Attachment 1)
14. Climate: Cold winters, warm summers. 70° - 80° expected daytime temps. June through September.
    a) average wind speed and direction: Prevailing from West to East.
    b)

	July	October	January	April
mean high temperature	70-80			60-70
mean low temperature	50-60			30-40

15. Hazardous Material Type: _Liquid X Solid _Sludge _Gas/Vapor _Other____
*16. Hazardous Material Characteristics: _Corrosive 1 Ignitable 3 Toxic _Volatile 0 Reactive _Radioactive _Carcinogenic _Other Persistance 3

* CERCLA Hazard Rating

17. Chemical Information Summary

Material Name	BHC	HCB	BHC					
Chemical Constituent	C6H6Cl6	C6Cl6						
Information Reference/Page	Hazardline	Hazardline	Sax					

Likely Encounter

Source (1)	Soil & G. W.	Soil & G. W.						
Physical State (2)	Solid	Solid						

Concentrations

Measured or Estimated?	Unknown *	Unknown *						
Media	"	"						
Maximum Value	"	"						
Minimum Value	"	"						

Pure Chemical Characteristics

Water Solubility G/100 G H_2O @ 20°C	0.001 G	Insoluble						
Vapor Density Air = 1	N.A.	9.8						
Flash Point Closed cup	Nonflammable	468°F						
Vapor Pressure @ 20°C, MMHG	< 0.001	1.0	0.0317					
LEL	-	Combustible						
UEL	-	Combustible						

Hazard Specifics of Pure Chemical

TLV (8 hrs. TWA)	0.5 Mg/m^3 *	N.A. *						
LD50/LC50	N.A. *	N.A. *	5-25 mg/kg	Cattle Oral				
IDLH Level	1000 Mg/m^3	None Specified						
Odor Threshold	Musty Odor	N.A.						
Hazard Property (3)	Toxic	Toxic						
Exposure Route (4)	* *	* *						
Toxic Effects (5)	(See Attachment 2)							

(1) Tank, drum, soil, ground water, surface impoundment, etc.
(2) Liquid, solid, gas, vapor, dust, fume, mist, sludge
(3) Corrosive, ignitable, toxic, volatile, reactive, radioactive, carcinogenic, infections, etc. Fill in all that apply.

* Monitor breathing zone with PID approximately every 10 minutes. (See Item 20 for PID action levels.)

* * Inhalation, Skin absorption, Ingestion, Skin or Eye contact

(4) Inhalation, Skin Absorption, etc.
(5) Exposure symptoms and effects

N.A. Specific information not available.

Task Description: Field Investigation
(Test Borings, Test Pits, Installation of Wells)

Task Name: Field Exploration

18. ANALYSIS OF KNOWN OR SUSPECTED UNMITIGATED HAZARDS		19. RISK ANALYSIS		
Hazard Type	How Does Hazard Exist?	Expos	Prob	Conseq
Mechanical	Drill rig and associated equipment	Cont.	Unu.	Mod.
Electrical	Overhead Powerlines	Occ.	Imp.	ser./ Fatal
Chemical	Site wastes BHC & HCB	Cont.	Unu.	Min.
Temperature	Restricted body ventilation in personal protective clothing.	Occ.	Like	Mod.
Acoustical	N/A			
Radioactive	N/A			
O2 Deficiency	N/A			
Biohazard	N/A			

Expos: Frequency of exposure to the hazard event
cont - many times per day
freq - once or twice per day
occ - once a week or month
seld - once a month or year

Prob: Liklihood that an injury will occur upon exposure
cert - certain
like - 50/50 chance
unu - unusual
imp - improbable

Conseq: Degree of injury if one occurs
fatal - fatality
ser - serious, requires hospitalization
mod - moderate, requires out-patient care
min - requires on-site first aid
chron - chronic, no acute affects

20. MITIGATION MEASURES	REQUIRED PERSONAL PROTECTIVE EQUIPMENT	
Usual drilling precautions	LEVEL __A __B _X_C __D Modified	
Keep safe distance from all electric lines	Head: Hard Hat	Eye/Face: Safety Goggles Face Shield (1)
See below	Hand: Neoprene Gloves	Body: Work Cloths Tyvek Suits or Slickers (2)
Use caution in personal protective clothing. Avoid heat stress.	Lung: ov Cartridge Respirator with filter (3)	Ear: N/A
	Foot: Steel toe/ Steel Shank Rubber boots	
	Special Equipment Required:	

Special Procedures Required:

(1) Face Shield used if liquid waste encountered.

(2) Polyethelene Tyvek suits or slickers used as deemed appropriate by site safety officer if liquid waste encountered. (See Attachment 3)

(3) Up to 5 ppm* Total Hydrocarbons use OV respirator with filters. Greater than 5 ppm* - evacuate up wind and make determination on protective equipment before continuing. (See Attachment 3)

Wind direction indicator to be attached to drill rig (i.e., small flags or ribbons, etc.)

No smoking or eating on site before decon.

* measured in breathing zone approximately every 10 minutes.

21. Required Personal Protective Equipment (Inventory List)

Task: Field Exploration

Level: ___A ___B X C ___D Modified

Head

X Hardhat

Eye/Face

___ Safety Glasses X Face Shield *
X Goggles

Hand

X Neoprene ___ Nitrile ___ PVC
___ Viton ___ Underglove ___ Other: ___

Body

___ Full Encapsulating Suit: ___
X Two Piece Rainsuit, *Material = PVC
___ One Piece Splash Suite, Material = ___
___ Tyvek Suit ___ Tyvek/Saranax Suit X Tyvek/Polyethylene Suit*
X Cloth Coveralls X Other: Standard work clothes (long sleeves)

Lung

X SCBA* (open circuit, pressure demand): ___
___ Full Face Respirator, cartridge = ___
X Half Mask Respirator, cartridge = OV (organic vapor with dust and mist filter)
___ Other: ___

Ear

___ Earplug, type = ___
___ Earmuff, type = ___

Foot

X Boots, type = Steel toe - Steel shank rubber boots.
___ Disposable Overboots, type = ___

22. Special Equipment, Facilities, or Procedures: Refer to Items 20, 23 and 28. No smoking or eating within Exclusion Zone 1 and Contamination Reduction Zone 2. All personnel entering Zones 1 and 2 will be safety briefed on standards established by this plan.

* To be employed if deemed appropriate by site safety officer in accordance with Item 20 and Attachment 3 of Safety Plan.

23. Decontamination Procedures: Seal drill holes per work plan Sec. C3.C.3. Decon of personnel and equipment per Attachment 4.

24. Investigation-Derived Material Disposal: Excess auger cuttings and excess water from well development will be stored in 55 gallon disposal drums and placed in designated staging area for Olin to transport and dispose of in approved Hazardous Waste Facility. Disposal details to be added as an addendum to the Safety Plan once finalized by Olin.

25. Site Resources

Water Supply: Available from vacant motel building west side of property.
Telephone: Office west side of property.
Radio: N/A
Other:

26.

Team Member	Responsibility	Date of Safety Training	Date of Physical Exam
Blaine Butaud (Olin)	Safety Officer	March 1985	Feb. 1985
Mike Bellotti (Olin)	Assistant Safety Officer	March 1985	June 1985
Steve Neely (HLA)	Project Manager	April 1985	June 1985
Bruce Stearns (HLA)	Field Engineering Geologist	May 1985	May 1985
John Sniderhan	Lead Driller	March 1985	Nov. 1984

27. Emergency Telephone Numbers

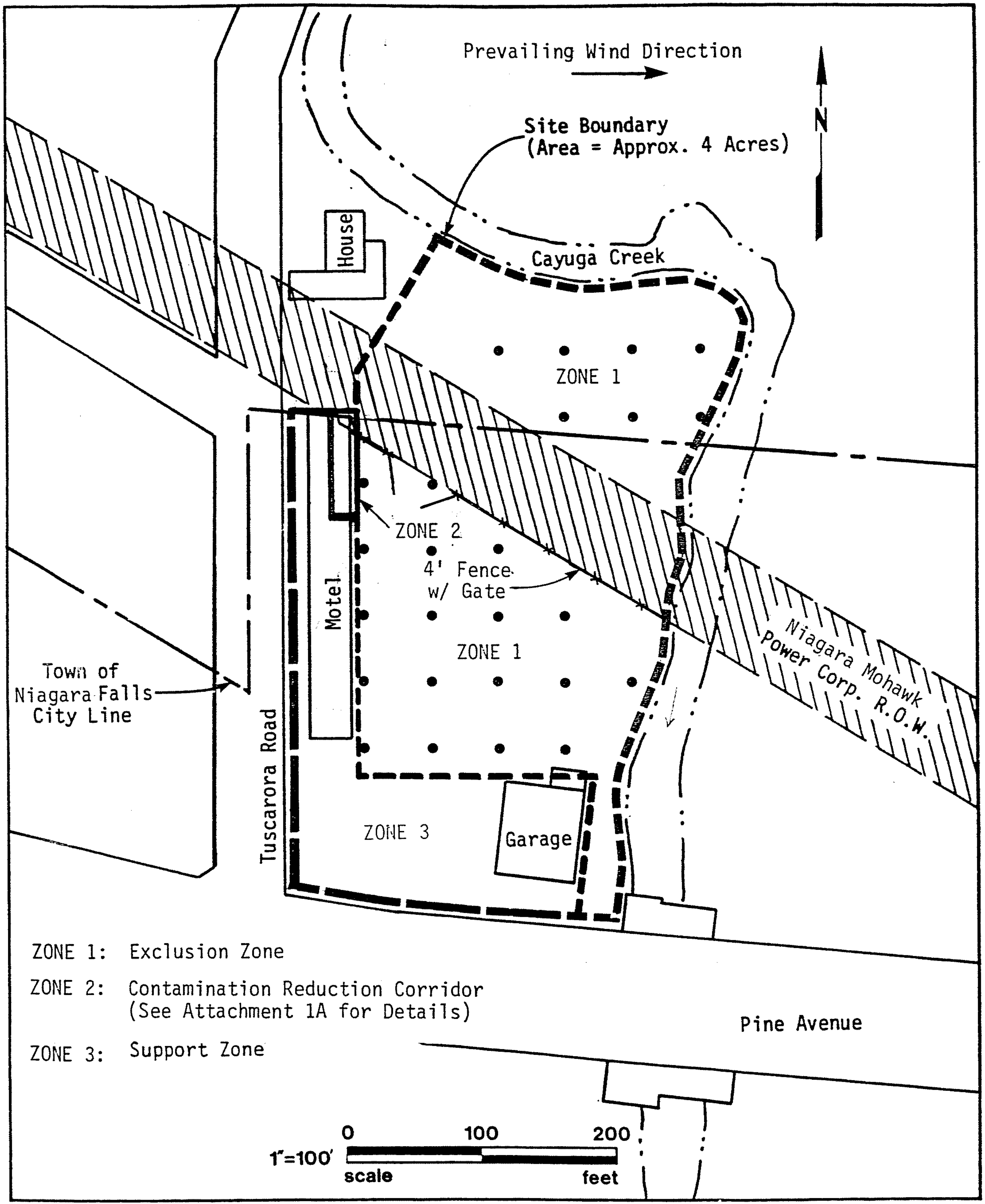
Phone/Radio Location: Phone-Office west side of property
Ambulance: Niagara Ambulance (284-4228)
Hospital Emergency Room: Mount St. Mary's Hosp. (297-4800)
Poison Control Center: 278-4511
Police: 278-8111 or 911
Fire Department: 285-1233 or 911
Airport:
Explosives Unit: 285-1233 or 911
EPA Contact:
State Contact: Gregory Shkuda (212) 488-3295
Client: Mike Bellotti/Blaine Butaud (615) 336-4576

28. Emergency Equipment Location

a. Safety Shower/Eyewash	Contamination Reduction Zone (See Attachment 1&1A)
b. First Aid Kit	Contamination Reduction Zone (See Attachment 1&1A)
c. Fire Extinguishers	Aboard Drilling equipment.
d. Other	Emergency eyewash bottles on drilling equipment.

29. Emergency Routes (give road or other directions; attach map)
Hospital (See Attachment 5)

Other



ZONE 1: Exclusion Zone

ZONE 2: Contamination Reduction Corridor
(See Attachment 1A for Details)

ZONE 3: Support Zone

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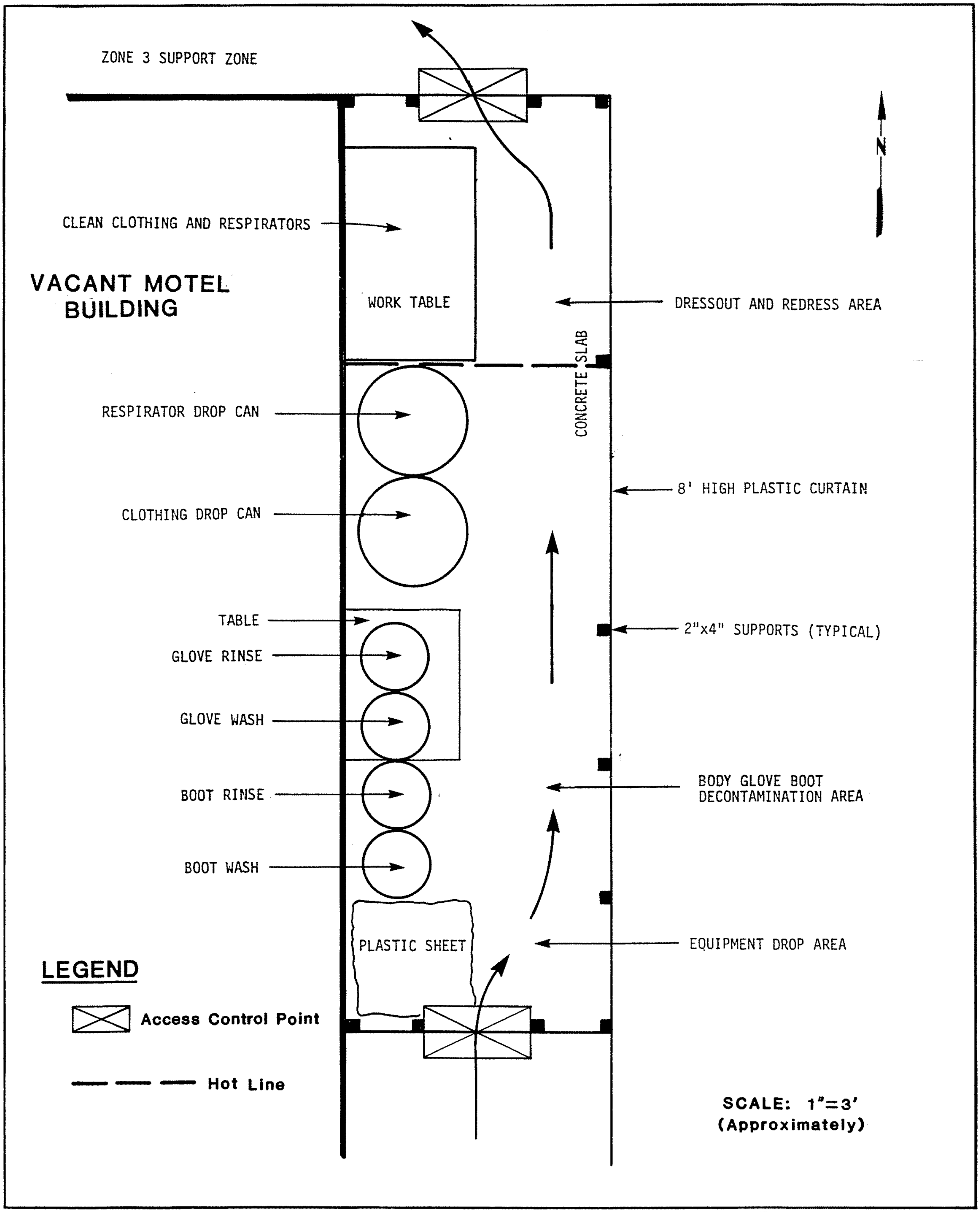
SITE PLAN

Niagara Falls Site
Olin Chemical Group

ATTACHMENT
1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MK	17497,001.12	SRN	5/13/85	MK	6/85



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CONTAMINATION REDUCTION ZONE

Niagara Falls Site
Olin Chemical Group

ATTACHMENT
1A

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
mK	17497,001.12	SRN	6/6/85	mK	6/6/85

CHEMICAL NAME
LINDANE BHC

FORMULA

CHEMICAL NAME
LINDANE

FORMULA
$C_6H_6Cl_6$

SYNONYMS
- BENZENE HEXACHLORIDE
- DETOX 25
- NCI-C00204
- TAP 85
- TRI-6
- GAMMA--BHC
- NA 2761
- CYCLOHEXANE, 1,2,3,4,5,6-HEXACHLORO-, GAMMA-ISOMER
- BENZENE HEXACHLORIDE--GAMMA-ISOMER
- GAMMA-HEXACHLORAN
- GAMMA-HEXCHLOROCYCLOHEXANE
- GAMMA-1,2,3,4,5,6-HEXACHLOROCYCLOHEXANE
- GAMMA-HEXACHLOROBENZENE
- HEXACHLOROCYCLOHEXANE, GAMMA-ISOMER
- 1,2,3,4,5,6-HEXACHLOROCYCLOHEXANE, GAMMA-ISOMER
- GAMMA-BENZENE HEXACHLORIDE
- GAMMA-HCH
- BBH
- BHC
- OHS12810

PERMISSIBLE EXPOSURE LIMIT
- 0.5 MG/M3 OSHA TWA (SKIN NOTATION)
- 0.5 MG/M3 ACGIH TWA (SKIN NOTATION)
- ANIMAL CARCINOGEN (IARC)
- SUSPECT HUMAN CARCINOGEN (NTP)
- NEGATIVE CARCINOGEN IN RATS/MICE (NCI)
- MUTAGENIC DATA (RTEC)
- ACCEPTABLE DAILY INTAKE (FAO/WHO): 0.01 MG/KG
- SURVEILLANCE INDEX CLASSIFICATION II: POTENTIAL HIGH HEALTH HAZARD
- CERCLA HAZARD RATINGS - TOXICITY 3 - IGNITABILITY 1 - REACTIVITY 0 - PERSISTENCE 3

TOXICOLOGY: LINDANE IS A CONVULSANT POISON AND SUSPECT CARCINOGEN. EXPOSURE TO LINDANE VAPORS WILL IRRITATE THE EYES, NOSE AND THROAT. REPEATED OR PROLONGED CONTACT WILL LEAD TO DERMATITIS. THE THRESHOLD LIMIT VALUE WAS SET AT A LEVEL TO PREVENT CONVULSIONS. SEE DOT.

NOTE: In order to be overlyconservative in developing the health and safety procedures presented herein, information on the most hazardous of all BHC isomers, lindane, was used to develop the procedures. Lindane, which is the gamma isomer of BHC, is <u>not</u> expected to be at the site. The <u>only</u> BHC isomers expected on site are the alpha, beta and delta isomers.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONCENTRATION
  1000 MG/M3
  OSHA/NIOSH

PHYSICAL DESCRIPTION
  COLORLESS SOLID WITH A MUSTY ODOR
  PURE MATERIAL IS ODORLESS

CHEMICAL AND PHYSICAL PROPERTIES
  MOLECULAR WEIGHT: 290.82
  BOILING POINT AT 1 ATM, F: DECOMPOSES
  SOLUBILITY IN WATER, G/100 G WATER AT 20C: 0.001 G
  FLASH POINT, CLOSED CUP, F (OR OPEN CUP IF OC): NONFLAMMABLE
  VAPOR PRESSURE @ 20 C, MMHG: <0.001 MM HG
  MELTING POINT, F: 234 F
  UPPER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: $
  LOWER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: $

INCOMPATIBILITIES
  STRONG ACIDS
  HEAT
  THERMAL DECOMPOSITION PRODUCTS ARE HAZARDOUS AND/OR TOXIC

PERSONAL PROTECTIVE EQUIPMENT
  FOLLOWING INFORMATION FROM NIOSH/OSHA "OCCUPATIONAL HEALTH GUIDELINES
   FOR CHEMICAL HAZARDS":

  PREVENT SKIN CONTACT, WHERE SKIN CONTACT MAY OCCUR
    WEAR IMPERVIOUS CLOTHING
    WEAR GLOVES
    WEAR FACESHIELD (8 INCH MINIMUM)

  PLACE CONTAMINATED CLOTHING IN CLOSED CONTAINERS FOR STORAGE UNTIL
    LAUNDERED OR DISCARDED
  IF CLOTHING IS TO BE LAUNDERED, INFORM PERSON PERFORMING OPERATION OF
    CONTAMINANT'S HAZARDOUS PROPERTIES

— — —

  ACGIH "GUIDELINES FOR SELECTION OF CHEMICAL PROTECTIVE
  CLOTHING" INDICATES THE FOLLOWING MATERIALS AND
  PROTECTIVE RATINGS BY INDEPENDENT VENDORS AGAINST
  INORGANIC BASES:
    EXCELLENT/GOOD:
  BUTYL RUBBER
  NATURAL RUBBER
  NEOPRENE
  NITRILE RUBBER
  POLYVINYL CHLORIDE

    GOOD/FAIR:
  NEOPRENE/STYRENE-BUTADIENE
  NITRILE/POLYVINYL CHLORIDE
  POLYETHYLENE
  CHLORINATED POLYETHYLENE
  POLYURETHANE
  STYRENE-BUTADIENE RUBBER
    FAIR/GOOD:
  POLYVINYL ALCOHOL

  A WIDE VARIATION IN RATINGS IS INDICATED FOR VITON

ATTACHMENT 2

GOGGLES
  PREVENT ANY POSSIBILITY OF EYE CONTACT

WASHING CHEMICALS FROM THE SKIN
  IMMEDIATELY WHEN SKIN BECOMES CONTAMINATED AND AT THE END OF WORK SHIFT

ROUTINE CHANGING OF WORK CLOTHING
  AFTER WORK SHIFT

CLOTHING REMOVAL FOLLOWING ACCIDENTAL CONTAMINATION
  PROMPTLY IF IT IS NON-IMPERVIOUS AND CONTAMINATED

SPECIFIC EMERGENCY PROVISIONS
  QUICK DRENCHING FACILITIES WITHIN IMMEDIATE WORK AREA WHERE EMPLOYEE'S BODY MAY BE EXPOSED TO SUBSTANCE
  EATING AND SMOKING SHOULD NOT BE PERMITTED IN IMMEDIATE WORK AREA
  WATER FOUNTAIN PROHIBITED IN WORK AREA
  CLOSED SYSTEM IF SUBSTANCE TO BE USED

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED)

25 MG/M3
- CHEMICAL CARTRIDGE RESPIRATOR
  WITH AN ORGANIC VAPOR CARTRIDGE
  WITH A FULL FACE-PIECE
  WITH A DUST AND MIST FILTER
  INCLUDING PESTICIDE RESPIRATORS MEETING THESE REQUIREMENTS
- GAS MASK
  (CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER)
  WITH AN ORGANIC VAPOR CANISTER
  WITH A DUST AND MIST FILTER
  INCLUDING PESTICIDE RESPIRATORS MEETING THESE REQUIREMENTS
- SUPPLIED-AIR RESPIRATOR
  WITH A FULL FACE-PIECE, HELMENT, OR HOOD
- SELF-CONTAINED BREATHING APPARATUS
  WITH A FULL FACE-PIECE

ESCAPE
- GAS MASK
  PROVIDING PROTECTION AGAINST ACID GASES
  INCLUDING PESTICIDE RESPIRATORS MEETING THESE REQUIREMENTS
- SELF-CONTAINED BREATHING APPARATUS
- SUPPLIED-AIR SUITS TO PREVENT SKIN CONTACT AND AUXILIARY SELF-CONTAINED BREATHING APPARATUS

5 MG/M3
- CHEMICAL CARTRIDGE RESPIRATOR
  WITH AN ORGANIC VAPOR CARTRIDGE
  WITH A DUST AND MIST FILTER
- SUPPLIED-AIR RESPIRATOR
- SELF-CONTAINED BREATHING APPARATUS

300 MG/M3
- POWERED AIR-PURIFYING RESPIRATOR
  WITH AN ORGANIC VAPOR CARTRIDGE
  WITH A HIGH-EFFICIENCY PARTICULATE FILTER
  INCLUDING PESTICIDE RESPIRATORS MEETING THESE REQUIREMENTS
- TYPE 'C' SUPPLIED-AIR RESPIRATOR
- SUPPLIED-AIR RESPIRATOR
  OPERATED IN PRESSURE-DEMAND, POSITIVE-PRESSURE, OR CONTINUOUS-FLOW MODE

ATTACHMENT 2

1000 MG/M3
- SUPPLIED-AIR RESPIRATOR
- TYPE 'C' SUPPLIED-AIR RESPIRATOR
  OPERATED IN PRESSURE-DEMAND, POSITIVE-PRESSURE, OR CONTINUOUS-FLOW MODE

FIREFIGHTING
- SELF-CONTAINED BREATHING APPARATUS
  WITH A FULL FACE-PIECE
  OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

ROUTE OF ENTRY INTO BODY
INHALATION
SKIN ABSORPTION
INGESTION
SKIN OR EYE CONTACT

SYMPTOMS
EYE IRRITATION
NASAL IRRITATION
THROAT IRRITATION
SKIN IRRITATION
DERMATITIS
ANXIETY
EXCITATION
CONFUSION
PARESTHESIA
HEADACHE
DIZZINESS
WEAKNESS
NAUSEA
VOMITING
TREMORS
DIARRHEA
CONVULSIONS
DYSPNEA
CYANOSIS
APLASTIC ANEMIA
MUSCULAR SPASM
HEPATIC ENLARGEMENT
LIVER DAMAGE
KIDNEY DAMAGE
HEMATURIA
DARK URINE
SKIN PIGMENTATION
HEPATIC CANCER IN EXPERIMENTAL ANIMALS

FIRST AID PROCEDURES FOLLOWING EXPOSURE

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

IF THIS CHLORINATED HYDROCARBON GETS ON SKIN, IMMEDIATELY WASH SKIN WITH SOAP AND WATER, RUBBING ALCOHOL, OR TINCTURE OF GREEN SOAP.

ATTACHMENT 2

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

WHEN THIS CHEMICAL HAS BEEN SWALLOWED, IMMEDIATELY GET MEDICAL ATTENTION. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, GET THE AFFECTED PERSON TO VOMIT BY HAVING HIM TOUCH THE BACK OF HIS THROAT WITH HIS FINGER OR BY GIVING HIM SYRUP OF IPECAC AS DIRECTED ON PACKAGE. THIS NON-PRESCRIPTION DRUG SHOULD BE KEPT WITH EMERGENCY MEDICAL SUPPLIES IN THE WORKPLACE AND IS AVAILABLE AT MOST DRUG COUNTERS. DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT.

IF THIS HALOGENATED PESTICIDE IS SWALLOWED, INDUCE VOMITING WITH SYRUP OF IPECAC. ADMINISTER ACTIVATED CHARCOAL FOLLOWED BY GASTRIC LAVAGE WITH 2 TO 4 LITERS OF TAP WATER. FOLLOW WITH SALINE CATHARTIC. DO NOT GIVE FATS OR OILS. PERFORM LAVAGE WITH 200 ML OF 20% MANNITOL USING A STOMACH TUBE. ADMINISTER DIAZEPAM (10 ML) INTRAVENOUSLY AS AN ANTICONVULSANT. IF CONVULSIONS PERSIST, USE A NEUROMUSCULAR BLOCKING AGENT. FOR HYPERACTIVITY OR TREMORS, GIVE 100 MG OF PHENOBARBITAL SODIUM SUBCUTANEOUSLY HOURLY UNTIL CONVULSIONS ARE CONTROLLED OR UNTIL 0.5 G HAS BEEN GIVEN. DO NOT GIVE STIMULANTS.
(DREISBACH - HANDBOOK OF POISONING, 11TH ED.)

ORGANS
- EYES
- SKIN
- CENTRAL NERVOUS SYSTEM
- BLOOD
- KIDNEYS
- LIVER

STATUS OF REGULATORY ENFORCEMENT

OSHA STANDARD 29CFR1910.1200 HAZARD COMMUNICATION

REQUIRES CHEMICAL MANUFACTURERS AND IMPORTERS TO ASSESS THE HAZARDS OF CHEMICALS WHICH THEY PRODUCE OR IMPORT, AND ALL EMPLOYERS HAVING WORKPLACES IN THE MANUFACTURING DIVISION, STANDARD INDUSTRIAL CLASSIFICATION CODES 20 THROUGH 39, TO PROVIDE INFORMATION TO THEIR EMPLOYEES CONCERNING HAZARDOUS CHEMICALS BY MEANS OF HAZARD COMMUNICATION PROGRAMS INCLUDING LABELS, MATERIAL SAFETY DATA SHEETS, TRAINING, AND ACCESS TO WRITTEN RECORDS
48FR53280 11/25/83

FOLLOWING OSHA STANDARDS APPLICABLE TO SUBSTANCES LISTED 29CFR1910. OTHERWISE ADVISE:

OSHA STANDARD 29CFR1910.1000 AIR CONTAMINANTS
TABLE Z-1

OSHA STANDARD 29CFR1910.94 VENTILATION

OSHA STANDARD 29CFR1910.134 RESPIRATORY PROTECTION

OSHA STANDARD 29CFR1910.20 ACCESS TO EMPLOYEE EXPOSURE AND MEDICAL RECORDS

ATTACHMENT 2

OSHA STANDARD 29CFR1910.132 PERSONAL PROTECTIVE EQUIPMENT
OSHA STANDARD 29CFR1910.141 SANITATION

OSHA STANDARD 29CFR1910.151 MEDICAL SERVICES AND FIRST AID

OSHA STANDARD 29CFR1910.133 EYE AND FACE PROTECTION

40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT
REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT ALLEGED TO HAVE BEEN CAUSED BY A SUBSTANCE OR MIXTURE. EPA MAY INSPECT AND REQUIRE REPORTING OF SUCH RECORDS.
48FR38178 08/22/83

SUBSTANCE ESTABLISHED AS CONFIRMED OR SUSPECTED CARCINOGEN (POTENTIAL CARCINOGEN) BY THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

SUBSTANCE LISTED AS 'KNOWN TO BE CARCINOGENIC' OR 'MAY REASONABLY BE ANTICIPATED TO BE CARCINOGENIC' IN NATIONAL TOXICOLOGY PROGRAM (NTP) THIRD ANNUAL REPORT ON CARCINOGENS
40CFR116 DESIGNATION OF HAZARDOUS SUBSTANCES
DESIGNATED AS HAZARDOUS SUBSTANCE IN ACCORDANCE WITH SECTION 311(B)(2)(A) OF THE FEDERAL WATER POLLUTION CONTROL ACT, AS AMENDED. INCLUDES ANY ISOMERS AND HYDRATES, AS WELL AS ANY SOLUTIONS AND MIXTURES CONTAINING THIS SUBSTANCE.
43FR10747 03/13/78
43FR27533 06/26/78
44FR10266 02/16/79 (AMENDMENT)
44FR10268 02/16/79 (AMENDMENT)
44FR65400 11/13/79 (AMENDMENT)
44FR66602 11/20/79 (AMENDMENT)

TECHNICAL ASSISTANCE DATA COMPLETED/PUBLISHED CLEAN WATER ACT (CWA) SECTION 311

REGULATION PROMULGATED CLEAN WATER ACT (CWA) SECTION 311
40CFR117

MONITORING/LEVELS MEASUREMENT IN DEVELOPMENT/PROGRESS CLEAN WATER ACT (CWA)

40CFR122, APPENDIX D - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT APPLICATION TESTING REQUIREMENTS
TABLE II - ORGANIC TOXIC POLLUTANTS IN EACH OF FOUR FRACTIONS IN ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (GS/MS)
48FR14153 04/01/83

CLEAN WATER ACT (CWA) SECTION 304(A)
WATER QUALITY CRITERIA FOR LINDANE:
4.0 UG/L FOR DOMESTIC WATER SUPPLY (HEALTH).
0.01 UG/L FOR FRESHWATER AQUATIC LIFE.
0.004 UG/L FOR MARINE AQUATIC LIFE.

40CFR141.12 NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS
MAXIMUM CONTAMINANT LEVEL FOR LINDANE: 0.004 MG/L
40FR59570 12/24/75
44FR68641 11/29/79

ATTACHMENT 2

40CFR261.24 CHARACTERISTIC OF EP TOXICITY
SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
45FR33084 05/19/80

TECHNICAL ASSISTANCE DATA COMPLETED/PUBLISHED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)

PREREGULATORY ASSESSMENT COMPLETED/PUBLISHED FEDERAL INSECTICIDE FUNGICIDE, AND RODENTICIDE ACT (FIFRA) SECTION 6

REBUTTABLE PRESUMPTION AGAINST REGISTRATION (RPAR) OR ADVANCED NOTICE OF PROPOSED RULEMAKING (ANPR) COMPLETED/PUBLISHED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA) SECTION 6

RISK DOCUMENTATION/ASSESSMENT COMPLETED/PUBLISHED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)

TEST METHOD DEVELOPMENT COMPLETED/PUBLISHED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)

MONITORING/LEVELS MEASUREMENT COMPLETED/PUBLISHED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)

REGULATION PROMULGATED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA) SECTION 6

EPA HAS ANNOUNCED ITS INTENT TO CANCEL THE REGISTRATIONS OF LINDANE FOR TWO USES, TO CONTINUE THE REGISTRATION OF ALL OTHER USES SUBJECT TO CERTAIN LABEL REQUIREMENTS AND USE PRACTICE PROHIBITIONS, AND TO DENY APPLICATIONS FOR REGISTRATION OF LINDANE PRODUCTS NOT IN ACCORDANCE WITH THE TERMS OF THE NOTICE.
48FR48512 10/19/83

REGULATION PROMULGATED SAFE DRINKING WATER ACT (SDWA)

MONITORING/LEVELS MEASUREMENT IN DEVELOPMENT/PROGRESS SAFE DRINKING WATER ACT (SDWA)

ANALYTICAL METHODS DEVELOPMENT IN DEVELOPMENT/PROGRESS CLEAN WATER ACT (CWA)

TEST METHOD DEVELOPMENT COMPLETED/PUBLISHED TOXIC SUBSTANCES CONTROL ACT (TSCA)

SUBSTANCES LISTED APPENDIX A -- CONSENT DECREE LIST OF INDUSTRIES AND TOXIC POLLUTANTS. SETTLEMENT AGREEMENT BETWEEN U.S. EPA AND NATIONAL RESOURCES DEFENSE COUNCIL, ET AL U.S. DISTRICT COURT DISTRICT OF COLUMBIA, JUNE 7 1976. SITE 8ERC2120, DDC 1976. MODIFIED MARCH 9. 1979. SITE 12ERC1833, DDC 1979 AND AGAIN ON OCTOBER 26. 1982.

SUBSTANCE LISTED COMMONWEALTH OF VIRGINIA STATE BOARD OF HEALTH HAZARDOUS WASTE MANAGEMENT REGULATIONS UNDER AUTHORITY OF THE CODE OF VIRGINIA, AS AMENDED. CHAPTER 6, TITLE 32.1. ARTICLE 3, SOLID WASTE MANAGEMENT

SUBSTANCE SUBJECT TO REQUIREMENTS OF GENERAL INDUSTRY SAFETY ORDER (GISO) 5194 OR TITLE 8 OF CALIFORNIA ADMINISTRATIVE CODE AND DIVISION 5. CHAPTER 2.5 OF CALIFORNIA LABOR CODE

ATTACHMENT 2

FOOD AND DRUG ADMINISTRATION (FDA) SURVEILLANCE INDEX CLASSIFICATION (SIC) - CLASS II: HIGH HEALTH/TOXICITY HAZARD HAS NOT BEEN DEMONSTRATED, BUT EVIDENCE EXISTS FOR POSSIBLE HIGH RISK TOXICITY EFFECTS

49CFR172.101 TABLES OF HAZARDOUS MATERIALS. THEIR DESCRIPTION. PROPER SHIPPING NAME, CLASS, LABEL, PACKAGING, AND OTHER REQUIREMENTS

DESIGNATED IN HAZARDOUS MATERIALS TABLE AS HAZARDOUS MATERIAL FOR THE PURPOSE OF TRANSPORTATION.

41FR15996 04/15/76
45FR34588 05/22/80 (AMENDMENT)
45FR46420 07/10/80 (AMENDMENT)
45FR62030 09/18/80 (AMENDMENT)
45FR74649 11/10/80 (AMENDMENT)
46FR17739 03/19/81 (AMENDMENT)
46FR19235 03/30/81 (AMENDMENT)

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 40CFR261.31 EPA HAZARDOUS WASTE NO. F024. WASTES, INCLUDING BUT NOT LIMITED TO, DISTILLATION RESIDUES, HEAVY ENDS, TARS, AND REACTOR CLEANOUT WASTES FROM THE PRODUCTION OF CHLORINATED ALIPHATIC HYDROCARBONS, HAVING CARBON CONTENT FROM ONE TO FIVE, UTILIZING FREE RADICAL CATALYZED PROCESSES. (THIS LIST DOES NOT INCLUDE LIGHT ENDS, SPENT FILTERS AND FILTER AIDS, SPENT DESSICANTS, WASTEWATER, WASTEWATER TREATMENT SLUDGES, SPENT CATALYSTS, AND WASTES LISTED IN 40CFR261.32)

49FR5308 02/10/84

MEDICAL SURVEILLANCE REQUIRED

EKG RECOMMENDED IF EMPLOYEE TO WEAR FULL-FACE RESPIRATOR
GENERAL MEDICAL HISTORY

40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT

TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS

48FR38187 08/22/83
48FR39225 08/30/83 (EFFECTIVE DATE CORRECTION)
PHYSICAL MEASUREMENTS
VISION TEST
CENTRAL NERVOUS SYSTEM TESTS, PERIPHERAL NEUROPATHY
COMPLETE BLOOD COUNT
BLOOD CHEMISTRY
RENAL AND LIVER FUNCTIONS
KIDNEY FUNCTION
SKIN EXAM
MORPHOLOGICAL BLOOD SLIDES
HEMATOLOGY
PRE-PLACEMENT AND ANNUAL EXAMS
14 BY 17 CHEST P.A. X-RAY
URINALYSIS
PHYSICIAN EXAMINATION
INDUSTRIAL EXPOSURE HISTORY
ATTENTION TO SMOKING, ALCOHOL, MEDICATION. AND EXPOSURE TO CARCINOGENS

ATTACHMENT 2

FOOD AND DRUG ADMINISTRATION (FDA) SURVEILLANCE INDEX
CLASSIFICATION (SIC) - CLASS II: A HIGH HEALTH/TOXICITY HAZARD
HAS NOT BEEN DEMONSTRATED, BUT EVIDENCE EXISTS FOR POSSIBLE
HIGH RISK TOXICITY EFFECTS. HAZARD POTENTIAL IS SUFFICIENT TO
WARRANT A TEMPORARY INCLUSION OF THIS PESTICIDE IN MEDICAL
MONITORING PROGRAM UNTIL TOXICITY/EXPOSURE DATA IS MORE CLEARLY
DEFINED
FOOD AND AGRICULTURE ORGANIZATION/WORLD HEALTH ORGANIZATION (FAO/WHO)
ACCEPTABLE DAILY INTAKE ESTABLISHED

CERTIFICATIONS

HEALTH STATUS CLASSIFICATION

NUCLEAR REG. 0041

OSHA RESPIRATOR CERTIFICATION 29CFR1910.134

DEPARTMENT OF TRANSPORTATION IF OPERATES HEAVY EQUIPMENT

EMPLOYEE HAZARDOUS MATERIALS EDUCATION RECEIPT

EMPLOYEE MEDICAL RECORDS RECEIPT

TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE
REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL
SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT
ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS.
CONTACT: JACK P. MCCARTHY, OFFICE OF TOXIC SUBSTANCES.
EPA (800)424-1404. 48FR38178 8/22/83

MEDICAL WARNING REQUIRED FOR MEDICAL EXAM REFUSAL SIGNED
BY EMPLOYEE

SPECIAL DIAGNOSTIC TESTS

CONVULSIONS - BLOOD ANALYSIS FOR GLUCOSE, CALCIUM, UREA NITROGEN AND
CARBON DIOXIDE

LEAKS AND SPILL PROCEDURES

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DEPARTMENT OF TRANSPORTATION HAZARD CLASS
49CFR172.101 HAZARDOUS MATERIALS TABLE

ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS
49CFR172.101 (SUBJECT TO ADDITIONAL LABELING REQUIREMENTS OF
49CFR172.402)

NONE

ATTACHMENT 2

* * *

INTERGOVERNMENTAL MARITIME ORGANIZATION HAZARD CLASS
49CFR172.102 OPTIONAL HAZARDOUS MATERIALS TABLE

ORGANOCHLORINE PESTICIDES, SOLID, TOXIC, N.O.S.
CLASS 6.1-POISONOUS (TOXIC) SUBSTANCE
UN 2761

INTERGOVERNMENTAL MARITIME ORGANIZATION LABELING SPECIFICATIONS FOR
DOMESTIC AND EXPORT SHIPMENTS
49CFR172.102

POISON

* * *

FOLLOWING INFORMATION FROM BUREAU OF EXPLOSIVES "EMERGENCY HANDLING OF HAZARDOUS MATERIALS":

IF MATERIAL ON FIRE OR INVOLVED IN FIRE:
* EXTINGUISH FIRE USING AGENT SUITABLE FOR TYPE OF SURROUNDING FIRE (MATERIAL ITSELF DOES NOT BURN OR BURNS WITH DIFFICULTY)

IF MATERIAL IS NOT ON FIRE AND IS NOT INVOLVED IN FIRE:
* KEEP MATERIAL OUT OF WATER SOURCES AND SEWERS
* BUILD DIKES TO CONTAIN FLOW AS NECESSARY

PERSONNEL PROTECTION:
* KEEP UPWIND
* WEAR BOOTS, PROTECTIVE GLOVES AND GAS TIGHT GOGGLES
* AVOID BREATHING DUST/VAPORS/FUMES FROM MATERIAL
* WASH AWAY ANY MATERIALS WHICH MAY HAVE CONTACTED THE BODY WITH COPIOUS AMOUNTS OF WATER OR SOAP AND WATER

LAND SPILL:
* DIG A PIT, POND, LAGOON OR HOLDING AREA TO CONTAIN LIQUID OR SOLID MATERIAL
* DIKE SURFACE FLOW USING SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE
* ABSORB BULK LIQUID WITH FLY ASH OR CEMENT POWDER

WATER SPILL:
* USE NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS TO LIMIT SPILL MOTION
* IF DISSOLVED, APPLY ACTIVATED CARBON AT 10 TIMES SPILLED AMOUNT AT 10PPM OR GREATER CONCENTRATION
* USE MECHANICAL DREDGES OR LIFTS TO REMOVE IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES
* THERMAL DECOMPOSITION TO PHOSGENE CAN OCCUR

* * *

FOLLOWING INFORMATION FROM DEPARTMENT OF TRANSPORTATION/U.S. COAST GUARD "CHEMICAL RESPONSE INFORMATION SYSTEM", REGARDING WATER SPILLS.

* SUBSTANCE SINKS IN WATER
* RESTRICT ACCESS OF GENERAL PUBLIC WHEN APPRECIABLE DANGER ARISES FROM SPILL
* RESTRICT HUMAN USE WHEN SUBSTANCE INVOLVED
* RESTRICT FARM USE WHEN SUBSTANCE SPILLED IN WATER USED FOR IRRIGATION

ATTACHMENT 2

OR ANIMALS

- CONTAIN SURFACE SLICKS
- USE MECHANICAL DREDGES OR LIFTS TO REMOVE IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES
- HIGHLY VOLATILE, AVOID INHALATION. VAPORS OR DUST ARE IRRITATING OR TOXIC
- HIGHLY CORROSIVE. AVOID DIRECT CONTACT, CONTACT WITH SKIN OR EYES CAN CAUSE IRRITATION OR BURNS

WASTE

THIS MATERIAL LISTED AS HAZARDOUS SUBSTANCE, AS DEFINED IN SECTION 101(14) OF THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) OF 1980, PURSUANT TO ONE OR MORE OF THE FOLLOWING:

- FEDERAL WATER POLLUTION CONTROL ACT (FWPCA) SECTION 311(B)(2)(A)
- SOLID WASTE DISPOSAL ACT SECTION 3001
- CLEAN WATER ACT (CWA) SECTION 307(A)
- CLEAN AIR ACT (CAA) SECTION 112
- TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 7
- COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) SECTION 102

EPA HAZARDOUS WASTE NUMBER D013
LINDANE (1,2,3,4,5,6-HEXACHLOROCYCLOHEXANE, GAMMA ISOMER)
MAXIMUM CONCENTRATION 0.4 MG/L

40CFR260 HAZARDOUS WASTE MANAGEMENT SYSTEM, GENERAL

PROVIDES DEFINITIONS OF TERMS, GENERAL STANDARDS, AND OVERVIEW INFORMATION APPLICABLE TO 40CFR PARTS 260-265

40CFR261 IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

IDENTIFIES THOSE SOLID WASTES WHICH ARE SUBJECT TO REGULATION AS HAZARDOUS WASTES UNDER 40CFR PARTS 262-265, 270, 271, AND 124 AND WHICH ARE SUBJECT TO THE NOTIFICATION REQUIREMENTS OF SECTION 3010 OF THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) AND IDENTIFIES ONLY SOME OF THE MATERIALS WHICH ARE HAZARDOUS WASTES UNDER SECTIONS 3007 AND 7003 OF RCRA

40CFR262 STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE

ESTABLISHES STANDARDS FOR GENERATORS OF HAZARDOUS WASTE

40CFR263 STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE

ESTABLISHES STANDARDS WHICH APPLY TO PERSONS TRANSPORTING HAZARDOUS WASTE WITHIN THE UNITED STATES IF THE TRANSPORTATION REQUIRES A MANIFEST UNDER 40CFR262

40CFR264 STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE AND DISPOSAL FACILITIES

ESTABLISHES MINIMUM NATIONAL STANDARDS WHICH DEFINE THE ACCEPTABLE MANAGEMENT OF HAZARDOUS WASTE

ATTACHMENT 2

CHEMICAL NAME

HEXACHLOROBENZENE

FORMULA

C6CL6

SYNONYMS

HCB
PENTACHLOROPHENYL CHLORIDE
PERCHLOROBENZENE
PHENYL PERCHLORYL
NO BUNT
ANTICARIE
SANOCIDE
UN 2729
BENZENE, HEXACHLORO-
AMATIN
BUNT-CURE
CO-OP HEXA
GRANOX NM
HEXA C.B.
JULIN'S CARBON CHLORIDE
NO BUNT 40
NO BUNT 80
NO BUNT LIQUID
SMUT-GO
SNIECIOTOX
OHS10730

PERMISSIBLE EXPOSURE LIMIT

SUSPECT HUMAN CARCINOGEN (NTP)(IARC)
ANIMAL CARCINOGEN (IARC)
MUTAGENIC DATA (RTECS)
ACCEPTABLE DAILY INTAKE (FAO/WHO): 0.0006 MG/KG (CONDITIONAL)
CERCLA HAZARD RATINGS - TOXICITY 2 - IGNITABILITY 0 - REACTIVITY 0 -
PERSISTENCE 3

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONCENTRATION

NONE SPECIFIED

PHYSICAL DESCRIPTION

SOLID NEEDLE CRYSTALS

CHEMICAL AND PHYSICAL PROPERTIES

MOLECULAR WEIGHT: 284.76
BOILING POINT AT 1 ATM, F: 612 F
SOLUBILITY IN WATER, G/100 G WATER AT 20C: INSOLUBLE
FLASH POINT, CLOSED CUP, F (OR OPEN CUP IF OC): 468 F
VAPOR PRESSURE @ 20 C, MMHG: 1 MM HG
MELTING POINT, F: 446 F
UPPER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: COMBUSTIBLE
LOWER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: COMBUSTIBLE
SPECIFIC GRAVITY: 1.5691 AT 74 F
VAPOR DENSITY (AIR=1): 9.8

ATTACHMENT 2

INCOMPATIBILITIES
DIMETHYL FORMAMIDE
HEAT
THERMAL DECOMPOSITION PRODUCTS ARE HAZARDOUS AND/OR TOXIC

PERSONAL PROTECTIVE EQUIPMENT
NO NIOSH/OSHA DATA; RECOMMEND
PREVENT ANY POSSIBILITY OF SKIN CONTACT
WEAR IMPERVIOUS CLOTHING
WEAR GLOVES
WEAR FACESHIELD (8 INCH MINIMUM)
PLACE CONTAMINATED CLOTHING IN CLOSED CONTAINERS FOR STORAGE UNTIL LAUNDERED OR DISCARDED
IF CLOTHING IS TO BE LAUNDERED, INFORM PERSON PERFORMING OPERATION OF CONTAMINANT'S HAZARDOUS PROPERTIES

— — —

ACGIH "GUIDELINES FOR SELECTION OF CHEMICAL PROTECTIVE CLOTHING" INDICATES THE FOLLOWING MATERIALS AND PROTECTIVE RATINGS BY INDEPENDENT VENDORS AGAINST UNSUBSTITUTED AROMATIC HALOGEN COMPOUNDS:

EXCELLENT/GOOD:
NONE INDICATED

GOOD/FAIR:
POLYETHYLENE

FAIR/POOR:
NATURAL RUBBER
NEOPRENE
CHLORINATED POLYETHYLENE
POLYVINYL CHLORIDE

FAIR/GOOD:
BUTYL RUBBER

A WIDE VARIATION IN RATINGS IS INDICATED FOR THE FOLLOWING MATERIALS:
NITRILE RUBBER
POLYURETHANE

GOGGLES
NO OSHA STANDARD. NIOSH CRITERIA DOCUMENT ADVISES:
WEAR FACE SHIELD OR VENTED GOGGLES

WASHING CHEMICALS FROM THE SKIN
NO OSHA STANDARD. NIOSH CRITERIA DOCUMENT ADVISES:
PROMPTLY WHEN SKIN BECOMES CONTAMINATED

ROUTINE CHANGING OF WORK CLOTHING
NO OSHA STANDARD, NIOSH CRITERIA DOCUMENT ADVISES:
IF IT IS REASONABLY PROBABLE THAT CLOTHING IS CONTAMINATED
LEAVE CLOTHING & EQUIPMENT FOR DECONTAMINATION & DISPOSAL

CLOTHING REMOVAL FOLLOWING ACCIDENTAL CONTAMINATION
NO OSHA STANDARD, NIOSH CRITERIA DOCUMENT ADVISES:
PROMPTLY IF IT IS NON-IMPERVIOUS AND CONTAMINATED

SPECIFIC EMERGENCY PROVISIONS
NO OSHA STANDARD. NIOSH CRITERIA DOCUMENT ADVISES:
EYE-WASH FOUNTAIN WITHIN IMMEDIATE WORK AREA WHERE EMPLOYEES' EYES MAY BE EXPOSED TO SUBSTANCE
QUICK DRENCHING FACILITIES WITHIN IMMEDIATE WORK AREA WHERE EMPLOYEES MAY BE EXPOSED TO SUBSTANCE

ATTACHMENT 2

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED)

NO SPEC ADVISE
- CHEMICAL CARTRIDGE RESPIRATOR
  WITH AN ORGANIC VAPOR CARTRIDGE

HIGH LEVELS
- SELF-CONTAINED BREATHING APPARATUS
  WITH A FULL FACE-PIECE, HELMENT. OR HOOD

FIREFIGHTING
- SELF-CONTAINED BREATHING APPARATUS
  WITH A FULL FACE-PIECE
  OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

ROUTE OF ENTRY INTO BODY
- INHALATION
- SKIN ABSORPTION
- INGESTION
- SKIN OR EYE CONTACT

SYMPTOMS
- CHLORACNE
- LIVER DAMAGE
- THYROID ENLARGEMENT
- WEIGHT LOSS
- CONJUNCTIVITIS
- ERYTHEMA
- REPRODUCTIVE EFFECTS
- EYE IRRITATION
- SKIN IRRITATION
- RESPIRATORY IRRITATION
- RESPIRATORY EDEMA
- COUGHING
- DYSPNEA
- SKIN BURNS
- ABDOMINAL PAIN
- VOMITING
- DIARRHEA
- CIRRHOSIS
- ANXIETY
- ATAXIA
- CONVULSIONS
- COMATOSE
- TREMORS
- DIZZINESS
- HEADACHE
- CENTRAL NERVOUS SYSTEM DEPRESSION
- HEPATOCELLULAR TUMOR IN EXPERIMENTAL ANIMALS
- HEPATOMA IN EXPERIMENTAL ANIMALS
- HEMANGIOENDOTHELIOMA IN EXPERIMENTAL ANIMALS
- THYROID ADENOMA IN EXPERIMENTAL ANIMALS

ATTACHMENT 2

FIRST AID PROCEDURES FOLLOWING EXPOSURE

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

IF THIS CHLORINATED HYDROCARBON GETS ON SKIN, IMMEDIATELY WASH SKIN WITH SOAP AND WATER, RUBBING ALCOHOL, OR TINCTURE OF GREEN SOAP.

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

WHEN THIS CHEMICAL HAS BEEN SWALLOWED, IMMEDIATELY GET MEDICAL ATTENTION. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, GET THE AFFECTED PERSON TO VOMIT BY HAVING HIM TOUCH THE BACK OF HIS THROAT WITH HIS FINGER OR BY GIVING HIM SYRUP OF IPECAC AS DIRECTED ON PACKAGE. THIS NON-PRESCRIPTION DRUG SHOULD BE KEPT WITH EMERGENCY MEDICAL SUPPLIES IN THE WORKPLACE AND IS AVAILABLE AT MOST DRUG COUNTERS. DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT.
IF THIS HALOGENATED PESTICIDE IS SWALLOWED, INDUCE VOMITING WITH SYRUP OF IPECAC. ADMINISTER ACTIVATED CHARCOAL FOLLOWED BY GASTRIC LAVAGE WITH 2 TO 4 LITERS OF TAP WATER. FOLLOW WITH SALINE CATHARTIC. DO NOT GIVE FATS OR OILS. PERFORM LAVAGE WITH 200 ML OF 20% MANNITOL USING A STOMACH TUBE. ADMINISTER DIAZEPAM (10 ML) INTRAVENOUSLY AS AN ANTICONVULSANT. IF CONVULSIONS PERSIST, USE A NEUROMUSCULAR BLOCKING AGENT. FOR HYPERACTIVITY OR TREMORS, GIVE 100 MG OF PHENOBARBITAL SODIUM SUBCUTANEOUSLY HOURLY UNTIL CONVULSIONS ARE CONTROLLED OR UNTIL 0.5 G HAS BEEN GIVEN. DO NOT GIVE STIMULANTS.
(DREISBACH - HANDBOOK OF POISONING, 11TH ED.)

ORGANS

EYES
SKIN
LYMPHATIC SYSTEM
ENDOCRINE SYSTEM
REPRODUCTIVE SYSTEM
LIVER
LUNGS
RESPIRATORY SYSTEM
MUCOUS MEMBRANES
CENTRAL NERVOUS SYSTEM

STATUS OF REGULATORY ENFORCEMENT

OSHA STANDARD 29CFR1910.1200 HAZARD COMMUNICATION

REQUIRES CHEMICAL MANUFACTURERS AND IMPORTERS TO ASSESS THE HAZARDS OF CHEMICALS WHICH THEY PRODUCE OR IMPORT, AND ALL EMPLOYERS HAVING WORKPLACES IN THE MANUFACTURING DIVISION, STANDARD INDUSTRIAL CLASSIFICATION CODES 20 THROUGH 39, TO PROVIDE INFORMATION TO THEIR EMPLOYEES CONCERNING HAZARDOUS CHEMICALS BY MEANS OF HAZARD COMMUNICATION PROGRAMS INCLUDING LABELS, MATERIAL SAFETY DATA SHEETS, TRAINING, AND ACCESS TO WRITTEN RECORDS

48FR53280 11/25/83

ATTACHMENT 2

FOLLOWING OSHA STANDARDS APPLICABLE TO SUBSTANCES LISTED 29CFR1910.
OTHERWISE ADVISE:

OSHA STANDARD 29CFR1910.94 VENTILATION

OSHA STANDARD 29CFR1910.134 RESPIRATORY PROTECTION
OSHA STANDARD 29CFR1910.20 ACCESS TO EMPLOYEE EXPOSURE AND MEDICAL RECORDS

OSHA STANDARD 29CFR1910.132 PERSONAL PROTECTIVE EQUIPMENT

OSHA STANDARD 29CFR1910.141 SANITATION

OSHA STANDARD 29CFR1910.151 MEDICAL SERVICES AND FIRST AID

OSHA STANDARD 29CFR1910.133 EYE AND FACE PROTECTION

40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT

REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT ALLEGED TO HAVE BEEN CAUSED BY A SUBSTANCE OR MIXTURE. EPA MAY INSPECT AND REQUIRE REPORTING OF SUCH RECORDS.
48FR38178 08/22/83

SUBSTANCE LISTED TOXIC SUBSTANCES CONTROL ACT INVENTORY

SUBSTANCE ESTABLISHED AS CONFIRMED OR SUSPECTED CARCINOGEN (POTENTIAL CARCINOGEN) BY THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

SUBSTANCE LISTED AS 'KNOWN TO BE CARCINOGENIC' OR 'MAY REASONABLY BE ANTICIPATED TO BE CARCINOGENIC' IN NATIONAL TOXICOLOGY PROGRAM (NTP) THIRD ANNUAL REPORT ON CARCINOGENS

49CFR172.101 TABLES OF HAZARDOUS MATERIALS. THEIR DESCRIPTION. PROPER SHIPPING NAME. CLASS, LABEL, PACKAGING, AND OTHER REQUIREMENTS

DESIGNATED IN HAZARDOUS MATERIALS TABLE AS HAZARDOUS MATERIAL (UNDER N.O.S CATEGORY) FOR THE PURPOSE OF TRANSPORTATION.
41FR15996 04/15/76
45FR34588 05/22/80 (AMENDMENT)
45FR46420 07/10/80 (AMENDMENT)
45FR62030 09/18/80 (AMENDMENT)
45FR74649 11/10/80 (AMENDMENT)
46FR17739 03/19/81 (AMENDMENT)
46FR19235 03/30/81 (AMENDMENT)

49CFR172.102 TABLES OF HAZARDOUS MATERIALS. THEIR DESCRIPTION. PROPER SHIPPING NAME, CLASS. LABEL, PACKAGING, AND OTHER REQUIREMENTS

DESIGNATED IN OPTIONAL HAZARDOUS MATERIALS TABLE WITH ALTERNATIVES TO CORRESPONDING REQUIREMENTS IN 49CFR172.101 FOR INTERNATIONAL SHIPMENTS AS AUTHORIZED BY 49CFR171.12
41FR15996 04/15/76
46FR29393 06/01/81 (AMENDMENT)
46FR32250 06/22/81 (AMENDMENT)

RISK DOCUMENTATION/ASSESSMENT COMPLETED/PUBLISHED CLEAN WATER ACT (CWA)

RISK DOCUMENTATION/ASSESSMENT COMPLETED/PUBLISHED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

ATTACHMENT 2

CONTROL TECHNOLOGY DEVELOPMENT COMPLETED/PUBLISHED CLEAN WATER ACT (CWA)

CONTROL TECHNOLOGY DEVELOPMENT COMPLETED/PUBLISHED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

TECHNICAL ASSISTANCE DATA COMPLETED/PUBLISHED FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)

REGULATION PROMULGATED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 40CFR260
PREREGULATORY ASSESSMENT COMPLETED/PUBLISHED TOXIC SUBSTANCES CONTROL ACT (TSCA)

TOXIC SUBSTANCE CONTROL ACT (TSCA) SECTION 8(E) INITIAL EVALUATION OF SUBSTANTIAL RISK SUBMITTED TO EPA. 1982

SUBSTANCES LISTED APPENDIX A – CONSENT DECREE LIST OF INDUSTRIES AND TOXIC POLLUTANTS. SETTLEMENT AGREEMENT BETWEEN U.S. EPA AND NATIONAL RESOURCES DEFENSE COUNCIL. ET AL U.S. DISTRICT COURT DISTRICT OF COLUMBIA, JUNE 7. 1976. SITE 8ERC2120. DDC 1976. MODIFIED MARCH 9, 1979. SITE 12ERC1333, DDC 1979 AND AGAIN ON OCTOBER 26, 1982.

SUBSTANCE SUBJECT TO REQUIREMENTS OF GENERAL INDUSTRY SAFETY ORDER (GISO) 5194 OR TITLE 8 OF CALIFORNIA ADMINSTRATIVE CODE AND DIVISION 5 CHAPTER 2.5 OF CALIFORNIA LABOR CODE

40CFR122, APPENDIX D - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT APPLICATION TESTING REQUIREMENTS
TABLE II – ORGANIC TOXIC POLLUTANTS IN EACH OF FOUR FRACTIONS IN ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (GC/MS) 48FR14153 04/01/83
REGULATION IN DEVELOPMENT/PROGRESS COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) SECTION 101

WATER QUALITY CRITERIA COMPLETED/PUBLISHED CLEAN WATER ACT (CWA) SECTION 304(A) 45CFR231

WATER QUALITY CRITERIA DOCUMENT COMPLETED/PUBLISHED CLEAN WATER ACT (CWA) SECTION 304(A)

MATERIALS BALANCE STUDY COMPLETED/PUBLISHED TOXIC SUBSTANCES CONTROL ACT (TSCA)

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 40CFR261.32 EPA HAZARDOUS WASTE NO. K042: HEAVY ENDS OR DISTILLATION RESIDUES FROM THE DISTILLATION OF TETRACHLOROBENZENE IN THE PRODUCTION OF 2,4.5–T. (T)

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 40CFR261.32 EPA HAZARDOUS WASTE NO. K018: HEAVY ENDS FROM THE FRACTIONATION COLUMN IN ETHYL CHLORIDE PRODUCTON (T)

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 40CFR261.32 EPA HAZARDOUS WASTE NO. K016: HEAVY ENDS OR DISTILLATION RESIDUES FROM THE PRODUCTION OF CARBON TETRACHLORIDE.((T)

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 40CFR261.32 EPA HAZARDOUS WASTE NO. K085: DISTILLATION OR FRACTIONATION COLUMN BOTTOMS FROM THE PRODUCTION OF CHLOROBENZENES.((T)

ATTACHMENT 2

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
CFR261.32 EPA HAZARDOUS WASTE NO. K030: COLUMN BOTTOMS OR
HEAVY ENDS FROM THE COMBINED PRODUCTION OF TRICHLOROETHYLENE
AND PERCHLOROETHYLENE. (T)

SUBSTANCE LISTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
40CFR261.31 EPA HAZARDOUS WASTE NO. F024: WASTES, INCLUDING BUT NOT
LIMITED TO, DISTILLATION RESIDUES, HEAVY ENDS, TARS, AND REACTOR
CLEANOUT WASTES FROM THE PRODUCTION OF CHLORINATED ALIPHATIC HYDROCARBONS, HAVING CARBON CONTENT FROM ONE TO FIVE, UTILIZING FREE RADICAL
CATALYZED PROCESSES. (THIS LIST DOES NOT INCLUDE LIGHT ENDS, SPENT
FILTERS AND FILTER AIDS, SPENT DESSICANTS, WASTEWATER, WASTEWATER TREATMENT SLUDGES, SPENT CATALYSTS, AND WASTES LISTED IN 40CFR261.32)
49FR5308 02/10/84
THIS SUBSTANCE TESTED FOR MUTAGENESIS/GENETIC TOXICITY
BY THE NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES
(NIEHS)

15CFR399.2, SUPPLEMENT 1 - COMMODITY INTERPRETATION 24: CHEMICALS
VALIDATED LICENSE REQUIRED FOR EXPORT TO LIBYA, NORTH KOREA, VIETNAM,
KAMPUCHEA, OR CUBA
45FR85942 12/30/80
46FR23942 04/29/81
47FR143 01/05/82
47FR41512 09/21/82
47FR51860 11/19/82
47FR58124 12/29/82

FOOD AND AGRICULTURE ORGANIZATION/WORLD HEALTH ORGANIZATION (FAO/WHO)
ACCEPTABLE DAILY INTAKE (ADI) ESTABLISHED

MEDICAL SURVEILLANCE REQUIRED
NO OSHA STANDARD, NIOSH CRITERIA DOCUMENT ADVISES:
EKG RECOMMENDED IF EMPLOYEE TO WEAR FULL-FACE RESPIRATOR
GENERAL MEDICAL HISTORY
40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES
CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT
TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES
MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES
TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR
30 YEARS
48FR38187 08/22/83
48FR39225 08/30/83 (EFFECTIVE DATE CORRECTION)
PHYSICIAN EXAMINATION
INDUSTRIAL EXPOSURE HISTORY
PRE-PLACEMENT AND ANNUAL EXAMS
MEDICAL WARNING FOR REFUSAL OF MEDICAL EXAMINATION
ATTENTION TO SMOKING, ALCOHOL, MEDICATION, AND EXPOSURE TO CARCINOGENS

PULMONARY FUNCTIONS
RESPIRATORY HISTORY
SPECIAL ATTENTION TO SKIN
RENAL AND LIVER FUNCTIONS
PERIODIC EXAM FOLLOWING EXPOSURE
FOOD AND AGRICULTURE ORGANIZATION/WORLD HEALTH ORGANIZATION (FAO/WHO)
ACCEPTABLE DAILY INTAKE ESTABLISHED

ATTACHMENT 2

CERTIFICATIONS

NO FEDERAL AGENCY REQUIREMENT, BUT DUE TO HAZARDOUS NATURE OF SUBSTANCE, ADVISE FOLLOWING:

HEALTH STATUS CLASSIFICATION

OSHA RESPIRATOR CERTIFICATION 29CFR1910.134

DEPARTMENT OF TRANSPORTATION IF OPERATES HEAVY EQUIPMENT

EMPLOYEE HAZARDOUS MATERIALS EDUCATION RECEIPT

EMPLOYEE MEDICAL RECORDS RECEIPT

TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS.
CONTACT: JACK P. MCCARTHY, OFFICE OF TOXIC SUBSTANCES, EPA (800)424-1404. 48FR38178 8/22/83
MEDICAL WARNING REQUIRED FOR MEDICAL EXAM REFUSAL SIGNED BY EMPLOYEE

SPECIAL DIAGNOSTIC TESTS

PULMONARY FUNCTION
URINARY METABOLITES

LEAKS AND SPILL PROCEDURES

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DEPARTMENT OF TRANSPORTATION HAZARD CLASS
49CFR172.101 HAZARDOUS MATERIALS TABLE

HAZARDOUS SUBSTANCE, LIQUID OR SOLID, N.O.S.
ORM-E
UN 9188

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS
49CFR172.101 (SUBJECT TO ADDITIONAL LABELING REQUIREMENTS OF 49CFR172.402)

POISON

****

INTERGOVERNMENTAL MARITIME ORGANIZATION HAZARD CLASS
49CFR172.102 OPTIONAL HAZARDOUS MATERIALS TABLE

CLASS 6.1-POISONOUS (TOXIC) SUBSTANCE

INTERGOVERNMENTAL MARITIME ORGANIZATION LABELING SPECIFICATIONS FOR DOMESTIC AND EXPORT SHIPMENTS
49CFR172.102

ATTACHMENT 2

ST. ANDREWS CROSS

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FOLLOWING INFORMATION FROM BUREAU OF EXPLOSIVES "EMERGENCY HANDLING OF HAZARDOUS MATERIALS":

HAZARDOUS SUBSTANCE, LIQUID OR SOLID, N.O.S.
ORM-E

IF MATERIAL ON FIRE OR INVOLVED IN FIRE:
- EXTINGUISH USING SUITABLE MATERIAL TO SURROUND FIRE

IF MATERIAL IS NOT ON FIRE AND IS NOT INVOLVED IN FIRE:
- KEEP MATERIAL OUT OF WATER SOURCES AND SEWERS
- BUILD DIKES TO CONTAIN FLOW AS NECESSARY

PERSONAL DANGER SITUATION PROTECTION:
- KEEP UPWIND
- WEAR BOOTS, PROTECTIVE GLOVES AND GAS TIGHT GOGGLES
- AVOID BREATHING VAPORS OR DUST
- WASH AWAY ANY MATERIAL WHICH MAY HAVE CONTACTED THE BODY WITH COPIOUS AMOUNTS OF WATER OR SOAP AND WATER

LAND SPILL
- DIG PIT, POND TO HOLD MATERIAL
- COVER SOLIDS WITH A PLASTIC SHEET TO PREVENT DISSOLVING IN RAIN OR FIREFIGHTING WATER

WATER SPILL
- IF DISSOLVED, APPLY ACTIVATED CARBON AT 10 TIMES SPILLED AMOUNT AT 10 PPM OR GREATER CONCENTRATION
- REMOVE TRAPPED MATERIAL WITH SUCTION HOSES
- USE MECHANICAL DREDGES OR LIFTS TO REMOVE IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES

WASTE

THIS MATERIAL LISTED AS HAZARDOUS SUBSTANCE, AS DEFINED IN SECTION 101(14) OF THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) OF 1980, PURSUANT TO ONE OR MORE OF THE FOLLOWING:

- FEDERAL WATER POLLUTION CONTROL ACT (FWPCA) SECTION 311(B)(2)(A)
- SOLID WASTE DISPOSAL ACT SECTION 3001
- CLEAN WATER ACT (CWA) SECTION 307(A)
- CLEAN AIR ACT (CAA) SECTION 112
- TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 7
- COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) SECTION 102

EPA HAZARDOUS WASTE NUMBER U127
HEXACHLOROBENZENE

40CFR260 HAZARDOUS WASTE MANAGEMENT SYSTEM: GENERAL

PROVIDES DEFINITIONS OF TERMS, GENERAL STANDARDS, AND OVERVIEW INFORMATION APPLICABLE TO 40CFR PARTS 260-265

40CFR261 IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

IDENTIFIES THOSE SOLID WASTES WHICH ARE SUBJECT TO REGULATION AS HAZARDOUS WASTES UNDER 40CFR PARTS 262-265, 270, 271, AND 124 AND WHICH ARE SUBJECT TO THE NOTIFICATION REQUIREMENTS OF SECTION 3010 OF THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) AND IDENTIFIES ONLY SOME OF THE MATERIALS WHICH ARE HAZARDOUS WASTES UNDER SECTIONS 3007 AND 7003 OF RCRA

ATTACHMENT 2

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  40CFR262  STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE

    ESTABLISHES STANDARDS FOR GENERATORS OF HAZARDOUS WASTE

  40CFR263  STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE

    ESTABLISHES STANDARDS WHICH APPLY TO PERSONS TRANSPORTING HAZARDOUS
  WASTE WITHIN THE UNITED STATES IF THE TRANSPORTATION REQUIRES A MANIFEST
  UNDER 40CFR262


  40CFR264  STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE
  TREATMENT, STORAGE, AND DISPOSAL FACILITIES

    ESTABLISHES MINIMUM NATIONAL STANDARDS WHICH DEFINE THE ACCEPTABLE
  MANAGEMENT OF HAZARDOUS WASTE


  40CFR265  INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS
  WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

    ESTABLISHES MINIMUM NATIONAL STANDARDS WHICH DEFINE THE ACCEPTABLE
  MANAGEMENT OF HAZARDOUS WASTE DURING THE PERIOD OF INTERIM STATUS


  40CFR267  INTERIM STANDARDS FOR OWNERS AND OPERATORS OF NEW HAZARDOUS
  WASTE LAND DISPOSAL FACILITIES

    ESTABLISHES MINIMUM NATIONAL STANDARDS THAT DEFINE THE ACCEPTABLE
  MANAGEMENT OF HAZARDOUS WASTE FOR NEW LAND DISPOSAL FACILITIES


  40CFR270  EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT
  PROGRAM

    ESTABLISHES PROVISIONS FOR THE HAZARDOUS WASTE PERMIT PROGRAM UNDER
  SUBTITLE C OF THE SOLID WASTE DISPOSAL ACT, AS AMENDED BY THE RESOURCE
  CONSERVATION AND RECOVERY ACT


  40CFR271  REQUIREMENT FOR AUTHORIZATION OF STATE HAZARDOUS WASTE
  PROGRAMS

    SPECIFIES THE PROCEDURES EPA WILL FOLLOW IN APPROVING, REVISING, AND
  WITHDRAWING APPROVAL OF STATE PROGRAMS AND THE REQUIREMENTS STATE
  PROGRAMS MUST MEET TO BE APPROVED BY THE ADMINISTRATION UNDER SECTION
  3006(B) OF RCRA


CAS NUMBER
  118-74-1

REGISTRY TOXIC CHEMICALS NUMBER
  DA2975000

BULLETINS

SPECIAL INFORMATION
  DECOMPOSES WHEN HEATED, EVOLVING HIGHLY TOXIC FUMES.
TYPE WHAT INFORMATION YOU REQUIRE
/ALL/, SPECIFIC INFORMATION (BY 4-LETTER COMMAND, /HELP/, OR /NONE/.
```

ATTACHMENT 2

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  40CFR265  INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS
  WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

    ESTABLISHES MINIMUM NATIONAL STANDARDS WHICH DEFINE THE ACCEPTABLE
  MANAGEMENT OF HAZARDOUS WASTE DURING THE PERIOD OF INTERIM STATUS


  40CFR267  INTERIM STANDARDS FOR OWNERS AND OPERATORS OF NEW HAZARDOUS
  WASTE LAND DISPOSAL FACILITIES

    ESTABLISHES MINIMUM NATIONAL STANDARDS THAT DEFINE THE ACCEPTABLE
  MANAGEMENT OF HAZARDOUS WASTE FOR NEW LAND DISPOSAL FACILITIES


  40CFR270  EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT
  PROGRAM

    ESTABLISHES PROVISIONS FOR THE HAZARDOUS WASTE PERMIT PROGRAM UNDER
  SUBTITLE C OF THE SOLID WASTE DISPOSAL ACT, AS AMENDED BY THE RESOURCE
  CONSERVATION AND RECOVERY ACT


  40CFR271  REQUIREMENT FOR AUTHORIZATION OF STATE HAZARDOUS WASTE
  PROGRAMS

    SPECIFIES THE PROCEDURES EPA WILL FOLLOW IN APPROVING, REVISING, AND
  WITHDRAWING APPROVAL OF STATE PROGRAMS AND THE REQUIREMENTS STATE
  PROGRAMS MUST MEET TO BE APPROVED BY THE ADMINISTRATION UNDER SECTION
  3006(B) OF RCRA


CAS NUMBER
  58-89-9

REGISTRY TOXIC CHEMICALS NUMBER
  GV4900000

BULLETINS

SPECIAL INFORMATION
TYPE WHAT INFORMATION YOU REQUIRE
/ALL/, SPECIFIC INFORMATION (BY 4-LETTER COMMAND), /HELP/, OR /NONE/.
```

ATTACHMENT 2

A. Action Levels (See Item 20)

The HNU photoionization detector will be used to measure hydrocarbons (HC) as an indicator of potential airborne contamination in the vicinity of the drilling operations.

- HC action limit for breathing zone samples is 5 ppm

- If breathing zone in drilling area has greater than 5 ppm HC, the team will move upwind and notify other site occupants to move upwind. Both upwind and downwind HNU readings will then be obtained.

- If downwind readings persist above 5 ppm HC for a period of more than 15 minutes, notify the Police Department to consider evacuating residents adjacent to the site. Assist police in defining safe downwind distance. Remediation could include covering the borehole, wetting down the contaminated area to supress dust air suspension, etc. A SCBA could be used for this activity as deemed necessary bythe Site Safety Officer.

- If downwind readings are below 5 ppm HC, check borehole area for breathing zone levels. If the borehole area breathing zone level is less than 5 ppm boring activities may be resumed, using prescribed protective equipment.

B. Protective Equipment (See Items 20 and 21)

Personnel within the exclusion area (Zone 1, Attachment 1) will be required, at a minimum, to wear:

- Hardhat
- Safety goggles with hooded vents
- Half mask respirator with organic vapor (OV) cartridges and dust and mist filters (Respirator cartridges or disposable respirators to be changed daily)
- Long sleeve cotton/polyester coveralls
- Gauntlet length neoprene gloves
- Steel toe/steel shank rubber boots

The safety officer may designate impermeable clothing (such as polyethelene coated tyvek suits or PVC rainsuits) and face shields be worn if liquid waste or precipitation are encountered.

If, in the judgement of the site safety officer (and in conjunction with the State DEC/DOL on site representative) heat stress concerns or symptoms (Table 1) are encountered, alternative protective clothing such as breathable tyvek suits may be selected.

C. Ambient Air Sampling

Six Ambient air samples will be collected for analysis of airborne BHC and HCB particulates. One sample set (one upwind sample and one downwind sample) will be collected prior to any intrusive activities. Two other sample sets will be collected in a similar fashion, one set during each of the two weeks of intrusive activities. Samples will be collected using a 2 liter/min flow rate. Filters will be digested and analyzed for BHC and HCB.

Table 1

Heat Stress Symptoms and Interventions

Disorder	Symptom	Treatment
Heat cramps	Painful muscle spasms	Rest Replace fluids and salt
Heat syncope	Fainting	Remove from heat
Heat exhaustion	Weakness Pale, cool skin Rapid pulse Decreased blood pressure	Remove from heat Replace fluids and salt Rest
Stroke	Fever, skin hot and dry Red complexion Elevated blood pressure Rapid pulse	Immediate removal from heat Bathe to reduce temperature Treat as an emergency

DECONTAMINATION PROCEDURES

Personnel

1. Details of the decontamination corridor are shown on Attachment 1A. Personnel will enter the contamination reduction corridor (Zone 2) at the north end when entering the site. All personnel entering the investigation area (Zone 1) must pass through this zone and be equipped with the proper safety equipment. New or cleaned Personal Protective equipment will be on (under for boots) the northern most table. Upon completion of suitup, individuals may cross the "hot line", pass the decontamination stations, and enter the site through the access control point at the south end.

   At the end of each work period (before eating, drinking, smoking, or leaving the site) each person who has entered the investigation area (Zone 1) will decontaminate by passing through the contamination reduction corridor (Zone 2). Each of the following stations will be entered and used as appropriate.

   - Equipment/Tool drop station
   - Boot Wash - soiled boots will be washed in a tub containing a detergent solution
   - Boot rinse - personnel will step into a tub containing rinse water after washing boots
   - Glove wash - Intact gloves will be wiped clean over a glove wash bucket containing detergent and water

- Glove rinse - washed gloves will be rinsed with water or wiped with a water wet towel

- Used work clothes will be dropped into a bag lined garbage can

- Spent disposal respirators or cartridges will be dropped into a bag lined garbage can

- Clean boots will be placed under the work table at the north end.

- Clean respirators, hardhats, goggles, and face shields will be placed onto the work table at the north end

- Personnel may then exit the north access control point.

2. Before leaving the site, personnel will change work clothes in the contamination reduction corridor over the concrete slab in an area protected by a plastic curtain on side walls. Work clothes will be placed into plastic bags for delivery to an approved laundry. Work clothes will be laundered daily.

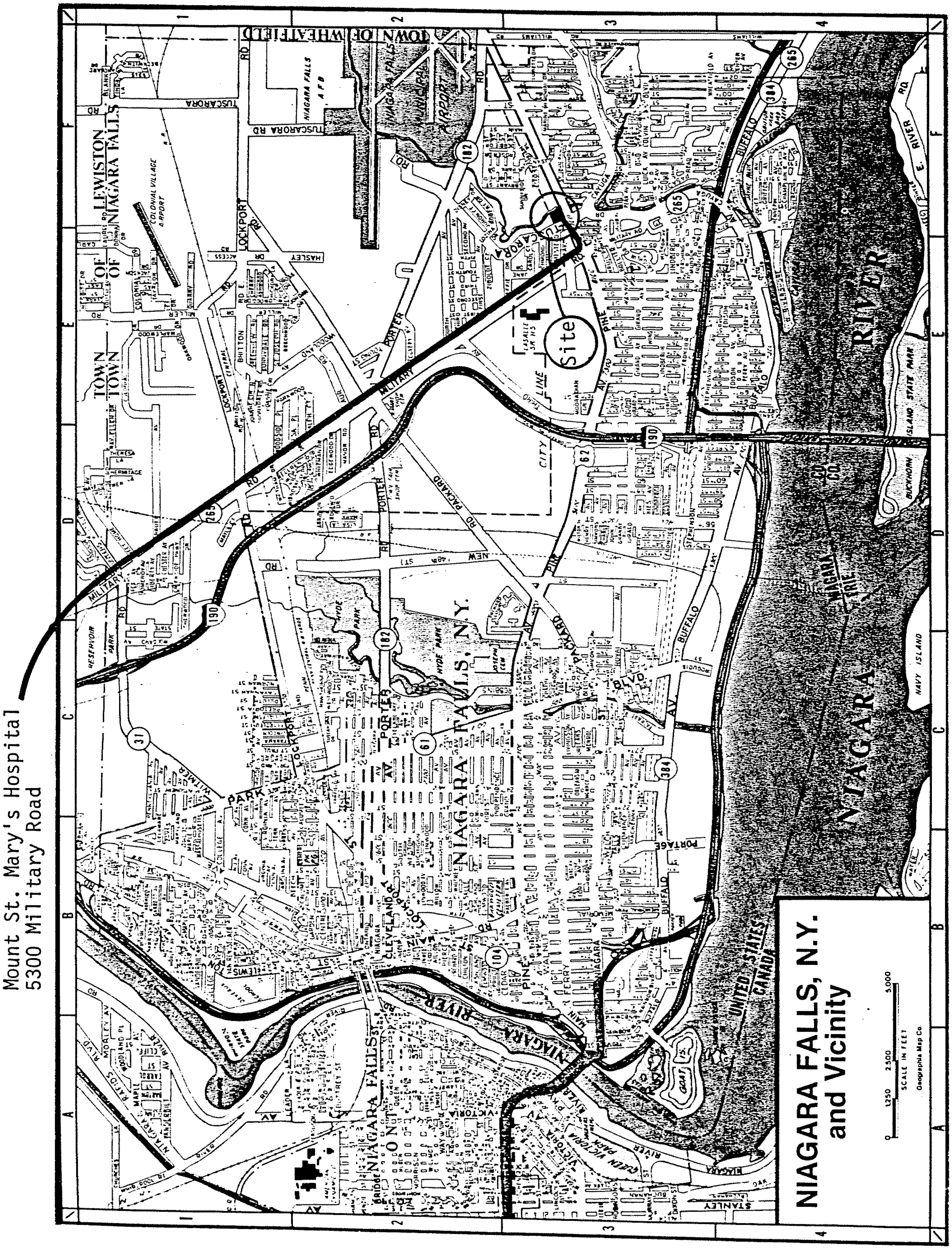
3. Soiled boots, hardhats, respirators, etc., will be inspected daily and, if necessary, washed and scrubbed in detergent and water. After cleaning, equipment shall be rinsed thoroughly in water and allowed to dry on a clean surface.

4. All disposable work clothes (if utilized), soiled gloves, and wash water will be collected and disposed of daily in 55-gallon drums. After inspection and cleaning, other items left at the site will be properly stored in a designated area.

5. Personnel will shower as soon as possible at the end of the work day.

Equipment

1. Prior to drilling equipment demobilization, loose mud will be removed using brushes and scrapers and equipment will be steam cleaned over polyethylene sheets. The perimeter of the sheeting will be elevated using formwork.
2. Polyethelene sheeting, mud, and wash water will be placed in drums for subsequent disposal. Liquids may be pumped directly into drums or mixed with absorbant materials as deemed appropriate by the project manager.
3. After each well installation, augers and tools will be cleaned similarly to the process described above.



Route to Hospital

ATTACHMENT

5

APPENDIX D

ANALYTICAL TEST METHODS

For BHC/HCB in particulate matter.

(1) ALDRIN AND (2) LINDANE

FORMULA: (1) $C_{12}H_8Cl_6$ (Aldrin);
(2) $C_6H_6Cl_6$ (Lindane)
M.W.: (1) 364.93; (2) 290.85

METHOD: 5502
ISSUED: 2/15/84

	(1)	(2)
OSHA:	0.5 mg/m³ (skin)	0.25 mg/m³ (skin)
NIOSH:	Group I Pesticides [1]	
ACGIH:	0.5 mg/m³ (skin)	0.25 mg/m³ (skin)

PROPERTIES: (1): solid; MP 104 °C; VP 0.008 Pa (6×10^{-6} mm Hg; 0.12 mg/m³) @ 20 °C
(2): solid; MP 1125 °C; VP 0.0013 Pa (9.4×10^{-6} mm Hg; 0.15 mg/m³) @ 20 °C

SYNONYMS: (1) Aldrin: Octalene; CAS #309-00-2.
(2) Lindane: gamma-hexachlorocyclohexane; CAS #58-89-9.

SAMPLING

SAMPLER: FILTER AND BUBBLER (glass fiber + 15 mL isooctane)

FLOW RATE: 0.2 to 1 L/min

VOL-MIN: 18 L @ 0.25 mg/m³ of (1) or (2)
-MAX: 240 L

SHIPMENT: transfer bubbler solutions and filters in scintillation vials; pack carefully

SAMPLE STABILITY: at least 1 week @ 25 °C

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: (1): 0.15 to 0.5 mg/m³ [2];
(2): 0.3 to 1.7 mg/m³ [2]

BIAS: not significant [2]

OVERALL PRECISION (s_r): (1): 0.092 [2];
(2): 0.086 [2]

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, ELECTROLYTIC CONDUCTIVITY DETECTOR

ANALYTE: Aldrin, Lindane

FILTER EXTRACTION: isooctane

INJECTION VOLUME: 15 µL

TEMPERATURE-FURNACE: 750 to 770 °C
-TRANSFER: 225 °C
-VENT: 205 to 260 °C
-COLUMN: 160 to 190 °C

GASES-H_2 (furnace): 150 to 160 mL/min
-N_2 (carrier): 140 mL/min

COLUMN: glass, 1.2 m x 3 mm OD; 5% SE-30 on 80/100 mesh acid-washed DMCS Chromosorb W or equivalent

CALIBRATION: solution of analyte in isooctane

RANGE: 5 to 135 µg per sample

ESTIMATED LOD: 3 µg (1) or (2) per sample

PRECISION (s_r): (1): 0.012 [2]; (2) 0.013 [2]

APPLICABILITY: The working range is 0.05 to 1.5 mg/m³ of either pesticide for a 90-L air sample. Evaporation of isooctane from the bubbler necessitates refilling the bubbler frequently.

INTERFERENCES: None identified.

OTHER METHODS: This method combines and replaces S275 [3] and S290 [3]. Lindane has also been sampled with a filter-solid sorbent train [4].

REAGENTS:
1. Aldrin, reagent grade.*
2. Lindane, reagent grade.*
3. Isooctane, chromatographic grade.
   NOTE: Needed for field use in sample collection.
4. Benzene, reagent grade.*
5. Calibration stock solution, 10 mg/mL. Dissolve 0.1 g accurately weighed Aldrin or Lindane in 1:5 (v:v) benzene:isooctane; dilute to 10 mL. Stable at least one week.
6. Hydrogen, prepurified.
7. Nitrogen, purified.

*See Special Precautions.

EQUIPMENT:
1. Sampler: glass fiber filter, organic binder-free (e.g., Gelman Type A/E), 37-mm, held without backup pad in a two-piece polystyrene cassette filter holder connected in series with a midget bubbler containing 15 mL of the collection medium.
   NOTE: a. Do not use filter holders made of Tenite.
   b. Place glass tube, 5 cm x 6 mm ID, plugged with glass wool between the exit cover of the bubbler and the inlet of the personal sampling pump to avoid splashover or solvent condensation.
2. Personal sampling pump, 0.2 to 1 L/min, with flexible connecting tubing.
3. Vial, scintillation, with PTFE-lined cap, graduated at 15 mL.
4. Gas chromatograph with electrolytic conductivity detector, quartz reduction furnace, in-line vent upstream of furnace, integrator and column (page 5502-1).
5. Syringes, 5-, 10- and 25-µL, for making standard solutions and GC injections.
6. Volumetric flasks.
7. Pipets, with pipet bulb.
8. Tweezers.

SPECIAL PRECAUTIONS: Benzene is a suspected human carcinogen; work with it only in a hood.

Aldrin and Lindane are toxic when absorbed through the skin [1].

SAMPLING:
1. Calibrate each personal sampling pump with a representative sampler in line.
2. Add 15 mL isooctane to the bubbler.
3. Sample at 0.5 L/min for 1 to 6 hrs (30 to 180 L).
   NOTE: Check liquid level in the bubbler every 15 min. Maintain between 10 and 15 mL isooctane in the bubbler throughout the sampling period with a volume at the end of sampling of about 10 mL.
4. Remove the bubbler stem and tap it gently against the inside wall of the bubbler to transfer solvent from the stem to the bubbler.
5. Transfer contents of the bubbler to a vial. Rinse the bubbler with 2 mL isooctane. Add the rinse to the vial.
6. Transfer the glass fiber filter to the same vial using tweezers.
7. Cap the vial and pack carefully for shipment.

SAMPLE PREPARATION:

8. Adjust the volume of solution in the vial to 15 mL.

CALIBRATION AND QUALITY CONTROL:

9. Calibrate daily with at least five solutions covering the range 3 to 135 µg Aldrin or Lindane per sample.
   a. Add calibration stock solution with a microliter syringe to 15 mL isooctane in a vial.
   b. Analyze the working standards together with samples and blanks (steps 10 through 13).
   c. Prepare calibration graph (peak area vs. µg Aldrin or Lindane). Analyze three additional quality control blind spikes and three analyst spikes to ensure that the calibration graph is in control.

MEASUREMENT:

10. Set gas chromatograph to manufacturer's specifications and to conditions given on page 5502-1.
11. Mix the contents of the scintillation vial thoroughly.
12. Inject 15 µL sample aliquot using solvent flush technique or autosampler.
    NOTE: Open vent valve for 20 sec, beginning with time of injection, to prevent the solvent peak from entering the furnace.
13. Measure peak area.

CALCULATIONS:

14. Determine the mass, µg, of Aldrin or Lindane found on the sample (filter plus bubbler), W, and average media blank (filter plus bubbler), B, from the measured peak areas and the calibration graph.
15. Calculate the concentration, C (mg/m³), of Aldrin or Lindane in the air volume sampled, V (L):

$$C = \frac{(W - B)}{V}, \text{ mg/m}^3$$

EVALUATION OF METHOD:

Methods S275 (Aldrin) and S290 (Lindane) were issued on February 27, 1976, and March 26, 1976, respectively [3]. The substances used to generate test atmospheres at 25 °C and 760 mm Hg in dry air were Aldrite emulsifiable concentrate (64% Aldrin) and Ortho-Lindane Borer and Leaf Miner Spray [2]. Collection efficiencies and analytical method recoveries were 1.00 for both substances in the range 22 to 90 µg per sample. Sample filters extracted in isooctane immediately and stored one week at ambient conditions gave recoveries of 103% and 102%, respectively. Overall precision, s_r, was 0.092 for Aldrin and 0.086 for Lindane. No significant bias was found for either substance.

REFERENCES:

[1] Criteria for a Recommended Standard...Occupational Exposure During the Manufacture and Formulation of Pesticides, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-174 (1978).
[2] Documentation of the NIOSH Validation Tests, S275 and S290, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977).
[3] NIOSH Manual of Analytical Methods, V. 3, S275 and S290, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).
[4] Hill, R.H. and J.E. Arnold. Arch. Environ. Contam. Toxicol., 8, 621-628 (1979).

METHOD REVISED BY: Gangadhar Choudhary, Ph.D., NIOSH/DPSE; S275 and S290 originally validated under NIOSH Contract CDC-99-74-45.

METHOD 7470

MERCURY (MANUAL COLD-VAPOR TECHNIQUE)

1.0 Scope and Application

1.1 Method 7470 is a cold-vapor atomic absorption procedure approved for determining the concentration of mercury in mobility procedure extracts, aqueous wastes and groundwaters. (Method 7470 can also be used for analyzing certain solid and sludge-type wastes; however, Method 7471 is usually the method of choice for these waste types.) All samples must be subjected to an appropriate dissolution step prior to analysis.

2.0 Summary of Method

2.1 Prior to analysis, the samples must be prepared according to the procedure discussed in this method.

2.2 Method 7470, a cold-vapor atomic absorption technique, is based on the absorption of radiation at 253.7 nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

2.3 The typical detection limit for this method is 0.0002 mg/l.

3.0 Interferences

3.1 Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/l of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from Type II water.

3.2 Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/l had no effect on recovery of mercury from spiked samples.

3.3 Seawaters, brines and industrial effluents high in chlorides require additional permanganate (as much as 25 ml) since, during the oxidation step, chlorides are converted to free chlorine which also absorbs radiation of 253 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 ml). In addition, the dead air space in the BOD bottle must be purged before adding stannous sulfate. Both inorganic and organic mercury spikes have been quantitatively recovered from seawater using this technique.

METHOD 7470

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3.4 Certain volatile organic materials that absorb at this wavelength may also cause interference. A preliminary run without reagents should determine if this type of interference is present.

4.0 Apparatus and Materials

4.1 Atomic absorption spectrophotometer or equivalent: Any atomic absoption unit having an open sample presentation area in which to mount the absorption cell is suitable. Instrument settings recommended by the particular manufacturer should be followed. Instruments designed specifically for the measurement of mercury using the cold-vapor technique are commercially available and may be substituted for the atomic absorption spectrophotometer.

4.2 Mercury hollow cathode lamp or electrodeless discharge lamp.

4.3 Recorder: Any multirange variable speed recorder that is compatible with the UV detection system is suitable.

4.4 Absorption cell: Standard spectrophotometer cells 10 cm long having quartz end windows may be used. Suitable cells may be constructed from plexiglass tubing, 1 in. O.D. x 4.5 in. The ends are ground perpendicular to the longitudinal axis and quartz windows (1 in. diameter x 1/16 in. thickness) are cemented in place. The cell is strapped to a burner for support and aligned in the light beam by use of two 2-in. x 2-in. cards. One-in.-diameter holes are cut in the middle of each card. The cards are then placed over each end of the cell. The cell is then positioned and adjusted vertically and horizontally to give the maximum transmittance.

4.5 Air pump: Any peristaltic pump capable of delivering 1 liter air/min may be used. A Masterflex pump with electronic speed control has been found to be satisfactory.

4.6 Flowmeter: Capable of measuring an air flow of 1 liter/min.

4.7 Aeration tubing: A straight glass frit having a coarse porosity. Tygon tubing is used for passage of the mercury vapor from the sample bottle to the absorption cell and return.

4.8 Drying tube: 6-in. x 3/4-in.-diameter tube containing 20 g of magnesium perchlorate or a small reading lamp with 60-W bulb which may be used to prevent condensation of moisture inside the cell. The lamp should be positioned to shine on the absorption cell so that the air temperature in the cell is about 10° C above ambient.

4.9 The cold-vapor generator is assembled as shown in Figure 1.

4.10 The apparatus shown in Figure 1 is a closed system. An open system, where the mercury vapor is passed through the absorption cell only once, may be used instead of the closed system.

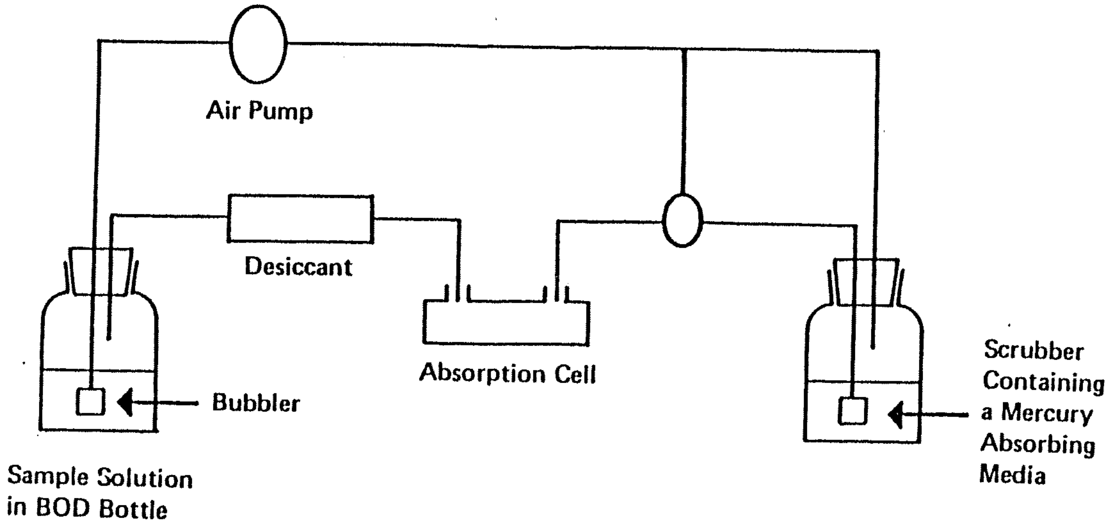

Figure 1. Apparatus for flameless mercury determination.

4.11 Because mercury vapor is toxic, precaution must be taken to avoid its inhalation. Therefore, a bypass has been included in the system to either vent the mercury vapor into an exhaust hood or pass the vapor through some absorbing media, such as:

1. equal volumes of 0.1 M $KMnO_4$ and 10% H_2SO_4
2. 0.25% iodine in a 3% KI solution

A specially treated charcoal that will adsorb mercury vapor is also available from Barnebey and Cheney, E. 8th Ave. and N. Cassidy St., Columbus, Ohio 43219, Cat. #580-13 or #580-22.

5.0 Reagents

5.1 ASTM Type II water (ASTM D1193): Water should be monitored for impurities.

5.2 Sulfuric acid, conc.: Reagent grade.

5.3 Sulfuric acid, 0.5 N: Dilute 14.0 ml of conc. sulfuric acid to 1.0 liter.

5.4 Nitric acid, conc.: Reagent grade of low mercury content. If a high reagent blank is obtained, it may be necessary to distill the nitric acid.

5.5 Stannous sulfate: Add 25 g stannous sulfate to 250 ml of 0.5 N sulfuric acid. This mixture is a suspension and should be stirred continuously during use. (Stannous chloride may be used in place of stannous sulfate.)

5.6 Sodium chloride-hydroxylamine sulfate solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate in Type II water and dilute to 100 ml. (Hydroxylamine hydrochloride may be used in place of hydroxylamine sulfate.)

5.7 Potassium permanganate, 5% solution (w/v): Dissolve 5 g of potassium permanganate in 100 ml of Type II water.

5.8 Potassium persulfate, 5% solution (w/v): Dissolve 5 g of potassium persulfate in 100 ml of Type II water.

5.9 Stock mercury solution: Dissolve 0.1354 g of mercuric chloride in 75 ml of Type II water. Add 10 ml of conc. HNO_3 and adjust the volume to 100.0 ml (2 ml = 1 mg Hg).

5.10 Mercury working standard: Make successive dilutions of the stock mercury solution to obtain a working standard containing 0.1 µg per ml. This working standard and the dilutions of the stock mercury solution should be prepared fresh daily. Acidity of the working standard should be maintained at 0.15% nitric acid. This acid should be added to the flask as needed before addition of the aliquot.

6.0 Sample Collection, Preservation, and Handling

6.1 All samples must have been collected using a sampling plan that addresses the considerations discussed in Section One of this manual.

6.2 All sample containers must be prewashed with detergents, acids, and Type II water. Plastic and glass containers are both suitable.

6.3 Aqueous samples must be acidified to a pH of less than 2 with nitric acid. The suggested maximum holding times for these samples are 38 days in glass containers and 13 in plastic containers.

6.4 Nonaqueous samples shall be refrigerated when possible, and analyzed as soon as possible.

7.0 Procedure

7.1 Sample preparation: Transfer 100 ml, or an aliquot diluted to 100 ml, containing not more than 1.0 µg of mercury, to a 300-ml BOD bottle. Add 5 ml of sulfuric acid and 2.5 ml of conc. nitric acid, mixing after each addition. Add 15 ml of potassium permanganate solution to each sample bottle. Sewage samples may require additional permanganate. Shake and add additional portions of potassium permanganate solution, if necessary, until the purple color persists for at least 15 min. Add 8 ml of potassium persulfate to each bottle and heat for 2 hr in a water bath maintained at 95° C. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate to reduce the excess permanganate. After a delay of at least 30 sec, add 5 ml of stannous sulfate and immediately attach the bottle to the aeration apparatus and continue as described in Section 7.3.

7.2 Standard preparation: Transfer 0-, 0.5-, 1.0-, 2.0-, 5.0-, and 10.0-ml aliquots of the mercury working standard containing 0 to 1.0 µg of mercury to a series of 300-ml BOD bottles. Add enough Type II water to each bottle to make a total volume of 100 ml. Mix thoroughly and add 5 ml of conc. sulfuric acid and 2.5 ml of conc. nitric acid to each bottle. Add 15 ml of $KMnO_4$ solution to each bottle and allow to stand at least 15 min. Add 8 ml of potassium persulfate to each bottle and heat for 2 hr in a water bath maintained at 95° C. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate solution to reduce the excess permanganate. When the solution has been decolorized, wait 30 sec, add 5 ml of the stannous sulfate solution, and immediately attach the bottle to the aeration apparatus and continue as described in Section 7.3.

7.3 Analysis: At this point the sample is allowed to stand quietly without manual agitation. The circulating pump, which has previously been adjusted to a rate of 1 liter/min, is allowed to run continuously. The absorbance will increase and reach a maximum within 30 sec. As soon as the recorder pen levels off (approximately 1 min), open the bypass valve and continue the aeration until the absorbance returns to its minimum value. Close the bypass valve, remove the stopper and frit from the BOD bottle, and continue the aeration.

7.4 Construct a calibration curve by plotting the absorbance of standards versus micrograms of mercury. Determine the peak height of the unknown from the chart and read the mercury value from the standard curve.

7.5 Analyze, by the method of standard additions, all EP extracts, all samples analyzed as part of a delisting petition, and all samples that suffer from matrix interferences.

7.6 Duplicates, spiked samples, and check standards should be routinely analyzed.

7.7 Calculate metal concentrations by (1) the method of standard additions, or (2) from a calibration curve, or (3) directly from the instrument's concentration readout. All dilution or concentration factors must be taken into account. Concentrations reported for multiphased or wet samples must be appropriately qualified (e.g., 5 µg/g dry weight).

8.0 Quality Control

8.1 All quality control data should be maintained and available for easy reference or inspection.

8.2 Calibration curves must be composed of a minimum of a blank and three standards. A calibration curve should be made for every hour of continuous sample analysis.

8.3 Dilute samples if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.

8.4 Employ a minimum of one blank per sample batch to determine if contamination or any memory effects are occurring.

8.5 Analyze check standards after approximately every 15 samples.

8.6 Run one duplicate sample for every 10 samples. A duplicate sample is a sample brought through the whole sample preparation process.

8.7 Spiked samples or standard reference materials shall be periodically employed to ensure that correct procedures are being followed and that all equipment is operating properly.

8.8 The method of standard additions shall be used for the analysis of all EP extracts, on all analyses submitted as part of a delisting petition, and whenever a new sample matrix is being analyzed.

METHOD 7471

MERCURY IN SOLID OR SEMISOLID WASTE (MANUAL COLD-VAPOR TECHNIQUE)

1.0 Scope and Application

1.1 Method 7471 is approved for measuring total mercury (organic and inorganic) in soils, sediments, bottom deposits, and sludge-type materials. All samples must be subjected to an appropriate dissolution step prior to analysis.

2.0 Summary of Method

2.1 Prior to analysis the samples must be prepared according to the procedures discussed in this method.

2.2 Method 7471, a cold-vapor atomic absorption method, is based on the absorption of radiation at the 253.7-nm wavelength by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

2.3 The typical detection limit for this method is 0.0002 mg/l.

3.0 Interferences

3.1 Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/l of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from Type II water.

3.2 Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/l had no effect on recovery of mercury from spiked samples.

3.3 Seawaters, brines, and industrial effluents high in chlorides require additional permanganate (as much as 25 ml) since, during the oxidation step, chlorides are converted to free chlorine which also absorbs radiation of 253 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 ml). In addition, the dead air space in the BOD bottle must be purged before adding stannous sulfate. Both inorganic and organic mercury spikes have been quantitatively recovered from seawater using this technique.

3.4 Certain volatile organic materials that absorb at this wavelength may also cause interference. A preliminary run without reagents should determine if this type of interference is present.

4.0 Apparatus and Materials

4.1 Atomic absorption spectrophotometer or equivalent: Any atomic absoption unit having an open sample presentation area in which to mount the absorption cell is suitable. Instrument settings recommended by the particular manufacturer should be followed. Instruments designed specifically for the measurement of mercury using the cold-vapor technique are commercially available and may be substituted for the atomic absorption spectrophotometer.

4.2 Mercury hollow cathode lamp or electrodeless discharge lamp.

4.3 Recorder: Any multirange variable speed recorder that is compatible with the UV detection system is suitable.

4.4 Absorption cell: Standard spectrophotometer cells 10 cm long having quartz end windows may be used. Suitable cells may be constructed from plexiglass tubing, 1 in. O.D. x 4.5 in. The ends are ground perpendicular to the longitudinal axis and quartz windows (1 in. diameter x 1/16 in. thickness) are cemented in place. The cell is strapped to a burner for support and aligned in the light beam by use of two 2-in. x 2-in. cards. One-in.-diameter holes are cut in the middle of each card. The cards are then placed over each end of the cell. The cell is then positioned and adjusted vertically and horizontally to give the maximum transmittance.

4.5 Air pump: Any peristaltic pump capable of delivering 1 liter air/min may be used. A Masterflex pump with electronic speed control has been found to be satisfactory.

4.6 Flowmeter: Capable of measuring an air flow of 1 liter/min.

4.7 Aeration tubing: A straight glass frit having a coarse porosity. Tygon tubing is used for passage of the mercury vapor from the sample bottle to the absorption cell and return.

4.8 Drying tube: 6-in. x 3/4-in.-diameter tube containing 20 g of magnesium perchlorate or a small reading lamp with 60-W bulb which may be used to prevent condensation of moisture inside the cell. The lamp should be positioned to shine on the absorption cell so that the air temperature in the cell is about 10° C above ambient.

4.9 The cold-vapor generator is assembled as shown in Figure 1.

4.10 The apparatus shown in Figure 1 is a closed system. An open system, where the mercury vapor is passed through the absorption cell only once, may be used instead of the closed system.

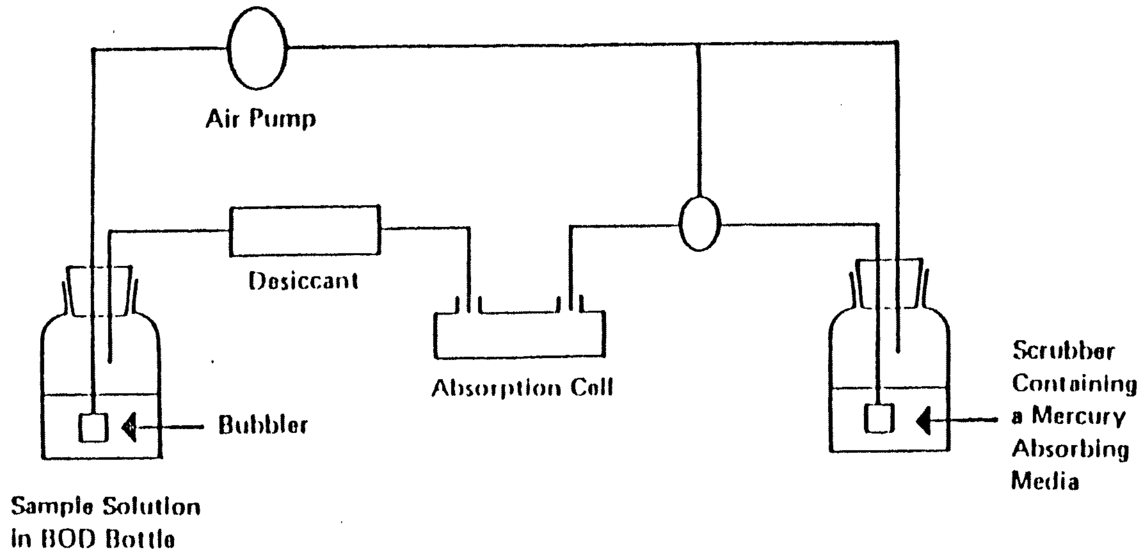

Figure 1. Apparatus for flameless mercury determination.

4.11 Because mercury vapor is toxic, precaution must be taken to avoid its inhalation. Therefore, a bypass has been included in the system to either vent the mercury vapor into an exhaust hood or pass the vapor through some absorbing media, such as:

1. equal volumes of 0.1 M $KMnO_4$ and 10% H_2SO_4
2. 0.25% iodine in a 3% KI solution

A specially treated charcoal that will adsorb mercury vapor is also available from Barnebey and Cheney, E. 8th Ave. and N. Cassidy St., Columbus, Ohio 43219, Cat. #580-13 or #580-22.

5.0 Reagents

5.1 ASTM Type II water (ASTM D1193): Water should be monitored for impurities.

5.2 Aqua regia: Prepare immediately before use by carefully adding three volumes of conc. HCl to one volume of conc. HNO_3.

5.3 Sulfuric acid, 0.5 N: Dilute 14.0 ml of conc. sulfuric acid to 1 liter.

5.4 Stannous sulfate: Add 25 g stannous sulfate to 250 ml of 0.5 N sulfuric acid. This mixture is a suspension and should be stirred continuously during use. A 10% solution of stannous chloride can be substituted for stannous sulfate.

5.5 Sodium chloride-hydroxylamine sulfate solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate in Type II water and dilute to 100 ml. Hydroxylamine hydrochloride may be used in place of hydroxylamine sulfate.

5.6 Potassium permanganate, 5% solution (w/v): Dissolve 5 g of potassium permanganate in 100 ml of Type II water.

5.7 Mercury stock solution: Dissolve 0.1354 g of mercuric chloride in 75 ml of distilled water. Add 10 ml of conc. nitric acid and adjust the volume to 100.0 ml (1.0 ml = 1.0 mg Hg).

5.8 Mercury working standard: Make successive dilutions of the stock mercury solution to obtain a working standard containing 0.1 µg/ml. This working standard and the dilution of the stock mercury solutions should be prepared fresh daily. Acidity of the working standard should be maintained at 0.15% nitric acid. This acid should be added to the flask as needed before adding the aliquot.

6.0 Sample Collection, Preservation, and Handling

6.1 All samples must have been collected using a sampling plan that addresses the considerations discussed in Section One of this manual.

6.2 All sample containers must be prewashed with detergents, acids, and Type II water. Plastic and glass containers are both suitable.

6.3 Aqueous samples must be acidified to a pH of less than 2 with nitric acid.

6.4 For solids or semi-solids, moisture may be driven off in a drying oven at a temperature of 60° C.

7.0 Procedure

7.1 Sample preparation: Weigh triplicate 0.2-g portions of dry sample and place in the bottom of a BOD bottle. Add 5 ml of Type II water and 5 ml of aqua regia. Heat 2 min in a water bath at 95° C. Cool, add 50 ml Type II water and 15 ml potassium permanganate solution to each sample bottle. Mix thoroughly and place in the water bath for 30 min at 95° C. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate to reduce the excess permanganate. Add 55 ml of Type II water. Treating each bottle individually, add 5 ml of stannous sulfate and immediately attach the bottle to the aeration apparatus. Continue as described under 7.4.

7.2 An alternate digestion procedure employing an autoclave may also be used. In this method, 5 ml of conc. H_2SO_4 and 2 ml of conc. HNO_3 are added to the 0.2 g of sample. Add 5 ml of saturated $KMnO_4$ solution and cover the bottle with a piece of aluminum foil. The samples are autoclaved at 121° C and 15 lb for 15 min. Cool, dilute to a volume of 100 ml with Type II water and add 6 ml of sodium chloride-hydroxylamine sulfate solution to reduce the excess permanganate. Purge the dead air space and continue as described under 7.4.

7.3 Standard preparation: Transfer 0.0-, 0.5-, 1.0-, 2.0-, 5.0-, and 10-ml aliquots of the mercury working standard containing 0 to 1.0 µg of mercury to a series of 300-ml BOD bottles. Add enough Type II water to each bottle to make a total volume of 10 ml. Add 5 ml of aqua regia and heat 2 min in a water bath at 95° C. Allow the sample to cool and add 50 ml Type II water and 15 ml of $KMnO_4$ solution to each bottle and return to the water bath for 30 min. Cool and add 6 ml of sodium chloride-hydroxylamine sulfate solution to reduce the excess permanganate. Add 50 ml of Type II water. Treating each bottle individually, add 5 ml of stannous sulfate solution and immediately attach to bottle to the aeration apparatus and continue as described in Section 7.4.

7.4 Analysis: At this point, the sample is allowed to stand quietly without manual agitation. The circulating pump, which has previously been adjusted to a rate of 1 liter/min, is allowed to run continuously. The absorbance, as exhibited either on the spectrophotometer or the recorder, will increase and reach maximum within 30 sec. As soon as the recorder pen levels off (approximately 1 min), open the bypass valve and continue the aeration until the absorbance returns to its minimum value. Close the bypass value, remove the fritted tubing from the BOD bottle, and continue the aeration.

7.5 Construct a calibration curve by plotting the absorbance of standards versus micrograms of mercury. Determine the peak height of the unknown from the chart and read the mercury value from the standard curve.

7.6 Analyze, by the method of standard additions, all EP extracts, all samples analyzed as part of a delisting petition, and all samples that suffer from matrix interferences.

7.7 Duplicates, spiked samples, and check standards should be routinely analyzed.

7.8 Calculate metal concentrations by (1) the method of standard additions, or (2) from a calibration curve, or (3) directly from the instrument's concentration readout. All dilution or concentration factors must be taken into account. Concentrations reported for multiphased or wet samples must be appropriately qualified (e.g., 5 µg/g dry weight).

8.0 Quality Control

8.1 All quality control data should be maintained and available for easy reference or inspection.

8.2 Calibration curves must be composed of a minimum of a blank and three standards. A calibration curve should be made for every hour of continuous sample analysis.

8.3 Dilute samples if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.

8.4 Employ a minimum of one blank per sample batch to determine if contamination or any memory effects are occurring.

8.5 Analyze check standards after approximately every 15 samples.

8.6 Run one duplicate sample for every 10 samples. A duplicate sample is a sample brought through the whole sample preparation process.

8.7 Spiked samples or standard reference materials shall be periodically employed to ensure that correct procedures are being followed and that all equipment is operating properly.

8.8 The method of standard additions shall be used for the analysis of all EP extracts, on all analyses submitted as part of a delisting petition, and whenever a new sample matrix is being analyzed.

NIOSH

MANUAL OF ANALYTICAL METHODS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
Division of Laboratories and Criteria Development

Cincinnati, Ohio 45202

1974

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FORMALDEHYDE IN AIR

Physical and Chemical Analysis Branch

Analytical Method

Analyte:	Formaldehyde	Method No:	P&CAM 125
Matrix:	Air	Range:	0.1 ppm – 2.0 ppm
Procedure:	Spectrophotometric	Precision:	±5%
Date Issued:	9/24/73	Classification:	C (Tentative)
Date Revised:	1/15/74		

1. Principle of the Method

1.1 Formaldehyde reacts with chromotropic acid-sulfuric acid solution to form a purple monocationic chromogen. The absorbance of the colored solution is read in a spectrophotometer at 580 nm and is proportional to the quantity of formaldehyde in the solution (References 11.2, 11.6).

1.2 The chemistry of this color reaction is not known with certainty (Reference 11.3).

2. Range and Sensitivity

2.1 From 0.1 μg/mℓ to 2.0 μg/mℓ of formaldehyde can be measured in the color developed solution.

2.2 A concentration of 0.1 ppm of formaldehyde can be determined in a 25 liter air sample based on an aliquot of 4 mℓ from 20 mℓ of absorbing solution and a difference of 0.05 absorbance unit from the blank.

3. Interferences

3.1 The chromotropic acid procedure has very little interference from other aldehydes. Saturated aldehydes give less than 0.01 percent positive interference, and the unsaturated aldehyde acrolein results in a few percent positive interference. Ethanol and higher molecular weight alcohols and olefins in mixtures with formaldehyde are negative interferences. However, concentrations of alcohols in air are usually much lower than formaldehyde concentrations and, therefore, are not a serious interference.

3.2 Phenols result in a 10 to 20 percent negative interference when present at an 8:1 excess over formaldehyde. They are, however, ordinarily present in the atmosphere at lesser concentrations than formaldehyde and, therefore, are not a serious interference.

3.3 Ethylene and propylene in a 10:1 excess over formaldehyde result in a 5 to 10 percent negative interference and 2-methyl-1,3-butadiene in a 15:1 excess over formaldehyde showed a 15 percent negative interference. Aromatic hydrocarbons also constitute a negative interference (Reference 11.6). It has recently been found that cyclohexanone causes a bleaching of the final color (Reference 11.4).

4. Precision and Accuracy

The method was checked for reproducibility by having three different analysts in three different laboratories analyze standard formaldehyde samples. The results listed in Table 1 agreed within ±5 percent.

TABLE 1

COMPARISON OF FORMALDEHYDE RESULTS FROM THREE LABORATORIES

Micrograms Formaldehyde	Absorbance		
	Lab. 1	Lab. 2	Lab. 3
1	0.057	0.063	0.061
3	0.183	0.175	0.189
5	0.269	0.279	0.262
7	0.398	0.381	0.392
10	0.566	0.547	0.537
20	1.02	0.980	1.07

5. Advantages and Disadvantages

5.1 Effect of Storage – Disadvantage

5.1.1 The absorbance of the reaction product increases slowly on standing. An increase of 3 percent in absorbance was noted after one day standing and an increase of 10 percent after eight days standing (11.6).

5.1.2 No information is available on the effect of storage on the collected air sample.

5.2 **Precision – Advantage.** Results checked for reproducibility agreed within ±5 percent (see Table 1).

6. Apparatus

6.1 **Sampling Equipment.** The sampling unit for the impinger collection method consists of the following components:

6.1.1 A graduated midget impinger containing the absorbing solution or reagent.

6.1.2 A pump suitable for delivering flow rates of 1 liter per minute for 24 hours. The sampling pump is protected from splashover or water condensation by an adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the impinger and the pump.

6.1.3 An integrating volume meter such as a dry gas or wet test meter.

6.1.4 Thermometer.

6.1.5 Manometer.

6.1.6 Stopwatch.

6.2 **Spectrophotometer or Colorimeter.** An instrument capable of measuring the absorbance of the color developed solution at 580 nm.

6.3 Associated laboratory glassware.

7. Reagents

7.1 **Chromotropic Acid Reagent.** Dissolve 0.10 g of 4,5-dihydroxy-2,7-naphthalenedisulfonic acid disodium salt (Eastman Kodak Company, Rochester, New York, Cat. No. P230) in water and dilute to 10 mℓ. Filter if necessary and store in a brown bottle. Make up fresh weekly.

7.2 Concentrated sulfuric acid.

7.3 **Formaldehyde Standard Solution "A"** (1 mg/mℓ). Dilute 2.7 mℓ of 37 percent formalin solution to 1 liter with distilled water. This solution must be standardized as described in Section 9.1. The solution is stable for at least a 3-month period. Alternatively sodium formaldehyde bisulfite (Eastman Kodak Company, Cat. No. P6450) can be used as a primary standard (Reference 11.4). Dissolve 4.4703 g in distilled water and dilute to 1 liter.

7.4 **Formaldehyde Standard Solution "B"** (10 μg/mℓ). Dilute 1 mℓ of standard solution "A" to 100 mℓ with distilled water. Make up fresh daily.

7.5 **Iodine, 0.1 N** (approximate). Dissolve 25 g of potassium iodide in about 25 mℓ of water, add 12.7 g of iodine and dilute to 1 liter.

7.6 **Iodine, 0.01 N.** Dilute 100 mℓ of the 0.1 N iodine solution to 1 liter. Standardize against sodium thiosulfate.

7.7 **Starch Solution, 1 Percent.** Make a paste of 1 g of soluble starch and 2 mℓ of water and slowly add the paste to 100 mℓ of boiling water. Cool, add several mℓ of chloroform as a preservative, and store in a stoppered bottle. Discard when a mold growth is noticeable.

7.8 **Sodium Carbonate Buffer Solution.** Dissolve 80 g of anhydrous sodium carbonate in about 500 mℓ of water. Slowly add 20 mℓ of glacial acetic acid and dilute to 1 liter.

7.9 **Sodium Bisulfite, 1 Percent.** Dissolve 1 g of sodium bisulfite in 100 mℓ of water. It is best to prepare a fresh solution weekly.

8. Procedure

8.1 **Cleaning of Equipment.** Care must be exercised to ensure the absence of probable contaminants like organic materials that can be charred by concentrated sulfuric acid. Soaking glassware for one hour in a 1:1 mixture of nitric and sulfuric acids, followed by thorough rinsing with double-deionized water will remove all possible organic contaminants.

8.2 Collection and Shipping of Samples

8.2.1 Pour 20 mℓ of the absorbing solution (distilled water) into each graduated midget impinger.

8.2.2 Connect two impingers in series to the vacuum pump (via the absorption tube) and the prefilter assembly (if needed) with short pieces of flexible tubing. The minimum amount of tubing necessary to make the joint between the prefilter and impingers should be used. The air being sampled should not be passed through any other tubing or other equipment before entering the impingers.

8.2.3 It has been recommended that two impingers must be used in series because under conditions of sampling, the collection efficiency of only one impinger is approximately 80 percent. With two impingers in series the total collection efficiency is approximately 95 percent. The contents of each impinger should be analyzed separately.

8.2.4 Turn on pump to begin sample collection. Care should be taken to measure the flow rate, time and/or volume as accurately as possible. The sample should be taken at a flow rate of 1 ℓpm for one hour. (References 11.1, 11.5). These conditions give a total of 60 liters of air that is drawn through the system. However, a shorter sampling time can be used providing enough formaldehyde is collected to be above the lower limit of sensitivity of the method.

8.2.5 After sampling, the impinger stem can be removed and cleaned. Tap the stem gently against the inside wall of the impinger bottle to recover as much of the sampling solution as possible. Wash the stem with a small amount (1-2 mℓ) of unused absorbing solution and add the wash to the impinger. Then the impinger is sealed with a hard, non-reactive stopper (preferably Teflon). Do not seal with rubber. The stoppers on the impingers should be tightly sealed to prevent leakage during shipping. If it is preferred to ship the impingers with the stems in, the outlets of the stem should be sealed with Parafilm or other non-rubber covers, and the ground glass joints should be sealed (i.e., taped) to secure the top tightly.

8.2.6 Care should be taken to minimize spillage or loss by evaporation at all times. Refrigerate samples if analysis cannot be done within a day.

8.2.7 Whenever possible, hand delivery of the samples is recommended. Otherwise, special impinger shipping cases designed by NIOSH should be used to ship the samples.

8.2.8 A "blank" impinger should be handled as the other samples (fill, seal and transport) except that no air is sampled through this impinger.

8.3 Analysis

8.3.1 Transfer the sample from each impinger to either a 25 mℓ- or 50 mℓ-graduate. Note the volume of each solution.

8.3.2 Pipet a 4 mℓ aliquot from each of the sampling solutions into glass stoppered test tubes. A blank containing 4 mℓ of distilled water must also be run. If the formaldehyde content of the aliquot exceeds the limit of the method, a smaller aliquot diluted to 4 mℓ with distilled water is used.

8.3.3 Add 0.1 mℓ of 1 percent chromotropic acid reagent to the solution and mix.

8.3.4 To the solution pipette slowly and cautiously 6 mℓ of concentrated sulfuric acid. The solution becomes extremely hot during the addition of the sulfuric acid. If the acid is not added slowly, some loss of sample could occur due to spattering.

8.3.5 Allow to cool to room temperature. Read at 580 nm in a suitable spectrophotometer using a 1 cm cell. No change in absorbance was noted over a 3 hour period after color development. Determine the formaldehyde content of the sampling solution from a curve previously prepared from standard formaldehyde solutions.

8.3.6 During the analysis procedure, it is good practice to group together the two impingers from each sampling series and label them as "A" and "B." The formaldehyde content calculated in "A" is added to that calculated in "B" to give the total amount in the sampled atmosphere by the impingers in series.

9. Calibration and Standards

9.1 Standardization of Formaldehyde Solution

9.1.1 Pipette 1 mℓ of formaldehyde standard solution "A" into an iodine flask. Into another flask pipette 1 mℓ of distilled water. This solution serves as the blank.

9.1.2 Add 10 mℓ of 1 percent sodium bisulfite and 1 mℓ of 1 percent starch solution.

9.1.3 Titrate with 0.1 N iodine to a dark blue color.

9.1.4 Destroy the excess iodine with 0.05 N sodium thiosulfate.

9.1.5 Add 0.01 N iodine until a faint blue end point is reached.

9.1.6 The excess inorganic bisulfite is now completely oxidized to sulfate, and the solution is ready for the assay of the formaldehyde bisulfite addition product.

9.1.7 Chill the flask in an ice bath and add 25 mℓ of chilled sodium carbonate buffer. Titrate the liberated sulfite with 0.01 N iodine, using a microburette, to a faint blue end point. The amount of iodine added in this step must be accurately measured and recorded.

9.1.8 One mℓ of 0.0100 N iodine is equivalent to 0.15 mg of formaldehyde. Therefore, since 1 mℓ of formaldehyde standard solution was titrated, the mℓ of 0.01 N iodine used in the final titration multiplied by the factor, 0.15, gives the formaldehyde concentration of the standard solution in mg/mℓ.

9.1.9 The factor, 0.15, must be adjusted or determined accordingly on the basis of the exact normality of the iodine solution.

9.2 Preparation of Standard Curve

9.2.1 Pipet 0, 0.1, 0.3, 0.5, 0.7, 1.0, and 2.0 mℓ of standard solution "B" into glass stoppered test tubes.

9.2.2 Dilute each standard to 4 mℓ with distilled water.

9.2.3 Develop the color as described in the analysis procedure (Section 8.3).

9.2.4 Plot absorbance against micrograms of formaldehyde in the color developed solution. Note that the microgram concentration of the formaldehyde is determined based on the standardization value of solution A.

10. Calculations

10.1 Convert the volume of air sampled (V) to the volume of air at standard conditions (V_s) of 760 mm of mercury and 25°C, using the correction formula:

$$V_s = V \times \frac{P}{760} \times \frac{298}{(T + 273)}$$

where:

V_s = volume of air in liters at standard conditions
V = volume of air sampled in liters
P = barometric pressure in mm of mercury
T = temperature of sample air, °C

10.2 Determine the total concentration (C_t) of formaldehyde present in the two sample impingers in series, A and B.

$$C_t = C_A \times F_A + C_B \times F_B$$

where:

C_t = total µg of formaldehyde in the sample.

C_A and C_B = respective formaldehyde concentration in µg of the sample aliquots taken from impingers A and B as determined from the calibration curve

F_A and F_B = respective aliquot factor; $\dfrac{\text{sampling soln. vol. in m}\ell}{\text{m}\ell\text{ aliquot used}}$

10.3 The concentration of formaldehyde in the sampled atmosphere may be calculated by using the following equation, assuming standard conditions are taken as 760 mm of mercury and 25°C:

$$\text{ppm (volume)} = \frac{C_t \times 24.47}{V_s \times \text{M.W.}}$$

where:

V_s = liters of air sampled at standard conditions

M.W. = molecular weight of formaldehyde (30.03)

24.47 = µℓ of formaldehyde gas in one micromole at 760 mm Hg and 25°C.

11. References

11.1 Altshuller, A.P.; L.J. Leng; and A.F. Wartburg, "Source and Atmospheric Analyses for Formaldehyde by Chromotropic Acid Procedure," Int. J. Air Wat. Poll, 6, 381 (1962).

11.2 Eegriwe, E., "Reaktionen and Reagenzien zum Nachweis Organischer Verbindungen IV," Z Anal Chem, 110, 22 (1937).

11.3 Feigl, F., *Spot Tests in Organic Analysis,* Seventh Ed., American Elsevier Publishing Company, New York, 434, (1966).

11.4 Feldstein, M. (Bay Area Air Pollution Control District) Personal Communication, March 1968.

11.5 MacDonald, W.E., "Formaldehyde in Air – A Specific Field Test," Amer Ind Hyg Assoc Quarterly, 15, 217 (1954).

11.6 Sleva, S.F., "Determination of Formaldehyde: Chromotropic Acid Method. Selected Methods for the Measurement of Air Pollutants," Public Health Service Publication No. 999-AP-11, H-1, 1965.

11.7 Treadwell and Hall, Analytical Chemistry, Vol. II, Ninth English Edition. John Wiley & Sons, Inc., New York, p. 590, 1951.

11.8 Treadwell and Hall, Analytical Chemistry, Vol. II, Ninth English Edition. John Wiley & Sons, Inc., New York, p. 588, 1951.

Inter-Office Correspondence

CC: D. M. Haile
Brent Huntsman
Tom Hoogheem

DATE : September 8, 1981

SUBJECT : FORMALDEHYDE IN WATER ANALYTICAL METHODOLOGY

REFERENCE :

TO : H. W. Nowick - 1870
Springfield Plant

The proposed analytical method(1) for field sampling and analysis of formaldehyde in water is as follows:

Reagents:

1) Chromotropic Acid Reagent: Dissolve 0.1g of 4,5 dihydroxy-2,7-naphthalenedisulfonic acid disodium salt in deionized/distilled water and dilute to 10 ml. (Make fresh weekly, store in a brown bottle.)

2) Concentrated Sulfuric Acid.

2) 1 mg/ml Standard Solution: Dissolve 4.4703 g of sodium formaldehyde bisulfite in 1L of deionized/distilled water. More dilute standards are made from serial dilutions of this solution. = 1000 ppm

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(1) NIOSH Analytical Method #P&CAM 125

Analysis:

1) Accurately pipet 4.0 ml of the solution to be analyzed into a teflon lined screw cap test tube (15 ml or larger).

2) Add 0.1 ml of the 1 percent chromotropic acid reagent to the solution and mix.

3) To this solution, add 6 ml of concentrated sulfuric acid cautiously.

4) Allow this solution to cool to room temperature and read at 580 nm in a suitable spectrophotometer. Determine the formaldehyde content of the samples from a curve previously prepared from standard formaldehyde solutions.

The spectrophotometer used for field work is a mini-portable spec-20. Calibrated repipets are used for sample and reagent dispensing in the field.

J. E. Boller

J. E. Boller

JEB/bi

APPENDIX E

ANALYTICAL TEST RESULTS - WATER SAMPLES (PRIORITY POLLUTANTS)

O'BRIEN & GERE

Laboratory Report

CLIENT Harding, Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Wells

DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED

DESCRIPTION		MW 1	MW 2	MW 3	MW 4	MW 4A	MW 5	MW 6
SAMPLE #		24	25	26	27	30	31	32
Antimony	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	ppm	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beryllium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	ppm	0.04	0.02	0.09	<0.01	<0.01	<0.01	0.03
Lead	ppm	<0.01	<0.01	<0.01	0.09	<0.01	<0.01	0.05
Mercury	ppm	<0.0005	0.0011	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel	ppm	<0.01	0.31	0.11	0.06	0.06	0.04	0.07
Selenium	ppm	<0.01	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	ppm	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01
Thallium	ppm	<1.	<1.	<1.	<1.	<1.	<1.	<1.
Zinc	ppm	0.86	18.5	0.22	20.9	20.0	6.1	1.7
Formaldehyde	ppm	0.5	0.1	0.18	0.24	0.25	0.24	0.25

Methodology: Federal Register — 40 CFR, Part 136, December 3, 1979

Comments:

Authorized:

Date: 1/17/86

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd / Syracuse, NY / 13221 / (315) 451-4700

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #1

SAMPLE NO. 24 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 12-10-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized: OCT

Date: 1/15/86

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #1

SAMPLE NO. 24 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-11-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	104%
2-Bromo-1-chloropropane	87%
Trifluorotoluene	87%

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #1

SAMPLE NO. 24 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	0.7	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	1.3	Endosulfan Sulfate	<0.2
Heptachlor	<0.5	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.1

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #2

SAMPLE NO. 25 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 12-10-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<01	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

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Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #2

SAMPLE NO. 25 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-11-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	98%
2-Bromo-1-chloropropane	99%
Trifluorotoluene	97%

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #2

SAMPLE NO. 25 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	0.1	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	<0.1	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.5

Authorized:

Date: 12-16-85

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #3

SAMPLE NO. 26 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 12-10-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/7/86

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #3

SAMPLE NO. 26 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	8.7	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	2.1	Endosulfan Sulfate	<0.2
Heptachlor	<0.5	Endrin Aldehyde	<0.2
δ-BHC	<0.5	Chlordane	<1.0
Aldrin	<0.5	Toxaphene	<5.0
Heptachlor Epoxide	<0.5	PCB-1221	<1.0
Endosulfan I	*	PCB-1232	<1.0
4,4'-DDE	<0.2	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

*Interference

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<1.0

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #3

SAMPLE NO. 26 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-12-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	96%
2-Bromo-1-chloropropane	93%
Trifluorotoluene	90%

Authorized:

Date: 12-17-85

O'Brien & Gere Engineers, Inc.
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O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4

SAMPLE NO. 27 DATE COLLECTED 10/25/85 DATE REC'D. 10/28/85 DATE ANALYZED 12/10/85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4

SAMPLE NO. 27 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-12-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	102%
2-Bromo-1-chloropropane	104%
Trifluorotoluene	96%

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Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517
DESCRIPTION Monitoring Well #4

SAMPLE NO. 27 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	1.1	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	0.2	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<1.0

Authorized:
Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4A

SAMPLE NO. 30 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 12-10-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, December 3, 1979

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4A

SAMPLE NO. 30 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-12-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		<1

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	101%
2-Bromo-1-chloropropane	106%
Trifluorotoluene	96%

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4A

SAMPLE NO. 30 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	1.5	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	0.3	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<1.0

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Assoicates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #5

SAMPLE NO. 31 DATE COLLECTED 10/25/85 DATE REC'D. 10/28/85 DATE ANALYZED 12-10-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #5

SAMPLE NO. 31 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-12-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	100%
2-Bromo 1-Chloro Propane	104%
Trifluorotoluene	103%

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #5

SAMPLE NO. 31 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	4.0	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	0.6	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<1.0

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #6

SAMPLE NO. 32 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 12-10-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50

Authorized:

Date: 1/17/86

O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #6

SAMPLE NO. 32 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 11-12-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	88%
2-Bromo-1-chloropropane	94%
Trifluorotoluene	92%

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Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #6

SAMPLE NO. 32 DATE COLLECTED 10-25-85 DATE REC'D. 10-28-85 DATE ANALYZED 10-31-85

	ppb		ppb
α-BHC	2.5	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	5.2	Endosulfan Sulfate	<0.2
Heptachlor	<1.0	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<1.0

Authorized:

Date: 12-17-85

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O'BRIEN & GERE

Laboratory Report

CLIENT Harding, Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Wells

DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED

DESCRIPTION		MW 1	MW 2	MW 3	MW 4	MW 5	MW 6	Dup./ MW 4	Field Blank
SAMPLE #		26785	26786	26787	26788	26789	26790	26791	26792
Antimony	ppm	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.2	--
Arsenic	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
Beryllium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
Cadmium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
Chromium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	0.28	0.03	--
Copper	ppm	0.07	<0.01	0.08	<0.01	0.07	<0.01	<0.01	--
Leadppm	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
Mercury	ppm	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	--
Nickel	ppm	0.02	0.09	0.06	<0.01	0.03	0.07	<0.01	--
Selenium	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
Silver	ppm	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
Thallium	ppm	<1.	<1.	<1.	<1.	<1.	<1.	<1.	--
Zinc	ppm	9.6	18.8	0.46	22.7	5.4	2.3	20.7	--
Formaldehyde	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	--

Methodology: Federal Register -- 40 CFR, Part 136, December 3, 1979

Comments:

Authorized:

Date: 1/17/86

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O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Wells - MW #1

SAMPLE NO. 26785 DATE COLLECTED 11/22/85 DATE REC'D. 11/22/85 DATE ANALYZED 12/11/85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #1

SAMPLE NO. 26785 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	1.2	Endosulfan II	<0.2
γ-BHC	0.1	4,4'-DDT	<0.2
β-BHC	1.5	Endosulfan Sulfate	<0.2
Heptachlor	<0.5	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.5

Authorized:

Date: 12/17/85

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #1

SAMPLE NO. 26785 DATE COLLECTED 11/22/85 DATE REC'D. 11/22/85 DATE ANALYZED 12/9/85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	90%
2-Bromo-1-chloropropane	91%
Trifluorotoluene	99%

Authorized:

Date: 12/17/85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #2

SAMPLE NO. 26786 DATE COLLECTED 11/22/85 DATE REC'D. 11/22/85 DATE ANALYZED 12/11/85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized: OCT

Date: 1/7/86

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #2

SAMPLE NO. 26786 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	2.5	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	<0.1	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.5

Authorized:

Date: 12-17-85

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #2

SAMPLE NO. 26786 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	100%
2-Bromo-1-chloropropane	113%
Trifluorotoluene	108%

Authorized:

Date: 12-17-85

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O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #3

SAMPLE NO. 26787 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized: OCT

Date: 1/7/86

O'Brien & Gere Engineers, Inc.
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O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #3

SAMPLE NO. 26787 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	1.9	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	0.9	Endosulfan Sulfate	<0.2
Heptachlor	<0.5	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.5

Authorized:

Date: 12-17-85

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #3

SAMPLE NO. 26787 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	104%
2-Bromo-1-chloropropane	103%
Trifluorotoluene	104%

Authorized:

Date: 12-17-85

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O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4

SAMPLE NO. 26788 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date:

O'Brien & Gere Engineers, Inc.
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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring WEll #4

SAMPLE NO. 26788 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	4
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	5	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Xylenes	2

SURROGATE RECOVERIES:

Bromochloromethane	106%
2-Bromo-1-chloropropane	104%
Trifluorotoluene	109%

Authorized:

Date: 12-17-85

O'Brien & Gere Engineers, Inc.
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O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4

SAMPLE NO. 26788 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	0.7	Endosulfan II	<0.2
γ-BHC	<0.1	4,4′-DDT	<0.2
β-BHC	0.1	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4′-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4′-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.5

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #5

SAMPLE NO. 26789 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #5

SAMPLE NO. 26789 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	88%
2-Bromo-1-chloropropane	98%
Trifluorotoluene	103%

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Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #5

SAMPLE NO. 26789 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	0.5	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	0.1	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.1

Authorized:

Date: 12-17-85

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O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #6

SAMPLE NO. 26790 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

Authorized: GCT

Date: 1/17/86

O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #6

SAMPLE NO. 26790 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	99%
2-Bromo-1-chloropropane	104%
Trifluorotoluene	102%

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #6

SAMPLE NO. 26790 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	<0.1	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	7.5	Endosulfan Sulfate	<0.2
Heptachlor	<1.0	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.1

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Authorized:

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4 (Duplicate)

SAMPLE NO. 26791 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates **JOB NO.** 3238.001.517

DESCRIPTION Monitoring Well #4 (Duplicate)

SAMPLE NO. 26791 **DATE COLLECTED** 11-22-85 **DATE REC'D.** 11-22-85 **DATE ANALYZED** 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	4
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	4	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Xylenes	<2

SURROGATE RECOVERIES:

Bromochloromethane	90%
2-Bromo-1-chloropropane	95%
Trifluorotoluene	100%

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Pesticide/PCB Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Monitoring Well #4 (Duplicate)

SAMPLE NO. 26791 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-2-85

	ppb		ppb
α-BHC	0.5	Endosulfan II	<0.2
γ-BHC	<0.1	4,4'-DDT	<0.2
β-BHC	0.1	Endosulfan Sulfate	<0.2
Heptachlor	<0.1	Endrin Aldehyde	<0.2
δ-BHC	<0.1	Chlordane	<1.0
Aldrin	<0.1	Toxaphene	<5.0
Heptachlor Epoxide	<0.1	PCB-1221	<1.0
Endosulfan I	<0.1	PCB-1232	<1.0
4,4'-DDE	<0.1	PCB-1016/1242	<1.0
Dieldrin	<0.2	PCB-1248	<1.0
Endrin	<0.2	PCB-1254	<1.0
4,4'-DDD	<0.2	PCB-1260	<1.0

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Methoxychlor	<0.2
Endrin Ketone	<0.2
HCB	<0.5

Authorized:

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Matrix Spike of Sample 26788 (MW #4)

SAMPLE NO. 26791 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

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O'BRIEN & GERE

Purgeable Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Field Blank

SAMPLE NO. 26792 DATE COLLECTED 11-22-85 DATE REC'D. 11-22-85 DATE ANALYZED 12-9-85

	ppb		ppb
Chloromethane	<1	1,2-Dichloropropane	<1
Bromomethane	<1	t-1,3-Dichloropropene	<1
Dichlorodifluoromethane	<1	Trichloroethene	<1
Vinyl chloride	<1	Benzene	<1
Chloroethane	<1	Dibromochloromethane	<1
Methylene chloride	<1	1,1,2-Trichloroethane	<1
Trichlorofluoromethane	<1	c-1,3-Dichloropropene	<1
1,1-Dichloroethene	<1	2-Chloroethylvinyl ether	<10
1,1-Dichloroethane	<1	Bromoform	<10
t-1,2-Dichloroethene	<1	1,1,2,2-Tetrachloroethane	<1
Chloroform	<1	Tetrachloroethene	<1
1,2-Dichloroethane	<1	Toluene	<1
1,1,1-Trichloroethane	<1	Chlorobenzene	<1
Carbon tetrachloride	<1	Ethylbenzene	<1
Bromodichloromethane	<1		

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

SURROGATE RECOVERIES:

Bromochloromethane	93%
2-Bromo-1-chloropropane	98%
Trifluorotoluene	103%

Authorized: O C Tifft Jr

Date: 12-17-85

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates **JOB NO.** 3238.001.517

DESCRIPTION Matrix Spike of Sample 26791 (MW# 4 Duplicate)

SAMPLE NO. 14322 **DATE COLLECTED** 11-22-85 **DATE REC'D.** 11-22-85 **DATE ANALYZED** 12-11-85

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/86

O'Brien & Gere Engineers, Inc.
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O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Methods Blank

SAMPLE NO. 46556 DATE COLLECTED DATE REC'D. DATE ANALYZED

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phenylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/84

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 451-4700

O'BRIEN & GERE

Base/Neutral Priority Pollutants

CLIENT Harding Lawson Associates JOB NO. 3238.001.517

DESCRIPTION Methods Blank

SAMPLE NO. 46852 DATE COLLECTED DATE REC'D. DATE ANALYZED

	ppb		ppb
1,3-Dichlorobenzene	<10	Diethylphthalate	<10
1,4-Dichlorobenzene	<10	N-nitrosodiphenylamine	<10
1,2-Dichlorobenzene	<10	Hexachlorobenzene	<10
Hexachloroethane	<10	4-Bromophenyl phenyl ether	<10
Bis (2-chloroethyl) ether	<10	Phenanthrene	<10
Bis (2-chloroisopropyl) ether	<10	Anthracene	<10
N-Nitrosodi-n-propylamine	<10	Di-n-butyl phthalate	<10
Nitrobenzene	<10	Fluoranthene	<10
Hexachlorobutadiene	<10	Pyrene	<10
1,2,4-Trichlorobenzene	<10	Benzidine	<10
Isophorone	<10	Butyl benzyl phthalate	<10
Naphthalene	<10	Bis(2-ethylhexyl)phthalate	<10
Bis (2-chloroethoxy) methane	<10	Chrysene	<10
Hexachlorocyclopentadiene	<10	Benzo(a)anthracene	<10
2-Chloronaphthalene	<10	3,3-Dichlorobenzidine	<20
Acenaphthylene	<10	Di-n-octylphthalate	<10
Acenaphthene	<10	Benzo(b)fluoranthene	<10
Dimethyl phthalate	<10	Benzo(k)fluoranthene	<10
2,6-Dinitrotoluene	<10	Benzo(a)pyrene	<10
Fluorene	<10	Indeno(1,2,3-cd)pyrene	<10
4-Chlorophenyl phenyl ether	<10	Dibenzo(a,h)anthracene	<10
2,4-Dinitrotoluene	<10	Benzo(g,h,i)perylene	<10
1,2-Diphenylhydrazine	<10	N-Nitrosodimethyl Amine	<10

Methodology: Federal Register — 40 CFR, Part 136, [redacted] Oct.26,1984

Comments:

Tetrachlorobenzene	<50
Pentachlorobenzene	<50
Pentachloronitrobenzene	<50
Phewnylmethylether	<50
Trichloroanisol	<50

Authorized:

Date: 1/17/84

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