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DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS

RI/FS FORMER LAKE ONTARIO ORDNANCE WORKS
LEWISTON/PORTER, NIAGARA COUNTY, NEW YORK

CONTRACT NO. DACA41-88-C-0005

PD-8a
Supplement to
Final Remedial Investigation Report

July 1990

ACRES INTERNATIONAL CORPORATION

200.1e

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1 - INTRODUCTION

The following report has been prepared as a supplement to the Remedial Investigation (RI) Report (PD-8) for the Lake Ontario Ordnance Works (LOOW) site in Niagara County, New York. This report presents the findings of supplemental field investigations completed by Acres International Corporation during the period from November 6, 1989 through January 4, 1990. This additional work was authorized by the Department of the Army, Kansas City District, Corps of Engineers (COE) under Modification No. P00010 to Acres engineering services contract as part of the Defense Environmental Restoration Program.

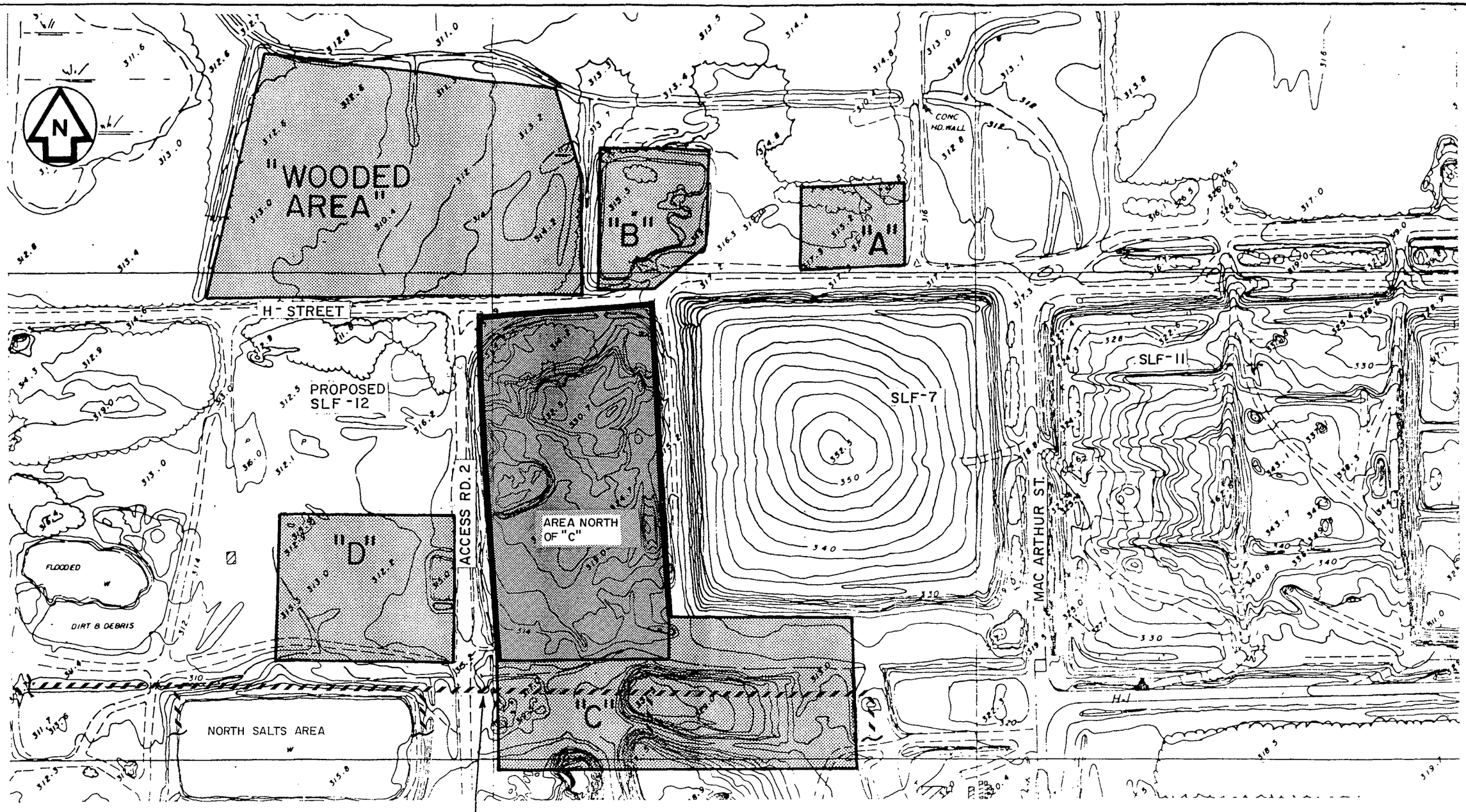
The purpose of the supplemental investigations was to fill previous data gaps and confirm the extent of contamination in the potential problem areas identified during the initial RI. The supplemental investigations were also carried out to confirm previous RI results and provide a better definition of the contamination problems and site conditions.

1.1 - General Overview

The initial RI field program was conducted during the period of April through July 1988 and investigated the following areas of the former LOOW site located on property presently owned by Chemical Waste Management, Inc. (CWM):

- An area suspected to contain approximately 30 buried drums identified as Area A;
- An area used for open incineration of wastes identified as Area B;
- Three areas suspected to contain 200 to 300 buried drums (Area C, Area north of C, and Area D);
- An area of suspected buried drums in the Wooded Area west of Area B; and
- Existing underground TNT and acid waste pipelines beneath the site.

The locations of these areas are presented in Figure 1.1.



NOTE: THE SUSPECTED LOCATIONS OF THE ACID WASTE LINES ARE LOCATED OFF BOUNDARIES OF THIS FIGURE.

LAKE ONTARIO ORDNANCE WORKS

PROJECT STUDY AREA

FIGURE 1-1

ACRES

These initial study areas and detailed scope of field investigations were defined by the Kansas City District, Corps of Engineers (COE) based on previous site reconnaissance and background information.

The results of the initial RI program did not reveal the presence of any drums or significant soil or groundwater contamination in the following areas:

- Area C;
- Area D;
- Area North of C; and
- The Wooded Area west of Area B.

In addition, acid waste pipelines were not found during the initial RI program. Some concrete encased TNT waste pipelines were found but misinterpreted as building foundations.

The initial RI program did identify elevated levels of contaminants in both Areas A and B as well as buried drums in Area A. Analytical results of soil, drum, and test pit water samples from Area A indicated elevated concentrations of volatile organic compounds (predominantly acetone) and semi-volatile organic compounds (predominantly phenanthrene). Sediment samples from the bermed pond in Area B also indicated elevated concentrations of volatile (predominantly chlorobenzene, ethylbenzene and styrene) and semi-volatile organic compounds (predominantly 1,2,4-trichlorobenzene). Boron and lithium, two elements used in the formulation of high energy fuels which were incinerated in Area B, were also found in elevated levels in the burn pit sediments and local groundwater.

[Note: Prior to and during the course of this RI/FS project, CWM identified chloroform and carbon tetrachloride contamination in soils and groundwater in an area along the western side of the Area North of C. The appropriation of responsibility for the investigation and remediation of this and other similar areas on CWM's property will be the subject of discussion during future meetings between the COE and CWM.]

Based upon the results of the initial RI program, a Draft Feasibility Study (FS) Report (PD-9) was prepared which identified several feasible alternatives for remediation at the site. The Draft FS also identified several data gaps which indicated that additional investigations were needed to further confirm site conditions. The results of these additional investigations will be used to refine the feasible remedial alternatives identified in the Draft FS.

The following supplement presents the specific objectives and scope of the supplemental RI program, a description of the procedures and methodologies followed, and the findings and conclusions regarding site conditions and contamination within the designated areas of investigation. The combined results of this supplemental field investigation and the initial RI program will be used to better develop feasible remedial alternatives which will be presented in the Advance Final Feasibility Study Report scheduled for submittal in the Summer 1990.

1.2 - Objectives

The objectives of the supplemental field investigation program were to better define the extent of contamination in Areas A, B, and the southern portion of the Wooded Area, and to further investigate possible hazardous conditions related to the buried TNT and acid waste pipelines at the site. Specific objectives for each area are further defined below.

1.2.1 - Area A

The objectives of the additional field investigations in Area A included:

- Defining the southern extent of the buried drum trench;

- Identifying the quality of surface water and sediments hydrologically downgradient of Area A;

- Defining the extent of soil contamination in the vicinity of the buried drum trench; and

- Identifying groundwater quality immediately hydrologically downgradient of the buried drum trench.

1.2.2 - Area B

The objectives of field investigations in Area B included:

- Identifying the quality of surface water and sediment hydrologically downgradient of Area B;

- Defining the extent of soil contamination within the bermed pond and in the vicinity of Area B;

- Confirmation of the quality of surface water within the bermed pond in Area B; and

- Defining groundwater quality immediately hydrologically downgradient of Area B.

1.2.3 - TNT and Acid Waste Pipelines

Supplemental investigative activities were also conducted in response to concerns of potential hazardous conditions related to the buried TNT and acid waste pipelines at the site. The objectives of these investigations included:

- Determining the location of the buried pipelines for the purpose of sampling and assessing the condition of the abandoned lines; and

- Determining the presence of potentially explosive hazardous materials within the pipeline system(s).

1.3 - Scope of Supplemental Field Investigation

The scope of the supplemental field investigation included the following activities.

1.3.1 - Air Monitoring

Air monitoring was performed during all field activities in order to determine the appropriate level of respiratory protection necessary for personnel involved in intrusive site activities.

1.3.2 - Geophysical Survey

A limited geophysical survey was conducted to help determine the location of TNT and acid waste pipelines and the southern extent of the buried drum trench and to screen and clear proposed soil boring locations. The survey included the following:

1. Ground penetrating radar and electromagnetic surveys to help determine the location of the buried pipelines;

2. Magnetometer and electromagnetic surveys to help determine the southern extent of the buried drum trench; and

3. Magnetometer surveys to screen and clear proposed boring locations.

1.3.3 - Subsurface Investigation

The following activities were conducted as part of the subsurface investigation:

1. A total of 31 soil borings were completed. Sixteen borings were performed in Area A, nine borings in Area B, five borings in the area between Areas A and B, and one boring in the southern portion of the Wooded Area. One boring in Area A and one boring in Area B were completed as long-term (i.e., remediation and post remediation) groundwater monitoring wells.

2. Collection and detailed chemical analyses of 26 subsurface soil samples with limited chemical analyses performed on another 12 subsurface soil samples.

3. Excavation of ten test pits in an attempt to locate TNT and acid waste pipelines with subsequent sampling of one acid and two TNT waste pipelines.

4. Collection and detailed chemical analyses of two groundwater samples from the long-term monitoring wells installed down-gradient of Areas A and B.

1.3.4 - Surface Investigation

Five sample sets consisting of surface water and sediment samples were collected from the drainage ditch system in Areas A and B for detailed chemical analyses. One surface water sample was also collected from the ponded water in Area B for detailed chemical analyses.

1.3.5 - Site Characterization

One set of groundwater levels was collected from the newly installed monitoring wells as well as from 15 wells installed by Acres during the initial RI program and 18 existing CWM wells. The groundwater measurements were used to further define groundwater flow at the site.

2 - SUPPLEMENTAL FIELD INVESTIGATION - METHODOLOGIES AND ANALYSES

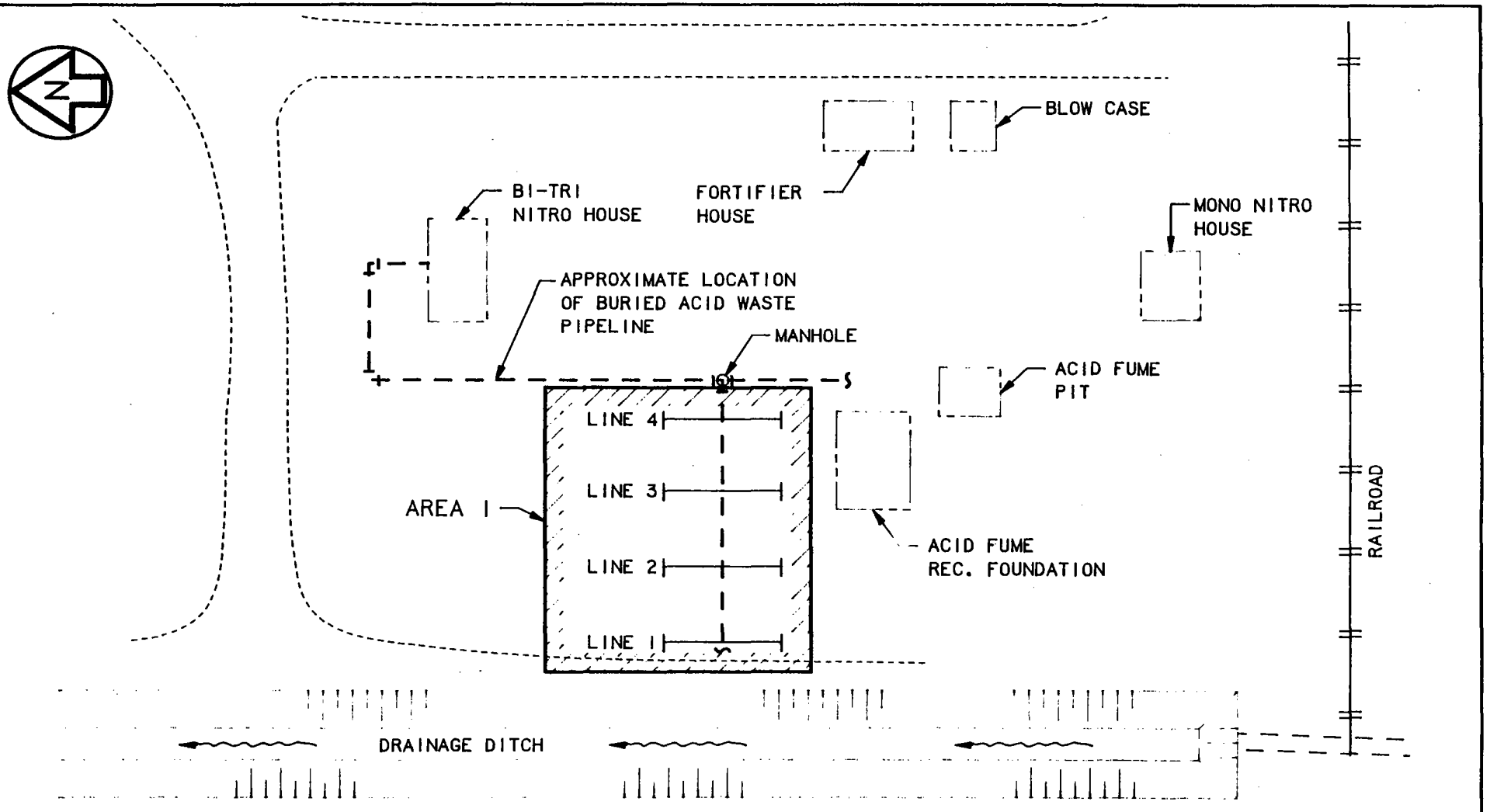
2.1 - Overview of Field Activities

As previously mentioned, the supplemental field investigation for the LOOW site RI/FS was conducted in order to determine the extent of contamination related to the buried drums in Areas A and the disposal and incineration of materials in Area B; and to identify the presence of potentially explosive materials in buried TNT and acid waste pipelines. Field activities carried out to attain these objectives included air monitoring, geophysical surveys, soil borings, monitoring well installations, test pit excavations, sampling, and analyses. The following subsections present descriptions of each field activity which was undertaken at the LOOW site during the period of November 6, 1989, through January 4, 1990. (A summary of all areas investigated as part of this supplemental investigation is presented in Figure 2-7).

2.2 - Air Monitoring

An air monitoring program was conducted during the soil boring, monitoring well installation, and test pit excavation activities at the LOOW site. The air monitoring was performed by the Site Safety Officer and consisted of using real-time instruments to monitor organic vapors, explosive gases, oxygen deficiency, and radiation. The air monitoring activities were conducted to determine the level of respiratory protection necessary for personnel involved in intrusive field activities. The first soil boring performed in Area A and the first three soil borings performed in Area B were initiated in Level C personnel protection as a precautionary measure. The air monitoring measurements recorded in the breathing zone during drilling activities resulted in upgrading respiratory protection to Level C during the drilling of two other soil borings in Area B.

As a precautionary measure, test pit excavation activities were initiated in Level B personnel protection. Test pit excavation activities were later



LEGEND

LINE 1 — GEOPHYSICAL SURVEY LINE

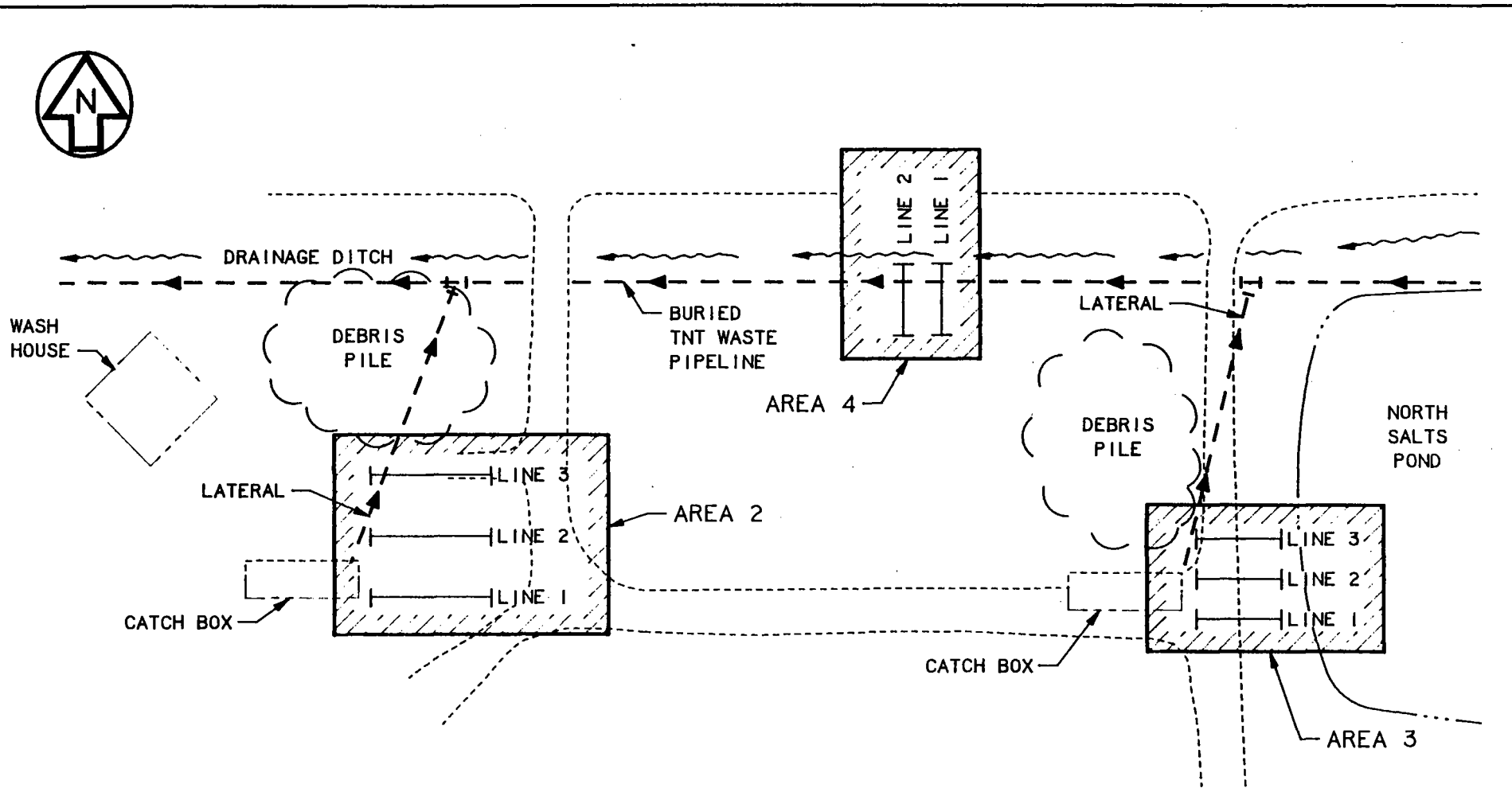
LAKE ONTARIO ORDNANCE WORKS

GEOPHYSICAL SURVEY AREA 1
ACID WASTE PIPELINE AREA

SCALE 0 50 100 FEET

FIGURE 2-1

ACRES



LEGEND

LINE 1 — GEOPHYSICAL SURVEY LINE

LAKE ONTARIO ORDNANCE WORKS

GEOPHYSICAL SURVEY
AREAS 2,3 & 4
TNT WASTE PIPELINE

SCALE 0 80 160 FEET

FIGURE 2-2

ACRES

of the waste and supply pipeline system of the original TNT plant (Wehran Drawing no. 7 of 7, Project No. 01361186 and Wehran Drawing "Site of Chem-Trol", Project No. 368020).

In Geophysical Survey Area 1, four survey lines, each 40 ft in length, were spaced approximately 25 ft apart along the suspected routing of an acid waste pipeline (see Figure 2-1). An acid waste pipeline manhole was located in the field facilitating the selection of the survey line locations.

In Geophysical Survey Area 2, three survey lines, each approximately 80 ft in length, were spaced 25 ft apart along the suspected trend of a TNT waste pipeline lateral (see Figure 2-2). In Geophysical Survey Area 3, three survey lines, each approximately 50 ft in length, were spaced 30 ft apart along the suspected trend of another TNT waste pipeline lateral. Based upon the site maps, each TNT waste pipeline lateral was assumed to have originated at a Wash House Catch Box and run approximately north to the main TNT waste pipeline system (see Figure 2-2).

Geophysical Survey Area 4 consisted of two survey lines, each approximately 40 ft in length, spaced 40 ft apart along the known routing of the main TNT waste pipeline system (see Figure 2-2). This particular area had been investigated during the initial RI field program during which time a concrete encased TNT waste pipeline was encountered during test pit excavation activities but misinterpreted as a building foundation (see Figure 5-3 in the Final RI report and the log for test pit TP-TNT1). This area was selected for geophysical screening in order to provide a comparison of screening results from a known pipeline location with those from the other suspected pipeline areas.

Ground penetrating radar and electromagnetic surveys were performed every 1 foot along the survey lines in Geophysical Survey Areas 1 through 4.

In order to achieve the second objective, defining the southern extent of the buried drum trench in Area A, a survey grid was established which overlapped the known portion of the buried drum trench. The survey grid was extended to the south across H Street to the toe of slope of SLF #7. The survey grid was also extended in both the eastern and western directions in order to overlap the suspected limits of the buried drum trench in those areas. The resultant survey grid measured approximately 60 ft in the north-south direction by 80 ft in the east-west direction. Both electromagnetic and vertical gradient magnetic surveys were performed at 5 ft intervals along the survey grid.

The third objective of the supplemental geophysical investigation, screening and clearing proposed boring locations, was accomplished by performing vertical gradient magnetic surveys in the vicinity of each proposed boring location. At each boring location, an area approximately 5 ft on either side of the proposed borehole location was screened with magnatometer readings taken every 2 ft in order to locate any buried metal which may hinder drilling.

The results of the supplemental geophysical surveys are presented in Section 3. A copy of pertinent sections of the geophysical survey report is presented as Attachment A.

2.4 - Subsurface Investigations

Subsurface investigations were conducted at the LOOW site in order to:

- Define the extent of contamination associated with the drum burial trench in Area A and the former burn pit in Area B;

- Install downgradient monitoring wells at locations closer to the contaminated areas within Areas A and B;

- Locate and sample buried TNT and acid waste pipelines and underlying soils; and

- Provide additional data to characterize groundwater flow at the site.

Drilling activities were performed during the period of November 20 through December 15, 1989. Drilling services were provided by Empire Soils Investigations, Inc. of Orchard Park, New York. Pertinent soil boring and monitoring well data are provided in Table 2-1. The locations of the newly installed monitoring wells and soil borings are presented in Figures 2-3 and 2-4.

In order to define the extent of contamination in Area A, a total of 16 soil borings (ACB-1 and AB-1 through AB-15) were performed with one of the borings (AB-15) completed as a long-term shallow (Zone 1) groundwater monitoring well (MW-A-89). As stated in the Supplement to the Work Plan (Acres, 1989 Supplement to PD-1A), the original drilling plan was to perform the soil borings in four sequences radiating away from the northern, northwestern, eastern, and western sides of the suspected buried drum trench while continuously collecting and screening soil samples for possible selection for detailed chemical analyses. The drilling in Area A was basically performed in this manner. However, the progression of drilling and borehole locations were modified based upon results of the soil headspace screening process (as described in Section 2.4.3).

The drilling in each sequence was terminated upon completing a borehole yielding no substantial positive responses to the screening process. (It was determined during the experimental runs of the screening process that apparently "clean" samples may yield low positive responses).

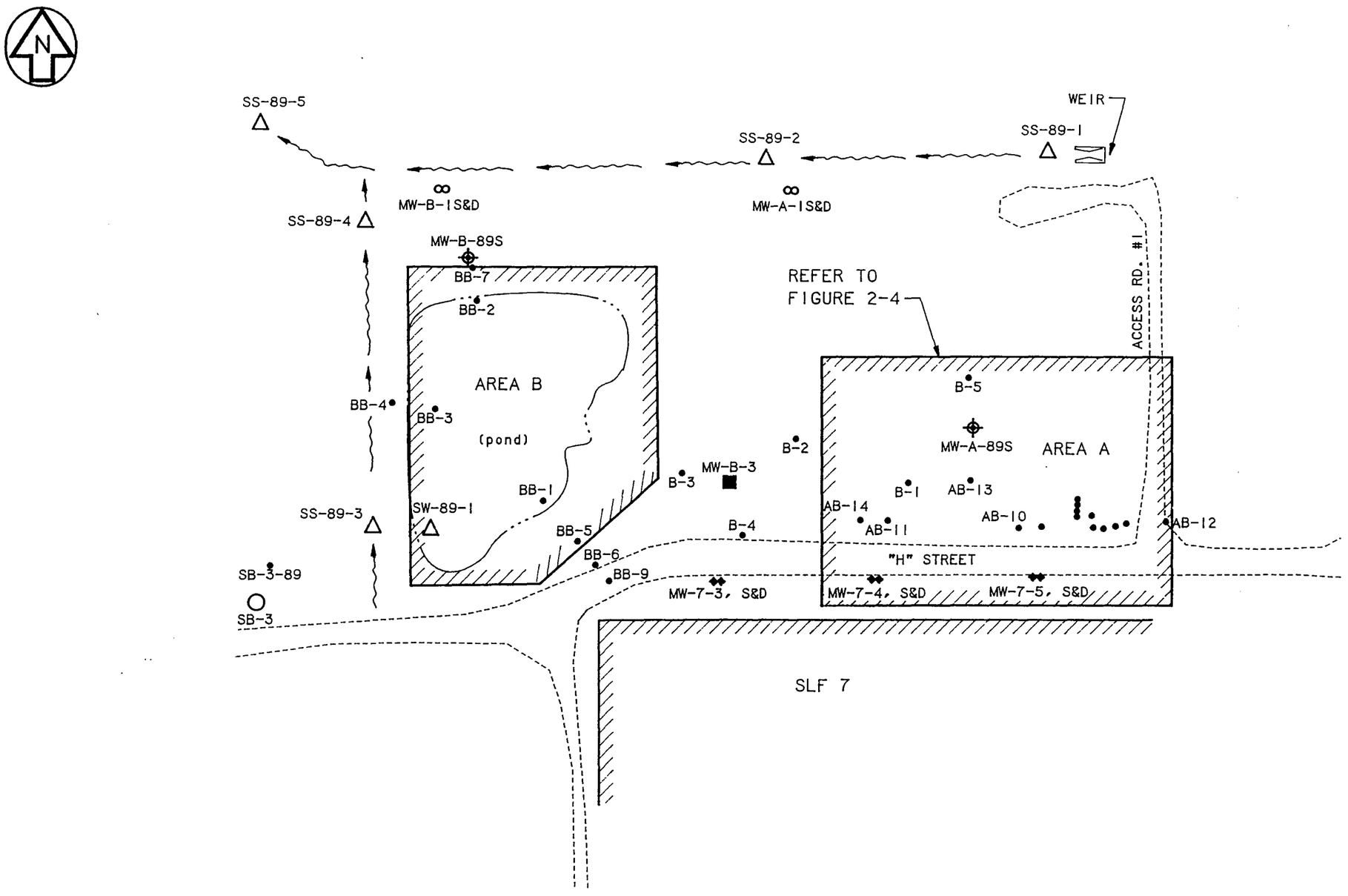
The first boring in Area A, ACB-1, was drilled into the buried drum trench. The contaminated samples obtained from this boring were used to calibrate the organic vapor meters (OVA and HNu) for subsequent soil headspace screening.

TABLE 2-1
MONITORING WELL/SOIL BORING DATA

WELL/BORING ID	COORDINATE LOCATION		ELEVATION (FT MSL)*			STICK-UP (FT)		TOTAL DEPTH	BOTTOM ELEV	TOP OF CLAY	TOP OF SCREEN	BOTTOM OF SCREEN	TOP OF SANDPACK	BOTTOM OF SANDPACK
	NORTHING	EASTING	GROUND SURFACE	SS RISER	PROTECTIVE CASING	SS RISER	PROTECTIVE CASING	(FT)	(FT MSL)	(FT BGS)	(FT BGS)	(FT BGS)	(FT BGS)	(FT BGS)
ACB-1	11042.0	10808.5	316.2	---	---	---	---	16.0	300.2	---	---	---	---	---
AB-1	11047.0	10808.5	316.2	---	---	---	---	24.0	292.2	18.0	---	---	---	---
AB-2	11052.5	10809.0	316.3	---	---	---	---	32.0	284.3	20.5	---	---	---	---
AB-3	11057.5	10809.0	316.3	---	---	---	---	24.0	292.3	22.2	---	---	---	---
AB-4	11032.5	10823.0	316.1	---	---	---	---	28.0	288.1	26.0	---	---	---	---
AB-5	11043.0	10821.5	316.2	---	---	---	---	22.0	294.2	18.5	---	---	---	---
AB-6	11031.5	10832.0	316.1	---	---	---	---	28.0	288.1	27.0	---	---	---	---
AB-7	11033.5	10842.5	316.2	---	---	---	---	10.0	306.2	---	---	---	---	---
AB-8	11036.0	10852.0	316.3	---	---	---	---	26.0	290.3	25.5	---	---	---	---
AB-9	11033.0	10777.5	315.8	---	---	---	---	18.0	297.8	15.0	---	---	---	---
AB-10	11032.0	10757.5	315.8	---	---	---	---	18.0	297.8	14.0	---	---	---	---
AB-11	11038.5	10640.5	315.6	---	---	---	---	18.0	297.6	13.8	---	---	---	---
AB-12	11037.5	10888.0	316.3	---	---	---	---	16.0	300.3	14.5	---	---	---	---
AB-13	11074.0	10714.5	315.4	---	---	---	---	16.0	299.4	14.0	---	---	---	---
AB-14	11039.0	10616.0	315.6	---	---	---	---	16.0	299.6	14.0	---	---	---	---
MW-A-89 (AB-15)	11120.62	10716.62	314.2	316.31	316.48	2.11	2.28	18.0	296.2	17.0	8.0	17.0	17.0	17.5
B-1	11072.0	10659.0	315.4	---	---	---	---	18.0	297.4	14.0	---	---	---	---
B-2	11111.0	10558.5	314.3	---	---	---	---	14.0	300.3	12.5	---	---	---	---
B-3	11080.5	10456.0	315.3	---	---	---	---	16.0	299.3	14.0	---	---	---	---
B-4	11025.5	10509.5	314.5	---	---	---	---	16.0	298.5	13.5	---	---	---	---
B-5	11165.0	10712.5	314.2	---	---	---	---	14.0	300.2	10.0	---	---	---	---
BB-1	11056.5	10332.0	313.5	---	---	---	---	14.0	299.5	12.0	---	---	---	---
BB-2	11234.0	10274.0	312.8	---	---	---	---	16.0	296.8	12.0	---	---	---	---
BB-3	11138.0	10237.0	312.9	---	---	---	---	12.0	300.9	10.0	---	---	---	---
BB-4	11143.5	10199.0	311.6	---	---	---	---	10.0	301.6	9.5	---	---	---	---
BB-5	11020.5	10362.5	315.5	---	---	---	---	14.0	301.5	13.0	---	---	---	---
BB-6	10999.5	10378.5	314.8	---	---	---	---	16.0	298.8	15.0	---	---	---	---
BB-7	11263.0	10270.0	311.8	---	---	---	---	12.0	299.8	10.0	---	---	---	---
BB-8 (MW-B-89)	11271.83	10266.25	312.0	314.19	314.30	2.19	2.30	14.0	298.0	12.0	6.3	11.3	5.3	12.0
BB-9	10985.0	10390.5	315.2	---	---	---	---	20.0	295.2	18.0	---	---	---	---
SB-3-89	10999.0	10091.5	318.0	---	---	---	---	22.0	396.0	21.0	---	---	---	---

Notes:

MSL* = Elevation datum is CWM site datum which is approximately equal (within 1 foot) of mean sea level (MSL).
SS = Stainless Steel
BGS = Below Ground Surface



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△ SS-89-1	SURFACE WATER AND SEDIMENT SAMPLE
△ SW-89-1	SURFACE WATER SAMPLE
• B-1	SOIL BORING
⊕ MW-A-89S	MONITORING WELL
∞ MW-A-1S&D	EXISTING MONITORING WELL COUPLET INSTALLED BY ACRES
◆◆ MW-7-3 S&D	EXISTING MONITORING WELL COUPLET INSTALLED BY OTHERS
■ MW-B-3	EXISTING WELL INSTALLED BY ACRES
○ SB-3	EXISTING BORING PERFORMED BY ACRES

SCALE 0 100 200 FEET

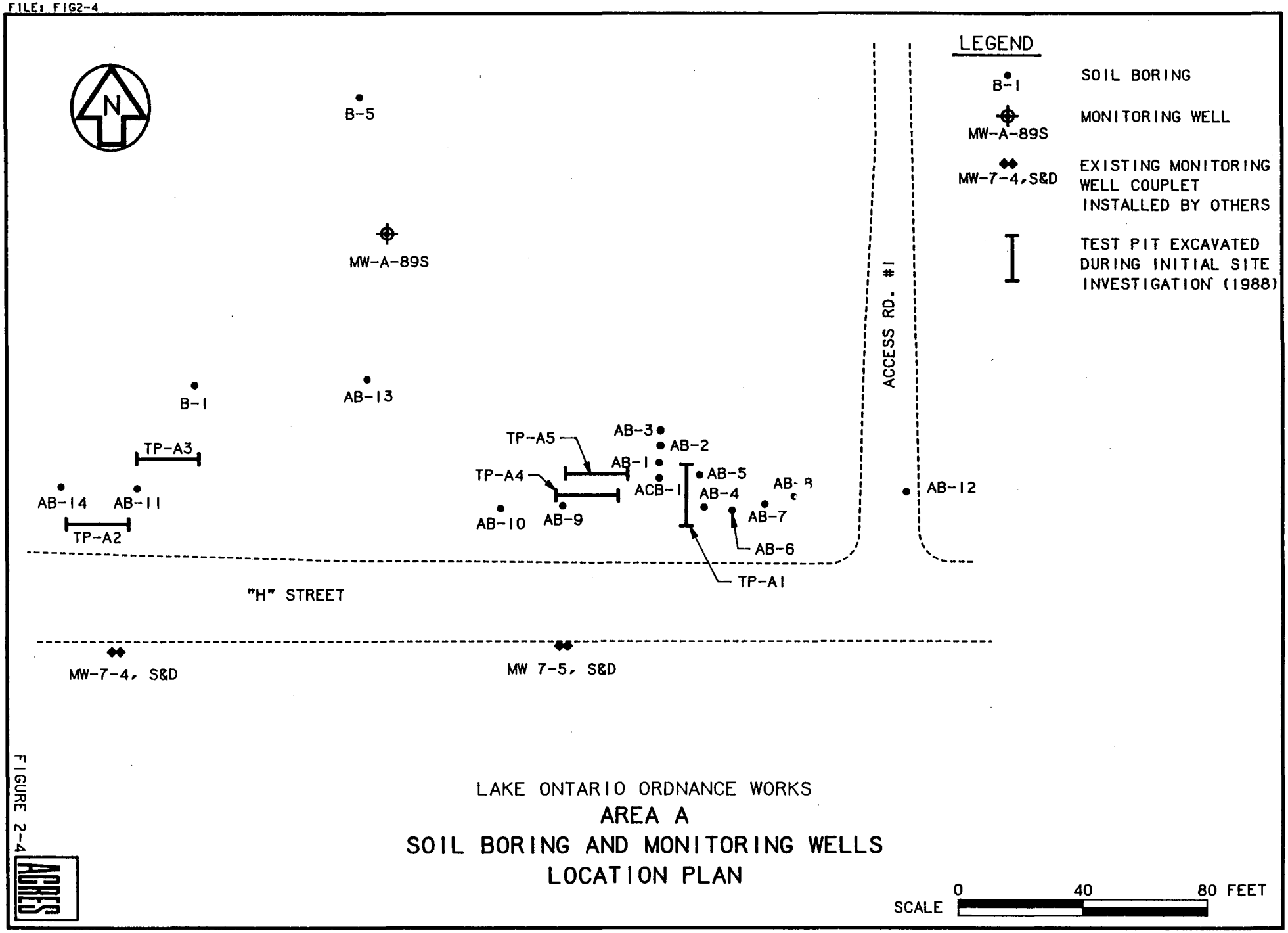
LAKE ONTARIO ORDNANCE WORKS

SOIL BORING, MONITORING WELL AND SURFACE SAMPLE LOCATION PLAN

FIGURE 2-3

ACRES

KAB 6/13/90
P0834109
FILE: FIG2-4



LAKE ONTARIO ORDNANCE WORKS

AREA A

SOIL BORING AND MONITORING WELLS LOCATION PLAN

SCALE 0 40 80 FEET

FIGURE 2-4

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Similar to Area A, the drilling program for Area B was designed to have soil borings performed in three sequences radiating away from the northern, western, and southeastern sides of the pond. During the drilling program for this additional field investigation, a total of nine borings were performed in this manner in Area B with one of the soil borings (BB-8) completed as a long-term shallow (Zone 1) groundwater monitoring well (MW-B-89). Also similar to Area A, the progression of drilling in Area B was based upon the results of soil headspace screening for volatile organics.

In the Area between Areas A and B, five soil borings (B-1 through B-5) were performed at randomly selected locations. One final soil boring (SB-3-89) was performed in the Wooded Area to the southwest of Area B. This location was selected because of an elevated boron concentration in a duplicate sample from boring SB-3 which was collected during the initial RI program.

The following subsections present specific drilling methodologies (Section 2.4.1), subsurface soil sampling procedures (Section 2.4.2), soil headspace screening procedures (Section 2.4.3), and monitoring well installation procedures (Section 2.4.4). The results of the soil headspace screening and detailed chemical analyses are further discussed in Section 4, Analytical Results, and Section 5, Summary of Supplemental Field Investigations. Boring logs are presented in Attachment B.

2.4.1 - Subsurface Drilling Methodology

Drilling for the additional field investigation was accomplished using either an Acker AD-2 truck-mounted drill rig or a CME 45 track-mounted drill rig. Soil borings ACB-1, AB-1 through AB-12, and B-1 through B-5 were performed with the Acker truck-mounted rig. The more inaccessible soil borings BB-1 through BB-8 and the remainder of the soil borings were performed with the CME track-mounted rig. The low water level of the Area B pond eliminated the need for a pontoon mounted drill rig as stated in the supplement to the Project Work Plan (PD-1A) for the in-pond borings (BB-1 through BB-3).

Each drill rig was operated by a crew of one driller and one driller's helper. Only auger drilling techniques were used. All drilling activities were directed by an Acres geologist. Each boring was advanced using 4-1/4 in inside diameter hollow stem augers. Subsurface soil sampling was performed in accordance with ASTM D-1586. However, 2 ft long by 3 in diameter split spoons were used in order to obtain sufficient quantities of soil for soil screening and possible laboratory analyses.

All soil borings, with the exception of ACB-1, AB-2, and AB-7, were drilled to the glaciolocustrine clay, a depth varying from about 9.5 to 27 ft below ground surface. Soil boring ACB-1, the calibration boring and first boring drilled in Area A, was intentionally drilled into the buried drum trench. In order to avoid transporting contaminated groundwater from the buried drum trench down into more permeable strata, the boring was terminated at a depth of 16 ft below ground surface. Soil boring AB-2 was drilled to a depth of 32 ft below ground surface (7 ft below the bottom of the glaciolocustrine clay) in order to sample the lower, more permeable strata. This boring was dry during drilling and upon completion. Boring AB-7 was terminated at a depth of 10 ft below ground surface after determining that the boring was still within the buried drum trench.

All soil borings, with the exception of AB-15 and BB-8, which were completed as groundwater monitoring wells, were tremie backfilled upon completion to the ground surface with a bentonite slurry. The bentonite slurry was composed of approximately 25 gallons of water to each 94 lb bag of bentonite powder.

2.4.2 - Subsurface Soil Sampling

Representative subsurface soil samples were continuously collected from each soil boring using 3 in outside diameter by 2 ft long split

spoon samplers. The split spoon samplers were advanced using either an 140 lb hammer (for the first 6 soil borings, ACB-1 and AB-1 through AB-5) or a 300 lb hammer (for the remaining 25 borings). Upon recovery of each sampler, the length of the sample recovered was recorded and each sample characterized for color and classified using the Unified Soil Classification System. Each borehole and recovered sample was monitored for organic vapors, explosive gases, and radioactivity.

All soil samples were then placed in clean (Eagle-Picher cleaning Level 2) 16 oz glass jars, labeled and chilled for subsequent organic vapor (headspace) screening. CWM personnel expressed concerns regarding the possible volatilization of organics during later transfer of samples scheduled for detailed volatile organic analyses into 4 oz glass jars (after soil screening). As a result, soil samples collected after soil boring B-5 (the 16th completed boring) were placed in both 16 oz and 4 oz glass jars upon sample recovery.

2.4.3 - Soil Screening

Upon completion of each soil boring, the collected samples were transferred to the field office trailer and refrigerated. Organic vapor (headspace) screening was performed using both a Foxboro OVA and an HNu model PI 101. Samples recovered from the first borings in Areas A and B were used to determine the appropriate settings on the OVA and HNu. Prior to initiating screening and between each soil boring, the instruments were calibrated using isobutylene calibration gas (benzene surrogate) supplied by the manufacturer (HNu). Once the proper calibration was checked for each instrument, the sensitivity of each instrument was maximized by adjusting the span potentiometer for the HNu or the gas select potentiometer on the OVA.

Preparation of samples for soil screening involved transferring approximately 2 oz of soil from the 16 oz jar to a tall 8 oz jar.

The 8 oz jar was then sealed with aluminum foil and cap replaced. Each 8 oz jar was then placed in a hot water bath of about 70°F for approximately 20 minutes. Once the allotted time had expired, the jars were removed from the water bath, cap removed, HNu and OVA probe inserted through the foil and measurements of the headspace were recorded.

Once the soil screening results were reviewed, a decision regarding the placement of the next boring could be made. The results of the soil screening were also used to determine which samples were to be selected for further detailed chemical analyses.

In Area A, two samples were selected from the calibration boring (ACB-1) for detailed chemical analysis: one sample from the zone displaying the greatest response to the soil screening process and one sample from the last positive response to the screening process. No sample from this boring from the zone below the last positive response to the screening process was obtained. In its place, a sample representing this zone was selected for detailed chemical analyses from boring AB-14.

The sequence of drilling and soil screening was repeated in the northern, northwestern, eastern and western directions relative to the buried drum trench in Area A. One sample showing the greatest response to the soil screening process was selected for detailed chemical analyses from each sequence. One verification sample of one of the last samples to have a positive response to the screening process was also selected for detailed chemical analyses.

The drilling and sample screening in Area A resulted in the selection of eight samples (and one duplicate sample) for detailed chemical analyses. Table 2-2 presents a listing of subsurface soil samples collected for detailed chemical analyses.

TABLE 2-2
ANALYTICAL PARAMETERS - SUBSURFACE SOIL SAMPLES
ADDITIONAL FIELD INVESTIGATIONS

Area	Sample ID (1)	Analytical Parameters(2)(3)				Comments
		Volatiles	Semi-Volatiles	Boron	Lithium	
AREA A	ACB-1-2-4	X	X	X	X	Calibration boring sample with greatest response to screening process.
	ACB-1-14-16	X	X	X	X	Calibration boring sample with last positive response to screening process.
	AB-2-6-8	X	X	X	X	North sequence sample with greatest response to screening process; sample also used for MS/MSD analyses.
	AB-4-12-14	X	X	X	X	Eastern sequence sample with greatest response to screening process.
	AB-9-6-8	X	X	X	X	Western sequence sample with greatest response to screening process.
	AB-13-12-14	X	X	X	X	Northwestern sequence sample with greatest response to screening process; sample also used as external duplicate.
	AB-14-6-8	X	X	X	X	Verification sample of last positive response to screening process.
	AB-14-8-10	X	X	X	X	Sample with no positive response to screening process.
	A-DUP	X	X	X	X	Duplicate of sample A-B-14-6-8.
	A-RB	-	X	X	X	Rinse blank.
	A-TB	X	-	-	-	Trip blank.
AREA B	BB-1-10-12	X	X	X	X	Southern in-pond sample with greatest response to screening process.
	BB-1-12-14	X	X	X	X	Additional southern in-pond sample.
	BB-2-6-8	X	X	X	X	Northern in-pond sample with greatest response to screening process.
	BB-2-10-12	X	X	X	X	Additional northern in-pond sample.
	BB-3-6-8	X	X	X	X	Western in-pond sample with greatest response to screening process.
	BB-3-8-10	X	X	X	X	Additional western in-pond sample.
	BB-4-6-8	X	X	X	X	Western sequence sample with greatest response to screening process; sample also used for MS/MSD analyses.
	BB-5-4-6	X	X	X	X	Southern sequence sample with greatest response to screening process; sample also used as external duplicate.
	BB-7-10-12	X	X	X	X	Northern sequence sample with greatest response to screening process; sample also used as internal duplicate.
	BB-9-12-14	X	X	X	X	Verification sample from southern sequence.
	B-DUP	X	X	X	X	Duplicate of sample B-B-7-10-12.
	B-RB	-	X	X	X	Rinse blank.
	B-TB	X	-	-	-	Trip blank.

TABLE 2-2

Area	Sample ID (1)	Analytical Parameters(2)(3)				Comments
		Volatiles	Semi-Volatiles	Boron	Lithium	
WOODED AREA	SB-3-89-4-6	X	X	X	X	Wooded Area sample with greatest response to screening process.
	SB-3-89-0-2	-	-	X	X	Wooded Area sample - randomly selected.
	SB-3-89-6-8	-	-	X	X	Wooded Area sample - randomly selected.
AREA BETWEEN AREAS A & B	B1-8-10	X	X	X	X	Sample with greatest response to screening process.
	B1-4-6	-	-	X	X	Randomly selected sample.
	B1-12-14	-	-	X	X	Randomly selected sample.
	B2-6-8	X	X	X	X	Sample with greatest response to screening process.
	B2-0-2	-	-	X	X	Randomly selected sample.
	B2-4-6	-	-	X	X	Randomly selected sample.
	B3-12-14	X	X	X	X	Sample with greatest response to screening process.
	B3-0-2	-	-	X	X	Randomly selected sample.
	B3-8-10	-	-	X	X	Randomly selected sample.
	B4-10-12	X	X	X	X	Sample with greatest response to screening process; sample also used as internal and external duplicate.
	B4-2-4	-	-	X	X	Randomly selected sample.
	B4-6-8	-	-	X	X	Randomly selected sample.
	B5-10-12	X	X	X	X	Sample with greatest response to screening process; sample also used for MS/MSD analyses.
	B5-0-2	-	-	X	X	Randomly selected sample.
	B5-6-8	-	-	X	X	Randomly selected sample.
	AB-DUP	X	X	X	X	Duplicate of sample B-4-10-12.
	AB-RB	-	X	X	X	Rinse blank.
	AB-TB	X	-	-	-	Trip blank.

NOTES:

(1) Sample ID designated as follows:
Example ACB-1-2-4
A - Area A;
CB - Calibration boring;
1 - Boring number; and
2-4 - Sample depth interval.

(2) Volatile and semi-volatile analyses performed according to Methods 8240 and 8270 stated in SW 846 Third Edition; tentative compound identification by computer library search not performed.
Boron analyses performed according to Method 6010.
Lithium analyses performed according to Method 303A in "Standard Methods for the Examination of Water and Wastewater," APHA, SWWA, WPCF, 16th Ed. 1985.

(3) Soil samples for boron and lithium analyses were prepared following SW-846 Method 3050.

The drilling and soil screening process was also conducted in Area B. In this area, three borings were performed within the pond. The first boring drilled in the pond functioned as the calibration boring. Two samples from zones displaying the greatest contamination were selected for detailed chemical analyses from each in-pond boring.

Upon completion of the three in-pond borings, the drilling was moved outside of the bermed pond and drilling and soil screening repeated in the northern, southeastern, and western directions. One sample from each direction, representing the zone exhibiting the greatest response to the screening process, was selected for detailed chemical analyses. One verification sample of one of the last samples to have a positive response to the screening process was also selected for detailed chemical analyses (see Table 2-2).

The drilling and soil screening process was also repeated at the five randomly selected drilling locations in the area between Areas A and B and at one location in the southern portion of the Wooded Area. One sample representing the zone displaying the greatest response to the screening process from each boring was selected for detailed chemical analyses. In addition, two separate samples from each boring were selected for boron and lithium analyses (see Table 2-2). The selection of the two separate samples was based upon the soil screening results or random selection.

All sampling equipment used during the additional field investigation, including split-spoon samplers, were decontaminated using the following procedures:

- Removal of all loose soils;
- Wash with Alconox and potable water;
- Potable water rinse;
- Isopropanol rinse; and
- Final rinse with distilled/deionized water.

More details regarding specific sample analyses are presented in Section 2.8, Analytical Procedures. The results of the soil screening procedures are presented in Section 4, Analytical Results. The locations of the soil borings and newly installed wells are shown in Figures 2-3 and 2-4.

2.4.4 - Monitoring Well Installation

As previously mentioned, two soil borings (AB-15 and BB-8) were completed as long-term shallow (Zone 1) groundwater monitoring wells (MW-A-89 and MW-B-89, respectively). The locations of the newly installed wells were selected so that groundwater quality could be monitored at locations closer to the contaminated areas than wells previously installed during the initial RI program. The specific location of each monitoring well was selected based upon completed downgradient borehole locations where no substantial positive responses were recorded during the soil screening process.

Each well was constructed with 2-in ID Schedule 304 stainless steel riser and #6 slot screen. The length of the screen and riser was dependent upon the final depth of each boring (see Table 2-1).

Once the desired depth was reached, the well screen and riser were suspended in the borehole and a No. 1 Q-Rock sandpack was placed in the annular space around the well screen to at least 1 ft above the screen and riser joint. A minimum of 2 ft of 3/8-in diameter bentonite pellets was then placed above the sandpack to prohibit downward migration of water in the borehole. Water was then added to the bentonite pellets in order to facilitate hydration.

Once the bentonite pellet seal was allowed to hydrate for a minimum of 15 hours, the remaining annulus was backfilled with a cement bentonite grout by use of a tremie pipe. The cement/bentonite grout

was composed of approximately 8 gallons of water and 3 lbs of bentonite powder to which 94 lbs of Portland Type I cement were added. Each well was fitted with a 6-in ID protective steel casing and locking cap seated within the grout. Each well was then completed with a concrete collar mounded around the base of the protective casing to direct precipitation runoff away from the well. Measurements of the depth of the borehole, sandpack, and bentonite seal were recorded using a weighted tape as well construction progressed. Monitoring wells were constructed with similar materials as existing CWM wells.

Well development activities were initiated on December 21, 1989. Monitoring well MW-A-89 was developed by evacuating the well using a suction lift impeller pump fitted with polyethylene tubing and check valve. During development, the polyethylene tubing and check valve were surged up and down within the well in order to force water in and out of the well screen and sandpack.

Monitoring well MW-A-89 had a moderate recharge rate with the water within the well returning to static level in about 12 hours after being evacuated to dryness. Water removed during development was monitored for temperature, pH, specific conductivity, volume removed, and visual clarity. Well development was considered complete after approximately ten standing volumes of water had been removed and the withdrawn water was visually clear.

Monitoring well MW-B-89 had produced no groundwater by the time of well development activities. Therefore, approximately eight gallons of clean water (obtained from the drilling water source) were added to the well. This water was then surged with a 1-1/4-in OD diameter stainless steel bailer for a minimum of 20 minutes. While this development was successful in removing fines from within the well, it failed to produce a sufficient volume of water by the time of groundwater sampling.

During well development activities, the calibration of the pH and conductivity meters was checked at least once a day using standard solutions. A two point calibration of the pH meter was performed using pH buffer solutions of 7.0 and 10.0 standard units. The conductivity meter was calibrated using standard solution of 3290 micromhos. Well development data for monitoring well MW-A-89 are presented in Attachment C.

2.5 - Test Pit Excavation

2.5.1 - Methodology

A total of ten test pits were excavated in order to locate and sample TNT and acid waste pipelines. Test pit excavation services were provided by Synergist, Inc. of Pottstown, Pennsylvania, during the period of December 19 through December 21, 1989. Test pit excavation was accomplished using a John Deere 790 excavator. Test pit excavation activities were initiated using Level B personnel protection and downgraded to Level D personnel protection after review of air monitoring results. All test pit activities were directed by a spotter from behind a Lexan and steel blast shield. Once each test pit was excavated, samples were collected, if required, and the test pit soils classified by an Acres geologist.

The following subsections describe test pit excavation activities performed in order to locate and sample TNT and acid waste pipelines.

a. Test pit excavation activities at the LOOW site were initiated on December 19, 1989 in the vicinity of the Bi-Tri Nitro House as shown on Figure 2-5 (Geophysical Survey Area 1). The first test pit to be excavated in this area, TP-1, was initiated adjacent to the drainage ditch berm approximately 90 ft west of the manhole and advanced in a north-south direction. The excavation of test

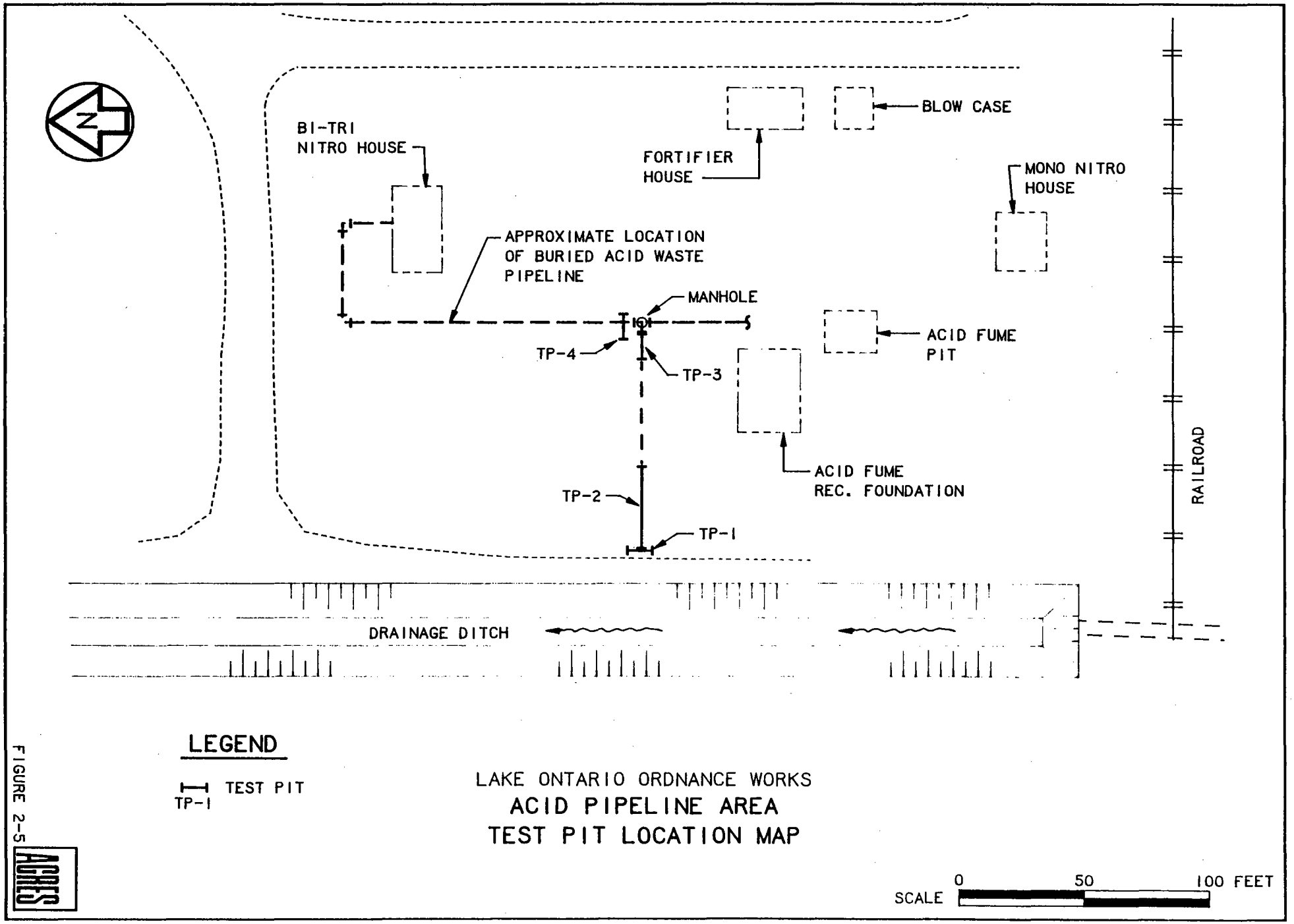


FIGURE 2-5

ACRES

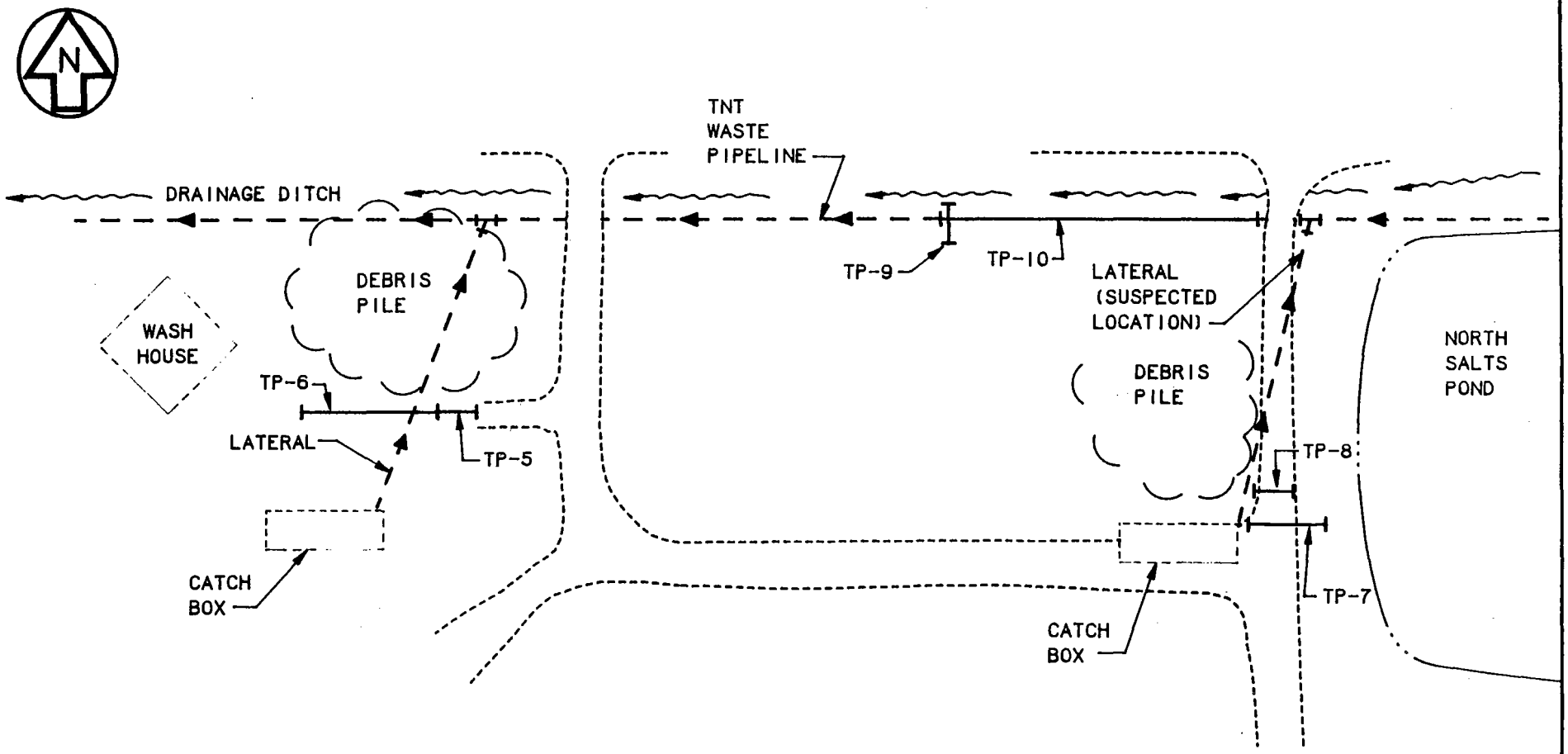
pit TP-1 resulted in identifying the location of the acid waste pipeline along the suspected trend of the pipeline (as will be discussed in Section 3, Geophysical Results, the geophysical survey was unsuccessful in locating the acid waste pipeline). The pipeline was found to be encased in concrete measuring about 2.5 ft wide by 4 ft deep with the top of the concrete at a depth of about 7 ft below ground surface. Attempts to break open the concrete encasement using the bucket of the excavator were unsuccessful. The second test pit excavated in this area (TP-2) was advanced in an easterly direction from the exposed pipeline in test pit TP-1 for a distance of about 35 ft, exposing the concrete encased pipeline along the entire distance. To determine if the pipeline was encased in concrete along its full length, a third test pit (TP-3) was excavated adjacent to the manhole and revealed concrete encased pipeline. After additional unsuccessful attempts were made to open the encased pipeline, the test pits were backfilled. Based on the sturdiness of the concrete encasement, the excavator operator believed that the pipeline may have been filled with concrete (possibly during the construction of the adjacent drainage ditch).

Prior to abandoning the acid waste pipeline area, one final attempt was made to expose and sample the pipeline. Test pit TP-4 was excavated in an east-west direction across the trend of a pipeline lateral leading to the Bi-Tri Nitro House at a location just north of the acid waste manhole. The concrete encased pipeline in this test pit was encountered at a depth of about 5 ft. This concrete encased pipeline was broken open by the excavator exposing 10-in diameter vitreous clay pipe. The pipeline was empty and dry and therefore there were no samples taken. The test pit was backfilled and excavation activities were moved to the TNT pipeline areas. All test pits excavated in the acid waste pipeline area were dry upon completion.

b. TNT Waste Pipelines

In an attempt to locate TNT waste pipelines, excavation activities were initially concentrated in the vicinity of suspected TNT pipeline laterals originating from the Wash House Catch Boxes. In Area 2 of the Geophysical Survey, test pit TP-5 was excavated in an east-west direction in the area just northeast of the western exposed catch box (see Figure 2-6). This test pit was excavated for a distance of 20 ft to a depth of approximately 10 ft without finding the pipeline. The excavation was then moved about 65 ft further west but remaining in line with test pit TP-5. In this test pit (TP-6), an encased TNT waste pipeline lateral was encountered at a location approximately 10 ft west of test TP-5 at a depth of about 5.5 ft. Upon opening this concrete encased (10-in vitreous clay) pipeline with the excavator, an estimated 30 gallons of water drained from the pipeline. After the flow of water had diminished, a light brown silty residue could be observed occupying about one-third of the pipeline. Samples of the residue (TNT-1-89-W) and soils (TNT-1-89-S) underlying the encased pipeline were then collected. Prior to backfilling, a cement plug composed of 94 lbs of Portland Type I cement and sufficient water to make a workable mixture was hand-packed into each end of the exposed pipeline.

Test pit excavation activities were then moved to Area 3 of the Geophysical Survey located just west of the North Salts Pond. In this area, test pits TP-7 and TP-8 were excavated to locate and sample another Catch Box lateral. Test pit TP-7 was excavated in an area immediately adjacent to an area where CWM personnel had reported encountering a blue liquid during their excavation activities. Both test pits TP-7, excavated in an east-west direction for a length of 40 ft and to a depth of about 12 ft, and TP-8, also excavated in an east-west direction for a length of 15 ft and to a depth of about 12 ft, failed to reveal any signs of TNT waste pipelines or any other foreign materials.



LEGEND

TP-5 TEST PIT

LAKE ONTARIO ORDNANCE WORKS
TNT PIPELINE AREA
TEST PIT
LOCATION MAP

SCALE 0 80 160 FEET

FIGURE 2-6

ACRES

The final test pits for locating and sampling TNT waste pipelines were excavated in Area 4 of the Geophysical Survey. The first test pit in this area, TP-9, was excavated in a north-south direction. A concrete encased TNT waste pipeline was encountered at a depth of about 3 ft below ground surface. Before attempting to open the TNT pipeline at this location, test pit TP-10 was advanced in an easterly direction from test pit TP-9 for a distance of about 120 ft exposing the concrete encased pipeline in an unsuccessful attempt to locate the lateral originating from the Catch Box. Test pit TP-10 was then backfilled and the concrete encased TNT pipeline in test pit TP-9 opened. Once the concrete encased pipeline was opened, an estimated 200 gallons of water drained from the pipeline. When the flow of water had diminished, the 18-in diameter vitreous clay pipeline was observed to be about 1/3 full of potential TNT residue. The deposit in the pipeline consisted of a black silt on top of a tan silty-clay. Samples of the pipeline residue (TNT-2-89-W) and underlying soils (TNT-2-89-S) were then collected. Upon completion of sample collection, the two open ends of the pipeline were plugged with cement and the test pit backfilled. During the excavation of test pits in the TNT area, test pit TP-6 was the only excavation to produce groundwater, albeit very low in volume. Test pit logs are presented in Attachment B.

2.5.2 - <u>TNT and Acid Waste Pipeline Sampling</u>

Samples of the TNT waste pipelines and underlying soils were collected into prelabeled 8 oz glass sample jars using dedicated stainless steel spoons. Each sample was then transferred to the field office trailer and chilled until subsequent TNT screening. At the field office trailer, approximately 3.5 g of each sample was taken from each sample jar and placed into individual 4 oz jars. Approximately 35 ml of anhydrous methanol was then added

to each 4 oz jar and shaken vigorously for approximately one minute. After allowing several minutes for settling, 3 ml of the methanol solution was decanted into a 40 ml VOA vial. Two drops of 10 percent aqueous sodium hydroxide solution was then added to the decantate and color change noted. The appearance of a purple color indicates the presence of TNT. Of the samples screened, only the sample from the TNT catch box lateral (TNT-1-89-W) indicated the presence of TNT.

All TNT waste pipeline and soil samples were then packed with vermiculite into one gallon paint cans, chilled, and shipped by ground freight to the COE Missouri River Division (MRD) Laboratory for United States Army Toxic and Hazardous Materials Agency (USATHAMA) explosives analyses.

Because the acid waste pipeline could not be directly sampled, one sample (Acid-1-89) of the sediment within the acid waste pipeline manhole was collected for analysis of USATHAMA explosives, sulfates, and nitrates. This sediment sample was collected on January 4, 1990, using a stainless steel hand auger. At the time of sample collection the manhole contained approximately 2 ft of leaves, twigs, and sediments. The sample was collected from the lower portion (predominantly sediment) of this material. The collected sample was placed into two prelabeled 8 oz glass jars, chilled, and delivered to the laboratory for subsequent analyses. One of the two 8 oz sample jars was analyzed for sulfates and nitrates and the other was analyzed for explosives following USATHAMA methodology. There was no field screening for TNT performed on these samples.

2.6 - Surface Water and Sediment Sampling

Surface water and sediment samples were collected from five locations in the drainage ditch system in Areas A and B on November 16, 1989, by Acres

personnel (see Figure 2-3 and Table 2-3). One sample set of surface water (SS-89-1-W) and sediment (SS-89-1-S) was collected from a location approximately 20 ft downstream of the CWM stormwater retention pond weir (upgradient of Area A). A second sample set (SS-89-2-S and SS-89-2-W) was collected from a point approximately 200 ft downstream of the weir (downgradient of Area A). In Area B, an upgradient sample set (SS-89-3-S and SS-89-3-W) was collected from the drainage ditch to the immediate west of Area B at a point approximately 50 ft north of H Street. A second sample set (SS-89-4-S and SS-89-4-W) was collected downgradient of Area B at a point in the Area B drainage ditch approximately 25 ft south of the confluence of the Area A and Area B drainage ditches.

The fifth surface water and sediment sample set (SS-89-5-W and SS-89-5-S, respectively) was collected from a point in the drainage ditch system approximately 100 ft downgradient of the confluence of the Area A and Area B drainage ditches.

In addition, one surface water sample set (SW-89-1) was collected from the pond in Area B.

All surface water samples were collected directly into the appropriate prelabeled sample containers. Upon collection of each surface water sample, measurements of pH, temperature, and conductivity were recorded. These measurements are presented in the field sampling report presented as Attachment C. All sediment samples were collected from the immediate proximity of each respective surface water sample after the surface water sample was collected. Samples scheduled for volatile organic analyses were collected directly into appropriate sample containers. The remaining samples were collected into precleaned, dedicated per sample, stainless steel homogenization bowls using dedicated, precleaned stainless steel spoons. Once each sediment sample was collected, it was thoroughly homogenized and then placed into appropriate prelabeled sample containers. Surface water and sediment sample collection was initiated at the most down-

TABLE 2-3
SURFACE WATER, SEDIMENT, AND GROUNDWATER SAMPLES
ADDITIONAL FIELD INVESTIGATIONS

	ANALYTICAL PARAMETERS(1)							
SAMPLE I.D.	VOLATILES	SEMI-VOLATILES	PEST/PCBs	BORON	LITHIUM	17 METALS(2)	3 METALS(3)	COMMENTS
SS-89-1S	X	X	X	---	---	X	---	Area A drainage ditch - upgradient sediment sample
SS-89-1W	X	X	X	---	---	X	---	Area A drainage ditch - upgradient surface water
SS-89-2S	X	X	X	---	---	X	---	Area A drainage ditch - downgradient sediment
SS-89-2W	X	X	X	---	---	X	---	Area A drainage ditch - downgradient surface water
SS-89-3S	X	X	X	---	---	X	---	Area B drainage ditch - upgradient sediment sample
SS-89-3W	X	X	X	---	---	X	---	Area B drainage ditch - upgradient surface water
SS-89-4S	X	X	X	---	---	X	---	Area B drainage ditch - downgradient sediment sample
SS-89-4W	X	X	X	---	---	X	---	Area B drainage ditch - downgradient surface water
SS-89-5S	X	X	X	---	---	X	---	Areas A & B drainage ditch - downgradient sediment
SS-89-5W	X	X	X	---	---	X	---	Areas A & B drainage ditch - downgradient surface water
SS-S-DUP	X	X	X	---	---	X	---	Duplicate of SS-89-2S
SS-W-DUP	X	X	X	---	---	X	---	Duplicate of SS-89-2W
SS-RB	---	X	X	---	---	X	---	Rinse blank prior to collecting sample SS-89-5S
TB-1	X	---	---	---	---	---	---	Trip Blank associated with surface water and sediment samples
PT-89-1	X	X	X	---	---	---	X	Drilling water sample from hydrant
MW-A-89	X	X	X	X	X	---	---	Area A groundwater sample
MW-B-1S	X	X	X	X	X	---	---	Area B groundwater sample
MW-DUP	X	X	X	X	X	---	---	Duplicate of MW-A-89
MW-TB	X	---	---	---	---	---	---	Trip blank associated with groundwater sample
MW-RB	---	X	X	X	X	---	---	Rinse blank prior to collecting sample MW-A-89

NOTES:
(1) Volatile, semi-volatile, and pest/PCBs analyses performed according to Methods 8240, 8270, and 8080 stated in SW 846 3rd Edition; tentative compound identification by computer library search not performed. Boron analyses performed according to Method 6010. Lithium analyses performed according to Method 303A in "Standard Methods for the Examination of Water and Wastewater", APHA, SWWA, WPCF, 16th Ed., 1985.
(2) 17 metals (by SW-846) include As, Ba, Be, B, Cd, Cr, Cu, Fe, Pb, LI, Hg, Ni, K, Se, Ag, Th, and Zn.
(3) 3 metals (by SW-846) include TR+D As, Hg, and Se.

stream sampling point and proceeded upstream. Duplicate surface water and sediment samples were collected from sampling point SS-89-2 while rinse blanks were collected prior to sampling at point SS-89-5.

Once collected, all samples were chilled, chain of custody initiated, and delivered to Recra Environmental Inc. (Recra) for subsequent analyses.

2.7 - Groundwater Sampling

The Scope of Work presented in the Supplement to the Work Plan called for sampling the two newly installed wells (i.e. MW-A-89 and MW-B-89) and resampling monitoring well MW-C-1S. Monitoring well MW-C-1S was not resampled because it had sustained damage which was probably a result of excavation activities in the vicinity of the well. Damage to this well was evidenced by a substantially cracked concrete collar and dented protective casing. The protective casing had also been knocked downward approximately 0.6 ft relative to the inner PVC riser.

As previously mentioned in Section 2.2.4, Monitoring Well Installation, monitoring well MW-B-89 had not produced a sufficient quantity of water at the time of groundwater sampling. As an alternative, monitoring well MW-B-1S was used for Area B groundwater sample collection in lieu of sampling well MW-B-89. However, it is anticipated that monitoring well MW-B-89 will produce groundwater during times of greater groundwater recharge and would be utilized for remediation and post-remediation monitoring, if possible.

Monitoring wells MW-A-89 and MW-B-1S were purged on January 3, 1990 in preparation for groundwater sampling the next day. The purging of monitoring well MW-A-89 also coincided with the last day of well development. Prior to sampling, monitoring well MW-A-89 had a minimum of 29 gallons of water removed.

Monitoring well MW-B-1S was purged to dryness with a volume of approximately 12 gallons of water removed prior to sampling. Measurements of groundwater level, pH, conductivity, temperature, and visual clarity were recorded at the time of purging and are presented in Attachment C.

Groundwater sampling was performed on wells MW-A-89 and MW-B-1S on January 4, 1990 after allowing approximately 15 hours for the wells to recover from the previous days purging. Groundwater samples were collected from each monitoring well using dedicated 1-1/4-in OD stainless steel bailers fitted with Teflon coated stainless steel cable. Sample collection proceeded with collecting volatile organic samples first and then collecting the remaining samples. All samples were collected directly into the appropriate prelabeled sample containers. Measurements of temperature, pH, conductivity, and visual clarity were recorded at the time of sample collection.

Internal duplicate samples for analyses by Recra were collected from monitoring well MW-A-89 while external duplicate samples for analyses by the COE MRD Laboratory were collected from monitoring well MW-B-1S. In addition, a rinse blank was collected prior to collecting groundwater samples from monitoring well MW-A-89. Groundwater sample designations and analyses are presented in Table 2-3.

Upon completion of groundwater sample collection, the samples were chilled, chain of custody initiated, and delivered to the appropriate laboratories for subsequent analyses. Figure 2-7 summarizes all areas investigated during this RI/FS program.

2.8 - Analytical Procedures

2.8.1 - Analytical Schedule

Surface water and sediment samples collected during the additional field investigation were analyzed for the parameters presented in Table 2-4. Groundwater samples were analyzed for parameters presented in Table 2-5. A sample of the water used in well construction and grout mixture was collected from the site fire hydrant prior to

TABLE 2-4
LOOW - ANALYTICAL PARAMETERS
SURFACE WATER AND SEDIMENT SAMPLES
ADDITIONAL FIELD INVESTIGATIONS

ANALYSES	METHOD	REFERENCE
Volatiles	8240 (TCL)	1
Semi-Volatiles	8270 (TCL)	1
Pesticides/PCBs	8080 (TCL)	1
Arsenic	7060	1
Barium	7080	1
Beryllium	7090	1
Boron	6010	1
Cadmium	7130	1
Chromium	7190	1
Copper	7210	1
Iron	7380	1
Lead	7421	1
Lithium	303A	2
Mercury	7470	1
Nickel	7520	1
Potassium	7610	1
Selenium	7740	1
Silver	7760	1
Thallium	7841	1
Zinc	7950	1

References and Notes:

1. "Test Methods for Evaluating Solid Waste", SW 846, Third Edition, USEPA, Office of Solid Waste and Emergency Response, November 1986.

2. "Standard Methods for the Examination of Water and Waste Water" APHA, AWWA, WPCF, 16th Ed. 1985.

3. Sediment samples for metals analyses were prepared according to SW-846 Method 3050.

4. A complete listing of the target compound list (TCL) is presented in Attachment E.

TABLE 2-5
LOOW - ANALYTICAL PARAMETERS
GROUNDWATER SAMPLES
ADDITIONAL FIELD INVESTIGATIONS

ANALYSES	METHOD	REFERENCE
Volatiles	8240 (TCL)	1
Semi-Volatiles	8270 (TCL)	1
Pesticides/PCBs	8080 (TCL)	1
Lithium	303A	2
Boron	6010	1

References and Notes:

1. "Test Methods for Evaluating Solid Waste", SW 846, Third Edition, USEPA, Office of Solid Waste and Emergency Response, November 1986.

2. "Method for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, USEPA, Environmental Monitoring and Support Laboratory, Revised March 1983.

3. A complete listing of the target compound list (TCL) is presented in Attachment E.

TABLE 2-6
LOOW - ANALYTICAL PARAMETERS
DRILLING WATER SOURCE
ADDITIONAL FIELD INVESTIGATIONS

ANALYSES	METHOD	REFERENCE
Volatiles	8240 (TCL)	1
Semi-Volatiles	8270 (TCL)	1
Pesticides/PCBs	8080 (TCL)	1
Arsenic (TR+D)	7060	1
Mercury (TR+D)	7470	1
Selenium (TR+D)	7740	1

References and Notes:

1. "Test Methods for Evaluating Solid Waste", SW 846, Third Edition, USEPA, Office of Solid Waste and Emergency Response, November 1986.

2. A complete listing of the target compound list (TCL) is presented in Attachment E.

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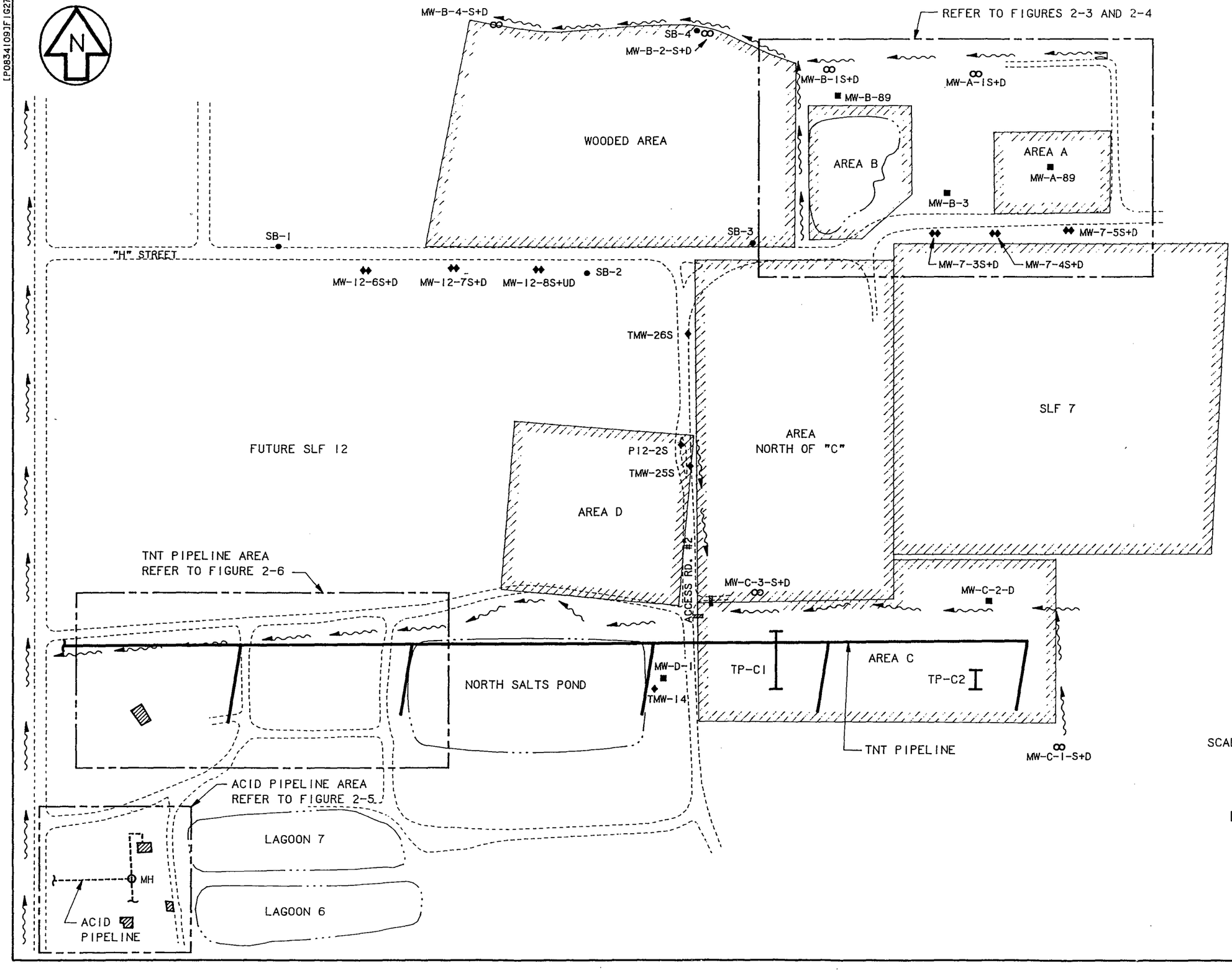


LEGEND

- ■ MONITORING WELL INSTALLED BY ACRES
- ∞ MONITORING WELL COUPLET INSTALLED BY ACRES
- ◆ MONITORING WELL INSTALLED BY OTHERS
- ◆◆ MONITORING WELL COUPLET INSTALLED BY OTHERS
- • SOIL BORING
- I TEST PIT

SCALE 0 200 400 FEET

LAKE ONTARIO ORDNANCE WORKS
SUMMARY OF AREAS
OF INVESTIGATION

FIGURE 2-7 ACRES

initiating drilling activities and analyzed for the parameters presented in Table 2-6. A complete detailed listing of the target compound list (TCL) is presented in Attachment E. Table 2-2 presents a detailed listing of samples and analytical parameters for subsurface soil samples collected during the supplemental field investigations. Samples collected from the TNT waste pipeline and underlying soils were analyzed for USATHAMA explosives by the COE MRD Laboratory following methods developed according to USATHAMA specifications. Samples from the acid waste pipeline manhole were analyzed by metaTRACE Inc., using method No. LW07 which was also developed according to USATHAMA specifications. Sulfate and Nitrate analyses of the acid waste manhole sample were performed by Recra using SW 846 3rd Edition Methods 9035 and 9200, respectively.

Changes in the analytical program from the initial RI program involved analyses for boron, rinse and trip blank collection frequency, and tentatively identified compound identification.

Boron analyses performed during the initial RI program were conducted according to Method 212.3 found in "Method for Chemical Analysis of Water and Wastewater", EPA 600/4-79-020, Revised 1983. This method using flame atomic absorption resulted in detection limits typically of 500 ug/g for soil samples. In order to attain lower detection limits, soil samples collected during the supplemental field investigation were analyzed according to Method 6010 found in SW-846 using inductively coupled plasma (ICP) analyses which resulted in substantially lower detection limits (typically 5.5 ug/g).

Because subsurface soil samples were collected over a long period of time, from November 20 through December 15, 1989, the collection and analyses of rinse and trip blanks was limited to analyzing one set of rinse and trip blanks per area (i.e., Area A, Area B, and the area between Areas A and B). This also equated to analyzing one set of rinse and trip blanks per ten samples sent to the laboratory for analyses. In addition, rinse and trip blanks accompanied surface water, sediment and groundwater samples.

During the initial field investigation conducted in 1988, samples analyzed for volatile and semi-volatile organic compounds received mass spectral library searches but did not reveal any significant concentrations of tentatively identified compounds. Therefore, library searches were eliminated from the analytical program of the supplemental investigations in order to reduce investigative costs and because it was felt that the contaminants of concern had already been adequately identified by standard target compound analyses.

2.8.2 - Deliverable Package

The deliverable analytical report from Recra as requested by the COE consisted of:

- All analytical results in tabular form;
- Matrix spike and matrix spike duplicate analysis;
- Field blank (trip and rinse blanks) results;
- Field duplicate analysis (submitted blind);
- Laboratory blank results;
- Surrogate spike and recovery data; and
- Chain-of-custody records.

Summary tables of the analytical results for trip, rinse, and method blanks are presented in Attachment E. A copy of the complete original analytical report for all samples analyzed during the supplemental investigation is available from Acres upon written request to Acres (with subsequent approval from COE). Summary tables listing only quantifiable non-negated target compound concentrations are provided in Section 4, Analytical Results. Summary tables including negated compound concentrations and qualifiers for data negation are provided in Attachment E.

2.9 - Land Survey

Upon completion of all drilling, test pit excavation, and sample collection activities, the locations of the newly installed monitoring wells, soil borings, and TNT waste pipeline sampling points were surveyed for coordinate locations and elevations by Ivan R. Klettke, licensed land surveyor. The grid coordinate system and elevation datum referenced in the land survey are CWM site systems and datum and are not related to any state or federal coordinate system or elevation datum. The elevation datum is, however, approximately equal (within 1 ft) to mean sea level datum.

The results of the land survey are presented in Attachment D. The elevation survey included the elevations of ground surface at each monitoring well and soil boring location, as well as elevations of the top of the stainless steel riser and protective steel casing for each monitoring well. The ground surface elevations for each monitoring well and soil boring have been included on the associated subsurface boring logs presented in Attachment B. All monitoring well and soil boring locations have been plotted on an area map and presented in Figures 2-3 and 2-4.

3 - RESULTS OF THE ADDITIONAL GEOPHYSICAL SURVEY

As previously mentioned in Section 2.3, the follow-up geophysical survey was intended to:

- Delineate the location of buried TNT and acid waste pipelines utilizing ground penetrating radar and electromagnetic surveys;

- Define the southern extent of the buried drum trench in Area A using electromagnetic and vertical gradient magnetic surveys; and

- To clear proposed soil boring locations using vertical gradient magnetic surveys.

A copy of pertinent sections of the geophysical report prepared by multiVIEW Geoservices is provided as Attachment A to this Supplement. The results presented in the geophysical report and actual subsurface site investigations are briefly discussed in the following subsections.

3.1 - TNT and Acid Waste Pipeline Delineation

The results of the geophysical survey in Area 1 indicated that the acid waste pipeline was located approximately 10 ft north of the baseline at a depth of about 8 ft below ground surface. Test pit excavation activities in this area revealed the concrete encased acid pipeline directly beneath the baseline at a depth of about 7 ft below ground surface.

In Area 2, several isolated anomalies were detected but no clear inference would be made as to the location of the TNT pipeline lateral. Test pit excavation activities in this area revealed the TNT pipeline lateral in the location of the western ends of survey lines 2 and 3 in this area.

In Area 3, no linear trends of interpreted anomalies could be distinguished. Actual test pit excavation activities in this area also failed to expose any TNT pipeline laterals.

In Area 4, the geophysical survey report indicated that there were virtually no anomalous conditions present, inferring that the waste pipelines may not be present in this area. However, actual test pit excavation activities in this area revealed the concrete encased TNT pipeline at a depth of about 3 ft below ground surface trending across the approximate center of the two survey lines. The lack of success in using the ground penetrating radar to determine the locations of the buried pipelines was contributed to the high clay and moisture content of the site soils.

3.2 - Area A - Buried Drum Trench

The geophysical results of the electromagnetic and vertical gradient magnetic surveys in Area A indicated an excellent correlation between the two data sets. The results strongly suggest that the buried drum trench trends east-west with the southern boundary of the trench located on the northern side of H Street. The results of the geophysical survey also indicate that the buried drum trench probably extends beyond the eastern and western sides of the survey grid.

The results of the additional geophysical survey correlates very well with the geophyscial survey performed during the initial RI program which was conducted in 1988. In addition, the results of drilling operations in this area confirm the results of the geophysical survey. Drilling performed to date indicate that the anomalous zone identified in Area A during the initial geophysical survey (see Plate 1 of Appendix C in the Final RI Report, PD-8) may actually define the boundaries of the buried drum trench.

3.3 - Borehole Clearing Survey

The vertical gradient magnetometer survey resulted in the clearing of 14 of 17 borehole locations, 4 of which were moved from their original locations. Proposed borehole locations on the eastern side of the drum burial trench were not cleared because of suspected buried metal.

4 - ANALYTICAL RESULTS

This section presents a summary of validated analytical data for samples collected during the supplemental field investigations. A summary of procedures used to validate the analytical data as well as the implications of rinse and trip blank collection frequency is presented as Attachment E-2. The following subsections present summaries of analytical data for each area of concern (i.e. Area A, Area B, the area between Areas A and B and TNT and Acid waste pipelines). Summary tables of the analytical data with negated concentrations and qualifers are presented in Attachment E.

This section makes reference to specific samples identified by an alpha-numeric code. This code indicates the location and depth of the sample. For example, sample BB-1-10-12 designates that the sample was taken in Area "B" from boring "B-1" at a depth of 10-12 feet.

4.1 - Area A - Analytical Results

Table 4-1 presents a summary of the organic and inorganic compounds detected in the nine subsurface soil samples collected from Area A. As indicated in this table, only four volatile organic compounds were detected: acetone, methylene chloride, tetrachloroethene, and toluene. Of these compounds acetone was detected most frequently, being found in seven of the nine samples in concentrations ranging from 28 to 610 ug/kg. Of the remaining volatile organic compounds, methylene chloride was detected in six samples, but the presence of this compound in four of the six samples was negated through data validation and the remaining two detections were at concentrations below the contract required quantitation limit (CRQL).

Tetrachloroethene was detected in two samples, but negated through data validation. Toluene was also detected in two samples, but at concentrations below the CRQL.

The analytical results for semi-volatile organics for Area A samples indicate the presence of five compounds: phenol, 4-chloroaniline, 2-methylnaphthalene, di-n-butylphthalate and bis (2-ethylhexyl) phthalate.

TABLE 4-1

SUMMARY OF ORGANIC AND INORGANIC ANALYSES

AREA A - SUBSURFACE SOIL SAMPLES

CHEMICAL PARAMETERS	ACB-1* 2-4'	ACB-1* 14-16'	AB-2* 6-8'	AB-4 12-14'	AB-9 6-8'	AB-13 12-14'	AB-14 6-8'	AB-14 6-8 (Dup)	AB-14 8-10'
Volatile Organics (ug/kg)									
Methylene Chloride	N	N	6 DJ	N	14 BDJ	N	-	-	-
Acetone	28	-	330 D	49	610 D	350 D	40	130	-
Tetrachloroethene	N	N	-	-	-	-	-	-	-
Toluene	1 J	-	-	-	11 DJ	-	-	-	-
TOTAL	29	-	336	49	635	350	40	130	-
Semi-Volatile Organics (ug/kg)									
Phenol	-	-	-	-	-	-	-	-	86 J
4-Chloroaniline	150 J	-	-	-	-	-	-	-	-
2-Methylnaphthalene	38 J	-	-	-	-	-	-	-	-
Di-n-butylphthalate	4400 B	N	N	N	750 BJ	N	2500 B	N	N
bis(2-Ethylhexyl)Phathalate	N	N	N	N	N	N	N	N	N
TOTAL	4588	-	-	-	750	-	2500	-	86
TOTAL ORGANICS	4617	-	336	49	1385	350	2540	130	86
Inorganics (mg/kg)									
Boron	<5.8	70.0	<5.5	63.7	86.8	<5.5	8.4	14.0	6.4
Lithium	35.7	32.7	27.4	49.1	107	27.2	37.5	42.0	36.4

NOTES:

1) Quantities listed indicated detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantification Limit (CRQL).
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
6) < indicates that the compound was not detected at the Contract Required Detection Limit (CRDL).
7) N indicates compound negated through data validation.
8) D indicates compound analyzed at secondary dilution factor.
9) • The holding times of seven days as required by the COE was exceeded for semi-volatile organics in these samples. However, these samples were extracted within 14 days as specified in SW-846 3rd Edition.
10) Samples ACB-1-2-4, ACB-1-14-16, AB-2-6-8, AB-4-12-14 and AB-9-6-8 were initially collected in 16 oz. glass jars and transferred into 4 oz. sample jars after the soil screening process.

Phenol was detected in only one sample (AB-14-8-10) at a concentration below the CRQL. Similarly, 4-chloroaniline and 2-methylnaphthalene were detected in one sample (ACB-1-2-4) at concentrations below the CRQL. The remaining two semi-volatile organic compounds, di-n-butylphthalate and bis (2-ethylhexyl) phthalate, were detected in all samples but bis (2-ethylhexyl) phthalate was negated in all samples through data validation and di-n-butylphthalate was negated in six of the nine samples. In the remaining three samples, di-n-butylphthalate was also detected in the method blank.

Boron and lithium were the only inorganic compounds analyzed in Area A subsurface soil samples. Boron was detected in six of the nine samples in concentrations ranging from 6.4 to 86.8 mg/kg. The highest concentrations of boron were found in samples from the buried drum trench. Lithium was detected in all samples in concentrations ranging from 27.2 to 107 mg/kg with the highest concentrations also occurring in the buried drum trench.

4.2 - Area B - Analytical Results

Table 4-2 presents a summary of the organic and inorganic compounds detected in Area B subsurface soil samples. In contrast with Area A which had only one compound (acetone) present in most samples, the contaminants detected in Area B were predominantly found in only four of the twelve subsurface soil samples (samples BB-1-10-12, BB-5-4-6, BB-9-12-14, and SB-3-89-4-6). In sample BB-1-10-12, collected from the inside of the bermed pond, three volatile organic compounds were detected at elevated concentrations (i.e. acetone 69 ug/kg, carbon disulfide 26 ug/kg, and chloroform 35 ug/kg). Methylene chloride was detected in this sample but negated through data validation while benzene was detected at a concentration below the CRQL. Benzoic acid was the only semi-volatile organic compound detected in this sample, but this compound was also detected in the method blank.

Sample BB-9-12-14, collected from the middle of "H" Street to the south of Area B, displayed the greatest concentration of contaminants of any of the samples collected and analyzed during the additional field investigation. This sample contained the volatile organic compounds carbon tetrachloride

TABLE 4-2
SUMMARY OF ORGANIC AND INORGANIC ANALYSES
AREA B - SUBSURFACE SOIL SAMPLES

CHEMICAL PARAMETERS	BB-1* 10-12'	BB-1* 12-14'	BB-2* 6-8'	BB-2* 10-12'	BB-3* 6-8'	BB-3* 8-10'	BB-4* 6-8'	BB-5* 4-6'	BB-7 10-12'	BB-7 10-12' (Dup)	BB-9 12-14'	SB-3-89 0-2	SB-3-89 4-6'	SB-3-89 6-8'
Volatile Organics (ug/kg)														
Methylene Chloride	N	N	-	N	-	8 B	-	N	-	-	N	N/A	N	N/A
Acetone	69	-	-	-	-	-	-	-	-	-	-	N/A	800	N/A
Carbon Disulfide	26	-	-	-	-	-	-	-	-	-	-	N/A	-	N/A
Chloroform	35	-	-	-	-	-	-	1 J	2 J	3 J	110 J	N/A	-	N/A
Carbon Tetrachloride	-	-	-	-	-	-	-	-	-	-	4500	N/A	-	N/A
Benzene	3 J	-	-	-	-	-	-	-	-	-	-	N/A	-	N/A
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-	11000		-	N/A
TOTAL	133	-	-	-	-	8	-	1	2	3	15610	-	800	-
Semi-Volatile Organics (ug/kg)														
Hexachloroethane	-	-	-	-	-	-	-	-	-	-	9000 E	N/A	-	N/A
Benzoic Acid	90 J	-	39 J	-	-	-	-	-	-	-	-	N/A	-	N/A
Napthalene	-	-	-	-	-	-	-	190 J	-	-	36 J	N/A	-	N/A
2-Methylnapthalene	-	-	-	-	-	-	-	580	-	-	57 J	N/A	-	N/A
Phenanthrene	-	-	-	-	-	-	-	-	-	-	53 J	N/A	-	N/A
Di-n-Butylphthalate	-	N	2500 B	N	N	N	N	N	1400 B	N	N	N/A	N	N/A
bis-(2-Ethylhexyl) Phthalate	-	N	290 BJ	450 BJ	420 BJ	450 BJ	N	420 BJ	90 J	230 J	N	N/A	N	N/A
TOTAL	90	-	2829	450	420	450	-	1190	1490	230	9146		-	N/A
TOTAL ORGANICS	223	-	2829	450	420	458	-	1191	1492	233	24756	N/A	800	N/A
Inorganics (mg/kg)														
Boron	84.9	32.0	18.5	15.9	26.1	53.8	23.4	58.0	31.5	33.2	12.5	18.8	29.8	10.1
Lithium	33.1	32.9	30.5	28.3	56.3	53.6	39.3	39.1	53.8	60.4	34.0	25.6	28.5	14.5

NOTES:

1) Quantities listed indicated detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantitation Limit (CRQL).
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
6) N indicates compound negated through data validation.
7) N/A indicates compound not analyzed for.
8) * indicates samples which were initially collected in 16 oz. glass jars and transferred into 4 oz. sample jars after the soil screening process.

and tetrachloroethene at concentrations of 4,500 and 11,000 ug/kg, respectively. Chloroform was detected at a concentration below the CRQL and the presence of methylene chloride was negated through data validation. Hexachloroethane, at an estimated concentration of 9,000 ug/kg, was the only semi-volatile organic compound detected above the CRQL. Naphthalene, 2-methylnaphthalene and phenanthrene were found at concentrations below the CRQL while the presence of di-n-butylphthalate and bis (2-ethylhexyl) phthalate were negated through data validation.

Sample BB-5-4-6, collected from the immediate south of the bermed pond, contained an elevated concentration of 2-methylnaphthalene at 580 ug/kg. Naphthalene and chloroform were detected at concentrations below the CRQL. Di-n-butylphthalate and methylene chloride were also detected, but negated through data validation. Bis (2-ethylhexyl) phthalate was detected at a concentration below the CRQL and was also detected in the method blank.

Sample SB-3-89-4-6, collected from the southeastern corner of the Wooded Area, displayed an elevated concentration of acetone at 800 ug/kg. The only other compounds detected in this sample, methylene chloride, di-n-butylphthalate, and bis (2-ethylhexyl) phthalate, were negated through data validation.

As shown in Table 4-2, the compounds detected in the remaining samples were either at concentrations below the CRQL, negated through data validation, or also present in the method blanks.

Boron and lithium were the only inorganic compounds analyzed in the Area B subsurface soil samples. Boron was found in all samples in concentrations ranging from 12.5 to 84.9 mg/kg. The highest boron concentration was found in sample BB-1-10-12 which was collected from within the burn pit. Lithium was also found in all samples from Area B with concentrations ranging from 28.3 to 60.4 mg/kg.

4.3 - Area Between Areas A and B - Analytical Results

Detailed chemical analyses were performed on six subsurface soil samples collected from five randomly selected locations in the area between Areas A and B. As shown in Table 4-3, the greatest concentration of contaminants was detected in sample B-3-12-14 which was collected from the immediate east of the bermed pond in Area B. This sample contained elevated concentrations of four volatile organic compounds: acetone (150 ug/kg), chloroform (110 ug/kg), tetrachloroethene (480 ug/kg), and toluene (420 ug/kg). Carbon tetrachloride was detected, but at a concentration below the CRQL. Methylene chloride was also detected, but negated through data validation.

Di-n-butylphthalate and bis (2-ethylhexyl) phthalate were the only two semi-volatile organic compounds detected in sample B-3-12-14, however, di-n-butylphthalate was also detected in the method blank and bis (2-ethylhexyl) phthalate was negated through data validation.

Sample B-2-6-8 was the only sample which did not contain any unqualified concentrations of organic compounds. Any compounds that were detected were either qualified as negated, present in the method blank or at concentrations below the CRQL.

Of the remaining four samples (B-1-8-10, B-4-10-12, B-4-10-12-duplicate, and B-5-10-12), acetone, ranging in concentration from 31 to 150 ug/kg, was the only volatile organic compound detected above the CRQL and not negated through data validation.

Di-n-butylphthalate and bis (2-ethylhexyl) phthalate were the only two semi-volatile organic compounds detected in the area between Areas A and B samples, but these compounds were either negated, also present in the method blanks or present at concentrations below the CRQL.

A total of 16 subsurface soil samples collected from this area were analyzed for boron and lithium. The concentrations of boron in these samples ranged from 4.8 to 82.0 mg/kg. Lithium concentrations ranged from 13.4 to 33.7 mg/kg.

Volatile Organics (ug/kg)															
Methylene Chloride	N/A	17 B	N/A	N/A	N/A	N	N/A	N/A	N	N/A	N/A	–	N	N/A	N
Acetone	N/A	130	N/A	N/A	N/A	–	N/A	N/A	150 D	N/A	N/A	92	150	N/A	N
Chloroform	N/A	–	N/A	N/A	N/A	–	N/A	N/A	110 D	N/A	N/A	–	–	N/A	N
Carbon Tetrachloride	N/A	–	N/A	N/A	N/A	–	N/A	N/A	21 DJ	N/A	N/A	–	–	N/A	N
Tetrachloroethene	N/A	–	N/A	N/A	N/A	–	N/A	N/A	480 D	N/A	N/A	–	–	N/A	N
Toluene	N/A	2 J	N/A	N/A	N/A	–	N/A	N/A	420 D	N/A	N/A	–	–	N/A	N
TOTAL	–	149	–	–	–	–	–	–	1181	–	–	92	150	–	–
Semi-Volatile Organics (ug/kg)															
Di-n-Butylphthalate	N/A	N	N/A	N/A	N/A	420 BJ	N/A	N/A	1500 B	N/A	N/A	N	N	N/A	I
bis-(2-Ethylhexyl) phthalate	N/A	N	N/A	N/A	N/A	260 BJ	N/A	N/A	N	N/A	N/A	N	1400 B	N/A	I
TOTAL	–	–	–	–	–	660	–	–	1500	N/A	N/A	–	1400	–	–
TOTAL ORGANICS	–	149	–	–	–	660	–	–	2681	–	–	92	1550	–	
Inorganics (mg/kg)															
Boron	17.0	19.3	4.8	21.8	61.4	14.7	55.0	57.8	82.0	45.9	46.9	44.5	24.3	28.8	5
Lithium	30.9	30.1	22.7	33.7	28.7	30.9	20.7	32.9	30.3	13.4	32.8	25.8	29.1	18.8	2

NOTES:

1) Quantities listed indicated detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantitation Limit (CRQL).
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
6) < indicates the compound not detected at the Contract Required Detection Limits (CRDL).
7) N indicates compound negated through data validation.
8) N/A indicates compound not analyzed for.

TABLE 4-3
SUMMARY OF ORGANIC AND INORGANIC ANALYSES
AREA BETWEEN A & B SUBSURFACE SOIL SAMPLES

CHEMICAL PARAMETERS	B-1 4-6'	B-1 8-10'	B-1 12-14'	B-2 0-2'	B-2 4-6'	B-2 6-8'	B-3 0-2'	B-3 8-10'	B-3 12-14'	B-4 2-4'	B-4 6-8'	B-4 10-12'	B-4 10-12' (Dup)	B-5 0-2'	B-5 6-8	B-5 10-12'
Volatile Organics (ug/kg)																
Methylene Chloride	N/A	17 B	N/A	N/A	N/A	N	N/A	N/A	N	N/A	N/A	-	N	N/A	N/A	N
Acetone	N/A	130	N/A	N/A	N/A	-	N/A	N/A	150 D	N/A	N/A	92	150	N/A	N/A	31
Chloroform	N/A	-	N/A	N/A	N/A	-	N/A	N/A	110 D	N/A	N/A	-	-	N/A	N/A	-
Carbon Tetrachloride	N/A	-	N/A	N/A	N/A	-	N/A	N/A	21 DJ	N/A	N/A	-	-	N/A	N/A	-
Tetrachloroethene	N/A	-	N/A	N/A	N/A	-	N/A	N/A	480 D	N/A	N/A	-	-	N/A	N/A	-
Toluene	N/A	2 J	N/A	N/A	N/A	-	N/A	N/A	420 D	N/A	N/A	-	-	N/A	N/A	-
TOTAL	-	149	-	-	-	-	-	-	1181	-	-	92	150	-	-	31
Semi-Volatile Organics (ug/kg)																
Di-n-Butylphthalate	N/A	N	N/A	N/A	N/A	420 BJ	N/A	N/A	1500 B	N/A	N/A	N	N	N/A	N/A	930 BJ
bis-(2-Ethylhexyl) phthalate	N/A	N	N/A	N/A	N/A	260 BJ	N/A	N/A	N	N/A	N/A	N	1400 B	N/A	N/A	N
TOTAL	-	-	-	-	-	660	-	-	1500	N/A	N/A	-	1400	-	-	930
TOTAL ORGANICS	-	149	-	-	-	660	-	-	2681	-	-	92	1550	-	-	961
Inorganics (mg/kg)																
Boron	17.0	19.3	4.8	21.8	61.4	14.7	55.0	57.8	82.0	45.9	46.9	44.5	24.3	28.8	58.8	38.2
Lithium	30.9	30.1	22.7	33.7	28.7	30.9	20.7	32.9	30.3	13.4	32.8	25.8	29.1	18.8	28.3	31.3

NOTES:

1) Quantities listed indicated detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantitation Limit (CRQL).
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
6) < indicates the compound not detected at the Contract Required Detection Limits (CRDL).
7) N indicates compound negated through data validation.
8) N/A indicates compound not analyzed for.

4.4 - Areas A and B Drainage Ditch System - Analytical Results

A total of six sediment samples were collected from five locations in the Area A and B drainage ditch system. Sampling point SS-89-2 was collected in duplicate for both sediment and surface water samples.

The analytical results for the sediment samples, presented in Table 4-4, indicate the presence of acetone in all sediment samples in concentrations ranging from 80 to 150 ug/kg. Methylene chloride was also detected in all samples, but negated through data validation. The semi-volatile organics, di-n-butylphthalate and bis (2-ethylhexyl) phthalate, were also detected and negated in all six samples except for sample SS-89-4S in which di-n-butyphthalate was not negated but was detected in the method blank.

Analyses for pesticides and PCBs in the sediment samples revealed the presence of Aroclor-1260 in samples SS-89-2S, SS-89-3S, and SS-89-4S in concentrations of 700, 3400, and 1500 ug/kg, respectively. Aroclor-1248 was detected in only one sample SS-89-2S, at a concentration of 240 ug/kg. Aroclor-1260 was present in each of the remaining samples but at concentrations below the working detection limit.

Each sediment sample collected from the Area A and B drainage ditch system was analyzed for 17 metals (see Table 4-4). The analytical results indicate that the Area B drainage ditch sediment samples have relatively higher concentrations of barium, boron, cadmium, copper, lead, lithium, mercury, and nickel in comparison with other sediment samples. The highest concentration of boron (430 mg/kg) was found in sample SS-89-5S which was collected from the location downstream of the confluence of the Area A and B drainage ditch system.

Review of the analytical results for the surface water samples, Table 4-5, indicates the absence of any of the sediment sample contaminants in the surface water samples. The results of the metals analyses does indicate that the Area B drainage ditch upstream sample (SS-89-3W) contains relatively high concentrations of barium, chromium, copper, iron, potassium, and zinc in comparison with the remaining drainage ditch surface water samples.

TABLE 4-4

SUMMARY OF ORGANIC AND INORGANIC ANALYSES

AREA A & B DRAINAGE DITCH SYSTEM SEDIMENT SAMPLES

CHEMICAL PARAMETERS	SS-89-1S	SS-89-2S	SS-89-2S (Dup)	SS-89-3S	SS-89-4S	SS-89-5S
Volatile Organics (ug/kg)						
Methylene Chloride	N	N	N	N	N	N
Acetone	130	150	81	190	80	150
Semi-Volatile Organics (ug/kg)						
Di-N-Butylphthalate	N	N	N	N	23000B	N
bis-(2-Ethylhexyl)Phathalate	N	N	N	N	-	N
Pesticides/PCBs (ug/kg)						
Aroclor - 1248	-	240	-	-	-	-
Aroclor - 1260	≤1400	700	≤1400	3400	1500	≤1500
Inorganics (mg/kg)						
Arsenic	13.3	9.3	10.0	9.7	13.0	11.4
Barium	186	102	131	291	252	133
Beryllium	0.88	1.5	1.5	1.1	1.5	1.8
Boron	<88	73.1	<82.7	121	254	430
Cadmium	3.7	2.5	3.5	6.1	5.8	2.5
Chromium	50.8	23.2	24.8	59.6	76.2	66.1
Copper	65.4	40.8	45.6	97.4	77.7	58.7

TABLE 4-4 (Cont'd)
SUMMARY OF ORGANIC AND INORGANIC ANALYSES
AREA A & B DRAINAGE DITCH SYSTEM SEDIMENT SAMPLES

CHEMICAL PARAMETERS	SS-89-1S	SS-89-2S	SS-89-2S (Dup)	SS-89-3S	SS-89-4S	SS-89-5S
Iron	35700	29100	30900	26600	26900	28300
Lead	56.2	30.7	29.8	139	70.0	42.7
Lithium	40.8	33.8	38.5	150	104	86.4
Mercury	0.44	1.2	1.5	1.8	2.2	0.67
Nickel	36.9	32.2	34.7	53.2	46.3	30.2
Potassium	2760	2030	2080	1990	2120	1700
Selenium	0.88	<0.73	0.86	<0.68	<1.2	1.0
Silver	1.8	1.0	1.7	2.2	1.1	<0.89
Thallium	0.88B	<0.73	<0.83	<0.68	<1.1	<0.89
Zinc	624	269	217	351	2.3	244

NOTES:

1) Quantities listed indicated detectable concentrations.
2) No data entry indicates no detectable concentration.
3) B indicates the presence of the compound in the method blank.
4) N indicates compound negated through data validation.
5) < indicates that the compound was not detected at the Contract Required Detection Limit (CRDL).
6) ≤ indicates compound may be present at trace levels relative to the detection limit but not subject to accurate quantification.

TABLE 4-5
SUMMARY OF ORGANIC AND INORGANIC ANALYSES
SURFACE WATER AND GROUNDWATER

CHEMICAL PARAMETERS	SS-89-1W	SS-89-2W	SS-89-2W (Duplicate)	SS-89-3W	SS-89-4W	SS-89-5W	SW-89-1	MW-A-89	MW-A-89 (Duplicate)	MW-B-1S
Volatile Organics (ug/l)										
Methylene Chloride	N	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	N	-	-	-	-	-	-	-
Tetrachloroethene	-	N	N	-	N	N	-	-	-	-
Benzene	-	-	-	-	-	-	-	0.6 J	-	-
Toluene	-	-	-	-	-	-	-	1 J	-	-
Chlorobenzene	-	-	-	-	-	-	-	0.7 J	-	-
Semi-Volatile Organics (ug/l)										
bis (2-ethylhexyl) phthalate	10 BJ	10 BJ	12 BJ	11 BJ	12 BJ	N	8 BJ	7 J	3 J	-
Pesticides/PCBs (ug/l)										
alpha BHC	0.15	0.14	0.15	0.49	0.30	0.18	$\leq$0.07	NA	NA	NA
Inorganics (mg/l)										
Total Arsenic	0.0032 B	0.0034 B	0.0046 B	0.071	<0.005	0.0054 B	0.0057 B	NA	NA	NA
Total Barium	0.23	0.31	0.15 B	1.3	0.36	0.32	0.32	NA	NA	NA
Total Beryllium	<0.005	<0.005	0.005	<0.005	<0.005	0.0065	<0.005	NA	NA	NA
Total Boron	<0.5	<0.5	<0.5	0.89	2.00	<0.5	27.0	5.7	5.7	0.79
Total Cadmium	0.012	0.006	0.007	0.023	0.008	0.012	0.008	NA	NA	NA
Total Chromium	0.01	0.013	0.011	0.17	0.012	0.017	<0.010	NA	NA	NA
Total Copper	0.019 B	0.023 B	0.020 B	0.22	0.009 B	0.024 B	0.017 B	NA	NA	NA
Total Iron	2.5	3.4	2.12	68.8	1.3	4.0	4.4	NA	NA	NA
Total Lead	0.012	0.014	0.011	0.096	<0.005	0.013	0.012	NA	NA	NA
Total Lithium	0.023	0.017	0.038	0.43	0.89	0.054	42.9	0.15	0.15	0.053
Total Mercury	<0.0004	<0.0004	<0.0004	0.006	<0.0004	<0.0004	<0.0004	NA	NA	NA
Total Nickel	<0.04	<0.04	<0.04	0.14	<0.04	0.05	<0.04	NA	NA	NA
Total Potassium	6.3	6.1	6.29	15.8	4.9 B	6.2	8.1	NA	NA	NA
Total Selenium	0.0086	0.0074	0.0042 B	0.0085	0.0077	0.0062	0.0039 B	NA	NA	NA
Total Silver	<0.005	0.005 B	<0.005	0.006 B	<0.005	<0.005	<0.005	NA	NA	NA
Total Zinc	0.077	0.1	0.082	0.96	0.080	0.12	0.079	NA	NA	NA

TABLE 4-5
SUMMARY OF ORGANIC AND INORGANIC ANALYSES
SURFACE WATER AND GROUNDWATER
(Cont'd)

NOTES:

2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantitation Limit (CRQL).
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
6) N indicates compound negated through data validation.
7) N/A indicates compound not analyzed for.

The highest concentrations of boron and lithium were noted in downstream sample (SS-89-4W) at 2.0 mg/l and 0.89 mg/l, respectively.

The analytical results for sample SW-89-1, collected from the Area B pond indicate elevated levels of boron (27.0 mg/l) and lithium (42.9 mg/l) which were substantially higher than the other surface water (drainage ditch) samples. There were no organic compounds detected above the CRQL in sample SW-89-1.

4.5 - Groundwater - Analytical Results

Analytical results for groundwater samples collected during the additional field investigation are presented in Table 4-5. As shown on this table, only three volatile organic compounds (benzene, chlorobenzene, and toluene) and one semi-volatile organic compound (bis (2-ethylhexyl) phthalate) were detected in sample MW-A-89 and all were at concentrations below the CRQL. There were no organic compounds detected in sample MW-B-1S.

Boron and lithium were the only two inorganic compounds analyzed in both groundwater samples. As shown in Table 4-5, both of these compounds were found in the groundwater samples. The concentration of boron and lithium were at relatively higher concentrations in sample MW-A-89 (boron 5.7, lithium 0.15) than in MW-B-1S (boron 0.79, lithium 0.053).

4.6 - TNT and Acid Waste Pipeline - Analytical Results

Analytical results for samples collected from the TNT waste pipeline system are presented in Table 4-6. As shown in this table, sample TNT-1-89-W, a pipeline residue sample collected from the western catch box lateral, contains the greatest concentration of explosives. The explosives compounds found in this sample are predominately trinitrotoluene (TNT) at 18,019 mg/kg and 2,4-dinitrotoluene (2,4-DNT) at 6,957 mg/kg. This sample also contains low concentrations of HMX (80 mg/kg), RDX (6 mg/kg) and trinitrobenzene (17 mg/kg). A sample of the underlying soils was found to contain only relatively low concentrations of TNT (4.96 mg/kg) and 2,4-DNT (1.56 mg/kg). There were no explosive compounds detected in the pipeline

TABLE 4-6
SUMMARY OF ANALYSES OF TNT AND ACID WASTE PIPELINE SAMPLES
ADDITIONAL FIELD INVESTIGATIONS

Parameter (mg/kg)	TNT-1-89-W	TNT-1-89-S	TNT-2-89-W	TNT-2-89-S	ACID-1-89
HMX	80	-	-	-	-
RDX	6	-	-	-	-
TNB	17	-	-	-	-
DNB	-	-	-	-	-
Tetryl	-	-	-	-	-
TNT	18019	4.96	-	-	-
2,4-DNT	6957	1.56	-	-	-
Nitrates	N/A	N/A	N/A	N/A	14.8
Sulfates	N/A	N/A	N/A	N/A	335

Notes:

(1) Explosives analyses of samples performed by MRD laboratory according to USATRAMA Method SM-02.

(2) No data entry indicates compound not detected.

(3) Explosives compounds are as follows:
HMX - Cyclotetramethylenetetranitramine
RDX - Cyclotrimethylenetrinitramine
DNB - Trinitrobenzene
DNB - Dinitrobenzene
Tetryl - Trinitrophenylmethylnitramine
TNT - Trinitrotoluene
2,4-DNT - 2,4-Dinitrotoluene

(4) N/A = Not Analyzed

sample or underlying soil sample collected from the main TNT waste pipeline system (TNT-2-89). Results for explosives analyses for the acid waste pipeline sample did not reveal the presence of any explosive compounds.

4.7 - Potable Water Results

Potable water used during the field investigation was obtained from the site fire hydrant located east of Area C. Results of the analyses of potable water used during the field investigation are summarized in Table 4-7. As shown in this table, chloroform and bromodichloromethane were the only two compounds detected in concentrations above the CRQL. Dibromochloromethane was also present, but at a concentration below the CRQL. The presence of tetrachloroethene was negated through data validation. Bis (2-ethylhexyl) phthalate was the only semi-volatile organic compound detected in the potable water sample, but at a concentration below the CRQL. This compound was also present in the method blank.

Total and soluble arsenic, mercury, and selenium were not detected in the potable water sample.

4.8 - Soil Headspace Screening Results

Soil headspace screening for organic vapors was performed on all subsurface soil samples collected during the additional field investigation. Based upon the results of the soil screening process, 27 samples were selected for detailed chemical analyses. A summary of the OVA soil headspace screening and chemical analytical results is presented in Table 4-8. Figure 4-1 presents a graphical depiction of the correlation of results of soil screening and chemical analyses. The following text provides a brief description of the soil screening results compared with the results of volatile organic analyses. Due to the ubiquitous presence of semi-volatile organic contaminants (typically phthalate esters) in the method blanks and the lack of detected concentrations of semi-volatile organic compounds above the CRQL, the discussion of the soil screening results was limited to volatile organic contaminants.

TABLE 4-7
SUMMARY OF ANALYTICAL RESULTS
POTABLE WATER (PT-1)
ADDITIONAL FIELD INVESTIGATIONS

Chemical Parameter	PT-1
Volatiles (ug/l)	
Chloroform	19
Bromodichloromethane	8
Dibromochloromethane	3J
Tetrachloroethene	*0.8JT
Semi-Volatiles (ug/l)	
Bis(2-Ethylhexyl)phthalate	10BJ
Inorganics (mg/l)	
Arsenic (Total)	<0.005
(Soluble)	<0.005
Mercury (Total)	<0.0004
(Soluble)	<0.0004
Selenium (Total)	<0.005
(Soluble)	<0.005

Notes:

(1) Quantities listed indicate detectable concentrations.
(2) B indicates the presence of the compound in the method blank.
(3) J indicates that the detected concentration is below the CRQL.
(4) < indicates compound not detected at given detection limits.
(5) * indicates data negated due to the presence of compound in the trip blank.

KAB 6/13/90
P0834109
FILE: FIG5-1

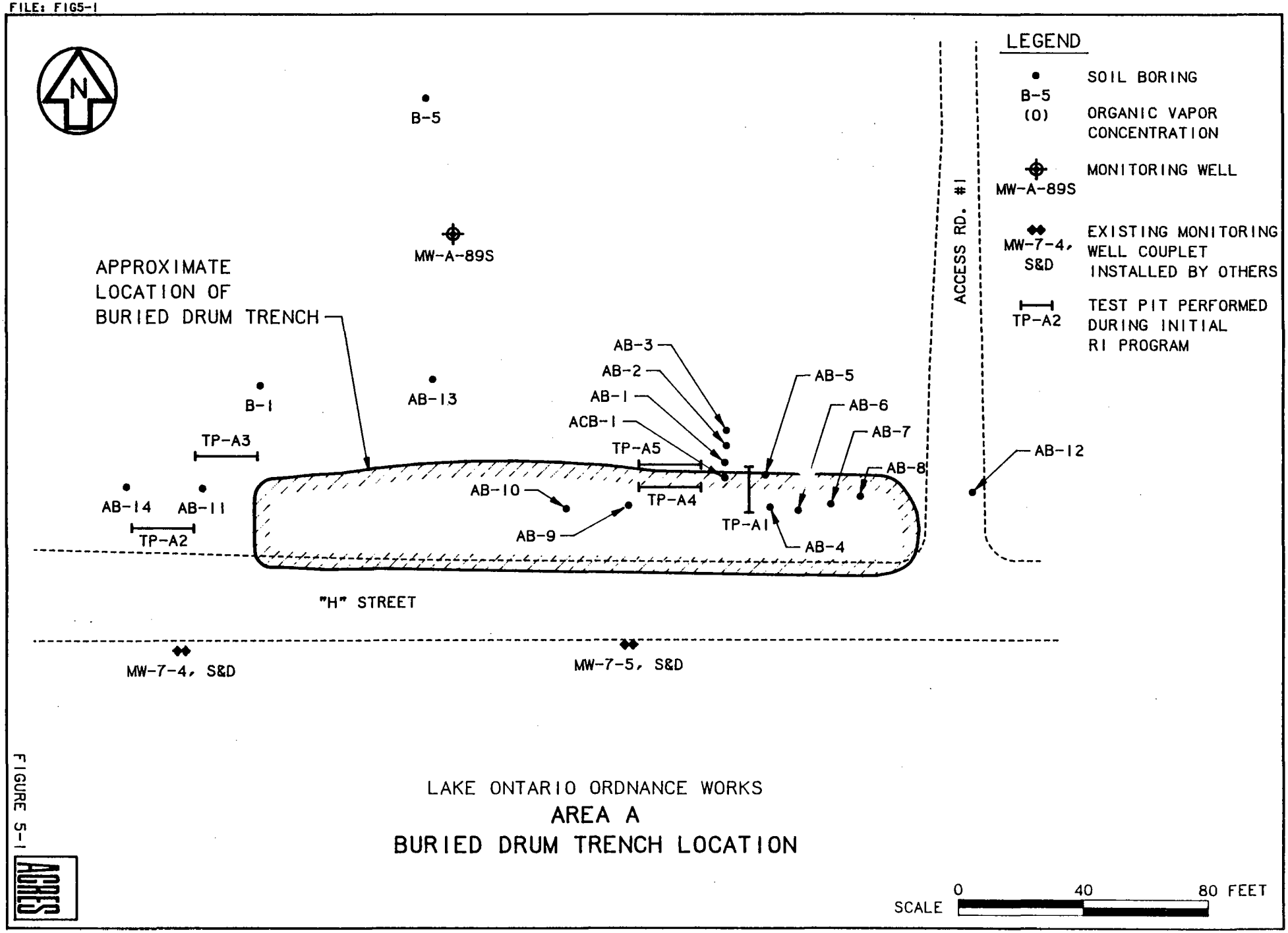


FIGURE 5-1

LAKE ONTARIO ORDNANCE WORKS

AREA A

BURIED DRUM TRENCH LOCATION

ACRES

The northern boundary of the trench is located about 25 ft north of "H" street. Drilling results indicate that this boundary is located between borings ACB-1, which penetrated the buried drum trench, and boring AB-1, which did not penetrate the drum trench. The distance between these two borings is 5 ft.

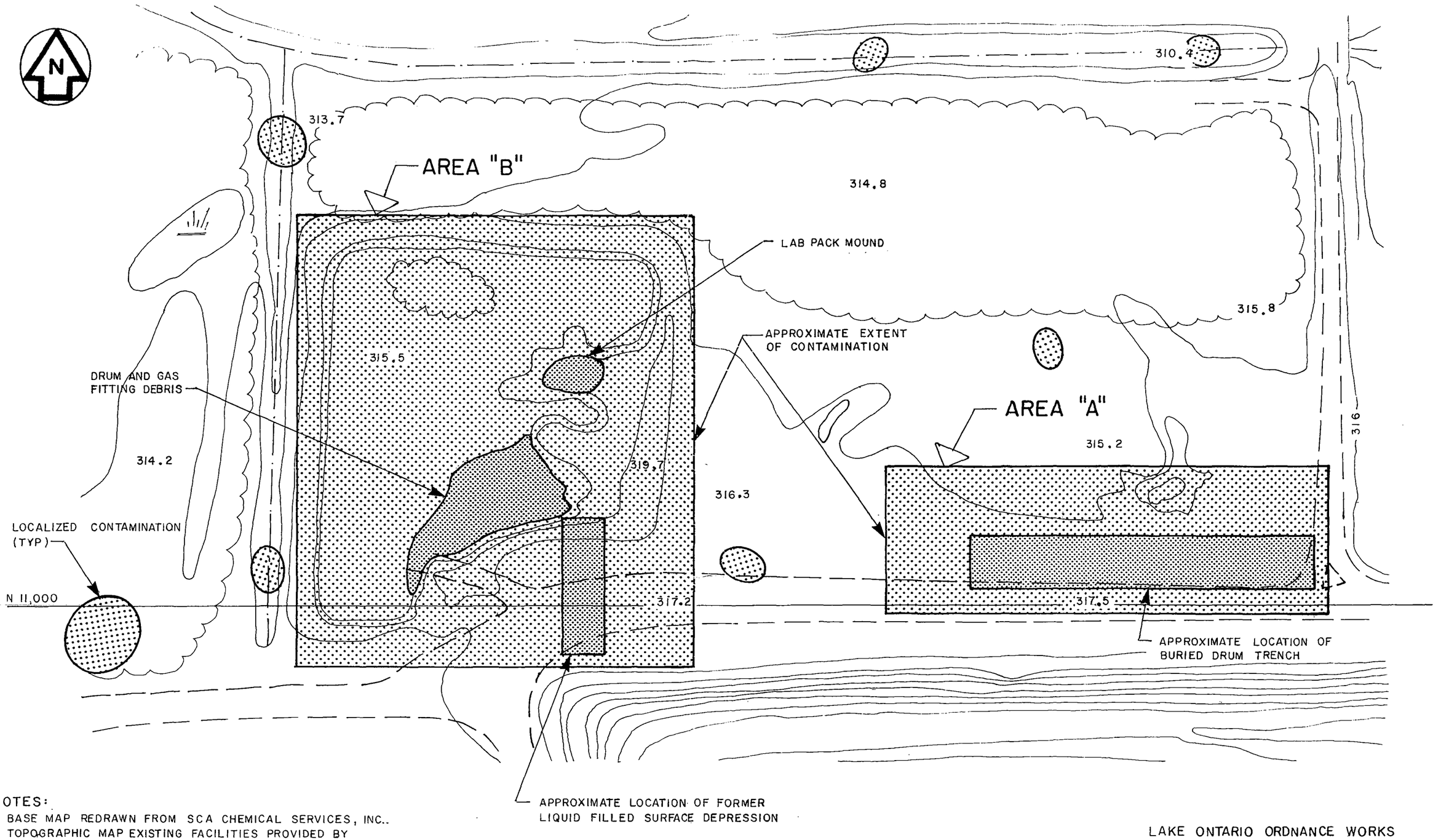
The location of this northern boundary as determined by drilling agrees with the results of the excavation of test pit TP-A5 performed in this area during the initial RI program.

The western boundary of the buried drum trench lies between borings AB-10 and AB-11. The distance between these borings is 117 ft. The previous geophysical results indicated that the western boundary of the buried drum trench is probably within 20 ft of boring AB-11. Test pits TP-A2 and TP-A3 performed in the AB-11 area during the initial RI program did not encounter the buried drum trench.

5.1.2 - Assessment of Contamination in Area A

Geophysical results from both the Ecology and Environment, Inc. Confirmation Study conducted in 1985 and the initial RI program performed by Acres in 1988 identified an elongated geophysical anomaly in Area A suspected to be a buried drum trench. Drilling and test pit excavation activities have since verified the existence, and better defined the boundaries, of this buried drum trench. The buried drum trench extends about 220 ft west from Access Road #1 and is approximately 35 ft in width with the southern boundary extending under the northern portion of "H" Street (see Figure 5-2).

Analytical results for test pit soils, water, and drum samples collected from the buried drum trench during the initial RI program identified the presence of 18 different organic contaminants occurring in concentrations above the CRQL. Of these compounds, acetone was most prominent being found in all samples and in greatest concentrations, ranging from 980 to 7300 ug/kg in the soil and drum samples and 1600 ug/l in the test pit water sample. Analytical



NOTES:

1. BASE MAP REDRAWN FROM SCA CHEMICAL SERVICES, INC.. TOPOGRAPHIC MAP EXISTING FACILITIES PROVIDED BY FRANK T. TRIPPI & ASSOCIATES, PC (JOB NO. 307-87).
2. SEDIMENT SAMPLES FROM THE DRAINAGE DITCH SYSTEM CONTAINED ACETONE CONTAMINATION, EXTENT IS UNKNOWN.

LAKE ONTARIO ORDNANCE WORKS

AREAS OF ASSESSED CONTAMINATION

SCALE 0 60 120 FEET

FIGURE 5.2

ACRES

results for the subsurface soil samples collected have also identified the presence of acetone contamination. However, acetone was the only organic contaminant identified in the subsurface soil samples in concentrations above the CRQL. The concentration of acetone contamination (up to 610 ug/kg) was also lower in the surrounding soils than in samples from within the buried drum trench.

The results of chemical analyses and soil headspace screening indicate that the lateral and vertical extent of acetone contamination is beyond the actual confines of the buried drum trench. The extent of contamination in Area A appears to be dependent on the presence of more permeable lenses, zones, and fractures within the upper glacial till unit and, to some extent, on previous intrusive site activities.

The presence of discontinuous fractures and silt and sand lenses was evident from test pit and drilling operations. In some instances, two exploration points were performed within 5 ft of each other with one point encountering groundwater while the other point was dry. For example, in Area A, all borings and test pits performed within the buried drum trench encountered abundant groundwater while very few borings outside of the trench encountered groundwater.

The results from detailed chemical analyses and soil headspace screening indicate that contamination associated with the buried drum trench is probably confined to within 50 ft of the defined boundaries of the buried drum trench (see Figure 5-2). Figure E-10 in Attachment E provides a summary of all exploration/sampling points utilized in the development of this figure. If there is a direct relationship between the occurrence of organic and inorganic contamination, i.e., both types of contaminants were disposed of at the same time, then the presence of elevated concentrations of organic contaminants and relatively low levels of inorganic contaminants (boron and lithium) in borings outside the drum trench may indicate that some migration of acetone (organic contaminant) in the vadose zone probably occurred through contaminant vapor diffusion.

In addition to disposal activities associated with the original operation of the buried drum trench, other possible routes of contaminant migration from Area A may be the result of past intrusive activities at the site. Review of available aerial photographs indicate intrusive activities were conducted in Area A as early as 1963. These activities were probably associated with the operation and decommissioning of Air Force Plant 68 (AFP-68). In 1979, extensive excavation activities related to the construction of SLF #7 were conducted in the area north of SLF #7 including Areas A, B and the area between A and B (refer to Figure 13 in Golder, 1989). Excavation activities were also conducted in Area A in 1980 and 1981 during SCA's remedial activities related to the clean up of the temporary drum storage area. Each of these intrusive activities could have contributed to the distribution of acetone contamination away from Area A to other portions of the site, such as at the locations of borings B-5 and AB-14 and in the drainage ditch sediments.

For the vertical migration route, soil headspace screening results indicate a distinctive drop in organic vapor concentration when moving from the upper glacial till unit to the more impermeable glaciolacustrine clay unit.

The possibility of contaminant migration from Area A via the surface runoff pathway is enigmatic due to the presence of acetone in similar concentrations in both the upgradient and downgradient sediment samples collected from the Area A drainage ditch. Analytical results for the drainage ditch sediments also identified the presence of low concentrations of PCB including Aroclor-1260 in both samples and Aroclor-1240 in the downgradient sample only. The surface water samples collected from these two locations were found to contain only very low levels of the pesticide alpha-BHC (0.14 to 0.49 ug/l). In order to determine the possible source of these contaminants, sediment sampling at points further upgradient of the Area A drainage ditch is recommended (refer to Section 6.5).

5.2 - Area B

5.2.1 - Review of Area B

Site background documentation and historical aerial photographs (photographs compiled by Golder Associates, Inc. for CWM, Golder 1989) indicate that several physical modifications have occurred in Area B. The first available aerial photograph which shows activities in Area B was taken on May 7, 1963. This photograph shows that the original disposal and incineration activities apparently occurred in the southern portion of Area B just north of "H" street. Two rectangular, liquid filled surface depressions also existed. One of the depressions measured about 200 ft long in the east-west direction by about 15 ft wide and was located in the northern portion of Area B. This depression is still visible in the northern portion of the bermed pond. The second surface depression measured about 100 ft long in the north-south direction by about 25 ft wide and was located in the southeast corner of Area B.

The next substantial change in Area B occurred as a result of the construction of SLF #7. During the construction of SLF #7, "H" Street was relocated about 25 ft north of its former location. This northern relocation of "H" street resulted in the elimination of the second surface depression mentioned above.

In 1981 SCA and Olin Mathieson conducted partial remediation of Area B. Although over 2,000 cubic yards of material was removed from Area B, the exact source(s) of material removed was not well documented.

The last significant physical modification to Area B occurred in 1986 when SCA constructed the berms which presently surround the pond in Area B. These berms were constructed in order to prevent the migration of surface water from the area. As a result, the bermed pond represents only about three-fourths of the original dimensions of Area B.

As part of the additional investigation in Area B, three soil borings were performed within the bermed pond and eight soil borings were performed outside the bermed pond. One of the outside borings was completed as a downgradient monitoring well. All subsurface soil samples were screened for volatile organic contaminants and 14 samples were selected for detailed chemical analyses. The chemical analyses were performed in order to determine the extent of contamination associated with the former burn pit.

One groundwater sample was collected from a downgradient monitoring well and two surface sample sets, each consisting of one surface water and sediment sample, were collected from the Area B drainage ditch. One surface water sample was collected from the ponded water in Area B. Detailed chemical analyses were performed on the sediment, surface water and groundwater samples in order to determine the presence of downgradient contaminant migration via the groundwater and surface water pathways.

5.2.2 - Assessment of Contamination in Area B

In Area B, only one of six samples from the three in-pond borings displayed detectable concentrations of contaminants (acetone, carbon disulfide, and chloroform). The low level concentrations of these contaminants are conspicuously different from the results for the pond sediment sample collected during the initial RI program which identified relatively high concentrations of other contaminants, specifically chlorobenzene, ethylbenzene, styrene, and 1,2,4-trichlorobenzene. This variety of contaminants is further confirmed by visual observations of the contents of the bermed pond. In the eastern section of the bermed pond, a circular area approximately 10 ft in diameter was excavated to a depth of about 12 ft (by persons unknown) revealing a variety of sample containers including 1 liter amber glass, 4 oz glass, 8 oz plastic and 40 ml septa vials (this area is referred to as the Lab Pack Mound in Figure 5-2). Some of these sample containers still contained liquid and soil matrix

encountered at approximately 3 ft below ground surface extending from the southern end of the test pit (located just north of H Street) to about 15 ft north in the test pit. Upon encountering the drums a substantial quantity of groundwater entered the test pit filling the test pit to the top of the drums. The drums found were predominantly 55 gallon drums with some 5 and 10 gallon drums. All drums were partially crushed and in various states of deterioration. Five drums were removed from the test pit using the excavation bucket and placed on plastic for subsequent sampling. Once sampling was completed (described in Section 5.5.2), each drum was placed in a separate over-pack Salvage drum, labeled and placed on plastic in a secure area until the final disposition of the drums is determined. The test pit was backfilled after soil samples from the test pit wall and bottom were collected.

As a result of negotiations with the COE regarding additional test pit excavations in Area A, the sequence of test pit excavations resulted in the excavator moving to excavate test pits in search of TNT and acid waste lines prior to returning to Area A. Prior to excavating any test pits in other areas the excavator bucket was decontaminated with high-pressure water by CWM personnel.

On July 22, 1988, additional test pits, TP-A2 through TP-A5, were excavated in Area A in an attempt to determine the boundaries of the drum burial trench. Test pits TP-A2 and TP-A3 were excavated in an east-west trend at the western end of the previously field-located geophysical anomoly. Each test pit was excavated to a depth of 8 ft and 20 ft in length. No drums or groundwater were encountered in these two test pits. Test pit excavation activities were then moved further east about 150 ft into the magnetic anomoly. During the excavation of test pit TP-A4, also excavated in an east-west direction, drums and groundwater were encountered at about 3 ft below ground surface. Test pit TP-A4 was then laterally extended to the north in an attempt to define the northern boundary of the drum burial trench. Test pit TP-A5 was excavated approximately 20 ft in length, 7 ft north of the original test pit TP-A4. No drums or

samples. In the southeastern portion of the bermed pond evidence of the disposal of metal drums and gas fittings was also observed (this area is identified on Figure 5-2 as the Drum and Gas Fitting Debris area).

Contamination in Area B, as determined from the supplemental field investigation, was found outside the eastern, southeastern, and southwestern sides of the bermed pond. To the east of the bermed pond, elevated concentrations of acetone, chloroform, tetrachloroethene and toluene were found in boring B-3.

The highest concentration of contaminants in Area B was found in boring BB-9 located southeast of the bermed pond in the middle of "H" Street. In a sample from this boring, concentrations of chloroform, tetrachloroethene and hexachloroethane totaled over 24,500 ug/kg.

The location of boring B-9 would be in the approximate center of the former southeastern surface depression. The detection in boring B-9 of carbon tetrachloride, tetrachloroethene (also found in boring B-3), and hexachloroethane may be due to the previous use of this depression as a waste disposal site. Contamination from this area may also be the source of chloroform, carbon tetrachloride, methylene chloride, and toluene contamination found in CMW well MW-7-3S located just southeast of this area. A review of the results of the MW-7-3S investigation performed by CWM in 1988 also indicate that this area may be a local source of the contamination found in well MW-7-3S.

Similar to Area A, acetone was detected in both upgradient and downgradient sediment samples collected from the Area B drainage ditch. In this particular instance, the downgradient sample contained a lower concentration of acetone (80 ug/kg) than the upgradient sample (190 ug/kg). The upgradient sample also contained a greater concentration of Aroclor-1260 (3400 ug/kg) than the downgradient sample (1500 ug/kg). These two sediment samples also contained the greatest concentrations of barium, boron, cadmium, copper, lead, lithium,

mercury, and nickel than other drainage ditch samples. Groundwater downgradient of Area B does not appear to be impacted. The areas of contamination in Area B are shown in Figure 5-2.

5.3 - Wooded Area

5.3.1 - Summary of Investigative Activities in the Wooded Area

To date, two soil borings, SB-3 and SB-3-89, have been performed in the southwestern portion of the Wooded Area. The purpose of these borings was to obtain subsurface soil samples for chemical analyses.

Analytical results for soil boring SB-3 indicate the presence of an elevated concentration of boron in the duplicate sample only; there were no organic analyses, except for explosives, performed on this sample. Soil boring SB-3-89 was performed during the supplemental field investigation in order to verify the presence of contamination in this area.

5.3.2 - Assessment of Contamination in the Southeast Corner of the Wooded Area

The analytical results for soil boring SB-3-89 revealed the presence of acetone contamination at 800 ug/kg. The results of soil headspace screening indicate that this contamination is probably confined to the near surface soils. The presence of acetone in this sample and in the sediment sample from surface sampling point SS-89-3 indicate that acetone contamination may be present around this immediate area and possibly related to the Area B burn pit or to the limited remedial activities previously conducted in the burn pit area. Soil headspace screening results of boring MW7-3S-4W conducted in this area by CWM during the MW-7-3S investigation did not reveal the presence of volatile organic vapors in that boring which further indicates that the occurrence of acetone may be local in extent.

The resultant areas of contamination in Areas A and B are shown in Figure 5-2.

5.4 - Area Between Areas A and B

5.4.1 - Summary of Investigations in the Area Between Areas A and B

A total of five borings were performed at randomly selected locations in the area between Areas A and B. The analytical results for boring B-1, located just north of the western end of the buried drum trench in Area A, reflect the contamination of the nearby buried drum trench. In the sample from this boring, acetone, at a concentration of 130 ug/kg, was the only organic compound detected. Acetone was also the only organic compound detected above the CRQL in the sample and duplicate sample from boring B-4 (92 and 150 ug/kg, respectively) and in the sample from boring B-5 (31 ug/kg). Elevated concentrations of acetone (150 ug/kg), chloroform (110 ug/kg), tetrachloroethane (480 ug/kg) and toluene (420 ug/kg) were detected in the sample from B-3. There were no organic compounds detected above the CRQL for the sample from boring B-2.

Three samples were selected from each of the soil borings in the area between Areas A and B for boron and lithium analyses. Samples from boring B-3 contained the highest concentration of boron, ranging from 52.0 to 82.0 mg/kg while samples from boring B-1 contained the lowest concentration of boron ranging from <4.8 to 19.3 mg/kg. The concentration of boron in the remaining samples was fairly equally distributed with a range of 14.7 to 61.4 mg/kg. Lithium concentrations were also equally distributed ranging from 13.4 to 33.7 mg/kg.

5.4.2 - Assessment of Contamination in the Area between Areas A and B

The presence of contamination in borings B-1, B-3, and B-4 appears to be related to nearby contaminant sources in either the buried drum trench (Area A) or burn pit (Area B). The presence of contamination in boring B-5 appears to be isolated and may be the result of the distribution of contaminants from the source areas by vapor diffusion or during previous disposal or remedial activities.

5.5 - TNT and Acid Wastelines

5.5.1 - Summary of TNT and Acid Wasteline Investigative Activities

A total of 10 test pits were excavated in order to determine the locations of the buried TNT and acid waste pipelines for subsequent sampling. Ground penetrating radar and electromagnetic geophysical survey techniques were unsuccessful in determining the locations of the buried pipelines. Results of test pit operations were successful in determining the locations of some sections of the concrete encased pipelines. Sections of the acid waste pipeline were located in the vicinity of existing TNT buildings, however, portions of the pipeline could not be opened and may possibly be filled with concrete. Another portion of the acid waste pipeline was opened but found to be dry and empty. Analytical results for a soil sample which was collected from an acid waste pipeline manhole in this area did not indicate the presence of explosive compounds.

One section of a TNT waste pipeline lateral was found originating from the western Wash House Catch Box. A sample of the residue from this concrete encased vitrified clay pipeline was found to contain over 18,000 ug/kg of explosive compounds. A sample of soil underlying this pipeline contained trace amounts of explosives but the presence of these compounds may be due to contamination caused by water exiting the pipeline at the time of excavation.

Excavation activities failed to locate another TNT pipeline lateral believed to be located in the vicinity (west) of the North Salts Pond. The excavation activities in this area also failed to reveal any discolored or foreign materials, as previously reported by CWM personnel in the area to the south of this excavation area.

One of the main TNT waste pipelines, trending in an east-west direction, was found in the area northwest of the North Salts Pond. Excavation activities in this area encountered a concrete encased 18-

in diameter vitreous clay pipeline. However, analytical results for the sample from this pipeline did not show the presence of any explosive materials.

5.5.2 - Assessment of TNT and Acid Waste Pipeline Contamination

The presence of explosive compounds in the buried TNT waste pipeline system has been confirmed by sampling and analyses conducted as part of this supplemental investigation. Although analytical results detected explosive compounds in only one of the two pipeline residue samples, previous investigations by SCA in 1983 found explosive compounds in concentrations up to 35 percent by weight (Hazards Research, 1983). Recent studies by the United States Army Toxic and Hazardous Materials Agency (USATHAMA) have determined that explosive-contaminated soil containing greater than 12 percent explosives is explosively reactive, even when wet (Little, 1987). Based upon the results of this study, USATHAMA suggested an explosive content of greater than 10 percent by weight as a limiting criteria for a potentially explosive hazard.

Considering the presence of explosive compounds in concentrations up to 35 percent by weight and that CWM is quite active in terms of construction and operations activities, the implied possible risk to onsite personnel has been judged to be moderate to high.

5.6 - Assessment of Groundwater Flow at the Site

Groundwater level measurements were recorded from 27 wells at the LOOW on January 3 and 4, 1990 in order to further define groundwater flow at the site. Groundwater measurements from wells south of the Wooded Area were not recorded during this period due to inaccessibility of the wells because of ongoing construction activities for SLF #12. However, groundwater level measurements recorded on November 16, 1989 are available for wells in the SLF #12 area. Based upon a review of groundwater level history and permeability data for these wells, it is believed that the November 16, 1989, groundwater levels are approximately representative of water levels

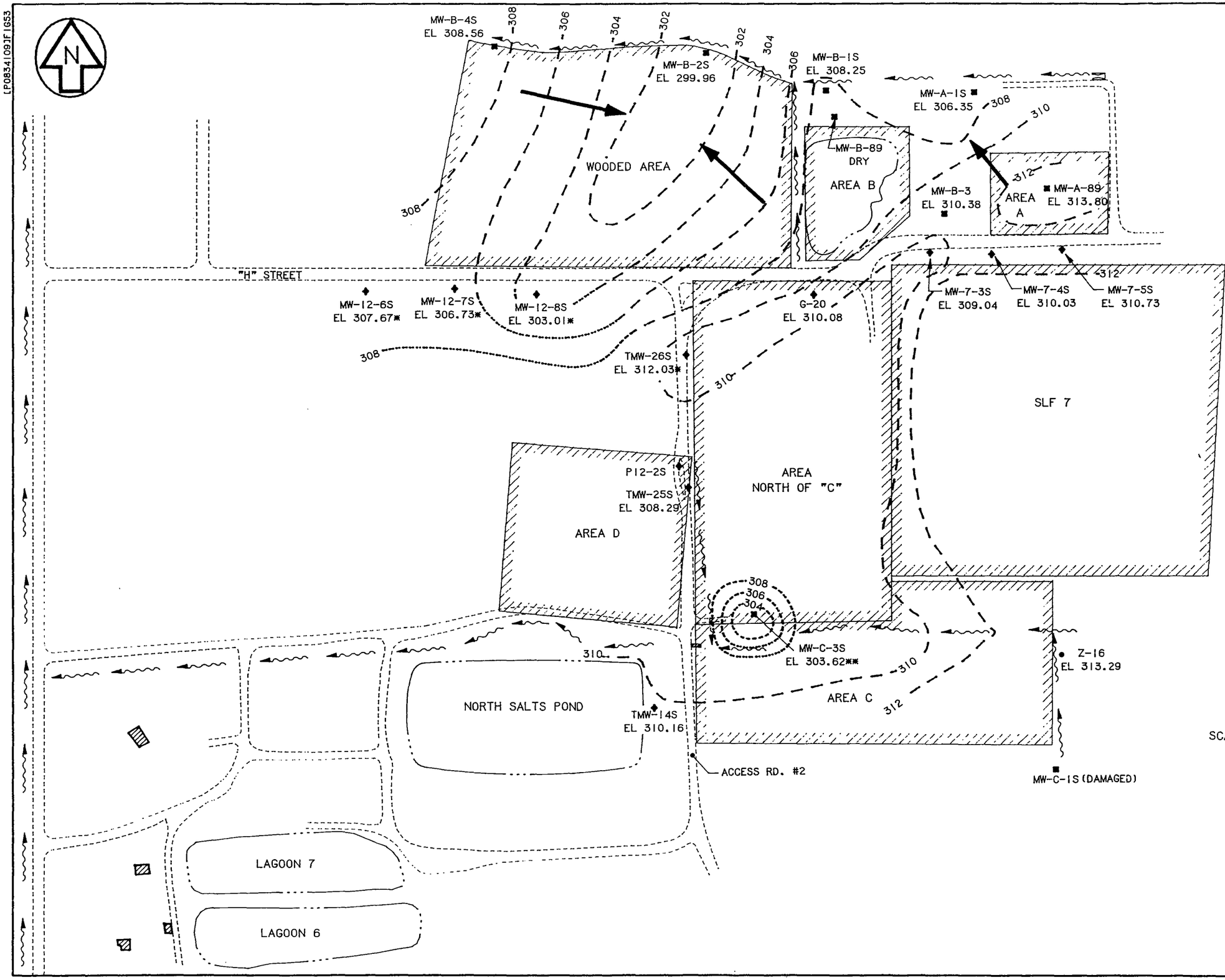
recorded during January 1990. Therefore, these data have been used in the construction of the Zone 1 Water Table Surface Contour Map (Figure 5-3) and Zone 3 Potentiometric Surface Contour Map (Figure 5-4). The groundwater level data recorded is summarized in Table 5-1.

5.6.1 - Upper Glacial Tills - Zone 1

The Water Table Surface Contour Map for Zone 1 (upper glacial till unit) was constructed using the November 1989 and January 1990 data (Figure 5-3) and contains more data points than the map constructed using 1988 data collected during the initial RI program (compare with Figure 8-11 in the Final RI Report). Still, the hydrogeologic data for the two periods of record reflects similar anisotropic characteristics of the upper glacial till unit. Upon review of these two figures some similarities are apparent. In particular, the two periods of record indicate the presence of zones of depression in the vicinities of wells MW-A-1S, MW-B-2S and MW-C-3S. Possible explanations for the observed results include the following:

- The observed zone of depression in the vicinity of monitoring well MW-A-1S may reflect the overall northerly groundwater flow of the site. Although the groundwater surface elevation of this well (El 306.35 ft) is well below the base of the drainage ditch elevation (approximately 310 ft) investigations by Golder (Golder, 1987) have found that site drainage ditches may have influence on groundwater flow in the vicinity of the ditches.

- The observed zone of depression in the vicinity of well MW-B-2S is basically similar for the two periods of record. In addition, a similar zone of depression is observed in the vicinity of monitoring well MW-12-8S. These two wells are probably in hydraulic communication as both wells are screened in alluvial silt/sand deposits. These more permeable alluvial deposits would therefore have a more profound influence on groundwater flow in these areas.



LEGEND

- ■ MW-A-1S — MONITORING WELL OR COUPLET INSTALLED BY ACRES
- ◆ MW-7-5S — MONITORING WELL OR COUPLET INSTALLED BY OTHERS
- EL 306.35 — GROUNDWATER ELEVATION MEASURED 1/3 & 4/90
- SURFACE DRAINAGE FLOW
- 306 — WATER TABLE SURFACE CONTOUR (INFERRED LOCATION). CONTOUR INTERVAL = 2 FT.
- 306 — WATER TABLE SURFACE CONTOUR (ESTIMATED LOCATION).
- GROUNDWATER FLOW LINE

NOTES

THE WATER TABLE SURFACE CONTOUR CONFIGURATION SHOWN HERE WAS CONSTRUCTED USING ACCEPTED HYDROGEOLOGIC PRACTICES AND PRINCIPLES. ACTUAL CONDITIONS MAY VARY FROM THOSE SHOWN.

* GROUNDWATER ELEVATION MEASURED 11/16/89, WELL INACCESSIBLE ON 1/3 & 4/90

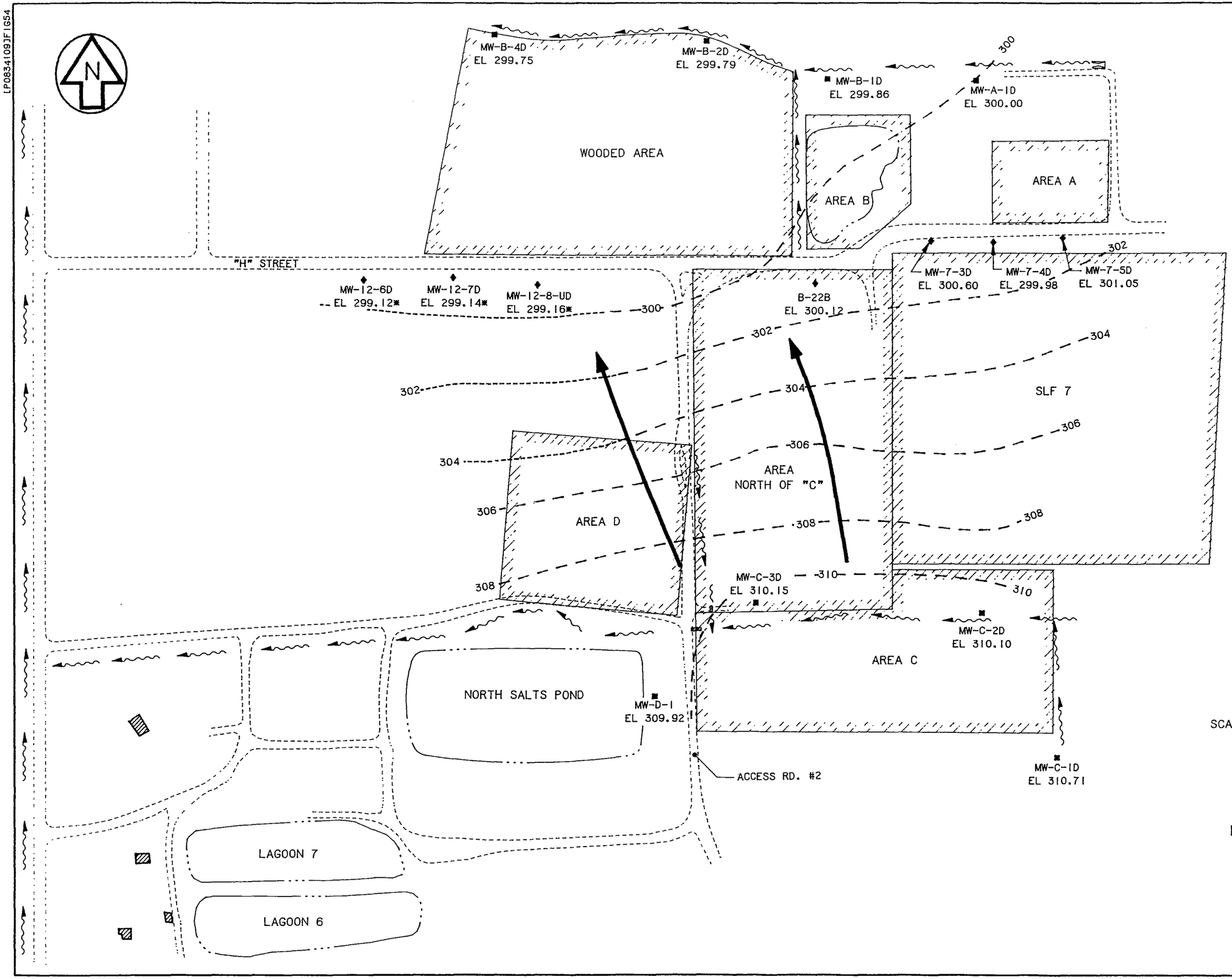
** THE WATER LEVEL FOR WELL MW-C-3S IS ANOMALOUSLY LOW AND THEREFORE QUESTIONABLE. THIS DATA POINT HAS BEEN INCLUDED IN THIS FIGURE ONLY FOR COMPARISON WITH PREVIOUSLY RECORDED RESULTS.

SCALE 0 200 400 FEET

LAKE ONTARIO ORDNANCE WORKS

ZONE 1
WATER TABLE SURFACE CONTOUR MAP

FIGURE 5-3



LEGEND

■ MW-A-1S	MONITORING WELL OR COUPLET INSTALLED BY ACRES
◆ MW-7-5S	MONITORING WELL OR COUPLET INSTALLED BY OTHERS
EL 300.12	GROUNDWATER ELEVATION MEASURED 1/3 & 4/90
302	POTENTIOMETRIC SURFACE CONTOUR (INFERRED LOCATION). CONTOUR INTERVAL = 2 FT.
302	POTENTIOMETRIC SURFACE CONTOUR (ESTIMATED LOCATION).
	GROUNDWATER FLOW LINE
	SURFACE DRAINAGE FLOW

NOTE

THE POTENTIOMETRIC SURFACE CONTOUR CONFIGURATION SHOWN HERE WAS CONSTRUCTED USING ACCEPTED HYDROGEOLOGIC PRACTICES AND PRINCIPLES. ACTUAL CONDITIONS MAY VARY FROM THOSE SHOWN.

* GROUNDWATER ELEVATION MEASURED 11/16/89. WELLS INACCESSIBLE ON 1/3 & 4/90.

SCALE 0 200 400 FEET

LAKE ONTARIO ORDNANCE WORKS
ZONE 3
POTENTIOMETRIC SURFACE CONTOUR MAP

FIGURE 5-4

TABLE 5-1
LAKE ONTARIO ORDNANCE WORKS
GROUNDWATER LEVEL MEASUREMENTS
RECORDED NOVEMBER 16, 1989 AND JANUARY 3-4, 1990
ADDITIONAL FIELD INVESTIGATIONS

Date	Time	Well ID	Water Level[1]	Reference Elevation[2]	Water Elevation
01/03/90	1427	MW-A-1S	8.33	314.68	306.35
01/04/90	1600	MW-A-1D	14.55	314.55	300.00
01/03/90	1205	MW-B-1S	5.15	313.40	308.25
01/03/90	1430	MW-B-1D	14.14	314.00	299.86
01/03/90	1437	MW-B-2S	11.36	311.32	299.96
01/03/90	1435	MW-B-2D	11.96	311.75	299.79
01/03/90	1503	MW-B-3	6.03	316.41	310.38
01/03/90	1443	MW-B-4S	4.02	312.58	308.56
01/03/90	1441	MW-B-4D	12.98	312.73	299.75
01/03/90	1415	MW-C-1S	3.77	318.55[3]	314.78
01/03/90	1420	MW-C-1D	7.86	318.57	310.71
01/03/90	1535	MW-C-2D	5.00	315.10	310.10
01/03/90	1520	MW-C-3S	9.01	312.63	303.62
01/03/90	1525	MW-C-3D	3.28	313.43	310.15
01/03/90	1515	MW-D-1	4.80	314.72	309.92
01/03/90	1100	MW-A-89	2.51	316.31	313.80
01/03/90	1000	MW-B-89	Dry	314.19	-
01/03/90		MW-7-3S	8.30	317.34	309.04
01/03/90		MW-7-3D	16.10	316.70	300.60
01/03/90		MW-7-4S	7.82	317.85	310.03
01/03/90		MW-7-4D	17.65	317.63	299.98
01/03/90		MW-7-5S	7.49	318.22	310.73
01/03/90		MW-7-5D	17.26	318.31	301.05
01/03/90		TMW-14S	4.56	314.72	310.16
01/03/90		Z-16	2.34	315.63	313.29
01/03/90		G-20-4	5.44	315.52	310.08
01/03/90		B-22B	14.93	315.05	300.12
01/03/90		TMW-25S	8.14	316.43	308.29
11/16/89		TMW-26S	4.05	316.08	312.03
11/16/89		MW-12-6S	7.94	315.61	307.67
11/16/89		MW-12-6D	16.76	316.18	299.42
11/16/89		MW-12-7S	8.46	315.19	306.73
11/16/89		MW-12-7D	16.39	315.53	299.14
11/16/89		MW-12-8S	11.75	314.76	303.01
11/16/89		MW-12-8UD	15.33	314.49	299.16

NOTES:

[1] Water levels measured in feet below reference elevation.

[2] Reference elevation is top of inner casing. All elevations in SCA datum which is approximately equal (within 1 ft) to mean sea level.

[3] Well damaged. Protective casing knocked down 0.61 ft relative to top of inner casing, therefore, reference elevation may have changed.

- The zone of depression observed in the vicinity of well MW-C-3S may be due to the tight hydrogeologic setting in which the well was installed (e.g., lack of transmissive fractures and sand and silt lenses). This is also apparent in the very slow recharge rate of the well.

One feature which is apparent in the recent data is a relative high in the water table surface in the vicinity of well MW-A-1S.

5.6.2 - Glaciolacustrine Silt/Sand - Zone 3

Groundwater measurements for Zone 3 - the glaciolacustrine silt/sand unit are very similar for the two periods of measurement (compare Figure 5-4 of this Supplement and Figure 8-12 of the RI report). A slight deflection of the potentiometric surface in the vicinity of well MW-D-1 is probably due to excavation activities to the immediate north of this well.

6 - CONCLUSIONS

The previous conclusions regarding each of the areas of suspected contamination were generally confirmed by the results of the supplemental investigations. An updated summary of the remedial investigations findings based on the supplemental data is presented in Table 6-1. The findings have been updated for Area A, Area B, the Area between A and B, the Wooded Area, and the buried TNT/acid waste lines. The findings for Areas C, North of C, and D remain unchanged.

Based on the additional site data provided by the supplemental investigations, the following conclusions have been drawn for each of the respective areas investigated.

6.1 - Area A

The buried drum trench in Area A has been determined to be approximately 220 ft long (east-west) by 35 ft wide by 10 ft deep. The southern boundary of the buried drum trench is located just under the northern side of the "H" Street. The eastern boundary is located just under the western side of Access Road #1. Contamination within the buried drum trench is primarily acetone although analytical results for drums removed from the buried drum trench indicate the presence of at least 18 other organic contaminants. Analytical and soil headspace screening results indicate that the contamination is probably confined to the area within 50 ft of the drum trench boundaries (See Figure 5-2). However, due to the presence of discontinuous fractures and silt and sand lenses which may act as conduits for contaminant migration, distinctive contaminant boundaries may not exist. In addition, previous disposal remediation and related onsite activities conducted in this area may have contributed to the distribution of contaminated materials throughout the area further complicating the determination of the actual extent of contamination associated with the buried drum trench.

TABLE 6-1
UPDATED SUMMARY OF FINDINGS - ADDITIONAL FIELD INVESTIGATIONS
(Incorporating Supplemental Field Investigations)

Investigated Area	Identified Contamination	Associated Offsite Conditions/Migration	Assessed Sources	Preliminary Assessed Risk (To)			Lacking Data/Additional Investigations Needed	Need for Remediation
				Public Health	Onsite Personnel	Environment		
A (Drum Burial Area)	1. Localized contamination problems resulting from buried drums including: - Undetermined no. of buried drums containing wastes; - Surrounding soil contamination; and - Localized GW contamination (pit water).	Investigations to date indicate no apparent downgradient migration in groundwater although sampling of upgradient and downgradient drainage ditch sediments indicate presence of contamination	Buried drums disposed of in area.	Low to negligible risk for offsite population based on data collected to date. Low risk of exposure by direct contact because of restricted site access.	Low risk for exposure to air and water contaminants. Greatest hazard posed by direct contact w/ contaminated soils & waste, if excavated.	Not Significant	1. Previous data gaps have been rectified by supplemental investigations. 2. Additional field investigations may be required to define full extent of sediment contamination in drainage system.	Yes, consideration of: - Drum and contaminated soil remediation; - Localized groundwater contamination. Drainage ditch sediment contamination identified by supplemental investigations also needs to be addressed.
B (Burn Pit Area)	1. Contaminated sediments and soils in pit area. 2. Accumulated surface water in pit area has only elevated contaminations of boron and lithium: boron levels above NYSDOH drinking water standards (no other applicable standard). 3. Contamination southeast of burn pit as evidenced in wells B-3 and MW-73S (and boring B-B-9) appears to be localized upgradient of the pit.	1. Upgradient groundwater contamination noted that is localized and possibly from remnants of burn pit operations. 2. No evidence of downgradient contamination of groundwater. 3. Upgradient and downgradient drainage ditch & sediments indicate the presence of contamination	1. Burn pit and immediate surrounding area. 2. A former liquid filled surface depression may be a possible source for contaminants detected in upgradient groundwater.	Same as Area A	Same as Area A	Not significant	Same as Area A.	Yes: Appears to be problem confined to local burn pit and the former surface depression to the southeast of the burn pit. Consideration of remediation of the following problems are recommended: - Localized contaminated sediment and soils in the burn pit area; and - Localized contamination of groundwater. Drainage ditch sediment contamination identified by supplemental investigations also needs to be addressed.
Area Between Areas A and B	Isolated pockets of low level acetone contamination exist based on soil samples collected.	None apparent	Identified contamination in this area may be possibly related to previous partial site remediation activities whereby material was spread into this area. Also most likely related to past waste disposal in Areas A and B.	Not Significant	Not Significant	Not Significant	-----	Consideration of remediation in this local area in conjunction with remedial action in Areas A and B. However, final cleanup criteria established in the FS will determine the need for remediation of this area.
C	Elevated levels of 1,2-dichloroethene in upgradient well MW-C-1S. (Results of initial RI)	None apparent	Other possible upgradient source for 1,2-dichloroethene contamination.	Negligible	Negligible	Negligible	Well damaged since initial RI program, unable to confirm elevated levels of contamination at well MW-C-1S.	No significant problem identified for remediation.

TABLE 6-1 - (Cont'd)

Investigated Area	Identified Contamination	Associated Offsite Conditions/Migration	Assessed Sources	Preliminary Assessed Risk (To)			Lacking Data/Additional Investigations Needed	Need for Remediation
				Public Health	Onsite Personnel	Environment		
Area North of C	Geophysics screening indicated no evidence of drum burial areas. No significant contamination identified.	None apparent	None apparent	None apparent based on investigation results	None apparent based on investigation results	None apparent based on investigation results	No information or evidence to warrant further investigation of this area	No significant problem identified as a result of this investigation. However, allocations of responsibility for investigations and remediation of contamination found by CWM in vicinity of well P12-2S will be determined in future meetings between the COE, CWM and NYSDEC.
D	Elevated concentration of acetone in upgradient well TMW-14S. Geophysics screening indicated no evidence of buried drums. Groundwater sampling downgradient of area indicated no evidence of a problem.	None apparent	Other possible upgradient source for acetone contamination	Negligible	Negligible	Negligible	No information or evidence to warrant further investigation of this area.	No significant problem identified for remediation
Wooded Area (North of "H" Street)	1. Southeast section has localized soil contamination possibly associated with adjacent burn pit area. 2. Downgradient groundwater quality appears not to be impacted	None apparent	Probably adjacent burn pit area (Area B).	Same as noted for Area A above.	Same as noted for Area above.	Not significant	Supplemental investigations provided additional information in SE corner of the wooded area.	Consideration of remediation of local contamination in SE corner with remediation of Area B. However, final cleanup criteria established in the FS will determine the need for remediation of this area.
Buried TNT and Acid Waste Lines	Presence of explosive compounds was found in a TNT waste pipeline lateral No contaminants found in main pipeline or in Acid Waste pipeline sampled.	Not likely	- - - -	The potential risk associated with the buried lines to the offsite public has been assessed to be low.	The potential risk to onsite personnel working in the immediate vicinity of lines has been assessed to be moderate to high.	None Apparent	The supplemental investigations have provided representative indication of pipeline conditions. The need for further investigation of the pipelines is not warranted.	Yes. TNT lines need to be remediated because of potential high concentrations of explosive compounds and potential risk posed to onsite personnel.

The extent of vertical contaminant migration appears to be confined to the unconsolidated deposits present above the glaciolacustrine clay unit. Soil headspace screening results indicate a distinct drop in organic vapor concentration when descending from the upper deposits to the more impermeable glaciolocustrine clay unit.

Although contamination was detected in groundwater samples taken from the buried drum trench, groundwater downgradient of the drum trench does not appear to be impacted by organic contamination. However, the groundwater sample collected from the newly installed well in Area A (MW-A-89) did contain low levels of boron and lithium. The concentration of boron in the new well is slightly elevated in comparison with analytical results for the downgradient monitoring well installed and sampled during the initial RI program (MW-A-1S). Lithium concentrations in wells MW-A-89 and MW-A-1S are about the same.

6.2 - Area B

Analytical and soil headspace screening results for subsurface soil samples collected from three soil borings located within the bermed pond area did not reveal the suspected levels or extent of contamination within the bermed pond. Analytical results from the initial RI program indicated the presence of relatively high levels of chlorinated benzene compounds while the results from the supplemental field investigation indicated the presence of relatively low levels of acetone, carbon disulfide and carbon tetrachloride in only one of six in-pond soil samples. Visual observations also indicate a heterogeneous mixture of materials that have been dumped in the bermed pond.

Analytical and drilling results performed outside of the bermed pond did not indicate any signs of contamination along the northern or western sides of the pond area. However, the area located to the southeast of the bermed pond was found to have the highest levels of contamination detected during the supplemental field investigation. Analytical results from this

drainage system. Therefore, the collection and analysis of several additional sediment samples at further upgradient and downgradient locations has been recommended and will be carried out by Acres prior to completing the Advance Final Feasibility Study.

7 - REFERENCES

Golder, 1989. Aerial Photographic Interpretation Report. Model City TSD Facility, Model City, New York. Golder Associates Inc. February 1989.

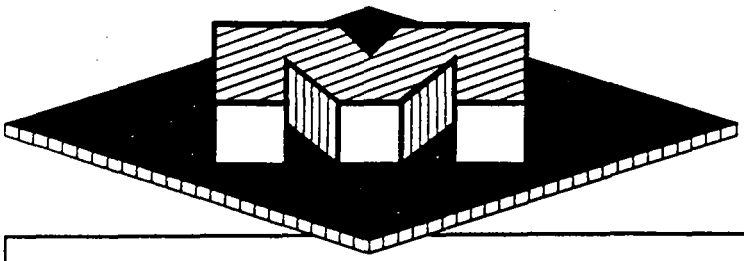
Hazards Research, 1983. Detonation Potential of TNT - Bearing Sludge, HRC Report 5333. Hazards Research Corporation. January 21, 1983.

Little, 1987. Testing to Determine Relationship Between Explosive Contaminated Sludge Components and Reactivity (Task Order Number 1). Final Report to United States Army Toxic and Hazardous Materials Agency, Arthur D. Little, Inc. January 1987.

ATTACHMENT A

GEOPHYSICAL SURVEY REPORT

NOTE: Due to the voluminous nature of the Geophysical Survey Report and awkward size of some of the figures (11" x 48") only pertinent sections of the report are presented here.



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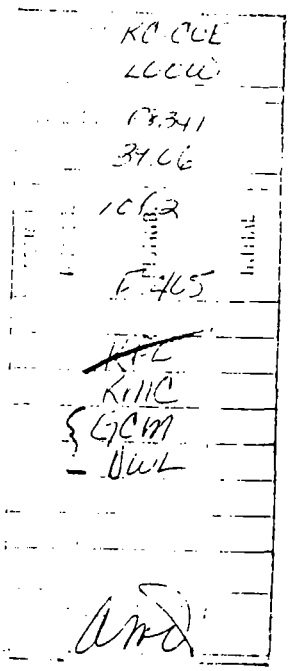
GEOPHYSICAL INVESTIGATION
AT THE SCA FACILITY
MODEL CITY, NEW YORK



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November, 1989

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EXECUTIVE SUMMARY

multiVIEW Geoservices Inc. have been retained by Acres International Corporation (Amherst) to conduct a geophysical investigation at the SCA Model City Facility. The geophysical investigation forms part of a groundwater study which Acres International Corporation are coordinating for the Department of the Army, Kansas City District, Corps of Engineers.

The objectives of the geophysical survey are to delineate the location of the TNT and acid pipelines for excavation and sampling (Areas 1 through 4), to more precisely define the boundary of a drum filled trench (Area A), and to clear seventeen (17) proposed borehole locations for monitor well placement. The geophysical survey work was carried out using ground penetrating radar, electromagnetic and vertical gradient magnetic methods.

The combined radar and electromagnetic surveys in Area 1 resulted in excellent correlation between the two data sets. The anomaly map of Area 1 infers that the acid line may lie east-west about 10 feet North of the Area 1 baseline buried about 8 feet below the ground surface. Several isolated anomalies were detected in Area 2 but no clear inference as to the location of the buried pipeline can be made.

At Area 3, no linear trend of interpreted anomalies could be distinguished except for a series of disturbed soil zones. There were virtually no anomalous conditions were present at Area 4, inferring that subsurface pipelines may not present within these survey areas.

The combined electromagnetic and vertical gradient magnetometer surveys in Area A resulted in excellent correlation between the two data sets. Both data sets infer the southern boundary of the drum filled trench to be trending slightly south of west, north of east with respect to the grid. The trench boundary is inferred to be located along approximately 40 to 41 feet North.

The vertical gradient magnetometer survey to clear borehole positions resulted in the clearing of 14 of 17 proposed borehole locations, 4 of which had to be moved from their original proposed locations. Boreholes BL-15, BL-16 and BL-17 could not be cleared

1. INTRODUCTION

multiVIEW Geoservices Inc. have been retained by Acres International Corporation (Amherst) to conduct a geophysical investigation at the SCA Model City Facility. The geophysical investigation forms part of a groundwater study which Acres International Corporation are coordinating for the Department of the Army, Kansas City District, Corps of Engineers.

Acres International Corporation are presently conducting a site investigation to locate, sample and excavate potentially hazardous TNT and acid pipelines, clean up any waste disposal trenches, and to drill monitor wells at various locations at the SCA Facility in Model City, New York.

The objective of the geophysical survey is to delineate the location of the TNT and acid pipelines for excavation and sampling and to more precisely define the southern boundary of a drum filled trench, which Acres International Corporation believe may have been expanded. In addition, seventeen (17) proposed borehole locations required evaluation to determine if metal objects (i.e. pipes, cables or drums) were in the path of the proposed drill hole. The geophysical survey work was carried out using ground penetrating radar, electromagnetic and vertical gradient magnetic methods.

2. SITE DESCRIPTION

2.1 General Site Characteristics

The SCA Model City Facility is located just east of Lewiston, N.Y. about 30 miles north of Buffalo as shown in Figure 1. The SCA Model City Facility is a controlled waste management area. Four survey areas and one test area within the facility were to be investigated. Several mud and gravel roads on the site provided easy access to all survey areas.

The TNT and acid lines are believed to be made of vitreous pipe which is a clay based material similar to household flower pot containers. The diameter of the lines are 10, 15 or 18 inches and the lines may or may not be filled with fluid. At the drum trench location, the buried drums were either stacked or piled in a trench which was backhoed into the local soils and subsequently backfilled with indigenous soil. It is not known whether or not the drums reach the limits of the trench.

The local geology consists of a surficial silt till layer overlying increasingly clay rich lower layers. During a rain, the water remained on surface indicating the relatively low permeability of the surficial soils.

2.2 Site Specific Features

Five areas were of specific interest. Figure 2 shows most of the SCA Facility and the location of survey Areas 1 through 4 and Area A. Area 1 is located just west of Lagoon 6 in a semi-forested area. The surface was covered with vines and low bushes making mobility difficult. Two manholes were found in Area 1. One provided access to a sewage system while the other was believed to be part of the acid waste line system. The locations of these manholes agreed well with the Acres International Corporation site maps. Several 3-foot diameter, 12-foot long sections of vitreous pipe filled with concrete were on surface at the south end of the area. Odd scraps of metal and concrete were scattered about this survey area.

Area 2 is located just north of Salts Area 7 on the south side of the ditch that runs east-west through the entire Facility. Surface features at this site included a mud road, a shallow swampy area with reeds, and an old foundation that protruded 1 foot above ground.

Area 3 is located east of Area 2 at the western edge of the North Salts pond, south of the east-west ditch that runs across the entire Facility. This area was partially on the berm of the pond and partially on a mud road.

Area 4 is the anticipated location of the TNT line and is positioned on the southern edge of the east-west ditch between Areas 2 and 3. The TNT line is thought to run in an east-west direction just south of the ditch, at the very northern end of Area 4.

Area A is an extension of a grid from a previous geophysical survey. The survey grid for the present geophysical survey overlapped the old grid by approximately 10 feet at the north end and extended south of M Street. The new survey grid is also approximately 5 feet wider on both the east and west side. New fill partially covers the northern part of the area and a mud road (M Street) crosses the southern part. The grid for the present survey was established by Acres International Corporation personnel and was referenced to existing landmarks such as roads and monitor wells. Surface features near Area A included a mud road, grassy fill areas and a pond surrounded by a 5 foot berm.

3. SURVEY PROCEDURES

The geophysical investigation used a multiplicity of methods to achieve three objectives. The first objective was to determine the location of buried acid and TNT waste lines (Areas 1, 2, 3, and 4 using both ground penetrating radar and electromagnetic methods). The second objective was to delineate the southern boundary of a drum filled trench (Area A using electromagnetic and vertical gradient magnetic methods). The third objective was to clear proposed borehole locations prior to drilling (near Area A using the vertical gradient magnetic method).

The survey was carried out in four calendar days between November 6th and 9th, 1989 which included mobilization to site, execution of the survey and demobilization. The weather was seasonally cool with temperatures ranging just above freezing point. On November 7th, it began raining at 11:00 A.M. and got harder as the day progressed. November 8th was wet but it did not start to rain until 3:00 P.M., while on November 9th it was wet but it did not rain.

3.1 Survey Grids

All survey grids were established by Acres International Corporation personnel prior to the commencement of the geophysical investigation. Thin metal survey pin flags spaced 20 feet apart established the location of the survey lines for Areas 1 through 4. The survey grids for Area 1 consisted of four (4) lines spaced approximately 30 feet apart, Area 2 had three (3) lines spaced 25 feet apart, Area 3 had three (3) lines spaced 30 feet apart and Area 4 had two (2) lines spaced 40 feet apart. The spatial location of the survey lines for Areas 1 through 4 are shown on Figure 3.

The survey grid for Area A consisted of survey pin flags spaced 20 feet apart along the southern end of the grid (0 North), and along 50 North. The grid origin (0 E, 0 N) was centred on the southern edge of the concrete platform around well Z-4. The spatial location of the proposed borehole locations and survey lines for Area A are shown on Figure 4. It should be noted that the actual positions of the proposed boreholes may not coincide with those indicated on Figure 4.

3.2 Ground Penetrating Radar Survey

The radar survey was conducted using a Sensors and Software Inc. pulseEKKO IV ground penetrating radar system. Appendix A discusses the pulseEKKO IV ground penetrating radar (radar) technique in detail.

Both the 50 and 100 MHz antenna systems were tested at the beginning of the survey. Upon review of the data by the multiVIEW Geoservices Inc. Geophysicist, it was determined that the 50 MHz antennas provided the best combination of penetration and resolution. Table 1 summarizes the ground penetrating radar data acquired and Table 2 presents the radar system parameters used for the survey.

Common mid-point (CMP) velocity soundings were conducted at Areas 1, 2, and 3 to provide depth calibration for the radar travel time measurements. The CMP sounding technique is discussed in further detail in Appendix A. Table 3 summarizes the locations of each CMP sounding.

3.3 Electromagnetic Survey

The field program consisted of measuring and recording electromagnetic data at 5 foot station intervals along all survey lines. The electromagnetic (EM) measurements were acquired using an EM-31 terrain conductivity meter manufactured by Geonics Limited. This unit measures ambient electrical conductivity over a circular footprint of approximately 20 feet in diameter. By traversing with this instrument, both the spatial location of buried metal objects and a profile of the lateral changes in soil conductivity can be obtained. A detailed description of the electromagnetic instrument and discussion of the electromagnetic method is located in Appendix B.

The survey procedure adopted in the field was to take readings with the boom aligned parallel to the direction of traverse with the sensor coil axes oriented in the vertical dipole configuration. For all measurements, the sensor boom was held at a height of approximately three feet above the ground with the boom parallel to the local ground surface. A total of 368 electromagnetic data points were acquired during the survey.

The spatial position of the measurements were interpolated by the instrument operator from the survey pin flags when measurements were not at flagged stations. In general, a relative positioning accuracy of ±3 feet is achieved by this procedure which is more than adequate considering the instrument measurement footprint size of 20 feet.

3.4 Vertical Gradient Magnetic Survey

The magnetic measurements were acquired using a GSM-19G vertical gradient magnetometer manufactured by Gem Systems Limited. This unit measures both the total field and vertical gradient field over a circular footprint of approximately 12 feet in diameter. By traversing with this instrument, the spatial location of buried ferrous objects can be obtained. A detailed description of the GSM-19G vertical gradient magnetometer and a discussion of the magnetic method is given in Appendix C.

For the drum-trench investigation, the total and vertical gradient magnetic field values were recorded at 5 foot station intervals along lines 0, 75 E, and 80 E. The remaining lines could not be surveyed due to erratic behavior of the instrument believed to be due to fluctuations of the Earth's geomagnetic field caused by the present high level of sun spot activity.

The spatial position of the measurements were interpolated by the instrument operator from the survey pin flags when measurements were not at flagged stations. In general, a relative positioning accuracy of ±3 feet is achieved by this procedure which is more than adequate considering the instrument measurement footprint size of approximately 12 feet.

For the borehole clearing investigation, the approach used was to take readings every 2 feet in a box extending 5 feet on either side of the proposed borehole location. If high gradient readings were measured, then the operator extended the area to try and locate a clear area for the borehole. A total of 429 magnetic data points were acquired during these surveys.

4. DATA COMPILATION

4.1 Ground Penetrating Radar Data

Upon return from the field, the radar data were transferred to multiVIEW Geoservices Inc.'s data processing facility. At this time the data were edited to correct any positioning or line annotation errors. All lines were annotated for survey grid position and any cultural features noted at the time of the survey. Each radar section shows the radar signal versus delay time and position in seismic-like wiggle trace format. Appendix A discusses the radar processing procedures in greater detail. Appendix D shows the radar data profiles obtained from Areas 1 through 4.

4.1.1 Determination of Radar Wave Velocity

In order to accurately infer the depth to reflected events on the radar data profiles, an estimate of the radar wave velocity within the soils must first be calculated. This velocity is determined from the common mid-point (CMP) velocity soundings. Figures D-12, D-13 and D-14 show the processed CMP data. Tables 4, 5 and 6 summarize the velocity analyses of the respective data. The velocities obtained from these analyses resulted in an average radar wave velocity of 0.312 feet per nanosecond (ft/ns) which was used to generate the depth scale on all radar profiles.

4.1.2 Radar Data Profiles

Figures D-1 through D-11 show the radar data profiles collected from Areas 1 through 4. In presenting the radar data in section form, the relative position along a transect is indicated at the top of the section. The position of the mid-point of the radar antennas is recorded at each reading location. In practice, position identification is often more conveniently referenced to landmarks and other visual features along the survey line. All such features are indicated at the bottom of the radar sections.

The data were processed according to the parameters in the tables which accompany each figure. Each data set has been processed with a 10-point running time average which has the effect of filtering out high frequency noise. The data are displayed with an Automatic Gain Control (AGC) which attempts to make all amplitudes equal. The AGC gain is useful for following trends in the data at the expense of amplitude fidelity.

4.2 Electromagnetic Data

The EM data were transferred from the field computer to multiVIEW Geoservices Inc.'s data processing facility. At this time the data were edited to correct any positioning or line annotation errors and to remove redundant readings taken for quality assurance purposes during the survey. A discussion of the processing procedures applied to the data is provided in Appendix B.

The EM conductivity and in-phase data for Area A are presented in surface plot and contour format as shown on Figures 5 and 6 respectively. The EM conductivity data were plotted with a contour interval of 10 mS/m and the EM in-phase data were plotted with a contour interval of 5 ppt. The contour maps are plotted at a scale of 1:120.

Figures E-1 through E-12 in Appendix E show the EM profile data obtained from Areas 1 through 4. The data are plotted at a horizontal scale of 1:60. All EM profiles are plotted with identical conductivity and in-phase ranges and scales to permit direct comparison of electromagnetic activity between lines and Areas. The tabulated EM conductivity and in-phase data are presented in Appendix G.

4.3 Vertical Gradient Magnetic Data

The vertical gradient magnetic data were transferred from the field computer to multiVIEW Geoservices Inc.'s data processing facility. At this time the data were edited to correct any positioning or line annotation errors and to remove redundant readings taken for quality assurance purposes during the survey. Appendix C discusses the vertical gradient magnetic processing procedures in greater detail.

The data acquired over the Area A grid are shown in profile format in Figures F-1, F-2, and F-3 in Appendix F. The horizontal scale of the plots is 1:60. The tabulated vertical gradient magnetic data are presented in Appendix H.

The data acquired for the borehole clearing investigation are summarized in Table 7. These data were reviewed and interpreted in the field during the data acquisition, hence, no further interpretation is provided in this report.

5. DISCUSSION OF RESULTS

5.1 Ground Penetrating Radar Survey

The radar profiles shown in Appendix D reveal some interesting features. The radar data from Areas 1 and 4 show a continuous gently northward dipping horizon at a depth of approximately 20 feet, occasionally accompanied by one or two deeper layers. These are likely the clay rich layers underlying the surficial material fill. In general, the signal penetration was far greater than expected.

All radar sections show a relatively flat, continuous reflector between 5 and 10 feet below surface. This layer shows some undulations and discontinuities along some of the lines. Some profiles show an additional layer varying between 10 and 15 feet beneath the surface. This layer also reveals some discontinuities at various points. In addition, some very shallow soil variations were noted along some of the radar sections.

The interpretation of the radar data is presented as the anomaly map shown in Figure 7. The standard multiVIEW Geoservices Inc. feature identification scheme was used to identify and classify the various features noted on the radar data.

There are three types of radar anomalies described at these sites. The first are point reflectors. These appear as hyperbolae on the radar records and may be indicative of buried pipes or cables, or large blocks within the fill material.

The second type of radar anomalies are the trench-type reflectors. These appear as depressions in the sequence of radar reflectors and are probably indicative of differential settling of subsurface soils, a change in fill composition or subsurface compaction conditions.

The third type of radar anomalies are zones of disturbed soils. These appear as areas of disrupted or discontinuous radar reflections and are probably indicative of disturbed soils or a change in fill composition.

5.1.1 Area 1

All four lines profiled at Area 1 indicate a subsurface feature at approximately the 10 foot North mark. Lines 1, 3 and 4 indicate a hyperbolic reflector between 6 and 8 feet below the surface whereas Line 2 indicates a shallow disturbance and a hyperbolic reflector about 17 feet down.

5.1.2 Area 2

The three lines profiled at Area 2 all indicate three or four flat lying stratigraphic layers. Some finer layers appear to pinch and swell in and out of view which indicate their thickness is at the limit of the resolution of the antenna frequency. Line 1 indicates a zone of disturbed soils at about 30 feet West, 3 weak hyperbolic reflectors approximately 16 feet below surface, and shallow trench about 7 feet deep. Line 2 indicates some disturbances approximately 12 feet below surface stretching from 52 to 58 feet West. Line 3 shows a hyperbolic reflector about 7 feet below surface and a deeper feature about 17 feet down with a zone of disturbance from 55 to 70 feet West.

5.1.3 Area 3

The radar data at Area 3 reveals a shallow disturbance approximately 7 feet below surface on all three profiles. Lines 1 and 3 indicate dipping subsurface stratigraphy with opposite slopes. One small hyperbolic reflector is located at 42 feet West along Line 3.

5.1.4 Area 4

The radar profile conducted along Line 1 only shows one anomaly, that of a disturbed zone between 4S and 0 at a depth of approximately 8 feet.

5.2 Electromagnetic Survey

5.2.1 Areas 1 through 4

The response curves for both conductivity and in-phase components from the EM data collected on Areas 1 through 4 are displayed in Appendix E. No significant magnitude anomalies are present within this data set, with only minor exceptions. Figure 7 indicates the positions of all EM anomalies detected at Areas 1 through 4.

At Area 1, Line 1 shows a weak anomaly at about 8 feet North. Line 4 reveals a strong in-phase response and weaker conductivity response possibly indicating the presence of near surface metal.

The EM data at Area 2 reveal broad but very weak anomalous zones. Changes are most likely indicative of natural changes in pore water content or clay content of the shallow soils.

Area 3 shows a weak conductivity and in-phase anomaly at about 40 West along Line 3 and no anomalous response at all along Line 2. Line 1 shows a sharp contrast in apparent conductivity between 0 and 30 West accompanied with no change in the in-phase component. This may indicate a sharp contrast in lithology or soil conditions. Interestingly, the radar data along Line 1 shows a layer which pinches out at 30 North, indicating a correlation between the two geophysical methods.

The EM data at Area 4 indicated no anomalous responses.

5.2.2 Area A EM

The processed electromagnetic conductivity and in-phase data are shown in Figures 5 and 6 respectively. These data are displayed in surface and contour map form which make lateral trends relatively easy to visualize. The anomaly map for Area A is shown on Figure 8.

Both the apparent conductivity and in-phase data for Area A correlate very well with one another. This indicates that any anomalous features are due to the presence of metal and not changing soil conditions or lithology. Both components indicate increased responses at about 40 North. The apparent conductivity peaks positively at about 40 N and negatively at about 50 N. The in-phase component peaks negatively at about 45 N and positively at 55 N. The EM conductivity and in-phase responses usually peak negative when directly centred over the buried target.

5.3 Vertical Gradient Magnetic Survey

5.3.1 Area A

The vertical gradient magnetic field data for Area A are shown in profile form in Appendix F. The data is well defined and readings are generally low to the south and high to the north. For the particular geometry of the trench and direction of magnetic survey lines (north-south), the magnetic response from a drum filled trench would be weak negative, followed by a strong positive response, which would become a strong negative response over the centre of the trench. The zero cross-over between the weak negative and the strong positive generally indicates the point of contact between two mediums of contrasting magnetic permanence. All vertical gradient magnetic data profiles illustrate this theoretical response with the zero cross-over in the vicinity of 40 North.

5.3.2 Borehole Clearing

The vertical gradient magnetic data collected around proposed borehole locations BL-1 through BL-17 are summarized in Table 7. Most locations were quiet with the exception of BL-4, BL-6, 7 and 8 and BL-15, 16 and 17. The gradients were mild, weak and high at these three sites respectively compared to extremely weak at all other locations.

In particular, the location for BL-4 was moved 10 feet N, and 5 feet W from the initial proposed location. The alignment for BL-6, 7 and 8 was moved 10 feet E from the initial proposed location. In addition, the proposed borehole locations for BL-15, 16 and 17 could not be cleared even after a greatly expanded effort to the north and east of the initial proposed location.

6. SUMMARY

The multidisciplinary geophysical survey carried out at the SCA Model City Facility resulted in the delineation of inferred locations of buried pipelines, the southern boundary of a drum filled trench, and provided borehole clearing.

The combined radar and electromagnetic surveys in Area 1 resulted in excellent correlation between the two data sets. The anomaly map of Area 1 shown on Figure 7, infers that the acid line may lie east-west about 10 feet North of the Area 1 baseline buried about 8 feet below the ground surface. Several isolated anomalies were detected in Area 2 but no clear inference as to the location of the buried pipeline can be made.

At Area 3, no linear trend of interpreted anomalies could be distinguished except for a series of disturbed soil zones. There were virtually no anomalous conditions present at Area 4, inferring that subsurface pipelines may not present within these survey areas.

The combined electromagnetic and vertical gradient magnetometer surveys in Area A resulted in excellent correlation between the two data sets. Both data sets infer the southern boundary of the drum filled trench to be trending slightly south of west, north of east with respect to the grid. The trench boundary is inferred to be located along approximately 40 to 41 feet North.

The vertical gradient magnetometer survey to clear borehole positions resulted in the clearing of 14 of 17 proposed borehole locations, 4 of which had to be moved from their original proposed locations. Boreholes BL-15, BL-16 and BL-17 could not be cleared.

I trust that the enclosed information will prove useful to aiding in the design for any remedial action as a result of your environmental site investigation at the SCA Facility. Should you require any further assistance, or further discussion of the data, I shall be pleased to assist you in this regard.

Respectfully submitted,

multiVIEW Geoservices Inc.

_____

P. Giamou
Geophysicist

PG/ggl

TABLE 1

RADAR SURVEY DATA SUMMARY

Area	Survey Line	Start	End	Traces
1	1	21 S	20 N	43
1	2	20 S	23 N	44
1	3	15 S	26 N	42
1	4	18 S	30 N	49
2	1	0	85 W	86
2	2	0	80 W	81
2	3	0	80 W	81
3	1	5 E	55 W	61
3	2	5 E	50 W	56
3	3	5 E	47 W	53
4	1	10 S	35 N	46

TABLE 2

RADAR SURVEY SYSTEM PARAMETERS

Nominal Frequency	50 MHz	All Lines
Antenna Spacing	6 feet	All Lines
Spacing Between Traces	1 foot	All Lines
Pulser Voltage	1000 V	All Lines
Range Window	256 ns	All Lines
Points per Trace	320	All Lines
Number of Stacks	256	All Lines

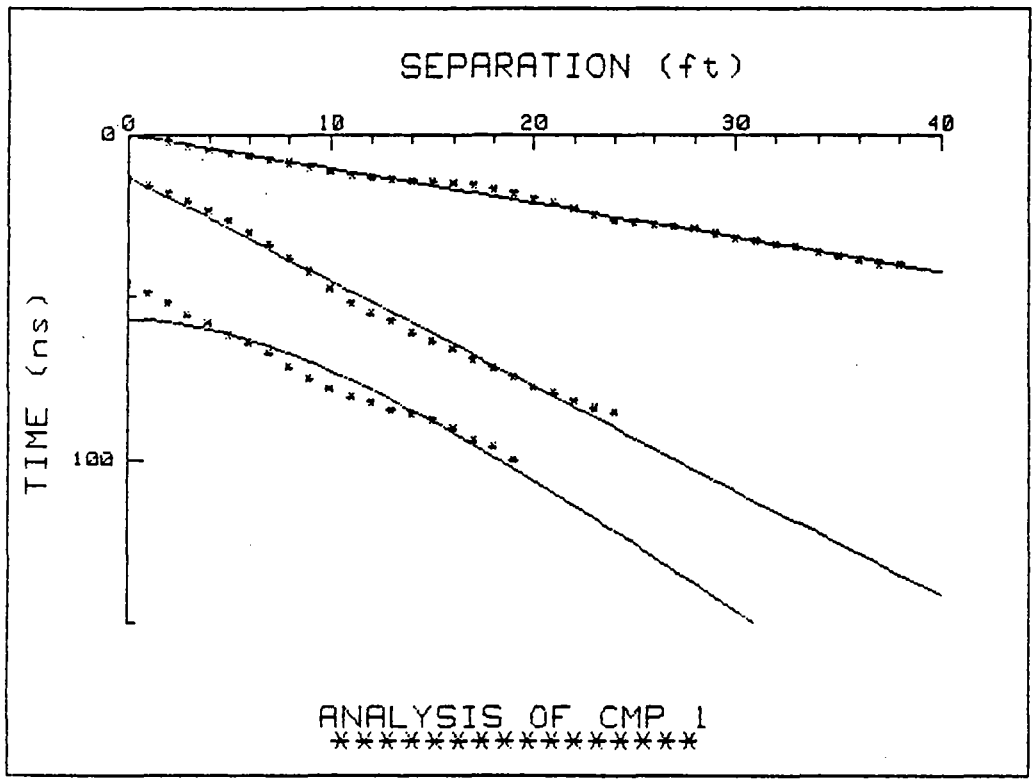
TABLE 3

CMP LOCATION SUMMARY

CMP 1	Area 1, along Line 1, Centred at 0 N
CMP 2	Area 2, along Line 3, Centred at 20 W
CMP 3	Area 3, along Line 2, Centred at 20 W

TABLE 4

multiVIEW Geoservices Inc. WARR and CMP Analysis



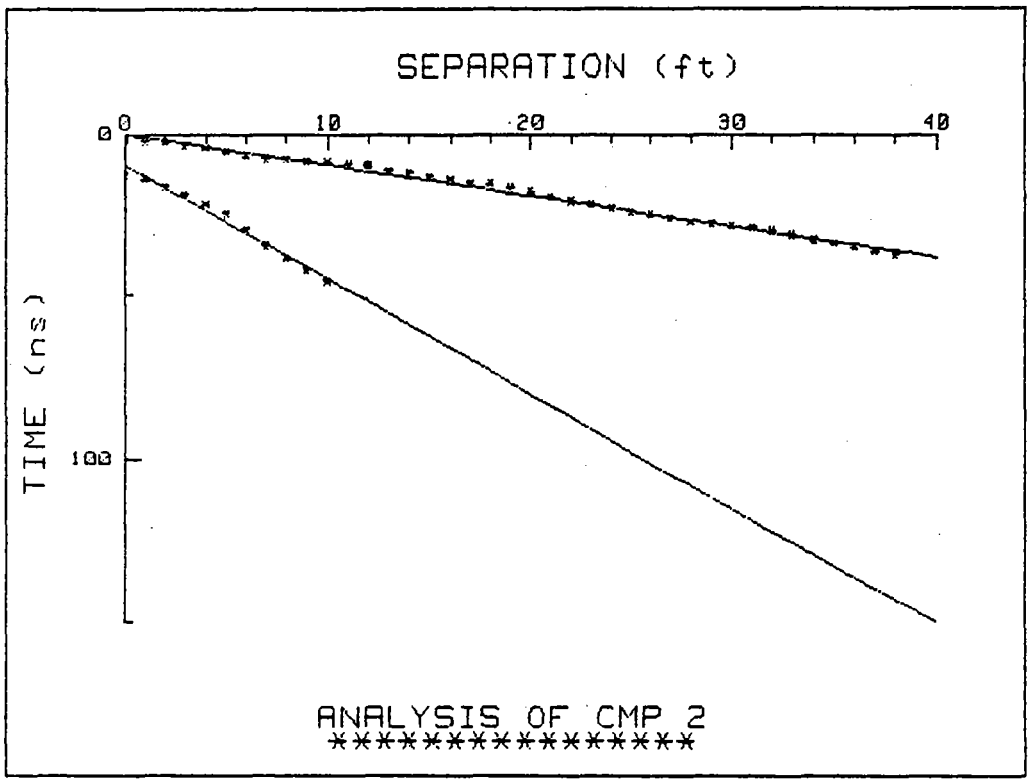
EVENT	INTERCEPT (ns)	VELOCITY(ft/ns)	K	DEPTH(ft)
AIRWAVE	+0.00	.946	1.000	
GROUNDWAVE	+13.08	.311	9.907	
REFLECTOR 1	+57.22	.223	19.327	6.378

EVENT	LAYER VELOCITY(ft/ns)	K	THICKNESS(ft)
LAYER 1	.223	19.3	6.38

TABLE 5

multiVIEW Geoservices Inc. WARR and CMP Analysis

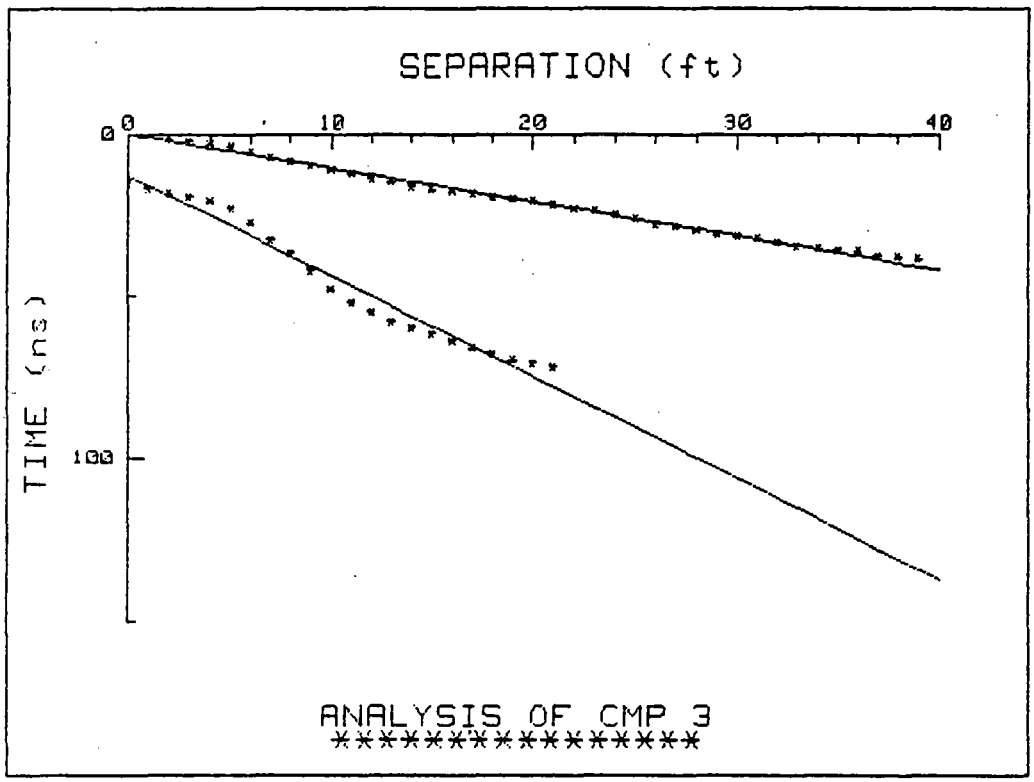
****



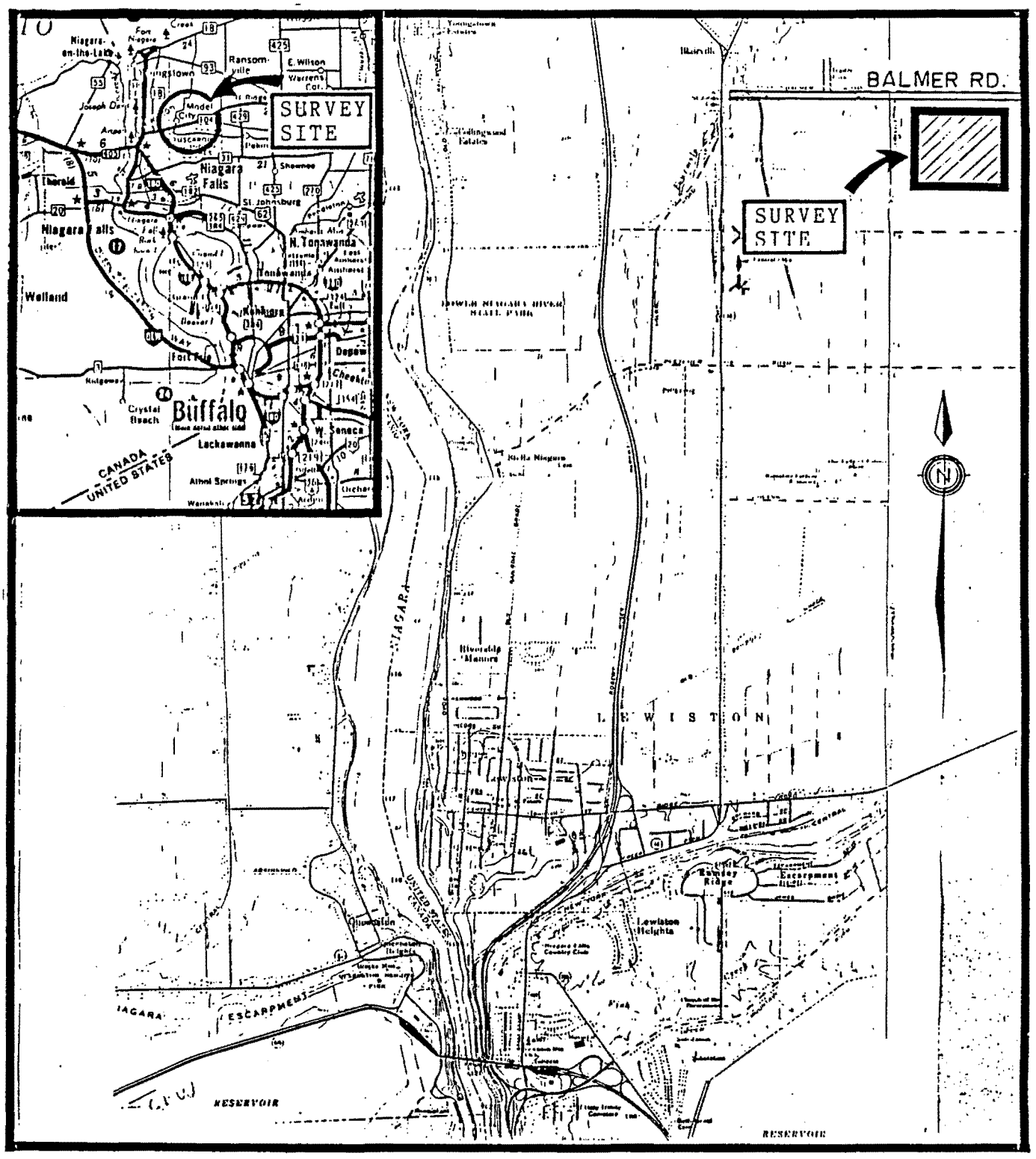
EVENT	INTERCEPT (ns)	VELOCITY(ft/ns)	K	DEPTH(ft)
AIRWAVE	+0.00	1.049	1.000	
GROUNDWAVE	+9.71	.284	11.902	

TABLE 6

multiVIEW Geoservices Inc. WARR and CMP Analysis



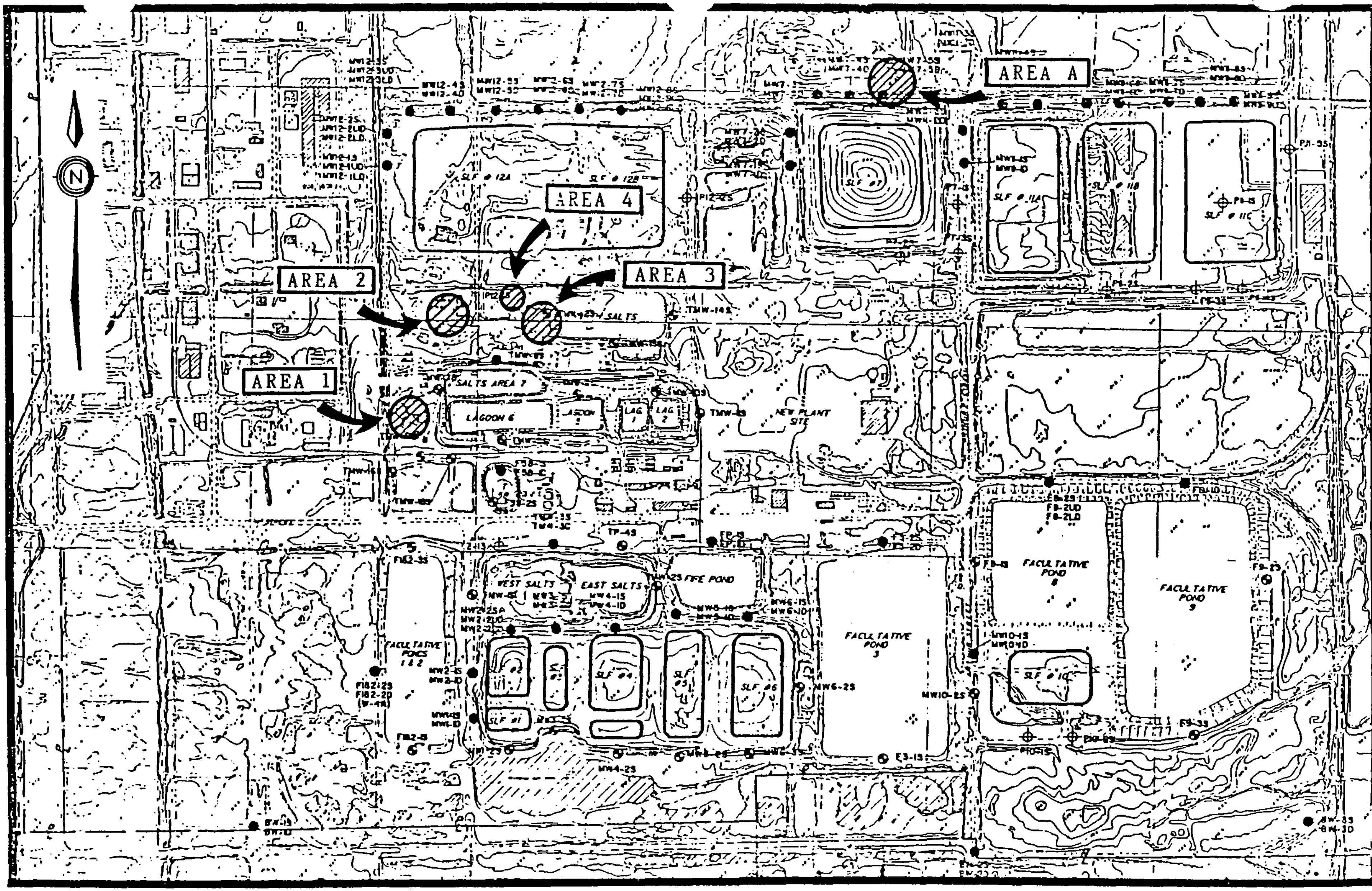
EVENT	INTERCEPT (ns)	VELOCITY(ft/ns)	K	DEPTH(ft)
AIRWAVE	+0.00	.963	1.000	
GROUNDWAVE	+12.65	.321	9.334	



multiVIEW Geoservices Inc.

AREA MAP OF MODEL CITY, N.Y. SHOWING LOCATION OF SCA FACILITY

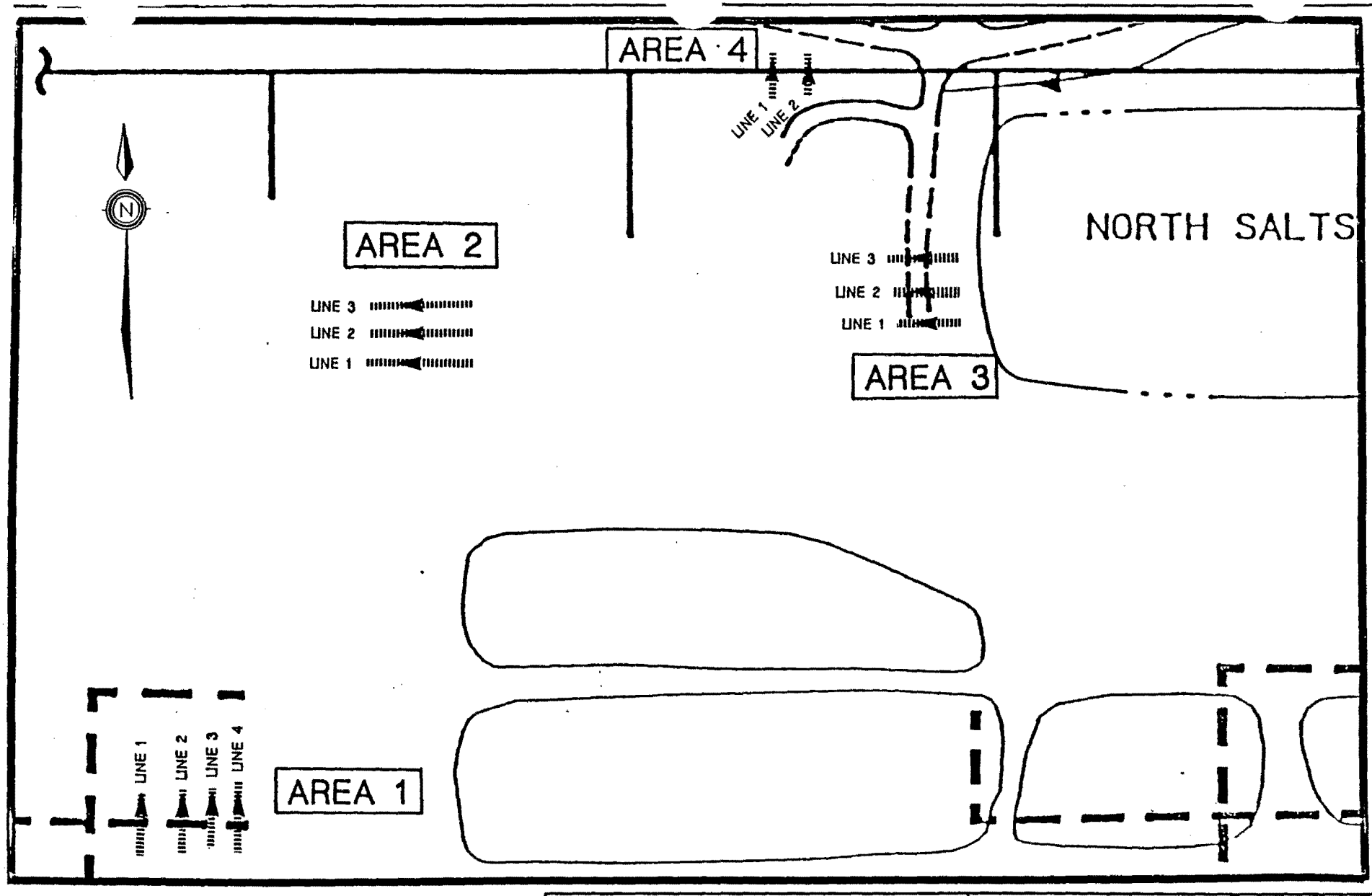
JOB	FIG.
5158	1



multiVIEW Geoservices Inc.

SITE MAP SHOWING LOCATIONS OF SURVEY AREAS

JOB	FIG.
5158	2



125' 0 125' 250'

SCALE

multiVIEW Geoservices Inc.

SITE MAP SHOWING SURVEY LINES OF AREAS 1 THROUGH 4

JOB 5158

FIG. 3

ATTACHMENT B

TEST PIT SOIL BORING AND MONITORING

WELL CONSTRUCTION LOGS

NOTES ON MONITORING WELL
AND TEST BORING CONSTRUCTION LOGS

1. Penetration test and split spoon sampling of soils performed in general accordance with ASTM D-1586-67 (1974).

2. Description of soils in general accordance with the Unified Soil Classification System. Consistency and density determinations based upon manual observations.

3. Abbreviated terms are as follows:

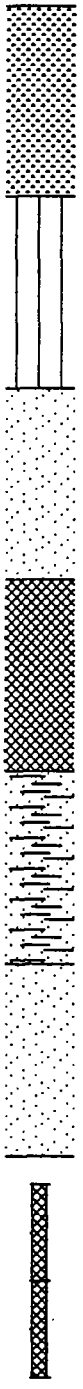
Bent	=	Bentonite
Compl	=	Completion
HSA	=	Hallow Stem Augers
OVA	=	Organic Vapor Analyzer
RDGS	=	Readings
Rec	=	Recovery
Ref	=	Refusal - based upon 100 blows with hammer
SS	=	Stainless Steel
WOR	=	Weight of Rods

ACRES

Test Boring/ Monitoring Well Construction Log

LEGEND

Date 1/30/90



Topsoil, typ. black to dark brown, some roots, moist

Upper Glacial Till Unit, typ. brown to red brown CLAY to SILT, may include some sand and gravel lenses, med. to hard, low to med. plasticity

Glaciolacustrine Clay Unit, typ. gray, may include brown streaks, some sand and gravel, occasional silt layers, soft to med.

FILL, typ. red brown to brown, may include black layers or cinders, metal, and/or wood

ROAD GRAVEL

SAND and/or GRAVEL lenses, typ. mod. to poorly sorted

Split spoon sample, standard penetration test

1	2
3	4

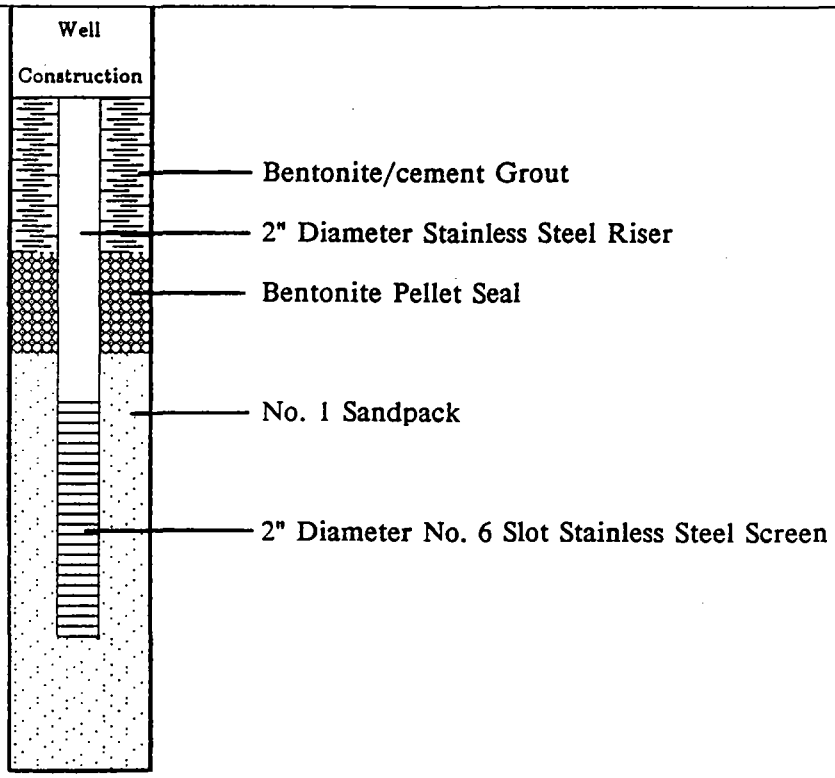
Standard Penetration Test - Blows per 6"

ACRES

Test Boring/ Monitoring Well Construction Log

LEGEND

Date 1/30/90



Test Boring/ Monitoring Well Construction Log

AGRES

DATE STARTED	11/20/89	PROJECT NO.	P834109
DATE FINISHED	11/21/89	WELL/BORING NO.	A-CB-1
COORDINATES		LOGGED BY	K. Connare
N 11042.00	E 10808.50	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	316.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	300.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1		5 12 / 18 24	1.4	Dark drown to brown SILT (ML), little tan patches, some gravel to 1", some roots, moist	OVA RDGS: #1 = 0 ppm
				2		60 58 / 30 34	1.6	Becoming red brown to brown below 2'	#2 = 3 ppm
			5	3		12 12 / 12 9	1.2		#3 = 1.0 ppm
				4		20 29 / 35 wor	0.8	Becoming red brown to gray brown SILT (ML) with some black	#4 = >10 ppm
				5		wor wor / 42 26	0.6	Increase in clay to Clayey SILT/Silty CLAY (ML), wet, borehole saturated at 7.5', spoon dripping	Void, may have drilled through drum at 7'
		305.7	10	6		12 27 / 34 37	0.6	10.5	Remainder of samples not recorded due to OVA malfunction
				7		17 22 / 32 30	2.0	Brown Clayey SILT/Silty CLAY (ML-CL), moist	
			15	8		24 36 / 71 64	2.0		
		300.2						16.0	
								Boring terminated at 16'	Water filled void in hole after removing augers
									Borehole backfilled to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	11/21/89	PROJECT NO.	P834109
DATE FINISHED	11/21/89	WELL/BORING NO.	A-B-1
COORDINATES		LOGGED BY	K. Connare
N 11047.00	E 10808.50	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	316.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	292.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	12	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	24 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	24.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Type	Blows		Rec.	CLASSIFICATION	REMARKS
				1		9 24	30 30	1.2	Dark brown to brown SILT (ML), little clay, some gravel to 1", some rust and green patches, dry to moist, stiff to v. stiff, some roots in upper ft.	OVA RDGS: #1 = 0 ppm
				2		42 ref		0.6	Becoming brown to red brown below 2'	#2 = 1.0 ppm Augered to 4'
			5	3		21 31	60 65	1.8		#3 = Not recorded
				4		20 39	70 100	1.7	Occasional sandy silt seams to 1/4" thick	#4 = 4-5 ppm
				5		57 47	77 100	2.0		#5 = 90 ppm
			10	6		25 34	39 41	2.0	Becoming grayer with increase in clay to Clayey SILT (ML)	#6 = 10 ppm
				7		16 24	30 32	2.0		#7 = 4 ppm
			15	8		35 89	69 32	1.2		#8 = 12 ppm
				9		40 35	36 36	2.0		#9 = 8-12 ppm
		298.2							18.0	
				10		5 9	10 16	2.0	Brown-gray to gray CLAY (CL), little to some silt, little gravel to 1/2", soft, wet	#10 = 4 ppm
			20	11		10 12	10 9	2.0		#11 = 10 ppm
				12		7 8	4 14	2.0		#12 = 0 ppm
		292.2							24.0	
									Boring terminated at 24'	Dry @ compl.
										Borehole backfilled to ground surface with bentonite slurry
										Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED 11/22/89
DATE FINISHED 11/22/89
COORDINATES
N 11052.50 E 10809.00
GROUND SURFACE ELEV. 316.3 ft

PROJECT NO. P834109
WELL/BORING NO. A-B-2
LOGGED BY K. Connare
INSPECTED BY K. Connare
APPROVED BY N. Bond
SHEET 2 of 2

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		284.3		16		5 7 / 17 47	2.0	Gray-brown Sandy SILT (ML), occasional gravel and clay lenses 32.0	#16 = 0 ppm
								Boring terminated at 32'	Borehole dry @ compl.
									Borehole backfilled to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/27/89	PROJECT NO.	P834109
DATE FINISHED	11/27/89	WELL/BORING NO.	A-B-3
COORDINATES		LOGGED BY	C. Baker
N 11057.50	E 10809.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.3 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	292.3 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	12	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	24	CASING STICK UP (ft)	N/A	TOTAL DEPTH	24.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1		11 15 / 15 18	1.5	Brown Silty CLAY (CL) some sand & gravel tr. wood & veg. to 1' (FILL)	OVA RDGS: #1 = 1.5 ppm
		313.4		2		29 50 / ref	1.0	Gray brown, some veg. to 2.5', 2.9	#2 = 0.2 ppm 0.5 ppm @ veg
		310.8	5	3		22 72 / 85 75	1.8	Red brown Silty CLAY (CL) with gray-green mottles, v. hard, moist. 5.5	Augered to 4' #3 = 0.7-0.9 ppm
		309.6		4		72 78 / 78 75	2.0	Brown SILT (ML) trace sand & gravel, sl. moist 6.7	@ clay < 0.5 ppm @ silt #4 = 2.5 ppm
				5		22 23 / 48 65	2.0	Red brown Silty CLAY (CL) some sand & gravel, moist As above, but with v. fine black laminae at 2-4" intervals	#5 = 6.5 ppm
			10	6		18 23 / 40 35	2.0		
				7		40 60 / 56 70	2.0	Gray fracture surface @ 10.5'. Less gravel @ 11'. As above, moist - v. moist. Higher OVA rdg. @ gray fracture.	#6 = 20 ppm @ gray frac. surf. 10 ppm below #7 = 6.5-18 ppm
			15	8		34 44 / 54 40	0.3		#8 = 10 ppm
				9		80 ref	0.3		
								Brown SILT & CLAY (CL) wet	#9 = 2 ppm Auger 16.7-18'
				10		11 13 / 16 26	0.3	Brown Silty CLAY (CL), some gravel, wet	#10 = 2 ppm
		295.8	20	11		18 38 / 50 25	0.3	20.5 SAND & CLAY, some gravel (SC) saturated (possible drill cuttings) 22.2	#11 = 1.5 ppm
		294.1		12		13 15 / 14 20	1.2	Gray CLAY (CL), tr. to some gravel, few silt and sand laminae, soft, v. moist 24.0	#12 = <1 ppm Dry @ compl.
		292.3						Boring terminated at 24'	Acker AD-2 drill rig, using 3" split spoons Borehole backfilled to ground surface with bentonite slurry

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/27/89	PROJECT NO.	P834109
DATE FINISHED	11/27/89	WELL/BORING NO.	A-B-4
COORDINATES		LOGGED BY	C. Baker
N 11032.50	E 10823.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.1 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	288.1 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	14	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	28 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	28.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1		13 25 / 40 42	1.8	Dark brown Silty CLAY, few roots, etc. to 1'	OVA RDGS:
								Light brown Silty CLAY, dry to sl. moist, v. hard (FILL)	#1 = <1 ppm
				2		65 70 / 55 36	1.5	Red brown Silty CLAY, some sand and gravel, v. hard, sl. moist	#2 = 1 ppm
			5	3		15 5 / 5 13	1.0		#3 = 30 ppm initial settled at 1 ppm
				4		37 55 / 17 5	0.0	Wet sand lenses from 6 to 6.5'	
		307.6						Saturated, possibly penetrated buried trench 8.5	#4 = Not recorded
				5		3 11 / 31 31	1.3	Red brown Silty CLAY (CL), some sand and gravel, moist	#5 = 3.5 ppm
			10	6		32 38 / 52 60	1.8	Increase in gravel	#6 = 30 ppm at 10.5'
				7		60 62 / 70 75	1.5		8 ppm at 11.5' #7 = 20-22 ppm
			15	8		58 79 / 70 58	0.8	Brown Silty CLAY (CL), few sand laminae	#8 = 3.5-4 ppm
				9		45 29 / 50 90	2.0	Becoming grayish brown, v. moist and soft below 17, 18.0	#9 = 2.5-4 ppm
		298.1							
				10		66 65 / 67 75	0.5	Becoming red brown SILT to Clayey SILT (ML-CL), some sand and gravel, moist to wet	#10 = 18-20 ppm
			20	11		32 39 / 30 32	0.8		#11 = 1.5-2 ppm
				12		24 22 / 28 32	1.8		#12 = 4.5-6 ppm
		292.4						23.7	
				13		26 37 / 47 57	0.0	Grayish brown Silty CLAY (CL)	#13 = 0 ppm
		290.1	25					26.0	
				14		60 30 / 23 29	2.0	Red brown SILT (ML), some gravel and sand, v. moist to wet	#14 = 0-0.5 ppm
		288.1						Gray SILT (ML), trace clay, v. moist to wet, low plasticity below 27.5' 28.0	Dry @ compl.
								Boring terminated at 28'	Borehole grouted to ground surface with bentonite slurry

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/28/89	PROJECT NO.	P834109
DATE FINISHED	11/28/89	WELL/BORING NO.	A-B-5
COORDINATES		LOGGED BY	C. Baker
N 11043.00	E 10821.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	294.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	11	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	22 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	22.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		312.7		1		9 18 / 28 38	1.5	Dark brown Silty CLAY (CL), trace to some sand and gravel, dry to sl. moist (FILL)	OVA RDGS: #1 = <1 ppm
				2		35 36 / 32 34	1.2	3.5	#2 = <1 ppm
			5	3		7 4 / 3 2	0.5	Red brown Silty CLAY (CL) below 3.5', moist Becoming wet at 4.5'	#3 = <1 ppm
				4		4 9 / 40 ref	0.4	Saturated, oily sheen on water, gray auger slough, probably in drum trench	#4 = 8 ppm 80 ppm in borehole Auger to 10'
				5		100 ref	0.3	Piece of metal recovered	#5 = 8 ppm >1000 ppm in borehole at 10'
			10	6		100 ref	0.0	Red brown Silty CLAY (CL) recovered from side of hole	#6 = 1.5 ppm Auger to 12'
				7		42 100 / ref	0.3	Recovered 3" piece of metal carried by auger	#7 = Not recorded Auger to 14'
			15	8		60 32 / 37 33	1.5	Red brown Silty CLAY (CL), trace to some sand and gravel, few silt pods and large gray mottles Gray CLAY (CL) 16.2 to 16.5'	#8 = 3-8 ppm
				9		82 60 / 31 44	2.0	Red brown Clayey SILT (ML) from 16.5 to 17', some to and sand and gravel	#9 = 6 ppm in silt <1 ppm in clay
		297.7		10		30 25 / 17 20	1.8	Gray Silty CLAY (CL) at 17 to 18' 18.5 Red brown Silty CLAY/Clayey SILT (CL-ML) 18 to 18.5', moist	#10 = <1 ppm
			20	11		17 20 / 17 23	1.5	Gray CLAY (CL), soft, trace of sand and gravel 22.0	#11 = 2-3 ppm in clay 6 ppm in slough Dry @ compl.
		294.2						Boring terminated at 22'	Borehole grouted to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/28/89	PROJECT NO.	P834109
DATE FINISHED	11/28/89	WELL/BORING NO.	A-B-6
COORDINATES		LOGGED BY	C. Baker
N 11031.50	E 10832.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.1 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	288.1 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	14	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	28 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	28.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1		28 25 / 45 55	1.5	Brown Silty CLAY (CL), trace to some sand and gravel, sl. moist below 0.5', v. hard (FILL)	OVA RDGS: #1 = <1 ppm
				2		25 30 / 55 40	1.0		#2 = <1 ppm
			5	3		7 12 / 17 16	0.7	Becoming moist below 4'	#3 = 20 ppm
		308.1		4		7 12 / 10 17	1.0	Mixed red brown and gray Silty CLAY (CL) Becoming wet and soft at 6.5'	#4 = 20 ppm at 6' 40 ppm at 6.5'
								8.0	
				5		15 19 / 33 40	1.9	Red brown Silty CLAY (CL), some sand and clay, sl. moist, v. hard	#5 = 6 ppm
			10	6		40 44 / 100 ref	1.5		#6 = 6 ppm
				7		52 52 / 53 47	1.5	Becoming moist	#7 = 15-17 ppm
			15	8		33 53 / 80 100	0.8	Color change to gray brown, gravel blocked spoon at 15'	#8 = 10 ppm
				9		37 46 / 35 35	1.0	Red brown SILT and GRAVEL (ML), some sand, v. moist to wet	#9 = 7 ppm
				10		22 26 / 17 20	1.2	Becoming grayish brown	#10 = 6 ppm
			20	11		32 36 / 36 36	0.0		#11 = Not recorded Drove gravel in sample #11
				12		16 36 / 37 28	1.2	Brown SILT and GRAVEL (ML), v. moist	#12 = 2-2.5 ppm
			25	13		35 36 / 36 37	0.0		#13 = Not recorded
				14		45 36 / 41 41	1.9	Brown SILT (ML), some gravel	#14 = 2 ppm in gray clay
		289.1						Gray Clayey SILT/Silty CLAY (ML-CL), some gravel, moist	27.0
		288.1							28.0 Dry at compl. Borehole grouted to ground surface with bentonite slurry
								Boring terminated at 28'	

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/29/89	PROJECT NO.	P834109
DATE FINISHED	11/29/89	WELL/BORING NO.	A-B-7
COORDINATES		LOGGED BY	C. Baker
N 11033.50	E 10842.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	306.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	5	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	10 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	10.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1	13 9 / 11 11	1.5	Red brown Silty CLAY (CL), some sand and gravel, dry to sl. moist	OVA RDGS: #1 = <1 ppm
				2	30 18 / 9 4	0.8	Becoming moist	#2 = 1-4 ppm
			5	3	11 11 / 12 22	0.3	Gray brown Clayey SAND (SP), saturated, possibly penetrated drum trench Void from 4.5 to 7.5'	#3 = Initial 500 ppm, settled at 1.5-2 ppm
		308.7 ▽		4	12 14 / 18 50	0.3	7.5	#4 = 3 ppm
				5	30 11 / 11 13	0.3	Gray Silty CLAY (CL), some sand and gravel, v. wet to saturated	#5 = 5 ppm
		306.2	10				10.0 Boring abandoned at 10'	Water at 7.5' after drilling Void from 4.5 to 7.5' during drilling Borehole backfilled to ground surface with bentonite slurry, auger cuttings, and bent. pellets Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/29/89	PROJECT NO.	P834109
DATE FINISHED	11/29/89	WELL/BORING NO.	A-B-8
COORDINATES		LOGGED BY	C. Baker
N 11036.00	E 10852.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.3 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	290.3 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	13	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	26 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	26.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1	9 10 / 20 27	1.9	Red brown Silty CLAY (CL), trace to some sand and gravel, sl. moist, v. hard	OVA RDGS: #1 = 0 ppm
				2	30 16 / 30 10	0.8	Becoming moist	#2 = 0.5 ppm
			5	3	16 9 / 30 30	0.2	Red brown Silty CLAY (CL), some gray, wet to saturated, probable metal from 5 to 8'	#3 = Not recorded
				4	22 30		Oily sheen on gray slough, probably penetrated drum trench	#4 = 17.5 ppm 2 ppm at borehole
		308.3					8.0	
				5	8 11 / 15 15	2.0	Red brown Silty CLAY (CL), some sand and gravel, moist, hard	#5 = 1-1.5 ppm 20 ppm at borehole
			10	6	8 10 / 18 20	2.0		#6 = 2-7 ppm 7 ppm at borehole
				7	42 47 / 52 46	2.0		#7 = 2-7 ppm
			15	8	37 26 / 21 24	1.3	Red brown SILT/Clayey SILT (ML), moist to 13.7', v. moist to wet below Red brown SILT (ML), some gravel, trace clay, v. moist	#8 = 1.5-2 ppm
				9	22 25 / 28 19	0.7	Becoming wet	#9 = <1 ppm
				10	7 13 / 10 9	0.7	Red brown SILT (ML), some sand and gravel, v. wet to saturated	#10 = 0 ppm
			20	11	7 8 / 8 8	0.8	Brown Sandy SILT (ML), v. wet to saturated	#11 = 0 ppm
				12	7 10 / 9 8	2.0	Becoming gray brown Sandy SILT and GRAVEL, saturated	#12 = 0 ppm #13 = 0 ppm Dry @ compl.
		290.8	25	13	9 9 / 5 5	1.5		
		290.3					25.5 Alternating brown SILT (ML) and gray Silty CLAY (CL) below 25.5' 26.0 Boring terminated at 26'	Borehole grouted to ground surface with bentonite slurry Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	11/30/89	PROJECT NO.	P834109
DATE FINISHED	11/30/89	WELL/BORING NO.	A-B-9
COORDINATES		LOGGED BY	C. Baker
N 11033.00	E 10777.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	315.8 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	297.8 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	9	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	18 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	18.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1	10 11 / 10 12	1.8	Red brown Silty CLAY (CL), some sand and gravel, moist (FILL)	OVA RDGS: #1 = 0 ppm
				2	20 18 / 13 9	1.8		#2 = <1 ppm
			5	3	2 3 / 2 3	0.5	Becoming gray brown Silty CLAY (CL), v. moist	#3 = 15 ppm
				4	1 1 / 1 1	0.5	Gray brown Silty CLAY (CL), some vegetation, wet, soft	#4 = 25-30 ppm
		306.8		5	2 1 / 1 4	1.0	9.0	#5 = 8-10 ppm
			10	6	8 10 / 11 11	1.0	Brown CLAY (CL), moist, stiff	#6 = 6-10 ppm
				7	21 17 / 30 30	1.8	Red brown Silty CLAY (CL), some sand and gravel, hard Gray CLAY (CL) from 13 to 13.5'	#7 = 2-10 ppm
		300.8	15	8	13 14 / 14 9	1.5	Red brown SILT and GRAVEL (ML), trace clay, sl. moist, hard 15.0 Gray to gray brown CLAY (CL), some sand and gravel, v. moist, stiff	#8 = 0 ppm
		299.3					16.5	
		298.8		9	14 13 / 9 8	2.0	17.0 Brown SILT and GRAVEL (ML) from 16.5 to 17'	#9 = 0 ppm
		297.8					18.0 Gray CLAY (CL) as above Boring terminated at 18'	Water level at 16' after drilling Water running into hole at 5' Borehole grouted to ground surface with bentonite slurry Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED 11/30/89
DATE FINISHED 11/30/89
COORDINATES
N 11032.00 E 10757.50
GROUND SURFACE ELEV. 315.8 ft

PROJECT NO. P834109
WELL/BORING NO. A-B-10
LOGGED BY C. Baker
INSPECTED BY C. Baker
APPROVED BY N. Bond
SHEET 1 of 1

DRILLING METHOD 4 1/4" HSA
HAMMER WT. 300 lb
HAMMER DROP 30 in
NO. SOIL SAMPLES 9
TOTAL OVERBURDEN 18 ft

ELEVATION TOP OF ROCK N/A
ELEVATION BOTTOM OF HOLE 297.8 ft
TOTAL ROCK DRILLED N/A
WELL MAT'L/DIA. (in) N/A
CASING STICK UP (ft) N/A

CLIENT KC Corps of Engineers
SITE LOOW
DRILLING CO. Empire Soils
DRILLER L. Schroeder
TOTAL DEPTH 18.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1		6 10 / 12 14	2.0	Brown Silty CLAY (CL), some sand and gravel, sl. moist, hard (FILL)	OVA RDGS: #1 = 0 ppm
				2		24 18 / 16 15	1.8	As above, v. hard, moist	#2 = Not recorded
			5	3		3 2 / 4 5	0.8	As above, trace sand and gravel, becoming wet	#3 = Initially >100 ppm then settled at 20 ppm
				4		4 2 / 1 1	0.3	Silty CLAY (CL), few pieces of red platy debris fragments, wet	#4 = 4-5 ppm
				5		5 2 / 10 12	0.2	Gray CLAY with Sand and Gravel, some metal fragments, probable drum trench to 10'	#5 = 4-5 ppm
		305.8	10					10.0	
				6		6 8 / 10 25	1.5	Red brown Silty CLAY (CL), some sand and gravel, moist, hard	#6 = 4-6 ppm
				7		12 12 / 15 16	1.9	Becoming moist to v. moist, med. to hard	#7 = 3-9 ppm
		301.8						14.0	
		300.3	15	8		6 6 / 5 13	2.0	Gray brown CLAY (CL), trace to some sand and gravel, v. moist	#8 = 0.5-1.5 ppm
				9		37 16 / 12 15	1.5	Red brown SILT (ML), some sand and gravel interbedded with gray brown Silty CLAY (CL), trace gravel	#9 = <1 ppm
		297.8						15.5 / 18.0	
								Boring terminated at 18'	Water level at 5.5' after drilling Borehole grouted to ground surface with bentonite slurry, auger and auger cuttings Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/4/89	PROJECT NO.	P834109
DATE FINISHED	12/4/89	WELL/BORING NO.	A-B-11
COORDINATES		LOGGED BY	C. Baker
N 11038.50	E 10640.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	315.6 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	297.6 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	9	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	18 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	18.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1		12 7 / 8 11	1.9	Red brown Silty CLAY (CL) mixed with black material typically in about 6" layers (FILL)	OVA RDGS: #1 = 0 ppm
				2		11 10 / 10 7	1.9		#2 = 2 ppm in 2-3' 30 ppm in 3-4'
			5	3		6 10 / 8 11	1.9		#3 = 130-200 ppm
		309.6						6.0	
				4		4 4 / 4 4	1.0	Red brown Silty CLAY (CL), some sand and gravel, moist, med. hard	#4 = 30-80 ppm
				5		8 3 / 7 10	1.0	Red brown SILT lens from 8 to 8.3'	#5 = 3.5 ppm
			10	6		14 12 / 16 14	2.0	Red brown Silty CLAY (CL), some sand and gravel, moist	#6 = 0 ppm
				7		14 16 / 24 21	2.0		#7 = 0 ppm
		301.8						13.8	
			15	8		23 13 / 11 9	0.0	Gray brown CLAY (CL), soft	#8 = Not recorded
				9		5 6 / 7 5	2.0	Interlayered red brown SILT and CLAY (ML-CL), some gravel and gray Silty CLAY (CL) in 6" layers	#9 = 1.5 ppm (possibly exhaust)
		297.6						18.0	
								Boring terminated at 18'	Dry @ compl.
									Borehole grouted to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/5/89	PROJECT NO.	P834109
DATE FINISHED	12/5/89	WELL/BORING NO.	A-B-12
COORDINATES		LOGGED BY	C. Baker
N 11037.50	E 10888.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	316.3 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	300.3 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1		22 16 / 16 14	1.5	Brown CLAY (CL)	OVA RDGS:
								Light brown SILT	#1 = <1-1.5 ppm
				2		22 22 / 18 18	1.8	Interbedded brown CLAY (CL) and fine SAND and SILT (SM), moist	
								Brown Silty CLAY (CL), some sand and gravel, moist, hard below 3'	#2 = 1.5-2 ppm
			5	3		7 10 / 14 14	1.9		#3 = 1-3 ppm
				4		45 45 / 35 32	2.0		#4 = 1-1.5 ppm
				5		7 10 / 21 31	1.9		#5 = 1 ppm
			10	6		14 18 / 23 25	2.0	As above, thin sand band at 9.8'	#6 = <1 ppm
				7		15 15 / 20 21	1.9	Brown Silty SAND lens from 12 to 12.5'	
		301.8						Brown CLAY (CL), some sand and gravel, few fine sand lenses 14.5	#7 = 4-8 ppm
			15	8		4 4 / 6 5	1.8		
		300.3						Gray brown Silty CLAY (CL), trace to some sand and gravel, v. moist, med. to soft 16.0	#8 = 2-4 ppm
									Dry @ compl.
								Boring terminated at 16'	Borehole grouted to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED 12/11/89
DATE FINISHED 12/11/89
COORDINATES
N 11074.00 E 10714.50
GROUND SURFACE ELEV. 315.4 ft

PROJECT NO. P834109
WELL/BORING NO. A-B-13
LOGGED BY K. Connare
INSPECTED BY K. Connare
APPROVED BY N. Bond
SHEET 1 of 1

DRILLING METHOD 4 1/4" HSA
HAMMER WT. 300 lb
HAMMER DROP 30 in
NO. SOIL SAMPLES 8
TOTAL OVERBURDEN 16 ft

ELEVATION TOP OF ROCK N/A
ELEVATION BOTTOM OF HOLE 299.4 ft
TOTAL ROCK DRILLED N/A
WELL MAT'L/DIA. (in) N/A
CASING STICK UP (ft) N/A

CLIENT KC Corps of Engineers
SITE LOOW
DRILLING CO. Empire Soils
DRILLER L. Schroeder
TOTAL DEPTH 16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		314.9		1	2 3 / 4 4	2.0	Brown SILT (ML) with some clay layers to 1/4", moist, some roots — 0.5	OVA RDGS: #1 = 0 ppm
				2	4 10 / 19 23	2.0	Red brown to brown Clayey SILT (ML), some gravel to 1/2", some black and green-gray silt patches to 1/2", moist	#2 = 0 ppm
			5	3	7 11 / 15 16	2.0		#3 = 0 ppm
				4	17 21 / 31 27	2.0		#4 = 0 ppm
				5	5 8 / 12 16	2.0	Slight increase in clay content, becoming v. stiff	#5 = 0.5 ppm
			10	6	4 7 / 9 11	2.0	Increase in clay content to Clayey SILT/Silty CLAY (ML-CL), some silt seams to 1/4", moist — 12.0	#6 = 0.5 ppm
		303.4						
		302.9		7	11 9 / 10 11	2.0	Coarse sand seam from 12 to 12.5' — 12.5	#7 = 0 ppm
		301.4					— 14.0	
			15	8	2 3 / 6 6	0.3	Brown-gray Silty CLAY (CL), some brown silt streaks, some gravel, soft — 16.0	#8 = 0 ppm
		299.4					Boring terminated at 16'	Stone pushed in shoe in last sample Dry @ compl. Borehole backfilled to ground surface with bentonite slurry CME 45 track mounted drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/12/89	PROJECT NO.	P834109
DATE FINISHED	12/12/89	WELL/BORING NO.	A-B-14
COORDINATES		LOGGED BY	K. Connare
N 11039.00	E 10616.00	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	315.6 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	299.6 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1	12 7 / 8 13	2.0	Brown black Gravelly SILT (ML), some clay, gravel to 1 1/2", moist, some wood and black cinders at 1.6 to 2.0'	OVA RDGS: #1 = 0 ppm
		312.4		2	7 11 / 13 16	2.0	Layer of brown Sandy CLAY (CL), some black silt, some glass from 2.8 to 3.2' 3.2	#2 = 0.5 ppm
			5	3	6 10 / 12 13	2.0	Brown Sandy SILT (ML), occasional tan fine sand lens to 1/2"	#3 = 0-1.0 ppm
				4	10 14 / 17 17	1.7	Increase in clay to Clayey SILT/Silty CLAY (ML-CL), moist	#4 = .5-2.0 ppm
				5	7 10 / 13 16	2.0	Color change to red-brown, some green-gray patches to 1/2", some gray partings	#5 = 0-0.25 ppm
			10	6	4 8 / 12 13	2.0	Black specs noted along partings	#6 = 0.25-1.0 ppm
				7	17 13 / 17 14	2.0	Increase in clay to Silty CLAY (CL), becoming grayer to gray-brown, some gravel to 1", moist	#7 = 0-0.5 ppm
		301.6					14.0	
			15	8	3 3 / 4 5	1.3	Gray-brown CLAY (CL), some gravel to 1/2", soft, moist 16.0	#8 = 0 ppm
		299.6					Boring terminated at 16"	Dry @ compl.
								Borehole backfilled to ground surface with bentonite slurry
								CME 45 track mounted drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	11/22/89	PROJECT NO.	P834109
DATE FINISHED	11/22/89	WELL/BORING NO.	A-B-2
COORDINATES		LOGGED BY	K. Connare
N 11052.50	E 10809.00	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	316.3 ft	APPROVED BY	N. Bond
		SHEET 1 of 2	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	140 lb	ELEVATION BOTTOM OF HOLE	284.3 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	16	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	32 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	32.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1	8 12 / 18 18	1.8	Dark brown to brown SILT (ML), little clay, little to some gravel, little roots, moist	OVA RDGS: #1 = 1.0 ppm
				2	30 40 / 60 50	1.8		#2 = 9.0 ppm
			5	3	14 33 / 52 95	1.6		#3 = 35 ppm
				4	90 100 / ref -	1.2	Contains some gray silt partings	#4 = 12 ppm
				5	100 78 / 40 54	1.0		#5 = 1-8 ppm
			10	6	15 50 / 62 64	0.0	Increase in clay content to Clayey SILT (ML), slightly grayer	#6 = Not recorded
				7	64 73 / 82 85	1.0		#7 = 8 ppm
			15	8	7 9 / 20 26	1.9		#8 = 12 ppm
		300.3					16.0	
				9	49 36 / 50 48	2.0	Brown SILT (ML) with some gravel	#9 = 20 ppm
				10	6 9 / 8 32	2.0		#10 = 25 ppm
		295.8	20				20.5	
				11	6 33 / 24 20	0.8	Brown-gray CLAY (CL), little silt, some gravel to 1/2", occasional silt and sand seams to 1/2"	#11 = 45 ppm
				12	16 22 / 22 15	2.0		#12 = 0-1 ppm
		291.3	25				25.0	
				13	10 20 / 23 18	1.5		#13 = 2.0 ppm
				14	16 22 / 25 27	0.5	Gray-brown Sandy SILT (ML), saturated, some gravel to 1/2", occasional gravel lenses and clay lenses to 1"	#14 = 0 ppm
				15	8 15 / 24 34	2.0		#15 = 0 ppm

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/13/89	PROJECT NO.	P834109
DATE FINISHED	12/13/89	WELL/BORING NO.	MW-A-89
COORDINATES		LOGGED BY	K. Connare
N 11120.62	E 10716.62	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	314.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	296.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	9	WELL MAT'L/DIA. (in)	SS/2"	DRILLER	A. Koske
TOTAL OVERBURDEN	18 ft	CASING STICK UP (ft)	2.28'	TOTAL DEPTH	18.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Blows	Rec.	CLASSIFICATION	REMARKS
		313.7		1	1 2 / 3 6	2.0	Dark brown SILT (ML), some roots, little gravel — 0.5	OVA RDGS:
				2	12 13 / 16 19	2.0	Brown Clayey SILT (ML), some gravel, some red and green patches, moist	#1 = 0 ppm
			5	3	8 18 / 32 27	1.5	Some gray vertical partings	#2 = 0.5 ppm
				4	29 36 / 39 34	0.0		#3 = 0 ppm
				5	4 8 / 13 13	2.0	Increase in clay to Clayey SILT/Silty CLAY (ML-CL), some gravel to 2", — 10.5	#4 = Not Recorded
		303.7	10	6	6 11 / 8 7	2.0	Brown SILT (ML), some gravel to 1", some gray vertical partings, occasional tan patches to 3/4" — 12.5	#5 = 0 ppm
		301.7		7	9 11 / 13 16	2.0	Brown Clayey SILT/Silty CLAY (ML-CL), some gravel to 1", some vertical gray partings	#6 = 0 ppm
			15	8	4 4 / 6 10	2.0		#7 = 0 ppm
		297.2		9	3 3 / 7 9	1.2	— 17.0	#8 = 0 ppm
		296.2					Gray Silty CLAY (CL), some gravel, soft — 18.0	#9 = 0 ppm
							Boring terminated at 18'	CME 45 track mounted drill rig, using 3" split spoons

Well Const:

9' No. 6 Slot SS Screen
10' SS Riser
No. 1 Sandpack
3/8" Bent. Pellet seal

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/6/89	PROJECT NO.	P834109
DATE FINISHED	12/6/89	WELL/BORING NO.	B-B-1
COORDINATES		LOGGED BY	C. Baker
N 11056.50	E 10332.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	313.5 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	299.5 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	7	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	14 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	14.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		312.5		1	2 1 / 1 2	1.8	Black and gray soil and debris to 1' (1.0)	OVA RDGS:
							Red brown Silty CLAY (CL), some sand and gravel, moist	#1 = 0.5 ppm
				2	6 9 / 12 19	2.0		#2 = 0.5 ppm
			5	3	10 12 / 13 15	1.8		#3 = 2.0 ppm
				4	17 17 / 24 56	1.5	Becoming Sandy SILT (ML), trace clay, moist	#4 = Not recorded
				5	20 26 / 25 35	1.0	Interbedded Sandy CLAY and SILT (ML), trace gravel and clay, moist	#5 = Not recorded
			10	6	26 55 / 14 16	1.0	Sandy SILT and GRAVEL, trace CLAY, sl. moist	#6 = 3-8 ppm
		301.5					(12.0)	
				7	17 14 / 16 13	2.0	Gray brown Silty CLAY, trace sand and gravel, v. moist, soft to med. (14.0)	#7 = 0.5 ppm
		299.5					Boring terminated at 14'	Dry @ compl.
								Borehole grouted to ground surface with bentonite slurry
								CME 45 track mounted drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/7/89	PROJECT NO.	P834109
DATE FINISHED	12/7/89	WELL/BORING NO.	B-B-2
COORDINATES		LOGGED BY	C. Baker
N 11234.00	E 10274.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	312.8 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	296.8 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1		1 1 / 3 2	1.0	Brown SILT and CLAY, some sand, moist, soft, loose	OVA RDGS: #1 = 0-2 ppm
		309.3		2		3 3 / 5 12	2.0	3.5	#2 = 1-3 ppm
			5	3		4 12 / 15 15	1.8	Red brown Silty CLAY (CL), some sand and gravel, moist Red brown SILT band from 5 to 5.5'	#3 = 1-1.5 ppm
				4		4 22 / 22 40	1.9	As above, moist, hard below 6'	#4 = 4-11 ppm
				5		6 13 / 16 17	1.9		#5 = 1.5-2 ppm
			10	6		4 16 / 14 14	2.0		#6 = 0-0.5 ppm
		300.8						12.0	
				7		4 9 / 12 16	0.3	Gray brown Silty CLAY (CL), trace sand and gravel, v. moist, soft	#7 = 0 ppm
			15	8		3 4 / 4 7	1.9		#8 = 0 ppm
		296.8						16.0	
								Boring terminated at 16'	Dry @ compl. Borehole grouted to ground surface with bentonite slurry CME 45 track mounted drill rig, using 3" split sponns

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/7/89	PROJECT NO.	P834109
DATE FINISHED	12/7/89	WELL/BORING NO.	B-B-3
COORDINATES		LOGGED BY	C. Baker
N 11138.00	E 10237.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	312.9 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	300.9 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	6	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	12 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	12.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		311.9		1	1 2 / 3 3	1.5	Brown Sandy SILT (ML), trace clay, loose, trace black debris (FILL) 1.0	OVA RDGS: #1 = 0.0-2 ppm
				2	3 4 / 8 8	2.0	Red brown Silty CLAY (CL), trace sand and gravel, moist. Brown SILT lense from 3.25 to 3.75'	#2 = 0.5-4 ppm
			5	3	4 7 / 10 14	2.0	Red brown Silty CLAY (CL), trace to some sand and gravel, sl. moist, hard	#3 = 4-10 ppm
				4	14 17 / 19 22	2.0		#4 = 10-20 ppm
				5	4 10 / 14 17	2.0		#5 = 10.-1.5 ppm
		302.9	10				10.0	
				6	3 4 / 7 7	2.0	Gray brown Silty CLAY (CL), trace sand and gravel, v. moist, med. 12.0	#6 = <0.5 ppm
		300.9					Boring terminated at 12'	Dry @ compl.
								Borehole grouted to ground surface with bentonite slurry
								CME 45 track mounted drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/8/89	PROJECT NO.	P834109
DATE FINISHED	12/8/89	WELL/BORING NO.	B-B-4
COORDINATES		LOGGED BY	C. Baker
N 11143.50	E 10199.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	311.6 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	301.6 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	5	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	10 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	10.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
		310.6		1		1 2	1.0	Brown Silty CLAY (CL), trace sand and gravel, trace black debris at 1', moist, soft (FILL) — 1.0	OVA RDGS:
						2 2			#1 = 0 ppm
				2		7 7	2.0	Brown Silty CLAY (CL) — 3.5	
		308.1				7 7			#2 = 0.5-1.5 ppm
		307.6				4 13		Brown SAND and SILT (SM) band 3.5 to 4' — 4.0	
		306.1	5	3		11 19	1.8	— 5.5	#3 = 1.5 ppm @ Clay
		305.8				17 28		Red brown Silty CLAY (CL), trace sand and gravel, hard — 5.8	5.0 ppm @Sand and gravel
				4		29 32	1.9		#4 = Not recorded
						4 6		Coarse sand and gravel lense from 5.5 to 5.8', saturated	
		302.1		5		7 7	1.5	— 9.5	#5 = Not recorded
		301.6	10					Red brown Silty CLAY (CL), some sand and gravel, moist, v. hard — 10.0	
								Gray brown Silty CLAY (CL), some sand and gravel, v. moist, soft	Water level at 7.4' after drilling
								Boring terminated at 10'	Borehole grouted to ground surface with bentonite slurry
									CME 45 track mounted drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/8/89	PROJECT NO.	P834109
DATE FINISHED	12/8/89	WELL/BORING NO.	B-B-5
COORDINATES		LOGGED BY	C. Baker
N 11020.50	E 10362.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	315.5 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	301.5 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	7	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	14 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	14.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
				1	36 17 / 19 14	1.8	Black debris mixed with brown Silty CLAY (CL) to 3.5' (FILL)	OVA RDGS: #1 = 0 ppm
		312.0		2	26 18 / 25 27	1.9	3.5	#2 = 0.5 ppm
			5	3	4 6 / 8 9	1.5	Red brown Clayey SILT (ML), moist Brown SILT (ML), moist	#3 = 200 ppm
		307.5		4	14 20 / 19 22	2.0	Red brown SILT and Silty CLAY (ML & CL) banded in 6" layers, moist 8.0	#4 = 1-8 ppm
		305.5	10	5	8 18 / 27 36	2.0	Red brown Silty fine SAND (SP), saturated 10.0	#5 = 2-6.5 ppm
		303.5		6	5 7 / 9 14	1.5	Red brown Silty CLAY (CL), some sand and gravel, moist 12.0	#6 = 0.5-1 ppm
		302.5		7	8 9 / 9 12	1.8	Med. gray green SAND (SP), saturated 13.0	#7 = 0.5 ppm
		301.5					Gray brown CLAY (CL), soft, moist 14.0 Boring terminated at 14'	Water level at 8.5' after drilling Borehole backfilled to ground surface with bentonite slurry CME 45 track mounted drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/8/89	PROJECT NO.	P834109
DATE FINISHED	12/8/89	WELL/BORING NO.	B-B-6
COORDINATES		LOGGED BY	C. Baker
N 10999.50	E 10378.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	314.8 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	298.8 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1	6 2 / 1 4	1.9	Mixed brown Silty CLAY (CL) and black debris (FILL)	OVA RDGS:
		312.8					2.0	#1 = 0-4 ppm
				2	10 14 / 22 26	2.0	Red brown to light brown Silty CLAY (CL), trace sand and gravel, moist, med. to hard	#2 = 1.0-4.5 ppm
			5	3	12 17 / 16 22	2.0		#3 = 30-100 ppm
				4	33 38 / 37 41	2.0	As above, spoon wet at 4 to 8'	#4 = 10-50 ppm
				5	5 15 / 25 25	2.0		#5 = 10-450 ppm
			10	6	5 73 / 17 24	2.0		#6 = >200 ppm at sand zones
				7	12 18 / 16 14	1.8	Red brown Silty CLAY (CL), med. to hard, moist, few bands of gray brown silty clay and silt	#7 = 40 ppm
		299.8					15.0	
			15	8	7 16 / 22 14	2.0	Gray brown Silty CLAY (CL), v. moist, soft	#8 = 5-25 ppm
		298.8					16.0	
							Boting terminated at 16'	Dry @ compl.
								Borehole backfilled to ground surface with bentonite slurry
								CME 45 track mounted drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED 12/11/89
DATE FINISHED 12/11/89
COORDINATES
N 11263.00 E 10270.00
GROUND SURFACE ELEV. 311.8 ft

PROJECT NO. P834109
WELL/BORING NO. B-B-7
LOGGED BY K. Connare
INSPECTED BY K. Connare
APPROVED BY N. Bond
SHEET 1 of 1

DRILLING METHOD 4 1/4" HSA
HAMMER WT. 300 lb
HAMMER DROP 30 in
NO. SOIL SAMPLES 6
TOTAL OVERBURDEN 12 ft

ELEVATION TOP OF ROCK N/A
ELEVATION BOTTOM OF HOLE 299.8 ft
TOTAL ROCK DRILLED N/A
WELL MAT'L/DIA. (in) N/A
CASING STICK UP (ft) N/A

CLIENT KC Corps of Engineers
SITE LOOW
DRILLING CO. Empire Soils
DRILLER A. Koske
TOTAL DEPTH 12.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		311.3		1	3 4 / 6 9	2.0	Black SILT (ML), roots, moist 0.5 (Topsoil) Orange brown SILT (ML), moist Brown to orange brown Silty CLAY (ML) lens from 1.7 to 2.0', becoming Clayey SILT below 2' 4.0	OVA RDGS: #1 = 0 ppm
		307.8		2	10 16 / 22 19	2.0		#2 = 0 ppm
			5	3	6 9 / 15 18	2.0	Brown to tan Clayey SILT/Silty CLAY (ML-CL), some gravel to 1", some green-gray fine sand patches to 1", few gray partings, some roots, moist 6.8	#3 = 0 ppm
		305.0		4	14 21 / 23 23	1.6		#4 = 1-10 ppm
		302.7		5	3 6 / 9 8	1.5	Brown Sandy SILT (ML), some gravel to 1", moist, loose 9.1	#5 = 0.5-0.75 ppm
		301.8	10				Brown Clayey SILT/Silty CLAY (ML), little gravel, moist 10.0	
		299.8		6	2 2 / 2 2	2.0	Brown-gray CLAY (CL), some brown streaks, some gray partings, moist, soft 12.0 Boring terminated at 12'	#6 = 0 ppm Dry @ compl. Borehole backfilled to ground surface with bentonite slurry CME 45 track mounted drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/14/89	PROJECT NO.	P834109
DATE FINISHED	12/15/89	WELL/BORING NO.	B-B-9
COORDINATES		LOGGED BY	K. Connare
N 10985.00	E 10390.50	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	315.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	295.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	10	WELL MAT'L/DIA. (in)	N/A	DRILLER	A. Koske
TOTAL OVERBURDEN	20 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	20.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		313.7		1		0.0	Road gravel	OVA RDGS:
							1.5	#1 = N/A
		312.9		2	7 7 / 9 13	2.0	1" layer of black SILT on top of gray Silty fine SAND, moist	Augered through road gravel
							2.3	#2 = 0.5-1.0 ppm
			5	3	5 16 / 9 11	2.0	Brown Clayey SILT (ML), some gravel, some red and orange-brown streaks, moist, subvertical gray partings	#3 = 3.5-8 ppm
		308.7		4	35 36 / 47 54	2.0	Same with some gray patches, gravel to 1 1/2", black and gray cinders at 4 to 4.3'	#4 = 7-12 ppm
							6.5	
				5	14 30 / 38 46	2.0	Brown fine Sandy SILT (ML), some gravel to 2", little red and orange patches	#5 = >1000 ppm
		304.4	10	6	15 13 / 13 17	2.0		
							10.8	#6 = 55 ppm
				7	17 20 / 31 26	2.0	Brown Clayey SILT (ML), some gravel to 1 1/2", moist	#7 = 30 ppm
			15	8	14 14 / 9 9	1.0		#8 = 220 ppm
				9	7 20 / 28 19	2.0	Increase in clay content to Clayey SILT/Silty CLAY (ML-CL), moist, silt seam from 17.8 to 18.0'	#9 = 4-6 ppm
		297.2					18.0	
				10	1 2 / 3 4	2.0	Gray CLAY (CL), some brown streaks, soft, some gravel to 1 1/2"	#10 = 1.0 ppm
		295.2	20				20.0	
							Boring terminated at 20'	Water with iridescent sheen in hole and on augers
								Borehole backfilled to ground surface with bentonite slurry, toppped with concrete
								CME 45 track mounted drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/12/89	PROJECT NO.	P834109
DATE FINISHED	12/12/89	WELL/BORING NO.	MW-B-89
COORDINATES		LOGGED BY	K. Connare
N 11271.83	E 10266.25	INSPECTED BY	K. Connare
GROUND SURFACE ELEV.	312.0 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	298.0 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	7	WELL MAT'L/DIA. (in)	SS/2"	DRILLER	A. Koske
TOTAL OVERBURDEN	14 ft	CASING STICK UP (ft)	2.30'	TOTAL DEPTH	14.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
		310.7		1		1 2	1.8	Dark brown SILT (ML), roots (TOPSOIL) 1.3	OVA RDGS:
		310.2				2 3		Tan fine SAND with black specs moist, loose 1.3 to 1.8' 1.8	#1 = 0 ppm
				2		3 3	2.0		
						6 11		Brown Clayey SILT (ML), some gravel, some red, tan and gray patches, firm, moist 4.1 4.9	#2 = 0 ppm
		307.9							
		307.1	5	3		9 11	1.8		#3 = 0-1.0 ppm
						13 16		Tan to brown fine Silty SAND (SP) 4.1 to 4.9', moist	
				4		21 28	2.0		#4 = 1-4 ppm
						29 33		Brown Clayey SILT (ML), some gravel up to 2 1/2", moist	
				5		5 9	2.0	Increase in clay to Clayey SILT/Silty CLAY (ML-CL), becoming gray-brown	#5 = 1-2.5 ppm
			10			12 16			
		301.0		6		4 13	2.0	11.0	
		300.7				10 18		Tan fine Silty SAND (SP) 11 to 11.3' 11.3 12.0	#6 = 1-1.5 ppm
		300.0		7		5 9	2.0		
		298.0				11 11		Gray-brown CLAY (CL), some gravel to 2", moist, soft 14.0	#7 = 0.5-0.75 ppm
								Boring terminated at 14'	Dry @ compl.

CME 45 track mounted drill rig, using 3" split spoons

Well const:

5' No. 6 Slot SS Screen

10' SS Riser

No. 1 Sandpack

3/8" Bent. Pellet Seal

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/1/89	PROJECT NO.	P834109
DATE FINISHED	12/1/89	WELL/BORING NO.	B-1
COORDINATES		LOGGED BY	C. Baker
N 11072.00	E 10659.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	315.4 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	297.4 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	9	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	18 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	18.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
		313.4		1		3 7 / 10 7	1.0	Brown Silty CLAY (CL), some sand and gravel (FILL)	OVA RDGS: #1 = 0-3 ppm
								2.0	
				2		3 8 / 9 11	2.0	Red brown Silty CLAY (CL), trace to some sand and gravel, few silt lenses, moist to v. moist, med. hard	#2 = 3 ppm
			5	3		7 12 / 14 20	2.0	As above, becoming moist and v. hard	#3 = 9-10 ppm
				4		30 24 / 23 31	2.0	Red brown Silty CLAY and Clayey SILT (CL-ML) banded in 6" layers, some sand and gravel, moist, med. to hard	#4 = 20-25 ppm
				5		6 9 / 12 9	2.0	Red brown Silty CLAY (CL), trace to some sand and gravel, moist, med. to hard	#5 = 15-20 ppm
			10	6		10 8 / 9 12	2.0	Increase in clay content	#6 = 0.5-1 ppm
				7		30 30 / 46 30	2.0	Red brown SILT (ML), trace clay, some sand and gravel, sl. moist, hard	#7 = 6-10 ppm
		301.4						14.0	
			15	8		6 6 / 8 10	0.0	Gray brown CLAY (CL), trace sand and gravel, few red brown silt bands	#8 = Not recorded
				9		18 56 / 24 20	2.0		#9 = 1 ppm
		297.4						18.0	
								Boring terminated at18'	Dry @ compl.
									Borehole grouted to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" slpit spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/1/89	PROJECT NO.	P834109
DATE FINISHED	12/1/89	WELL/BORING NO.	B-2
COORDINATES		LOGGED BY	C. Baker
N 11111.00	E 10558.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	314.3 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	300.3 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	7	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	14 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	14.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		313.3		1	2 3 / 4 5	1.5	Brown SILT (ML), some clay — 1.0	OVA RDGS:
				2	8 27 / 30 56	1.5	Red brown Silty CLAY (CL), trace sand and gravel, moist Becoming sl. moist, v. hard, some silt bands from 2 to 3 '	#1 = 0 ppm #2 = 0 ppm
			5	3	42 40 / 42 40		Becoming v. hard, black staining at horizontal partings	#3 = .5-1.5 ppm
				4	50 56 / 52 31		Red brown Silty CLAY (CL), trace sand and gravel, sl. moist	#4 = 1-2 ppm
				5	11 20 / 19 27		As above, increase in gravel content, moist	#5 = 0 ppm
			10	6	11 9 / 27 19			#6 = 0-1.5 ppm
		301.8		7	14 13 / 12 11		Red brown SILT, hard, sl. moist 12 to 12.5' — 12.5	#7 = Not recorded
		300.3					Gray brown CLAY (CL), some sand and gravel, v. moist, med. — 14.0 Boring terminated at 14'	Dry @ compl. Borehole grouted to ground surface with bentonite grout Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/1/89	PROJECT NO.	P834109
DATE FINISHED	12/1/89	WELL/BORING NO.	B-3
COORDINATES		LOGGED BY	C. Baker
N 11080.50	E 10456.00	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	315.3 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	299.3 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Sample Blows	Sample Rec.	CLASSIFICATION	REMARKS
		312.9		1	3 4 / 5 10	1.0	Brown Silty CLAY (CL), some gravel, mixed black and brown material (possible burned debris)	OVA RDGS: #1 = 0 ppm
				2	7 7 / 7 7	1.5	2.4 Brown to red brown Clayey SILT/Silty CLAY (CL), moist	#2 = 0 ppm
			5	3	9 10 / 11 15	2.0	Brown Silty CLAY (CL), trace to some sand and gravel, moist, med., few lt. brown silt bands	#3 = 0 ppm
				4	13 28 / 24 22	1.3	As above, becoming hard below 6'	#4 = 1-1.5 ppm
				5	8 16 / 22 21	1.9		#5 = 2-4.5 ppm
			10	6	10 8 / 16 21	2.0	Brown Silty CLAY (CL), trace to some sand and gravel, v. moist, med. to hard	#6 = 1.5 ppm
				7	21 27 / 25 23	2.0		#7 = 1.5 ppm
		301.3					14.0	
			15	8	4 5 / 5 13	2.0	Interbedded gray brown CLAY (CL) and brown SILT (ML), trace clay, sand and gravel, v. moist, med. hard	#8 = 3-4 ppm
		299.3					16.0 Boring terminated at 16'	Dry @ compl.
								Borehole grouted to ground surface with bentonite slurry
								Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/2/89	PROJECT NO.	P834109
DATE FINISHED	12/2/89	WELL/BORING NO.	B-4
COORDINATES		LOGGED BY	C. Baker
N 11025.50	E 10509.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	314.5 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	298.5 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	8	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	16 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	16.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Blows	Rec.	CLASSIFICATION	REMARKS
		312.5		1	10 14 / 14 10	0.3	Brown and red brown CLAY (CL) with mixed black material, moist	OVA RDGS: #1 = 0.5 ppm
							2.0	
				2	10 20 / 14 15	1.0	Light brown Sandy CLAY (CL), sl. moist	#2 = 0.5 ppm
			5	3	27 30 / 32 20	0.0		#3 = Not recorded
				4	43 56 / 40 ref	0.2		#4 = 1 ppm
				5	12 19 / 21 30	2.0	Red brown Silty CLAY (CL), some sand and gravel, sl. moist, hard	#5 = 0.5-1.5 ppm
			10	6	15 21 / 25 23	2.0	As above, few gray mottles	#6 = 0.5-1.5 ppm
		301.0		7	16 24 / 16 13	2.0		#7 = 0.5-1 ppm
							13.5	
			15	8	5 6 / 6 6	1.9	Brown to gray brown Silty CLAY (CL), trace to some sand and gravel, moist, med. hard	#8 = 0 ppm
		298.5					16.0	Dry @ compl.
							Boring terminated at 16'	Borehole grouted to ground surface with bentonite slurry
								Acker AD-2 drill rig, using 3" split spoons

Test Boring/ Monitoring Well Construction Log

ACRES

DATE STARTED	12/2/89	PROJECT NO.	P834109
DATE FINISHED	12/2/89	WELL/BORING NO.	B-5
COORDINATES		LOGGED BY	C. Baker
N 11165.00	E 10712.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	314.2 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	300.2 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	7	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	14 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	14.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No.	Sample Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1	SS	3 4 / 5 9	0.3	Brown Silty CLAY to 1'	OVA RDGS:
				2	SS	30 31 / 38 30	1.6	Light brown SILT (ML), some sand and gravel, dry	#1 = 0.5 ppm
			5	3	SS	11 20 / 26 20	2.0	Red brown Silty CLAY (CL), some sand and gravel, sl. moist, v. hard	#2 = 3.5 ppm
				4	SS	47 36 / 44 30	2.0		#3 = <1 ppm
				5	SS	8 10 / 12 14	2.0	As above, few gray mottles, some iron staining along fractures	#4 = 0 ppm
		304.2	10					10.0	#5 = 0 ppm
				6	SS	9 6 / 9 10	0.3	Gray brown Silty CLAY (CL), v. moist, med.	#6 = 0 ppm
				7	SS	6 8 / 7 8	2.0		#7 = 0 ppm
		300.2						14.0	Dry @ compl.
								Boring terminated at 14'	Borehole grouted to ground surface with bentonite slurry
									Acker AD-2 drill rig, using 3" split spoons

ACRES

Test Boring/ Monitoring Well Construction Log

DATE STARTED	12/4/89	PROJECT NO.	P834109
DATE FINISHED	12/4/89	WELL/BORING NO.	SB-3-89
COORDINATES		LOGGED BY	C. Baker
N 10999.00	E 10091.50	INSPECTED BY	C. Baker
GROUND SURFACE ELEV.	318.0 ft	APPROVED BY	N. Bond
		SHEET 1 of 1	

DRILLING METHOD	4 1/4" HSA	ELEVATION TOP OF ROCK	N/A	CLIENT	KC Corps of Engineers
HAMMER WT.	300 lb	ELEVATION BOTTOM OF HOLE	296.0 ft	SITE	LOOW
HAMMER DROP	30 in	TOTAL ROCK DRILLED	N/A	DRILLING CO.	Empire Soils
NO. SOIL SAMPLES	11	WELL MAT'L/DIA. (in)	N/A	DRILLER	L. Schroeder
TOTAL OVERBURDEN	22 ft	CASING STICK UP (ft)	N/A	TOTAL DEPTH	22.0 ft

Well Construction	Strat Sym.	Scale Elev.	Scale Depth	Sample No. Type	Blows	Rec.	CLASSIFICATION	REMARKS
				1	10 5 / 4 8	1.0	Brown Silty CLAY (CL)	OVA RDGS: #1 = 0 ppm
		316.0					2.0	
				2	23 20 / 22 27	2.0	Brown fine SAND and SILT (SP), few gray zones, sl. moist, v. fine laminations	#2 = 2-8 ppm
			5	3	18 26 / 26 37	2.0		#3 = 2.5-3.5 ppm
				4	25 40 / 40 50	1.8	As above, becoming moist	#4 = 1.5-3.5 ppm
				5	30 13 / 16 30	1.8	As above, becoming wet	#5 = 0.5-1 ppm
			10				Alternating brown and gray brown SILT and CLAY (ML-CL), wet	
		307.0		6	13 15 / 14 12	1.5	11.0	#6 = 1-2 ppm
				7	100 ref	0.2	Gray fine SAND and SILT (SP), few gray clay bands up to 1" thick, v. moist	#7 = 0.5 ppm
							Interbedded gray brown SAND and SILT (SP)	
			15	8	11 12 / 26 23	1.8		#8 = 0.5 ppm
				9	25 50 / 80 ref	0.5	Brown gray GRAVEL (GP), subrounded to angular, trace clay, some sand layers	#9 = <0.5 ppm
		300.0 ▽					18.0	
				10	22 32 / 70 ref	1.5	Gray brown SILT (ML), trace gravel, saturated	#10 = <0.5 ppm
			20					
		297.0		11	24 14 / 12 19	1.5	21.0	#11 = <0.5 ppm
		296.0					Gray brown Silty CLAY (CL), some sand and gravel 22.0	
							Boring terminated at 22'	Water level at 17.5' after drilling
								Borehole grouted to ground surface with bentonite slurry
								CME 45 track mounted drill rig, using 3" split spoons

Test Pit Report

JOB P8341.09
PIT TP-1
SHEET 1 OF 1

CLIENT Kansas City Corps of Engineers
PROJECT LOOW RI/FS Add'l Field Investigations SITE LOOW - Acid Area
LOCATION: LATITUDE ~90' W of Manhole DEPARTURE
CONTRACTOR Synergist STARTED 1500 hour 19 day 12 month 89 year
METHOD OF EXCAVATION John Deere 790 FINISHED 1700 hour 19 day 12 month 89 year
WEATHER Overcast & Cold TEMPERATURE ~15°F
ELEVATIONS: DATUM SCA BOTTOM OF PIT
GROUND SURFACE ~321 ft MSL WATER LEVEL None
ROCK SURFACE N/A
PIT LENGTH 18 ft ; WIDTH 6 ft ; DEPTH ~9 ft

DEPTH (ft)	SOIL TYPE	DESCRIPTION (COLOR, CONSISTENCY/DENSITY, TEXTURE, STRUCTURE, MOISTURE, GRAIN SIZE, PLASTICITY, ODOR, DILATENCY, GRAIN SHAPE, COMPOSITION)	SAMPLE *TYPE	SAMPLE No.	SAMPLE SIZE (mm)	SAMPLE DEPTH (m)	qu
0-1	PT	Frozen topsoil, leaves, roots, etc.					
1-3	ML-CL	Dark brown SILT and CLAY trace gravel, moist					
3-9	ML	Light Brown Tan Sandy Silt, little gravel, moist					
		Test pit excavated N-S on Geophysics Line #1					
		Concrete encased pipeline encountered at ~16' S at depth of ~7' bgs. Pipeline measures ~2' wide X ~4' deep, unable to open.					

*SAMPLING METHOD
B - THIN WALL TUBE
G - SHOVEL
H - CARVED BLOCK

SHIPPING CONTAINER
O - TUBE
P - TIN
Q - GLASS JAR
R - CLOTH BAG
S - PLASTIC BAG
T - METAL CAN
U - WOODEN BOX
Z - DISCARDED

qu UNCONFINED COMPRESSIVE STRENGTH IN kg/cm² MEASURED WITH POCKET PENETROMETER

INSPECTOR Kevin Connare
LOGGED
APPROVED
DATE 12/19/89

FORM 315 A

Test Pit Report

JOB P8341.09
PIT TP-2
SHEET 1 OF 1

CLIENT Kansas City Corps of Engineers
PROJECT LOOW RI/FS Add'l Field Investigations SITE LOOW - Acid Area
LOCATION: LATITUDE 90' West of Manhole DEPARTURE
CONTRACTOR Synergist, Inc. STARTED 1440 hour 19 day 12 month 89 year
METHOD OF EXCAVATION John Deere 790 FINISHED 1030 hour 20 day 12 month 89 year
WEATHER 12/19 Overcast + Lt. Snow 12/20 Clear TEMPERATURE 15°-20°F
ELEVATIONS: DATUM SCA
GROUND SURFACE ~ 321
ROCK SURFACE N/A
BOTTOM OF PIT None
WATER LEVEL
PIT LENGTH 35 ft (E-W) ; WIDTH 6 ft ; DEPTH 11.5 ft

DEPTH (ft)	SOIL TYPE	DESCRIPTION — COLOR, CONSISTENCY/DENSITY, TEXTURE, STRUCTURE, MOISTURE, GRAIN SIZE, PLASTICITY, ODOR, DILATENCY, GRAIN SHAPE, COMPOSITION	SAMPLE TYPE*	SAMPLE No.	SAMPLE SIZE (mm)	SAMPLE DEPTH (m)	qu
0.0	OL	Moist (frozen) brown organic SILT,					
		trace gravel, trace cobble (topsoil)					
2.5	FILL	Slag and gravel (Fill), layer ~4 in.					
		thick					
2.8	ML/CL	Moist dark brown SILT and CLAY,					
		trace gravel, slightly plastic					
5.0	ML	Moist pale brown (F) sandy SILT,					
		little CLAY, massive, homogeneous					
		structure					
9.0	CL/CH	Moist reddish gray Silty CLAY, trace					
		cobble, stiff, plastic					
11.5		Excavation completed					
		NOTE: Concrete encased sewer line					
		present at 7 ft to 10 ft BGS,					
		parallel to center of test pit (E-W)					

*SAMPLING METHOD
B - THIN WALL TUBE
G - SHOVEL
H - CARVED BLOCK

SHIPPING CONTAINER
O - TUBE
P - TIN
Q - GLASS JAR
R - CLOTH BAG
S - PLASTIC BAG
T - METAL CAN
U - WOODEN BOX
Z - DISCARDED

qu UNCONFINED COMPRESSIVE STRENGTH IN kg/cm² MEASURED WITH POCKET PENETROMETER

INSPECTOR J.R. Stachowski
LOGGED
APPROVED
DATE 12/20/89

FORM 315 A

Test Pit Report

JOB P8341.09
PIT TP-3
SHEET 1 OF 1

CLIENT Kansas City Corps of Engineers
PROJECT LOOW RI/FS Add'l Field Investigations SITE LOOW - Acid Area
LOCATION: LATITUDE DEPARTURE
CONTRACTOR Synergist, Inc. STARTED 0930 hour 20 day 12 month 89 year
METHOD OF EXCAVATION FINISHED 0945 hour 20 day 12 month 89 year
WEATHER Overcast and Cold TEMPERATURE ~15°
ELEVATIONS: DATUM SCA BOTTOM OF PIT
GROUND SURFACE ~321 ft NSL WATER LEVEL None
ROCK SURFACE N/A
PIT LENGTH ~10 ft ; WIDTH 4 ft ; DEPTH 7 ft

DEPTH (ft)	SOIL TYPE	DESCRIPTION — COLOR, CONSISTENCY/DENSITY, TEXTURE, STRUCTURE, MOISTURE, GRAIN SIZE, PLASTICITY, ODOR, DILATENCY, GRAIN SHAPE, COMPOSITION	SAMPLE *TYPE	SAMPLE No.	SAMPLE SIZE (mm)	SAMPLE DEPTH (m)	qu
0-.5	PT	Frozen topsoil, leaves, twigs, etc.					
.5-3	CL	Dark brown Silty CLAY, moist, some					
		gravel					
3-7	ML	Light brown - tan Sandy SILT, moist					
		NOTE: Excavated TP-3 east-west					
		~10' west of manhole to see if					
		pipeline encased along entire length.					
		Encountered encased pipeline -					
		backfilled test pit.					

*SAMPLING METHOD
B - THIN WALL TUBE
G - SHOVEL
H - CARVED BLOCK

SHIPPING CONTAINER
O - TUBE
P - TIN
Q - GLASS JAR
R - CLOTH BAG
S - PLASTIC BAG
T - METAL CAN
U - WOODEN BOX
Z - DISCARDED

qu UNCONFINED COMPRESSIVE STRENGTH IN kg/cm² MEASURED WITH POCKET PENETROMETER

INSPECTOR K.M. Connare
LOGGED
APPROVED
DATE 12/20/89

FORM 315 A

Test Pit Report

JOB P8341.09
PIT TP-4
SHEET 1 OF 1

CLIENT Kansas City Corps of Engineers
PROJECT LOOW RI/FS Add'l Field Investigations SITE LOOW - Acid Area
LOCATION: LATITUDE 2' N of Manhole DEPARTURE
CONTRACTOR Synergist, Inc. STARTED 1100 hour 20 day 12 month 89 year
METHOD OF EXCAVATION John Deere 790 FINISHED 1115 hour 20 day 12 month 89 year
WEATHER Overcast and Cold TEMPERATURE 15°F
ELEVATIONS: DATUM SCA BOTTOM OF PIT
GROUND SURFACE ~321 ft MSL WATER LEVEL None
ROCK SURFACE N/A
PIT LENGTH 5 ft ; WIDTH 4 ft ; DEPTH 4 ft

DEPTH (ft)	SOIL TYPE	DESCRIPTION COLOR, CONSISTENCY/DENSITY, TEXTURE, STRUCTURE, MOISTURE, GRAIN SIZE, PLASTICITY, ODOR, DILATENCY, GRAIN SHAPE, COMPOSITION	SAMPLE *TYPE	SAMPLE No.	SAMPLE SIZE (mm)	SAMPLE DEPTH (m)	qu
0-.5	PT	Frozen Topsoil, leaves, twigs, roots,					
		moist					
.5-4	CL	Dark brown Silty CLAY, moist					
		NOTE: Excavated test pit to expose					
		north trending pipeline. Encountered					
		concrete encased 10" vitreous clay					
		pipeline. Opened with backhoe.					
		Pipeline dry and empty, not sampled.					

*SAMPLING METHOD
B - THIN WALL TUBE
G - SHOVEL
H - CARVED BLOCK

SHIPPING CONTAINER
O - TUBE
P - TIN
Q - GLASS JAR
R - CLOTH BAG
S - PLASTIC BAG
T - METAL CAN
U - WOODEN BOX
Z - DISCARDED

qu UNCONFINED COMPRESSIVE STRENGTH IN kg/cm² MEASURED WITH POCKET PENETROMETER

INSPECTOR K.M. Connare
LOGGED
APPROVED
DATE 12/20/89

FORM 315 A

ATTACHMENT C

FIELD SAMPLING REPORT

LOOW - RI/FS
ADDITIONAL FIELD INVESTIGATIONS

NOVEMBER 16, 1989 -- JANUARY 4, 1990

TABLE I
ACRES INTERNATIONAL CORPORATION
SAMPLE COLLECTION DATA

Project KC-COE LOOW
Project No. P8341.09

Sample I.D. SS-89-1S (Sediment) and SS-89-1W (Surface Water)
Date/Time 11/16/89 - 1430
Samplers K. Connare and C. Baker
Location Area A drainage ditch - upgradient, 20' west of weir
Weather Conditions Overcast and 40°F.
Sampling Conditions Heavy flow, weir opened within past 2 hrs.
Sample collected from area free of gravel associated with weir.

Sample Mesurements

pH	7.60 S.U.			
T	6°C			
Conductivity	857μS			
Other	Sl. Turbid			
Other				

Sample Containers/Lab Recra

1 l. Amber	3
500 ml. Plastic	1
40 ml. VOA	2
8 oz. Glass	1
4 oz. Glass	2

Other Analyses: Vol., Semi-Vol., Pest/PCBs, and 17 metals
Other
Other

Comments

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. SS-89-2S (Sediment) and SS-89-2W (Surface Water)

Date/Time 11/16/89 - 1310

Samplers K. Connare and C. Baker

Location Approximately 200' downstream of SS-89-1

Weather Conditions Overcast and 40°F

Sampling Conditions Heavy flow, weir opened within past 2 hrs.

Sample Mesurements

pH	7.53 S.U.			
T	8°C			
Conductivity	827 µS			
Other	Sl. Turbid			
Other				

Sample Containers/Lab	Recra	MRD Lab
1 l. Amber	8	3
500 ml. Plastic	2	1
40 ml. VOA	4	2
8 oz. Glass	2	1
4 oz. Glass	4	2

Other Analyses: Vol., Semi-Vol., Pest/PCBs, and 17 metals

Other

Other

Comments Internal duplicate collected for Recra (SS-S-DUP and SS-W-DUP) sent blind.

External duplicate collected for MRD Lab (SS-S-DUP and SS-W-DUP).

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. SS-89-3S (Sediment) and SS-89-3W (Surface Water)

Date/Time 11/16/89 - 1520

Samplers K. Connare and C. Baker

Location Area B drainage ditch about 50' north of H Street

Weather Conditions Overcast and 40°F

Sampling Conditions Samples collected at first area with standing water - drainage ditch pourly defined in this area. No culvert from H Street found.

Sample Mesurements

pH	7.11 S.U.			
T	6°C			
Conductivity	515 µS			
Other	Sl. Turbid			
Other				

Sample Containers/Lab Recra

1 l. Amber	4
500 ml. Plastic	1
40 ml. VOA	2
8 oz. Glass	1
4 oz. Glass	2

Other Analyses: Vol., Semi-Vol., Pest/PCBs, and 17 metals

Other

Other

Comments Area has very little water. Surface water sample from pond collected directly east of this site.

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. SS-89-4S (Sediment) and SS-89-4W (Surface Water)

Date/Time 11/16/89 - 1400

Samplers K. Connare and C. Baker

Location Area B drainage ditch about 25' south of confluence

Weather Conditions Overcast and 40°F

Sampling Conditions Ditch about 2' wide, water 4" deep with little flow.

Sample Mesurements

pH	7.07 S.U.			
T	8°C			
Conductivity	584 µS			
Other	Sl. Turbid			
Other				

Sample Containers/Lab Recra

1 l. Amber	4
500 ml. Plastic	1
40 ml. VOA	2
8 oz. Glass	3
4 oz. Glass	6

Other Analyses: Vol., Semi-Vol., Pest/PCBs, and 17 metals

Other

Other

Comments Triplicate sediment sample collected for MS/MD analyses.

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. SS-89-5S (Sediment) and SS-89-5W (Surface Water)

Date/Time 11/16/89 - 1310

Samplers K. Connare and C. Baker

Location About 100' downstream of confluence of Area A and B ditches.

Weather Conditions Overcast and 40°F

Sampling Conditions Ditch flowing due to recent rains and weir recently opened.

Sample Mesurements

pH	7.66 S.U.			
T	8°C			
Conductivity	811 µS			
Other	Sl. Cloudy			
Other				

Sample Containers/Lab Recra

1 l. Amber	12
500 ml. Plastic	3
40 ml. VOA	6
8 oz. Glass	1
4 oz. Glass	2

Other Analyses: Vol., Semi-Vol., Pest/PCBs, and 17 metals

Other

Other

Comments Triplicate surface water collected for MS/MSD analyses. Rinse blank collected prior to sampling this point.

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. SW-89-1

Date/Time 11/16/89 - 1545

Samplers K. Connare and C. Baker

Location Area B pond - west side - near SS-89-3 location

Weather Conditions Overcast and 40°F

Sampling Conditions Sample collected in about 6" of water.

Sample Mesurements

pH	7.78 S.U.			
T	4°C			
Conductivity	958 μS			
Other				
Other				

Sample Containers/Lab Recra

1 l. Amber	3
500 ml. Plastic	1
40 ml. VOA	2
8 oz. Glass	
4 oz. Glass	
Other	Analyses: Vol., Semi-Vol., Pest/PCBs, and 17 metals.
Other	
Other	

Comments

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. TNT-1-89W (Waste line) and TNT-1-89S (Underlying Soil)

Date/Time 12/20/89 - 1610

Samplers Paul Zelenski (Synergist)

Location West Catch Box Lateral 10" Clay Pipeline (TP-5) N9978.0 E8876.00

Weather Conditions Overcast and 15°F

Sampling Conditions Concrete encased pipeline opened with backhoe. About 30 gal. water came out of pipe. Sample appears as brown-tan sediment.

Sample Mesurements		TNT-1-89W		TNT-1-89S	
pH					
T					
Conductivity					
Other	TNT Screen*	purple		clear	
Other					

Sample Containers/Lab MRD Lab

1 l. Amber

500 ml. Plastic

40 ml. VOA

8 oz. Glass 2

4 oz. Glass

Other Analyses: USATHAMA explosives

Other

Other

Comments Red to purple color indicates presence of TNT in sample. One sample each of pipeline residue and underlying soils sent to MRD Lab for analyses. Samples packed with vermiculite in paint cans and chilled. Sent as flamable-solids by ground freight.

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. TNT-2-89W (Waste line) and TNT-2-89S (Underlying Soils)

Date/Time 12/21/89 - 1615

Samplers Rick Page (Synergist)

Location Main TNT Waste Pipeline (TP-9) 15" clay pipeline N10133.0 E9192.0

Weather Conditions Snow and 15°C

Sampling Conditions Concrete encased pipeline opened with backhoe. About 200 gal. water came out of pipeline. Pipeline residue appears as 1" black SILT on top of 2" tan Silty CLAY

Sample Mesurements	TNT-2-89W		TNT-2-89S	
pH				
T				
Conductivity				
Other	TNT Screen*	Clear	Clear	
Other				

Sample Containers/Lab MRD Lab

1 l. Amber

500 ml. Plastic

40 ml. VOA

8 oz. Glass 3

4 oz. Glass

Other Analyses: USATHAMA explosives

Other

Other

Comments Red to purple color indicates presence of TNT in sample. One sample of underlying soil and two samples of waste pipeline residue (one duplicate) sent to MRD Lab for analyses. Samples packed with vermiculite in paint cans and chilled. Sent by ground freight as flamable-solids.

TABLE I

ACRES INTERNATIONAL CORPORATION

SAMPLE COLLECTION DATA

Project KC-COE LOOW

Project No. P8341.09

Sample I.D. ACID-1-89

Date/Time 1/4/90 - 1100

Samplers K. Connare

Location Acid Area Manhole

Weather Conditions Partly Cloudy and 40°F

Sampling Conditions Manhole contains about 3' soil. Top mostly leaves and twigs. Collected sample from beneath.

Sample Mesurements

pH				
T				
Conductivity				
Other				
Other				

Sample Containers/Lab Recra metaTRACE

1 l. Amber		
500 ml. Plastic		
40 ml. VOA		
8 oz. Glass	1	1
4 oz. Glass		

Other Analyses: USATHAMA explosives, sulfates, and nitrates

Other

Other

Comments Samples delivered to Recra. Recra to send one sample jar to metaTRACE for USATHAMA explosives analyses. Samples collected with hand auger.

TABLE II

WELL DEVELOPMENT / PURGING LOG

ACRES

PROJECT NO. P8341.09
WELL NO. MW-A-89
PERSONNEL: KMC/JRS
INSPECTED BY: K. Connare
APPROVED BY:
DATE 12/21/89 SHEET 1 OF 2

CLIENT Kansas City Corps of Engineers
PROJECT: Lake Ontario Ordnance Works
SITE: Area A

TOTAL CASING AND SCREEN LENGTH (FT.) 19'
CASING INTERNAL DIAMETER (IN.) 2"
WATER LEVEL BELOW TOP OF CASING (FT.) 5.27'
VOLUME OF WATER IN CASING (GAL.) 2.33

WELL ID	VOL GAL/FT.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS OR WELL VOLUMES)										
	1989								1990		
DATE	12/21 1115	12/21 1600	12/28 1335	12/28 1350	1403	1411	1420	1445	1/2 1425	1440	1515
PUMPING RATE (GAL./MIN.)	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm	5 gpm
PH (STANDARD UNITS)	7.24	7.36	7.30	7.17	7.23	7.25	7.11	7.25	7.21	7.30	Meter Malfunc
CONDUCTIVITY (μMHOS/CM)	1173	1723	1738	1312	1334	1326	1289	1255	1492	1521	"
TEMP (CELSIUS)	7°	7°	7°	7°	8°	8°	8°	8°	7°	7°	7°
WATER LEVEL (FT. BELOW T.O.L.)	5.27	--	5.45		--						
VOLUME (TOTAL GAL.)	1.75	5.25	Init.	2.43	3.69	4.81	5.81	8.81	Init.	3.0	9.0
TURBIDITY	Turbid Gray	Turbid	Clear	Sl. Cldy	Sl. Cldy	Sl. Cldy	Sl. Cldy	Sl. Cldy	Sl. Cldy to Clr	Clear	Clear

REMARKS: Total of 29.06 gal. removed from well prior to sampling.
Moderate recovery rate. 1 day to static level.

WELL DEVELOPMENT/ PURGING LOG

ACRES

PROJECT NO. P8341.09
WELL NO. MW-A-89
PERSONNEL: KMC/JRS
INSPECTED BY: K. Connare
APPROVED BY:
DATE 12/21/89 SHEET 2 OF 2

CLIENT Kansas City Corps of Engineers
PROJECT: Lake Ontario Ordnance Works
SITE: Area A

TOTAL CASING AND SCREEN LENGTH (FT.) 19'
CASING INTERNAL DIAMETER (IN.) 2"
WATER LEVEL BELOW TOP OF CASING (FT.)
VOLUME OF WATER IN CASING (GAL.)

WELL ID	VOL GAL/FT.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS OR WELL VOLUMES)										
	1990										
DATE	1/3 1100										
PUMPING RATE (GAL. / MIN.)	5 gpm										
PH (STANDARD UNITS)	7.45										
CONDUCTIVITY (μMHOS/CM)	1304										
TEMP (CELSIUS)	7°										
WATER LEVEL (FT. BELOW T.O.L.)	2.51										
VOLUME (TOTAL GAL.)	6										
TURBIDITY	Clear										

REMARKS:

WELL DEVELOPMENT / PURGING LOG

PROJECT NO. P8341.09
WELL NO. MW-B-1S
PERSONNEL: KMC
INSPECTED BY: K. Connare
APPROVED BY:
DATE 1/3/90 SHEET 1 OF 1

CLIENT Kansas City Corps of Engineers
PROJECT: Lake Ontario Ordnance Works
SITE: Area B

TOTAL CASING AND SCREEN LENGTH (FT.) 19.1'
CASING INTERNAL DIAMETER (IN.) 4"
WATER LEVEL BELOW TOP OF CASING (FT.) 5.15'
VOLUME OF WATER IN CASING (GAL.) 9.21

WELL ID	VOL GAL/FT.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS OR WELL VOLUMES)										
	1990										
DATE	1/3 1215										
PUMPING RATE (GAL. / MIN.)	5 gpm										
PH (STANDARD UNITS)	7.45										
CONDUCTIVITY (μMHOS/CM)	1004										
TEMP (CELSIUS)	7°										
WATER LEVEL (FT. BELOW T.O.L.)	5.15										
VOLUME (TOTAL GAL.)	12 dry										
TURBIDITY	Sl. Cldy - Turbid										

REMARKS: Well pumped dry. One (1) day prior to sampling slow recovery rate. > 1 day to static level.

TABLE III
WELL PURGING INFORMATION

WELL ID	DATE	TIME	SIZE/TYPE OF CASING	WATER LEVEL (FT.)*	BOTTOM OF WELL (FT.)*	VOLUME OF STANDING WATER (GAL.)	METHOD OF EVACUATION	VOLUME EVACUATED (GAL.)	RECHARGE RATE +
MW-A-89	1/3/90	1100	2" SS	2.51	19.0	2.64	Suction Lift	6 gal.	3
MW-B-1S	1/3/90	1205	4" PVC	5.15	19.1	9.07	Suction Lift	12 gal.	4

+ Recharge Rate Determined by the Following Criteria:
1 Continuous - no drop in water level during evacuation.
2 Rapid - recharges within one (1) hour.
3 Slow - recharges within eight (8) hours.
4 Very Slow - recharges within 24 hours.
5 Negligible - does not recharge within 48 hours.
* From Top of Inner Casing.

TABLE IV
ACRES INTERNATIONAL CORPORATION
Field Sampling Record

Sample ID MW-A-89 | Date 1/4/90
Location Area A | Project LOOW RI/FS
Samplers K. Connare | Project # P8341.09
Well Size/Type 2 in. Stainless Steel
Client U.S. Army Corps of Engineers

I. **WATER LEVEL MEASUREMENTS (from top of casing) IN FEET:**

Total Well Depth 19 ft | Well Volumes (gal/ft) 0.16
Depth to Water 2.51 ft | 2" ID = 0.16
Height of Water Column 16.49 ft | 4" ID = 0.65
Gals of Standing Water 2.64 gal. | 6" ID = 1.47

II. **WELL PURGING:** Start 1/3/90 1100 | Complete 1/3/90 1315
Equipment: Pump Suction Lift | Bailer --
Observations during Purging:

III. **SAMPLE COLLECTION:** Time 1/4/90 0920 | ID # MW-A-89 / MW-DUP
Method: Bailer 1-1/4 in. Stainless Steel | Other Water Level 2.24 ft BTOC
Containers 3-1 l. amber, 1-500 ml. pl. + 2 VOA | QC (dups) 3-1 l. amber, 1-500 pl. + 2 VOA
Sample Appearance and Odor Clear

IV. **FIELD MEASUREMENTS:**

	1/3/90 1100	1/4/90 0920		
Temp	7°C	8°C		
pH	7.45 S.U.	6.89 S.U.		
Conductivity	1304 µS	1258 µS		
Turbidity	Clear	Clear		
Volume Removed	6 gal.	Samples Collected		

Weather Partly cloudy and mild, 40°F

Comments Well developed during previous 2 weeks. pH measurement recorded during sampling was not typical of previous pH measurements.

ACRES INTERNATIONAL CORPORATION

Field Sampling Record

Sample ID: MW-B-1S
Date: 1/4/90
Location: Area B
Project: LOOW RI/FS
Samplers: K. Connare
Project #: P8341.09
Well Size/Type: 4 in. PVC
Client: U.S. Army Corps of Engineers

I. **WATER LEVEL MEASUREMENTS (from top of casing) IN FEET:**

Total Well Depth: 19.1 ft
Depth to Water: 5.15 ft
Height of Water Column: 13.95 ft
Gals of Standing Water: 9.07 gal.

Well Volumes (gal/ft): 0.65
2" ID = 0.16
4" ID = 0.65
6" ID = 1.47

II. **WELL PURGING:** Start: 1/3/90 1205 Complete: 1/3/90 1240

Equipment: Pump: Suction Lift Bailer: --

Observations during Purging: Water initially turbid becoming slightly cloudy, well pumped dry.

III. **SAMPLE COLLECTION:** Time: 1/4/90 1005 ID #: MW-B-1S / MW-B-1S Duplicate

Method: Bailer: 1-1/4 in. Stainless Steel Other: Water level 11.62 ft BTOC

Containers: 3-1 l. amber, 1-500 ml. plastic + ~~2 VOA~~ QC (dups): 2-1 l.amber, 1-500 ml. plastic + ~~2 VOA~~

Sample Appearance and Odor: slightly cloudy

IV. **FIELD MEASUREMENTS:**

	1/3/90 1205	1/4/90 1005		
Temp	7°C	9°C		
pH	7.45 S.U.	7.27 S.U.		
Conductivity	1004 µS	948 µS		
Turbidity	Turbid	Sl. Cloudy		
Volume Removed	12 gal.	Samples Collected		

Weather: Partly cloudy and mild, approximately 40°F.

Comments: Duplicate sample sent to MRD laboratory for external QC.

ATTACHMENT D

LAND SURVEY DATA

IVAN R. KLETTKE LICENSED LAND SURVEYOR

SUCCESSOR TO ALEX P. KLETTKE

2470 Stoelting St. (Bergholz)
Niagara Falls, N.Y. 14304

Phone 731-5613

January 3, 1990

Report of Coordinate Locations and Elevations of Monitoring Wells, Boreholes, and Trenches.

Location - Former Lake Ontario Ordnance Works, Town of Porter, Niagara County, NY.

Notes- Coordinate Values for monitoring wells and boreholes were developed using "SCA Control Monumentation established February 1988" Monument Nos. 101 R and 109; Elevations based on Monument No. 101R (Published Elevation=316.01).

Trench Coordinates established from Monument Nos. 111 and 108R; Elevations based on Monument No. 111 (Published Elevation=312.25)

Monitoring Well inner casing elevations were taken at high point of stainless steel pipe.

Monitoring Well Locations and Elevations

Well No.	North	East	Exist. Ground Elevation	(Hi Point) Top of Inner St. Steel Casing	Top of Outer Casing
MW-A-89	11,120.62	10,716.62	314.2	316.31	316.48
MW-B-89	11,271.83	10,266.25	312.0	314.19	314.30
Boreholes					
Boring No.					
AB 1	11,047.0	10,808.5	316.2		
AB 2	11,052.5	10,809.0	316.3		
AB 3	11,057.5	10,809.0	316.3		
AB 4	11,032.5	10,823.0	316.1		
AB 5	11,043.0	10,821.5	316.2		
AB 6	11,031.5	10,832.0	316.1		
AB 7	11,033.5	10,842.5	316.2		
AB 8	11,036.0	10,852.0	316.3		
AB 9	11,033.0	10,777.5	315.8		
AB 10	11,032.0	10,757.5	315.8		
AB 11	11,038.5	10,640.5	315.6		
AB 12	11,037.5	10,888.0	316.3		
AB 13	11,074.0	10,714.5	315.4		

(cont'd)

Former Lake Ontario Ordnance Works, Town of Porter

Boreholes

Boring No.	North	East	Exist. Ground Elevation
AB 14	11,039.0	10,616.0	315.6
ACB 1	11,042.0	10,808.5	316.2
B 1	11,072.0	10,659.0	315.4
B 2	11,111.0	10,558.5	314.3
B 3	11,080.5	10,456.0	315.3
B 4	11,025.5	10,509.5	314.5
B 5	11,165.0	10,712.5	314.2
BB 1	11,056.5	10,332.0	313.5
BB 2	11,234.0	10,274.0	312.8
BB 3	11,138.0	10,237.0	312.9
BB 4	11,143.5	10,199.0	311.6
BB 5	11,020.5	10,362.5	315.5
BB 6	10,999.5	10,378.5	314.8
BB 7	11,263.0	10,270.0	311.8
BB 9	10,985.0	10,390.5	315.2
SB-3-89	10,999.0	10,091.5	318.0

Trenches

Westerly Trench	9,978.0	8,876.0	313.3
Northeasterly Trench	10,133.0	9,192.0	309.7

Note: Locations and Elevations of Trenches are at points indicated by Kevin Connare at time of Survey.

ATTACHMENT E

CHEMICAL ANALYTICAL RESULTS

E-1 Soil Screening Results

E-2 QA Data Validation Procedures

E-3 Analytical Data
(Available on Request)

ATTACHMENT E-1

LAKE ONTARIO ORDNANCE WORKS

SOIL SCREENING RESULTS

November 20 through December 15, 1989

SECTION E-1

LOOW SOIL SCREENING RESULTS

1 - INSTRUMENTATION

1.1 - Photoionization Detector

HNu Model PI-101 Trace Gas Analyzer with 10.2 eV Ultraviolet Lamp.

1.2 - Flame Ionization Dectector

Foxboro Century Systems Model OVA-128 Portable Organic Vapor Analyzer.

2 - CALIBRATION

Each organic vapor analyzer was calibrated prior to screening samples from each boring.

2.1 - HNu PI-101

Calibration of the HNu analyzer was performed using isobutylene calibration gas (benzene surrogate, HNu pn 101-350). The concentration of the isobutylene used was 54 ppm at a span setting of 9.8. Once the proper calibration was obtained, the span setting was adjusted in order to obtain a maximum reading, typically about 240 on the 0-2000 scale.

Initially, the HNu proved useful in the soil screening, however, it developed a problem with off specification measurements of the calibration gas even after repeated cleaning of the lamp as recommended by the manual. An HNu representative stated that the behavior of the analyzer was likely due to contamination in the ion chamber of the analyzers probe. However, cleaning of the ion chamber failed to eradicate the problem. It was later determined that a defective battery may have been a contributing factor in the instrument behavior. Due to the erratic behavior of the HNu analyzer,

little confidence has been placed in the results of the HNu soil screening measurements.

2.2 - OVA

During the screening program, the OVA was calibrated using the same isobutylene calibration gas. However, internal gain and bias adjustments were not made. Using the calibration gas, the gas select knob of the OVA was adjusted in order to obtain a maximum concentration reading. Typically the measurements on a 10X scale ranged from 46 to 52 with most readings at about 48 with the gas select varying between 1.5 and 0.

3 - SOIL SCREENING MEASUREMENTS

Because the sensitivities of the instruments had been maximized by adjusting the appropriate controls (i.e., span or gas select knobs), the resultant measurements could not be directly interpreted as actual contaminant concentrations. However, while not actual contaminant concentrations, the readings obtained from the soil screening process are considered estimates of the relative degree of volatile organic contamination between samples.

In addition, the background concentrations recorded by each instrument were adjusted to zero prior to each sample screening.

Soil screening results are presented in Table E-1. Figures E-1 through E-9 present a conservative estimate of organic vapor concentration for various sample depths in Area A.

TABLE 2-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
11/20/89	A-CB-1-0-2	80°C	1654-1715	3	0.6	0	
	A-CB-1-2-4+	"	" "	1400	8	3	
	A-CB-1-4-6	"	" "	540	3	1.0	
	A-CB-1-6-8	"	" "	150	*	>10	*OVA Wet -
	A-CB-1-8-10	"	" "	48	*	*	Not Functioning
	A-CB-1-10-12	"	" "	19	*	*	
11/21/89	A-CB-1-0-2	68°C	1012-1027	8	0.6	0	Sample Rerun
	A-CB-1-2-4+	"	" "	580	450	3	" "
	A-CB-1-4-6	"	" "	90	32	1.0	" "
	A-CB-1-6-8	"	" "	40	10	>10	" "
	A-CB-1-8-10	"	" "	20	18	*	" "
	A-CB-1-10-12	"	" "	8	5	*	" "
	A-CB-1-12-14	"	" "	90	100	*	Collected 11/21/89
	A-CB-1-14-16+	"	" "	1.5	20	*	" "
11/21/89	A-B-1-0-2	68°C	1537-1552	1	0.3	0	
	A-B-1-2-4	"	" "	0.6	1.4	1.0	
	A-B-1-4-6	"	" "	13	120	NR	NR = Not Recorded
	A-B-1-6-8	"	" "	15	60	4-5	
	A-B-1-8-10	"	" "	22	67	90	
	A-B-1-10-12	"	" "	6	240	10	
	A-B-1-12-14	"	" "	14	260	4	
	A-B-1-14-16	"	" "	55	220	12	
	A-B-1-16-18	68°C	1615-1630	39	150	8-12	
	A-B-1-18-20	"	" "	62	230	4	
	A-B-1-20-22	"	" "	84	290	10	
	A-B-1-22-24	"	" "	12	18	0	
11/22/89	A-B-2-0-2	70°C	1331-1346	30	40	1.0	
	A-B-2-2-4	"	" "	10	96	9.0	
	"	"	" "	25	140	9.0	Second Run
	A-B-2-4-6	"	" "	30	280	35	
	A-B-2-6-8+	"	" "	57	450	12	
	A-B-2-8-10	"	" "	0	12	1-8	
	A-B-2-10-12	-	--	-	-	NR	No Recovery

SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
11/22/89	A-B-2-12-14	70°C	1331-1346	-	80	8	
	A-B-2-14-16	73°C	1411-1426	32	120	12	
	A-B-2-16-18	"	" "	2	56	20	
	A-B-2-18-20	"	" "	21	140	25	
	A-B-2-20-22	"	" "	41	140	45	
	A-B-2-22-24	"	" "	0.4	9	0-1	
	A-B-2-24-26	"	" "	0.1	1.0	2	
	A-B-2-26-28	74°C	1430-1445	2	18	0	
	A-B-2-28-30	"	" "	0.4	13	0	
	A-B-2-30-32	"	" "	11.5	53	0	
11/27/89	A-B-3-0-2	68°C	1355-1415	0.2	0.4	1.5	
	A-B-3-2-4	"	" "	0.1	0.4	0.2	
	A-B-3-4-6	"	" "	0.6	5.2	0.5	
	A-B-3-6-8	"	" "	0.2	4.0	<0.5-0.9	
	A-B-3-8-10	"	" "	0.2	12.0	2.5	
	A-B-3-10-12	"	" "	1.5	18.0	6.5	
	A-B-3-12-14	"	" "	0.5	18.0	6.5-18	
	A-B-3-14-16	70°C	1437-1452	54/46	210/210	10	Duplicate Sample Runs
	A-B-3-16-18	"	" "	5.4/16	36/44	2	" " "
	A-B-3-18-20	"	" "	72/58	260/200	2	" " "
	A-B-3-20-22	"	" "	7.5/12	18/18	1.5	" " "
	A-B-3-22-24	"	" "	NR/0.1	5/4	<1	
	Blank Run			0	0	--	NR - Not Recorded
11/28/89	A-B-4-0-2	68°C	1045-1103	0.1	0	<1	
	A-B-4-2-4	"	" "	1.5	1.6	1	
	A-B-4-4-6	"	" "	58	20	1	
	A-B-4-6-8	-	--	--	--	--	No Recovery
	A-B-4-8-10	68°C	1045-1103	7.5*	160	30	Possible Moisture Problem
	A-B-4-10-12	"	" "	5.2*	190	3.5	" " "
	A-B-4-12-14+	"	" "	6.2	200	30	
	A-B-4-14-16	"	1123-1143	5.5	140	3.5-4	
	A-B-4-16-18	"	" "	6.2	34	2.5-4	
	A-B-4-18-20	"	" "	300	450	18-20	

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
11/28/89	A-B-4-20-22	68°C	1123-1143	(Meter Malfunction) Rerun = 2.0	6.3	1.5-2	
	A-B-4-22-24	"	" "	0.2	6.5	4.5-6	
	A-B-4-24-26	-	--	--	--	--	No Recovery
	A-B-4-26-28	68°C	1123-1143	0.1	4.6	0-0.5	*Possible Moisture Problem
11/29/89	A-B-5-0-2	73°C	1123-1143	Instrument Malfunction	12	<1	
	A-B-5-2-4	"	" "	" "	4.2	<1	
	A-B-5-4-6	"	" "	" "	16	<1	
	A-B-5-6-8	"	" "	" "	170	8	
	A-B-5-8-8.3	"	" "	" "	70	8	
	A-B-5-10-12	-	--	--	--	1.5*	No Recovery *OVA at Borehole >1000 ppm at 10 ft
	A-B-5-12-14	-	--	--	--	NR	Piece of metal NR = Not Recorded
	A-B-5-14-16	73°C	1123-1143	Instrument Malfunction	34	3-8	
	A-B-5-16-17.5	"	" "	" "	24	<1-6	
	A-B-5-19-19.5	"	" "	" "	3	<1	
	A-B-5-21-21.5	"	" "	" "	14	2-3	
11/29/89	A-B-6-0-2	68°C	1340-1356	Instrument Malfunction	1.6	<1	
	A-B-6-2-4	"	" "	" "	2.5	<1	
	A-B-6-4-6	"	" "	" "	36	20	
	A-B-6-6-8	"	" "	" "	180	40	
	A-B-6-8-10	"	" "	" "	--	--	No Recovery
	A-B-6-10-12	"	" "	" "	180	6	
	A-B-6-12-14	"	" "	" "	90	15-17	
	A-B-6-14-16	"	" "	" "	44	10	

TABLE 4-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
	A-B-6-16-18	68°C	1340-1356	Instrument Malfunction	22	7	
	A-B-6-18-20	"	" "	" "	26	6	
	A-B-6-20-22	"	" "	" "	--	--	No Recovery
	A-B-6-22-24	"	" "	" "	11	2-2.5	
	A-B-6-24-26	"	" "	" "	--	--	No Recovery
	A-B-6-26-28	"	" "	" "	22	3	
	Blank Run	"	" "	10	0.2	--	
11/30/89	A-B-7-0-2	55°-70°C	1015-1033	150?	0.1	<1	HNU Readings Questionable
	A-B-7-2-4	" "	" "	145?	1.0	1-4	" " "
	A-B-7-4-6	" "	" "	450?	92	1.5-2.0 (500 initial)	" " "
	A-B-7-6-8	" "	" "	450?	72	3	" " "
	A-B-7-8-10	" "	" "	180?	250 initial	5	" " "
11/30/89	A-B-8-0-2	72°-74°C	1110-1128	87*	0.3	0	*HNU taking a while to come down, readings questionable
	A-B-8-2-4	" "	" "	90*	0.6	0.5	" " "
	A-B-8-4-6	" "	" "	95*	2.2	NR	" " "
	A-B-8-6-7	" "	" "	210*	220	17.5	" " "
	A-B-8-8-10	" "	" "	100*	150	1-1.5	" " "
	A-B-8-10-12	" "	" "	100*	60	2-7	" " "
	A-B-8-12-14	75°C	1315-1335	90*	120	1.5-2	" " "
	A-B-8-14-16	"	" "	92*	170	<1	" " "
	A-B-8-16-18	"	" "	90*	48	0	" " "
	A-B-8-18-20	"	" "	90*	26	0	" " "
	A-B-8-20-22	"	" "	87*	62	0	" " "
	A-B-8-22-24	"	" "	83*	40	0	" " "

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
11/30/89	A-B-8-24-26	75°C	1315-1335	90*	3		*HNU taking a while to come down, readings questionable
12/01/89	A-B-9-0-2	68°C	0903-0920	0.4*	0.4	0	
	A-B-9-2-4	"	" "	1.5*	56	<1	*Showed moisture effect
	A-B-9-4-6	"	" "	1.5*	170	15	" " "
	A-B-9-6-8+	"	" "	20*	720	15-30	" " "
	A-B-9-8-10	"	" "	5*	450	8-10	" " "
	A-B-9-10-12	"	" "	4*	180	6-10	" " "
	A-B-9-12-14	"	" "	3.5*	280	2-10	" " "
	A-B-9-14-16	72°C	0925-0940	0.5	4	0	
	A-B-9-16-18	"	" "	0.2	5.5	0	
12/01/89	A-B-10-0-2	65°-68°C	1010-1025	Meter Malfunction	1.2	0	
	A-B-10-2-4	" "	" "	" "	92		NR
	A-B-10-4-6	" "	" "	" "	7		Initial - >100
	A-B-10-6-8	" "	" "	" "	550	4-5	Settled - 20+
	A-B-10-8-10	" "	" "	" "	520	4-6	
	A-B-10-10-12	70°-74°C	1043-1100	" "	140	3-9	
	A-B-10-12-14	" "	" "	" "	36	0.5-1.5	
	A-B-10-14-16	" "	" "	" "	40	<1.0-1.5	
	A-B-10-16-18	" "	" "	" "	7	<1	
	Blank Run	65°C	1010-1025	" "	0.1	--	
12/01/89	B-1-0-2	68°C	1300-1320	1.0	1.6	0-3	
	B-1-2-4	"	" "	0.2	0.1	3	
	B-1-4-6	"	" "	1.5	4.0	9-10	
	B-1-6-8	"	" "	0.8	6.6	20-25	
	B-1-8-10+	"	" "	6.5	40	15-20	
	B-1-10-12	"	" "	5.5	1.8	0.5-1	

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
12/01/89	B-1-12-14	68°C	1300-1320	4.0	20	6-10	
	B-1-14-16	"	" "	--	--	NR	No Recovery
	B-1-16-18	68°C	1300-1320	2.5	3.8	1	
12/01/89	B-2-0-2	70°C	1500-1520	Meter Malfunction	20+	0	+High veg. matter
	B-2-2-4	"	" "	" "	0.5	0	
	B-2-4-6	"	" "	" "	1.5	0.5-1.5	
	B-2-6-8+	"	" "	" "	31	1-2	
					Rerun 18		
	B-2-8-10	"	" "	" "	0.1	0	
	B-2-10-12	"	" "	" "	0.1	0-1.5	
	B-2-12-14	"	" "	" "	0.1	NR	Not Recorded
	Blank Run	"	" "	" "	0	--	
12/02/89	B-3-0-2	68°C	1130-1145	Not Used	59	0	
	B-3-2-4	"	" "	"	2.2	0	
	B-3-4-6	"	" "	"	0.7	0	
	B-3-6-8	"	" "	"	2.1	1-1.5	
	B-3-8-10	"	" "	"	49	2-4.5	
	B-3-10-12	"	" "	"	31	1.5	
	B-3-12-14+	"	" "	"	280	1.5	
	B-3-14-16	"	" "	"	260	3.4	
	B-4-0-2	68°C	1400-1420	Not Used	4.3	0.5	
	B-4-2-4	"	" "	"	59	0.5	
	B-4-4-6	"	" "	"	NR	NR	No Recovery
	B-4-6-8	"	" "	"	180	1	
	B-4-8-10	"	" "	"	18	0.5-1.5	
	B-4-10-12+	"	" "	"	26	0.5-1.5	
	B-4-12-14	"	" "	"	38	0.5-1	
	B-4-14-16	"	" "	"	3.0	0	
	B-5-0-2	70°C	1530-1545	Not Used	0	0.5	
	B-5-2-4	"	" "	"	0	3.5	
	B-5-4-6	"	" "	"	0	<1	
	B-5-6-8	"	" "	"	0	0	

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
12/02/89	B-5-8-10	70°C	1530-1545	Not Used	0	0	
	B-5-10-12+	"	" "	"	1.0	0	
	B-5-12-14	"	" "	"	0	0	
12/04/89	SB-3-89-0-2	70°C	1500-1530	0.5	0.4	0	
	SB-3-89-2-4	"	" "	40	80	2-8	
	SB-3-89-4-6+	"	" "	156	210	2.5-3.5	
	SB-3-89-6-8	"	" "	12	24	1.5-3.5	
	SB-3-89-8-10	"	" "	0.6	1.3	0.5-1	
	SB-3-89-10-12	"	" "	0.2	1.0	1-2	
	SB-3-89-12-14	"	" "	1.0	3.0	0.5	
	SB-3-89-14-16	73°C	1550-1610	3.0	4.0	0.5	
	SB-3-89-16-18	"	" "	4.0	22	<0.5	
	SB-3-89-18-20	"	" "	0.2	1.8	<0.5	
	SB-3-89-20-22	"	" "	0.2	0.6	<0.5	
12/05/89	A-B-11-0-2	68°C	0855-0912	Not Functioning	0.8	0	
	A-B-11-2-4	"	" "	"	70	2-30	
	A-B-11-4-6	"	" "	"	260	130-200	
	A-B-11-6-8	"	" "	"	55	30-80	
	A-B-11-8-10	"	" "	"	3.4	3.5	
	A-B-11-10-12	"	" "	"	0.1	0	
	A-B-11-12-14	"	" "	"	15	0	
	A-B-11-14-16	"	" "	"	NR	- -	No Recovery
	A-B-11-16-18	"	" "	"	1.4	1.5	
	A-B-12-0-2	76°C	1555-1615	Not Functioning	0.2	1.5-4	
	A-B-12-2-4	"	" "	"	23	1.5-2	
	A-B-12-4-6	"	" "	"	2.5	1.3	
	A-B-12-6-8	"	" "	"	2.0	1-1.5	
	A-B-12-8-10	"	" "	"	0.2	1	
	A-B-12-10-12	"	" "	"	0.3	<1	
	A-B-12-12-14	"	" "	"	27	4-8	
	A-B-12-14-16	"	" "	"	1	2-4	

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
12/07/89	B-B-1-0-2	68°C	1025-1045	Not Functioning	0.4	0.5	
	B-B-1-2-4	"	" "	"	21	0.5	
	B-B-1-4-6	"	" "	"	75	NR	Not Recorded
	B-B-1-6-8	"	" "	"	78	2.0	
	B-B-1-8-10	"	" "	"	68	NR	Not Recorded
	B-B-1-10-12+	"	" "	"	150	3.8	
	B-B-1-12-14+	"	" "	"	18	0.5	
	B-B-2-0-2	70°C	1415-1445	Not Functioning	0.6	0.2	
	B-B-2-2-4	"	" "	"	5.1	1.3	
	B-B-2-4-6	"	" "	"	4.0	1-1.5	
	B-B-2-6-8+	"	" "	"	66	4-11	
	B-B-2-8-10	"	" "	"	23	1.5-2	
	B-B-2-10-12+	"	" "	"	1.5	0-0.5	
	B-B-2-12-14	"	" "	"	14	0	
	B-B-2-14-16	"	" "	"	1.0	0	
	B-B-3-0-2	72°C	1550-1605	Not Functioning	0	0-2	
	B-B-3-2-4	"	" "	"	16	0.5-4	
	B-B-3-4-6	"	" "	"	120	4-10	
	B-B-3-6-8+	"	" "	"	200	10-20	
	B-B-3-8-10+	"	" "	"	28	1.0-1.5	
	B-B-3-10-12	"	" "	"	1.2	<0.5	
12/08/89	B-B-4-0-2	70°C	1400-1420	Not Functioning	0	0	
	B-B-4-2-4	"	" "	"	0.4	0.5-1.5	
	B-B-4-4-6	"	" "	"	5.5	1.5-5	
	B-B-4-6-8+	"	" "	"	19	NR	Not Recorded
	B-B-4-8-10	"	" "	"	0.8	NR	" "
12/08/89	B-B-5-0-2	70°C	1435-1453	Not Functioning	0.8	0	
	B-B-5-2-4	"	" "	"	5.8	0.5	
	B-B-5-4-6+	"	" "	"	>1000	200	
	B-B-5-6-8	"	" "	"	23	1-8	
	B-B-5-8-10	"	" "	"	160	2-6.5	
	B-B-5-10-12	"	" "	"	180	0.5-1	
	B-B-5-12-14	"	" "	"	150	0.5	

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
12/11/89	B-B-6-0-2	68°C	0910-0930	700	4	0-4	
	B-B-6-2-4	"	" "	200	12	1-4.5	
	B-B-6-4-6	"	" "	170	108	30-100	
	B-B-6-6-8	"	" "	210	150	10-50	
	B-B-6-8-10	"	" "	200	310	10-450	
	B-B-6-10-12	"	" "	150	500	200	
	B-B-6-12-14	"	" "	110	220	40	
	B-B-6-14-16	"	" "	20	140	5.25	
	B-B-7-0-2	68°C	1550-1615	400	0	0	
	B-B-7-2-4	"	" "	10	2.2	0	
	B-B-7-4-6	"	" "	40	0	0	
	B-B-7-6-8	"	" "	20	0	1-10	
	B-B-7-6-8	"	" "	15	1.5	1-10	Duplicate Run
	B-B-7-8-10	"	" "	10	5	0.5-7.5	
	B-B-7-8-10	"	" "	15	7	0.5-7.5	Duplicate Run
	B-B-7-10-12+	"	" "	30	20	20	
12/12/89	A-B-13-0-2	68°C	0900-0920	0	16	0	
	A-B-13-2-4	"	" "	0	18	0	
	A-B-13-4-6	"	" "	Not Functioning	8	0	
	A-B-13-6-8	"	" "	"	10	0	
	A-B-13-8-10	"	" "	"	20	0.5	
	A-B-13-10-12	"	" "	"	22	0.5	
	A-B-13-12-14+	"	" "	"	60	0	
	A-B-13-14-16	"	" "	"	28	0	
	A-B-14-0-2	68°C	1438-1458	3	3	0	
	A-B-14-2-4	"	" "	3	3	0.5	
	A-B-14-4-6	"	" "	2	12	0-1	
	A-B-14-6-8+	"	" "	60	180	0.5-2	
	A-B-14-8-10+	"	" "	0	2.5	0-0.25	
	A-B-14-10-12	"	" "	1	4	0.25-1.0	
	A-B-14-12-14	"	" "	28	42	0-0.5	
	A-B-14-14-16	"	" "	3.5	4.2	0	

TABLE E-1
SOIL SCREENING RESULTS

Date	Sample	Bath Temp.	Duration	HNU	OVA	Field OVA (ppm)	Comments
12/13/89	B-B-8-0-2	70°C	0810-0830	0	0.2	0	
	B-B-8-2-4	"	" "	0	0	0	
	B-B-8-4-6	"	" "	22	64	0-1.0	
	B-B-8-6-8	"	" "	2	6.5	1-2	
	B-B-8-8-10	"	" "	20	24	1-2.5	
	B-B-8-10-12	"	" "	16	20	1-1.5	
	B-B-8-12-14	"	" "	24	28	0.5-7.5	
	A-B-15-0-2	68°C	1600-1620	8	14	0	
	A-B-15-2-4	"	" "	1	2	<0.5	
	A-B-15-4-6	"	" "	0.5	2.4	0	
	A-B-15-6-8	"	" "	--	--	NR	No Recovery
	A-B-15-8-10	"	" "	0	0	0	
	A-B-15-10-12	"	" "	0	0	0	
	A-B-15-12-14	"	" "	0	0.6	0	
	A-B-15-14-16	"	" "	0	0.4	0	
	A-B-15-16-18	"	" "	0.2	0.8	0	
12/14/89	B-B-9-0-2	72°C	1555-1615	--	--	NR	No Recovery
	B-B-9-2-4	"	" "	1.0	8.0	0.5-1.0	
	B-B-9-4-6	"	" "	220	60	3.5-8	
	B-B-9-6-8	"	" "	20	200	7-12	
	B-B-9-8-10	"	" "	90	480	>100	
	B-B-9-10-12	"	" "	200	>1000	55	
	B-B-9-12-14+	"	" "	400	>1000	30	
12/15/89	B-B-9-14-16	68°C	1035-1055	420	>1000	220	
	B-B-9-16-18	"	" "	30	900	4-6	
	B-B-9-18-20	"	" "	9.5	90	1.0	

NOTE:

\+ indicates sample selected for detailed chemical analyses.

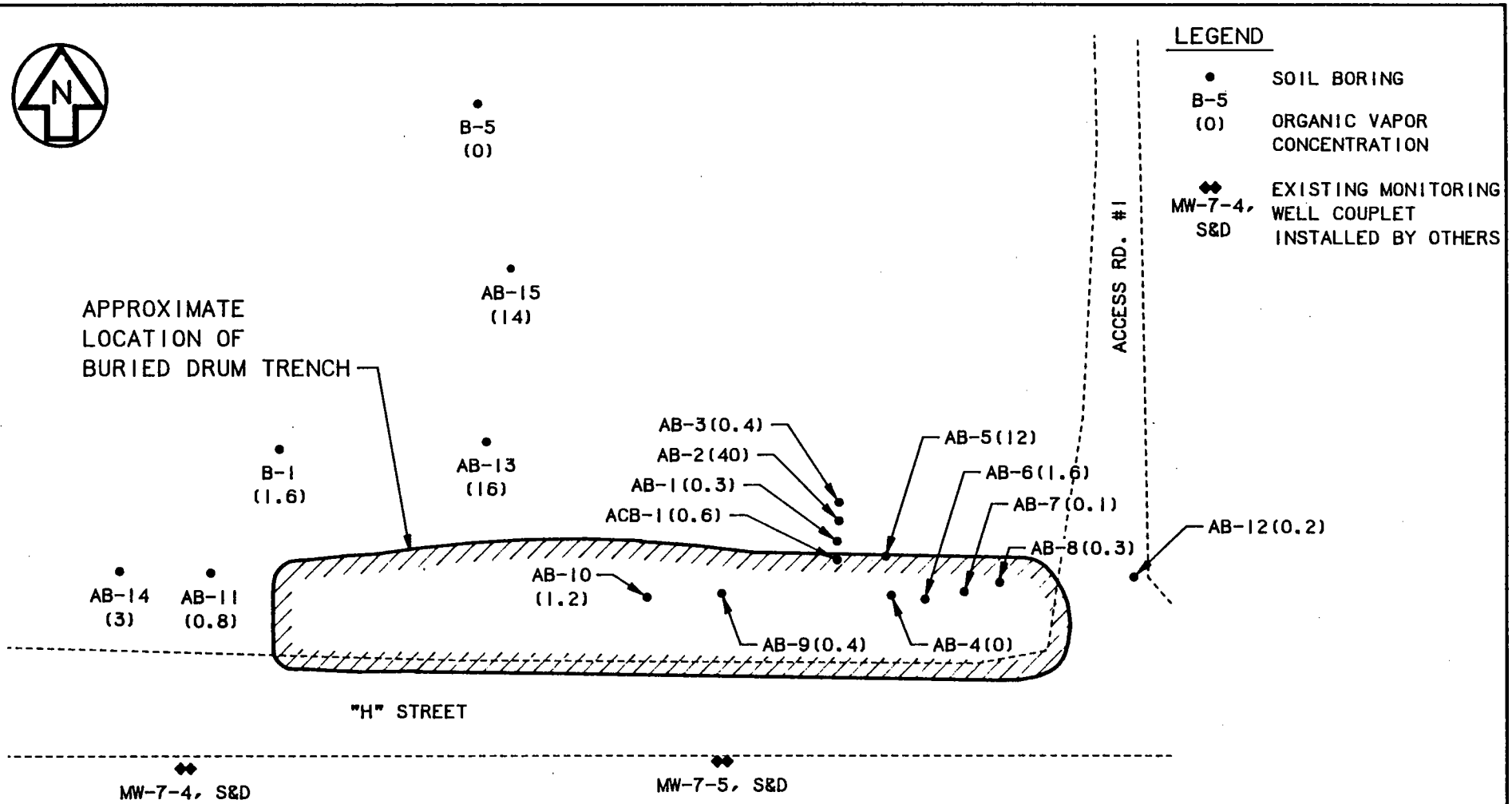


FIGURE E-1

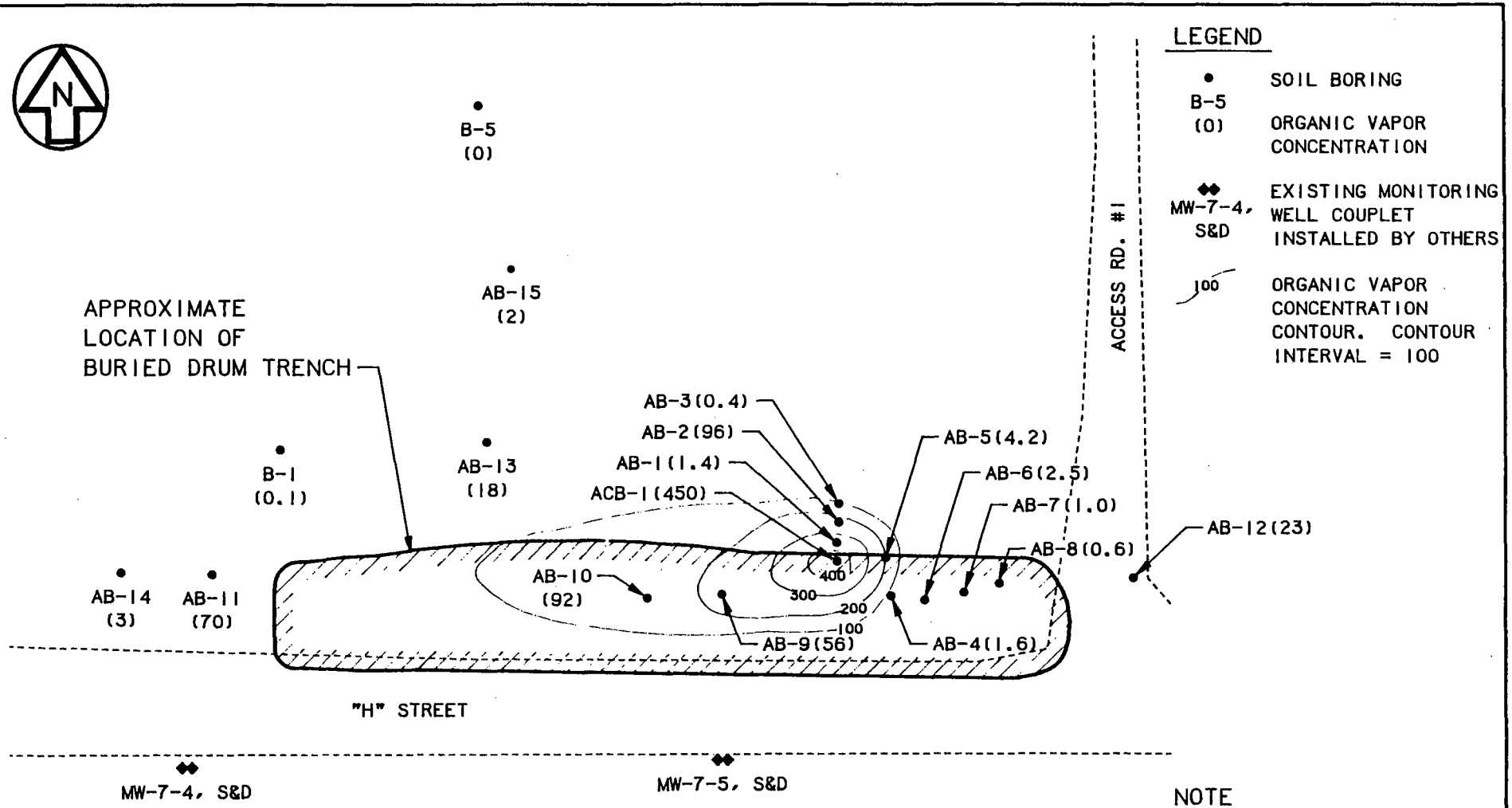
LAKE ONTARIO ORDNANCE WORKS

AREA A

SOIL SCREENING RESULTS (0'-2')

ACRES

SCALE 0 40 80 FEET



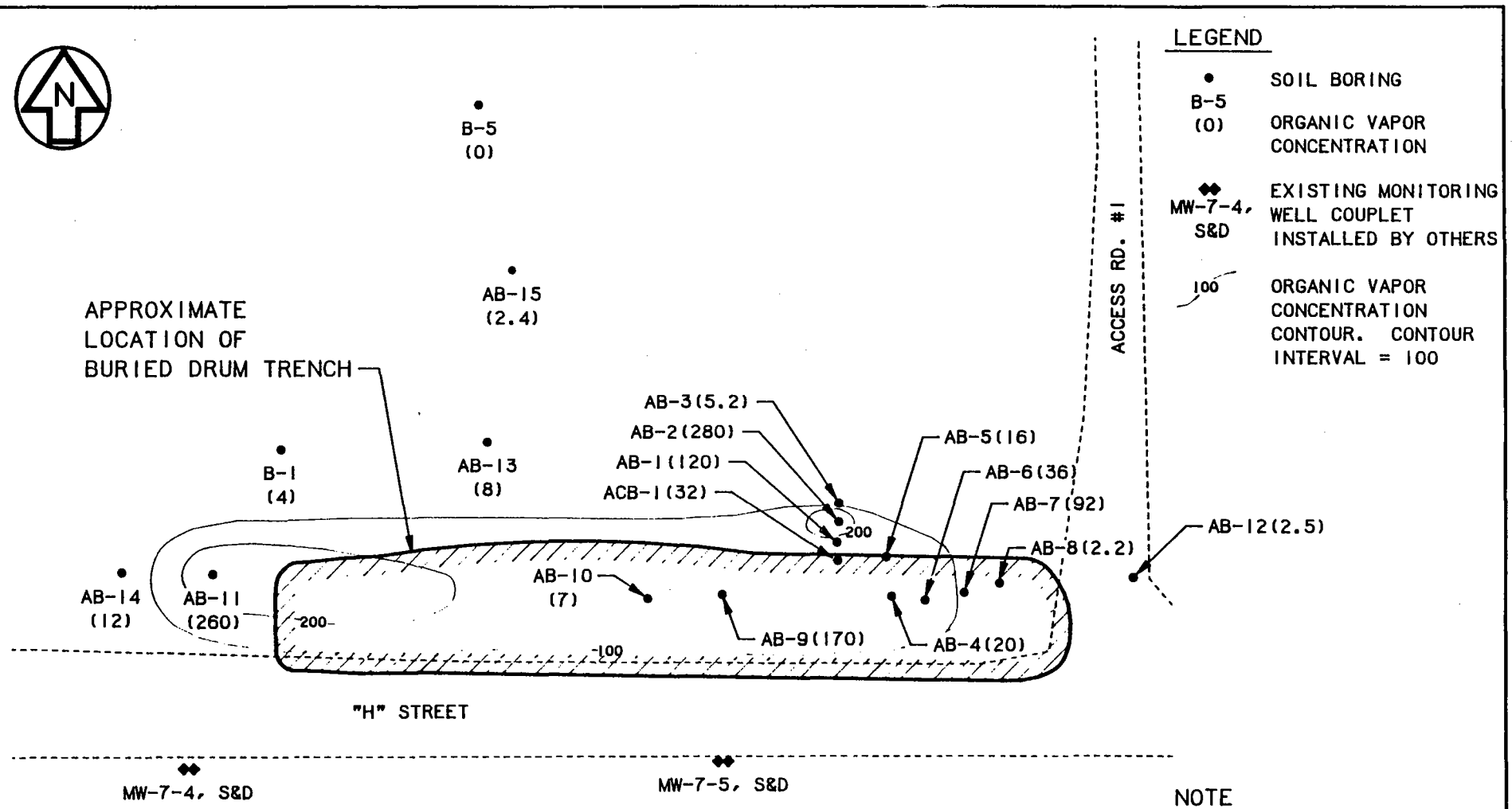
LAKE ONTARIO ORDNANCE WORKS

AREA A

SOIL SCREENING RESULTS (2'-4')

FIGURE E-2

ARCADIS



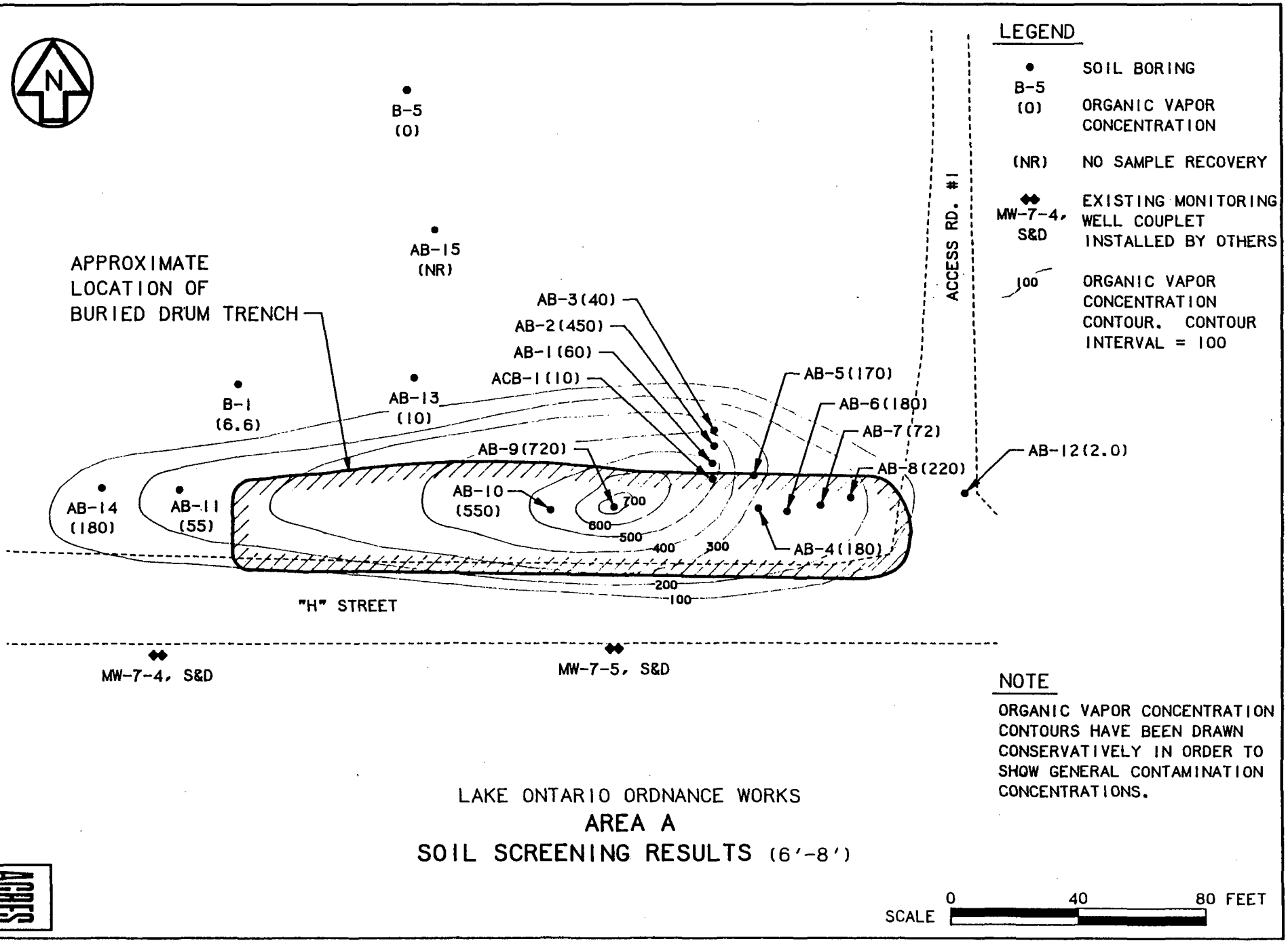
LAKE ONTARIO ORDNANCE WORKS

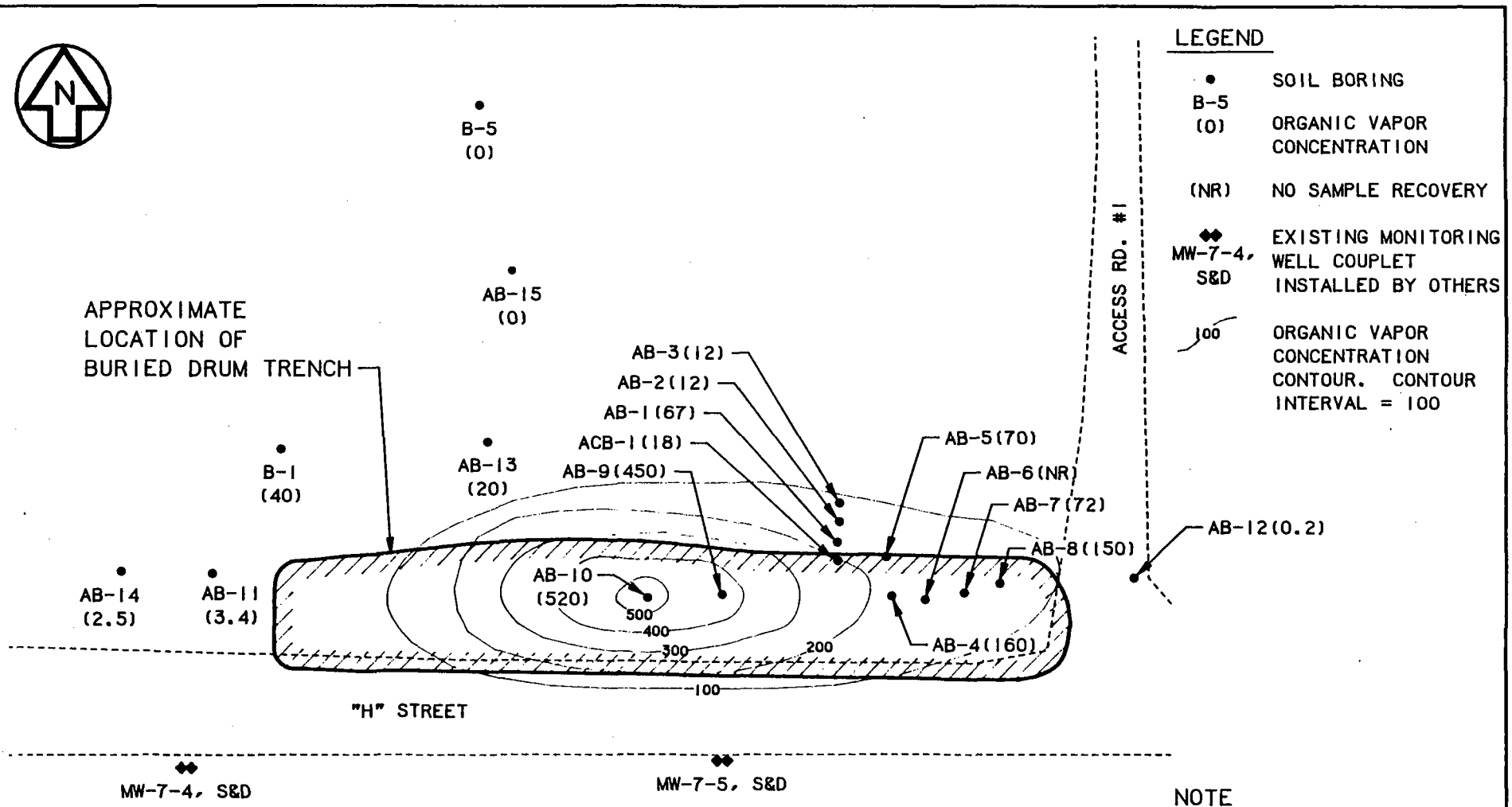
AREA A

SOIL SCREENING RESULTS (4'-6')

FIGURE E-3

ACRES


N
B-5
(0)
AB-15
(NR)
APPROXIMATE
LOCATION OF
BURIED DRUM TRENCH
B-1
(6.6)
AB-13
(10)
AB-14
(180)
AB-11
(55)
AB-10
(550)
AB-9(720)
ACB-1(10)
AB-1(60)
AB-2(450)
AB-3(40)
AB-5(170)
AB-6(180)
AB-7(72)
AB-8(220)
AB-12(2.0)
AB-4(180)
700
600
500
400
300
200
100
ACCESS RD. #1
"H" STREET
MW-7-4, S&D
MW-7-5, S&D
LEGEND
SOIL BORING
B-5
(0)
ORGANIC VAPOR CONCENTRATION
(NR)
NO SAMPLE RECOVERY
MW-7-4, S&D
EXISTING MONITORING WELL COUPLET INSTALLED BY OTHERS
100
ORGANIC VAPOR CONCENTRATION CONTOUR. CONTOUR INTERVAL = 100
NOTE
ORGANIC VAPOR CONCENTRATION CONTOURS HAVE BEEN DRAWN CONSERVATIVELY IN ORDER TO SHOW GENERAL CONTAMINATION CONCENTRATIONS.
LAKE ONTARIO ORDNANCE WORKS
AREA A
SOIL SCREENING RESULTS (6'-8')
SCALE
0
40
80 FEET
FIGURE E-4
ACRES



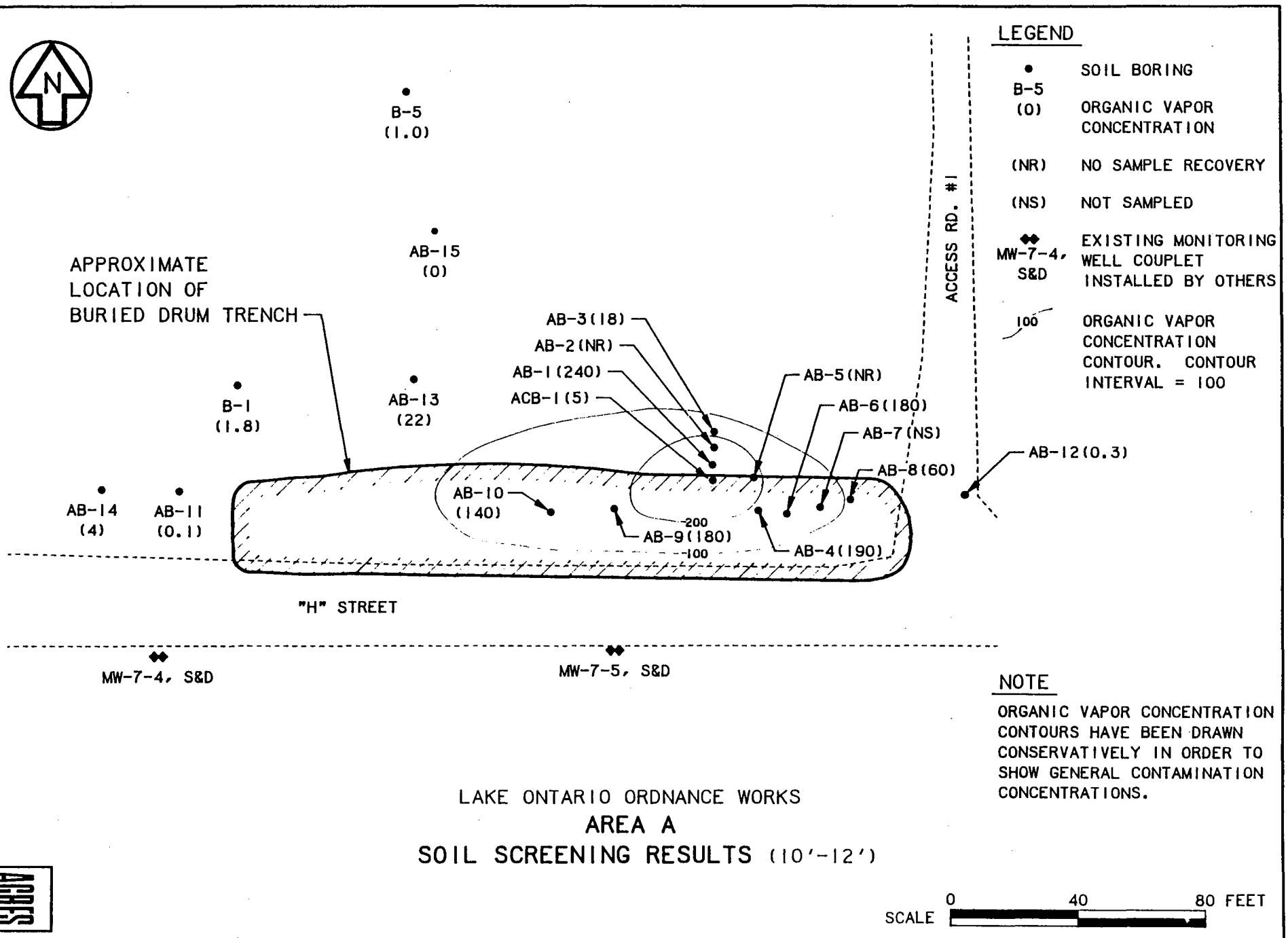
LAKE ONTARIO ORDNANCE WORKS

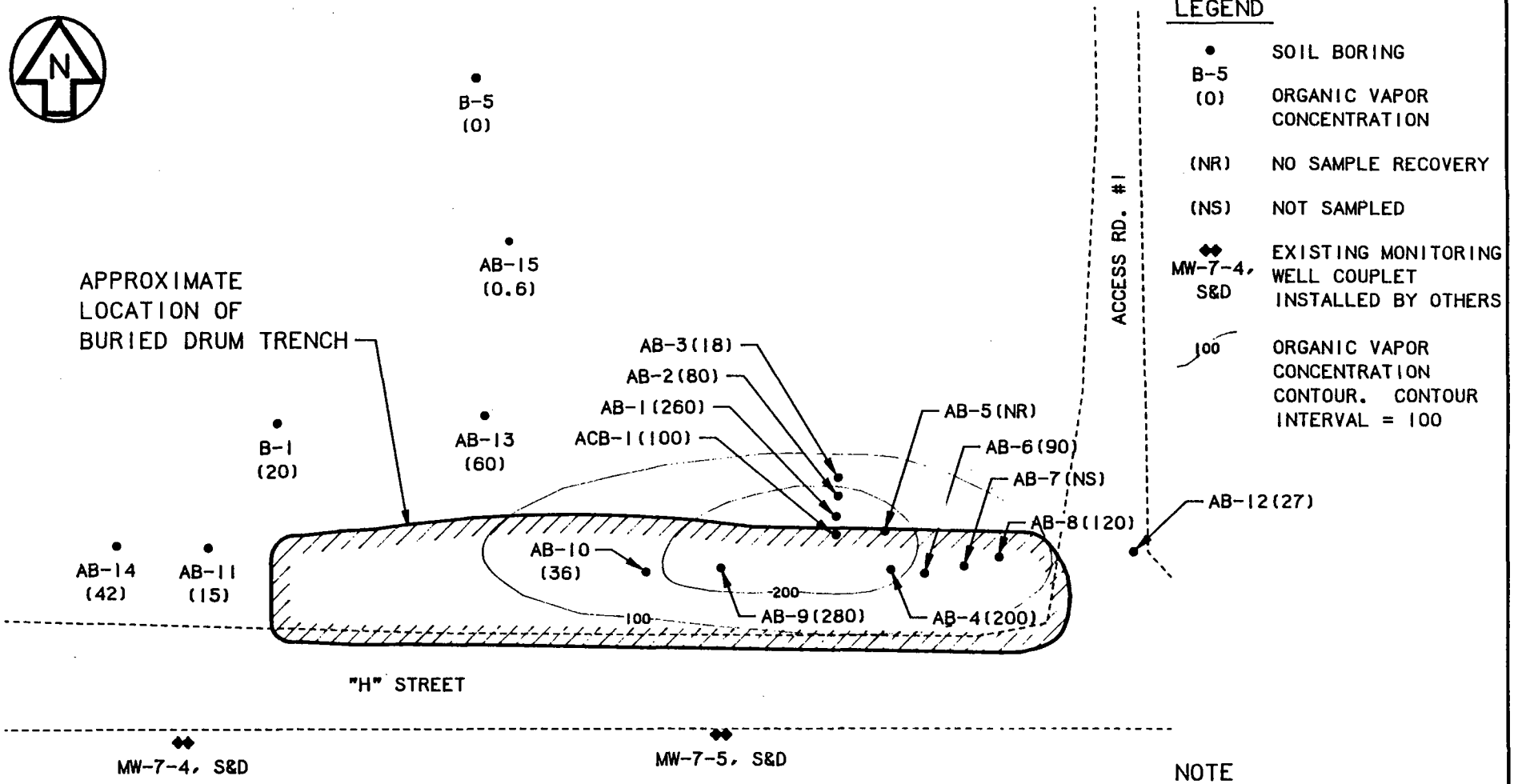
AREA A

SOIL SCREENING RESULTS (8'-10')

FIGURE E-5

ACRES


N
B-5
(1.0)
AB-15
(0)
APPROXIMATE
LOCATION OF
BURIED DRUM TRENCH
B-1
(1.8)
AB-13
(22)
AB-3(18)
AB-2(NR)
AB-1(240)
ACB-1(5)
AB-5(NR)
AB-6(180)
AB-7(NS)
AB-8(60)
AB-12(0.3)
ACCESS RD. #1
AB-14
(4)
AB-11
(0.1)
AB-10
(140)
200
AB-9(180)
100
AB-4(190)
"H" STREET
MW-7-4, S&D
MW-7-5, S&D
LEGEND
B-5
(0)
SOIL BORING
ORGANIC VAPOR CONCENTRATION
(NR)
NO SAMPLE RECOVERY
(NS)
NOT SAMPLED
MW-7-4, S&D
EXISTING MONITORING WELL COUPLET INSTALLED BY OTHERS
100
ORGANIC VAPOR CONCENTRATION CONTOUR. CONTOUR INTERVAL = 100
NOTE
ORGANIC VAPOR CONCENTRATION CONTOURS HAVE BEEN DRAWN CONSERVATIVELY IN ORDER TO SHOW GENERAL CONTAMINATION CONCENTRATIONS.
LAKE ONTARIO ORDNANCE WORKS
AREA A
SOIL SCREENING RESULTS (10'-12')
SCALE
0
40
80 FEET
FIGURE E-6
ACRES



LAKE ONTARIO ORDNANCE WORKS

AREA A

SOIL SCREENING RESULTS (12'-14')

FIGURE E-7

AGRES

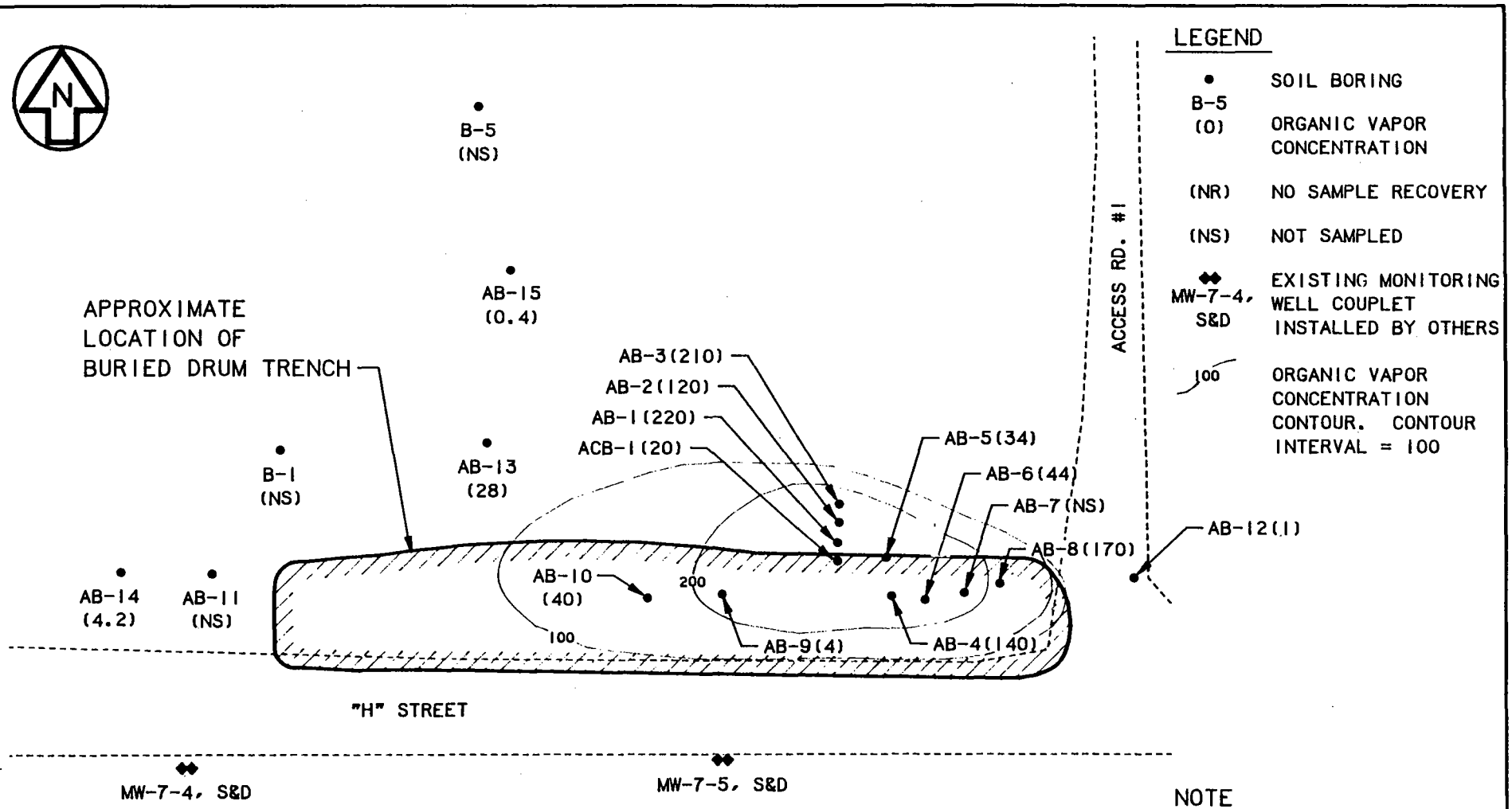
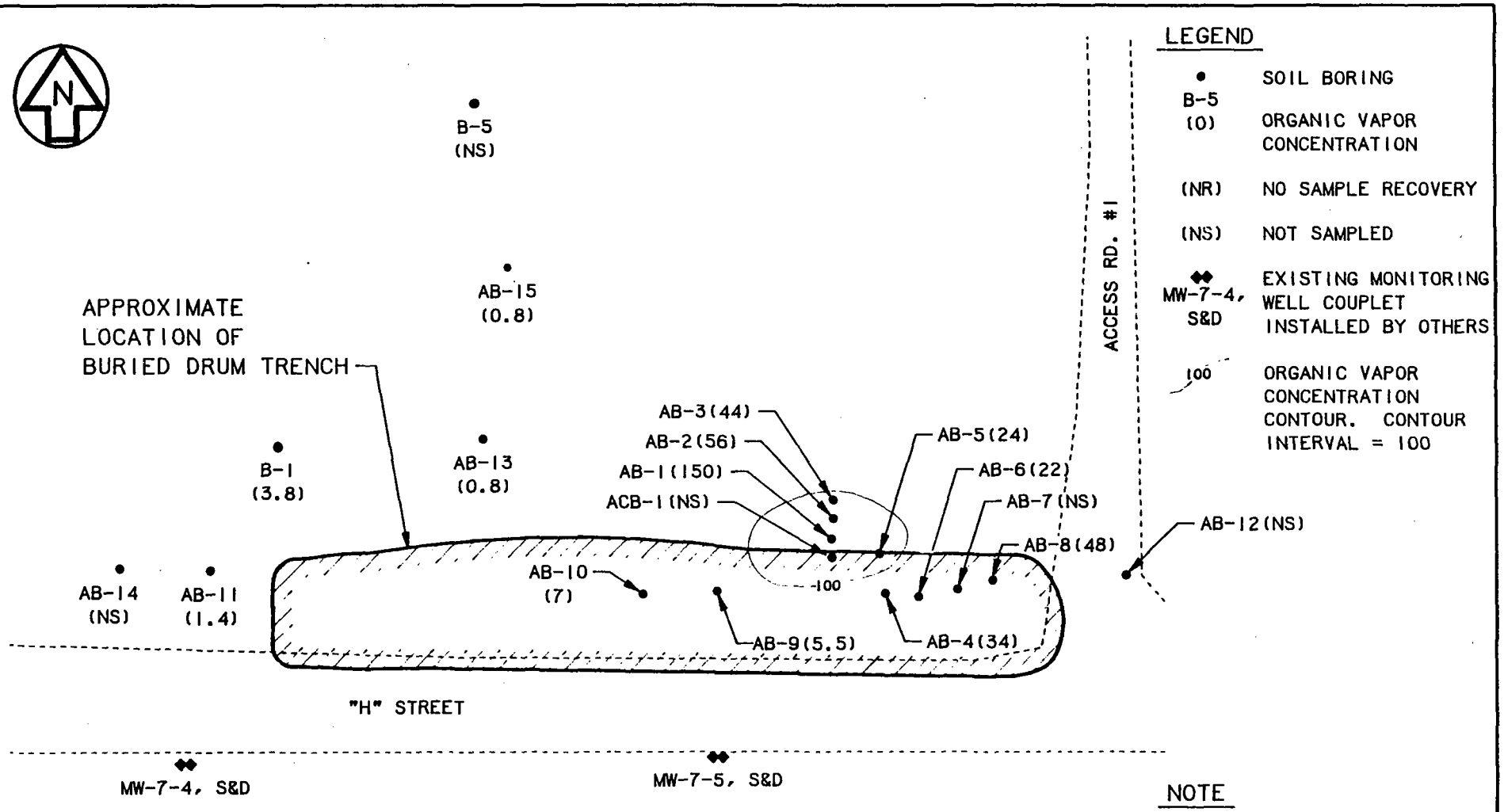


FIGURE E-8

ACRES



LAKE ONTARIO ORDNANCE WORKS

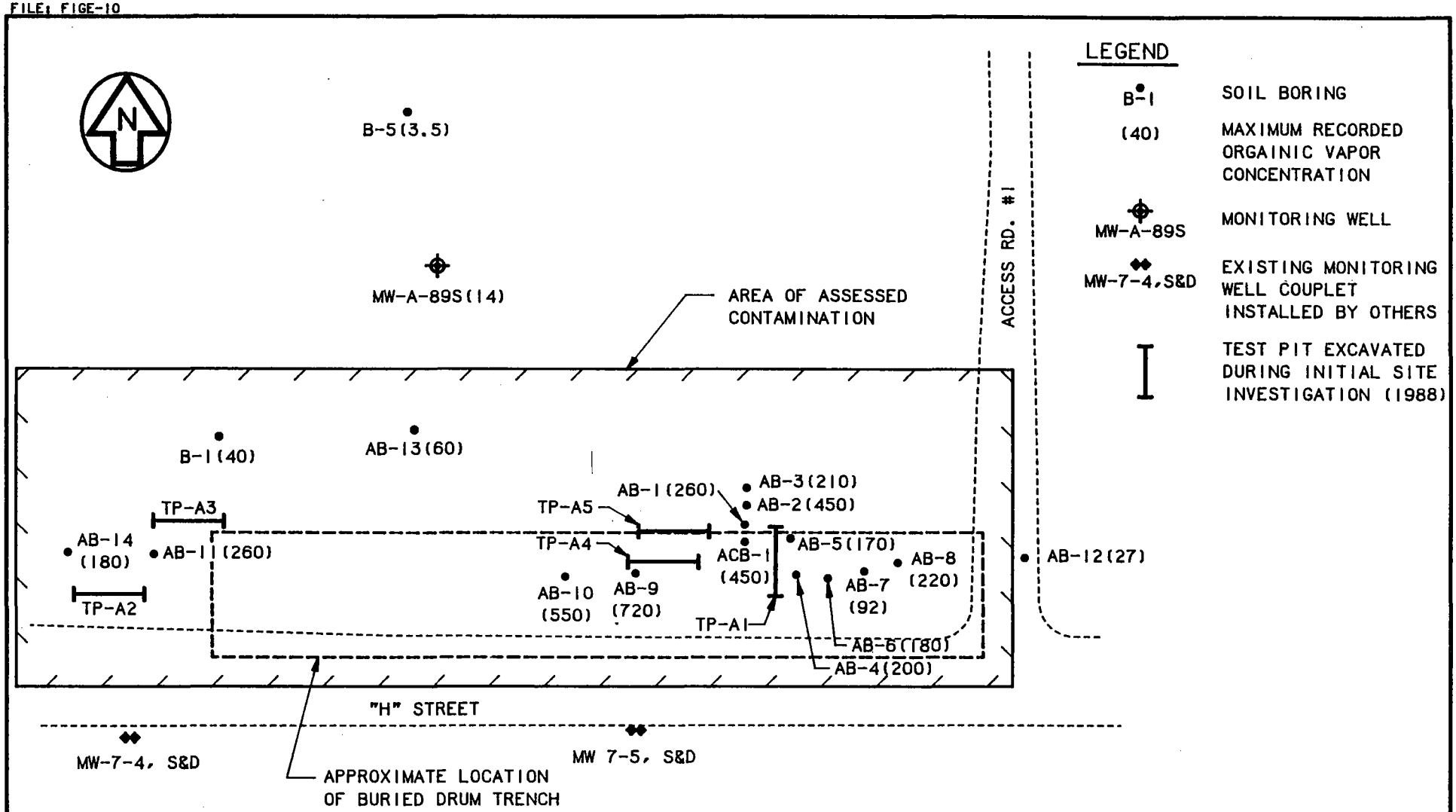
AREA A

SOIL SCREENING RESULTS (16'-18')

FIGURE E-9

ACRES

KAB 6/13/90
P0834109
FILE: FIGE-10



LAKE ONTARIO ORDNANCE WORKS

AREA A
SUMMARY OF MAXIMUM RECORDED ORGANIC VAPOR CONCENTRATIONS

SCALE 0 40 80 FEET

FIGURE E-10

ACRES

ATTACHMENT E-2

LAKE ONTARIO ORDNANCE WORKS

DATA VALIDATION

ATTACHMENT E-2

DATA QA VALIDATION SUMMARY

1 - INTRODUCTION

Prior to the use of analytical data, the data received quality assurance (QA) validation. The QA validation was performed on analytical data to determine the quality of the data for environmental interpretation. The QA validation process involved first, the evaluation of quality control (QC) data which are obtained from the analysis of laboratory and field QC samples and second, the evaluation of QC procedures utilized by the lab during or prior to sample analysis.

The following types of field QC samples were evaluated for the QA data validation:

- Trip blanks (VOA);
- Rinse blanks; and
- Blind duplicates.

The following types of laboratory QC samples were evaluated for the QA data validation:

- Method blanks;
- Matrix spike/matrix spike duplicates;
- Laboratory post-digestion spikes.

The following types of laboratory QC procedures were performed and evaluated for all organic field samples during QA data validation:

- Internal standard area; and
- Surrogate recovery.

The following is a brief description of each type of QC sample and procedure and its intended purpose:

Trip blank analysis was used to determine the existence and magnitude of sample contamination from sample bottles and from the laboratory. Trip blanks consisted of laboratory prepared volatile free water which was poured in the field into 40 ml VOA sample vials, and returned to the laboratory for analysis. Trip blank analytical data are presented in Tables E-2.1. Field samples associated with trip blanks are listed in Table E-2.2.

Rinse blank analysis was used to check the effectiveness of the decontamination procedures used on sampling equipment between sample collection. Rinse blanks were obtained by pouring deionized water over or through field sampling tools and collecting this water in a sample bottle. Rinse blank analytical data are presented in Table E-2.1. Field samples associated with rinse blanks are listed in Table E-2.2.

Blind duplicate analysis provided a method to check analytical precision without laboratory knowledge of which sample was being analyzed in duplicate. Blind duplicate samples were collected in the field at the same time as the original sample, but given a separate identification.

Method blank analysis was used to determine the existence and magnitude of laboratory contamination in the samples. Method blanks consisted of a deionized water sample which was prepared in the laboratory and analyzed in a similar manner to the field samples. Method blank analytical data are presented in Tables E-2.3 through E-2.5. Field samples associated with method blanks are listed in Tables E-2.6 and E-2.7.

Matrix spike (MS) and matrix spike duplicate (MSD) samples were collected as field samples. In the laboratory, both the MS and MSD samples were spiked with compounds prior to sample preparation. During sample analysis the percent recovery of each spike compound was determined and compared with acceptable recovery limits. The relative percent difference (RPD) between the MS and MSD was calculated for each organic spike compound and compared to a list of maximum RPD's. The relative standard deviation (RSD) between MS and MSD was calculated for inorganic spikes and examined relative to guidelines for maximum RSD's. These data were used to determine

long-term precision and accuracy of the analytical methods on various sample matrices. A summary of MS/MSD performance is listed in Table E-2.8.

Laboratory post-digestion spike recovery results provided data to evaluate accuracy for each inorganic analytical method. Inorganic spikes were added to laboratory duplicate samples after sample preparation (digestion). Laboratory duplicates were generally selected from MS/MSD samples. Spike recovery data were compared with MS/MSD results to determine sample matrix effects on instrument accuracy.

Internal standards were added to each volatile organic analysis and semi-volatile organic analysis sample at the end of sample preparation. During sample analysis, the area beneath each internal standard peak was determined and compared with the area beneath the internal standard peaks in the calibration standard samples. Changes in the internal standard areas were used to assess gas chromatograph performance and loss of instrument sensitivity.

Surrogates were added to each sample as spike compounds prior to sample preparation. During sample analysis, the percent recovery of each of these compounds was determined to evaluate laboratory and instrument performance (i.e. accuracy). Surrogate recovery may also be effected by interferences inherent to the sample and high concentrations of organics or inorganics. The range of recovery limits for surrogates in soil sample was greater than the range of recovery limits in water samples due to the greater possibility of matrix interferences in soil samples. Surrogate recovery limits are presented in Table E-2.9.

2 - QA VALIDATION PROCEDURE FOR ORGANIC ANALYSES

2.1 - Holding Times

The first step of the QA validation process was to check sample holding times for extraction and analysis. Holding time criteria were based on SW-846, third edition requirements and are summarized in Table E-2.10.

Following holding time examination, the samples were compared with associated method blanks, trip blanks, and rinse blanks.

2.2 - Negation of Blank Data

Compounds in the sample which were found at concentrations less than 3 times the concentration in any of the blanks (trip, rinse or method) were considered to be present in the sample due to outside influences. These compounds were negated from the sample contamination evaluation and were qualified in the analytical summary tables.

2.3 - Field Duplicates

Blind field duplicate analysis was the next step in the QA validation process. No EPA guidelines have been established for field duplicate analysis. Duplicates were compared with original samples by calculation and review of the relative standard deviation of the sample concentrations. Soil samples tend to have greater differences between original and duplicate analyses, since soils are generally less homogeneous than liquids.

2.4 - Internal Standards

Internal standard area summaries and surrogate recovery summaries were also examined during QA validation. Internal standard areas for each sample were required to be within -50 to +100 percent of the calibration standard. Three internal standards were run for each volatile organic sample and six internal standards were run with each semi-volatile organic sample.

2.5 - Surrogates

Surrogate compounds were examined for all organic analyses. Three surrogates were required for each volatile analysis, six surrogates for semi-volatile analysis and one surrogate for pesticide/PCB analysis. Surrogate recovery limits are presented in Table E-2.9. (Note: One surrogate is allowed to be out of QC limits for semi-volatile analyses.)

2.6 - Spiked Samples

MS/MSD samples data were reviewed for volatile and semi-volatile analyses. One set of MS/MSD samples was collected for each area of investigation with an approximate frequency of 1 per 10 samples per matrix. Spike recovery analysis was performed for pesticide analyses. Acceptable MS/MSD ranges are recommended (not mandatory) guidelines for the EPA CLP.

3 - QA VALIDATION PROCEDURE FOR INORGANICS

The procedure for QA validation of inorganic data was somewhat similar to that for organic data.

3.1 - Holding Times

Sample holding times as specified in SW-846, third edition, were checked to insure that the analyses were performed within an acceptable length of time.

3.2 - Blanks

Samples were compared with associated rinse blanks to check for possible outside contamination. No data negation was performed on inorganic samples.

3.3 - Spiked Samples

MS/MSD and post-digestion spike recovery data were reviewed for inorganic analytes. The frequency of these analyses was one set for each area equating to 1 per 10 samples per matrix. Acceptable recovery ranges for MS/MSD and post digestion spike analyses are 75-125 percent based on EPA CLP guidelines.

MS/MSD precision results were acceptable when the relative standard deviation (standard deviation divided by the mean) of the recoveries was less than 0.3.

3.4 - Field Duplicates

Field duplicate results were evaluated by the RSD of each analyte from the concentrations of duplicate and original samples. RSDs greater than 0.3 were noted, but not considered to be unacceptable.

3.5 - Elimination of Mass Spectral Library Searches

Based upon a review of the analytical data for initial RI program no tentatively identified compounds were repeatedly observed in substantial concentrations. Therefore, the elimination of the mass spectral library search in the supplemental investigation does not appear to have impacted the assessment of contamination of the site. Tables E-2.11 through E-2.14 present a listing of the compounds included in the target compound list (TCL) for this investigation.

4 - DATA VALIDATION RESULTS

The following is a summary of the results of the data validation for the samples collected at LOOW. The reader is directed to refer to the Section 4 analytical tables of the main text for a complete summary of contaminants identified in each sample including negated values.

4.1 - Subsurface Soil

4.1.1 - Subsurface Soil Organics

Sample holding times for all volatile organic analyses were below maximum limits. No pesticide/PCB analyses were performed on subsurface soil samples. Semi-volatile holding times before extraction (7 days) were exceeded for the following samples: ACB-2-4; ACB-14-16; AB-2-6-8; AB-2-6-8MS; AB-2-6-8MSD; and B-3-12-14.

The concentration of hexachloroethane in sample BB-9-12-14 exceeded the volatile organic calibration range. No sample dilution and reanalysis was performed. The concentration of this compound should be written >9000 ug/kg.

Low concentrations of the following compounds were detected in some of the volatile and semi-volatile organic blanks (method, trip and rinse):

- Volatiles: methylene chloride, trichloroethene, and tetrachloroethene;

- Semi-volatiles: Phenol, bis(2-ethylhexyl)phthalate and di-n-butylphthalate.

All of these contaminants, except trichloroethene, were detected in some of the field samples. Contaminant concentrations were negated in samples when the concentration in the sample was less than 3 times the concentration in the blank.

VBLK99 was run as a medium concentration method blank associated with sample BB-9-12-14. Methylene chloride was detected at a concentration of 450J ug/Kg, which was below the CRQL.

All volatile and semi-volatile organic internal standard areas were within the -50 to +100 percent QC limits.

The following samples had one or more volatile or 2 or more semi-volatile organic surrogate recoveries outside QC limits:

- Volatiles: B-3-12-14#; SB-3-89-4-6#; B-5-10-12#;

- Semi-volatiles: AB-DUP*; AB-13-12-14**; AB-14-6-8**; AB-14-8-10**; BB-9-12-14**; and A-DUP**

- Sample reanalysis proved matrix effect on surrogate recoveries.

* - The lab did not reanalyze to prove matrix effect.

** - The lab did not reanalyze to prove matrix effect, but the COE decided not to reanalyze the samples.

The following samples had one semi-volatile surrogate recovery outside QC limits: BB-7-10-12; AB-2-6-8; BB-2-10-12; BB-2-6-8; BB-3-6-8; BB-3-8-10; BB-4-6-8MSD;

- MS/MSD analyses were performed for volatile and semi-volatile organics on low concentration samples B-5-10-12; AB-2-6-8; and BB-4-6-8. A medium concentration MS/MSD analysis was performed for volatile organics on BB-9-12-14. Table E-2.8 summarizes the recovery and RPD data for the MS/MSD analyses.

- Three pairs of subsurface soil field duplicate samples were collected at the LOOW site:

A-DUP: AB-14-6-8
B-DUP: BB-7-10-12
AB-DUP: B-4-10-12

Volatile and semi-volatile RSD precision results were <.30 for all detected analytes except acetone and bis(2-ethylhexyl)phthalate.

4.1.2 - Subsurface Soil Inorganics

Sample holding times for lithium and boron analysis were within maximum limits.

Boron was found at a concentration of 0.34 mg/kg in rinse blank AB-RB. A-RB and B-RB contained no detectable levels of boron or lithium.

Lithium and boron MS/MSD analysis was performed on the 3 samples analyzed for volatile and semi-volatile MS/MSD. Half of the lithium recoveries were outside the 75 - 120 percent QC limits. Only 17 percent of the boron recoveries did not fall within these accuracy limits. All RSD precision data were less than the .30 maximum limit.

Three sets of subsurface soil samples were analyzed for lithium and boron. Lithium concentrations between A-DUP and AB-14-6-8 were the only instance of RSD less than .30.

4.1.3 - Subsurface Soil QA Summary

Volatile and semi-volatile data are questionable in samples with surrogate recoveries outside QC limits. These samples include:

- Volatiles: B-3-12-14; SB-3-89-4-6; B-5-10-12;

- Semi-volatiles: AB-DUP; AB-13-12-14; AB-14-6-8; AB-14-8-10; BB-9-12-14; and A-DUP.

Samples ACB-2-4, ACB-14-16, AB-2-6-8, AB-2-6-8 MS, and AB-2-6-8 MSD were extracted after the COE required seven-day maximum holding deadline but within (10 to 14 days) a 14-day holding time period. The semi-volatile results of these samples have qualified on the analytical tables holding time exceedance.

The presence and concentration of the following blank contaminants are questionable in samples associated with these blanks:

- Volatiles: methylene chloride, trichloroethene, and tetrachloroethene;

- Semi-volatiles: Phenol, bis(2-ethylhexyl)phthalate and di-n-butylphthalate; and

- Metals: Boron.

All boron data are questionable due to poor MS/MSD recoveries.

Poor surrogate and spike recoveries are believed to result from matrix interference.

4.2 - Surface Sediment

4.2.1 - Surface Sediment Organics

Sample holding times for all volatile organics and pesticide/PCBs were below maximum limits. Semi-volatile holding times before extraction (seven days) were exceeded for samples SS-89-1-S and SS-89-4-S, however, these samples were initially extracted and analyzed within the holding time, but had poor surrogate recoveries. The results reported on the data summary sheet are for the second extraction, which was performed after the holding time deadline had expired.

Low concentrations of the following compounds were detected in some of the volatile and semi-volatile organic blanks (method, trip and rinse):

- Volatiles: methylene chloride, dibromochloromethane, 1,1,2-trichloroethane, bromoform, 1,1,2,2-tetrachloroethane, vinyl chloride, trans-1,3-dichloropropene, tetrachloroethene, and chlorobenzene; and

- Semi-volatiles: 4-chlorophenyl-phenylether, di-n-butylphthalate, bis(2-ethylhexyl)phthalate

Methylene chloride, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate were the only blank contaminants detected in the field samples. These contaminants were usually negated in samples, since the concentrations in the samples were generally less than 3 times the concentration in the blanks.

One volatile and one semi-volatile internal standard area was outside of the -50 to +100 percent recovery limits for samples SS-89-5-S and SS-89-5-SRE.

One volatile surrogate was outside QC limits in sample SS-89-5-SRE.

One semi-volatile surrogate was outside QC limits in samples SS-RB-89 and SS-89-2-S.

DBC pesticide surrogate recoveries fell outside the recommended guidelines for soil (20 - 150 percent) in the following samples: SS-89-2-S, SS-89-3-S, SS-89-4-SMSD, and SS-S-DUP. Pesticide/PCB sample analyses are not required to achieve recommended surrogate recovery limits.

MS/MSD analyses were performed for volatile, semi-volatile and PCB analyses on sample SS-89-4-S. Recommended recoveries for Aroclor PCB analyses are between 60 - 140 percent based on prior laboratory performance. Table E-2.8 summarizes the recovery and RPD data for the MS/MSD analyses.

Samples SS-89-2S and SS-S-DUP were surface sediment samples. Volatile and semi-volatile RSD precision results were < .30 for all detected analytes except acetone. Arochlor 1248 was detected in SS-89-2S at 240 ug/kg, but was not found in SS-S-DUP.

4.2.2 - Surface Sediment Inorganics

Sample holding times were within maximum limits for all metal analyses.

The following metals were detected in the surface sediment rinse blank (concentrations in mg/kg): barium - 0.20; cadmium - 0.009; potassium - 0.07B; selenium - 0.0038B; thallium - 0.024; and zinc - 0.32. Concentrations qualified with a "B" are less than the CRDL.

MS/MSD analysis was performed for all proposed metals except boron and lithium. The following metals have recoveries outside the 75 - 125 percent QC limits in the matrix spike and/or the matrix spike duplicate: arsenic, beryllium, chromium, selenium, and zinc. Arsenic and selenium had zero recoveries in both the MS and MSD analyses. All precision RSDs were below the .30 QC maximum, except for arsenic and selenium.

All post digestion spike results were within QC limits.

Samples SS-89-2S and SS-S-DUP were surface sediment field duplicate samples. All metals RSD precision data were within QC guidelines, except for boron and selenium. Boron was detected at 73.1 mg/kg in the original sample and not the duplicate. Selenium was detected at 0.86 mg/kg in the duplicate and not the original sample.

4.2.3 - Surface Sediment QA Summary

Volatile data in SS-89-5-SRE are questionable due to one surrogate recovery outside QC limits.

Volatile concentrations in samples SS-89-5-S and SS-89-5-SRE are questionable due to one internal standard area beyond the +50 to +100 percent requirement.

The presence and concentration of the following blank contaminants are questionable in samples associated with these blanks:

- Volatiles: methylene chloride, dibromochloromethane, 1,1,2-trichloroethane, bromoform, 1,1,2,2-tetrachloroethane, vinyl chloride, trans-1,3-dichloropropene, tetrachloroethene, and chlorobenzene;

- Semi-volatiles: 4-chlorophenyl-phenylether, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate.

Metals: barium, cadmium, potassium, selenium, thallium, and zinc.

Beryllium, chromium, and zinc concentrations are somewhat questionable due to MS/MSD recoveries outside the 75 - 125 percent QC range.

Arsenic and selenium concentrations are questionable since these metals had zero spike recoveries in the MS/MSD analysis.

Poor internal standard areas, surrogate recoveries, and spike recoveries are believed to result from matrix interference.

4.3 - Surface Water and Groundwater

4.3.1 - Surface Water and Groundwater Organics

All sample holding times for volatile, semi-volatile, and pesticide/PCB analyses were within allowable limits.

Low concentrations of the following compounds were detected in some of the volatile and semi-volatile organic blanks (method and trip):

- Volatiles: methylene chloride, trichloroethene, 1,1,2,2-tetrachloroethane, vinyl chloride, trans-1,3-dichloropropene, tetrachloroethene, and chlorobenzene;

- Semi-volatiles: bis(2-ethylhexyl)phthalate

Methylene chloride, trichloroethene, and bis(2-ethylhexyl)phthalate were the only blank contaminants detected in the water samples. Methylene chloride and trichloroethene were negated from the samples since sample concentrations were less than 3 times blank concentrations.

All volatile and semi-volatile organic internal standard areas were within the -50 to +100 percent QC limits.

One semi-volatile surrogate was outside QC limits in SS-W-DUP and MW-RB.

MS/MSD analyses were performed for volatile, semi-volatile and pesticide analyses on sample SS-89-5-W, and for volatile, semi-volatile, boron and lithium analyses on sample MW-B-1S. Table E-2.8 summarizes the recovery and RPD data for the MS/MSD analyses.

Samples SS-89-2W and SS-W-DUP and MW-A-89 and MW-DUP were the surface water and groundwater field duplicate samples, respectively. Organic RSD precision results in the surface water duplicates were <.30 for all detected compounds which were not negated.

The following compounds were detected in MW-A-89 and not in MW-DUP benzene - 0.6J, toluene - 1J, and chlorobenzene 0.7J. The RSD for bis(2-ethylbexyl)phthalate was >0.30.

4.3.2 - Surface Water and Groundwater Inorganics

Sample holding times were within maximum limits for all metal analyses.

No rinse blanks were collected for the surface water samples since the samples were collected directly into sample bottles. Boron and lithium were detected in MW-RB at concentrations of 0.79 and 0.053 mg/L, respectively.

MS/MSD analysis for surface water was performed on all proposed metals except boron. The following metals have recoveries which fell outside the 75 - 125 percent QC limits in the matrix spike and/or the matrix spike duplicate: beryllium, selenium, and thallium. All precision RSDs were below the .30 QC maximum.

MS/MSD results for boron and lithium in the groundwater samples found both boron recoveries outside the 75-125 percent OC limits. All precision RSDs were below the 0.30 QC maximum.

All post digestion spike results were within QC limits.

Samples SS-89-2W and SS-W-DUP and MW-A-89 and MW-DUP were the surface water and groundwater field duplicate samples. All surface water metals RSD precision data were within QC guidelines, except for iron, lithium, and selenium. Silver was detected at .005 mg/kg in the original sample and not the duplicate. Beryllium was detected at .005 mg/kg in the duplicate and not the original sample.

All boron and lithium RSDs for the groundwater duplicates were < 0.30.

4.3.3 - Surface Water and Groundwater QA Summary

The presence and concentration of the following blank contaminants are questionable in samples associated with these blanks:

- Volatiles: methylene chloride, trichloroethene, 1,1,2,2-tetrachloroethane, vinyl chloride, trans-1,3-dichloropropene, tetrachloroethene, and chlorobenzene;

- Semi-volatiles: bis(2-ethylhexyl)phthalate

Beryllium, selenium, and thallium concentrations are somewhat questionable due to MS/MSD recoveries outside the 75 - 125 percent QC range.

5 - DATA VALIDATION RESULTS

Validated analytical results with negated data and qualifier are presented in Tables E-2.15 through E-2.19. The evolution of the analytical results and assessed site contamination is provided in Sections 4, 5 and 6 of the main text.

TABLE E-2.1

SUMMARY OF RINSE AND TRIP BLANK ANALYSES

Parameter	A-TB	B-TB	AB-TB	TB-1	MW-TB	A-RB	B-RB	AB-RB	SS-RB	MW-RB
Volatiles (ug/l)										
Vinyl chloride	-	-	-	0.8 J	-	NA	NA	NA	NA	NA
Methylene Chloride	42	44	46 B	33	31	NA	NA	NA	NA	NA
Trichloroethene	-	0.8 J	-	0.8 J	-	NA	NA	NA	NA	NA
Tetrachloroethene	-	0.6 J	-	2 J	-	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	-	-	-	0.7 J	-	NA	NA	NA	NA	NA
Chlorobenzene	-	-	-	0.5 J	-	NA	NA	NA	NA	NA
Semi-Volatiles (ug/l)										
Phenol	NA	NA	NA	NA	NA	-	1 J	-	-	-
bis (2-ethylhexyl) phthalate	NA	NA	NA	NA	NA	-	-	N	38 B	-
Inorganics (mg/l)										
Barium	NA	NA	NA	NA	NA	NA	NA	NA	0.20	NA
Boron	NA	NA	NA	NA	NA	NA	NA	0.34	-	0.13
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	0.009	NA
Lithium	NA	NA	NA	NA	NA	NA	NA	NA	-	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	0.07 B	0.01
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	0.0038 B	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	0.024	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	0.032	NA

TABLE E-2.2
RINSE BLANKS, TRIP BLANKS AND ASSOCIATED SAMPLES

Rinse Blanks

A-RB	B-RB	AB-RB	SS-RB	MW-RB
BB-9-12-14	BB-4-6-8	AB-DUP	SS-89-1S	MW-A-89
BB-9-12-14MS	BB-4-6-8MS	B3-12-14	SS-89-2S	MW-B-1-S
BB-9-12-14MSD	BB-4-6-8MSD	B3-12-14DL	SS-89-3S	MW-DUP
AB-13-12-14	BB-5-4-6	B3-12-14DLRE	SS-89-4S	
AB-13-12-14DL		B4-10-12	SS-89-5S	MW-B-1-SMS
AB-14-68		B5-10-12	SS-89-5SRE	MW-B-1-SMSD
AB-14-8-10		SB3-89-4-6	SS-S-DUP	
A-DUP		SB3-89-4-6RE	SS-89-4SMS	
		B5-10-12MS	SS-89-4SMSD	
		B5-1 12MSD		

Trip Blanks

A-TB	B-TB	AB-TB	TB-1	MW-TB
BB-9-12-14	BB-4-6-8	AB-DUP	SS-89-1S	MW-A-89
BB-9-12-14MS	BB-4-6-8MS	B3-12-14	SS-89-2S	MW-B-1S
BB-9-12-14MSD	BB-4-6-8MSD	B3-12-14DL	SS-89-3S	MW-DUP
AB-13-12-14	BB-5-4-6	B3-12-14DLRE	SS-89-4S	
AB-13-12-14DL		B4-10-12	SS-89-5S	MW-B-1SMS
AB-14-5-8		SB3-89-4-6RE	SS-89-4SMSD	MW-B-1SMSD
AB-14-8-10		SB3-89-4-6	SS-S-DUP	
A-DUP		SB3-89-4-6RE	SS-89-4SMS	
		B5-10-12MS	SS-89-4SMSD	
		B5-10-12MSD	PT-89-1	
			SS-89-2W	
			SS-89-3W	
			SS-89-4W	
			SS-89-5W	
			SS-W-DUP	
			SW-89-1	
			SS-89-5WMS	
			SS-89-5WMSD	
			SS-89-1W	
			SS-89-3WRE	

TABLE E-2.3
SUMMARY OF SOIL METHOD BLANK ANALYSES
VOLATILE ORGANICS (ug/l)

Parameter	VBLK 10 11/22	VBLK 15 12/05	VLK 76 11/21	VBLK 78 11/28	VBLK 82 12/04	VBLK 89 12/11	VBLK 90 12/12	VBLK 91 12/12	VBLK 98 12/18	VBLK 99 12/18
Methylene Chloride	4 J	-	8	-	2 J	2 J	-	-	3 J	450 J*
Dibromochloromethane	-	-	0.8 J	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	2 J	-	-	-	-	-	-	-
Bromoform	-	-	2 J	-	-	-	-	-	-	-
Tetrachloroethene	0.9 J	-	-	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	-	-	4 J	-	-	-	-	-	-	-

* This blank was run for samples with medium levels of contamination.

TABLE E-2.4
SUMMARY OF SOIL METHOD BLANK ANALYSES
SEMI-VOLATILE ORGANICS (ug/l)

Parameter	SBLK 45 12/04	SBLK 54 12/19	SBLK 84 11/21	SBLK 86 12/15	SBLK 94 12/16	SBLK 97 12/13
Diethylphthalate	-	-	28 J	-	-	-
Di-n-butylphthalate	540	600	420 J	380 J	240 J	440 J
bis (2-ethylhexyl) phthalate	1100	86 J	250 J	-	65 J	68 J

TABLE E-2.5

SUMMARY OF WATER METHOD BLANK ANALYSES

PARAMETER	VBLK06 1/08/90	VBLK 28 1/20/89	VBLK 62 11/21/89	VBLK 72 12/06/89	VBLK 75 12/11/89	VBLK 81 12/18/89	SBLK04 1/08/90	SBLK 47 12/12/89	SBLK 49 12/16/89	SBLK 74 11/20/89	SBLK 95 12/11/89
Volatile Organics (ug/l)											
Methylene Chloride	--	--	--	5	--	--	NA	NA	NA	NA	NA
Semi-Volatile Organics (ug/l)											
bis (2-ethylhexyl) phthalate	NA	NA	NA	NA	NA	NA	--	--	--	2 J	2 J

NA = Not Analyzed

TABLE E-2.6
METHOD BLANKS AND ASSOCIATED SOIL SAMPLES

Volatile Organic Method Blanks

VBLK 10 11/22/89	VBLK 15 12/15/89	VBLK 76 11/21/89	VBLK 78 11/28/89	VBLK 82 12/04/89
ACB-14-16	AB-DUP	SS-89-1S	AB-2-6-8	AB-4-12-14
ACB-2-4	B3-12-14	SS-89-2S	AB-2-6-8DL	AB-9-6-8
	B3-12-14DL	SS-89-3S	AB-2-6-8MSDDL	B1-8-10
	B3-12-14DLRE	SS-89-4S	AB-2-6-8MSDL	B2-6-8
	B4-10-12	SS-89-5S		
	B5-10-12	SS-89-5SRE		
	SB3-89-4-6	SS-S-DUP		
	SB3-89-4-6RE	SS-89-4SMS		
	B5-10-12MS	SS-89-4SMSD		
	B5-10-12MSD			

VBLK 89 12/11/89	VBLK 90 12/12/89	VBLK 91 12/12/89	VBLK 98 12/18/89	VBLK 99 12/18/89
BB-1-10-12	BB-4-6-8	BB-7-10-12	AB-13-12-14	BB-9-12-14
BB-1-12-14	BB-4-6-8MS	B-DUP	AB-13-12-14DL	BB-9-12-14MS
BB-2-10-12	BB-4-6-8MSD		AB-14-6-8	BB-9-12-14MSD
BB-2-6-8			AB-14-8-10	
BB-3-8-10			A-DUP	
BB-5-4-6				

Semi-Volatile Organic Method Blanks

SBLK 45 12/04/89	SBLK 54 12/19/89	SBLK 84 11/21/89	SBLK 86 12/15/89	SBLK 94 12/06/89	SBLK 97 12/13/89
ACB-14-16	AB-13-12-14	SS-89-2S	BB-7-10-12	SS-89-1S	BB-10-12
ACB-2-4	AB-14-16-8	SS-89-3S	B-DUP	SS-89-4S	BB-1-12-14
	AB-14-8-10	SS-89-5S		AB-DUP	BB-1-12-14
	BB-9-12-14	SS-89-5SRE		B4-10-12	BB-2-10-12
	A-DUP	SS-S-DUP		B5-10-12	BB-2-6-8
		SS-89-4SMS		SB-3-89-4-6	BB-3-6-8
		SS-89-4SMSD		B5-10-12MS	BB-3-8-10
				B5-10-12MSD	BB-4-6-8
				AB-2-6-8	BB-5-4-6
				AB-2-6-8MS	BB-4-6-8MS
				AB-2-6-8MSD	BB-4-6-8-MSD
				AB-9-6-8	
				B1-8-10	
				B2-6-8	
				AB-4-12-14	

TABLE E-2.6 - 2

Pesticide/PCB Method Blanks

SOIL METHOD BLANK 11/23/89
SS-89-1S
SS-89-2S
SS-89-3S
SS-89-4S
SS-89-5S
SS-S-DUP

TABLE E-2.7
METHOD BLANKS AND ASSOCIATED WATER SAMPLES

Volatile Organic Method Blanks

VBLK 06 1/8/90	VBLK 28 11/20/89	VBLK 62 11/21/89	VBLK 72 12/06/89	VBLK 75 12/11/89	VBLK 81 12/18/89
MW-A-89	PT-89-1	SS-89-1W	AB-TB	B-TB	A-RB
MW-B-1S	SS-89-2W	SS-89-3WRE			A-TB
MW-DUP	SS-89-3W				
MW-TB	SS-89-4W				
MW-B-1SMS	SS-89-5W				
MW-B-1SMD	SS-W-DUP				
	SW-89-1				
	TB-1				
	SS-89-5WMS				
	SS-89-5WMSD				

Semi-Volatile Organic Method Blanks

SBLK 04 1/8/90	SBLK 47 12/12/89	SBLK 49 12/16/89	SBLK 74 11/20/89	SBLK 95 12/11/89
MW-A-89	B-RB	A-RB	PT-89-1	AB-RB
MW-B-1S			SS-89-1W	
MW-DUP			SS-89-2W	
MW-RB			SS-89-3W	
MW-B-1SMS			SS-89-4W	
MW-B-1SMSD			SS-89-5W	
			SS-RB-89	
			SS-W-DUP	
			SW-89-1	
			SS-89-5WMS	
			SS-89-5WMSD	

Pesticide/PCB Method Blanks

Water Method Blank 11/22/89	
SS-89-1W	SS-W-DUP
SS-89-2W	SS-RB
SS-89-3W	TB-1
SS-89-4W	PT-89-1
SS-89-5W	SW-89-1

TABLE E-2.8

SUMMARY OF MS/MSD DATA

Sample No.	Fraction	Recoveries Out of QC Limit	RSDs out of QC Limit
Subsurface Soil			
AB-2-6-8	VOA	0 of 10	0 of 5
	BNA	3 of 22	0 of 11
	Li&B	2 of 4	0 of 2
BB-4-6-8	VOA	0 of 10	0 of 5
	BNA	6 of 22	0 of 11
	Li&B	1 of 4	0 of 2
B-5-10-12	VOA	0 of 10	0 of 5
	BNA	4 of 22	1 of 11
	Li&B	1 of 4	0 of 2
BB-9-12-14*	VOA	0 of 10	0 of 5
Surface Sediment			
SS-89-4-S	VOA	0 of 10	0 of 5
	BNA	1 of 22	0 of 11
	PCB	0 of 4	0 of 2
	Metals	10 of 26	0 of 13
Surface Water			
SS-89-5-W	VOA	0 of 10	0 of 5
	BNA	3 of 22	0 of 11
	Pest	0 of 12	0 of 6
	Metals	4 of 32	0 of 16
Ground Water			
MW-B-1S	VOA	0 of 10	0 of 5
	BNA	2 of 22	1 of 11
	Li&B	2 of 4	0 of 2

*Sample analyzed for medium concentrations of VOAs

TABLE E-2.9

SURROGATE RECOVERY

Volatile Surrogate Recovery

Compound	QC Limits Soil	QC Limits Water
Toluene-d8	81-117	88-110
Bromofluorobenzene	74-121	86-115
1,2-Dichloroethane-d4	70-121	76-114

Semi-Volatile Surrogate Recovery

Compound	QC Limits Soil	QC Limits Water
Nitrobenzene-d5	35-114	23-120
2-Fluorobiphenyl	43-116	30-115
Terphenyl	33-141	18-137
Phenol-d5	10-94	24-113
2-Fluorophenol	21-100	25-121
2,4,6-Tribromophenol	10-123	19-122

TABLE E-2.10

SAMPLE CONTAINERS, PRESERVATIONS, HOLDING TIMES

TYPE	CONTAINER	PRESERVATION	HOLDING TIME
SOIL:			
Volatiles	Glass, 1-2 ml VOA Vials	Cool to 43C	14 Days
Semi-Volatiles	Glass, 8-oz. Bottle	Cool to 43C	Ext 7/Anl 40 Days
Pesticides/PCBs	Same Bottle Above	Cool to 43C	Ext 7/Anl 40 Days
Mercury	Same Bottle Above	Cool to 43C	28 Days
All Other Metals	Same Bottle Above	Cool to 43C	6 Months
WATER:			
Volatiles	Glass, 2-40 ml VOA Vials	Cool to 43C	14 Days
Semi-Volatiles	Glass, 4-1L Bottle, AMBER	Cool to 43C	Ext 7/Anl 40 Days
Pesticides/PCBs	Glass, 1-L Bottle, AMBER	Cool to 43C	Ext 7/Anl 40 Days
Metals:			
Total Recoverable	Plastic, 1-L Bottle	pH<2 with HNO_3	6 Months
Dissolved	Plastic, 1-L Bottle	Filter 0.45 u pH<2 with HNO_3	
Mercury	Same as Above		28 Days
WASTE/RESIDUE:			
USATHAMA (Water)	Glass 2-1l Bottle, AMBER		ASAP
USATHAMA (Soil)	Glass, 8-oz. Bottle		ASAP
Nitrates	Glass, 8-oz. Bottle		28 Days
Sulfates	Same Bottle Above		28 Days
DRUM WATER: (In addition to soil parameters listed below)			
Ignitability	Glass 8-oz. Bottle	None	N/A
Corrosivity	Same Bottle Above	None	N/A
Reactivity	Same Bottle Above	None	N/A
EP Toxicity (Metals & Organics)	Same Bottle Above	None	N/A
Paint Filter Test	Same Bottle Above	None	N/A

TABLE E-2.11

VOLATILE ORGANIC ANALYSIS
TARGET COMPOUND LIST (TCL)
SW-846 3RD ED. METHOD 8240

Compound
Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene (total)
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
trans-1,3-dichloropropene
Bromoform
4-Methyl-2-Pentanone
2-Hexanone
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Total Xylenes

TABLE E-2.12

SEMI-VOLATILE ORGANIC ANALYSIS
TARGET COMPOUND LIST (TCL)
SW-846 3RD ED. METHOD 8270

Compound

Phenol
bis (2-Chloroethyl)Ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl)Ether
4-Methylphenol
N-Nitroso-Di-n-Propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic Acid
bis(2-Chloroethoxy)Methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-Methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethyl Phthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl-phenylether
Fluorene

TABLE E-2.12

SEMI-VOLATILE ORGANIC ANALYSIS
TARGET COMPOUND LIST (TCL)
SW-846 3RD ED. METHOD 8270
(Cont'd)

Compound
4-Nitroaniline
4,6-Dinitro-2-Methylphenol
N-Nitrosodiphenylamine (1)
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-n-Butylphthalate
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)Anthracene
Chrysene
Bis(2-Ethylhexyl)Phthalate
Di-n-Octyl Phthalate
Benzo(b)Fluoranthene
Benzo(k)Fluoranthene
Benzo(a)Pyrene
Indeno(1,2,3-cd)Pyrene
Dibenz(a,h)Anthracene
Benzo(g,h,i)Perylene

TABLE E-2.13

PESTICIDES/PCBs ANALYSIS
TARGET COMPOUND LIST (TCL)
SW-846 3RD ED. METHOD 8080

Compound
Aldrin
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC
Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Heptachlor
Heptachlor expoxide
Toxaphene
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Endrin ketone
Methoxychlor

TABLE E-2.14

METALS ANALYSIS

Parameter	SW-846 Method Number
Total Arsenic	7061
Total Barium	7080
Total Beryllium	7090
Total Boron	6010
Total Cadmium	7130
Total Chromium	7190
Total Copper	7210
Total Iron	7380
Total Lead	7421
Total Lithium	303A*
Total Mercury	7470
Total Nickel	7520
Total Potassium	7610
Total Selenium	7741
Total Silver	7760
Total Thallium	7841
Total Zinc	7950

*Standard Methods for the Examination of Water and Wastewater, 16th Edition.

TABLE E-2.15

SUMMARY OF ORGANIC AND INORGANIC ANALYSES WITH NEGATED DATA

AREA A - SUBSURFACE SOIL SAMPLES

CHEMICAL PARAMETERS	ACB-1* 2-4'	ACB-1* 14-16'	AB-2* 6-8'	AB-4 12-14'	AB-9 6-8'	AB-13 12-14'	AB-14 6-8'	AB-14 6-8 (Dup)	AB-14 8-10'
Volatile Organics (ug/kg)									
Methylene Chloride	N	N	6 DJ	N	14 BDJ	N	-	-	-
Acetone	28	-	330 D	49	610 D	350 D	40	130	-
Tetrachloroethene	N	N	-	-	-	-	-	-	-
Toluene	1 J	-	-	-	11 DJ	-	-	-	-
TOTAL	29	-	336	49	635	350	40	130	-
Semi-Volatile Organics (ug/kg)									
Phenol	-	-	-	-	-	-	-	-	86 J
4-Chloroaniline	150 J	-	-	-	-	-	-	-	-
2-Methylnaphthalene	38 J	-	-	-	-	-	-	-	-
Di-n-butylphthalate	4400 B	N	N	N	750 BJ	N	2500 B	N	N
bis(2-Ethylhexyl)Phathalate	N	N	N	N	N	N	N	N	N
TOTAL	4588	-	-	-	750	-	2500	-	86
TOTAL ORGANICS	4617	-	336	49	1385	350	2540	130	86
Inorganics (mg/kg)									
Boron	<5.8	70.0	<5.5	63.7	86.8	<5.5	8.4	14.0	6.4
Lithium	35.7	32.7	27.4	49.1	107	27.2	37.5	42.0	36.4

NOTES:

1) Quantities listed indicate detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantification Limit (CRQL).
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instrument for that specific analysis.
6) < indicates that the compound was not detected at the Contract Required Detection Limit (CRDL).
7) D indicates compound analyzed at secondary dilution factor.
8) *The holding times of seven days as required by the COE was exceeded for semi-volatile organics in these samples. However, these samples were extracted within 14 days as specified in SW-846 3rd Edition.
9) **Indicates negated data due to the presence of the compound in the method blank (M) or trip blank (T).

TABLE E-2.16
SUMMARY OF ORGANIC AND INORGANIC ANAL
AREA B - SUBSURFACE SOIL

CHEMICAL PARAMETERS	BB-1* 10-12'	BB-1* 12-14'	BB-2* 6-8'	BB-2* 10-12'	BB-3* 6-8'	BB-3* 8-10'	BB 6-
Volatile Organics (ug/kg)							
Methylene Chloride	N	N	-	N	-	8 B	
Acetone	69	-	-	-	-	-	
Carbon Disulfide	26	-	-	-	-	-	
Chloroform	35	-	-	-	-	-	
Carbon Tetrachloride	-	-	-	-	-	-	
Benzene	3 J	-	-	-	-	-	
Tetrachloroethene	-	-	-	-	-	-	-
TOTAL	133	-	-	-	-	8	
Semi-Volatile Organics (ug/kg)							
Hexachloroethane	-	-	-	-	-	-	
Benzoic Acid	90 J	-	39 J	-	-	-	
Napthalene	-	-	-	-	-	-	
2-Methylnapthalene	-	-	-	-	-	-	
Phenanthrene	-	-	-	-	-	-	
DI-n-Butylphthalate	-	N	2500 B	N	N	N	
bis-(2-Ethylhexyl) Phthalate	-	N	290 BJ	450 BJ	420 BJ	450 BJ	-
TOTAL	90	-	2829	450	420	450	
TOTAL ORGANICS	223	-	2829	450	420	458	
Inorganics (mg/kg)							
Boron	84.9	32.0	18.5	15.9	26.1	53.8	23.
Lithium	33.1	32.9	30.5	28.3	56.3	53.6	39.

NOTES:

1) Quantities listed indicate detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantitation Lin
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/MS instru
6) N/A indicates compound not analyzed for.
7) ** indicates negated data due to the presence of the compound in the method blank (M) or tr

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SUMMARY OF ORGANIC AND INC
AREA BETWEEN A & E

CHEMICAL PARAMETERS	B-1 4-6'	B-1 8-10'	B-1 12-14'	B-2 0-2'	B-2 4-6'	B-2 6-8'
Volatile Organics (ug/kg)						
Methylene Chloride	N/A	17 B	N/A	N/A	N/A	N
Acetone	N/A	130	N/A	N/A	N/A	-
Chloroform	N/A	-	N/A	N/A	N/A	-
Carbon Tetrachloride	N/A	-	N/A	N/A	N/A	-
Tetrachloroethene	N/A	-	N/A	N/A	N/A	-
Toluene	N/A	2 J	N/A	N/A	N/A	-
TOTAL	-	149	-	-	-	-
Semi-Volatile Organics (ug/kg)						
Di-n-Butylphthalate	N/A	N	N/A	N/A	N/A	420 BJ
bis-(2-Ethylhexyl) Phthalate	N/A	N	N/A	N/A	N/A	260 BJ
TOTAL	-	-	-	-	-	660
TOTAL ORGANICS	-	149	-	-	-	660
Inorganics (mg/kg)						
Boron	17.0	19.3	4.8	21.8	61.4	14.7
Lithium	30.9	30.1	22.7	33.7	28.7	30.9

NOTES:

1) Quantities listed indicate detectable concentrations.
2) No data entry indicates no detectable concentration.
3) J indicates that the detected concentration is below the Contract Required Quantita
4) B indicates the presence of the compound in the method blank.
5) E identifies compounds whose concentrations exceed the calibrated range of the GC/M
6) < indicates the compound not detected at the Contract Required Detection Limits (CR
7) N/A indicates compound not analyzed for.
8) ** indicates negated data due to the presence of the compound in the method blank (

TABLE E-2.18

SUMMARY OF ORGANIC AND INORGANIC ANALYSES WITH NEGATED DATA

AREA A & B DRAINAGE DITCH SYSTEM SEDIMENT SAMPLES

CHEMICAL PARAMETERS	SS-89-1S	SS-89-2S	SS-89-2S (Dup)	SS-89-3S	SS-89-4S	SS-89-5S
Volatile Organics (ug/kg)						
Methylene Chloride	N	N	N	N	N	N
Acetone	130	150	81	190	80	150
Semi-Volatile Organics (ug/kg)						
Di-n-butylphthalate	N	N	N	N	23000B	N
bis-(2-Ethylhexyl)Phathalate	N	N	N	N	-	N
Pesticides/PCBs (ug/kg)						
Aroclor - 1248	-	240	-	-	-	-
Aroclor - 1260	≤1400	700	≤1400	3400	1500	≤1500
Inorganics (mg/kg)						
Arsenic	13.3	9.3	10.0	9.7	13.0	11.4
Barium	186	102	131	291	252	133
Beryllium	0.88	1.5	1.5	1.1	1.5	1.8
Boron	<88	73.1	<82.7	121	254	430
Cadmium	3.7	2.5	3.5	6.1	5.8	2.5
Chromium	50.8	23.2	24.8	59.6	76.2	66.1
Copper	65.4	40.8	45.6	97.4	77.7	58.7