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Fuss & O'Neill Inc. *Consulting Engineers*

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Remedial Investigation/Feasibility Study

Remedial Investigation Report

Linemaster Switch Corporation
Woodstock, Connecticut

VOLUME I of V
TEXT

August 1992

Prepared for:

Linemaster Switch Corporation
Woodstock, Connecticut

Prepared by:

Fuss & O'Neill, Inc.
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#86-88

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REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT

VOLUME I OF V
TEXT

AUGUST 1992
REVISED DECEMBER 1992

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REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT

VOLUME I OF V
TEXT

PREPARED BY
FUSS & O'NEILL, INC.
MANCHESTER, CONNECTICUT

AUGUST 1992
REVISION 1.0 DECEMBER 1, 1992

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REMEDIAL INVESTIGATION
EXECUTIVE SUMMARY

Linemaster Switch Corporation is located in the small, rural community of Woodstock, Connecticut. The site is located on a 45 acre parcel of woodlands and grass fields. The Linemaster manufacturing facility is located on a central topographic high within the site. The site is surrounded by residences with the majority located to the northeast, east, and southeast. Potable water in the study area is primarily obtained from individual bedrock and overburden wells.

The site was identified as an environmental concern due to the detection of solvents, primarily trichloroethene (TCE), in on-site and off-site water-supply wells in 1986. Other solvents detected in on-site water-supply wells included 1,2-dichloroethene, toluene, and xylenes. Preliminary investigations of the site conducted by Linemaster, the Environmental Protection Agency (EPA), and the Connecticut Department of Environmental Protection (DEP) located four potential contaminant source areas: the area of the former dry well and former paint settling booth located east of the facility (Zone 1); the former facility wastewater disposal system (Zone 2); the former Blakely residence leaching field (Zone 3); and, the paint shed area (Zone 4).

The Zone 1 area east of the facility was considered the primary potential source area because it contained a dry well that reportedly was used for disposal of waste solvents from 1969 to 1979. The facility wastewater disposal system was considered a potential source area because water obtained from a contaminated

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production well was discharged into the system. Similarly, water obtained from the Blakely water-supply well was contaminated and was discharged into the residence's leaching field. Because the paint shed was used to store solvents and other manufacturing chemicals, this area was also considered a potential source area.

Pursuant to Section 105(8)(b) of CERCLA, 42 U.S.C. § 9605(8)(b), the site was proposed for inclusion on the National Priorities List (NPL) published by the Administrator of EPA in the Federal Register on June 24, 1988 (NPL update #7, 53 FR 23988). The site was listed on the NPL on February 21, 1990 (NPL final rule update #8, 55 FR 6154).

Environmental investigations have been conducted at the site since 1986. This report summarizes the results of the investigations conducted prior to the placement of the site on the NPL and investigations conducted since 1990 during Phase 1A and 1B investigations of the Remedial Investigation/Feasibility Study (RI/FS).

Results of Phase 1A, 1B, and prior investigations of VOCs in soils within suspected contaminant source areas at the study area indicate the following:

<u>Zone 1 (Former Dry Well, Former Paint Settling Booth, and Area East of Facility)</u>

- Zone 1 is the primary source area of volatile organic compounds (VOCs) at the site;

- Elevated levels of residual VOCs, predominantly TCE, were found in the soil at Zone 1; and,

- The low hydraulic conductivity of the soil has caused a substantial portion of the VOCs to remain in the ground water and soil in Zone 1.

Zone 2 (Former Facility Wastewater Disposal System)

- Zone 2 was not found to be a significant VOC source area;
- VOCs found in Zone 2 appear to have originated from Zone 1; and,
- No significant VOC contamination remains from former facility wastewater discharges.

Zone 3 (Former Blakely Leaching Field)

- Zone 3 was not found to be a significant VOC source area.

Zone 4 (Paint Shed Area)

- Zone 4 was not found to be a separate VOC source area; and,
- VOCs found at Zone 4 appear to have originated from Zone 1.

Results of Phase 1A, 1B, and prior investigations of the hydrogeology at the study area indicate the following:

- The geology of the site consists of glacial till deposits overlying fractured schist bedrock with granite pegmatite intrusions;

- Ground water exists in three hydraulically distinct units in the study area: till; shallow bedrock; and, deep bedrock; and,

- Horizontal ground-water flow velocities are lowest in the till (0.0004 ft/day to 0.24 ft/day) due to its low hydraulic conductivity, compaction, and composition;

- Horizontal ground-water flow velocities are higher in the shallow bedrock (0.002 ft/day to 0.421 ft/day) than in the till because the shallow bedrock has higher hydraulic conductivity;

- Horizontal ground-water flow velocities are highest in the deep bedrock (0.04 ft/day to 11.08 ft/day);

- Ground water flows approximately radially outward in till and shallow bedrock units from the central topographic high where the facility is located;

- Ground-water flow in the deep bedrock is partially radial. Preferential flow within the deep bedrock appears to be the result of fracture orientation and water-supply well pumping; and,

- Ground water migrates vertically downward from the till unit to the bedrock in the central area of the site. Generally, ground water migrates vertically upward from the bedrock to the till unit at the study area boundaries.

Results of Phase 1A, 1B, and prior investigations of VOC occurrence in ground water at the study area indicate the following:

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- VOCs are present at highest concentrations in till, shallow bedrock, and deep bedrock monitoring wells located close to or in the Zone 1 source area;

- The VOC found the most frequently and at the highest concentration in ground water is TCE;

- VOCs are primarily migrating to the east-northeast in the till, shallow bedrock, and deep bedrock;

- VOCs migrate vertically from the Zone 1 source area till into the bedrock; and,

- VOCs have migrated off site to the north, northeast, east, and southeast.

Results of Phase 1A, 1B, and prior investigations of VOC occurrence in surface water and sediment indicate the following:

- The presence of VOCs in two study area ponds is believed due to diversion of, or recharge by, contaminated ground water; and,

- Low concentrations of VOCs are present in sediments in one study area pond and the northwest wetlands. The presence of VOCs in the sediments is believed to be due to diversion of, or recharge by, contaminated ground water.

Results of Phase 1A and 1B investigations of acid/base/neutral extractables occurrence in soil and ground water at the study area indicate the following:

- Acid/base/neutral extractables are believed to be related to laboratory contamination; and,

- Data validation of acid/base/neutral extractable results indicates laboratory blank contamination.

Results of Phase 1A and 1B investigations of metal occurrence in soil and ground water at the study area indicate the following:

- In the study area, metals occur naturally in the bedrock and in the soils (till) glacially derived from the bedrock;

- Although the concentrations of arsenic, beryllium, cadmium, and nickel are elevated with respect to background ground-water concentrations, the occurrence of these metals is most likely due to natural geologic processes rather than historical site activities; and

- The distribution of metal concentrations in study area soils does not indicate the presence of significant metals source areas.

The results of the Interim Water-Supply Well Monitoring Program conducted since 1986 indicate the following:

- TCE was detected at concentrations above 5 ug/l during more than one sampling event at four currently active off-site water-supply wells;

- TCE concentrations less than 5 ug/l have been detected during more than one sampling event at five locations;

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- Single unconfirmed detections of TCE occurred at three locations; and,

- TCE was not detected above 5 ug/l at any active, off-site, water-supply well during 1992 sampling.

Results of the air quality assessment indicate the following:

- Annual average air concentrations of TCE are not expected to exceed 1.31 ug/m^3;

- The total impact on the air pathway of exposure is minimal when compared with typical ambient levels of concern. The maximum concentration modeled corresponds to an eight-hour average concentration of 43.3 ug/m^3, which is well below the Connecticut Hazard Limiting Value of 1,350 ug/m^3; and,

- The majority of TCE contributed to the air originates from the remedial activities currently taking place at the site. Only a small fraction of TCE in the air emanates from the Zone 1 VOC source area.

The results of the ecological assessment indicate the following:

- The Linemaster site consists of typical assemblages of plant and animal habitats for this rural/suburban region of northeastern Connecticut; and,

- No visible signs of ecological degradation on the site by TCE contamination are apparent in either the uplands, which dominate the property, or in the fringing wetlands.

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The results of the transport and fate assessment indicate the following:

- Ground-water advection is considered the primary mode of contaminant migration;

- Contaminant migration by surface water is of minor importance;

- Atmospheric migration is not considered a significant transport route;

- A number of natural processes affect the persistence and the fate of VOCs in the environment. These processes include biotransformation/biodegradation, bioaccumulation, hydrolysis, photolysis/oxidation, sorption, and volatilization;

- Biodegradation, which has been occurring at the site, has been identified to be the most important transformation process in natural water and soil systems. The primary biodegradation product of TCE is dichloroethene; other by-products include dichloroethane, vinyl chloride, and chloroethane;

- Biotransformation/biodegradation is likely not important at the Linemaster Switch site in the soils and shallow ground water, because significant numbers of microbes probably do not exist, and proper nutrients are likely not available;

- Sorption is not an important fate for contaminants at the site. Preliminary pilot testing indicates that TCE may be dissolved in the ground water rather than sorbed onto the soil;

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- Volatilization is considered to be insignificant on a site-wide basis due to the low air permeability of the unsaturated till materials.

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I Background Water-Level Study

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REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

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1.0 INTRODUCTION

1.1 Purpose of Report

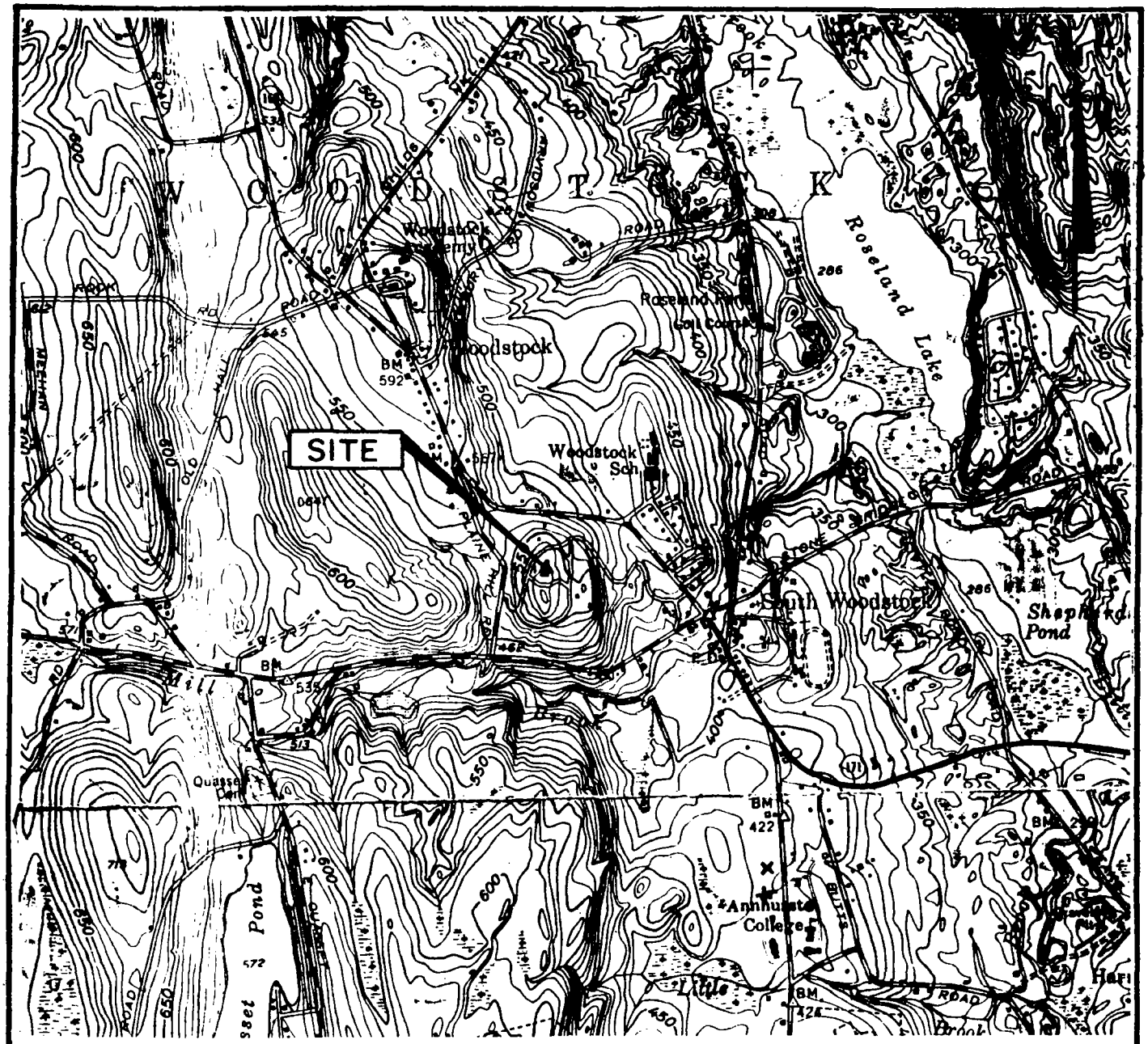
This report is the Remedial Investigation Report which is a Phase 1B Deliverable in Attachment A, the Statement of Work (SOW), of the U.S. Environmental Protection Agency (EPA) Administrative Order by Consent Docket No. I-91-1104, authorized October 7, 1991 and provided in Appendix A. This report is part of the on-going Remedial Investigation/Feasibility Study (RI/FS) being conducted at Linemaster Switch Corporation in Woodstock, Connecticut and was generated using data gathered from both pre-RI/FS and RI/FS studies. The analyses and interpretations were based on the currently available data. The purpose of this report is to address the requirements of the Remedial Investigation Report as identified in the Administrative Order by Consent.

Pursuant to Section 105(8)(b) of CERCLA, 42 U.S.C. § 9605(8)(b), the site was proposed for inclusion on the National Priorities List (NPL) published by the Administrator of EPA in the Federal Register on June 24, 1988 (NPL update #7, 53 FR 23988). The site was listed on the NPL on February 21, 1990 (NPL final rule update #8, 55 FR 6154).

1.2 Site Description

Linemaster Switch Corporation is located on Plaine Hill Road in Woodstock, Connecticut. A site location map is provided as Figure 1-1.

Woodstock is a small, rural community located in the northeastern corner of the State. Linemaster Switch is situated on a local topographic high and is bounded on the north and east by property owned by Nancy Blakely, on the west by Plaine Hill Road and on



MAP SOURCE :
UNITED STATES GEOLOGICAL SURVEY TOPOGRAPHICAL MAP, PUTNAM QUADRANGLE, CONNECTICUT, 7.5 MINUTE SERIES, 1955. PHOTOREVISED 1970.

FIGURE 1-1

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

SITE LOCATION
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.

PLAINE HILL ROAD WOODSTOCK, CT.

PROJ. NO. 86-88 DATE MAR. 1992 SCALE: 1" = 2000'

REV: 7/20/92

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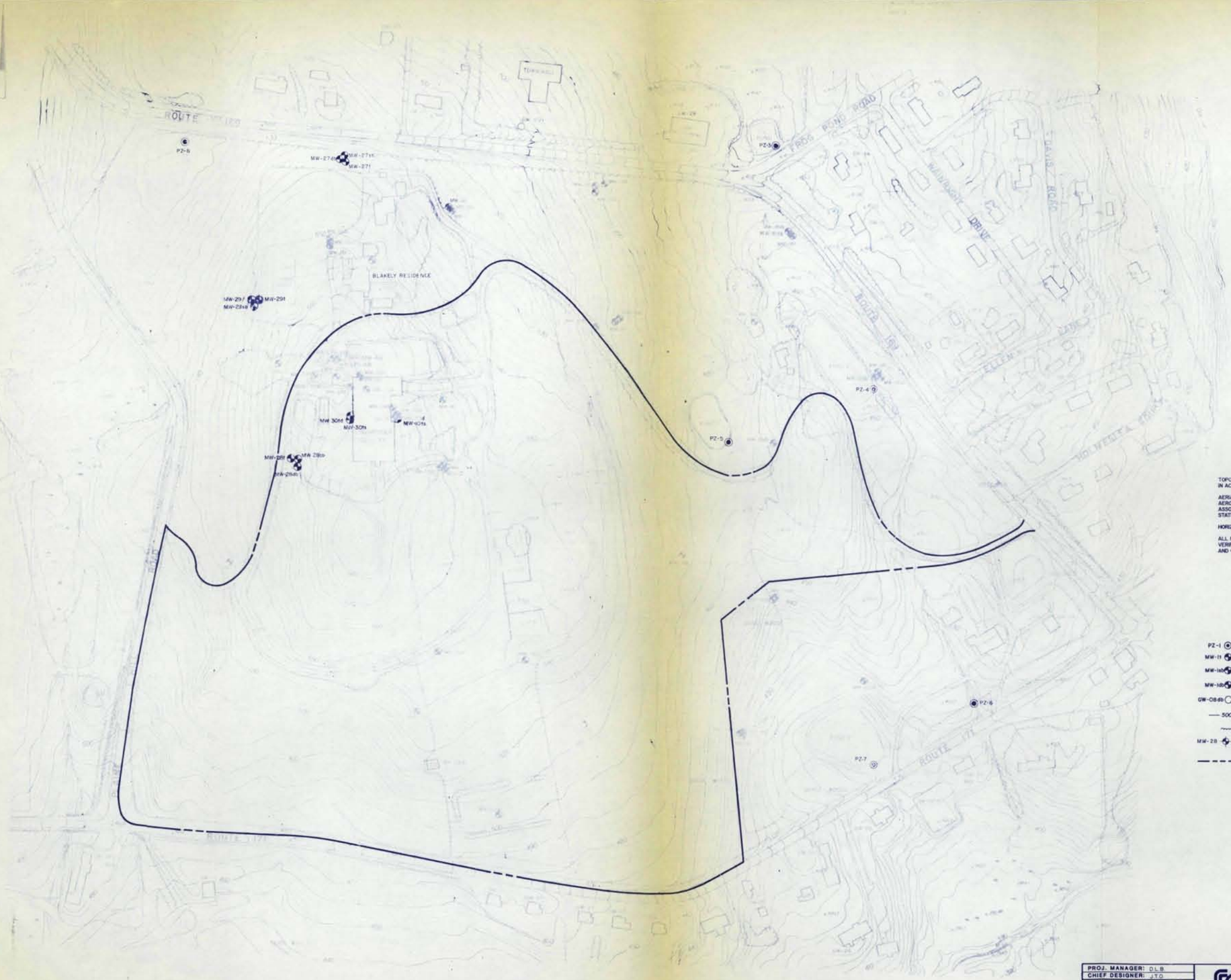
the south by State Route 171.

In this report, "site" refers to the Linemaster property; the term "study area" refers to the area surrounding the Linemaster property. The Linemaster property, consisting of approximately 45 acres, is moderate to extreme in relief. Figure 1-2 depicts the topographic and existing cultural features of the Linemaster site. Relief is most extreme near the center of the property adjacent to the facility and lessens toward the property boundaries.

The Linemaster property is covered by both grass fields and hardwood forest. Paved areas are located near the facility buildings. Exposures of bedrock are present across the site.

The Linemaster manufacturing facility is located near the center of the site as shown on Figure 1-2. Linemaster corporate offices are located southeast of the manufacturing facility in an early twentieth century structure built by previous owners of the Linemaster property. Directly west of the manufacturing facility is a paint shed used to store paints, thinners, solvents, and other chemicals used in the manufacturing processes and a garage used to store vehicles and large equipment. Located north of Linemaster is property owned by Nancy Blakely (owner of Linemaster), upon which are several buildings which are part of the residence. A summer cottage belonging to Nancy Blakely is present adjacent to the eastern boundary of the site, west of Pond 1. Two residences and a restaurant, located near the southeastern corner of the site, are also owned by Nancy Blakely.

Several ponds and one unnamed stream are located near the eastern boundary of the site as shown on Figure 1-2. The ponds are identified as Northeast Pond, Pond 1, Pond 2, and Pond 3.



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.74'.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-14b	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-14d	EXISTING DEEP BEDROCK MONITORING WELL
GW-08-89	EXISTING WATER SUPPLY WELL
500	TOPOGRAPHIC CONTOUR (ft.-msl)
	TREE LINE
MW-28	PROPOSED MONITORING WELL CLUSTER
	APPROXIMATE LOCATION OF LINEMASTER PROPERTY BOUNDARY

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTG		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ 2/21/92	△	△
△ 7-8-92	△	△
SCALE: HOR. IN. FT. / VER. IN. FT.		

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

STUDY AREA LOCATION MAP
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV., 1991		86-88 D	1-2

Diesel fuel and gasoline are currently stored at the site in three above-ground storage tanks with secondary containment. These tanks are contained in an open garage structure located northeast of the factory, and include: a 550 gallon diesel; a 550 gallon regular unleaded gasoline; and, a 550 gallon premium unleaded gasoline. Underground storage tanks had been used in the past; however, the tanks were removed in 1988 with the concurrence and participation of the Connecticut Department of Environmental Protection (DEP). Heating oil is stored at the site in a 3000 gallon above-ground storage tank located west of the garage. This tank has been registered with the DEP.

Currently, there are no municipal water or sewer utilities in the area; however, the Town plans to extend the sanitary sewer service to the Linemaster area. Linemaster obtains its water from one on-site production well designated as GW-08db. The water is treated by air-stripping and carbon filtration to remove volatile organic compounds (VOCs). Factory wastewater is temporarily stored in holding tanks and hauled to the Killingly publicly owned treatment works (POTW) because no suitable areas exist on the site for wastewater disposal. The Blakely residence also obtains water from GW-08db, but has its own leaching field for sanitary waste disposal. The two other on-site residences and the restaurant obtain water from GW-09db and have their own leaching fields. Three former water-supply wells, designated as GW-12db, GW-30ob, and GW-36db, are present on the Blakely property; however, these wells currently are not being used.

1.3 Objectives

The objectives of the Remedial Investigation were derived from those delineated for the Initial Site Characterization Report in the EPA Statement of Work (SOW) (Appendix A) for the Linemaster Switch site. The objectives as listed in the SOW are to

determine and/or address the following:

1. Characterize possible site-specific source areas, including but not limited to industrial waste disposal areas (including the dry well area and the area around the paint shed), leach fields, underground tanks, buried containers, and the surrounding areas potentially contaminated by the above-mentioned possible source areas (Section 4.0);

2. Determine the amount, concentration, toxicity, environmental fate, transport (e.g., bioaccumulation, persistence, mobility), phase (e.g., solid, liquid), and other significant characteristics of each hazardous substance present (Sections 3.0, 4.0, 5.0, and 7.0);

3. Identify waste mixtures, the media of occurrence, interface zones between media, and critical parameters for decontamination (e.g., soil chemistry, soil types, porosity) (Sections 3.0, 4.0, and 7.0);

4. Discuss hydrogeologic factors (e.g., depth to ground-water table, hydraulic gradients, hydraulic conductivity, proximity to residential wells, flood plains, and wetlands) (Sections 3.0, 4.0, and 6.0);

5. Evaluate the effect of climate and water-table fluctuation (e.g. precipitation, run-off, stream flow, water budget) (Sections 1.0 and 3.0);

6. Identify routes of exposure and receptors (Section 6.0 and EPA Risk Assessment);

7. Identify populations and environmental concerns, including biological communities and habitats on or potentially

affected by the site (Section 6.0 and EPA Risk Assessment);

8. Describe the extent to which the hazardous substances have migrated or are expected to migrate from their original location (Sections 3.0, 4.0, 5.0, and 7.0);

9. Assess the extent to which buildings, foundations, or other underground structures contain or overlie hazardous substances or contaminant plumes and the potential for decontaminating them (Sections 4.0 and Feasibility Study Report);

10. Evaluate contribution to the contamination of air, land, water, and the food chain (Sections 6.0, 7.0, and EPA Risk Assessment);

11. Identify surface-water classifications and existing use designations (Section 1.6.4);

12. Discuss ground-water characteristics and current and potential ground-water uses (e.g., characteristics related to the ground-water classes described in the Ground Water Protection Strategy, (U.S. EPA, 1984) and CT Water Quality Standards and Classifications, C.G.S. 22a-426) (Section 1.6.6);

13. Identify the extent to which contamination levels exceed health-based levels prompting a response action (Section 4.0 and EPA Risk Assessment);

14. Delineate the waste characteristics that affect the type of treatment possible (e.g., BTU values, pH, BOD) (Section 7.0);

15. Evaluate the extent to which substances at the site may be reused or recycled (Feasibility Study Report);

16. Identify the potential extent and risk of future releases of substances or residuals remaining on the site (EPA Risk Assessment);

17. Describe the physical characteristics of the site, including important surface features, soils, geology, hydrogeology, meteorology, and ecology (Sections 1.0, 3.0, and 6.0);

18. Evaluate the extent to which the source can be adequately identified and characterized (Sections 4.0 and 8.0); and,

19. Identify other factors, such as sensitive populations, that pertain to the characterization of the site or support the analysis of potential remedial action alternatives (EPA Risk Assessment).

1.4 History

Site history information was obtained through conversations with Linemaster personnel, file searches at the DEP, and review of information prepared by Linemaster, EPA, and NUS Corporation, an EPA subcontractor. Aerial photography analysis and information contained within an EPA prepared Site Analysis Report (U.S. EPA 1990) was reviewed to augment the site history.

Linemaster Switch Corporation began manufacturing foot-operated switches in the on-site carriage house at the site on May 1, 1952. The carriage house, built in 1904, initially was added to by Linemaster, but was later demolished as part of facility expansions. Additions to the Linemaster manufacturing facility were constructed in 1952, 1955, 1958, 1963-64, 1968, 1974, 1982,

1985, and 1989. Fill material is believed to underlie portions of the manufacturing facility. Prior to acquisition by Linemaster, the property changed ownership several times and was used for residential purposes, as well as for small-scale farming with areas of fields and orchards. Significant amounts of topsoil are believed to have been brought to the site to support past agricultural and horticultural activities.

As part of Linemaster manufacturing operations, paint thinner, trichloroethene (TCE), and other chemicals were used. Additionally, paint solid residue, tumbling waste, and other process waste (e.g. floor wash water from manufacturing areas) have also been generated by Linemaster Switch Corporation. A list of the chemicals from material safety data sheets that are known to have been used at Linemaster is provided in Table 1-1 (Murtha et al., 1988). Information was also obtained from a 1980 DEP inspection report (CT DEP, 1980). This report indicates that 1,1,1-trichloroethene [sic] was used. The spelling of this compound appears to be incorrect in the DEP report; the intended compound may be 1,1,1-trichloroethane. Paint thinner was acquired on an as needed basis, used, and disposed of (Murtha et al., 1988). Paint thinner use began in 1952 for a spray painting operation. The amount of paint thinner used and disposed of is unknown (Murtha et al., 1988). Use of TCE for a vapor degreasing operation began in 1969 (Murtha et al., 1988). The estimated amount of TCE used between 1969 and 1979 was approximately 100 to 600 gallons per year (Murtha, et al., 1988). Of this amount, approximately 20 to 200 gallons per year were disposed of (Murtha et al., 1988). Information suggests that TCE and paint thinner were released to a dry well located east of the facility. Reportedly, the release may have occurred during the time period from approximately 1969 through 1979 (Murtha et al., 1988). The exact amount of TCE and other waste material discharged to the dry well is unknown.

TABLE 1-1

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HISTORICAL CHEMICAL USE LIST

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT

December 1992

PRODUCT CLASS	NAME	INGREDIENTS	PERCENT
solvent	trichlor trichloroethene	trichloroethene	100
paint thinner	synthetic reducer	toluene	100
reducer	lacquer thinner	lt. aliphatic hydrocarbon solvent	20
		v.m. & p naphtha	15
		toluene	15
		xylene	5
		methanol	<5
		ethanol	5
		2-methyl-1-propanol	<5
		2-butoxyethanol	<5
		acetone	20
		methyl n-amyl ketone	<5
		isobutyl acetate	5
reducer	paint thinner v.m.& p. naphtha	v.m.& p. naphtha	100
paint, catalyst and thinner	pretreatment coating system	butyl alcohol	20
		isopropyl alcohol	58
	pretreatment coating compound	chromate pigment	22*
		isopropyl alcohol	100
	pretreatment thinner acid component compound	isopropyl alcohol	74
		butyl alcohol	19
		phosphoric acid	7
solvent	1,1,1-trichloroethane**	1,1,1-trichloroethane**	?

* Percent chromate pigment inferred, percent not specified on material safety data sheet.

** Mispelled as 1,1,1-trichloroethene in the DEP Inspection Report

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The DEP conducted a RCRA site inspection in 1980 (CT DEP, 1980). During this site visit, the DEP reported that dried paint solids, from a paint settling booth, were brought to the "town dump" or were buried on the site. The DEP conducted a preliminary assessment at the site in 1984 and reported that dried paint waste had possibly been buried on the site or taken to the Town landfill for approximately 20 to 30 years (CT DEP, 1984). Neither the 1980 nor the 1984 report indicated where the alleged on-site burial of paint waste occurred. The DEP performed a RCRA site inspection in 1985; however, no on-site disposal of paint solids was identified (CT DEP, 1985).

As a result of DEP investigations in 1980 and 1984, EPA and NUS Corporation, an EPA subcontractor, conducted site inspections at Linemaster on December 19, 1985, February 12, 1986, and June 24, 1986 (NUS, 1987). During these inspections, EPA/NUS sampled the on-site production well, GW-08db, and the backup production well, GW-10db, in addition to off-site water-supply wells. Results of sampling and analysis indicated the presence of VOCs in the on-site production and backup production wells and several off-site wells. TCE, the primary VOC detected, was identified in GW-08db and GW-10db at concentrations of 1,100 micrograms per liter (ug/l) and 3,900 ug/l, respectively. TCE was also detected in off-site water-supply wells at the Blakely residence (formerly Simond), Tarr Apartments and the Harvest at Bald Hill Restaurant at concentrations of 5,000 ug/l, 11 ug/l, and 2.4 ug/l, respectively. Arsenic was also detected at GW-10db and GW-12db at concentrations of 141 ug/l and 52 ug/l, respectively.

1.5 Potential Source Area Zones

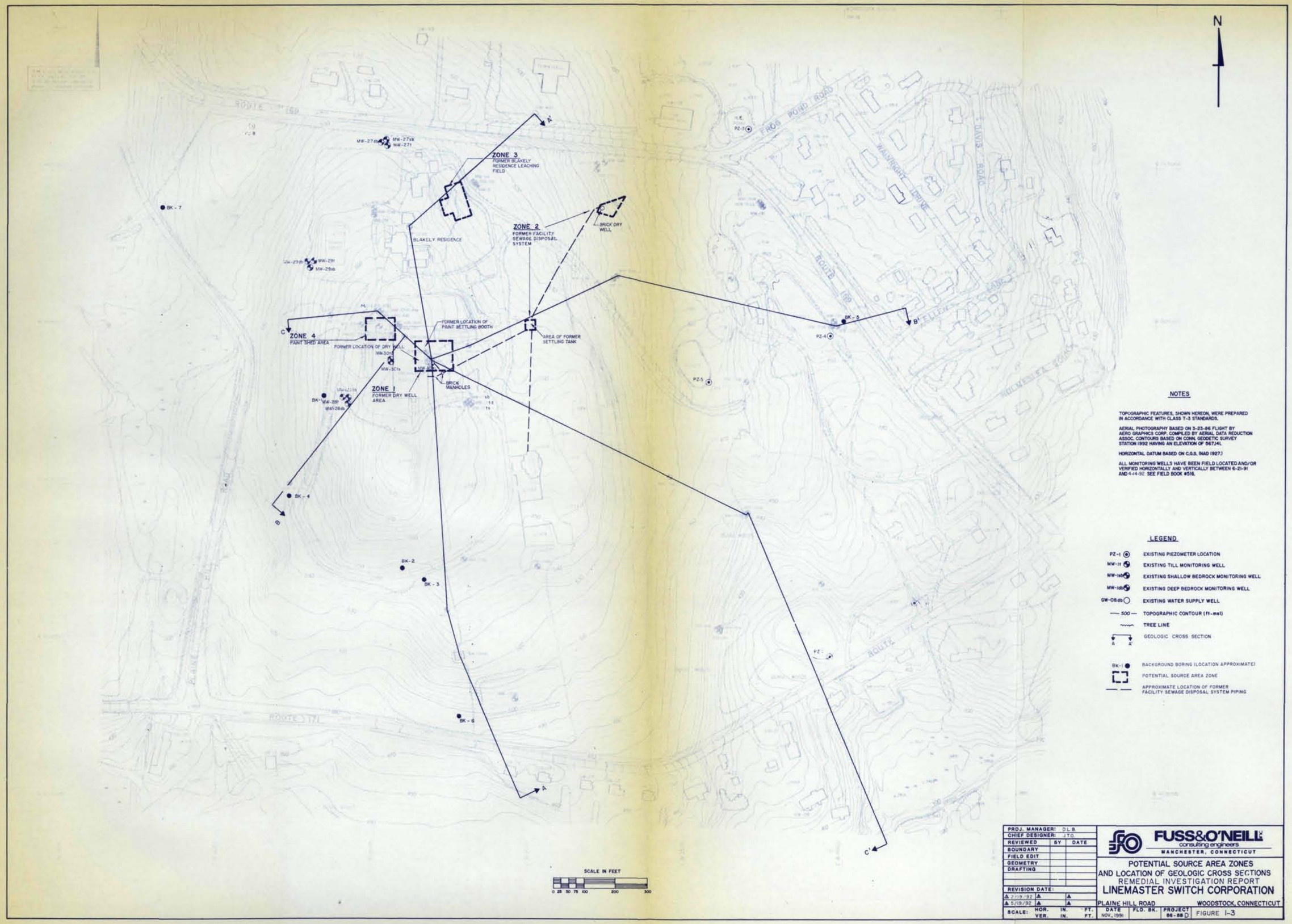
Based on observations, historical accounts, DEP, EPA, and Linemaster investigations completed prior to the preparation of this Remedial Investigation Report, four separate potential

source area zones had been identified at the Linemaster site. In the context of this report, a potential source area is considered to be an area or zone where the soil and/or underlying ground water may have become contaminated due to the historical or a one-time release of contaminants at or below the ground surface. The identified potential source area zones include: the area east of the facility where the former dry well and paint settling booth were located (Zone 1); the former wastewater disposal system for the Linemaster facility (Zone 2); the former leaching field for the Blakely Residence (Zone 3); and, the paint shed area (Zone 4). Locations of these areas are depicted on Figure 1-3. The description and delineation of the four potential source area zones and the rationale for their inclusion are discussed in the following sections.

1.5.1 Zone 1 (Former Dry Well, Former Paint Settling Booth, and Area East of Facility)

The area directly east of the manufacturing facility was identified as a potential source area due to the historical release of solvents into the dry well, which formerly existed in this area (See Figure 1-3). The dry well reportedly was approximately six feet deep and constructed of concrete blocks placed in a sand- and gravel-lined pit excavated in the natural till materials. Evidence suggests that TCE and paint thinners/solvents were discharged to the dry well during the time period between 1969 and 1979 (Murtha et al., 1988). The dry well was removed in 1989. During the removal, approximately 1000 gallons of water containing a high concentration of TCE were pumped from the dry well and disposed of by a licensed hazardous waste hauler (Kennett, Personal communication, 1992).

An area of paint solids accumulation formerly existed east of the manufacturing facility in the Zone 1 area. As a result of spray



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-24-92. SEE FIELD BOOK #516.

LEGEND

- PZ-1 — EXISTING PIEZOMETER LOCATION
- MW-11 — EXISTING TILL MONITORING WELL
- MW-16b — EXISTING SHALLOW BEDROCK MONITORING WELL
- MW-16db — EXISTING DEEP BEDROCK MONITORING WELL
- GW-08db — EXISTING WATER SUPPLY WELL
- 500 — TOPOGRAPHIC CONTOUR (ft-msl)
- TREE LINE
- A A' — GEOLOGIC CROSS SECTION
- BK-1 — BACKGROUND BORING (LOCATION APPROXIMATE)
- POTENTIAL SOURCE AREA ZONE
- APPROXIMATE LOCATION OF FORMER FACILITY SEWAGE DISPOSAL SYSTEM PIPING

PROJ. MANAGER:	D.L.B.	
CHIEF DESIGNER:	J.T.O.	
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ 2/19/92	△	△
△ 5/19/92	△	△
SCALE: HOR.	IN.	FT.
VER.	IN.	FT.

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

POTENTIAL SOURCE AREA ZONES
AND LOCATION OF GEOLOGIC CROSS SECTIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV., 1991		88-88 D	1-3

painting operations, paint solids accumulated in a wooden paint settling booth formerly located near the northwest corner of Zone 1 as shown on Figure 1-3. Paint mist was directed into the booth by ducts from inside the factory. The paint solids accumulated on the dirt floor of the booth and were removed periodically and disposed of off site (Kennett, Personal communication, 1992). The paint settling booth structure and the remaining paint solids were removed in 1986. Soil samples collected underneath the booth were analyzed to ensure that all the paint solids were removed. These results are discussed in Section 4.1.3. An air make-up unit for the Linemaster manufacturing operation was subsequently erected in this area.

1.5.2 Zone 2 (Former Facility Wastewater Disposal System)

The former wastewater disposal system for the Linemaster factory was identified as a potential contaminant source due to the discharge of TCE-contaminated water to the system. The water originated from the on-site production well (GW-08db), which had concentrations of TCE detected as high as approximately 1,100 ug/l near the beginning of the site investigations in 1986. The former facility wastewater disposal system consisted of clay tile pipe with cleanouts of brick construction, a steel settling tank, and a brick dry well as indicated on Figure 1-3. While in operation, wastewater flowed northeast from the Linemaster manufacturing facility through clay tile pipe into the settling tank, then, through more clay tile pipe to the brick dry well. The brick dry well had an open top that allowed it to overflow and discharge to the ground surface. Sanitary waste piping and roof drains from the Linemaster offices (mansion) were also connected to the disposal system. The purpose of the roof drain connection may have been to aid in flushing the system. Use of the former wastewater disposal system was discontinued in 1988 when two new holding tanks were installed in the same area as the

former settling tank. On-site disposal was discontinued and the contents of the holding tanks are now emptied periodically and transferred off site to the Killingly POTW.

1.5.3 Zone 3 (Former Blakely Leaching Field)

The former leaching field for the Blakely residence was identified as a potential contaminant source area due to the discharge of water obtained from the Blakely supply well (GW-12db) which had concentrations of TCE detected up to approximately 5,500 ug/l near the beginning of site investigations in 1986. The location of the former leaching field is northeast of the residence as shown on Figure 1-3. Water from GW-12db was treated by carbon filters beginning in 1986. The Blakely residence is now supplied with treated water from production well GW-08db. The leaching field was abandoned in 1989 when a new leaching field for the Blakely residence was constructed northwest of Pond 3.

1.5.4 Zone 4 (Paint Shed Area)

The paint shed area adjacent to the northwest corner of the Linemaster facility (See Figure 1-3) was also identified as a potential source area due to the tentative identification of VOCs in a surface soil sample collected during the December 1985 EPA/NUS site inspection and due to the results of ground-water sampling conducted in the area during investigations for the RI. Monitoring well MW-EPA-Ats, which is located slightly north of the paint shed, was found to have ground water with TCE concentrations ranging from approximately 30,000 to 50,000 ug/l as determined from July and December, 1990 sampling. At that time, MW-EPA-Ats was not considered to be downgradient of Zone 1. Therefore, the only other area that potentially could have been the source of TCE in MW-EPA-Ats was thought to be the paint shed

area where TCE routinely was stored and handled. It was thought that surface discharges of TCE might have occurred as a result of empty drum storage or drum handling in the vicinity of the paint shed.

1.6 Site Setting

1.6.1 Local Topography

The Linemaster facility is situated on a topographic high at an approximate elevation of 574 feet above mean sea level (MSL) in the central portion of the study area as shown in Figure 1-1. The highest topographic point in the study area is located approximately 100 yards south of the Linemaster facility at an approximate elevation of 585 feet MSL.

The topography drops off in all directions from the Linemaster facility toward the boundaries of the study area. Elevations decrease to approximately 500, 450, 440, and 520 feet MSL at the perimeter of the study area to the north, east, south, and west, respectively. The lowest point within the study area lies southeast of the site at an approximate elevation of 390 feet MSL.

1.6.2 Regional Geology

The study area is located within the Putnam quadrangle in the northeastern corner of Connecticut. This area lies within the New England Uplands Physiographic Province. Most of the quadrangle is located within the upper plate of the Lake Char Fault (U.S.G.S., 1982). The regional topography was modified by glaciation during the Pleistocene epoch resulting in the current physiographic features.

1.6.2.1 Regional Overburden

The surficial deposits of the region have been identified as glacial deposits (Randall et al., 1966). These materials consist of stratified drift, composed of fine- to coarse-grained deposits, and till, composed of poorly sorted fine to coarse sand, silt, clay, cobbles, and boulders. The occurrence of stratified drift in the region generally is limited to topographic lows and valley floors. Till has been mapped at both topographic highs and lows.

1.6.2.2 Regional Bedrock

The Putnam Geologic Quadrangle map (U.S.G.S., 1982) was referenced to obtain regional bedrock information for the study area. The bedrock geological formations underlying the area have been interpreted to consist of lower to possibly middle Paleozoic sedimentary, volcanic, and intrusive igneous rocks which were subsequently subjected to medium- and high-grade metamorphism. Bedrock units present within the upper plate of the Lake Char fault include:

"the Quinebaug Formation, a heterogeneous group of metavolcanic rocks; the Tatnic Formation, a sequence of pelitic gneisses with lesser amounts of calc-silicate gneiss; the Hebron Formation, a thinly layered, fine-grained calcic schist; the Scotland Formation, a pelitic schist; the Southbridge Formation, a pelitic gneiss here considered to be correlative with the upper part of the Tatnic Hill Formation; and the Ayer Granite..." (U.S.G.S., 1982).

The principle bedrock formation underlying the study area is the Hebron Formation which is Silurian or older. Bedrock of this formation is composed of fine- to medium-grained, thinly layered biotite-quartz-andesine schist, epidote-actinolite-biotite-quartz-andesine schist, and lesser amounts of muscovite-biotite

andesine-quartz schist. The minerals calcite, microcline or diopside may be present locally. Accessory minerals consist of opaque minerals, apatite, zircon, tourmaline, sphene, and rarely garnet. The formation is well layered with individual layers varying from 0.5 to 5 cm in thickness. Extensive physical deformation has been identified in some parts of the Hebron formation. In large exposures, the Hebron has shown strong folding. In addition, in some areas the formation is strongly cataclysmic.

Granite pegmatite intrusions are present in all bedrock units within the quadrangle. Parts of the Hebron formation have the most abundant intrusions in the quadrangle. These intrusions are Devonian or older. These rocks are coarse- to fine-grained and range in composition from granite to quartz diorite and are composed of quartz, microcline, and oligoclase with secondary amounts of either or both biotite and muscovite, and accessory sphene, opaque minerals, apatite, zircon, epidote-allanite, and locally garnet. The rock is usually well foliated and locally faintly laminated; however, some of the coarse-grained rock is nonfoliated. The granite in the vicinity of the study area has been interpreted to consist of thick sills between layers of the Hebron Formation. Also present at this locality are two stages of an intrusion where fine- to medium-grained, foliated granite gneiss is cut by coarse-grained nonfoliated pegmatite.

1.6.3 Hydrology

1.6.3.1 Regional Hydrology

The study area is located in northeastern Connecticut within the north-central portion of the Quinebaug River basin. The Quinebaug basin drains a total area of approximately 743 square miles in Connecticut, Massachusetts, and Rhode Island (Randall et

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al., 1966). The Quinebaug River and the Moosup River are the two largest streams within the basin. The headwaters of the Quinebaug River and its largest tributary, the French River, originate in south-central Massachusetts. The Moosup River flows west-northwest into Connecticut from western Rhode Island (Randall et al., 1966).

1.6.3.2 Local Hydrology

Surface-water streams in the vicinity of the site generally flow east or northeasterly into Roseland Lake, located approximately 0.75 miles east of the study area, which then drains to the south into the Little River. The Little River flows south and discharges to the Quinebaug River in Putnam, approximately 3.5 miles southeast of the site.

The nearest surface-water bodies outside the study area are an easterly flowing unnamed stream located approximately 2,000 feet to the north, a southerly flowing unnamed stream to the west, and the Mill Brook, which flows parallel to the southern and eastern boundaries of the study area. The unnamed stream to the north flows into Roseland Lake approximately 0.75 miles east of the study area. The unnamed stream to the west joins the Mill Brook southwest of the site. Mill Brook also flows into Roseland Lake. The Little River enters and exits Roseland Lake and flows southeasterly through Shepherds Pond before discharging to the Quinebaug River.

Four ponds and one unnamed stream are located within the eastern portion of the study area as shown on Figure 1-2. For the purposes of this report, the ponds are referred to as Northeast Pond, Pond 1, Pond 2, and Pond 3. Pond 2 has no surface-water inlet and drains to the south by a small stream that empties into a wetlands adjacent to the Mill Brook. Pond 3 also has no inlet

and discharges into the unnamed stream just north of Pond 1. The unnamed stream originates at Northeast Pond just north of Route 169, enters and exits Pond 1, and eventually discharges into Mill Brook in the southeastern portion of the study area.

1.6.4 Surface-Water Quality Classification

Surface waters in Mill Brook, unnamed streams to the north, west, and adjacent to the eastern boundary of the site, and study area ponds are classified as AA by the DEP. This classification is for surface waters "known or presumed to meet water quality criteria which support the designated uses." The AA DEP designation indicates that this water is to be used for "existing or proposed drinking water supply; fish and wildlife habitat; recreational use; agricultural, industrial supply, and other purposes, (recreational uses may be restricted)" (CT DEP, 1987).

Roseland Lake, Shepherds Pond, and the Little River surface-water bodies are classified as B/AA. This classification is for surface waters presently meeting class B criteria designated by the DEP to be upgraded to class AA. The B classification is for waters that are designated by the DEP to be used for "recreational use; fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation" (CT DEP, 1987); the class AA criteria are described above.

1.6.5 Regional Hydrogeology

The site is located within the Quinebaug River Basin in northeastern Connecticut (Randall et al., 1966). Three principal aquifers are used for water development in the basin (Randall et al., 1966). These aquifers are the bedrock, which underlies all of the basin, till, which overlies the bedrock at most places, and the stratified drift, which overlies the till and bedrock

within most valleys.

1.6.6 Ground-Water Quality Classification

Ground-water quality information was obtained from Water Quality Standards published by the DEP (DEP, 1987). Ground water at the site is classified as GA by the DEP. This classification is for "Ground waters within the area of influence of private and potential public wells. Presumed suitable for direct human consumption without the need for treatment. The State's goal is to maintain the drinking water quality."

Ground water in sections of the study area to the east and southeast is designated as GAA by the DEP. This classification is for "Ground waters tributary to public water supply watersheds or within the area of influence of community and non-community water supply wells. Presumed suitable for direct human consumption without need for treatment. The State's goal is to maintain drinking water quality."

1.7 Data Presentation

The floppy disk attached (two copies provided: one for RPM; the second for use in the Baseline Risk Assessment) consists of the majority of the soil and ground-water data collected during the investigations. The disk includes all but the most recent analytical data and all validated data in the form of a data base management system that is compatible with that specified for EPA subcontractors.

Data in this Remedial Investigation Report are presented in a tabular format. Data for VOCs, acid/base/neutral extractables (ABNs), and metals have been summarized in separate tables for soil and ground water in addition to till, shallow bedrock, and

deep bedrock.

The disk contains files WATER92B.EXE and SOIL92B.EXE which are self-extracting ascii delimited text files. Type WATER92B or SOIL92B followed by the destination drive in which the text file will be located.

Example: WATER92B C:\

This will extract the text file and place it in the destination drive as WATER92B.TXT
The fields in the WATER92B file are as follows:

Field Contents	Format
1) Sample Location	Alphanumeric (8)
2) Month/Year	Alphanumeric (5)
3) Month/Day/Year	Date
4) Sample ID	Alphanumeric (12)
5) Lab ID	Alphanumeric (12)
6) Parameter	Alphanumeric (48)
7) Unit	Alphanumeric (10)
8) Value (Alphanumeric)	Alphanumeric (9)
9) Status (B=BMDL)	Alphanumeric (1)
10) Value (Numeric)	Number

The fields in the SOIL92B file are as follows:

Field Contents	Format
1) F&O Sample ID	Alphanumeric (12)
2) Date of Sample	Date
3) Zone #	Alphanumeric (5)
4) Sample Location	Alphanumeric (15)
5) Depth of Sample (ft)	Alphanumeric (11)
6) Analytical Method	Alphanumeric (12)
7) Parameter Name	Alphanumeric (30)
8) Replicate #	Number (N)
9) Method Detection Limit	Alphanumeric (8)
10) Unit	Alphanumeric (7)
11) Reported Value	Alphanumeric (10)
12) Statistical Value (Numeric)	Number
13) Detection Status (BMDL)	Alphanumeric (6)
14) Validated (Y/N)	Alphanumeri1c (1)

2

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2.0 SITE INVESTIGATIONS

2.1 Site Survey

The location of the site relative to the surrounding area is shown on the site-location map, Figure 1-1. This map is based on the U.S. Geological Survey 7.5-minute Putnam quadrangle map.

Aerial photography of the study area was conducted in March 1986 to obtain information required to produce an accurate base map of the site. This information was used to prepare the study area location map, Figure 1-2. This map shows topographic, physiographic, cultural, and facility features. Surface-water bodies are also shown on the study area location map. In addition, the surveyed locations of the monitoring wells are shown. The elevations of these wells were determined relative to Connecticut Geodetic Survey.

2.2 Source Area Investigations

On-site investigation of the potential contaminant source(s) and the nature, degree, and extent of soil contamination was initiated in late 1985. A summary of both pre-RI/FS and RI/FS investigations related to source area identification is provided as follows:

EPA/NUS Corporation Investigations

December 19, 1985
- Soil, sediment, surface-water, and on-site and off-site water-supply well sampling;

February 12, 1986
- Sediment, surface-water, and on-site and off-site water-

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supply well sampling;

June 24, 1986
- On-Site and off-site water-supply well sampling;

Fuss & O'Neill Pre-RI/FS Investigations

February 10, 1987
- Zone 2 settling tank sampling;

February 20, 1987
- Zone 2 settling tank sampling;

May 20-21, 1987
- Zones 1 and 2 ground-water and soil sampling;

June 1987
- Zones 1-3 soil gas screening investigation;

January 13, 1988
- Zones 1-3 Tenax-sorbed soil gas sampling;

December 1988
- Zones 1 and 2 soil sampling;

June 6, 1989
- Zones 2 and 3 soil sampling;

August 8, 1989
- Zone 2 soil sampling;

October 1989
- Zone 3 soil sampling;

Fuss & O'Neill RI/FS Phase 1A Investigations

December 11-13, 1990
- Zones 2 and 4 soil gas survey;

April 23, 1991
- Zone 4 monitoring well and MW-16sb installation and sampling;

June 1991

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- Background and Zones 1, 2, 3, and 4 soil sampling;

Fuss & O'Neill RI/FS Phase 1B Investigations

November and December 1991
- Background and Zone 1 soil sampling;

April 1992
- Background and Zone 4 soil sampling (soils under paint shed); and,

May 1992
- Zone 1 soil sampling (paint settling booth).

2.3 Soil Investigations

2.3.1 Background Investigations

Background locations were sampled in June 1991, December 1991, January 1992, and April 1992 to establish the naturally occurring concentrations of metals in the shallow and deep till sediments at the Linemaster site. Samples were collected from locations both within and outside the study area. Study area samples were collected from borings installed in areas interpreted to likely be least impacted by the potential contaminant source area zones. These borings, BK-1, BK-2, BK-3, BK-4, BK-5, BK-6, and BK-7, were installed in areas not known to have been used for any type of industrial activity and are located south, west, and east of the manufacturing facility as shown on Figure 1-3. Samples BK-8, BK-9, and BK-10 were collected at locations more distant from the site as indicated in Figure 2-1. A total of 15 soil samples collected from probable background locations were analyzed for metals; eight soil samples were collected for VOC analysis. Two samples, BK-1 (40-42 ft) and BK-2 (5-7 ft) duplicate, were lost by the laboratory. Boring logs are provided in Appendix B.

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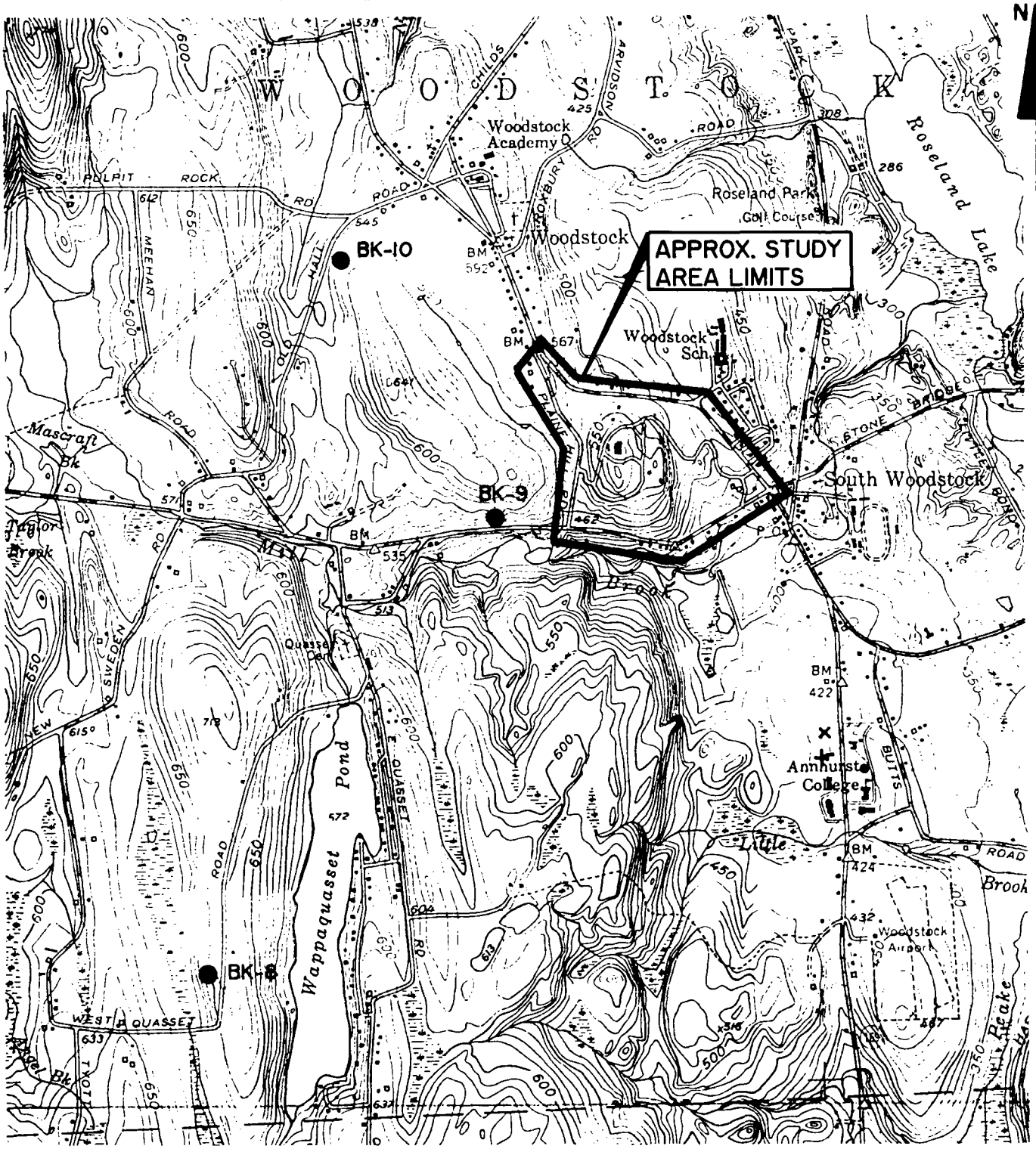

LEGEND

● BK-8 APPROX. SOIL SAMPLING LOCATION

FIGURE 2-1

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

DISTANT BACKGROUND
SOIL SAMPLING LOCATIONS

REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD WOODSTOCK, CT.

PROJ. NO. 86-88 DATE: AUG. 92 CHECKED BY: T.L.W

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Field data sheets are included in Appendix C.

Till soil samples collected from the background borings were analyzed for arsenic, barium, beryllium, cadmium, chromium, lead, and nickel or the Hazardous Substance List (HSL) metals indicated in Table 2-1. The metal analytical methods are also listed in the table. To ensure that background sampling locations were representative of undisturbed natural conditions and had not been impacted by potential on-site source areas, the collected samples were also analyzed for VOCs by EPA Method 8240. Because VOCs are the primary site contaminants, it was assumed that if no VOCs were detected in the background samples, the sampled areas have not been impacted by site operations and that the metals concentrations are due to naturally occurring processes.

2.3.2 Zone 1 Investigations

A soil gas screening investigation was conducted in the vicinity of the former dry well in Zone 1 during June 1987 to evaluate, preliminarily, the presence of VOCs in the soil and identify zones of probable soil contamination (Fuss & O'Neill, 1987). Soil gas samples were collected at locations identified on Figure 2-2 by driving a hollow probe 2 to 3 feet into the subsurface. Subsequent to probe installation, an organic vapor analyzer (OVA) utilizing a flame-ionization detector was attached to the probe. The OVA soil gas readings were recorded in parts-per-million relative to methane and are plotted and contoured on Figure 2-2. On January 13, 1988 a soil gas sample collected using a 300 ml stainless-steel syringe was sorbed onto a tenax medium for analysis by EPA Method 8010 to determine which, if any, VOCs were responsible for the positive soil gas

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TABLE 2-1

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HSL METALS ANALYTICAL METHODS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METAL	EPA METHOD (1)
Al	6010
Sb	6010
As	7060
Ba	6010
Be	6010
Cd	7131 or 6010
Cr	7191 or 6010
Cu	6010
Pb	7421 or 6010
Mg	6010
Mn	6010
Hg	7470
Ni	6010
Se	7741
Ag	6010
Tl	7841 or 6010
V	6010
Zn	6010

1. Test Methods for Evaluating Solid Waste
   EPA SW-846 3rd Edition

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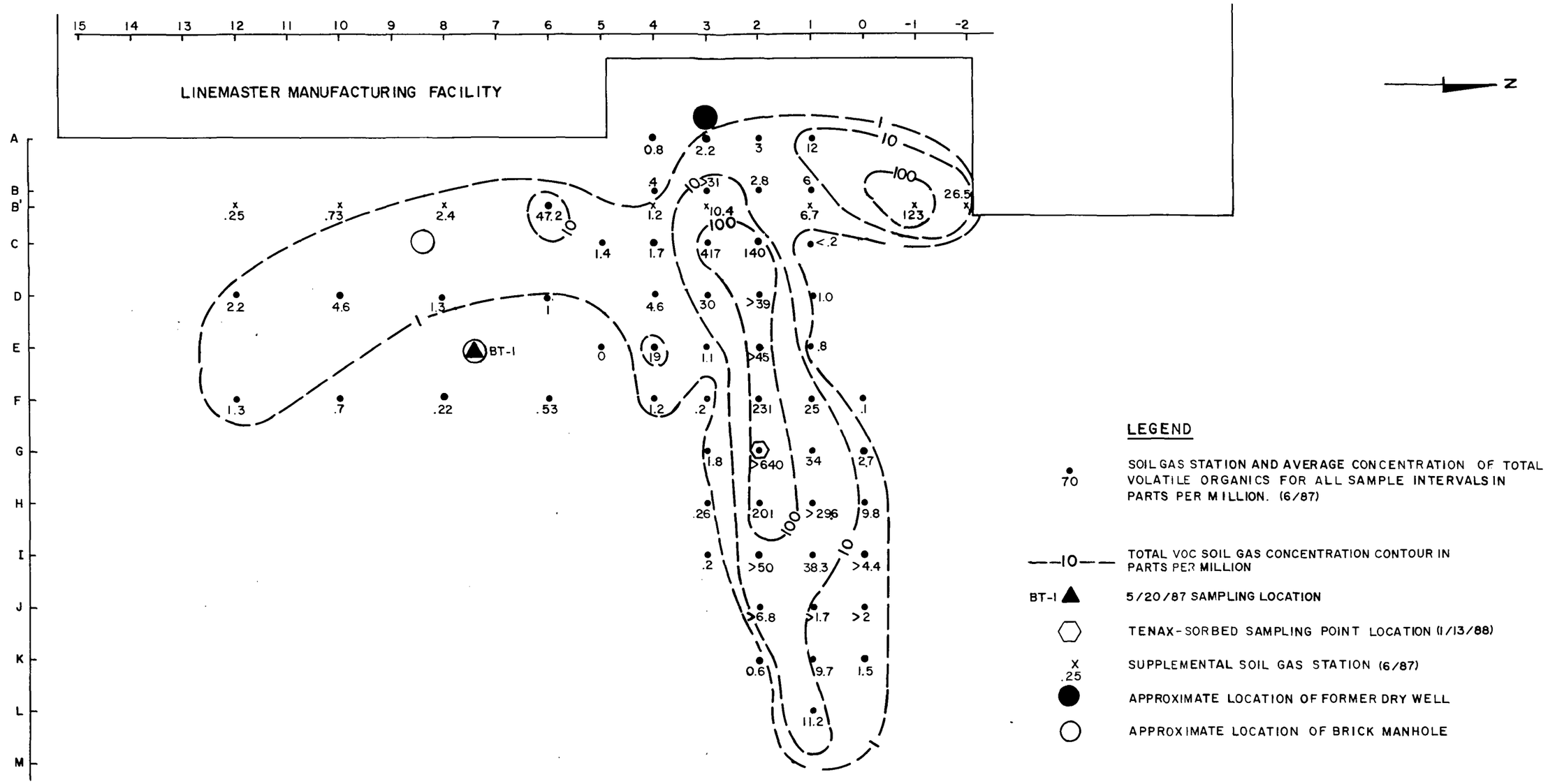

MODIFIED FROM: PLATE NO. 2 IN "SOIL GAS SURVEY REPORT AND PROPOSED SAMPLING PROGRAM, LINEMASTER SWITCH CORPORATION, WOODSTOCK, CONNECTICUT, SEPTEMBER 1987" PREPARED BY FUSS & O'NEILL INC.

REVISION DATE: 7/21/92
REVISION DATE: 10/29/92

SCALE: 1" = 20'
0 20' 40'

FIGURE 2-2

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

ZONE I
SOIL GAS SCREENING INVESTIGATION
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT

PROJ. NO. 86-88D DATE: 2/20/92 SCALE: 1" = 20'

concentrations recorded in the previous Zone 1 soil gas investigation. The tenax-sorbed sampling point is identified on Figure 2-2.

On May 20, 1987 a water sample (BT-1) was collected from the northeastern-most brick manhole in Zone 1 (see Figure 2-2) for VOC analysis by EPA Method 8010 as part of the facility sewage system investigation. Sample BT-1 results are discussed in the Zone 1 section of this report due to the physical proximity of the sampling location to Zone 1.

Based on the results of the soil gas screening investigation, a soil sampling plan was developed and implemented in December 1988 to delineate the extent of contaminated soil in Zone 1 (Fuss & O'Neill, 1989). A total of 20 soil borings (B-1, B-2, B-6 to B-21, B-23, and B-24) were completed at locations shown on Figure 2-3. Split-spoon soil samples were collected from the soil borings at 2-foot intervals; soil sampling depths ranged from 2 to 32 feet. Soil samples were screened in the field with an OVA and were selected for laboratory analysis based on the field screening results. Generally, the samples with the highest OVA concentrations from each boring were submitted for lab analysis, although several samples with non-detectable OVA VOC concentrations were also submitted for confirmatory analysis. A total of 42 soil samples from 14 borings were submitted for laboratory analysis by EPA Method 8010. A total of eight of these soil samples (B-13 8-9′ and 11-12′, B-15 2-3′ and 6-7′, B-23 3-4′, 6-7′, 9-10′, and 10-11′) were also analyzed for aromatic VOCs by EPA Method 8020.

Between March and June 1991, soil sampling was conducted as part

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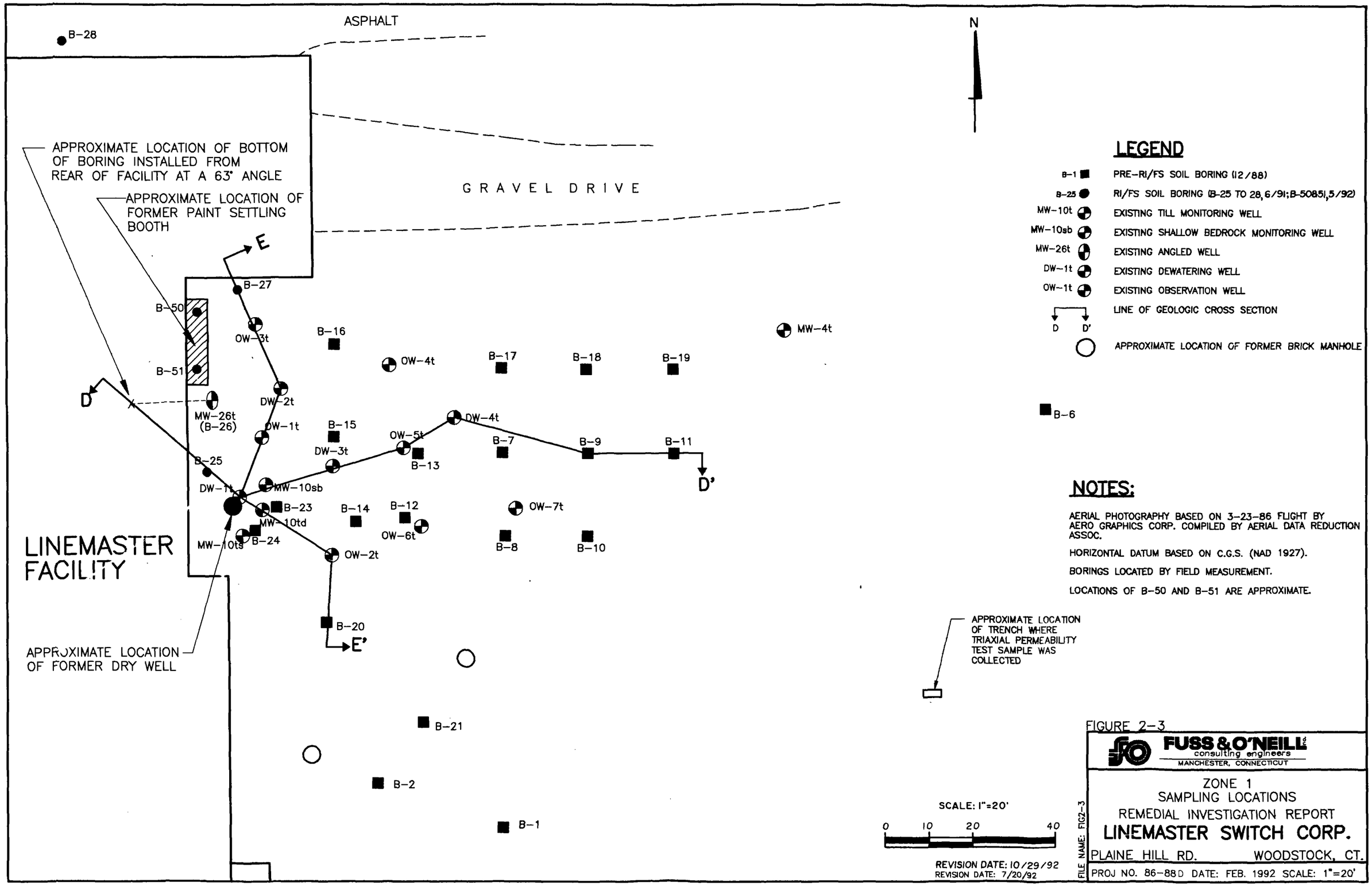
ASPHALT
N
B-28
APPROXIMATE LOCATION OF BOTTOM OF BORING INSTALLED FROM REAR OF FACILITY AT A 63° ANGLE
APPROXIMATE LOCATION OF FORMER PAINT SETTLING BOOTH
GRAVEL DRIVE
E
B-27
B-50
OW-3t
B-16
MW-4t
B-51
OW-4t
B-17
B-18
B-19
D
DW-2t
MW-26t (B-26)
DW-1t
B-15
DW-4t
OW-5t
B-7
B-9
B-11
B-6
DW-3t
B-13
B-25
D'
DW-1t
MW-10sb
B-23
B-14
B-12
OW-7t
MW-10td
OW-6t
B-24
B-8
B-10
MW-10ts
OW-2t
LINEMASTER FACILITY
B-20
E'
APPROXIMATE LOCATION OF FORMER DRY WELL
B-21
B-2
B-1
LEGEND
B-1 PRE-RI/FS SOIL BORING (12/88)
B-25 RI/FS SOIL BORING (B-25 TO 28, 6/91; B-50&51, 5/92)
MW-10t EXISTING TILL MONITORING WELL
MW-10sb EXISTING SHALLOW BEDROCK MONITORING WELL
MW-26t EXISTING ANGLED WELL
DW-1t EXISTING DEWATERING WELL
OW-1t EXISTING OBSERVATION WELL
D D' LINE OF GEOLOGIC CROSS SECTION
APPROXIMATE LOCATION OF FORMER BRICK MANHOLE
NOTES:
AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC.
HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927).
BORINGS LOCATED BY FIELD MEASUREMENT.
LOCATIONS OF B-50 AND B-51 ARE APPROXIMATE.
APPROXIMATE LOCATION OF TRENCH WHERE TRIAXIAL PERMEABILITY TEST SAMPLE WAS COLLECTED
SCALE: 1"=20'
0 10 20 40
REVISION DATE: 10/29/92
REVISION DATE: 7/20/92
FIGURE 2-3
FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT
ZONE 1
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.
PLAINE HILL RD. WOODSTOCK, CT.
PROJ NO. 86-88D DATE: FEB. 1992 SCALE: 1"=20'
FILE NAME: FIG2-3

of the Phase 1A RI/FS investigations to further delineate the extent of VOC contamination in Zone 1 and substantiate the findings of the pre-RI/FS investigations. As part of this investigation, soil samples were collected to characterize the nature of the soils as well as the lateral and vertical extent of VOC contamination in the vicinity of the former dry well. Soil samples were also collected from the soils underneath the manufacturing facility building. Additionally, soil samples were collected to characterize metals concentrations and determine if acid/base/neutral extractables (ABNs) were present in Zone 1. Analysis for metals was performed because metal-containing wastes (e.g. paint solid residue and tumbling waste) are known to have been generated by Linemaster. ABN analysis was completed as an EPA requirement.

Phase 1A soil sampling was conducted in Zone 1 in accordance with the Sampling and Analysis Plan (SAP) Addendum for soil sampling (Fuss & O'Neill, 1991a). A total of five borings (B-25 to B-28 and DW-1t) were installed in Zone 1 at the locations shown on Figure 2-3 during this investigatory phase. Boring DW-1t was installed approximately 5 feet east of the location of the former dry well. Borings B-25 and B-27 were installed to bedrock to characterize the vertical soil profile adjacent to the building. Boring B-28 was installed to determine if soil contamination extended north of the manufacturing building. Boring B-26 was installed at a 63-degree angle from the east side of the building to provide information about soil conditions beneath the facility. This boring was successfully converted to an angled monitoring well, MW-26t.

During Phase 1A RI/FS boring installation, split-spoon soil

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samples were collected for the analysis of VOCs and ABNs by EPA Methods 8240 and 8270, respectively. A total of 24 samples were collected from the five borings for VOC analysis; one sample from each boring was collected from the bottom of the till unit and analyzed for ABNs. Ten soil samples, two from each boring, were collected for analysis for barium, beryllium, cadmium, chromium, lead and nickel by EPA Method 6010; arsenic was analyzed by EPA Method 7060. One sample was collected at a depth of approximately one-half the thickness of the till unit and the other was collected from the bottom of the till unit. The sample collected from the bottom of the till unit at each boring was also analyzed for the HSL metals listed on Table 2-1. Boring logs and field data sheets are provided in Appendices B and C, respectively.

Phase 1B RI/FS soil investigations were conducted between November and December 1991 and in May 1992 to further delineate the extent of VOCs in the soils at Zone 1, supplement the Phase 1A investigations, and as part of well installations for a Zone 1 dewatering feasibility study (Fuss & O'Neill, 1992a). Soil samples were collected to characterize the horizontal and vertical extent of VOCs at Zone 1. Additionally, soil samples were collected at representative locations to characterize the metals concentrations and provide additional information on ABN occurrence. ABN detections in Phase 1A samples are believed to be related to laboratory blank contamination. Phase 1B ABN sampling was performed to help confirm this interpretation. The results of Phase 1A and 1B ABN sampling and the rationale for attributing ABN detections to laboratory contamination are provided in Section 4.1.2.

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Soil samples were collected for VOC, ABN, and metals analyses from the location of the former paint settling booth in Zone 1 during May 1992. This area was considered a possible source of metals due to the historical accumulation of paint solids on the dirt floor of the former booth.

Soil samples were also collected for VOC analysis during the installation of monitoring wells MW-30ts and MW-30td, which are located adjacent to the west side of the facility. These locations were sampled to define the western extent of Zone 1 soil contamination.

Phase 1B soil sampling was conducted in Zone 1 in accordance with the SAP Addendum for soil sampling (Fuss & O'Neill, 1991a). A total of 12 borings (DW-2t to DW-4t, OW-1t to OW-7t, B-50, and B-51) were installed in Zone 1 at the locations shown on Figure 2-3. DW and OW borings were installed at representative locations in Zone 1 to characterize the vertical and horizontal soil conditions, and were converted to observation and dewatering wells as part of the Zone 1 Dewatering Feasibility Study (Fuss & O'Neill, 1992a). Borings B-50 and B-51 were installed to intercept the soils beneath the location of the former paint settling booth.

During Phase 1B RI/FS boring installation, split-spoon samples were collected for the analysis of VOCs and ABNs by EPA Methods 8240 and 8270, respectively. A total of 52 samples were collected from 12 borings for VOC analysis. Eight of the samples collected from OW-1t, OW-2t, OW-3t, DW-3t, B-50, and B-51 were also analyzed for ABNs and the HSL metals listed on Table 2-1. In addition, five duplicate samples were collected.

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2.3.3 Zone 2 Investigations

The initial investigation of potential contamination associated with the former Linemaster wastewater disposal system was performed in early 1987. Two samples (ST-1 and ST-2) of the contents of the former settling tank in Zone 2 were collected on February 10 and 20, 1987 and analyzed by EPA Method 8010 for the presence of VOCs.

Amid concerns of septic system leakage or failure, six test pits were installed in May 1987 in an attempt to identify the location of the leaching field; however, no evidence of a leaching field was discovered. The approximate locations of the six test pits are depicted on Figure 2-4. Four soil samples (SS-1 0-0.5′, 0.5-1′, 1-1.5′, and 1.5-2′) were collected from test pit 1. Three additional soil samples (SS-2, SS-3, and SS-4) were collected east of the brick dry well, the ultimate sewage discharge point, as shown in Figure 2-5. Two aqueous samples of sewage outbreak (LO-1 and LO-2) were also collected in Zone 2 as indicated in Figure 2-4. The nine samples collected from Zone 2 on May 20-21, 1987 were analyzed for VOCs by EPA Method 8010.

A soil gas screening investigation was performed in the area of the Linemaster sewage settling tank in June 1987 (Fuss & O'Neill, 1987) to identify any areas of potential VOC contamination. The survey was conducted using the same methodology used for Zone 1 as described in Section 2.3.2 On January 13, 1988 a soil-gas sample was sorbed onto a Tenax medium for analysis by EPA Method 8010 to determine if chlorinated VOCs were responsible for the positive soil gas concentrations recorded in the previous Zone 2 soil gas investigation. The location of this sampling point is

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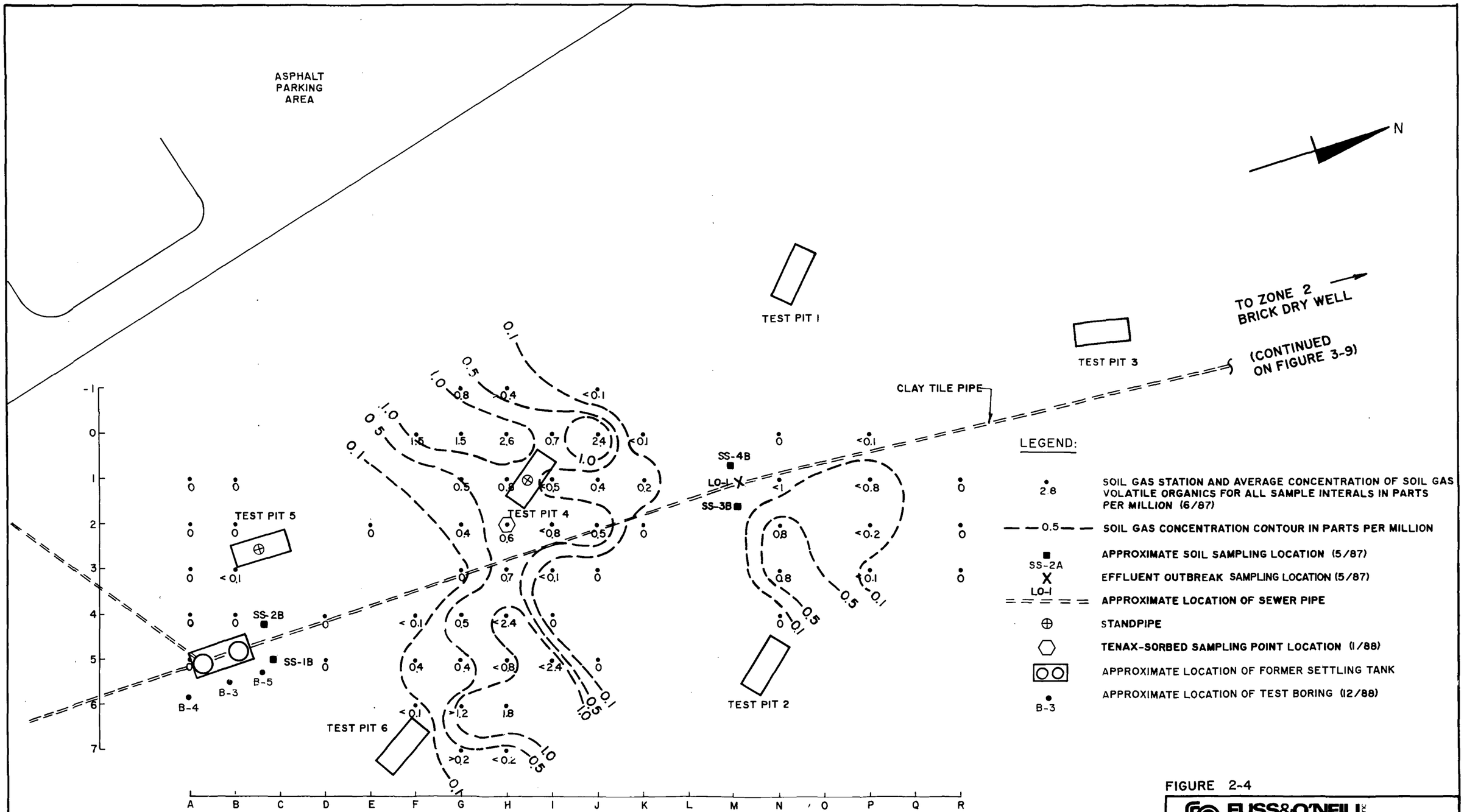


MODIFIED FROM: PLATE NO. 4 IN "SOIL GAS SURVEY REPORT AND PROPOSED SAMPLING PROGRAM, LINEMASTER SWITCH CORPORATION, WOODSTOCK, CONNECTICUT, SEPTEMBER 1987" PREPARED BY FUSS & O'NEILL INC.

REVISION DATE: 7/21/92
REVISION DATE: 10/29/92

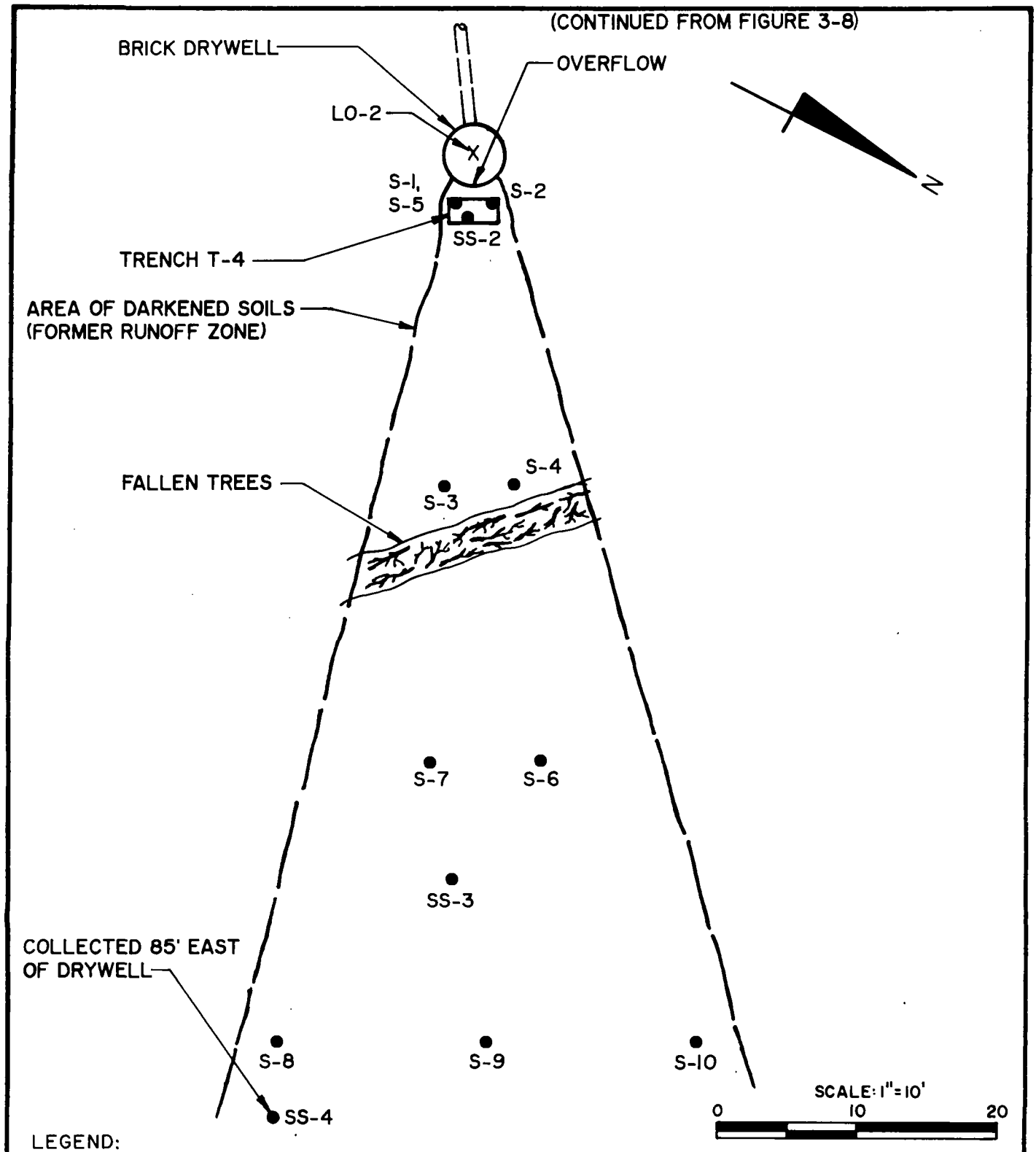
SCALE: 1" = 20'

FIGURE 2-4

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

ZONE 2
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL RD. WOODSTOCK, CT.

PROJ. NO. 86-88D DATE: 2/14/92 SCALE: 1"=20'



LEGEND:

- ● APPROXIMATE SOIL SAMPLE LOCATIONS (S-1 TO 10, 8/89; SS-2 TO 4, 5/87)
- ▭ APPROXIMATE TRENCH LOCATION (6/91)
- T-4 X LO-2 EFFLUENT OUTBREAK SAMPLING LOCATION (5/87)

MODIFIED FROM PLATE NO. 4 IN SEPT. 1987 "SOIL GAS REPORT & PROPOSED SAMPLING PROGRAM"

REVISION DATE: 10/29/92
REVISION DATE: 7/21/92

FIGURE 2-5

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

ZONE 2

BRICK DRY WELL SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL RD. WOODSTOCK, CT.

PROJ. NO. 86-88 DATE 2/14/92 CHECKED BY: TLW

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shown on Figure 2-4.

Three test borings (B-3, B-4, and B-5) were installed in Zone 2 on the eastern, or downslope, side of the former settling tank on December 14, 1988 as shown in Figure 2-4. Split-spoon soil samples were collected and screened for the presence of VOCs with a field portable OVA.

Additional sampling was performed in Zone 2 during June 1989 (Fuss & O'Neill, 1987). On June 6, 1989 four soil samples (SS-1B, SS-2B, SS-3B, SS-4B) were collected in shallow, hand auger borings adjacent to the clay tile pipe leading from the former settling tank to the brick dry well. The samples collected were analyzed for VOCs by EPA Method 8010 to evaluate the possibility of seepage of VOC-contaminated sewage from the pipe. Sampling locations are shown on Figure 2-4.

During August 1989, a total of ten soil samples (S-1 to S-10) were collected east of the Zone 2 brick dry well as shown on Figure 2-5. These samples were collected from the near surface (0-1' depth) on August 8, 1989 to evaluate the extent of potential soil VOC contamination due to brick dry well overflow. These samples were analyzed for VOCs by EPA Method 8010.

Two soil gas samples were collected immediately adjacent to the brick dry well between December 11 and 13, 1990, and screened for VOCs using a Photovac 10S50 portable gas chromatograph.

In accordance with the SAP Addendum for soil sampling (Fuss & O'Neill, 1991a), soil sampling was conducted at the brick dry well in June 1991 during Phase 1A RI/FS investigations to

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supplement previous Zone 2 investigations. On June 25, 1991, soil samples were collected from a trench (T-4) excavated adjacent to the downslope side of the brick dry well, as shown on Figure 2-5. Two sets of soil samples were collected at opposite ends of the trench from the near surface (approx. 0.5′ deep) and the base of the trench (approx. 4′ deep). All four samples and one duplicate were analyzed for VOCs by EPA Method 8240. Two samples and two duplicates were analyzed for ABNs by EPA Method 8270. Two samples and two duplicates were also analyzed for the HSL metals listed on Table 2-1.

2.3.4 Zone 3 Investigations

A soil gas screening investigation was performed in the area of the former Blakely residence leaching field in June 1987 (Fuss & O'Neill, 1987) to preliminarily identify any areas of possible VOC contamination. The methodology for the survey followed the same procedures utilized for Zone 1 as described in Section 2.3.2. On January 13, 1988, a soil gas sample was sorbed onto a Tenax medium for VOC analysis by EPA Method 8010 to determine if chlorinated VOCs were responsible for the previously recorded positive soil gas readings in Zone 3.

As described in a Soil Sampling Plan (Fuss & O'Neill, 1989) prepared following evaluation of the results of the 1987 soil gas screening investigation, soil samples were collected from Zone 3 in June 1989. Five samples (SS-1 to SS-5) were collected on June 6, 1989 at locations with the highest soil VOC screening concentrations as depicted in Figure 2-6. Samples were collected from a shallow depth (approx. 1 foot) to prevent damage to the leaching field, which was active at that time. The soil samples

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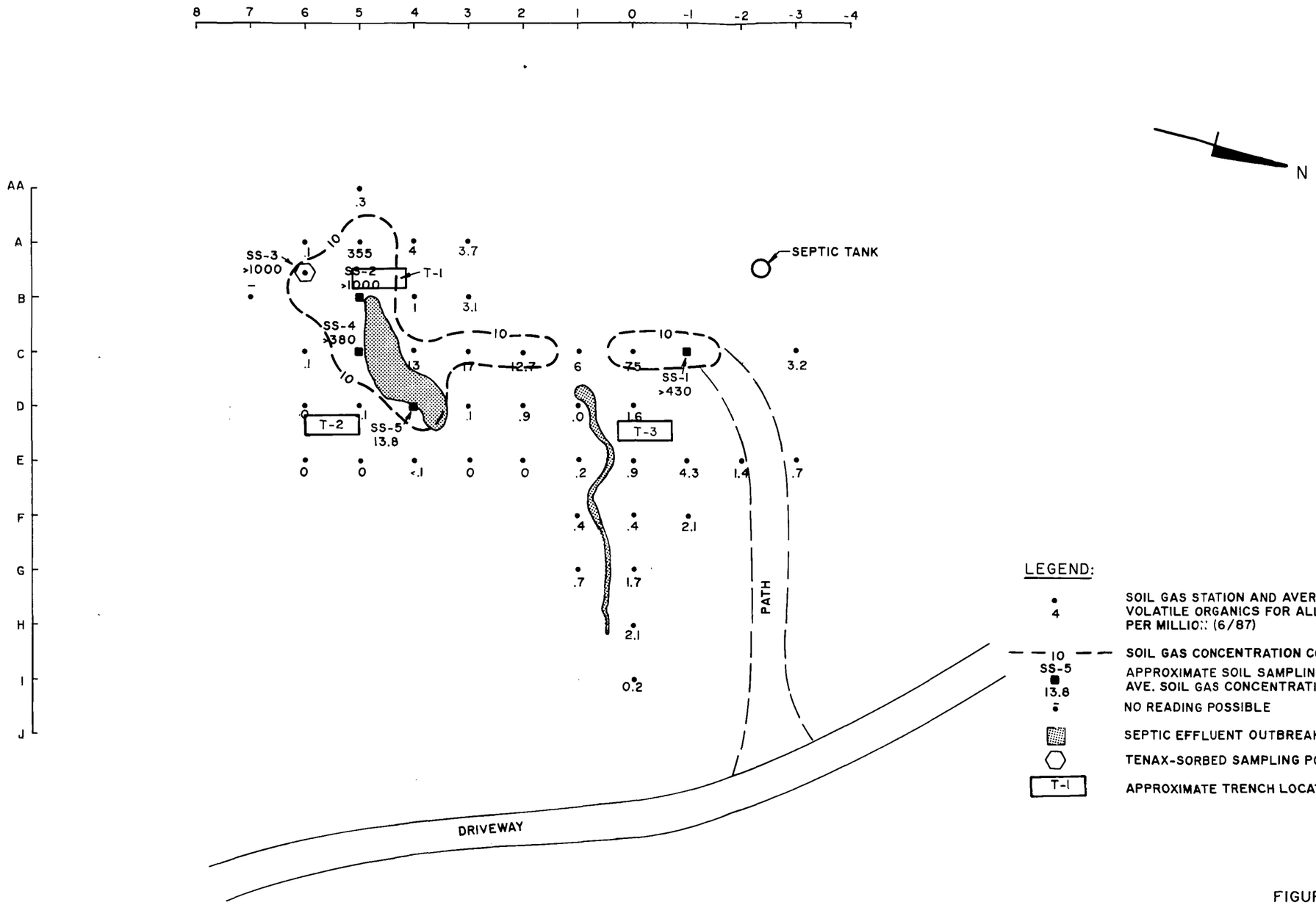

LEGEND:

- 4 — SOIL GAS STATION AND AVERAGE CONCENTRATION OF SOIL GAS VOLATILE ORGANICS FOR ALL SAMPLE INTERVALS IN PARTS PER MILLION (6/87)
- 10 — SOIL GAS CONCENTRATION CONTOUR IN PARTS PER MILLION
- SS-5 / 13.8 — APPROXIMATE SOIL SAMPLING LOCATION (6/89) AVE. SOIL GAS CONCENTRATION (PPM)
- NO READING POSSIBLE
- SEPTIC EFFLUENT OUTBREAK
- TENAX-SORBED SAMPLING POINT LOCATION (1/88)
- T-1 — APPROXIMATE TRENCH LOCATION (6/91)

MODIFIED FROM: PLATE NO. 5 IN "SOIL GAS SURVEY REPORT AND PROPOSED SAMPLING PROGRAM, LINEMASTER SWITCH CORPORATION, WOODSTOCK, CONNECTICUT, SEPTEMBER 1987" PREPARED BY FUSS & O'NEILL INC.

REVISION DATE: 10/29/92
REVISION DATE: 7/21/92

SCALE: 1" = 20'
0 10 20 40

FIGURE 2-6

FUSS&O'NEILL INC.
MANCHESTER, CONNECTICUT

ZONE 3
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL RD. WOODSTOCK, CT.

PROJ. NO. 86-88D DATE: 2/14/92 SCALE: 1" = 20'

were analyzed by EPA Method 8010 to confirm or refute the presence of VOCs in the soils in the vicinity of the former Blakely leaching field.

One additional soil sample (SL-1) was collected in October 1989 from a trench excavation in the former leaching area when the Blakely residence was being connected to the new leaching area. The exact sampling location was not recorded. This soil sample was analyzed for VOCs by EPA Method 8010.

In accordance with the SAP Addendum for soil sampling (Fuss & O'Neill, 1991a), Phase 1A RI/FS soil sampling in Zone 3 was conducted in June 1991 to supplement pre-RI/FS sampling data. Soil samples were collected on June 25, 1991 from three trenches (T-1, T-2, T-3) excavated at the approximate locations depicted on Figure 2-6. The trenches were located in the general area of the leaching field laterals because these soils were expected to have the highest probability of contamination due to domestic wastewater discharge. The soil samples were collected at depths of 0.5 and 3 feet in each trench.

During the Zone 3 Phase 1A RI/FS sampling investigation, nine soil samples were collected for the analysis of VOCs by EPA Method 8240; five soil samples were collected for the analysis of ABNs by EPA Method 8270. Four samples were analyzed for the HSL metals listed on Table 2-1.

2.3.5 Zone 4 Investigations

Prior to the RI/FS, no comprehensive sampling of the area surrounding the paint shed in Zone 4 had been conducted.

Previous sampling was limited to a single surficial soil sample (SS-01) collected between the paint shed and the manufacturing building on December 19, 1985 as part of the EPA/NUS site inspection (NUS, 1987). As reported by NUS, in-house screening tentatively identified "substantial amounts" of TCE (NUS, 1987) in this sample.

As part of the Phase 1A RI/FS investigations, a soil gas survey was performed in Zone 4 between December 11 and 13, 1990 (Fuss & O'Neill, 1990b). Soil gas samples were collected from a total of 28 sampling points located within and adjacent to Zone 4. Soil gas samples were analyzed on site using a portable Photovac 10S50 gas chromatograph.

Monitoring well MW-16sb was installed slightly northeast of the Zone 4 paint shed (See Figure 2-7) on April 23, 1991. The two split-spoon soil samples collected from the monitoring well boring with the highest OVA readings were analyzed for VOCs by EPA Method 8240. Two samples from this boring were also analyzed for barium, beryllium, cadmium, chromium, lead, and nickel by EPA Methods 6010; arsenic was analyzed by EPA Method 7060.

In order to investigate the shallow and deep soils in the vicinity of the paint shed, extensive test borings and soil sampling and analysis were subsequently conducted in Zone 4 during June 1991 Phase 1A RI/FS investigations in accordance with the SAP Addendum for soil sampling (Fuss & O'Neill, 1991a). Shallow soils were considered the upper 4 feet of the soil profile. A total of 20 soil borings (B-29 to B-46, MW-24t, and MW-25t) were installed in the vicinity of the paint shed area between June 13 and 21, 1991. Three of these borings (B-29,

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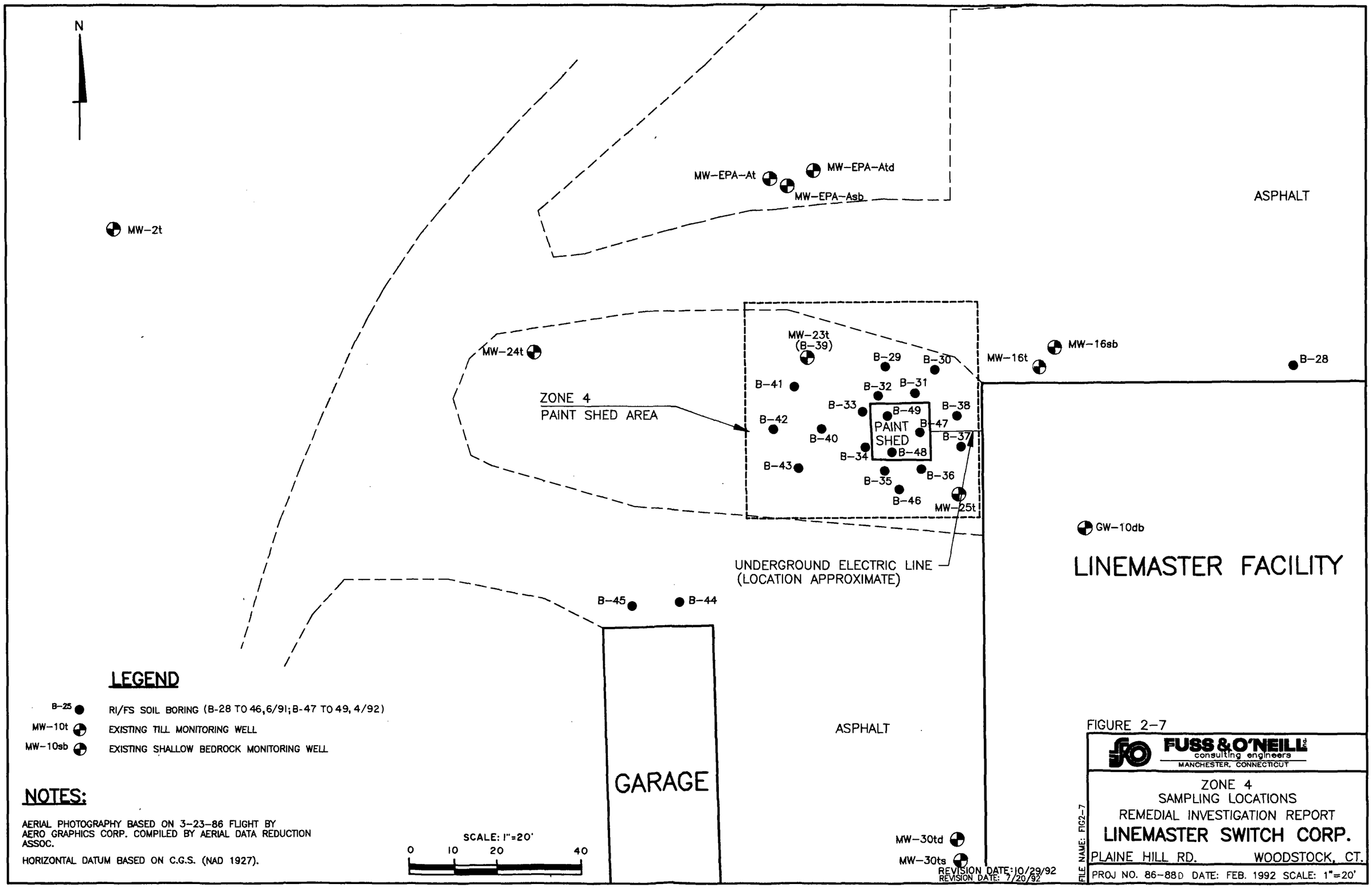
N
MW-EPA-At
MW-EPA-Atd
MW-EPA-Asb
ASPHALT
MW-2t
MW-24t
MW-23t
(B-39)
B-29
B-30
MW-16t
MW-16sb
B-28
B-41
B-32
B-31
ZONE 4
PAINT SHED AREA
B-33
B-49
B-38
B-42
PAINT
SHED
B-47
B-40
B-37
B-34
B-48
B-43
B-35
B-36
B-46
MW-25t
GW-10db
LINEMASTER FACILITY
UNDERGROUND ELECTRIC LINE
(LOCATION APPROXIMATE)
B-45
B-44
GARAGE
ASPHALT
MW-30td
MW-30ts
SCALE: 1"=20'
0 10 20 40
LEGEND
B-25 RI/FS SOIL BORING (B-28 TO 46, 6/91; B-47 TO 49, 4/92)
MW-10t EXISTING TILL MONITORING WELL
MW-10sb EXISTING SHALLOW BEDROCK MONITORING WELL
NOTES:
AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC.
HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927).
REVISION DATE: 10/29/92
REVISION DATE: 7/20/92
FIGURE 2-7
FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT
ZONE 4
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.
PLAINE HILL RD. WOODSTOCK, CT.
PROJ NO. 86-88D DATE: FEB. 1992 SCALE: 1"=20'
FILE NAME: FIG2-7

B-39, and B-46) were installed to bedrock, which was found at a depth of approximately 60 feet. The remaining borings were installed to a depth of 4 feet. Boring locations are identified on Figure 2-7.

During the investigation, several data needs became apparent that required the installation of additional monitoring wells and borings in the paint shed area. The data needs were identified by the detection of elevated OVA readings from samples collected from B-39. The data needs included: 1) identification of the source of the elevated readings, and 2) determination of ground-water quality in the area. These data needs were addressed by installing boring B-46 and monitoring wells MW-23t, MW-24t, and MW-25t in the vicinity of the paint shed (See Figure 2-7). These borings and wells were used to further delineate the extent of VOCs in soil and ground water in the paint shed area.

Boring B-46 was installed adjacent to the south side of the paint shed to investigate the extent of a minor fuel oil release which occurred several days prior to the drilling. The release occurred during the excavation of an underground fuel oil line which connected a former aboveground heating oil tank west of the paint shed to the facility. B-46 was also installed to examine the full vertical profile of the till unit in this area. Boring B-39 was completed as monitoring well MW-23t due to elevated readings obtained on the OVA field instrument during split-spoon soil sampling. Monitoring well MW-24t was installed west of MW-23t to determine the western extent of soil and ground-water contamination. Monitoring well MW-25t was installed southeast of the paint shed to investigate soil and ground-water quality upgradient of the paint shed area.

A total of 64 soil samples were collected during Phase 1A Zone 4 boring installations for analysis of VOCs by EPA Method 8240. Six samples were analyzed for ABNs by EPA Method 8270. Twenty-two samples were collected for the analysis of barium, beryllium, cadmium, chromium, lead, and nickel by EPA Method 6010; arsenic was analyzed by EPA Method 7060 in these same samples. Six soil samples were also analyzed for the HSL metals listed on Table 2-1.

Phase 1B investigations at Zone 4 consisted of sampling the soils beneath the paint shed. These soils were considered a potential source area due to their location underneath the paint shed. Three borings (B-47, B-48, and B-49) were installed inside the paint shed through the concrete floor to a depth of 3.5 feet. Two soil samples were collected at each boring by split spoon from the 0-2 foot and 2.5-3.5 foot depths. These samples were analyzed for VOCs by EPA Method 8240, ABNS by EPA Method 8270, and the HSL metals listed on Table 2-1. Soil sampling during Phase 1B investigations was conducted in accordance with the SAP addendum for soil sampling (Fuss & O'Neill, 1991a).

A description of the geologic profiles and a listing of OVA readings are presented on boring logs provided in Appendix B. Field data sheets are compiled in Appendix C.

2.4 Ground-Water Investigations

Hydrogeological investigations have been ongoing at the Linemaster Switch site since 1986 to characterize study area hydrogeology and define the nature and extent of ground-water contamination. Investigations have included water-supply well

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sampling, monitoring well installations, ground-water sampling, hydraulic conductivity tests, pilot pumping tests, a background water-level study, geophysical surveys, and packer tests.

2.4.1 Monitoring Well Installations

Phase 1 till and shallow bedrock monitoring wells, designated as MW-1t, MW-2t, MW-3t, MW-4t, MW-5sb, MW-6t, MW-7sb, MW-8sb, and MW-9sb, were installed in August 1987. Phase 2 deep bedrock monitoring wells, designated as MW-12db, MW-13db, and MW-14db, were installed in December 1989. Phase 2 till and shallow bedrock monitoring wells, designated as MW-6sb, MW-10td, MW-10sb, MW-11t, MW-11sb, MW-12t, MW-12sb, MW-14sb, and MW-EPA-Ats, were installed in January 1990. Phase 3 till, shallow bedrock and deep bedrock monitoring wells, designated as MW-1sb, MW-1db, MW-6db, MW-8t, MW-8db, MW-11db, MW-15t, MW-15sb, MW-15db, MW-16t, MW-16sb, MW-17ts, MW-17td, MW-17sb, MW-17db, MW-18t, MW-18sb, MW-18db, MW-19sb, MW-20sb, MW-21db, MW-22db, MW-EPA-Atd, MW-EPA-Asb, MW-23t, MW-24t, MW-25t, and MW-26t, were installed in May and June 1991. Final Phase 3 monitoring wells, designated as MW-27t, MW-27sb, and MW-27db, were installed in October 1991. Phase 4, till shallow bedrock and deep bedrock monitoring wells MW-10ts, MW-28t, MW-28sb, MW-28db, MW-29t, MW-29sb, MW-29db, MW-30ts, and MW-30td were installed in March and April 1992. The s, d, t, and b well letter suffixes stand for shallow, deep, till, and bedrock, respectively. Well drilling completion reports and well completion diagrams for the monitoring wells are provided in Appendix D. A summary of well completion details is provided in Table 2-2. Monitoring well locations are shown on Figure 1-2.

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TABLE 2-2
SUMMARY OF WELL COMPLETION DETAILS
MONITORING REPORT - DEEP BEDROCK INTERIM REMOVAL ACTION
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

WELL	ELEVATION (1)			WELL DIAMETER	TOTAL DEPTH OF BORING	BEDROCK		MONITORED ZONE					
	TOP OF STEEL CASING (ft-MSL)	TOP OF PVC (ft-MSL)	GROUND SURFACE (ft-MSL)	(inches)	(feet)	DEPTH (feet)	SURFACE ELEVATION (ft-MSL)	(2) AQUIFER	SCREEN LENGTH (feet)	MONITORED DEPTH (feet)	WELL POINT ELEVATION (ft-MSL)	SLOT SIZE (in.)	DATE COMPLETED
MW-1t	528.82	528.46	526.98	2	64.5	74	453	t	10	35.57-45.57	481.41	0.010	03-Aug-87
MW-1sb	528.64	528.44	526.94	2	90	74	453	sb	10	79.71-89.71	437.24	0.010	25-Apr-91
MW-1db	528.26	NA	527.17	6	304	74	453	db	NA	84.0-304	223	NA	24-Apr-91
MW-2t	563.29	563.60	561.35	2	45	45	516	t	5	30.52-35.52	525.83	0.010	27-Jul-87
MW-3t	545.10	544.72	542.87	2	21	21	522	t	5	14.58-19.58	523.29	0.010	24-Jul-87
MW-4t	556.97	556.53	554.77	2	36.5	>36	<519	t	5	30.53-35.53	519.24	0.010	12-Aug-87
MW-5sb	539.32	538.89	537.46	2	44	10	527	sb	5	30.86-35.86	501.60	0.010	30-Jul-87
MW-6t	500.88	500.83	498.95	2	22	22	477	t	5	14.99-19.99	478.96	0.010	04-Aug-87
MW-6sb	500.86	500.85	498.86	2	37.5	22	477	sb	10	27.52-37.52	461.34	0.010	09-Feb-90
MW-6db	504.42	NA	505.33	6	301	21	484	db	NA	35.0-301	204	NA	26-Apr-91
MW-7sb	486.73	486.61	484.81	2	28	2	483	sb	5	23.03-28.03	456.78	0.010	07-Aug-87
MW-8t	437.26	436.68	435.14	2	20.5	-	-	t	10	10.30-20.30	414.84	0.010	10-May-91
MW-8sb	437.85	437.62	435.16	2	28.5	21	414	sb	5	24.20-29.20	405.96	0.010	06-Aug-87
MW-8db	437.62	NA	435.52	6	202	20	416	db	NA	30.0-202	234	NA	29-Apr-91
MW-9sb	470.09	469.93	467.90	2	15.5	6	462	sb	5	10.29-15.29	452.61	0.010	10-Aug-87
MW-10ts		573.43	569.40	2	25	-	-	t	10	16.45-26.45	542.95	0.010	01-Apr-92
MW-10td	570.13	569.95	568.64	2	43.5	44	525	t	10	33.79-43.79	524.85	0.010	18-Jan-90
MW-10sb	569.44	569.29	568.40	2	64	44	525	sb	10	52.41-62.41	505.99	0.010	17-Jan-90

NA-Not Applicable

(1) Elevations surveyed/resurveyed 6/91-4/92
(2) t-till sb-shallow bedrock db-deepbedrock
(3) caved to 305 ft.
(4) angled well installed at 63 degrees.
(5) approximate

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TABLE 2-2 (CONTINUED)
SUMMARY OF WELL COMPLETION DETAILS
MONITORING REPORT - DEEP BEDROCK INTERIM REMOVAL ACTION
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

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WELL	ELEVATION (1)			WELL DIAMETER	TOTAL DEPTH OF BORING	BEDROCK		MONITORED ZONE					
	TOP OF STEEL CASING (ft-MSL)	TOP OF PVC (ft-MSL)	GROUND SURFACE (ft-MSL)	(inches)	(feet)	DEPTH (feet)	SURFACE ELEVATION (ft-MSL)	(2) AQUIFER	SCREEN LENGTH (feet)	MONITORED DEPTH (feet)	WELL POINT ELEVATION (ft-MSL)	SLOT SIZE (in.)	DATE COMPLETED
MW-11t	493.65	493.48	491.41	2	27.5	-	-	t	10	18.04-28.04	463.37	0.010	08-Jan-90
MW-11sb	493.58	493.36	491.54	2	44	28.5	464	sb	10	33.72-43.72	447.82	0.010	11-Jan-90
MW-11db	490.16	NA	489.18	6	250	28.5	459	db	NA	29.5-250	239	NA	08-May-91
MW-12t	455.84	455.51	453.93	2	17	17	437	t	10	6.74-16.74	437.19	0.010	10-Jan-90
MW-12sb	455.75	455.73	453.80	2	33.5	17	437	sb	10	23.99-33.99	419.81	0.010	11-Jan-90
MW-12db	455.08	NA	453.95	6	201	17	437	db	NA	25.0-201	253	NA	19-Dec-89
MW-13db	540.83	NA	540.24	6	300	5	535	db	NA	19.0-300	240	NA	21-Dec-89
MW-14sb	441.41	441.35	439.72	2	25.5	11	428	sb	10	15.49-25.49	414.23	0.010	15-Jan-90
MW-14db	442.35	NA	439.76	6	201	11	428	db	NA	24.0-201	239	NA	20-Dec-89
MW-15t	552.84	552.60	552.85	2	137	136	417	t	10	127.24-137.24	415.61	0.010	23-Apr-91
MW-15sb	552.65	552.47	552.65	2	153	139	413	sb	10	144.44-154.44	398.21	0.010	07-May-91
MW-15db	551.38	NA	552.32	6	(3) 400	140	413	db	NA	(3) 164-400	152	NA	10-May-91
MW-16t	569.71	569.35	569.74	2	30	-	-	t	10	19.74-29.74	540.00	0.010	24-Apr-91
MW-16sb	568.98	568.46	568.92	2	68	48	521	sb	10	56.91-66.91	502.01	0.010	24-Apr-91
MW-17ts	560.07	559.86	560.10	2	20	-	-	t	10	9.79-19.79	540.31	0.010	06-May-91
MW-17td	560.34	560.09	560.37	2	42.5	-	-	t	10	32.46-42.46	517.91	0.010	06-May-91
MW-17sb	560.78	560.32	560.82	2	68	50	511	sb	10	58.27-68.27	492.55	0.010	06-May-91
MW-17db	560.31	NA	560.80	6	400	50	510	db	NA	60.0-400	160	NA	29-Apr-91
MW-18t	466.99	466.55	465.10	2	14	-	-	t	10	4.59-14.59	450.51	0.010	09-May-91
MW-18sb	467.07	466.61	465.31	2	45	27	438	sb	10	35.23-45.23	420.08	0.010	09-May-91
MW-18db	465.93	NA	465.24	6	200	27	438	db	NA	40.0-200	265	NA	06-May-91

NA-Not Applicable

(1) Elevations surveyed/resurveyed 6/91-4/92
(2) t-till sb-shallow bedrock db-deepbedrock
(3) caved to 305 ft.
(4) angled well installed at 63 degrees.
(5) approximate

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TABLE 2-2 (CONTINUED)
SUMMARY OF WELL COMPLETION DETAILS
MONITORING REPORT - DEEP BEDROCK INTERIM REMOVAL ACTION
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

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WELL	ELEVATION (1)			WELL DIAMETER	TOTAL DEPTH OF BORING	BEDROCK		MONITORED ZONE					
	TOP OF STEEL CASING (ft-MSL)	TOP OF PVC (ft-MSL)	GROUND SURFACE (ft-MSL)	(inches)	(feet)	DEPTH (feet)	SURFACE ELEVATION (ft-MSL)	(2) AQUIFER	SCREEN LENGTH (feet)	MONITORED DEPTH (feet)	WELL POINT ELEVATION (ft-MSL)	SLOT SIZE (in.)	DATE COMPLETED
MW-19sb	469.54	469.28	467.53	2	19.5	4.5	463	sb	10	9.22-19.22	448.31	0.010	13-May-91
MW-20sb	427.70	427.62	425.40	2	20.5	5	420	sb	10	10.45-20.45	404.95	0.010	01-May-91
MW-21db	549.29	NA	550.00	6	411	35	515	db	NA	46.0-411	139	NA	26-Apr-91
MW-22db	504.52	NA	503.09	6	348	23	480	db	NA	40.0-348	155	NA	22-Apr-91
MW-23t	570.09	569.62	570.09	2	69	69	501	t	10	15.84-25.84	544.25	0.010	14-Jun-91
MW-24t	568.12	567.67	568.11	2	26	-	-	t	10	16.43-26.43	541.68	0.010	19-Jun-91
MW-25t	570.91	570.34	570.91	2	47	47	523.91	t	10	16.29-26.29	544.62	0.010	21-Jun-91
MW-26t (4)	569.96	569.65	568.81	2	44.5	44.5	524	t	10	35.50-44.41	524.40	0.010	27-Jun-91
MW-27t	537.95	537.70	537.97	2	128	-	-	t	10	115.96-125.96	412.01	0.010	14-Oct-91
MW-27sb	537.42	537.14	537.45	2	143	128	410	sb	10	133-143	395	0.010	11-Oct-91
MW-27db	539.07	NA	537.58	6	342	128	410	db	NA	150-342	196	NA	09-Oct-91
MW-28t		567.66	567.20	2	35	35	532	t	10	24.9-34.9	532.30	0.010	25-Mar-92
MW-28sb		571.49	568.00	2	49	32	536	sb	10	38.95-48.95	519.05	0.010	25-Mar-92
MW-28db	570.24	NA	568.30	6	500	28	540	db	NA	44-500	68.30	0.010	25-Mar-92
MW-29t		554.59	551.14	2	60	60	491	t	10	50.28-60.28	490.86	0.010	25-Mar-92
MW-29sb		551.04	549.70	2	78	60	490	sb	10	68.65-78.65	471.05	0.010	25-Mar-92
MW-29db	551.78	NA	549.80	6	400	56	494	db	NA	72-400	149.80	NA	25-Mar-92
MW-30ts		573.60	573.57	2	28	-	-	t	10	18.33-28.33	545.24	0.010	31-Mar-92
MW-30td		573.34	573.39	2	41	41	532	t	10	30.84-40.84	532.55	0.010	31-Mar-92

NA-Not Applicable

(1) Elevations surveyed/resurveyed 6/91-4/92
(2) t-till sb-shallow bedrock db-deepbedrock
(3) caved to 305 ft.
(4) angled well installed at 63 degrees.
(5) approximate

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TABLE 2-2 (CONTINUED)
SUMMARY OF WELL COMPLETION DETAILS
MONITORING REPORT - DEEP BEDROCK INTERIM REMOVAL ACTION
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

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WELL	ELEVATION (1)			WELL DIAMETER	TOTAL DEPTH OF BORING	BEDROCK		MONITORED ZONE					
	TOP OF STEEL CASING (ft-MSL)	TOP OF PVC (ft-MSL)	GROUND SURFACE (ft-MSL)	(inches)	(feet)	DEPTH (feet)	SURFACE ELEVATION (ft-MSL)	(2) AQUIFER	SCREEN LENGTH (feet)	MONITORED DEPTH (feet)	WELL POINT ELEVATION (ft-MSL)	SLOT SIZE (in.)	DATE COMPLETED
MW-EPA-Ats	570.40	570.36	568.88	2	28.5	66	501	t	10	18.48-28.48	540.40	0.010	16-Jan-90
MW-EPA-Atd	570.29	570.00	568.80	2	64.5	66	501	t	10	53.76-63.76	505.04	0.010	12-Apr-91
MW-EPA-Asb	569.99	569.93	568.83	2	81.5	66	501	sb	10	71.85-81.85	486.98	0.010	11-Apr-91
DW-1t	570.33	569.92	568.71	2	43	44	525	t	40	2.55-42.55	526.16	0.010	15-Apr-91
DW-2t	NA	568.91	567.6	4	40.5	41	527	t	36	4.5-40.5	527.1	0.010	02-Dec-91
DW-3t	NA	570.53	567.0	4	38.5	38.5	529	t	34.5	2.0-36.5	528.5	0.010	06-Dec-91
DW-4t	NA	566.02	564.5	4	37.5	37.5	527	t	34	3.5-37.5	527.0	0.010	26-Nov-91
OW-1t	NA	570.93	568.1	4	42.5	42.5	525	t	38	4.5-42.5	525.6	0.010	05-Dec-91
OW-2t	NA	568.46	567.5	4	41	41	527	t	37	4.0-41.0	526.5	0.010	04-Dec-91
OW-3t	NA	569.26	567.9	4	44	44	524	t	40	4.0-44.0	523.9	0.010	27-Nov-91
OW-4t	NA	565.69	565.2	4	39.5	39.5	526	t	36	3.5-39.5	525.7	0.010	02-Dec-91
OW-5t	NA	567.50	565.5	4	40.5	40.5	525	t	36	4.5-40.5	525.0	0.010	25-Nov-91
OW-6t	NA	566.83	565.5	4	39.5	40	526	t	36	3.5-39.5	526.0	0.010	21-Nov-91
OW-7t	NA	567.38	564.0	4	40.5	40.5	524	t	40	0.5-40.5	523.5	0.010	20-Nov-91
GW-08db	522.39	NA	(5) 528	6	(5) 300	?	?	db	NA	(5) 33-300	(5) 222	NA	unknown
GW-10db	574.25	NA	574.25	6	(5) 325	(5) 42	(5) 532	db	NA	(5) 43-325	(5) 249	NA	unknown
GW-12db	554.00	NA	554.00	6	131	(5) 98	(5) 456	db	NA	98-131	423	NA	unknown
VW-1	NA	567.70	---	2	18.0	---	---	t	5	5.0-10.0	557.7	0.010	22-May-89

NA-Not Applicable

(1) Elevations surveyed/resurveyed 6/91-4/92
(2) t-till sb-shallow bedrock db-deepbedrock
(3) caved to 305 ft.
(4) angled well installed at 63 degrees.
(5) approximate

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TABLE 2-2 (CONTINUED)
SUMMARY OF WELL COMPLETION DETAILS
MONITORING REPORT - DEEP BEDROCK INTERIM REMOVAL ACTION
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

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WELL	ELEVATION (1)			WELL DIAMETER	TOTAL DEPTH OF BORING	BEDROCK		MONITORED ZONE					
	TOP OF STEEL CASING (ft-MSL)	TOP OF PVC (ft-MSL)	GROUND SURFACE (ft-MSL)	(inches)	(feet)	DEPTH (feet)	SURFACE ELEVATION (ft-MSL)	(2) AQUIFER	SCREEN LENGTH (feet)	MONITORED DEPTH (feet)	WELL POINT ELEVATION (ft-MSL)	SLOT SIZE (in.)	DATE COMPLETED
PZ-3	468.37	NA	---	0.55	NA	NA	NA	t	NA	463.37-468.37	463.37	NA	15-May-92
PZ-4	453.25	NA	---	0.55	NA	NA	NA	t	NA	448.25-453.25	448.25	NA	15-May-92
PZ-5	475.35	NA	---	0.55	NA	NA	NA	t	NA	470.35-475.35	470.35	NA	15-May-92
PZ-6	419.67	NA	---	0.55	NA	NA	NA	t	NA	414.67-419.67	414.67	NA	12-May-92
PZ-7	415.24	NA	---	0.55	NA	NA	NA	t	NA	410.24-415.24	410.24	NA	12-May-92
PZ-8	517.75	NA	---	0.55	NA	NA	NA	t	NA	512.75-517.75	512.75	NA	15-May-92

NA-Not Applicable

(1) Elevations surveyed/resurveyed 6/91-4/92
(2) t-till sb-shallow bedrock db-deepbedrock
(3) caved to 305 ft.
(4) angled well installed at 63 degrees.
(5) approximate

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2.4.2 Ground-Water Sampling

Ground-water samples were collected from Phase 1 monitoring wells prior to the RI/FS studies to delineate on-site ground-water contamination in the till and shallow bedrock. Ground-water samples were collected from the Phase 1 monitoring wells during October 1987. Samples were also collected from these wells during February 1988. Well locations are shown on a study area map, Figure 1-2.

Two rounds of RI/FS ground-water sampling were conducted during July 1990 and December 1990 for the Phase 1 and 2 till and shallow bedrock monitoring wells listed above. Round 1 sampling was conducted in July and August 1991 for Phase 3 till and shallow bedrock wells, except MW-27t and MW-27sb. Round 1 sampling of MW-27t and MW-27sb, and Round 2 sampling of the Phase 3 till and shallow bedrock monitoring wells, was conducted in January 1992. Round 2 sampling of Phase 3 wells MW-27t and MW-27sb, and Round 1 sampling of Phase 4 till and shallow bedrock monitoring wells, were conducted in April 1992.

Packer ground-water sampling was conducted at deep bedrock monitoring wells during the RI/FS. Two rounds of packer sampling were conducted at Phase 2 deep bedrock monitoring wells and former supply wells GW-10db and GW-12db in July and December 1990. Round 1 packer sampling was conducted at Phase 3 deep bedrock monitoring wells in June and July 1991. Round 2 packer sampling at Phase 3 deep bedrock monitoring wells MW-1db, MW-8db, MW-11db, MW-18db, MW-21db, and MW-22db was performed in December 1991. Phase 3 wells MW-6db, MW-15db, and MW-17db were equipped with pitless adapters for pumps to be used as part of the ground-

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water extraction system for the Interim Removal Action. These adapters were installed prior to Round 2 sampling; consequently, these wells could not be sampled by packer, but instead were purged using a submersible pump and then sampled with a bailer.

Round 1 packer sampling was performed at Phase 4 deep bedrock monitoring wells in April 1992. Ground-water samples were collected from each well at discrete fracture zones that had previously been identified by borehole geophysics and/or drilling activities.

Field data sheets for these sampling events are provided in Appendix E. Ground-water sampling during the RI/FS was performed in accordance with procedures outlined in the Sampling and Analysis Plan (SAP) for ground water (Fuss & O'Neill, 1990a).

Ground-water grab samples have periodically been collected from GW-10db, Linemaster's backup production well ,and GW-12db, the former Blakely production well. Grab samples have also been collected from the Linemaster production well GW-08db.

Ground-water samples collected during October 1987 and February 1988 were analyzed by EPA Method 8010. Samples collected at the Linemaster production well (GW-08db), backup production well (GW-10db), and the former Blakely production well (GW-12db) have also been analyzed by EPA Method 8010.

Samples collected from wells during the RI/FS investigations suspected of having no or low levels of VOCs (<100 ug/l) were analyzed using EPA Method 524.2 to achieve low limits of detection. Wells analyzed by this method included MW-1t, MW-1sb,

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MW-2t, MW-3t, MW-5sb, MW-7sb, MW-8t, MW-8sb, MW-8db, MW-11t, MW-11sb, MW-12t, MW-12sb, MW-12db, MW-14sb, MW-14db, MW-15t, MW-15sb, MW-17td, MW-17sb, MW-18t, MW-18sb, MW-18db, MW-19sb, MW-20sb, MW-22db, MW-27t, MW-27sb, MW-27db, MW-28t, MW-28sb, MW-28db, MW-29t, MW-29sb, and MW-29db. Samples collected from these wells were selected for analysis by EPA Method 524.2 based on sampling conducted during pre-RI/FS investigations and the location of the wells relative to the source area. These wells are located away from contaminant source areas and/or near site boundaries where the potential for levels of VOCs in ground water greater than 100 ug/l generally is low.

During the RI/FS, samples collected from wells suspected of having VOC concentrations $\geq$ 100 ug/l, as determined from pre-RI/FS ground-water data and the location of the wells relative to the source area, were analyzed using EPA Method 8240. Wells analyzed by this method included MW-EPA-Ats, MW-EPA-Atd, MW-EPA-Asb, MW-1sb, MW-4t, MW-6t, MW-6sb, MW-6db, MW-9sb, MW-10ts, MW-10td, MW-10sb, MW-11db, MW-13db, MW-15t, MW-15sb, MW-15db, MW-16t, MW-16sb, MW-16db, MW-17ts, MW-17td, MW-17sb, MW-17db, MW-19sb, MW-21db, MW-23t, MW-24t, MW-25t, MW-26t, MW-30ts, MW-30td, GW-08db, GW-10db, and GW-12db. These wells are located near source areas or in the direction of contaminant migration.

Ground-water samples collected from all till, shallow bedrock, and deep bedrock wells during the RI/FS were analyzed for total arsenic, barium, beryllium, cadmium, chromium, lead, and nickel by EPA Methods 7060, 6010, 6010, 7131 or 6010, 7191 or 6010, 7421 or 6010 and 6010, respectively. Samples from a select number of wells were filtered in the field and analyzed for the above

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soluble metals. Wells were selected to represent till, shallow bedrock, and deep bedrock ground-water quality at representative areas across the site. Wells where filtering was conducted include MW-1sb, MW-1db, MW-6t, MW-6sb, MW-6db, MW-8t, MW-8db, MW-10t, MW-10sb, MW-11t, MW-11sb, MW-11db, MW-14db, MW-15t, MW-15db, MW-16t, MW-17td, MW-17db, MW-18sb, MW-21db, MW-22db, MW-24t, MW-29db, MW-EPA-Asb, GW-10db, and GW-12db. A representative number of wells and a number of EPA required wells were analyzed for the total and soluble HSL metals listed on Table 2-1. This set of wells included MW-1sb, MW-3t, MW-6t, MW-6sb, MW-6db, MW-7sb, MW-12sb, MW-16t, MW-17td, MW-17db, MW-18sb, MW-23t, MW-25t, MW-26t, MW-28t, MW-28sb, and MW-28db. Samples were also collected for total suspended solids analysis at representative locations where total and soluble metals were collected.

During the RI/FS, a representative number of wells and a number of EPA required wells were sampled and analyzed for ABNs by EPA Method 8270. This set of wells included MW-1sb, MW-3t, MW-4t, MW-6t, MW-6sb, MW-7sb, MW-10ts, MW-12t, MW-12sb, MW-16t, MW-17td, MW-17db, MW-18sb, MW-23t, MW-25t, MW-26t, MW-28t, MW-28sb, and MW-28db. This group of wells was selected to include wells located in or near potential source areas as well as in the direction of ground-water flow from the potential source areas.

2.4.3 Hydraulic Conductivity Tests

2.4.3.1 Slug Tests

Slug tests were conducted to assess the hydraulic conductivity of the geological materials at the site. Slug tests were performed in Phase 1, 2, and 3 till and shallow bedrock monitoring wells

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during April 1990 and June 1991. Tests were conducted in the Phase 2 and 3 deep bedrock wells during May 1990 and June 1991. Data gathered during these field tests were subsequently analyzed using the Slugix computer program (Inteprex, 1988) utilizing analytical solutions developed by Bouwer and Rice (1976) and Cooper, Bredehoeft, and Papadopulos (1967).

Slug testing consists of inducing an instantaneous change in water levels in a well and measuring the recovery of those levels back to equilibrium. The transmissivity (hydraulic conductivity) of the aquifer is based on fitting the recovery data to analytical equations derived for a specific model.

Bouwer and Rice Model

The Bouwer and Rice model is applicable for wells screened in unconfined aquifers. Assumptions for this model are the following:

(1) drawdown of the water table around the well is negligible;
(2) flow above the water table (in capillary fringe) is negligible;
(3) well losses are negligible; and,
(4) the aquifer is homogeneous and isotropic.

The equation relating the recovery data and hydraulic conductivity of the aquifer using the Bouwer and Rice model is the following:

$$Ln(S_o) - Ln(S_t) = \frac{2KLt}{r_c^2 Ln(r_e \backslash r_w)} \qquad (1)$$

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where,

S_o	≡	initial instantaneous change (drawdown) in water levels in the well (L)
S_t	≡	drawdown in well at time t (L)
K	≡	hydraulic conductivity of the aquifer (L/t)
L	≡	length of screened portion of aquifer (L)
t	≡	time (t)
r_e	≡	radius from well over which head loss in aquifer occurs during test (L)
r_w	≡	radius of well (including surrounding gravel pack) (L)
r_c	≡	radius of well casing over which the water levels change. (L)

The unknowns in Equation (1) are K, which is to be determined, and r_e. However, based on electroresistivity analogue analyses, Bouwer and Rice (1976) have determined that the values of $Ln(r_e/r_w)$ are a function of the known parameters r_w, H, and D, where,

H	≡	depth to the bottom of the screened horizon below the water table (L); and,
D	≡	saturated thickness of the aquifer.

Consequently, K is the only parameter which is unknown.

The parameters in Equation 1 which are least well-defined and thus introduce the most error, include r_w, which is the radius of the boring in which the well was emplaced, and L, which is the length of the screened portion of the aquifer. For the analyses

equipment used to complete the boring. Therefore, r_w is equal to 0.167, 0.323, 0.542, or 0.124 feet for borings completed with 4", 7.75", 13", or 3" O.D. augers or NX bedrock core barrel, respectively. Based on slug test methodologies listed in SW-846 (US EPA, 1986), the value for L should be equal to the length of the well screen. However, it may be more appropriate to use the length of the gravel pack surrounding the screened horizon (Herman Bouwer, personal communication, 1992). Therefore, the values of L used in the slug test analyses for this report are equal to the length of the gravel pack where it is fully saturated. In general, the gravel pack is two feet longer than the screened horizon.

A sensitivity analysis of Equation 1 with respect to parameters r_w and L was conducted using slug test data from monitoring wells MW-1t and MW-11t. Based on results of those analyses, a 10 percent increase in the value of r_w resulted in a 17 or 27 percent decrease in the estimated hydraulic conductivity value for monitoring well MW-1t and MW-11t, respectively. A 20 percent decrease in value of L (from 12 to 10 feet) resulted in a 34 percent decrease in estimated hydraulic conductivity value for well MW-11t.

Cooper et al. Model

The Cooper et al. model is applicable for wells screened in confined aquifers. Assumptions for this model include the following:

(1) water is released from storage in the aquifer due to an instantaneous decrease in water levels in a well;

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(2) flow is unsteady;

(3) the well fully penetrates the aquifer; and,

(4) the aquifer is homogeneous and isotropic.

The equation derived from this model is mathematically complex. However, Cooper et al. (1967) derived type curves in which dimensionless head values (H_t/H_o) are plotted against dimensionless time, β, where,

H_t ≡ drawdown in the well at time t; (L)

H_o ≡ initial drawdown in the well at t=0; (L)

and,

$$\beta = \frac{Tt}{r_{c2}}$$

where,

T ≡ transmissivity (L^2/t)

t ≡ time (t)

r_c ≡ radius of the well casing (L)

Each type curve corresponds to different values of another dimensionless quantity, α, such that

$$\alpha = \frac{r_w^2 S}{r_c^2}$$

where,

r_w ≡ radius of well (and gravel pack)(L), and

S ≡ storage coefficient (dimensionless)

Analysis using the Cooper et al. model involves fitting the

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recovery data to a type curve in a similar fashion as fitting pumping test data to a Theis Model curve. The type curves are shown in SW-846.

A sensitivity analyses using the Cooper et al. model curves was conducted using the slug test data for well MW-10sb. Based on results from those analyses, a 10 percent increase in the value of r_w resulted in a one percent decrease in value for transmissivity for the aquifer and a 16 percent decrease in value of storativity. The values of transmissivity and storativity were not affected by a change in length of the screened horizon.

The results of the slug tests, as they relate to site-specific hydrogeologic conditions, are discussed in greater detail in Section 3.3.1. Slug test data and model curves for the till, shallow bedrock, and deep bedrock wells are presented in Appendix F.

2.4.3.2 Packer Tests

Packer tests were conducted at Phase 2 and 3 deep bedrock monitoring wells during the RI/FS. Nitrogen inflatable bladders were used to perform hydraulic conductivity tests at deep bedrock monitoring wells MW-12db, MW-13db, MW-14db, GW-10db, and GW-12db during July 1990. Packer tests were conducted at deep bedrock monitoring wells MW-1db, MW-6db, MW-8db, MW-15db, MW-17db, MW-18db, MW-21db, and MW-22db from June to July 1991. Discrete fracture zones, previously identified by borehole geophysics and drilling activities, were tested within each of the wells. The data were analyzed using a Bureau of Reclamation Method (U.S. Department of the Interior, 1987).

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A packer test consists of inducing flow into a sealed portion of the well under a specific hydraulic head in order to determine the hydraulic conductivity of the aquifer. The hydraulic conductivity of the aquifer over the portion of the well subjected to a packer test is directly proportional to the flow and inversely proportional to the hydraulic head based on the following assumptions:

(1) the induced hydraulic head and flow are constant;
(2) well losses are negligible; and,
(2) the aquifer is homogeneous and isotropic.

The resulting equation is:

$$K = (Q/2\pi LH)\,Ln(L/r_w) \qquad (1)$$

where,

K ≡ hydraulic conductivity of the aquifer (L/t)
Q ≡ flow into the well during the test (L^3/t)
L ≡ length of portion of well (aquifer) being tested (L)
H ≡ induced head during test (L)
r_w ≡ radius of well (L)

The unknown in Equation (1) is K, the hydraulic conductivity, which is variable of interest.

The flow and induced head parameters are controlled by the equipment used to conduct the packer test. The precision of those two parameters for the tests which were conducted is

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approximately 1.0 and 0.7 percent, respectively. The length of the portion of the well subjected to a packer test was either 20, 30, 40, 50, 60 or 70 feet. The radius of all wells subjected to a packer test is 0.25 feet. An error of 0.5 feet in length of 20 feet or 0.05 feet in radius results in an approximate 2 or 4 percent error in calculated hydraulic conductivity value, respectively.

A source of error during the tests may result from leakage through the packers used to seal the portion of the well to be tested. However, during all tests, water levels in the well above the sealed portion were monitored for any leakage.

Results of the packer data analyses are provided in Appendix G and are discussed in Section 3.3.1.2 A complete description of the packer testing apparatus and protocols is provided in the SAP (Fuss & O'Neill, 1990a).

2.4.3.3 Triaxial Cell Permeability Test

A triaxial cell permeability test (Army Corps of Engineers, EM 1110-2-1906) was conducted on an undisturbed till sample collected at a depth of 6 feet in Zone 1 at the location shown on Figure 2-3. This test was conducted to determine a representative value for the till vertical hydraulic conductivity so that a vertical ground-water flow velocity could be calculated for the till unit.

A triaxial cell permeability test is similar to a constant head permeability test. In this test, one dimensional flow is induced through the sample. The assumptions for the test are:

(1) the induced hydraulic head and flow are constant;

(2) flow through the sample is laminar.

Thus, the resulting equation is a variation of Darcy's law:

$$K = (VL)/(Ath) \qquad (1)$$

where,

K ≡ hydraulic conductivity of the sample in the direction of flow (L/t)

V ≡ volume of water which flowed through the sample during the test (L^3)

L ≡ length of sample in direction of flow (L)

A ≡ cross-sectional area of sample over which flow occurred (L^2)

t ≡ time over which the test was conducted (t)

h ≡ difference in hydraulic head over the length of the sample (L)

The unknown in Equation (1) is K, the hydraulic conductivity, which is variable of interest. Note that the term "coefficient of permeability" is the same as hydraulic conductivity.

The possible sources of error include:

(1) stratification of the sample during the test;

(2) incomplete saturation of the sample;

(3) excessive hydraulic gradient;

(4) leakage along the side of the sample; and,

(5) evaporation losses of water which flowed through the sample.

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The advantages of a triaxial cell permeability test over a normal constant head test are that (a) leakage along the sides of the sample is minimized, and (b) hydraulic conditions in the field can be induced.

A sensitivity analysis was performed based on the reported results. For a conservative analysis, i.e., maximum error, the error of measurement of the diameter and length of the sample is assumed to be 0.05 inches, the error of measurement for the volume of water is assumed to be 5 cubic centimeters, the error of measurement of the time and hydraulic head during the test is assumed to be negligible and the test is assumed to have been conducted a minimum of two (2) hours. Based on those errors of measurements, the maximum error in calculated hydraulic conductivity value is seven (7) percent of the reported value.

The results of the triaxial cell permeability test and the vertical flow velocity calculation are discussed in Section 3.3.3.

2.4.4 Water-Level Measurements

Water levels were measured in monitoring wells at the site to determine ground-water elevations and water-table fluctuations and as part of the monitoring program for a deep bedrock Interim Removal Action. Measurements were taken in January, July, and August 1990, September 1991, January, March, April, May, and June 1992. These data are discussed in detail in Section 3.3.

2.4.5 Pilot Pumping Tests

Pilot pumping tests were conducted at GW-10db and GW-12db in April 1991. These tests were conducted to estimate the pumping rates and determine the approximate area of influence of the wells. This information was required prior to the initiation of the deep bedrock Interim Removal Action. GW-10db and GW-12db were found to yield approximately 10 gpm and 4 gpm, respectively. Many of the deep bedrock wells at the site were influenced during the tests, indicating the presence of an extensive interconnected fracture network. The facility production well, GW-08db, remained active during the pumping tests because this well also supplies the Blakely residence. In addition, it was not feasible to provide the Linemaster facility with an alternate supply of water during this time period. The detailed results of these pilot pumping tests are provided in Appendix H.

2.4.6 Background Water-Level Study

A background water-level study was conducted in September and November 1991 to assess the water-level changes associated with water use in the area and to establish background water-level conditions prior to the start-up of the deep bedrock Interim Removal Action. This study was conducted using on-site monitoring wells and water-supply wells and selected off-site water-supply wells. The results of this study are discussed in Section 3.3 and are detailed in Appendix I.

2.4.7 Zone 1 Dewatering Feasibility Study

A pumping test was conducted on DW-1t, located in Zone 1, in April 1992 to assess the feasibility of dewatering the Zone 1 soils by pumping. The test was conducted over a period of 1.5 months. During this time, water levels were measured in nearby observation and monitoring wells. Additionally, ground-water samples were collected from the pumping well for analysis of VOCs, ABNs, and HSL metals. The results of this study are provided in Appendix J.

2.5 Geophysical Surveys

2.5.1 EM Survey

Electromagnetic mapping (EM) of low-conductivity zones was conducted at the site in September 1988 by the U.S. Geological Survey (USGS). The investigation delineated probable areas where bedrock exists close to the surface at the site. However, USGS equipment limitations limit the usefulness of the information. The methodology, area of coverage and results of this investigation are provided in Appendix K. A summary of EM methodology and purpose is provided in Table 2-3.

2.5.2 Borehole Geophysics

The USGS performed borehole geophysical investigations on monitoring wells GW-10db (former facility production well) and GW-12db (former Blakely residence supply well) in November 1989. Borehole geophysical methods employed during this investigation

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TABLE 2-3
SUMMARY OF GEOPHYSICAL SURVEYS[1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Electromagnetic (above ground)	Electromagnetic surveys are utilized to: - map contaminant plumes - assess natural hydrogeologic conditions - locate buried metal objects - locate buried trenches - identify bedrock fractures and faults - define lithological units - map grain size distributions	An EM survey provides a means of measuring the electrical conductivity of subsurface soil, rock and ground water. Through the measurement of the conductivity of any pore fluids, and determining the fluid composition, assessments of natural geohydrologic conditions as well as the mapping of contaminant plumes may be accomplished. EM instruments read conductivity in millimhos/meter. Conductivity is most often influenced by water as well as porosity, the extent of saturation, concentrations of electrolytes and colloids in the pore fluid and the temperature of the pore fluid.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS[1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Caliper (borehole)	Caliper logs are utilized to: - identify fractures in igneous and metamorphic bedrock - identify solution openings in limestone - collect data regarding lithology and stratigraphic correlation - collect data regarding casing corrosion and cementing - correct other logging functions	The caliper device provides a continuous record of the average diameter of a drill hole. Caliper resolution is horizontal and vertical. The caliper device is lowered and raised up the borehole.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
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METHOD	PURPOSE	METHODOLOGY
Temperature (borehole)	The probe is lowered and raised up the borehole thus providing a temperature profile of the entire borehole. Temperature logs are utilized to: - provide information regarding ground-water flow - identify saturated zones - provide information regarding dispersion dilution - provide information regarding movement of contaminants	Temperature logging provides a continuous record of temperature changes of the fluid surrounding the down-hole probe. The probe is lowered and raised up the borehole thus providing a temperature profile of the entire borehole.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
16" and 64" Normal Resistivity (borehole)	16" and 64" normal resistivity logging is utilized to obtain information regarding bedrock fracture density. Fracture density refers to either fractures per unit area or total fracture aperture per unit area.	16" and 64" normal resistivity is conducted by supplying a constant current to a current electrode where the resulting voltage drop is measured on a return electrode. The resistivity of the surrounding formation and bore-hole fluid is determined by Ohm's Law and the geometry of the electrode spacing. The differences between 16" and 64" logging are the electrode spacing, depth of the investigation and other geometric factors. 16" and 64" normal resistive electrodes are part of a probe which is lowered and raised up the borehole.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Fluid Resistivity (borehole)	Fluid resistivity logging is utilized to: - provide information regarding ground-water flow - provide information regarding ground-water quality	Fluid resistivity measures the voltage drop between the two electrodes. The probes are part of a probe which is lowered and raised up the borehole.
Natural Gamma (borehole)	Natural gamma logging is utilized to: - identify differing lithologies - identify water yielding zones	Natural gamma logging is conducted by measuring the natural occurring gamma radiation that is emitted from the decay of radioisotopes found in rocks. The gamma sensing device is part of a probe which is lowered and raised up the borehole.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Single Point Resistivity (borehole)	Single point resistivity logging is utilized to: - provide information regarding geologic correlation - identify areas of fracturing, caving, and washouts	Single-point resistivity logging measures the resistance of the rock and fluid between and in-hole electrode and a surface electrode. During logging of a borehole, any change in the electrical resistance of the formation or fractures will show as a change in resistance on the log. Voltage is converted to resistance through Ohm's Law. Cavings, washouts and fractures are areas of less resistance.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Guard Resistivity (borehole)	Guard resistivity logging is utilized to: - define the lithology - identify fractures	Guard resistivity logging is conducted by supplying a constant current through an electrode bounded by two larger electrodes above and below. The larger guard electrodes provide currents which focus the center electrode current into a thin plane at right angles to the probe's long axis. This thin current plane penetrates the borehole wall and the result is a thin bed resolution resistivity. The probe is lowered then raised up the borehole

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

recycled paper

TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Video (borehole)	Borehole video is utilized to obtain information regarding: - texture of the walls of the borehole - the presence and geometry of fractured - fracture density - changes in mineralogy - fluid flow, inferred by the observation of moving particles in and out of fractures	Borehole video is conducted by lowering a video camera unit down the well. The housing around the camera contains a light and view portal.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

recycled paper

TABLE 2-3
(CONTINUED)
SUMMARY OF GEOPHYSICAL SURVEYS [1]
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

METHOD	PURPOSE	METHODOLOGY
Spontaneous Potential (borehole)	Spontaneous potential logging is utilized to identify changes in lithology.	Spontaneous potential logging measures small differences in voltage caused by chemical and physical contacts between the borehole fluid and the surrounding formation. These differences in voltage will occur at changes in lithology in the borehole. The spontaneous potential probe is lowered then raised up the borehole.
Acoustic Televiewer (borehole)	Acoustic televiewer logging is utilized to: - identify fractures 3-dimensionally - locate vugs and washouts - identify different lithologies - determine the strike and dip of fractures	Acoustic televiewer logging is conducted by transmitting ultrasonic seismograms through a downhole probe. Acoustic televiewer logs record the irregularities or physical changes along the bore-hole wall. These logs are sinusoidal and are indicative of fracture aperture and geometry.

1. References - U.S. EPA, 1987c
   - Colog Report in Appendix N

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consisted of caliper, temperature, gamma, focused resistivity, single point resistance, spontaneous potential, and acoustic televiewer logging. The acoustic televiewer data for GW-10db was later analyzed by Colog, Inc. to determine strikes and dips and aperture widths for the fractures identified within the well. Data gathered from both investigations are provided in Appendix L.

Additional borehole geophysics were performed by Weston Geophysical Corp. for Phase 2 monitoring wells MW-12db, MW-13db, and MW-14db in March 1990. Methods used for this investigation included caliper, temperature, gamma, single point resistance, spontaneous potential, and fluid conductivity logging. Data from this investigation are provided in Appendix M.

Borehole geophysics were performed in May 1991 by Colog, Inc. for Phase 3 deep bedrock wells MW-1db, MW-6db, MW-8db, MW-11db, MW-15db, MW-17db, MW-18db, MW-21db, and MW-22db in May 1991. Geophysical methods included full waveform sonic, caliper, natural gamma, 16-inch and 64-inch normal resistivity, guard resistivity, spontaneous potential, temperature, and fluid resistivity logging, as well as borehole video. Results of this investigation are summarized in a report provided in Appendix N.

The results of the borehole geophysical surveys and how they relate to site-specific conditions are discussed in detail in Sections 3.1 and 3.3. A summary of borehole geophysics methodologies and purposes is provided in Table 2-3.

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2.6 Surface-Water Investigations

2.6.1 Piezometer Installations

Piezometers PZ-1 and PZ-2 were installed in Pond 1 and Pond 2, respectively, during 1990 to measure surface-water elevations. Six additional piezometers (PZ-3 to PZ-8) were installed in study area surface-water bodies during Phase 1B investigations conducted in May 1992. Piezometers PZ-4 and PZ-7 were installed in Pond 1 and Pond 2 to replace PZ-1 and PZ-2, respectively, which had accidentally been destroyed. Prior to the installation of the six Phase 1B piezometers, wooden stakes were installed to mark the piezometer locations and allow measurement of surface-water elevations during April 1992. All piezometer elevations were surveyed relative to a National Geodetic Vertical Datum on May 20, 1992 and are recorded on Table 2-2.

2.6.2 Surface-Water Sampling

Prior to the RI/FS, initial surface-water quality sampling in the study area was performed on two occasions by NUS Corporation, an EPA subcontractor. On December 19, 1985, NUS collected surface-water samples from four locations within the study area. The sampling locations were at upstream and downstream locations in the unnamed stream west of the site, and upstream and downstream locations in Mill Brook south of the site, as indicated on Figure 1 in the March 23, 1987 NUS Corp. report (NUS, 1987).

On February 12, 1986, NUS also collected surface-water samples

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from six locations within the study area. These sampling locations included two wetland areas northwest of the site, Pond 1, Pond 2, Northeast Pond, and the point where the unnamed eastern stream crosses Route 171, as indicated on Figure 1 in the March 23, 1987 NUS Corp. report (NUS, 1987).

VOC analysis of two of the surface-water samples collected on December 19, 1985 was performed by CLP procedures. NUS did not specify how the samples were selected. The remaining eight surface-water samples collected during December, 1985 and February 1986 were also analyzed for VOCs by NUS in-house screening methods using a Photovac 10A10 gas chromatograph. Two of the December, 1985 surface-water samples were analyzed for metals by CLP methods. Additionally, all surface-water samples were analyzed for metals by a NUS in-house screening method using a Kevex 7000 x-ray fluorescence instrument (NUS, 1987).

Phase 1A RI/FS surface-water sampling was performed by Fuss & O'Neill during July 1990. Most surface-water samples were collected from locations where sediment samples were concurrently collected. Field data sheets for samples collected in July are provided in Appendix O. Locations of the surface-water sampling points, designated as "SW", are provided on Figure 2-8.

Surface-water samples were collected from 11 locations on July 19-20, 1990. These locations, designated as SW-1, SW-3, SW-4, SW-5, SW-6, SW-7, SW-9, SW-10, SW-11, SW-12, and SW-13, are shown on Figure 2-8. A sample from SW-2 was not collected because a surface-water body did not exist in the planned collection area located adjacent to Route 169 north of the Blakely residence. Sample SW-8 was scheduled to be collected from a point south of

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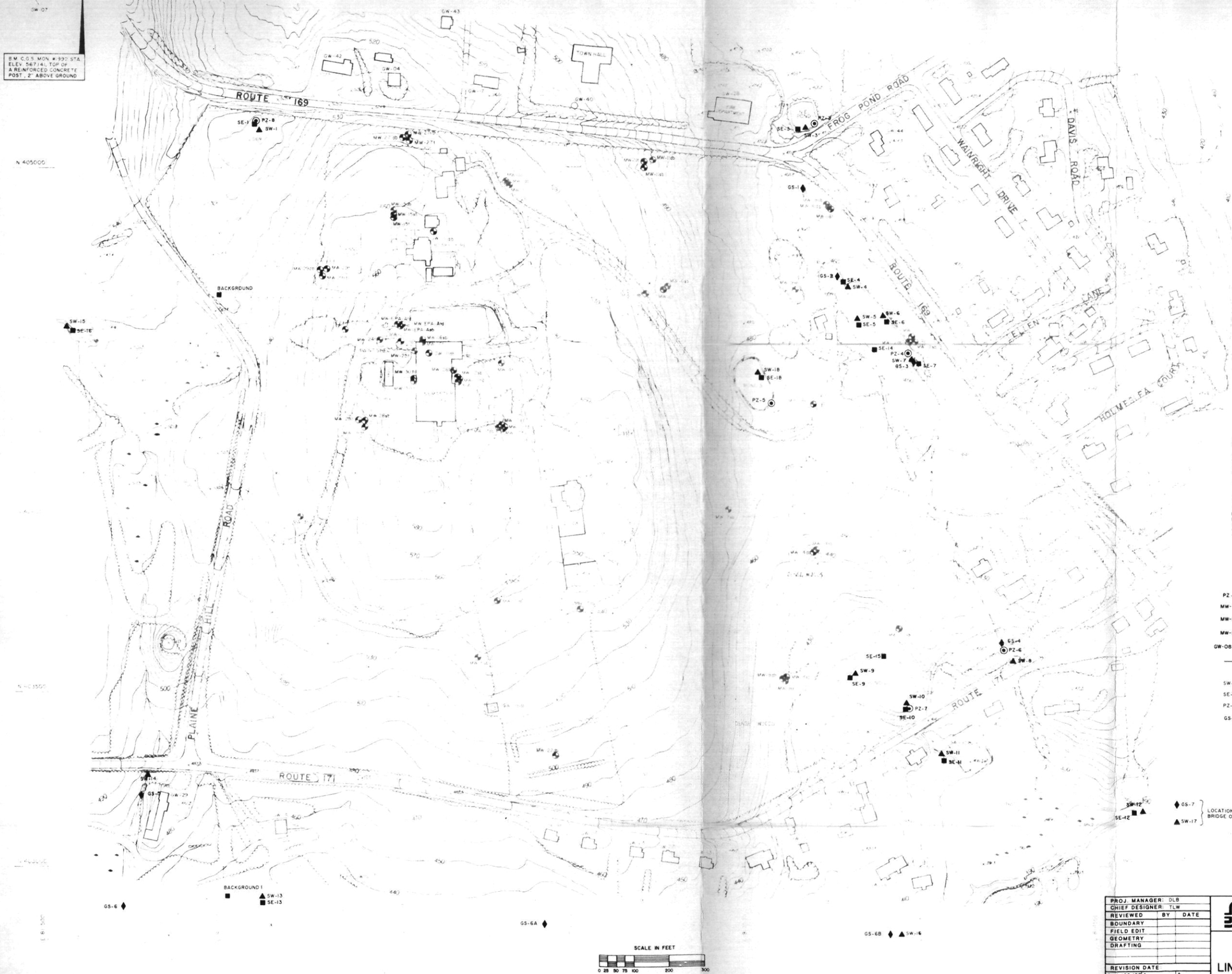

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-96 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LOCATIONS OF SURFACE-WATER & SEDIMENT SAMPLING POINTS, PIEZOMETERS & STREAM GAUGING STATIONS ARE APPROXIMATE. ALL PIEZOMETERS WERE FIELD LOCATED & VERIFIED VERTICALLY ON 5/20/92. SEE FIELD BOOK #525

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
SW-1	SURFACE-WATER SAMPLING LOCATION
SE-1	SEDIMENT SAMPLING LOCATION
PZ-3	PIEZOMETER LOCATION
GS-1	STREAM GAUGING STATION LOCATION

GS-7, SW-17: LOCATION APPROX. 300' TO N.E. AT RTE. 169 BRIDGE OVER MILL BROOK

PROJ. MANAGER: DLB		
CHIEF DESIGNER: TLW		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE		
△ 10/29/92 △		△
△	△	△

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

SURFACE-WATER & SEDIMENT INVESTIGATION LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

Pond 1 in the unnamed stream adjacent to the eastern site boundary, but the stream was dry at the time of sample collection. An additional surface-water sample, SW-14, was collected on October 1, 1991 from the unnamed stream west of the site as shown in Figure 2-8. Field data sheets for the collection activities are provided in Appendix O.

Surface-water samples were collected from Pond 3 on the following dates: December 11, 1990; March 5, 1991; April 4, 1991; and June 7, 1991.

During Phase 1B activities, 12 additional surface-water samples were collected during May 1992. With the exception of sample SW-17, which was collected May 15, all Phase 1B surface-water samples were collected on May 8. Samples SW-1, SW-3, SW-4, SW-7, SW-8, SW-10, SW-13, and SW-14 were collected at the same locations that were sampled during Phase 1A activities. Samples SW-15, SW-16, and SW-17 were collected at previously unsampled surface-water body locations. Sample SW-18 was collected from Pond 3. The locations of all surface-water sampling points are identified on Figure 2-8. Field data sheets for Phase 1B surface-water samples are included in Appendix O.

All Phase 1A and 1B RI\FS surface-water samples were analyzed for VOCs using EPA Method 524.2. Additionally, all Phase 1A samples were analyzed for total arsenic by EPA Method 7060, with the exception that several of the Pond 3 samples were not analyzed for arsenic. All Phase 1B surface-water samples were also analyzed for total arsenic, chromium, and lead by EPA Methods 7060, 6010, and 7421, respectively.

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2.7 Sediment Investigations

Pre-RI/FS sediment sampling was conducted in the study area by NUS on December 19, 1985 and February 12, 1986. On December 19, 1985, NUS collected sediment samples from four locations in the study area. Sediment samples were collected at upstream and downstream locations in the unnamed stream west of the site and upstream and downstream locations in Mill Brook south of the site, as indicated on Figure 1 in the March 23, 1987 NUS Corp. report (NUS, 1987). On February 12, 1986, NUS collected six additional sediment samples from locations within the study area. These sampling locations included two wetland areas northwest of the site, Pond 1, Pond 2, Northeast Pond, and the point where the unnamed eastern stream crosses Route 171. Sampling locations were identified on Figure 1 in the March 23, 1987 NUS Corp. report (NUS, 1987).

All sediment samples collected by NUS were analyzed for VOCs by in-house screening methods using a Photovac 10A10 gas chromatograph. Metals analyses were conducted for eight sediment samples by an in-house method using a Kevex 7000 x-ray fluorescence instrument.

Sediment samples were collected as part of the Phase 1A RI/FS studies in July 1990. Generally, paired sediment and surface-water samples were collected at each sampling location. Field data sheets for samples collected in July are provided in Appendix O. Locations of the sediment-sampling points, designated by the prefix "SE", are provided on Figure 2-8.

Sediment samples were collected from 13 locations during Phase 1A

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RI/FS investigations on July 19-20, 1990. These locations, designated as SE-1, SE-3, SE-4, SE-5, SE-6, SE-7, SE-9, SE-10, SE-11, SE-12, SE-13, SE-14, and SE-15, are shown on Figure 2-8. Sample SE-2 was not collected because a surface-water body did not exist at the proposed SE-2/SW-2 sampling point as discussed in Section 2.7. Sediment sample SE-8 was scheduled to be collected from a point south of Pond 1 in the unnamed stream adjacent to the eastern site boundary, but the stream was dry at the time of sampling and therefore no sample was collected. Two sediment samples (Background and Background-1) were also collected from the western portion of the study area to determine background sediment conditions.

Six Phase 1B sediment samples were collected between May 8 and May 13, 1992. Sediment samples SE-1, SE-3, SE-4, and SE-10 were collected at the same sampling points as the like designated Phase 1A sediment samples. Sediment sample SE-16 was a background sample collected from the unnamed stream northwest of the site. Sample SE-18 was collected from Pond 3. Phase 1B sediment sampling locations are indicated on Figure 2-8. Field data sheets, completed during Phase 1B sediment sampling, are included in Appendix O.

All RI/FS sediment samples were analyzed for VOCs by EPA Method 8240 and for total organic carbon (TOC), with the exception of the Phase 1A background samples, which were only analyzed for VOCs. Phase 1A sediment samples were analyzed for TOC by EPA Method 9060, whereas Phase 1B samples were analyzed by EPA Method Lloyd Kahn. Grain size analysis of sediment samples was performed by ASTM Method D422-63 (American Society of Testing and Materials, 1972).

Phase 1A samples were analyzed for arsenic by EPA Method 7060. Phase 1B samples SE-3, SE-4, and SE-10 were analyzed for HSL metals; however, the remaining Phase 1B sediment samples were only analyzed for arsenic (EPA Method 7060), chromium (EPA Method 6010), and lead (EPA Method 6010 or EPA Method 7421).

2.8 Long-Term Monitoring and Sampling

2.8.1 Interim Water-Supply Well Monitoring Program

An Interim Water-Supply Well Monitoring Program has been conducted at the Linemaster site since 1986. During this time period, a total of approximately 67 different drinking water sources in the study area have been sampled by the EPA, DEP, and Linemaster. The locations of water-supply wells that are part of the program are shown in Figure 2-9. A summary of positive detections for VOCs and arsenic is provided in Appendix P. The current residences that are part of the program, and frequencies of sampling, are listed in Table 2-4. All of these locations are utilized for drinking-water purposes except GW-36db and GW-41. GW-36db is an inactive well used for ground-water monitoring, which was formerly used by the Harvest at Bald Hill Restaurant. GW-41 is the discharge point of a curtain drain associated with the Blakely leaching field. A listing of construction details and other pertinent information for some of the water-supply wells is presented in Table 2-5. The ob and db letter suffixes identify water-supply wells completed in the overburden and deep bedrock, respectively. Well designations without suffixes indicate that the well completion information is incomplete or unknown. As can be seen from Table 2-5, water-supply wells in the study area are completed in both the overburden and bedrock

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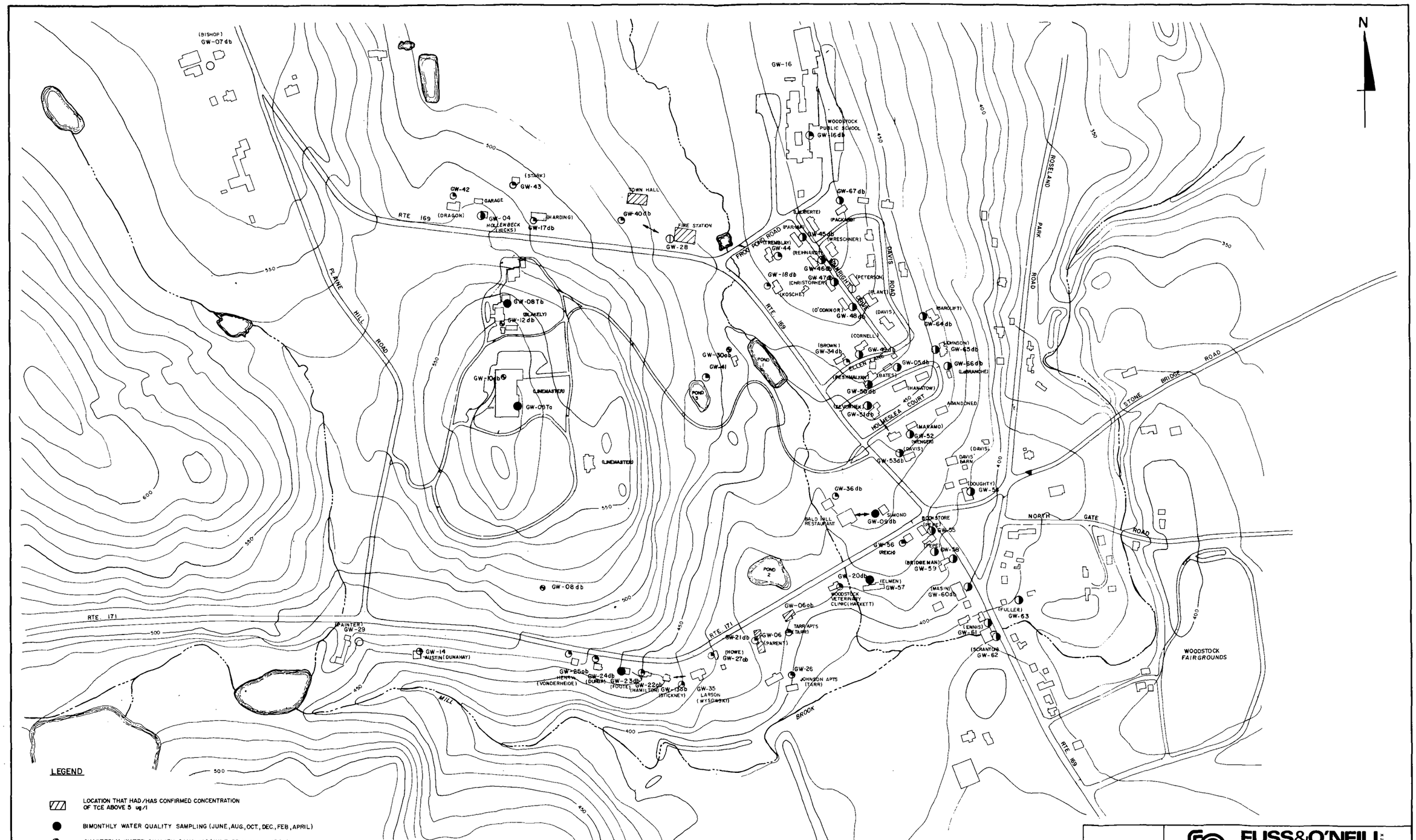

LEGEND

- LOCATION THAT HAD/HAS CONFIRMED CONCENTRATION OF TCE ABOVE 5 ug/l
- BIMONTHLY WATER QUALITY SAMPLING (JUNE, AUG, OCT, DEC, FEB, APRIL)
- QUARTERLY WATER QUALITY SAMPLING (JUNE, SEPT, DEC, MARCH)
- SEMI-ANNUAL WATER QUALITY SAMPLING (AUG, FEB.)
- ANNUAL WATER QUALITY SAMPLING (AUG)
- (A NAME) INDICATES PROPERTY OWNER
- INDICATES SHARED SUPPLY WELL
- WATER SUPPLY WELL (NOT SAMPLED)
- GW-50db DEEP BEDROCK WATER SUPPLY WELL
- GW-06ob OVER BURDEN WATER SUPPLY WELL
- GW-14 COMPLETION DETAILS UNKNOWN

SCALE IN FEET

0 200 400

NOTE:
CULTURAL FEATURES FROM 1985 AIR PHOTO. TOPOGRAPHY SOURCE MAP IS A PHOTOGRAPHIC ENLARGEMENT OF THE U.S.G.S. 7.5 MINUTE SERIES QUADRANGLE (PUTNAM 1955-PHOTOREVISED 1970)

LOCATIONS OF WELLS GW-06, GW-13, GW-17, GW-18, GW-21, GW-24, GW-25, GW-26, GW-27, GW-34, GW-36, GW-43, GW-56 WERE DETERMINED IN THE FIELD BY METHOD OF TRIANGULATION. OTHER WELL LOCATIONS ARE UNKNOWN.

REVISIONS
MAY 1989
JUNE 1991
OCT. 1991
NOV. 1991
JAN. 1992
JULY 21, 1992

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MANCHESTER, CONNECTICUT

INTERIM WATER SUPPLY WELL
MONITORING PROGRAM
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

PROJ NO	DATE	SCALE	FIELD BK	DESIGNER	CHECKER	FIGURE
86-88D	AUG. 1986		N A			2-9

TABLE 2-4

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INTERIM WATER-SUPPLY WELL MONITORING PROGRAM

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well Designation (1)	Description
BI-MONTHLY (FEB., APRIL, JUNE, AUGUST, OCT., DEC.)	
GW-08db (2)	Linemaster Factory (untreated)
GW-08Ta	Linemaster Factory (treated - after stripper - before carbon filter)
GW-08Tabt	Linemaster Factory (treated - between carbon filters)
GW-08Taac	Linemaster Factory (treated - after carbon filters)
GW-08Tb	Blakely Residence (supply from GW-08)
GW-09db	Petersen Residence
GW-17db	Harding Residence
GW-23db	Foote Residence
GW-57	Elmen Residence
QUARTERLY (MARCH, JUNE, SEPT., DEC.)	
GW-06ob	Tarr Apartments (untreated)
GW-06T	Tarr Apartments (treated)
GW-13ob	Stickney and Larson Residences
GW-14	Austin Residence
GW-16db	Woodstock Public School
GW-18db	Kosche Residence
GW-20db	Woodstock Veterinary Clinic
GW-21db	Parent Residence
GW-22ob	Hamilton Residence
GW-24db	Durga Residence
GW-25ob	Henry Residence
GW-26	Johnson Apartments
GW-27ob	Howe Residence
GW-34db	Brown Residence
GW-36db	Former Harvest at Bald Hill Restaurant (untreated)
GW-40db (2)	Woodstock Town Hall (untreated)
GW-40B	Woodstock Town Hall (between carbon filters)
GW-40T	Woodstock Town Hall (treated after carbon filters)
GW-41	Blakely Leaching Field Curtain Drain
GW-42	Dragon Residence
GW-43	Stark Residence
GW-44	Tremblay Residence (Abandoned)
GW-48db	O'Conner Residence (untreated)
GW-48T	O'Conner Residence (untreated)
GW-53db	Wenger Residence
GW-55	Bookstore
GW-56	Reich Residence

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TABLE 2-4 DRAFT

(CONTINUED) REV. 1.0 120192

INTERIM WATER-SUPPLY WELL MONITORING PROGRAM

REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORPORATION

WOODSTOCK, CONNECTICUT

DECEMBER 1992

Well Designation (1)	Description
SEMI-ANNUAL (FEB., AUGUST)	
GW-04	Hicks Apartments
GW-05db	Bates Residence
GW-45db	Parham Residence
GW-46db (3)	Reinhardt Residence
GW-47db (3)	Gayles Residence
GW-49db	Cornell Residence
GW-50db	Pershmalyan Residence
GW-51db	Zevornek Residence
GW-52	Maramo Residence
GW-54	Doughty Residence
GW-58	Pepe Residence
GW-59	Bridgeman Residence
GW-60db	Masin Residence
GW-61	Ennis Residence
GW-62	Scranton Shops
GW-63	Fuller Residence
GW-64db	Barclift Residence
GW-65db	Johnson Residence
GW-66db	LaBranche Residence
GW-67db (3)	Packard Residence
Stripper	
Backwash	Stripper for GW-08 (January and February)
ANNUAL (AUGUST)	
GW-07db	Bishop Residence
GW-29	Painter Residence
GW-06B	Tarr Apartments (between carbon filters)
GW-48B	O'Conner Residence (Between carbon filters)

(1) Well designation suffixes:
- 0b - well screened or completed in the overburden
- db - well screened or completed in the deep bedrock
- no suffix - information on well completion unavailable

(2) Totalizer reading obtained.

(3) Sample obtained before carbon filters.

86088\JT00625B.WQ1

TABLE 2-5

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RESIDENTIAL WELL CHARACTERISTICS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

SAMPLING ID(1)	LOCATION	DIA.	YEAR	TOTAL DEPTH (FT)	DEPTH TO BEDROCK (FT)	CASING LENGTH(FT)	SCREENED INTERVAL(2)	STATIC WATER LEVEL	APPROX. YIELD (gpm)
GW-04	HICKS APART	6"		>150				55	
GW-05db	BATES	6"	1982	132	4	20	OBH(21-132)	54	30+
GW-06ob	TARR APART	3'		8		~6	~4-8	~2	
GW-07db	BISHOP	6"	1984	225				34	10
GW-08db	LINEMASTER	6"		300				50	28
GW-09db	PETERSEN	6"		130					
GW-13ob	STICKNEY/LARSON	6"	1955	73	79+	67	68-73	0	4
GW-14	AUSTIN								
GW-16db	WOODSTOCK	6"	~1979	~300					
	PUBLIC SCHOOL								
GW-17db	HARDING	6"	1972	140	110	115	OBH(116-140)	20	7
GW-18db	KOSCHE	6"	1978	130	40	45	OBH(46-130)		100
GW-20db	WOODSTOCK								
	VETERINARY								
GW-21db	PARENT	6"	~1962	106					
GW-22ob	HAMILTON	6"	~1956	78					5-6
GW-23db	FOOTE	6"	1962	198					
GW-24db	DURGA								
GW-25ob	HENRY	24"	~1955						
GW-26	JOHNSON APTS.								
GW-27ob	HOWE	6"		55					
GW-29	PAINTER								
GW-34db	BROWN	6"	1978	215	35	40	OBH(40-215)	30	100
GW-36db	BALD HILL			105				17.9	
	RESTAURANT								
GW-40db	WOODSTOCK	6"	1989	165	48	63	OBH(62-165)	12	20+
	TOWN HALL								
GW-42	DRAGON								
GW-43	STARK								
GW-44	TREMBLAY		1953	120				6-8'	
GW-45db	PARHAM	6"	1978	270	45	50		9	75
GW-46db	REINHARDT	6"	1982	205	39	46		90	30+
GW-47db	GAYLES	6"	1978	210	35	40		35	75
GW-48db	O'CONNOR	6"	1978	265	30	35		35	35
GW-49db	CORNELL	6"	1979]	205	31	38		20	50
GW-50db	PERSHMALYAN	6"	1982]	176	20	27		73	30+
GW-51db	ZEVORNEK	6"	1982]	232	33	40		48	8
GW-52	MARAMO								
GW-53db	WENGER	6"	1984	210	15	30		53	30+
GW-54	DOUGHTY								
GW-55	PEPE-BOOKSTORE								
GW-56	REICH		~1960						
GW-57	ELMEN								
GW-58	PEPE-RESIDENCE								
GW-59	BRIDGEMAN								
GW-60db	MASIN	6"	1964	70	14	23		10	8
GW-61	ENNIS								
GW-62	SCRANTON SHOPS			3' BELOW BASEMENT					
GW-63	FULLER								
GW-64db	BARCLIFT	6"	1982	119	6	20		55	30+
GW-65db	JOHNSON	6"	1982	132	4	20		54	30+
GW-66db	LABRANCHE	6"	1982	138	4	21		50	30+
GW-67db	PACKARD	6"	1977	164	45	52		128	20+
GW-69db	DRAGON	6"	1992	350	76.5	90	OBH(88-350)	40	15

(1) db - BEDROCK
ob - OVERBURDEN
(2) OBH - OPEN BORE HOLE

86088/JT00625A.WQ1

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aquifers.

The Linemaster water-supply well (GW-08db) is treated by an air stripper and granular activated carbon (GAC) filters due to VOC contamination. This treated source also supplies the Blakely residence.

Currently, GAC systems at the Tarr apartments and the Woodstock Town Hall have been installed to remove VOCs from ground water to less than the Connecticut drinking water action levels.

The Harvest at Bald Hill Restaurant obtains water from the Peterson residence well (GW-09db). Use of well GW-36db, which originally supplied the restaurant, was discontinued because of high iron and manganese concentrations. A water softener and iron and manganese filtration system was installed to treat the water; however, low levels of VOCs were detected in samples collected from the well and use was subsequently discontinued. GW-36db is now sampled as a monitoring location and is not being used for potable water supply.

The analytical methods for water-supply samples have changed over the course of the Interim Water-Supply Well Monitoring Program. Samples collected during the NUS site inspections in 1985 and 1986 were analyzed by in-house screening methods and by the Contract Laboratory Program (CLP) procedures. Samples collected on behalf of Linemaster from 1986 to 1990 have been analyzed by EPA Method 8010. The analytical method for VOCs was changed in June 1990 to EPA Method 524.2 and arsenic analysis by EPA Method 206.2 was added to sampling program. Some residences have also been sampled for barium, beryllium, cadmium, chromium, lead, and

nickel or HSL metals listed on Table 2-1 as part of the on-going RI/FS metals investigation for the study area.

2.8.2 Interim Removal Action Monitoring

An Interim Removal Action Start-Up Monitoring Plan was submitted to the CT DEP in July 1991 (Fuss & O'Neill, 1991b). A subsequent revision of this plan was approved by the DEP. The original and revised plans proposed a ground-water extraction and treatment system for the deep bedrock aquifer on the site. The construction at the system was completed in April 1992 and the Interim Action was initiated in June 1992. During operation of the system, water levels in all on-site monitoring wells, in addition to selected off-site water-supply wells, are being monitored. Ground-water sampling and analysis will also be performed at selected on-site monitoring wells. The details of monitoring and sampling are summarized in Tables 2-6 and 2-7, respectively.

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TABLE 2-6

INTERIM REMOVAL ACTION - WATER-LEVEL MONITORING

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well	Monitoring Frequency	Duration	Montoring Device
MW-8db, MW-11db, MW-18db, MW-27db, GW-8db	Continuous	Month 1	Pressure Transducer/ data logger
On-site till wells On-site shallow bedrock wells, On-site deep bedrock wells, GW-4, GW-17db, GW-40db	3/Week (M,W,F) 1/Week 1/Month	Weeks 1-2 Weeks 2-5 Months 1-12	Fiberglass tape

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TABLE 2-7

INTERIM REMOVAL ACTION - GROUND-WATER SAMPLING

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well	Sampling Frequency	Analysis
GW-10db, MW-1db, MW-6db, MW-8db, MW-11db, MW-15db, MW-17db, MW-19sb, POND3of	Monthly first 6 months, then quarterly.	8240 or 524.2 and Arsenic
All deep bedrock wells (14 wells), intermittent stream at Route 171	Quarterly	8240 or 524.2 and Arsenic
MW-1sb, MW-6sb, MW-7sb, MW-8sb, MW-9sb, MW-10t, MW-10sb, MW-11sb, MW-16sb, MW-16t, MW-17sb, MW-17ts, MW-17td, MW-20sb, MW-EPA-Ats, MW-EPA-Atd, MW-EPA-Asb	Semiannually	8240 or 524.2 and Arsenic
All other Monitoring Wells	Annually	8240 or 524.2 and Arsenic

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3.0 STUDY AREA CHARACTERIZATION

3.1 Geology

The site-specific geology of the study area has been determined using published information and data gathered during site investigations. Geologic site investigations consisted of overburden and bedrock test borings and borehole geophysics. Based on data obtained during test borings conducted at the site, it was determined that till is the principle overburden unit overlying two distinct bedrock units in the study area. The test borings and borehole geophysics revealed that both bedrock units are physically altered and fractured in some areas.

3.1.1 Site Overburden

The overburden or unconsolidated deposits in the study area have been mapped as till (Randall et. al, 1966). This unit consists of a non-sorted and non-stratified mixture of clay, silt, sand, gravel, and boulders and may also contain thin interbedded lenses of stratified sand, silt or gravel. Till sediments were deposited beneath the glacier and from meltwater above and through ice channels during the last glacial age.

During drilling investigations at the site, till deposits were encountered at all boring locations as indicated on boring logs provided in Appendices B and D. This material was found to consist of a dense, compact, non-sorted and non-stratified mixture of clay, silt, sand, gravel, cobbles, boulders, and angular rock fragments. Boulders were found within the till unit at MW-4t and MW-10t. These boulders may be present as a result of plucking as the glacier moved over and eroded the bedrock high

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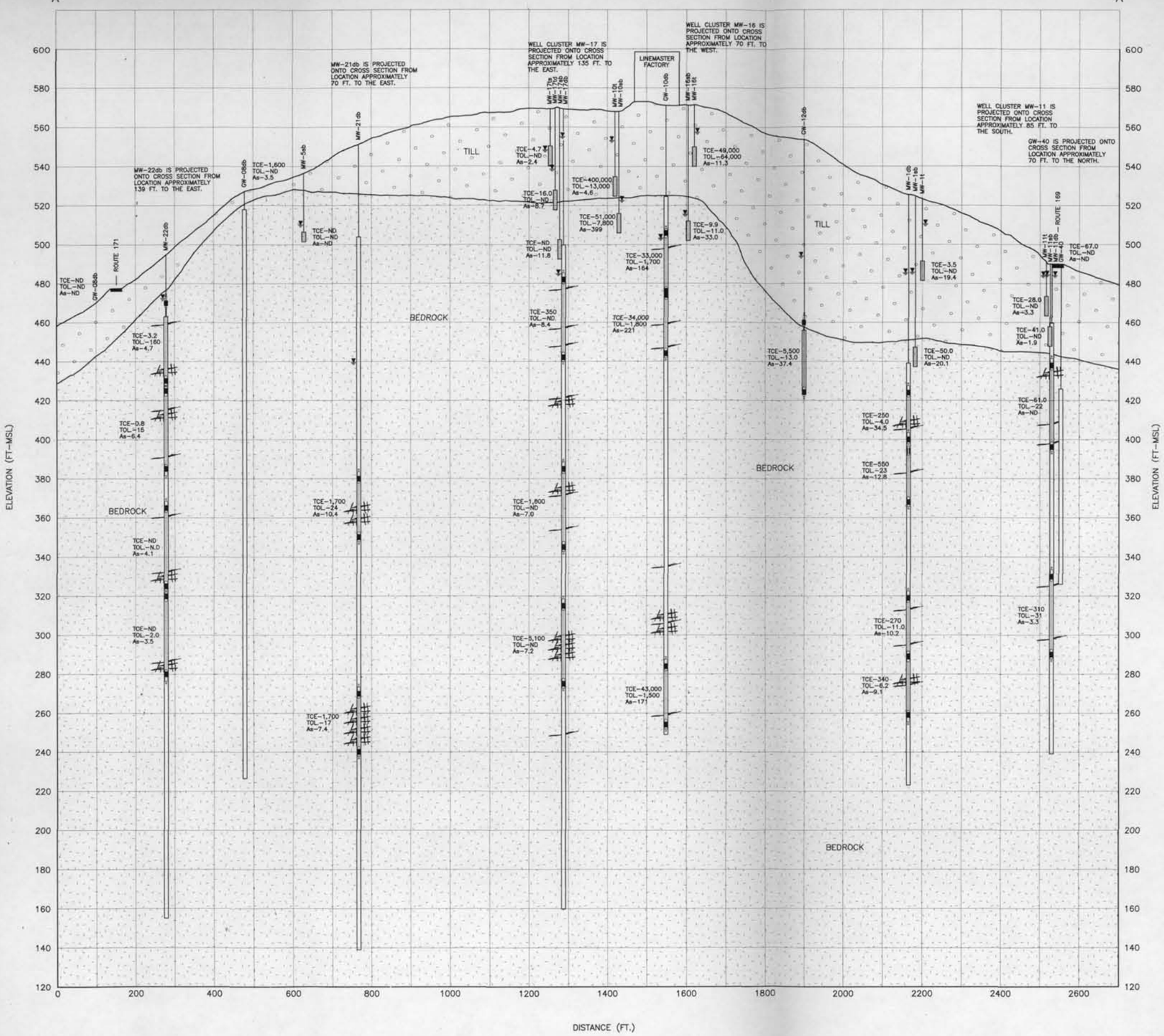
now present under the Linemaster manufacturing facility.

Overall, the till contains higher percentages of sand in the southern and eastern portions of the study area as shown by the deposits at MW-5sb, MW-7sb, MW-8sb, MW-9sb, MW-12t, MW-14sb, MW-18sb and MW-20sb. Distinct sand lenses were found within the till at MW-6t (15 ft) and MW-2t (46.5 ft).

The Quinebaug basin report (Randall et. al, 1966) contains mapping which shows stratified drift occurring between bedrock and till within the portion of Mill Brook Valley located east and southeast of the site. Stratified drift usually occurs above, rather than below till. According to the report, the stratified drift may have been deposited below the till as the ice sheet advanced or in tunnels in or below the ice. Information gathered during research of water-supply well construction indicates stratified drift occurrence; a well completion report (DEP, Well Completion Reports) for the Stickney residence (GW-13ob), located southeast of the site, reported that the water-supply well is screened within a sand lens in the till at a depth of 68 to 73 feet.

Overburden thickness varies considerably within the study area as shown on geologic cross sections (Figures 3-1, 3-2 and 3-3) and an overburden isopach map (Figure 3-4). North to south, till overburden thickness decreases from 140 feet at MW-15, located north of the Linemaster facility on the Blakely property, to 5 feet at MW-5sb, located in the southern part of the site. West to east, the overburden thickness varies from 21 feet at MW-3t to approximately 40 feet at GW-34db. Overburden is nonexistent at a bedrock outcrop just south of the Linemaster facility. In general, the overburden is thickest in the northern part of the



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- OPEN BORE HOLE (DEEP BEDROCK WELLS)
- FRACTURE ZONE
- SINGLE FRACTURE
- PACKER TEST INTERVAL
- TCE — TRICHLOROETHENE CONCENTRATION (ug/l)
- TOL — TOLUENE CONCENTRATION (ug/l)
- As — ARSENIC CONCENTRATION, TOTAL (ug/l)
- GROUND-WATER LEVEL MEASURED ON 9/24/91

NOTE

CHEMICAL DATA FOR MW-1t, MW-5sb, MW-10t, MW-10sb, MW-11t, MW-11sb, GW-10db AND GW-12db FROM SAMPLING CONDUCTED IN DECEMBER 1990.

CHEMICAL DATA FOR MW-11db, MW-16t, MW-16sb, MW-17ts, MW-17td, MW-17db, MW-21db AND MW-22db FROM SAMPLING CONDUCTED IN JUNE AND JULY 1991.

CHEMICAL DATA FOR GW-08db, GW-40 AND GW-25 FROM SAMPLING CONDUCTED IN MARCH, JUNE AND SEPTEMBER 1991 RESPECTIVELY.

FOR LINE OF CROSS SECTION SEE FIGURE 1-3

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.T.O.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
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△ 7-16-92 △		△
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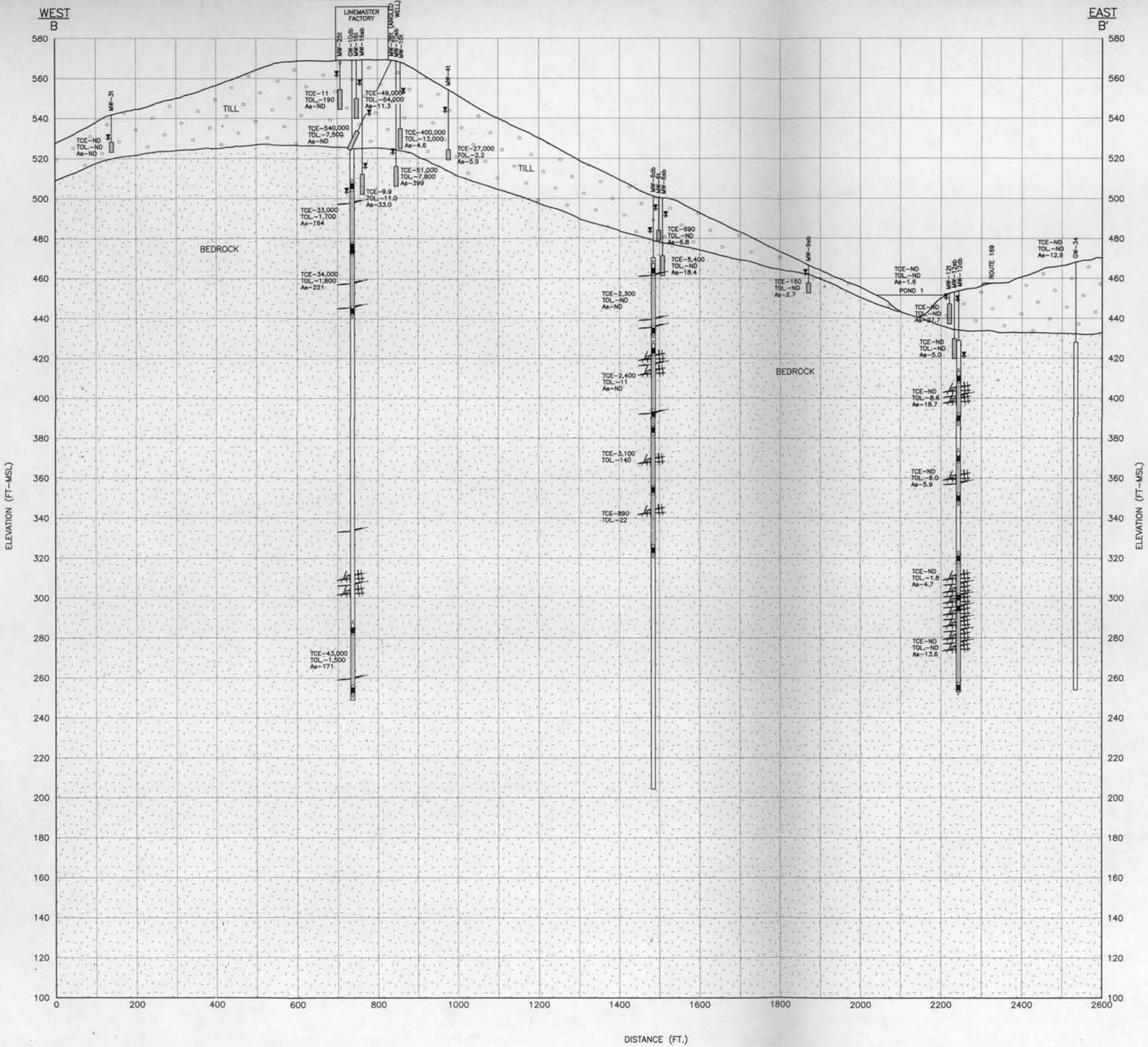
CROSS SECTION A–A'
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT	FLD. BK.	DATE	
86-88 D		NOV. 1991	FIGURE 3-1



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- OPEN BORE HOLE (DEEP BEDROCK WELLS)
- FRACTURE ZONE
- SINGLE FRACTURE
- PACKER TEST INTERVAL
- TCE — TRICHLOROETHENE CONCENTRATION (ug/l)
- TOL — TOLUENE CONCENTRATION (ug/l)
- As — ARSENIC CONCENTRATION, TOTAL (ug/l)
- GROUND-WATER LEVEL MEASURED ON 9/24/91

NOTE

CHEMICAL DATA FOR MW-3t, MW-4t, MW-6t, MW-6sb, MW-9sb, MW-10t, MW-10sb, MW-12t, MW-12sb, MW-12db AND GW-10db FROM SAMPLING CONDUCTED IN DECEMBER 1990.

CHEMICAL DATA FOR MW-6db, MW-16t, MW-16sb, MW-25t, AND MW-26t FROM SAMPLING CONDUCTED IN JUNE, JULY AND AUGUST 1991.

CHEMICAL DATA FOR GW-34 FROM SAMPLING CONDUCTED IN SEPTEMBER 1991.

CHEMICAL DATA FOR POND 1 FROM SAMPLING CONDUCTED IN AUGUST 1991.

FOR LINE OF CROSS SECTION SEE FIGURE 1-3

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CROSS SECTION B-B'
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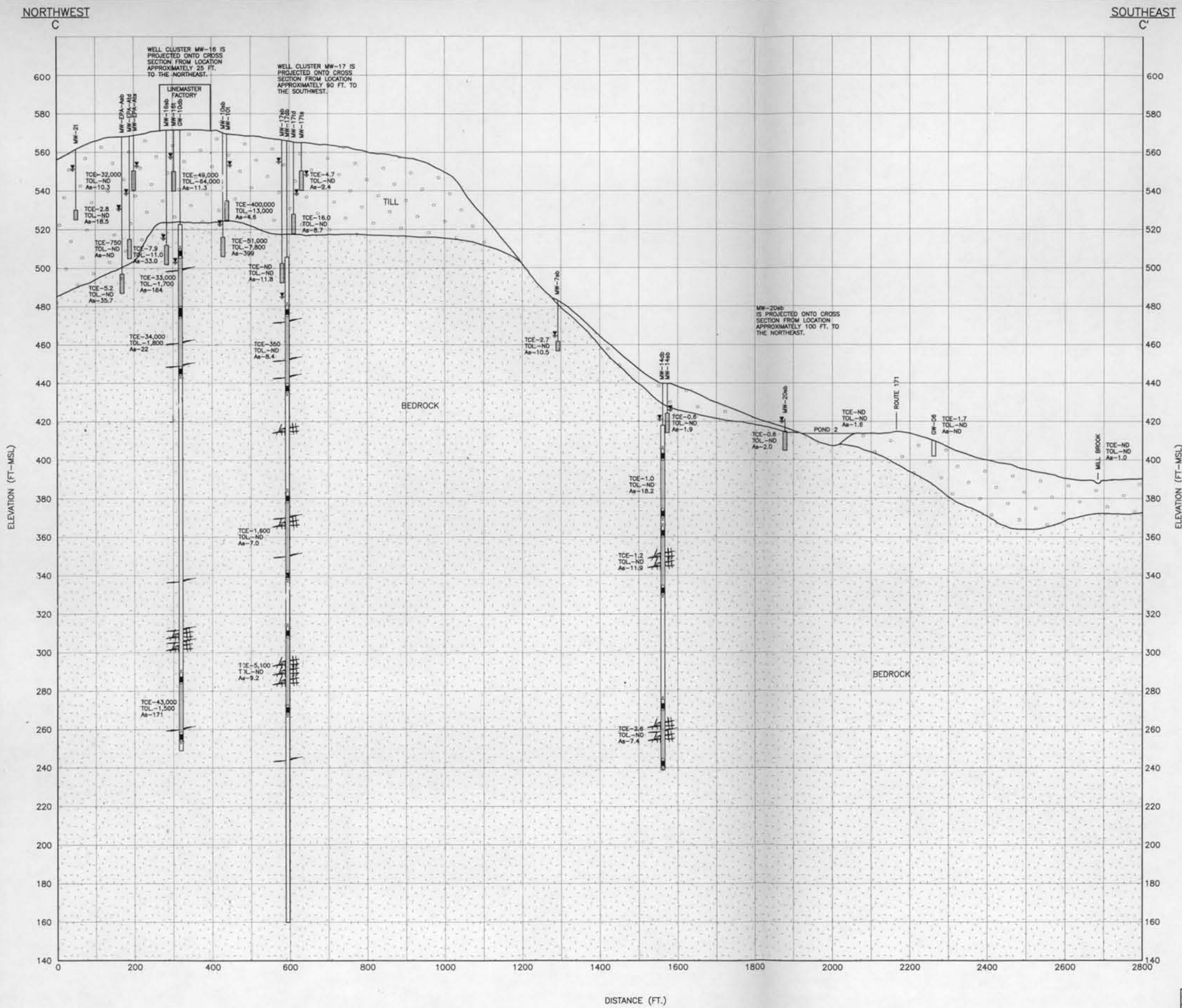
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT	FLD. BK.	DATE	
86-88D		NOV. 1991	FIGURE 3-2



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- OPEN BORE HOLE (DEEP BEDROCK WELLS)
- FRACTURE ZONE
- SINGLE FRACTURE
- PACKER TEST INTERVAL
- TCE — TRICHLOROETHENE CONCENTRATION (ug/l)
- TOL — TOLUENE CONCENTRATION (ug/l)
- As — ARSENIC CONCENTRATION, TOTAL (ug/l)
- GROUND-WATER LEVEL MEASURED ON 0/24/91

NOTE

CHEMICAL DATA FOR MW-2t, MW-7sb, MW-10t, MW-10sb, MW-14sb, MW-14db, MW-EPA-Ats AND GW-10db FROM SAMPLING CONDUCTED IN DECEMBER 1990.

CHEMICAL DATA FOR MW-EPA-At, MW-EPA-Asb, MW-16t, MW-17sb, MW-17ts, MW-17td, MW-17sb, MW-17db, AND MW-2[illegible] FROM SAMPLING CONDUCTED [illegible] JUNE AND JULY 1991.

CHEMICAL DATA FOR POND 2 AND MILL BROOK FROM SAMPLING CONDUCTED IN AUGUST 1990.

CHEMICAL DATA FOR GW-06 FROM SAMPLING CONDUCTED IN SEPTEMBER 1991.

FOR LINE OF CROSS SECTION SEE FIGURE 1-3

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CROSS SECTION C-C'
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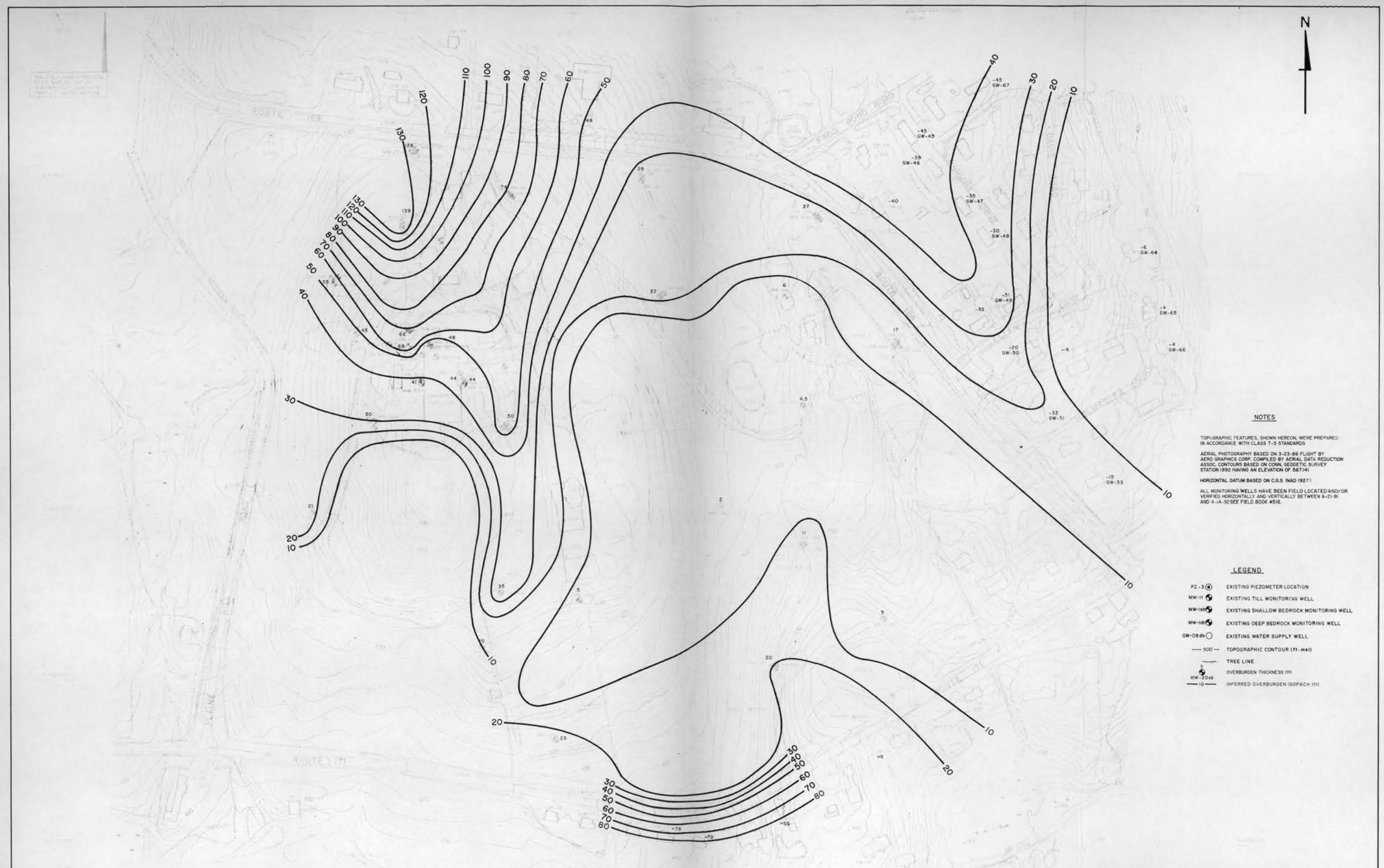
PROJECT	FLD. BK.	DATE	
86-88 D		NOV. 1991	FIGURE 3-3



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14'

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-16b	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-16d	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
MW-20db	OVERBURDEN THICKNESS (ft)
— 10 —	INFERRED OVERBURDEN ISOPACH (ft)

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OVERBURDEN ISOPACHS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

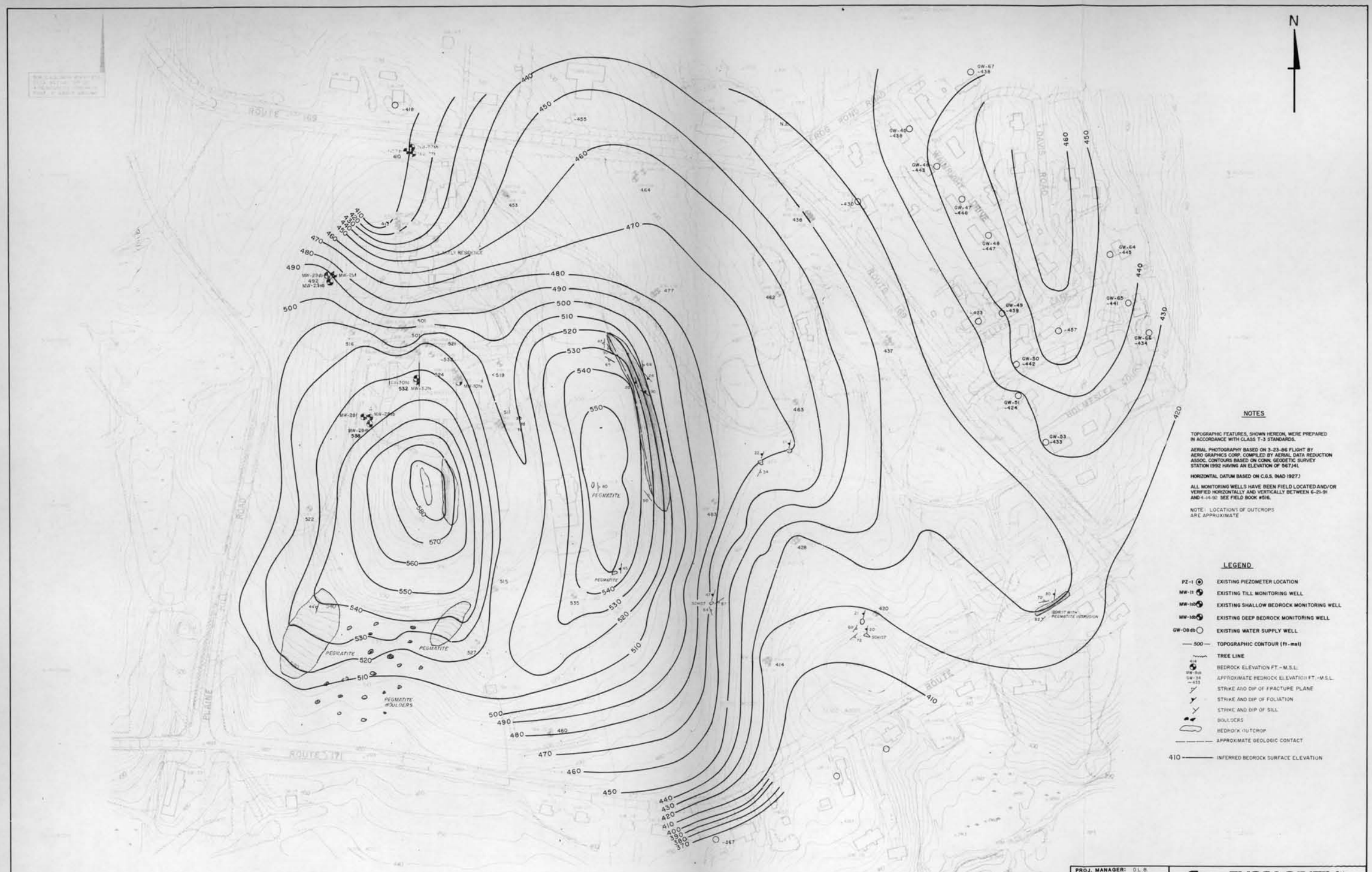
DATE	FLD. BK.	PROJECT	FIGURE
AUG. 1992		86-88 D	3-4

Site, less thick in the immediate vicinity of the Linemaster facility and thinnest in the southern and southeastern areas of the site.

The following hypothetical depositional model for the till at the site was developed based on the distribution of till thicknesses and regional geologic information discussed in Section 1.6.2.: the till was deposited by the glacier as it moved from the north-northwest to the south-southeast over the weather-resistant granite pegmatite present in the central portion of the study area. The thickest deposits of till accumulated immediately upstream (north-northwest) of the topographic high where the bedrock may have been scoured out by the glacier due to a structural weakness in this area. The structural weakness may be related to pre-glacial fault gouging or cataclysm. South and southeast or downstream of the topographic high, where rock is more competent, the till thins and the conditions for accumulation of thick till were not as favorable.

3.1.2 Site Bedrock

The depth to the bedrock surface across the study area has been determined by bedrock coring and from information on DEP well completion reports. Based on this information, a bedrock contour map has been prepared and is depicted in Figure 3-5. As can been seen from the bedrock contour map, two bedrock highs are present in the area of the Linemaster manufacturing facility and are separated by a north-south oriented bedrock trough. The elevation of the bedrock surface decreases in all directions from the manufacturing facility. East of the site, the bedrock surface elevation increases in the area of the Rawson residence (GW-05db). The bedrock surface elevation drops off significantly



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△ MAR 1992	△	△
SCALE: HOR. IN FT.		
VER. IN. FT.		

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BEDROCK SURFACE CONTOURS
REMEDIAL INVESTIGATION REPORT
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PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
OCT. 1990	516, 525, 567	86-88 D	FIGURE 3-5

to the north of the manufacturing facility where the granite pegmatite intrusions are believed to terminate. The bedrock surface was found at a depth of 140 feet during the installation of MW-15sb. The bedrock surface elevation appears to decrease in the southern part of the study area based on the well completion diagram (DEP, Well Completion Reports) for the Stickney residence (GW-13ob), which indicates bedrock at a depth greater than 79 feet below the ground surface. Another significant feature in the study area is the possible existence of a structural bedrock fold in the vicinity of MW-14. The bedrock contours in Figure 3-5 suggest that a fold-like structure is present in this area. MW-14 appears to be located near the fold axis or hinge line of this apparent structural feature. This is supported by U.S.G.S mapping (1982) which identified plunging mineral lineations in bedrock outcrops close to MW-14. However, this does not appear to be supported by measurements recorded during site investigations, although outcrop information is limited in the area of MW-14db.

Rock cores were collected during the installation of shallow bedrock wells. A minimum of 15 feet of bedrock core was collected from each shallow bedrock well installation. In addition, bedrock drill cuttings were collected from the wash at the top of the casing at every five foot interval during the installation of Phase 3 and 4 deep bedrock monitoring wells.

Detailed descriptions of rock cores are provided on rock core logs in Appendix D. Recorded observations of rock cores include a general description of the rock type and composition, fracture density and foliation. In addition, Deere (1964) rock quality designations (RQD), a measure of rock competency, were determined.

During the investigations at the site, three distinct bedrock types were found: schist; granite; and, pegmatite. For purposes of this study, the granite and pegmatite will be considered a single bedrock unit due to their structural and mineral similarities. The characteristics of the units are similar to those described in the literature for the Hebron Formation.

3.1.2.1 Schist

Schist was encountered during the installation of the following wells or well clusters: MW-1; MW-6; MW-7sb; MW-8; MW-9sb; MW-11; MW-12; MW-14; MW-15; MW-17; MW-18; MW-19sb; MW-20sb; MW-27; MW-28; MW-29; and, MW-EPA-Asb. Granite pegmatite was found during the installation of MW-5sb, MW-10sb, MW-13db, MW-16sb, and MW-EPA-Asb. Granite pegmatite was also seen in concordant layers less than 2-feet thick in the schist cores collected from the shallow bedrock well installations and was present at multiple depths and various thicknesses at all of the deep bedrock wells. The thicknesses of granite pegmatite layers generally increase toward the topographic high as evident from drilling investigations. Both schist and granite pegmatite were identified in outcrops at the site.

The schist is the country bedrock in the region and was subsequently intruded by the granite pegmatite. Much of the granite pegmatite intrusions appear to occur as a series of sills. During drilling of deep bedrock wells, granite pegmatite sills were encountered. The Linemaster manufacturing facility is situated on a granite pegmatite sill as evidenced from bedrock cores from MW-10sb. Schist present at MW-17, located immediately southeast of the facility, has been intruded by sills of granite pegmatite as evidenced from rock cuttings and cores.

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A contact between the granite pegmatite and schist was field located in a bedrock exposure just east of the Linemaster offices. This contact has a strike of approximately 312 degrees and a dip of approximately 90 degrees.

The schist unit was found to be moderately to highly weathered at the site. High degrees of weathering are present at MW-7sb, MW-9sb, and MW-11sb. This is probably the result of the weathering of calcite, microcline, and/or diopside, which appear to be locally more abundant in these areas. During drilling and borehole geophysical investigations, the bedrock at well cluster MW-15 and MW-27 was found to be highly fragmented and mixed with a clay-like material to a depth of 400 and 340 feet, respectively, the end of explorations. This may be the result of cataclysm or a fault gouge. The Putnam fault is located approximately 1 mile northeast of the site (U.S.G.S., 1982). The cataclysm may be associated with the granite pegmatite intrusion or folding. Cataclysm has been found at other locations within the quadrangle (U.S.G.S., 1982).

Deere rock quality designations (RQDs) (Deere, 1964) for schist cores collected during well installation ranged from 10 to 84 percent for MW-1sb, 69 to 90 percent for MW-6sb, 23 to 38 percent for MW-7sb, 31 to 96 percent for MW-8sb, 0 to 35 percent for MW-11sb, 34 to 67 percent for MW-14sb, 0 to 29 percent for MW-15sb, 9 to 75 for MW-16sb, 68 to 87 for MW-17sb, 69 to 86 for MW-18sb, 7 to 76 percent for MW-19sb, 0 to 42 percent for MW-20sb, 0 to 15 percent for MW-27sb, 59 to 95 for MW-28sb, 64 to 83 percent from MW-29sb, and 0 to 96 percent for MW-EPA-Asb. As evidenced by the ranges of RQD, bedrock competency varies considerably at the site due to differences in the degree of weathering, physical alteration and fracture density.

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The schist unit is well layered and fine grained. Schist outcrops at the site also have a well-defined foliation with measured strikes ranging from 15 to 36 degrees with dips 34 to 90 degrees west. Data from the borehole geophysical investigations indicate variable foliation dips relative to the boreholes across the site. Concordant granite pegmatite sills are present within the schist. These sills have thicknesses averaging less than 2 feet. Sill thicknesses are greatest in areas proximal to the main intrusions as observed at MW-6sb, MW-7sb, and MW-17db. Schist in direct contact with the sills is more resistant to weathering and has a higher degree of metamorphism (contact metamorphism), resulting in a gneiss-like appearance.

3.1.2.2 Granite Pegmatite

As previously indicated, the granite pegmatite unit at the site is composed of two distinct bedrock types, granite and pegmatite. The granite was intruded first through the schist country bedrock (U.S.G.S., 1982). The pegmatite was intruded through the granite during later stages of the intrusion (U.S.G.S., 1982). Pegmatites are coarser grained than the granites and have a different mineralogy.

Overall, the granite pegmatite is relatively unweathered compared to the schist, although an extremely altered zone was found at MW-5sb. This zone ranged from the approximate till/bedrock contact to a depth 29 feet below the bedrock surface. This zone is probably not the result of weathering, but may be cataclysmic in origin, similar to the bedrock at well clusters MW-15 and MW-27. No significant weathering was found at any other wells penetrating the granite pegmatite unit. Cores from MW-10sb, drilled into the granite pegmatite, are competent and have RQDs

ranging from 98 to 100 percent.

The granite pegmatite is coarse grained with the pegmatite areas being the coarsest. The primary minerals are quartz, microcline, oligoclase, with secondary amounts of muscovite (U.S.G.S., 1982). Accessory minerals include garnet, pyrite, arsenopyrite, apatite, and zircon. Data from the borehole geophysics indicate sulfide mineralization at MW-21db (135′ and 198′) and MW-22db (92′ and 142′). This may indicate the presence of arsenopyrite, an arsenic sulfide mineral.

The granite pegmatite has a minor foliation, appearing to parallel fracture planes, with a strike ranging from 326 to 14 degrees and a dip ranging from 24 to 45 degrees west as measured in outcrops at the site.

3.1.2.3 Fracture Characterization

Fractures were characterized using information gathered from borehole logging, core logging, borehole geophysical investigations, outcrop mapping (Figure 3-5), as well as fracture trace analysis.

Fracture strikes, ranging from 346 to 33 degrees and dips ranging from 19 to 47 degrees east were measured in outcrops of the schist unit. Data from the borehole geophysical investigations indicate that high and lower angle fractures are present parallel to foliation. Fractures were also observed in cores obtained during the installation of the shallow bedrock monitoring wells. Aperture widths are tight in unweathered areas of the schist and wide in weathered zones as evidenced from the cores. In addition, the fractures generally are planar and smooth.

Fractures at intersections of sills are planar to non-planar, jagged and are generally coated with iron- and clay-like deposits.

Overall, the granite pegmatite is less fractured than the schist. The primary fracture set, as measured in bedrock outcrops, has a strike ranging from 326 to 14 degrees and dip ranging from 47 to 90 degrees west. The main fracture sets within both bedrock units at the site have approximately the same orientation. Based on core logs provided in Appendix D, the aperture width of fractures within the granite pegmatite is less than that in the schist. Fractures within the granite pegmatite are also planar to non-planar and are generally jagged instead of smooth.

Borehole geophysics were conducted in Phase 2 and 3 (except MW-27db) deep bedrock monitoring wells, as well as former supply wells GW-10db and GW-12db, as discussed in Section 2.5.2. From these investigations (results provided in Appendices L, M, and N), fracture zones were identified at varying depths in each of the wells as indicated on Figures 3-1, 3-2, and 3-3, cross sections of the study area depicting fracture zones in deep bedrock wells identified by borehole geophysics and/or drilling activities. Fracture zones identified in each well, along with flow potential based on ground-water temperature anomalies, are listed in Table 3-1. These fracture zones were grouped or individually sampled by packers, depending on flow attributes, for ground-water quality information.

Acoustic televiewer logging data were used to estimate the strike and dip, as well as the aperture width, for fractures within GW-10db (Appendix L), the only deep bedrock well other than GW-12db where acoustic televiewer logging was conducted. The

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TABLE 3-1

DEEP BEDROCK FRACTURE ZONES

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LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

WELL NO.	FRACTURE ZONES	POTENTIAL FLOW	VIDEO ATTRIBUTES (1) (2)
MW-1db	82- 83 ft		bottom of casing
	119-124 ft	3	major <H fracture and breakout
	146-148 ft	3	<L, nearly horizontal feature
	216-217 ft	2	wall pitted, fluid cloudy
	234-236 ft	1	
	251-254 ft	3	several <L pits and scraps
MW-6db	34- 35 ft		bottom casing
	42- 43 ft	1	<L feature
	65 & 68 ft	1	<L feature
	82- 92 ft	3	<L breakouts
	110-111 ft	1	minor fracture features
	134-136 ft	2	<L fracture features
	161-163 ft	2	<L fracture features
MW-8db	30- 48 ft	3	bottom casing focus?
	88,95,101,107,123	1	guard spikes, <L foliation features
	122-126 ft	2	cloudy borehole fluid
	165-170 ft	1	too cloudy
	190-194 ft	2	too cloudy
GW-10db	71-75 ft		temperature anomaly
	94-96 ft		temperature anomaly
	124-129 ft		temperature anomaly
	269.4 ft		temperature anomaly
MW-11db	40- 42 ft		bottom casing
	54- 56 ft	1	breakout zone and <L features
	79- 82 ft	3	major breakout zone
	90.5 ft	1	<H fracture
	162-164 ft	1	<H fracture parallels foliation
	188-190 ft	2	wall pitted, particles appear to be flowing across screen
MW-12db	49-55 ft		possible zone of small fractures
	92-95 ft		
	95-97 ft		water flowing into borehole
	142-183 ft		zone of limited fracturing
MW-13db	165-171 ft		possible zone of fracturing or weathering
	215-282 ft		possible zone of fracturing or weathering
MW-14db	88-95 ft		fracture zone with probable water intrusion
	177-185 ft		fracture zone with probable water intrusion
MW-15db	160-252 ft	3	highly fractured interval, highest flow potential @ 169 ft and 236 ft.

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TABLE 3-1
(CONTINUED)
DEEP BEDROCK FRACTURE ZONES

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LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

WELL NO.	FRACTURE ZONES	POTENTIAL FLOW	VIDEO ATTRIBUTES (1) (2)
MW-15db	266-267 ft		
	277-281 ft	}	no T or video log
	296-298 ft	}	no T or video log
	307-325 ft		
MW-17db	89-90 ft	1	pitted borehole wall
	109 ft	1	boundary of mineralized zone
	118 ft	1	<L fracture @ mineralization boundary
	144-147 ft		no fractures apparent on video
	190-195 ft	1	<H fracture
	211 ft	1	possible <L feature
	265-277 ft	3	several <L shadows, fluid cloudy
	316 ft	1	cloudy borehole fluid
MW-18db	81-82 ft	1	no noticeable video attributes
	133-135 ft	2	<H fracture
	151-152 ft	1	<L foliation feature
	155-157 ft	1	wall pitted, some <L features
	164-165 ft	1	small breakout zone
	188 ft	2	cloudy fluid
MW-21db	185-192 ft	2	fractures not readily evident on video
	287-305 ft	1	alternating light and dark banding with some <L features
MW-22db	42-45 ft	1	Breakout, minor <L fracture
	66-68 ft		Dark lithology with minor fractures along interface of white mineralized swirls
	87-93 ft	2	major <H fracture
	112-113 ft		no T or FLRES anomaly
	142-144 ft		no T or FLRES anomaly
	171-176 ft	3	several <Hfractures
	217-221 ft		no T of FLRES anomaly

(1) (1 = some probability flow)
(3 = high probability flow)
<L - low angle
<H - high angle

(2) Video logging and flow potential not determined for GW-10db, MW-12db, MW-13db and MW-14db.

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acoustic televiewer log for GW-12db was not interpreted due to the limited depth of the well (approximately 130 feet) and the cataclysmic nature of the bedrock in this area. Although no well log or construction information could be located for GW-10db, geology in this area is assumed to be similar to that found at MW-28db; bedrock in this area is comprised of schist with alternating intrusions of granite pegmatite. The strike and dip of fractures identified within GW-10db are plotted on a rose diagram presented in Appendix L. A bimodal direction of strike was measured from the acoustic televiewer log interpretation with one set trending 265-300 degrees and a second set trending 330-20 degrees. The amount of dip ranges from 0 to 80 degrees east with a vector mean of 41 degrees. Generally, the strike and dip of fractures measured in outcrops of schist or granite pegmatite are close to or within the range identified by the acoustic televiewer investigation.

Thirty-five possible fracture traces were identified in the study area using 1970 and 1975 aerial photography (U.S. EPA, 1990). These were grouped into two major sets, the first trending 10-20 and 100-120 degrees and the second trending 50-60 degrees and 160-170 degrees. The orientation of the fracture traces are in general agreement with the fracture orientations measured in outcrops and determined from the acoustic televiewer log interpretation. The number and orientation of the identified fracture planes indicate a moderately fractured bedrock unit. The possible impact of these fracture traces on ground-water flow is discussed in Section 3.3.

3.2 Hydrology

Surface-water bodies in the vicinity of the site are depicted in Figure 2-9. More detailed mapping of the water bodies most proximal to the site is provided in Figure 2-8. The site is primarily drained by a small, unnamed stream in the eastern portion of the study area which flows south parallel to Route 169 and discharges to Mill Brook. Surface-water runoff from the western portion of the site enters the small, wooded, wetland area in the northwestern portion of the Blakely property. Another small unnamed stream west of Plaine Hill Road flows to the south and discharges to Mill Brook in the southwestern portion of the study area. Mill Brook flows west to east parallel to Route 171 along the southern border of the study area, until crossing Route 169 and turning to the north before ultimately draining into Roseland Lake.

3.2.1 Study Area Water Bodies

The surface-water system along the eastern portion of the study area consists of a southerly flowing unnamed stream and several ponds. The stream originates at Northeast Pond, enters the Blakely property via a concrete culvert, flows through Pond 1 and continues to the south paralleling Route 169, exits the Blakely property via a concrete culvert under Route 171, and then discharges into a wetlands adjacent to Mill Brook to the south. The ponds adjacent to and along the course of the easterly unnamed stream are man made.

Northeast Pond, the origin of the unnamed eastern stream, is a small fire pond with no surface-water inlets. The unnamed stream flows through Pond 1, which was constructed for aesthetic

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purposes. Linemaster personnel reported that excavation during the construction of Pond 1 encountered bedrock, although the exact depth to bedrock was not recorded. Figure 3-2, a cross-sectional view of the study area through Pond 1, was prepared to reflect the assumption that the bottom of the pond rests on the bedrock surface. A small fountain is present in the center of the pond for aesthetic purposes.

Pond 3, a man-made pond constructed in 1989 for aesthetic purposes, is located west of Pond 1. Bedrock was encountered during the construction of this pond, which has no direct surface-water inlets. Treated effluent from the Interim Removal Treatment System, non-contact cooling water from the manufacturing facility and ground water intercepted and diverted around the Blakely leaching field by a curtain drain discharge to Pond 3. The discharge from Pond 3 is directed to the unnamed eastern stream just north of Pond 1 via underground piping. A fountain was installed in Pond 3 for aesthetic purposes.

Pond 2, a small man-made pond west of the unnamed eastern stream near the southern portion of the study area, has no surface-water inlet and drains to the south by a small stream that empties into the wetlands adjacent to the Mill Brook. Pond 2 is inferred to be bottomed on bedrock, as indicated in Figure 3-3, on the basis of bedrock exposures present along the north bank of the pond. The elevation of the bedrock surface underlying Pond 2 was not measured, but is estimated to be approximately 410 feet MSL.

A small, intermittent stream is present in the wooded wetland area in the northwestern portion of the Blakely property. This unnamed seasonal stream does not have a defined channel, but apparently drains the surrounding wetlands and generally flows in

a northerly direction before terminating on site south of Route 169.

The headwaters of the Mill Brook lie west of the study area. In the vicinity of the site, Mill Brook flows to the east along the southern border of the study area, crosses under Route 171, and then turns north. The unnamed stream west of Plaine Hill Road, Pond 2 and the unnamed stream in the eastern portion of the study area all drain into Mill Brook south of Route 171.

3.2.2 Streamflow Rate Measurements

In accordance with the Phase 1B Work Plan (Fuss & O'Neill, 1992b), initial quarterly streamflow measurements were made at nine stream gauging stations in the study area on June 15, 1992. Streamflow discharge rates were also recorded at five gauging stations on August 19, 1992. A round of streamflow measurements was also performed on August 3, 1990 at the approximate locations of RI/FS gauging stations GS-1, GS-2, GS-3, and GS-4 in the stream along the eastern portion of the study area. Based on streamflow measurements and the cross-sectional area at each gauging station, stream discharges were calculated to determine whether the streams adjacent to the site are discharge zones for ground water and to evaluate any seasonal variability. By evaluating the relative change in discharge between gauging stations, it can be determined if the stream is gaining or losing water at the time of measurement.

The locations of the nine stream gauging station are shown on Figure 2-8. Gauging stations GS-1, GS-2, GS-3, and GS-4 are located in the unnamed stream in the eastern portion of the study area. Gauging station GS-2 is located at the entrance of Pond 1,

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approximately 20 feet downstream of the Pond 3 overflow culvert inlet. Gauging station GS-5 is located in the unnamed stream west of Plaine Hill Road, north of the confluence of the stream and Mill Brook. Stations GS-6, GS-6A, GS-6B, and GS-7 were established in Mill Brook in the southern portion of the study area.

The June and August 1992 streamflow velocity measurements were made with an electronic flow meter. Average cross-sectional areas were estimated by measuring the width of the stream and the depth at each of the points along the cross section where velocity measurements were made. The August, 1990 discharge rates were estimated by temporarily damming the stream and measuring the time for a container of known volume to be filled from a discharge pipe inserted into the dam. Estimated stream discharge rates are summarized in Table 3-2.

Due to periods of heavy rainfall in the two weeks preceding both the June and August 1992 stream gauging events, the recorded stream discharge rates are believed to be more typical of wet season conditions. The August, 1990 discharge estimates are believed to more typical of drier season conditions. It should be noted that since May 12, 1992, in addition to influx from storm event precipitation, runoff, and ground-water discharge, the eastern stream system has received water by the discharge of the Interim Removal Treatment System treated effluent to Pond 3 and subsequent Pond 3 overflow to the stream.

The approximate discharge of the eastern stream at gauging station GS-1 entering the northern portion of the Blakely property was 0.0006 cubic feet per second (cfs) on June 15, 1992. The estimated discharge at this same location on August 3, 1990

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TABLE 3-2

ESTIMATED STREAM DISCHARGE RATES

REMEDIAL INVESTIGATION REPORT
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WOODSTOCK, CONNECTICUT
DECEMBER 1992

GAUGING STATION	DISCHARGE (CUBIC FEET PER SECOND)		
	8/3/90	6/15/92	8/19/92
GS-1	0.0005	0.0006	---
GS-2	0.0004	0.22	---
GS-3	0.0001	0.10	0.14
GS-4	0.0	0.12	0.20
GS-5	---	0.12	1.02
GS-6	---	8.83	33.35
GS-6A	---	4.51	---
GS-6B	---	2.31	---
GS-7	---	1.98	25.32

NOTE: --- indicates discharge not measured

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was 0.0005 cfs. On June 15, 1992 and August 19, 1992, the estimated discharge at station GS-4, the most downstream gauging station in the eastern stream, was 0.12 cfs and 0.20 cfs. At this same location on August 3, 1990 the stream was dry.

3.2.3 Surface-Water Piezometer Data

Six shallow surface-water piezometers were installed during the week of May 12, 1992, after preliminary testing of the Interim Removal Treatment System was initiated. Water levels measured inside and outside of the hollow piezometers enabled determination of piezometric and surface-water elevations, respectively. The difference in the surface-water and piezometric elevations at each piezometer location is indicative of the potential vertical flow direction; upward flow potential is indicated when the piezometric elevation is greater than the surface-water elevation and, conversely, downward flow potential is indicated when the surface-water elevation is greater than the piezometric elevation.

After allowing the piezometers to equilibrate for two weeks following their installation, water levels were measured on seven occasions at each piezometer location between June 1 and June 15, 1992. Water levels since that time have been measured at least monthly. The resultant surface-water and piezometric elevations are recorded in Table 3-3. Also included in Table 3-3 are surface-water elevations measured on April 27, 1992 at the locations where the piezometers were subsequently installed.

It should be noted that the potential vertical flow direction between the surface-water bodies and the underlying soils are expected to vary throughout the year in response to seasonal

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TABLE 3-3

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SURFACE-WATER PIEZOMETER DATA

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PIEZOMETER	4/27/92	6/1/92	6/3/92	6/5/92	6/8/92	6/10/92	6/12/92	6/15/92
PZ-3 (NE POND)								
Piezometric Elev.	-	467.24	467.01	466.65	467.11	467.23	467.17	466.74
Surface-water Elev.	466.92	466.88	466.84	466.72	466.82	466.85	466.83	466.79
PZ-4 (POND 1)								
Piezometric Elev.	-	451.12	451.10	451.10	451.30	451.32	451.21	451.04
Surface-water Elev.	451.75	451.80	451.75	451.72	451.76	451.78	451.72	451.75
PZ-5 (POND 3)								
Piezometric Elev.	-	472.35	470.97	470.90	471.15	471.04	470.97	470.70
Surface-water Elev.	474.00	474.13	474.11	474.12	474.05	474.12	474.10	474.10
PZ-6 (E STREAM)								
Piezometric Elev.	-	416.94	416.75	416.69	416.79	416.89	416.51	416.69
Surface-water Elev.	416.63	416.74	416.65	416.17	416.79	416.63	416.60	416.65
PZ-7 (POND 2)								
Piezometric Elev.	-	413.46	413.96	412.91	413.06	413.06	412.89	412.80
Surface-water Elev.	414.18	414.13	414.04	413.99	414.04	414.02	413.97	413.97
PZ-8 (NW WETLANDS)								
Piezometric Elev.	-	516.42	516.32	516.36	516.43	516.39	516.24	516.33
Surface-water Elev.	516.30	516.27	516.24	516.28	516.29	516.27	516.23	516.18

NOTE: 4/27/92 Surface-water elevations measured at same locations where piezometers subsequently were installed.
All elevations are in ft msl.

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TABLE 3-3 (Continued)

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SURFACE-WATER PIEZOMETER DATA

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PIEZOMETER	7/30/92	8/19/92	9/8/92	9/15/92	9/25/92	10/9/92
PZ-3 (NE POND)						
Piezometric Elev.	466.67	467.57	465.85	467.13	466.63	466.46
Surface-water Elev.	466.69	466.85	466.71	466.66	466.67	DRY
PZ-4 (POND 1)						
Piezometric Elev.	450.86	450.60	451.13	450.91	450.90	450.82
Surface-water Elev.	451.77	451.84	451.82	451.83	451.86	451.86
PZ-5 (POND 3)						
Piezometric Elev.	DRY	DRY	DRY	470.28	470.45	470.28
Surface-water Elev.	474.09	474.11	474.09	474.18	474.23	474.16
PZ-6 (E STREAM)						
Piezometric Elev.	416.56	417.17	416.60	417.09	416.68	416.54
Surface-water Elev.	416.57	416.63	416.60	416.62	416.61	416.64
PZ-7 (POND 2)						
Piezometric Elev.	412.86	413.63	412.92	413.04	412.50	412.00
Surface-water Elev.	413.92	414.00	413.98	413.80	413.65	413.33
PZ-8 (NW WETLANDS)						
Piezometric Elev.	516.23	516.73	516.35	516.32	516.20	515.87
Surface-water Elev.	516.21	516.28	516.21	516.15	516.00	DRY

NOTE: 4/27/92 Surface-water elevations measured at same locations where piezometers subsequently were installed.
All elevations are in ft msl.

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climatic conditions and that the available piezometer data represent conditions during a very limited time period. Additionally, ground-water withdrawal and treated effluent discharge related to the operation of the Interim Removal Treatment System may have influenced the observed surface-water and piezometric elevations. Additional piezometer data will be collected quarterly to evaluate seasonal fluctuations.

Downward flow potentials were observed at piezometers PZ-4 in Pond 1, PZ-5 in Pond 3, and PZ-7 in Pond 2 during all piezometer measuring events between June and October, 1992. An upward flow potential was recorded at PZ-8 in the intermittent stream in the northwest wetland area during the same time period. Although the vertical flow potential direction varied at PZ-3 in Northeast Pond and PZ-6 in the unnamed eastern stream, an upward flow potential was observed more frequently at these locations.

3.2.4 Water Balance

The water balance for the study area was estimated using the Thornthwaite and Mather (1957) method. This method enables an estimation of the major components in the hydrologic cycle (i.e. rainfall, evapotranspiration and runoff) to be made from mean monthly temperature and precipitation values. This model assumes that over the long term, average annual precipitation is offset by water losses resulting from evapotranspiration, surface-water runoff, ground-water discharge to streams, and the change in soil moisture storage.

Table 3-4 provides a summary of the annual water balance representative of all the areas within the study area watershed based on average monthly temperature and precipitation values.

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TABLE 3-4

WATER BALANCE

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN TEMP. (Degrees F)	23.2	25.6	35.3	46.0	56.6	65.1	70.6	69.3	60.6	49.7	40.4	28.5	
1. PRECIPITATION (P)	3.90	3.19	4.15	4.27	4.39	4.03	4.18	4.36	3.79	3.96	4.69	4.22	49.13
2. POTENTIAL EVAPOTRANSPIRATION (PET)	0	0	0.27	1.50	3.05	4.39	5.10	4.60	3.11	1.63	0.65	0	
3. P - PET	3.90	3.19	3.88	2.77	1.34	-0.36	-0.92	-0.24	0.68	2.33	4.04	4.22	
4. ACCUMULATED POTENTIAL WATER LOSS						-0.36	-1.28	-1.52					
5. SOIL MOISTURE (SM)	5.90	5.90	5.90	5.90	5.90	5.59	4.72	4.61	5.29	5.90	5.90	5.90	
6. CHANGE IN SOIL MOISTURE	0	0	0	0	0	-0.31	-0.87	-0.11	0.68	0.61	0	0	
7. ACTUAL EVAPOTRANSPIRATION (AET)	0	0	0.27	1.50	3.05	4.34	5.05	4.47	3.11	1.63	0.65	0	24.07
8. SOIL MOISTURE DEFICIT (D)						-0.05	-0.05	-0.13					
9. SOIL MOISTURE SURPLUS (S)	0	0	3.88	2.77	1.34	0	0	0	0	1.72	4.04	0	
10. TOTAL AVAILABLE FOR RUNOFF	1.23	0.61	4.18	4.86	3.77	1.88	0.94	0.47	0.23	1.83	4.95	2.47	
11. RUNOFF (RO)	0.62	0.31	2.09	2.43	1.89	0.94	0.47	0.24	0.12	0.92	2.48	1.24	13.75
12. SNOWMELT RUNOFF (SMRO)	0	0	4.52	5.65	1.14	0	0	0	0	0	0	0	11.31
13. DETENTION													
RO	0.61	0.30	2.09	2.43	1.88	0.94	0.47	0.23	0.11	0.91	2.47	1.23	
SMRO	8.12	11.31	6.79	1.14	0	0	0	0	0	0	0	4.22	
14. TOTAL RUNOFF	0.62	0.31	6.61	8.08	3.03	0.94	0.47	0.24	0.12	0.92	2.48	1.24	25.06

NOTE: ALL VALUES EXCEPT TEMPERATURE ARE EXPRESSED IN INCHES.

ASSUMPTIONS:
1. RO 50% IN MONTH IT FALLS, 50% IN ENSUING MONTH
2. SMRO 40% IN 1ST MONTH W/ T>32 DEGREES F, 50% 2ND MONTH, 10% 3RD MONTH
3. SOIL MOISTURE = AWC X ROOTING DEPTH (15% X 3.28 FT = 5.90 IN)

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Average monthly temperature and precipitation values were determined from data collected between 1965 and 1991 at the NOAA/US Corps of Engineers West Thompson Lake climatological station in West Thompson, Connecticut, located approximately three miles northeast of the Linemaster site.

Potential evapotranspiration (PET) and actual evapotranspiration (AET) volumes were determined using the methods described by Thornthwaite and Mather (1957). A soil moisture storage capacity of 5.90 inches was calculated based on an estimated 3.28 foot (1.0 meter) root zone and an available water capacity (AWC) of approximately 0.15 inch per inch of soil. The average AWC of soils in the study area is based on values reported in the Windham County Soil Survey report prepared by the Soil Conservation Service (1981). A site-specific root zone estimate was made in consideration of the study area vegetation and root zone values for different types of vegetation provided by Thornthwaite and Mather (1957). The soil moisture surplus (S) represents the amount of monthly precipitation remaining after actual evapotranspiration demands have been satisfied.

Runoff (RO) is the summed estimate of the volume of water resulting from surface runoff during storms and ground-water discharge to streams. In accordance with the Thornthwaite and Mather method, runoff was derived from moisture surplus by allowing one-half of monthly surplus to leave the basin as runoff during the current month, while distributing the remainder to the moisture surplus of ensuing months. This procedure incorporates a time-lagging function into the water balance and is expressed by entering the remaining one-half of monthly surplus as runoff detention on Line 13 of Table 3-4.

The Thornthwaite and Mather model assumes that precipitation falling in months when the average air temperature is less than 32 degrees Fahrenheit is stored as snow, which gradually becomes available for runoff in the subsequent months when average air temperatures exceed 32 degrees Fahrenheit. The Thornthwaite and Mather model also incorporates a time-lagging function for snow melt runoff (SMRO) by assuming that the volume of precipitation in the form of snow becomes available for runoff at a rate of ten percent the first month that the average temperature exceeds 32 degrees Fahrenheit and that 50 percent of the remaining volume runs off in the ensuing months. Experience has indicated that this procedure results in atypical monthly runoff and stream flow rates for Connecticut, (i.e. snow melt runoff continuing into fall months) therefore, snow melt runoff values in Table 3-4 were calculated based on the assumption that the snow volume becomes available for runoff during the first, second and third months at rates of 40 percent, 50 percent and 10 percent, respectively, when average monthly temperatures exceeded 32 degrees Fahrenheit. The rates chosen for time-lagging snow melt detention runoff provide monthly runoff estimates that are generally consistent with the monthly runoff distribution trend reported by the USGS (1966) for the Quinebaug Basin. The volume of time-lagged, or detained, snow melt runoff is expressed on Line 13 of Table 3-4. Runoff and snow melt runoff are totalled on Line 14 and represent an estimate of total runoff in the watershed. This estimate represents the total volume of surface runoff and ground-water discharge to surface-water bodies due to precipitation.

As summarized in Table 3-4, of the average annual 49.13 inches of precipitation, approximately 24.07 inches returns to the atmosphere as evapotranspiration (evaporation and plant transpiration). The remaining 25.06 inches of precipitation

appears as some form of runoff, either as direct surface runoff during storm events, or as water that infiltrates the soil, enters the saturated zone, and appears later as streamflow via ground-water discharge. Consistent with observations made by the USGS for the Quinebaug Basin (1966), the volume of study area runoff peaks during March and April when evapotranspiration is low and snow melt runoff is highest. Runoff decreases steadily to its low point in late summer and early fall as a result of increased evapotranspiration and reduced precipitation. It should be noted that zero net change in soil moisture and ground-water storage from year to year are inherent assumptions in the Thornthwaite and Mather water balance model.

Particularly in light of recent winters with limited snowfall, it appears that the volume of precipitation in the form of snow in Table 3-4 is overestimated due to the Thornthwaite and Mather model's manipulation of precipitation during winter months when the average temperature is below freezing. However, because the time-lag function used to calculate snow melt runoff is similar to the storm water runoff lag function, only slightly higher average monthly runoff volumes during the late winter months and corresponding reduced spring runoff volumes are expected. Regardless of this apparent minor inconsistency, the annual total runoff figure of 25.06 inches remains unaffected.

In order to estimate the average annual total runoff, infiltration, and surface runoff in the study area, the Soil Conservation Service (SCS) TR-55 method (1986) was employed. This method estimates total runoff for a given watershed based on cover conditions and total rainfall. Because this method is typically used to estimate runoff during one storm event and is dependent on rainfall during that one event, estimating the

annual runoff in the study area requires analyzing the volume of precipitation from each storm during a typical year. In order to provide an estimate of runoff from a typical year, 1988 precipitation data were utilized because the total annual precipitation for that year (49.66 inches) was approximately equal to the average annual precipitation measured at the West Thompson Lake station (49.13 inches) between 1965 and 1991.

Based on study area cover conditions and 1988 rainfall data, the total annual surface runoff was estimated to be 6.50 inches. As this number represents the typical annual storm runoff volume, using a total runoff value of 25.06 inches, the value estimated by the Thornthwaite and Mather method, an average annual infiltration volume of 18.56 inches was estimated for the study area. This volume represents the total estimated amount of ground-water recharge due to precipitation. The estimated percentage of precipitation that infiltrates to ground water in the study area, 38 percent, is slightly higher than calculated from the data in the Quinebaug Basin report (USGS, 1966), 23 percent. That a more significant portion of precipitation infiltrates to the ground-water system than results in surface runoff at the site is consistent with the relative absence of well defined natural surface-water drainage features within the study area and the site's location on an isolated topographic high with no other upland areas contributing to site runoff.

3.2.5 Surface-Water Recharge and Discharge Areas

Presently, insufficient data are available to identify seasonal fluctuations in surface-water body and ground-water recharge relationships. Additional quarterly streamflow measurements and surface-water and ground-water monitoring will be performed to

evaluate this relationship, as described in the Phase 1B Work Plan (Fuss & O'Neill, 1992b). On the basis of the temporally-limited surface-water piezometer data, estimated stream discharge rates, and water balance analysis, as well as the historical overburden/shallow bedrock vertical flow gradient data (See Section 3.3), preliminary interpretations of study area surface-water recharge and discharge areas have been made.

Areas of Surface-Water Recharge by Ground Water

Northwest Wetlands

The June to October, 1992 surface-water and piezometric elevations recorded at PZ-8, located in the small intermittent stream in the northwest wetland area of the study area, indicate an upward flow potential. The recorded piezometer data, the lack of surface-water input, and the presence of the surrounding wetlands indicate that this portion of the study area receives ground-water recharge. However, the intermittent nature of the stream suggests that ground-water recharge in this area may diminish or cease during drier periods of the year.

Northeast Pond

The upward flow potential generally present at PZ-3 in Northeast Pond between June and October 1992 indicates that the pond was recharged by ground-water during this period. As there are no surface-water inlets to this body of water, precipitation and surface runoff are the only other sources of pond recharge. The increase in streamflow rate observed between GS-1 and GS-2 in the eastern stream south of Northeast Pond and upward flow potential from the shallow bedrock to the overburden typically present at

the MW-11 well cluster, located approximately 450 feet west of Northeast Pond, support the conclusion that Northeast Pond is recharged by ground water. It should be noted, however, that although an upward gradient most commonly was observed at piezometer PZ-3 in Northeast Pond between June and October 1992, a downward gradient was noted at PZ-3 several times during this same time period. This indicates that Northeast Pond may also be a ground-water recharge area during certain times of the year as well.

Eastern Stream System

The net increase in discharge rates between gauging stations GS-1 and GS-2 on June 15, 1992 indicates that south of Northeast Pond and north of Pond 1 the unnamed eastern stream was being recharged by ground-water. The decrease in discharge between GS-2 and GS-3 on June 15, 1992 suggests that the stream was losing water to the ground-water system in the Pond 1 section of the stream at that time. On the same date, however, the slight increase in discharge between GS-3 and GS-4 and the upward flow potential noted at PZ-6, located in the stream adjacent to Route 171, indicate that the stream was receiving ground-water recharge south of Pond 1. It is possible that evapotranspiration at Pond 1 was partially responsible for the decrease in discharge rates noted between the inlet and outlet of Pond 1 on June 15, 1992, although it is more likely that this decrease is largely due to surface-water discharge to the ground water. The August 1990 streamflow discharge estimates indicate that the stream was discharging to the ground-water system along its length from Route 169 to just south of Pond 1 where it became completely dry. The relationship between the unnamed stream in the eastern portion of the study area and the ground-water system varies in

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response to seasonal and, in all probability, daily conditions (e.g. storm events, evapotranspiration etc.) as evidenced by the variable potential vertical flow directions observed at PZ-6 between June and October 1992 and the net decrease in downstream discharge on August 3, 1990.

Areas of Surface-Water Discharge to Ground Water

Pond 1

The decrease in discharge on June 15, 1992 between GS-2 and GS-3, stream gauging stations located at the northern and southern ends of Pond 1, and the downward potential flow observed at PZ-4 between June and October 1992 indicate that surface water in Pond 1 was lost to the ground-water system during this time period. Influx to Pond 1 is from the unnamed eastern stream, which flows through it, and precipitation and ensuing runoff. The Pond 3 discharge culverted to the eastern stream just north of the entrance to Pond 1 may affect the magnitude of the vertical gradient between the surface water and ground water in Pond 1. The Pond 3 input, caused by the Interim Removal Treatment System discharge to Pond 3, most likely creates a mounding effect and increases the potential for downward flow from the surface water in Pond 1 to the ground water. Although wet season data is lacking, the fact that a downward vertical gradient has historically been observed between the overburden and the shallow bedrock at the adjacent MW-12 well cluster suggests that Pond 1 surface waters likely discharge to the ground-water system throughout the entire year.

Pond 2

Piezometer data collected from PZ-7 between June and October 1992 indicate that the surface water in Pond 2 was being discharged to the ground-water system. Storm event precipitation and runoff provide recharge to Pond 2, which has no surface-water inlets and is believed to intercept the water table. The upward vertical ground-water flow potential between the till and shallow bedrock historically noted at the MW-8 well cluster, located approximately 200 feet west of Pond 2 at a higher elevation, and the fact that the pond is bottomed on bedrock, suggest that shallow bedrock discharge to Pond 2 is possible at times.

Pond 3

Pond 3 is a man-made pond that has no natural surface-water inlets. This pond receives influx from the Interim Removal Treatment System, the manufacturing facility non-contact cooling water system, the Blakely leaching field curtain drain, precipitation, and surface runoff. The artificial discharges likely cause mounding in Pond 3 as evidenced by the strong downward flow potential observed at PZ-5 between June and October 1992. Based on the piezometer data and the historical downward gradient between the till and shallow bedrock at the nearby MW-6 well cluster, Pond 3 likely loses water to the ground-water system throughout the year; Pond 3 is not expected to receive recharge from the overburden or shallow bedrock. It should be noted that when the surface-water level in Pond 3 increases to approximately 474 ft msl, overflow discharges to the eastern stream by a culvert.

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Mill Brook

The noted decrease in discharge between the upstream (GS-6) and downstream (GS-7) gauging stations in Mill Brook observed on June 15, 1992 and August 19, 1992 indicate that Mill Brook was losing water to the ground-water system during this time period. Based on the relatively large magnitude of decrease in discharge (approximately 7.0 to 8.0 cfs between the upstream and downstream gauging stations, it is likely that the Mill Brook discharges to ground-water throughout the year. Future quarterly streamflow gauging will be performed to further evaluate this hypothesis.

As previously discussed, the existing data suggest that, at times, surface waters in Northeast Pond and the eastern stream system south of Pond 1 may also recharge the ground-water system. However, it should be noted that the existing data has been collected between the months of June and October. The water balance analysis in Section 3.2.4 indicates that this time period generally coincides with what is normally the dry season of the year. Based on estimates of monthly total runoff, and the fact that the majority of available runoff infiltrates and ultimately recharges the ground-water system rather than occurring as surface runoff, ground-water recharge is expected to be most significant during the normal wetter seasons when evapotranspiration is lower. The water balance analysis indicates that ground-water recharge is most significant during the late fall, early winter, and spring. Although no surface-water data have been collected during these periods, it may be expected that during times of ground-water recharge, areas where surface waters discharge to ground water (i.e. Pond 1, Pond 2, Pond 3, and Mill Brook) during dry season conditions will continue to do so during wet season conditions. However, the

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vertical gradient may be reversed during wet seasons in areas where surface waters are recharged by ground water (i.e. Northwest wetlands) during dry seasons. Areas that functioned as both surface-water recharge and discharge areas during the dry season (i.e. Northeast Pond and the eastern stream system) will likely discharge to ground water during the wetter seasons.

3.3 Hydrogeology

Two principal geologic units utilized as aquifers were identified during the investigations conducted at the site. These units, the overburden and bedrock, are both used as sources of drinking water in the area. Drinking water is obtained from fractures within the bedrock and is also obtained from sandier till areas or from sand lenses within the till and stratified drift overlying bedrock and underlying till. The overburden deposits provide water to a limited number of residences in the area. Bedrock wells provide the majority of water used for domestic purposes. On-site water is obtained from a bedrock well and treated prior to use due to VOC contamination.

3.3.1 Hydraulic Characteristics

Slug tests were conducted to assess the hydraulic conductivity of the till deposits at the site. Slug test data were analyzed using the Bouwer and Rice solution (Bouwer and Rice, 1976) for unconfined aquifers.

Slug tests were also used to assess the hydraulic conductivity of the shallow bedrock. Slug test data were subsequently analyzed using the mathematical solutions developed by Bouwer and Rice (1976) Cooper, Bredehoeft and Papadopulos (1967) depending on

whether the well response indicated confined or unconfined conditions.

Both slug and packer tests were performed to determine the relative hydraulic conductivities of the deep bedrock at the site. Data were analyzed using the Cooper, Bredehoeft and Papadopulos analytical solutions (1967) for slug test data and the U.S. Department of Interior, Bureau of Reclamation method (1987) for packer test data. Data and model curves for the slug and packer tests are provided in Appendices F and G, respectively.

Slug test data for till and shallow bedrock monitoring wells MW-25t, MW-1sb, MW-16sb, and MW-EPA-Asb were not amenable to analysis due to problems encountered during field data collection. Problems at till and shallow bedrock wells consisted of uneven slug pulls or equipment malfunction. The lack of data for these wells is of minor importance because they are not located in primary areas of VOC transport. Slug test data for deep bedrock monitoring wells MW-15db, MW-18db, MW-21db, MW-22db, and GW-10db were not amenable to analysis. The inability to obtain data at the deep bedrock wells was due to the limitations of the field equipment for slug testing 6-inch diameter, high-yielding deep bedrock wells and interferences from on-site and off-site production well pumping. Hydraulic conductivity data from packer tests were used where slug test data were lacking.

Hydraulic conductivities of the geological materials at the site were found to vary significantly between the individually tested wells and at different areas of the site. This distribution is attributed to differences in aquifer type, overburden heterogeneity, and the degree of weathering, physical

deformation, and fracturing. Hydraulic conductivities estimated by slug tests may have been biased lower than those that actually exist at some till wells due to "smearing" from the hollow-stem augers method used to install the wells. Attempts were made to develop the till wells to eliminate the smearing effect; however, the wells may not have been developed thoroughly due to the fine-grained nature and low yield of the till.

Highest hydraulic conductivities were measured in the shallow bedrock in areas where high degrees of weathering, fracturing, and physical alteration are present. Lowest hydraulic conductivities were measured in the till and due to the fine grained nature and degree of compaction present in the till unit.

3.3.1.1 Till Hydraulic Conductivity

Hydraulic conductivities range from 0.001 ft/day (MW-2t) to 11.7 ft/day (MW-8t) for the till wells. Table 3-5 presents a summary of measured hydraulic conductivities and transmissivities for each well. Compositional heterogeneities are present within the till unit at the site. The two till wells with the highest hydraulic conductivities are MW-6t and MW-8t. These conductivities correspond to a sand lens (MW-6t) and an area of sandier till (MW-8t). Overall, the overburden till unit exhibits low hydraulic conductivity, which is reflective of its composition and high degree of compaction.

Generally, hydraulic conductivities at till wells increase at lower elevations away from the facility toward the site boundaries. Till deposits with higher fractions of sand are found in these areas. The surficial deposits at topographic lows in the study area generally have higher percentages of sand, as

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TABLE 3-5

SUMMARY OF SLUG TEST ANALYSES

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
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DECEMBER 1992

WELL	HYDRAULIC CONDUCTIVITY (ft/day)	TRANSMISSIVITY (sq. ft/day)	STORATIVITY (1)	COMMENTS
MW-1t	0.002	0.16		
MW-2t	0.001	0.06		
MW-3t	0.006	0.16		
MW-4t	0.001	0.8		
MW-6t	0.29	7.9		Sand lens
MW-8t	11.7	59.2		Sandy till
MW-10td	0.001	0.02		
MW-11t	0.1	2.9		Sandy till
MW-12t	2.0	32.7		Sandy till
MW-15t	0.01	0.96		
MW-16t	0.007	0.29		
MW-17ts	0.08	3.8		
MW-17td	0.005	0.18		
MW-18t	1.0	24.8		Sandy till
MW-23t	0.006	0.36		
MW-24t	0.001	0.008		
MW-25t	(2)			
MW-26t	(3)			
MW-EPA-Ats	0.01	0.88		
MW-EPA-Atd	0.003	0.12		
DW-1t	0.14	5.1		Possible sand pack influence

(1) Confined bedrock only
(2) Data not amenable to analysis
(3) Not tested

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TABLE 3-5
(CONTINUED)
SUMMARY OF SLUG TEST ANALYSES

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
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WELL	HYDRAULIC CONDUCTIVITY (ft/day)	TRANSMISSIVITY (sq. ft/day)	STORATIVITY (1)	COMMENTS
MW-1sb	(2)			
MW-5sb	0.22	1.09	2x10-5	
MW-6sb	0.003	0.03	8x10-3	contact metamor-phosed schist
MW-7sb	55.7	278	1x10-6	weathered rock
MW-8sb	12.8	320		
MW-9sb	8.6	42.8	5x10-3	
MW-10sb	0.04	0.35	0.758	granite pegmatite
MW-11sb	0.36	3.6	0.041	
MW-12sb	0.52	5.2	3x10-5	
MW-14sb	7.0	69.8	2x10-4	
MW-15sb	0.88	8.8	6x10-3	
MW-16sb	(2)			
MW-17sb	0.014	0.14	3x10-4	
MW-18sb	0.53	5.3	1x10-4	
MW-19sb	0.50	1.9		
MW-20sb	0.07	0.74	1.637	fractures filled with fine sand
MW-EPA-sb	(2)			

(1) Confined bedrock only
(2) Data not amenable to analysis
(3) Not tested

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TABLE 3-5
(CONTINUED)
SUMMARY OF SLUG TEST ANALYSES

REMEDIAL INVESTIGATION REPORT
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WOODSTOCK, CONNECTICUT
DECEMBER 1992

WELL	HYDRAULIC CONDUCTIVITY (ft/day)	TRANSMISSIVITY (sq. ft/day)	STORATIVITY (1)	COMMENTS
MW-1db	4.6	996	4x10-6	high yielding
MW-6db	0.13	34	6x10-3	
MW-8db	0.03	5.6	5x10-3	
MW-11db	0.48	104	2x10-5	
MW-12db	0.15	26	2x10-5	
MW-13db	0.17	48	8x10-4	
MW-14db	4.9	871	3x10-4	high yielding
MW-15db	(2)			
MW-17db	0.06	21.6	1x10-3	
MW-18db	(2)			
MW-21db	(2)			
MW-22db	(2)			
GW-10db	(2)			
GW-12db	1.0	34.3	0.06	

(1) Confined bedrock only
(2) Data not amenable to analysis
(3) Not tested

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discussed in Section 3.1.1.

3.3.1.2 Bedrock Hydraulic Conductivity

Hydraulic conductivities based on slug test data analyses range from 0.003 ft/day (MW-6sb) to 55.7 ft/day (MW-7sb) for the shallow bedrock. Table 3-5 presents a summary of the data for shallow bedrock wells including corresponding hydraulic conductivities, transmissivities, and storativities. Slug test data from several shallow bedrock wells were not amenable to analysis for the reasons discussed in Section 3.3.1. The shallow bedrock wells screened within areas of weathered bedrock, MW-7sb, MW-8sb, MW-9sb, and MW-14sb, have the highest hydraulic conductivities (7.0 - 55.7 ft/day). The lowest hydraulic conductivity was measured at MW-6sb (0.003 ft/day), which is indicative of the low degree of weathering observed at this location. Bedrock in this particular area has been contact metamorphosed by the granite pegmatite intrusion and is more gneiss-like and resistant to weathering than the schist present in other areas of the site. Wells screened within the granite pegmatite unit generally have lower hydraulic conductivities than the schist. Overall, there is a high degree of variability in hydraulic conductivities in the shallow bedrock across the site. This is the result of lithologic heterogeneity and the degree of weathering and metamorphism.

Hydraulic conductivities, transmissivities and storativities obtained by slug tests of the deep bedrock wells are presented in Table 3-5. Table 3-6 contains a tabular summary of the hydraulic conductivities determined by slug tests and packer tests for the deep bedrock wells. Calculated K values from the slug tests range from 0.03 ft/day (MW-8db) to 4.9 ft/day (MW-14db). Values

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TABLE 3-6

DEEP BEDROCK HYDRAULIC CONDUCTIVITIES

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

WELL	ZONE (feet blow grade)	PACKER TEST HYDRAULIC CONDUCTIVITY (ft/day)	SLUG TEST HYDRAULIC CONDUCTIVITY (ft/day)
MW-1db	105-135	0.45	4.6
	130-160	0.10	
	240-270	1.4	
MW-6db	81-111	0.92	0.13
	120-150	0.06	
	150-180	0.13	
MW-8db	30-70	0.17	0.03
	87-127	0.13	
	160-200	0.01	
MW-11db	52-92	0.13	0.48
	160-200	0.04	
MW-12db	45-65	0.04	0.15
	85-105	0.07	
	135-155	0.07	
	160-180	0.04	
	180-200	0.02	
MW-13db	60-80	0.12	0.17
	160-180	0.02	
	210-230	0.05	
MW-14db	40-70	0.02	4.9
	80-110	0.02	
	170-200	0.84	
MW-15db	155-225	0.63	(1)
	255-305	0.46	
MW-17db	83-123	0.04	0.06
	250-290	0.15	
	300-340	0.04	
MW-18db	70-100	0.04	(1)
	130-160	4.4	
	160-190	2.8	
MW-21db	170-200	0.02	(1)
	280-310	0.004	
MW-22db	35-75	0.07	(1)
	80-120	0.16	
	120-180	0.50	
	185-225	0.13	
GW-10db	68-98	0.34	(1)
	100-130	0.18	
	290-320	0.05	
GW-12db	95-135	0.21	1.0

(1) Data not amenable to analysis

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from slug tests represent the average hydraulic conductivity of all fracture zones throughout the entire length of the borehole.

Slug test data from MW-15db, MW-18db, MW-21db, MW-22db, and GW-10db could not be analyzed due to the limitations of the field equipment, as discussed in Section 3.1.1, and/or water-level interferences resulting from cycling of the production well or other off-site pumping sources. Based on background water-level studies detailed in Appendix I, intermittent pumping of the deep bedrock aquifer by the Linemaster production well causes the water levels to slowly decrease slowly in these wells during the day and recover at night when pumping is less frequent. This phenomenon affects the apparent recovery rate of the wells during the slug test and generally results in very low hydraulic conductivity estimates which disagree with the yields estimated from driller's tests. In consideration of the fact that no alternate water sources exist and the large number of wells involved, it is not feasible to stop on-site and off-site pumping wells during slug tests.

Hydraulic conductivities for fracture zones or individual fractures were also determined during packer tests. Measured hydraulic conductivities for fracture zones range from 0.004 ft/day (MW-21db, 280-310') to 4.4 ft/day (MW-18db, 130-160'). A comparison of the hydraulic conductivity values obtained by slug test and packer test methods indicates some differences. At most wells, the hydraulic conductivity obtained by the slug test method was generally higher than the highest hydraulic conductivity determined by packer tests for a specific fracture zone in any given well. Nonetheless, these results are not considered to be contradictory; two different field methods and mathematical models were used to interpret the data and resulted

in hydraulic conductivity estimates of similar magnitude. Different mathematical assumptions are implicit in each of the models. The Cooper et al. solution used for the slug test analysis assumes non-steady state flow, whereas the Bureau of Reclamation packer test analytical model assumes steady state flow.

It appears that most of the shallow and deep bedrock aquifer at the site is confined. The storativities measured at most shallow and deep bedrock wells fall within the characteristic range of a confined aquifer, 0.005 to 0.00005 (U.S. Department of the Interior, 1979). Unconfined conditions were found at MW-8sb and MW-19sb. Data from these wells could not be solved by the Cooper et al. confined aquifer solution, but were solved by the Bouwer and Rice unconfined aquifer solution. MW-8sb is in an area southwest of the facility where the till unit is not considered to be a confining layer due to a greater abundance of sand within the till unit. MW-19sb is east of the facility in an area where bedrock is close to the surface and the water table is within the screened interval of the well.

K data that were not solved by either the unconfined or confined models may indicate areas of leaky or semi-confining conditions. Such data were collected from wells MW-10sb, MW-11sb, MW-20sb, and GW-12db. MW-10sb and GW-12db are located near the top of the topographic feature where the bedrock aquifer probably is not completely confined. MW-11sb is located in an area where the till has greater sand content and hydraulic conductivity and consequently is not as an effective confining layer as found at other areas of the site. MW-20sb is located in an area where the bedrock is close to the surface and where the shallow bedrock may potentially discharge to Pond 2. MW-5sb, MW-7sb, MW-9sb, and

MW-14sb appear to have unconfined water levels; however, the slug test data were solved by the confined model. This may be indicative of confined fractures within the rock at these locations. Further discussion of the confined and unconfined conditions at the site and how they relate to the site conceptual model is presented in Sections 3.3.5 and 7.3.

The water level above the upper packer was monitored during the packer tests at the deep bedrock wells. Water-level data, provided in Table 3-7, indicate water levels above the packer changed during the packer tests and sampling. This could be attributed to leakage through the fracture system, assuming a high degree of fracture interconnection, leakage around the packers, the downward ground-water flow potentials or influences from nearby supply well pumping; however, the water-level changes are more likely related to the initial water volume displaced by the packers. When the packer is inserted into the borehole, an amount of water equal in volume to the packer apparatus is displaced. During the test, the hydraulic head near the borehole equilibrates with the hydraulic head in the surrounding aquifer. During this equilibration process, water-level changes are induced. This is true for water levels that decrease above the packer.

Increasing water levels above the packer may be attributed to the downward flow potential present at most shallow-deep bedrock well pairs at the site. Due to the fact that the lower receiving zone is isolated from the upper zone where recharge is occurring, the water level will increase above the upper packer.

TABLE 3-7

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PACKER WATER LEVELS

REMEDIAL INVESTIGATION REPORT
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	SAMPLING (1991)			PERMEABILITY TESTING	
WELL	DEPTH ZONE (ft)	SAMPLING TIME (min)	WATER LEVEL CHANGE (FT)	TESTING TIME (min)	WATER LEVEL CHANGE (FT)*
MW-1db	(105-135)	30	0.49	3	-0.10
	(130-160)	30	0	2	-0.10
	(210-240)	30	1.15	2	-1.60
	(240-270)	30	1.12	11.5	-2.60
MW-6db	(40-70)	180	-3.58	2	0
	(81-111)	30	0	3	-0.70
	(120-150)	N/A	0.04	3	0
	(150-180)	30	0.18	5	0
MW-8db	(30-70)	112	0.04	2.5	0
	(87-127)	33	0.18	3	0
	(160-200)	256	0.20	3	0.3
MW-11db	(52-92)	30	-0.08	2	-0.1
	(160-200)	224	0.15	2.5	0.1
MW-12db	(45-65)	46	0.12	5	0.05
	(85-105)	130	-0.38	7	0.60
	(135-155)	61	-0.73	5	0.18
	(160-200)	68	-0.29	5	-0.61 (160-180)
				4.5	-0.79 (180-200)
MW-13db	(60-80)		DRY		DRY
	(160-180)	63	2.93	3.5	0.02
	(210-230)	97	0.79	3.8	-0.20
MW-14db	(40-70)	30	-0.05	3.3	-0.01
	(80-110)	50	0.11	2.5	0
	(170-200)	30	0.01	2.9	0.02
MW-15db	(155-225)	193	2.61	3.5	-0.8
	(255-305)	100	0.44	2.5	-0.6
MW-17db	(83-123)	140	0	3	-0.2
	(180-220)	140	0	3.5	-0.9
	(250-190)	36	0	2.5	-0.9
	(300-340)	120	0.13	3	-0.6
MW-18db	(70-100)	45	-0.02	2	0.0
	(130-160)	23	0.02	2	0.0
	(160-190)	27	-0.82	2.5	-7.0
MW-21db	(170-200)	184	-1.40	3	-1.2
	(280-310)	135	19.5	12	0.5
MW-22db	(35-75)	20	-0.5	3.5	-0.6
	(80-120)	160	2.76	2.5	-0.3
	(140-180)	36	2.85	2.5	-0.3
	(185-225)	67	-11.55	3	-6.7
GW-10db	(68-98)	35	-0.08	4.5	
	(110-130)			4.8	1.68
	(290-320)	65	-0.9	5.8	
GW-12db	(95-135)	95	1.68	3.3	0.06

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3.3.2 Horizontal Ground-Water Flow Directions and Rates

Several rounds of water-level data were collected at the site. These data are included in Table 3-8 and discussed below. All water-level data resulted in similar ground-water elevation contours. Seasonal water level variations occur as indicated by the data in Table 3-8. Generally, the water-level elevations in monitoring wells increase during the wet spring season and decrease during the dry summer season.

3.3.2.1 Till Horizontal Ground-Water Flow Directions and Rates

Ground water in the till unit flows radially outward from the approximate center of the site where the bedrock high and the Linemaster manufacturing facility are located. Figures 3-6 and 3-7 present ground-water contour maps of the till unit prepared from water-level data (Table 3-8) collected on September 24, 1991 and April 27, 1992, respectively. The ground-water contours are not parallel to the surface topography, but rather are observed to parallel the bedrock surface as shown in Figure 3-5. For consistent depth comparison, only the wells screened immediately above the till/bedrock contact were used to construct the ground-water contour map. The ground-water flow at this depth may be influenced more by the bedrock surface than by the surface topography. Ground-water flow in the upper portion of the till is expected to be influenced more by surface topography.

The facility buildings and the adjacent parking lots appear to be creating a hydraulic low as evidenced by the till ground-water contour lines in this area. This results in a westward ground-water flow gradient from Zone 1 to the area underneath the facility. The significance of this feature relative to

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TABLE 3-8
WATER-LEVEL MEASUREMENTS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
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	1/19/90		7/23-26/90		8/3/90		9/24/91	
	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)
MW-1t		513.68	18.52	509.91	17.91	510.52	17.95	510.54
MW-1sb							42.65	485.82
MW-1db							44.07	485.52
MW-2t	9.08	553.86	13.17	549.77	14.32	548.62	12.28	551.32
MW-3t	8.12	536.56	11.99	532.69	12.16	532.52	14.51	530.21
MW-4t	10.72	545.76	17.75	538.73	21.29	535.19	12.83	543.70
MW-5sb	24.15	515.25	25.38	514.02	25.86	513.54	28.64	510.25
MW-6t	5.72	495.06	10.71	490.07	9.17	491.61	6.04	494.79
MW-6sb			12.61	488.17	11.72	489.06	9.45	491.40
MW-6db							20.96	483.46
MW-7sb	16.15	470.38	21.29	465.24	21.05	465.48	21.75	464.86
MW-8t							20.53	416.15
MW-8sb	15.60	421.91	19.72	417.79	20.02	417.49	20.37	417.25
MW-8db							18.73	418.89
MW-9sb	7.32	462.53	7.87	461.98	7.29	462.56	7.48	462.45
MW-10td	DRY		19.73	550.14	20.32	549.55	16.67	553.28
MW-10ts								
MW-10sb	33.22	535.99	47.97	521.24	48.35	520.86	46.49	522.80
MW-11t	7.72	485.74	9.79	483.67	9.27	484.19	9.32	484.16
MW-11sb	7.42	485.92	9.38	483.96	8.83	484.51	8.85	484.51
MW-11db							5.95	484.21
MW-12t	4.60	450.81	5.52	449.89	5.20	450.21	5.20	450.31
MW-12sb	5.62	450.04	6.79	448.87	6.07	449.59	6.42	449.31
MW-12db	34.22	420.80	35.93	419.09	34.43	420.59	33.96	421.12
MW-13db	20.33	520.48	62.30	478.51	85.07	455.74	66.00	474.83
MW-14sb	12.49	428.84	15.35	425.93	15.11	426.17	15.11	426.24
MW-14db	20.27	422.97	22.60	419.64	21.79	420.45	21.07	421.28
MW-15t							59.34	493.26
MW-15sb							65.24	487.23
MW-15db							65.80	485.58
MW-16t							11.85	557.50
MW-16sb							52.87	515.59
MW-17ts							5.17	554.69
MW-17td							11.53	548.56
MW-17sb							21.47	538.85
MW-17db							75.03	485.28
MW-18t							3.90	462.65
MW-18sb							4.41	462.20
MW-18db							42.24	423.69
MW-19sb							12.08	457.20
MW-20sb							7.34	420.28
MW-21db							109.83	439.46
MW-22db							32.05	472.47
MW-23t							11.67	557.95
MW-24t							17.02	550.65
MW-25t							8.44	561.90
MW-26t							24.33	545.32
MW-27t								
MW-27sb								
MW-27db								
MW-28t								
MW-28sb								
MW-28db								
MW-29t								
MW-29sb								
MW-29db								
MW-30td								
MW-30ts								
MW-EPA-Ats	9.14	561.14	12.40	557.88	12.43	557.85	17.38	552.98
MW-EPA-Atd							31.08	538.92
MW-EPA-Asb							39.14	530.79
GW-10db			48.30	530.95	73.55	500.70	71.00	503.25
GW-12db			53.85	500.15	56.24	497.76	60.03	493.97

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TABLE 3-8 (CONTINUED)
WATER-LEVEL MEASUREMENTS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

DRAFT
REV. 1.0 120192

	1/2/92		2/13/92		3/16/92		4/20/92	
	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)
MW-1t	14.06	514.45			11.62	516.89	12.45	516.06
MW-1sb	40.42	488.02			39.20	489.24	38.35	490.09
MW-1db	41.72	485.40			40.65	486.47	39.76	487.36
MW-2t	8.71	554.89			7.73	555.87	7.68	555.92
MW-3t	5.78	538.98			4.67	540.09	4.33	540.43
MW-4t	11.77	544.76			9.20	547.33	9.80	546.73
MW-5sb	20.22	518.67			18.64	520.25	19.40	519.49
MW-6t	4.62	496.21	5.38	495.45	4.31	496.52	3.70	497.13
MW-6sb	7.82	493.03			6.95	493.90	6.44	494.41
MW-6db	17.96	486.46			17.66	486.76	17.08	487.34
MW-7sb	13.30	473.31			24.95	461.66	12.76	473.85
MW-8t	11.15	425.53			9.08	427.60	10.06	426.62
MW-8sb	11.04	426.58			25.80	411.82	9.94	427.68
MW-8db	12.86	424.76			11.16	426.46	11.75	425.87
MW-9sb	7.29	462.64			7.20	462.73	6.89	463.04
MW-10td	15.02	554.93	15.68	554.27	14.06	555.89	18.40	551.55
MW-10ts							10.39	563.04
MW-10sb	43.77	525.52	43.56	525.73	40.53	528.76	40.77	528.52
MW-11t	6.99	486.49			6.09	487.39	5.70	487.78
MW-11sb	6.83	486.53			6.08	487.28	5.49	487.87
MW-11db	3.75	486.41			2.81	487.35	1.63	488.53
MW-12t	4.51	451.00			4.39	451.12	4.06	451.45
MW-12sb	5.62	450.11			5.42	450.31	4.99	450.74
MW-12db	30.90	424.18			30.41	424.67	29.82	425.26
MW-13db	45.20	495.63			37.54	503.29	36.33	504.50
MW-14sb	6.35	435.00			3.35	438.00	3.16	438.19
MW-14db	18.76	423.59			18.02	424.33	18.05	424.30
MW-15t	55.22	497.38			52.55	500.05	52.36	500.24
MW-15sb	62.93	489.54			61.51	490.96	60.99	491.48
MW-15db	62.73	488.65			62.20	489.18	60.66	490.72
MW-16t	9.60	559.75	10.69	559.02	7.65	561.70	7.13	562.22
MW-16sb	50.39	518.07	14.18	554.78	46.36	522.10	45.97	522.49
MW-17ts	2.69	557.17			2.42	557.44	1.99	557.87
MW-17td	8.58	551.51	9.64	550.45	7.57	552.52	7.72	552.37
MW-17sb	18.46	541.86	13.41	546.91	16.96	543.36	17.61	542.71
MW-17db	68.16	492.15			68.22	492.09	65.22	495.09
MW-18t	3.42	463.13			3.54	463.01	3.00	463.55
MW-18sb	4.06	462.55			4.05	462.56	3.55	463.06
MW-18db	32.29	433.64			37.93	428.00	38.06	427.87
MW-19sb	9.32	459.96			7.70	461.58	7.33	461.95
MW-20sb	6.16	421.46			5.71	421.91	5.22	422.40
MW-21db	106.38	442.91			87.55	461.74	93.96	455.33
MW-22db	27.88	476.64			25.26	479.26	25.46	479.06
MW-23t	5.87	563.75			3.38	566.24	2.39	567.23
MW-24t	4.32	563.35	4.87	562.80	2.07	565.60	1.56	566.11
MW-25t	5.97	564.37	4.92	565.99	4.86	565.48	4.03	566.31
MW-26t	22.77	546.88	25.86	543.79	23.64	546.01		
MW-27t	46.63	491.07			46.68	491.02	46.41	491.29
MW-27sb	36.13	501.01			91.96	445.18	87.23	449.91
MW-27db	52.22	486.85			51.07	488.00	50.26	488.81
MW-28t							3.79	563.87
MW-28sb							19.54	551.95
MW-28db							65.15	505.09
MW-29t							24.58	530.01
MW-29sb							28.41	522.63
MW-29db							60.06	491.72
MW-30td							10.52	562.82
MW-30ts							6.09	567.51
MW-EPA-Ats	7.40	562.96	8.40	561.96	5.20	565.16	4.14	566.22
MW-EPA-Atd	25.63	544.37	26.05	543.95	23.06	546.94	23.26	546.74
MW-EPA-Asb	34.99	534.94	35.50	534.43	32.67	537.26	32.80	537.13
GW-10db								
GW-12db	53.32	500.68						

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TABLE 3-8 (CONTINUED)
WATER-LEVEL MEASUREMENTS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

DRAFT
REV. 1.0 120192

	4/27/92							
	DEPTH TO WATER (ft)	GRND.WATER ELEV.(ft-msl)						
MW-1t	11.81	516.70						
MW-1sb	38.38	490.06						
MW-1db	40.27	486.85						
MW-2t	7.27	556.33						
MW-3t	4.36	540.40						
MW-4t	8.93	547.60						
MW-5sb	18.06	520.83						
MW-6t	3.58	497.25						
MW-6sb	6.26	494.59						
MW-6db	16.33	488.09						
MW-7sb	12.46	474.15						
MW-8t	9.07	427.61						
MW-8sb	8.99	428.63						
MW-8db	11.06	426.56						
MW-9sb	6.88	463.05						
MW-10td	14.44	555.51						
MW-10ts	9.57	563.86						
MW-10sb	40.22	529.07						
MW-11t	5.21	488.27						
MW-11sb	5.17	488.19						
MW-11db	1.81	488.35						
MW-12t	4.05	451.46						
MW-12sb	4.91	450.82						
MW-12db	29.69	425.39						
MW-13db	34.74	506.09						
MW-14sb	2.35	439.00						
MW-14db	18.00	424.35						
MW-15t	52.11	500.49						
MW-15sb	60.97	491.50						
MW-15db	60.78	490.60						
MW-16t	6.79	562.56						
MW-16sb	45.13	523.33						
MW-17ts	1.88	557.98						
MW-17td	7.37	552.72						
MW-17sb	17.26	543.06						
MW-17db	63.33	496.98						
MW-18t	2.91	463.64						
MW-18sb	3.48	463.13						
MW-18db	38.03	427.90						
MW-19sb	7.01	462.27						
MW-20sb	4.93	422.69						
MW-21db	97.86	451.43						
MW-22db	25.37	479.15						
MW-23t	2.20	567.42						
MW-24t	1.43	566.24						
MW-25t	3.86	566.48						
MW-26t	23.14	546.51						
MW-27t	66.52	471.18						
MW-27sb	104.05	433.09						
MW-27db	50.59	488.48						
MW-28t	3.92	563.74						
MW-28sb	19.13	552.36						
MW-28db	64.66	505.58						
MW-29t	30.09	524.50						
MW-29sb	35.82	515.22						
MW-29db	60.04	491.74						
MW-30td	10.11	563.23						
MW-30ts	5.51	568.09						
MW-EPA-Ats	4.06	566.30						
MW-EPA-Atd								
MW-EPA-Asb	32.29	537.64						
GW-10db								
GW-12db								

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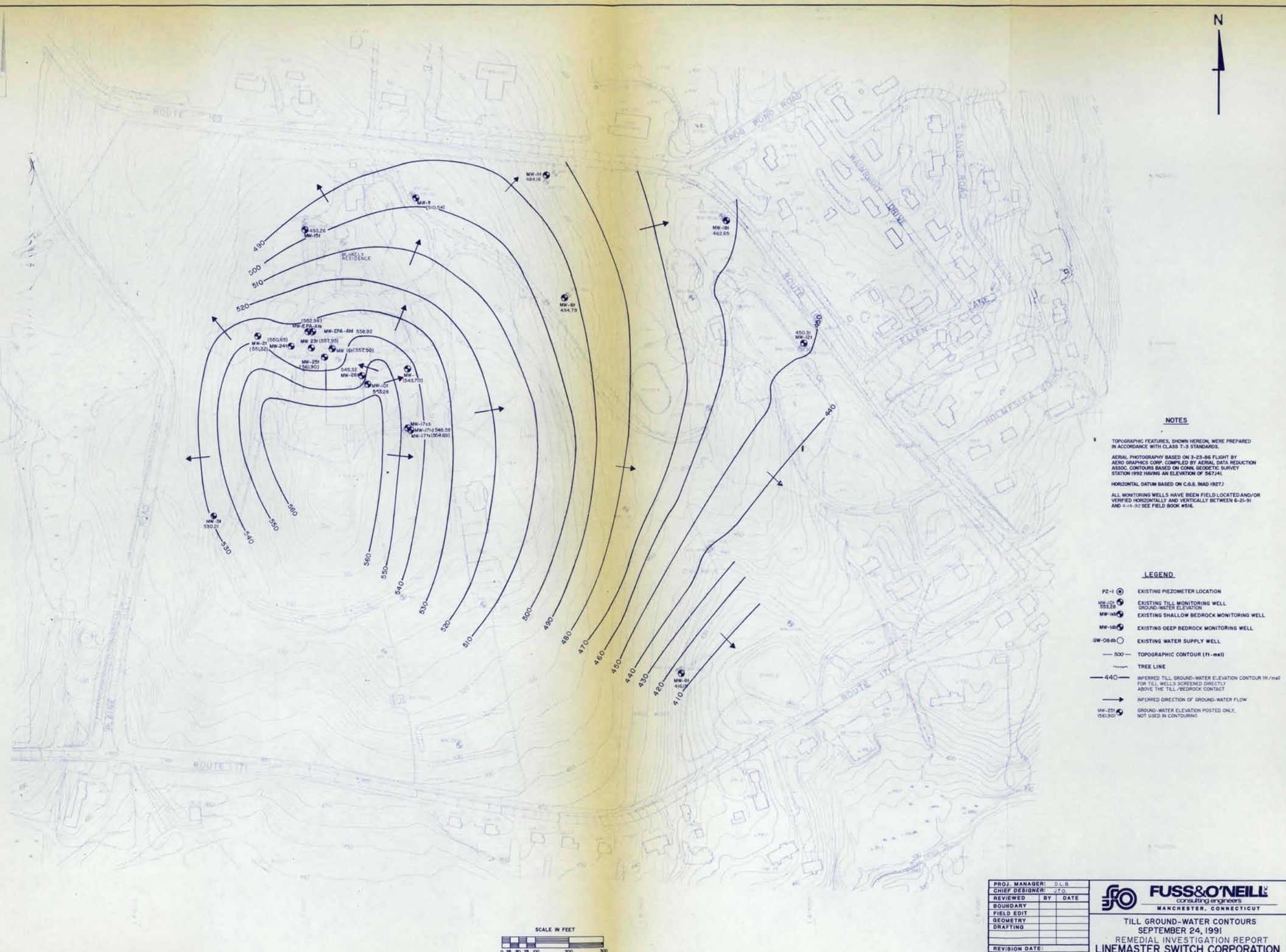


NOTES

1. TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-10r 553.28	EXISTING TILL MONITORING WELL GROUND-WATER ELEVATION
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
— 440 —	INFERRED TILL GROUND-WATER ELEVATION CONTOUR (ft/msl) FOR TILL WELLS SCREENED DIRECTLY ABOVE THE TILL/BEDROCK CONTACT
→	INFERRED DIRECTION OF GROUND-WATER FLOW
MW-25r (561.90)	GROUND-WATER ELEVATION POSTED ONLY, NOT USED IN CONTOURING

SCALE IN FEET

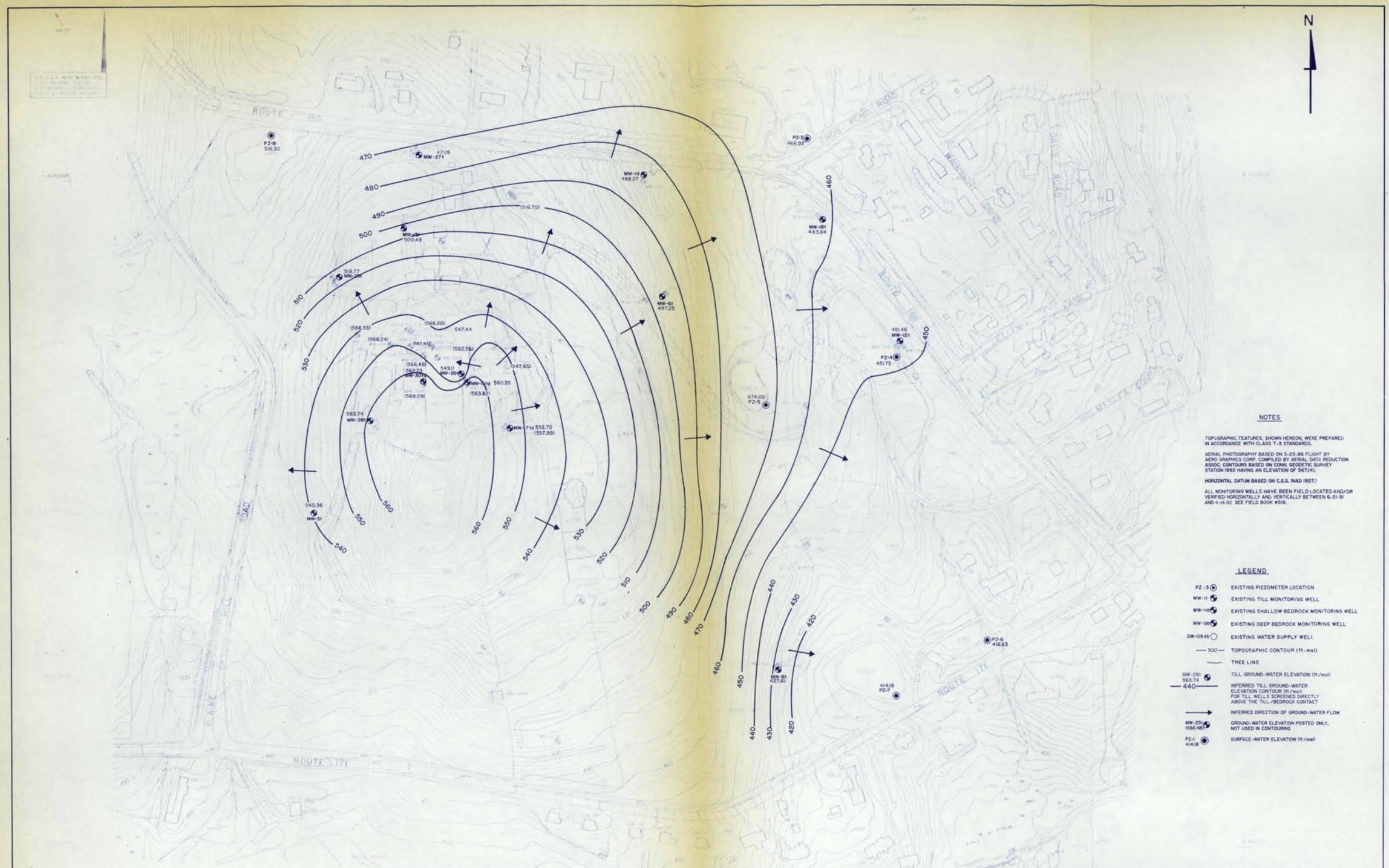
0 25 50 75 100 200 300

PROJ. MANAGER:	D.L.B.	
CHIEF DESIGNER:	J.T.O.	
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ MAR 1992	△	△
△ 7-16-92	△	△
SCALE: HOR.	IN.	FT.
VER.	IN.	FT.

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

TILL GROUND-WATER CONTOURS
SEPTEMBER 24, 1991
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV. 1991		86-[illegible]	3-6



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-14S	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-14D	EXISTING DEEP BEDROCK MONITORING WELL
GW-0846	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft.-msl)
~~	TREE LINE
MW-28I 563.74	TILL GROUND-WATER ELEVATION (ft./msl)
— 440 —	INFERRED TILL GROUND-WATER ELEVATION CONTOUR (ft./msl) FOR TILL WELLS SCREENED DIRECTLY ABOVE THE TILL/BEDROCK CONTACT
→	INFERRED DIRECTION OF GROUND-WATER FLOW
MW-25I (566.48)	GROUND-WATER ELEVATION POSTED ONLY, NOT USED IN CONTOURING
PZ-1 414.18	SURFACE-WATER ELEVATION (ft./msl)

SCALE IN FEET

0 25 50 75 100 200 300

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE		
△	△	△
△	△	△
SCALE: HOR. IN. FT.		
VER. IN. FT.		

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

TILL GROUND-WATER CONTOURS
APRIL 27, 1992
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
AUG. 1992	-	86-88 D	3-7

contaminant transport is discussed in Section 4.3.1.

The horizontal ground-water gradient is steep near the top of the central topographic high as evidenced by the close spacing of the ground-water contour lines. The horizontal gradient generally decreases at lower topographic elevations, as indicated by the wider spacing between ground-water contour lines, except to the north and southeast where the gradients are noticeably steep reflecting the decrease in the bedrock surface elevation at these areas.

Based on the Darcy equation for flow in porous media, the average linear ground-water flow velocity within the till unit was calculated using the formula:

$$V = \frac{k\ i}{n}$$

where,

V = average linear ground-water flow velocity (ft/day)
k = hydraulic conductivity (ft/day)
i = hydraulic gradient (ft/ft)
n = porosity (dimensionless)

The average linear ground-water flow velocity was calculated for the primary direction of VOC transport in the till unit using water-level data collected on September 24, 1991. The predominant direction of VOC transport in the till unit is generally from Zone 1 to the east-northeast, as further discussed in Section 4.3.1. The hydraulic conductivity of the till generally increases with distance away from the facility as discussed in Section 3.3.1.1. A transect through the approximate

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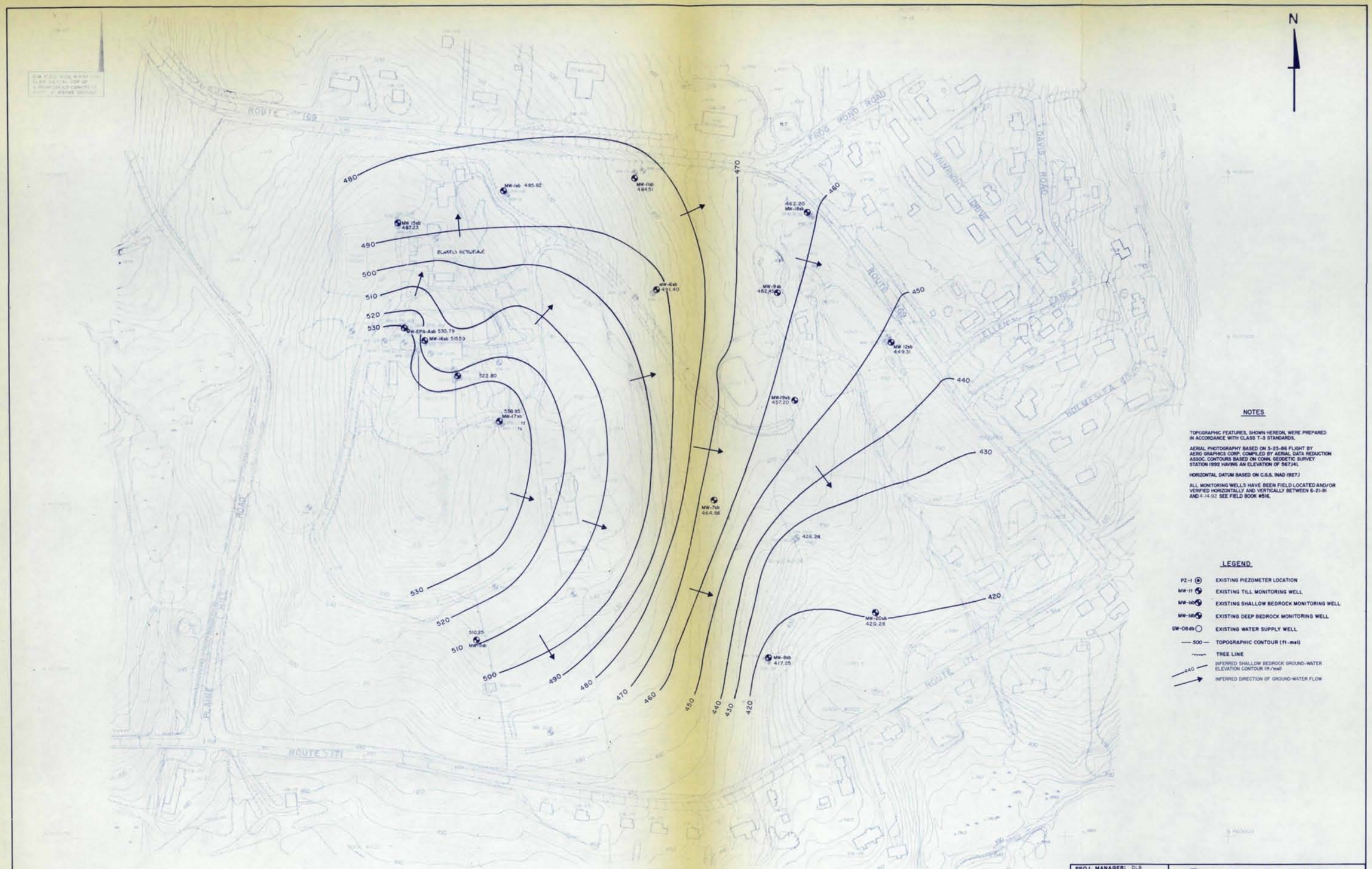
center of the VOC plume would intersect MW-10t, MW-6t, and MW-18t. The hydraulic conductivity for the length of this transect could be envisioned to be divided into thirds, with each third representing the hydraulic conductivity of MW-10t, MW-6t or MW-18t. In this way, the ground-water flow velocity can be approximated into ranges across this area of contaminant transport by taking into consideration the varying hydraulic conductivities and gradients.

The hydraulic conductivities at MW-10t, MW-6t, and MW-18t are 0.001 ft/day, 0.29 ft/day, and 1.0 ft/day, respectively. The hydraulic gradients between MW-10t and MW-6t and between MW-6t and MW-18t are 0.09 ft/ft and 0.06 ft/ft, respectively. A porosity value of 0.25 was estimated for the Zone 1 till using physical parameters measured from soil samples. Using these values, average linear ground-water flow velocities range from 0.0004 ft/day to 0.10 ft/day between MW-10t and MW-6t and from 0.07 ft/day to 0.24 ft/day between MW-6t and MW-18t.

3.3.2.2 Shallow Bedrock Horizontal Ground-Water Flow Directions and Rates

The overall ground-water flow direction within the shallow bedrock is similar to the ground-water flow direction within the deep till. Ground water in the shallow bedrock unit flows radially outward from the site's central topographic high.

Figures 3-8 and 3-9 depict ground-water contours in the shallow bedrock at the site. Water levels used to construct these maps were collected on September 24, 1991 and April 27, 1992 and are presented in Table 3-8. The shallow bedrock ground-water contours generally parallel the bedrock surface topography. The



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
440	INFERRED SHALLOW BEDROCK GROUND-WATER ELEVATION CONTOUR (ft/msl)
→	INFERRED DIRECTION OF GROUND-WATER FLOW

SCALE IN FEET

0 25 50 75 100 200 300

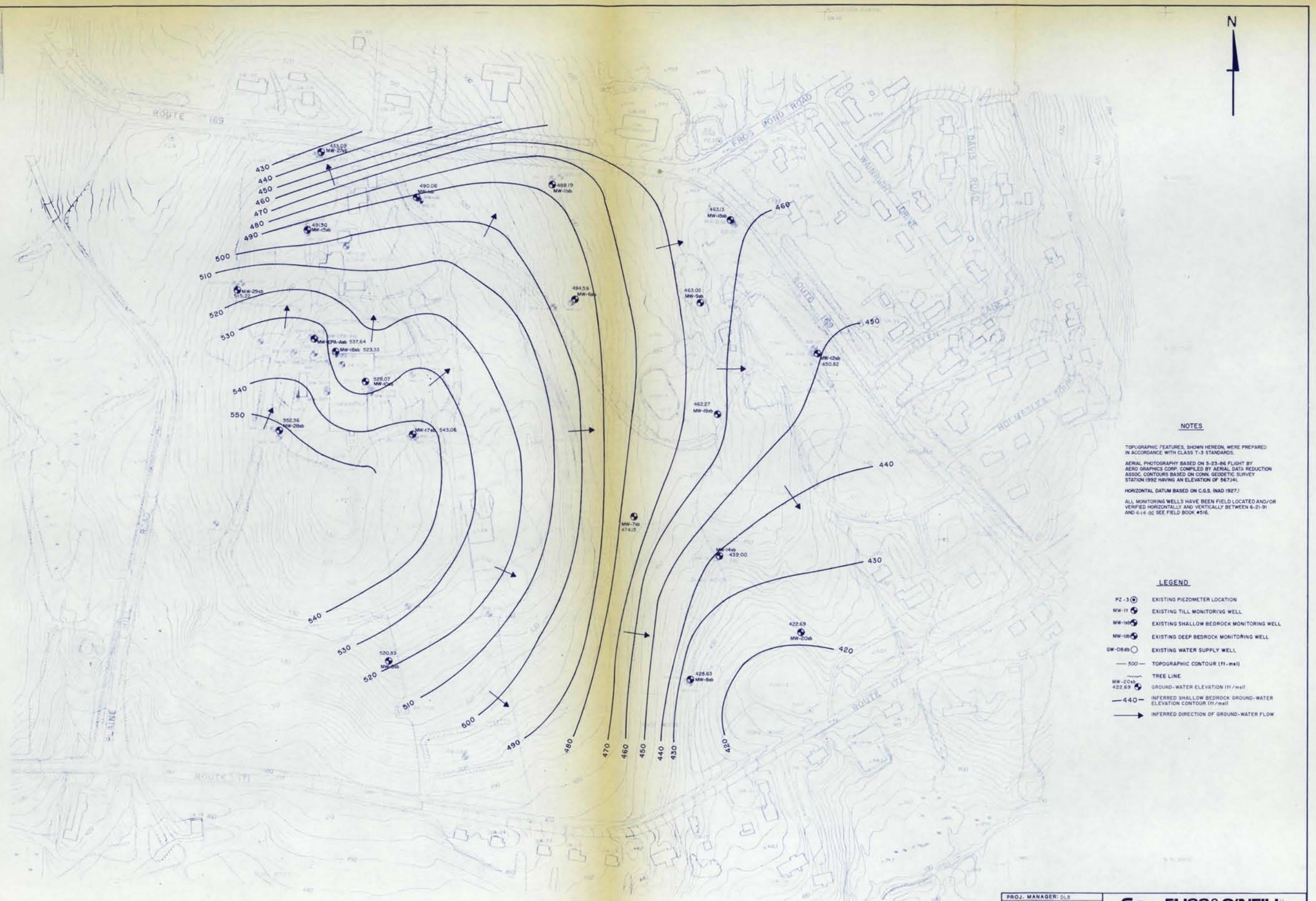
PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ MAR 1992	△	△
△ 7-16-92	△	△
SCALE: HOR. IN. FT.		
VER. IN. FT.		

FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT

SHALLOW BEDROCK GROUND-WATER CONTOURS
SEPTEMBER 24, 1991
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
NOV. 1991		86-88 D	FIGURE 3-8



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
—500—	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
MW-20sb 422.69	GROUND-WATER ELEVATION (ft/msl)
—440—	INFERRED SHALLOW BEDROCK GROUND-WATER ELEVATION CONTOUR (ft/msl)
→	INFERRED DIRECTION OF GROUND-WATER FLOW

SCALE IN FEET

0 25 50 75 100 200 300

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JAJ		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△	△	△
△	△	△
SCALE: HOR. IN. FT. VER. IN. FT.		

FUSS&O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

SHALLOW BEDROCK GROUND-WATER CONTOURS
APRIL 27, 1992
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
AUG. 1992		86-88 D	3-9

ground-water gradient is steep southeast of the site where the bedrock topography is steep, as evidenced by the close spacing of the contour lines.

The ground-water contours east of the site may be influenced by the bedrock high east of Route 169. The Linemaster facility building and parking lot may be creating a hydraulic low as evidenced by the shallow bedrock ground-water contours shown in Figures 3-8 and 3-9.

The ground-water flow velocity in fractured bedrock is difficult to predict because the water-transmitting capabilities of adjacent fractures can vary by several orders of magnitude. The rate of ground-water flow through bedrock depends primarily on the nature of fracturing and the degree of interconnection as well as the degree of weathering. The path of ground-water flow through fractured, unweathered bedrock may be longer than the linear distance between two points because fractures typically are connected through a step-like network. This is especially significant when several sets of fractures are present and are oriented at right angles to each other. However, it should also be noted that travel distances may be shorter in the areas where a high degree of fracturing or physical alteration is present where the path would be more direct. The physical alteration of bedrock at the site is variable, as discussed in Section 3.1.2, indicating the potential for ground water to flow at different rates depending on the path taken.

The average linear ground-water flow velocity within bedrock was calculated using an equation presented by Sowers (1981). This equation is related to the Darcy equation for flow in porous media; however, the Sowers equation includes a factor for

turbulent flow instead of the laminar flow assumed by the Darcy equation. The Sowers equation is as follows:

$$Q = ki^N A$$

where;

Q = discharge per unit time (ft/day)
k = pseudohydraulic conductivity (ft/day)
i = hydraulic gradient (ft/ft)
N = exponent related to flow, ranges from 0.5 for turbulent flow to 1.0 for laminar flow
A = cross sectional area (ft^2)

This equation can be modified according to a similar modification of Darcy's equation to calculate average linear flow velocity:

$$V = \frac{ki^N}{n}$$

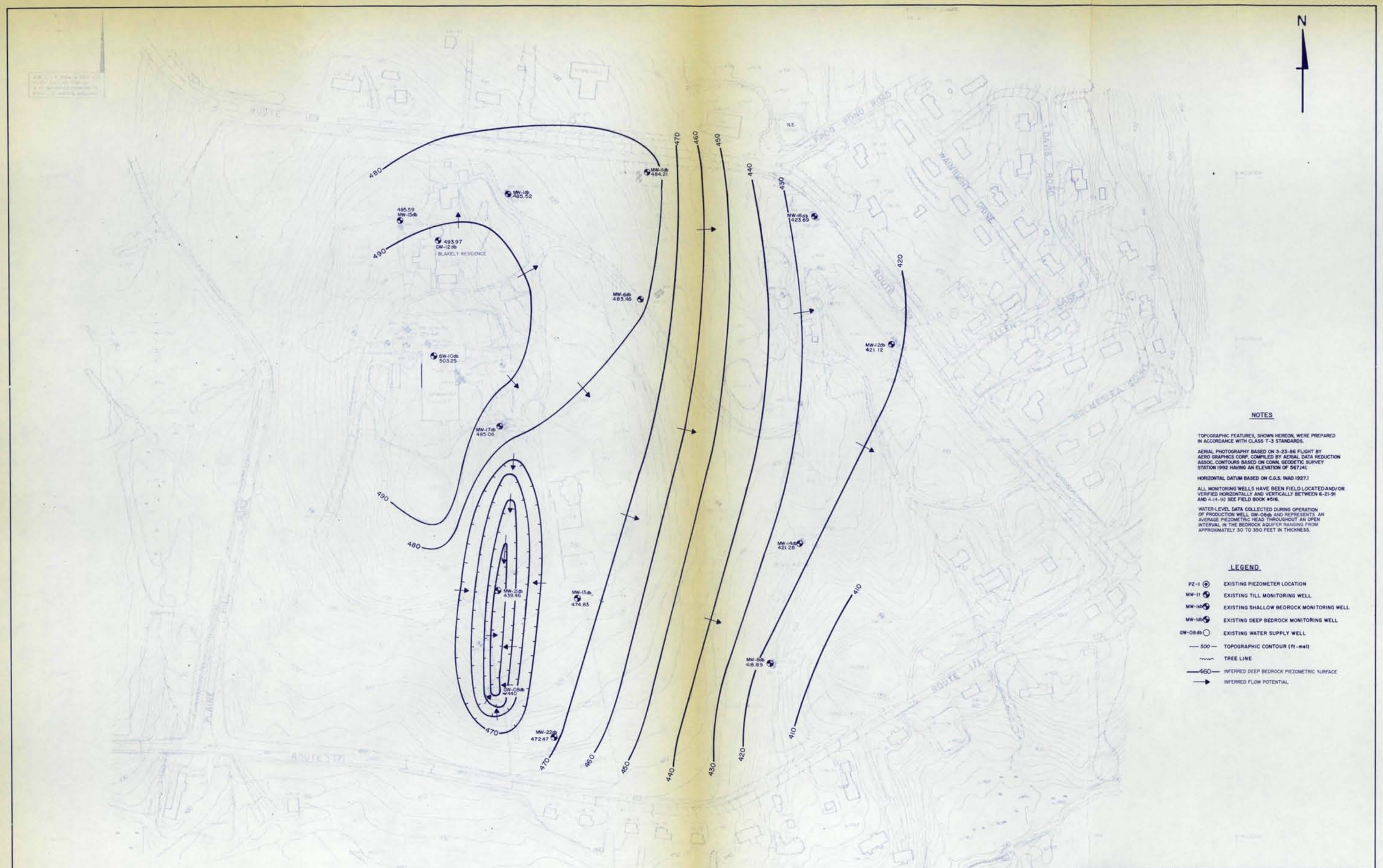
where;
V = average linear ground-water flow velocity (ft/day)
n = effective porosity (dimensionless)

Average linear ground-water flow rates for the shallow bedrock were calculated for the same area as the till, as described in Section 3.3.2.1, using water-level data collected on September 24, 1991. This transect area is the primary transport direction for contaminants in the shallow bedrock from the Zone 1 source area and includes monitoring wells MW-10sb, MW-6sb and MW-18sb. The hydraulic conductivities for MW-10sb, MW-6sb and MW-18sb are 0.04 ft/day, 0.003 ft/day, and 0.53 ft/day, respectively. The hydraulic gradients between MW-10sb and MW-6sb and between MW-6sb and MW-18sb are 0.05 ft/ft and 0.06 ft/ft, respectively. A value of 0.9 was used for N because laminar flow is believed to predominate in the metamorphic bedrock system at the site. A

value of 0.1 was used for the effective porosity as given in the range provided by Freeze and Cherry (1979). Using these values, average linear ground-water flow velocities range from 0.002 ft/day to 0.03 ft/day for the distance between MW-10sb and MW-6sb and from 0.002 ft/day to 0.42 ft/day for the distance between MW-6sb and MW-18sb.

3.3.2.3 Deep Bedrock Horizontal Ground-Water Flow Directions and Rates

The horizontal ground-water flow direction within the deep bedrock shown in Figures 3-10 and 3-11 is similar to the ground-water flow in the till and shallow bedrock units. These figures represent idealized general flow directions and were constructed using water-level data which reflect the average piezometric values of the entire deep bedrock borehole. Water levels used to construct these maps were collected on September 24, 1991 and April 27, 1992 and are presented in Table 3-8. The bedrock surface topography appears to have less influence on the deep bedrock ground-water flow patterns than it has on ground-water flow in the till and shallow bedrock. The bedrock piezometric surface depicts a north-south oriented ellipsoidal area of drawdown caused by the pumping of Linemaster production well GW-08db. Although MW-21db and MW-13db are located only 240 feet apart, the water level in MW-21db on September 24 was 35.37 feet lower than the water level in MW-13db. The water level in MW-17db on September 24 was 18.19 feet lower than the water level in GW-10db. MW-17db is located 290 feet southeast of GW-10db as shown in Figure 3-10. These observations may be indicative of ground-water migration along the fractures and fracture traces discussed in Section 3.1.2.3.



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

WATER-LEVEL DATA COLLECTED DURING OPERATION OF PRODUCTION WELL GW-08db AND REPRESENTS AN AVERAGE PIEZOMETRIC HEAD THROUGHOUT AN OPEN INTERVAL IN THE BEDROCK AQUIFER RANGING FROM APPROXIMATELY 30 TO 350 FEET IN THICKNESS.

LEGEND

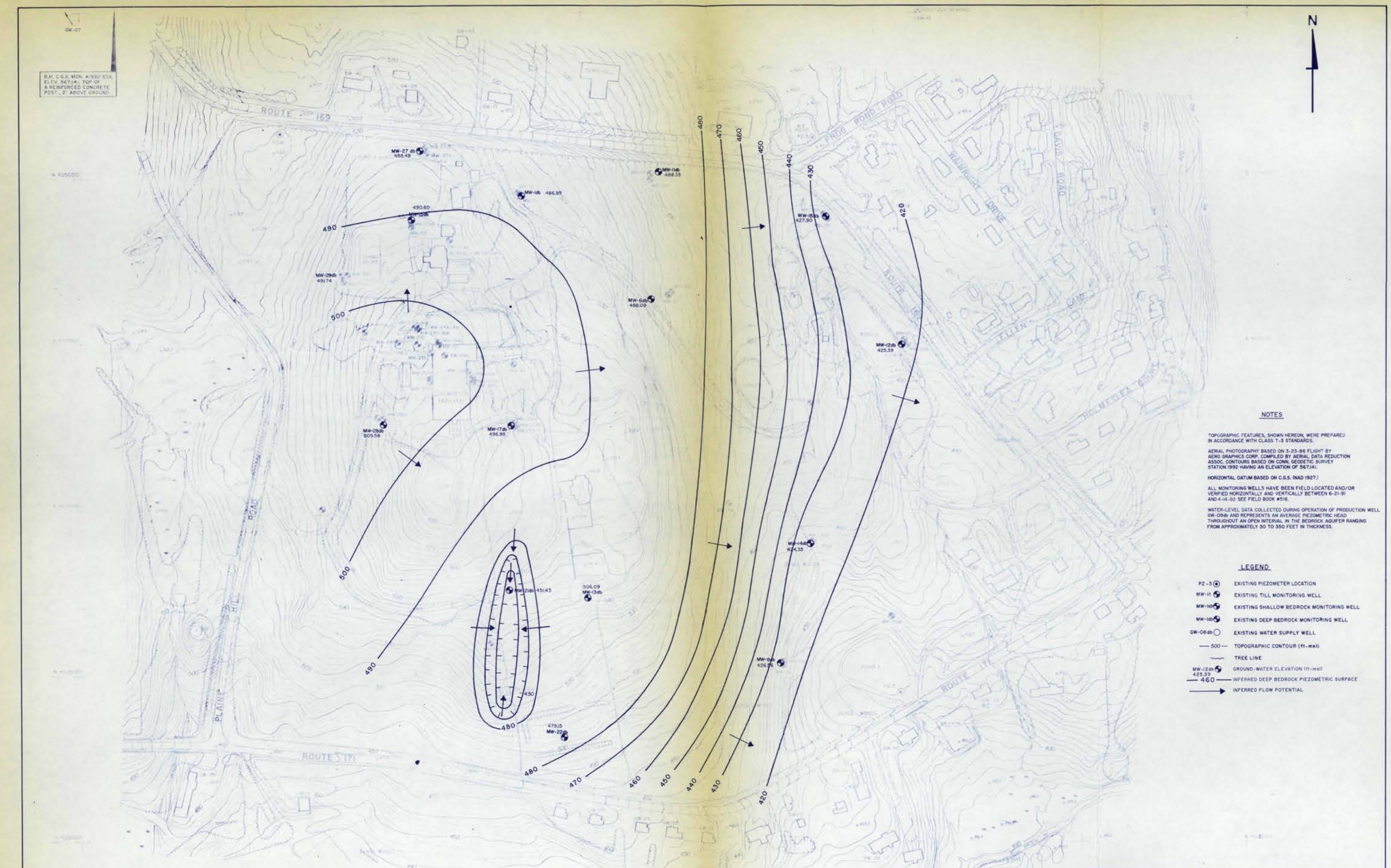
PZ-1	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1db	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft - msl)
~~	TREE LINE
—460—	INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
→	INFERRED FLOW POTENTIAL

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ 2/19/92	△	△
△ 7-16-92	△	△
SCALE: HOR. IN. FT.		
VER. IN. FT.		

FUSS&O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
SEPTEMBER 24, 1991
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV. 1991		86-88D	3-10



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.141.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

WATER-LEVEL DATA COLLECTED DURING OPERATION OF PRODUCTION WELL GW-08db AND REPRESENTS AN AVERAGE PIEZOMETRIC HEAD THROUGHOUT AN OPEN INTERVAL IN THE BEDROCK AQUIFER RANGING FROM APPROXIMATELY 30 TO 350 FEET IN THICKNESS.

LEGEND

- PZ-3 — EXISTING PIEZOMETER LOCATION
- MW-11 — EXISTING TILL MONITORING WELL
- MW-18bs — EXISTING SHALLOW BEDROCK MONITORING WELL
- MW-18bd — EXISTING DEEP BEDROCK MONITORING WELL
- GW-08db — EXISTING WATER SUPPLY WELL
- 500 — TOPOGRAPHIC CONTOUR (ft-msl)
- TREE LINE
- MW-12db 425.39 — GROUND-WATER ELEVATION (ft-msl)
- 460 — INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
- INFERRED FLOW POTENTIAL

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
SCALE: HOR. IN. FT. / VER. IN. FT.		

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MANCHESTER, CONNECTICUT

INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
APRIL 27, 1992
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
AUG. 1992		86-88D	3-11

The average linear deep bedrock ground-water flow velocity was calculated using the same water level data set, formula, and method as the shallow bedrock as described in Section 3.3.2.2. The difficulties in estimating the ground-water flow rate in fractured bedrock were previously discussed. The same site area used to calculate the flow rates in the till and shallow bedrock units was also used for the deep bedrock. This area includes monitoring wells GW-10db, MW-6db, and MW-18db and is within the primary migration direction of contaminants at the site. Hydraulic conductivities were calculated for the deep bedrock by both slug and packer tests, although some differences in Ks were evident as discussed in Section 3.3.1.2. The lowest and highest hydraulic conductivities obtained by each method for each individual well were used to estimate the range of ground-water flow velocities. The lowest and highest hydraulic conductivities (from Table 3-6) for the above wells are: GW-10db, 0.05 ft/day and 0.34 ft/day; MW-6db, 0.06 ft/day and 0.92 ft/day; and, MW-18db, 0.04 ft/day and 4.4 ft/day. The hydraulic gradient between GW-10db and MW-6db and between MW-6db and MW-18db are 0.03 ft/ft and 0.1 ft/ft, respectively. A value of 0.9 was used for N because laminar flow predominates in metamorphic bedrock systems. A value of 0.05 was used for the effective porosity as given in the range provided by Freeze and Cherry (1979). Using these parameter values, average linear ground-water velocities range from 0.04 ft/day to 0.78 ft/day for the distance between GW-10db to MW-6db and from 0.15 ft/day to 11.08 ft/day for the distance between MW-6db and MW-18db.

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3.3.3 Vertical Ground-Water Migration

Vertical ground-water till/shallow bedrock gradients and shallow bedrock/deep bedrock potentials, presented in Table 3-9, were calculated to help determine the respective recharge and discharge zones in the study area and to qualitatively estimate vertical ground-water migration rates. Downward vertical ground-water gradients and potentials, indicative of downward vertical ground-water migration, were found at all nested well sets with the exception of MW-8, MW-11, and MW-27. Downward potentials from the till to the shallow bedrock were observed at MW-1, MW-6, MW-10, MW-12, MW-15, MW-16, MW-17, MW-18, MW-28, and MW-29. Downward potentials from the shallow bedrock to the deep bedrock were present at MW-1, MW-6, MW-10/GW-10, MW-11, MW-12, MW-14, MW-15, MW-17, MW-18, MW-28, and MW-29. As can be seen from these data, the greatest downward potentials occur near the top of the topographic high. Generally, downward potential magnitudes decrease toward site boundaries at lower elevations.

Upward potentials, indicative of upward vertical ground-water migration, were found at MW-8 and MW-11 as indicated in Table 3-9. MW-8, MW-11, and MW-27 are located near the boundary of the study area where ground water may discharge from the bedrock to the till unit.

The vertical ground-water migration rate was calculated for the till at Zone 1 using the average linear ground-water velocity formula described in Section 3.3.2.1. The inputs to this equation include: the vertical hydraulic conductivity; vertical gradient; and porosity. The vertical hydraulic conductivity was estimated as 0.03 ft/day based on the triaxial permeability test of a till sample collected at a depth of 3 feet in Zone 1. The

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TABLE 3-9

VERTICAL GROUND-WATER GRADIENTS/POTENTIALS

REMEDIAL INVESTIGATION REPORT
LIFEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

		1/19/90			7/23-26/90			8/30/90			9/24/91			1/2/92			4/27/92		
	Dv (ft)	GRND.WATER ELEV. (ft-msl)	VERTICAL * GRADIENT (ft/ft)	SB/DB * POTENTIAL (FT)	GRND.WATER ELEV. (ft-msl)	VERTICAL * GRADIENT (ft/ft)	SB/DB * POTENTIAL (FT)	GRND.WATER ELEV. (ft-msl)	VERTICAL * GRADIENT (ft/ft)	SB/DB * POTENTIAL (FT)	GRND.WATER ELEV. (ft-msl)	VERTICAL * GRADIENT (ft/ft)	SB/DB * POTENTIAL (FT)	GRND.WATER ELEV. (ft-msl)	VERTICAL * GRADIENT (ft/ft)	SB/DB * POTENTIAL (FT)	GRND.WATER ELEV. (ft-msl)	VERTICAL * GRADIENT (ft/ft)	SB/DB * POTENTIAL (FT)
MW-1t	44.17	513.68			509.91			510.52			510.54	-0.560		514.45	-0.598		516.78	-0.580	
MW-1mb	214.24	**			**			**			485.82	-0.001	-0.30	488.82	-0.012	-2.62	491.06	-0.020	-4.21
MW-1db		**			**			**			485.52			485.40			486.85		
MW-6t	17.62	495.86			490.07	-0.108		491.61	-0.145		494.79	-0.192		496.21	-0.180		497.25	-0.151	
MW-6mb	257.34	**			488.17			489.96			491.40	-0.031	-7.94	493.03	-0.026	-6.57	494.59	-0.024	-6.10
MW-6db		**			**			**			483.46			486.46			488.49		
MW-8t	8.88	**			**			**			416.15	0.124		425.53	0.118		427.61	0.141	
MW-8mb	171.96	421.91			417.79			417.49			417.25	0.010	1.64	426.58	-0.011	-1.82	428.86	-0.013	-2.30
MW-8db		**			**			**			418.89			424.76			426.56		
MW-10ts		**			**			**			**			**			NM		
MW-10td	10.86	DRY			550.14	-1.532		549.55	-1.521		553.28	-1.616		554.93	-1.559		560.35		
MW-10mb		535.99			521.24			520.86			522.88			525.52			NM		
MW-11t	15.55	485.74	0.012		483.67	0.019		484.19	0.021		484.16	0.023		486.49	-0.062		488.27	-0.005	
MW-11mb	208.82	485.92			483.96			484.51			484.51	-0.001	-0.30	485.53	0.004	0.88	488.19	0.001	0.16
MW-11db		**			**			**			484.21			486.41			488.35		
MW-12t	17.38	450.81	-0.044		449.89	-0.059		450.21	-0.036		450.31	-0.058		451.88	-0.051		451.46	-0.037	
MW-12mb	166.81	450.04	-0.175	-29.24	448.87	-0.179	-29.78	449.59	-0.174	-29.00	449.31	-0.169	-28.19	450.11	-0.155	-25.93	450.82	-0.152	-25.43
MW-12db		420.88			419.09			420.59			421.12			424.18			425.39		
MW-14mb	175.23	428.84	-0.039	-6.87	425.93	-0.036	-6.29	426.17	-0.033	-5.72	426.24	-0.028	-4.96	435.88	-0.065	-11.81	439.08	-0.084	-14.65
MW-14db		421.97			419.64			420.45			421.28			423.59			424.35		
MW-15t	17.48	**			**			**			493.26	-0.326		497.38	-0.451		500.49	-0.517	
MW-15mb	246.21	**			**			**			487.59	-0.008	-2.00	489.54	-0.004	-0.89	491.50	-0.004	-0.98
MW-15db		**			**			**			485.59			488.65			490.60		
MW-16t	37.59	**			**			**			557.50	-1.103		559.75	-1.097		562.56	-1.033	
MW-16mb		**			**			**			515.59			518.07			523.33		
MW-17ts	22.48	**			**			**			554.69	-0.274		557.63	-0.283		558.44	-0.266	
MW-17td	25.36	**			**			**			548.56	-0.303		551.28	-0.301		552.49	-0.301	
MW-17mb	332.55	**			**			**			538.85	-0.162	-53.79	541.63	-0.149	-49.48	542.83	-0.138	-45.85
MW-17db		**			**			**			485.06			492.15			496.98		
MW-18t	38.43	**			**			**			462.65	-0.015		463.13	-0.019		463.64	-0.017	
MW-18mb	155.08	**			**			**			462.28	-0.248	-38.51	462.55	-0.232	-35.91	463.13	-0.227	-35.23
MW-18db		**			**			**			423.69			426.64			427.98		
MW-27t	17.81	**			**			**			**			491.87	0.584		471.18	-2.239	
MW-27mb	199.08	**			**			**			**			501.01	-0.071	-14.16	433.09	0.278	55.39
MW-27db		**			**			**			**			486.05			488.48		
MW-28t	13.25	**			**			**			**			**			563.74	-0.859	
MW-28mb	450.75	**			**			**			**			**			552.36	-0.104	-46.78
MW-28db		**			**			**			**			**			505.58		
MW-29t	19.81	**			**			**			**			**			524.58	-0.468	
MW-29mb	321.25	**			**			**			**			**			515.22	-0.073	-23.48
MW-29db		**			**			**			**			**			491.74		
MW-30ts	12.69	**			**			**			**			**			568.09	-0.383	
MW-30td		**			**			**			**			**			563.23		
MW-EPA-Ats	35.36	561.14			557.88			557.85			552.98	-0.398		562.96	-0.526		566.38	-0.533	
MW-EPA-Atd	18.06	**			**			**			538.92	-0.450		544.37	-0.522		547.44	-0.543	
MW-EPA-Amb		**			**			**			530.79			534.94			537.64		

* + value indicates upward flow potential
- value indicates downward flow potential

Dv = vertical distance between base of screens

** = monitor well not installed at time of water level measurement

NM=Not Measured

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vertical gradient was calculated using depths to water from MW-10ts and MW-10td, 9.57 feet and 14.44 feet respectively, measured on April 27, 1992. An average porosity value of 0.25 was derived from physical soil tests performed on samples collected below the water table at depths of 18-20′ (DW-3t), 27-29′ (OW-2t), and 28-30′ (OW-1t) in Zone 1. Using the above values an average vertical ground-water velocity, or migration rate, was estimated as 0.06 ft/day.

3.3.4 Ground-Water Recharge/Discharge

Ground-water recharge/discharge areas have been hypothesized for the study area based on ground-water and surface-water elevation data collected from monitoring wells and piezometers. However, due to the ground-water demands from the local off-site water-supply wells, the apparent hydrogeologic conditions have probably modified from their natural conditions. This is evidenced by the background water-level study data, which indicate that water levels in study area monitoring wells, particularly the boundary wells, are influenced by off-site supply well pumping.

3.3.4.1 Till Ground-Water Recharge/Discharge

The till unit at the site is recharged almost solely by precipitation. Based on the observed ground-water gradients, ground-water recharge to the till unit from bedrock is expected to be minimal in areas adjacent to the central topographic high. Ground-water recharge from the bedrock to the till unit is probably more significant at lower elevations in the vicinity of the study area boundaries to the north, northeast, and southeast as suggested by the upward ground-water potential present at well

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cluster MW-8 and fluctuating upward potentials at well clusters MW-11 and MW-27, as indicated on Table 3-9.

Ground water may discharge from the till unit to the surface-water bodies adjacent to the perimeter of the study area depending on seasonal conditions as discussed in Section 3.2.

3.3.4.2 Bedrock Ground-Water Recharge/Discharge

The downward vertical ground-water gradients and potentials (Table 3-9) present in most portions of the study area indicate that bedrock ground water is recharged by the till unit. Bedrock may also be recharged by Mill Brook, located south of the site. Ground water may discharge from bedrock to Pond 2 in the southeastern portion of the study area as discussed in Section 3.2. The boundary between areas of bedrock recharge and bedrock discharge is expected to vary as a result of seasonal trends and water-table fluctuations.

3.3.5 Geologic Controls on Ground-Water Migration

Horizontal and vertical ground-water migration rates and paths are influenced at the site by the hydraulic conductivities of the different media, the hydraulic head relationships between or within the units, the topography of the bedrock surface, the differential weathering of the bedrock, and the presence of hydraulic barriers. Significant influence is exerted by the heterogeneities within the till and bedrock units, such as fractured and weathered areas within the bedrock and the sandier areas within the till unit. Overall, the primary avenues of transport are intergranular pore spaces in the till, fractures and weathered bedrock in the shallow bedrock, and fractures and

areas of physical deformation in the deep bedrock.

The segment of Mill Brook located south of the site may be acting as a hydraulic barrier impeding ground-water flow. The brook loses a significant amount of flow to the overburden (possibly stratified drift) along this segment, as discussed in Section 3.2.

Till

The horizontal ground-water flow velocity within the till unit is relatively slow based on the low hydraulic conductivities of this material. The sandier areas of the till located near the site boundaries have higher hydraulic conductivities. Assuming similar porosities, ground water generally flows at increasing rates toward the study area boundaries.

The horizontal ground-water flow direction in the deep till near the till/bedrock interface generally parallels the bedrock surface topography. In the shallow till, the flow contours appear to conform more to the ground-surface topography than the bedrock surface topography.

Generally, the till unit is considered to be a confining layer or leaky confining layer at the site due to its low hydraulic conductivity and position within the stratigraphic sequence. The till unit is not a confining layer at the study area boundaries where the unit is sandier. At these unconfined areas, the bedrock ground water can migrate upward, vertically discharging into the till unit.

The greatest downward, vertical, ground-water flow gradients in

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the till unit are present near the Linemaster facility at the top of the central topographic high. Assuming similar till vertical hydraulic conductivities, this indicates a relatively high rate of potential downward vertical ground-water migration. The magnitudes of these gradients and possible related downward vertical ground-water migration rates generally decrease toward the site boundaries.

Bedrock

Ground water migrates horizontally at a higher rate in the deep bedrock than in the shallow bedrock at the site. Although the shallow bedrock is more weathered, the deep bedrock has larger and more transmissive fracture openings. Relatively high horizontal ground-water flow velocities were calculated for a number of deep bedrock wells.

Horizontal shallow bedrock ground-water flow contours generally parallel the bedrock surface topography, unlike the deep bedrock ground-water flow which does not conform. The vertical flow potential from the shallow bedrock to the deep bedrock, similar to the till/shallow bedrock relationship, is greatest near the Linemaster facility at the top of the central topographic high and decreases toward the study area boundaries. This indicates that the potential for downward vertical ground-water migration from the shallow bedrock to the deep bedrock is greatest near the top of the central topographic high and decreases toward the study area boundaries. Unconfined conditions and an upward vertical ground-water flow potential at the site boundaries are indicative of ground-water migration from the bedrock to the till unit.

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In the deep bedrock, ground water flows primarily through the fracture zones with the highest water-transmitting capabilities. Once in these fracture systems, ground water moves according to the strike and dip of the fracture, interconnection with other fracture systems, and hydraulic potential within the fracture. The deep bedrock ground-water contour maps, Figures 3-10 and 3-11, are only inferred interpretations of the piezometric surface on two separate dates. It is difficult to determine if ground-water flow within the deep bedrock follows the fracture traces and the strike and dip of fracture sets discussed in Section 3.1.2.3. Some indication of ground-water movement along fracture traces is suggested by the ellipsoidal drawdown caused by the GW-08db facility production well. The effected area is oriented approximately north-south with the long axis nearly parallel to one of the major fracture traces which trends 10-20 degrees. This is also supported by the field outcrop strike and dip measurements and acoustic televiewer logging.

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4.0 CONTAMINATION ASSESSMENT

4.1 Soil

4.1.1 VOCs

4.1.1.1 Zone 1

Results

The results of the June 1987 soil gas screening investigation indicated the presence of VOC vapors in the subsurface in Zone 1. The depth-interval averaged OVA soil gas total VOC concentration at each sampling point, reported in parts per million relative to methane, is plotted and contoured on Figure 2-2. As evidenced by the data, the highest soil gas concentrations were present in the vicinity of the former dry well and areas downslope to the east. The January 13, 1988 Tenax-sorbed soil gas sample had TCE, carbon tetrachloride, 1,1-dichloroethene, and 1,1-dichlorethane identified by EPA Method 8010 as indicated in Table 4-1.

The May 20, 1987 sample of the liquid contents of the northeastern most brick manhole in Zone 1 contained TCE, 1,1-dichloroethene, and chloroform at concentrations less than found in production well GW-08db, the original source of the disposal system water (see Table 4-2).

The results of the December 1988 soil sampling and analyses confirmed the presence of VOCs in Zone 1 soils (Fuss & O'Neill, 1989). Field VOC screening results are noted on the boring logs included in Appendix B. The most common VOC detected by laboratory analyses was TCE. This halogenated VOC

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TABLE 4-1

TENAX-SORBED SOIL GAS RESULTS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Volatile Organic Compound	SAMPLE LOCATION		
	Zone 1 G-2	Zone 2 H-2	Zone 3 B-6
Trichloroethene	Present	Present	Present
Carbon Tetrachloride	Present	ND	ND
1,1-Dichloroethene	Present	Present	ND
1,1-Dichloroethane	Present	Present	ND

Notes:

1. Soil gas samples extracted by 300 ml stainless steel syringe and sorbed onto tenax media for EPA Method 8010 analysis.

2. ND= Not Detected

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TABLE 4-2

SUMMARY OF VOCs DETECTED IN SEWAGE SYSTEM SAMPLES

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

SAMPLE	LOCATION	PARAMETER	REPORTED VALUE	UNIT	SAMPLE DATE
ST-1	Settling Tank	trans-1,2-Dichloroethene	104	ug/l	2/20/87
		Trichloroethene	387	ug/l	
ST-2	Settling Tank	Bromodichloromethane	11.2	ug/l	2/10/87
		Chloroform	3.3	ug/l	
		trans-1,2-Dichloroethene	516	ug/l	
LO-1	Leachate Outbreak	Chloroform	5.2	ug/l	5/20/87
		Trichloroethene	41.5	ug/l	
LO-2	Leachate Outbreak	Chloroform	105	ug/l	5/20/87
		trans-1,2-Dichloroethene	55.8	ug/l	
		Trichloroethene	22.0	ug/l	
BT-1	Brick Manhole	Chloroform	90.5	ug/l	5/20/87
		1,1-Dichloroethene	10.5	ug/l	
		Trichloroethene	187	ug/l	

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was detected in 12 of the 42 soil samples as indicated in Table 4-3. TCE was detected in at least one sample from borings B-7, B-9, B-12, B-14, B-23, and B-24 with concentrations ranging from 57 ug/kg (B-14, 6-7′) to 2149 ug/kg (B-7, 5-6′). TCE was detected by laboratory analysis in samples collected from both the saturated and unsaturated portions of the till. Tetrachloroethene (PCE) was the second most common VOC detected and was present in a total of five samples collected from borings B-7 and B-23. PCE concentrations ranged from 100 ug/kg to 984 ug/kg. PCE was detected in soil samples collected above and below the water table. Toluene and xylenes were detected by laboratory analysis in only two of the eight samples analyzed for aromatic VOCs. Toluene and xylenes were detected in shallow soil samples (3-4′ and 6-7′) from boring B-23 at concentrations ranging from 79 to 7577 ug/kg and from 100 to 4318 ug/kg, respectively. The highest aromatic VOC concentrations were present in the deeper of the two samples, which was collected at the approximate depth of the water table. No aromatic VOCs were detected in samples collected from greater depths in boring B-23. Ethylbenzene was detected at a concentration of 2750 ug/kg in the 6 to 7 foot interval sample collected from boring B-23.

Elevated concentrations of chlorinated and aromatic VOCs were found in Zone 1 soils during the RI investigations of 1991 and 1992, confirming this zone as a primary VOC source area. The primary VOCs found in the soil at Zone 1 include TCE, toluene, and xylenes. In general, the highest VOC concentrations were detected in samples collected from below the water table at boring DW-1t, which was installed adjacent to the former dry well location. The lowest VOC concentrations were detected in boring MW-30ts, installed adjacent to the western side of the manufacturing facility.

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TABLE 4-3

ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-6	B-7			B-8				B-9	
Depth (ft)	10-11	2-3	4-5	5-6	7-8	9-10	11-12	13-14	1-2	3-4
Date	12/15/88	12/15/88	12/15/88	12/15/88	12/15/88	12/15/88	12/15/88	12/15/88	12/15/88	12/15/88
Sample ID	30988121551	30988121553	30988121555	30988121556	30988121566	30988121567	30988121568	30988121569	30988121570	30988121571
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene										
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
Methyl ethyl ketone										
Methyl isobutyl ketone										
Acetone										
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene										
Tetrachloroethene	-	602	614	418	-	-	-	-	-	-
Toluene										
Trichloroethene	-	587	4022	2149	-	-	-	-	72	-
Xylenes										

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-9		B-11		B-12				B-13	
Depth (ft)	5-6	7-8	4-5	11-12	1-2	3-4	5-6	11-12	8-9	11-12
Date	12/15/88	12/15/88	12/20/88	12/20/88	12/21/88	12/21/88	12/21/88	12/21/88	12/21/88	12/21/88
Sample ID	30988121572	30988121573	309881220112	309881220117	309881221158	309881221159	309881221171	309881221164	309881221155	309881221157
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene										
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
Methyl ethyl ketone										
Methyl isobutyl ketone										
Acetone										
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene									-	-
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene									-	-
Trichloroethene	-	-	-	-	330	100	-	91	-	-
Xylenes									-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-14									
Depth (ft)	3-4	5-6	6-7	7-8	8-9	9-10	11-12	13-14	19-20	27-28
Date	12/16/88	12/16/88	12/16/88	12/16/88	12/16/88	12/16/88	12/16/88	12/16/88	12/16/88	12/16/88
Sample ID	30988121686	30988121687	309881216106	30988121689	30988121690	30988121691	30988121692	30988121693	30988121697	309881216101
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene										
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
Methyl ethyl ketone										
Methyl isobutyl ketone										
Acetone										
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene										
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene										
Trichloroethene	-	-	57	-	-	-	-	82	-	-
Xylenes										

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-14	B-15			B-16	B-17	B-18	B-23		
Depth (ft)	31-32	1-2	2-3	6-7	5-6	1-2	13-14	3-4	6-7	9-10
Date	12/16/88	12/21/88	12/21/88	12/21/88	12/21/88	12/20/88	12/20/88	12/16/88	12/16/88	12/16/88
Sample ID	309881216103	309881221143	309881221140	309881221142	309881221146	309881220125	309881220138	30988121675	30988121677	30988121680
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene										
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
Methyl ethyl ketone										
Methyl isobutyl ketone										
Acetone										
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene			-	-				-	2750	-
Tetrachloroethene	-	-	-	-	-	-	-	-	984	357
Toluene			-	-				79	7577	-
Trichloroethene	-	-	-	-	-	-	-	73	-	660
Xylenes			-	-				100	4318	-

- Not detected
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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-23	B-24	B-25					B-26		
Depth (ft)	10-11	15-16	0-2	8-10	18-20	28-30	38-40	9-10	19-20	24-25
Date	12/16/88	12/22/88	6/10/91	6/10/91	6/10/91	6/10/91	6/10/91	6/27/91	6/27/91	6/27/91
Sample ID	30988121681	30988122174	40191061001	40191061002	40191061003	40191061004	40191061005	40191062799	401910627100	401910627101
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	11	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	56	32	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene			-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	56	110	-	-	-
Methyl ethyl ketone			-	-	-	-	-	-	-	-
Methyl isobutyl ketone			-	-	-	-	-	-	-	-
Acetone			-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-		-	200	-	16	38	-	-	-
Tetrachloroethene	100	-	-	-	-	56	97	-	22	-
Toluene	-		5.5	110	-	300	870	-	18	-
Trichloroethene	462	104	5.1	17	23	3000	-	-	5400	200
Xylenes	-		3.3	1200	-	94	210	-	11	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-26		B-27				B-28			
Depth (ft)	28-29	39-40	8-10	18-20	28-30	38-40	8-10	18-20	28-30	38-40
Date	6/27/91	6/27/91	6/11/91	6/11/91	6/11/91	6/11/91	6/12/91	6/12/91	6/12/91	6/12/91
Sample ID	401910627102	401910627103	40191061106	40191061107	40191061108	40191061109	40191061210	40191061211	40191061212	40191061213
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	10	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
Methyl ethyl ketone	-	-	-	270	12000	2300	-	-	-	-
Methyl isobutyl ketone	-	-	-	-	430	-	-	-	-	-
Acetone	-	-	-	240	5900	1800	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	-	9.3	-	-	58	-	-	-	-	-
Trichloroethene	-	360	-	-	-	10	-	58	-	13
Xylenes	-	14	-	-	22	-	-	-	-	-

- Not detected
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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	B-50	B-51	DW-1t						DW-2t	
	Depth (ft)	3	3	0-2	8-10	14-16	18-20	28-30	38-40	0-2	9-11
	Date	5/01/92	5/01/92	3/27/91	3/27/91	3/27/91	3/27/91	3/27/91	3/28/91	11/27/91	11/27/91
	Sample ID	40192050101	40192050102	40291032701	40291032702	40291032703	40291032704	40291032705	40291032808	37391112771	37391112773
Parameter (ug/Kg)											
1,1,1-Trichloroethane		-	-	-	1000	-	-	-	-	-	-
1,1-Dichloroethane		-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane		-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene		-	-	-	83	-	-	92	-	-	-
cis-1,2-Dichloroethene		-	-	-	-	-	-	-	-	14	-
Methyl ethyl ketone		-	-	-	-	-	-	-	-	-	-
Methyl isobutyl ketone		-	-	-	-	-	-	-	-	-	-
Acetone		-	-	-	-	-	-	-	-	-	-
Chloroform		-	-	-	-	-	-	-	-	-	-
Dichloromethane		-	-	-	-	-	-	-	-	-	-
Ethylbenzene		-	-	-	130	-	-	-	-	-	-
Tetrachloroethene		-	-	-	670	-	-	-	-	-	-
Toluene		-	-	-	2100	380	220	250	-	-	-
Trichloroethene		-	-	-	210000	51000	22000	20000	16000	-	-
Xylenes		-	-	-	640	210	58	-	-	-	-

- Not detected
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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	DW-2t					DW-3t				
Depth (ft)	9-11	19-21	30-32	30-32	40-41	2-4	2-4	10-12	10-12	20-22
Date	11/27/91DUP	12/02/91	12/02/91	12/02/91DUP	12/02/91	12/05/91	12/05/91DUP	12/05/91	12/05/91DUP	12/05/91
Sample ID	37391112774	37391120277	37391120278	37391120278	37391120280	373911205116	373911205116	373911205118	373911205118	373911205119
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	8	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	62	-	-	-	-	-	-	22
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	88	-	-	22	-	-	-	30
Methyl ethyl ketone	130	980	4200	2400	3800	39	-	-	-	490
Methyl isobutyl ketone	-	-	260	-	110	-	-	-	-	-
Acetone	-	1000	3600	-	5000	-	-	-	-	760
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	160	-	-	1300	-	350	-	59
Tetrachloroethene	-	-	230	-	-	12	-	-	-	240
Toluene	42	-	1600	-	15	3400	-	110	-	820
Trichloroethene	-	16	9800	6	8.7	310	-	-	-	9900
Xylenes	28	15	960	18	10	4600	-	2200	-	280

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	DW-3t					DW-4t				
Depth (ft)	20-22	30-32	30-32	35-37	35-37	0-2	10-12	10-12	20-22	25-27
Date	12/05/91DUP	12/06/91	12/06/91DUP	12/06/91DUP	12/06/91DUP2	11/25/91	11/25/91	11/25/91DUP	11/26/91	11/26/91
Sample ID	373911205119	373911206123	373911206123	373911206124	373911206124	37391112554	37391112556	37391112558	37391112666	37391112660
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	81	-	17	-	-	-	-	9	26
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	94	-	21	-	270	-	-	60	130
Methyl ethyl ketone	1300	230	300	-	-	-	-	-	-	-
Methyl isobutyl ketone	-	-	-	-	-	-	-	-	-	-
Acetone	1400	2400	2600	1800	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	66	-	-	-	-	-	-	29	84
Tetrachloroethene	-	120	-	-	-	200	-	-	15	110
Toluene	-	1200	11	110	16	-	-	-	180	650
Trichloroethene	6.5	3200	190	5800	860	200	-	-	3300	7700
Xylenes	-	380	26	26	7	-	-	-	210	570

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	DW-4t	MW-4				MW-10ts				
Depth (ft)	30-32	0-0.65	5-6	6-6.5	15-15.4	0-2	5-7	10-12	15-17	20-22
Date	11/26/91	8/11/87	8/11/87	8/11/87	8/11/87	4/01/92	4/01/92	4/01/92	4/01/92	4/01/92
Sample ID	37391112661	17287081101	17287081102	17287081103	17287081104	40192040110	40192040111	40192040112	40192040113	40192040114
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	13	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	120	-	-	-	-	-	-	-	-	-
Methyl ethyl ketone	750	-	-	-	-	-	760	-	-	-
Methyl isobutyl ketone	-	-	-	-	-	-	880	-	-	-
Acetone	520	-	-	-	-	-	460	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	140	-	-	-	-	-	1300	-	-	-
Tetrachloroethene	31	-	-	-	-	25	2800	-	-	-
Toluene	3800	-	-	-	-	-	4000	-	28	11
Trichloroethene	7300	-	-	-	-	20	72	-	430	110
Xylenes	990	-	-	-	-	-	8300	-	16	24

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	MW-10ts	MW-30ts				OW-1t				
Depth (ft)	24-26	5-7	15-17	25-27	35-37	0-2	10-12	20-22	25-27	25-27
Date	4/01/92	3/31/92	3/31/92	3/31/92	3/31/92	12/05/91	12/05/91	12/05/91	12/05/91	12/05/91DUP
Sample ID	40192040115	40192033102	40192033104	40192033106	40192033108	373911205103	373911205105	373911205109	373911205110	373911205110
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	30	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	19	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	41	-	24	-
Methyl ethyl ketone	-	-	-	-	-	-	100	180	180	250
Methyl isobutyl ketone	-	-	-	-	-	-	-	-	-	-
Acetone	-	-	-	-	-	-	-	300	220	400
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	9.1	260	-	-	-
Tetrachloroethene	-	-	-	-	-	-	75	-	9.6	-
Toluene	-	-	-	-	-	13	1000	-	100	-
Trichloroethene	30	-	-	-	-	7.3	24000	-	6400	120
Xylenes	-	-	-	-	-	100	1700	6	20	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	OW-1t			OW-2t						
	Depth (ft)	30-32	30-32	40-42	0-2	9-11	19-21	19-21	19-21	24-26	24-26
	Date	12/05/91	12/05/91DUP	12/05/91	12/04/91	12/04/91	12/04/91	12/04/91DUP1	12/04/91DUP2	12/04/91	12/04/91DUP
	Sample ID	373911205112	373911205112	373911205114	37391120490	37391120492	37391120494	37391120495	37391120495	37391120496	37391120496
Parameter (ug/Kg)											
1,1,1-Trichloroethane		-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane		-	-	-	-	-	8	-	-	32	-
1,2-Dichloroethane		-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		39	-	-	-	-	26	-	-	46	-
Methyl ethyl ketone		190	-	120	-	51	-	120	-	107	-
Methyl isobutyl ketone		-	-	-	-	-	-	-	-	-	-
Acetone		-	-	-	-	-	-	-	-	-	-
Chloroform		-	-	-	-	-	-	114	-	11	-
Dichloromethane		-	-	-	-	-	-	-	-	95	-
Ethylbenzene		5.4	150	-	-	-	-	-	-	19	-
Tetrachloroethene		12	270	-	-	-	7	-	-	67	-
Toluene		150	270	-	-	-	49	-	9	370	46
Trichloroethene		6300	4800	770	36	-	6800	87	1000	9100	2500
Xylenes		51	1100	-	9	-	10	-	-	110	33

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	OW-2t		OW-3t						OW-4t	
Depth (ft)	29-31	40-41	0-2	9-11	14-16	14-16	19-21	42-44	0-2	9-11
Date	12/04/91	12/04/91	11/26/91	11/26/91	11/27/91	11/27/91DUP	11/27/91	11/27/91	12/02/91	12/02/91
Sample ID	37391120498	373911204101	37391112663	37391112665	37391112767	37391112767	37391112768	37391112770	37391120281	37391120283
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	16	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	4	-	29	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	23	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	400	-	100	-	-	-
Methyl ethyl ketone	52	36	-	-	-	-	330	4700	-	200
Methyl isobutyl ketone	-	-	-	-	-	-	50	88	-	-
Acetone	-	-	-	-	-	-	500	3900	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	150	-	-	-
Ethylbenzene	8	-	-	-	64	-	68	-	-	-
Tetrachloroethene	8	-	-	-	15	-	31	-	-	-
Toluene	47	-	-	-	160	-	1400	150	-	33
Trichloroethene	1500	15	-	-	1600	-	6100	270	-	29
Xylenes	58	-	-	-	180	-	410	40	-	35

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE I SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	OW-4t			OW-5t						
Depth (ft)	19-21	24-26	29-31	0-2	0-2	9-11	9-11	19-21	19-21	29-31
Date	12/02/91	12/02/91	12/02/91	11/21/91	11/21/91DUP	11/21/91	11/21/91DUP	11/21/91	11/21/91DUP	11/25/91
Sample ID	37391120285	37391120286	37391120287	37391112143	37391112143	37391112145	37391112146	37391112148	37391112148	37391112551
Parameter (ug/Kg)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	37	-	-	1800	76	-	-	-	-	-
Methyl ethyl ketone	1600	3500	4600	-	-	-	-	1500	1600	1500
Methyl isobutyl ketone	89	180	350	-	-	-	-	190	180	-
Acetone	2900	5100	12000	-	-	-	-	2200	2600	5300
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	120	68	80	-	-	7000	1700	30	-	-
Tetrachloroethene	10	-	-	-	-	-	-	9.7	-	-
Toluene	1700	1300	1800	-	-	16000	7500	280	-	-
Trichloroethene	2300	430	97	-	-	4600	1300	1110	-	-
Xylenes	760	460	520	7.5	7.0	52000	37000	180	18	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	OW-5t	OW-6t						OW-7t		
	Depth (ft)	39-39.8	4-6	9-11	14-16	29-31	39-41	39-41	0-2	9-11	19-21
	Date	11/25/91	11/20/91	11/20/91	11/20/91	11/20/91	11/21/91	11/21/91DUP	11/19/91	11/19/91	11/19/91
	Sample ID	37391112553	37391112034	37391112035	37391112036	37391112039	37391112142	37391112142	37391111921	37391111923	37391111925
Parameter (ug/Kg)											
1,1,1-Trichloroethane		-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane		13	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane		-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		40	-	-	2.6	7.8	23	-	-	-	5.1
Methyl ethyl ketone		840	-	-	100	590	810	290	-	-	-
Methyl isobutyl ketone		61	-	-	37	1100	150	-	-	-	-
Acetone		2500	-	-	98	740	1300	480	-	-	-
Chloroform		-	-	-	-	-	-	-	-	-	-
Dichloromethane		-	-	-	-	-	-	-	-	-	-
Ethylbenzene		15	-	-	3.2	19	68	-	-	-	-
Tetrachloroethene		11	-	-	4.6	18	-	-	-	-	-
Toluene		910	-	-	27	170	760	-	5.2	-	-
Trichloroethene		8000	-	4	590	2000	1500	-	-	-	170
Xylenes		77	-	-	31	160	450	10	4.6	-	10

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-3
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	OW-7t	
Depth (ft)	29-29.5	39-40.5
Date	11/19/91	11/20/91
Sample ID	37391111927	37391112032
Parameter (ug/Kg)		
1,1,1-Trichloroethane	-	-
1,1-Dichloroethane	-	-
1,2-Dichloroethane	-	-
1,2-Dichloroethene	-	-
cis-1,2-Dichloroethene	90	-
Methyl ethyl ketone	-	630
Methyl isobutyl ketone	-	57
Acetone	-	1000
Chloroform	-	-
Dichloromethane	-	-
Ethylbenzene	17	-
Tetrachloroethene	6.1	-
Toluene	34	6.0
Trichloroethene	680	-
Xylenes	90	11

- Not detected
Blank space indicates parameter was not analyzed for.

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The most common VOC detected by laboratory analysis was TCE. This halogenated VOC was detected in 67 of the 106 samples as indicated in Table 4-3. TCE was detected in at least one sample from every boring except B-50, B-51, and MW-30ts. Concentrations ranged from 5.1 ug/kg (B-25, 0-2') to 210,000 ug/kg (DW-1t, 8-10'). Degradation products of TCE have also been found, including cis-1,2-dichloroethene.

Xylenes were the second most common VOC detected and were present in a total of 61 samples with concentrations ranging from 3.3 ug/kg (B-25, 0-2') to 52,000 ug/kg (OW-5t, 9-11').

Discussion

As discussed in Section 1.4, TCE was discharged as a spent solvent into the dry well. Toluene and xylenes are solvents and are also found in paint thinners. The high concentrations of xylenes and toluene in the vicinity of the former dry well suggest that these compounds may have also been discharged into the dry well. Several other VOCs were found at varying concentrations in Zone 1 soils as indicated in Table 4-3. These compounds may have been components of paint thinners or other chemical products discharged into the dry well.

VOCs may have also been released to the subsurface as a result of paint emission into the former paint settling booth; however, samples collected at depths of 3 feet from B-50 and B-51, borings installed in the location of the former booth, did not contain any detectable VOCs. It is possible that any VOCs that may have been present in the upper soils volatilized during demolition of the booth, described in Section 1.5.1, and after soil had been removed to a depth of 2.5 feet.

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The horizontal distribution of total VOCs for the 0 to 5, 5 to 15 and 15 to 30 foot depth intervals are shown in Figures 4-1, 4-2, and 4-3, respectively. The 0 to 5 foot depth interval map represents the soil above the water table at Zone 1. The 5 to 15 foot depth interval map represents the soil at the water table and capillary fringe and also includes the interval near the reported bottom depth of the former dry well. The 15 to 30 foot depth interval map represents the soil in the middle of the till unit in Zone 1. The two outlines on each of the figures represent the inferred extent of VOCs in soil; one outline is based on field instrument readings and the other outline is based on laboratory analyses. The extent of VOCs in soil inferred from the field instrument readings is likely an overestimation. At the 0 to 5 foot depth interval, the field instrument may have detected VOCs in the soil resulting from the off-gassing of VOCs into the vadose zone from contaminated ground water. Similarly, at the 5 to 15 and 15 to 30 foot depth intervals, the field instrument may have detected VOCs from the off-gassing of contaminated ground water held within the soil pore spaces. The extent of VOCs in soil estimated from laboratory analyses, in both instances, is a more appropriate representation.

To determine if soil contamination exists underneath the building, borings were drilled immediately adjacent to the building and a boring was drilled at an angle to intercept the soil underneath the building. VOCs were found at boring B-25, located adjacent to the building, indicating that VOCs have migrated toward the building from the former dry well area. VOCs were also found at boring B-26, drilled at a 63 degree angle to intercept soils beneath the facility. Concentrations of TCE at B-26 ranged from ND (9-10′) to 5400 ug/kg (19-20′), thereby confirming the existence of VOCs in soil underneath the facility.

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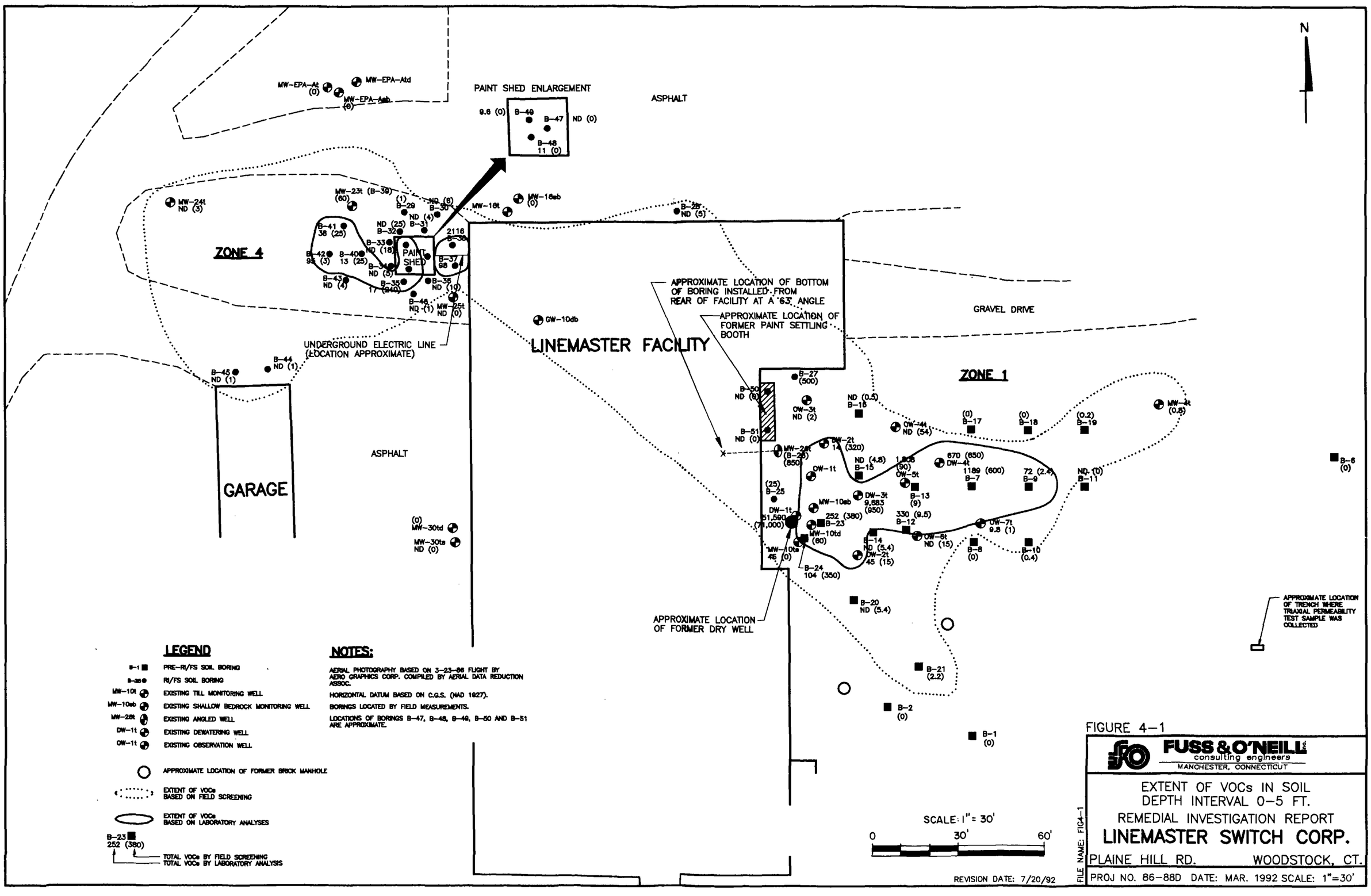

FIGURE 4-1

FUSS & O'NEILL Inc.
consulting engineers
MANCHESTER, CONNECTICUT

EXTENT OF VOCs IN SOIL
DEPTH INTERVAL 0-5 FT.
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.
PLAINE HILL RD. WOODSTOCK, CT.

PROJ NO. 86-88D DATE: MAR. 1992 SCALE: 1"=30'

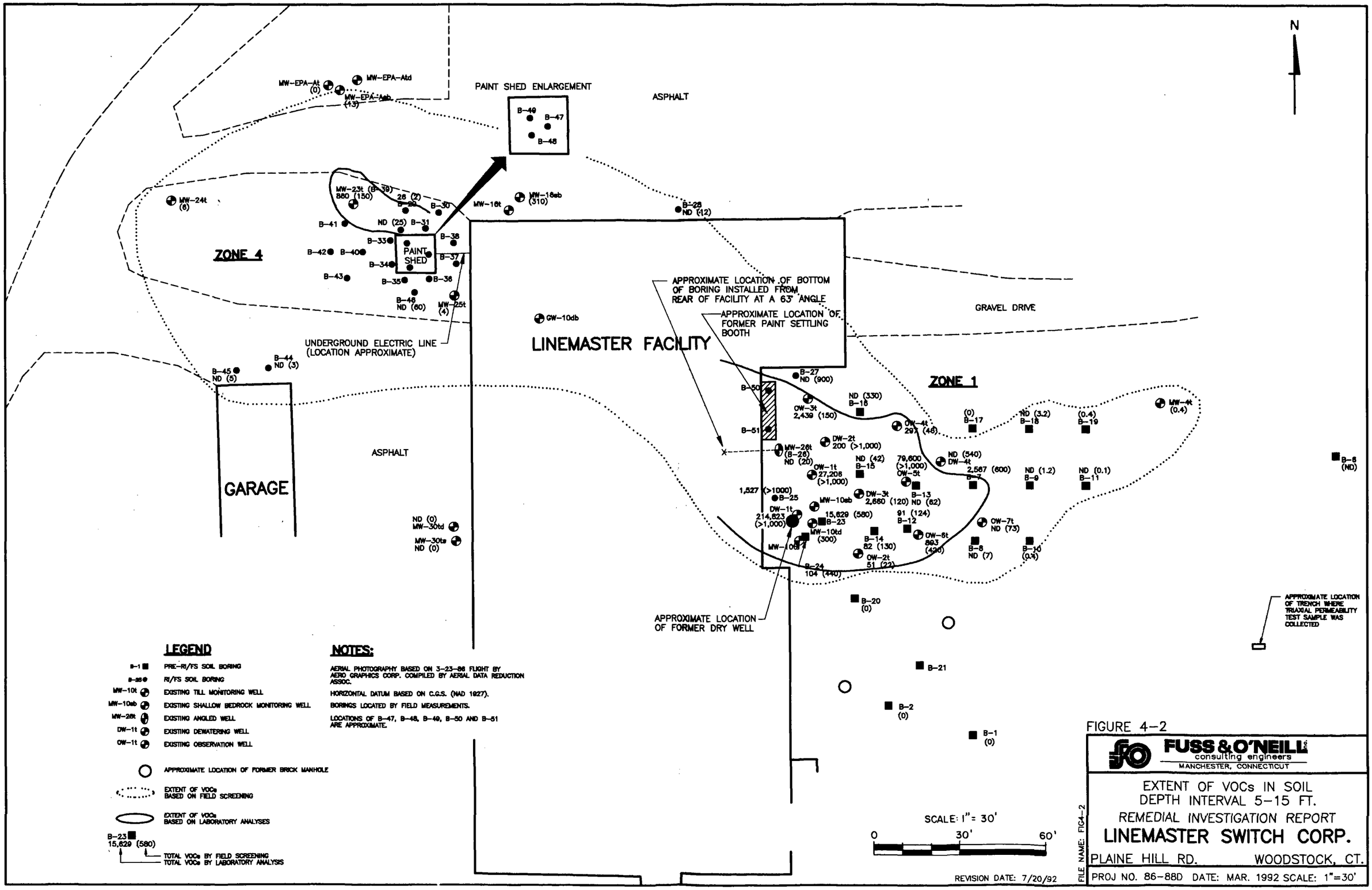

FIGURE 4-2

FUSS & O'NEILL Inc.
consulting engineers
MANCHESTER, CONNECTICUT

EXTENT OF VOCs IN SOIL
DEPTH INTERVAL 5-15 FT.

REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORP.

PLAINE HILL RD. WOODSTOCK, CT.

PROJ NO. 86-88D DATE: MAR. 1992 SCALE: 1"=30'

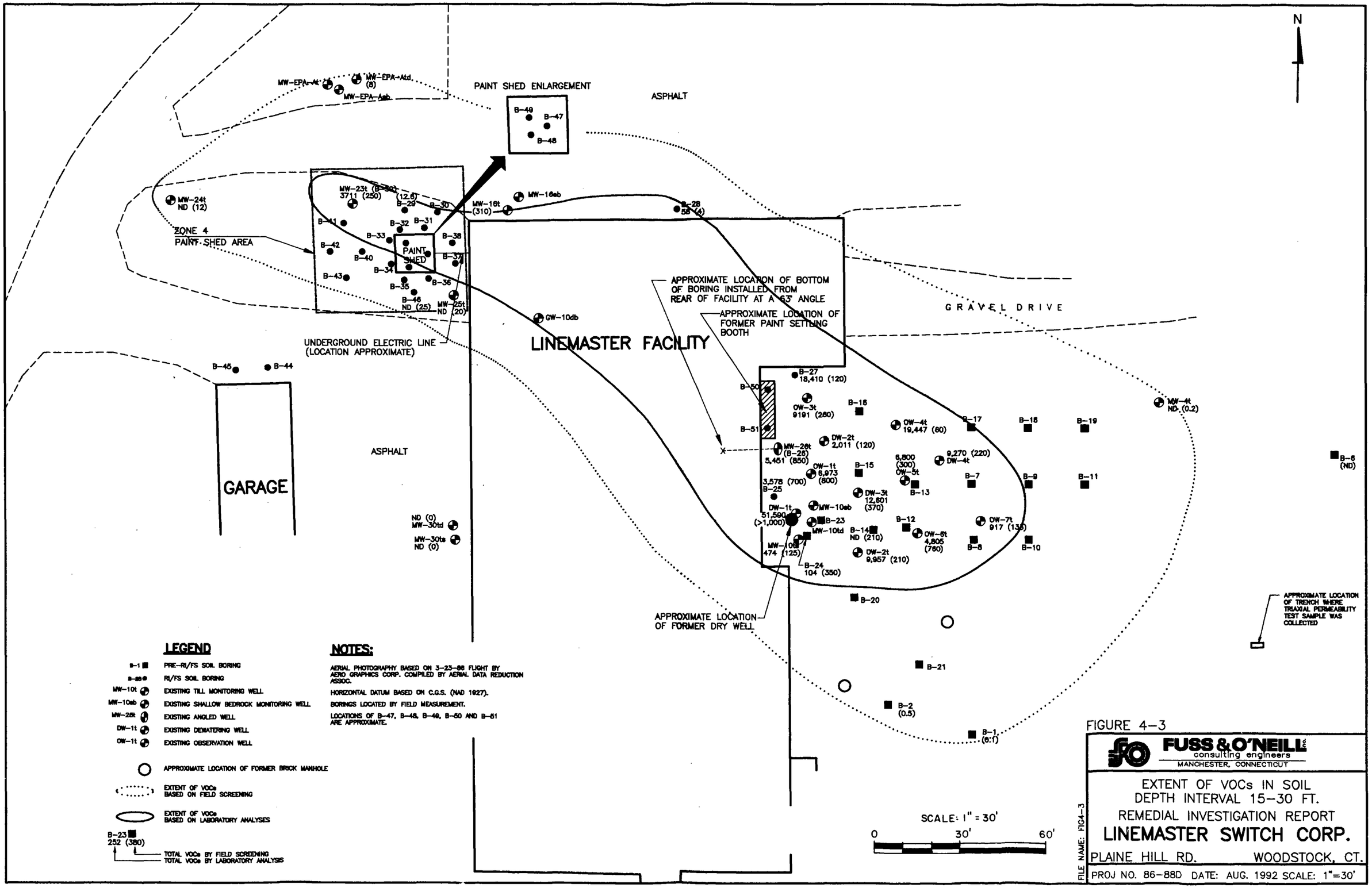

FIGURE 4-3

FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT

EXTENT OF VOCs IN SOIL
DEPTH INTERVAL 15-30 FT.
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.
PLAINE HILL RD. WOODSTOCK, CT.

PROJ NO. 86-88D DATE: AUG. 1992 SCALE: 1"=30'

FILE NAME: FIG4-3

This soil is considered a potential source for ground-water contamination.

It appears that VOCs have moved under the building and toward the northwest, possibly due to ground-water transport, as indicated by the VOCs at MW-26t. The role of ground-water VOC transport and VOC distribution is discussed in Section 4.3.1. Low levels of VOCs found at boring B-28, located on the north side of the building, may be indicative of the northern extent of contamination. These VOCs are likely related to ground-water transport. The VOCs in the saturated till soil east of the location of the former dry well are also attributable to ground-water transport. The VOCs in the unsaturated till east of the facility may be related to past disposal practices at the dry well. During times of heavy discharge to the dry well, the infiltration capability of the till may have been exceeded. As a result, discharge may have flowed out of the top of the dry well and onto the ground surface, which slopes to the east. This surface discharge would have flowed easterly following the topography and subsequently may have infiltrated into the shallow soil. No detectable levels of VOCs were found in samples collected from MW-30ts, located adjacent to the facility building west of Zone 1, indicative of the western extent of contamination.

The vertical distribution of VOCs in soil are shown on the cross sections shown on Figures 4-4 and 4-5. The cross-section lines are indicated on Figure 2-3. As indicated on the figures, the highest levels of VOCs were found in the vicinity of the former dry well, confirming it as a former source of the VOCs. Soil samples from boring DW-1t, located close to the site of the former dry well, had the highest detected TCE concentrations,

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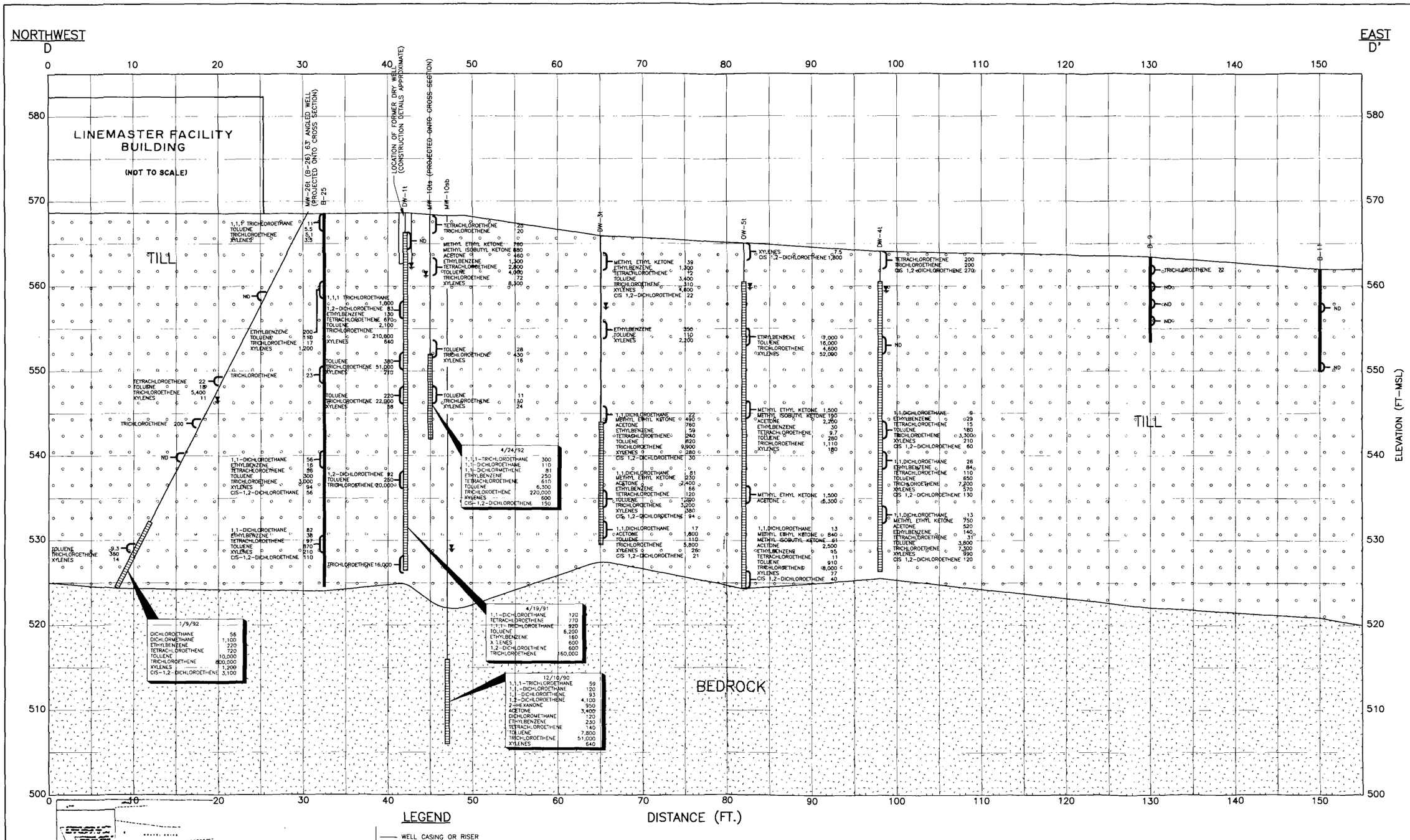

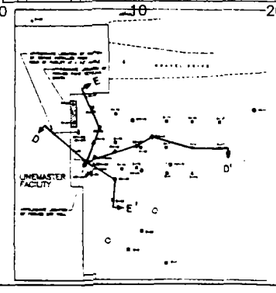

LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- SOIL BORING
- SOIL SAMPLE INTERVAL AND VOLATILE ORGANIC PARAMETERS IN ug/kg
- GROUND-WATER SAMPLE DATA, VOLATILE ORGANIC PARAMETERS IN ug/l.
- GROUND-WATER LEVEL MEASURED ON 4/27/92

NOTES:

FOR LINE OF CROSS SECTION SEE FIGURE 2-3

SOIL DATA FOR DW-1t COLLECTED IN MARCH 1991.

SOIL DATA FOR B-9, B-11, AND COLLECTED IN DECEMBER 1988.

SOIL DATA FOR DW-3t, DW-4t AND OW-5t COLLECTED IN NOVEMBER AND DECEMBER 1991.

SOIL DATA FOR B-25, MW-26t COLLECTED IN JUNE 1991.

SOIL DATA FOR MW-10ts AND COLLECTED IN APRIL 1992

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.A.J.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
OFFICE REVIEW		
REVISION DATE:		

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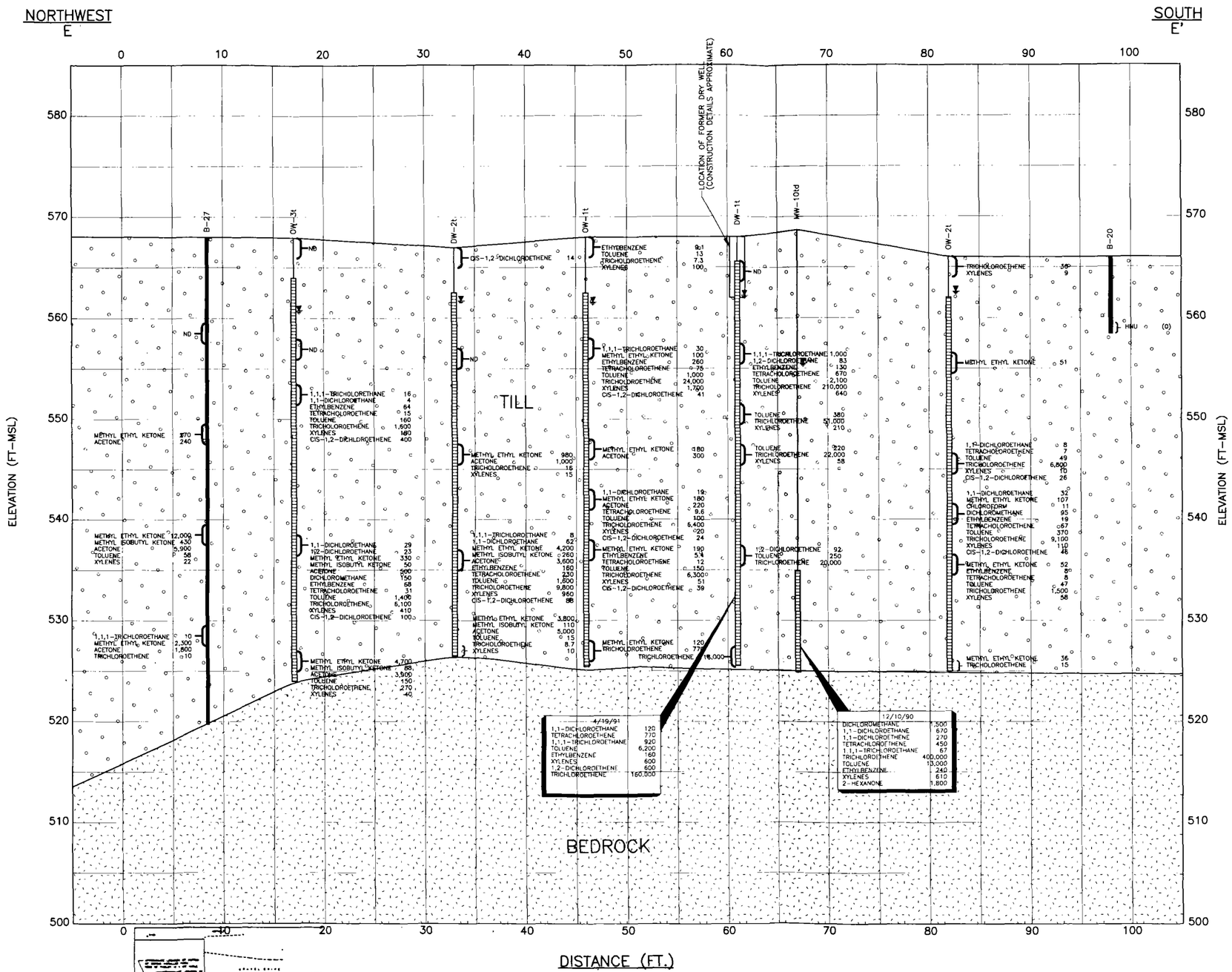
CROSS SECTION D-D'
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

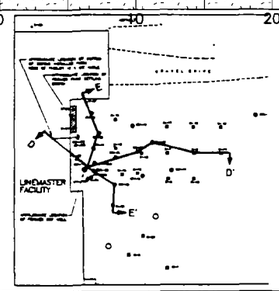
PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

PROJECT	FLD. BK.	DATE	
86-088D		JULY 1992	FIGURE 4-4



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- SOIL BORING
- SOIL SAMPLE INTERVAL AND VOLATILE ORGANIC PARAMETERS IN ug/kg
- GROUND-WATER SAMPLE DATA VOLATILE ORGANIC PARAMETERS IN ug/l.
- GROUND-WATER LEVEL MEASURED ON 4/27/92



NOTES:

FOR LINE OF CROSS SECTION SEE FIGURE 2-3

SOIL DATA FOR DW-1t COLLECTED IN MARCH 1991.

SOIL DATA FOR DW-2t, OW-1t, OW-2t, OW-3t COLLECTED IN NOVEMBER AND DECEMBER 1991.

SOIL DATA FOR B-27 COLLECTED IN JUNE 1991.

SOIL DATA FOR B-20 COLLECTED IN DECEMBER 1988.

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.A.J.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
OFFICE REVIEW		
REVISION DATE:		

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CROSS SECTION E-E'
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT	FLD. BK.	DATE	
86-088D		JULY 1992	FIGURE 4-5

ranging from non-detect (ND) (0-2') to 210,000 ug/kg (8-10'). The high VOC concentration at the 8 to 10 foot depth interval, shown on the cross sections, indicates that the bottom of the dry well was near this depth range. As the figures further indicate, VOCs are distributed throughout the soil profile.

The distribution of VOCs is not uniform in the Zone 1 till deposits. This is probably due to the heterogeneity of the till which resulted in VOC migration along preferential pathways. As a result, the VOCs would have accumulated at different rates and different depths within the area.

4.1.1.2 Zone 2

Results

Trichloroethene, trans-1,2-dichloroethene, bromodichloromethane, and chloroform were detected in some combination in the two samples (ST-1 and ST-2) collected from the Zone 2 settling tank during February 1987. Zone 2 sampling locations are shown on Figures 2-4 and 2-5. As indicated in Table 4-2, the maximum detected concentrations of TCE and trans-1,2-dichloroethene were 387 and 516 ug/l, respectively.

As discussed in Section 4.1.1.1, TCE (187 ug/l), 1,1-dichloroethene (10.5 ug/l), and chloroform (90.5 ug/l) were detected in the Zone 1 brick manhole sample (BT-1) collected on May 20, 1987.

No VOCs were detected in any of the four SS-1 soil samples collected from test pit 1 during May 20, 1987, as shown in Table 4-4. Of the three surficial soil samples collected

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TABLE 4-4

ZONE 2 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
	Depth (ft)	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
	Date	8/08/89	8/08/89	8/08/89	8/08/89	8/08/89	8/08/89	8/08/89	8/08/89	8/08/89	8/08/89
	Sample ID	31889080801	31889080802	31889080803	31889080804	31889080805	31889080806	31889080807	31889080808	31889080809	31889080810
Parameter (ug/Kg)											
Toluene		-	-	-	-	-	-	-	-	-	-
Trichloroethene		-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-4
(CONTINUED)
ZONE 2 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	SS-1				SS-1B	SS-2	SS-2B	SS-3	SS-3B	SS-4
	Depth (ft)	0-0.5	0.5-1	1-1.5	1.5-2	1-2	0-1	1-2	0-1	1-2	0-1
	Date	5/20/87	5/20/87	5/20/87	5/20/87	6/06/89	5/21/87	6/06/89	5/21/87	6/06/89	5/21/87
	Sample ID	31887052001	31887052002	31887052003	31887052004	31889060621B	31887052105	31889060622B	31887052106	31889060623B	31887052107
Parameter (ug/Kg)											
Toluene		-	-	-	-	-	-	-	-	-	-
Trichloroethene		-	-	-	-	-	202	-	-	-	-

- Not detected

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TABLE 4-4
(CONTINUED)
ZONE 2 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	SS-4B	T-4-1				T-4-2	
	Depth (ft)	1-2	.5	.5	4	4	.5	4
	Date	6/06/89	6/25/91	6/25/91DUP	6/25/91	6/25/91DUP	6/25/91	6/25/91
	Sample ID	31889060624B	40191062584	40191062586	40191062587	40191062589	40191062585	40191062588
Parameter (ug/Kg)								
Toluene		-	18	-	-	-	9.5	-
Trichloroethene		-	36	8.0	6.9	-	5.1	-

- Not detected

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adjacent to the Zone 2 brick dry well on May 21, 1987, only SS-2, the sample collected closest to the brick dry well, had VOCs detected (Table 4-4). TCE was the only VOC detected in this sample and was present at a concentration of 202 ug/kg. As seen in Table 4-2, sample LO-2, the sample of the overflow from the brick dry well, was analyzed and found to contain TCE (22 ug/l), trans-1,2-dichloroethene (55.8 ug/l), and chloroform (105 ug/l). The LO-1 aqueous sample collected from the sewage breakout in the central portion of Zone 2 also had TCE (41.5 ug/l) and chloroform (5.2 ug/l) detected (Table 4-2).

Results of the June 1987 soil gas screening investigation indicated the presence of VOCs in the low part per million range (Fuss & O'Neill, 1989); however, there is a possibility that the soil gas detected may have been methane. As previously discussed, in addition to VOCs, the OVA field instrument utilized in the soil screening survey detects methane, which is commonly associated with sewage. Depth-averaged soil gas screening total VOC concentrations are depicted and contoured on Figure 2-4.

The January 13, 1988 tenax-sorbed soil gas sample collected from Zone 2 grid intersection H-2 (Figure 2-4) had TCE, 1,1-dichloroethene, and 1,1-dichloroethane identified by EPA Method 8010 as indicated in Table 4-1.

Split-spoon soil samples from borings B-3, B-4, and B-5 were collected and screened for VOCs in the field on December 14, 1988. No indication of the presence of VOCs was detected in any of these samples.

No VOCs were detected in the four soil samples (SS-1B to SS-4B) collected adjacent to the clay tile pipe on June 6, 1989 or in

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the ten shallow soil samples (SS-1 to SS-10) collected downslope of the brick dry well as indicated in Table 4-4.

The two soil gas samples collected adjacent to the brick dry well between December 11 and 13, 1990 had no VOCs detected as determined by portable gas chromatograph screening.

As indicated in Table 4-4, toluene and TCE were detected at combined total concentrations less than 54 ug/kg in the RI/FS soil samples collected on June 25, 1991 from trench T-4, which was excavated adjacent to the brick dry well. TCE was detected in four of the five samples analyzed and ranged in concentration from ND to 36 ug/kg. Toluene was detected in only two of the five samples analyzed; the maximum concentration of TCE detected was 18 ug/kg.

Discussion

The sewage system sample analyses indicate low levels of TCE and other related VOCs in the waste. This would be expected because the water discharged into the system was obtained from the facility production well, GW-08db, which was shown to contain the same contaminants. The samples were collected prior to the initiation of ground-water treatment at GW-08db. The ground water from GW-08db had TCE concentrations of approximately 1400 ug/l at the time of sample collection in 1987.

The area of the former settling tank is not considered to be a potential source area. This has been determined from sampling and analysis conducted at this area prior to RI/FS investigations. The results of these investigations did not indicate any significant VOC contamination.

The rationale for RI/FS sampling at Zone 2 was to sample the soil in the vicinity of the brick dry well area first, because this area received most of the facility sewage discharge and would likely have the highest potential for contaminant accumulation. Low concentrations of VOCs were detected in the soil samples collected adjacent to the brick dry well; therefore, it was decided that no sampling would be performed along the remaining section of clay tile pipe leading from the former tank area to the brick dry well. Although the clay tile pipe was probably not water tight and may have leaked, the potential for contaminant accumulation from the leaking clay tile pipe is believed to be low. The till likely would not have accepted much water from a leaking pipe due to its low permeability. It is probable that the opposite occurred. During much of the year, the pipe may have acted as a ground-water drain and received water from the saturated till.

The TCE and toluene in the T-4 trench soil samples may be the result of brick dry well overflow or, possibly, ground-water transport. Contaminant presence due to ground-water transport is the more likely hypothesis. The water table is close to or at the ground surface at this location during wet seasons. TCE has been detected in nearby monitoring wells at concentrations exceeding those found in the soil samples. Ground water at MW-6t, located nearby and upgradient of the sampling point, has had TCE detected at concentrations as high as 7180 ug/l.

The RI/FS sampling data do not indicate that the brick dry well and associated area are a significant source area. VOCs detected in this area are generally believed to be related to ground-water transport from Zone 1. Because of this, none of the other components of the former Linemaster facility sewage disposal

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system (i.e. clay tile piping and former settling tank) are considered to be source areas.

4.1.1.3 Zone 3

Results

Results of the 1987 soil gas screening investigation indicated that VOCs were present in the soil gas in the vicinity of the former Blakely leaching field (Fuss & O'Neill, 1989). Depth-averaged total VOC screening concentrations are plotted and contoured on Figure 2-6. Higher soil gas VOC concentrations may correlate with the location of the leaching field laterals. It was also noted that the levels of VOCs may have been due, in part or whole, to the presence of methane gas (Fuss & O'Neill, 1989). The OVA is not capable of distinguishing between methane gas and other VOCs, and methane gas commonly is found in sewage disposal areas.

Trichloroethene was the only VOC identified by EPA Method 8010 in the January 13, 1988 tenax-sorbed soil gas sample collected from Zone 3 as indicated in Table 4-1. The sample was collected from grid intersection B-6 as shown on Figure 2-6.

No VOCs were detected in any of the soil samples (SS-1 to SS-5) collected from the former Blakely sewage leaching field on June 6, 1989. Sampling locations are depicted on Figure 2-6.

The results of the June 25, 1991 Zone 3 RI/FS trench soil sampling indicated that VOCs were not present in any of the soil samples collected from the three trenches.

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Discussion

Although the initial soil gas screening investigation indicated that VOCs may have been present in the Zone 3 soils, the absence of VOCs in the soils, as determined by laboratory analysis, indicates that residual VOC contamination from former sewage discharges to Zone 3 is not present. The apparent soil gas readings may have been due to the presence of methane or related to ground-water VOC off-gassing. It is also possible that residual levels of VOCs were present in Zone 3 during 1987, the time of the soil gas screening investigation, but have since decreased to less than the limit of detection. In support of this interpretation it should be noted that discharge of VOC-contaminated water from production well GW-12db to the former Blakely septic system ceased following the installation of the GAC filtration system in 1986. At that time, water from GW-12db had TCE concentrations as high as approximately 5,500 ug/l. The Blakely residence has been supplied with treated water from the Linemaster production well, GW-08db, since 1989. Regardless of the explanation, the recent analytical data indicate that Zone 3 is not a VOC source area.

4.1.1.4 Zone 4

Results

The low permeability soils and cross contamination encountered during the December 1990 Zone 4 soil gas survey limited the effectiveness of the investigation (Fuss & O'Neill, 1990b). VOCs were tentatively identified at a total of four soil gas sampling points in Zone 4.

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No VOCs were detected in the two soil samples collected during installation of monitoring well MW-16sb on April 23, 1991 as indicated in Table 4-5. Table 4-5 also shows that VOCs were detected in a total of 11 samples collected from eight of the soil borings installed during June 1991. Both chlorinated (TCE, PCE, and cis-1,2-dichloroethene) and aromatic VOCs (toluene and xylenes) were detected. VOCs were detected in borings B-29, B-35, B-37, B-38, B-39, B-40, B-41, and B-42. The most frequently detected compound was TCE, which was found in nine of the 12 samples with positive detections. Concentrations of TCE ranged from 13 ug/kg (B-40, 0-2') to 3,700 ug/kg (B-39, 28-30'). PCE was only detected in the 0-2 foot sample at B-38 (79 ug/kg). Cis-1,2-dichloroethene was only detected in the 28-30 foot sample at B-39. Maximum detected toluene and xylenes concentrations were 2,100 ug/kg (B-38, 2-4') and 17 ug/kg (B-35, 2-4'), respectively. Listed in Table 4-5 are the results for the analysis of soil samples collected from underneath the paint shed in April 1992. A total of six samples were collected from the three borings (B-47, B-48, and B-49) installed; two samples were collected from each boring, one at the 0-2 foot depth and the other at the 2-3.5 foot depth. TCE, the only VOC detected, was present, in two samples at concentrations of 11 ug/kg (B-48, 0-2') and 9.6 ug/kg (B-49, 0-2').

Discussion

Due to the soil gas survey limitations, non-detections of VOCs were not necessarily indicative of the absence of these compounds; however, the positive soil gas detections indicated that additional investigation should be conducted in Zone 4.

VOCs were detected in ten of the 24 soil borings. Both

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TABLE 4-5

ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	B-29			B-30		B-31		B-32		B-33
	Depth (ft)	8-10	18-20	28-30	0-2	2-4	0-2	2-4	0-2	2-4	0-2
	Date	6/13/91	6/13/91	6/13/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91
	Sample ID	40191061314	40191061315	40191061316	40191061741	40191061742	40191061731	40191061732	40191061721	40191061722	40191061723
Parameter (ug/Kg)											
Tetrachloroethene		-	-	-	-	-	-	-	-	-	-
Toluene		-	-	-	-	-	-	-	-	-	-
Trichloroethene		26	-	-	-	-	-	-	-	-	-
Xylenes		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-33	B-34		B-35		B-36		B-37		B-38
Depth (ft)	2-4	0-2	2-4	0-2	2-4	0-2	2-4	0-2	2-4	0-2
Date	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91
Sample ID	40191061724	40191061725	40191061726	40191061727	40191061728	40191061729	40191061730	40191061745	40191061746	40191061743
Parameter (ug/Kg)										
Tetrachloroethene	-	-	-	-	-	-	-	-	-	79
Toluene	-	-	-	-	-	-	-	-	44	180
Trichloroethene	-	-	-	-	-	-	-	-	54	1200
Xylenes	-	-	-	-	17	-	17	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-38	B-39				B-40		B-41		B-42
Depth (ft)	2-4	8-10	18-20	28-30	44-46	0-2	2-4	0-2	2-4	0-2
Date	6/17/91	6/14/91	6/14/91	6/14/91	6/14/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91
Sample ID	40191061744	40191061417	40191061418	40191061419	40191061420	40191061733	40191061734	40191061735	40191061736	40191061739
Parameter (ug/Kg)										
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	2100	-	-	-	-	-	-	-	-	-
Trichloroethene	-	860	-	3700	1300	13	-	38	-	95
Xylenes	16	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	11	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	B-42	B-43		B-44		B-45		B-46		
	Depth (ft)	2-4	0-2	2-4	4-6	10-12	4-6	10-12	4-6	8-10	14-16
	Date	6/17/91	6/17/91	6/17/91	6/18/91	6/18/91	6/18/91	6/18/91	6/20/91	6/20/91	6/20/91
	Sample ID	40191061740	40191061737	40191061738	40191061847	40191061848	40191061849	40191061850	40191062057	40191062058	40191062059
Parameter (ug/Kg)											
Tetrachloroethene		-	-	-	-	-	-	-	-	-	-
Toluene		-	-	-	-	-	-	-	-	-	-
Trichloroethene		-	-	-	-	-	-	-	-	-	-
Xylenes		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	B-46									
	Depth (ft)	18-20	24-26	26-28	28-30	34-36	38-40	44-46	48-50	54-56	58-60
	Date	6/20/91	6/20/91	6/20/91	6/20/91	6/20/91	6/20/91	6/20/91	6/20/91	6/20/91	6/20/91
	Sample ID	40191062060	40191062061	40191062062	40191062063	40191062064	40191062065	40191062066	40191062067	40191062068	40191062069
Parameter (ug/Kg)											
Tetrachloroethene		-	-	-	-	-	-	-	-	-	-
Toluene		-	-	-	-	-	-	-	-	-	-
Trichloroethene		-	-	-	-	-	-	-	-	-	-
Xylenes		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-47		B-48		B-49		MW-16sb		MW-24t	
Depth (ft)	0-2	2-3.5	0-2	2-3.0	0-2	2-3.5	34-36	46-48	4-6	8-10
Date	4/02/92	4/02/92	4/02/92	4/02/92	4/02/92	4/02/92	4/23/92	4/23/92	6/19/91	6/19/91
Sample ID	40192040221	40192040222	40192040223	40192040224	40192040225	40192040226	40192042329	40192042338	40191061951	40191061952
Parameter (ug/Kg)										
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	11	-	9.6	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	MW-24t				MW-25t					
	Depth (ft)	14-16	18-20	24-26	28-30	5-7	10-12	14-16	18-20	25-27	29-31
	Date	6/19/91	6/19/91	6/19/91	6/19/91	6/21/91	6/21/91	6/21/91	6/21/91	6/21/91	6/21/91
	Sample ID	40191061953	40191061954	40191061955	40191061956	40191062170	40191062171	40191062172	40191062173	40191062174	40191062175
Parameter (ug/Kg)											
Tetrachloroethene		-	-	-	-	-	-	-	-	-	-
Toluene		-	-	-	-	-	-	-	-	-	-
Trichloroethene		-	-	-	-	-	-	-	-	-	-
Xylenes		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-

- Not detected

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TABLE 4-5
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	MW-25t	
	Depth (ft)	35-37	45-47
	Date	6/21/91	6/21/91
	Sample ID	40191062176	40191062177
Parameter (ug/Kg)			
Tetrachloroethene		-	-
Toluene		-	-
Trichloroethene		-	-
Xylenes		-	-
cis-1,2-Dichloroethene		-	-

- Not detected

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chlorinated and aromatic VOCs were detected. The primary compound found was TCE. Concentrations of TCE ranged from 9.6 to 3,700 ug/kg. Most of the detections were in borings not immediately adjacent to the paint shed. Low or non-detectable levels of VOCs were found in the soils underlying the paint shed.

The horizontal extent of VOCs in the soils in Zone 4 is shown in Figures 4-1, 4-2, and 4-3. The extent of VOCs in soil is best estimated by laboratory analyses rather than field screening results. The field instrument may have detected off-gassing from ground water in the sample or from VOCs emanating from the paint ventilation unit. This unit, located on the west side of the paint shed, occasionally activated during field activities. Low background concentrations of VOCs have been detected by the OVA in the ambient air during field activities in this area.

The VOC concentrations in the 0 to 5 foot depth interval (Figure 4-1) are generally low. The highest VOC concentrations in the 0 to 5 foot depth interval detected by laboratory analysis were found in borings B-37 and B-38, which are located between the paint shed and the facility. The VOCs detected in these borings may be the result of off-gassing from ground water. This area is paved, whereas the other areas immediately surrounding the paint shed are not paved. The vapors may become trapped and accumulate beneath the pavement, whereas, in unpaved areas they may be released to the atmosphere. It is also possible that the VOCs between the paint shed and the facility are the result of former spillage which may have occurred during material handling and transfer between the paint shed and the facility. The low VOC concentrations at borings B-40, B-41, and B-42 may be the result of atmospheric deposition from the paint shed ventilation unit.

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VOC concentrations detected by laboratory analysis in the 5 to 15 and 15 to 30 foot depth intervals, depicted in Figures 4-2 and 4-3, respectively, are highest immediately northwest of the paint shed. No VOCs were found at these depth intervals south of the paint shed or north of the garage. The field instrument positive detections may also be the result of the ventilation unit emissions.

Vertical profiling of soil VOC concentrations conducted at B-29, B-39, B-40, MW-24t, and MW-25t indicated that the highest levels of VOCs were present north of the paint shed. The highest levels of VOCs were found in the saturated till at B-39 (28-30'), located northwest of the paint shed as indicated on Figure 4-3. No VOCs were found in the deep borings south and west of the paint shed.

The Zone 4 soil data do not indicate that VOCs originated for the paint shed. Low or non-detectable levels of VOCs were found in the unsaturated soils underlying the paint shed. The VOC concentrations in the shallow soils adjacent to the paint shed are generally low and do not indicate a previous widespread surface release of VOCs. The highest concentrations of VOCs were found within the saturated till. The most likely origin for the VOCs in Zone 4 soils is ground-water transport from Zone 1.

4.1.2 ABNs

Acid\base\neutral extractables (ABNs) were detected in soil samples collected during Phase 1A investigations as summarized in the Revised Initial Site Characterization Report (Fuss & O'Neill, 1992b). In that report it was hypothesized that the most frequently detected target compound list (TCL) ABNs, bis(2-

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ethylhexyl)phthalate, and di-n-butylphthalate, were the result of laboratory contamination or cross contamination. This was based on: 1) the lack of historical chemical information documenting the use of these compounds at Linemaster; 2) the distribution of the detections at the site does not indicate a source area(s); and, 3) di-n-butylphthalate leaches from certain types of tubing and containers (Verschueren, 1983) which may be present in laboratories. To determine the accuracy of the data, a representative number of sample results with positive detections of these compounds were submitted for data validation as proposed in the Phase 1B Work Plan included in the Revised Initial Site Characterization Report (Fuss & O'Neill, 1992b).

Phase 1B investigations also consisted of ABN sampling in the area of the former paint settling booth, in the soils underneath the paint shed and at representative locations in Zone 1 to determine if an ABN source exists at any of these areas.

Results

The samples were validated in accordance with U.S. EPA Region 1 data validation guidelines for organic analysis (U.S. EPA, 1988b). Validation identified laboratory method blank contamination problems. The data validation reports and validation summary tables are provided in Appendix Q; a summary of positive detections for validated and unvalidated soil sample results are provided in Table 4-6. All bis(2-ethylhexyl)-phthalate and di-n-butylphthalate concentrations for sample results that were validated were reduced to ND after validation. The polynuclear aromatic (PNA) compound concentrations detected in Zone 2 (T-4-1, 0.5') and in Zone 4 (B-37, 2-4') were qualified as estimated at the reported values after validation.

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TABLE 4-6

SOILS - SUMMARY OF DETECTED ABNs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Zone	1									
	Sample Location	B-25	B-26	B-27	B-28	B-50	B-51	DW-1t	DW-3t		
	Depth (ft)	38-40	39-40	38-40	38-40	3	3	38-40	2-4	20-22	35-37
	Date	6/10/91	6/27/91	6/11/91	6/12/91	5/01/92	5/01/92	3/28/91	12/05/91	12/05/91	12/06/91
	Sample ID	40191061005	401910627103	40191061109	40191061213	40192050101	40192050102	40291032808	373911205116	373911205119	373911206124
Parameter (ug/Kg)											
Anthracene		*	-	-	*	-	-	-	-	-	-
Benzo(a)anthracene		*	-	-	*	-	-	-	-	-	-
Benzo(a)pyrene		*	-	-	*	-	-	-	-	-	-
Benzo(b)fluorathene		*	-	-	*	-	-	-	-	-	-
Benzoic acid		*	-	-	*	8262	-	-	-	-	-
Bis(2-ethylhexyl)phthalate		*	-	329	*	13229	1188	-	4700	-	-
Di-n-butylphthalate		*	-	2191	*	-	-	-	1080	1500	3350
Fluoranthene		*	-	-	*	-	-	-	209	-	-
Fluorene		*	-	-	*	-	-	-	-	-	-
Phenanthrene		*	-	-	*	-	-	-	-	-	-
Pyrene		*	-	-	*	-	-	-	-	-	-

- Not detected
* Validated non-detect
Data Validation Qualifiers
J reported concentration is an estimated value.

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TABLE 4-6
(CONTINUED)
SOILS - SUMMARY OF DETECTED ABNs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Zone	1					2				3
Sample Location	OW-1t			OW-2t		T-4-1				T-1
Depth (ft)	10-12	20-22	25-27	0-2	29-31	.5	.5	4	4	0.5
Date	12/05/91	12/05/91	12/05/91	12/04/91	12/04/91	6/25/91	6/25/91DUP	6/25/91	6/25/91DUP	6/25/91
Sample ID	37391120510	373911205109	373911205110	37391120490	37391120498	40191062584	40191062586	40191062587	40191062589	40191062591
Parameter (ug/Kg)										
Anthracene	-	-	-	-	-	*	*	*	*	-
Benzo(a)anthracene	-	-	-	-	-	*	*	*	*	-
Benzo(a)pyrene	-	-	-	-	-	*	*	*	*	-
Benzo(b)fluorathene	-	-	-	-	-	*	*	*	*	-
Benzoic acid	-	-	-	-	-	*	*	*	*	-
Bis(2-ethylhexyl)phthalate	-	730	-	-	-	*	*	*	*	-
Di-n-butylphthalate	2380	2100	2200	2050	2690	*	*	*	*	-
Fluoranthene	-	-	-	-	-	150J	*	*	*	-
Fluorene	-	-	-	-	-	*	*	*	*	-
Phenanthrene	-	-	-	-	-	*	*	*	*	-
Pyrene	-	-	-	-	-	145J	*	*	*	-

- Not detected
* Validated non-detect
Data Validation Qualifiers
J reported concentration is an estimated value.

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TABLE 4-6
(CONTINUED)
SOILS - SUMMARY OF DETECTED ABNs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Zone	3								4	
	Sample Location	T-1				T-2			T-3	B-29	B-33
	Depth (ft)	0.5	3	3	3	0.5	3	3	3	28-30	2-4
	Date	6/25/91DUP	6/25/91	6/25/91	6/25/91DUP	6/25/91	6/25/91	6/25/91	6/25/91	6/13/91	6/17/91
	Sample ID	40191062593	40191062595	40191062596	40191062598	40191062590	40191062592	40191062594	40191062597	40191061316	40191061724
Parameter (ug/Kg)											
Anthracene		-	-	*	*	-	*	*	-	*	*
Benzo(a)anthracene		-	-	*	*	-	*	*	-	*	*
Benzo(a)pyrene		-	-	*	*	-	*	*	-	*	*
Benzo(b)fluorathene		-	-	*	*	-	*	*	-	*	*
Benzoic acid		-	-	*	*	-	*	*	-	*	*
Bis(2-ethylhexyl)phthalate		-	-	*	*	-	*	*	-	*	*
Di-n-butylphthalate		-	-	*	*	-	*	*	-	*	*
Fluoranthene		-	-	*	*	-	*	*	-	*	*
Fluorene		-	-	*	*	-	*	*	-	*	*
Phenanthrene		-	-	*	*	-	*	*	-	*	*
Pyrene		-	-	*	*	-	*	*	-	*	*

- Not detected
* Validated non-detect
Data Validation Qualifiers
J reported concentration is an estimated value.

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TABLE 4-6
(CONTINUED)
SOILS - SUMMARY OF DETECTED ABNs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Zone	4									
	Sample Location	B-37	B-39	B-44	B-45	B-47		B-48		B-49	
	Depth (ft)	2-4	28-30	10-12	10-12	0-2	2-3.5	0-2	2.5-3.0	0-2	2.5-3.5
	Date	6/17/91	6/14/91	6/18/91	6/18/91	4/02/92	4/02/92	4/02/92	4/02/92	4/02/92	4/02/92
	Sample ID	40191061746	40191061419	40191061848	40191061850	40192040221	40192040222	40192040223	40192040224	40192040225	40192040226
Parameter (ug/Kg)											
Anthracene		255J	*	-	*	-	-	-	-	-	-
Benzo(a)anthracene		275J	*	-	*	-	-	-	-	-	-
Benzo(a)pyrene		195J	*	-	*	-	-	-	-	-	-
Benzo(b)fluoranthene		199J	*	-	*	-	-	-	-	-	-
Benzoic acid		*	*	-	*	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate		*	*	-	*	-	-	-	-	-	-
Di-n-butylphthalate		*	*	-	*	-	-	-	-	-	-
Fluoranthene		702J	*	-	*	-	-	-	-	-	-
Fluorene		153J	*	-	*	-	-	-	-	-	-
Phenanthrene		904J	*	-	*	-	-	-	-	-	-
Pyrene		521J	*	-	*	-	-	-	-	-	-

- Not detected
* Validated non-detect
Data Validation Qualifiers
J reported concentration is an estimated value.

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ABNs were detected at all Zone 1 sampling locations during Phase 1B investigations as indicated in Table 4-6. ABNs were not detected in the samples collected from the soils underneath the paint shed in Zone 4 as indicated in Table 4-6. None of the analytical results for these samples have been validated.

Tentatively identified compounds (TIC) were not included in the tables due to limited importance at the site based on historical chemical information.

Discussion

Data validation established revised detection limits and qualified the concentrations of ABNs, thereby providing a more accurate representation of site conditions. All bis(2-ethylhexyl)phthalate and di-n-butylphthalate concentrations were revised to ND after validation; the unvalidated positive detections for Phase 1B samples are expected to be similarly revised. Based on these findings, these parameters are not of concern at the site.

The polynuclear aromatic hydrocarbon (PNA) and benzoic acid detections in Zone 1 may be related to former discharges; however, the parameters are of limited concern due to their one time detection and minimal area of occurrence. The PNA detections at Zone 4 may be indicative of residual concentrations from a minor Danielson Oil Co. fuel oil spill (3 to 5 gallons) that occurred in February 1986 (NUS, 1987). Alternately, the PNAs may be related to a small loss of oil which reportedly occurred during the excavation of a fuel oil tank pipe leading from the facility to a heating oil storage tank previously located directly west of the paint shed.

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4.1.3 Metals

4.1.3.1 Background

Analytical results for the 15 samples collected from the ten background soil sampling locations that were analyzed for metals during RI/FS investigations are listed in Table 4-7. These samples were collected at depths ranging from near surface (<1 foot) to approximately 42 feet. Samples collected within the study area were also analyzed for the presence of VOCs to identify any sampling locations that may have been affected by historical site activities or by ground-water contamination. As summarized in Table 4-8, low concentrations of VOCs were detected in samples collected from locations BK-3 and BK-7. Additionally, ABNs also were detected in the BK-3 samples as indicated in Table 4-8.

In general, the same metals were detected in soil samples collected from the different background sampling locations. Aluminum, arsenic, barium, chromium, lead, magnesium, manganese, nickel, vanadium, and zinc were detected in all background soil samples. Selenium, silver, and tin were not detected at any background sampling locations. Beryllium was detected in samples collected from all sampling locations except BK-8. Copper was detected at all sampling locations except BK-6 and BK-7. Several metals were detected at fewer than half of the ten background soil sampling locations. Antimony was only detected in samples collected from two locations (BK-5 and BK-7). Cadmium was only detected in samples collected from locations BK-1, BK-2, and BK-3. Mercury and thallium were only detected at four sampling locations.

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TABLE 4-7

BACKGROUND SOILS - SUMMARY OF METALS RESULTS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	BK-1	BK-2		BK-3		BK-4		BK-5		
Depth (ft)	3.5-5.5	3.5-5.5	5-7	2	2	2.5-3.5	14.33-14.67	2.5-3.5	13-15	15-17
Date	6/24/91	6/24/91	6/24/91	12/04/91	12/05/91	4/02/92	4/02/92	4/02/92	4/02/92	4/02/92
Sample ID	40191062478	40191062481	40191062483	373911204102	373911205120	40192040219	40192040220	40192040216	40192040217	40192040218
Parameter (mg/Kg)										
Aluminum, Total	22300	21100		16200	15700	11000	7050	4860	4430	4230
Antimony, Total	ND@6.2	ND@6.4		ND@6.8	ND@6.7	ND@5.7	ND@6.24	7.9	ND@4.8	ND@5.9
Arsenic, Total	7.37	9.90	11.8	23.4	18.4	6.5	8.8	7.3	7.9	5.8
Barium, Total	127	55.1	55.4	42.3	50.9	112	96.8	45.3	56.0	52.8
Beryllium, Total	0.8	0.9	0.8	0.94	0.46	0.59	ND@0.43	0.79	0.66	0.41
Cadmium, Total	1.7	1.3	1.3	ND@0.94	1.4	ND@0.78	ND@0.86	ND@0.79	ND@0.66	ND@0.81
Chromium, Total	72.9	42.8	44.9	32.9	34.7	52.9	49.5	37.4	29.6	26.4
Copper, Total	17.0	8.8		2.4	6.9	5.9	4.3	ND@2.0	ND@1.7	4.1
Lead, Total	6.37	16.1	1.15	23.4	29.8	5.4	3.5	4.0	3.3	2.9
Magnesium, Total	7750	5430		4260	4230	7050	6640	4290	4160	3780
Manganese, Total	348	226		231	229	315	282	169	160	144
Mercury, Total	ND@0.09	ND@0.08		0.10	0.15	ND@0.10	ND@0.10	0.37	ND@0.10	ND@0.10
Nickel, Total	41.4	21.7	22.3	14.1	16.2	23.5	25.8	15.7	16.5	16.3
Selenium, Total	ND@0.41	ND@0.40		ND@0.44	ND@0.44	ND@0.34	ND@0.35	ND@0.30	ND@0.31	ND@0.26
Silver, Total	ND@1.5	ND@1.5		ND@1.6	ND@1.6	ND@1.8	ND@1.9	ND@1.8	ND@1.5	ND@1.8
Thallium, Total	ND@0.35	ND@0.33		ND@0.44	ND@0.44	0.45	ND@0.42	ND@0.36	ND@0.37	ND@0.31
Tin, Total				ND@11.8	ND@11.6	ND@9.8	ND@10.8	ND@9.8	ND@8.2	ND@10.2
Vanadium, Total	46.7	33.0		23.5	23.1	35.3	30.1	17.7	16.5	16.3
Zinc, Total	48.9	39.5		42.3	39.3	33.3	32.3	21.7	23.0	22.3

Blank space indicates parameter was not analyzed for.

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TABLE 4-7
(CONTINUED)
BACKGROUND SOILS - SUMMARY OF METALS RESULTS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	BK-6	BK-7	BK-8	BK-9	BK-10
	Depth (ft)	1.5	1.5	1	0.7	0.7
	Date	4/03/92	4/03/92	12/10/91	4/02/92	4/02/92
	Sample ID	40192040327	40192040328	31391121035	40192040230	40192040229
Parameter (mg/Kg)						
Aluminum, Total		10400	13300	9690	9430	13500
Antimony, Total		ND@6.8	11.5	ND@6.2	ND@7.0	ND@7.1
Arsenic, Total		5.2	7.6	11.8	5.6	4.1
Barium, Total		42.3	92.4	53.0	111	113
Beryllium, Total		1.65	2.3	ND@0.11	1.5	2.0
Cadmium, Total		ND@0.94	ND@1.2	ND@0.85	ND@0.96	ND@0.98
Chromium, Total		25.9	54.9	36.1	57.9	63.7
Copper, Total		ND@2.4	ND@2.9	6.4	2.4	2.5
Lead, Total		11.3	13.4	4.3	5.6	8.4
Magnesium, Total		3590	5910	5390	9550	8560
Manganese, Total		138	339	182	371	331
Mercury, Total		0.11	ND@0.14	ND@0.10	ND@0.10	0.20
Nickel, Total		14.1	23.1	14.8	26.5	26.9
Selenium, Total		ND@0.35	ND@0.42	ND@0.33	ND@0.29	ND@0.36
Silver, Total		ND@2.1	ND@2.6	ND@1.5	ND@2.2	ND@2.2
Thallium, Total		ND@0.42	0.56	ND@0.33	0.58	0.72
Tin, Total		ND@11.8	ND@14.4	ND@10.6	ND@12.1	ND@12.2
Vanadium, Total		26.2	43.3	19.1	51.8	65.8
Zinc, Total		28.2	49.5	29.7	43.4	49.0

Blank space indicates parameter was not analyzed for.

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TABLE 4-8

BACKGROUND SOILS - SUMMARY OF DETECTED VOCs AND ABNs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	BK-3						BK-7
Depth (ft)							1.5
Date	11/19/91	11/20/91	11/25/91	11/27/91	12/04/91	12/05/91	4/03/92
Sample ID	37391111930	37391112040	37391112559	37391112776	37391120410	37391120512	40192040328
Parameter (ug/Kg)							
2-Methyl naphthalene						297	
Acenaphthylene					1100	1570	
Anthracene					628	830	
Benzo(a)anthracene					2450	2480	
Benzo(a)pyrene					3080	3200	
Benzo(b)fluoranthene					4780	6100	
Benzo(ghi)perylene					2020	2000	
Benzo(k)fluoranthene					4780	6100	
Bis(2-ethylhexyl)phthalat						850	
Chlorobenzene		4.2					
Chrysene					4600	4700	
Di-n-butylphthalate					4750	7440	
Dibenzo(a,h)anthracene						490	
Ethylbenzene		7.1					
Fluoranthene					6830	6630	
Fluorene					400	644	
Indeno(1,2,3-cd)pyrene					2150	2000	
Naphthalene					704	820	
Phenanthrene					6550	6900	
Pyrene					8800	8640	
Toluene		55	14		7		11
Trichloroethene	3.2	9.5			10	18	14
Xylenes		43	17	7	18		

Blank space indicates compound was not detected.

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Maximum and minimum values of the metals analyzed for in background soil samples BK-1, BK-2, BK-4, BK-5, BK-6, BK-8, BK-9, and BK-10 are provided in Table 4-9. Due to the presence of VOCs and/or ABNs in samples BK-3 and BK-7, these samples were not considered in the determination of the concentration ranges of metals identified in Table 4-9. It should be noted that although field VOC screening of soil samples collected from borings BK-1 and BK-2 apparently indicated the presence of VOCs (See boring logs in Appendix B), laboratory analysis of these samples determined that no VOCs were present. Therefore, BK-1 and BK-2 sample results were considered for determining maximum and minimum background metal concentrations.

The metals concentration ranges detected in study area background soil samples are summarized in Table 4-9, which also includes the average concentration of elements in soils and other surficial materials in the conterminous United States as reported by the USGS (Shacklette and Boerngen, 1984) for comparison. Although the maximum study area background soil metal concentrations slightly exceed the average US soil concentration for several metals, the background soil metals concentration ranges identified in Table 4-9 are believed to be representative of the naturally occurring or "background" concentrations of metals present in study area soils.

The background soil metal concentration ranges have been established as a general guideline to assist identification of elevated metals concentrations in environmental soil samples collected in the study area. It should be noted that although one or more metals in an environmental soil sample may exceed the maximum background concentration, the exceedance is not necessarily indicative of an impact related to current or

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TABLE 4-9

BACKGROUND SOILS - MINIMUM AND MAXIMUM METALS CONCENTRATIONS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Parameter	Units	Minimum	Maximum	USGS Average (1)
Aluminum, Total	mg/Kg	4230	22300	72000
Antimony, Total	mg/Kg	ND	7.9	NR
Arsenic, Total	mg/Kg	4.1	11.8	7.2
Barium, Total	mg/Kg	42.3	127	580
Beryllium, Total	mg/Kg	ND	2.0	0.92
Cadmium, Total	mg/Kg	ND	1.7	NR
Chromium, Total	mg/Kg	25.9	72.9	54
Copper, Total	mg/Kg	ND	17	25
Lead, Total	mg/Kg	1.15	16.1	19
Magnesium, Total	mg/Kg	3590	9550	9000
Manganese, Total	mg/Kg	138	371	550
Mercury, Total	mg/Kg	ND	0.37	0.09
Nickel, Total	mg/Kg	14.1	41.4	19
Selenium, Total	mg/Kg	ND	ND	0.39
Silver, Total	mg/Kg	ND	ND	NR
Thallium, Total	mg/Kg	ND	0.72	NR
Tin, Total	mg/Kg	ND	ND	1.3
Vanadium, Total	mg/Kg	16.3	65.8	80
Zinc, Total	mg/Kg	21.7	49.0	60

(1) From USGS Professional Paper 1270, Shacklette and Boerngen, 1984
Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States

NOTE: Does not include data from BK-3 and BK-7 samples.
ND - Not detected
NR - Not reported

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historical site operations. Exceedances may reflect natural heterogeneities in soil composition related to pre- and post-depositional processes or derivation from a different bedrock lithology. Locally, higher concentrations of metals in the saturated till, particularly near the till-bedrock interface, may be present due to weathering, dissolution and transport of mineral assemblages present in the bedrock by ground water.

4.1.3.2 Zone 1

A total of 20 soil samples from ten borings in Zone 1 were collected and analyzed for metals. Two or three samples were collected from various depths in borings B-25 (18-20′ and 38-40′), B-26 (19′-20′ and 39-40′), B-27 (18-20′ and 38-40′), B-28 (8-10′ and 38-40′), DW-1t (18-20′ and 38-40′), DW-3t (2-4′, 20-22′ and 35-37′), OW-1t (10-12′, 20-22′ and 25-27′), and OW-3t (0-2′ and 29-31′). Samples analyzed from shallow borings B-50 and B-51 were collected at a depth of three feet. The locations of these borings are shown on Figure 2-3.

In general, the same suite of metals was present in all analyzed Zone 1 soil samples. Metals analytical results for these samples are presented in Table 4-10. Aluminum, arsenic, barium, beryllium, chromium, copper, lead, magnesium, manganese, nickel, vanadium, and zinc were detected in all samples. Cadmium was detected in all samples except B-50 and B-51. Antimony, cobalt, mercury, selenium, thallium, and tin were detected in samples collected from three or fewer borings. Silver was not detected in any samples.

With the exception of boring B-28, located adjacent to the north end of the manufacturing facility building, borings where soil

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TABLE 4-10

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ZONE 1 SOILS - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-25		B-26		B-27		B-28		B-50	B-51
Depth (ft)	18-20	38-40	19-20	39-40	18-20	38-40	8-10	38-40	3	3
Date	6/10/91	6/10/91	6/27/91	6/27/91	6/11/91	6/11/91	6/12/91	6/12/91	5/01/92	5/01/92
Sample ID	40191061003	40191061005	401910627100	401910627103	40191061107	40191061109	40191061210	40191061213	40192050101	40192050102
Parameter (mg/Kg)										
Aluminum, Total		20360		24000		20908		14786	16600	19900
Antimony, Total		-		-		7.2		8.3	-	-
Arsenic, Total	3.93	5.00	4.34	7.60	4.45	6.89	5.35	2.49	[illegible]	[illegible]
Barium, Total	134	130	136	172	142	144	135	115	82.1	86.4
Beryllium, Total	0.44	0.5	0.7	0.9	0.4	0.4	0.7	0.4	0.70	0.93
Cadmium, Total	2.05	3.0	3.8	3.3	3.8	2.6	3.3	2.6	-	-
Chromium, Total	72.1	75.1	74.5	83.1	73.1	76.9	63.9	57.3	[illegible]	[illegible]
Cobalt, Total									[illegible]	[illegible]
Copper, Total		22.5		25.7		20.4		17.9	[illegible]	16.3
Lead, Total	5.13	6.70	4.93	5.96	1.12	1.62	6.01	4.82	[illegible]	[illegible]
Magnesium, Total		10250		11800		10380		7745	7660	9110
Manganese, Total		421		425		356		315	263	257
Mercury, Total		-		-		-		-	-	-
Nickel, Total	40.7	41.2	47.0	61.8	44.1	43.0	39.3	36.1	39.9	39.7
Selenium, Total		-		-		-		-	-	0.35
Silver, Total		-		-		-		-	-	-
Thallium, Total		-		0.64		-		-	-	0.70
Tin, Total									-	-
Vanadium, Total		57.4		63.7		51.7		40.2	32.9	39.7
Zinc, Total		66.1		65.7		58.4		42.8	70.4	81.7

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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TABLE 4-10
(CONTINUED)
ZONE 1 SOILS - SUMMARY OF DETECTED METALS

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	DW-1t		DW-3t			OW-1t			OW-2t	
Depth (ft)	18-20	38-40	2-4	20-22	35-37	10-12	20-22	25-27	0-2	29-31
Date	3/27/91	3/28/91	12/05/91	12/05/91	12/06/91	12/05/91	12/05/91	12/05/91	12/04/91	12/04/91
Sample ID	40291032704	40291032808	373911205116	373911205119	373911206124	373911205105	373911205109	373911205110	37391120490	37391120498
Parameter (mg/Kg)										
Aluminum, Total		29800	20600	17900	21800	17500	21000	20600	28100	21200
Antimony, Total		-	-	-	-	-	-	-	15.6	8.4
Arsenic, Total	5.3	14.7	8.8	6.8	7.6	8.2	6.7	7.0	9.3	5.8
Barium, Total	133	217	124	138	141	120	145	159	70.0	118
Beryllium, Total	0.4	0.9	0.42	0.42	0.67	0.38	0.42	0.66	1.3	0.86
Cadmium, Total	2.3	2.5	1.9	1.7	2.2	1.7	1.2	1.5	1.0	1.1
Chromium, Total	70.5	110	73.7	69.4	71.7	66.5	74.8	81.0	59.7	70.6
Cobalt, Total										
Copper, Total		81.3	12.6	16.8	15.7	9.5	12.5	15.3	13.0	10.7
Lead, Total	4.5	6.3	5.7	5.8	5.8	4.7	5.6	5.8	13.4	4.9
Magnesium, Total		15200	8750	8780	9800	8550	10900	11200	6220	8570
Manganese, Total		516	332	322	354	325	349	387	275	342
Mercury, Total		-	-	0.21	-	-	-	-	0.11	-
Nickel, Total	49.0	48.5	33.7	40.0	40.3	34.2	37.4	41.5	28.5	40.7
Selenium, Total		-	-	-	-	-	-	-	0.51	-
Silver, Total		-	-	-	-	-	-	-	-	-
Thallium, Total		-	-	-	0.45	-	-	-	-	-
Tin, Total			-	-	15.7	-	-	-	-	-
Vanadium, Total		80.9	46.3	48.4	51.5	41.8	51.9	59.0	38.9	47.1
Zinc, Total		87.3	44.2	48.4	51.5	41.8	51.9	56.8	77.8	53.5

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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samples were collected at multiple depth intervals exhibited a general increase in metals concentrations with increasing depth.

The highest concentrations of metals present in the Zone 1 soil samples were generally detected in samples collected from boring DW-1t, which is located immediately adjacent to the former dry well. The maximum concentrations of aluminum (29800 mg/kg), barium (217 mg/kg), copper (31.3 mg/kg), magnesium (15200 mg/kg), manganese (516 mg/kg), nickel (69.5 mg/kg), vanadium (80.9 mg/kg), and zinc (87.3 mg/kg) were detected in the 38-40 foot sample collected from DW-1t. The maximum concentrations of antimony, beryllium, cadmium, mercury, selenium and tin were detected in samples collected from borings B-25, DW-3t and OW-2t, which are also located within 25 feet of the former dry well. The maximum concentrations of arsenic (38.1 mg/kg), chromium (127 mg/kg), cobalt (14.1 mg/kg), lead (338 mg/kg), and thallium (0.70 mg/kg) were detected in samples collected from borings B-50 and B-51, which were installed at the location of the former paint settling booth.

The concentrations of metals detected in each of the Zone 1 soil samples were compared to the maximum background soil sample concentrations in Table 4-9 to identify potential areas with elevated concentrations. Exceedances of background maximum concentrations for each Zone 1 soil sample are identified by shading in Table 4-10. More than half of the analyzed samples exceeded the background concentrations of barium, cadmium, chromium, and zinc. The greatest number and magnitude of exceedances for individual metals were found in the 38-40 foot sample collected from boring DW-1t. Exceedances of background concentrations of lead were only noted in samples from borings B-50 and B-51. Arsenic exceedances were also identified in

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samples collected from borings B-50, B-51, and DW-1t.

The results of Zone 1 soil samples analyzed for metals indicate the presence of elevated concentrations of several metals in the vicinity of the former dry well. The degree to which this impact is related to past site operations is uncertain. The general trend of metals concentrations increasing with depth suggests that the concentrations may be related to enhanced metals solubilization by the VOC-contaminated till ground water in the Zone 1 source area. As discussed in more detail in Section 4.3.3.4, one possible mechanism for metal solubilization in the till ground water in the vicinity of the Zone 1 source area is the acid extraction of naturally occurring metals from the till sediments due to the by-products of trichloroethene biodegradation. If the upper portion of the saturated till contains sufficient dissolved oxygen, aerobic biological mechanisms exist for the formation of acids which may decrease the pH locally and favor enhanced solubilization of metals. However, at greater depths in the till, where aerobic activity is limited due to low dissolved oxygen content and the pH is more neutral, this process may be reversible and result in localized precipitation of the solubilized metals onto saturated till sediments and result in the observed metals concentration trend.

The elevated concentrations of arsenic, chromium, and lead in samples collected from shallow borings B-50 and B-51 appear to be related to the paint settling booth formerly located in Zone 1. The former location of the paint settling booth is shown on Figure 2-3. Linemaster is known to have used paint containing a chromium-based pigment in the past (See Table 1-1) and both arsenic and lead can be present in paints. Paint solids were historically deposited on the bare ground floor of the paint

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settling booth formerly located in Zone 1, as discussed in Section 1.5.1. During the dismantling of the booth, soil was removed to a depth of approximately 2.5 feet. At that time, a sample was collected from the base of the excavation and analyzed for arsenic, barium, selenium, mercury, silver, cadmium, chromium, lead, and nickel by the EP toxicity test. Mercury was detected at a concentration of 0.001 mg/l. No other metals were detected. The presence of visible paint chips in the samples collected from borings B-50 and B-51 may be responsible for the elevated metals concentrations in these samples and indicate that minor amounts of paint residue remain at this location.

4.1.3.3 Zone 2

Four soil samples collected from the T-4 trench, located downslope of the brick dry well in Zone 2, were analyzed for metals during RI/FS investigations. Detected metals concentrations are summarized in Table 4-11. Aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc were detected in all samples. Mercury was detected in two of the four samples. Antimony and silver were detected in one sample each. Thallium was not detected in any of the four Zone 2 soil samples.

In general, higher concentrations of metals were detected in the samples collected from the base of the trench (approx. 4 feet deep) than from the near surface (approx. 0.5 feet deep). Concentrations of arsenic and selenium exhibited little variability with depth.

Metals concentrations in each Zone 2 sample exceeding the background concentrations in Table 4-9 are indicated by shading

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TABLE 4-11

ZONE 2 SOILS - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	T-4-1			
	Depth (ft)	.5	.5	4	4
	Date	6/25/91	6/25/91DUP	6/25/91	6/25/91DUP
	Sample ID	40191062584	40191062586	40191062587	40191062589
Parameter (mg/Kg)					
Aluminum, Total		13800	15200	23700	26800
Antimony, Total		-	11.6	-	-
Arsenic, Total		7.36	7.31	7.37	7.26
Barium, Total		59.6	70.8	119	122
Beryllium, Total		0.6	0.6	1.1	1.1
Cadmium, Total		2.3	2.7	5.4	1.6
Chromium, Total		37.3	48.7	75.7	89.5
Copper, Total		54.9	70.5	134	119
Lead, Total		55.7	58.5	420	704
Magnesium, Total		3940	4820	5950	6710
Manganese, Total		319	316	437	520
Mercury, Total		-	-	2.01	2.03
Nickel, Total		8.4	12.5	18.4	13.2
Selenium, Total		0.54	0.62	0.78	0.76
Silver, Total		2.4	-	-	-
Thallium, Total		-	-	-	-
Vanadium, Total		16.5	22.1	30.5	33.4
Zinc, Total		125	164	176	221

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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in Table 4-11. Exceedances of background concentrations of cadmium, copper, lead, selenium, and zinc were noted in all samples. The largest exceedances noted in the Zone 2 samples were for copper (134 mg/kg), lead (420 mg/kg), and zinc (444 mg/kg). These exceedances and the elevated concentrations of other metals present in the soils downslope of the Zone 2 brick dry well may be related to the leaching of metals from plumbing fixtures and piping or may be associated with the former discharge of facility sewage.

4.1.3.4 Zone 3

During Phase 1A RI/FS investigations, four soil samples collected from trenches T-1 and T-2, located in the vicinity of the former Blakely residence leaching field in Zone 3 as shown on Figure 2-6, were analyzed for metals. One sample and one duplicate sample were collected from a depth of three feet in both trenches. Detected metal concentrations are summarized in Table 4-12. Aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, vanadium, and zinc were detected in all samples analyzed for theses parameters. Thallium was detected in three of the four samples and antimony and mercury were detected in two of the four samples. Selenium and silver were not detected in any of the four samples.

The metals concentrations detected in the samples collected from the base of trenches T-1 and T-2 are very similar; however, slightly higher concentrations of cadmium, chromium, and lead were detected in the samples collected from trench T-1.

Metals concentrations in each Zone 3 sample exceeding the

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TABLE 4-12

ZONE 3 SOILS - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	T-1		T-2	
	Depth (ft)	3	3	3	3
	Date	6/25/91	6/25/91DUP	6/25/91	6/25/91DUP
	Sample ID	40191062596	40191062598	40191062592	40191062594
Parameter (mg/Kg)					
Aluminum, Total		28600	27300	21800	25100
Antimony, Total		-	12.7	-	7.5
Arsenic, Total		5.37	6.10	7.23	6.54
Barium, Total		127	179	128	114
Beryllium, Total		1.0	1.1	1.1	1.1
Cadmium, Total		2.6	2.3	1.6	1.5
Chromium, Total		79.5	81.9	71.0	65.5
Copper, Total		18.9	21.8	20.4	31.8
Lead, Total		7.23	8.01	6.63	6.57
Magnesium, Total		9920		9180	8500
Manganese, Total		362	318	301	347
Mercury, Total		-	0.22	-	0.25
Nickel, Total		38.0	48.3	43.3	3.8
Selenium, Total		-	-	-	-
Silver, Total		-	-	-	-
Thallium, Total		-	0.53	0.59	0.48
Vanadium, Total		55.3	55.7	52.2	45.3
Zinc, Total		50.1	51.4	48.6	40.9

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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background concentrations in Table 4-9 are indicated by shading in Table 4-12. Exceedances of background concentrations of aluminum and copper were present in all four samples. The concentrations of these two metals and the concentrations of other metals exceeding background metals concentrations were only slightly higher than the background concentrations.

The metals concentrations present in the Zone 3 trench soil samples indicate that the soils in this area have not been significantly impacted by historical site operations. The slightly elevated metals concentrations may be related to the leaching of metals from plumbing fixtures and interior and exterior piping and the discharge of VOC-contaminated water to the leaching field.

4.1.3.5 Zone 4

Thirty-six soil samples collected from the 22 borings or wells installed during Zone 4 Phase 1A and 1B RI/FS investigations were analyzed for metals. One or two shallow (< 4 feet) soil samples were collected from borings B-30, B-32, B-33, B-34, B-35, B-36, B-37, B-38, B-40, B-41, B-42, B-43, B-47 (2 samples), B-48 (2 samples), and B-49 (2 samples). One sample was collected from the 10-12 foot depth intervals in borings B-44 and B-45. Two or more samples were collected at depth intervals ranging from 4-6 feet to 45-47 feet in borings B-29, B-39, MW-16sb, MW-24t, and MW-25t. Zone 4 boring locations are shown in Figure 2-7.

All Zone 4 soil samples were analyzed for arsenic, barium, beryllium, cadmium, chromium, lead, and nickel or for the list of HSL metals included in Table 2-1. Detected metal concentrations in samples collected from Zone 4 borings are summarized in

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Table 4-13. Aluminum, arsenic, barium, chromium, copper, lead, magnesium, manganese, nickel, vanadium, and zinc were detected in all samples analyzed for these parameters. Beryllium, cadmium, and thallium were detected in most samples analyzed for these metals. Mercury and selenium were detected in only one and two samples, respectively, of the 12 samples analyzed for these parameters. Silver was not detected in the 12 Zone 4 soil samples analyzed for this metal.

Although evaluation of Zone 4 soil sample metals data is complicated by the fact that samples were collected from different depth intervals and analyzed for separate lists of metals, several trends are apparent. Arsenic concentrations were generally highest in samples collected at depths of less than four feet. Conversely, barium concentrations appear to increase with depth. Concentrations of chromium and lead were also generally higher in samples collected at greater depths. With the exception of samples collected from shallow borings B-47, B-48, and B-49, the concentrations of individual metals do not appear to indicate any spatial distribution trends. The three aforementioned shallow borings were installed through the concrete floor of the paint shed in the center of Zone 4. The highest concentrations of arsenic detected in Zone 4 soil samples (17.8 mg/kg to 20.7 mg/kg) were found in the 0-2 foot sampling interval at these three locations. However, this sampling interval was noted to consist of a combination of topsoil, fill, and till. Arsenic concentrations in the 2-4 foot sampling intervals at these same three locations were significantly lower (4.4 mg/kg to 6.9 mg/kg).

The concentrations of the metals detected in each of the Zone 4 soil samples were compared to the maximum background soil sample

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TABLE 4-13

ZONE 4 SOILS - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-29		B-30	B-32	B-33	B-34	B-35	B-36	B-37	B-38
Depth (ft)	8-10	28-30	0-2	0-2	2-4	0-2	2-4	0-2	2-4	0-2
Date	6/13/91	6/13/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91	6/17/91
Sample ID	40191061314	40191061316	40191061741	40191061721	40191061724	40191061725	40191061728	40191061729	40191061746	40191061743
Parameter (mg/Kg)										
Aluminum, Total		20400			26500				22300	
Antimony, Total		-			-				-	
Arsenic, Total	7.85	5.25	16.6	6.18	6.35	5.28	7.01	6.41	4.79	5.86
Barium, Total	117	148	64.3	68.9	125	64.0	105	80.0	79.1	65.0
Beryllium, Total	0.5	0.4	0.7	0.8	1.2	0.6	0.6	0.7	0.9	0.7
Cadmium, Total	1.6	1.1	1.3	1.1	3.1	40.4	1.9	4.1	1.6	3.1
Chromium, Total	55.7	80.1	55.3	50.4	79.5	50.9	84.0	62.7	56.4	57.5
Copper, Total		23.1			38.2				13.3	
Lead, Total	5.68	6.69	16.2	18.4	7.27	26.4	6.54	39.1	7.65	7.74
Magnesium, Total		2380			8620				6160	
Manganese, Total		361			407				206	
Mercury, Total		-			-				-	
Nickel, Total	37.0	48.7	47.6	31.4	42.7	30.3	46.1	34.4	32.2	43.5
Selenium, Total		-			-				-	
Silver, Total		-			-				-	
Thallium, Total		0.53			0.56				-	
Tin, Total										
Vanadium, Total		53.5			49.3				39.5	
Zinc, Total		47.5			51.6				39.2	

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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TABLE 4-13
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED METALS

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-39		B-40	B-41	B-42	B-43	B-44	B-45	B-47	
Depth (ft)	18-20	28-30	0-2	2-4	0-2	0-2	10-12	10-12	0-2	2-3.5
Date	6/14/91	6/14/91	6/17/91	6/17/91	6/17/91	6/17/91	6/18/91	6/18/91	4/02/92	4/02/92
Sample ID	40191061418	40191061419	40191061733	40191061736	40191061739	40191061737	40191061848	40191061850	40192040221	40192040222
Parameter (mg/Kg)										
Aluminum, Total		18700					19000	24000	5520	12700
Antimony, Total		-					-	-	-	-
Arsenic, Total	5.97	4.79	6.01	7.06	5.25	4.78	6.20	7.45	15.1	4.7
Barium, Total	115	148	65.2	113	72.2	63.2	120	348	59.5	73.2
Beryllium, Total	0.7	0.7	0.9	0.9	0.9	0.8	0.2	0.5	-	0.71
Cadmium, Total	0.9	0.9	6.1	7.0	5.2	5.6	-	-	-	-
Chromium, Total	74.4	76.7	58.7	84.6	55.9	56.5	68.1	81.1	36.0	54.3
Copper, Total		17.4					6.8	22.0	15.2	7.1
Lead, Total	5.12	5.40	11.3	7.60	8.68	8.68	5.64	5.86	5.2	7.4
Magnesium, Total		10100					9300	11100	5880	6770
Manganese, Total		352					3.2	495	213	198
Mercury, Total		-					-	-	-	0.27
Nickel, Total	45.0	47.2	34.8	51.4	55.4	35.6	42.3	50.1	21.6	18.9
Selenium, Total		-					-	-	-	-
Silver, Total		-					-	-	-	-
Thallium, Total		0.59					0.61	0.57	0.38	-
Tin, Total									-	11.6
Vanadium, Total		52.2					44.7	59.7	23.4	37.8
Zinc, Total		57.4					48.4	51.3	36.0	35.4

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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TABLE 4-13
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED METALS

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	B-48		B-49		MW-16sb		MW-24t			
Depth (ft)	0-2	2.5-3.0	0-2	2.5-3.5	34-36	46-48	4-6	8-10	14-16	18-20
Date	4/02/92	4/02/92	4/02/92	4/02/92	4/23/91	4/23/91	6/19/91	6/19/91	6/19/91	6/19/91
Sample ID	40192040223	40192040224	40192040225	40192040226	34391042329	34391042338	40191061951	40191061952	40191061953	40191061954
Parameter (mg/Kg)										
Aluminum, Total	9860	15500	7130	11000						
Antimony, Total	-		-	-						
Arsenic, Total	17.8	6.9	19.5	4.4	7.6	4.3	9.10	8.02	9.26	5.22
Barium, Total	57.9	76.7	49.0	68.2	185	172	129	138	153	139
Beryllium, Total	0.64	0.72	-	0.60	-	-	0.6	0.6	0.4	0.5
Cadmium, Total	-		-	-	1.6	2.0	-	-	-	0.9
Chromium, Total	45.0	76.7	44.6	52.1	85.5	80.9	73.2	77.8	70.6	77.9
Copper, Total	6.43	12.0	11.1	8.0						
Lead, Total	7.4	7.2	30.8	6.3	5.8	6.2	6.37	5.81	5.51	7.89
Magnesium, Total	5850	10800	6380	6770						
Manganese, Total	197	271	247	237						
Mercury, Total	-	0.22	-	-						
Nickel, Total	19.3	26.4	17.8	20.1	51.7	50.3	42.0	45.0	42.8	44.5
Selenium, Total	0.37	-	-	-						
Silver, Total	-	-	-	-						
Thallium, Total	-	-	-	0.40						
Tin, Total	-	19.2	11.1	-						
Vanadium, Total	27.9	55.1	31.2	38.1						
Zinc, Total	34.3	45.6	29.0	32.1						

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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TABLE 4-13
(CONTINUED)
ZONE 4 SOILS - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	MW-24t		MW-25t			
Depth (ft)	24-26	28-30	10-12	18-20	29-31	45-47
Date	6/19/91	6/19/91	6/21/91	6/21/91	6/21/91	6/21/91
Sample ID	40191061955	40191061956	40191062171	40191062173	40191062175	40191062177
Parameter (mg/Kg)						
Aluminum, Total						
Antimony, Total						
Arsenic, Total	22.0	8.53	13.4	4.16	6.95	5.26
Barium, Total	146	137	116	139	185	153
Beryllium, Total	0.4	0.4	0.4	0.7	0.7	0.7
Cadmium, Total	-	-	1.5	1.8	2.3	1.4
Chromium, Total	80.8	75.9	95.8	76.6	84.1	81.1
Copper, Total						
Lead, Total	5.94	5.72	5.05	5.22	5.70	5.58
Magnesium, Total						
Manganese, Total						
Mercury, Total						
Nickel, Total	45.8	41.3	51.3	51.8	52.3	50.8
Selenium, Total						
Silver, Total						
Thallium, Total						
Tin, Total						
Vanadium, Total						
Zinc, Total						

- Not detected
Blank space indicates parameter was not analyzed for.
Shaded results indicate exceedances of maximum background concentration.

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concentrations in Table 4-9; exceedances of background maximum concentrations for each Zone 4 soil sample are identified by shading in Table 4-13. Nearly half or more of the analyzed Zone 4 soil samples exceeded the background concentrations of barium, cadmium, chromium, and nickel. Exceedances of background concentrations of other metals were only noted in five or fewer samples. There were no exceedances of background antimony, beryllium, mercury, silver, thallium or vanadium concentrations in any of the Zone 4 samples analyzed for these parameters.

In general, concentrations of barium, chromium, and nickel were more frequently in excess of background soil sample concentrations in deep samples collected than in shallow (< 4 feet) samples. Exceedances of cadmium background concentrations were more common in shallow soil samples than in deep samples.

The source(s) of the apparently elevated concentrations of barium, cadmium, chromium, and nickel in Zone 4 soil samples is uncertain. The fact that barium, chromium, and nickel concentrations generally are higher in deep soil samples suggests that the possible impact may be related to ground-water contaminant transport. The elevated near-surface cadmium concentrations may be naturally occurring or may be related to the possible disposal or storage of material within or adjacent to the paint shed; however, cadmium was not detected in any of the samples collected from the borings installed through the concrete shed floor. The elevated concentrations of arsenic in the 0-2 foot interval below the paint shed floor suggest that the paint shed or the fill material underlying the paint shed are possible arsenic sources. The paint shed or underlying fill material are not considered to be a significant source of arsenic

based on the following observations: 1) arsenic concentrations decreased significantly from the 0 to 2 foot to the 2 to 4 foot sampling intervals in the borings installed through the paint shed floor; and, 2) arsenic concentrations in shallow samples collected adjacent to the paint shed did not exhibit concentrations in excess of background arsenic levels.

4.2 Water-Supply Well Monitoring

A summary of positive VOC detections for the Interim Water-Supply Monitoring Program, discussed in Section 2.8.1, is provided in Appendix P. The primary VOC that has been detected and subsequently confirmed is TCE. This compound has been detected at concentrations above 5 ug/l during more than one sampling event at the following currently active off-site water-supply wells: GW-06ob (Tarr Apartments); GW-09db (Peterson); GW-21 (Parent); and, GW-40db (Woodstock Town Hall). TCE has also been detected at concentrations above 5 ug/l during more than one sampling event at GW-28ob, a currently inactive well, formerly used by the Woodstock Fire Department. TCE concentrations less than 5 ug/l have been detected during more than one sampling event at GW-16db (Woodstock Public School), GW-17db (Harding), GW-23db (Foote), GW-25ob (Henry), and GW-26 (Johnson Apartments). Single, unconfirmed detections of TCE have been observed at GW-14 (Austin), GW-18 (Kosche), and GW-22 (Hamilton). During 1992 sampling, TCE has been detected at GW-06ob (Tarr), GW-09db (Peterson), GW-40db (Woodstock Town Hall), and GW-57 (Elmen); all of the detections have been less than 5 ug/l.

Minimum, maximum and mean values of TCE detections in the water-supply wells are listed in Table 4-14. Also listed in this table are the number of sampling events and the number of non-detects.

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TABLE 4-14
SUMMARY OF TCE DETECTIONS IN WATER-SUPPLY WELLS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well	Number of Sampling Events	Number of NDs	Mean (ug/l)	Minimum (ug/l)	Maximum (ug/l)
GW-04	24	24	0	0	0
GW-05db	17	17	0	0	0
GW-06ob	35	5	6.6	0	55.5
GW-07db	16	16	0	0	0
GW-09db	39	21	0.7	0	7.2
GW-13ob	34	34	0	0	0
GW-14	9	8	0	0	0.6
GW-16db	40	38	0	0	0.8
GW-17db	28	24	0	0	2.4
GW-18db	32	31	0	0	1.8
GW-20db	35	35	0	0	0
GW-21	31	14	1.9	0	12.2
GW-21db	11	3	0.8	0	1.5
GW-21ob	4	2	1.3	0	3.6
GW-22ob	32	31	0.9	0	27.7
GW-23db	33	26	0	0	0.7
GW-24db	35	35	0	0	0
GW-25ob	39	37	0	0	15.0
GW-26	39	36	0	0	0.5
GW-27ob	35	35	0	0	0
GW-28ob	18	3	18.1	0	106.0
GW-29	16	16	0	0	0
GW-34db	27	27	0	0	0
GW-36db	17	12	3.0	0	24.0
GW-40db	24	4	42.6	0	220.0
GW-42	6	6	0	0	0

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As can be seen from Table 4-14, locations where the mean TCE value is above 5 ug/l include GW-06ob (Tarr Apartments), GW-28ob (former Woodstock Fire Department well), and GW-40db, (Woodstock Town Hall). Both of the active wells, GW-06ob and GW-40db are equipped with GAC treatment systems. The mean TCE values range from 0 to 42.6 ug/l with maximum values ranging from 0 to 220 ug/l as indicated in Table 4-14.

Correlations are not evident between the detected VOC concentrations and sample collection months indicating no apparent seasonal trends. However, a similar yearly trend is evident for only three water-supply well sampling locations. This trend is characterized by increasing VOC concentration from approximately 1986, when water-supply sampling was initiated, to 1988, when the highest concentrations were detected. After 1988 the concentrations decreased to their current level. Wells that exhibited this trend include GW-06ob, GW-21, and GW-28ob. As indicated, two of these wells are overburden wells. The Parent Residence, GW-21, has two water-supply wells; one is an overburden well and the other is a deep bedrock well. It is not known which of the two wells was sampled prior to mid 1991 because the homeowner frequently used both wells intermittently. Therefore, the yearly trend at this sampling location cannot be attributed to either the overburden or deep bedrock well. Recently, the homeowner has agreed to use only the deep bedrock well.

The reason for the yearly trend is uncertain but may be related to Linemaster's discharge history. At this time, data is lacking to establish a connection between increasing VOC concentrations from 1986 to 1988 to Linemaster's discharge history. Therefore, the significance of this trend is uncertain.

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The confirmed detections of chlorinated VOCs in water-supply wells are likely due to the Linemaster site. The occurrences of VOCs at the site are discussed in Section 4.3. The occasional detections of trihalomethanes at some water-supply wells may be due to laboratory cross contamination because these compounds were not detected in significant quantities at the site. The detection of benzene in GW-16db, GW-47db, and GW-67db is not attributed to Linemaster. Both GW-47db and GW-67db are located in an area potentially downgradient of the Woodstock Public School (GW-16db), which has underground fuel storage tanks. Currently, the Town of Woodstock Education Department is investigating a possible discharge from the underground tanks at the school.

Arsenic

As part of the Interim Water-Supply Monitoring Program, domestic supply wells have historically been sampled and analyzed for arsenic. Additionally, several supply wells have also been sampled and analyzed for the HSL metals listed in Table 2-1 as part of RI/FS investigations.

A summary of positive detections for arsenic sampling and analysis conducted at the study area since 1990 is provided in Appendix P. Arsenic has been detected at approximately 35 off-site sampling locations. Total arsenic concentration above 50 ug/l, the Federal MCL, were detected at two currently active off-site supply wells, GW-21 and GW-34db, on June 21, 1990 at concentrations of 57.3 ug/l and 50.4 ug/l, respectively. Concentrations of other metals detected in the active domestic supply wells did not exceed Federal MCLs.

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Arsenic is a common element present in water-supply wells (U.S. EPA, 1982). Arsenic has been identified as a naturally occurring element in the bedrock unit in the study area as discussed in a metals study report provided in Appendix R. The metals study report also identifies naturally elevated concentrations of arsenic in other water-supply wells in New England that produce from the same bedrock unit that underlies the study area.

The distribution of arsenic concentrations in water-supply wells does not indicate any perceivable spatial trend, nor does it correspond to the occurrence of VOCs in the water-supply wells. Based on the sampling results from the Interim Water-Supply Well Monitoring Program (and from study area monitoring wells, as discussed in Section 4.3.3) arsenic is believed to be naturally occurring in the water-supply wells and is not related to the Linemaster site. A more detailed discussion of the occurrence and origin of arsenic and other metals in study area ground water is provided in Section 4.3.3.

4.3 Ground Water

4.3.1 VOCs

Results

The ground-water sampling and analysis conducted at the site indicates the presence of a mixture of chlorinated and aromatic VOCs in the ground water as indicated in Tables 4-15, 4-16, and 4-17. The chlorinated VOC and aromatic VOC found at the highest concentrations and with the most widespread occurrence were TCE and toluene, respectively. The maximum concentrations of both TCE and toluene were detected in monitoring wells located in or

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TABLE 4-15

TILL GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-1t					MW-2t			
Date	09/10/87	10/20/87	02/19/88	07/23/90	12/04/90	09/10/87	10/20/87	07/23/90	12/04/90
Sample ID	MW1870910	MW1871020	MW1880219	31390072305	31390120406	MW2870910	MW2871020	31390072304	31390120404
Parameter (ug/l)									
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene				-	-			-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene									
cis-1,2-Dichloroethene				5.6	11			-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-
2-Hexanone									
Acetone									
Benzene				-	-			-	0.6
Carbon tetrachloride	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-
Ethylbenzene				-	-			-	-
Hexachlorobutadiene				-	-			-	-
Methyl isobutyl ketone									
Methyl ethyl ketone									
Tetrachloroethene	-	-	-	-	-	-	-	-	-
Toluene				-	-			-	-
Trichloroethene	-	-	14.2	1.5	3.5	-	-	0.9	2.8
Vinyl acetate									
Xylenes				-	-			-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-15
(CONTINUED)
TILL GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-3t					MW-4t				
Date	09/10/87	10/20/87	07/23/90	12/04/90	04/24/92	09/10/87	10/20/87	02/19/88	07/25/90	12/07/90
Sample ID	MW3870910	MW3871020	31390072301	31390120401	37392042402	MW4870910	MW4871020	MW4880219	31390072523	31390120724
Parameter (ug/l)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	10.9	81	280
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	22	-
1,1-Dichloroethene			-	-	-				7.4	14
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene									-	390
cis-1,2-Dichloroethene			-	-	-				200	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-
2-Hexanone									-	-
Acetone									-	-
Benzene			-	-	-				-	-
Carbon tetrachloride	-	-	0.9	1.4	3.4	-	-	-	-	-
Chloroform	-	-	-	0.7	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene			-	-	-				-	-
Hexachlorobutadiene			-	-	-					
Methyl isobutyl ketone									-	-
Methyl ethyl ketone									-	-
Tetrachloroethene	-	-	-	-	-	-	-	10.8	117	560
Toluene			-	-	-				2.0	2.2
Trichloroethene	-	-	-	-	2.2	-	-	4600	1950	27000
Vinyl acetate									1830	-
Xylenes			-	-	-				-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-15
(CONTINUED)
TILL GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-6t							MW-8t		MW-10ts
Date	09/10/87	10/20/87	10/20/87DUP	02/19/88	07/25/90	07/25/90DUP	12/07/90	06/11/91	01/03/92	04/24/92
Sample ID	MW6870910	MW6871020	MW6DUP87102	MW6880219	31390072521	31390072525	31390120721	31391061104	31392010307	37392042401
Parameter (ug/l)										
1,1,1-Trichloroethane	46.4	43	30.5	56.2	4.2	6.4	6.9	-	-	300
1,1,2-Trichloroethane	-	-	-	1.8	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	110
1,1-Dichloroethene					-	-	-	-	-	81
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene					-	-	14	-	-	-
cis-1,2-Dichloroethene					27	27	-	-	-	150
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-
2-Hexanone					-	-	-	-	-	-
Acetone					85	112	-	-	-	-
Benzene					-	-	-	-	-	-
Carbon tetrachloride	-	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene					-	-	-	-	-	250
Hexachlorobutadiene										
Methyl isobutyl ketone					-	-	-	-	-	-
Methyl ethyl ketone					-	-	-	-	-	-
Tetrachloroethene	13.1	-	-	5.0	2.7	3.3	-	-	-	610
Toluene					-	-	-	-	-	6300
Trichloroethene	1120	7180	6700	3100	431	485	690	7.9	4.1	220000
Vinyl acetate					-	-	-	-	-	-
Xylenes					-	-	-	-	-	600

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-15
(CONTINUED)
TILL GROUND WATER - SUMMARY OF DETECTED VOCs

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-10td			MW-11t			MW-12t			
Date	07/25/90	12/10/90	12/10/90DUP	07/23/90	12/06/90	12/06/90DUP	07/24/90	07/24/90DUP	12/05/90	04/21/92
Sample ID	31390072627	31390121027	31390121030	31390072307	31390120614	31390120616	31390072415	31390072417	31390120512	35192042114
Parameter (ug/l)										
1,1,1-Trichloroethane	-	67	58	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	813	670	640	-	-	-	-	-	-	-
1,1-Dichloroethene	-	270	280	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	1900	2000							
cis-1,2-Dichloroethene	2430	-	-	1.1	2.1	1.9	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-
2-Hexanone	-	1800	1800							
Acetone	-	-	-							
Benzene	-	-	-	-	-	-	-	-	-	-
Carbon tetrachloride	-	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	1.2	-	-
Dichloromethane	1810	1500	1600	-	-	-	-	-	-	-
Ethylbenzene	-	240	260	-	-	-	-	-	-	-
Hexachlorobutadiene				-	-	-	-	-	-	-
Methyl isobutyl ketone	-	-	-							
Methyl ethyl ketone	-	-	-							
Tetrachloroethene	-	450	380	-	-	-	-	-	-	-
Toluene	8700	13000	13000	-	-	-	-	-	-	-
Trichloroethene	289000	400000	400000	13	28	28	-	-	-	-
Vinyl acetate	-	-	-							
Xylenes	-	610	600	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-15
(CONTINUED)
TILL GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-15t		MW-16t		MW-17ts		MW-17td		MW-18t	
Date	06/11/91	01/06/92	06/13/91	01/09/92	06/12/91	01/07/92	06/12/91	01/08/92	06/11/91	01/03/92
Sample ID	31391061107	31392010614	31391061318	31392010940	31391061212	31392010727	31391061210	31392010828	31391061101	31392010311
Parameter (ug/l)										
1,1,1-Trichloroethane	-	-	-	-	4.0	4.2	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	1.5	3.1	46	45	-	-
1,1-Dichloroethene	-	-	-	-	5.6	10	26	32	-	-
1,2-Dichloroethane	-	-	-	-	2.1	3.0	7.8	7.6	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-		
cis-1,2-Dichloroethene	7.6	24	12000	26000	-	-	3.5	4.4	-	-
1,2-Dichloropropane	-	-	420	-	-	-	-	-	-	-
2-Hexanone	-	-	2100	-	-	-	-	-		
Acetone	-	-	50000	21000	-	-	-	-		
Benzene	-	-	54	-	-	-	-	-	-	-
Carbon tetrachloride	-	-	-	-	14	9.3	-	-	-	-
Chloroform	-	-	-	-	4.0	2.6	-	-	-	-
Dichloromethane	-	-	-	-	-	9.5	39	53	-	-
Ethylbenzene	-	-	150	190	-	-	-	-	-	-
Hexachlorobutadiene									-	-
Methyl isobutyl ketone	-	-	350000	62000	-	-	-	-		
Methyl ethyl ketone	-	-	38000	14000	-	-	-	-		
Tetrachloroethene	-	-	30	-	-	-	-	-	-	-
Toluene	-	-	64000	36000	-	-	-	-	-	-
Trichloroethene	74	310	49000	26000	4.7	9.4	16	30	-	-
Vinyl acetate	-	-	-	-	-	-	-	-		
Xylenes	-	-	580	710	-	-	-	-	-	-

- Not detected
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TABLE 4-15
(CONTINUED)
TILL GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-23t		MW-24t		MW-25t		MW-26t		MW-27t	
Date	08/28/91	01/09/92	08/28/91	01/09/92	08/28/91	01/08/92	08/28/91	01/09/92	01/07/92	04/21/92
Sample ID	35991082829	31392010943	35991082830	31392010944	35991082831	31392010831	35991082832	31392010945	31392010721	35192042111
Parameter (ug/l)										
1,1,1-Trichloroethane	18	36	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	2.5	-	-	-	-	-	-	730	-	-
1,1-Dichloroethene	14	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-		
cis-1,2-Dichloroethene	200	40	-	-	-	-	-	3100	-	-
1,2-Dichloropropane	-	-	-	-	4.1	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-	-	-		
Acetone	-	-	-	-	-	-	-	-		
Benzene	-	-	-	-	-	2	-	-	-	-
Carbon tetrachloride	-	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	1100	-	-
Ethylbenzene	1.3	-	-	-	3.3	4.1	-	220	-	-
Hexachlorobutadiene									-	-
Methyl isobutyl ketone	-	-	-	-	-	-	-	-		
Methyl ethyl ketone	-	-	-	-	-	-	-	-		
Tetrachloroethene	28	48	-	-	-	-	-	720	-	-
Toluene	36	23	-	-	190	430	7500	10000	-	-
Trichloroethene	43000	120000	4.2	38	11	-	540000	800000	-	-
Vinyl acetate	-	-	-	-	-	-	-	-		
Xylenes	2.8	-	-	-	9.7	10	-	1200	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-15
(CONTINUED)
TILL GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-28t	MW-29t	MW-30ts	MW-30td	MW-EPAAts		MW-EPAAtd	
Date	04/21/92	04/21/92	04/21/92	04/21/92	07/25/90	12/10/90	06/12/91	01/08/92
Sample ID	35192042105	35192042101	35192042107	35192042106	31390072518	31390121025	31391061215	31392010836
Parameter (ug/l)								
1,1,1-Trichloroethane	-	-	-	-	-	49	-	-
1,1,2-Trichloroethane	-	-	-	-	-	23	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	22	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-
1,2-Dichloroethene			-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	110	37
1,2-Dichloropropane	-	-	-	-	-	-	-	-
2-Hexanone			-	-	-	-	-	-
Acetone			-	-	-	-	-	-
Benzene	-	-	-	-	-	-	-	-
Carbon tetrachloride	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-
Hexachlorobutadiene	-	-			250			
Methyl isobutyl ketone			-	-	-	-	-	-
Methyl ethyl ketone			-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	21	-	-
Toluene	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	-	50200	32000	750	78
Vinyl acetate			-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-16

SHALLOW BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-1sb		MW-5sb					MW-6sb	
Date	06/13/91	01/08/92	09/10/87	10/20/87	07/24/90	07/24/90DUP	12/04/90	07/25/90	12/07/90
Sample ID	31391061317	31392010832	MW5870910	MW5871020	31390072403	31390072403	31390120403	31390072522	31390120722
Parameter (ug/l)									
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	11
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-			-	-	-	-	-
1,2-Dichloroethene	-							-	58
cis-1,2-Dichloroethene	4.9	2.7			-	-	-	48	-
1,2-Dichloropropane	-	-	-	-	-	-	-	12	24
2-Hexanone	-							-	-
Acetone	-							140	-
Benzene	-	-			-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-			-	-	-	-	-
Hexachlorobutadiene	-	-			-	-	-	50	
Methyl isobutyl ketone	-							-	-
Tetrachloroethene	-	-	-	-	-	-	-	-	12
Toluene	-	-			-	-	-	-	-
Trichloroethene	50	51	-	-	-	-	-	990	5400
Xylenes	-	-			-	-	-	-	-

- Not detected
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TABLE 4-16
(CONTINUED)
SHALLOW BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-7sb					MW-8sb				
Date	09/10/87	10/20/87	02/19/88	07/24/90	12/06/90	09/10/87	10/20/87	02/19/88	07/24/90	12/05/90
Sample ID	MW7870910	MW7871020	MW7880219	31390072413	31390120615	MW8870910	MW8871020	MW8880219	31390072411	31390120510
Parameter (ug/l)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene				-	-				-	-
1,2-Dichloroethene										
cis-1,2-Dichloroethene				0.7	-				-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-
2-Hexanone										
Acetone										
Benzene				-	-				-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene				-	-				-	-
Hexachlorobutadiene				-	-				-	-
Methyl isobutyl ketone										
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene				-	-				-	-
Trichloroethene	-	237	128	12	2.7	-	36.0	308	11	12
Xylenes				-	-				-	-

- Not detected
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TABLE 4-16
(CONTINUED)
SHALLOW BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-9sb					MW-10sb		MW-11sb	
Date	09/10/87	10/20/87	02/19/88	07/25/90	12/06/90	07/25/90	12/10/90	07/23/90	12/05/90
Sample ID	MW9870910	MW9871020	MW9880219	31390072520	31390120617	31390072524	31390121028	31390072308	31390120508
Parameter (ug/l)									
1,1,1-Trichloroethane	4.5	5.9	-	-	-	-	59	-	-
1,1-Dichloroethane	-	-	-	-	-	-	120	-	-
1,1-Dichloroethene				-	-	-	93	-	-
1,2-Dichloroethene				-	-	-	4100		
cis-1,2-Dichloroethene				3.8	2.3	5230	-	1.6	3.8
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-
2-Hexanone				-	-	-	950		
Acetone				160	-	-	3400		
Benzene				-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	200	120	-	-
Ethylbenzene				-	-	150	230	-	-
Hexachlorobutadiene								-	-
Methyl isobutyl ketone				-	-	1180	-		
Tetrachloroethene	1.4	-	-	-	-	-	140	-	-
Toluene				-	-	5120	7800	-	-
Trichloroethene	585	541	1920	117	160	43000	51000	17	41
Xylenes				-	-	480	640	-	-

- Not detected
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TABLE 4-16
(CONTINUED)
SHALLOW BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-12sb			MW-14sb		MW-15sb		MW-16sb		MW-17sb	
Date	07/24/90	12/05/90	04/21/92	07/24/90	12/05/90	06/11/91	01/06/92	06/13/91	01/09/92	06/12/91	01/08/92
Sample ID	31390072414	31390120511	35192042115	31390072412	31390120509	31391061108	31392010615	31391061321	31392010942	31391061213	31392010829
Parameter (ug/l)											
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	5.2
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene						-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	6.7	0.6	-	-	2.2	19	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-	-
2-Hexanone						-	-	-	-	-	-
Acetone						-	-	93	-	-	120
Benzene	-	-	-	-	-	-	-	-	-	-	-
Dichloromethane	-	-	-	-	-	-	-	-	-	-	5.9
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobutadiene	-	-	-	-	-		-				
Methyl isobutyl ketone								29	-	-	-
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	11	14	-	-
Trichloroethene	0.8	-	-	6.4	0.6	-	8.1	9.9	110	-	4.3
Xylenes	-	-	-	-	-	-	-	-	-	-	-

- Not detected
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TABLE 4-16
(CONTINUED)
SHALLOW BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-18sb		MW-19sb		MW-20sb		MW-27sb			MW-28sb	MW-29sb
Date	06/12/91	01/03/92	06/11/91	01/03/92	06/11/91	01/03/92	01/07/92	01/07/92DUP	04/21/92	04/21/92	04/21/92
Sample ID	31391061209	31392010309	31391061105	31392010312	31391061102	31392010308	31392010718	31392010724	35192042110	35192042103	35192042102
Parameter (ug/l)											
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene											
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-	-
2-Hexanone											
Acetone		79					230	150	93		
Benzene	-	-	-	-	-	-	-	-	-	-	0.84
Dichloromethane	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobutadiene	-	-	-	-	-	-	-	-	-	-	-
Methyl isobutyl ketone											
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-	-	5.7
Trichloroethene	-	-	28	3.6	0.6	0.6	39	20	20	-	-
Xylenes	-	-	-	-	-	-	-	-	-	-	-

- Not detected
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TABLE 4-16
(CONTINUED)
SHALLOW BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-EPAAsb										
Date	06/12/91	01/08/92									
Sample ID	31391061216	31392010835									
Parameter (ug/l)											
1,1,1-Trichloroethane	-	-									
1,1-Dichloroethane	-	-									
1,1-Dichloroethene	-	-									
1,2-Dichloroethene	-	-									
cis-1,2-Dichloroethene	-	-									
1,2-Dichloropropane	-	-									
2-Hexanone	-	-									
Acetone	-	62									
Benzene	-	-									
Dichloromethane	-	-									
Ethylbenzene	-	-									
Hexachlorobutadiene											
Methyl isobutyl ketone	-	-									
Tetrachloroethene	-	-									
Toluene	-	-									
Trichloroethene	5.2	3.1									
Xylenes	-	-									

- Not detected
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TABLE 4-17

DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	GW-10db						GW-12db		
Depth (ft)	68-98		100-130		290-230		95-135		
Date	07/13/90	12/21/90	07/13/90	12/21/90	07/13/90	12/21/90	07/16/90	07/16/90DUP	12/20/90
Sample ID	19290071302	31390122125	19290071303	31390122124	19290071304	31390122121	19290071602	19290071603	31390122018
Parameter (ug/l)									
1,1,1-Trichloroethane	-	-	22	-	-	-	-	-	-
1,1,2-Trichloroethane	3.3	-	-	-	-	-	-	-	-
1,1-Dichloroethane	72	-	59	-	67	49	8.2	6.8	6.4
1,1-Dichloroethene	44	-	21	-	60	43	3.2	3.2	2.9
1,2-Dichloroethane	2.8	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	3200	-	4000	-	6800	-	-	540
cis-1,2-Dichloroethene	3700	-	4700	-	15000	-	670	660	-
trans-1,2-Dichloroethene	9.2	-	-	-	37	-	11	10	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-	-	70	-	-	-
Acetone	210	-	-	-	-	-	68	51	-
Benzene	3.5	-	-	-	-	-	-	-	-
Carbon disulfide	-	-	12	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-
Ethylbenzene	98	-	96	-	120	110	-	-	1.6
Methyl Isobutyl Ketone	150	-	139	-	92	-	-	-	-
Tetrachloroethene	51	-	57	-	-	65	5.4	5.2	8.0
Toluene	2100	1700	1900	1800	1800	1500	3.8	3.7	13
Trichloroethene	5100	33000	10800	34000	12500	43000	1400	1400	5500
Vinyl acetate	264	-	-	-	-	-	-	-	-
Vinyl chloride	10	-	-	-	-	-	-	-	-
Xylenes	270	345	270	310	760	500	2.8	2.6	7.7

- Not detected
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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-1db							
Depth (ft)	105-135	105-135	130-160		210-240		240-270	
Date	06/20/91	12/17/91	06/20/91	12/17/91	06/21/91	12/17/91	06/21/91	12/17/91
Sample ID	34391062001	31391121701	34391062004	31391121702	34391062105	31391121703	34391062106	31391121705
Parameter (ug/l)								
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	18	28	39	25	17	24	21	26
trans-1,2-Dichloroethene	-	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-	-	-
Acetone	-	-	-	-	-	-	-	-
Benzene	2.4	-	12	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-
Methyl Isobutyl Ketone	-	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-	-	-
Toluene	4.0	17	23	51	11	16	6.2	19
Trichloroethene	250	380	550	350	270	360	340	360
Vinyl acetate	-	-	-	-	-	-	-	-
Vinyl chloride	-	-	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-6db						MW-8db					
Depth (ft)	GRAB	40-70	81-111	81-111	120-150	150-180	30-70		87-127		160-200	
Date	01/08/92	07/08/91	07/08/91	07/08/91DUP	07/09/91	07/09/91	07/01/91	12/19/91	07/01/91	12/19/91	07/02/91	12/19/91
Sample ID	31392010830	34391070850	34391070846	34391070847	34391070951	34391070952	34391070137	31391121908	34391070138	31391121909	34391070240	31391121911
Parameter (ug/l)												
1,1,1-Trichloroethane	-	-	5.0	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	2.1	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-						
cis-1,2-Dichloroethene	150	140	190	150	180	100	0.6	0.5	-	-	0.7	-
trans-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane	24	-	36	-	33	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-						
Acetone	-	-	-	-	-	-						
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-						
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	11	-	9.7	-	32	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-
Methyl Isobutyl Ketone	-	-	-	-	-	-						
Tetrachloroethene	7.0	-	8.3	-	-	-	-	-	-	-	-	-
Toluene	-	-	11	-	140	22	140	87	14	17	37	11
Trichloroethene	2900	2300	2400	2800	3100	890	13	7.8	6.4	6.3	9.9	2.5
Vinyl acetate	-	-	-	-	-	-						
Vinyl chloride	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	5.3	-	-	-	8.9	-

- Not detected
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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-11db				MW-12db								
Depth (ft)	52-92	52-92	160-200		45-65		85-105		135-155		160-200	160-200	
Date	07/05/91	12/26/91	08/05/91	12/26/91	07/11/90	12/18/90	07/11/90	12/18/90	07/11/90	12/18/90	07/11/90	12/18/90	12/18/90DUP
Sample ID	34391070543	31391122617	34391070544	31391122619	19290071104	31390121810	19290071103	31390121809	19290071102	31390121807	19290071101	31390121806	31390121808
Parameter (ug/l)													
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-									
cis-1,2-Dichloroethene	17	26	75	34	-	-	-	-	-	-	-	-	-
trans-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-									
Acetone	-	-	-	-									
Benzene	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon disulfide	-	-	-	-									
Chloroform	-	-	-	-	-	3.7	-	2.6	-	-	-	-	-
Chloromethane	-	-	63	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-	-	9.9	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
Methyl Isobutyl Ketone	-	-	-	-									
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	22	14	31	-	132	8.6	100	6.0	88	1.8	155	-	-
Trichloroethene	61	140	310	190	-	-	-	-	-	-	-	-	-
Vinyl acetate	-	-	-	-									
Vinyl chloride	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-	-	-	-	15	-	-

- Not detected
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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-13db						
Depth (ft)	60-80		160-180		210-230		
Date	07/12/90	12/19/90	07/12/90	12/19/90	07/12/90	07/12/90DUP	12/19/90
Sample ID	19290071205	31390121916	19290071204	31390121915	19290071202	19290071203	31390121912
Parameter (ug/l)							
1,1,1-Trichloroethane	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	-
trans-1,2-Dichloroethene	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-	-
Acetone	-	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-
Methyl Isobutyl Ketone	-	-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-	-
Toluene	59	17	71	21	38	37	30
Trichloroethene	-	-	4.7	-	4.5	22	-
Vinyl acetate	-	-	-	-	-	-	-
Vinyl chloride	-	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Well ID	MW-14db						MW-15db			
	Depth (ft)	40-70	40-70	80-110		170-200		GRAB	155-255	255-305	
	Date	07/10/90	12/17/90	07/10/90	12/17/90	07/10/90	12/17/90	01/07/92	06/21/91	06/24/91	06/24/91DUP
	Sample ID	19290071003	31390121703	19290071002	31390121702	19290071001	31390121701	31392010723	34391062109	34391062410	34391062411
Parameter (ug/l)											
1,1,1-Trichloroethane		-	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane		-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane		-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene		-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane		-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene								-	-	-	-
cis-1,2-Dichloroethene		-	-	-	-	-	-	-	30	19	37
trans-1,2-Dichloroethene		-	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane		-	-	-	-	-	-	-	-	-	-
2-Hexanone								-	-	-	-
Acetone								-	-	-	-
Benzene		-	-	-	-	-	-	-	-	-	-
Carbon disulfide								-	-	-	-
Chloroform		-	-	-	-	-	-	-	-	-	-
Chloromethane		-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane		-	-	-	-	-	-	-	-	-	-
Ethylbenzene		-	-	-	-	-	-	-	-	-	-
Methyl Isobutyl Ketone		-	-					-	-	-	-
Tetrachloroethene		-	-	-	-	-	-	-	-	-	-
Toluene		18	-	37.6	-	45.6	-	-	-	4.1	7.1
Trichloroethene		-	1.0	1.6	1.2	3.5	2.6	24	320	210	310
Vinyl acetate								-	-	-	-
Vinyl chloride		-	-	-	-	-	-	-	-	-	-
Xylenes		-	-	-	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-17db						MW-18db					MW-18db	
Depth (ft)	GRAB	83-123	180-200	250-290		300-340	70-100		130-160			160-190	
Date	01/07/92	06/27/91	06/27/91	06/27/91	06/27/91DUP	06/28/91	06/28/91	12/27/91	07/01/91	12/27/91	12/27/91DUP	07/01/91	12/27/91
Sample ID	31392010726	34391062723	34391062724	34391062725	34391062728	34391062829	34391062831	31391122723	34391070134	31391122724	31391122726	34391070135	31391122725
Parameter (ug/l)													
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	5.3	1.8	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	1.6	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-	-	-							
cis-1,2-Dichloroethene	600	30	160	780	750	1000	1.0	-	0.7	-	-	0.9	-
trans-1,2-Dichloroethene	-	-	-	-	-	8.0	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-							
Acetone	-	-	-	-	-	-							
Benzene	-	29	-	-	-	-	0.8	-	-	-	-	-	-
Carbon disulfide	-	-	-	-	-	-							
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-	-	67	-	-	4.8	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	1.7	-	-	-	-	8.5	-	-	-	-	-	-	-
Methyl Isobutyl Ketone	-	-	-	-	-	-							
Tetrachloroethene	5.3	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	6.4	-	-	-	-	110	45	31	27	5.7	5.2	33	9.9
Trichloroethene	3500	350	1600	5100	5200	2900	8.4	0.6	8.4	-	-	9.1	-
Vinyl acetate	-	-	-	-	-	-							
Vinyl chloride	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes	7.0	-	-	-	-	27	3.7	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-21db				MW-22db								
Depth (ft)	70-200	170-200	280-310		35-75			80-120	80-120	140-180		185-225	
Date	06/26/91	12/23/91	06/26/91	12/23/91	06/25/91	12/30/91	12/30/91DUP	06/25/91	12/30/91	06/25/91	12/30/91	06/25/91	12/30/91
Sample ID	34391062619	31391122314	34391062620	31391122315	34391062513	31391123027	31391123029	34391062514	31391123030	34391062515	31391123031	34391062516	31391123032
Parameter (ug/l)													
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene	-	-	-	-									
cis-1,2-Dichloroethene	490	310	520	370	-	-	-	-	-	-	-	-	-
trans-1,2-Dichloroethene	8.0	6.4	7.4	4.7	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-									
Acetone	-	-	-	-									
Benzene	-	-	-	-	-	-	-	-	-	1.7	-	-	-
Carbon disulfide	-	-	-	-									
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
Methyl Isobutyl Ketone	-	-	-	-									
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	24	93	17	79	160	86	78	15	69	-	35	2.0	8.0
Trichloroethene	1700	1200	1700	1200	3.2	1.6	1.4	0.8	0.8	-	-	-	-
Vinyl acetate	-	-	-	-									
Vinyl chloride	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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TABLE 4-17
(CONTINUED)
DEEP BEDROCK GROUND WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-27db	MW-28db				MW-29db				
Depth (ft)	GRAB	80-110	130-160	260-290	350-380	90-130	180-220	280-320		320-360
Date	01/06/92	04/28/92	04/28/92	04/28/92	04/29/92	04/30/92	04/30/92	05/01/92	05/01/92DUP	05/01/92
Sample ID	31392010616	37392042801	37392042802	37392042803	37392042905	37392043008	37392043009	37392050110	37392050113	37392050112
Parameter (ug/l)										
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethene										
cis-1,2-Dichloroethene	-	3.3	2.9	4.6	6.0	2.2	2.6	2.0	2.0	2.1
trans-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-	-	-	-	-
2-Hexanone										
Acetone										
Benzene	-	-	-	-	-	-	-	-	-	-
Carbon disulfide										
Chloroform	-	-	-	-	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	-
Methyl Isobutyl Ketone										
Tetrachloroethene	-	-	-	-	-	-	-	-	-	-
Toluene	-	72	53	21	23	7.0	17	54	54	46
Trichloroethene	17	49	47	77	84	34	31	27	27	28
Vinyl acetate										
Vinyl chloride	-	-	-	-	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.

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close to Zone 1, the former dry well area. Detected TCE concentrations across the study area ranged from 0.06 ug/l (MW-20sb, MW-18db) to 800,000 ug/l (MW-26t); detected toluene concentrations ranged from 1.8 ug/l (MW-12db) to 64,000 ug/l (MW-16t) as indicated in Tables 4-15, 4-16, and 4-17. MW-26t is located immediately east of the facility in Zone 1 and was installed at a 63 degree angle to intercept the soil and ground water underneath the facility. MW-16t is located immediately north of the facility.

VOC concentrations during individual sampling events are comparable with the exception of MW-4t. No VOCs were detected at this location during October 1987; however, TCE and other VOCs were subsequently detected at elevated concentrations during later sampling events. The initial non-detect likely was the result of residual drilling water introduced during well installation that could not be completely purged from the formation during well development due to the extremely low hydraulic conductivity of the till.

Other chlorinated and aromatic VOCs were detected as indicated in the tables. Significant concentrations of acetone and dichloromethane were reported in several ground-water samples. The data for some of these samples will be validated to determine if laboratory contamination is a possible source of these compounds.

Discussion

The reported use of the dry well for waste disposal has been confirmed by soil sampling conducted in Zone 1 (former dry well, former paint settling booth and area east of facility) as

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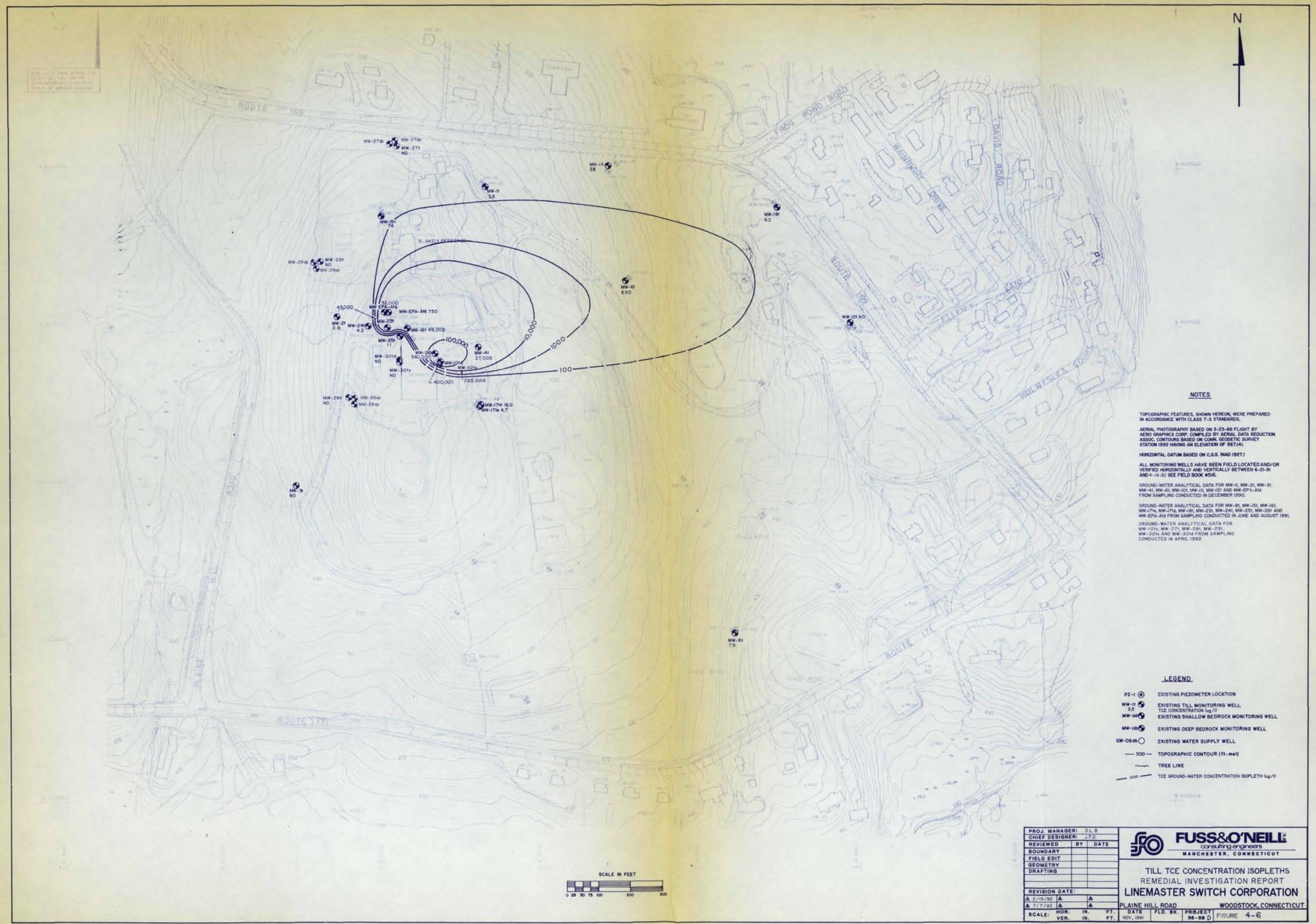
discussed in Section 4.1.1.1. The soils at potential source areas, Zone 2 (former facility wastewater disposal system), Zone 3 (former Blakely leaching field), and Zone 4 (paint shed area) are not significant sources of VOC contamination as discussed in Section 4.1.1. Relatively low levels of VOCs were detected in the soil at these locations and are attributed to ground-water transport from Zone 1.

Till

VOCs, mainly TCE, are being transported from the Zone 1 source area to the northwest, north, northeast, east, southeast, and southwest in the till unit as shown on Figure 4-6 and in Table 4-15. The primary direction of ground-water transport for TCE and other VOCs in the till unit is to the east-northeast following the natural hydraulic gradient as indicated on Figures 3-6, 3-7 and 4-6. In addition, the bedrock may exert some control and influence ground-water flow and VOC transport in the till unit. Ground-water flow in deep portion of the till appears to be influenced by the bedrock surface topography as discussed in Section 3.3.2.1. The north-south oriented bedrock trough shown on Figure 3-5 may direct ground-water flow in the deep portion of the till to the northeast and thus assist transport of aqueous phase VOCs in that direction. This trough could also influence the migration of DNAPLs if present; however, no DNAPLs have been found at the site to date.

As can be seen in Table 4-15, elevated concentrations of total VOCs (summation of individual VOC detections) were found at MW-10td (420,507 ug/l) and MW-26t (817,070 ug/l). MW-10td is located downgradient and within 10 feet of the former dry well location. MW-26t is an angled monitoring well with the screen



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

GROUND-WATER ANALYTICAL DATA FOR MW-1t, MW-2t, MW-3t, MW-4t, MW-6t, MW-10t, MW-1f, MW-12t AND MW-EPA-Ad FROM SAMPLING CONDUCTED IN DECEMBER 1990.

GROUND-WATER ANALYTICAL DATA FOR MW-8t, MW-15t, MW-16t, MW-17ts, MW-17td, MW-18t, MW-23t, MW-24t, MW-25t, MW-26t AND MW-EPA-Ad FROM SAMPLING CONDUCTED IN JUNE AND AUGUST 1991.

GROUND-WATER ANALYTICAL DATA FOR MW-10s, MW-27; MW-28t, MW-29t, MW-30s AND MW-30d FROM SAMPLING CONDUCTED IN APRIL 1992

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-1t 3.5	EXISTING TILL MONITORING WELL TCE CONCENTRATION (ug/l)
MW-1ab	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-06db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
— 1000 —	TCE GROUND-WATER CONCENTRATION ISOPLETH (ug/l)

SCALE IN FEET

0 25 50 75 100 200 300

PROJ. MANAGER:	D.L.B.	
CHIEF DESIGNER:	J.T.O.	
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ 2/19/92	△	△
△ 7/7/92	△	△
SCALE: HOR.	IN.	FT.
VER.	IN.	FT.

FUSS&O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

TILL TCE CONCENTRATION ISOPLETHS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV. 1991		86-88 D	4-6

located underneath the Linemaster facility. The high VOC concentrations at these wells indicate that much of the contamination has remained in Zone 1 because of the low hydraulic conductivity of the till as discussed in Section 3.3.1.1. It is possible that DNAPLs may be present in these areas as indicated by the high VOC concentrations; however, no DNAPLs have been found to date.

Although MW-26t, screened at an angle beneath the Linemaster facility, is topographically higher than the former dry well area, MW-26t is located hydraulically downgradient of the former dry well area as indicated in Figures 3-6 and 3-7. Based on this, ground water flows from the former dry well area to MW-26t. Therefore, the VOCs detected at MW-26t have originated from the former dry well area. The natural ground-water conditions at the former dry well area may be influenced by the building. The building acts as a cap or barrier to precipitation and prevents infiltration to the sediments underlying the facility. This would have the effect of creating an area of relatively lower hydraulic potential underneath the building. Ground water from "uncapped" areas adjacent to the facility would tend to flow toward the areas of low hydraulic potential under the facility. The VOCs at MW-26t probably migrated from the area of the former dry well due to this condition, as suggested by the ground-water contours shown in Figures 3-6 and 3-7.

Ground-water migration to the area underneath the facility may also have occurred in the past due to drawdown in the till unit caused by the pumping of GW-10db, the former backup facility production well located underneath the facility. The drawdown in the till unit may have been due to a natural hydraulic connection or a leaky well casing at GW-10db. The seal and integrity of

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this well are questionable because the well was installed at least 30 years ago and construction information is lacking. If the seal of this well is leaking, water may have been drawn from the till unit in addition to the bedrock unit. Since June 1992, GW-10db has served as an extraction well for the deep bedrock ground-water extraction and treatment being conducted, as part of an Interim Removal Action. Monitoring data collected from Zone 1 till wells during operation of the system do not indicate a significant hydraulic connection between the bedrock and the till in this area; however, it is possible that the pumping has not been performed for a sufficient period of time. The drawdown in the till will continue to be evaluated as part of the Interim Removal Action Monitoring.

Migration of ground water from Zone 1 to beneath the facility may also have been caused by ground-water mounding associated with former discharges into the dry well. If mounding occurred, which is likely due to the low hydraulic conductivity of the till, the flow of VOC-contaminated ground water toward the building may have been facilitated.

VOCs, after migrating from Zone 1 to underneath the building, may have migrated to the Zone 4 area on the opposite side of the building as indicated by the ground-water contours on Figures 3-6 and 3-7 and by the VOCs present in ground water at MW-16t, MW-23t, and MW-EPA-Ats. Ground-water migration from underneath the building to Zone 4 may have been facilitated in the past by the pumping of GW-10db. This may have caused migration of contaminants in the till unit from the Zone 1 source area into the GW-10db cone of depression under the building, as discussed above, and consequently to the northwest corner of the facility where the paint shed is located. TCE has been detected

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at GW-10db (33,000 ug/l) at similar concentrations found at MW-23t (43,000 ug/l), MW-EPA-Ats (32,000 ug/l) and MW-16t (49,000 ug/l). The natural hydraulic gradient may influence VOC migration in the area west of the facility. The till ground-water elevation is higher at MW-25t than at MW-23t, indicating a ground-water flow potential from southeast to north across this area. MW-25t is not in the center of the VOC ground-water plume; however, it may be located on the plume edge as indicated by the low levels of VOCs found in the ground water at this well. Although sand lenses or stringers were not intercepted during the installation of till wells MW-23t and MW-25t, preferential flow of VOC-contaminated ground water through such or similar features may also explain the presence of VOCs at MW-23t and the absence of VOCs at MW-25t.

Elevated concentrations of methyl ethyl ketone (MEK) and methyl isobutyl ketone (MIBK) were detected at MW-16t, located immediately adjacent to the northwest corner of the facility. MEK and MIBK were detected at concentrations of 14,000 ug/l and 62,000 ug/l, respectively, in a ground-water sample collected on January 9, 1992. These compounds were not detected in ground-water samples collected from MW-10ts and MW-10td, wells located adjacent to the former dry well area, as indicated in Table 4-15. However, these compounds were detected in deep soil samples collected adjacent to the location of the former dry well as indicated in Figures 4-5 and 4-6. This suggests that MEK and MIBK may have been discharged into the dry well and have subsequently migrated away from the area. It is also possible that these compounds were discharged at some other area adjacent to the facility. Another possible historical discharge area of MEK and MIBK is the former paint settling booth as shown on Figure 2-3. These compounds are present in certain types of

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paint thinners that may have been discharged as paint mist into the settling booth; however, historical chemical use information (Table 1-1) does not suggest that these compounds were present in paint thinners used by Linemaster. Phase 1B soil sampling at the booth area did not detect any MEK or MIBK as discussed in Section 4.1.1.1; however, the sampling was conducted at shallow depths where the former discharges may have since volatilized. These compounds were detected at greater depths from Phase 1B soil sampling in the area adjacent to the booth as indicated in Figures 4-5 and 4-6.

VOCs, primarily TCE, have been transported to other till areas of the site by the natural horizontal hydraulic gradient. The presence of VOCs at MW-8t and MW-11t may be related to bedrock discharge to the overlying till. MW-8t and MW-11t are located in areas where there is an upward ground-water potential from the bedrock to the till unit as indicated in Table 3-9. As a result, the bedrock likely discharges to the till unit at these locations. Detected VOC concentrations in the bedrock ground water in these areas are greater than the concentrations detected in the till unit. This may be explained by bedrock discharge and subsequent dilution from nearby till ground water.

Shallow Bedrock

VOCs, mainly TCE, are being transported from the Zone 1 source area to the northwest, north, northeast, east and southeast in the shallow bedrock unit as shown on Figure 4-7 and in Table 4-16. The primary transport direction of VOCs in the shallow bedrock is to the east-northeast, parallel to the ground-water flow direction as shown on Figures 3-8, 3-9 and 4-7. The highest concentration of total VOCs was found at MW-10sb

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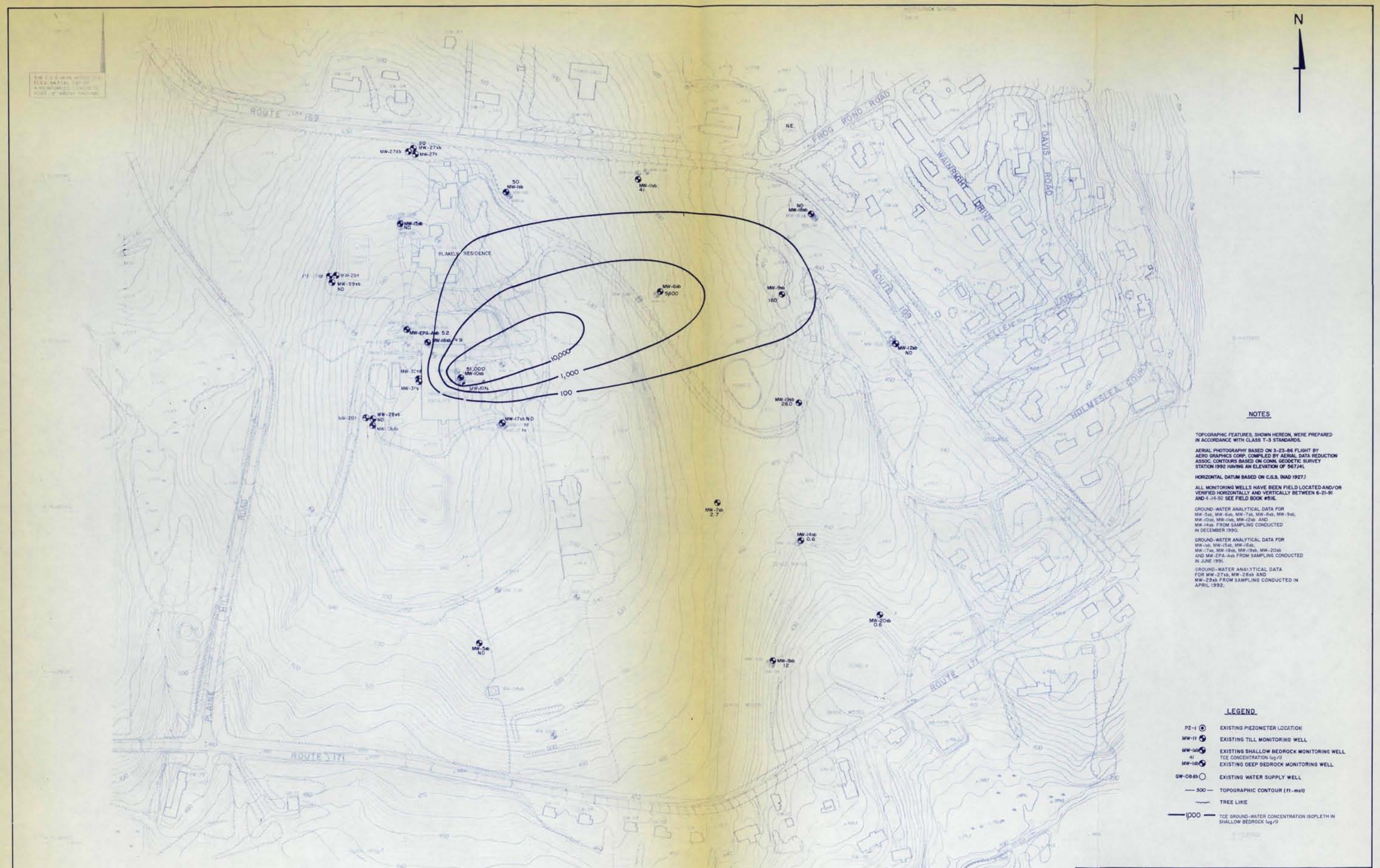

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.74.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

GROUND-WATER ANALYTICAL DATA FOR MW-5sb, MW-6sb, MW-7sb, MW-8sb, MW-9sb, MW-10sb, MW-11sb, MW-12sb AND MW-14sb FROM SAMPLING CONDUCTED IN DECEMBER 1990.

GROUND-WATER ANALYTICAL DATA FOR MW-1sb, MW-15sb, MW-16sb, MW-17sb, MW-18sb, MW-19sb, MW-20sb AND MW-EPA-Aab FROM SAMPLING CONDUCTED IN JUNE 1991.

GROUND-WATER ANALYTICAL DATA FOR MW-27sb, MW-28sb AND MW-29sb FROM SAMPLING CONDUCTED IN APRIL 1992.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1sb 41	EXISTING SHALLOW BEDROCK MONITORING WELL TCE CONCENTRATION (ug/l)
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-084b	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
— 1000 —	TCE GROUND-WATER CONCENTRATION ISOPLETH IN SHALLOW BEDROCK (ug/l)

SCALE IN FEET

0 25 50 75 100 200 300

PROJ. MANAGER:	DLB	
CHIEF DESIGNER:	JTO	
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
7/13/92		
7/7/92		
SCALE: HOR. IN. FT. VER. IN. FT.		

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

SHALLOW BEDROCK
TCE CONCENTRATION ISOPLETHS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV. 1991		86-88 D	4-7

(68,652 ug/l). VOC migration to the east-northeast is indicated by the total VOC concentration at MW-6sb (5,447 ug/l); this concentration is significantly higher than found in the till ground water at MW-6t (696.9 ug/l). This is probably due to the higher ground-water migration rate in shallow bedrock than in the till as discussed in Section 3.3. It is also probably due to a higher retardation rate in the till than in the shallow bedrock. The north-south oriented bedrock trough shown on Figure 3-5 may assist VOC transport to the northeast in the shallow bedrock. This trough could influence the migration of DNAPLS if present; however, no DNAPLs have been detected at the site to date.

Deep Bedrock

TCE and VOCs are being transported radially in deep bedrock ground water from the Zone 1 source area with several preferential directions of migration as shown on Figure 4-8 and in Table 4-17. The primary direction of VOC migration, toward the east-northeast, is parallel to the ground-water flow direction as shown on Figures 3-10, 3-11 and 4-8. The primary direction of VOC migration also appears to coincide with the two major fracture traces identified and discussed in Section 3.1.2.3. This may explain the presence of VOCs at MW-6db, MW-11db, and GW-40db. Preferential ground-water flow through fractures may also explain the trace levels of VOCs detected at GW-04, GW-07db, GW-14, and GW-29. Preferential ground-water flow within the easterly dipping schist fracture planes may also be a factor contributing to the northeasterly migration of the ground-water VOC plume. The north-south oriented bedrock trough east of the facility, shown in Figure 3-5, may be influencing ground-water flow in the till and shallow bedrock; however, it is not believed to exert a significant influence on deep bedrock

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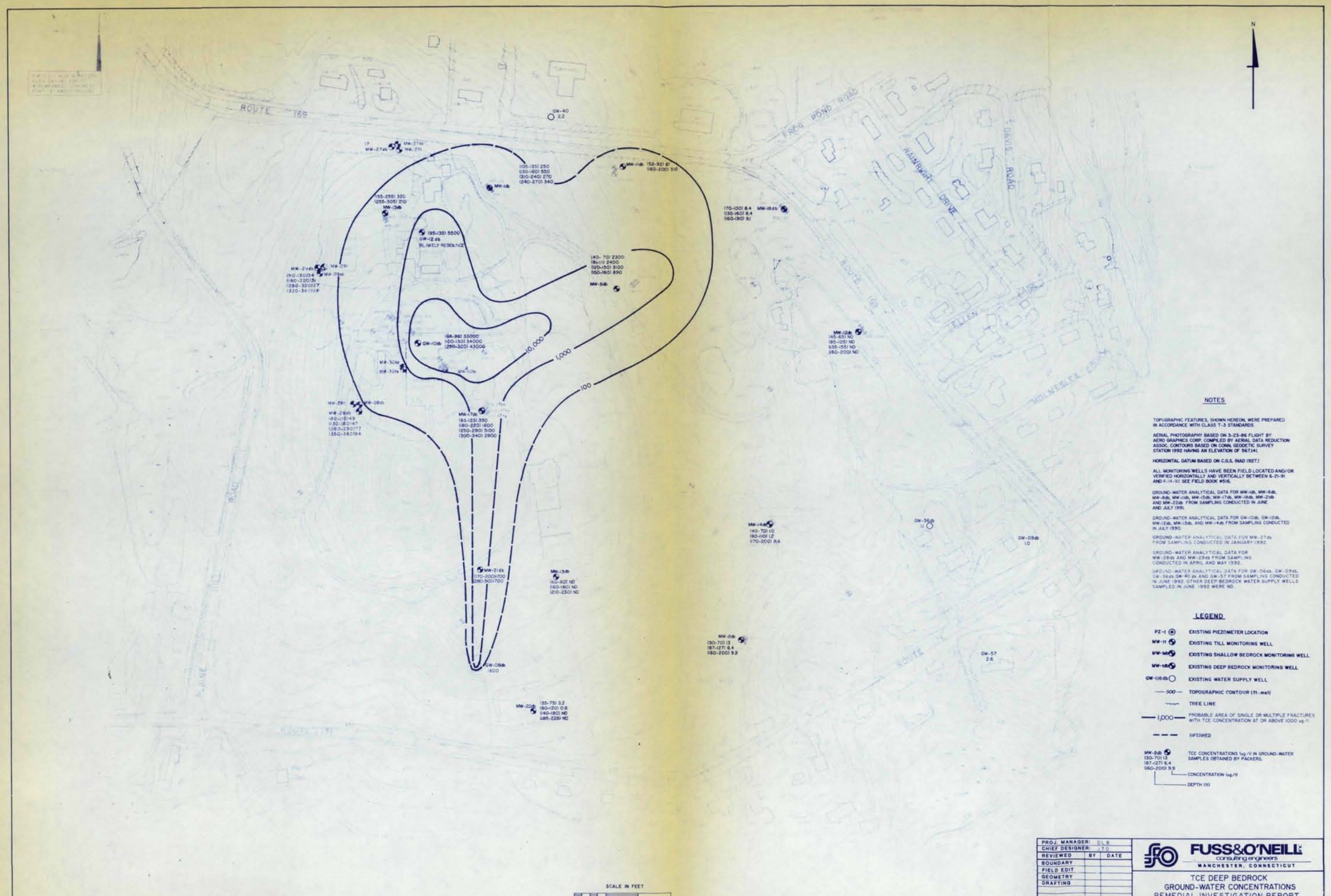

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

GROUND-WATER ANALYTICAL DATA FOR MW-4db, MW-6db, MW-8db, MW-10db, MW-15db, MW-17db, MW-18db, MW-21db AND MW-22db FROM SAMPLING CONDUCTED IN JUNE AND JULY 1991.

GROUND-WATER ANALYTICAL DATA FOR GW-10db, GW-12db, MW-12db, MW-13db, AND MW-14db FROM SAMPLING CONDUCTED IN JULY 1990.

GROUND-WATER ANALYTICAL DATA FOR MW-27db FROM SAMPLING CONDUCTED IN JANUARY 1992.

GROUND-WATER ANALYTICAL DATA FOR MW-28db AND MW-29db FROM SAMPLING CONDUCTED IN APRIL AND MAY 1992.

GROUND-WATER ANALYTICAL DATA FOR GW-06db, GW-09db, GW-36db, GW-40 db AND GW-57 FROM SAMPLING CONDUCTED IN JUNE 1992. OTHER DEEP BEDROCK WATER-SUPPLY WELLS SAMPLED IN JUNE 1992 WERE ND.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1db	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-06db	EXISTING WATER SUPPLY WELL
500	TOPOGRAPHIC CONTOUR (ft.-msl)
	TREE LINE
1,000	PROBABLE AREA OF SINGLE OR MULTIPLE FRACTURES WITH TCE CONCENTRATION AT OR ABOVE 1000 ug/l.
	INFERRED
MW-8db (30-70) 13 (87-127) 6.4 (160-200) 9.9	TCE CONCENTRATIONS (ug/l) IN GROUND-WATER SAMPLES OBTAINED BY PACKERS. CONCENTRATION (ug/l) DEPTH (ft)

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ FEB. 1992	△ OCT. 1992	△
△ JULY 7, 1992	△	△
SCALE:		

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

TCE DEEP BEDROCK
GROUND-WATER CONCENTRATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV. 1991		86-88 H	4-8

ground-water flow.

High levels of VOCs have been detected at the Linemaster backup production well (GW-10db) since 1986. Concentrations of TCE have ranged from 5,100 ug/l to 58,000 ug/l. High concentrations of trans-1,2-dichloroethene and toluene were also detected at this well. Moderate levels of VOCs have also been detected at GW-08db, the facility production well south of the facility, and at GW-12db, the Blakely residence former supply well, located north of the facility. VOC migration within the deep bedrock to these wells was likely induced and facilitated by pumping. The pumping of GW-08db affects the aquifer in the area of the facility as discussed in Section 3.3.2.3 and in the background water-level study included in Appendix I. VOCs have migrated in a southerly direction within the deep bedrock from the Zone 1 area to GW-08db as indicated by the presence of VOCs in MW-17db and MW-21db and the absence of TCE in MW-13db. Historical pumping of GW-12db has drawn the VOC plume to the north as indicated by the detection of TCE at MW-1db and MW-15db. VOCs in the deep bedrock are found at greater distances from the source area than in the till and shallow bedrock. This is likely due to the generally higher hydraulic conductivity and water transmitting capabilities of the fractured deep bedrock as discussed in Section 3.3. In addition, on-site and off-site supply-well pumping may be a contributing factor.

4.3.2 ABNs

ABNs were detected in ground-water samples collected during Phase 1A investigations as summarized in the Revised Initial Site Characterization (ISC) Report (Fuss & O'Neill, 1992b). Similar conditions were found in the soil samples as discussed in Section

4.1.2. In the ISC report, it was hypothesized that the most frequently detected target compound list (TCL) ABNs, bis(2-ethylhexyl)phthalate and di-n-butylphthalate, were the result of laboratory contamination or cross contamination. This was based on: 1) the lack of historical chemical information documenting the use of these compounds at Linemaster; 2) The fact that the distribution of the detections at the site does not indicate a source area(s); and, 3) di-n-butylphthalate leaches from certain types of tubing and containers (Verschueren, 1983) which may be present in laboratories. To determine the accuracy of the data, a representative number of sample results with positive detections of these compounds were submitted for data validation as proposed in the Phase 1B Work Plan included in the Revised ISC Report (Fuss & O'Neill, 1992b).

Phase 1B investigations also consisted of limited ground-water sampling for ABNs. Samples were collected from MW-16t, MW-23t, MW-25t, and MW-26t, wells located in the vicinity of the paint shed area (Zone 4) and potentially downgradient of the former dry well and paint settling booth locations (Zone 1). Other representative locations were sampled including MW-17td, MW-1sb, and MW-27db.

Results

The analytical results were validated in accordance with U.S. EPA Region 1 data validation guidelines for organic analysis (U.S. EPA, 1988b). Validation identified laboratory method blank contamination. The data validation reports and validation summary tables are provided in Appendix Q; a summary of positive detections for validated and unvalidated sample results are provided in Table 4-18 for the till, shallow bedrock and deep

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TABLE 4-18

GROUND WATER - SUMMARY OF DETECTED ABNs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Well ID	MW-1sb		MW-4t	MW-6sb	MW-6t		MW-7sb	MW-16t	
	Depth (ft)									
	Date	06/13/91	01/08/92	07/26/90	07/25/90	07/25/90	07/25/90DUP	07/24/90	06/13/91	01/09/92
	Sample ID	31391061317	31392010832	31390072623	31390072522	31390072521	31390072525	31390072413	31391061318	31392010940
Parameter (ug/l)										
2-Methyl phenol		*	-	*	*	*	*	*	185*	-
4-Methyl phenol		*	-	*	*	*	*	*	129*	-
Benzoic acid		*	-	*	*	*	*	*	90J	-
Di-n-butyl phthalate		*	-	*	3J	*	*	*	3J	-
Hexachlorobutadiene		*	-	*	*	*	*	*	*	-

- Not detected
* Validated non-detect.
185* Data validated, no qualifers neccessary.
Data Validation Qualifiers
J Reported concentration is an estimated value.

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TABLE 4-18
(CONTINUED)
GROUND WATER - SUMMARY OF DETECTED ABNs

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-17db		MW-17td		MW-18sb	MW-23t	MW-25t	MW-26t	MW-27db
Depth (ft)	250-290	250-290							
Date	06/27/91	06/27/91DUP	06/12/91	01/08/92	06/12/91	01/09/92	01/08/92	01/09/92	01/06/92
Sample ID	34391062725	34391062725	31391061210	31392010828	31391061209	31392010943	31392010831	31392010945	31392010616
Parameter (ug/l)									
2-Methyl phenol	*	*	*	-	*	-	-	-	-
4-Methyl phenol	*	*	*	-	*	-	-	-	-
Benzoic acid	*	*	*	-	*	-	-	-	-
Di-n-butyl phthalate	*	*	*	-	*	-	-	-	-
Hexachlorobutadiene	*	*	*	-	*	-	-	-	-

- Not detected
* Validated non-detect.
185* Data validated, no qualifers neccessary.
Data Validation Qualifiers
J Reported concentration is an estimated value.

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bedrock ground water. All bis(2-ethylhexyl)phthalate and di-n-butylphthalate concentrations that were validated were reduced to ND after validation except for MW-16t and MW-6sb. Di-n-butylphthalate remained at concentrations of 3J ug/l (J-reported concentration is an estimated value) for both wells after validation. No di-n-butylphthalate was detected in the method blanks associated with MW-16t and MW-6sb; however, the concentrations are low in the environmental samples. The polynuclear aromatic (PNA) compounds detected at MW-16t were qualified as estimated at the reported values after validation.

No TCL ABNs were detected at any of the study area locations sampled during Phase 1B investigations as indicated in Table 4-18. The analytical results for these samples have not been validated.

Tentatively identified compounds (TIC) were not included in the tables due to limited importance at the site based on historical chemical information.

Discussion

Data validation established revised detection limits and qualified the concentrations of ABNs, thereby providing a more accurate representation of site conditions. All bis(2-ethylhexyl)phthalate and di-n-butylphthalate concentrations were revised to ND after validation except for two samples; concentrations of di-n-butylphthalate were estimated at 3 ug/l for the two samples. This compound is not considered a parameter of concern due to the low concentrations and the possibility that the detections are related to laboratory blank contamination.

The PNAs and benzoic acid detected in MW-16t may be related to former discharges; however, these parameters are of limited concern due to their one time detection and minimal area of occurrence. The PNA detections may be indicative of residual concentrations from a minor Danielson Oil Co. (3 to 5 gallons) fuel oil spill that had occurred in February 1986 (NUS, 1987). Alternately, the PNAs may be associated with a small loss of oil reportedly occurred during the excavation of a fuel oil tank pipe leading from the facility to a heating oil storage tank previously located directly west of the paint shed.

4.3.3 Metals

4.3.3.1 Overview

Analyses for metals in ground water in the study area have been performed because paint solid residue and other metal-containing waste have been generated by Linemaster as discussed in Section 1.4. During initial RI/FS investigations, analysis of ground-water samples for metals was generally limited to arsenic, because it was the only metal that was detected at concentrations exceeding the drinking water standard during the 1986 NUS site-screening investigations. During later Phase 1A RI/FS investigations, analyses were conducted for the HSL metals listed in Table 2-1 to determine if elevated concentrations of metals were present at the site. Analyses for calcium, cobalt, iron, potassium, sodium, strontium, and tin have infrequently been performed during RI/FS investigations. Analytical results for all ground-water samples collected and analyzed for either total or dissolved metals during RI/FS investigations are summarized in tabular form in Appendix S.

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Data Analysis

Due to the number of wells in the study area and the voluminous metals data, statistical analyses were performed to identify areas where the ground water may potentially have been impacted by metals contamination. Five wells, referred to as the background wells, were selected to establish naturally occurring concentrations of several metals in the ground water. Background metals concentrations in these wells were subsequently compared with metals concentration data from the remaining study area wells. Statistical analysis of the data from the background wells was performed to facilitate this evaluation.

For statistical analyses to be valid and meaningful, the data must be normally distributed. Cumulative frequency or probability plots of the analytical data were prepared for each metal data set to test the normal distributional assumption. As commonly observed in most environmental data, the metals data from both the background and study area wells were not normally distributed as indicated by the skewness in the probability plots (See Appendix S). (Note: The observed skewness or asymmetric distribution of the metal data sets is typical of environmental data sets when the mean is near zero, i.e. within one standard deviation, because concentration values can not be negative.) Furthermore, the normality of the data was evaluated using the coefficient-of-variation test for each metal data set. For most metal data sets, the coefficient-of-variation values exceeded 1.00, which generally indicate that the data are not normally distributed (Gilbert, 1987).

Because of the non-normal distribution, transformation of the data to obtain a normal distribution was performed by calculating

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the natural logarithm of each value. The linear relationship generally observed in the probability plots of the transformed data for each metal indicates that the data sets are indeed lognormally distributed. The normal distributional assumptions for performing statistical analysis of the metals data are satisfied after the logarithmic transformation.

Based on the transformed metals data from the five background wells, the mean, standard deviation, variance and other statistical parameters for each metal were determined. Non-detect data values were assigned numerical values equal to one-half the detection limit. To enable comparison of background metals concentrations with the study area monitoring well metals data, an upper tolerance limit was established for each background metal data set. The upper tolerance limit calculated for each metal defines the upper limit of the range of background data within which a specific proportion of the study area well observations should fall with a specific probability. Metals concentrations from the study area monitoring wells were compared to the upper tolerance limit determined for each metal from the background data set. When an individual monitoring well data value is greater than the upper tolerance limit, statistically significant evidence suggests that the data value has a small probability of being from the background population and alternatively, may be from a population with a greater mean. More simply, exceedances of the upper tolerance limits indicate that, relative to background concentrations, elevated concentrations of certain metals are likely present.

Total Versus Dissolved Metals Analysis

Within the scientific community at the present time, controversy

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exists regarding the appropriate sampling procedure for determining the most representative concentrations of metals migrating through an aquifer. Metals may migrate through porous and fractured media not only as dissolved species, but also as precipitated phases, polymeric species or as species adsorbed to colloidal-sized inorganic and organic particles (U.S. EPA, Puls and Barcelona, 1989). Analysis of unfiltered samples to determine total metals concentration results in reported concentrations that represent the sum of the soluble (dissolved) species and metals species adsorbed to suspended particles. The filtration of samples following collection, which is performed prior to analyzing for the concentration of dissolved metals, removes suspended particles greater than 0.45 microns. Filtration may also remove some mobile metals species and, therefore, may significantly underestimate the concentrations of mobile metal species present (U.S. EPA, 1989).

Puls and Barcelona (U.S. EPA, 1989) report that, due in the inaccuracies inherent to filtration of ground-water samples, it is more appropriate, albeit conservative, to analyze unfiltered samples to determine concentrations of mobile metals species. However, it should be noted that in addition to the probable overestimation of mobile metals species resulting from analysis of unfiltered samples, other factors may bias analysis and result in an overestimation of mobile metal concentrations. The size of suspended particles is primarily controlled by ground-water velocity. Larger particles than are normally capable of being transported by quiescent ground water can be entrained by the greater velocities created by high-flow pumps or bailers, such as those used for well purging and sampling during this RI/FS. Metals adsorbed to these particles will be included during analysis of unfiltered samples and result in total metals

concentrations in excess of concentrations naturally migrating through the aquifer. This phenomenon is believed to occur at the Linemaster site, particularly in the till wells. The extensive amount of time required to develop the till wells at the site was due to the abundance of fine-grained particles and the extremely slow recharge of the till. Recharge to the till wells, which often become dewatered during purging prior to sampling, entrains a significant amount of fines as evidenced by the silty appearance of the ground-water samples and the high total suspended solids concentrations.

Total Suspended Solids and Total Metals Correlation

Total suspended solids (TSS) concentrations recorded in samples collected during the RI/FS are summarized in Table 4-19. Statistical analyses were performed to determine if any correlation exists between TSS concentrations and concentrations of arsenic, barium, beryllium, cadmium, chromium, lead, and nickel in as many as 70 samples. Linear regression of the scatter plots of the natural log of TSS and individual metals concentrations, which are included in Appendix S, were performed to evaluate the suspected correlation.

The correlation coefficient value, r, may range from 1.0 to -1.0 and is indicative of the degree of correlation between the two variables being compared. An r of 1.0 indicates a perfect correlation, an r of 0.0 indicates no correlation, and a negative r value indicates an inverse correlation. The calculated correlation coefficients between TSS and the individual metals are listed in Table 4-20.

Good correlation (r = 0.634 to 0.762) between TSS concentrations

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TABLE 4-19

GROUND WATER - SUMMARY OF TOTAL SUSPENDED SOLIDS (TSS) CONCENTRATIONS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	Sample ID	Date	TSS (mg/l)
GW04	31390122840	12/28/90	5
GW06ob	31390122835	12/28/90	ND@5
GW10db3	31390122121	12/21/90	68
GW10dbPT	31391040101	04/01/91	ND@5
GW10dbPT	31391040102	04/01/91	ND@5
GW10dbPT	19291040310	04/03/91	109
GW10dbPT	19291040311	04/03/91	49
GW10dbPT	19291040312	04/03/91	108
GW10dbPT	19291040313	04/03/91	22
GW10dbPT	19291040314	04/03/91	45
GW10dbPT	19291040315	04/03/91	54
GW10dbPT	19291040316	04/03/91	63
GW12db1	31390122018	12/20/90	2400
GW12dbPT	19291040201	04/02/91	8
GW12dbPT	19291040202	04/02/91	32
GW12dbPT	19291040203	04/02/91	216
GW12dbPT	19291040204	04/02/91	11
GW12dbPT	19291040205	04/02/91	52
GW12dbPT	19291040206	04/02/91	ND@5
GW12dbPT	19291040207	04/02/91	65
GW21db	31390122734	12/27/90	ND@5
GW23db	31390122836	12/28/90	5
GW24db	31390122837	12/28/90	ND@5
GW34db	31391010301	01/03/91	ND@5
GW40db	31390122838	12/28/90	ND@5
MW01db1	34391062001	06/20/91	943
MW01db1	31391121701	12/17/91	457
MW01db4	34391062106	06/21/91	426
MW01db4	31391121705	12/17/91	454
MW01sb	31391061317	06/13/91	454
MW01sb	31392010832	01/08/92	279
MW06db	31392010830	01/08/92	222
MW06db2	34391070846	07/08/91	2109
MW06db2D	34391070847	07/08/91	3130
MW06db4	34391070952	07/09/91	367
MW06sb	31390122627	12/26/90	1610
MW06t	31390122626	12/26/90	764
MW08db1	34391070137	07/01/91	412
MW08db1	31391121908	12/19/91	1040

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TABLE 4-19
(CONTINUED)
GROUND WATER - SUMMARY OF TOTAL SUSPENDED
SOLIDS (TSS) CONCENTRATIONS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	Sample ID	Date	TSS (mg/l)
MW08db3	31391121911	12/19/91	377
MW08t	31391061104	06/11/91	2360
MW08t	31392010307	01/03/92	5060
MW10sb	31390122630	12/26/90	383
MW10td	31390122629	12/26/90	628
MW11db1	34391070543	07/05/91	483
MW11db1	31391122617	12/26/91	305
MW11sb	31390122732	12/27/90	51
MW11T	31390122731	12/27/90	4450
MW12db4	31390121806	12/18/90	1980
MW12db4D	31390121808	12/18/90	1780
MW12sb	35192042115	04/21/92	407
MW13db1	31390121916	12/19/90	424
MW14db3	31390121701	12/17/90	124
MW15db	31392010723	01/07/92	163
MW15db1	34391062109	06/21/91	2560
MW15db2	34391062410	06/24/91	545
MW15db2D	34391062411	06/24/91	746
MW15t	31391061107	06/11/91	216
MW15t	31392010614	01/06/92	141
MW16t	31391061318	06/13/91	921
MW16t	31392010940	01/09/92	78900
MW17db	31392010726	01/07/92	456
MW17db1	34391062723	06/27/91	110
MW17db3	34391062725	06/27/91	103
MW17db3D	34391062728	06/27/91	100
MW17td	31391061210	06/12/91	1210
MW17td	31392010828	01/08/92	2590
MW18db2	31391122724	12/27/91	12
MW18db2D	31391122726	12/27/91	12
MW18sb	31391061209	06/12/91	759
MW18sb	31392010309	01/03/92	295
MW21db1	34391062619	06/26/91	99
MW21db1	31391122314	12/23/91	836
MW22db2	34391062514	06/25/91	446
MW22db2	31391123030	12/30/91	199
MW22db3	34391062515	06/25/91	757
MW22db3	31391123031	12/30/91	78

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TABLE 4-19
(CONTINUED)
GROUND WATER - SUMMARY OF TOTAL SUSPENDED
SOLIDS (TSS) CONCENTRATIONS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	Sample ID	Date	TSS (mg/l)
MW23t	31392010943	01/09/92	32700
MW24t	31392010944	01/09/92	1150
MW25t	31392010831	01/08/92	12920
MW26t	31392010945	01/09/92	8830
MW27db	31392010616	01/06/92	87
MW28db3	37392042803	04/28/92	166
MW29db3	37392050110	05/01/92	52
MW29db3D	37392050113	05/01/92	33
MWEPAAsb	31391061216	06/12/91	4760
MWEPAAsb	31392010835	01/08/92	3050
MWEPAAtd	31392010836	01/08/92	6630

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Table 4-20

TSS-TOTAL METALS CONCENTRATION CORRELATION

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Independent Variable	Dependent Variable	Data Pairs	Correlation Coefficient
Total Suspended Solids	Arsenic	70	-0.363
Total Suspended Solids	Barium	64	0.653
Total Suspended Solids	Beryllium	64	0.257
Total Suspended Solids	Cadmium	64	0.634
Total Suspended Solids	Chromium	64	0.762
Total Suspended Solids	Lead	64	0.692
Total Suspended Solids	Nickel	64	0.669

Note: Regression analysis was performed on logarithmically transformed data.

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and concentrations of barium, cadmium, chromium, lead, and nickel was identified. This correlation indicates the concentrations of these metals are highest in samples with high concentrations of total suspended solids. This relationship suggests that metals species adsorbed to suspended particles account for a substantially greater portion of the total metals concentration than the soluble species in the same sample.

The negative correlation ($r = -0.382$) between TSS and arsenic is indicative of the trend that total arsenic concentrations decrease slightly with increasing TSS concentrations. The relatively low correlation value suggests that total arsenic and TSS concentrations are relatively independent and that other factors may influence the occurrence and distribution of total arsenic in the ground water. The weak correlation between TSS and beryllium may be due to the relatively large number of non-detects for beryllium; however, based on the TSS concentrations in samples that contain beryllium at concentrations in excess of the limit of detection, it is apparent that higher TSS concentrations are associated with high concentrations of beryllium.

The significance of the strong correlation between TSS and total metals concentrations at the site is that total metals concentrations for all metals, with the exception of arsenic, may greatly overestimate the concentration of metals migrating through the aquifer. The obvious difference between dissolved and total concentrations of metals in ground-water samples collected at the site are related to metals transport mechanisms, sample collection methodology, the nature of the aquifer, and whether the ground-water samples were filtered prior to analysis. However, based on the previous discussion, and in consideration

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of the objective to identify locales within the study area that may have been impacted by the possible migration of metals related to historical industrial operations and activities, the focus of this report has been limited to the interpretation of total metals concentrations in unfiltered ground-water samples.

4.3.3.2 Background Concentrations

To establish the range of naturally occurring, or background, concentrations of metals in the study area ground waters, metals analytical data from ground-water monitoring wells MW-3t, MW-12t, MW-12sb, and MW-12db and residential water-supply well GW-29 were considered. These particular wells were chosen "because they do not seem to be impacted by the groundwater plumes" in accordance with the recommendations and guidance provided in a March 10, 1992 letter from Mr. Michael Nalipinski, EPA CT Remedial Project Manager, to Mr. David Bramley of Fuss & O'Neill. Monitoring well MW-3t is located approximately 400 feet southwest of the Linemaster manufacturing facility and is screened in the till unit. The MW-12 well cluster, consisting of a till well, a shallow bedrock well, and a deep bedrock well, is located adjacent to the southeastern portion of Pond 1 in the eastern part of the study area. The Painter residence water-supply well, GW-29, is located in the southwestern portion of the study area opposite the intersection of Route 171 and Plaine Hill Road.

Ground-water VOC data from the five selected background wells were also evaluated to identify sampling locations that may have been impacted by the ground-water VOC plume. As noted in Tables 4-15, 4-16, and 4-17 and in Appendix P, trace concentrations (<5 ug/l) of VOCs were detected in samples collected from wells MW-3t, MW-12t, MW-12sb, and GW-29.

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Concentrations of toluene as high as 155 ug/l have been detected in samples collected from MW-12db. Xylenes, dichlorodifluoromethane, and chloroform have infrequently been detected at MW-12db at concentrations of 15 ug/l or less. Overall, the five selected wells are interpreted to be minimally impacted by the existing ground-water VOC contamination at the site and, therefore, are suitable for establishing background ground-water metals concentrations.

Analytical results for the 26 ground-water samples collected from the five background monitoring wells analyzed for total and/or dissolved metals during RI/FS investigations are listed in Table 4-21. Total and dissolved concentrations of the following metals were detected in one or more of the background wells: aluminum; arsenic; barium; beryllium; cadmium; magnesium; manganese; nickel; and, zinc. The following metals were only detected in unfiltered samples from one or more wells: antimony; calcium; chromium; cobalt; copper; iron; lead; lithium; potassium; sodium; strontium; thallium; tin; and, vanadium. Mercury, selenium, and silver were not detected in any filtered or unfiltered ground-water background samples.

The metals concentrations identified in Table 4-21 are believed to be representative of the naturally occurring concentrations of metals present in the ground water in the study area. In general, the highest background concentrations of both total and dissolved metals species were detected in samples collected from the two till monitoring wells, MW-3t and MW-12t.

The mean, standard deviation, and maximum and minimum concentration values of both the raw and logarithmically transformed background data sets for each metal are listed in

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TABLE 4-21

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BACKGROUND GROUND WATER - SUMMARY OF METALS RESULTS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	GW-29				MW-3t			MW-12db1	
Date	08/22/90	10/12/90	08/22/91	04/27/92	07/23/90	12/04/90	04/24/92	07/11/90	12/18/90
Sample ID	34390082201	31390101207	31391082207	35192042730	31390072301	31390120401	37392042402	19290071104	31390121810
Parameter (ug/l)									
Aluminum, Dissolved							312		
Aluminum, Total				ND@90.0			254000		
Antimony, Dissolved							ND@29.0		
Antimony, Total				ND@29.0			56		
Arsenic, Dissolved							ND@1.4		
Arsenic, Total	6.9	5.8	6.1	10.8	18.3	ND@1.8	ND@1.4	13.1	18.7
Barium, Dissolved							55		
Barium, Total				ND@10.0		1695	2250		923
Beryllium, Dissolved							ND@2.0		
Beryllium, Total				ND@2.0		ND@1.0	10		ND@1.0
Cadmium, Dissolved							ND@4.0		
Cadmium, Total				ND@4.0		13.0	ND@4.0		9.0
Calcium, Total									
Chromium, Dissolved							ND@10.0		
Chromium, Total				ND@10.0		688	969		278
Cobalt, Dissolved							ND@10.0		
Cobalt, Total							264		
Copper, Dissolved							ND@10.0		
Copper, Total				49.0			368		
Iron, Total									
Lead, Dissolved							ND@1.6		
Lead, Total				1.0		75.2	71.3		80.4
Lithium, Total									
Magnesium, Dissolved							3190		
Magnesium, Total				1660			134000		
Manganese, Dissolved							18		
Manganese, Total				36			4160		
Mercury, Dissolved							ND@0.2		
Mercury, Total				ND@0.2			ND@0.2		
Nickel, Dissolved							ND@18.0		
Nickel, total				ND@18.0		419	647		182
Potassium, Total									
Selenium, Dissolved							ND@1.9		
Selenium, Total				ND@2.1			ND@1.9		
Silver, Dissolved							ND@9.0		
Silver, total				ND@9.0			ND@9.0		
Sodium, Total									
Strontium, Total									
Thallium, Dissolved							ND@1.5		
Thallium, Total				ND@1.3			4.3		
Tin, Dissolved							ND@50.0		
Tin, Total				ND@50.0			60		
Vanadium, Dissolved							ND@10.0		
Vanadium, Total				ND@10.0			659		
Zinc, Dissolved							9		
Zinc, Total				100			879		

ND - Not detected at indicated limit of detection
Blank space indicates parameter was not analyzed for.

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TABLE 4-21
(CONTINUED)
BACKGROUND GROUND WATER - SUMMARY OF METALS RESULTS

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-12db2		MW-12db3		MW-12db4		
Date	07/11/90	12/18/90	07/11/90	12/18/90	07/11/90	12/18/90	12/18/90
Sample ID	19290071103	31390121809	19290071102	31390121807	19290071101	31390121806	31390121808
Parameter (ug/l)							
Aluminum, Dissolved							
Aluminum, Total							
Antimony, Dissolved							
Antimony, Total							
Arsenic, Dissolved						ND@1.8	ND@1.8
Arsenic, Total	1.9	5.9	1.3	4.7	21.1	13.6	8.3
Barium, Dissolved						ND@32.0	ND@32.0
Barium, Total		172		242		1588	1192
Beryllium, Dissolved						ND@1.0	ND@1.0
Beryllium, Total		ND@1.0		ND@1.0		ND@1.0	ND@1.0
Cadmium, Dissolved						ND@6.0	ND@6.0
Cadmium, Total		ND@6.0		ND@6.0		7.0	7.0
Calcium, Total							
Chromium, Dissolved						ND@9.0	ND@9.0
Chromium, Total		72		58		281	188
Cobalt, Dissolved							
Cobalt, Total							
Copper, Dissolved							
Copper, Total							
Iron, Total							
Lead, Dissolved						ND@2.0	ND@2.0
Lead, Total		13.4		19.1		36.2	25.9
Lithium, Total							
Magnesium, Dissolved							
Magnesium, Total							
Manganese, Dissolved							
Manganese, Total							
Mercury, Dissolved							
Mercury, Total							
Nickel, Dissolved						ND@22.0	ND@22.0
Nickel, total		43		42		183	131
Potassium, Total							
Selenium, Dissolved							
Selenium, Total							
Silver, Dissolved							
Silver, total							
Sodium, Total							
Strontium, Total							
Thallium, Dissolved							
Thallium, Total							
Tin, Dissolved							
Tin, Total							
Vanadium, Dissolved							
Vanadium, Total							
Zinc, Dissolved							
Zinc, Total							

ND - Not detected at indicated limit of detection
Blank space indicates parameter was not analyzed for.

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TABLE 4-21
(CONTINUED)
BACKGROUND GROUND WATER - SUMMARY OF METALS RESULTS

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Well ID	MW-12sb					MW-12t				
Date	07/24/90	12/05/90	04/21/92	04/28/92	05/20/92	07/24/90	07/24/90DUP	12/05/90	04/21/92	05/20/92
Sample ID	31390072414	31390120511	35192042115	37392042804	40192052001	31390072415	31390072417	31390120512	35192042114	40192052002
Parameter (ug/l)										
Aluminum, Dissolved			ND@90.0						ND@90.0	
Aluminum, Total				51300	1040					185000
Antimony, Dissolved			ND@29.0						ND@29.0	
Antimony, Total				ND@29.0	ND@29.0					290
Arsenic, Dissolved			3.4						ND@1.4	
Arsenic, Total	8.9	5.0		19.1	2.2	131	240	27.7		65.6
Barium, Dissolved			44						70.0	
Barium, Total		ND@32.0		250	32			369		1290
Beryllium, Dissolved			4						4.0	
Beryllium, Total		ND@1.0		ND@5.0	ND@2.0			ND@1.0		7
Cadmium, Dissolved			9						ND@4.0	
Cadmium, Total		ND@6.0		ND@5.0	ND@4.0			ND@6.0		ND@4.0
Calcium, Total					43100					81900
Chromium, Dissolved			ND@10.0						ND@10.0	
Chromium, Total		144		163	ND@10.0			470		690
Cobalt, Dissolved										
Cobalt, Total					ND@10.0					162
Copper, Dissolved			ND@10.0						ND@10.0	
Copper, Total				46	ND@10.0					224
Iron, Total					1200					219000
Lead, Dissolved			ND@1.6						ND@1.6	
Lead, Total		5.8		63	1.7			20.9		66.0
Lithium, Total					ND@50.0					235
Magnesium, Dissolved			6460						10700	
Magnesium, Total				35600						
Manganese, Dissolved			59						4370	
Manganese, Total				1630						
Mercury, Dissolved			ND@0.2						ND@0.2	
Mercury, Total				ND@0.2	ND@0.2					ND@0.2
Nickel, Dissolved			ND@18.0						18.0	
Nickel, total		ND@22.0		90	ND@18.0			119		444
Potassium, Total					5950					77500
Selenium, Dissolved			ND@1.9						ND@1.9	
Selenium, Total				ND@9.5	ND@1.9					
Silver, Dissolved			ND@9.0						ND@9.0	
Silver, total				ND@10.0	ND@9.0					ND@19
Sodium, Total					25300					95200
Strontium, Total					158					582
Thallium, Dissolved			ND@1.5						ND@1.5	
Thallium, Total				ND@1.5	ND@1.5					ND@1.5
Tin, Dissolved			ND@50.0						ND@50.0	
Tin, Total				ND@50.0	ND@50.0					53
Vanadium, Dissolved			ND@10.0						ND@10.0	
Vanadium, Total				85	ND@10.0					429
Zinc, Dissolved			24						40.0	
Zinc, Total				193	13					506

ND - Not detected at indicated limit of detection
Blank space indicates parameter was not analyzed for.

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Table 4-22. As previously discussed in Section 4.3.3.1, non-detect data values were assigned numerical values equal to one-half the detection limit. Tolerance limits were established for the background arsenic, barium, beryllium, cadmium, chromium, lead, and nickel data sets. Insufficient background data (five or fewer sample results) for the other metal data sets precluded construction of meaningful tolerance limits. Based on the transformed background data for each background metal, an upper tolerance limit (TL) was calculated for each metal by the following formula:

$$TL = x + KS$$

where x is the population mean; K is the one-sided normal tolerance factor; and, S is the standard deviation of the population. The upper tolerance limit was constructed to include 95 percent of the background population with a tolerance coefficient of 95 percent. These values result in an upper tolerance limit that has a 95 percent probability of being greater than 95 percent of the background population. Because the upper tolerance limit was constructed on the logarithms of the background data, the antilogarithm of the tolerance limit was taken to enable comparison with untransformed data from the study area monitoring wells. Upper tolerance limits and the corresponding antilog values, expressed in micrograms per liter, for each metal data set are also included in Table 4-22.

4.3.3.3 Study Area Monitoring and Supply Well Concentrations

In order to identify study area locations where ground water may contain elevated metal concentrations, metal concentrations in all ground-water samples collected from monitoring and water-

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TABLE 4-22

BACKGROUND GROUND WATER - METALS STATISTICAL SUMMARY

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

RAW DATA						LOGARITHMICALLY TRANSFORMED DATA					
Metal	Number of Observations	Minimum ug/l	Maximum ug/l	Mean ug/l	Standard Deviation ug/l	Minimum	Maximum	Mean	Standard Deviation	Tolerance Limit	Tolerance Limit ug/l
Aluminum	5	45.0	254000	98277.0	115197.6	3.087	12.45	9.23	3.74		
Antimony	5	14.5	290	77.9	119.9	2.674	5.67	3.54	1.33		
Arsenic	27	0.7	240	24.4	50.5	-0.357	5.48	2.18	1.35	5.24	188
Barium	13	5.0	2250	771.1	761.2	1.609	7.72	5.66	1.96	10.88	52997
Beryllium	13	0.5	10.0	2.0	3.0	-0.693	2.30	-0.03	1.07	2.83	16.9
Cadmium	13	2.0	13.0	4.5	3.5	0.693	2.57	1.29	0.65	3.01	20.4
Calcium	2	43100	81900	62500.0	27435.7	10.671	11.31	10.99	0.45		
Chromium	13	5.0	969	308.5	305.4	1.609	6.88	4.94	1.70	9.48	13148
Cobalt	3	5.0	764	143.7	130.5	1.609	5.58	4.09	2.16		
Copper	5	5.0	368	138.4	153.6	1.609	5.91	4.13	1.68		
Iron	2	1200	219000	110100.0	154007.9	7.09	12.30	9.69	3.68		
Lead	13	1.0	80.4	36.9	30.0	0.00	4.39	3.00	1.45	6.87	967
Lithium	2	25.0	235	130.0	148.5	3.22	5.46	4.34	1.58		
Magnesium	3	1660	134000	57086.7	68736.7	7.42	11.81	9.90	2.25		
Manganese	3	36.0	4160	1942.0	2079.6	3.58	8.33	6.44	2.52		
Nickel	13	9.0	647	179.2	200.8	2.20	6.47	4.42	1.47	8.36	4256
Potassium	2	5950	77500	41725.0	50593.5	8.69	11.26	9.98	1.82		
Sodium	2	25300	95200	60250.0	49426.8	10.14	11.46	10.80	0.94		
Strontium	2	158	582	370.0	299.8	5.06	6.37	5.72	0.92		
Thallium	5	0.65	4.3	1.4	1.6	-0.43	1.46	0.03	0.80		
Tin	5	25.0	60.0	37.6	17.4	3.22	4.09	3.54	0.45		
Vanadium	5	5.0	659	236.6	294.0	1.61	6.49	4.04	2.35		
Zinc	5	13.0	879	338.2	355.0	2.57	6.78	5.09	1.64		

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supply wells during RI/FS investigations were evaluated in consideration of the background well ground-water data. Study area well concentrations of arsenic, barium, beryllium, cadmium, chromium, lead, and nickel were compared to the background upper tolerance limits for the same metals to identify wells with elevated metals concentrations. Figures 4-9 to 4-15 provide a graphical comparison of monitoring and supply well concentrations and the background upper tolerance limits for the seven metals.

Based on concentrations exceeding the background upper tolerance limit in ground-water samples, several wells were found to have potentially elevated concentrations of arsenic, beryllium, cadmium, and nickel. Table 4-23 summarizes the observed exceedances. In all, 21 wells were found to have exceedances of one or more of the four metals. The exceedances were identified in five deep bedrock wells, four shallow bedrock wells, and 12 till wells.

An exceedance of the background data set upper tolerance limit was deemed to present statistically significant evidence that the data were from a population with a higher mean and might be indicative of elevated concentrations. However, it also should be noted that although the concentration of a metal in a ground-water sample may exceed the background tolerance limit concentration, the exceedance may reflect a natural variation rather than an impact from historical waste disposal. Natural variations in ground-water chemistry can be related to heterogeneities in soil types or bedrock lithology. For example, arsenopyrite, an arsenic-containing mineral observed in cores collected during bedrock well installations at the site, typically occurs in mineralized zones and fractures and is expected to contribute to higher concentrations of arsenic in the

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FIGURE 4-9
TOTAL ARSENIC IN GROUND WATER

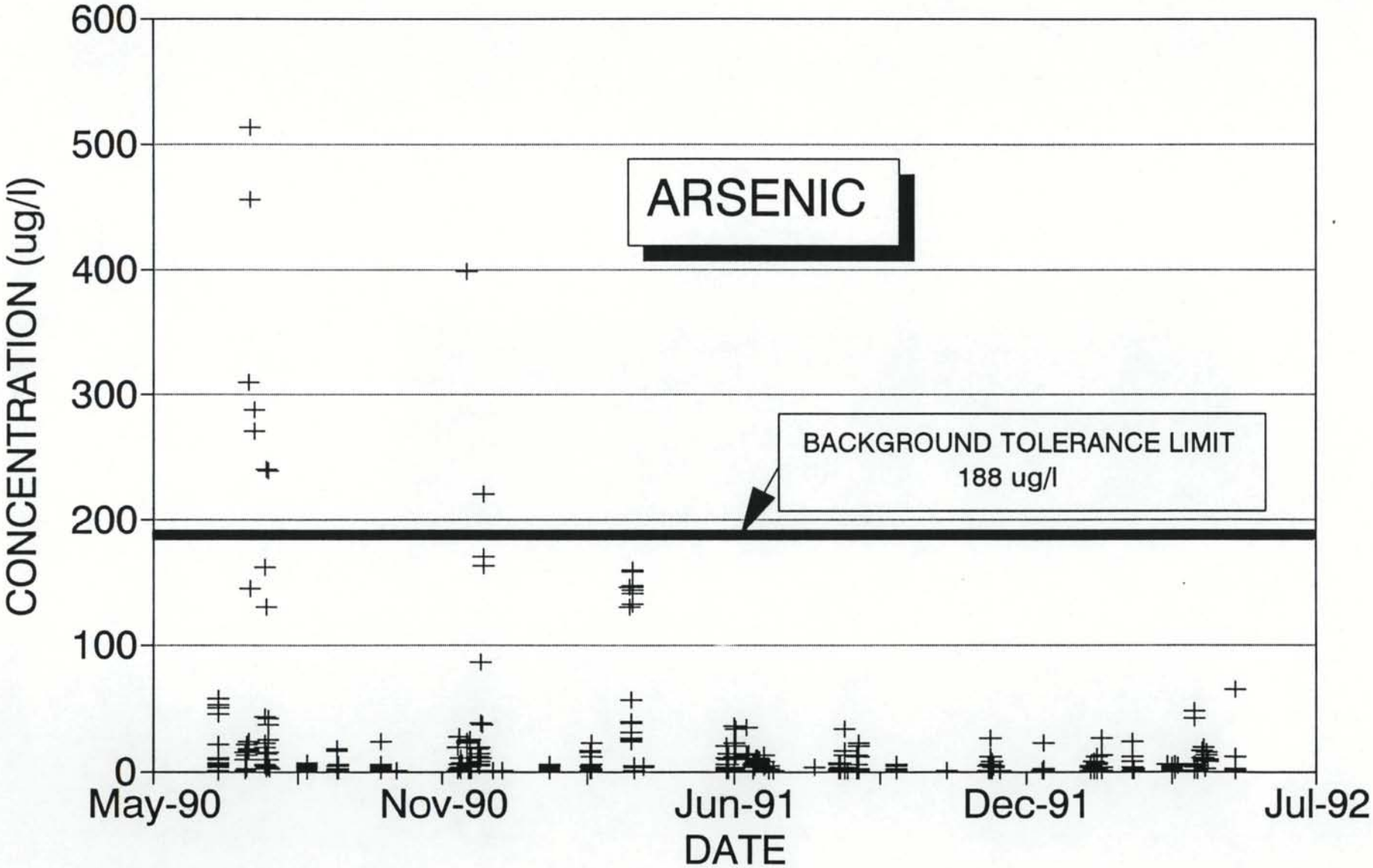

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FIGURE 4-10
TOTAL BARIUM IN GROUND WATER

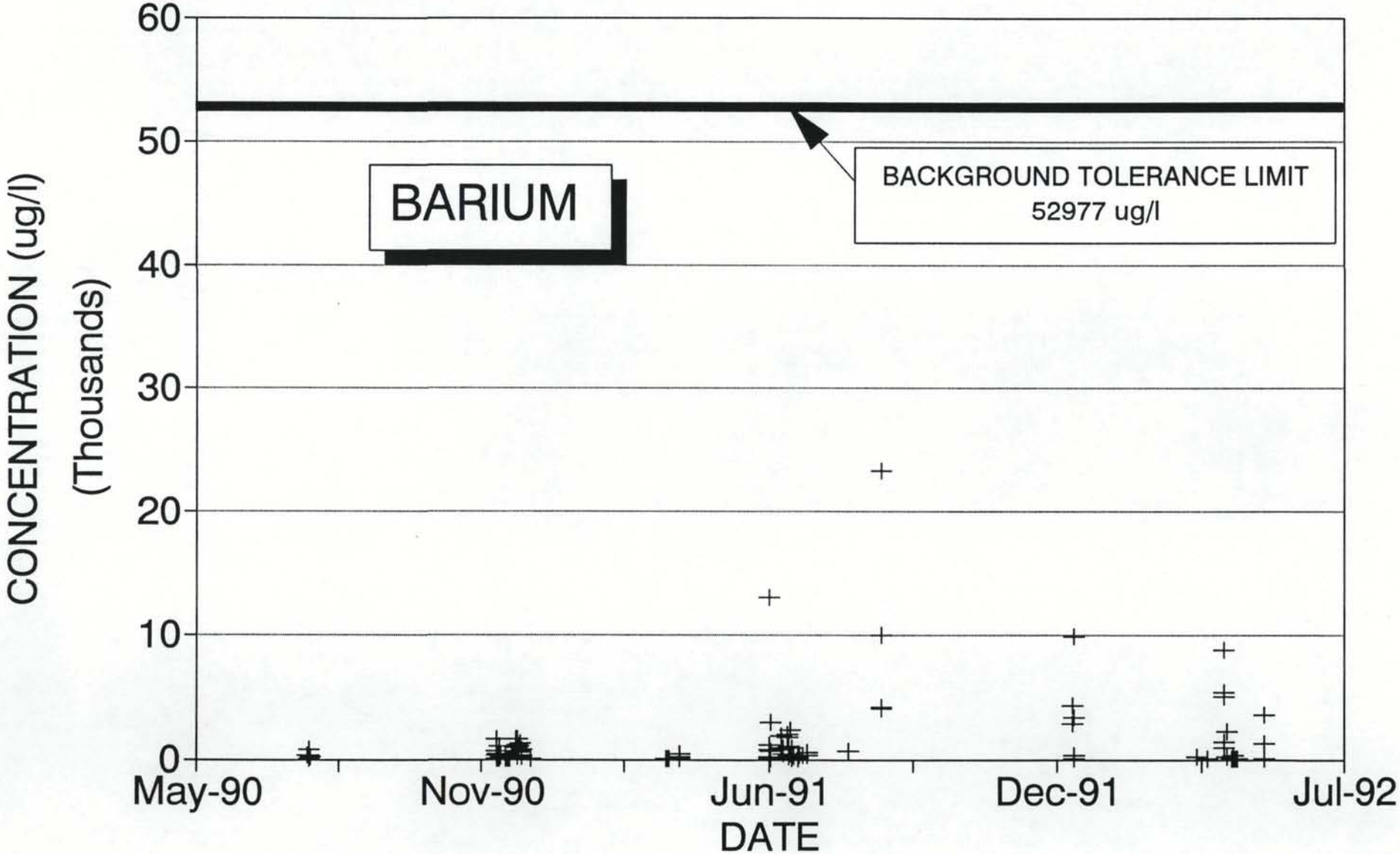

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FIGURE 4-11
TOTAL BERYLLIUM IN GROUND WATER

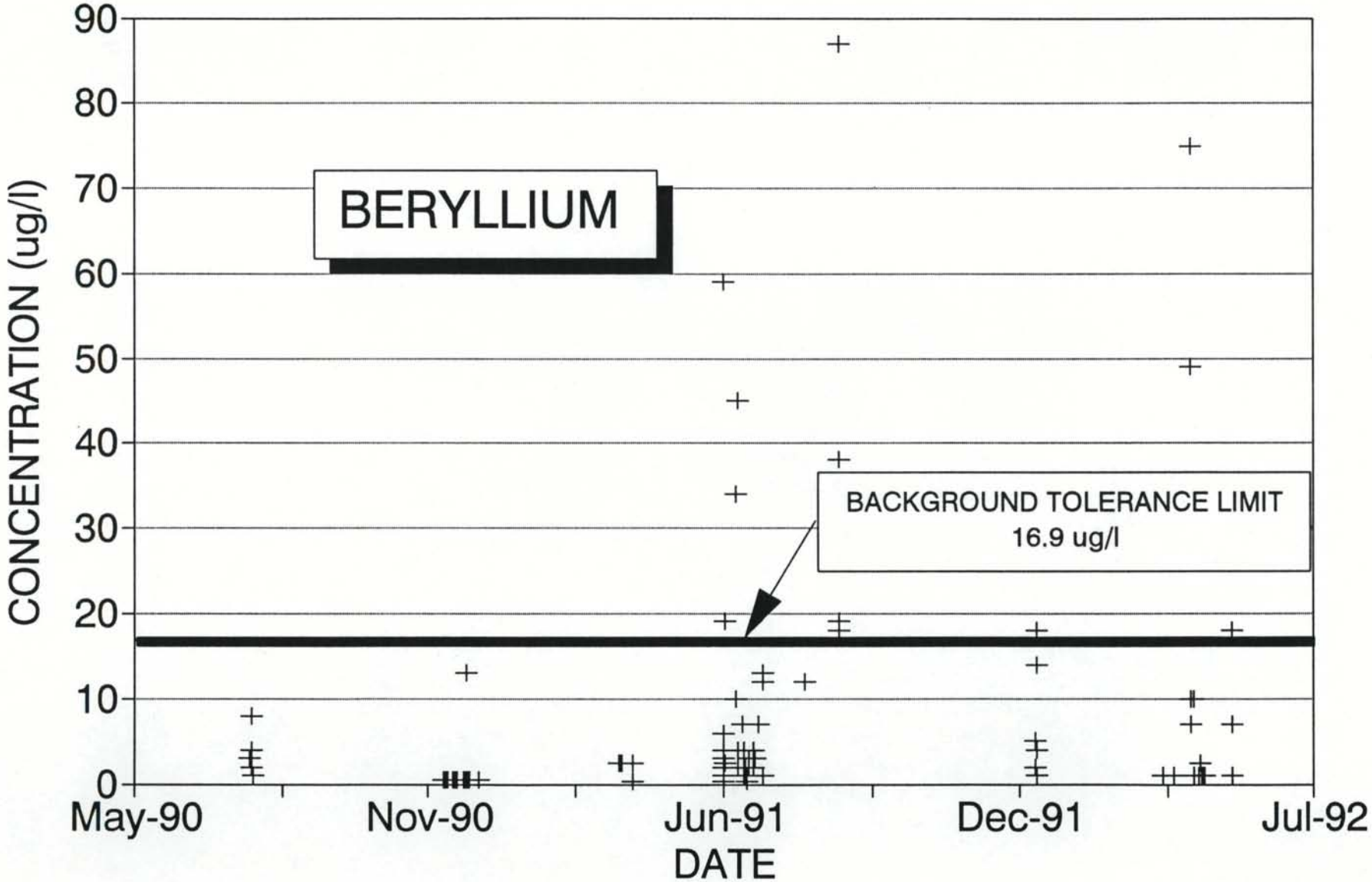

FIGURE 4-12
TOTAL CADMIUM IN GROUND WATER

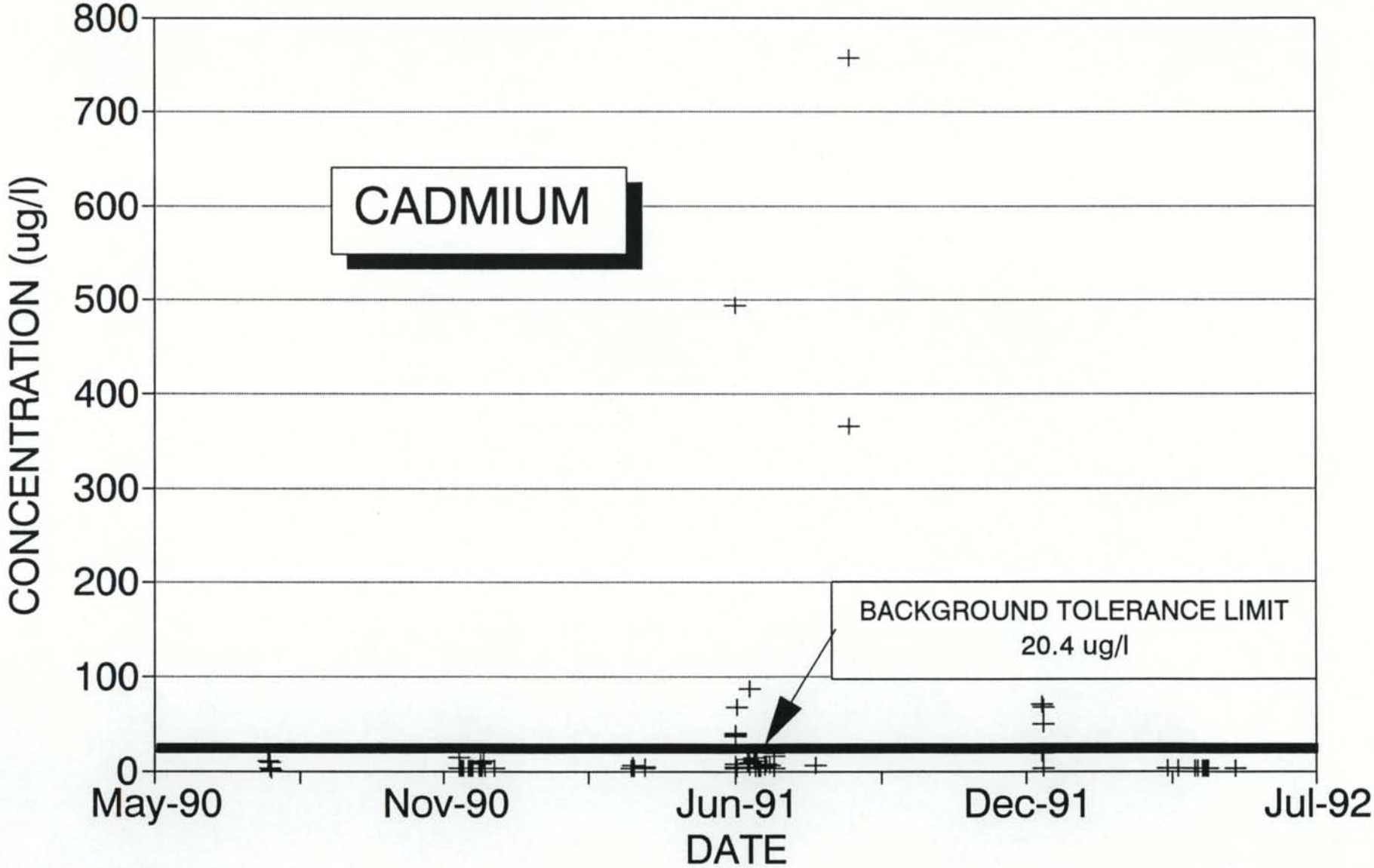

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FIGURE 4-13
TOTAL CHROMIUM IN GROUND WATER

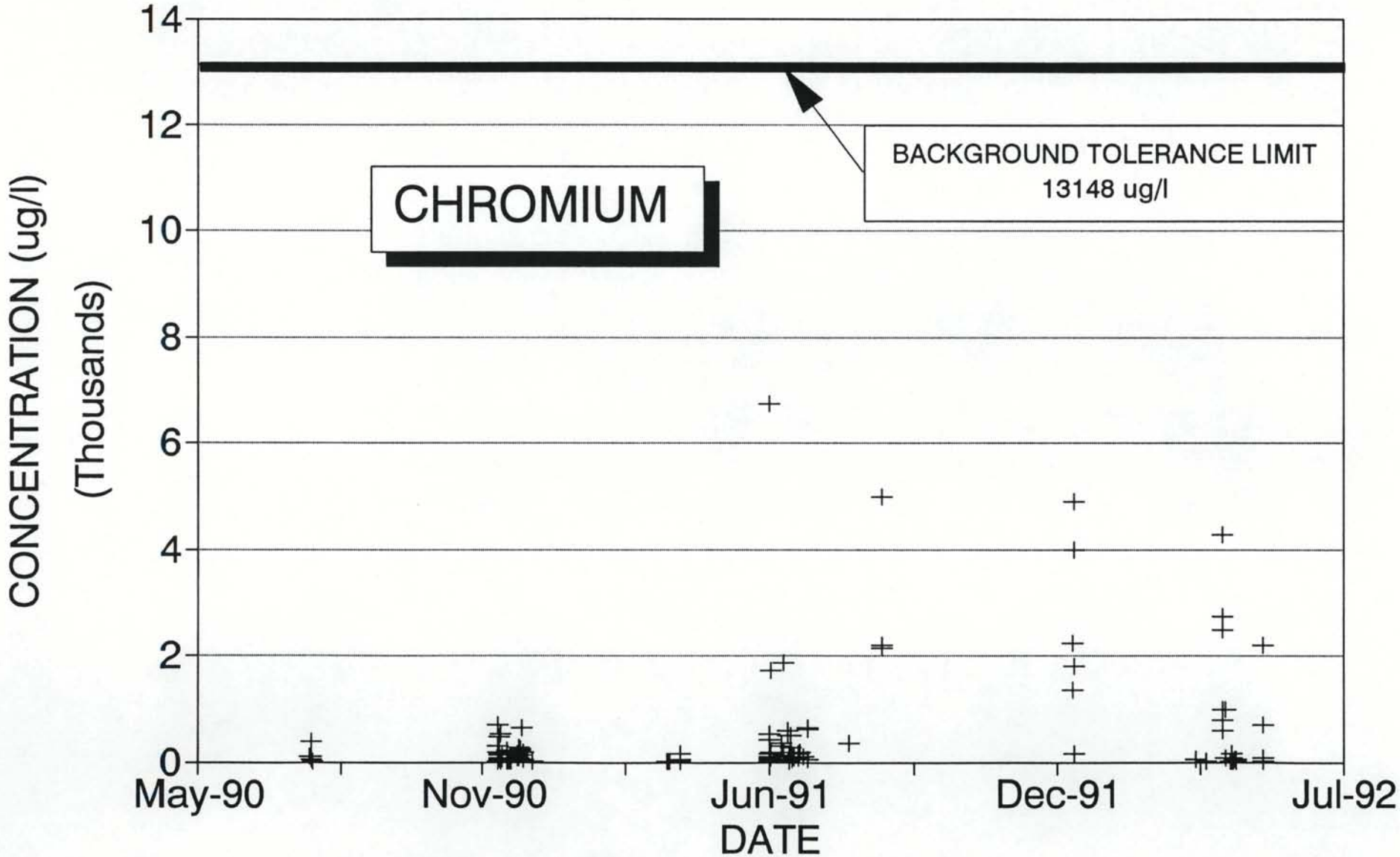

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FIGURE 4-14
TOTAL LEAD IN GROUND WATER

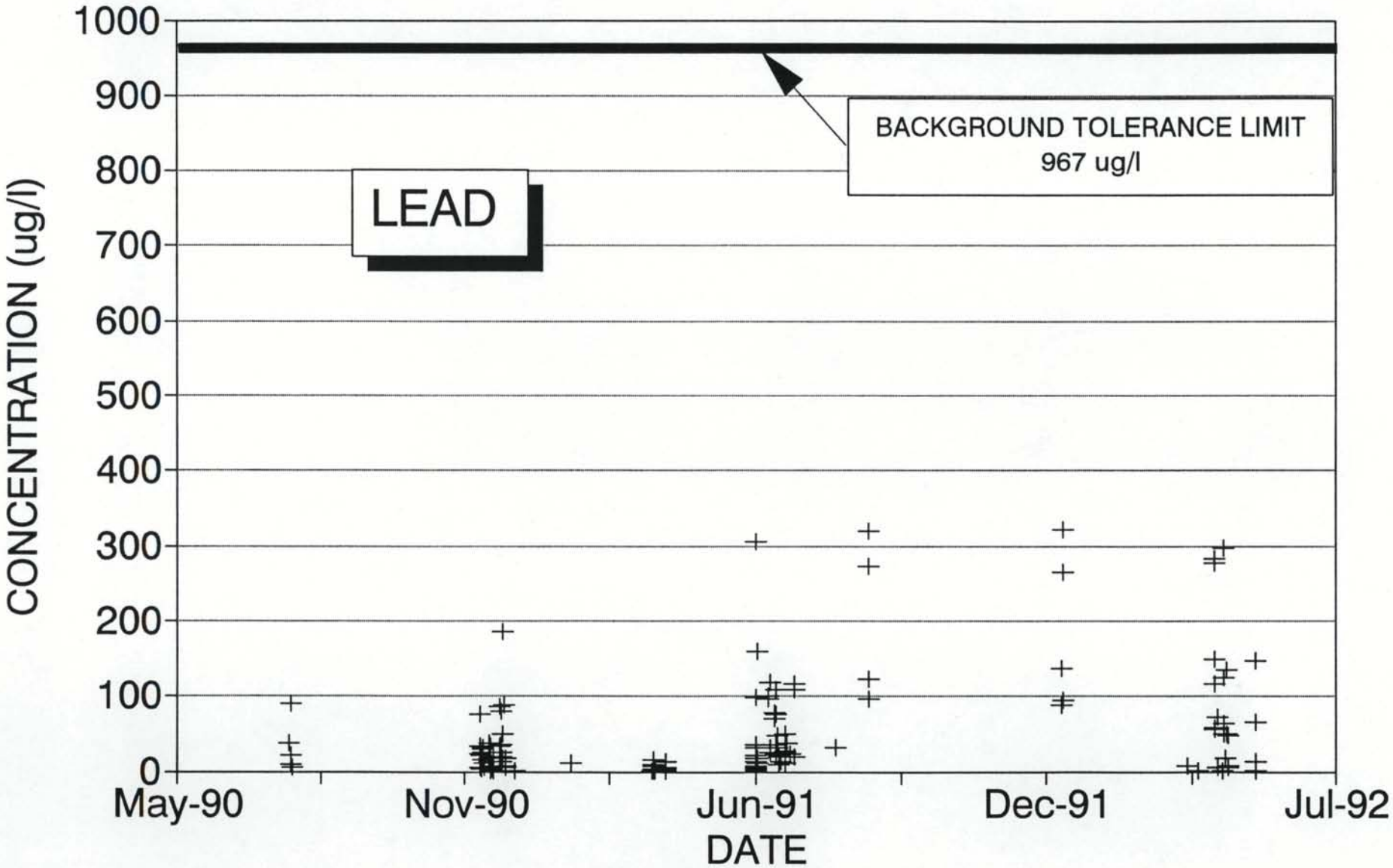

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FIGURE 4-15
TOTAL NICKEL IN GROUND WATER

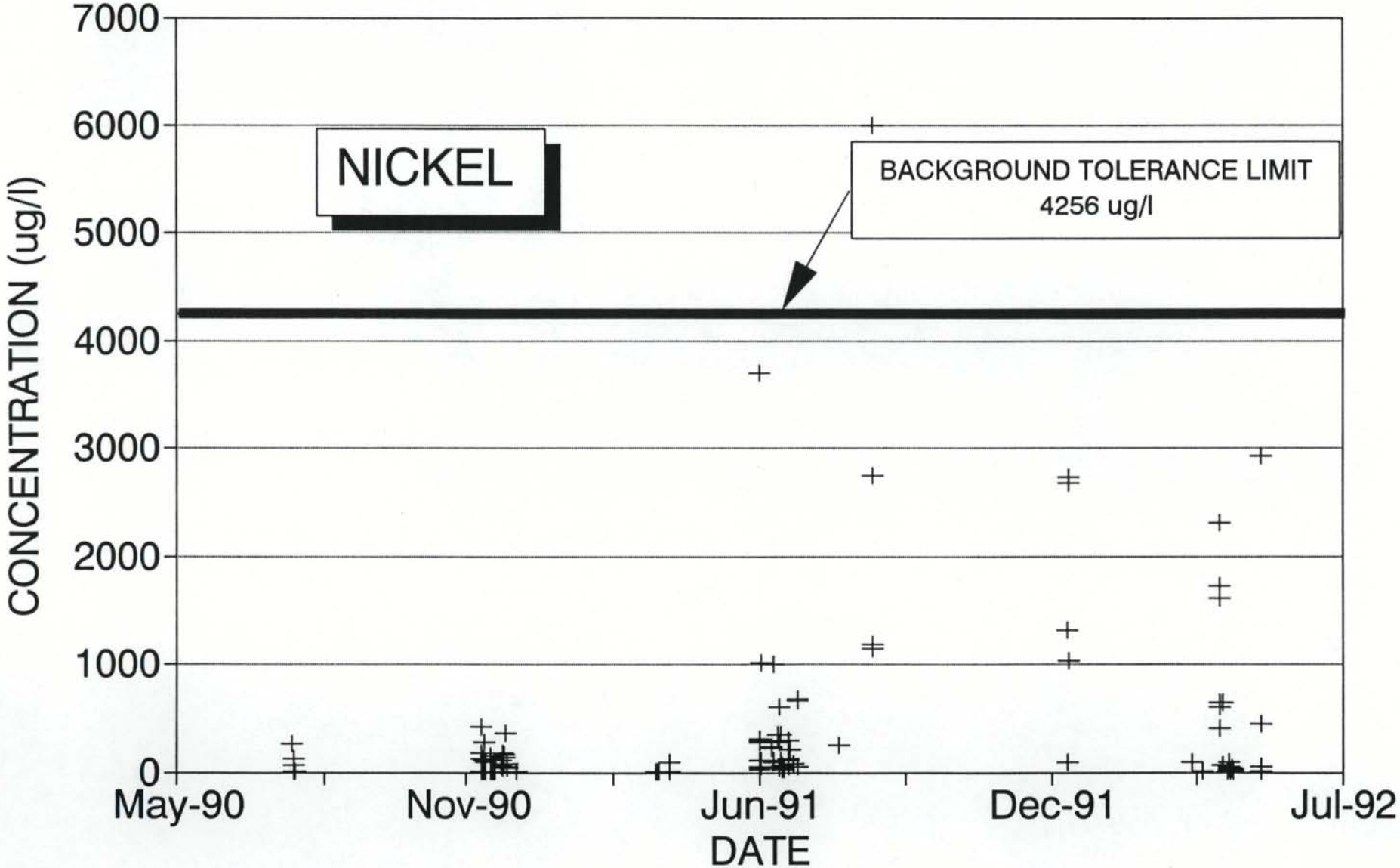

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TABLE 4-23

GROUND WATER - EXCEEDANCES OF BACKGROUND METALS TOLERANCE LIMITS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	DATE	SAMPLE ID	TOTAL ARSENIC ug/l	TOTAL BERYLLIUM ug/l	TOTAL CADMIUM ug/l	TOTAL NICKEL ug/l
BACKGROUND TOLERANCE LIMIT			188	16.9	20.4	4256
WELL						
GW-10DB	07/13/90	19290071303	456			
	07/13/90	19290071304	513			
	12/21/90	31390122124	221			
GW-12DB	07/16/90	19290071602	288			
	07/16/90	19290071603	271			
MW-01DB	06/20/91	34391062001		34		
MW-08T	06/11/91	31391061104			38	
MW-10SB	12/10/90	31390121028	399			
	7/25/90	31390072524	239			
MW-12T	7/24/90	31390072417	240			
MW-13DB	07/12/90	19290071205	310			
MW-15DB	06/21/91	34391062109		45	87	
MW-16SB	06/13/91	31391061321		19	68	
MW-16T	06/13/91	31391061318			49	
MW-17TS	06/12/91	31391061212			39	
MW-23T	01/09/92	31392010943		18	68	
	08/28/91	35991082829		87	757	6000
MW-24T	08/28/91	35991082830		19		
	01/09/92	31392010944			172	
MW-25T	01/08/92	31392010831		38	366	
	08/28/91	35991082831			71	
MW-26T	08/28/91	35991082832		18	21	
	01/09/92	31392010945			178	
MW-27SB	04/21/92	35192042110		75		
MW-27T	04/21/92	35192042111		49		
MW-28T	05/20/92	40192052005		18		
MW-30TD	04/21/92	35192042106		26		
MW-EPAASB	06/12/92	31391061216			37	
MW-EPAATD	01/08/92	31392010836		59	494	

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ground water in such areas. Additionally, as summarized in Table 4-24, arsenic, barium, beryllium, cadmium, chromium, lead, and nickel are present at varying concentrations in bedrock cuttings collected during drilling. The rock cuttings were powdered and then digested in a nitric hydrochloric acid solution before being analyzed by EPA Method 6010 or 7060 as applicable.

Arsenic

Arsenic concentrations exceeding the background tolerance limit of 188 ug/l were detected in samples from three deep bedrock wells, GW-10db, GW-12db, and MW-13db, and one shallow bedrock well, MW-10sb. The only exceedance of the background tolerance limit for arsenic in till monitoring wells was observed in MW-12t, one of the background wells. This apparent exceedance is believed to reflect a natural heterogeneity in the till elemental composition. This occurrence also exemplifies the fact that the concentration value of a member of the population subjected to analysis has a slight chance of exceeding the tolerance limit because the tolerance limit was calculated to determine the concentration value that was greater than 95 percent of the population with a 95 percent probability. No exceedances of the background arsenic tolerance limit were identified in any water-supply wells.

The lateral distribution of maximum total arsenic concentrations detected at all study area monitoring wells shown on Figure 4-16 and the vertical distribution of total arsenic concentrations shown on the cross sections in Figures 3-1, 3-2, and 3-3 do not indicate the presence of a centralized arsenic plume or a single arsenic source area. If disposal of arsenic-containing waste historically occurred via flushing to the former dry well or by

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TABLE 4-24

ROCK CUTTINGS - SUMMARY OF METALS RESULTS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	MW-1sb	MW-1sb	MW-6sb	MW-10sb	MW-11sb	MW-15db	MW-15db	MW-16sb	MW-17db	MW-21db	MW-EPA-Asb
Depth of Sample (ft)	74-78	88-89		52-57		205	280		270	290-295	
Date of Sample	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91	20-Nov-91
Sample ID	31391112006	31391112005	31391112009	31391112007	31391112010	31391112004	31391112001	31391112008	31391112003	31391112002	31391112011
Parameter (mg/kg)											
Arsenic, Total	ND@0.34	1.5	3.1	136	ND@0.28	8.3	1.91	0.66	ND@0.36	ND@0.34	7.1
Barium, Total	214	ND@1.3	243	3.8	230	ND@1.5	ND@1.3	ND@1.3	209	160	350
Beryllium, Total	1.1	0.38	0.38	0.96	0.56	2.6	1.7	0.19	0.95	0.57	0.76
Cadmium, Total	1.5	ND@0.77	1.7	ND@0.77	1.1	1.8	1.5	ND@0.75	1.3	1.1	1.7
Chromium, Total	95.9	ND@1.3	103	1.9	111	128	77.4	ND@1.3	93.6	74.1	141
Lead, Total	5.7	5.8	3.0	8.8	5.5	29.2	9.7	2.1	9.6	4.7	12.3
Nickel, Total	60.2	ND@3.3	86.5	ND@3.3	50.2	88.2	60.4	ND@3.2	81.7	70.3	126

NOTE: Rock cuttings were crushed to a powder and digested in a nitric hydrochloric acid solution prior to analysis by EPA Method 6010 or 7060.

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NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.141.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92.SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-14S	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-14D	EXISTING DEEP BEDROCK MONITORING WELL
GW-0849	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
GW-1049 513	MAXIMUM TOTAL ARSENIC CONCENTRATION DETECTED (ug/l)
513	INDICATES CONCENTRATION EXCEEDS BACKGROUND UPPER TOLERANCE LIMIT OF 188 ug/l
ND	NOT DETECTED

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MAXIMUM TOTAL ARSENIC CONCENTRATIONS IN GROUND WATER
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
AUG. 1992		86-88 D	FIGURE 4 - 16

on-site burial, arsenic concentrations would be expected to be highest in the till and not in the bedrock. However, arsenic concentrations are generally highest in bedrock wells.

The distribution of total arsenic concentrations does not correspond to areas of high VOC concentrations. For example, total arsenic was detected at concentrations less than 1.5 ug/l in MW-26t, the well with the highest concentration of TCE (800,000 ug/l). Although total arsenic concentrations exceeded the background upper tolerance limit in MW-10sb, located adjacent to the former dry well in Zone 1, arsenopyrite, a naturally occurring arsenic sulfide mineral, visually was identified in the bedrock core collected from this well. The exceedance of background tolerance limit concentrations in the shallow and deep bedrock wells is believed to be due to higher, naturally occurring concentrations of arsenic in the bedrock at these areas.

High levels of arsenic have also been detected in the ground water at other locations in New England that are underlain by the same bedrock formation that underlies the site (Barosh, 1990). A report prepared by Barosh (1990) which discusses and summarizes these natural arsenic occurrences is included for reference as Appendix R.

Beryllium

Beryllium concentrations exceeding the background tolerance limit of 16.9 ug/l were detected in samples collected from two deep bedrock wells, MW-1db and MW-15db, two shallow bedrock wells, MW-16sb and MW-27sb, and eight till wells, MW-23t, MW-24t, MW-25t, MW-26t, MW-27t, MW-28t, MW-30td, and MW-EPA-Atd. No

exceedances were detected in any of the water-supply wells.

The distribution of the maximum total beryllium concentrations detected at all study area monitoring wells is depicted on Figure 4-17. The highest concentrations of total beryllium were detected in till wells MW-23t (87 ug/l) and MW-27sb (75 ug/l). Concentrations exceeding the background tolerance limit for beryllium are generally restricted to wells adjacent to and north of the north end of the Linemaster manufacturing facility.

Beryllium background tolerance limit exceedances may be related to mobilization of naturally occurring beryllium, either by adsorption to suspended particles or by entrainment of particles naturally containing beryllium, rather than due to historical waste disposal. Exceedances of the beryllium upper tolerance limit were identified in recently installed till wells (April 1991 to March 1992). In most cases, exceedances were noted in the first sampling event following well installation. Despite extensive well development, many of the recently installed till wells still yield silty ground-water samples and have had high TSS concentrations detected. This suggests that in the vicinity of these wells the aquifer has not returned to equilibrium following the disturbances created during well installation and development due to the fine-grained nature and low hydraulic conductivity of the till aquifer. The background beryllium tolerance limit was determined from samples collected from wells that were installed prior to January 1990 and have had significantly more time to re-equilibrate.

Additionally, many of the till wells become dewatered during purging prior to sample collection. As previously discussed, fine-grained particles containing metals species or particles

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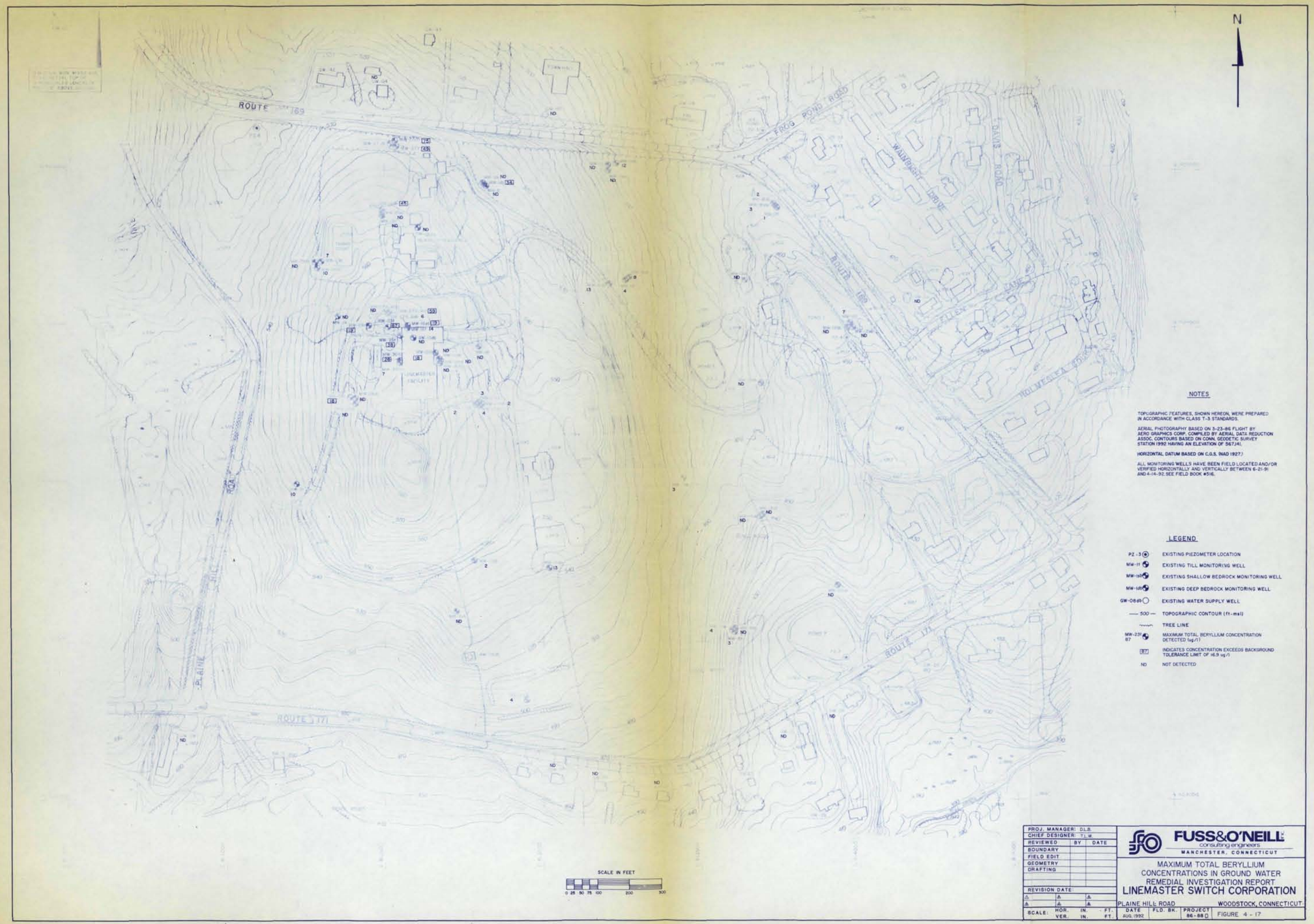

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.(4).

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92. SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-1T	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
MW-23T 87	MAXIMUM TOTAL BERYLLIUM CONCENTRATION DETECTED (ug/l)
87	INDICATES CONCENTRATION EXCEEDS BACKGROUND TOLERANCE LIMIT OF 16.9 ug/l
ND	NOT DETECTED

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MAXIMUM TOTAL BERYLLIUM
CONCENTRATIONS IN GROUND WATER
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
AUG. 1992		86-88 D	FIGURE 4 - 17

with adsorbed metals species may be entrained by the relatively high flow velocities created during purging and sampling, as well as by the cascading of water into the base of the dry till wells during recharge. In general, the amount of fine-grained material introduced into the wells during purging and sampling normally is expected to decrease with time as the aquifer equilibrates following well installation and development. The observed correlation between TSS and total beryllium concentrations indicates that as the concentration of TSS decreases, corresponding beryllium concentration decreases can also be expected. If total beryllium concentrations are related to suspended fine-grained particles as hypothesized, and the amount of suspended solids is expected to decrease with time as the aquifer returns to more normal conditions, then total beryllium concentrations would also be expected to decrease with time. In fact, in several of the till wells (i.e. MW-1db, MW-23t, MW-24t, MW-26t) beryllium concentrations in samples collected subsequent to the sampling event when the background tolerance limit was exceeded have decreased and since have not exceeded the background tolerance limit.

Furthermore, based on the relatively lower till hydraulic conductivities in the vicinity of the central topographic high on which the manufacturing facility is situated, the till in this area may be finer grained than in other portions of the study area. Because of this, the ground water in this area may contain significantly higher concentrations of TSS, which may also lead to naturally elevated beryllium concentrations.

Cadmium

Cadmium concentrations exceeding the background tolerance limit

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of 20.4 ug/l were detected in samples collected from deep bedrock well MW-15db, shallow bedrock wells MW-16sb and MW-EPA-Asb, and eight till wells, MW-8t, MW-16t, MW-17ts, MW-23t, MW-24t, MW-25t, MW-26t, and MW-EPA-Atd. No exceedances of the background cadmium upper tolerance limit were detected in any water-supply wells.

Figure 4-18 depicts the distribution of maximum total cadmium concentrations detected in study area domestic supply and ground-water monitoring wells. Similar to beryllium, till wells with cadmium exceedances of the background upper tolerance limit are concentrated in the vicinity of the north end of the Linemaster manufacturing facility. The highest concentrations of total cadmium were detected in till wells MW-23t (757 ug/l) and MW-25t (366 ug/l).

The exceedances of the cadmium upper tolerance limit are believed to reflect an area of naturally higher concentrations of cadmium, rather than a centralized source area. The exceedances at MW-8t, located adjacent to Pond 2 southeast of the manufacturing facility, and MW-17ts, located approximately 130 feet southeast of the facility, do not appear to be related to the elevated concentrations in the vicinity of the north end of the manufacturing facility. Furthermore, the one cadmium exceedance in a deep bedrock well was identified at MW-15db, located approximately 350 feet north of the manufacturing facility, also does not support an interpretation that cadmium exceedances are related to a central source area.

Again, similar to beryllium, exceedances of the background tolerance limit are limited to recently installed wells (April 1991 to June 1991). This supports the hypothesis that cadmium background tolerance limit exceedances may be related to the

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

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HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92. SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-1t	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
MW-23t 757	MAXIMUM TOTAL CADMIUM CONCENTRATION DETECTED (ug/l)
757	INDICATES CONCENTRATION EXCEEDS BACKGROUND UPPER TOLERANCE LIMIT OF 20.4 ug/l
ND	NOT DETECTED

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MAXIMUM TOTAL CADMIUM CONCENTRATIONS IN GROUND WATER
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
AUG. 1992		86-98 D	FIGURE 4 - 18

entrainment of suspended fine-grained particles that either contain cadmium or that have adsorbed naturally occurring cadmium species.

Nickel

The only nickel concentration exceeding the background upper tolerance limit of 4256 ug/l was detected at MW-23t during August 1991. MW-23t is a till monitoring well located adjacent to the northwest corner of the manufacturing facility. No exceedances of the background nickel tolerance limit were detected in any other till, shallow bedrock, deep bedrock, or water-supply well.

MW-23t has been sampled and analyzed for total nickel on two occasions. The exceedance of the nickel upper tolerance limit was detected during the initial sampling round conducted during August 1991. The total nickel concentration detected during the subsequent January 1991 sampling event (2680 ug/l) was significantly less than both the August 1991 concentration (6000 ug/l) and the background upper tolerance limit (4256 ug/l).

The single one-time exceedance of the background upper tolerance limit for nickel at MW-23t does not suggest that nickel contamination is present at the site. The exceedance at MW-23t is believed to be due to sampling prior to aquifer equilibration and the resulting entrainment of suspended particles that either naturally contain nickel or have adsorbed naturally occurring nickel species.

Barium, Chromium, and Lead

Concentrations of barium, chromium, and lead in study area

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monitoring wells and water-supply wells are less than the upper tolerance limit for these metals, which indicates that these metals are present at naturally occurring concentrations in study area ground waters.

Other Metals

As previously discussed, insufficient background data prevented determination of tolerance limits for the remaining metals (aluminum, antimony, calcium, cobalt, copper, iron, lithium, magnesium, manganese, mercury, potassium, selenium, silver, sodium, strontium, thallium, tin, vanadium, and zinc). Despite the limited study area monitoring well data for these metals, the concentrations and distribution of these metals do not appear to indicate the presence of any significant metals contamination in the study area.

4.3.3.4 Summary

The range of naturally occurring concentrations of total metals in the ground water at the site has been determined based on the metals data from five wells deemed representative of unimpacted background conditions. Statistical analyses of the background data allowed construction of an upper tolerance limit. The upper tolerance limit was constructed to have a 95 percent probability of being greater than 95 percent of the background population. In general, an exceedance of the upper tolerance limit is interpreted to present statistically significant evidence that elevated metals concentrations may be present; however, soil and bedrock heterogeneities may also lead to apparent exceedances as well. Tolerance limits were constructed for the metals of primary concern at the site (arsenic, barium, beryllium, cadmium,

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chromium, lead, and nickel). Insufficient background data precluded determination of tolerance limits for other metals.

Based on comparison with background tolerance limits, there is no evidence to suggest that barium, chromium or lead ground-water contamination is present at the site or in the study area. Additionally, there is no evidence of domestic supply well contamination by arsenic, barium, beryllium, cadmium, chromium, lead or nickel. Total metals concentrations for aluminum, antimony, calcium, cobalt, copper, iron, lithium, magnesium, manganese, mercury, potassium, selenium, silver, sodium, strontium, thallium, tin, vanadium, and zinc from the study area monitoring wells and domestic supply wells are interpreted to fall within the expected naturally occurring concentration ranges.

Exceedances of the background upper tolerance limit for arsenic were detected in bedrock wells. Although no spatial concentration distribution trend was apparent, total arsenic concentrations were generally higher in bedrock wells (513 ug/l maximum) than in the till wells (240 ug/l maximum). The total arsenic exceedances are interpreted to be related to areas where the bedrock contains higher natural concentrations of arsenic. Chemical analysis of rock cuttings indicates that arsenic, as well as other metals, occur naturally at varying concentrations in the bedrock lithologies at the site. The arsenic exceedance in background well MW-12t, a till well considered representative of background conditions, indicates that arsenic concentrations vary spatially in the till ground water, as well as in the bedrock.

Exceedances of background upper tolerance limits may suggest that

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elevated concentrations of arsenic, beryllium, cadmium, and nickel are present at the site. In general, the one identified nickel exceedance and the several exceedances of the background upper tolerance limits for beryllium and cadmium were concentrated in the till and shallow bedrock wells located adjacent to the north end of the manufacturing facility. Although the spatial distribution of exceedances may suggest the existence of a metals source area, the exceedances are believed to be due to sampling prior to aquifer equilibration following well installation and development and the entrainment of suspended particles containing naturally occurring metals or having adsorbed naturally occurring metals species during purging and sampling. The fact that higher total metals concentrations generally correlate well to high TSS concentrations and that the general decreasing total metals concentration trend over time for certain metals in many of the till wells where exceedances were identified, also support the conclusion that the occurrence of metals in the ground water is a natural phenomenon.

One possible mechanism for metal solubilization in the till ground water in the vicinity of the Zone 1 source area is the acid extraction of naturally occurring metals from the till due to the by-products of trichloroethene biodegradation. If the upper portion of the saturated till contains sufficient dissolved oxygen, aerobic biological mechanisms exist for the formation of formic acid, glyoxylic acid and dichloroacetic acid from the biodegradation of TCE (Little et al., 1988). Although a co-substrate such as methane or methanol has been used in laboratory research, the biotransformation process has been shown to degrade TCE and subsequently decrease pH without a co-substrate (Oldenhuis et al., 1989). Because the degrading bacteria are largely attached to the soil particles (Roberts et al., 1989),

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the concentration of acid will decrease away from the particle surfaces. The higher acid concentration at the surface of the soil particles could result in higher rates of metal extraction from the till sediments than would be predicted from the normally higher pH of the bulk ground water in the saturated till. As previously discussed in Section 4.1.3.2, this process may be reversible and result in localized precipitation of the solubilized metals onto saturated till sediments at a depth where the pH is more neutral.

4.4 Surface Water

4.4.1 VOCs

No VOCs (NUS, 1987) were detected in the two December 19, 1985 NUS pre-RI/FS surface-water samples analyzed by CLP methods (NUS, 1987); however, during NUS investigations in December, 1985 and February, 1986 , tentative identification of TCE was made in four of the surface-water samples analyzed by the NUS in-house gas chromatograph screening method. As reported by NUS (NUS, 1987), TCE was tentatively identified in samples collected from the northwest wetlands adjacent to Route 169, at a concentration of 0.4 ppb and from the unnamed stream east of the site as it crosses Route 171 at a concentration less than the detection limit. TCE was also identified in samples collected from Pond 1 (38 ppb) and from Pond 2 (4 ppb). It should be noted that the in-house VOC screening methods employed by NUS resulted in tentative compound identification only; concentrations of VOCs tentatively identified by the NUS screening method are estimated values expressed relative to a VOC standard of known concentration.

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Evaluation of the analytical VOC data reported for the 13 RI/FS Phase 1A surface-water samples collected on June 19-20, 1990 was performed in accordance with EPA Region I data validation guidelines for organics analyses (U.S. EPA, 1988b). Validation identified several deficiencies with the laboratory data, most notably the presence of low-level method blank contamination. The surface-water sample validation report, including a tabular summary of validated surface-water VOC data, is included in Appendix T.

A summary of the VOCs detected in the Phase 1A and 1B surface-water samples and other surface-water samples collected during the RI/FS (i.e. SW-14 and Pond 3) is included in Table 4-25. Any required validation qualifiers for the Phase 1A samples are duly noted in this table. The results for the Phase 1B surface-water samples should be considered preliminary and are subject to future data validation correction and qualification.

The surface-water analytical data indicate the presence of low concentrations of VOCs in Ponds 1, 2 and 3. Pond 1 samples collected adjacent the inlet (SW-4) and outlet (SW-7) of the pond during the July 1990 and May 1992 sampling events contained TCE and/or 1,2-dichloroethene (or cis-1,2-dichloroethene). TCE concentrations ranged from 5.9 ug/l to 6.7 ug/l. Detected concentrations of 1,2-dichloroethene ranged from 0.9 ug/l to 3 ug/l.

TCE was detected in surface-water sample SW-18 which was collected from Pond 3 on May 8, 1992. Although Pond 3 was not sampled during the Phase 1A sampling event, TCE was also detected in other surface-water samples collected from Pond 3 during the RI/FS investigation. Concentrations of TCE present in Pond 3

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TABLE 4-25

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SURFACE WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SW-1		SW-3		SW-4		SW-5		SW-6
Date	07/19/90	05/08/92	07/19/90	05/08/92	07/19/90	05/08/92	07/19/90	07/19/90DUP	07/19/90
Sample ID	19290071902	40192050817	19290071905	40192050810	19290071907	40192050813	19290071908	19290071909	19290071910
Parameter (ug/l)									
1,2-Dichloroethene (total)	-	-	-	-	3*	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	1.2	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	-	-	6.7	-	-	-

- Not detected
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-25
(CONTINUED)
SURFACE WATER - SUMMARY OF DETECTED VOCs

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	SW-7	SW-7	SW-8	SW-9	SW-10			SW-11	SW-12	SW-13
	Date	07/19/90	05/08/92	05/08/92	07/20/90	07/20/90	07/20/90DUP	05/08/92	07/20/90	07/20/90	07/20/90
	Sample ID	19290071911	40192050812	40192050809	19290072013	19290072009	19290072010	40192050806	19290072007	19290072005	19290072003
Parameter (ug/l)											
1,2-Dichloroethene (total)		-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene		-	0.9	-	-	-	-	-	-	-	-
Chloroform		-	-	-	2J	2J	1J	-	-	-	-
Trichloroethene		-	5.9	-	-	-	-	-	-	-	-

- Not detected
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-25
(CONTINUED)
SURFACE WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location		SW-14		SW-15	SW-16		SW-17	SW-18
Date	05/08/92	10/01/91	05/08/92	05/08/92	05/08/92	05/08/92DUP	05/15/92	05/08/92
Sample ID	40192050804	31391100107	40192050803	40192050801	40192050805	40192050807	40192051501	40192050818
Parameter (ug/l)								
1,2-Dichloroethene (total)	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	-	-	-	-	2.8

- Not detected
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-25
(CONTINUED)
SURFACE WATER - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	POND3			
	Date	12/11/90	03/05/91	04/04/91	06/07/91
	Sample ID	3139012110	31391030513	31391040407	31391060718
Parameter (ug/l)					
1,2-Dichloroethene (total)		-	-	-	-
cis-1,2-Dichloroethene		-	-	-	-
Chloroform		-	-	-	-
Trichloroethene		2.6	10	7.0	-

- Not detected
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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ranged from not detected (ND) to 10 ug/l.

Chloroform, the only VOC detected in surface-water samples collected from Pond 2, was detected in samples SW-9, SW-9 Duplicate, and SW-10, which were collected on July 20, 1992. The low estimated concentrations (1-2 ug/l) of chloroform in these samples may be due to laboratory contamination. This interpretation is supported by the fact that chloroform was not detected in the SW-10 sample collected from Pond 2 on May 8, 1992.

The presence of low concentrations of TCE in Pond 3 surface-water samples may be due to either pond recharge by contaminated ground water or, more likely, the discharge of contaminated ground water to the pond from the curtain drain for the Blakely residence leaching field. The low concentrations of VOCs present in Pond 1 may be due to a combination of discharge from Pond 3 and contaminated ground-water recharge to the eastern stream north of Pond 1.

4.4.2 Metals

No "elevated levels of inorganic metals" (NUS, 1987) were detected in surface-water samples analyzed by NUS in-house screening methods during the NUS 1985 and 1986 site-screening investigations.

Arsenic was detected in all 12 surface-water samples collected during Phase 1A investigations on July 19-20, 1990. The Phase 1A arsenic results were validated and found to have no data quality deficiencies (See Appendix T). Phase 1B surface-water samples were collected from 12 surface-water sampling locations and

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analyzed for the presence of total arsenic, total chromium, and total lead. Total arsenic concentrations in excess of the analytical limit of detection were only present in the Pond 3 surface-water sample (SW-18) collected during the Phase 1B investigation. It is possible that the fewer number of detectable total arsenic concentrations observed in the Phase 1B surface-water samples may be due to the slightly higher detection limit for the Phase 1B samples (1.4 ug/l to 1.7 ug/l) than for the Phase 1A samples (1.0 ug/l). Two Phase 1B surface-water samples (SW-8 and SW-17) were found to contain total lead concentrations above the detection limit. None of the Phase 1B samples contained detectable concentrations of total chromium. Low concentrations of total arsenic were detected in two other surface-water samples collected from Pond 3 during RI/FS investigations. The results of all surface-water sample metal analyses are summarized in Table 4-26.

Background surface-water metal concentrations have been estimated based on the limited data collected from sampling locations SW-3 in Northeast Pond, and SW-13, SW-14, and SW-15, which are located in the western portion of the study area. These sampling locations are far enough downgradient of the site so that no surface-water VOC impact has been observed and therefore are believed to provide representative background surface-water metals concentration data. Total arsenic concentrations at these background surface-water sampling locations have ranged from not detected (ND) to 3.2 ug/l. Total chromium and total lead were not detected at any of the background surface-water sampling locations.

Total arsenic concentrations in excess of the maximum background concentration, 3.2 ug/l, have only been detected at SW-1 in the

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TABLE 4-26

SURFACE WATER - SUMMARY OF DETECTED METALS

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REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SW-1		SW-3		SW-4		SW-5		SW-6
Date	07/19/90	05/08/92	07/19/90	05/08/92	07/19/90	05/08/92	07/19/90	07/19/90DUP	07/19/90
Sample ID	19290071902	40192050817	19290071905	40192050810	19290071907	40192050813	19290071908	19290071909	19290071910
Parameter (ug/l)									
Arsenic, Total	9.1*	-	3.2*	-	1.2*	-	2.6*	2.4*	1.5*
Chromium, Total		-		-		-			
Lead, Total		-		-		-			

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-26
(CONTINUED)
SURFACE WATER - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SW-7		SW-8	SW-9	SW-10			SW-11	SW-12
Date	07/19/90	05/08/92	05/08/92	07/20/90	07/20/90	07/20/90	05/08/92	07/20/90	07/20/90
Sample ID	19290071911	40192050812	40192050809	19290072013	19290072009	19290072010	40192050806	19290072007	19290072005
Parameter (ug/l)									
Arsenic, Total	1.8*	-	-	1.6*	1.3*	1.6*	-	2.4*	1.0*
Chromium, Total		-	-				-		
Lead, Total		-	1.8				-		

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-26
(CONTINUED)
SURFACE WATER - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SW-13		SW-14		SW-15	SW-16		SW-17	SW-18
Date	07/20/90	05/08/92	10/01/91	05/08/92	05/08/92	05/08/92	05/08/92	05/15/92	05/08/92
Sample ID	19290072003	40192050804	31391100107	40192050803	40192050801	40192050805	40192050807	40192051501	40192050818
Parameter (ug/l)									
Arsenic, Total	1.3*	-	2.0	-	-	-	-	-	1.8
Chromium, Total		-		-	-	-	-	-	-
Lead, Total		-		-	-	-	-	2.3	-

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-26
(CONTINUED)
SURFACE WATER - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	POND3			
Date	06/07/91	12/11/90	03/05/91	04/04/91
Sample ID	31391060718	3139012110	31391030513	31391040407
Parameter (ug/l)				
Arsenic, Total	-	3.7	2.9	-
Chromium, Total	-	-	-	-
Lead, Total	-	-	-	-

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary.
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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northwest wetlands area (9.1 ug/l) and in Pond 3 (3.7 ug/l); however, it should noted that non-detectable arsenic concentrations have also been recorded at these two sampling points. Seasonal factors or variable hydrologic and hydrogeologic conditions (e.g. seasonal precipitation, storm events, stream discharge rates, amount of baseflow, recharge/discharge relationships etc.) may also be responsible for the variation in total arsenic concentrations observed at SW-1, Pond 3, and other surface-water sampling locations.

In general, the distribution of Phase 1A total arsenic concentrations in the surface-water bodies does not appear to be related to current or historical site operations, nor does the distribution appear to correspond to variation in underlying bedrock lithologies or soil types. Because arsenic has been determined to be naturally occurring in study area soils, bedrock, and ground water (See Sections 3.1, 4.1, 4.2, and 4.3), the presence of arsenic in the study area surface-water bodies is interpreted to be the result of natural accumulation.

The two detections of total lead concentrations in the surface water at sample locations SW-8 and SW-17 are not explicable based on the present knowledge of site conditions. Speculatively, these detections could possibly be related to the particulate emission of lead from vehicular traffic as the SW-8 and SW-17 surface-water sampling points are located immediately adjacent to sections of Routes 169 and 171.

As detailed in the Phase 1B Work Plan, additional quarterly surface-water sampling and analyses for total metals will be performed to evaluate the occurrence of metals in the study area water bodies and identify any seasonal influences or variability.

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4.5 Sediment

4.5.1 VOCs

During NUS pre-RI/FS site-screening investigations, toluene was detected in "trace amounts" in a sediment sample collected from an upstream location in the Mill Brook (NUS, 1987). TCE was detected in "moderate amounts" in sediment samples collected from Pond 2 and the unnamed stream east of the site where it crosses Route 171. TCE tentatively was identified in "substantial amounts" in a sample collected from Pond 1 (NUS, 1987). Benzene was detected in "trace amounts" in a sediment sample collected from the unnamed stream east of the site near the Route 171 crossing (NUS, 1987). As previously discussed, the NUS in-house VOC screening methods provide tentative compound identification only; concentrations of tentatively identified compounds in soil samples could not be quantified and therefore were expressed as relative estimates (NUS, 1987).

Validation of the VOC analytical data reported for the 15 RI/FS sediment samples collected on June 19-20, 1990 was performed in accordance with EPA Region I data validation guidelines (U.S. EPA, 1988b). As discussed in the data validation report included in Appendix T, laboratory method blank contamination and several other deficiencies (e.g. non-compliant calibration and variable internal standard response stability) were identified during validation. As a result of the data quality deficiencies, all Phase 1A sediment sample VOC concentrations were qualified as estimated concentrations.

During Phase 1B investigations, sediment samples were collected from six surface-water body locations. The original Phase 1B

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sample collected at location SE-4 erroneously was not analyzed for VOCs; however, a duplicate sample (SE-4 Duplicate) collected from this same location was analyzed for VOCs. The results of the Phase 1B sediment samples should be considered preliminary and are subject to future data validation correction and qualification.

A summary of the VOCs detected in Phase 1A and 1B sediment samples is provided in Table 4-27. Data validation qualifiers for the Phase 1A sample results are noted in this table.

Data validation revealed that the VOCs detected in the Phase 1A sediment samples were also present in several laboratory method blanks, suggesting a possible laboratory source of these compounds. The presence of laboratory method blank contamination and the estimated VOC concentrations and elevated or rejected VOC detection limits in the majority of the Phase 1A sediment samples necessitates that the Phase 1A sediment data be viewed with a degree of uncertainty. For these reasons, the evaluation of the nature and extent of sediment VOC contamination in the study area is primarily based on the results of the Phase 1B sediment sample analyses.

VOCs were detected in Phase 1A sediment samples collected from the inlet (SE-4) and outlet (SE-7) of Pond 1 and from Pond 2 (SE-9, SE-10, SE-10 Duplicate, and SE-15). VOCs were also detected in Phase 1A sediment samples SE-11 and SE-12, which were collected from surface-water bodies south of Route 171. VOCs present in these samples included benzene, toluene, 4-methyl-2-pentanone (MIBK), and vinyl acetate. TCE was not detected in any of the Phase 1A sediment samples analyzed.

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TABLE 4-27

SEDIMENT - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	BACKGROUND	BACKGROUND1	SE-1		SE-3			SE-4		SE-5
Date	7/20/90	7/19/90	7/19/90	5/08/92	7/19/90	5/13/92	5/13/92DUP	5/08/92DUP	7/19/90	7/19/90
Sample ID	19290072002	19290071901	19290071904	40192050815	19290071906	40192051303	40192051304	40192050816	19290071912	19290071915
Parameter (ug/Kg)										
4-Methyl-2-pentanone	-	-	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	-	-	10J	-
Toluene	-	-	-	-	-	-	-	-	11J	-
Vinyl acetate	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	-	-	-	190	-	-	-	33	-	-

- Not detected
* - Data validated, no qualifiers necessary
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-27
(CONTINUED)
SEDIMENT - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SE-5	SE-6	SE-7	SE-9	SE-10			SE-11	SE-12	SE-13
Date	7/19/90DUP	7/19/90	7/19/90	7/20/90	7/20/90	7/20/90DUP	5/13/92	7/20/90	7/20/90	7/20/90
Sample ID	19290071914	19290071917	19290071913	19290072014	19290072011	19290072012	35192051302	19290072008	19290072006	19290072004
Parameter (ug/Kg)										
4-Methyl-2-pentanone	-	-	-	-	-	-	-	6 J	8 J	-
Benzene	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	22 J	30 J	1 J	-	-	81 J	71 J	-
Vinyl acetate	-	-	-	130 J	-	220 J	-	830 J	-	-
cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-

- Not detected
* - Data validated, no qualifiers necessary
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-27
(CONTINUED)
SEDIMENT - SUMMARY OF DETECTED VOCs

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

	Sample Location	SE-14	SE-15	SE-16	SE-18
	Date	7/19/90	7/20/90	5/13/92	5/08/92
	Sample ID	19290071916	19290072015	35192051301	35192050819
Parameter (ug/Kg)					
4-Methyl-2-pentanone		-	-	-	-
Toluene		-	10 J	-	-
Vinyl acetate		-	46 J	-	-
cis-1,2-Dichloroethene		-	-	-	-

- Not detected
* - Data validated, no qualifiers necessary
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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Samples collected at locations SE-1 and SE-4 were the only Phase 1B sediment samples in which VOCs were detected. The only VOC detected in these two samples was cis-1,2-dichloroethene, which was detected at a concentrations of 130 ug/kg and 33 ug/kg in samples SE-1 and SE-4, respectively. As discussed in Section 4.4.2, cis-1,2-dichloroethene was also detected in the Phase 1B SW-4 surface-water sample concurrently collected from the inlet to Pond 1, but was not detected in the surface-water sample concurrently collected from the SW-1 sampling point in the northwest wetland. The presence of cis-1,2-dichloroethene in the SE-1 and SE-4 sediment samples may be due to contaminated ground-water discharge to the sediments and surface waters in these two areas. The occurrence of cis-1,2-dichloroethene in the sediment sample collected from the inlet to Pond 1 may also be due to Pond 3 discharge to the eastern stream upstream of the SE-4 sampling point.

4.5.2 Metals

No "elevated levels of inorganic metals" (NUS, 1987) were detected in the eight sediment samples screened by NUS in-house methods during pre-RI/FS site-screening investigations.

Arsenic was detected in all Phase 1A sediment samples at concentrations ranging from 3.3 mg/kg to 11.7 mg/kg. Data validation (See Appendix T) determined that the arsenic concentrations reported for Phase 1A samples SE-9 to SE-15 should be treated as estimated values due to low matrix spike recovery or poor replicated linearity near the contract required detection limit (CRDL). In addition to arsenic, all Phase 1B sediment samples were analyzed for the presence of chromium and lead. Phase 1B sediment samples SE-3, SE-4, and SE-10 were also

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analyzed for HSL metals. A summary of detected metals concentrations is provided in Table 4-28.

Background surface-water sediment concentrations have been estimated for arsenic, chromium, and lead based on the limited data collected from sampling locations SE-3 in Northeast Pond, and SE-13, SE-16, and Background-1, which are located in the western portion of the study area. These sampling locations are far enough down gradient of the site so that no surface-water VOC impact has been observed and therefore are believed to provide representative background sediment metals concentration data. Arsenic concentrations at these background sediment sampling locations ranged from 3.3 mg/kg to 11.7 mg/kg. Background sediment chromium and lead concentrations ranged from 26.9 to 45.4 mg/kg and 11.2 to 55.6 mg/kg, respectively.

Sediment arsenic concentrations in excess of the maximum background concentration, 11.7 mg/kg, have only been detected at SE-1 in the northwest wetlands area (20.3 mg/kg). Chromium concentrations at sediment sampling locations SE-1 in the northwest wetlands (79.0 mg/kg), SE-10 in Pond 2 (67.8 mg/kg), and in Pond 3 at SE-18 (52.3 mg/kg) exceeded the maximum background concentration of 45.4 mg/kg. Lead concentrations at SE-1 (158 mg/kg) and in Pond 1 at SE-4 (74.4 to 89.0 mg/kg) exceeded the maximum background sediment concentration of 55.6 mg/kg.

The highest concentrations of arsenic, chromium and lead detected in Phase 1B sediment samples were present in sample SE-1, which was collected from the northwest wetland area. The reason for this occurrence may be related to the high percentage of fine-grained particles and the high total organic carbon content of

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TABLE 4-28

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SEDIMENT - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	BACKGROUND1	SE-1		SE-3			SE-4			SE-5
Date	7/19/90	7/19/90	5/08/92	7/19/90	5/13/92	5/13/92DUP	7/19/90	5/08/92	5/08/92DUP	7/19/90
Sample ID	19290071901	19290071904	40192050815	19290071906	35192051303	35192051304	19290071912	40192050814	40192050816	19290071915
Parameter (mg/Kg)										
Aluminum, Total					12100	23000		13200	15500	
Antimony, Total					-	-		-	-	
Arsenic, Total	11.7	5.0*	20.3	4.4*	4.5	11.1	7.6*	5.0	5.1	5.5*
Barium, Total					47.8	74.3		59.3	76.7	
Beryllium, Total					-	0.83		-	-	
Cadmium, Total					-	-		-	-	
Calcium, Total					1120	2140		2760	4470	
Chromium, Total			79.0		26.9	45.4		34.6	44.7	
Cobalt, Total					6.0	8.3		4.9	-	
Copper, Total					9.0	16.5		14.8	19.2	
Iron, Total					8300	17000		9840	12400	
Lead, Total			158		24.0	55.6		74.4	89.0	
Lithium, Total					18.9	20.1		-	-	
Mercury, Total					-	-		-	-	
Nickel, Total					14.9	24.8		29.7	51.1	
Potassium, Total					1410	2010		2220	2180	
Selenium, Total					-	-		-	-	
Silver, Total					-	-		-	-	
Sodium, Total					293	450		420	319	
Strontium, Total					13.5	-		-	-	
Thallium, Total					-	-		-	-	
Tin, Total					-	-		-	-	
Vanadium, Total					17.9	37.1		24.7	31.9	
Zinc, Total					45.8	64.2		59.3	76.7	

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-28
(CONTINUED)
SEDIMENT - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SE-5	SE-6	SE-7	SE-9	SE-10			SE-11	SE-12	SE-13
Date	7/19/90DUP	7/19/90	7/19/90	7/20/90	7/20/90	7/20/90DUP	5/13/92	7/20/90	7/20/90	7/20/90
Sample ID	19290071914	19290071917	19290071913	19290072014	19290072011	19290072012	35192051302	19290072008	19290072006	19290072004
Parameter (mg/Kg)										
Aluminum, Total							22900			
Antimony, Total							-			
Arsenic, Total	5.6*	5.0*	8.2*	5.6 J	9.4 J	2.8*	5.1	7.8 J	5.9 J	3.3 J
Barium, Total							99.3			
Beryllium, Total							0.48			
Cadmium, Total							-			
Calcium, Total							2830			
Chromium, Total							67.8			
Cobalt, Total							14.5			
Copper, Total							21.8			
Iron, Total							24900			
Lead, Total							9.9			
Lithium, Total							24.2			
Mercury, Total							-			
Nickel, Total							48.4			
Potassium, Total							8110			
Selenium, Total							-			
Silver, Total							-			
Sodium, Total							218			
Strontium, Total							9.3			
Thallium, Total							-			
Tin, Total							-			
Vanadium, Total							46.0			
Zinc, Total							48.3			

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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TABLE 4-28
(CONTINUED)
SEDIMENT - SUMMARY OF DETECTED METALS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	SE-14	SE-15	SE-16	SE-18
Date	7/19/90	7/20/90	5/13/92	5/08/92
Sample ID	19290071916	19290072015	35192051301	40192050819
Parameter (mg/Kg)				
Aluminum, Total				
Antimony, Total				
Arsenic, Total	9.4 J	7.2 J	4.5	6.1
Barium, Total				
Beryllium, Total				
Cadmium, Total				
Calcium, Total				
Chromium, Total			30.5	52.3
Cobalt, Total				
Copper, Total				
Iron, Total				
Lead, Total			11.2	6.8
Lithium, Total				
Mercury, Total				
Nickel, Total				
Potassium, Total				
Selenium, Total				
Silver, Total				
Sodium, Total				
Strontium, Total				
Thallium, Total				
Tin, Total				
Vanadium, Total				
Zinc, Total				

- Not detected
Blank space indicates parameter was not analyzed for.
* - Data validated, no qualifiers necessary
Data Validation Qualifiers
J - Reported concentration is an estimated value.

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this sample as discussed in Section 4.5.3.

In general, the distribution of metals concentrations in the surface-water body sediments does not appear to be related to current or historical site operations, nor does the distribution appear to correspond to variation in underlying bedrock lithologies or soil types. Because arsenic, chromium, and lead have been determined to be naturally occurring in study area soils, bedrock, and ground water (See Sections 3.1, 4.1, 4.2 and 4.3), the presence of these and other metals in the study area surface-water body sediments is interpreted to be the result of natural accumulation.

4.5.3 Grain Size and Total Organic Carbon

Results of Phase 1A and Phase 1B sediment sample grain-size analyses are summarized in Table 4-29. The analytical results reflect the fact that sediment grain-size distribution varies between sediment samples collected at the same location during separate sampling events, and even between duplicate samples collected during the same sampling event. As a whole, the surface-water body sediments are composed of a substantial portion of fine-grained particles. Combined, grains of clay and silt size (particles less than approximately 0.06 millimeters in diameter) account for more than 50% of sample weight in the majority of the sediment samples.

Phase 1A and 1B sediment sample total organic carbon (TOC) concentrations are listed in Table 4-30. Phase 1A sediment sample TOC concentrations ranged from 8,900 mg/kg to 100,200 mg/kg. Phase 1B sample TOC concentrations ranged from 1,120 mg/kg to 266,000 mg/kg. Direct comparison of Phase 1A and

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TABLE 4-29

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SEDIMENT - SUMMARY OF SIEVE ANALYSES

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PERCENT PASSING

Sample Location	SE-1		SE-3			SE-4			SE-5
Sample ID	7/19/90	5/08/92	7/19/90	5/13/92	5/13/92DUP	7/19/90	5/08/92	5/08/92DUP	7/19/90
Date	19290071904	40192050815	19290071906	40192051303	40192051304	19290071912	40192050814	40192050816	19290071915
Sieve									
1"									
3/4"			100	100					
1/2"				95					
3/8"				95					100
#4		98	94.8	94	100		100	100	99.1
#8			87.8						98.7
#10		96		92	99		97	99	
#16	100		77.4			100			97.4
#20		93		86	97		94	97	
#30	97.5		62.6			97.4			93.1
#40		91		77	94		90	94	
#50	91.9		43.5			95.0			91.3
#60	87.4	89	39.1	68	88	93.0	86	90	87.8
#100	79.4	87	30.4	62	81	83.7	74	75	83.5
#200	58.0	82	20.9	56	69	64.3	48	46	58.3
0.06 MM		75		54	58		44	39	
#400	44	62	16	49	32	53	24	21	48
.005MM	4.1		1.9			4.9			7.5

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TABLE 4-29
(CONTINUED)
SEDIMENT - SUMMARY OF SIEVE ANALYSES

DRAFT
REV. 1.0 120192

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PERCENT PASSING

Sample Location	SE-6	SE-7	SE-9	SE-10		SE-11	SE-12	SE-13	SE-14
Sample ID	7/19/90	7/19/90	7/20/90	7/20/90	5/13/92	7/20/90	7/20/90	7/20/90	7/19/90
Date	19290071917	19290071913	19290072014	19290072011	35192051302	19290072008	19290072006	19290072004	19290071916
Sieve									
1"									
3/4"					100				
1/2"			100		98				
3/8"				100	95				100
#4	100		98.3	93.9	87			100	96.5
#8	97.0	100	96.5	92.2		100	100	99.1	91.3
#10					79				
#16	92.6	99.9	95.7	91.3		99.1	98.7	97.4	84.3
#20					72				
#30	84.1	98.1	91.3	87.8		97.4	96.2	94.8	75.7
#40					64				
#50	74.3	93.0	85.2	82.6		93.1	92.4	88.7	65.2
#60	66.4	91.3	82.6	80.0	58	92.2	89.9	86.1	62.6
#100	54.9	83.4	72.2	71.3	48	86.1	79.1	72.2	50.4
#200	30.4	62.1	48.7	52.2	30	73.1	52.3	42.6	30.4
0.06 MM					28				
#400	19	50	35	46	23	66	38	28	22
.005MM	4.1	3.6	1.8	6.1		4.2	4.1	1.9	1.8

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TABLE 4-29
(CONTINUED)
SEDIMENT - SUMMARY OF SIEVE ANALYSES

DRAFT
REV. 1.0 120192

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PERCENT PASSING

Sample Location	SE-15	SE-16	SE-18
Sample ID	7/20/90	5/13/92	5/08/92
Date	19290072015	35192051301	40192050819
Sieve			
1"			100
3/4"			97
1/2"			94
3/8"	100	100	90
#4	99.4	98	84
#8	93.5		
#10		95	79
#16	86.3		
#20		87	73
#30	79.0		
#40		76	66
#50	69.8		
#60	66.3	65	60
#100	57.6	49	47
#200	44.2	26	28
0.06 MM		23	26
#400	37	13	19
.005MM	2.3		

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TABLE 4-30 REV. 1.0 120192

SEDIMENT - SUMMARY OF TOC CONCENTRATIONS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Sample Location	Sample ID	Date	TOC (mg/Kg)
BACKGROUND1	19290071901	07/19/90	28600
SE-1	19290071904	07/19/90	52200
SE-1	40192050815	05/08/92	266000
SE-3	19290071906	07/19/90	100200
SE-3	40192051303	05/13/92	60900
SE-3 Dup	40192051304	05/13/92	39000
SE-4	19290071912	07/19/90	39000
SE-4	40192050814	05/08/92	57800
SE-5	19290071915	07/19/90	35100
SE-5 Dup	19290071914	07/19/90	39400
SE-6	19290071917	07/19/90	39000
SE-7	19290071913	07/19/90	30800
SE-9	19290072014	07/20/90	8900
SE-10	19290072011	07/20/90	28500
SE-10	40192051302	05/13/92	1120
SE-10 Dup	19290072012	07/20/90	23700
SE-11	19290072008	07/20/90	31800
SE-12	19290072006	07/20/90	43500
SE-13	19290072004	07/20/90	24100
SE-14	19290071916	07/19/90	25700
SE-15	19290072015	07/20/90	18600
SE-16	40192051301	05/13/92	8890
SE-18	40192050819	05/08/92	6340

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1B TOC results is not possible due to the different analytical methods employed. Phase 1A sediment samples were analyzed by EPA Method 9060, whereas Phase 1B samples were analyzed by EPA Method Lloyd Kahn. The procedures employed by the Lloyd Kahn analytical method result in the most accurate determination of the amount of total organic carbon present in sediment samples (Lloyd Kahn, 1992 pers. comm.).

In general, the TOC and grain-size analyses indicate that favorable conditions (i.e. fine-grained particles and sufficient organic carbon) for contaminant accumulation were present in the sediments collected and analyzed. In order to determine if sediment metals concentrations were related to the sediment sample TOC and grain size characteristics, the graphs in Figures 4-19, and 4-20 were prepared. These graphs depict Phase 1A and Phase 1B arsenic concentrations plotted versus TOC concentrations (expressed as percentages) and the percentage of grains smaller than 0.06 mm (silt and clay particles), respectively. Because of the greater amount of arsenic concentration data relative to the otherwise limited sediment metals concentration data, arsenic was selected to evaluate any sediment grain-size/TOC contaminant relationships. The graphs reveal no consistent correlation between detected arsenic concentrations and grain size or TOC concentrations. However, it should be noted that the highest concentration of arsenic (as well as chromium and lead) was detected in Phase 1B sample SE-1, the same sample that had the highest TOC concentration and the greatest percentage of fines.

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FIGURE 4-19
Phase 1A-Arsenic v. TOC-Grain Size

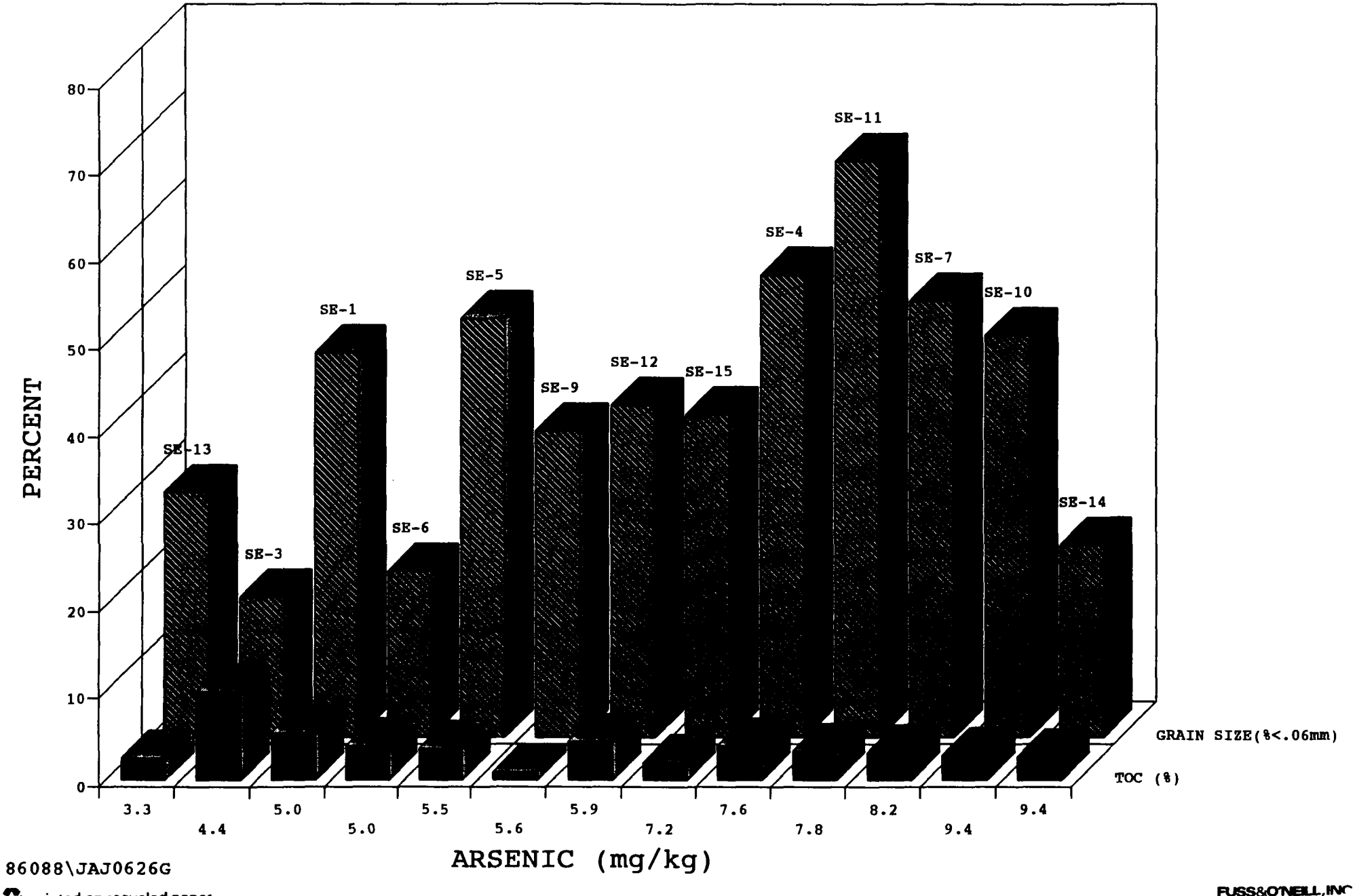

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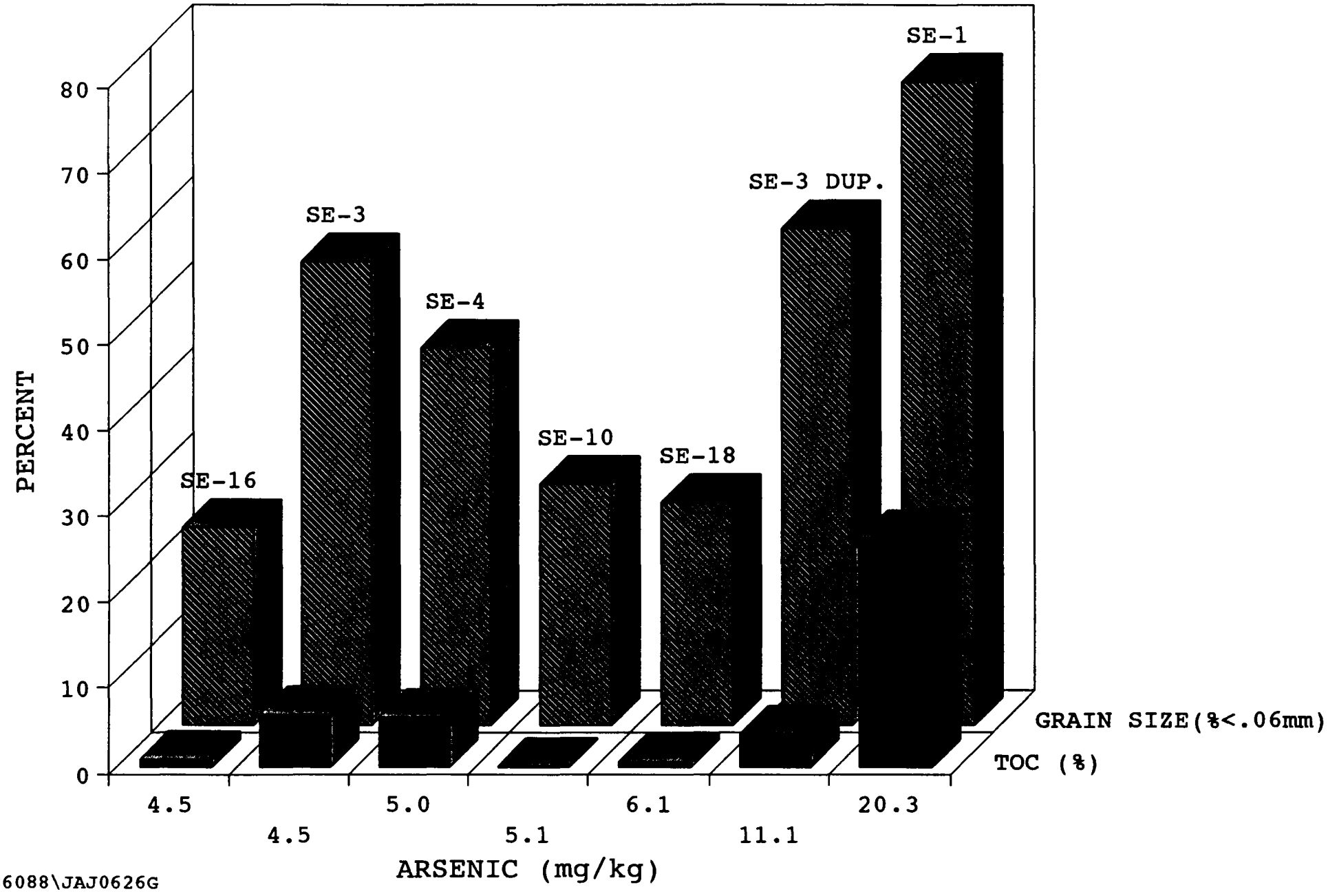
FIGURE 4-20
Phase 1B-Arsenic v. TOC-Grain Size



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4.6 Summary of Contamination Assessment

4.6.1 VOCs

Soil

Analysis of data collected during site investigations indicates that Zone 1, the location of the former dry well and paint settling booth, is the primary VOC source area. High residual concentrations of VOCs are present in the Zone 1 soil due to former solvent discharges into the dry well. VOCs are also present under the facility adjacent to Zone 1; however, the magnitude and extent of VOCs under the building are unknown.

No DNAPLs have been identified at the site by physical measurements to date. However, chemical data from the sampling of MW-26t, the angled monitoring well screened underneath the facility, indicates the possible existence of DNAPLs.

Zone 2, the former facility wastewater disposal system, and Zone 3, the former Blakely residence leaching field, are not considered potential VOC source areas. Soil sampling and analysis conducted at Zones 2 and 3 indicate low or non-detectable concentrations of VOCs that may be attributable to ground-water transport. Zone 4, the paint shed area, is not considered a potential VOC source area because of the low or non-detectable VOCs in the shallow soils. The highest concentrations of VOCs in Zone 4 soils were found within the saturated till, indicating VOC transport by ground water from Zone 1. It is likely that the contaminated soils beneath the paint shed are an extension of the Zone 1 contamination.

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Water-Supply Monitoring

The confirmed detections of chlorinated VOCs in water-supply wells are likely attributable to the Linemaster site. The detection of the aromatic VOC benzene in water-supply wells is not attributed to Linemaster. Benzene was detected in wells located in an area potentially downgradient of the Woodstock Public School, which has underground fuel storage tanks. Currently, the Town of Woodstock is investigating a possible release from these tanks.

Correlations are not evident between the detected VOC concentrations and sample collection months indicating no apparent seasonal trends. However, a similar yearly trend is evident for only three water-supply well sampling locations. This trend is characterized by increasing VOC concentrations from approximately 1986, when water supply sampling was initiated, to 1988, when the highest concentrations were detected. After 1988 the concentrations decreased to their current level. Due to data limitations, the significance of this trend is uncertain.

Ground Water

VOCs, mainly TCE, are being transported from the Zone 1 source area to the northwest, north, northeast, east, southeast, and southwest in the till unit. The primary direction of transport of VOCs in the till unit is to the east-northeast following the natural hydraulic gradient. In addition, the bedrock surface topography may exert some control and influence ground-water flow and VOC transport in the till unit.

The highest concentrations of total VOCs were found at MW-10td

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(420,507 ug/l) and MW-26t (817,070 ug/l). MW-10td is located downgradient and within 10 feet of the former dry well location. MW-26t is an angled monitoring well with the screen located underneath the Linemaster facility. The high VOC concentrations at these wells indicate that significant contamination remains in Zone 1 because of the low hydraulic conductivity of the till.

Although MW-26t is topographically higher than the former dry well area, MW-26t is located hydraulically downgradient of the former dry well area as indicated by the ground-water contours. Based on this, ground water flows from the former dry well area to MW-26t. Therefore, the VOCs detected at MW-26t have originated from the former dry well. The natural ground-water conditions at the dry well area may be influenced by the building which acts as a cap or barrier to precipitation and prevents infiltration to the sediments underlying the facility. This would have the effect of creating an area of relatively lower hydraulic potential underneath the building. Ground-water migration to the area underneath the facility may also have occurred in the past due to drawdown in the till unit caused by the pumping of GW-10db, the former backup facility production well located underneath the facility. Migration from Zone 1 to beneath the facility may also have been caused by the hydraulic influences of former discharges into the dry well which may have caused ground-water mounding.

VOCs, after migrating from Zone 1 to underneath the building, appear to have migrated to the Zone 4 area on the opposite side of the building as indicated by the ground-water contours and by the VOCs present in monitoring wells at this area. Ground-water migration from underneath the building to Zone 4 may have been facilitated in the past by the pumping of GW-10db. TCE has been

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detected at similar concentrations in the production well and in wells located in the vicinity of the paint shed. Although sand lenses or stringers were not intercepted during the installation of till wells in the paint shed area, preferential flow of VOC-contaminated ground water through such or similar features may also explain the presence of VOCs at the paint shed area.

Elevated concentrations of MEK and MIBK were detected at MW-16t, located immediately adjacent to the northwest corner of the facility. These compounds were not detected in ground-water samples collected from wells located adjacent to the former dry well area. Based on this, the former paint settling booth area may be a source of possible historical discharge of MEK and MIBK. These compounds were also detected in soil samples collected in areas near the former dry well and former paint settling booth located in Zone 1. It is also possible that some other historical discharge area may exist in the area of MW-16t; however, no such areas have been identified to date in Zone 1. MEK and MIBK are present in certain types of paint thinners that may have been discharged as paint mist into the settling booth.

VOCs, primarily TCE, have been transported in ground water to other till areas of the site by the natural horizontal hydraulic gradient. The presence of VOCs in overburden deposits at the study area boundaries may be related to bedrock discharge.

VOCs, mainly TCE, are being transported in ground water from the Zone 1 source area to the northwest, north, northeast, east, and southeast in the shallow bedrock unit. The primary VOC transport direction in the shallow bedrock is to the east-northeast, parallel to the ground-water flow direction. The highest concentrations of total VOCs in the shallow bedrock were found at

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wells located in the vicinity of the former dry well.

In the deep bedrock, TCE and VOCs are being transported in all directions from the Zone 1 area with several preferential directions of migration. The primary direction of VOC migration, toward the east-northeast, appears to coincide with the two identified major fracture traces. Preferential ground-water flow through fractures may also explain the trace levels of VOCs detected at water-supply wells, although this remains to be confirmed. Preferential ground-water flow within the easterly dipping schist fracture planes may also be a factor contributing to the northeasterly migration of VOCs.

Elevated levels of VOCs have been detected at the Linemaster backup production well (GW-10db) since 1986. Moderate levels of VOCs have also been detected at GW-08db, the facility production well south of the facility, and at GW-12db, the Blakely residence former water-supply well, located north of the facility. VOC migration within the deep bedrock to these wells was likely induced and facilitated by pumping. The pumping of GW-08db affects the deep bedrock aquifer in the area of the facility as determined from a background water-level study. VOCs in the deep bedrock are found at greater distances from the source area than in the till and shallow bedrock. This is likely due to the greater hydraulic conductivity and water-transmitting capabilities of the fractured deep bedrock.

Surface Water

Low concentrations of VOCs (< 10 ug/l) have been detected in surface-water samples collected from Ponds 1, 2, and 3. TCE and cis-1,2-dichloroethene have been detected in Pond 1 surface

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water. Only TCE has been detected in surface-water samples collected from Pond 3. Chloroform was detected in surface-water samples collected from Pond 2 during the Phase 1A sampling event, but was not detected at this location during the Phase 1B sampling event.

The presence of VOCs in Pond 3 may be related to recharge of the pond by contaminated ground water; however, it is more likely that the VOCs are present in Pond 3 due to the diversion of contaminated ground water to the pond by the Blakely leaching field curtain drain. VOCs present in Pond 1 surface water may be related to stream recharge by contaminated ground water north of Pond 1 or the discharge of Pond 3 overflow into the eastern stream system just north of the inlet to Pond 1. The low concentrations of chloroform detected in Pond 2 during Phase 1A investigations were not substantiated during Phase 1B investigations and, therefore, are believed to be due to laboratory contamination.

Sediment

Due to data quality deficiencies associated with the Phase 1A sediment analytical data, the nature and extent of possible sediment VOC contamination has been evaluated based on Phase 1B sediment sample analyses. During Phase 1B investigations, VOCs were detected in sediment samples collected from Pond 1 and the wetland area in the northwest corner of the Blakely property. Cis-1,2-dichlorethene was the only VOC detected at these two sampling locations. Discharge of contaminated ground water to the eastern stream north of Pond 1 and the northwest wetland may be responsible for the presence of cis-1,2-dichlorethene in the sediments at these locations. Discharge of Pond 3 overflow to

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Pond 1 may also be partially responsible for the presence of cis-1,2-dichlorethene in Pond 1 sediments.

4.6.2 ABNs

Soil

ABNs were detected in soil samples collected during Phase 1A investigations. It was hypothesized that the most frequently detected TCL ABNs, bis(2-ethylhexyl)phthalate and di-n-butylphthalate, were the result of laboratory contamination or cross contamination. This was based on: 1) the lack of historical chemical information documenting the use of these compounds at Linemaster; 2) the distribution of the detections at the site does not indicate a source area(s); and, 3) di-n-butylphthalate leaches from certain types of laboratory equipment. To determine the accuracy of the data, a representative number of sample results with positive detections of these compounds were submitted for data validation.

Validation of ABN analytical data indicates that the compounds bis(2-ethylhexyl)phthalate and di-n-butylphthalate are not parameters of concern at the site and are most likely related to laboratory blank contamination. Several other ABNs were detected once in Zone 1 and Zone 4 soils; however, these compounds may be associated with former discharges (Zone 1) or the result of a small oil spill (Zone 4). Regardless, due to their minimal extent and occurrence, these parameters are of limited concern at the site.

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Ground Water

Similar to the soil samples discussed in the previous section, ABNs were detected in ground-water samples collected during Phase 1A investigations. To determine the accuracy of the data, a representative number of sample results with positive detections of these compounds were submitted for data validation.

Data validation established revised detection limits and qualified the concentrations of ABNs, thereby providing a more accurate representation of site conditions. All bis(2-ethylhexyl)phthalate and di-n-butylphthalate concentrations were revised to ND after validation, except for two samples where di-n-butylphthalate remained at low concentrations. These compounds are not considered parameters of concern due to the low concentrations of the compounds and the possibility that the compounds are related to laboratory blank contamination.

The PNAs and benzoic acid detected in MW-16t may be indicative of residual concentrations from a minor fuel oil spill or from a small loss of oil during the excavation of a fuel oil tank pipe in the paint shed area.

4.6.3 Metals

Soil

The range of naturally occurring, or background, metals concentrations in soils were established based on the analytical results from soil samples collected from eight on- and off-site locations that have not been impacted by VOCs. The concentrations of metals in soil samples collected during RI/FS

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investigations in Zones 1, 2, 3, and 4 were compared to the maximum background concentration for each metal to determine if potentially elevated concentrations of metals were present.

Potentially elevated concentrations of arsenic, barium, cadmium, chromium, lead, and zinc were identified in soil samples collected from Zone 1. In general, concentrations of barium, cadmium, chromium, and zinc were elevated in soil samples collected in the vicinity of the former dry well. Concentrations of these metals generally increased with depth, suggesting that the concentrations may be related to the presence of metals in the till ground water. Elevated concentrations of arsenic, chromium, and lead were detected in samples collected from the former paint settling booth location. Paint chips were observed in several of these samples and may be responsible for the elevated metals concentrations.

Concentrations of cadmium, chromium, lead, selenium, and zinc exceeding the maximum background concentrations for these metals were detected in soil samples collected from the trench adjacent to the brick dry well in Zone 2. The potentially elevated concentrations in these samples may be related to metals leaching out of plumbing fixtures and piping or may associated with the discharge of facility wastewater to the brick dry well.

Slightly elevated concentrations of several metals were detected in Zone 3 soil samples collected from the trenches installed in the vicinity of the former Blakely leaching field. Because the concentrations of metals were less than or only slightly higher than the maximum background concentrations, Zone 3 soils are interpreted to be free of significant impact from historical site operations.

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Analysis of soil samples collected adjacent to the paint shed in Zone 4 identified several metals that exceeded the maximum background concentrations. Of these metals, barium, cadmium, chromium, and nickel concentrations most commonly exceeded the maximum background concentrations. The fact that the concentrations of these metals generally increase with depth suggests a possible influence from metals present in the till ground water. Elevated arsenic concentrations were detected in the fill material and soil immediately underlying the concrete floor of the paint shed. However, the fact that arsenic concentrations in soil samples collected at slightly deeper depths below the concrete floor were significantly lower suggests that the extent of the soils with elevated arsenic concentrations is very limited.

Water-Supply Well Monitoring

Based on statistical analyses of background ground-water data, no statistically elevated concentrations of metals were detected in water-supply wells. However, during a June 1990 sample event, concentrations of total arsenic exceeding the federal MCL of 50 ug/l were detected in two water-supply wells (GW-21 and GW-34db). No other exceedances of primary drinking water standards for metals were detected in any active water-supply well. The concentrations of metals detected in samples collected from water-supply wells are believed to represent naturally occurring concentrations and are not related to the Linemaster site.

Ground Water

Analytical data from five study area monitoring and water-supply

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wells were statistically analyzed to establish the background, or naturally occurring, concentrations of total metals in ground water. Based on the upper tolerance limits calculated from the background data, potentially elevated concentrations of arsenic, beryllium, cadmium, and nickel were present in several study area monitoring wells. Potentially elevated concentrations were not identified in any domestic supply wells.

Potentially elevated concentrations of total arsenic were only detected in four shallow or deep bedrock wells. The arsenic concentrations in these wells are interpreted to be associated with higher, naturally occurring concentrations of arsenic in the bedrock. This interpretation is supported by the visual observation of arsenopyrite, an arsenic-sulfide mineral, in a bedrock core sample collected from MW-10sb and the reported occurrence of naturally elevated concentrations of arsenic in water-supply wells yielding from the same bedrock formation in other parts of New England.

Potentially elevated concentrations of total beryllium and total cadmium were identified in a number of till monitoring wells located adjacent to and north of the north end of the Linemaster manufacturing facility. The concentration of total nickel was also potentially elevated in one well in the same area. Although the spatial distribution of potentially elevated concentrations of total beryllium, total cadmium, and total nickel may suggest that a metals source area exists in the vicinity of the north end of the manufacturing facility, these metals are believed to be naturally occurring, rather than related to past site activities.

The potentially elevated concentrations of these metals are believed to be due to sampling prior to aquifer equilibration and

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the entrainment of suspended particles containing naturally occurring metals or having adsorbed naturally occurring metals species during purging and sampling. The fine-grained nature of the till, the correlation between total metals concentrations and TSS concentrations and the general decreasing total metals concentration trend over time for certain metals in many of the till wells also support the conclusion that the occurrence of metals in the ground water is a natural phenomenon.

Surface Water

Samples collected from study area surface-water bodies have been analyzed for total arsenic, total chromium, and total lead. No detectable concentrations of total chromium were detected in any surface-water samples. Although arsenic concentrations in two surface-water bodies exceeded background arsenic surface-water concentrations, the low total arsenic concentrations (less than 10 ug/l) in study area surface-water bodies and the fact that, arsenic has been found to naturally occur in study area soils and bedrock, the occurrence of arsenic in study area surface-water bodies is believed to be the result of natural phenomena. The concentrations of lead in excess of background lead surface-water concentrations in two surface-water bodies adjacent to Routes 169 and 171 in the southern portion of the study area are not believed to be related to the Linemaster site, but may be due to vehicular emissions.

Sediment

All sediment samples collected during RI/FS investigations were analyzed for arsenic. Several samples were also analyzed for chromium and lead or for HSL metals. The only sediment sample

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with an arsenic concentration exceeding the maximum arsenic sediment background concentration was collected from the northwest wetland. Lead concentrations exceeding the maximum background lead concentration were detected in sediment samples collected from Pond 1 and the northwest wetland. Exceedances of the maximum background chromium concentration was also detected in sediment samples collected from the northwest wetland, Pond 2, and Pond 3. Overall, the concentrations and distribution of arsenic, chromium, lead, and the other metals detected in the sediment samples collected during RI/FS investigations are believed to be the result of naturally occurring processes.

Results of grain size and total organic carbon analyses indicated that favorable conditions existed for the accumulation of contaminants in the sediment samples analyzed. The fact that the highest concentrations of arsenic, chromium, and lead were detected in a sample collected from the northwest wetland may be related to the comparatively high percentage of silt- and clay-sized particles and the high total organic carbon content also present in this sample.

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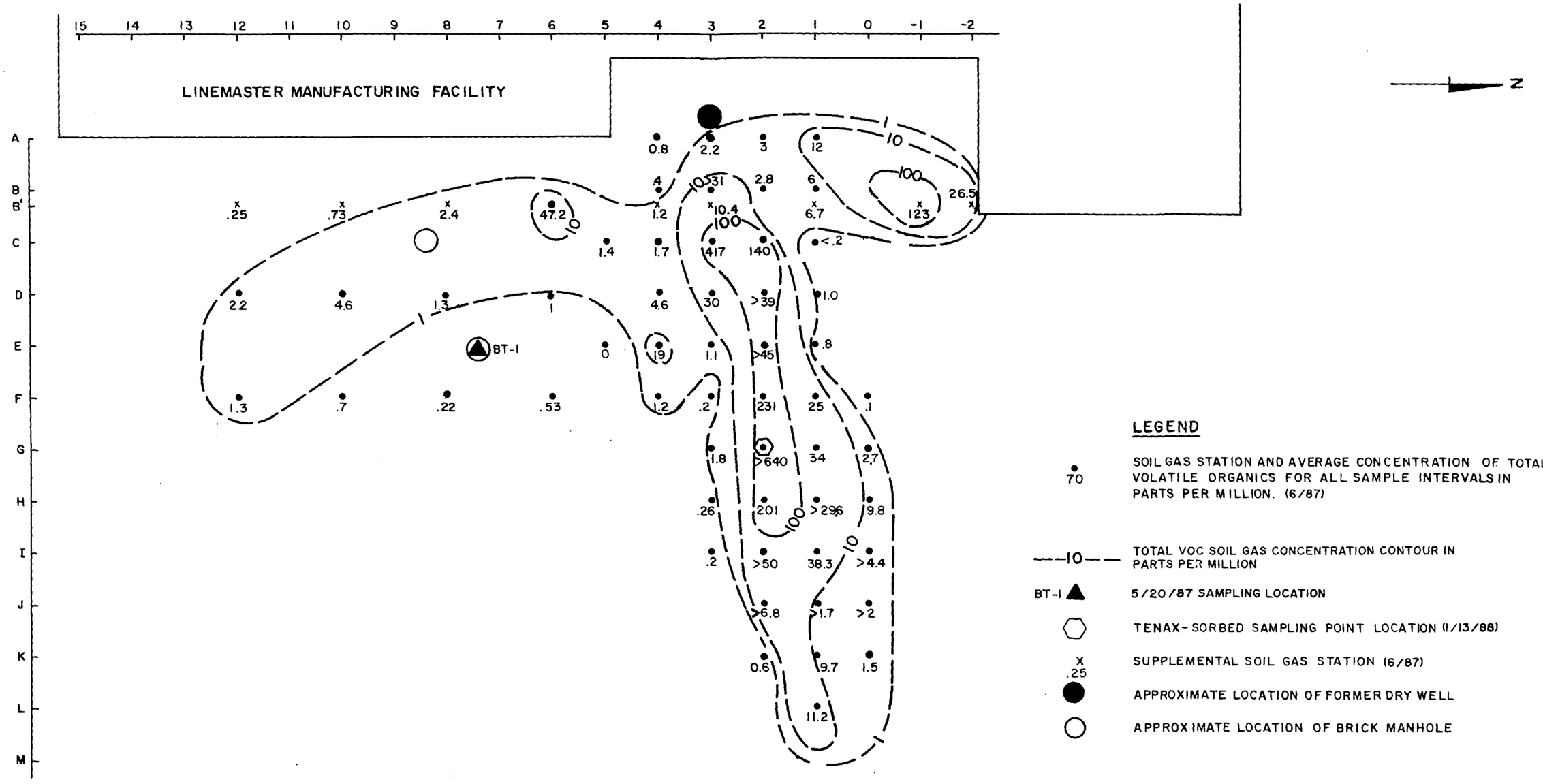

FIGURE 2-2

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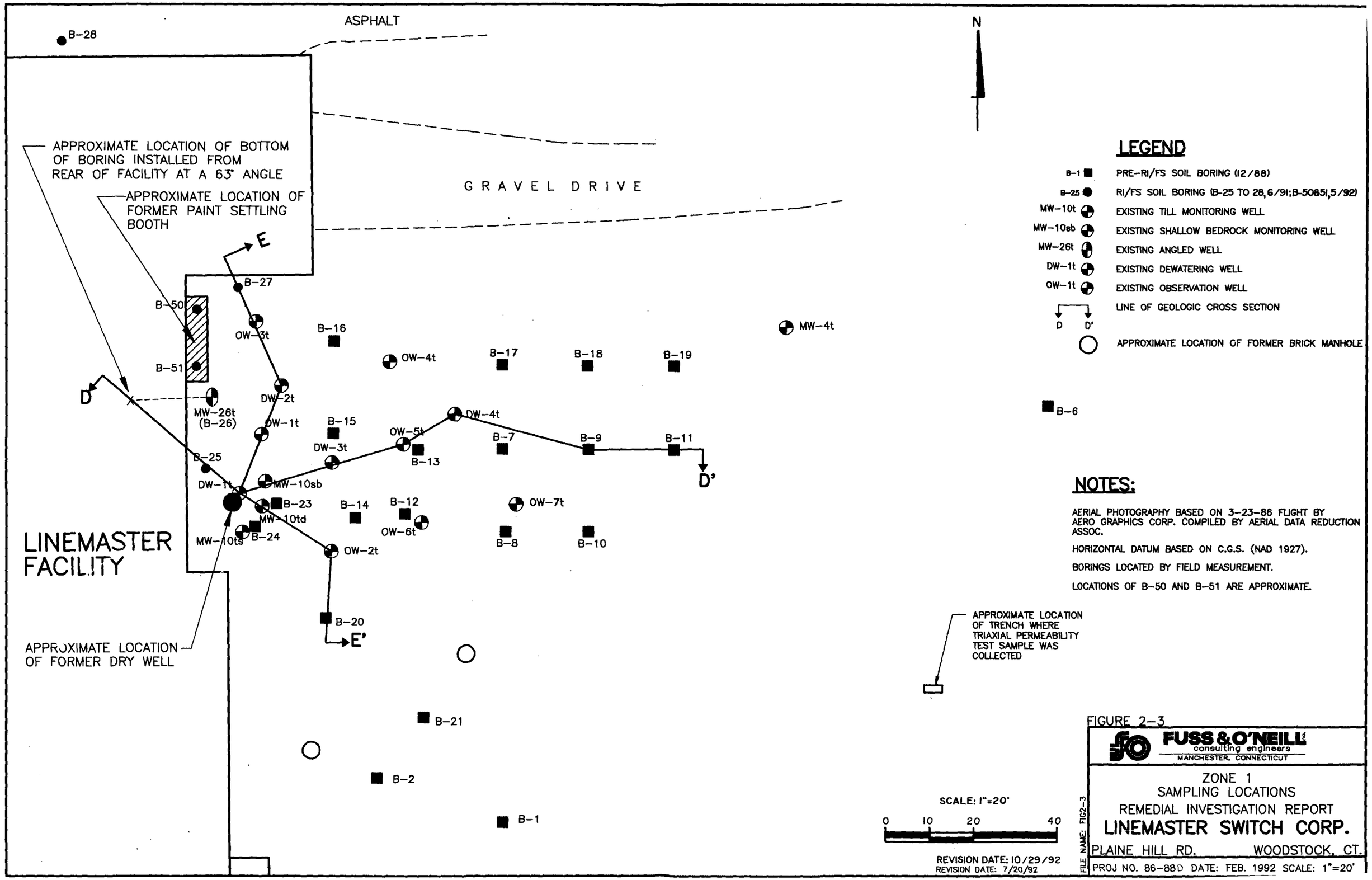
ZONE I
SOIL GAS SCREENING INVESTIGATION
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT

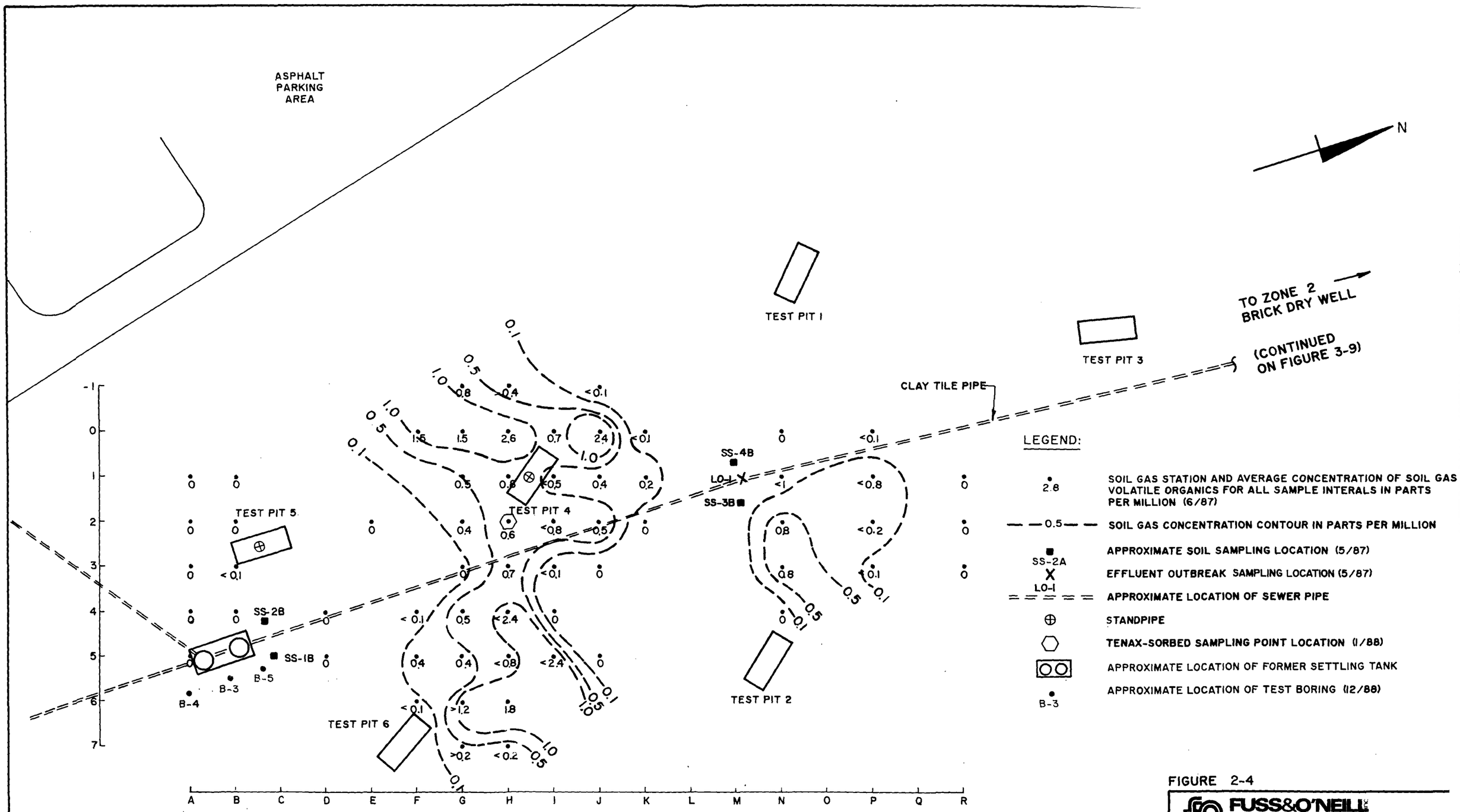
PROJ. NO. 86-88D DATE: 2/20/92 SCALE: 1" = 20'

MODIFIED FROM: PLATE NO. 2 IN "SOIL GAS SURVEY REPORT AND PROPOSED SAMPLING PROGRAM, LINEMASTER SWITCH CORPORATION, WOODSTOCK, CONNECTICUT, SEPTEMBER 1987" PREPARED BY FUSS & O'NEILL INC.

REVISION DATE: 7/21/92
REVISION DATE: 10/29/92

SCALE: 1" = 20'
0 20' 40'


ASPHALT
N
B-28
APPROXIMATE LOCATION OF BOTTOM OF BORING INSTALLED FROM REAR OF FACILITY AT A 63° ANGLE
APPROXIMATE LOCATION OF FORMER PAINT SETTLING BOOTH
GRAVEL DRIVE
E
B-27
B-50
OW-3t
B-16
OW-4t
B-17
B-18
B-19
MW-4t
B-51
D
DW-2t
MW-26t (B-26)
DW-1t
B-15
DW-4t
OW-5t
B-7
B-9
B-11
B-6
DW-3t
B-13
B-25
D'
DW-1t
MW-10sb
B-23
B-14
B-12
OW-7t
MW-10td
OW-6t
B-24
B-8
B-10
MW-10ts
OW-2t
LINEMASTER FACILITY
B-20
E'
APPROXIMATE LOCATION OF FORMER DRY WELL
B-21
B-2
B-1
LEGEND
B-1 PRE-RI/FS SOIL BORING (12/88)
B-25 RI/FS SOIL BORING (B-25 TO 28, 6/91; B-50 & 51, 5/92)
MW-10t EXISTING TILL MONITORING WELL
MW-10sb EXISTING SHALLOW BEDROCK MONITORING WELL
MW-26t EXISTING ANGLED WELL
DW-1t EXISTING DEWATERING WELL
OW-1t EXISTING OBSERVATION WELL
D D' LINE OF GEOLOGIC CROSS SECTION
APPROXIMATE LOCATION OF FORMER BRICK MANHOLE
NOTES:
AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC.
HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927).
BORINGS LOCATED BY FIELD MEASUREMENT.
LOCATIONS OF B-50 AND B-51 ARE APPROXIMATE.
APPROXIMATE LOCATION OF TRENCH WHERE TRIAXIAL PERMEABILITY TEST SAMPLE WAS COLLECTED
SCALE: 1"=20'
0 10 20 40
REVISION DATE: 10/29/92
REVISION DATE: 7/20/92
FIGURE 2-3
FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT
ZONE 1
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.
PLAINE HILL RD. WOODSTOCK, CT.
PROJ NO. 86-88D DATE: FEB. 1992 SCALE: 1"=20'
FILE NAME: FIG2-3



MODIFIED FROM: PLATE NO. 4 IN "SOIL GAS SURVEY REPORT AND PROPOSED SAMPLING PROGRAM, LINEMASTER SWITCH CORPORATION, WOODSTOCK, CONNECTICUT, SEPTEMBER 1987" PREPARED BY FUSS & O'NEILL INC.

REVISION DATE: 7/21/92
REVISION DATE: 10/29/92

SCALE: 1" = 20'

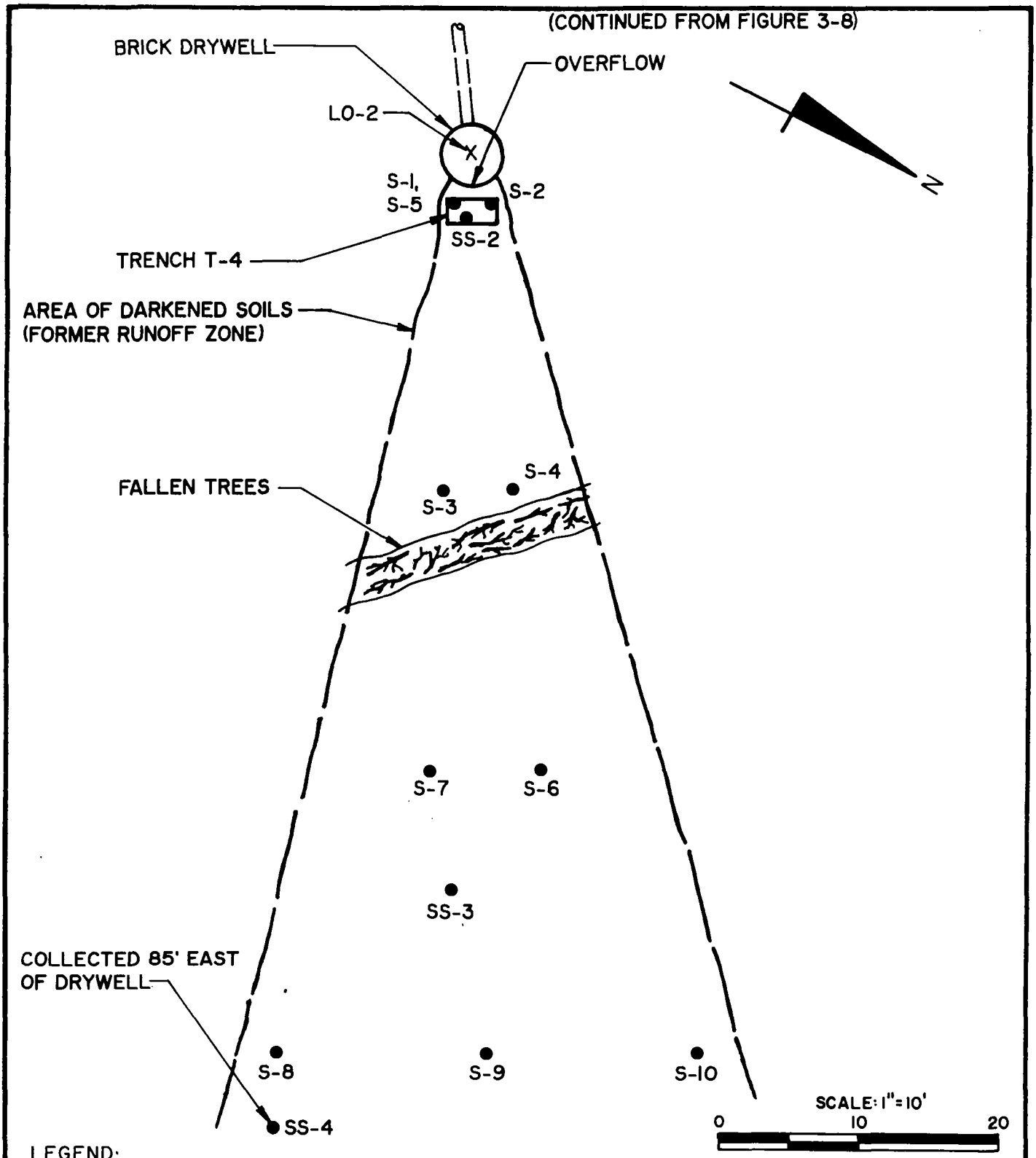
0 10 20 40

FIGURE 2-4

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

ZONE 2
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATIC
PLAINE HILL RD. WOODSTOCK, C

PROJ. NO. 86-88D DATE: 2/14/92 SCALE: 1"=20'



LEGEND:

- ● APPROXIMATE SOIL SAMPLE LOCATIONS (S-1 TO 10, 8/89; SS-2 TO 4, 5/87)
- ▭ APPROXIMATE TRENCH LOCATION (6/91)
- T-4 X LO-2 EFFLUENT OUTBREAK SAMPLING LOCATION (5/87)

MODIFIED FROM PLATE NO. 4 IN SEPT. 1987 "SOIL GAS REPORT & PROPOSED SAMPLING PROGRAM"

REVISION DATE: 10/29/92
REVISION DATE: 7/21/92

FIGURE 2-5

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

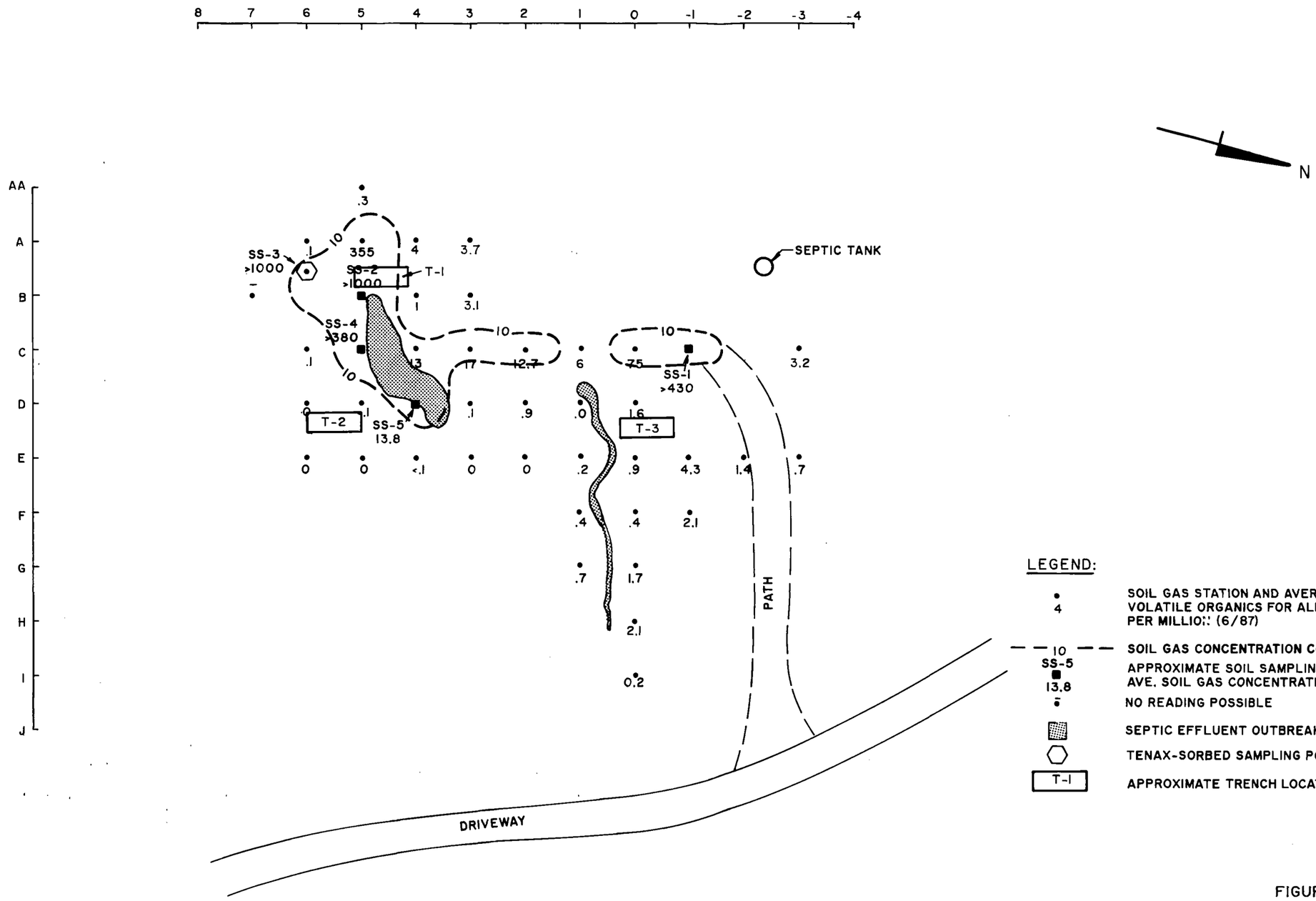
ZONE 2

BRICK DRY WELL SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL RD. WOODSTOCK, CT.

PROJ. NO. 86-88 DATE: 2/14/92 CHECKED BY: TLW

063977



LEGEND:

- 4 — SOIL GAS STATION AND AVERAGE CONCENTRATION OF SOIL GAS VOLATILE ORGANICS FOR ALL SAMPLE INTERVALS IN PARTS PER MILLION (6/87)
- 10 — SOIL GAS CONCENTRATION CONTOUR IN PARTS PER MILLION
- SS-5 / 13.8 — APPROXIMATE SOIL SAMPLING LOCATION (6/89) AVE. SOIL GAS CONCENTRATION (PPM)
- NO READING POSSIBLE
- SEPTIC EFFLUENT OUTBREAK
- TENAX-SORBED SAMPLING POINT LOCATION (1/88)
- T-1 — APPROXIMATE TRENCH LOCATION (6/91)

FIGURE 2-6

MODIFIED FROM: PLATE NO. 5 IN "SOIL GAS SURVEY REPORT AND PROPOSED SAMPLING PROGRAM, LINEMASTER SWITCH CORPORATION, WOODSTOCK, CONNECTICUT, SEPTEMBER 1987" PREPARED BY FUSS & O'NEILL INC.

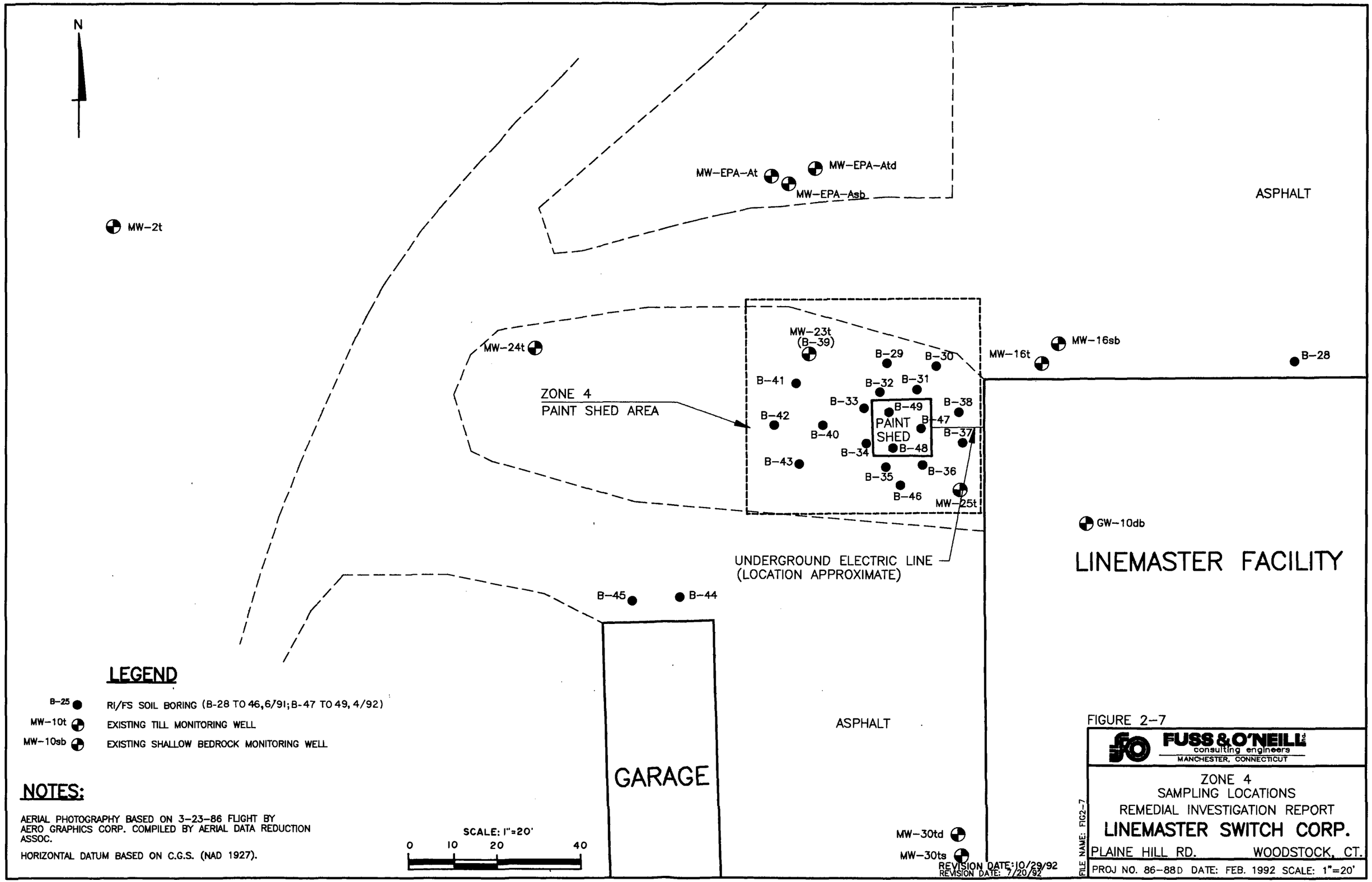
REVISION DATE: 10/29/92
REVISION DATE: 7/21/92

SCALE: 1" = 20'
0 10 20 40

FUSS&O'NEILL INC.
MANCHESTER, CONNECTICUT

ZONE 3
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL RD. WOODSTOCK, CT.

PROJ. NO. 86-88D DATE: 2/14/92 SCALE: 1" = 20'



LEGEND

B-25 ● RI/FS SOIL BORING (B-28 TO 46, 6/91; B-47 TO 49, 4/92)

MW-10t EXISTING TILL MONITORING WELL

MW-10sb EXISTING SHALLOW BEDROCK MONITORING WELL

NOTES:

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927).

REVISION DATE: 10/29/92
REVISION DATE: 7/20/92

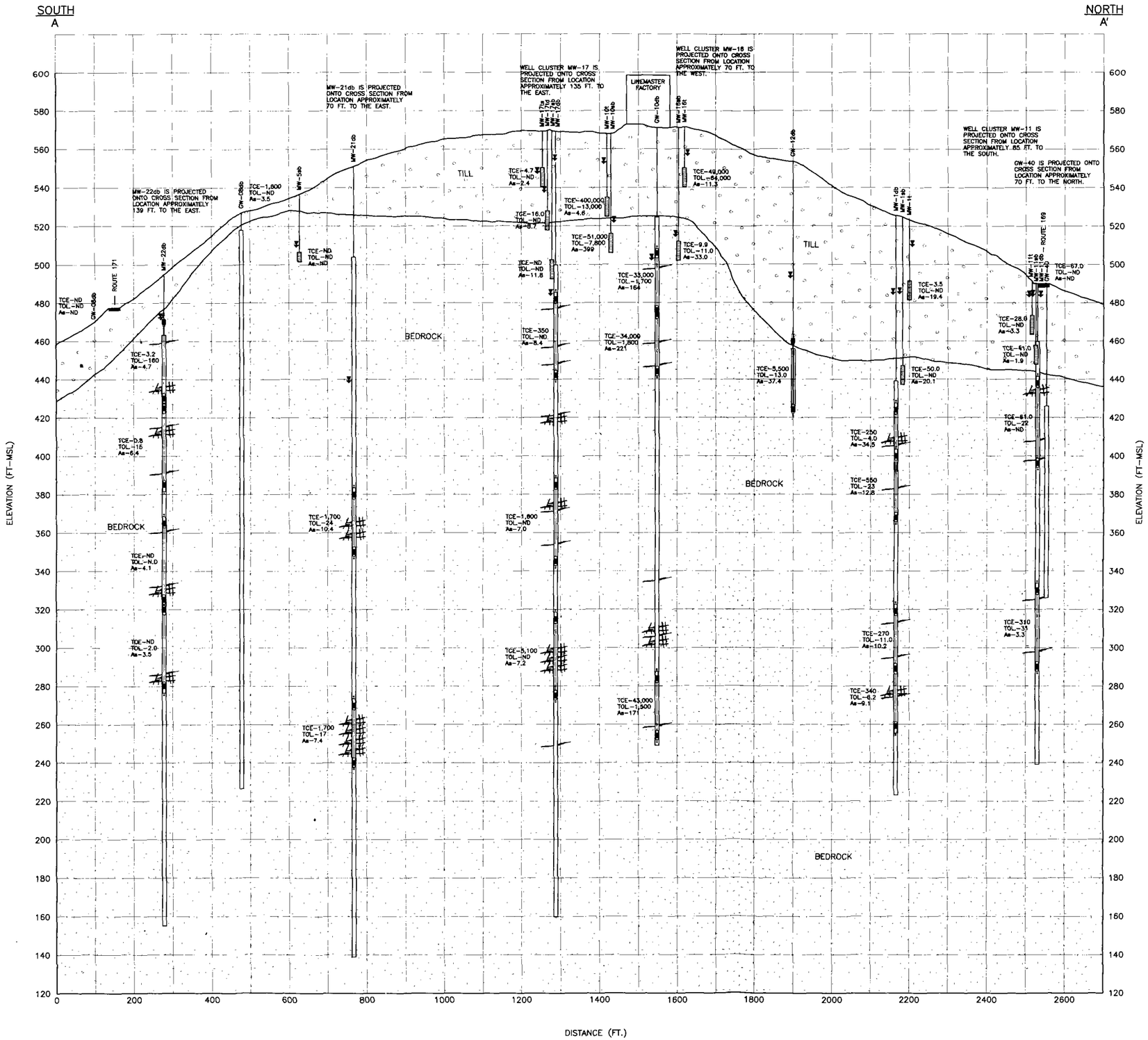
FIGURE 2-7

FUSS & O'NEILL Inc.
consulting engineers
MANCHESTER, CONNECTICUT

ZONE 4
SAMPLING LOCATIONS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.
PLAINE HILL RD. WOODSTOCK, CT.

PROJ NO. 86-88D DATE: FEB. 1992 SCALE: 1"=20'

FILE NAME: FIG2-7



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- OPEN BORE HOLE (DEEP BEDROCK WELLS)
- FRACTURE ZONE
- SINGLE FRACTURE
- PACKER TEST INTERVAL
- TCE — TRICHLOROETHENE CONCENTRATION (ug/l)
- TOL — TOLUENE CONCENTRATION (ug/l)
- As — ARSENIC CONCENTRATION, TOTAL (ug/l)
- GROUND-WATER LEVEL MEASURED ON 9/24/91

NOTE

CHEMICAL DATA FOR MW-1t, MW-5sb, MW-10t, MW-10sb, MW-11t, MW-11sb, GW-10sb AND GW-12db FROM SAMPLING CONDUCTED IN DECEMBER 1990

CHEMICAL DATA FOR MW-11db, MW-16t, MW-16sb, MW-17ts, MW-17td, MW-17db, MW-21db AND MW-22db FROM SAMPLING CONDUCTED IN JUNE AND JULY 1991

CHEMICAL DATA FOR GW-08db, GW-40 AND GW-25 FROM SAMPLING CONDUCTED IN MARCH, JUNE AND SEPTEMBER 1991 RESPECTIVELY

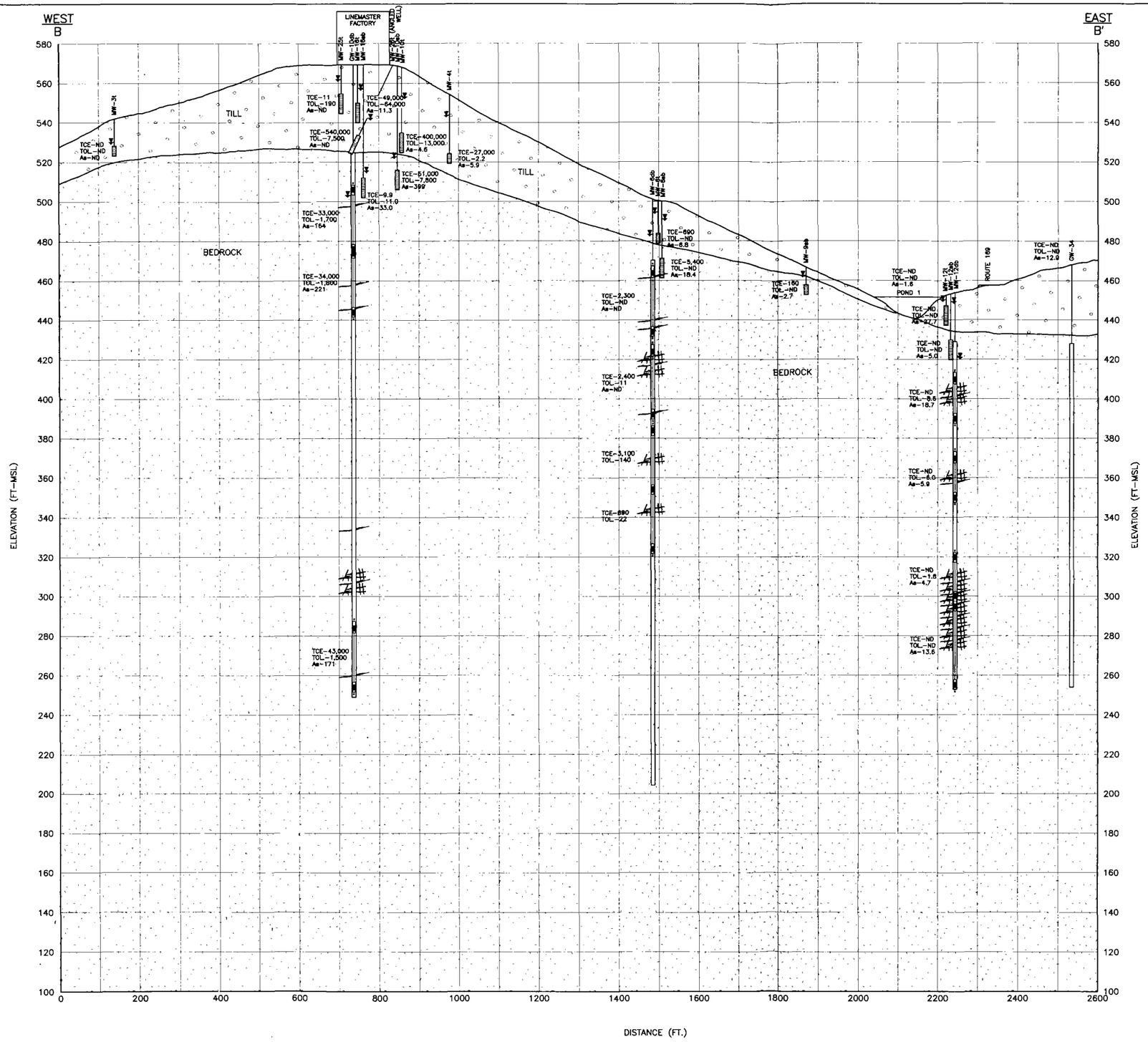
FOR LINE OF CROSS SECTION SEE FIGURE 1-3

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.T.O.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
OFFICE REVIEW		
REVISION DATE:		
▲ 2-20-92 ▲		▲
▲ 7-16-92 ▲		▲
VERT. EXAG. = 5X		

FUSS&O'NEILL INC.
consulting engineers
146 HARTFORD ROAD, MANCHESTER, CONNECTICUT 06040
(203) 646-2469

CROSS SECTION A–A'
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT	FLD BK	DATE	
86-88 D		NOV. 1991	FIGURE 3-1



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- OPEN BORE HOLE (DEEP BEDROCK WELLS)
- FRACTURE ZONE
- SINGLE FRACTURE
- PACKER TEST INTERVAL
- TCE — TRICHLOROETHENE CONCENTRATION (ug/l)
- TOL — TOLUENE CONCENTRATION (ug/l)
- As — ARSENIC CONCENTRATION, TOTAL (ug/l)
- GROUND-WATER LEVEL MEASURED ON 9/24/91

NOTE

CHEMICAL DATA FOR MW-3t, MW-4t, MW-6t, MW-6sb, MW-9sb, MW-10t, MW-10sb, MW-12t, MW-12sb, MW-12db AND GW-10db FROM SAMPLING CONDUCTED IN DECEMBER 1990.

CHEMICAL DATA FOR MW-6db, MW-16t, MW-16sb, MW-25t, AND MW-26t FROM SAMPLING CONDUCTED IN JUNE, JULY AND AUGUST 1991.

CHEMICAL DATA FOR GW-34 FROM SAMPLING CONDUCTED IN SEPTEMBER 1991.

CHEMICAL DATA FOR POND 1 FROM SAMPLING CONDUCTED IN AUGUST 1991.

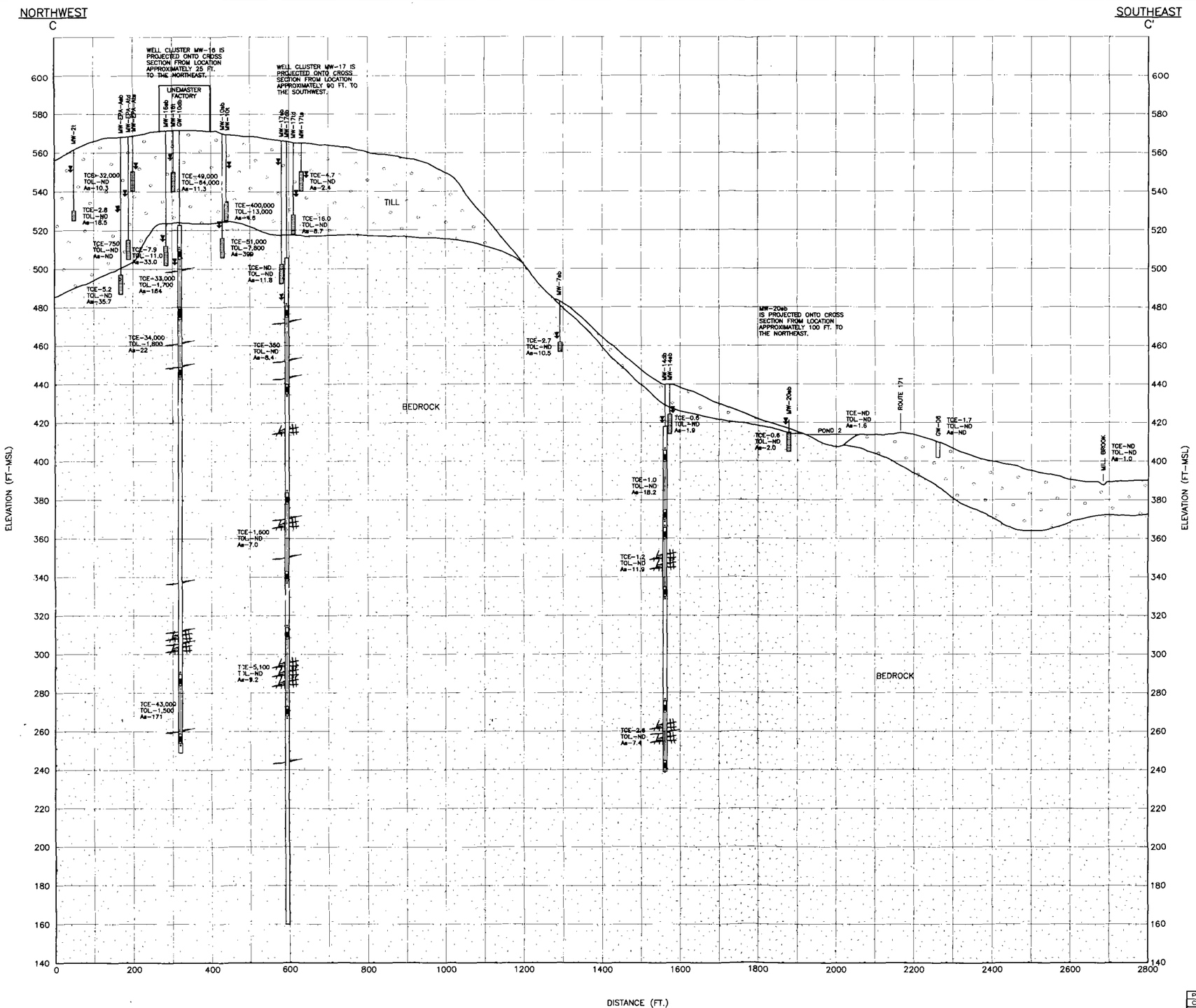
FOR LINE OF CROSS SECTION SEE FIGURE 1-3

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.T.O.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
OFFICE REVIEW		
REVISION DATE:		
▲ 2-20-92 ▲		▲
▲ 7-16-92 ▲		▲
VERT. EXAG. = 5X		

FUSS&O'NEILL INC
consulting engineers
146 HARTFORD ROAD, MANCHESTER, CONNECTICUT 06040
(203) 646-2469

CROSS SECTION B–B'
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT	FLD. BK.	DATE	
86-88D		NOV. 1991	FIGURE 3-2



LEGEND

- WELL CASING OR RISER
- WELL SCREEN (SHALLOW BEDROCK AND TILL WELLS)
- OPEN BORE HOLE (DEEP BEDROCK WELLS)
- FRACTURE ZONE
- SINGLE FRACTURE
- PACKER TEST INTERVAL
- TCE — TRICHLOROETHENE CONCENTRATION (ug/l)
- TOL — TOLUENE CONCENTRATION (ug/l)
- As — ARSENIC CONCENTRATION, TOTAL (ug/l)
- GROUND-WATER LEVEL MEASURED ON 3/24/91

NOTE

CHEMICAL DATA FOR MW-2t, MW-7sb, MW-10t, MW-10sb, MW-14sb, MW-14db, MW-EPA-4ts AND GW-10cb FROM SAMPLING CONDUCTED IN DECEMBER 1990.

CHEMICAL DATA FOR MW-EPA-4t, MW-EPA-4sb, MW-16t, MW-17ts, MW-17td, MW-17t, MW-17db, AND MW-2 FROM SAMPLING CONDUCTED JUNE AND JULY 1991

CHEMICAL DATA FOR POND 2 AND MILL BROOK FROM SAMPLING CONDUCTED IN AUGUST 1990

CHEMICAL DATA FOR GW-06 FROM SAMPLING CONDUCTED IN SEPTEMBER 1991.

FOR LINE OF CROSS SECTION SEE FIGURE 1-3

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.T.D.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
OFFICE REVIEW		
REVISION DATE:		
▲ 2-20-92	▲	▲
▲ 7-16-92	▲	▲
VERT. EXAG. = 5X		

FUSS&O'NEILL INC
consulting engineers
146 HARTFORD ROAD, MANCHESTER, CONNECTICUT 06040
(203) 646-2469

CROSS SECTION C–C'
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT	FLD. BK.	DATE	
86-88 D		NOV. 1991	FIGURE 3-3

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

NOTE: LOCATIONS OF OUTCROPS ARE APPROXIMATE

LEGEND

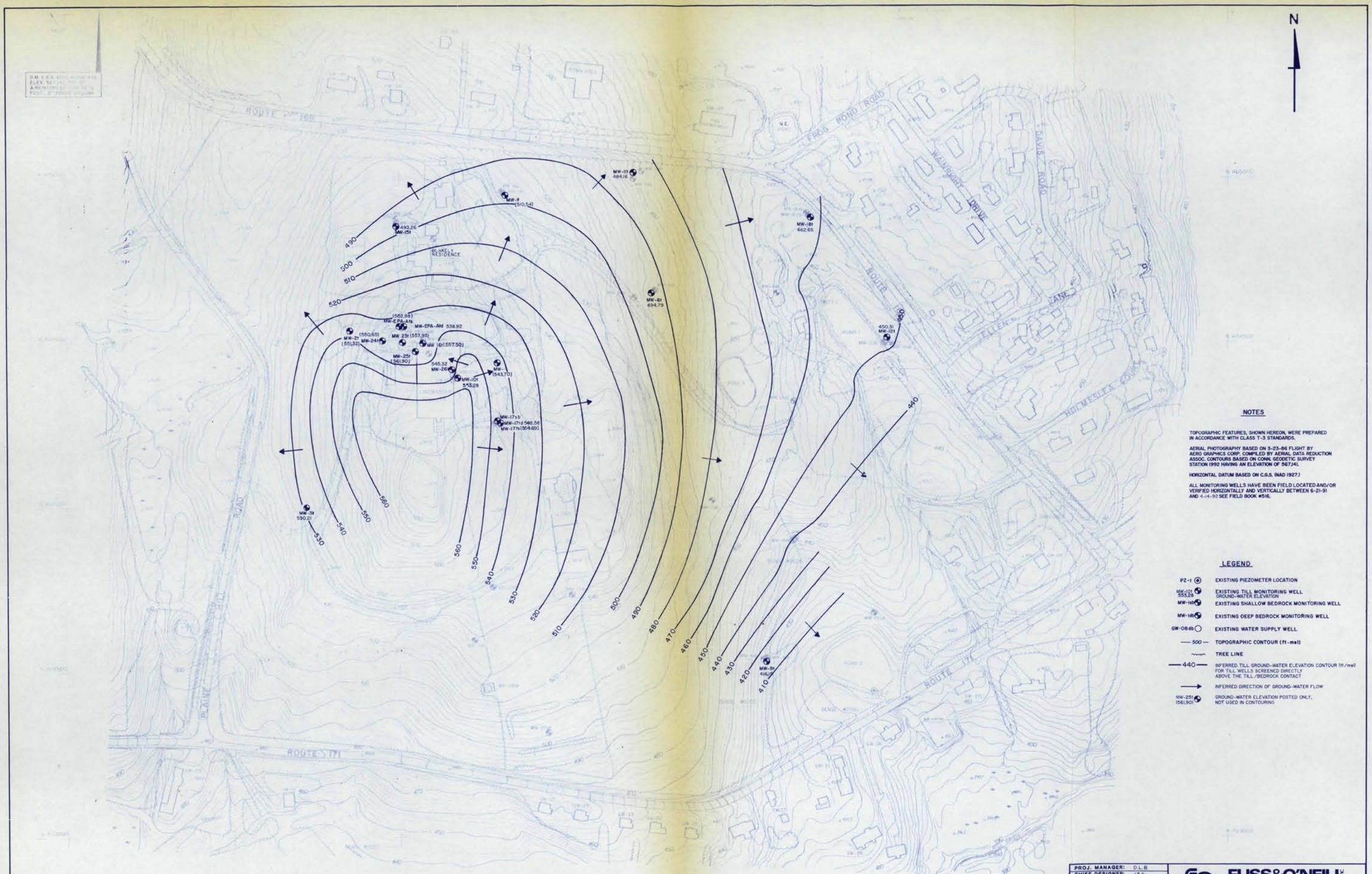
- PZ-1 — EXISTING PIEZOMETER LOCATION
- MW-1T — EXISTING TILL MONITORING WELL
- MW-1sb — EXISTING SHALLOW BEDROCK MONITORING WELL
- MW-1db — EXISTING DEEP BEDROCK MONITORING WELL
- GW-08db — EXISTING WATER SUPPLY WELL
- 500 — TOPOGRAPHIC CONTOUR (ft.-msl)
- TREE LINE
- 410 MW-8sb — BEDROCK ELEVATION FT.-M.S.L.
- GW-34 —433 — APPROXIMATE BEDROCK ELEVATION FT.-M.S.L.
- STRIKE AND DIP OF FRACTURE PLANE
- STRIKE AND DIP OF FOLIATION
- STRIKE AND DIP OF SILL
- BOULDERS
- BEDROCK OUTCROP
- APPROXIMATE GEOLOGIC CONTACT
- 410 — INFERRED BEDROCK SURFACE ELEVATION

PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.T.C.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ OCT. 1991	△ 6/30/92	△
△ MAR. 1992	△	△
SCALE: HOR. IN FT. / VER. IN. FT.		

FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT

BEDROCK SURFACE CONTOURS
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
OCT. 1990	516, 525,567	86-88D	FIGURE 3-5



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-10i 553.28	EXISTING TILL MONITORING WELL GROUND-WATER ELEVATION
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
— 440 —	INFERRED TILL GROUND-WATER ELEVATION CONTOUR (ft/msl) FOR TILL WELLS SCREENED DIRECTLY ABOVE THE TILL/BEDROCK CONTACT
→	INFERRED DIRECTION OF GROUND-WATER FLOW
MW-25i (561.90)	GROUND-WATER ELEVATION POSTED ONLY, NOT USED IN CONTOURING

SCALE IN FEET

0 25 50 75 100 200 300

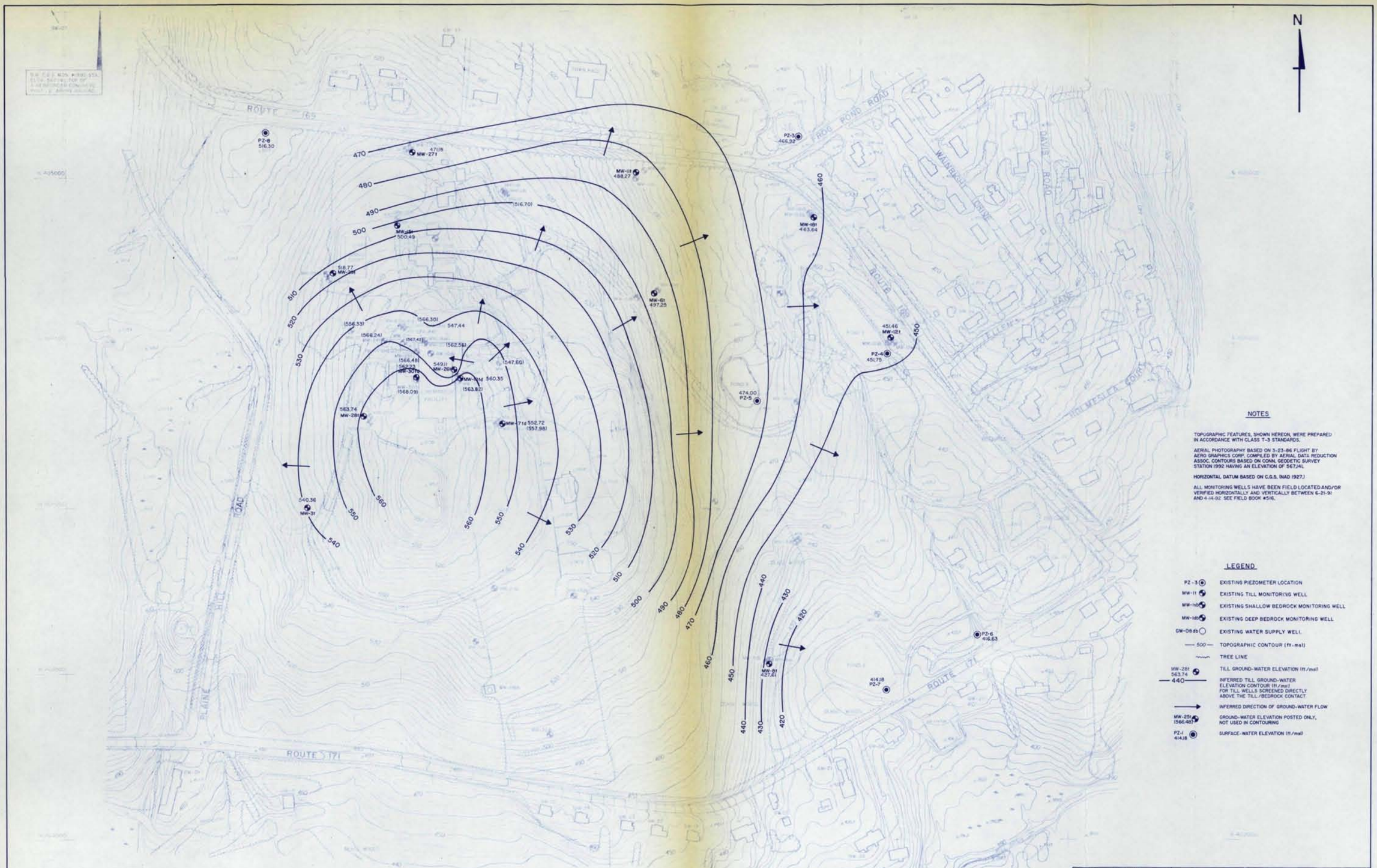
PROJ. MANAGER:	D.L.B.	
CHIEF DESIGNER:	J.T.O.	
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ MAR 1992	△	△
△ 7-16-92	△	△
SCALE: HOR.	IN.	FT.
VER.	IN.	FT.

FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT

TILL GROUND-WATER CONTOURS
SEPTEMBER 24, 1991
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV., 1991		86-88 D	3-6



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92. SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-1I	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
—500—	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
MW-28I 563.74	TILL GROUND-WATER ELEVATION (ft./msl)
—440—	INFERRED TILL GROUND-WATER ELEVATION CONTOUR (ft./msl) FOR TILL WELLS SCREENED DIRECTLY ABOVE THE TILL/BEDROCK CONTACT
→	INFERRED DIRECTION OF GROUND-WATER FLOW
MW-25I 1566.48	GROUND-WATER ELEVATION POSTED ONLY, NOT USED IN CONTOURING
PZ-1 414.18	SURFACE-WATER ELEVATION (ft./msl)

SCALE IN FEET
0 25 50 75 100 200 300

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△	△	△
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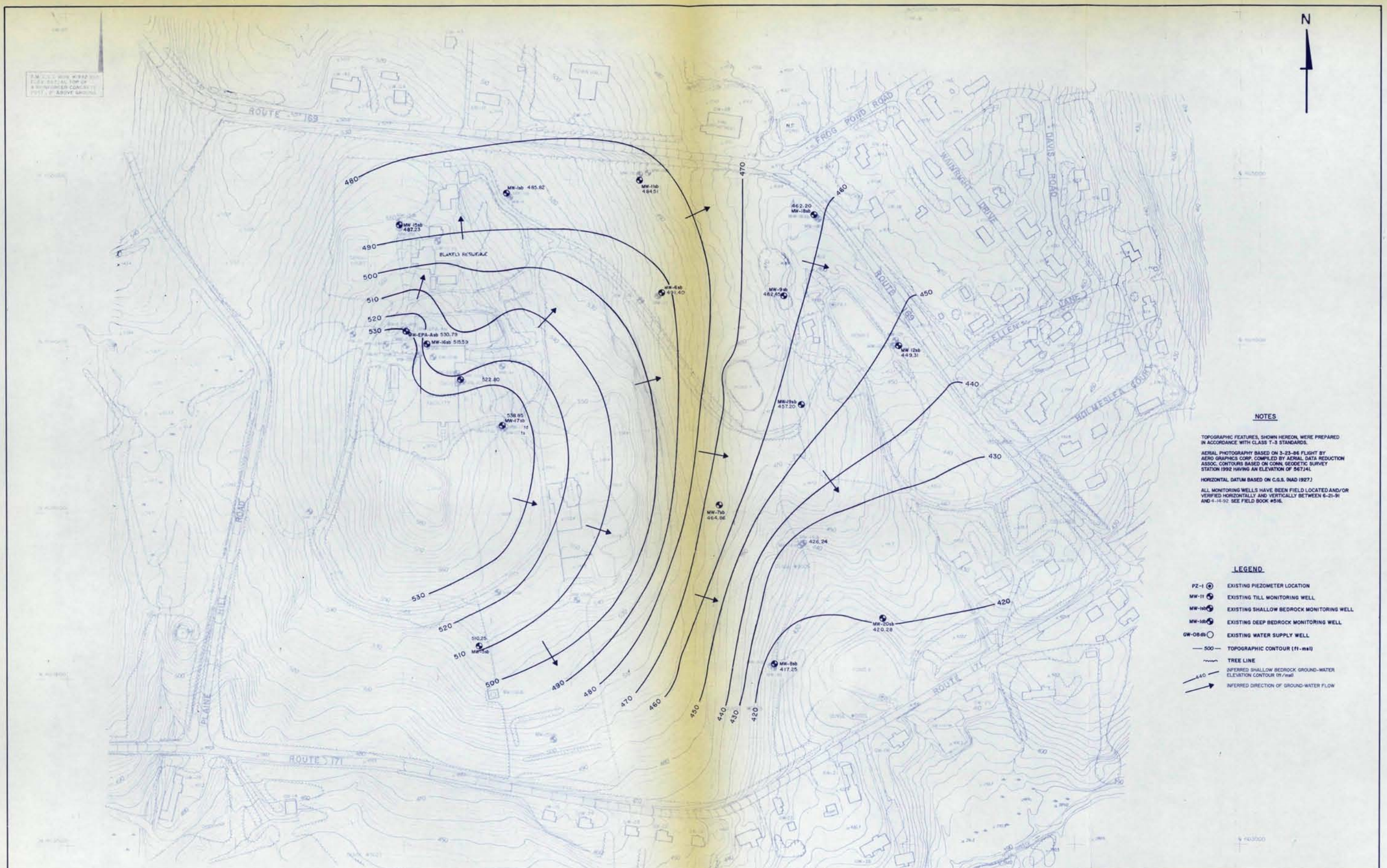
FUSS&O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

TILL GROUND-WATER CONTOURS
APRIL 27, 1992
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

SCALE:	HOR. IN. = FT.	DATE	FLD. BK.	PROJECT	FIGURE
	VER. IN. = FT.	AUG. 1992		86-88D	3-7



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION (992 HAVING AN ELEVATION OF 567.14).

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92. SEE FIELD BOOK #516.

LEGEND

- PZ-1 — EXISTING PIEZOMETER LOCATION
- MW-11 — EXISTING TILL MONITORING WELL
- MW-18S — EXISTING SHALLOW BEDROCK MONITORING WELL
- MW-18b — EXISTING DEEP BEDROCK MONITORING WELL
- GW-08db — EXISTING WATER SUPPLY WELL
- — 500 — TOPOGRAPHIC CONTOUR (ft-msl)
- TREE LINE
- 440 — INFERRED SHALLOW BEDROCK GROUND-WATER ELEVATION CONTOUR (ft/msl)
- INFERRED DIRECTION OF GROUND-WATER FLOW

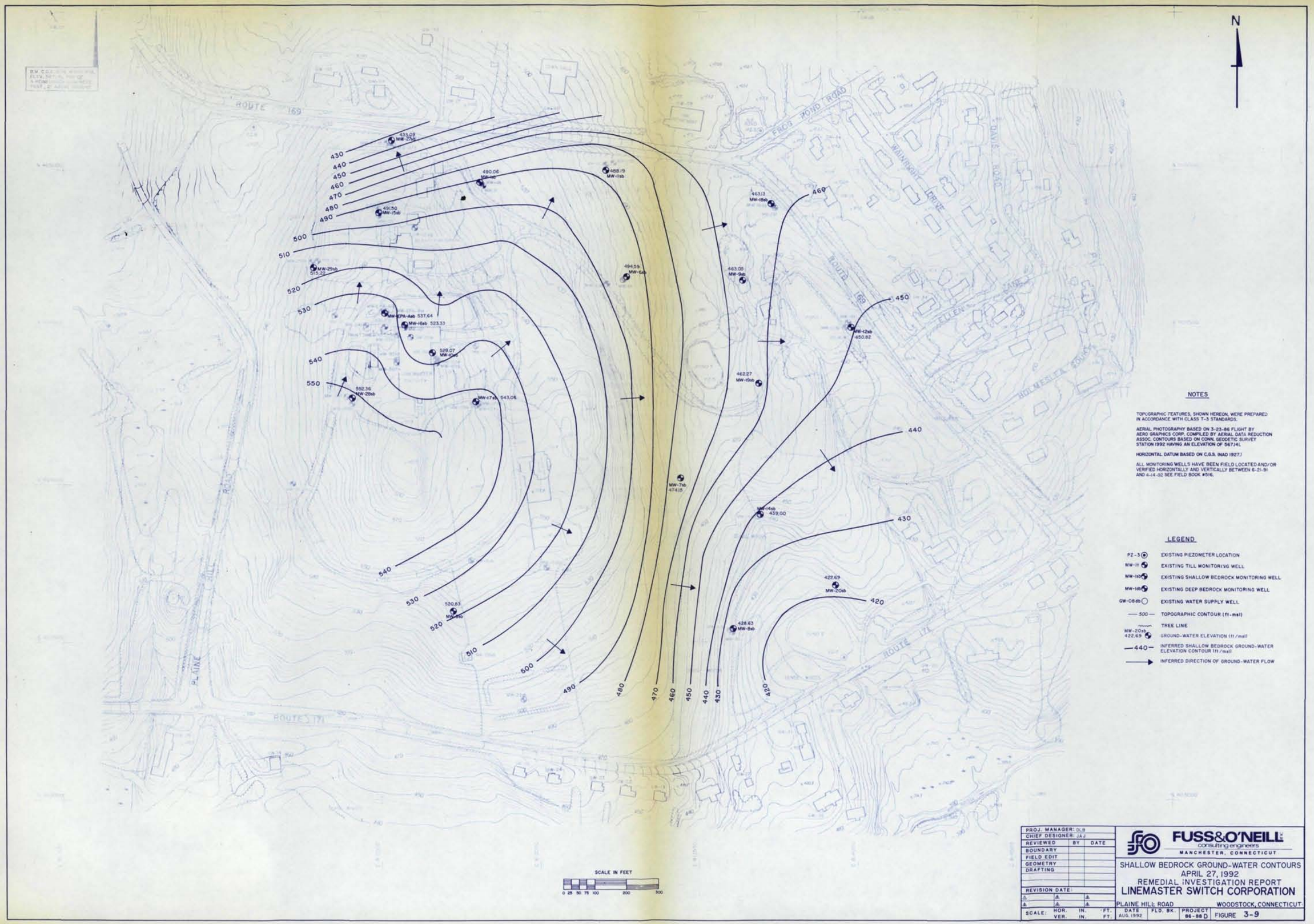
PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTC		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ MAR. 1992 △	△	
△ 3-16-92 △	△	
SCALE: HOR. IN. FT.		
VER. IN. FT.		

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

SHALLOW BEDROCK GROUND-WATER CONTOURS
SEPTEMBER 24, 1991
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	
NOV. 1991		86-88 D	FIGURE 3-8



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14L

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-1t	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08sb	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft.-msl)
	TREE LINE
MW-20sb 422.69	GROUND-WATER ELEVATION (ft./msl)
—440—	INFERRED SHALLOW BEDROCK GROUND-WATER ELEVATION CONTOUR (ft./msl)
→	INFERRED DIRECTION OF GROUND-WATER FLOW

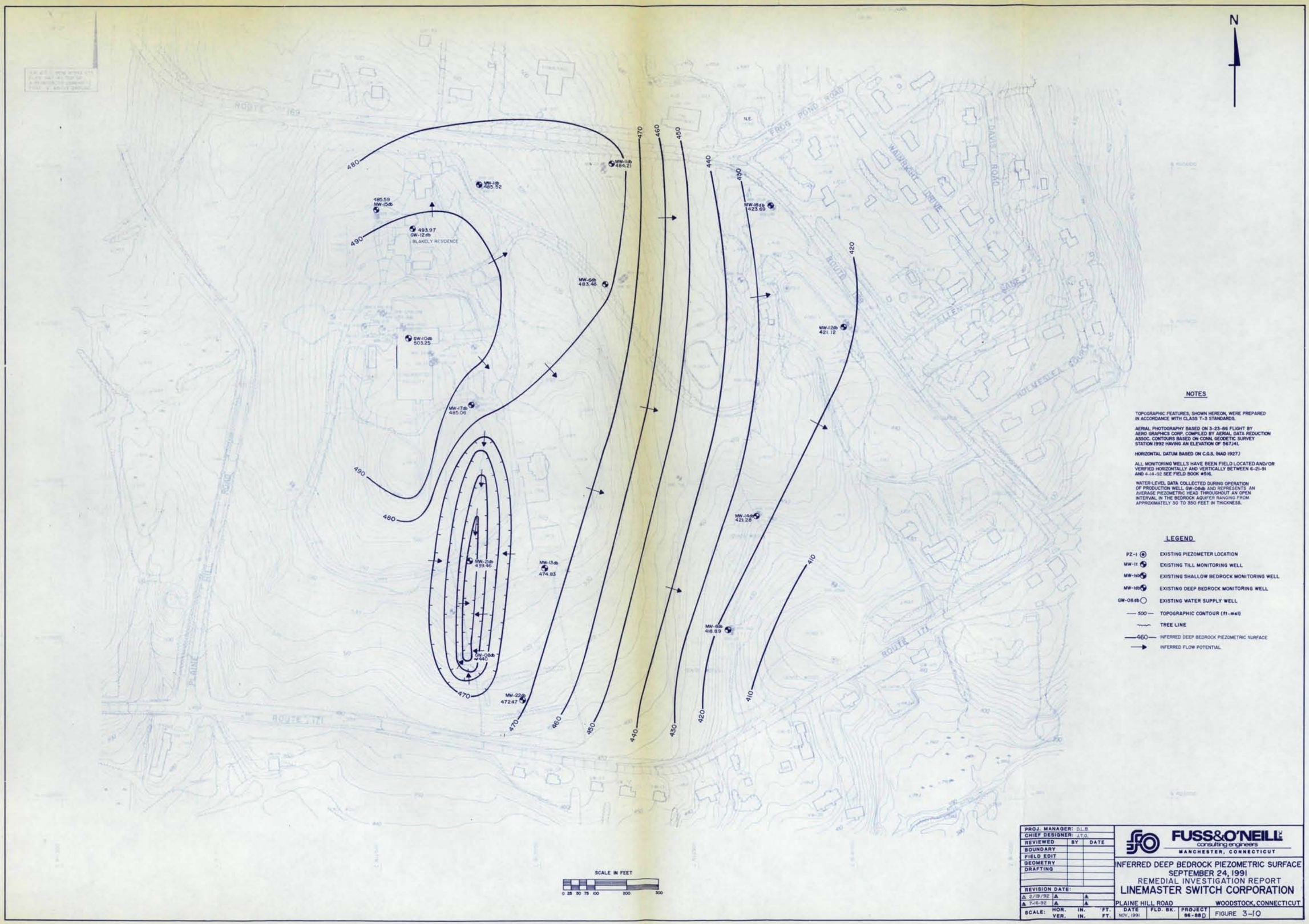
PROJ. MANAGER: DLB		
CHIEF DESIGNER: JAJ		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△	△	△
△	△	△
SCALE:	HOR. IN. : FT.	
	VER. IN. : FT.	

FUSS&O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

SHALLOW BEDROCK GROUND-WATER CONTOURS
APRIL 27, 1992
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
AUG. 1992		86-88 D	3-9



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

WATER-LEVEL DATA COLLECTED DURING OPERATION OF PRODUCTION WELL GW-08db AND REPRESENTS AN AVERAGE PIEZOMETRIC HEAD THROUGHOUT AN OPEN INTERVAL IN THE BEDROCK AQUIFER RANGING FROM APPROXIMATELY 30 TO 350 FEET IN THICKNESS.

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1db	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1dd	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft-msl)
~~	TREE LINE
—460—	INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
—▶	INFERRED FLOW POTENTIAL

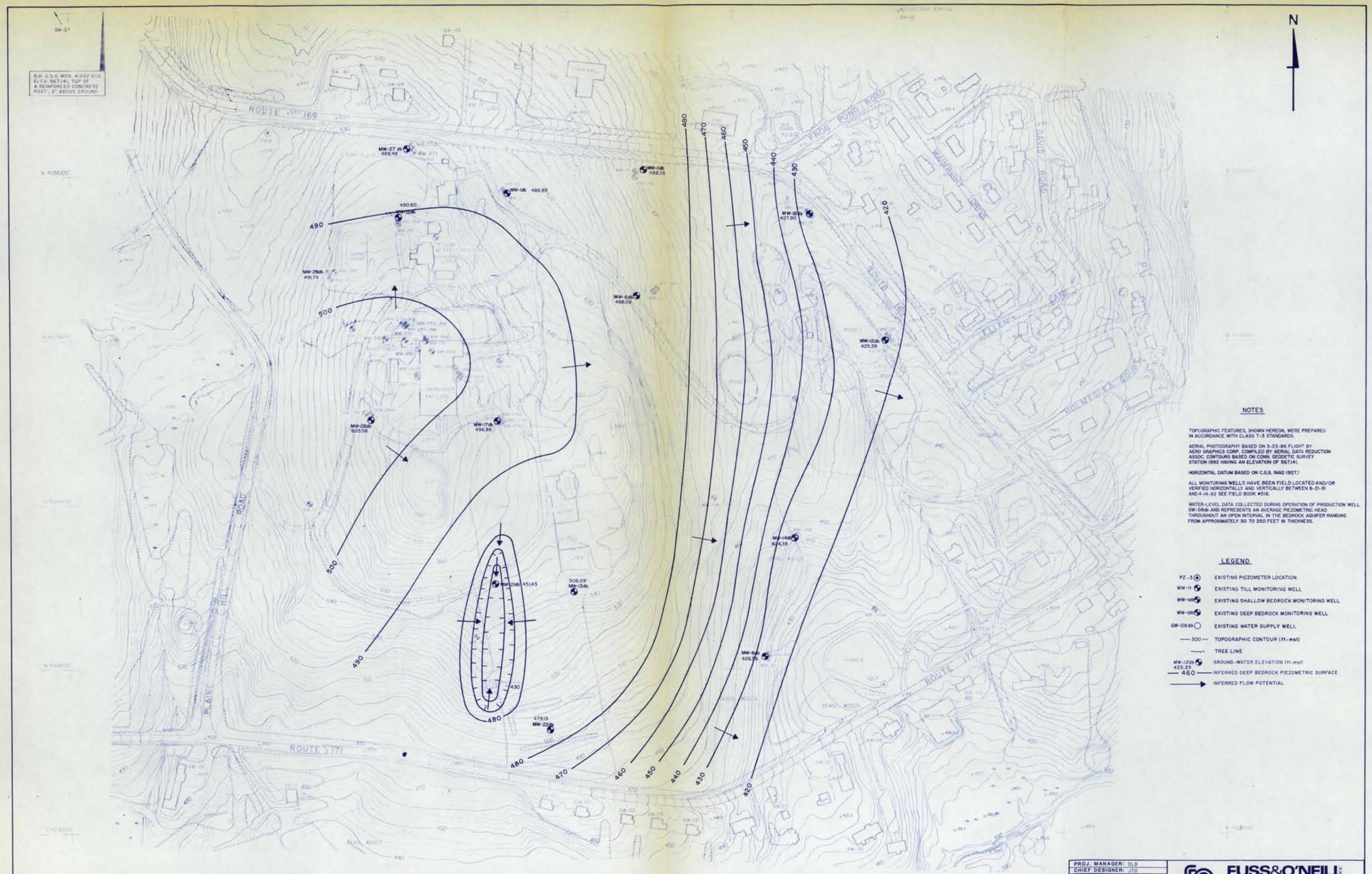
PROJ. MANAGER: D.L.B.		
CHIEF DESIGNER: J.T.O.		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
△ 2/19/92	△	△
△ 7-16-92	△	△
SCALE: HOR. IN. FT. / VER. IN. FT.		

FUSS & O'NEILL INC.
consulting engineers
MANCHESTER, CONNECTICUT

INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
SEPTEMBER 24, 1991
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD — WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
NOV. 1991		86-88D	3-10



NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.14.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927.)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 4-14-92 SEE FIELD BOOK #516.

WATER-LEVEL DATA COLLECTED DURING OPERATION OF PRODUCTION WELL GW-08db AND REPRESENTS AN AVERAGE PIEZOMETRIC HEAD THROUGHOUT AN OPEN INTERVAL IN THE BEDROCK AQUIFER RANGING FROM APPROXIMATELY 30 TO 350 FEET IN THICKNESS.

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-1sb	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1db	EXISTING DEEP BEDROCK MONITORING WELL
GW-08db	EXISTING WATER SUPPLY WELL
— 500 —	TOPOGRAPHIC CONTOUR (ft.-msl)
~~	TREE LINE
MW-12db 425.39	GROUND-WATER ELEVATION (ft.-msl)
— 460 —	INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
→	INFERRED FLOW POTENTIAL

PROJ. MANAGER: DLB		
CHIEF DESIGNER: JTO		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION DATE:		
SCALE: HOR. IN. FT. / VER. IN. FT.		

FUSS & O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

INFERRED DEEP BEDROCK PIEZOMETRIC SURFACE
APRIL 27, 1992
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD. BK.	PROJECT	FIGURE
AUG. 1992		86-88 D	3-11

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5.0 AIR QUALITY ASSESSMENT

The objective of performing an Air Pathway Analysis (APA) in the context of this Remedial Investigation Report is to provide data that are "necessary and sufficient" to characterize the "nature and extent" of contamination at the site. The specific requirement for dispersion modeling for this site is contained in a letter to the facility from L. Conley, Region I EPA Remedial Project Manager, dated November 26, 1990. Air dispersion modeling was performed to:

1. provide input to conduct risk assessments and prepare contingency plans;

2. provide input for the preparation and implementation of health and safety plans; and

3. evaluate compliance with State and Federal Applicable or Relevant and Appropriate Requirements (ARARs).

5.1 Emission Sources, Rates, and Quantities

5.1.1 Emission Sources

Three of the emission sources considered in this air assessment have been modeled previously and are described in the "Initial Site Characterization Report (ISCR)" (Fuss & O'Neill, 1991c). These sources include a point source from the exhaust of a pre-existing air stripping column (air stripper 1) treating contaminated ground water and the emissions from an area source resulting from soil contamination modeled as two discrete area sources. The ISCR contains a complete description of these sources. Two manufacturing paint booths were not modeled in this study for the same reasons as cited in the above referenced report.

Linemaster has eliminated a major manufacturing source of TCE. As of July 31, 1992, the trichloroethene vapor degreaser was replaced with an aqueous-based degreaser. For this reason, the degreaser was eliminated as a source in this modeling study.

An additional source was added to the modeling study which consisted of the discharge from a second stripping column (air stripper 2). The stripping column is utilized for ground-water treatment at the site. It was modeled as a point source using data on the influent water quality and assuming 100 percent volatilization of all of the VOCs entering the column.

5.1.2 Emission Inventory

Contamination at the site which contributes to the air pathway of exposure consists of solvents previously used for degreasing operations and miscellaneous other constituents. The list of constituents present, as follows, consists of those contaminants detected in the ground-water monitoring and production wells at the site and any other compounds detected by soil gas analysis at significant concentrations.

Trichloroethene (TCE),
Tetrachloroethene (PCE),
1,2-trans-Dichloroethene (1,2-t-DCE),
1,1,1-Trichloroethane (TCA),
Toluene and
Xylene.

As discussed in the ISCR, the most significant compound at the site is TCE. Fuss and O'Neill modeled the emissions of TCE based on the relative concentrations of this compound to other chemicals in the ground water (composed of degradation products of TCE). TCE was the only compound modeled as an estimate of the

risk posed from site activities because the relative risk from this compound is far greater than for the other compounds present in the ground water at the site and subsequently emitted into the air. It was felt that if the risk posed by TCE was well within safe limits, the risk from other compounds would be far less.

This conclusion was based on the following considerations: a) TCE is present in the ground water and in the water supplied to the air stripping columns in concentrations ranging from five to ten times that of the next most abundant compound, 1,2-dichloroethene, and up to two orders of magnitude greater than the other compounds identified; b) diffusion data, Table 5-1, show that other compounds would not diffuse, and therefore be emitted to the air, at rates which would enrich their concentrations relative to TCE; and c) ACGIH 8-hour and 30-minute exposure data show that TCE has the highest toxicity, somewhat higher than tetrachloroethene, and one to two orders of magnitude higher than for the other compounds.

This last consideration was based on acute exposure limits rather than on long-term chronic effects or carcinogenic potential. The 1991 Annual Health Effects Assessment Summary Tables (OERR9200.6-303 (91-1)), however, lists only three of the compounds (1,1,1-trichloroethane, xylenes, and toluene) as showing noncarcinogenic chronic effects, with RfCs ranging from 300 to 10,000 ug/m^3. Two of the compounds, TCE and PCE, are B2 carcinogens (sufficient evidence of animal carcinogenicity with inadequate or lack of evidence in humans). The concentrations of these compounds correspond to 1 in 10^6 risk are 0.6 and 1.9 ug/m^3, respectively. (Note that in Figure 5-2, 0.7 ug/m^3 is the highest concentration of TCE predicted outside of the facility, and the concentration of PCE would be at least one order of magnitude less.

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TABLE 5-1

PHYSICAL CONSTANTS FOR COMPOUNDS OF INTEREST
FEASIBILITY STUDY REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

COMPOUND	HENRY'S LAW CONSTANT	DIFFUSIVITY IN AIR cm^2/sec
Trichloroethene	0.0091	0.079
Tetrachloroethene	0.0290	0.072
1,2-t-Dichloroethene	0.00532	0.0070
1,1,1-Trichloroethane	0.0172	0.078
Toluene	0.00668	0.087
Xylenes	0.00525	0.0714

Source: CHEMDAT6

Therefore, for long-term chronic and carcinogenic effects, as well as for acute effects, the risk associated with TCE is one to four orders of magnitude greater than for the other compounds present. Furthermore, the concentrations predicted by the modeling should not pose an unacceptable risk.

5.1.3 Rates and Quantities

The emission rates from three of the sources at the facility have been calculated in the previous modeling exercise. For the purpose of this analysis, a brief overview of these sources is provided along with a description of the emission rates from the newly installed air stripper.

For air stripper 1, the air emissions consist of the compounds contained in the influent ground water based on monitoring well data from well GW-08db. It was assumed that these compounds are

100 percent volatilized by the stripper and that the stripper operates continuously. This gave a total emission rate of 0.0051 grams/second (g/s) (0.0404 lbs/hr).

The second air stripper emits the same compounds present in the contaminated ground water and has been installed as part of an Interim Removal Treatment System to control the flow of contaminated ground water. For this modeling study, it was assumed that the stripper operates continuously. Again, it was assumed that 100 percent of the VOCs entering the column are emitted to the air. Sample data for the influent ground water to this stripper indicated a TCE concentration of approximately 4,800 ug/l. At an influent flow rate of approximately 60 gpm, this gives an emission rate of 0.0185 g/s (0.147 lbs/hr).

The emission rates used for the two area sources were determined utilizing the Chemdat6 computer program as described in the ISCR. (Appendix U contains the Chemdat6 input and output data.) The areas within the 100,000 ug/l and the 10,000 ug/l TCE isopleths, were used to describe the area sources for the model. These concentrations were used as the concentrations of the contaminated ground water wetting the soil. The total annual average emission rate for the smaller, higher-concentration, area (approximately 9070 ft^2) was computed as 0.489 milligrams TCE/second (mg/s) (0.00387 lbs/hr). The calculated emission rate from the larger area, a size of approximately 126,600 ft^2, was calculated as 0.068 mg/s (5.39×10^{-4} lbs/hr). On a unit area basis, the area encompassed by the lower-concentration isopleth produced an emission rate of less than one hundredth of the emissions from the more concentrated area. Based on this result, it was decided that modeling the emissions for a more dilute isopleth, i.e. 1000 ug/l, was not necessary.

It should be noted that for the area sources, the calculated

emission rates are conservative because the area is covered partly by the Linemaster manufacturing building. In addition, much of the area within the 100,000 ug/l isopleth is covered by plastic sheeting. This would have the effect of significantly reducing actual emissions from this source.

5.2 Model Selection, Use, and Receptor Locations

5.2.1 Model Selection

In the previous modeling study of the ISCR, the air dispersion model selected for the APA was the Industrial Source Complex - Long Term (ISCLT) Model. Subsequently, the ISC models have been revised by the EPA and the ISCLT model has been superseded by the ISCLT2. A number of improvements have been made on the previous version (U.S. EPA, 1992) and, therefore, the ISCLT2 model was used for this modeling study. A summary of the model selection is provided below.

Both the Industrial Source Complex-Short Term (ISCST) and ISCLT2 are appropriate models for this study since they have a number of advantages not found in other UNAMAP series models. The advantages include: a) the ability to accommodate a number of sources including point sources and area sources, as is the case at Linemaster, and b) the ability to take into account building wake effects which are expected for the structures containing the existing air strippers.

The area source algorithm in ISCST, which processes an area source as a single line segment source whereas the Long-Term model calculates area sources as virtual point sources located some distance upwind of the area. It was decided that the Long-Term model would be more appropriate. Another concern in the previous modeling study was the fact that neither of these

models is capable of simulating the entrainment of a plume in the recirculating cavity downwind of a large building. Therefore, the SCREEN module, present in the EPA screening model TSCREEN (U.S. EPA 1988a), was used for both the degreaser and the stripping column (air stripper 1) in the previous study to determine if cavity entrainment would be significant. (Appendix U contains the results of the TSCREEN model run.) It was concluded that plume entrainment into a building cavity would not normally occur at the Linemaster facility.

5.2.2 Model Use

ISCLT2 was used in the concentration mode to predict ground level concentrations of TCE on an annual basis. The rural option was used in conjunction with five years of data from Bradley International Airport, which is located approximately 40 miles due west of the facility. Since both the facility and Bradley field are approximately 50 miles north (inland) of Long Island Sound, these data are deemed representative of site meteorology.

Meteorological data used in the modeling study consisted of hourly observations of wind speed, direction, temperature, stability category and mixing height. These data were obtained from the National Climatic Data Center in Asheville, N.C. for Bradley (Hartford) Airport, with upper air data from Albany, N.Y. The data were processed into a STAR summary (a statistical joint frequency of occurrence for the above parameters) for use in the ISCLT model. A five-year meteorological record period from 1970 through 1974, which is the period used and specified by the Connecticut DEP, was used in this modeling exercise. Where appropriate, the Regulatory Default model options were selected.

The four sources described above were modeled as separate source inputs using the rates and discharge parameters described

previously. They also were modeled as a source group consisting of all of the sources taken together. A complete listing of the model inputs and outputs for each of the five years modeled is included in Appendix V.

5.2.3 Receptors

A cartesian grid of 17 by 17 receptors spaced as shown in Figure 5-1 was used for a total of 289 receptors. In addition, eleven discrete receptors were modeled which consisted of the Woodstock Town Hall, the Woodstock Fire Department, the Woodstock Elementary School and eight residences along a north-south alignment, since the STAR summary indicates a strong north-south component to the wind rose.

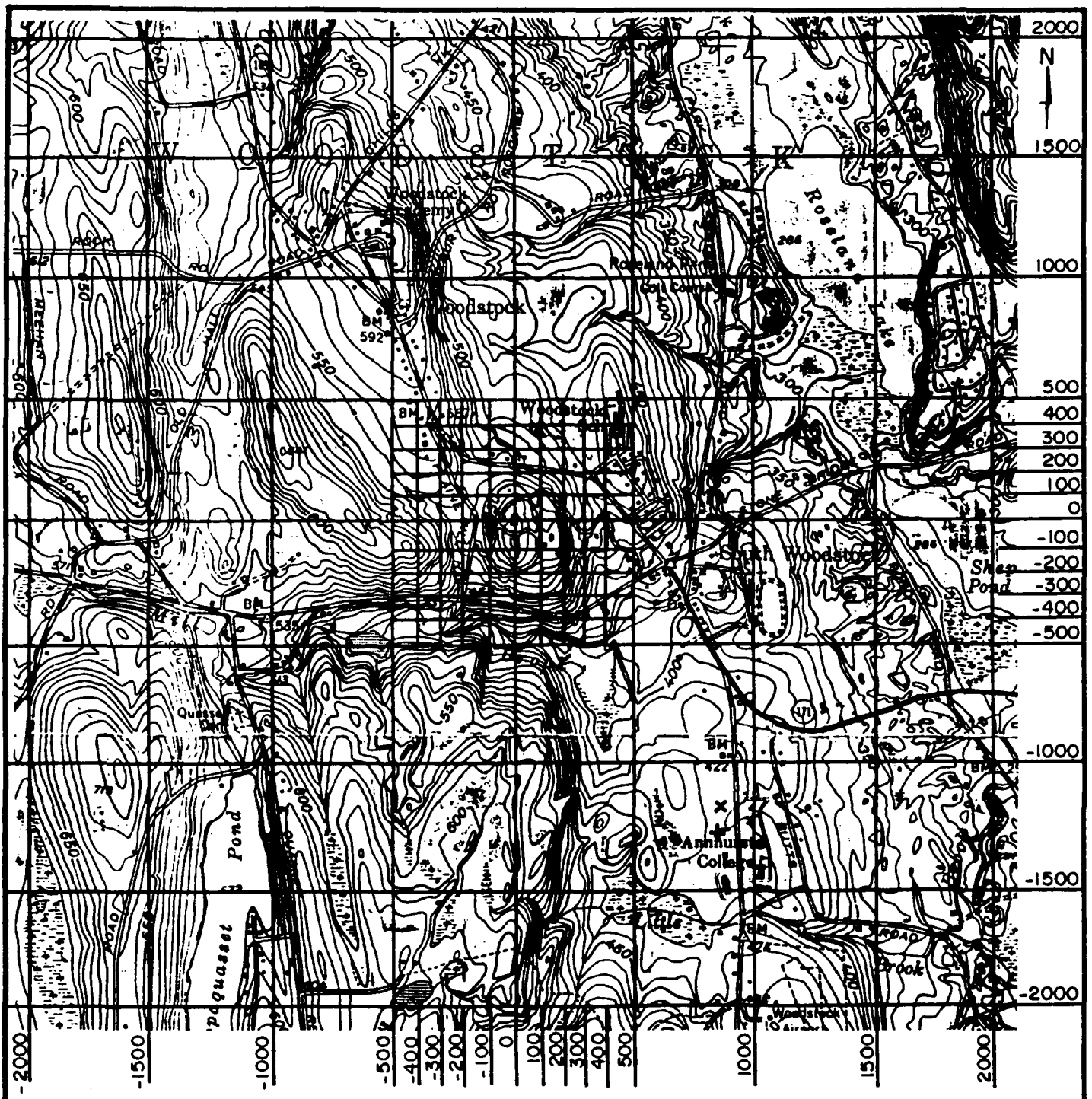
5.3 Results and Discussion

5.3.1 Results

The output from the computer modeling of the five separate years of meteorological data is presented in Appendix V. The total ground level concentrations resulting from all of the existing sources at the site for each year are included. Also included in the output are the individual contributions of each source.

The highest ground level concentration calculated for any year was 1.31 ug/m^3, which resulted from the 1972 meteorological data set. This concentration occurred at a location 100 meters due south of the main production building. The concentration falls to 1.17 ug/m^3 in the next 100 meters and decreases still further with greater distances. An isopleth map of ground level concentrations for the year 1972 is presented as Figure 5-2.

The highest ground level concentrations for all of the other



0 2000' 4000'

SCALE 1"=2000'

TAKEN FROM U.S.G.S. QUAD. # 28

FIGURE 5-1

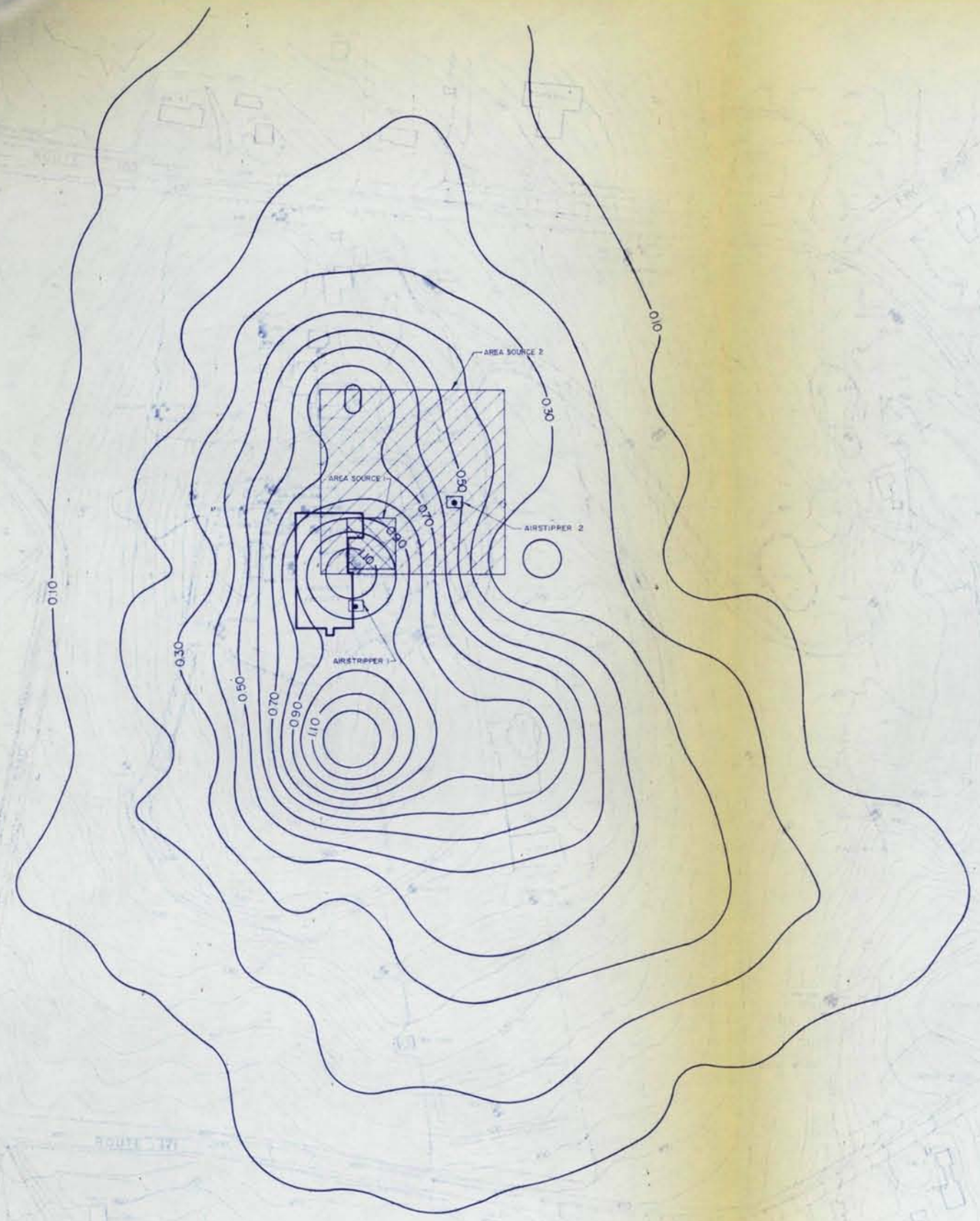
FUSS&O'NEILL
MANCHESTER, CONNECTICUT

AIR MODELING RECEPTOR GRID
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORP.

PLAINE HILL RD. WOODSTOCK, CT.

PROJ. NO. 86-88 DATE: AUGUST 1992

065822



N

NOTES

TOPOGRAPHIC FEATURES, SHOWN HEREON, WERE PREPARED IN ACCORDANCE WITH CLASS T-3 STANDARDS.

AERIAL PHOTOGRAPHY BASED ON 3-23-86 FLIGHT BY AERO GRAPHICS CORP. COMPILED BY AERIAL DATA REDUCTION ASSOC. CONTOURS BASED ON CONN. GEODETIC SURVEY STATION 1992 HAVING AN ELEVATION OF 567.41.

HORIZONTAL DATUM BASED ON C.G.S. (NAD 1927)

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 7-12-91. SEE FIELD BOOK #516

LEGEND

PZ-3	EXISTING PIEZOMETER LOCATION
MW-11	EXISTING TILL MONITORING WELL
MW-16b	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-16d	EXISTING DEEP BEDROCK MONITORING WELL
GW 0869	EXISTING WATER SUPPLY WELL
500	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
0.3	TCE AIR CONCENTRATION ISOPLETH (ug/m³)

DISCRETE RECEPTORS

NO.	LOCATION, FT	
1	-310	900
2	-160	870
3	120	850
4	390	900
5	810	780
6	1270	530
7	120	-1300
8	395	-1320
9	520	-1350
10	630	-1370
11	745	-1390
12	1350	1120

SCALE IN FEET

0 25 50 75 100 200 500

PROJ. MANAGER: DLB		
CHIEF DESIGNER: RES		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
GEOMETRY		
DRAFTING		
REVISION	DATE	
△	△	△
△	△	△
SCALE	HOR. IN. = FT.	
	VER. IN. = FT.	

FUSS&O'NEILL
consulting engineers
MANCHESTER, CONNECTICUT

TCE AIR CONCENTRATION ISOPLETHS
REMEDIAL INVESTIGATION REPORT

LINEMASTER SWITCH CORPORATION

PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

DATE	FLD BK	PROJECT	FIGURE
AUG 1992		86-88 D	5-2

years occurred at either the above noted receptor location or at the location of the main production building (the model origin), and ranged from 1.11 to 1.24 ug/m^3. The location of the high-concentration areas along a north-south alignment fairly close to the building indicates that a building wake effect is largely responsible for these concentrations. In the absence of wake effects, an even lower concentration would be calculated.

Table 5-2 shows the relative contributions to the highest ground-level concentration for each of the sources modeled. As can be seen, the contribution of the area sources, which correspond to the unregulated activities at the site, contribute 7.8 percent of the maximum total annual ambient concentration predicted by the model. A review of the output contained in Appendix V shows; however, that the area sources contribute up to 15 percent of the total annual ambient concentration at the origin as predicted by the model.

TABLE 5-2

RELATIVE CONTRIBUTIONS OF MODELED SOURCES
TO THE COMBINED HIGHEST GROUND LEVEL CONCENTRATION
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

Source	Concentration (ug/m^3)	Percent of Total
Area 1	0.0677	5.2
Area 2	0.0347	2.6
Air Stripper 1	0.873	66.6
Air Stripper 2	0.335	25.6
Total	1.31	100

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5.3.2 Discussion

In order to evaluate compliance with State and Federal Applicable or Relevant and Appropriate Requirements (ARARs), a comparison with the Connecticut Hazardous Air Pollutant Regulations contained in RCSA 22a-174-29 is appropriate. A direct comparison; however, of the annual ambient concentration of TCE predicted by the model with the Connecticut Hazard Limiting Value is not possible due to the different averaging times. A rough rule of thumb is that the effect of increasing averaging time is a reduction in concentration decreasing as the -0.5 power of the averaging time (Williamson, 1973). This would indicate that an annual concentration of 1.31 ug/m^3 would correspond roughly with an eight-hour concentration of 43.3 ug/m^3. As can be seen, this concentration is well below the Connecticut 8-hour TCE Hazard Limiting Value of 1,350 ug/m^3.

From the previous modeling study, it is important to note that the bulk of the ground level TCE concentration originated from the degreasing operation (up to 92 percent of the maximum modeled annual average TCE concentration). The maximum concentration obtained from the model utilizing the vapor degreaser as a source resulted in a concentration of 9.43 ug/m^3. The elimination of the vapor degreaser resulted in a reduction in the maximum concentration of more than 86 percent even with the addition of the second air stripper. It should be also noted that the maximum concentrations for the area sources are lower in this exercise than in the previous model study. This is due to refinements in the previous versions of the ISC model. As described in the ISC2 User's Guide (U.S. EPA, 1992), the change affects area sources, volume sources and point sources with the largest differences occurring for receptors located relatively close to the source.

From the above, it is apparent that the majority of the TCE originates from the two air strippers. The contribution of TCE from the area sources; however, is greatest immediately adjacent to the manufacturing building. Overall, the magnitude of the predicted ambient concentrations of pollutants resulting from the site contamination, and the remedial activities currently taking place, is minimal. As with the previous modeling exercise, the total ambient concentrations predicted in this modeling study are very low when compared with Applicable or Relevant and Appropriate Requirements (ARARs) such as the Connecticut Hazardous Air Pollutant Regulations contained in RCSA 22a-174-29.

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6.0 ECOLOGICAL ASSESSMENT

6.1 Introduction

This section has been prepared by Fugro-McClelland (East), Inc. (formerly IEP) for Linemaster Switch Corporation and through the direction of Fuss & O'Neill to provide an ecological assessment of Linemaster's 90-acre site in Woodstock, Connecticut. The site is situated north of Route 171, south and west of Route 169, and east of Plaine Hill Road in South Woodstock. The ecological assessment is required as part of the Statement of Work issued by the U.S.E.P.A. in connection with the Remedial Investigation and Feasibility Study pursuant to the comprehensive Environmental Response, Compensation and Liability Act. The focus of Fugro-McClelland's ecological assessment was to identify, delineate, classify and inventory the wetlands of the site, inventory the upland and aquatic habitats of the site, and to qualitatively assess these and surrounding habitats relative to potential impacts from on-site contamination.

On October 21, 1991, Fugro-McClelland, Inc. conducted a site visit to complete reconnaissance of the approximately 90 acre parcel and delineate wetland boundaries. A Fugro-McClelland Ecologist, Wetland Biologist, and Soil Scientist participated in the site investigations. The site work was performed to characterize the site conditions in order to evaluate whether contamination has affected the on-site or neighboring habitats. The Linemaster site is centered on an elevated till-and-bedrock land form, with the production facilities and corporate offices covering much of the higher ground. The land slopes off relatively steeply in all directions leading to wetland along the

recycled paper

east and northeast portions of the property. The majority of the land is wooded with sparse development. The west/central portion of the property is comprised of the Linemaster facility and Blakely residence. Small paved roadways access the business via Route 169 and Plaine Hill Road. Along the properties internal roadways, understory vegetation has been maintained to create a park-like setting with a mature overstory of deciduous hardwoods and conifers. Expanses of mowed lawn are the typical setting of the man-made ponds. The following describes the ecological inventory work completed on-site, potential receptors of the contamination, and remediation in regard to effects on wetlands.

6.2 Upland Habitats

The site consists primarily of mixed upland, deciduous forest with species composition typical of the southern New England region. Predominant species (listed in Appendix W) include black oak (*Quercus velutina*), white oak (*Quercus alba*), white ash (*Fraxinus americana*), white birch (*Betula papyrifera*), sugar maple (*Acer saccharum*), Norway maple (*Acer platanoides*) and American beech (*Fagus grandifolia*). Evergreen or coniferous forest species exist intermixed with the deciduous forest and in separate stands. White pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*) are among the dominant coniferous trees on-site.

The majority of the site forested areas contain a fairly dense shrub understory comprised of maple-leaved viburnum (*Viburnum acerifolium*), honeysuckle (*Lonicera* sp.), tall huckleberry (*Gaylussacia frondosa*), multiflora rose (*Rosa multiflora*), mountain laurel (*Kalmia latifolia*) and others typical of the

recycled paper

region. In portions of the site near buildings and some of the roadways (i.e., the western-central part of the site), shrub undergrowth has been cleared from the forest understory.

Many cultivated and/or non-native species were found throughout the site which were presumably brought in during development of the former estate. Observed species include Japanese maple (Acer palmatum), winged euonymus (Euonymus alatus), yew (Taxus sp.), and Rhododendron (Rhododendron sp.), among others.

The site's upland forest contains a generally sparse herbaceous community, consisting mainly of hayscented fern (Dennstaedtia punctilobula), several other species of ferns, club mosses (Lycopodium spp.) and several grasses.

Non-forested portions of the site include the vicinity of the Linemaster plant and adjacent estate to the north. A large grassed corridor extends south from the plant to Route 171 and along the eastern part of the site among the 3 ponds and the lower stream system. These areas contain occasional tree specimens and wind rows, but are mainly mown grass corridors.

6.3 Wetland and Aquatic Habitats

Investigations were conducted by a Wetland Biologist and Soil Scientist from Fugro-McClelland to identify, delineate, classify, and inventory state and federally-defined wetlands on the property. The wetland plant list is included in Appendix W. Two main wetland areas were located along the eastern and western boundaries of the property (Figure 6-1). These vegetated wetland areas were delineated in the field with alpha numerical series of

recycled paper

NOTES

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HORIZONTAL DATUM BASED ON C.G.S. DAD 1927.

ALL MONITORING WELLS HAVE BEEN FIELD LOCATED AND/OR VERIFIED HORIZONTALLY AND VERTICALLY BETWEEN 6-21-91 AND 7-12-91. SEE FIELD BOOK #616.

IEP, INC. APPROXIMATE LOCATION OF POORLY DRAINED AND VERY POORLY DRAINED SOILS AND FEDERAL JURISDICTIONAL WETLAND BOUNDARY (COE 1987). ON-SITE BOUNDARY DELINEATED BY IEP, INC. 10/21/91 BUT NOT FIELD SURVEYED. NOT FOR DRAFTING PURPOSED. WETLANDS CLASSIFIED ACCORDING TO USFWS (COWARDIN ET AL, 1979).

LEGEND

PZ-1	EXISTING PIEZOMETER LOCATION
MW-1R	EXISTING TILL MONITORING WELL
MW-1A	EXISTING SHALLOW BEDROCK MONITORING WELL
MW-1B	EXISTING DEEP BEDROCK MONITORING WELL
GW-06db	EXISTING WATER SUPPLY WELL
600	TOPOGRAPHIC CONTOUR (ft-msl)
	TREE LINE
PFO1	PALUSTRINE FORESTED WETLAND-BROAD LEAVED DECIDUOUS
POW	PALUSTRINE OPEN WATER
PEM5	PALUSTRINE EMERGENT-NARROW LEAVED PERSISTENT
	APPROXIMATE WETLAND BOUNDARY

PROJ. MANAGER: DLB		
CHIEF DESIGNER: FM		
REVIEWED	BY	DATE
BOUNDARY		
FIELD EDIT		
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FUSS&O'NEILL consulting engineers
MANCHESTER, CONNECTICUT

WETLAND DELINEATION
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
PLAINE HILL ROAD WOODSTOCK, CONNECTICUT

PROJECT 86-88 FIGURE 6-1

plastic flagging or stakes. The outer limits of wetland areas were determined based on a multiparameter approach. Vegetative cover, soils and evidence of hydrology were examined per the criteria and the methodologies detailed in the U.S. Army Corps of Engineers Wetland Delineation Manual, 1987. As such, the delineations are intended to satisfy the federal criteria as interpreted under Section 404 of the Clean Water Act. These methodologies also generally comply with the definitions and intent of the state wetland regulations (Connecticut Inland Wetland and Watercourses Act, Section 22a-36 through 22a-45).

A stream and pond complex located along the eastern property line parallels Route 169 with flow direction to the south. Large sections of this system have been manipulated, as evidenced by the presence of three artificial ponds. The main system consists of a stream channel bisected by Pond 1, and the wetland vegetation bordering the stream. West of Pond 1, a smaller artificial Pond 3 exists. Pond 3 was not flagged since the edge of water can be considered the edge of wetland. A pump circulates water in the center of Pond 3.

At the edge of Route 171, about 200 feet west of the stream channel, another isolated man-made pond (Pond 2) exists. The edge of water clearly defines the limits of Pond 2, and thus flagging was not conducted. The lawn was mowed up to the water edge, and wetland conditions do not extend beyond the water line. No inlet flow was visible. Some emergent vegetation has established within the pond, primarily cattails (Typha sp.). A great blue heron was observed wading amongst the vegetation and fish were noted breaking the water surface. Outlet flow was observed via a grassed ditch and culvert to the south combining

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with the stream heading toward Mill Brook.

The stream system which incorporates Pond 1 is delineated in the field by the "A" and "B" series of wetland flagging. Wetland flags A1 through A41 delineate the outer limits of wetland along the western side of the system, and the flags B1 through B36 mark the eastern edge of wetland. The stream channel originates from a small fire pond and upgradient red maple (Acer rubrum) wooded swamp on the north side of Route 169 and Frog Pond Road. Water is discharged off-site via a concrete culvert under Route 169. On the subject property the stream channel shows evidence of ditching. A wooden bridge is present near Route 169 for crossing the stream as a cart path. South of the bridge the wetland widens from the stream channel to include a wooded wetland plant community comprised of mature red maples, arrowwood (Viburnum recognitum), winterberry (Ilex verticillata), and winged euonymus (Euonymus alatus). Although the growing season had ended, plant parts of skunk cabbage (Symplocarpus foetidus), jewelweed (Impatiens capensis) and royal fern (Osmunda regalis) were noted as dominant ground cover. Small erosional channels carrying upland runoff toward the stream were visible along the wetland edge. Soils were saturated to the surface in the vegetated wetland areas adjacent to the stream channel.

The stream, rocky in parts, flows into man-made Pond 1 which appears to be several feet deep. A pump recirculates water in the pond center and a stand of cattails has established at the inlet and outlet areas. An algal bloom was noted on the water surface especially along the pond margins. A few other wetland plants have colonized the shallow waters of the pond near the cattail stands including beggars ticks (Bidens connata), spike

rush (Eleocharis sp.), rice cutgrass (Leersia oryzoides) and mud plantain (Alisma sp.).

The stream downgradient of the pond is narrow (2 to 4 feet wide) and overgrown with dense woody growth of young red maple and white pine. The grounds are maintained up to the wooded plantings along the stream edge. In one area near the base of the slope, wetland flagging extends into the mowed lawn where wetland hydrology was apparent. The lower section of the stream flows through maintained areas where lawns were mowed to the stream edge. In those places the edge of flagging is the edge of the stream bank. The outlet discharges water under Route 171 toward Mill Brook.

The eastern wetland complex can generally be categorized as a stream with wooded wetland and artificial ponds. In utilizing the U.S. Fish and Wildlife Service Manual, Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et al, 1979), the area would be classified as Palustrine Forested Wetland with a dominance of broad-leaved deciduous cover. The artificial ponds are classified as Palustrine Unconsolidated Bottom (Open Water), and the stream itself as Riverine Upper Perennial Unconsolidated Bottom or perhaps Intermittent Streambed.

At the western site bounds, a second wetland system extending from Plaine Hill Road north to Route 169 was delineated by the 'C' series of wetland flagging. Although a defined stream channel was not present within the wooded wetland, flow was noted in a northerly direction. An inlet or outlet to this system was not observed which may indicate that the area is a seasonal

wetland and not likely to transmit contaminants off the site. The 'C' series wetland is characterized by an overstory of red maple and shrubby understory with a diversity of species such as winterberry, arrowwood, multiflora rose (Rosa multiflora), silky dogwood (Cornus amomum), and elderberry (Sambucus canadensis). The soils of much of the 'C' series wetland were saturated to the surface. Downstream of the apparent outlet culvert, a stream channel was noted flowing north toward a wooded wetland. This wooded wetland system is classified as Palustrine Forested Wetland with broad-leaved deciduous species, primarily red maple, according to Cowardin et al (1979).

In addition to the two main wetland systems in the eastern and western sections of the property, a third small wetland area was observed. A hillside seep and an old well structure was noted about 75 feet east of the Blakely driveway and MW-6. The area, characterized by pooling water at the base of steep bedrock outcrops was not delineated due to the small size. The dominant vegetation surrounding the dilapidated well house included jewelweed and poison ivy (Toxicodendron radicans). The surface water pooled in a small pocket but no evidence of downgradient flow was observed.

A sample of soil and of the ground water was collected from the area of the old well house. The samples were analyzed for VOCs by EPA Method 8260. Analyses for metals used various methods depending on the metal. Neither VOCs nor metals were detected in elevated concentrations in comparison with other soil and ground-water analyses. There was no detection of VOCs in the soil sample. TCE was detected in the ground-water sample at 71 ug/l, a concentration similar to that in the samples collected from the

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Blakely leaching field curtain drain. Arsenic concentrations for both the soil and ground-water sample (8.1 mg/kg and 27.5 ug/l) were consistent with the concentrations observed in the background soil and ground-water samples. As a result, despite the location of the old well, there has been little impact from past activities on the site.

The wetlands on this site are small headwater systems with limited watershed area situated in a till and bedrock upland setting. As a result, the stream and wetland systems on-site are not likely to have 10 year or 100 year floodplains which extend outside of the flagged wetland boundaries. It is possible that the stream may occasionally overtop its banks during either storm event, but stormwaters likely will not extend past the flagged wetland boundary.

In an effort to inventory aquatic habitats on site, benthic invertebrates were collected in the stream channel of the eastern wetland complex. Macroinvertebrates were collected upstream and downstream of Pond 1. Submerged rocks were examined and a representative sampling of the species utilizing the substrate were collected and preserved. No microhabitats other than the submerged rocks were sampled although areas such as overhanging vegetation, bank undercuts and submerged leaf detritus were present.

The macroinvertebrate fauna of the small eastern stream exhibits minimal diversity (Table 6-1). The community is disproportionately composed of members of the three taxa (Simuliidae, Leuctridae, and Cheumatopsyche). Many taxa that typify the benthic community of stream ecosystems are lacking,

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TABLE 6-1

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RESULTS OF MACROINVERTEBRATE
SAMPLING OF EASTERN STREAM

REMEDIAL INVESTIGATION REPORT
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WOODSTOCK, CONNECTICUT
DECEMBER 1992

INSECTA	UPSTREAM	DOWNSTREAM
Coleoptera (beetles)		
Elmidae	R	R
Diptera (flies and midges)		
Chironomidae (midges)	R	R
Simuliidae (blackflies)	O	C
Plecoptera (stoneflies)		
Leuctridae	A	---
Trichoptera (caddisflies)		
Cheumatopsyche	---	A
Brachycentridae (?)	---	R
CRUSTACEA		
Isopoda		
Caecidotea	R	---
MOLLUSCA		
Gastropoda (snails)		
Physa	O	O

Estimated Percent Composition:

A: Abundant (>50%)
C: Common (25-50%)
O: Occasional (10-24%)
R: Rare (<10%)

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including the insect orders Megaloptera (dobsonflies) and Ephemeroptera (mayflies). A cursory assessment of the physical characteristics of the system indicate that the habitat is sufficient to support a more diverse fauna. It is possible that the past management of the site, including pond construction, channelization and landscaping has impaired the ability of the stream to support such fauna, especially given the headwater setting and seasonality of flow.

6.4 Wildlife

This section is intended to address the known or potential utilization of the site by wildlife. Due to the limited time period of on-site investigations by Fugro-McClelland, the focus of this assessment is on potential wildlife use as indicated by habitat conditions and regional location of the site. Estimating wildlife use using habitat characteristics is a well accepted methodology among Wildlife Biologists, since actual censusing is time consuming and often limited by the time of year.

As previously described, the predominant habitat on the site consists of mature upland forest. Both deciduous and evergreen forest cover occurs, and often there is a mixed assemblage. The upland forest is broken by mowed fields, the buildings and paved areas of the facility, and the wetlands and ponds found in the low-lying portions. Considering the presence, size, quality and relative abundance of these habitats, and considering the juxtaposition of the site with other surrounding habitat in a relatively rural portion of northern Connecticut, a reliable inventory of potential wildlife likely to use the site for one or more functions can be generated. Appendix W provides the

inventory list of reptiles, amphibians, mammals, and birds which are potential users of the site.

Generally, the Linemaster site offers excellent habitat for wildlife requiring moderate-sized tracts of upland forests. The interspersed open meadows add diversity to the site and increase ecotone along the forest edge; however, actual use of the meadows by wildlife is limited due to the mowed condition. Edge habitat also is provided along the stream system in the eastern part of the site, and the stream/wetland system provides a water source and aquatic habitat attractive to many wildlife species.

Fugro-McClelland encountered no evidence of use on the site by "rare" species or "species of special concern" as listed by the Connecticut Natural Diversity Data Base. Fugro-McClelland contacted the Data Base to obtain site-specific records. A response dated December 12, 1991 (Appendix W) reported no known extant populations of Federally Endangered and Threatened species proposed for State Endangered, Threatened or Special Concern occurring at the site.

Use of the site by wildlife having sport or commercial significance is likely to be minimal. Minor use by deer, roughed grouse, woodcock, rabbit and fox is anticipated, but the actual sport or commercial signature of this use is likely to be minimal.

6.5 On-site Soils

According to the Soil Survey of Windham County, Connecticut, the site soils formed in compact glacial till derived mainly from

schist and gneiss. The site contains the following related, mostly well drained soil series: Canton and Charlton fine sandy loam, 8-15 percent slopes; Charlton-Hollis fine sandy loam, very rocky, 3-15 percent slopes; Paxton fine sandy loam, 3-8 percent slopes; Woodbridge fine sand loam, 3-8 percent slopes; Woodbridge very stony sand loam, 3-8 percent slopes; and a small area of Ridgebury fine sandy loam.

All of these soils, with the exception of Woodbridge and Ridgebury, are well drained to somewhat excessively drained (Hollis) soils on rolling hillsides. Paxton, Woodbridge, and Ridgebury soils are found on the northern half of the site along Route 169, and the Canton and Charlton and Charlton-Hollis units are concentrated in the southern half of the site along Route 171. A partially exposed bedrock ridge, mapped as the Charlton-Hollis unit, traverses the center of site from north to south.

On-site wetlands are found mainly within the moderately well drained Woodbridge soils and the lowest portion of the Canton and Charlton soils which contains a narrow stream. Poorly drained Ridgebury soils, which extend briefly on to the site in the northeast corner, were found to extend further into the site in this corner. This area was probably too small to include as part of the Ridgebury unit and is a mapping inclusion of the Woodbridge series.

Ridgebury soils also likely to extend into Woodbridge soils in the northeastern part of the site along the eastern stream and pond system.

Overall, on-site wetland (hydric) soils are characterized by deep, silty, highly organic, black and gray surface horizons overlying olive brown to gray, mottled fine sandy loam. Soils in these low areas appear to accumulate silty alluvium from overland flow from adjacent upland slopes. This results in the deep, silty surface horizons found throughout site wetlands, particularly near the upper wetland boundary. At the time of the investigation, wetland soils were saturated between 18" and less than 12" below the ground surface.

Off-site to the west, a small stream flows south along the western property line. The wetland system in the northwestern corner of the site is associated with this drainageway, which contains long, narrow poorly drained Ridgebury soil series units. This stream flows into Mill Brook, flowing east along the southern property boundary. The brook traverses portions of well drained Charlton-Hollis soils, moderately well drained Sutton very stony fine sandy loam and Pootatuck fine sandy loam, as well as poorly drained Saco silt loam.

North of the site, a larger wooded swamp and stream underlain by Ridgebury, Leicester and Whitman extremely stony fine sandy loam, flows onto the site under Route 169. The stream flows through the site and off to the south and joins Mill Brook, mentioned above. Due to the rolling topography and dense glacial till surface sediments in this area, the stream systems and associated wetlands are narrow, well-defined areas.

6.6 On-Site Contamination Receptors

On-site vegetative communities, wetlands and surface-water

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systems were evaluated generally for potential effects of known contaminants released from the Linemaster facility. TCE, an industrial solvent, has been found in ground water, sediments, surface water and soils on the site. This investigation does not comprise an ecological risk assessment; only a general site walkover and survey was conducted to identify and characterize any visible indicators of plant, animal, and/or other ecological stress associated with the released contaminant.

TCE is characterized as a toxic solvent and a suspected occupational carcinogen (Material Safety Data Sheet, 1987). It is a colorless, nonflammable mobile liquid, and has a sweetish, chloroform-like odor. It has a specific density of 1.46 at 68° F, so it tends to sink if it enters the ground water. The compound finds the lowest point in the aquifer, or the contaminant plume surfaces where the ground water discharges to a wetland or open water system in the landscape.

The source of TCE contamination has been identified as the Linemaster facility. Ground-water concentrations of TCE in both the deep bedrock and till is discussed in Section 4.0. According to the TCE concentration isopleths, the TCE plume within the till aquifer has remained fairly close to the Linemaster facility, due to the relative impermeability of the till in the vicinity of the former dry well. A concentration of TCE in the deep bedrock aquifer has been detected more broadly to the east toward the edge of the eastern wetland. Actual release of TCE to the surface-water system however, while documented through surface water and sediment sampling and analyses, did not show, through this ecological assessment, an obvious or recognizable physical effect on the surface waters or vegetation of the system.

On-going investigations, including the start-up of the Interim Removal System will provide additional information on the migration of TCE in the various media.

There are immediate human health-related concerns about TCE exposure hazards. It does not appear however, that the concentrations of TCE detected in the surface water or sediment would approach the acute or chronic toxicity concentrations of 45,000 and 21,900 ug/l respectively. For arsenic (V), the likely most prevalent form of arsenic at the site, there is no defined toxicity concentration. Inorganic arsenic(V) is acutely toxic to freshwater aquatic animals at concentrations as low as 850 ug/l. One analysis showed acute toxicity at 28 ug/l. Detected concentrations of arsenic in surface water samples has been less than 5 ug/l.

There are no set parameters for evaluating the ecosystem (e.g. vegetation, wildlife populations, microbial biota, benthic organisms, etc.) for impacts and population stress associated with this compound. Therefore, Fugro-McClelland has conducted a generalized site walkover to evaluate overall ecosystem functioning and health.

The narrow wetland/stream/pond system along the eastern edge of the site appears to be functioning normally. No vegetative stress, dieback or discoloration was noted throughout the system. Stream and pond water was clear and free of suspended sediments or oxidized metals.

Similarly, no apparent impacts are evident in the upland communities of the site. Because of the time of year of the

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investigation, normal leaf drop was occurring. Any potential plant stress, if present, may have been masked or unrecognizable. However, no other obvious stresses were visible. Use of the site by both migratory and permanent-resident bird species typical of the region was noted, and several small mammals were observed. Again, there is no indication of ecological impacts on the site or in surrounding habitats due to the TCE contamination.

6.7 Remediation Effects on Natural Habitats

As discussed in Feasibility Study Report, on-site remediation of contaminated ground water will involve pumping of six ground-water wells which are located in the contaminant plume. Ground water will be air-stripped to remove TCE, and clean water will be discharged to Pond 3. This procedure will continue indefinitely to assure long-term removal of TCE from the ground water.

Ground-water pumping associated with air-stripping could entail pumping 100 to 130 gpm, collectively, from the six designated ground-water wells. Currently, the system operates at approximately half that rate. Without the inclusion of additional wells, it is unlikely that the extraction rate would approach the design rate.

No pump-test modelling has been performed, however, to determine the potential cone of influence of water withdrawal for the site. Due to the dense till and shallow bedrock setting of the site, particularly at upper elevations near the production facility (and TCE source), in Fugro-McClelland's opinion, water withdrawal likely will have little influence on adjacent and downgradient natural communities such as upland forest, wooded swamp, the pond

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and stream system, or the isolated ponds. Further investigations regarding ground-water and surface-water interactions would be required for a quantitative discussion of potential effects of ground-water withdrawal on the site.

It is anticipated that TCE will degrade naturally in the environment, particularly in wetland soils and shallow water sediments, where exposed to sunlight and anaerobic microbial populations. Biodegradation occurs as dehalogenation, and sunlight exposure may cause oxidation, degradation and polymerization.

In addition, non-contact cooling water presently is being discharged to Pond 3 from the production facility. Pond 3 is a newly created isolated basin (within the last 3 years) and cooling water discharge has been initiated this year (1991). Longer-term monitoring will be required to determine what effects, if any, the discharge will have on the pond's aquatic environment. Due to isolated nature of the pond, however, the low discharge volume of the cooling water, and the long stretch of underground piping across the site before discharge (allowing for cooling during transport), impacts associated with cooling-water discharge are not anticipated.

6.8 Summary

The Linemaster site consists of typical assemblages of plant and animal habitats for this rural/suburban region of northeastern Connecticut. In Fugro-McClelland's opinion there are no visible signs of ecological degradation on the site, in either the uplands which dominate the property or in the fringing wetlands,

which indicate TCE contamination or impacts from it in these habitats. While this assessment is limited due to the short time frame of Fugro-McClelland's investigations and season of the year when the site was reviewed, it is our opinion that appreciable ecological impact has not occurred.

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7.0 CONTAMINANT TRANSPORT AND FATE

7.1 Potential Contaminants and Migration Routes

The primary contaminants of concern at the site are volatile organic compounds including chlorinated alkanes, chlorinated alkenes, aromatics compounds, ketones, and vinyl compounds. Arsenic is the only metal identified as a potential contaminant of concern. The physical and chemical properties of the compounds of concern are presented in Tables 7-1 through 7-5. In general, most are liquid solvents with boiling points less than or near that of water, indicating a relatively high volatility. Generally, only the ketones exhibit any appreciable water solubility. Despite the relatively low solubility of the other VOCs in water, however, most compounds, exhibit sufficient solubility to be dissolved in the ground water. The chlorinated compounds are denser than water. If present at concentrations greater than their solubility in water may accumulate as a separate phase below the water table surface. The nonchlorinated organics are less dense than water and tend to accumulate as a separate floating on the water table surface if present at concentrations exceeding their solubility in water. Except for some samples collected from MW-26t, there is no indication of the likelihood of the presence of separate phases.

Potential contaminant migration mechanisms in the soil, surface water, ground water, and air at the site include, but are not limited to, ground-water advection, atmospheric migration by particulate matter or volatile emissions, lateral movement of gases in the subsurface and transport of contaminants by surface waters. All of these potential migration mechanisms and routes were examined with respect to site and study area conditions.

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TABLE 7-1

PHYSICAL AND CHEMICAL PROPERTIES OF CHLORINATED ALKANE COMPOUNDS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PROPERTY	1,1,1-Trichloroethane	Dichloromethane	Carbon Tetrachloride	Chloroethane	1,2-Dichloroethane
Molecular weight	133	84.94	153.84	64.52	98.96
Color	colorless	colorless	colorless	colorless	colorless
Physical state	liquid	liquid	liquid	gas	liquid
Odor	ether like	penetrating ethereal	heavy ethereal	ether like	sweet, chloroform like
Melting point, C	-32.5	-96.7	-23	-138.3	-35.5
Boiling point, C	74.1	39.75	76.54	12.2	83.5
Autoignition temperature, C	537	556	none	518	413
Solubility in water, %	insoluble	slightly	very slightly	slightly	soluble
Solubility in organic solvents	soluble in alcohol, ether	alcohol, ether	miscible in most solvents	miscible with solvents	miscible w/ alcohol, chloroform, ether
Density/specific gravity	1.325	1.3255	1.594	0.9214	1.2569
Vapor pressure, mm Hg	100	440	91.3	1000	87
Henry's law constant (atm*m^3/mol)	1.441E-02	2.476E-03	2.941E-02	6.919E-03	1.178E-03
Refractive index	NA	1.4244	1.4607	NA	1.444
Flash point, C	none	none	none	-50	13
Flammability limits (vol % in air)	8-10.5	12-19	none	3.6-14.8	6.2-15.9
Conversion factors					
Air (20 DEGREES C)	1 mg/m^3 = 0.18 ppm				
	1 ppm = 5.46 mg/m^3				
Water	1 ppm (w/v) = 1 mg/L = 1 ug/mL				

Source: MSDS, Genium's Reference Collection
Hawley's Condensed Chemical Dictionary
NA - Not Available

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TABLE 7-2

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PHYSICAL AND CHEMICAL PROPERTIES OF CHLORINATED ALKENE COMPOUNDS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PROPERTY	1,1-Dichloroethene	1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
Molecular weight	96.94	96.95	166	131.4
Color	colorless	colorless	colorless	colorless
Physical state	liquid	liquid	liquid	liquid
Odor	mild, sweet, chloroform like	pleasant	ether like	ether like
Melting point, C	-122.5	-49 to -82	-22	-87.1
Boiling point, C	31.7	48	121	86.7
Autoignition temperature, C	570	460	none	410
Solubility in water, %	slightly	insoluble	insoluble	slightly
Solubility in organic solvents	NA	NA	miscible w/ alcohol ether, oils	miscible w/ alcohol ether, oils
Density/specific gravity	1.2129	1.27	1.62	1.456
Vapor pressure, mm Hg	591	180-264	18	59
Henry's law constant (atm*m^3/mol)	3.408E-02	6.581E-03	2.685E-02	1.167E-02
Refractive index	NA	NA	1.5029	1.4735
Flash point, C	-28	2.8	none	none
Flammability limits (vol % in air)	5.6-11.4	5.6-12.8	none	8-10.5
Conversion factors				
Air (20 DEGREES C)	1 mg/m^3 = 0.18 ppm			
	1 ppm = 5.46 mg/m^3			
Water	1 ppm (w/v) = 1 mg/L = 1 ug/mL			

Source: MSDS, Genium's Reference Collection
Hawley's Condensed Chemical Dictionary
NA - Not Available

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TABLE 7-3

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PHYSICAL AND CHEMICAL PROPERTIES OF AROMATIC COMPOUNDS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PROPERTY	Ethyl Benzene	Benzene	Xylene	Toluene
Molecular weight	106	78.11	106	92.15
Color	colorless	colorless	colorless	colorless
Physical state	liquid	liquid	liquid	liquid
Odor	sweet, aromatic	sweet, aromatic	sweet	sweet
Melting point, C	-95	5.5	-25	-94.5
Boiling point, C	136	80.1	135-145	110.7
Autoignition temperature, C	432.2	498	464	536
Solubility in water, %	slight	slight	insoluble	slight
Solubility in organic solvents	alcohol, benzene carbon tetrachloride ether	miscible w/ alcohol, solvents	soluble in alcohol ether	soluble in alcohol ether
Density/specific gravity	0.86258	0.879	0.86	0.86
Vapor pressure, mm Hg	7.1	100	7-9	28.7
Henry's law constant (atm*m^3/mol)	8.043E-03	5.566E-03	6.662E-03	6.356E-03
Refractive index	1.495	1.5011	1.497	1.497
Flash point, C	18	-11	27.2-46.1	4.4
Flammability limits (vol % in air)	1-6.7	1.3-7.1	1-7	1-7
Conversion factors				
Air (20 DEGREES C)	1 mg/m^3 = 0.18 ppm			
	1 ppm = 5.46 mg/m^3			
Water	1 ppm (w/v) = 1 mg/L = 1 ug/mL			

Source: MSDS, Genium's Reference Collection
Hawley's Condensed Chemical Dictionary

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TABLE 7-4

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PHYSICAL AND CHEMICAL PROPERTIES OF KETONES

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PROPERTY	2-Hexanone	MIBK	MEK	Acetone
Molecular weight	100.16	100.18	72.12	58
Color	colorless	colorless	colorless	colorless
Physical state	liquid	liquid	liquid	liquid
Odor	acetone like, sweetish	sharp, mintlike	moderately sharp, mintlike	pleasant, sweetish
Melting point, C	-57	-84	-86	-94
Boiling point, C	128	116	80	56
Autoignition temperature, C	532.2	460	516	465
Solubility in water, %	3.5	slightly	27.1	complete
Solubility in organic solvents	alcohol, ether	miscible with most solvents	benzene, alcohol ether, oils	alcohol, ether chloroform, oils
Density/specific gravity	0.81	0.8	0.805	0.778
Vapor pressure, mm Hg	10	16	72	180
Henry's law constant (atm*m^3/mol)	NA	NA	2.741E-05	2.061E-05
Refractive index	1.4024	1.3959	1.379	1.3591
Flash point, C	24.9	22.8	-6.7	-17
Flammability limits (vol % in air)	1.22-8.0	1.4-7.5	1.8-10	2.9-12.8
Conversion factors				
Air (20 DEGREES C)	1 mg/m^3 = 0.18 ppm			
	1 ppm = 5.46 mg/m^3			
Water	1 ppm (w/v) = 1 mg/L = 1 ug/mL			

Source: MSDS, Genium's Reference Collection
Hawley's Condensed Chemical Dictionary
NA - Not Available

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TABLE 7-5

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PHYSICAL AND CHEMICAL PROPERTIES OF VINYL COMPOUNDS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

PROPERTY	Vinyl Acetate	Vinyl Chloride
Molecular weight	86	107
Color	colorless	colorless
Physical state	liquid	compressed gas
Odor	faint, sweetish, ether like	sweet
Melting point, C	-93 to -100	-159.7
Boiling point, C	73	-13.9
Autoignition temperature, C	472	472
Solubility in water, %	2.3	slightly
Solubility in organic solvents	soluble in most solvents	soluble in alcohol, ether
Density/specific gravity	0.932	0.9121
Vapor pressure, mm Hg	115	2300
Henry's law constant (atm*m^3/mol)	NA	8.198E-02
Refractive index	1.3941	NA
Flash point, C	-8	-77
Flammability limits (vol % in air)	2.6-13.4	4-22
Conversion factors		
Air (20 DEGREES C)	1 mg/m^3 = 0.18 ppm	
	1 ppm = 5.46 mg/m^3	
Water	1 ppm (w/v) = 1 mg/L = 1 ug/mL	

Source: MSDS, Genium's Reference Collection
Hawley's Condensed Chemical Dictionary
NA - Not Available

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7.1.1 Atmosphere

Atmospheric migration is not considered a significant contaminant transport route either by airborne transport of particulate matter or volatile emissions. The Zone 1 area is temporarily capped with a polyethylene cover to prevent infiltration by precipitation and subsequent flushing of contaminants into the ground water. This cover also serves as a vapor barrier and limits volatile emission to the atmosphere.

Uncontrolled migration of VOCs volatilized from the near surface soil was sources modeled to predict the ambient air impacts as reported in Section 5.0. The model included three sources, the air stripper treating the water supply to the production facility (air stripper 1), the air stripper constructed as part of the Interim Removal Treatment System (air stripper 2), and the area source (the ground comprising the Zone 1 area in which the discharge of VOCs occurred). Modelling predicted that total ambient air impacts at the site were minimal and the Zone 1 area soil source accounted for only 15 percent of the impact. Furthermore, the model used to obtain an emission rate for the Zone 1 soil surface assumed that the polyethylene cover was not present, and is therefore conservative.

Initial modeling of the site showed that the bulk of the ground level TCE concentration, 9.43 ug/m^3, originated from the degreasing operation (92 percent of the maximum modeled annual average TCE concentration). The elimination of the vapor degreaser resulted in a reduction in the maximum concentration of more than 86 percent even with the addition of the second air stripper.

The primary sources of atmospheric TCE are the two air strippers.

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The contribution of TCE from the Zone 1 area source is small, but is highest immediately adjacent to the manufacturing building. Overall, the magnitude of the predicted ambient VOC concentrations due to site contamination, and the remedial activities currently taking place, is minimal.

Although VOCs have been detected in soil gas, soil and ground-water samples collected during Zone 1 investigations, HNu readings taken above the cover have not detected VOCs in this area during ambient conditions. The soils in Zone 1 generally are not conducive to gaseous movement of contaminants under ambient conditions. As a potential remedial measure, soil vapor extraction may induce soil gas migration by artificially decreasing or increasing pore pressures. Induced soil gas migration during vapor extraction is expected to be toward low-pressure areas created adjacent to vapor extraction wells. Lateral soil vapor migration toward the edges of the synthetic cover is not likely during operation of a vapor extraction system. As is discussed in the Feasibility Study Report (Section 13.0), the effectiveness of vadose zone VOC concentration reduction by soil vapor extraction may be enhanced by concurrent dewatering of the Zone 1 area.

7.1.2 Surface Water

Contaminant migration by surface water is of minor importance at the site. This has been concluded based on the results of surface-water and sediment sampling. Sampling results indicate the presence of low concentrations of VOCs and metals (arsenic, chromium and lead) in these media. As previously discussed, the detected metals concentrations are believed to be representative of naturally occurring concentrations. Details of surface-water

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and sediment sampling and results are discussed in Sections 4.4 and 4.5.

Contaminants present in the surface-water bodies in the study area may be due to one or more of the following mechanisms: contaminant transport from on-site and off-site locations by surface-water runoff; wet or dry deposition of airborne particulate matter; condensation of VOC vapor emission; fluvial particulate deposition; and, surface-water body recharge by contaminated ground water. However, of these mechanisms, surface-water recharge by ground water is believed to be the most significant mechanism. The presence of low VOC concentrations in Pond 3 likely is due to the discharge of ground water from the Blakely leaching field curtain drain to the pond. The low VOC concentrations detected in Pond 1 may be due to ground water recharge to the eastern stream north of Pond 1 or to overflow from Pond 3.

Future surface-water body contaminant concentrations are expected to fluctuate in response to seasonal surface-water body flow-rate variation and ground-water and surface-water recharge/discharge equilibration. It is possible that higher surface-water contaminant concentrations may occur in the future if contaminated ground water continues to migrate toward the surface-water bodies. However, surface-water concentrations are expected to be remain significantly less than those present in the ground water. Surface-water body and ground-water recharge and discharge rates can not be calculated from the limited data currently available; however, the VOC concentrations in the till and/or bedrock ground water recharging the surface-water bodies are expected to be diluted due to mixing with the relatively uncontaminated surface waters. Additionally, volatilization of

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VOCs upon exposure to the atmosphere may result in decreased surface-water VOC concentrations.

7.1.3 Ground Water

Ground-water advection is considered to be the primary mechanism mode of contaminant migration at the site. Ground water is in contact with the soils at Zone 1, the identified VOC source area. The water table has been found to fluctuate considerably in this area. Contaminants at this location are dissolved in and transported by ground water. Significant levels of VOCs have been found in this area in the till, shallow bedrock and deep bedrock aquifers as discussed in Section 4.3. Figures 4-6, 4-7, and 4-8 depict TCE concentration isopleths at the site in the till, shallow bedrock and deep bedrock units, respectively.

Dissolved phase VOCs are transported horizontally in the till, shallow bedrock and deep bedrock units from the Zone 1 source area by ground water. Ground-water migration is influenced by the horizontal hydraulic gradients, depicted on Figures 3-6 through 3-11, as well as the hydraulic conductivity and porosity of the medium. Use of Linemaster's bedrock production well also affects the migration of dissolved VOCs in the deep bedrock as shown on Figure 4-8. Dissolved VOCs are transported vertically through the till unit under the influence of the vertical gradient, hydraulic conductivity, and porosity of the till. Vertical migration of dissolved VOCs in the bedrock units is influenced by the same factors as the till, as well as by production well pumping. As expected due to the extreme contrasts in hydraulic conductivity between the till and deep bedrock, production well pumping does not appear to significantly affect the water levels in the till at the Zone 1 source area as

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evidenced by the background water-level study in Appendix I. Therefore, the production well pumping is not expected to influence the vertical migration of dissolved VOCs in the till. The vertical migration rate of VOCs in the till is controlled by the hydraulic conductivity, vertical gradient and porosity of the till and not by the withdrawal of water from the underlying bedrock.

No DNAPL has physically been measured at the site; however, ground-water sampling data from MW-26t, where TCE was detected at 800,000 ug/l, suggests that DNAPL may be present in the till unit. If DNAPL is present in the till near MW-26t, it is probably in the form of isolated pockets or small residual drops due to the high dispersivity of the till. The initial discharge of solvents into the dry well likely was in the form of DNAPL. After the DNAPL was discharged into the dry well, it would have moved vertically downward through the unsaturated and saturated soils under the influence of gravity. The DNAPL probably was segregated as it moved through the till due to the high dispersivity of the till. The movement of DNAPL may also have been influenced by the presence of less permeable confining layers of silt within the till. The DNAPL, being unable to penetrate these confining layers rapidly, would have migrated according to the pitch of the confining layer. The pumping of Linemaster's bedrock production wells would not have influenced the migration of DNAPL in the till due to the much greater force exerted by gravity relative to the force associated with natural or induced ground-water flow in the till. As indicated above, limited hydraulic influence is induced in the till unit during pumping of the bedrock production well. After reaching the bottom of the till unit, DNAPL, may have accumulated or entered the bedrock. No DNAPL has physically been measured in the

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bedrock during the RI indicating that any DNAPL that entered the bedrock through the till is now dissolved in the ground water. Furthermore, ground-water data from both packer and grab sampling of bedrock wells does not indicate the presence of DNAPL.

7.2 Contaminant Persistence and Fate

7.2.1 Chlorinated Aliphatic Compounds

The most prevalent chlorinated aliphatic compounds that have been found at the site include TCE, cis-1,2-dichloroethene (c-1,2-DCE), 1,1,1-trichloroethene (1,1,1-TCA) and tetrachloroethene (PCE). The compound with the highest concentrations and most widespread occurrence is TCE, as described in Section 4.0. For these reasons, discussion of the fate of chlorinated aliphatic compounds will focus on TCE. A summary of pertinent physical and chemical properties of TCE is presented in Table 7-2.

The degradation pathways of various VOCs in soil systems are shown in Figure 7-1 and are as follows. PCE can be degraded to TCE; 1,1,1-TCA can be degraded to 1,1-dichloroethane (1,1-DCA) or 1,1-dichloroethene (1,1-DCE). TCE can then undergo reductive dehalogenation (the exchange of one chloride atom for one hydrogen atom) to form three possible products: 1,1-DCE, c-1,2-DCE and/or trans-1,2-dichloroethene (t-1,2-DCE). 1,1-DCE can undergo reductive dehalogenation to form vinyl chloride or be reduced to 1,1-DCA. C-1,2-DCE and t-1,2-DCE can undergo reductive dehalogenation to form 1,2-dichloroethane (1,2-DCA). 1,1-DCA and 1,2-DCA can undergo reductive dehalogenation to form vinyl chloride or chloroethane (U.S. EPA, 1991e).

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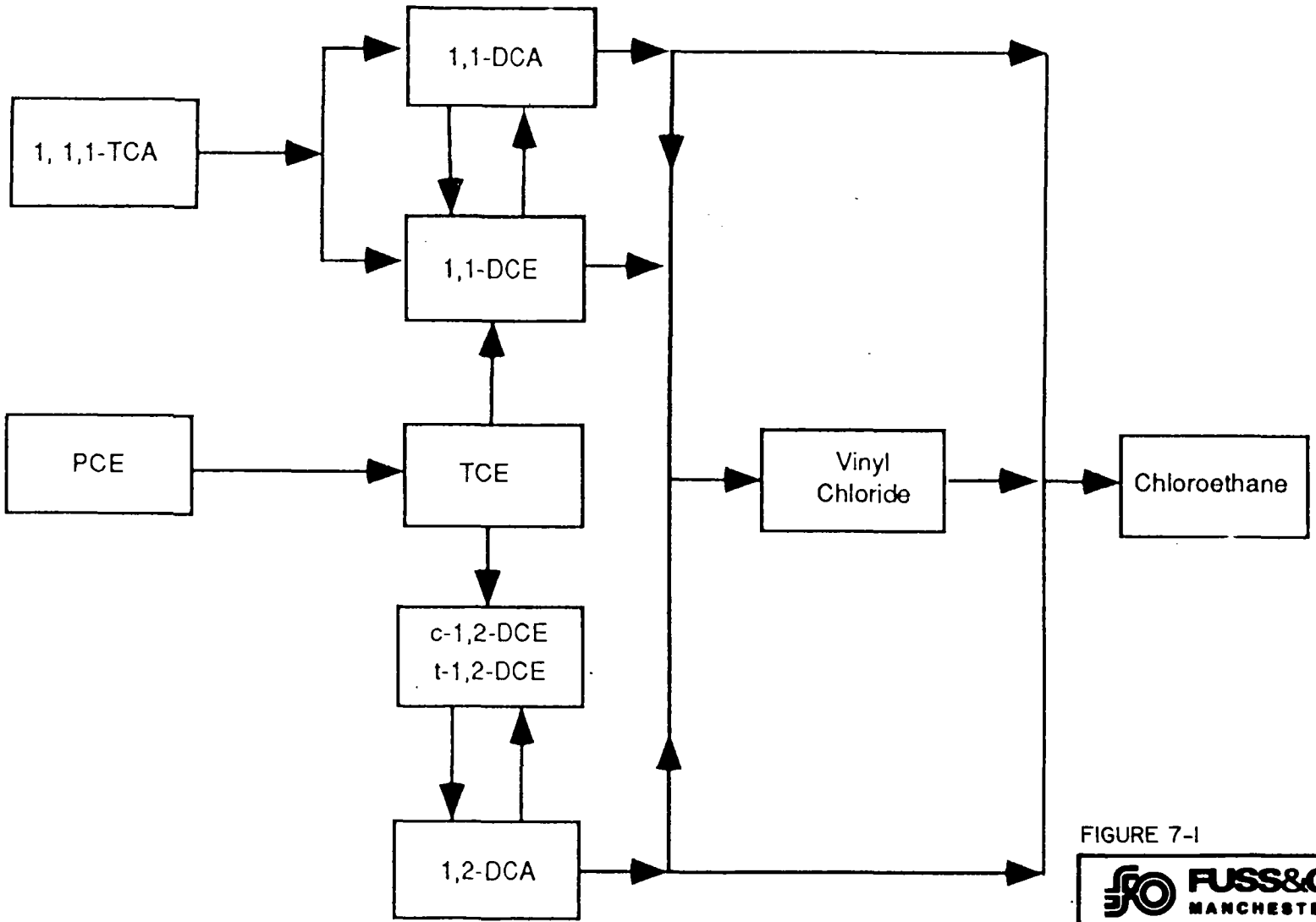

REFERENCE: EPA/540/4-90/054
JANUARY 1991

FIGURE 7-I

FUSS&O'NEILL
MANCHESTER, CONNECTICUT

TRANSFORMATION PATHWAYS IN SOIL SYSTEMS

LINEMASTER SWITCH CORP.

PLAINE HILL ROAD WOODSTOCK, CT

PROJ. NO. 86-88/26 DATE DEC. '92 SCALE: NONE

A number of natural processes affect the persistence and the fate of VOCs in the environment. These processes include; biotransformation/biodegradation, bioaccumulation, hydrolysis, photolysis/oxidation, sorption and volatilization (U.S. EPA, 1979).

7.2.1.1 Biodegradation

Biodegradation has been identified to be the most important transformation process in natural water and soil systems. The biodegradation process has been found not to occur rapidly on an environmental scale. The primary biodegradation product of TCE is dichloroethene, although small amounts of vinyl chloride also can form (U.S. PHS, 1988).

The biodegradation process is occurring at the site. Both TCE and dichloroethene have been found to coincide at sampling locations, both at the source area (e.g. MW-10td) and at distant water-supply monitoring locations (e.g. GW-40db).

Vinyl chloride has been detected only twice at Linemaster. Vinyl chloride was detected in at less than 1 ug/l at GW-12db in October 1988 and at a concentration of 10 ug/l in GW-10db in July 1990. It appears that some site limiting condition may prevent the degradation of TCE into vinyl chloride. At this time the nature of this limiting condition is not known.

Generally, biodegradation can occur under both aerobic and anaerobic conditions. A the site, the upper depths of the till likely exhibit aerobic characteristics while anaerobic conditions likely exist near the bedrock interface. While not confirmed for the Linemaster site, the aerobic organisms generally are strains

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of *Coryneforms* and *Pseudomonas* which will form products based upon intermediate epoxide formation. The epoxide will dechlorinate yielding gloxylate and carbon dioxide (CO_2). Anaerobic organisms produce byproducts (c- and t-1,2 DCE and vinyl chloride) by reductive dehalogenation. The anaerobic organisms, like the aerobic organisms, need a carbon substrate, such as methanol or methane. When the TCE concentration reaches 3,000-5,000 ug/l, for the anareobic organisms, toxic inhibition occurs and biodegradation ceases (Little, et al., 1988 and Roberts, et al., 1989).

Biotransformation/biodegradation is the enzyme catalyzed transformation of VOCs by microbial organisms (U.S. EPA, 1979). Microbes need energy and carbon for growth and maintenance. The microbes can meet these requirements by producing enzymes which break down VOCs into energy and carbon. This process may be important at the Linemaster Switch site in the soils and shallow ground water, where significant numbers of microbes exist and proper nutrients are available.

In natural water and soil systems, biodegradation of TCE may be an important final degradation process, although it does not appear to occur rapidly. Biodegradation screening tests and laboratory studies found TCE to be resistant to biodegradation, or only slowly biodegraded. Other screening studies noted more rapid biodegradation under proper inocula and adaptation (U.S. PHS, 1988).

Speital and Closmann (1991) researched the feasibility of treatment by in-situ bioremediation with indigenous methanotrophs utilizing batch biodegradation experiments on unsaturated soils. Of three chlorinated solvents tested, TCE degraded the second

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fastest. It was concluded in these studies, that at the degradation rate constants calculated, in-situ bioremediation generally would take several months to several years. In addition, significant quantities of non-volatile byproducts may be produced which may not represent acceptable remediation results. Nutrient availability significantly affected the degradation rate of chlorinated solvents. At the Linemaster site, no analyses of BOD, COD, nitrate, TKN or DO have been performed to address nutrient availability or potential microbial activity.

TCE can be biologically degraded if methane is used as a carbon source. TCE biodegradation by strain 46-1, a type I methanotrophic bacteria, was determined to occur only if a growth substrate such as methane or methanol was added (Little, et al., 1988). This strain of bacteria, grown on methane or methanol, degraded TCE to carbon dioxide (CO_2) and water soluble products in soil columns. Strain 46-1 was determined to be unable to degrade TCE in the absence of methane or methanol, indicating that biodegradation by this microorganism is a cometabolic process.

A laboratory-scale model of a treatment system was constructed to treat soil containing TCE and TCA (Wilson, et al., 1987). Propane or natural gas was run through a coarse sand containing TCE and TCA. Initial acclimation of the microorganisms took approximately two weeks, at which time extensive removal of TCE was observed.

Strand et al. (1990) studied the kinetics of chlorinated hydrocarbon degradation by suspended cultures of methane-oxidizing bacteria in a closed system reactor. TCE

degradation followed first-order kinetics for concentrations less than 3,000 ug/l. The oxidative activity of methanotrophic bacteria ceased at dissolved TCE concentrations of greater than 7,700 ug/l. Degradation ceased in the absence of methane after a period of 104 hours. At Linemaster, TCE concentrations in the till and bedrock in the Zone 1 area are greater than 7,700 ug/l as seen in Figures 4-6, 4-7 and 4-8. Biodegradation would not be expected to occur unless the concentrations of TCE decreased to below this limit.

In a subsequent study (Strand et al., 1991), the biodegradation of chlorinated solvents in a methanotrophic biofilm reactor was studied. The cometabolic degradation of TCE (using a mixed culture sparged with methane gas) was determined to be 0.4 ug/l/hr at concentrations below 1,000 ug/l with a maximum degradation rate of 400 ug/l/hr.

In the above studies, methane or methanol must be used as the carbon source for TCE biodegradation. Since non-chlorinated aliphatic compounds such as methanol were not found within the till or bedrock waters, natural degradation by methantropic organisms will not occur. TCE transformation by mixed and pure ground-water cultures was evaluated by Roberts et al. (1989). TCE degrading bacterial cultures were obtained from a contaminated ground-water aquifer. Intermediates produced in the transformation of TCE by methanotrophic oxidation included acids, formate, glyoxylate and dichloroacetate.

Freedman and Gosset (1989) presented evidence that anaerobic enrichment cultures, which support methanogenesis, are capable of completely dechlorinating PCE and TCE to ethylene. The most effective electron donor to sustain the reductive dechlorination

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was again methanol, although hydrogen, formate, acetate, and glucose also were effective. High electron donor quantities must be supplied in order to complete the conversion from vinyl chloride to ethylene.

The experiments of Fogel (1986) with biodegradation of TCE by methane utilizing mixed bacterial culture indicated that approximately half the TCE had been converted into CO_2 and bacterial biomass under anaerobic conditions.

Vogel et al. (1987) reviewed the transformation of halogenated aliphatic compounds including TCE. The review included a description of redox reactions and dehydrohalogenations. Redox reactions were determined to be more prevalent in mammalian and microbiological systems, where they are mediated by enzymes or coenzymes.

Metabolic dehalogenation of TCE, c-1,2-DCE, 1,1,1-TCA, and PCE can be accomplished by the following biodegradation processes: the introduction of electron donor and acceptor combinations; addition of nutrients; use of engineered microorganisms and the use of enzyme systems capable of catalyzing reductive dehalogenation (Sims et al., 1990/1991).

With the exception of 1,1,1 TCA, natural biodegradation rates of the other compounds present were not discussed in the literature reviewed. The environmental half-life of 1,1,1-TCA was reported between 0.5 and 2.5 years at 20 degrees C (Vogel et al., 1987). The biological reductive dechlorination of PCE, TCE and DCE by a methane-utilizing mixed culture was described by Fogel et al. (1986). Biodegradation rates under methanotrophic conditions for TCE, PCE, and DCE were reported as 2.5 x 10^6 umol/hr-ug protein,

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0 umol/hr-ug protein, and 11 x 10^6 umol/hr-ug protein, respectively.

Bitton et al.(1986) reported the following findings. Under laboratory conditions, TCE is slowly biodegraded as compared to other chlorinated hydrocarbons; continuous-flow studies have shown that TCE is biodegraded under anaerobic conditions in the presence of methanogenic bacteria; TCE is biodegraded anaerobically in soils; the anaerobic by-products of TCE are c- and t-1,2-DCE and vinyl chloride; and, anaerobic biodegradation of TCE operates through reductive dehalogenation.

In summary, TCE will not readily biodegrade in the subsurface environment under natural conditions at this site for the following reasons.

- Nutrients, principally nitrate, are not present. Although no analysis for nitrate was conducted on the till and bedrock samples, there is no reason to expect that sufficient nitrogen exists.

- Even if sufficient carbon and nitrogen sources exist, the reaction kinetics are slow and require years to achieve appreciable degradation.

- Methanol or other soluble aliphatic compounds are not present in the till and bedrock ground water at the site. Because the anaerobic organisms studied need such a carbon source, it would have to be introduced or produced by another strain.

- The TCE ground-water concentrations are above the toxic concentration for anaerobic bacteria in most of the Zone 1

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area. Until the TCE concentrations are reduced below approximately 7,700 ug/l, anaerobic degradation within the central contaminated region would be unlikely.

7.2.1.2 Bioaccumulation

Bioaccumulation occurs when VOCs (among other compounds) are incorporated into the body tissues of living organisms (U.S. EPA 1979). This is not considered to be an important fate for contaminants at the site due to low amounts of these contaminants at points of exposure. Points of exposure for organisms include surface soils and surface waters, where, as previously stated, low levels of contaminants were found.

Benthic organisms (caddisfly, blackfly, stonefly, etc.) within the streams and ponds may be subject to exposure and bioaccumulation. Direct consumers of the benthic population include fish, and, to a lesser extent birds, reptiles and amphibians such as turtles, frogs, and salamanders. The latter three groups tend to consume mature flies and other invertebrates which, as larvae, potentially may have accumulated contaminants. Higher-level consumers of fish, reptiles, and amphibians include raptors such as osprey, heron, and kingfishers, and some mammals such as raccoon and skunk. Any human consumption of the contaminated fish or mammal population also potentially would result in a bioaccumulated contaminant concentration in the human consumer. Given the characteristics of the site and the types of fish and wildlife indicated to be potential users of the habitat, the potential for human consumption is extremely small. Direct consumption of water from the surface-water system by on-site and/or downgradient mammals and birds also may result in the direct accumulation of contaminants.

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7.2.1.3 Other Processes

Hydrolysis is the introduction of a hydroxyl group (-OH) into the chemical structure. This introduction commonly causes the loss of a halide such as chloride (-X). The rate of reaction is promoted by an acid and/or base, as it is pH dependent. The chemical reaction between the chlorinated compound and the hydroxide ion proceeds by nucleophilic substitution where the hydroxl group occupies the molecular site held by the halide. Generally, the alkyl chloride must be heated with aqueous sodium chloride for the reaction to occur. This process is not considered important for the Linemaster Switch site due to the nature of the contamination and the characteristics of the ground water. No strong acids or bases are present within the contaminant mixture at the site. The pH of the ground water is neither acidic nor basic, but rather falls in the neutral range, between 6 and 8.

Photolysis/oxidation of chemicals occurs due to exposure to light (U.S. EPA, 1979). This is especially important in surface waters and atmospheric environments when chemicals are exposed to direct sunlight for extended periods of time. This process is not considered important for the VOCs at the site because most of the contaminants are in the subsurface shielded from direct sunlight. However, once contaminants have moved into surface water or the atmosphere, photolysis is considered an important fate process.

Sorption is the tendency of contaminants to adhere to suspended and bottom sediments (U.S. EPA, 1979). This likely is not an important fate for contaminants at the site. Preliminary pilot testing indicates that TCE may be dissolved in the ground water rather than sorbed onto the soil. Additional investigation is

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being conducted. Sediment samples were collected from study area streams and ponds. The results indicate low or non-detectable levels of contaminants. For a complete description of sediment sampling results refer to Section 4.5.

If contaminants are introduced into the surface water due to the discharge of contaminated ground water, then sorption on sediments could be a repository mechanism for the VOCs and their subsequent long-term release back into the surface waters. All remediation efforts will minimize surface-water discharge of contaminants. Remediation will produce effluents within or near drinking water standards to guard against surface-water contamination.

Volatilization can be a significant fate for contaminants existing in the vadose zone. This process is considered to be insignificant on a site-wide basis due to the low air permeabilities of the unsaturated till materials.

7.2.2 Monocyclic Aromatic Compounds

The most prevalent monocyclic aromatic compounds detected at the site include toluene and xylenes. Toluene has been found at the highest concentrations. In addition, toluene has been detected at a greater number of locations. A summary of pertinent physical and chemical properties of toluene is presented in Table 7-3.

It is expected that there will be little biodegradation of toluene in the subsurface environment. Anaerobic conditions will prevail in the natural soil environment which will limit the effectiveness of the biodegradation process. The degradation of

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BTX (benzene, toluene and xylenes), under anaerobic conditions, was researched. Chiang et al. (1989) determined that little or no degradation will occur if the dissolved oxygen (D.O.) content in the subsurface is less than 0.5 ppm. The study was based on a number of soil microcosms mixed with BTX. It was concluded that for rapid biodegradation of these compounds to occur, the D.O. concentration should be greater than 2 ppm.

Major et al. (1988), assessed the biodegradation of BTX utilizing oxygen or nitrate as the electron acceptor and compared the results to biodegradation under anaerobic conditions. The study utilized soil microcosms with the addition of acetate, formate, or lactate as the primary substrates. Under anaerobic conditions it was found that the percent removals of toluene, o-xylene, and m-xylene were 65, 73, and 59, respectively, after 62 days. Up to 20 percent of this removal however, was accounted for by sorption onto the soil or glass container.

The biodegradation of toluene and xylenes also is cited in the Handbook of Environmental Data on Organic Chemicals, 2nd ed. (Verschueren, 1983). It is noted that incubation with the natural flora of ground water at 13°C resulted in complete removal of toluene, m-xylene, and o-xylene, after 192 hours, at initial concentrations of 2.22 ug/l, 3.26 ug/l and 1.03 ug/l, respectively. The environmental conditions such as oxygen and substrate concentrations, were not provided. In addition, biodegradation rates of toluene were reported as $(41 \pm 8) \times 10^{-3}$ to $(150 \pm 40) \times 10^{-3}$ ug/l-day. The biodegradation product of toluene was CO_2, whereas o-xylene forms o-toluic acid under cooxidation.

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7.2.3 Arsenic

Arsenic moves through the environment through a complex cycle of chemical interconversions and transfers between media. Arsenic can enter the atmosphere as particulate matter and later return to the surface by wet or dry deposition. Arsenic in water can undergo either reduction or oxidation depending on the pH and the electrochemical oxidation-reduction potential (Eh). The soluble forms of arsenic are mobile in water, whereas the less soluble forms tend to be adsorbed to clay of soil particles. Organisms in the soil can reduce and methylate arsenic, which then may volatilize into the atmosphere (U.S. PHS, 1987).

Arsenic can occur in multiple oxidation states, thus making its chemistry complex and mode of transport uncertain. The primary oxidation states are +5, +3 and 0. In highly oxygenated waters the arsenic species (H_3AsO_4, $H_2AsO_4^{-1}$, $HAsO_4^{-2}$, AsO_4^{-2}) are highly stable. If the organisms were methylated, then arsenic at an oxidation state of -3 would be formed. This state requires a low redox potential and therefore, arsenic (+3) is rare outside of surface-water bodies that have reducing environments such as swamps and bogs. For most surface waters and ground waters containing dissolved oxygen in the pH range of 7 to 9, the dominant specie is $HAsO_4^{-2}$ (U.S. EPA, 1987b). This specie is the form expected to be present on the site. This arsenic specie has the highest solubility and greatest mobility. The remediation efforts contemplated should only enhance the dissolved oxygen levels of the ground and surface waters, and therefore should not have a major impact on altering the current conditions (U.S. EPA, 1987a).

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7.3 Contaminant Migration/Site Conceptual Model

The Linemaster manufacturing facility is situated on a topographic high in the central portion of the site. The geologic setting at the site consists of glacial till overlying fractured schist intruded by granite pegmatite sills.

The primary potential receptors in the study area include water supply wells and surface-water bodies. The locations of these receptors are shown on Figure 1-2.

The primary VOC contaminant source area, Zone 1 (former dry well and former paint settling booth area), is located east of the manufacturing facility, near the top of the central topographic high. Historically, TCE and other solvents were discharged to the former dry well located in the Zone 1 till unit. The primary VOCs detected have been TCE and associated degradation products and toluene. These VOCs, at the time of discharge, appear to have entered the saturated and unsaturated soils and ground water beneath the dry well. Since the time of the discharge, VOCs have been migrating with ground water from this area. No DNAPLs have been physically measured at the site; however, chemical data from Zone 1 monitoring wells do not preclude DNAPL presence. The saturated till unit at Zone 1 has retained a substantial portion of the solvent discharge due to its fine-grained nature and low hydraulic conductivity (0.001 ft/day) as evidenced by elevated VOC ground-water concentrations (MW-26t, 817,070 ug/l).

VOCs move vertically through the Zone 1 till unit into the underlying shallow bedrock and subsequently to the deep bedrock. This is the result of downward vertical ground-water potentials and gradients in this area. The ground-water potential between

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the till and shallow bedrock and between the shallow bedrock and deep bedrock were measured to be 30.48 feet and 50.03 feet, respectively, in Zone 1. Downward vertical ground-water potentials and gradients are greatest in the central area of the site near the topographic high where the facility and Zone 1 source area are located. Generally, downward vertical ground-water potentials decrease toward the study area boundaries. Near the study area boundaries the flow potential reverses and the till unit does not appear to function as a confining layer, indicating that VOC contaminated ground water from the bedrock may discharge to the till unit.

The vertical ground-water migration rate was estimated at 0.03 ft/day for the till at Zone 1. This rate is greater than the estimated till horizontal ground-water migration rate (0.0004 ft/day) for Zone 1, indicating a tendency for ground water and contaminants to migrate faster vertically than horizontally.

The VOCs migrate from Zone 1 horizontally in the till, shallow bedrock, and deep bedrock ground water. VOCs in the till are migrating to the northwest, north, northeast, east, southeast, and southwest. The primary direction of VOC migration within the till is to the east-northeast. VOCs in the shallow bedrock are migrating to the northwest, north, northeast, east, and southeast. The primary direction of VOC migration within the shallow bedrock, similar to the till unit, is to the east-northeast. VOCs in the deep bedrock are migrating in all directions with several preferential directions of migration. The primary direction of VOC migration within the deep bedrock, similar to the till and shallow bedrock units, is to the east-northeast. Migration to the south in the deep bedrock is occurring due to the operation of the facility production well

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(GW-08db) located south of the Zone 1 source area. Former pumping of supply well (GW-10db) and the Blakely residence well (GW-12db), located north of Zone 1, may have caused migration of VOCs in the deep bedrock to the north and northwest.

The ranges of average linear ground-water flow velocities for till, shallow bedrock, and deep bedrock from the Zone 1 source area to the east-northeast, the primary direction of VOC transport, were calculated to be 0.0004 ft/day to 0.24 ft/day, 0.002 ft/day to 0.42 ft/day, and 0.04 ft/day to 11.08 ft/day, respectively. As apparent from these values, flow velocities and the horizontal migration rate of VOCs are expected to be highest in the deep bedrock unit and lowest in the till unit.

The observed distribution of VOCs is due to the natural hydraulic gradient, porosity, and hydraulic conductivity of the geologic units, as well as preferential migration pathways within the units. Preferential pathways that may exert control include:

- till heterogeneities (e.g. sand lenses);
- regional and local bedrock fabric (e.g. fractures, faults, intrusions, cataclysmic zones); and,
- bedrock surface topography (e.g. troughs).

The distribution of VOCs in the bedrock may also be influenced by on-site and off-site water-supply well pumping as suggested by the background water-level study.

The impact of contaminated ground-water discharge to surface-water bodies appears to be minimal at the study area. Therefore, contaminant transport by surface water is of relatively minor importance. Dilution of contaminated ground-water discharge and

volatilization upon exposure to the atmosphere will likely limit significant VOC migration by surface waters.

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8.0 SUMMARY AND CONCLUSIONS

Historical information suggests that solvents, composed primarily of VOCs, were discharged to a dry well located immediately adjacent to the eastern side of the Linemaster facility. Based on environmental investigations conducted since 1986, four potential contaminant source areas have been identified. These consist of the area of the former dry well and paint settling booth (Zone 1), the former facility wastewater disposal system (Zone 2), the former Blakely leaching field (Zone 3) and the paint shed area (Zone 4). The following sections summarize the findings of site investigations conducted to date.

8.1 Site Characterization

Horizontal and vertical ground-water migration rates and paths are influenced at the site by the hydraulic conductivities of the different media, the hydraulic head relationships between or within the units, the topography of the bedrock surface, the differential weathering of the bedrock, and the presence of hydraulic barriers. Significant influence is exerted by the heterogeneities within the till and bedrock units, such as fractured and weathered areas within the bedrock and the sandier areas within the till unit. Overall, the primary avenues of ground-water transport are intergranular pore spaces in the till, fractures and weathered bedrock in the shallow bedrock, and fractures and areas of physical deformation in the deep bedrock.

Till

The horizontal ground-water flow velocity within the till unit is relatively slow due to the low hydraulic conductivities of this

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material. The sandier areas of the till located near the site boundaries have higher hydraulic conductivities. Ground water generally flows at increasing rates toward the study area boundaries.

The horizontal ground-water flow direction in the deep portion of the till near the till/bedrock interface is influenced by the bedrock surface topography. In the shallow till, the flow contours appear to be influenced more by the ground-surface topography than the bedrock surface topography.

Generally, the till unit is considered to be a confining layer or a leaky confining layer at the site due to its low hydraulic conductivity and position within the stratigraphic sequence. The till unit is not a confining layer at the study area boundaries where the unit is sandier. At these unconfined areas, bedrock ground water may migrate upward, vertically discharging into the till unit.

The greatest downward vertical ground-water flow gradients in the till unit are present near the Linemaster facility located adjacent to the center of the topographic high. This indicates a high potential for downward vertical ground-water migration. The magnitudes of these gradients and the potential for related downward vertical ground-water migration generally decrease toward the site boundaries.

The till unit at the site is almost solely recharged by precipitation. Based on the observed ground-water gradients, ground-water recharge to the till unit from bedrock is expected to be minimal in areas adjacent to the central topographic high. Ground-water recharge from the bedrock to the till unit is

probably more significant at lower elevations in the vicinity of the study area boundaries to the north, northeast, and southeast as suggested by the upward ground-water potential present at well cluster MW-8 and seasonal upward potentials at well clusters MW-11 and MW-27.

Ground water may discharge from the till unit to the surface-water bodies near the study area boundaries depending on seasonal conditions.

Bedrock

Ground water migrates horizontally at a higher rate in the deep bedrock than in the shallow bedrock at the site. Although the shallow bedrock is more weathered, the deep bedrock has larger and more transmissive fracture openings. Relatively high horizontal ground-water flow velocities were calculated for a number of deep bedrock wells.

Horizontal shallow bedrock ground-water flow contours generally are parallel to the bedrock surface topography, unlike the deep bedrock ground-water flow contours. The vertical flow potential from the shallow bedrock to the deep bedrock, similar to the till/shallow bedrock relationship, is greatest near the facility at the top of the central topographic high and decreases toward the study area boundaries. This indicates that downward vertical ground-water migration from the shallow bedrock to the deep bedrock is greatest near the top of the central topographic high and decreases toward the study area boundaries. Unconfined conditions and an upward vertical ground-water flow potential at the site boundaries are indicative of ground-water migration from the bedrock to the till unit.

In the deep bedrock, ground water flows primarily through the fracture zones with the highest water transmitting capabilities. Once in these fracture systems, ground water moves according to the strike and dip of the fracture, interconnection with other fracture systems and the hydraulic potential within the fracture. The deep bedrock ground-water contour maps presented in this report are only inferred interpretations of the piezometric surface on two separate dates. It is difficult to determine if ground-water flow within the deep bedrock follows the fracture traces and the strike and dip of fracture sets. Some indication of ground-water movement along fracture traces is identified by the ellipsoidal drawdown caused by the GW-08db facility production well. The effected area is oriented approximately north-south with the long axis nearly parallel to one of the major fracture traces which trends 10-20 degrees. This is also supported by field outcrop strike and dip measurements and acoustic televiewer logging.

The downward vertical ground-water gradients and potentials present in most portions of the study area indicate that bedrock ground water is recharged by the till unit. Bedrock may also be recharged by Mill Brook located south of the site. Ground water may discharge from bedrock to the ponds in the eastern portion of the study area. The boundary line between the area of bedrock recharge and bedrock discharge is expected to vary as a result of seasonal trends and water-table fluctuations.

The segment of Mill Brook located south of the site may function as a hydraulic barrier impeding ground-water flow. The brook loses a significant amount of flow to the overburden (possibly stratified drift) along this segment.

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8.2 Contamination Assessment

8.2.1 VOCs

Soil

Evaluation of data collected during the site investigations indicates that Zone 1, the location of the former dry well and paint settling booth, is the primary VOC source area. High residual concentrations of VOCs are present in the Zone 1 soils due to former solvent discharges into the dry well. VOCs are also present under the facility building adjacent to Zone 1; however, at this time the magnitude and extent of VOCs under the building is unknown.

No DNAPLs have been identified at the site by physical measurements to date. However, chemical data from the sampling of MW-26t, the angled monitoring well screened underneath the facility, indicate the possible existence of DNAPLs.

Zone 2, the former facility wastewater disposal system, and Zone 3, the former Blakely residence leaching field, are not considered potential VOC source areas. Soil sampling and analysis conducted at Zones 2 and 3 indicate low or non-detectable concentrations of VOCs which may be attributable to ground-water transport. Zone 4, the paint shed area, is not considered a potential VOC source area because of the low or non-detectable VOCs in the shallow soils. The highest concentrations of VOCs in soils at Zone 4 were found within the saturated till, indicating VOC transport by ground water from Zone 1. It is likely that the contaminated soils beneath the paint shed are an extension of Zone 1.

Water-Supply Monitoring

The confirmed detections of chlorinated VOCs in water-supply wells are likely due to the Linemaster site. Correlations are not evident between the detected VOC concentrations and sample collection months, indicating no apparent seasonal trends. However, a similar yearly trend is evident for several supply well sampling locations. This trend is characterized by increasing VOC concentration from approximately 1986, when water supply sampling was initiated, to 1988, when the highest concentrations were detected. After 1988, the concentrations decreased to their approximate current level.

Ground Water

VOCs, mainly TCE, are being transported from the Zone 1 source area to the northwest, north, northeast, east, southeast, and southwest in the till unit. The primary direction of transport of VOCs in the till unit is to the east-northeast following the natural hydraulic gradient. In addition, the bedrock may exert some control and influence ground-water flow and VOC transport in the till unit.

The highest concentrations of total VOCs were found at MW-26t (817,070 ug/l). MW-26t is an angled monitoring well with the screen located underneath the Linemaster facility. Similar total VOC concentrations were found at MW-10td (420,507 ug/l). MW-10td is located downgradient and within 10 feet of the former dry well location. The high VOC concentrations at these wells indicate that much of the contamination has remained in Zone 1 because of the low hydraulic conductivity of the till.

VOCs at MW-26t have apparently migrated from the area of the former dry well because MW-26t is located hydraulically downgradient of this area. The natural ground-water conditions may be influenced by the building, which acts as a cap or barrier to precipitation and limits infiltration to the sediments underlying the facility. This would have the effect of creating an area of relatively lower hydraulic potential underneath the building. Migration from Zone 1 to beneath the facility may also have been caused by the hydraulic influences of former discharges into the dry well which may have caused ground-water mounding.

VOCs, after migrating from Zone 1 to underneath the building, may have migrated to the Zone 4 area on the opposite side of the building as indicated by the ground-water contours and by the VOCs present in monitoring wells at this area. Although sand lenses or stringers were not intercepted during the installation of till wells in the paint shed area, preferential flow of VOC-contaminated ground water through such or similar features may also explain the presence of VOCs at the paint shed area.

Elevated concentrations of MEK and MIBK were detected at MW-16t, located immediately adjacent to the northwest corner of the facility. These compounds may have been a by-product of paint mist directed into the paint settling booth at Zone 1. It is also possible that they were discharged at some other area near MW-16t.

VOCs have primarily been transported to other till areas of the site by the natural horizontal hydraulic gradient. The presence of VOCs in overburden at the study area boundaries may be related to bedrock discharge.

VOCs, mainly TCE, are being transported from the Zone 1 source area to the northwest, north, northeast, east, and southeast in the shallow bedrock unit. The primary transport direction of VOCs in the shallow bedrock is to the east-northeast, parallel to the ground-water flow direction. The highest concentrations of total VOCs in the shallow bedrock were found at wells located in the vicinity of the former dry well.

TCE and VOCs are being transported in all directions in the deep bedrock from the Zone 1 area with several preferential directions of migration. The primary direction of VOC migration, toward the east-northeast, appears to coincide with the two major fracture traces. This may explain the presence of VOCs detected at these areas. Preferential ground-water flow through fractures may also explain the trace levels of VOCs detected at other supply wells, although this remains to be confirmed. Preferential ground-water flow within the easterly dipping schist fracture planes may also be a factor contributing to the northeasterly migration of the ground-water VOC plume.

Elevated levels of VOCs have been detected at the Linemaster backup production well (GW-10db) since 1986. Moderate levels of VOCs have also been detected at GW-08db, the facility production well south of the facility, and at GW-12db, the Blakely residence former water-supply well located north of the facility. VOC migration within the deep bedrock to these wells was likely induced and facilitated by pumping. The pumping of GW-08db affects the deep bedrock aquifer in the area of the facility as determined from a background water-level study. VOCs in the deep bedrock are found at greater distances from the source area than in the till and shallow bedrock. This is likely due to the

greater hydraulic conductivity and water-transmitting capabilities of the fractured deep bedrock.

Surface Water and Sediment

Low concentrations of VOCs have been detected in surface-water samples collected from Ponds 1, 2, and 3. VOCs have also been detected in sediment samples collected from Pond 1 and the northwest wetlands. TCE, cis-1,2-dichloroethene, and chloroform are the VOCs that have been detected in surface-water samples. Cis-1,2-dichloroethene was the only VOC detected in the sediment samples.

The low concentrations of chloroform detected in Pond 2 are believed to be the result of laboratory contamination. The presence of VOCs in the surface waters and sediment in Pond 1 and the northwest wetlands are believed to be related to recharge by contaminated ground water. The presence of VOCs in Pond 3 surface waters may be due to the diversion of contaminated ground water to the pond by the Blakely leaching field curtain drain. VOCs present in Pond 1 surface waters and sediment may also be related to discharge of Pond 3 overflow into the eastern stream system just north of the inlet to Pond 1.

8.2.2 ABNs

Soil

ABNs were detected in soil samples collected during Phase 1A investigations. It was hypothesized that the most frequently detected TCL ABNs, bis(2-ethylhexyl)phthalate and di-n-butylphalate, were the result of laboratory contamination or

cross contamination. This was based on: 1) the lack of historical chemical information documenting the use of these compounds at Linemaster; 2) the fact that the distribution of the detections at the site does not indicate a source area(s); and, 3) di-n-butylphthalate leaches from certain types of laboratory equipment. To determine the accuracy of the data, a representative number of sample results with positive detections of these compounds were submitted for data validation.

Validation of ABN analytical data indicates that the compounds bis(2-ethylhexyl)phthalate and di-n-butylphthalate are not parameters of concern at the site and are most likely related to laboratory blank contamination. Several other ABNs were detected one time within Zone 1 and Zone 4; however, these may be associated with former discharges (Zone 1) or are the result of minor fuel oil releases (Zone 4). In any event, due to their limited extent and occurrence, these compounds are not considered parameters of concern at the site.

Ground Water

Similar to the soil samples discussed in the previous section, ABNs were detected in ground-water samples collected during Phase 1A investigations. To determine the accuracy of the data, a representative number of sample results with positive detections of these compounds were submitted for data validation.

Data validation established revised detection limits and qualified the concentrations of ABNs, thereby providing a more accurate representation of site conditions. All bis (2-ethyl-hexyl) phthalate and di-n-butylphthalate concentrations were revised to ND after validation except for two samples in which

di-n-butylphthalate remained at low concentrations. These compounds are not considered parameters of concern due to the low detections of the compounds and the possibility that the detections are related to laboratory blank contamination.

The PNAs and benzoic acid detected in MW-16t may be indicative of residual concentrations from two minor releases of fuel oil that occurred in the Zone 4 area.

8.2.3 Metals

Soil

The ranges of naturally occurring metals concentrations in soils were established based on the analytical results from soil samples collected from eight on- and off-site locations. The concentrations of metals in soil samples collected during RI/FS investigations were compared to the maximum background concentration for each metal to identify areas where potentially elevated concentrations of metals were present.

Potentially elevated concentrations of arsenic, barium, cadmium, chromium, lead, and zinc were identified in soil samples collected from Zone 1. Concentrations of these metals were highest in the vicinity of the former dry well and generally increased with depth, suggesting that the concentrations may be related to the presence of metals in the till ground water. Elevated concentrations of arsenic, chromium, and lead detected in samples collected from the former paint settling booth location may be due to the presence of residual paint chips in this area.

Concentrations of cadmium, chromium, lead, selenium, and zinc exceeding the maximum background soil concentrations for these metals were detected downslope of the brick dry well in Zone 2. The potentially elevated concentrations in these samples may be related to metals leaching out of plumbing fixtures and piping or may be associated with the discharge of facility wastewater to the brick dry well.

Although slightly elevated concentrations of several metals were detected in Zone 3 soil samples collected in the vicinity of the former Blakely leaching field, these soils are interpreted to be free of significant impact by historical site operations.

In Zone 4 soil samples, barium, cadmium, chromium, and nickel were the metals that most commonly exceeded the maximum background concentrations. The general trend of increasing metals concentrations with depth suggests that the elevated concentrations of these metals in the Zone 4 soils may be influenced by metals present in the till ground water. Elevated arsenic concentrations were only detected in the soils and fill material present immediately below the paint shed floor.

Water-Supply Well Monitoring

No statistically elevated concentrations of metals were detected in active water-supply wells. Concentrations of total arsenic exceeding the federal MCL of 50 ug/l were detected in two water-supply wells. No other exceedances of primary drinking water standards for metals were detected in any water-supply well. The concentrations of metals detected in samples collected from water-supply wells are believed to represent naturally occurring concentrations and are not related to the Linemaster

site.

Ground Water

Based on the upper tolerance limits calculated from the background monitoring and water-supply well data, potentially elevated concentrations of total arsenic, beryllium, cadmium, and nickel were identified in several study area monitoring wells. Potentially elevated metals concentrations were not identified in any active water-supply wells.

Potentially elevated concentrations of total arsenic were limited to four bedrock monitoring wells. The presence of arsenic-containing minerals in the study area bedrock and the naturally elevated concentrations of arsenic reported in water-supply wells installed in the same bedrock formation in other parts of New England suggest that total arsenic concentrations in the four bedrock monitoring wells are related to the natural occurrence of arsenic in the bedrock.

The elevated concentrations of beryllium, cadmium, and nickel (one well only) most commonly detected in till wells in the vicinity of the north end of the Linemaster manufacturing facility are believed to be naturally, not artificially, elevated. The fine-grained nature of the till, high TSS concentrations (likely due to aquifer disruption during well installation), and employed sampling techniques are believed to be responsible for the entrainment of particles naturally containing metals or having adsorbed naturally occurring metals species during sample collection. Analyses of these unfiltered, silty samples likely results in the apparently elevated concentrations. It is possible that enhanced solubilization of

metals due to TCE degradation by-products may be responsible for the localized mobilization of naturally occurring metals, particularly in the Zone 1 source area.

Surface Water and Sediment

No detectable concentrations of total chromium were detected in any surface-water samples. Due to the natural occurrence of arsenic in study area soils and bedrock, the low total arsenic concentrations in study area surface-water bodies are believed to be the result of natural accumulation. The presence of detectable concentrations of lead in two surface-water bodies adjacent to Routes 169 and 171 in the southern portion of the study area is not believed to be related to the Linemaster site.

Arsenic, chromium, and lead were detected at concentrations exceeding the maximum background sediment concentrations in a sediment sample collected from the northwest wetlands. These exceedances may be related to the comparatively high percentage of silt- and clay-sized particles and the high total organic carbon content also present in this sample. A lead concentration exceeding the maximum background concentration was also detected in a sediment sample collected from Pond 1. Exceedances of the background chromium concentration were also noted in samples collected from Pond 2 and Pond 3. In general, the presence of arsenic, chromium, lead, and the other metals detected in sediment samples collected during RI/FS investigations is believed to be the result of natural accumulation.

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8.3 Air Quality Assessment

An air pathway analysis was performed for the TCE sources at the Linemaster site. The model used for this analysis was the Industrial Source Complex - Long Term, Version 2 (ISCLT2) model, a revised version of the ISCLT model. The sources of TCE modeled included an area source overlying the TCE contaminated ground water and two air strippers utilized to remove TCE from the ground water. The meteorological data used in this modeling study were from Bradley Airport and Albany, New York from the years of 1970 to 1974. The highest ground level annual average concentration modeled for any year was 1.31 ug/m^3, which resulted from the 1972 data set and occurred at a location 100 meters due south of the main production building. The highest ground level concentrations for the other years occurred at either the location of the main production building or 100 meters due south of this building and ranged from 1.11 to 1.24 ug/m^3. The maximum annual average concentration of 1.31 ug/m^3 corresponds to an eight-hour average concentration of 43.3 ug/m^3, which is well below the Connecticut TCE Hazard Limiting Value of 1,350 ug/m^3. The majority of TCE was determined to originate from the two air strippers and not the area source.

8.4 Ecological Assessment

The Linemaster site consists of typical assemblages of plant and animal habitats for this rural/suburban region of northeastern Connecticut. No visible signs of ecological degradation on the site by TCE contamination are apparent in either the uplands, which dominate the property, or in the fringing wetlands.

8.5 Contaminant Transport and Fate

Potential Migration Routes

Ground-water advection is considered the primary mode of contaminant transport at the site. Ground water is in contact with the soils at Zone 1, the primary VOC source area. Contaminants at this location are entrained and transported by ground water. Significant levels of VOCs have been found in this area in the till, shallow bedrock, and deep bedrock aquifers.

Contaminant migration by surface water is of minor importance at the site. This has been concluded based on the results of surface-water and sediment sampling. Sampling results indicate the presence of low concentrations of VOCs.

Atmospheric migration is not considered a significant contaminant transport route either by airborne transport of particulate matter or volatile emissions.

Contaminant Persistence

The most prevalent chlorinated aliphatic compounds that have been found at the site include trichloroethene (TCE), cis-1,2-dichloroethene (c-1,2-DCE), 1,1,1-trichloroethene (1,1,1-TCA), and tetrachloroethene (PCE). The compound with the highest concentrations and most widespread occurrence is TCE.

In soil systems, TCE can undergo reductive dehalogenation (the exchange of one chloride atom for one hydrogen atom) to form three possible products: 1,1-DCE, c-1,2-DCE, and/or trans-1,2-dichloroethene (t-1,2-DCE). 1,1-DCE can undergo

reductive dehalogenation to form vinyl chloride or be reduced to 1,1-DCA. C-1,2-DCE and t-1,2-DCE can undergo reductive dehalogenation to form 1,2-dichloroethane (1,2-DCA). 1,1-DCA and 1,2-DCA can undergo reductive dehalogenation to form vinyl chloride or chloroethane.

A number of natural processes affect the persistence and the fate of VOCs in the environment. These processes include, biotransformation/biodegradation, bioaccumulation, hydrolysis, photolysis/oxidation, sorption, and volatilization.

Biodegradation, which has been occurring at the site, has been identified to be the most important transformation process in natural water and soil systems. The primary biodegradation product of TCE is dichloroethene, although small amounts of vinyl chloride can also form.

Biotransformation/biodegradation is likely not important at the Linemaster Switch site in the soils and shallow ground water, because significant numbers of microbes probably do not exist, and proper nutrients are likely not available. Nutrient availability significantly affects the degradation rate of chlorinated solvents. At Linemaster, no analyses of BOD, COD, nitrate, TKN or DO have been performed to address nutrient availability or potential microbial activity. There is, however, no basis to assume that the till soil contains the appropriate nutrients at adequate concentrations.

TCE can be biologically degraded if methane is used as a carbon source. Chlorinated hydrocarbon degradation by suspended cultures of methane-oxidizing bacteria in a closed system reactor have been studied. TCE degradation followed first-order kinetics

for concentrations less than 3,000 ug/l. The oxidative activity of methanotrophic bacteria ceased at dissolved TCE concentrations of greater than 7,700 ug/l. At Linemaster, TCE concentrations in the till and bedrock in the Zone 1 area are greater than 7,700 ug/l. At this concentration, biodegradation would not be expected to occur.

Methane or methanol has often been used as the carbon source for TCE biodegradation. Because non-chlorinated aliphatic compounds such as methanol have not been found within the till or bedrock waters, natural degradation by methanotrophic organisms probably would not occur.

In summary, TCE would not readily biodegrade in the subsurface environment under natural conditions for the following reasons. First, nutrients, principally nitrate, are not present. Second, even if sufficient carbon and nitrogen sources exist, the reaction kinetics are slow and require years to achieve appreciable degradation. Third, methanol or other soluble aliphatic compounds, to support anaerobic decomposition, are not present in the till and bedrock ground water at the site. Fourth, the TCE ground-water concentrations are above the toxic concentration for anaerobic bacteria in most of the Zone 1 area.

Bioaccumulation occurs when VOCs (among other compounds) are incorporated into the body tissues of living organisms. This is not considered to be an important fate for contaminants at the site due to low amounts of these contaminants at points of exposure. Points of exposure for organisms include surface soils and surface waters.

Hydrolysis is the introduction of a hydroxyl group (-OH) into the

chemical structure. The rate of reaction is promoted by an acid and/or base, as it is pH dependent. This process is not considered important for the Linemaster Switch site due to the nature of the contamination and the characteristics of the ground water.

Photolysis/oxidation of chemicals occurs after being exposed to light. This process is not considered important for the VOCs at the site because most of the contaminants are in the subsurface shielded from direct sunlight.

Sorption is the tendency of contaminants to adhere to suspended and bottom sediments. This is likely not an important fate for contaminants at the site. Preliminary pilot testing indicates that TCE may be dissolved in the ground water rather than sorbed onto the soil.

Volatilization can be a significant fate for contaminants existing in the vadose zone. This process is considered to be insignificant on a site-wide basis due to the low air permeability of the unsaturated till materials.

The most prevalent monocyclic aromatic compounds detected at the site include toluene and xylenes. It is expected that there will be little biodegradation of toluene in the subsurface environment. Anaerobic conditions would prevail in the natural soil environment which would limit the effectiveness of the biodegradation process. The biodegradation products of toluene have rarely been detected during the site investigations, although cresol was detected at a concentration of 314 ug/l and toluene at a concentration of 64,000 ug/l at MW-16t. Ground-water flow is toward the north in this area. The cresol

may be the result of biodegradation of toluene.

Arsenic occurs naturally at the site in the soils and bedrock. Arsenic enters the ground-water system as a result of naturally occurring processes and is present in ground-water samples. Arsenic moves through the environment via a complex cycle of chemical interconversions and transfers between media. For most surface waters and ground waters containing dissolved oxygen in the pH range of 7 to 9, the dominant specie is $HAsO_4^{-2}$. This specie is the form expected to be present on the site. This arsenic specie has the highest solubility and greatest mobility. The remediation efforts contemplated should only enhance the dissolved oxygen levels of the ground and surface waters, and therefore should not have a major impact on altering the current conditions under which arsenic is leaching from the soil and bedrock.

Site Conceptual Model

The Linemaster manufacturing facility is situated on a topographic high in the central portion of the site. The geologic setting at the site consists of glacial till overlying fractured schist intruded by granite pegmatite sills. The primary potential receptors in the study area include water-supply wells and surface-water bodies.

The primary VOC contaminant source area, Zone 1 (former dry well and former paint settling booth area), is located east of the manufacturing facility near the top of the central topographic high. Historically, TCE and other solvents were discharged to the former dry well located in the Zone 1 till unit. The primary VOCs detected have been TCE and associated degradation products

and toluene. These VOCs, at the time of discharge, appear to have entered the saturated and unsaturated soils and ground water beneath the dry well. Since the time of the discharge, VOCs have been migrating with ground water from this area. No DNAPLs have been measured physically at the site; however, chemical data from Zone 1 monitoring wells suggest DNAPL presence. The saturated till unit at Zone 1 has retained a substantial portion of the solvent discharge due to its fine-grained nature and low hydraulic conductivity (0.001 ft/day) as evidenced by elevated VOC ground-water concentrations (MW-26t, 817,070 ug/l).

VOCs move vertically through the Zone 1 till unit into the underlying shallow bedrock and subsequently to the deep bedrock. This is the result of downward vertical ground-water potentials and gradients. Downward vertical ground-water potentials and gradients are greatest in central areas of the site near the top of the topographic high where the facility and Zone 1 source area are located and generally decrease toward the study area boundaries. Near the study area boundaries, the flow potential reverses and the till unit does not appear to function as a confining layer, indicating that VOC contaminated ground water from the bedrock may discharge to the till unit.

The vertical ground-water migration rate was estimated at 0.03 ft/day for the till at Zone 1. This rate is greater than the estimated till horizontal ground-water migration rate (0.0004 ft/day) for Zone 1, indicating a tendency for ground water and contaminants to migrate faster vertically than horizontally.

The VOCs migrate from Zone 1 horizontally in the till, shallow bedrock, and deep bedrock ground water. VOCs are migrating

horizontally in the till to the northwest, north, northeast, east, southeast, and southwest. The primary direction of VOC migration within the till is to the east-northeast. VOCs are migrating horizontally in the shallow bedrock to the northwest, north, northeast, east, and southeast. The primary direction of VOC migration within the shallow bedrock, similar to the migration in the till unit, is to the east-northeast. VOCs are migrating horizontally in the deep bedrock to all directions with several preferential directions of migration. The primary direction of VOC migration within the deep bedrock, similar to the till and shallow bedrock units, is to the east-northeast. Migration to the south in the deep bedrock is occurring due to the operation of the facility production well (GW-08db) located south of the Zone 1 source area. Former pumping of production well (GW-10db) and the Blakely residence well (GW-12db), located north of Zone 1, may have caused the migration of VOCs in the deep bedrock to the north and northwest.

The range of average linear ground-water flow velocities for till, shallow bedrock, and deep bedrock from the Zone 1 source area to the east-northeast, the primary direction of VOC migration, were calculated at 0.0004 ft/day to 0.24 ft/day, 0.002 ft/day to 0.42 ft/day and 0.04 ft/day to 11.08 ft/day, respectively. As apparent from these values, flow velocities and the horizontal migration rate of VOCs are probably highest in the deep bedrock unit and lowest in the till unit.

The observed distribution of VOCs is due to the natural hydraulic gradient, as well as preferential migration pathways within the units. Preferential pathways that may exert control include:

- till heterogeneities (e.g. sand lenses);

- regional and local bedrock fabric (e.g. fractures, faults, intrusions, cataclysmic zones); and,
- bedrock surface topography (e.g. troughs).

The distribution of VOCs may also be influenced by on-site and off-site supply well pumping as suggested by the background water-level study.

The impact of contaminated ground-water discharge to surface-water bodies appears to be minimal at the study area. Therefore, contaminant migration by surface water is of relatively minor importance. Dilution of contaminated ground-water discharge and volatilization upon exposure to the atmosphere will likely limit significant VOC migration by surface water.

GLOSSARY OF ACRONYMS

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GLOSSARY OF ACRONYMS

1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
1,2-t-DCE	1,2-trans-dichloroethene
AET	Actual Evapotranspiration
ABNs	Acid\Base\Neutral Extractables
APA	Air Pathway Analysis
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society of Testing and Materials
AWC	Average Water Capacity
BMDL	Below Minimum Detection Limit
BOD	Biological Oxygen Demand
BTUs	British Thermal Units
BTX	Benzene, Toluene and Xylenes
c-1,2-DCE	cis-1,2-dichloroethene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFS	Cubic Feet Per Second
CLP	Contract Laboratory Program
CN	Curve Number
COD	Chemical Oxygen Demand
CRDL	Contract Required Detection Limit
DCA	Dichloroethane

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GLOSSARY OF ACRONYMS
(CONTINUED)

DCE	Dichlorethene
DEP	Department of Environmental Protection (Connecticut)
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DW	Dewatering Well
EM	Electromagnetic
EPA	(U.S.) Environmental Protection Agency
FS	Feasibility Study
GAC	Granular Activated Carbon
GPM	Gallons Per Minute
GW	Ground-Water (Supply) Well
HASP	Health and Safety Plan
HSL	Hazardous Substance List
IEP	IEP, Inc.
ISCLT	Industrial Source Complex - Long Term
ISCR	Initial Site Characterization Report
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
MEK	Methyl ethyl ketone
MIBK	Methyl isobutyl ketone
MSL	Mean Sea Level
MW	Monitoring Well
ND	Not Detected

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GLOSSARY OF ACRONYMS
(CONTINUED)

NPL	National Priorities List
NUS	NUS Corporation
OVA	Organic Vapor Analyzer
OW	Observation Well
PCE	Perchloroethene (Tetrachloroethene)
PET	Potential Evapotranspiration
PNAs	Polynuclear Aromatic Compounds
POTW	Publicly Owned Treatment Works
PPB	Parts Per Billion
PVC	Polyvinyl Chloride (pipe)
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RO	Runoff
RQD	Deere's Rock Quality Designation
RCSA	Regulations of Connecticut State Agencies
SAP	Sampling and Analysis Plan
SCS	Soil Conservation Service
SMRO	Snowmelt Runoff
SOW	Statement of Work
TCA	1,1,1-trichloroethane
TCE	Trichloroethene
TCL	Target Compound List

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GLOSSARY OF ACRONYMS
(CONTINUED)

TDS	Total Dissolved Solids
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TL	Tolerance Limit
TLV	Threshold Limit Value
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USGS	U.S. Geological Survey
USPHS	U.S. Public Health Service
VOCs	Volatile Organic Compounds

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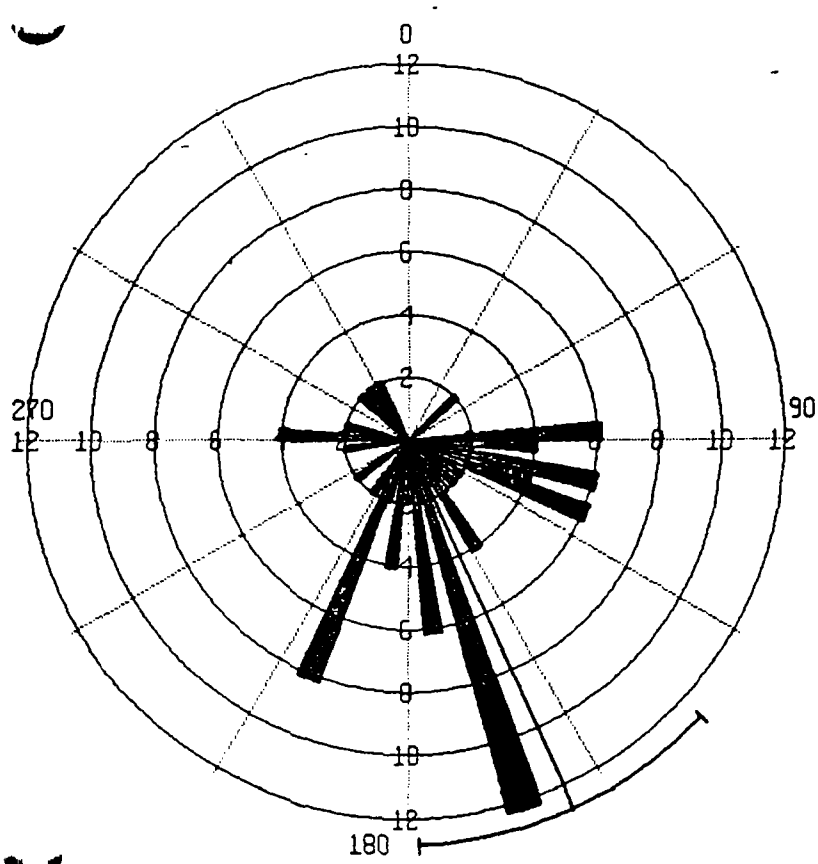
APPENDIX L
USGS BOREHOLE GEOPHYSICAL RESULTS AND ACOUSTIC TELEVIEWER LOG INTERPRETATION

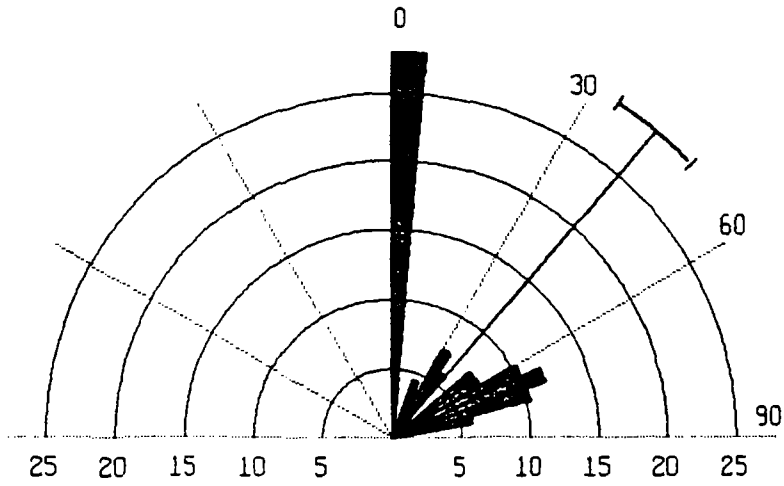
REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

recycled paper



WELL GW-10 DIP DIRECTION

Calculation Method	Frequency
Class Interval	5 Degrees
Filtering	Deactivated
Data Type	Unidirectional
Rotation Amount	0.0 Degrees
Population	49
Maximum Percentage	12.2 Percent
Mean Percentage	3.6 Percent
Standard Deviation	2.46 Percent
Vector Mean	155.67 Degrees
Confidence Interval	22.55 Degrees
R-mag	0.47



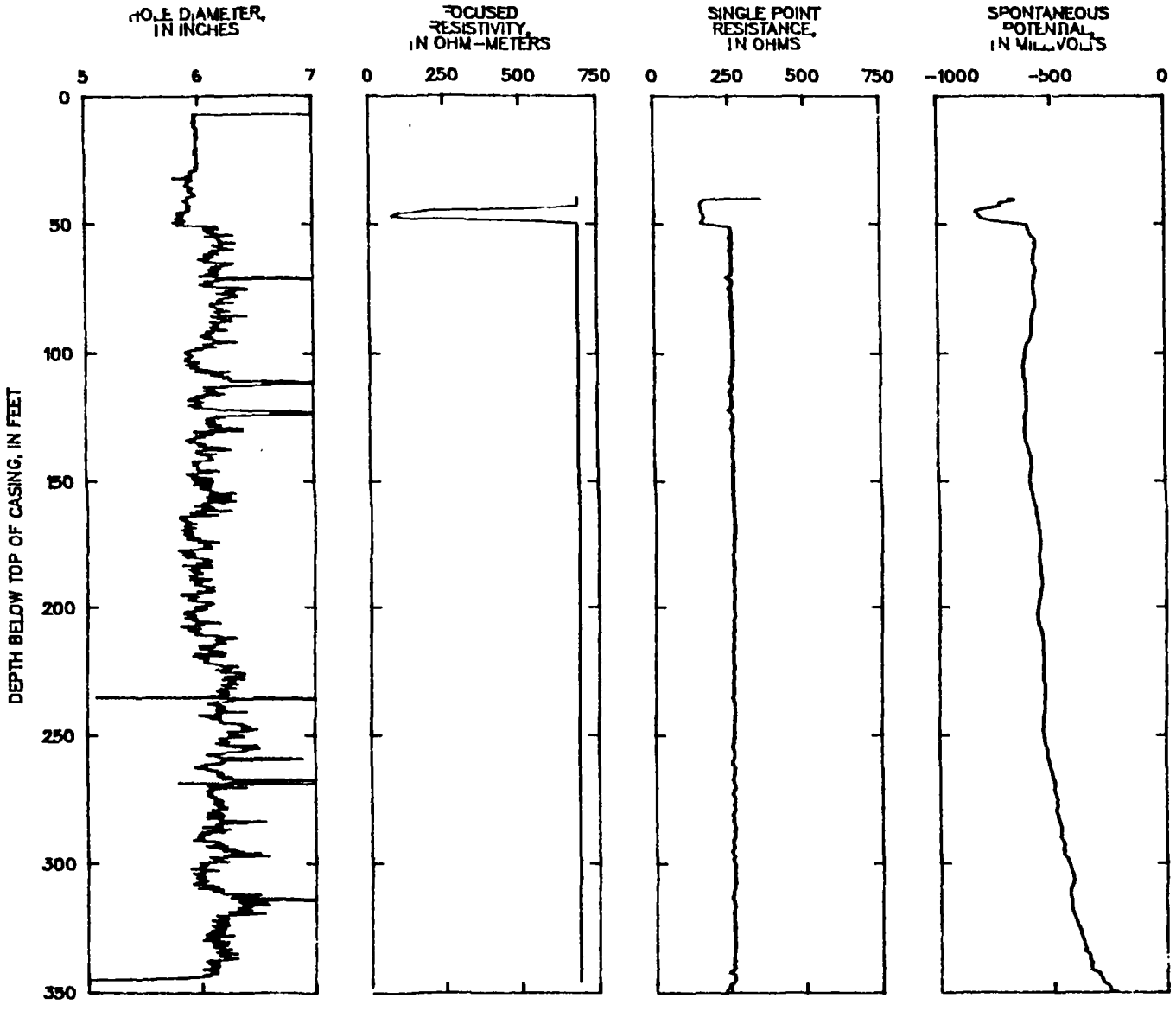
WELL GW-10 DIP ANGLE

Calculation Method	Frequency
Class Interval	5 Degrees
Filtering	Deactivated
Data Type	Unidirectional
Rotation Amount	0.0 Degrees
Population	68
Maximum Percentage	27.9 Percent
Mean Percentage	9.1 Percent
Standard Deviation	6.89 Percent
Vector Mean	41.04 Degrees
Confidence Interval	6.86 Degrees
R-mag	0.88

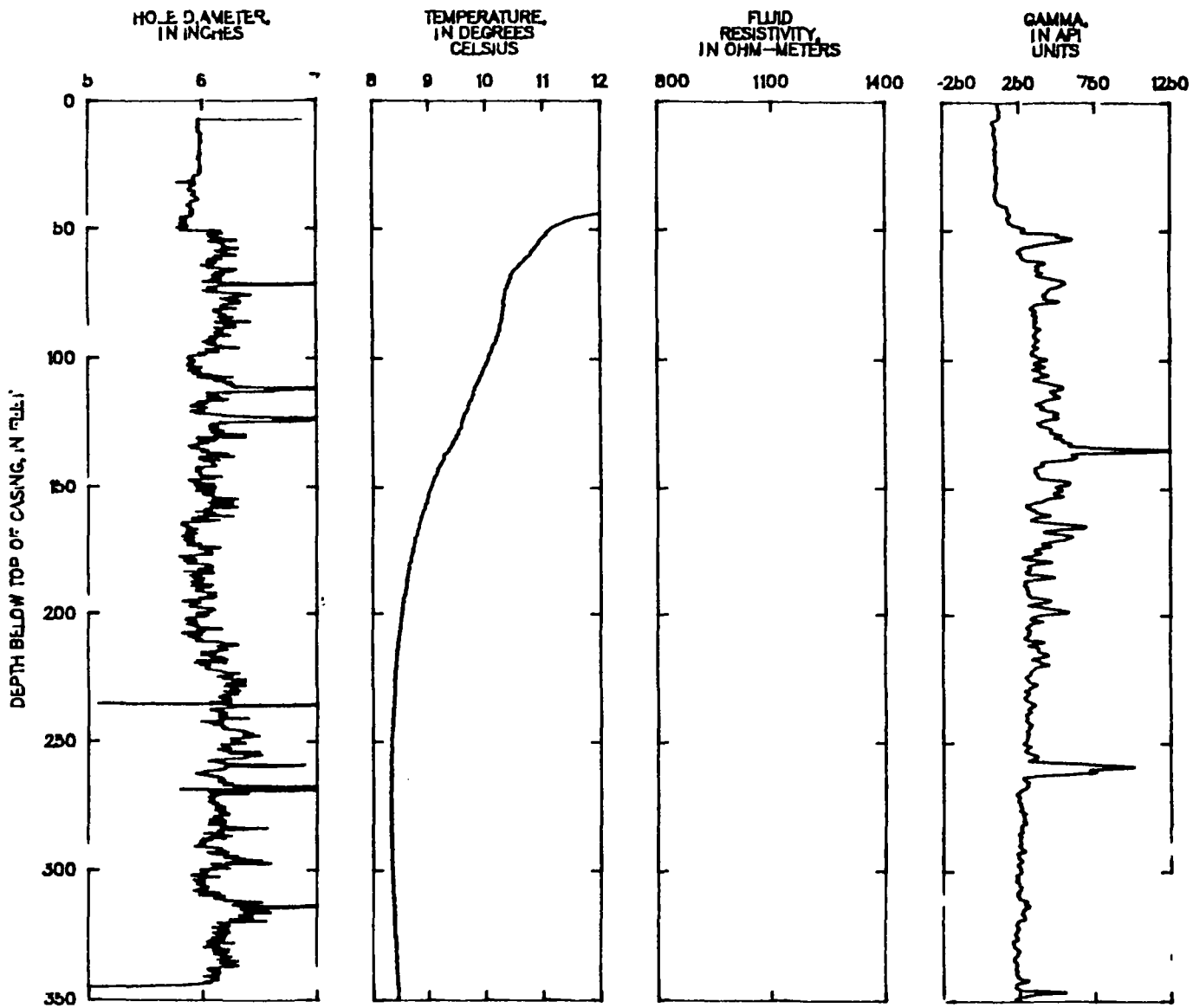
Well GW-10 ATV FRACTURES LIST

DEPTH (Feet)	DIP DIRECTION (Degrees)	DIP AMOUNT (Degrees)	APERATURE WIDTH (Inches)	APERATURE WIDTH (Feet)	HEIGHT (Feet)
58.30	145.00	57.99	1.20	0.10	0.80
71.10	120.00	30.96	8.40	0.70	0.30
75.10	260.00	68.96	1.20	0.10	1.30
75.70		0.00	1.20	0.10	0.00
84.20	270.00	30.96	1.20	0.10	0.30
85.80	200.00	38.66	2.40	0.20	0.40
89.90		0.00	1.20	0.10	0.00
91.40	200.00	30.96	1.20	0.10	0.30
96.00	195.00	30.96	2.40	0.20	0.30
107.30	45.00	50.19	2.40	0.20	0.60
109.80		0.00	1.20	0.10	0.00
111.80	85.00	63.44	7.20	0.60	1.00
112.00	85.00	63.44	7.20	0.60	1.00
116.40	155.00	57.99	1.20	0.10	0.80
122.80	85.00	79.51	1.80	0.15	2.70
123.10	185.00	50.19	2.40	0.20	0.60
129.90		0.00	2.40	0.20	0.00
129.90	320.00	67.38	2.40	0.20	1.20
141.60	160.00	45.00	1.20	0.10	0.50
145.20	275.00	73.61	1.20	0.10	1.70
148.50	280.00	70.35	1.20	0.10	1.40
153.00	90.00	68.96	1.20	0.10	1.30
154.80		0.00	1.20	0.10	0.00
156.00		0.00	1.20	0.10	0.00
157.20	110.00	67.38	1.20	0.10	1.20
161.70	170.00	21.80	1.20	0.10	0.20
163.40	145.00	38.66	2.40	0.20	0.40
164.40	330.00	21.80	2.40	0.20	0.20
177.00		0.00	1.20	0.10	0.00
189.30	185.00	38.66	1.20	0.10	0.40
206.30	180.00	30.96	2.40	0.20	0.30
210.40		0.00	1.20	0.10	0.00
212.50	325.00	65.56	1.20	0.10	1.10
216.90	170.00	57.99	1.20	0.10	0.80
235.00	100.00	63.44	3.60	0.30	1.00
236.90		0.00	1.20	0.10	0.00
247.20		0.00	1.20	0.10	0.00
254.00		0.00	1.20	0.10	0.00
255.20	100.00	70.35	2.40	0.20	1.40
255.40	110.00	75.96	8.40	0.70	2.00
260.50	140.00	72.65	1.20	0.10	1.60
260.70	200.00	54.46	1.20	0.10	0.70
262.60	160.00	60.95	1.20	0.10	0.90
264.70	160.00	57.99	1.20	0.10	0.80
267.60	130.00	68.96	1.20	0.10	1.30
268.50	110.00	79.88	2.40	0.20	2.80
269.40	310.00	77.20	1.20	0.10	2.20
274.60	90.00	72.65	1.20	0.10	1.60
277.60	105.00	57.99	1.20	0.10	0.80

DEPTH (Feet)	DIP DIRECTION (Degrees)	DIP AMOUNT (Degrees)	APERATURE WIDTH (Inches)	APERATURE WIDTH (Feet)	HEIGHT (Feet)
277.90	105.00	70.35	1.20	0.10	1.40
284.00	200.00	38.66	1.20	0.10	0.40
284.20		0.00	1.20	0.10	0.00
285.80		0.00	1.20	0.10	0.00
288.40	170.00	67.38	1.20	0.10	1.20
293.00		0.00	1.20	0.10	0.00
294.80		0.00	1.20	0.10	0.00
295.60	100.00	72.65	7.20	0.60	1.60
298.00	270.00	50.19	1.20	0.10	0.60
298.50	160.00	67.38	2.40	0.20	1.20
303.60		0.00	1.20	0.10	0.00
306.70	160.00	62.24	1.20	0.10	0.95
308.20	165.00	60.95	1.20	0.10	0.90
311.50	160.00	60.95	1.20	0.10	0.90
313.80	210.00	50.19	3.60	0.30	0.60
315.30		0.00	1.20	0.10	0.00
319.50		0.00	1.20	0.10	0.00
324.80	230.00	21.80	1.20	0.10	0.20
330.50		0.00	1.20	0.10	0.00



LINEMASTER, GW10



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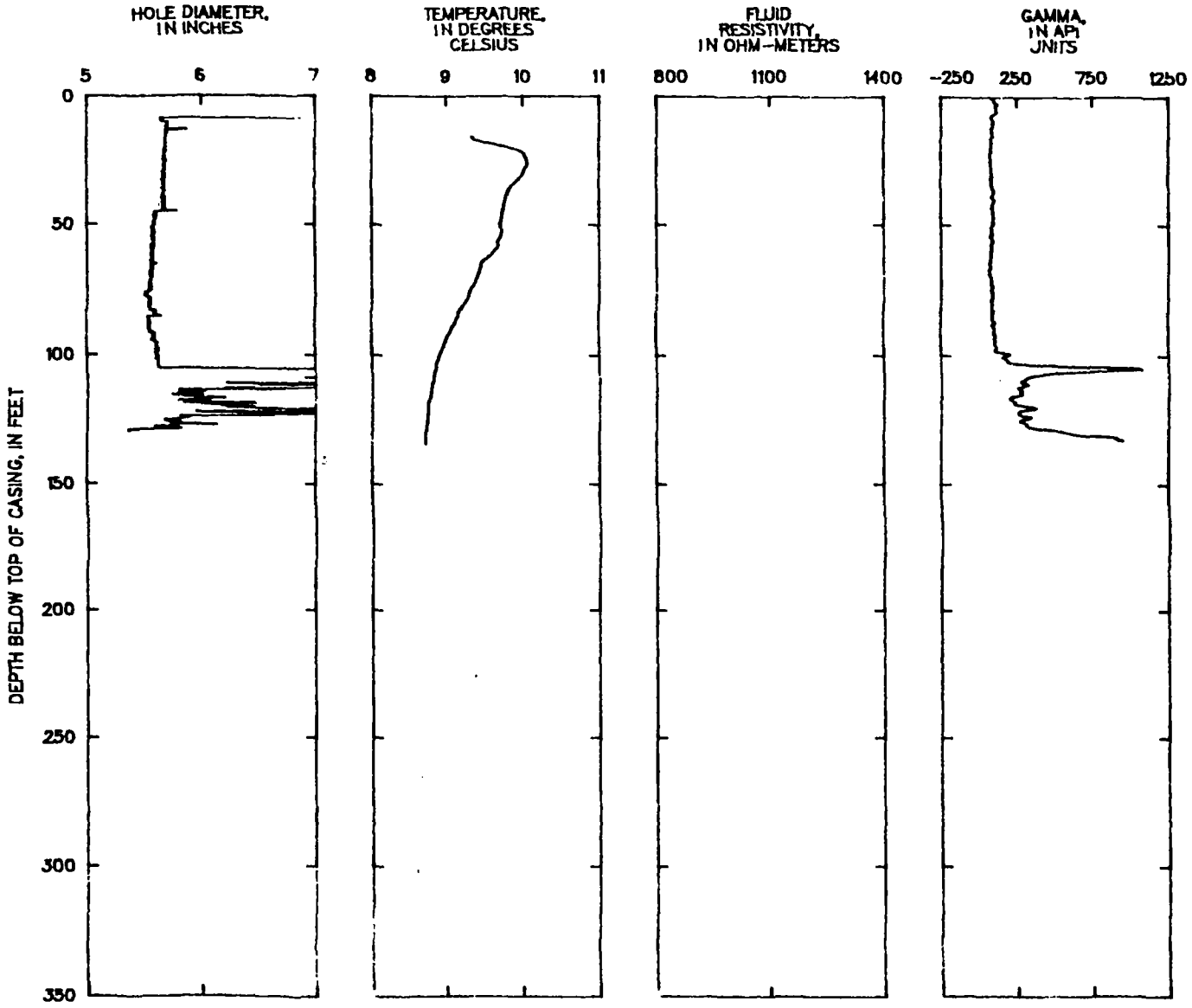

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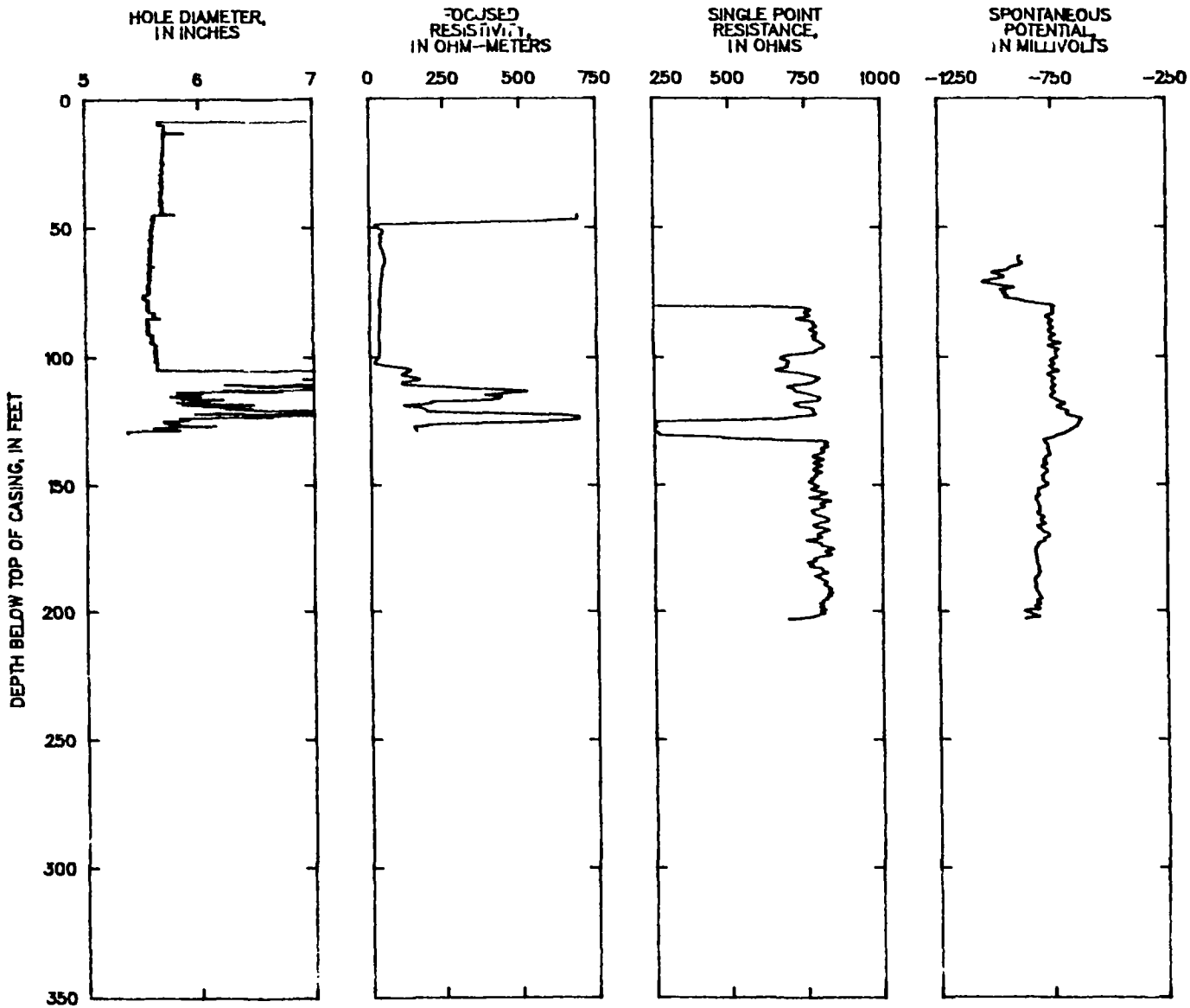

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APPENDIX U
EMISSION ESTIMATE AND BUILDING CAVITY CALCULATIONS

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

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FUSS&O'NEILL consulting engineers	PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
	RES	10/18/91	WTR	11/1/91	86-88/27

EMISSION RATE PRELIM. CALCULATIONS

SHEET NO. 1 of

OBJECTIVE: TO OBTAIN A ROUGH COMPARISON OF SOIL GAS DATA-DERIVED EMISSION RATES WITH LAND-7 PREDICTED RATES.

1. SOIL GAS DATA INDICATES AN ISOPLETH OF 100 PPMV + WITHIN AND DOWNGRADIENT OF ZONE 1 (SOURCE: VAPEX).

2. MONITOR WELL DATA INDICATES A CONTOUR OF ≥ 100,000 µg/l COVERING ROUGHLY THE SAME AREA (SHALLOW G.W.; SOURCE: E&O DRAFT REPORT)

3. CALCULATE CONC IN AIR IN EQUILIBRIUM WITH 100 PPM TRICHLOROETHYLENE IN WATER

HENRY'S LAW (LAND7) = 0.91×10^{-2}

" " (AWWA) = 0.375 m.c./m.c. at 20° C

USE EQN 6-5 FROM CHEMDAT6 MANUAL

$$P_i = \frac{H_{ci}\,\rho\,X_i}{MW} \times 10^6$$

$H_{ci} = 0.91 \times 10^{-2}$

ρ = 1 at. DILUTE CONC.

MW ≅ 18

$$X_i = \frac{100 \times 10^{-6}/131.4}{1/18 + (100 \times 10^{-6}/131.4)}$$

$= 1.37 \times 10^{-5}$

$$P_i = \frac{0.91 \times 10^{-2}\,(1)\,(1.37 \times 10^{-5})}{18} \times 10^6$$

= 0.007 atm.

$$C_{si} = \frac{P_i\,MW_i}{RT} = \frac{(131.4)\,0.007}{82.05\,(294)}$$

$= 3.8 \times 10^{-5}$ g/cc

FO-#110

3.8×10^{-5} g/cc $\times 10^6$ cc/m^3 $\times 10^6$ µg/g

$= 3.8 \times 10^7$ µg/m^3

$\frac{3.8 \times 10^7}{131.4\ (40.81)} = 7086$ ppmv

AT 50° F (= 10° C) = 7387 ppmv (3.96×10^{-5} g/cc)

4. CALCULATE DIFFUSION-INDUCED EMISSIONS

$J_i = -D_{ei}\ (C_{2i} - C_{1i}) / l$

WHERE $D_{ei} = D_{ai}\ (\epsilon_a^{10/3} / \epsilon_t^2)$

FOR CLAY, USE $\epsilon_t = 0.4$, $\epsilon_a = 0.2$

$D_{ei} = 0.079\ (.0047/.16)$

$= 0.0023$ cm²/SEC

FOR l USE 8' TO GROUND WATER MINUS 3' WETTED SOIL (i.e., 3' OF WASTE)

5' = 152.4 cm

$\therefore\ J_i = \frac{-0.0023\ (-3.96 \times 10^{-5})}{152.4} = 5.98 \times 10^{-10}$ gm/cm²-SEC

5. MULTIPLY BY AREA:

FROM PLANIMETRY OF 100,000 µg/l CONTOUR,

$0.907\ m^2 \times (100\ FT)^2 \times 929\ cm^2/FT^2$

$= 8.43 \times 10^6\ cm^2$

$(8.43 \times 10^6)(5.98 \times 10^{-10}) = 5.04 \times 10^{-3}$ g/SEC

EMISSION RATE PRELIM. CALCULATIONS

6 CALCULATE EMISSIONS DUE TO BAROMETRIC PUMPING:

a) VOLUME OF GAS:

$$3' = 91.4 \text{ cm} \times 8.43 \times 10^6 \times 0.2$$

$$V_G = 1.54 \times 10^8 \text{ cc}$$

b) Δ VOL DUE TO BAROMETRIC PRESSURE (AS PER CHEMDAT6)

$$V_B = 1.54 \times 10^8 \left[\left(\frac{1013}{1009}\right)(1) - 1 \right]$$

$$= 6.11 \times 10^5 \text{ cc}$$

c) $$Q = \frac{V_B}{\Delta t \, A} = \frac{6.11 \times 10^5}{86{,}400 \, (8.43 \times 10^6)}$$

$$= 8.38 \times 10^{-7} \text{ cm}^3/\text{cm}^2\text{-sec}$$

D) $$E_{2i} = Q \cdot C_{3i} \cdot A$$

$$= (8.38 \times 10^{-7})(3.96 \times 10^{-5})(8.43 \times 10^6)$$

$$= 2.8 \times 10^{-4} \text{ g/sec}$$

7. TOTAL RATE $= 2.8 \times 10^{-4} + 5.04 \times 10^{-3}$

$$E_i^* = 5.32 \times 10^{-3}$$

8 AVERAGE ANNUAL RATE

$$E_{Ai}(t) = \frac{31.56 \, E_{iT}^*}{\lambda t} \left[1 - e^{-\lambda t} \right]$$

WHERE $\lambda = 2.63 \times 10^6 \, E_i^* / M_{oi}$

AND

$$M_{oi} = C_i \, WAD$$

$C_L = 100 \times 10^{-6}$

$W = 0.2$ (WET POROSITY − DRY POROSITY)

$A = 8.43 \times 10^6$

$D = 91.4$

$M_{OL} = 15,410$ g

$$\therefore \lambda = \frac{2.63 \times 10^6 (5.32 \times 10^{-3})}{15,410}$$

$= 0.908$

$$\therefore E_{AL}(t) = \frac{31.56 (5.32 \times 10^{-3})}{12 (.908)} \left[1 + e^{-(.908)(12)} \right]$$

$= 0.0154$ Mg / YR

$= 34$ LB / YR

CLOSED LANDFILL

A, LF area (cm2)	8.4300E+06
l, cap thickness (cm)	152.4
ea, cap air porosity	0.2
et,cap total porosity	0.4
T, avg. LF temp. (C)	10
efw, waste porosity	0.4
Pref, ref. pressure (mbar)	1013
Pl, new pressure (mbar)	1009
Tref, reference temp. (C)	10
Tl, new temp. (C)	10
dt,bar.pump time int.(s)	86400
weight fraction oil	0.2
weight fraction water	0.2
weight fraction VO	0.0001
W, liquid in waste (g/cm3)	0.2
mwt oil	147
t, time of calc. (mo.)	12
D, depth of waste (cm)	91.4
CC/GVOC CONV	1750
active biomass (g/cc)	0.00E+00
VO diss. in water, enter 1	1
rho-liquid,density (g/cm3)	1
MW-liquid, (g/g mol)	18

CLOSED LANDFILL AIR EMISSIONS

COMPOUND NAME	EMISS. FRACTION	BIOL. FRACTION	EMISSION RATES 12 months AVERAGE	INST.
TRICHLOROETHYLENE	1.000	0.000	0.015410	8.4E-11

FUSS&O'NEILL consulting engineers	PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
	RES	10/25/91			86-38/21

Rev 11/6/92

INPUT TO CHEMDAT 6 FOR CLOSED LANDFILLS

SHEET NO. of

1. DATA FROM "WATER RESOURCE CONDITIONS IN CT." BY USGS/DEP, SEPT. 1991

MANSFIELD MONITORING WELL DATA (CLOSEST TO SITE)

	HIGH	LOW
FT BELOW GROUND:	10.2	12.9
DATE	APR '90	SEPT '90
FT BELOW GROUND:	10.2	12.9
DATE	MAY '91	OCT. '91

∴ APPROX 3' IS WETTED ON AN ANNUAL BASIS, IGNORING MINOR TRANSIENT FLUCTUATIONS.

2. RUN MODEL AS PREVIOUSLY FOR 10,000 μg/l ISOPLETH.

3. AREA FROM PLANIMETRY:

$$12.66\ IN^2 \times (100)^2\ FT^2/IN^2 = 126{,}600\ FT^2$$

$$126{,}600\ FT^2 \times 929\ CM^2/FT^2 = 1.18 \times 10^8\ CM^2$$

NOTE:

Initially, insufficient site-specific information was available to estimate groundwater fluctuation. In the intervening time measurements at MW-10 to, the well that best represents the conditions in the till in the Zone I area, showed an annual fluctuation of approximately 2.6 feet vs the estimated 3 feet. Thus, the evaluation remains conservative.

CLOSED LANDFILL

A, LF area (cm2)	1.1800E+08
l, cap thickness (cm)	152.4
ea, cap air porosity	0.2
et,cap total porosity	0.4
T, avg. LF temp. (C)	10
efw, waste porosity	0.4
Pref, ref. pressure (mbar)	1013
P1, new pressure (mbar)	1009
Tref, reference temp. (C)	10
T1, new temp. (C)	10
dt,bar.pump time int.(s)	86400
weight fraction oil	0.2
weight fraction water	0.2
weight fraction VO	0.00001
W, liquid in waste (g/cm3)	0.2
mwt oil	147
t, time of calc. (mo.)	12
D, depth of waste (cm)	91.4
CC/GVOC CONV	1750
active biomass (g/cc)	0.00E+00
VO diss. in water, enter 1	1
rho-liquid,density (g/cm3)	1
MW-liquid, (g/g mol)	18

CLOSED LANDFILL AIR EMISSIONS

COMPOUND NAME	EMISS. FRACTION	BIOL. FRACTION	EMISSION RATES 12 months AVERAGE	INST.
TRICHLOROETHYLENE	1.000	0.000	0.021570	1.2E-10

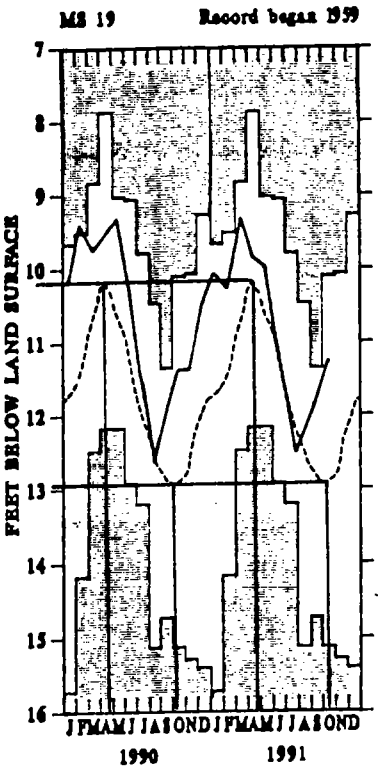
GROUND-WATER STORAGE

STATUS OF GROUND-WATER STORAGE AS INDICATED ON THE MAP IS BASED ON WATER LEVEL CHANGES IN OBSERVATION WELLS AS SHOWN ON HYDROGRAPHS.

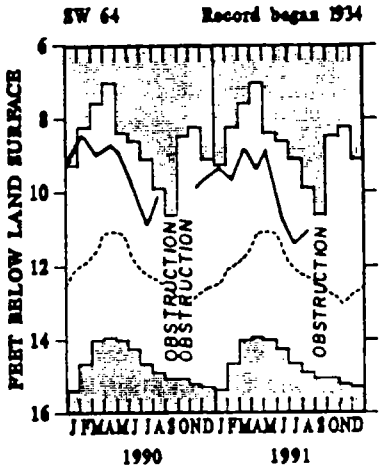
Unshaded areas on graphs show range between highest and lowest month-end water levels of record.

———— Solid line shows current water levels. - - - - - - - - Dashed line is monthly median for period of record.

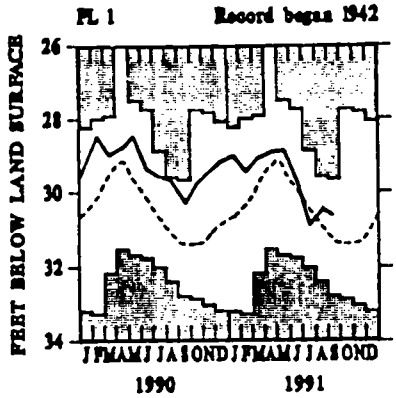
MANSFIELD

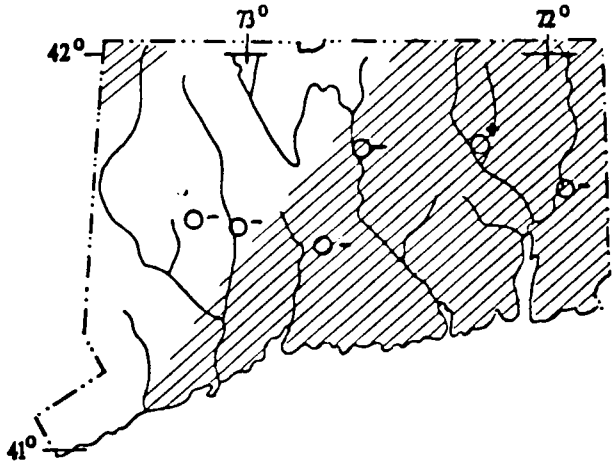


SOUTH WINDSOR



PLAINFIELD





EXPLANATION

ABOVE NORMAL
Within the highest 25 percent of record for this month

NORMAL RANGE
Between the highest and lowest 25 percent of record for this month

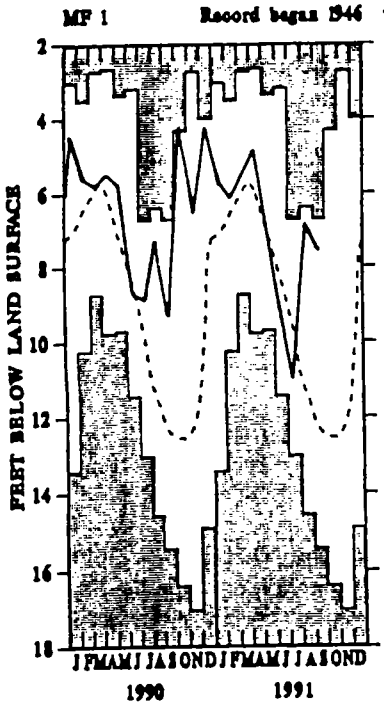
BELOW NORMAL
Within the lowest 25 percent of record for this month

+ Water level rose since last month

— Water level fell since last month

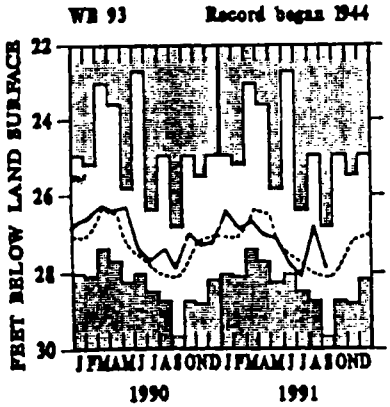
O Location of well with hydrograph

MIDDLEFIELD

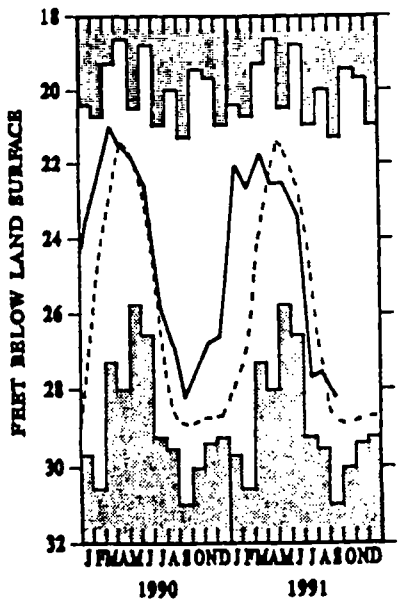


Map based on 14 long-term observation wells (shown on map, p.8). Elsewhere conditions are generalized.

WATERBURY



WOODBURY



GROUND-WATER STORAGE

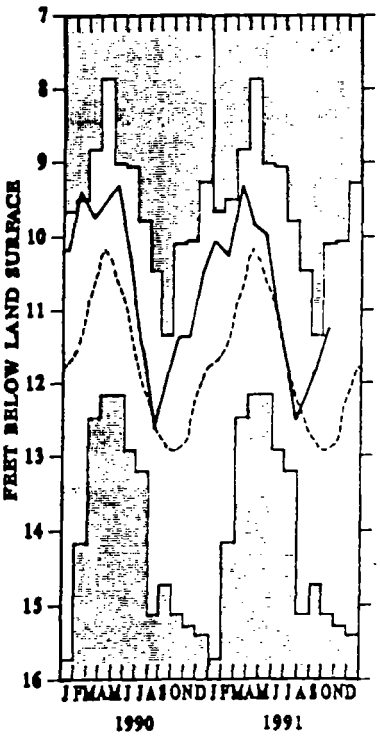
STATUS OF GROUND-WATER STORAGE AS INDICATED ON THE MAP IS BASED ON WATER LEVEL CHANGES IN OBSERVATION WELLS AS SHOWN ON HYDROGRAPHS.

Unshaded areas on graphs show range between highest and lowest month-end water levels of record.

———— Solid line shows current water levels. - - - - - - - - Dashed line is monthly median for period of record.

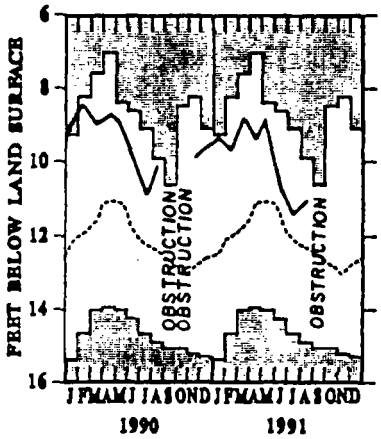
MANSFIELD

MS 19 Record began 1959



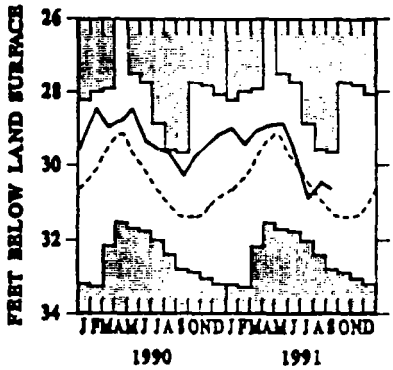
SOUTH WINDSOR

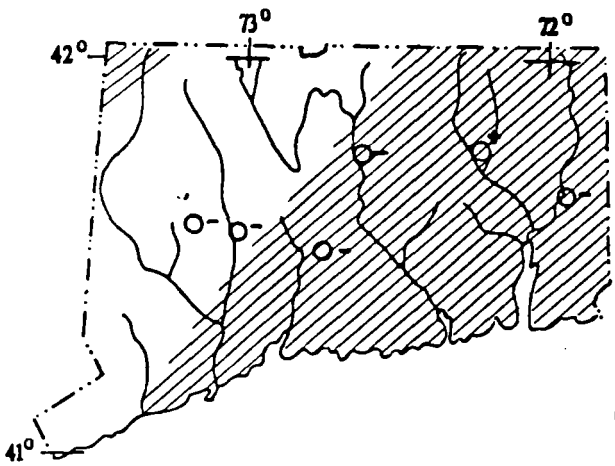
SW 64 Record began 1934



PLAINFIELD

PL 1 Record began 1942





EXPLANATION

ABOVE NORMAL
Within the highest 25 percent of record for this month

NORMAL RANGE
Between the highest and lowest 25 percent of record for this month

BELOW NORMAL
Within the lowest 25 percent of record for this month

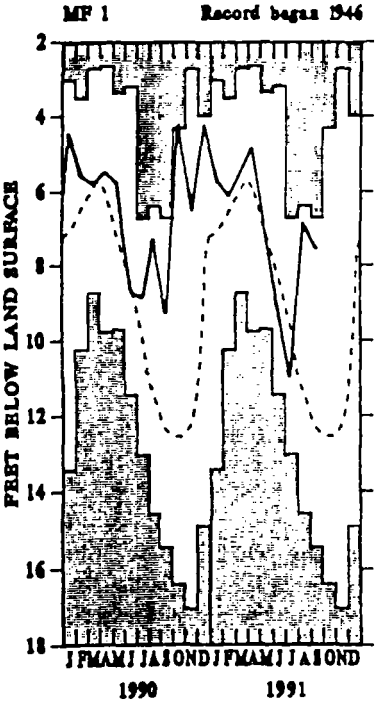
+ Water level rose since last month

— Water level fell since last month

O Location of well with hydrograph

MIDDLEFIELD

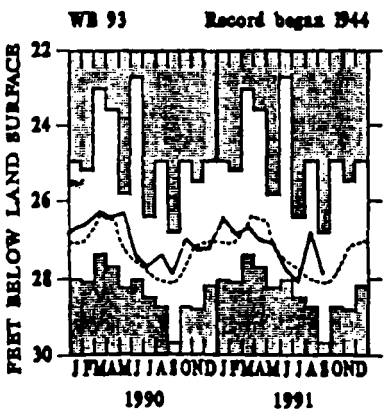
MF 1 Record began 1946



Map based on 14 long-term observation wells (shown on map, p.8). Elsewhere conditions are generalized.

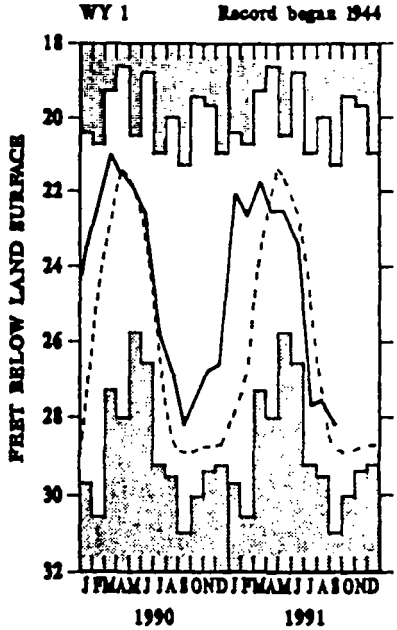
WATERBURY

WB 93 Record began 1944



WOODBURY

WY 1 Record began 1944



FUSS&O'NEILL consulting engineers	PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
	RES	10/24/91	NTR	11/1/91	86-88/21

CAVITY SCREENING - DEGREASER

SHEET NO. 1 of

1. EMISSION RATE CALC:

1990 TCE PURCHASED: 6 x 1320# = 7920#
1990 MANIFESTED OFF-SITE: = 2618#
5302

THIS WEIGHT IS EXHAUSTED OVER 8 HR / 5 DA / 52 WKS:

$8 \times 3600 \times 5 \times 52 = 7.488 \times 10^6$ SEC

$\frac{5302 (454)}{7.488 \times 10^6} = 0.32$ g/SEC

2. STACK HEIGHT = ROOF HEIGHT + 3'

BLDG. HEIGHT = 30' = 9.1 M AT EXHAUST
STACK HEIGHT = 33' = 10.06 M

3. STACK DIAM. 6" = 0.15 M

4. EXIT VELOCITY

100 CFM = 2.83 M^3/MIN = 0.047 M^3/SEC

AREA OF EXIT PIPE = $\pi (0.15/2)^2$ = 0.0177 M^2

0.047 / 0.0177 = 2.66 M/SEC

10-24-91
12:07:30

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

[illegible]n. assessment of degreaser cavity modeling - Linemaster

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	.3200
STACK HEIGHT (M)	=	10.06
STK INSIDE DIAM (M)	=	.15
STK EXIT VELOCITY (M/S)	=	2.66
STK GAS EXIT TEMP (K)	=	293.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	9.10
MIN HORIZ BLDG DIM (M)	=	33.50
MAX HORIZ BLDG DIM (M)	=	70.00

BUOY. FLUX = .00 M**4/S**3; MOM. FLUX = .04 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

[illegible]T (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
10.	.0000	0	.0	.0	.0	.0	.0	.0	NA
100.	1502.	6	1.0	1.0	5000.0	10.1	4.1	9.7	SS
200.	787.9	6	1.0	1.0	5000.0	10.1	7.7	10.8	SS
300.	531.4	6	1.0	1.0	5000.0	10.1	11.2	11.9	SS
400.	396.8	6	1.0	1.0	5000.0	10.1	14.6	12.9	SS
500.	313.2	6	1.0	1.0	5000.0	10.1	18.0	13.9	SS
600.	258.9	6	1.0	1.0	5000.0	10.1	21.2	14.5	SS
700.	218.0	6	1.0	1.0	5000.0	10.1	24.5	15.4	SS
800.	187.1	6	1.0	1.0	5000.0	10.1	27.6	16.2	SS
900.	162.9	6	1.0	1.0	5000.0	10.1	30.8	17.0	SS
1000.	143.7	6	1.0	1.0	5000.0	10.1	33.9	17.8	SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 10. M:

28.	2963.	6	1.0	1.0	5000.0	10.1	1.3	5.7	SS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
[illegible]MMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN DISTANCE RANGE (M)

HT (M)	MINIMUM	MAXIMUM
0.	10.	1000.

*** CAVITY CALCULATION - 1 ***			*** CAVITY CALCULATION - 2 ***		
CONC (UG/M**3)	=	.0000	CONC (UG/M**3)	=	.0000
CRIT WS @10M (M/S)	=	99.99	CRIT WS @10M (M/S)	=	99.99
CRIT WS @ HS (M/S)	=	99.99	CRIT WS @ HS (M/S)	=	99.99
DILUTION WS (M/S)	=	99.99	DILUTION WS (M/S)	=	99.99
CAVITY HT (M)	=	9.22	CAVITY HT (M)	=	9.10
CAVITY LENGTH (M)	=	41.91	CAVITY LENGTH (M)	=	30.53
ALONGWIND DIM (M)	=	33.50	ALONGWIND DIM (M)	=	70.00

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S. CONC SET = 0.0

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	2963.	28.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

FUSS&O'NEILL consulting engineers	PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
	RES	10/24/91	WJK	11/1/91	86-88/21

SHEET NO. 1 of 1

CAVITY SCREENING - STRIPPING TOWER

1. EMISSION RATE CALC.

- 3000 µg/l of VOC's (MOSTLY TCE)
- 27 g.p.m. WHEN RUNNING (INTERMITTENT OPERATION)

$$\frac{27 \times 3.785 \times 3 \times 10^{-3}}{60} = 0.00511 \text{ g/sec}$$

2. STACK HEIGHT = 29'6" + 8' ADDED SECTION + 3' EXIT PIPE

= 40.5' = 12.34 M

3. INSIDE DIAM. OF EXIT PIPE = 6" = 0.15 M

4. EXIT VELOCITY CALC:

330 CFM = 330/35.3 = 9.3 M^3/MIN

= 0.1557 M^3/SEC

AREA OF EXIT PIPE:

$= \pi(0.15/2)^2 = 0.0177 \text{ M}^2$

0.1557/0.0177 = 8.8 M/SEC

5. BLDG HEIGHT AT STRIPPER = 28 FT = 8.5 M

6. BLDG IS 110' x 230' = 33.5 M x 70 M

10-24-91
10:00:38

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

elim. assessment of stripping tower cavity modeling - Linemaster

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	.5110E-02
STACK HEIGHT (M)	=	12.34
STK INSIDE DIAM (M)	=	.15
STK EXIT VELOCITY (M/S)	=	8.80
STK GAS EXIT TEMP (K)	=	293.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	8.50
MIN HORIZ BLDG DIM (M)	=	33.50
MAX HORIZ BLDG DIM (M)	=	70.00

BUOY. FLUX = .00 M**4/S**3; MOM. FLUX = .44 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
10.	.0000	0	.0	.0	.0	.0	.0	.0	NA
100.	6.612	6	1.0	1.1	5000.0	12.6	4.1	6.0	SS
200.	5.991	6	1.0	1.1	5000.0	12.6	7.7	7.4	SS
300.	5.245	6	1.0	1.1	5000.0	12.6	11.2	8.7	SS
400.	4.497	6	1.0	1.1	5000.0	12.6	14.6	10.0	SS
500.	3.798	6	1.0	1.1	5000.0	12.6	18.0	10.8	SS
600.	3.283	6	1.0	1.1	5000.0	12.6	21.2	11.9	SS
700.	2.858	6	1.0	1.1	5000.0	12.6	24.5	12.9	SS
800.	2.508	6	1.0	1.1	5000.0	12.6	27.6	13.9	SS
900.	2.230	6	1.0	1.1	5000.0	12.6	30.8	14.5	SS
1000.	1.993	6	1.0	1.1	5000.0	12.6	33.9	15.4	SS
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 10. M:									
85.	6.740	6	1.0	1.1	5000.0	12.6	3.5	5.8	SS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN DISTANCE RANGE (M)

HT (M)	MINIMUM	MAXIMUM
0.	10.	1000.

```
*** CAVITY CALCULATION - 1 ***
CONC (UG/M**3)       =    .0000
CRIT WS @10M (M/S)   =    99.99
CRIT WS @ HS (M/S)   =    99.99
DILUTION WS (M/S)    =    99.99
CAVITY HT (M)        =     8.58
CAVITY LENGTH (M)    =    40.05
ALONGWIND DIM (M)    =    33.50

*** CAVITY CALCULATION - 2 ***
CONC (UG/M**3)       =    .0000
CRIT WS @10M (M/S)   =    99.99
CRIT WS @ HS (M/S)   =    99.99
DILUTION WS (M/S)    =    99.99
CAVITY HT (M)        =     8.50
CAVITY LENGTH (M)    =    29.53
ALONGWIND DIM (M)    =    70.00

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0
```

```
****************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
****************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	6.740	85.	0.

```
*****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*****************************************************
```

APPENDIX W
ECOLOGICAL ASSESSMENT SUPPORTING DATA

REMEDIAL INVESTIGATION REPORT
LINEMASTER SWITCH CORPORATION
WOODSTOCK, CONNECTICUT
DECEMBER 1992

recycled paper

POTENTIAL REPTILE AND AMPHIBIAN SPECIES

Project Name: **Linemaster Switch** ***Weather:*** **Sunny 60's**
Date: **October 1991** ***Comments:***
Location: **Woodstock, CT**

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Spotted salamander	*Ambystoma maculatum*	*
Red-spotted newt	*Notophthalmus v. viridescens*	*
Redback salamander	*Plethodon cinereus*	*
Four-toed salamander	*Hemidactylium scutatum*	
Northern two-lined salamander	*Eurycea b. bislineata*	*
Eastern spadefoot	*Scaphiopus h. holbrookii*	
Eastern American toad	*Bufo a. americanus*	*
Fowler's toad	*Bufo woodhousii fowleri*	
Northern spring peeper	*Hyla c. cruficer*	*
Gray treefrog	*Hyla versicolor*	*
Bullfrog	*Rana catesbeiana*	
Green frog	*Rana clamitans melanota*	*
Wood frog	*Rana sylvatica*	*
Northern leopard frog	*Rana pipiens*	*
Pickerel frog	*Rana palustris*	*
Common snapping turtle	*Chelydra s. serpentina*	
Stinkpot	*Sternotherus odoratus*	
Spotted turtle	*Clemmys quttata*	
Wood turtle	*Clemmys insculpta*	
Eastern box turtle	*Terrapene c. carolina*	*
Eastern painted turtle	*Chrysemys p. picta*	*
Blanding's turtle	*Emydoidea blandingii*	
Northern water snake	*Nerodia s. sipedon*	
Northern brown snake	*Storeria d. dekayi*	*
Northern redbelly snake	*Storeria o. occipitomaculata*	*
Eastern garter snake	*Thamnophis s. sirtalis*	*
Eastern ribbon snake	*Thamnophis s. sauritus*	*
Eastern hognose snake	*Heterodon platyrhinos*	
Northern ringneck snake	*Diadophis punctatus edwardsi*	
Northern black racer	*Coluber c. constrictor*	*
Eastern smooth green snake	*Opheodrys v. vernalis*	*
Eastern milk snake	*Lampropeltis t. trianqulum*	*

Note:

FE = Federally Endangered by the U.S. Fish and Wildlife Service
FT = Federally Threatened by the U.S. Fish and Wildlife Service
(Federal status is based on current federal list)

* Species which may utilize the on-site habitats based on the literature.

POTENTIAL BIRD SPECIES

Project Name: **Linemaster Switch**
Date: **October 1991**
Location: **Woodstock, CT**

Weather: **Sunny 60's**
Comments:

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Pied-billed grebe	*Podilymbus podiceps*	
Great blue heron	*Ardea herodias*	
Green-backed heron	*Butorides striatus*	
Black-crowned night-heron	*Nycticorax nycticorax*	
Mute swan	*Cygnus olor*	
Canada goose	*Branta canadensis*	
Wood duck	*Axis sponsa*	
Green-winged teal	*Anas crecca*	
American black duck	*Anas rubripes*	
Mallard	*Anas platyrhynchos*	
Blue-winged teal	*Anas discors*	
Bufflehead	*Bucephala albeola*	
Osprey	*Pandion haliaetus*	
Sharp-shinned hawk	*Accipiter striatus*	
Cooper's hawk	*Accipiter copperii*	
Northern goshawk	*Accipiter gentilis*	
Red-shouldered hawk	*Buteo lineatus*	*
Broad-winged hawk	*Buteo platypterus*	*
Red-tailed hawk	*Buteo jamaicensis*	
Northern harrier	*Circus cyaneus*	
American kestrel	*Falco sparverius*	*
Merlin	*Falco columbarius*	
Peregrine falcon	*Falco peregrinus*	
Ring-necked pheasant	*Phasianus colchicus*	*
Ruffed grouse	*Bonasa umbellus*	*
Northern bobwhite	*Colinus virginianus*	
Killdeer	*Charadrius vociferus*	
Spotted sandpiper	*Actitis macularia*	
Common snipe	*Gallinago gallinago*	
American woodcock	*Scolopax minor*	*

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(Federal status is based on current federal list)

* Species which may utilize the on-site habitats based on the literature.

POTENTIAL BIRD SPECIES

Project Name: **Linemaster Switch** ***Weather:*** **Sunny 60's**
Date: **October 1991** ***Comments:***
Location: **Woodstock, CT**

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Lesser yellow legs	*Tringa flavipes*	
Solitary sandpiper	*Tringa solitaria*	
Herring gull	*Larus argentatus*	
Great black-backed gull	*Larus marinus*	
Mourning dove	*Zenaida macroura*	
Black-billed cuckoo	*Coccyzus erythropthalmus*	*
Yellow-billed cuckoo	*Coccyzus americanus*	
Common barn-owl	*Tyto alba*	
Eastern screech-owl	*Otus asio*	*
Great horned owl	*Bubo virginianus*	
Barred owl	*Strix varia*	
Long-eared owl	*Asio otus*	
Short-eared owl	*Asio flammeus*	
Northern saw-whet owl	*Aegolius acadicus*	
Common nighthawk	*Chordeiles minor*	
Whip-poor-will	*Caprimulqus vociferus*	
Chimney swift	*Chaetura pelaqica*	
Ruby-throated hummingbird	*Archilochus colubris*	
Belted kingfisher	*Ceryle alcyon*	
Downy woodpecker	*Picoides pubescens*	*
Hairy woodpecker	*Picoides villosus*	*
Northern flicker	*Colaptes auratus*	*
Yellow-bellied sapsucker	*Sphyrapicus varius*	
Eastern wood-pewee	*Contopus virens*	*

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POTENTIAL BIRD SPECIES

Project Name: **Linemaster Switch** ***Weather:*** **Sunny 60's**
Date: **October 1991** ***Comments:***
Location: **Woodstock, CT**

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Flycatcher	*Empidonax spp*	*
Least flycatcher	*Empidonax minimus*	
Eastern phoebe	*Sayornis phoebe*	*
Great crested flycatcher	*Myiarchus crinitus*	*
Eastern kingbird	*Tyrannus tyrannus*	*
Tree swallow	*Tachycineta bicolor*	*
Northern rough-winged swallow	*Stelgidopteryx serripennis*	
Bank swallow	*Riparia riparia*	
Cliff swallow	*Hirundo pyrrhonota*	
Barn swallow	*Hirundo rustica*	
Blue jay	*Cyanocitta cristata*	*
American crow	*Corvus brachyrhynchos*	*
Black-capped chickadee	*Parus atricapillus*	*
Tufted titmouse	*Parus bicolor*	*
Red-breasted nuthatch	*Sitta canadensis*	
White-breasted nuthatch	*Sitta carolinensis*	*
Brown creeper	*Certhia americana*	*
Carolina wren	*Thryothorus ludovicianus*	
House wren	*Troglodytes aedon*	*
Marsh wren	*Cistothorus palustris*	
Golden-crowned kinglet	*Regulus satrapa*	*
Ruby-crowned kinglet	*Regulus calendula*	*
Blue-gray gnatcatcher	*Polioptila caerulea*	
Eastern bluebird	*Sialia sialis*	
Veery	*Catharus fuscescens*	*
Hermit thrush	*Catharus guttatus*	
Wood thrush	*Hylocichla mustelina*	*
American robin	*Turdus migratorius*	*

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POTENTIAL BIRD SPECIES

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Date: **October 1991**
Location: **Woodstock, CT**

Weather: **Sunny 60's**
Comments:

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Gray catbird	*Dumetella carolinensis*	*
Northern mockingbird	*Mimus polyglottos*	*
Brown thrasher	*Toxostoma rufum*	
Cedar waxwing	*Bombycilla cedrorum*	*
Northern shrike	*Lanius excubitor*	
Loggerhead shrike	*Lanius ludovicianus*	
European starling	*Sturnus vulgaris*	*
White-eyed vireo	*Vireo griseus*	
Solitary vireo	*Vireo solitarius*	
Yellow-throated vireo	*Vireo flavifrons*	
Warbling vireo	*Vireo gilvus*	*
Red-eyed vireo	*Vireo olivaceus*	
Blue-winged warbler	*Vermivora pinus*	*
Golden-winged warbler	*Vermivora chrysoptera*	
Nashville warbler	*Vermivora ruficapilla*	
Yellow warbler	*Dendroica petechia*	
Chestnut-sided warbler	*Dendroica pensylvanica*	*
Magnolia warbler	*Dendroica magnolia*	
Black-throated blue warbler	*Dendroica caerulescens*	
Blackpoll warbler	*Dendroica striata*	
Yellow-rumped warbler	*Dendroica coronata*	*
Black-throated green warbler	*Dendroica virens*	
Pine warbler	*Dendroica pinus*	
Prairie warbler	*Dendroica discolor*	
Black-and-white warbler	*Mniotilta varia*	*
American redstart	*Setophaga ruticilla*	*
Ovenbird	*Seiurus aurocapillus*	*
Northern waterthrush	*Seiurus noveboracensis*	
Common yellowthroat	*Geothlypis trichas*	*
Canada warbler	*Wilsonia canadensis*	
Yellow-breasted chat	*Icteria virens*	
Scarlet tanager	*Piranga olivacea*	*

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POTENTIAL BIRD SPECIES

Project Name: **Linemaster Switch** ***Weather:*** **Sunny 60's**
Date: **October 1991** ***Comments:***
Location: **Woodstock, CT**

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Northern cardinal	*Cardinalis cardinalis*	*
Rose-breasted grosbeak	*Pheucticus ludovicianus*	*
Indigo bunting	*Passerina cyanea*	
Rufous-sided towhee	*Pipilo erthrophthalmus*	
American tree sparrow	*Spizella arborea*	
Chipping sparrow	*Spizella passerina*	*
Field sparrow	*Spizella pusilla*	
Vesper sparrow	*Pooecetes gramineus*	
Savannah sparrow	*Passerculus sandwichensis*	
Fox sparrow	*Passerella iliaca*	
Song sparrow	*Melospiza melodia*	*
Swamp sparrow	*Melospiza georgiana*	
White-throated sparrow	*Zonotrichia albicollis*	
Dark-eyed junco	*Junco hyemalis*	*
Lapland longspur	*Calcarius lapponicus*	
Snow bunting	*Plectrophenax nivalis*	
Red-winged blackbird	*Agelaius phoeniceus*	
Eastern meadowlark	*Sturnella magna*	
Common grackle	*Quiscalus quiscula*	
Brown-headed cowbird	*Molothrus ater*	*
Orchard oriole	*Icterus spurius*	
Northern oriole	*Icterus galbula*	*
Pine grosbeak	*Pinicola enucleator*	
Purple finch	*Carpodacus purpureus*	*
House finch	*Carpodacus mexicanus*	*
Common redpoll	*Carduelis flammea*	
Pine siskin	*Carduelis pinus*	
American goldfinch	*Carduelis tristis*	*
Evening grosbeak	*Coccothraustes vespertinus*	*
House sparrow	*Passer domesticus*	*

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POTENTIAL MAMMAL SPECIES

Project Name: **Linemaster Switch** ***Weather:*** **Sunny 60's**
Date: **October 1991** ***Comments:***
Location: **Woodstock, CT**

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Virginia opossum	*Didelphis virginiana*	*
Masked shrew	*Sorex cinereus*	*
Northern short-tailed shrew	*Blarina brevicauda*	*
Hairy-tailed mole	*Parascalops breweri*	
Eastern mole	*Scalopus aquaticus*	*
Star-nosed mole	*Condylura cristata*	
Little brown myotis	*Myotis lucifugus*	*
Keen's myotis	*Myotis keenii*	*
Silver-haired bat	*Lasionycteris noctivagans*	
Eastern pipistrelle	*Pipistrellus subflavus*	
Big brown bat	*Eptesicus fuscus*	*
Red bat	*Lasiurus borealis*	
Hoary bat	*Lasiurus cinereus*	
Eastern cottontail	*Sylvilagus floridanus*	*
New England cottontail	*Sylvilagus transitionalis*	
Snowshoe hare	*Lepus americanus*	
Eastern chipmunk	*Tamias striatus*	*
Woodchuck	*Marmota monax*	*
Gray squirrel	*Sciurus carolinensis*	*
Red squirrel	*Tamiasciurus hudsonicus*	*
Southern flying squirrel	*Glaucomys volans*	*
White-footed mouse	*Peromyscus leucopus*	*
Southern red-backed vole	*Clethrionomys gapperi*	*
Meadow vole	*Microtus pennsylvanicus*	*
Woodland vole	*Microtus pinetorum*	*
Muskrat	*Ondatra zibethicus*	
Southern bog lemming	*Synaptomys cooperi*	
Northern bog lemming	*Synaptomys borealis*	
Norway rat	*Rattus norvegicus*	*
House mouse	*Mus musculus*	*

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POTENTIAL MAMMAL SPECIES

Project Name: **Linemaster Switch** ***Weather:*** **Sunny 60's**
Date: **October 1991** ***Comments:***
Location: **Woodstock, CT**

COMMON NAME	SCIENTIFIC NAME	POTENTIAL USER
Meadow jumping mouse	*Zapus hudsonius*	*
Coyote	*Canis latrans*	
Red fox	*Vulpes vulpes*	*
Gray fox	*Urocyon cinereoargenteus*	
Raccoon	*Procyon lotor*	*
Ermine	*Mustela erminea*	
Long-tailed weasel	*Mustela frenata*	
Mink	*Mustela vison*	
Striped skunk	*Mephitis mephitis*	*
River otter	*Lutra canadensis*	
Bobcat	*Felis rufus*	
White-tailed deer	*Odocoileus virginianus*	*

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UPLAND PLANT SPECIES IDENTIFIED AT LINEMASTER SWITCH CORPORATION

Project Name: Linemaster Switch
Date: October 21, 1991
Location: Woodstock, CT

Weather: Sunny, 60's
Comments:

COMMON NAME	SCIENTIFIC NAME
Trees	
Black oak	*Quercus velutina*
White oak	*Quercus alba*
White ash	*Fraxinus americana*
White birch	*Betula papyrifera*
Sugar maple	*Acer saccharum*
Norway maple	*Acer platanoides*
American beech	*Fagus grandifolia*
White pine	*Pinus strobus*
Eastern hemlock	*Tsuga canadensis*
Shrubs	
Maple-leaved viburnum	*Viburnum acerifolium*
Honeysuckle	*Lonicera sp.*
Huckleberry	*Gaylussacia frondosa*
Multiflora rose	*Rosa multiflora*
Mountain laurel	*Kalmia latifolia*
Japanese maple	*Acer palmatum*
Winged euonymus	*Euonymus alatus*
Yew	*Taxus sp.*
Rhododendron	*Rhododendron sp.*
Herbs	
Hayscented fern	*Dennstaedtia punctilobula*
Club moss	*Lycopodium spp.*

WETLAND PLANT SPECIES IDENTIFIED AT LINEMASTER SWITCH CORPORATION

Project Name: Linemaster Switch
Date: October 21, 1991
Location: Woodstock, CT

Weather: Sunny, 60's
Comments:

COMMON NAME	SCIENTIFIC NAME
Trees	
Red maple	*Acer rubrum*
Shrubs	
Arrowwood	*Viburnum recognitum*
Winterberry	*Ilex verticillata*
Winged euonymus	*Euonymus alatus*
Multiflora rose	*Rosa multiflora*
Silky dogwood	*Cornus amomum*
Elderberry	*Sambucus candensis*
Herbs	
Skunk cabbage	*Symplocarpus foetidus*
Jewelweed	*Impatiens capensis*
Royal fern	*Osmunda regalis*
Beggars tick	*Bidens connata*
Spike rush	*Eleocharis sp.*
Rice cutgrass	*Leersia oryzoides*
Mud plantain	*Alisma sp.*
Poison ivy	*Toxicodendron radicans*

MA-1

10/21/91 Main Hill Rd, Woodstock, CT

Begin flagging 'A' series at culvert KT169

ditch by A3 flagging veers away from

dit[illegible] to include red maple, arrowwood,

[illegible], occasional channels, skunk cabbage

royal, jewelweed, saturated soils

winged euyonomus, sparse to moderate

tree cover A6 to A10 dense shrubs -

winterberry along disturbed fill edge, + debris (wood - [illegible])

seepy area, A10 out by edge of cabin

in grass next to man-made pond w/

erator - inlet to pond lots of multiflora

rose, willows, little veg in pond - some

cattails - angustifolia, Bidens, spike rush,

rice cut grass, mud plantain

g clump at inlet end + outlet end

A20 begin ditched outlet

good filter of cattails at outlet

outlet stream is ditched w/ 2-3 feet

in width - thick tree margin of

white pine, red maple then lawn

wa flag A32 at pond road/stone bridge
then downstream of bridge mowed lawn
to meandering stream edge end A41
low at large concrete headwall at PT171
dis 'B' series side of same
wate system B14-16 small wet seepy
all area off of ditch/stream, saturated,
of skunk cabbage, poison ivy - shrub cover
has been maintained
Oc end B36 opposite A1
over Pond 3 - did not flag - edge of H_2O
flow is the edge of wet - put one flag in
pock place - no outlet, man-made
air 3 small pvc pipes w/ flow entering
wa several feet deep, little to no veg
d in water
fl 'C' series - begin near RT169
corp ponded - natural area, then [illegible]
cha swamp - ilex, multiflora, silky
vari dogwood, elderberry, soft rust.
small stream visible here [illegible]

E29 connects C1
turned culvert seems likely but not
visible - flow directly across
RT169 heads in small channel
down to pond

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

NATURAL RESOURCES CENTER
165 Capitol Avenue, Room 553
Hartford, Connecticut 06106
Natural Diversity Data Base

December 12, 1991

Ms. Ann McMenemy
Associate Wetlands Biologist
IEP, Inc.
PO Box 780
Northborough, MA 01532

Re: 90 Acre Site
Route 169 and 171
Woodsotck, CT

Dear Ms. McMenemy:

I have reviewed Natural Diversity Data Base maps and files regarding the area delineated on the map which you provided. According to our information, there are no known extant populations of Federally Endangered and Threatened Species or species proposed for State Endangered, Threatened or Special Concern occurring at the site in question.

Natural Diversity Data Base information includes all information regarding critical biologic resources available to us at the time of the request. This information is a compilation of data collected over the years by the Natural Resources Center's Geological and Natural History Survey and cooperating units of DEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultation with the Data Base should not be substituted for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available.

Please contact me if you have further questions (566-3540). Thank you for consulting the Natural Diversity Data Base.

Sincerely,

Kenneth J. Metzler
Senior Biologist

KJM/dmt