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VOLUME I

PHASE II SUPPLEMENTAL INVESTIGATION FOR THE FORMER GENERAL ELECTRIC FACILITY, 50 FORDHAM ROAD, WILMINGTON/NORTH READING, MASSACHUSETTS

Prepared For

GE AEROSPACE

Environmental Programs
230 East Goddard Boulevard
King of Prussia, PA 19406

November 1991

WEHRAN ENGINEERING CORPORATION
Andover, Massachusetts

Environmental Engineers • Scientists • Constructors

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1.0 INTRODUCTION

Wehran Engineering Corporation (Wehran) has conducted this supplemental Phase II investigation on behalf of General Electric Aerospace (GE) at the former GE Aerospace facility located at 50 Fordham Road in Wilmington and North Reading, Massachusetts (Figure 1). This investigation was conducted pursuant to Phase II Remedial Response Action provisions of the Massachusetts Contingency Plan (MCP), 310 CMR 40.545. The results of this investigation and data collected during previous investigations at the site are described in this report. The purpose of this investigation was to further characterize site conditions and to obtain sufficient information which, when combined with existing data, would facilitate development of a baseline risk assessment and selection of a remedy for the site.

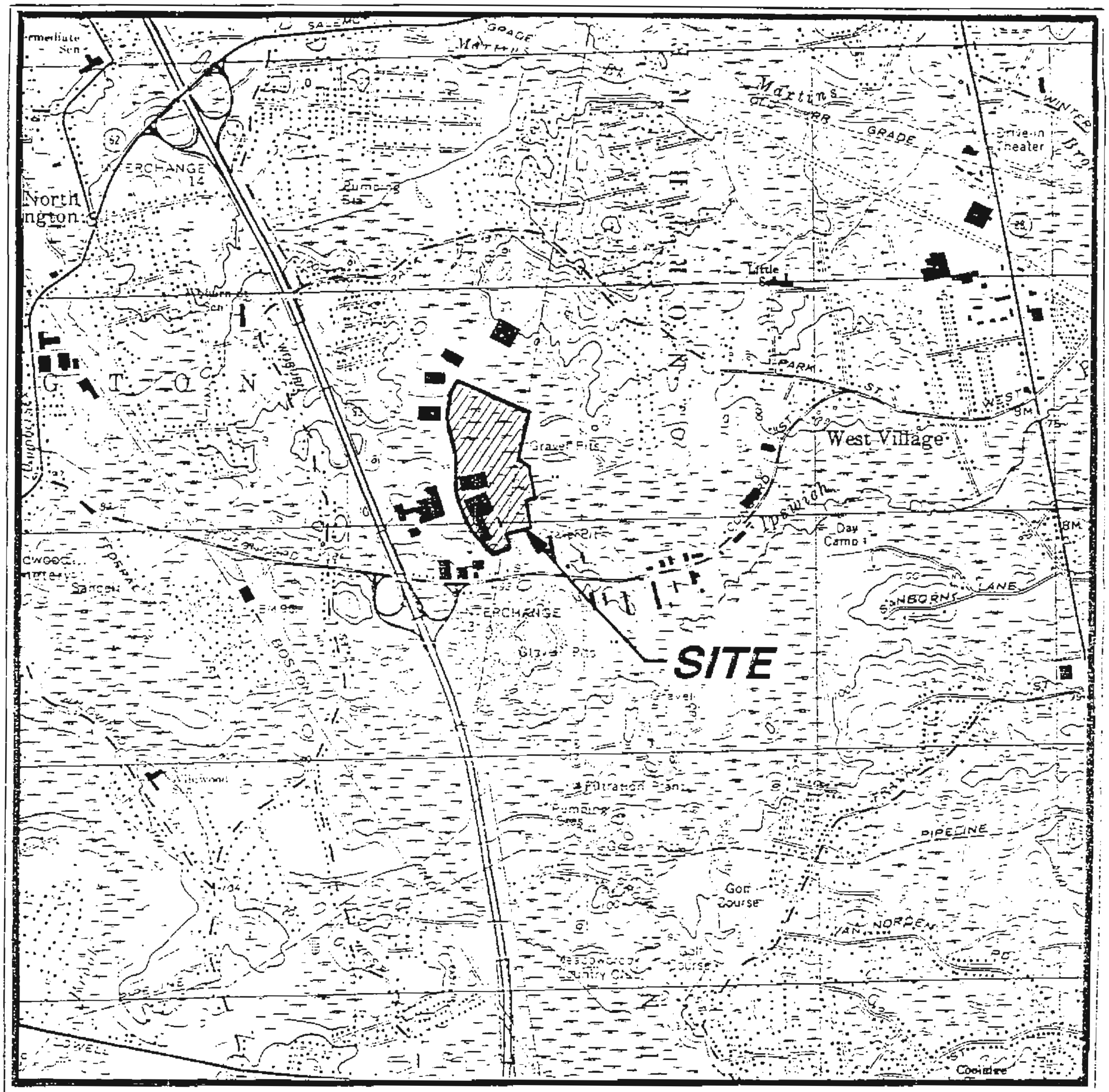
1.1 OBJECTIVES

The primary objectives of this supplemental assessment were to:

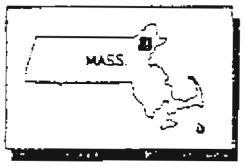
- assess physical characteristics of the site;
- assess the sources, nature, distribution, and extent of contamination in soil, sediment, surface water, and groundwater at the site;
- identify potential contaminant migration pathways; and
- assess fate and transport of contaminants at the site.

1.2 SUMMARY OF PREVIOUS INVESTIGATIONS

Previous investigations have been conducted at the site and in its vicinity since approximately 1985 by Camp, Dresser and McKee, Inc., ERM-New England, Inc., and Goldberg-Zoino and Associates, Inc. (GZA). In April 1990, GZA submitted a Phase II report for the site to the Massachusetts Department of Environmental Protection (DEP). The GZA report includes a general description and history of the site and surrounding area, a summary of field activities that have been completed at the site and in its vicinity, results of field screening and laboratory analyses, a description of the local and regional geology and hydrogeology, the nature and distribution of hazardous materials and oil in environmental media at the site, general solute transport analyses from suspected contaminant source areas, and a public health and environmental risk characterization.



BASE TAKEN FROM 1:25,000 USGS
TOPOGRAPHIC QUADRANGLE
READING, MASS.-PR. 1979
WILMINGTON, MASS.-PR. 1979



QUADRANGLE LOCATION

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FIGURE 1

SITE LOCUS MAP

GENERAL ELECTRIC - AEROSPACE
PHASE II SUPPLEMENTAL INVESTIGATION
WILMINGTON/N. READING, MASSACHUSETTS

WEHRAN PROJECT NO. 01501.01

Prior to the investigation described herein, approximately 46 monitoring wells had been installed on the site and approximately another 20 had been installed in its immediate vicinity. Thirty-four of the on-site wells were installed in overburden and 12 were installed in bedrock. In addition, 14 separate soil borings had been advanced on site and 38 additional piezometers had been installed; 31 in overburden and 7 in bedrock. Environmental sampling and field screening had been conducted in sediment, surface water, soil gas, groundwater, and soil at multiple areas and on several occasions throughout the property. Hydrogeologic and geologic properties of site overburden and bedrock have been described previously. Potentiometric monitoring to determine groundwater flow rate and direction of flow in both overburden and bedrock has been conducted. The GZA Phase II document (GZA, 1990) contains a comprehensive presentation of these previous data and should be reviewed for specific information concerning site history, a description of the area, and results of prior investigations.

1.3 CURRENT REGULATORY STATUS

The GZA Phase II document was submitted to the DEP in April 1990 for review and comment. Currently, the Phase II report is still being reviewed by DEP. However, from April 1991 through August 1991, DEP provided several comments to GE related to the Site Risk Characterization section of the Phase II report. In these comments, DEP requested that a modified risk characterization be completed for the site. DEP also requested additional data collection activities in order to form a more complete data set on which to base the modified risk characterization.

because the Risk Assessment portion was not acceptable & revised RA was required before DEP could issue comment.

The risk characterization is currently being conducted based upon information developed during the supplemental activities described herein and based upon previous data collected at the site. The final draft risk characterization document will be submitted for review to the DEP under separate cover in December 1991.

Based upon findings of the GZA Phase II investigation and recent conversations with DEP officials, it was also determined that additional data were needed in certain areas of the site. The scope of work outlined in Section 1.5 below, completed as part of the supplemental Phase II investigation described herein, was intended to meet both these and the modified risk characterization data requirements.

1.4 GENERAL SITE DESCRIPTION

The property comprises approximately 13 acres and is located at 50 Fordham Road in Wilmington and North Reading, Massachusetts. A site locus map indicating approximate property boundaries is provided as Figure 1. A site map is provided as Figure 2. As shown in Figure 2, the town line separating Wilmington and North Reading is located in the eastern portion of the property. The site is located within an industrial park and is abutted by wetlands to the north and east, by Fordham Road and industrial properties to the west, and by another industrial parcel to the south.

There are currently seven permanent structures on the property (Figure 2). These include Building 1, Building 1A, Building 2, Building 3, a regulated substance storage building, a security guard house, and a sewage treatment plant. Several storm water drains and two drainage outfalls are located on the property to serve these structures, as discussed by GZA (1990).

Topographic relief at the site is relatively minimal although previous investigations indicate that the property may have been filled prior to construction of the buildings. The majority of the property is comprised of the buildings discussed above and parking space for employees. Relatively small grassed areas surround the buildings. A wetlands area is located immediately east of the parking area.

GE leased the property from Wilmington Realty Trust since its development in 1968 until August 1989. During this period, GE subleased portions of the property to a sporting shoe manufacturer and to a manufacturer of hydrogen generators. In 1989, GE sold its manufacturing operations to Ametek, Inc. which currently occupies the property. Additional details concerning the site description and present operations at Ametek, Inc., are provided by GZA (1990).

Results of prior studies conducted at the site, including the GZA Phase II study, identified seven areas for investigation. These are shown in Figure 2 and include the Tank Farm Area, the Tank F Area, The Tank K Area, the Eastern Parking Lot Area, two Outfall Areas, designated Outfall 001 and Outfall 002, and the Wetlands Area.

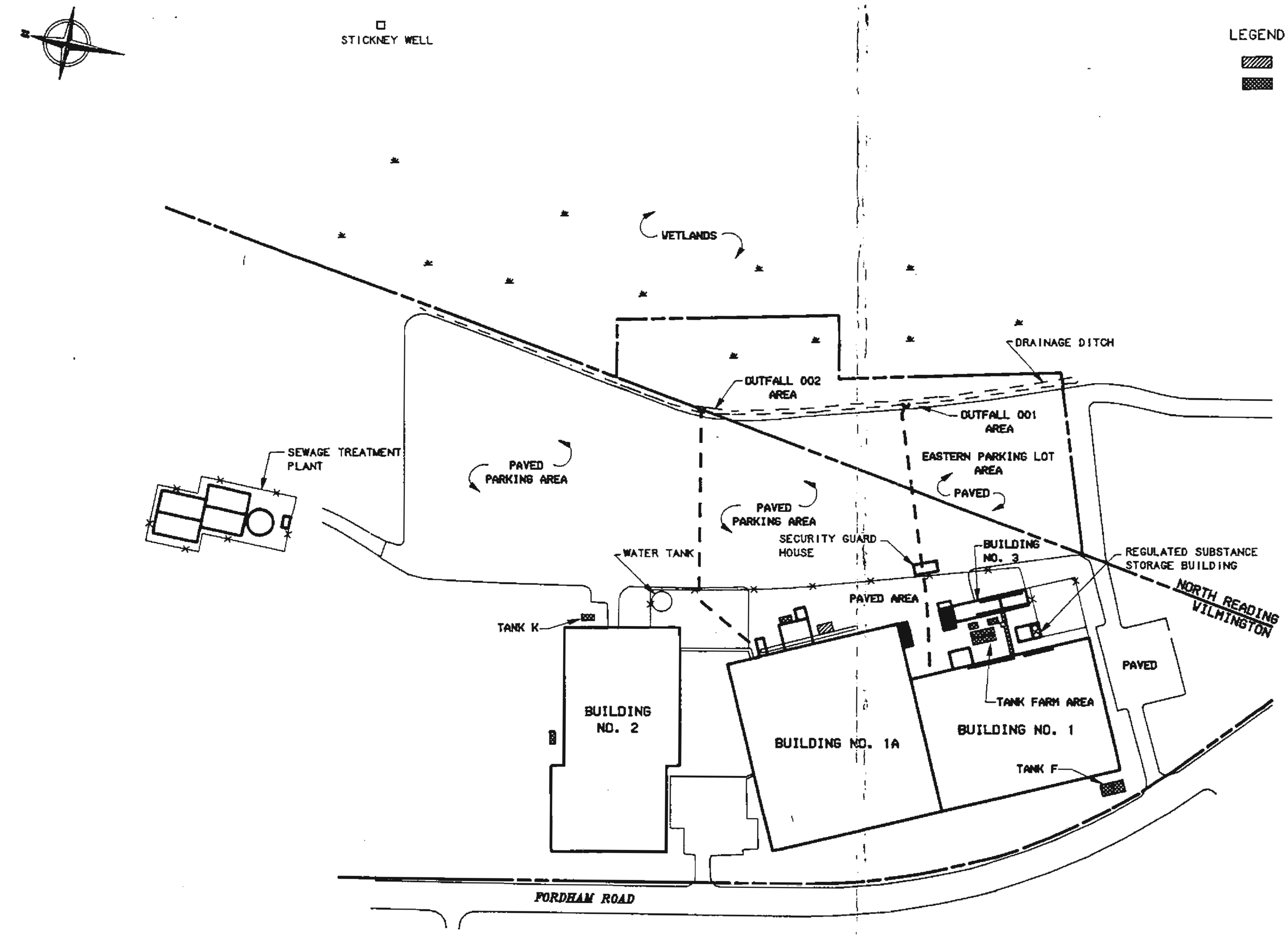
1.5 SUPPLEMENTAL PHASE II SCOPE OF WORK

Field investigation activities conducted during this supplemental investigation included advancement of soil borings; installation of monitoring wells; groundwater, surface

LEGEND:

▨ UNDERGROUND STORAGE TANK LOCATION-EXISTING TANK

▩ UNDERGROUND STORAGE TANK LOCATION-REMOVED TANK



0 200
APPROXIMATE
SCALE, IN FEET

FIGURE 2

SITE MAP

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

WEHRAN PROJECT NO. 01501.0

NOTE:
1. BASE MAP PROVIDED TO WEHRAN ENGINEERING BY AUTOMATED COMPLIANCE SYSTEMS, INC. (ACS) BRIDGEWATER, NJ. ACS MAP DEVELOPED FROM PLAN PROVIDED BY GENERAL ELECTRIC COMPANY ENTITLED "SITE PLAN", UNDATED. ORIGINAL SCALE = 1" - 40'.

DCM:(01501.01.HG)BASE MAP 11X17 DWG: LL109125 water, soil, and sediment sampling; an elevation and location survey of new monitoring wells; and in-situ hydraulic conductivity testing of new monitoring wells.

In order to assess alternatives for groundwater treatment in the Tank Farm, Tank F, Tank K, and Eastern Parking Lot Areas, groundwater treatability data were obtained from groundwater samples collected from four existing overburden monitoring wells, from five existing bedrock monitoring wells, and from five newly installed overburden monitoring wells in these areas. Samples were analyzed for ten treatability parameters.

As part of this supplemental investigation, it was determined that the nature and extent of contamination in the Eastern Parking Lot Area, the Outfall Areas, and the Tank K Area could be further defined. Further, DEP requested collection of more recent soil analytical data from the Tank Farm and Tank F Areas to support the modified risk characterization. Accordingly, four soil borings were advanced in the Eastern Parking Lot Area, six hand auger borings were advanced in the Outfall Areas, seven borings and five monitoring wells were completed in the Tank K Area, and three soil borings each were advanced in both the Tank Farm Area and the Tank F Area to address these data gaps. Soil samples were collected from the borings and soil headspace was screened in the field. Selected samples were submitted for laboratory analysis for volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), TPH fingerprint, and total organic carbon (TOC). In addition, groundwater samples were collected from newly installed monitoring wells in the Tank K Area and submitted for TPH and VOC analyses. Following monitoring well installation, the elevations of the wells were surveyed and referenced to the same elevation datum used previously for the site. Potentiometric measurements were made of the newly installed wells to assess groundwater flow direction. Following monitoring well development, in-situ hydraulic conductivity tests were conducted in the newly installed monitoring wells.

it was decided before Supp. Ph. II work that more work needed here

In order to assess the nature and extent of separate phase product in the Eastern Parking Lot Area and to support modified risk characterization activities, groundwater samples collected from selected monitoring wells in this area for treatability analyses were also submitted for TPH and TPH fingerprint analyses. Where possible, the extent of product thickness was measured in borings, monitoring wells, and piezometers.

Due to the extent of TPH contamination identified in previous studies in the Outfall Areas and based upon site conditions, surface water and sediment samples were collected from five locations in the Wetlands Area. Samples were collected to assist in defining the nature and extent of TPH contamination in the wetlands adjacent to the drainage outfall areas and to support modified risk characterization activities. Selected samples were analyzed for VOCs, TPH, TPH fingerprint, acid/base neutral extractable compounds, and priority pollutant metals. → Original SOW from GZA 5/30/91 "Ph. III Scope of work"

The scope of work described above was presented to the DEP and approved by them during a meeting on August 26, 1991. Details relating to the scope of work described above are provided in Sections 3.0 and 4.0 of this report.

Approved in DEP's 7/9/91 cond. approval letter. DEP approved exploration locations only in 8/26/91 mtg.

Since this report is intended to be a supplement to the Phase II report prepared by GZA and submitted to the DEP in 1990, information from the Phase II report that was judged to be significant for data interpretation has been used in this report. Wehran has used data as they were presented. No validation of the data presented or referenced in the Phase II report or the methods used to collect them has been conducted as part of this supplemental investigation. The integration of the data from this and prior investigations was conducted to maximize use of available data. There are potential limitations arising from integration of data that have been collected over a period of years with respect to a description of current site conditions. Potential limitations may include varying sampling and analytical methods, reporting techniques, differences in sample matrices, or temporal changes in site conditions, for example.

1.6 REPORT ORGANIZATION

Section 2.0 discusses prior results concerning site physical characteristics and is intended to summarize information and provide a conceptual understanding of the site with minimal reference to the original Phase II document. Section 3.0 provides a discussion of the field activities and specific methods used during this supplemental investigation. Section 4.0 summarizes the results of the physical and analytical testing and describes the nature of oil and hazardous material observed at the site during this investigation. Section 5.0 provides a summary of the distribution of oil and hazardous materials at the site based upon qualitative integration of previous data with data developed during this supplemental Phase II investigation. Section 6.0 integrates the site description from Section 2.0 with the integrated data in Section 5.0 to discuss contaminant fate and transport at the site.

2.0 SITE CHARACTERISTICS

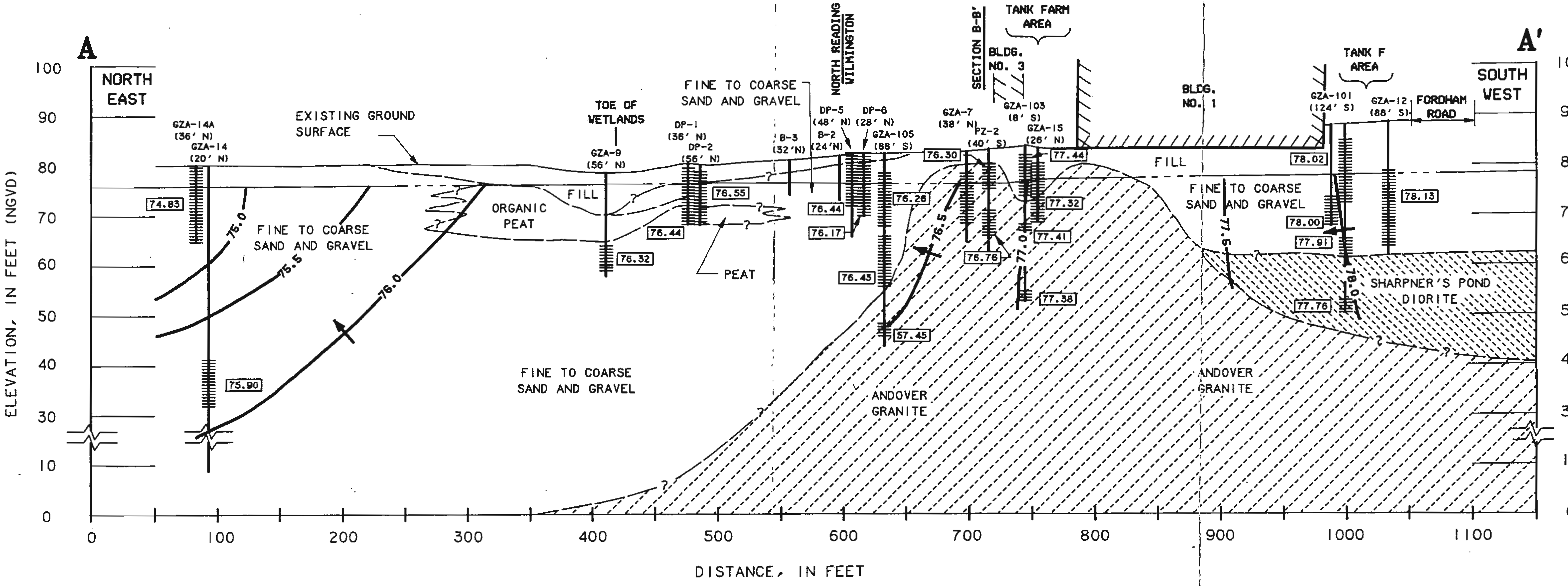
This section is intended to summarize site physical characteristics and to provide a description of the hydrogeologic environment at the site based upon information developed during previous studies. Specific data from which this description was developed and further information concerning the regional hydrogeology and hydrology is provided in the Phase II GZA report.

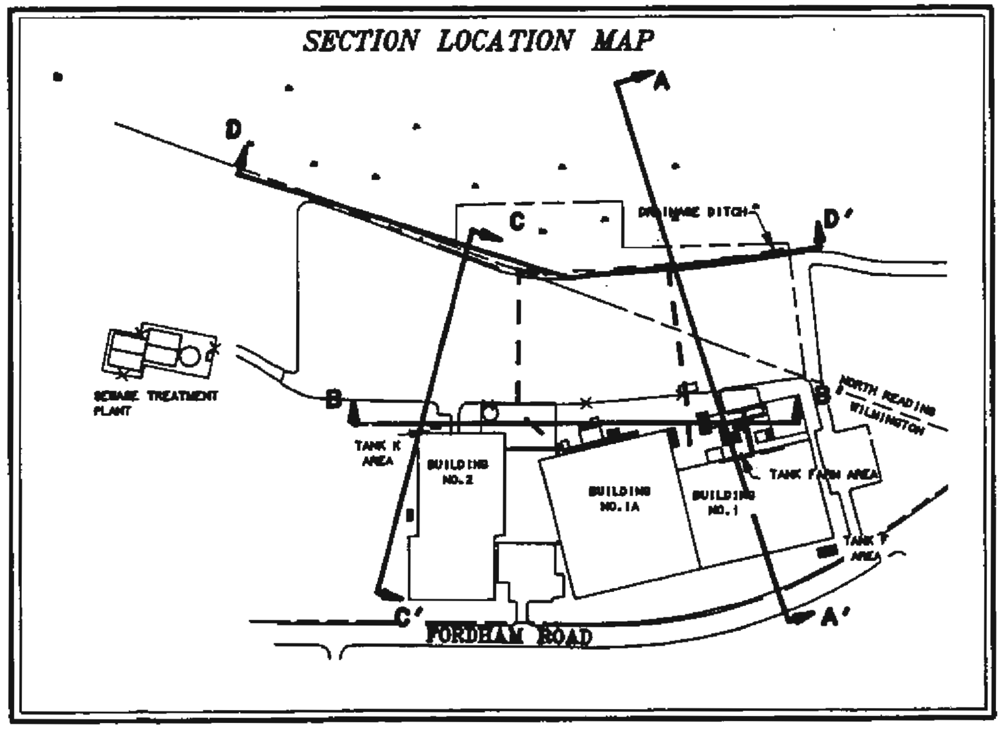
A significant number of environmental sampling and monitoring points have been located on the site and in its vicinity. Pertinent locations that existed on the site prior to this investigation and which were judged to be useful for integrating and interpreting data from this investigation are shown in Figure 3.

2.1 OVERBURDEN GEOLOGY

The majority of the site is underlain by approximately two to eight feet of fill material consisting primarily of silty, fine to coarse sand with varying amounts of gravel. Exceptions to this include an area to the east of Building 1A (Figure 3), including monitoring locations PZ-4, PZ-5, GZA-8, and GZA-104, where gravel was not observed in the upper overburden which was described as fill and the area to the east of and between Building 1A and Building 2 (Figure 3) where silty sand was observed in the upper six feet at borings for DP-11 and DP-12. In the vicinity of the former Tank F location, fill was observed to extend to approximately 12 feet below the ground surface (bgs). This is likely due to refilling the excavation following removal of the tank formerly in this area. In borings GZA-1, GZA-2, and PZ-9, located in the northern portion of the site, fill was not observed in the upper overburden. However, a layer of organic peat varying in thickness from approximately two and one-half feet to six feet was encountered in these borings at ground surface.

Where present, the fill material is in turn underlain by two different strata. In the eastern portion of the site, peat, varying in thickness from 2 feet to 12 feet, was observed to underlie the fill from depths of approximately 5 to 19 feet bgs. These observations were made in the vicinity of borings DP-1, DP-2, DP-3, DP-4, DP-7, DP-8, PZ-6, GZA-6, GZA-9, GZA-11, and GZA-106. It appears that the peat is continuous in overburden material in the





LEGEND:

GZA-5 (16'N) — MONITORING WELL/BORING LOCATION

OFFSET IN FEET AND DIRECTION FROM CROSS-SECTION

SCREENED INTERVAL

APPROXIMATE WATER TABLE SURFACE OCTOBER 30, 1989

GEOLOGIC CONTACT

75.0 — EQUIPOTENTIAL LINE - ARROW INDICATES GENERAL DIRECTION OF GROUNDWATER FLOW

74.83 — POTENTIOMETRIC SURFACE MEASURED ON OCTOBER 30, 1989

NGVD — NATIONAL GEODETIC VERTICAL DATUM

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 80'

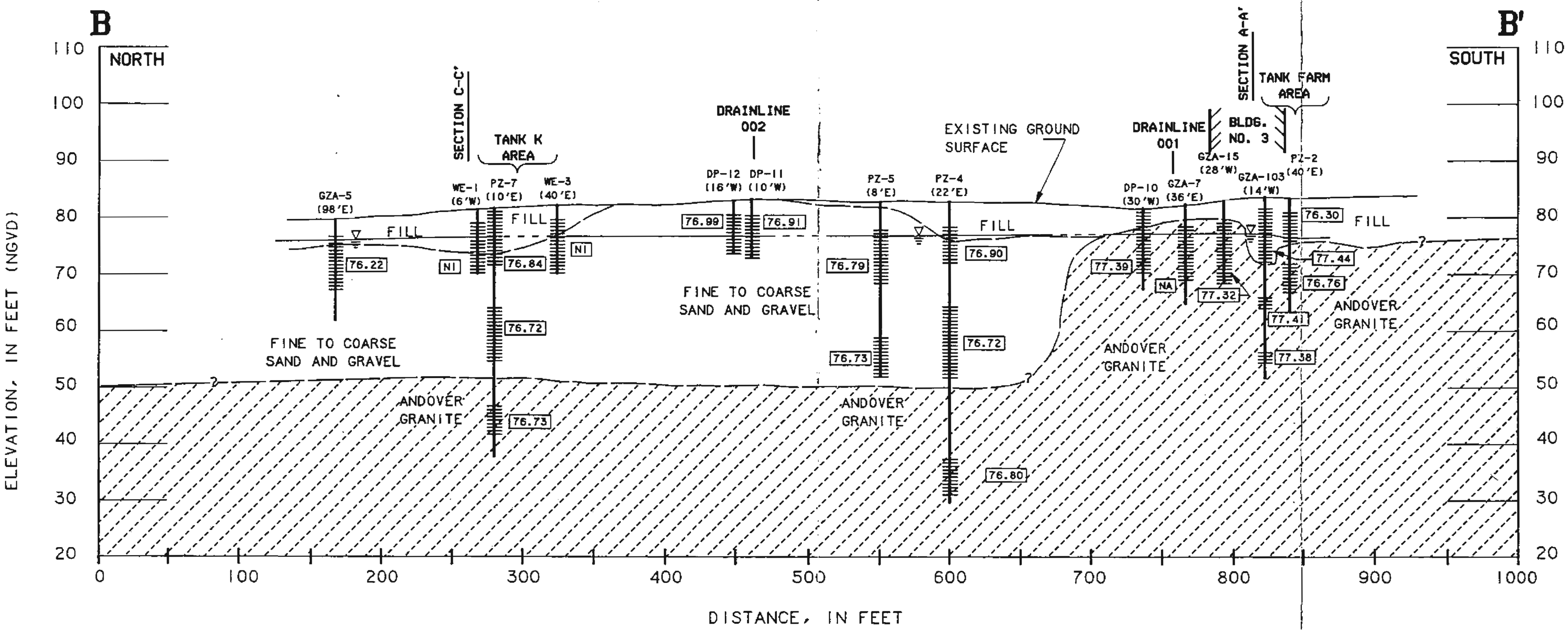
FIGURE 4

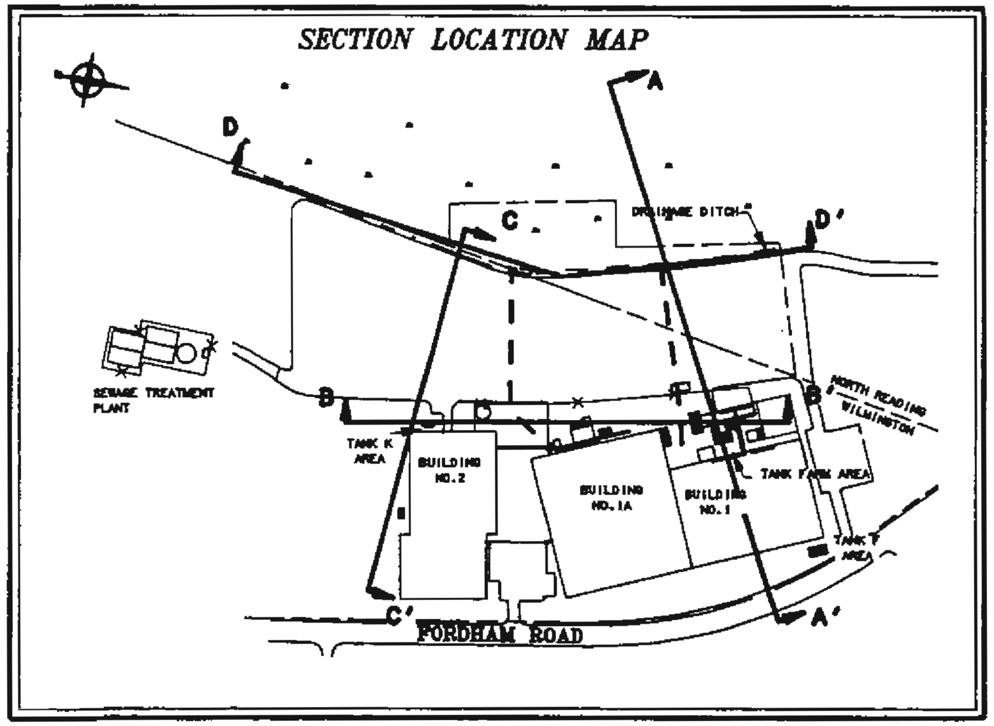
HYDROGEOLOGIC CROSS SECTION A-A'

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

OCM: [01501.01.HG]SECTION A-A DWG: LL109131

WEHRAN PROJECT NO. 01501.01





LEGEND:

GZA-5	MONITORING WELL/BORING LOCATION
(16'N)	OFFSET IN FEET AND DIRECTION FROM CROSS-SECTION
╪	SCREENED INTERVAL
▽	APPROXIMATE WATER TABLE SURFACE OCTOBER 30, 1989
—	GEOLOGIC CONTACT
76.73	POTENTIOMETRIC SURFACE MEASURED ON OCTOBER 30, 1989. NA = DATA NOT AVAILABLE. NI = WELL NOT INSTALLED AT TIME OF POTENTIOMETRIC MEASURMENTS.
NGVD	NATIONAL GEODETIC VERTICAL DATUM

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 80'

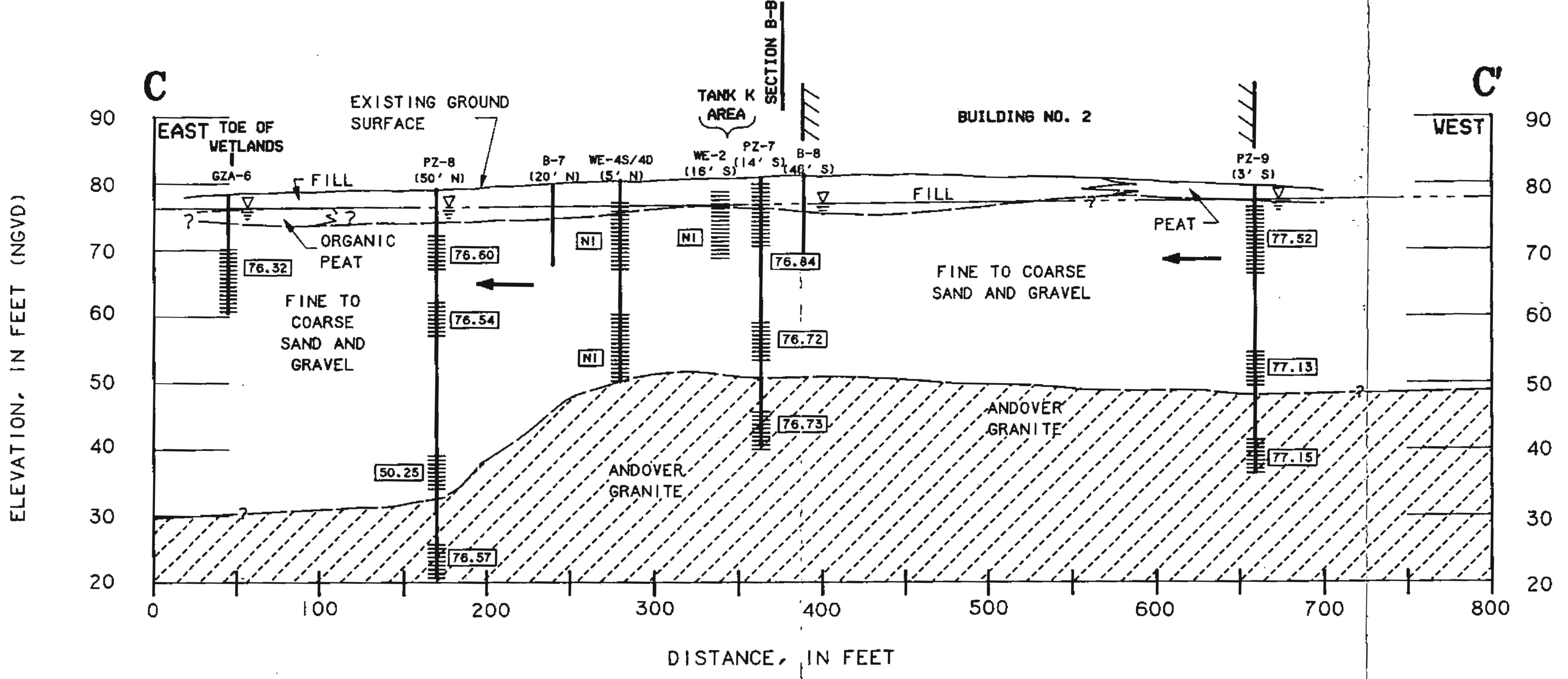
FIGURE 5

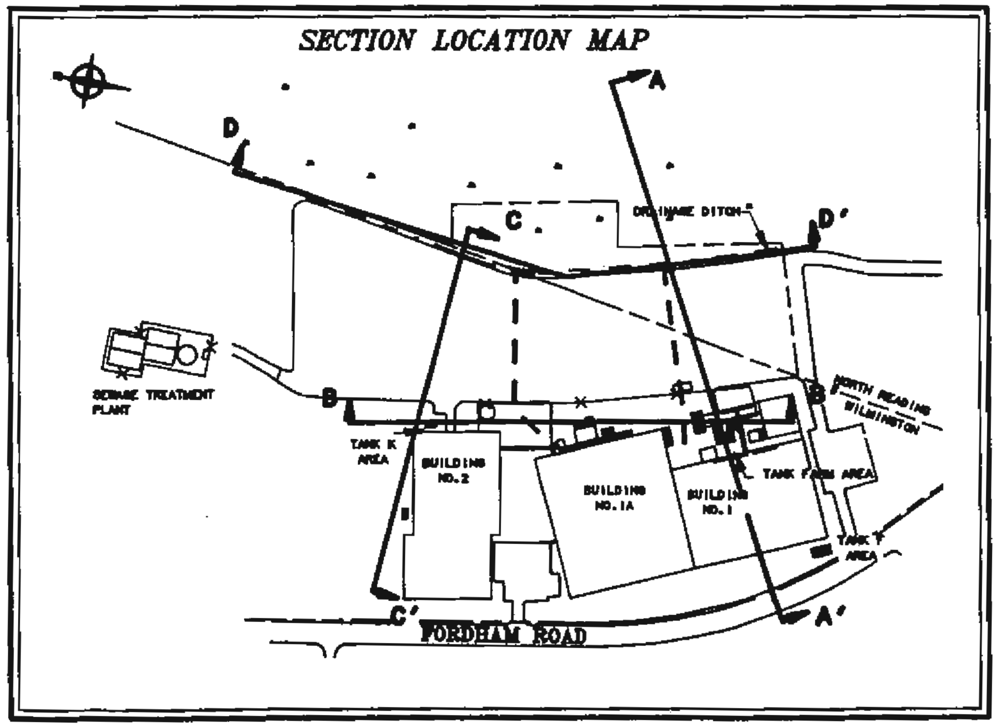
HYDROGEOLOGIC CROSS SECTION B-B'

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

WEHRAN PROJECT NO. 01501.01

OCM: (01501.01.HG)SECTION B-B DWG: LL109132





LEGEND:

PZ-8	MONITORING WELL/BORING LOCATION
(50'N)	OFFSET IN FEET AND DIRECTION FROM CROSS-SECTION
╪	SCREENED INTERVAL
---▽---	APPROXIMATE WATER TABLE SURFACE OCTOBER 30, 1989
———	GEOLOGIC CONTACT
73.76	POTENTIOMETRIC SURFACE MEASURED ON OCTOBER 30, 1989
NI	WELL NOT INSTALLED AT TIME OF POTENTIOMETRIC MEASURMENTS
←	GENERAL DIRECTION OF GROUNDWATER FLOW
NGVD	NATIONAL GEODETIC VERTICAL DATUM

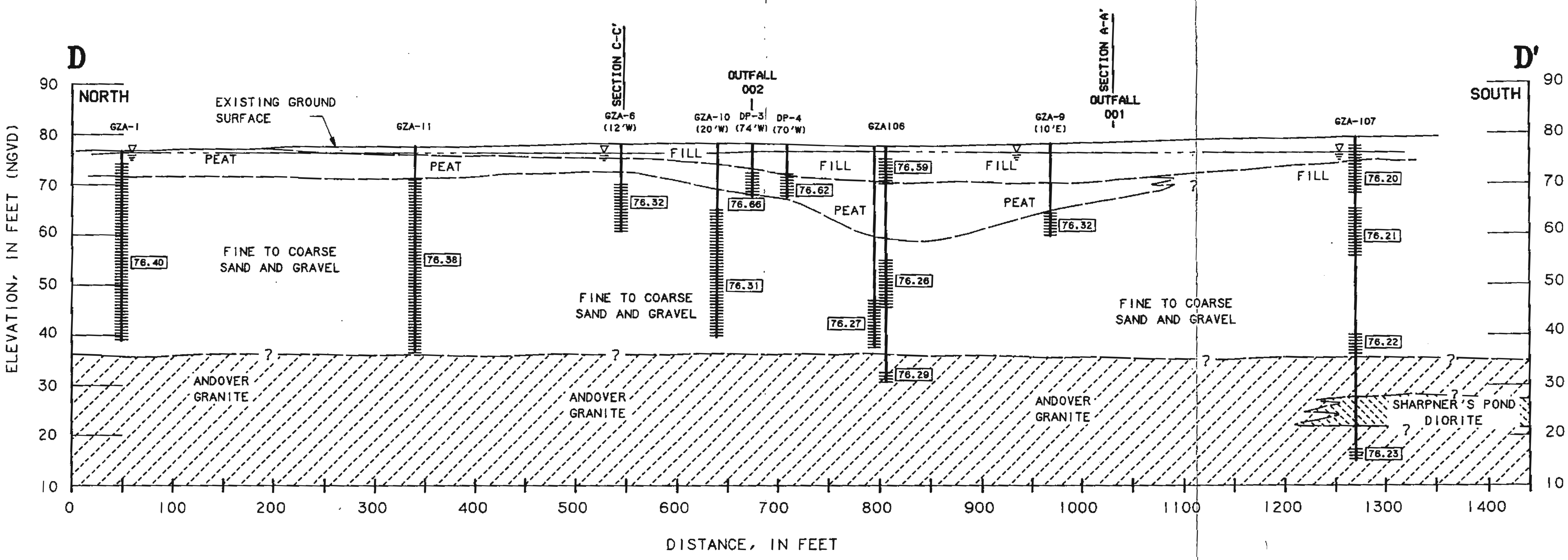
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 80'

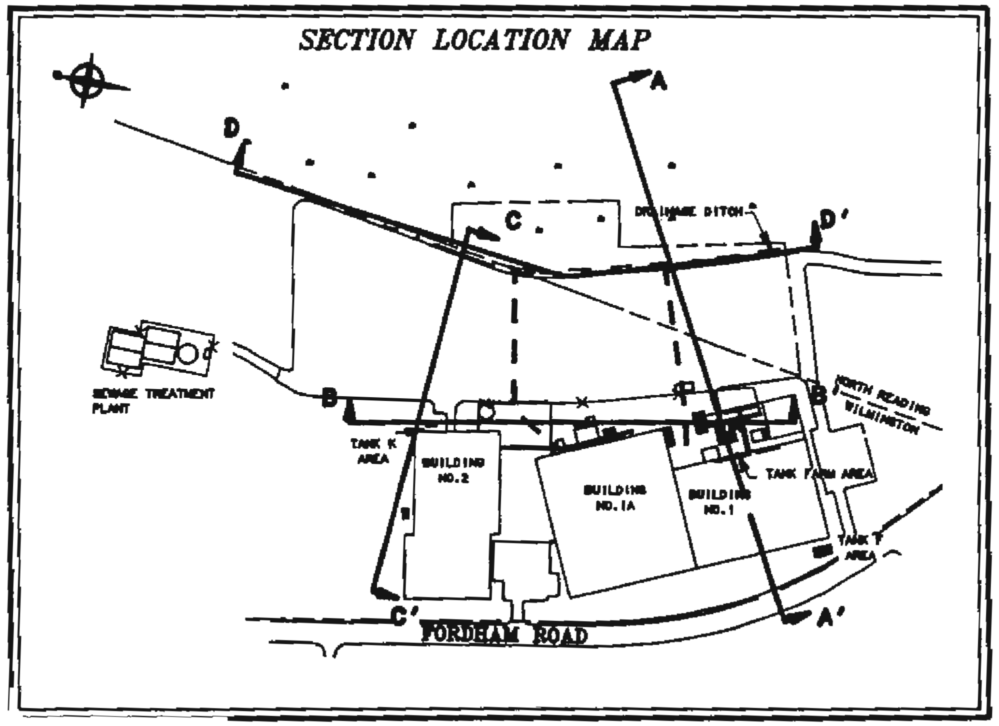
FIGURE 6

HYDROGEOLOGIC CROSS SECTION C-C'

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

WEHRAN PROJECT NO. 01501.01





LEGEND:

GZA-6	MONITORING WELL/BORING LOCATION
(12'W)	OFFSET IN FEET AND DIRECTION FROM CROSS-SECTION
╪	SCREENED INTERVAL
---▽---	APPROXIMATE WATER TABLE SURFACE OCTOBER 30, 1989
———	GEOLOGIC CONTACT
76.40	POTENTIOMETRIC SURFACE MEASURED ON OCTOBER 30, 1989
NGVD	NATIONAL GEODETIC VERTICAL DATUM

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 100'

FIGURE 7

HYDROGEOLOGIC
CROSS SECTION D-D'

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

general area abutting the wetlands (Figure 3), however it was not observed in borings advanced west of this area, except as previously noted at PZ-9.

Beneath the peat, where present, and beneath the fill in the remaining portions of the site (i.e., beneath the entire site), the second stratum observed in overburden material consists primarily of fine to coarse sand and gravel with traces to little amounts of silt. Observations from boring logs indicate that the silt fraction in this stratum tends to be most prevalent in the upper portions while increasing amounts of gravel, and in the southwest portion of the site, cobbles and boulders, tend to replace the silt component with depth. This sand and gravel stratum forms the interface with the top of bedrock at the site.

Figure 3 shows the location of four geologic cross-sections constructed to illustrate the overburden stratigraphy at the site. The locations of the cross-sections were chosen based upon the estimated overburden groundwater flow direction, and potential areas of contamination identified previously. Figures 4 through 7 illustrate the geologic cross-sections shown in Figure 3 and the stratigraphy discussed above.

2.2 BEDROCK GEOLOGY

Based upon results from rock cores previously collected at the site, two types of plutonic bedrock have been described to underlie the overburden material. Andover granite was observed in rock cores from most bedrock monitoring points, while at monitoring locations GZA-101, GZA-104, GZA-107, GZA-108, and PZ-3, Sharpner's Pond diorite was observed. With the exception of GZA-104, where the diorite was observed above the granite, the diorite was observed to underlie the granite. Where both rock types were observed, granitic or dioritic intrusions were generally observed.

As shown in Figures 4 through 7, the bedrock surface is quite variable in the site vicinity. One of the most prominent features of the bedrock topography is the existence of a bedrock knob in the vicinity of Building 1 and Building 3 (Figures 3 and 4). At monitoring locations DP-9, DP-10, and PZ-3, bedrock was observed approximately four feet bgs. Furthermore, bedrock was observed to outcrop near the entrance driveway for the facility south of Building 3. Bedrock appears to slope relatively steeply downward to the west from the area of the buildings (approximately five feet bgs) to approximately 25 feet bgs near GZA-101 and GZA-13 and to greater than 40 feet bgs to the east, near GZA-106, GZA-107, and PZ-8. The slope of the bedrock surface toward the east is more gentle in the northern portion of the site where bedrock was observed approximately 30 feet bgs in the area of PZ-7 and PZ-9 and near 40 feet bgs near the wetlands. Further east of the property in the wetlands, the bedrock is anticipated to continue to slope downward, although data have not been collected to confirm this.

Information from rock cores indicates that approximately the upper 5 to 15 feet of the bedrock encountered is moderately to heavily fractured while zones beneath this are competent. A bedrock surface contour map and further information are provided in the GZA Phase II report.

2.3 GROUNDWATER FLOW CONDITIONS

Figures 4 through 7 illustrate the potentiometric surface in overburden monitoring wells observed in October 1989. Based upon this information, it appears that the depth to the water table during this measurement period varied from approximately less than one foot to ten feet bgs and that the water table was primarily located in the sand and gravel unit discussed previously. Exceptions to this condition were noted east of Building 2 toward the wetlands, between GZA-6 and GZA-9, and near GZA-103, where the water table appeared to be present in the fill unit. The potentiometric surface in PZ-2 appears to be inconsistent with data from other overburden monitoring points in the area. The reason for this is unclear, however it may be related to the distance PZ-2 is offset from the geologic cross-section (Figure 3). Alternatively, it may be due to changes in the magnitude of the hydraulic conductivity and direction of vertical hydraulic gradients between the bedrock and the overlying overburden material which could affect groundwater elevations in this localized area.

Previous information indicated that a horizontal hydraulic gradient ranging between 0.001 and 0.006 was observed in the overburden on site with horizontal components of groundwater flow in this unit in a northeasterly direction in the vicinity of on-site Buildings 1 and 1A, and in an easterly direction in other portions of the site.

Bedrock groundwater flow patterns were reported to generally mimic those in the overburden with horizontal hydraulic gradients ranging from approximately 0.001 to 0.003. Figures providing estimated overburden and groundwater flow directions on site are provided in the GZA Phase II report.

Vertical hydraulic gradients during October 1989 were assessed. These data were used because one of the more comprehensive rounds of potentiometric monitoring was conducted at the site during this time period. Data from that measurement period are also presented in Figures 4 through 7. Review of potentiometric data (summarized in the GZA Phase II report) indicates that the vertical hydraulic gradients change seasonally in some monitoring points and are fairly variable throughout the site, both in magnitude and direction. This variability is typical in heterogenous material such as that observed on-site.

The horizontal hydraulic gradients appear to be more significant in affecting groundwater flow beneath the site than the varied vertical hydraulic gradients observed. Figure 4 illustrates estimated equipotential contours based upon October 1989 data. The vertical exaggeration in this figure should be considered in assessing the equipotential contours. This figure illustrates that predominantly horizontal flow was occurring during this period, with some variation in vertical hydraulic gradients observed at monitoring couplets. Therefore, in combining the horizontal and vertical hydraulic gradient information discussed above, during October 1989, groundwater appeared to be flowing primarily with a horizontal component in a northeasterly and easterly direction.

3.0 PHASE II SUPPLEMENTAL FIELD INVESTIGATIONS

Since soil borings were advanced and environmental samples were collected in several media and in many areas of the site during this investigation, a general discussion of field techniques used is provided below. Details concerning specific methods are provided in subsections of Section 3.0 for the specific area investigated.

3.1 SOIL BORINGS AND SOIL SAMPLING METHODS

Seventeen soil borings were advanced at the site between September 12-18, 1991 by New Hampshire Boring, Inc. of Derry, New Hampshire under the supervision of a Wehran geologist. Soil borings were advanced using 4.25-inch inside diameter (ID) hollow-stem augers. Soil samples were collected continuously to the water table, and either continuously or at five-foot intervals thereafter using a two-inch outside diameter (OD), 24-inch, split-spoon sampler in accordance with the American Society for Testing and Material (ASTM) Standard Penetration Test Method (ASTM D-1586). This method specifies soil sample collection using a split-spoon sampler driven by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler 24 inches with the 140-pound hammer were recorded as a measure of material density. Sampling frequency was determined based upon the objective at each area of investigation.

Upon retrieval from the borehole, the split-spoon sampler was opened. Samples were immediately collected and placed into sample containers for laboratory analysis and for headspace screening for total volatile organic vapor concentrations. The following method was used for headspace screening: 1.) Clean glass jars were three-quarter filled with soil, sealed with aluminum foil, and then capped; 2.) Jars were vigorously shaken for approximately 15 seconds, allowed to stabilize for 15 to 20 minutes, and shaken again; 3.) The probe from an HNu Systems 10.2 electron volt (eV) photoionization detector (PID) instrument, calibrated to an isobutylene standard, was then inserted through the aluminum seal and total volatile organic vapors were screened in the jar headspace.

Geologic descriptions of the samples were made immediately following soil sample screening and collection. A geologic log was prepared by a Wehran geologist in accordance with the Burmister Soil Classification System based upon the geologic descriptions. Air monitoring was conducted during borehole drilling with the PID instrument to monitor organic vapors, and an oxygen/explosion (O2LEL) meter was used to monitor potential explosive conditions.

To prevent cross-contamination, the split-spoon sampler was washed with non-phosphate detergent, rinsed with methanol, allowed to air dry, and then rinsed with distilled water between samples. All downhole tools were steam cleaned prior to each boring and at the completion of drilling activities.

Samples were stored on ice in a cooler immediately after sample collection and were kept on ice during shipment to the analytical laboratory. Sampling methods, chain of custody, and documentation requirements for soil samples collected during this investigation were conducted in accordance with DEP Policy #WSC-89-004, "Minimum Standards for Analytical Data for Remedial Response Actions Under M.G.L. c. 21E". Soil samples were analyzed by NET Laboratory in Bedford, Massachusetts (Massachusetts Certification #023), excluding one sample from the Tank K Area, discussed below, which was analyzed for grain size and moisture content at Wehran Engineering's Soils Laboratory in Tuxedo, New York.

3.2 GROUNDWATER SAMPLING METHODS

Groundwater quality samples were collected from the five newly installed monitoring wells, five existing monitoring wells, an existing recovery well, five existing gas-driven sampling devices, commonly termed Barcads, and four existing piezometers. Groundwater samples were collected from September 30 to October 3, 1991 by Wehran personnel. Prior to sampling, the elevation of the potentiometric surface of the groundwater and the separate phase product, if present, was measured to the nearest 0.01 foot using a water level recorder, and either an oil/water interface probe or tape and oil/water paste, respectively. The water level recorder and oil/water interface equipment were rinsed with methanol, air dried, and rinsed with distilled water between monitoring points to minimize the potential for cross contamination.

Each well was either bailed or pumped until a minimum of three well volumes were evacuated and until consecutive readings of pH, specific conductance, and temperature of the evacuated water were within ten percent variation. Information and measurements made during well evacuation, including notes on odor, color, and clarity, were recorded in a field notebook. Evacuated water from wells in which separate phase product was detected or in which headspace responses with the PID exceeded ten parts per million (ppm) was drummed, labelled, and stored on site for subsequent disposal. The pH and specific conductance meters were calibrated daily to laboratory standards prior to sample collection.

Due to the variation in design of the monitoring points sampled, three groundwater sampling techniques were utilized. The five newly installed monitoring wells, three existing monitoring wells, and the existing recovery well were sampled using clean teflon bailers lowered into the well on dedicated nylon rope. The bailer was emptied directly into appropriate sample containers. The bailers were decontaminated in the field prior to sampling each well according to the following process: tap water rinse, non-phosphate detergent wash, methanol rinse, air dry, and distilled water rinse.

Piezometers were sampled using peristaltic pumps and clean, dedicated, Tygothane suction tubing for each piezometer. The tubing was extended to the bottom of each piezometer and groundwater was pumped directly into pre-cleaned sample containers.

Monitoring points containing Barcad samplers were sampled by applying pressure from a cylinder of compressed nitrogen gas to the top of the outer riser tube. A check valve within the sampler, which closed when it was pressurized, forced water within the riser tube out through a dedicated inner Tygothane sample tube installed through the PVC riser tube. Groundwater samples were collected directly into pre-cleaned sample containers.

Field filtering was conducted for dissolved metals analyses by using dedicated, acid-washed, 0.45 micron filters. Field blanks were collected by first conducting a decontamination of the bailer as described previously, then by pouring distilled water supplied by the analytical laboratory into the bailer. The bailer was then covered on both ends, shaken vigorously, and the distilled water was subsequently poured into the sample container. Field blanks were submitted as blind samples to the analytical laboratory. Trip blanks were provided by the laboratory with each shipment of sampling containers and were also submitted as blind samples.

Sample containers were provided by the analytical laboratory and, where required, were provided with preservative. Groundwater samples were stored on ice in a cooler immediately after sample collection and were kept on ice during shipment to the analytical laboratory. Sampling methods, chain of custody, and documentation requirements for groundwater samples collected during this investigation were conducted in accordance with DEP Policy #WSC-89-004, "Minimum Standards for Analytical Data for Remedial Response

Assume VOC samples acidified w/HCl as required in DEP's 7/8/91 letter.

Actions Under M.G.L. c. 21E". Groundwater samples were analyzed by NET Laboratory in Bedford, Massachusetts.

3.3 TANK FARM AREA SAMPLING METHODS

3.3.1 Soil Borings

Three soil borings (B-15, B-16, and B-17) (Figure 3) were advanced in the former Tank Farm Area to obtain soil analytical data to support the modified risk characterization and to assess contaminant fate and transport. Split spoon samples were collected continuously at each boring to an approximate depth of ten feet bgs until the boring was advanced beneath the water table. Soil sample headspace screening was conducted according to the methods described above. Auger and split spoon refusal was encountered at each of the three borings conducted in the Tank Farm Area. Boring logs with geologic descriptions and headspace results are presented in Appendix A.

3.3.2 Soil and Groundwater Sampling

Two soil samples from boring B-16 were submitted for analytical testing based upon visual observations and headspace screening. One unsaturated sample from a depth of four to six feet bgs (GEW-SS-B16-006) was submitted for VOC and TPH analyses. In addition, one saturated sample from a depth of eight to ten feet bgs (GEW-SS-B16-007) was submitted for VOC, TPH, and TOC analyses.

Due to results from previous investigations in which Stoddard solvent was reported as a petroleum hydrocarbon in some samples, TPH fingerprint analyses were conducted to identify the potential presence of Stoddard solvent in soil samples submitted. This is a semi-quantitative analysis by gas chromatography that was used to assess the extent, if any, of Stoddard solvent in soil and groundwater at the site. Therefore, for selected samples in which TPHs were reported above detection limits, TPH fingerprint analyses were also conducted. This included soil samples from four to six feet bgs (GEW-SS-B16-006) and from eight to ten feet bgs (GEW-SS-B16-007) in boring B-16 from the Tank Farm Area. A summary of analyses conducted for each sample is presented in Table 1.

To assist in remedial alternative evaluation, groundwater samples were collected from seven monitoring points in the vicinity of the Tank Farm Area and analyzed for treatability parameters and TPHs. Monitoring points sampled included GZA-102S,

Table 1
GE AEROSPACE
WILMINGTON/NORTH READING MASSACHUSETTS
LABORATORY ANALYSES

Site Location	Sampling Location	Depth(1)	Sample Designation	Matrix	Analyte																
					VOC	TPH	TPH-FP	TOC	COD	BOD	NO_3	P	Hd	Fe (Tot)	Mn (Tot)	Fe (Dis)	Mn (Dis)	ABN	PP Metals	MC	GS
Tank Farm Area	B-16	4 – 6(U)	GEW-SS-B16-006	Soil	X	X	X														
	B-16	8 – 10(S)	GEW-SS-B16-007	Soil	X	X	X	X													
	GZA-102S ✓		GEW-GW-102S-034	GW		X	X	X	X	X	X	X	X	X	X	X	X				
	GZA-102S ✓		GEW-GW-102D-035(2)	GW		X	X														
	GZA-102R2		GEW-GW-102R2-008	GW		X		X	X	X	X	X	X	X	X	X	X				
	GZA-103S ✓		GEW-GW-103S-013	GW		X	X	X	X	X	X	X	X	X	X	X	X				
	GZA-103R1		GEW-GW-103R1-012	GW		X		X	X	X	X	X	X	X	X	X	X				
	GZA-103R2		GEW-GW-103R2-011	GW		X		X	X	X	X	X	X	X	X	X	X				
	GZA-7		GEW-GW-GZA7-015	GW		X		X	X	X	X	X	X	X	X	X	X				
	RW-1		GEW-GW-RW-014	GW		X		X	X	X	X	X	X	X	X	X	X				
	PZ-2S		GEW-GW-PZ2S-021	GW		X	X														
Tank F Area	GZA-101R ✓		GEW-GW-101R-017	GW		X		X	X	X	X	X	X	X	X	X	X				
Tank K Area	WE-2	2 – 4(U)	GEW-SS-WE2-005	Soil	X	X	X	X												X	X

Wilman advanced 3 borings to 10' below GW; no headspace conc. detected; no soil discoloration, so no lab analyses.

What about GZA-101D?
This well was to have been sampled per 5/30/91 GZA Ph-III proposal.

GZA-101D no longer there

Table 1
GE AEROSPACE
WILMINGTON/NORTH READING MASSACHUSETTS
LABORATORY ANALYSES

Site Location	Sampling Location	Depth(1)	Sample Designation	Matrix	Analyte																
					VOC	TPH	TPH-FP	TOC	COD	BOD	NO_3	P	Hd	Fe (Tox)	Mn (Tox)	Fe (Dis)	Mn (Dis)	ABN	PP Metals	MC	GS
	WE-4D	6 – 8$^{(S)}$	GEW-SS-WE4D-004	Soil	X	X															
Tank K Area	WE-1		GEW-GW-WE1-001	GW	X			X	X	X	X	X	X	X	X	X	X				
(continued)	WE-2		GEW-GW-WE2-005	GW	X			X	X	X	X	X	X	X	X	X	X				
	WE-2		GEW-GW-WE5-006$^{(2)}$	GW	X																
	WE-3		GEW-GW-WE3-002	GW	X			X	X	X	X	X	X	X	X	X	X				
	WE-4S		GEW-GW-WE4S-003	GW	X			X	X	X	X	X	X	X	X	X	X				
	WE-4D		GEW-GW-WE4D-004	GW	X			X	X	X	X	X	X	X	X	X	X				
Eastern Parking Lot Area	B-1	4 – 6$^{(U)}$	GEW-SS-B1-001	Soil		X															
	B-2	4 – 6$^{(U)}$	GEW-SS-B2-002	Soil	X	X	X														
	B-4	5 – 6.5$^{(U)}$	GEW-SS-B4-003	Soil	X	X	X														
	DP-5		GEW-GW-DP5-022	GW		X															
	DP-6		GEW-GW-DP6-016	GW		X	X														
	GZA-105S		GEW-PR-105S-038	GW			X														
	GZA-105R ✓		GEW-GW-105R-007	GW		X		X	X	X	X	X	X	X	X	X	X				

Table 1
GE AEROSPACE
WILMINGTON/NORTH READING MASSACHUSETTS
LABORATORY ANALYSES

Site Location	Sampling Location	Depth$^{(1)}$	Sample Designation	Matrix	Analyte																
					VOC	TPH	TPH-FP	TOC	COD	BOD	NO$_3$	P	Hd	Fe (Tox)	Mn (Tox)	Fe (Dis)	Mn (Dis)	ABN	PP Metals	MC	GS
	PZ-3		GEW-GW-PZ3-020	GW		X															
Outfall 001																					
	S-5A	0 – 1.5$^{(S)}$	GEW-S5A-OF1-010	SD		X	X														
	S-6A	0 – 1.5$^{(S)}$	GEW-S6A-OF1-011	SD		X	X														
Outfall 002																					
	S-2A	0 – 1.5$^{(S)}$	GEW-S2A-OF2-008	SD		X	X														
	S-3B	1.5 – 3.0$^{(S)}$	GEW-S3B-OF2-009	SD		X	X														
Wetlands Area																					
	WL-1	0 – 2.0$^{(S)}$	GEW-SD-WL1-033	SD	X	X	X											X	X		
	WL-1		GEW-SW-WL1-032	SW	X	X															
	WL-2	0 – 2.0$^{(S)}$	GEW-SD-WL2-030	SD	X	X	X											X	X		
	WL-2		GEW-SW-WL2-029	SW	X	X															
	WL-3	0 – 2.0$^{(S)}$	GEW-SD-WL3-028	SD	X	X	X											X	X		
	WL-3		GEW-SW-WL3-027	SW	X	X															
	WL-4	0 – 2.0$^{(S)}$	GEW-SD-WL4-026	SD	X	X												X	X		
	WL-4		GEW-SW-WL4-025	SW	X	X															
	WL-5	0 – 2.0$^{(S)}$	GEW-SD-WL5-024	SD	X	X												X	X		

Table 1
GE AEROSPACE
WILMINGTON/NORTH READING MASSACHUSETTS
LABORATORY ANALYSES

Site Location	Sampling Location	Depth(1)	Sample Designation	Matrix	Analyte																
					VOC	TPH	TPH-FP	TOC	COD	BOD	NO_3	P	Hd	Fe (Tox)	Mn (Tox)	Fe (Dis)	Mn (Dis)	ABN	PP Metals	MC	GS
Wetlands Area (continued)	WL-5		GEW-SW-WL5-023	SW	X	X															
QA/QC Samples	Trip Blank		GEW-GW-WE6-009	–	X																
	Field Blank		GEW-GW-WE7-010	–	X																
	Trip Blank		GEW-GW-109R1-018	–	X																
	Field Blank		GEW-GW-109R2-019	–	X																
	Trip Blank		GEW-GW-WL6-031	–	X																
	Field Blank		GEW-GW-WL7-036	–	X																

Legend
VOC = Volatile Organic Compounds
TOC = Total Organic Carbon
BOD = Biological Oxygen Demand
P = Phosphorus
Fe = Iron
Mn = Manganese
ABN = Acid/Base Neutral Extractable Compounds
MC = Moisture Content
GW = Groundwater
SD = Sediment

TPH-Total Petroleum Hydrocarbons; FP = Fingerprint Analysis
COD = Chemical Oxygen Demand
NO_3 = Nitrate
Hd = Hardness
Tot = Total
Dis = Dissolved
PP = Priority Pollutant
GS = Grain Size
SW = Surface Water

Notes:
(1) Depths are in feet below ground surface and apply only to soil or sediment samples.
(2) Duplicate analysis.

(U) = Unsaturated
(S) = Saturated

GZA-102R2, GZA-103S, GZA-103R1, GZA-103R2, GZA-7, RW-1, and PZ-2S (Figure 3). Treatability parameters analyzed included total and dissolved iron, total and dissolved manganese, total hardness, nitrogen, phosphorous, TOC, biological oxygen demand (BOD), and chemical oxygen demand (COD). In addition, specific conductance and pH were measured in the field. Selected samples in which TPHs were reported above detection limits were also submitted for TPH fingerprint analysis. These included samples from monitoring points GZA-103S and PZ-2S. A summary of analyses conducted for each sample is presented in Table 1.

3.3.3 Oil/Water Interface Measurements

Measurements to assess the potential for separate phase product on top of the water table and at the base of the monitoring points were conducted using an oil/water interface probe. Measurements were conducted at monitoring locations GZA-7, GZA-103S, RW-1, and PZ-2S (Figure 3) prior to sampling groundwater from these locations. – this is a bit unclear – did they measure these wells only? or are these wells the ones w/separate phase product?

3.4 TANK F AREA SAMPLING METHODS

3.4.1 Soil Borings

Hydrogeologic data previously collected from the site suggested that shallow overburden groundwater flow may have been to the west or southwest in the Tank F Area. To assess whether there may have been releases of oil or hazardous material to the subsurface from Tank F, two soil borings were advanced to approximately ten feet beneath the water table with continuous split spoon sampling. Soil borings B-12 and B-13 (Figure 3) were advanced northwest and southwest of the former Tank F location, respectively, to assess this possibility. Sample headspace screening was conducted according to the methods described above.

In order to provide recent data to support modified risk characterization activities, one additional boring, B-14 (Figure 3), was completed to a similar depth in the approximate center of the former Tank F location using similar procedures as those described above.

Since soil headspace screening responses were not detected and no discoloration in soil was observed, soil samples from these borings were not submitted for analytical testing. Boring logs with geologic descriptions are included in Appendix A.

3.4.2 Groundwater Sampling

To assist in remedial alternative evaluation, groundwater samples were proposed to be collected from two wells, GZA-101R and GZA-101D (Figure 3), in the Tank F Area and analyzed for treatability parameters and TPHs. However, monitoring well GZA-101D, which may have been destroyed or removed during removal of Tank F, could not be located and thus, it was not included in the sampling schedule. Groundwater from monitoring well GZA-101R was sampled and analyzed for TPHs and treatability parameters including total and dissolved iron, total and dissolved manganese, total hardness, nitrogen, phosphorous, TOC, BOD, and COD. In addition, specific conductance and pH were measured in the field. A summary of analyses conducted for this sample is presented in Table 1.

3.5 TANK K AREA SAMPLING METHODS

3.5.1 Soil Borings and Monitoring Well Installation

To assess the possible presence of separate phase floating product and to better define the vertical and horizontal extent of gasoline constituents in soil and groundwater in the vicinity of and downgradient from the Tank K Area, six shallow water table borings, designated B-6 through B-11, and one deep overburden boring, designated B-5, were completed. Split-spoon soil samples were collected continuously to the water table and at five foot intervals thereafter using methods described previously.

Three of the shallow borings, B-11, B-9, and B-10, were subsequently completed as monitoring wells WE-1, WE-2, and WE-3, respectively (Figure 3). In addition, a monitoring well couplet consisting of one water table well (WE-4S) and one deeper overburden well screened 16 to 26 feet below the water table (WE-4D) was installed approximately downgradient of the former Tank K location (Figure 3) in borings B-6 and B-5, respectively. The shallow water table monitoring wells were screened seven feet below and three feet above the water table to obtain measurements of potential separate phase floating hydrocarbons and to allow for seasonal fluctuations of the water table.

Monitoring wells WE-1, WE-3, WE-4S, and WE-4D were constructed of 0.010-inch slot, two-inch ID, flush-jointed, threaded, Schedule 40 polyvinyl chloride (PVC) screens at appropriate depths and two-inch ID flush-jointed, threaded, Schedule 40 PVC casing to the surface. Monitoring well WE-2 was constructed of 0.010-inch slot, four-inch ID, flush-jointed, threaded, Schedule 40 PVC screen and four-inch ID flush-jointed, threaded, Schedule 40 PVC riser to the surface. The annulus of each well was packed with silica sand from the bottom of the boring to a minimum of two feet above the top of the well screen. A hydrated bentonite seal at least one foot thick was placed above the sand pack to prevent seepage along the borehole to the well screen. Cement/bentonite grout was placed in the borehole around the casing from the top of the bentonite seal to near the ground surface. The wells were completed at the surface with flush-mounted steel protective road boxes surrounded by a concrete pad. Monitoring well construction diagrams are included on the boring logs in Appendix A.

All newly installed monitoring wells were developed by pump and surge techniques using the pump on the drill rig and polyethylene hose to remove cuttings and to clean the well screens. The monitoring wells were developed until the water attained visual clarity. Between each monitoring well, the inside and outside of the hose was decontaminated to minimize potential for cross-contamination. Development water and drill cuttings exhibiting a sheen or headspace readings above ten ppm were drummed in DOT-approved containers, labelled, and stored on-site for later disposal.

Following monitoring well installation, a location and elevation survey of the newly installed wells was conducted by Wehran. The wells were surveyed to the nearest foot and hundredth foot (0.01) for location and elevation, respectively, to the top of well casing, to the top of the inner lip of the road box, and to ground surface. Accuracy used in the elevation survey was third order, second class standards, per U.S. Coast Guard and Geodetic Survey specifications. Elevations were referenced to existing wells on site which were surveyed relative to the National Geodetic Vertical Datum (NGVD) during previous investigations.

3.5.2 Hydraulic Conductivity Testing

In situ permeability (slug) tests were conducted at the screened interval of the five newly installed monitoring wells to estimate the hydraulic conductivity of the materials in the vicinity of the installed well screens. Slug testing was conducted by recording static water level, then rapidly lowering the water level in the well and monitoring the response of the water level as it returned toward static conditions. The water level was lowered by rapidly removing a known volume of water from the well by bailer. Water level measurements were recorded at selected time intervals using an In-Situ Hermit Datalogger and pressure transducer. Decontamination of equipment placed in wells during the tests was conducted between each monitoring well to minimize potential for cross-contamination. Dedicated rope and bailers were used at each monitoring well.

Semi-logarithmic plots of hydraulic head as a function of time during well recovery were constructed and analyzed using methods developed by Bouwer and Rice (1976) and Bouwer (1989). Water level recovery data were analyzed using commercially available software (Aqtesolv). Analytical methods used to estimate hydraulic conductivity are provided in Appendix B.

3.5.3 Soil and Groundwater Sampling

Based upon visual observations and field headspace screening results, one saturated soil sample (GEW-SS-WE4D-004) was collected from approximately six to eight feet bgs in boring WE-4D (Figure 3) for VOC and TPH analyses. In addition, one unsaturated soil sample (GEW-SS-WE2-005) was collected from approximately two to four feet bgs in boring B-9A (located five feet north of WE-2) and submitted for VOC, TPH, TOC, moisture content, and grain size analyses. (The soil sample from boring B-9A is referred to as WE-2 (Figure 3) since this boring was advanced adjacent to WE-2 solely to collect this sample.) As discussed for the Tank Farm Area, one soil sample from two to four feet bgs from boring WE-2 (GEW-SS-WE2-005) (Figure 3) in which TPHs were reported above detection limits was also submitted for TPH fingerprint analysis. A summary of analyses conducted for each sample is presented in Table 1.

Groundwater quality samples were collected from the five newly installed wells; WE-1, WE-2, WE-3, WE-4S, and WE-4D (Figure 3). One groundwater sample was collected from each well and analyzed for VOCs. In addition, samples from each well were analyzed for treatability parameters including total and dissolved iron, total and dissolved manganese, total hardness, phosphorous, TOC, BOD, and COD. Specific conductance and pH were also measured in the field. A summary of analyses conducted for each sample is presented in Table 1.

3.5.4 Potentiometric Monitoring

Following monitoring well installation and prior to beginning groundwater sampling in the Tank K Area, depth to groundwater was measured at monitoring points WE-1, WE-2, WE-3, WE-4S, WE-4D, and PZ-7 (Figure 3) using an oil/water interface probe on the new wells while the potentiometric surface in PZ-7 was measured with an electronic water level indicator. Groundwater elevations, referenced to the NGVD were then calculated using results of the elevation survey. These data were subsequently used to estimate groundwater flow direction in the vicinity of the Tank K Area.

3.5.5 Oil/Water Interface Measurements

Measurements to assess the potential for separate phase product floating on top of the water table were conducted using an oil/water interface probe both during monitoring well installation and approximately two weeks following installation. Measurements were conducted at monitoring wells WE-1, WE-2, WE-3, WE-4S, and WE-4D prior to sampling groundwater from these locations.

3.6 EASTERN PARKING LOT AREA SAMPLING METHODS

3.6.1 Soil Borings

Information from previous site investigations indicated that separate phase product was identified in the vicinity of piezometer DP-6 and monitoring well GZA-105 (Figure 3). In addition, petroleum hydrocarbon contamination has been documented to exist at or near the unsaturated-saturated zone interface in this area. However, information concerning the nature and extent of contamination in unsaturated soil and groundwater in the Eastern Parking Lot Area was judged to be incomplete. Accordingly, four soil borings, designated B-1, B-2, B-3, and B-4 were advanced in locations shown in Figure 3 with continuous split-spoon sampling to the saturated zone using similar methods as those described previously. - did they drill into the saturated zone? if so, continuous or 5'?

3.6.2 Soil and Groundwater Sampling

Based upon soil headspace screening responses, soil samples from the unsaturated zone were selected from B-1 (GEW-SS-B1-001), B-2 (GEW-SS-B2-002), and B-4 (GEW-SS-B4-003) and submitted for TPH analyses. Two soil samples were also collected from borings B-2 (GEW-SS-B2-002) and B-4 (GEW-SS-B4-003) for VOC analyses. Samples from four to six feet bgs (GEW-SS-B2-002) and from five to six and one-half feet bgs

(GEW-SS-B4-003) from borings B-2 and B-4, respectively, which were reported to have TPH concentrations above detection limits, were also submitted for TPH fingerprint analyses.

In order to assess the nature and extent of contamination in groundwater in the Eastern Parking Lot Area, groundwater beneath the separate phase product layer in monitoring well GZA-105S and from piezometers PZ-3, DP-5, and DP-6 (Figure 3) was sampled for TPHs. Two groundwater samples, from piezometer DP-6 and monitoring well GZA-105S, which were reported with a TPH concentration above detection limits, were also submitted for TPH fingerprint analyses. Specific conductance and pH were measured in the field prior to sampling at these locations. A summary of analyses conducted for each sample is presented in Table 1.

To assist in remedial alternative evaluation, a groundwater sample was collected from monitoring well GZA-105R (Figure 3) in the Eastern Parking Lot Area and analyzed for treatability parameters. Treatability parameters analyzed included total and dissolved iron, total and dissolved manganese, total hardness, nitrogen, phosphorous, TOC, BOD, and COD.

3.6.3 Oil/Water Interface Measurements

Measurements to assess the potential for separate phase product floating on top of the water table were conducted using an oil/water interface probe and a steel tape with oil/water indicator paste. Measurements were conducted at monitoring locations GZA-102S and GZA-105S using the oil/water interface probe while the steel tape and indicator paste were used at monitoring points DP-6 and PZ-3 due to the relatively narrow diameter (0.75 inches) of PVC at these locations.

3.7 WETLANDS AREA SAMPLING METHODS

Based upon review of prior data and DEP comments, it was determined that there were insufficient data from this area to conduct the modified risk characterization. Therefore, sediment and surface water samples were collected from five locations, designated WL-1 through WL-5 (Figure 3), in the Wetlands Area adjacent to the southern portion of the eastern parking lot.

Composite sediment samples were collected from a depth of zero to two feet bgs using a stainless hand auger and submitted for analysis of VOCs, TPHs, acid and base/neutral (ABN) extractable compounds, and priority pollutant metals. For samples in which TPHs were reported above detection limits, TPH fingerprint analyses were also requested. These included sediment samples collected at locations WL-1, WL-2, and WL-3. Surface water samples were collected directly into pre-cleaned sample containers and submitted for VOC and TPH analyses. A summary of analyses conducted for each sample is presented in Table 1.

The hand auger was decontaminated between sediment sampling locations to minimize the potential for cross contamination using a non-phosphate, detergent wash, methanol rinse, air dry, and distilled water rinse.

3.8 OUTFALL AREA SAMPLING METHODS

To define the extent of petroleum hydrocarbon contamination reported in sediment near the former Outfall Areas 001 and 002 (Figure 3), a total of three hand-auger borings, designated S-1 through S-3 and S-4 through S-6 were advanced at each of these areas. Sampling locations are shown in Figure 3 and were selected based upon data gaps identified in prior investigations in these areas. Sediment samples were collected with a stainless steel hand auger from each boring at depths of 0 to 1.5 feet bgs and from 1.5 to 3 feet bgs. Samples from the upper sampling interval were labeled "A", while samples from the lower interval were labeled "B". Sediment headspace screening was conducted in the field. Based upon headspace screening results, two sediment samples from each outfall location were submitted for TPH analysis. Three of the samples were from the 0 to 1.5 foot sampling interval while the fourth was from the 1.5 to 3 foot interval. For each sample submitted from the Outfall Areas, a TPH fingerprint analysis was also conducted. A summary of analyses conducted for each sample is presented in Table 1.

The hand auger was decontaminated between sediment sampling locations to minimize potential for cross contamination using similar procedures as those described for sediment sampling in the Wetlands Area.

4.0 FIELD INVESTIGATION RESULTS

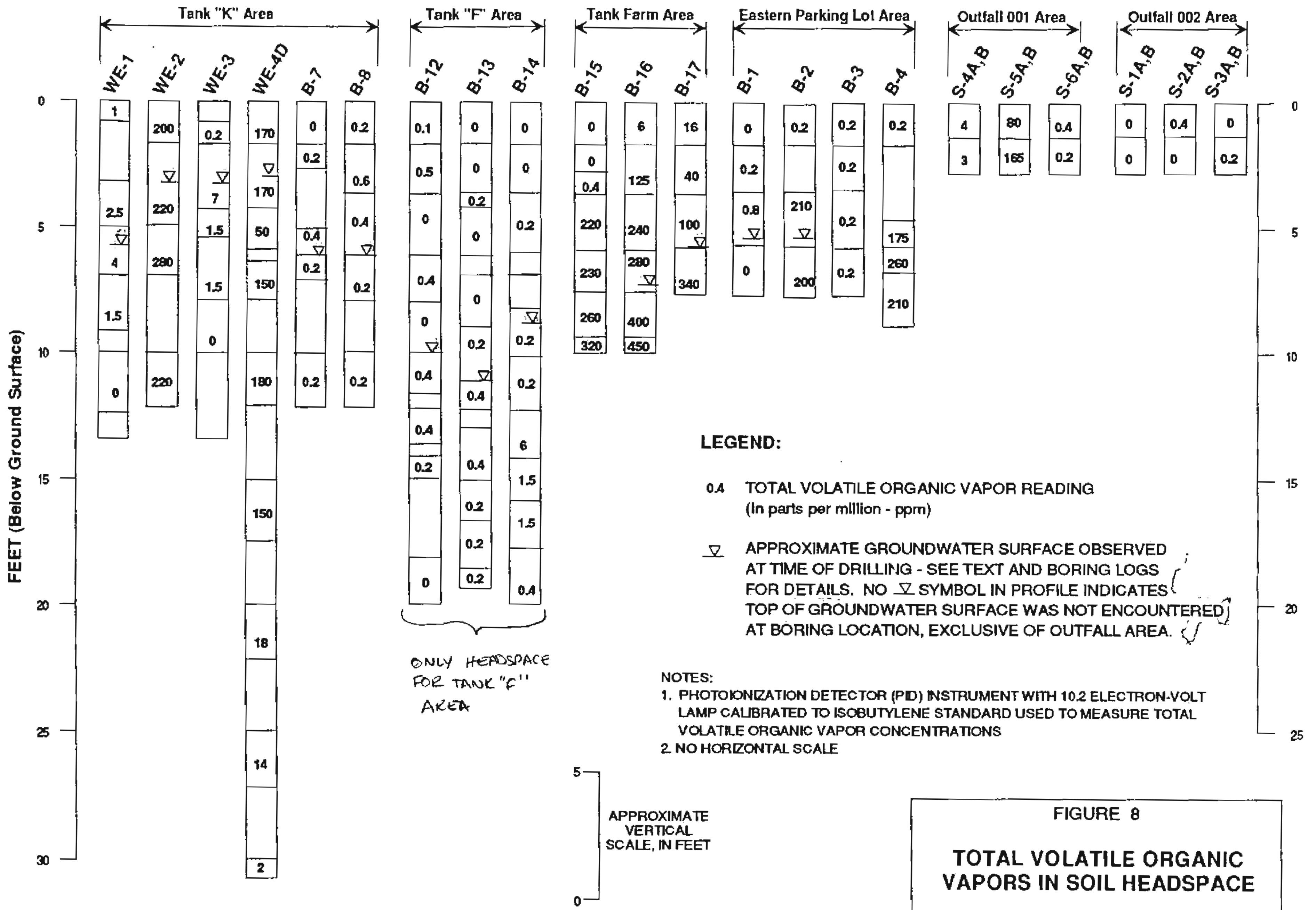
This section summarizes data obtained during the supplemental investigations described in this report. Results discussed below and referenced in tables and figures accompanying this report have been evaluated in accordance with the DEP data validation policy #WSC-89-004, discussed previously. Data validation parameters assessed included holding times; method blank, field blank, and trip blank analyses; surrogate recovery analyses for organic data; laboratory control sample analyses for inorganic and TPH data; matrix spike and matrix spike duplicate (MS/MSD) analyses; and field duplicate analyses. The data below reflect data qualification actions taken that were judged to be necessary based upon data validation results. Raw data are provided in Appendix C. Individual data qualification actions for specific sampling events are discussed in the following subsections, where appropriate.

4.1 TANK FARM AREA RESULTS

4.1.1 Soil Sampling Results

Borings advanced in this area B-15, B-16, and B-17 (Figure 3), ranged in depth from approximately eight to ten feet bgs. Soils were generally classified as medium dense, dark brown, fine to coarse sand with little amounts of gravel; pieces of asphalt and plastic were noted in some samples also. Boring logs are provided in Appendix A. Based upon these observations, the soils in this area were classified as fill material, likely placed in the area following removal of the tanks formerly located here. This classification is consistent with the information from boring GZA-103 advanced previously in this area. Additional observations included black-staining and a gray color to the soil from the saturated zone (approximately 8 to 10 feet bgs) in borings B-15 and B-17. Slight sheens and/or strong odors were also noted in saturated soil samples collected from borings B-15 and B-17. Auger and split-spoon refusal were encountered at approximately eight to ten feet bgs. Groundwater was encountered approximately eight feet bgs in borings B-16 and B-17, however due to the apparent presence of a localized perched water condition, a wet soil zone was encountered at approximately three feet bgs in boring B-15.

Figure 8 summarizes VOC headspace screening responses, referenced to an isobutylene standard, as measured with the PID during borehole advance. This figure also



ONLY HEADSPACE FOR TANK "F" AREA

LEGEND:

0.4 TOTAL VOLATILE ORGANIC VAPOR READING (In parts per million - ppm)

▽ APPROXIMATE GROUNDWATER SURFACE OBSERVED AT TIME OF DRILLING - SEE TEXT AND BORING LOGS FOR DETAILS. NO ▽ SYMBOL IN PROFILE INDICATES TOP OF GROUNDWATER SURFACE WAS NOT ENCOUNTERED AT BORING LOCATION, EXCLUSIVE OF OUTFALL AREA. ✓

NOTES:

1. PHOTOIONIZATION DETECTOR (PID) INSTRUMENT WITH 10.2 ELECTRON-VOLT LAMP CALIBRATED TO ISOBUTYLENE STANDARD USED TO MEASURE TOTAL VOLATILE ORGANIC VAPOR CONCENTRATIONS
2. NO HORIZONTAL SCALE

WehranEnviroTech

FIGURE 8

TOTAL VOLATILE ORGANIC VAPORS IN SOIL HEADSPACE

GENERAL ELECTRIC-AEROSPACE
WILMINGTON/NO. READING, MASSACHUSETTS

30.11/91.A(14)01501.DRW

WEHRAN PROJECT NO. 01501.01

indicates the approximate depth of the water table observed at the time of drilling. Results indicated headspace screening responses ranging from non-detected up to 450 ppm total volatile organic vapors within soil samples from the saturated zone.

One unsaturated and one saturated soil sample were submitted from boring B-16 for laboratory analysis for VOCs and TPHs. The saturated sample was also submitted for TOC analysis to provide data for assessing VOC soil/water partitioning. Review of data validation parameters indicated that sample holding times, and results of MS/MSD and surrogate recovery analyses were within acceptable limits. Acetone was detected at ten parts per billion (ppb) in one of the three method blanks analyzed for these samples. Therefore, one data qualification action, discussed below, was required.

Table 1 summarizes laboratory analyses conducted on these soil samples and raw analytical and quality assurance/quality control (QA/QC) data are provided in Appendix C. Table 2 summarizes compounds detected in soil samples analyzed. Analytical results for the unsaturated sample (GEW-SS-B16-006) indicated the presence of xylenes, toluene, and acetone in concentrations ranging from 60 micrograms per kilogram (ug/kg) to 99 ug/kg. However, the presence of acetone in the method blank suggests that some of the acetone detected at 99 ug/kg in the soil sample from B-16 may be due to laboratory contamination. Therefore, this result is considered approximate, as noted in Table 2. TPHs were detected at 2,000 milligrams per kilogram (mg/kg) in this sample (GEW-SS-B16-006). Toluene was the primary constituent identified in the saturated sample (GEW-SS-B16-007), at a concentration of 28,000 ug/kg. In addition, xylenes, trichlorofluoromethane, and TPHs were reported at concentrations of 4,100 ug/kg, 1,600 ug/kg, and 11,000 mg/kg, respectively. Results of the TOC analysis indicated approximately 1.1 percent TOC in the saturated sample (GEW-SS-B16-007) analyzed (Table 2).

Table 3 summarizes results of TPH fingerprint analyses conducted on the two soil samples from boring B-16. Results indicate the presence of 4,100 mg/kg of Stoddard solvent in the unsaturated sample and 230 mg/kg of Stoddard solvent in the saturated sample.

4.1.2 Oil/Water Interface Measurements

Results of separate phase product measurements made in the Tank Farm Area at monitoring points GZA-7, GZA-103S, and RW-1 indicated that separate phase product was

Table 2
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
VOLATILE ORGANIC COMPOUNDS AND TOTAL PETROLEUM HYDROCARBONS DETECTED IN SOIL AND SEDIMENT SAMPLES

Site Location	Sampling Location	Depth[1]	TPH (mg/kg)	Acetone (ug/kg)	TCFM (ug/kg)	1,1-DCA (ug/kg)	MEK (ug/kg)	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl - benzene (ug/kg)	Total Xylenes (ug/kg)	TOC (mg/kg)	MC (%)	Total VOCs (ug/kg)
Tank Farm Area	B-16	4-6$^{(U)}$	2,000	99$^{(J)}$	<5.0	<5.0	<5.0	<5.0	60	<5.0	80	NA	NA	239
	B-16	8-10$^{(S)}$	11,000	<1,300	1,600	<1,300	<1,300	<1,300	28,000	<1,300	4,100	11,000	NA	33,700
Tank K Area	WE-2	2-4$^{(U)}$	730	<2,800	<2,800	<2,800	<2,800	<2,800	22,000	15,000	177,000	10,000	12.99	214,000
	WE-4D	6-8$^{(S)}$	6,300	<12,000	<12,000	<12,000	<12,000	12,000	450,000	240,000	1,740,000	NA	NA	2,442,000
Eastern Parking Lot Area	B-1	4-$^{(U)}$	<75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	B-2	4-6$^{(U)}$	26,000	1,100	<570	<570	<570	<570	<570	<570	1,360	NA	NA	2,460
	B-4	5-6.5$^{(U)}$	83	41	<6	<6	<6	<6	<6	<6	<6	NA	NA	41
Outfall 001	S-5A	0-1.5$^{(S)}$	610	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S-6A	0-1.5$^{(S)}$	<370	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Outfall 002	S-2A	0-1.5$^{(S)}$	<310	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S-3B	1.5-3.0$^{(S)}$	<390	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wetlands Area	WL-1	0-2.0$^{(S)}$	2,600	240	<26	<26	<26	<26	<26	<26	<26	NA	NA	240
	WL-2	0-2.0$^{(S)}$	1,100	210	<23	35	<23	<23	<23	38	35	NA	NA	318
	WL-3	0-2.0$^{(S)}$	920	12	<6	<6	<6	<6	<6	<6	<6	NA	NA	12
	WL-4	0-2.0$^{(S)}$	<480	720 ✓	<26	<26	190	<26	<26	<26	<26	NA	NA	910
	WL-5	0-2.0$^{(S)}$	<130	7	<6	<6	<6	<6	<6	<6	<6	NA	NA	7

Legend:

TPH = Total Petroleum Hydrocarbons
TCFM = Trichlorofluromethane
1,1-DCA = 1,1-Dichloroethane
MEK = Methyl Ethyl Ketone
TOC = Total Organic Carbon
MC = Moisture Content

(U) = Unsaturated
(S) = Saturated
NA = Not Analyzed
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
(J) = Approximate value due to presence of this compound in the method blank.

Notes:

1. Depths are in feet below ground surface.

Table 3

GE - AEROSPACE

WILMINGTON/NORTH READING, MASSACHUSETTS

TOTAL PETROLEUM HYDROCARBON FINGERPRINT ANALYSES

Site Location	Sampling Location	Depth[1]	Matrix[2]	Comment[3]
Tank Farm Area	B-16	4-6(U)	Soil	4.1 mg/g Stoddard solvent
	B-16	8-10(S)	Soil	0.230 mg/g Stoddard solvent
	GZA-102S		GW	<5 mg/l indeterminate heavy weight PHC.
	GZA-102D[5]		GW	<5 mg/l indeterminate heavy weight PHC.
	GZA-103S		GW	1.3 mg/l-estimated Stoddard solvent
	PZ-2S		GW	400 mg/l Stoddard solvent
Tank K Area	WE-2	2-4(U)	Soil	1.3 mg/g indeterminate heavyweight PHC.
Eastern Parking Lot Area	B-2	4.6(U)	Soil	1.3 mg/g Stoddard solvent
	B-4	5-6.5(U)	Soil	0.049 mg/g Stoddard solvent
	DP-6		GW	280 mg/l Stoddard solvent
	GZA-105S		GW	100% Stoddard solvent
Outfall 001	S-5A	0-1.5(S)	SD	Unable to characterize [4]
	S-6A	0-1.5(S)	SD	Unable to Characterize [4]
Outfall 002	S-2A	0-1.5(S)	SD	Unable to Characterize [4]
	S-3B	1.5-3.0(S)	SD	Unable to Characterize [4]
Wetlands Area	WL-1	0-2.0(S)	SD	Unable to Characterize [4]
	WL-2	0-2.0(S)	SD	Unable to Characterize [4]
	WL-3	0-2.0(S)	SD	Unable to Characterize [4]

Notes:

1. Depths are in feet below ground surface.
   U = Unsaturated S = Saturated
2. GW = Groundwater; SD = sediment.
3. PHC = Petroleum Hydrocarbon
4. Due to high dilution.
5. Duplicate sample of GZA-102S.

not observed floating on top of the water table or present at depth within these monitoring points. Approximately one foot of separate phase product was observed to be floating on top of the water table at monitoring point PZ-2S.

4.1.3 Groundwater Sampling Results

Groundwater samples were collected from monitoring points GZA-102S, GZA-102R2, GZA-103S, GZA-103R1, GZA-103R2, GZA-7, RW-1, and PZ-2S and analyzed in the field for pH and specific conductance after purging the monitoring point. Table 4 summarizes results of pH and specific conductance measurements. Results indicate pH values within anticipated levels for groundwater in this region. Specific conductance values were slightly higher than expected for an industrial area, with increased specific conductance results observed in the bedrock groundwater samples.

Groundwater samples collected from the monitoring points discussed above were also submitted for analysis for TPHs, TOC, COD, BOD, nitrate, phosphorus, total hardness, total and dissolved iron, and total and dissolved manganese. Review of data validation parameters indicated that sample holding times, and results of MS/MSD, method blanks, and laboratory control sample analyses were within acceptable limits. Therefore, data qualification actions were not taken. The relative percent difference (RPD) was calculated for compounds identified as a result of analysis of a blind duplicate groundwater sample collected from monitoring well GZA-102S and submitted for TPH analysis. Results indicated that the RPD was approximately 29%. This is slightly higher than the typically accepted 20% window, however, based upon results of the other QA/QC results discussed previously, data qualification actions were not judged to be necessary.

Table 1 summarizes laboratory analyses conducted on these groundwater samples and raw analytical and QA/QC data are provided in Appendix C. Table 5 summarizes TPH concentrations detected in groundwater samples analyzed. Analytical results indicate less than 7 milligrams per liter (mg/l) of TPHs were detected in each monitoring location sampled except at PZ-2S (Figure 3) where 650 mg/l of TPHs was reported.

Table 3 summarizes results of TPH fingerprint analyses conducted on samples from monitoring points PZ-2S, GZA-102S (and duplicate GZA-102D), and GZA-103S. Data indicate Stoddard solvent was present in the samples from PZ-2S and GZA-103S at concentrations of 400 mg/l and 1.3 mg/l, respectively. An indeterminate petroleum

Table 4
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
SUMMARY OF INDICATOR PARAMETERS IN GROUNDWATER AND SURFACE WATER

Site Location	Sampling Location	Matrix[1]	pH (Standard Units)	Specific Conductance (umhos/cm)
Tank Farm Area	GZA-102S	GW	6.67	488
	GZA-102R2	GW	7.34	571
	GZA-103S	GW	6.64	312
	GZA-103R1	GW	6.94	631
	GZA-103R2	GW	6.72	820
	GZA-7	GW	6.25	515
	RW-1	GW	6.98	702
	PZ-2S	GW	6.29	341
Tank F Area	GZA-101R	GW	11.36	2500
Tank K Area	WE-1	GW	6.05	193
	WE-2	GW	6.50	253
	WE-3	GW	6.07	763
	WE-4S	GW	6.54	584
	WE-4D	GW	6.75	413
Eastern Parking Lot Area	DP-5	GW	5.69	138
	DP-6	GW	6.01	552
	GZA-105R	GW	9.08	436
	PZ-3	GW	6.10	560
Wetlands Area	WL-1	SW	6.71	423
	WL-2	SW	6.33	547
	WL-3	SW	6.33	576
	WL-4	SW	6.41	572
	WL-5	SW	6.14	198

Notes:
1. GW = Groundwater; SW = Surface Water

Table 5
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
VOLATILE ORGANIC COMPOUNDS AND TOTAL PETROLEUM HYDROCARBONS DETECTED IN GROUNDWATER AND SURFACE WATER

Site Location	Sampling Location	TPH (mg/l)	Acetone (ug/l)	1,1-DCA (ug/l)	MEK (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Ethyl-benzene (ug/l)	Total Xylenes (ug/l)	TCE (ug/l)	VC (ug/l)	Total VOCs (ug/l)
Tank Farm Area	GZA-102S	3.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-102S(Dup)	4.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-102R2	<3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-103S	6.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-103R1	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-103R2	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-7	3.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RW-1	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	PZ-2S	650	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tank F Area	GZA-101R	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tank K Area	WE-1	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	WE-2	NA	<1,250	<1,250	<1,250	2,300	22,000	2,000	22,000	<1,250	<1,250	48,300
	WE-2(Dup)	NA	<50	<500	<500	2,900	25,000 ✓	2,500 ✓	26,000 ✓	<500	<500	56,400
	WE-3	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	WE-4S	NA	<250	<250	<250	6,200 ✓	12,000	1,800	13,000	<250	<250	33,000
	WE-4D	NA	47	<5.0	27	64	11	<5.0	106	<5.0	<5.0	255
Eastern Parking Lot Area	DP-5	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	DP-6	420	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	PZ-3	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	GZA-105R	<2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Legend:
NA = Not analyzed
Dup = Duplicate Sample
TPH = Total Petroleum Hydrocarbons
1,1-DCA = 1,1-Dichloroethane
MEK = Methyl Ethyl Ketone
TCE = Trichloroethene
VC = Vinyl Chloride

Samples obtained on 9/30/91

Table 5
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
VOLATILE ORGANIC COMPOUNDS AND TOTAL PETROLEUM HYDROCARBONS DETECTED IN GROUNDWATER AND SURFACE WATER ?

Site Location	Sampling Location	TPH (mg/l)	Acetone (ug/l)	1,1-DCA (ug/l)	MEK (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Ethyl - benzene (ug/l)	Total Xylenes (ug/l)	TCE (ug/l)	VC (ug/l)	Total VOCs (ug/l)
Wetlands Area	WL-1	<2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	WL-2	<2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	WL-3	<2	<5	6 ✓	<5	<5	<5	<5	<5	5 ✓	10 ✓	21
	WL-4	<2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	WL-5	<2	10 ✓	<5	<5	<5	<5	<5	<5	<5	<5	10

Legend:

NA = Not analyzed
Dup = Duplicate Sample
TPH = Total Petroleum Hydrocarbons
1,1-DCA = 1,1-Dichloroethane
MEK = Methyl Ethyl Ketone
TCE = Trichloroethene
VC = Vinyl Chloride

9/91 Sample?

hydrocarbon was reported in the sample from GZA-102S and its duplicate at less than 5 mg/l.

Groundwater treatability parameters from monitoring points GZA-102S, GZA-102R2, GZA-103S, GZA-103R1, GZA-103R2, GZA-7, and RW-1, are summarized in Table 6. These data indicate that relatively elevated levels of COD and TOC were observed in groundwater samples from GZA-102S, GZA-102R, GZA-7, and RW-1, indicating that groundwater may be impacted in the vicinity of these wells. The five-day BOD concentrations were within expected levels, excluding the sample from GZA-102S in which a result of 350 mg/l was reported. This may indicate the presence of biodegradable constituents in groundwater near this well. Nitrate nitrogen, phosphorus, hardness, total and dissolved iron, and total and dissolved manganese results were generally within anticipated levels for the region.

4.2 TANK F AREA RESULTS

4.2.1 Soil Sampling Results

Borings advanced in this area, B-12, B-13, and B-14 (Figure 3), were all completed at approximately 20 feet bgs. Soils were generally classified as medium dense to very dense, gray to dark brown, coarse to fine sand with little to some gravel. Boring logs are provided in Appendix A. These classifications are consistent with prior observations made in the area during drilling of borings GZA-101 and GZA-12. Based upon these observations, the upper four to seven feet of overburden was classified as fill in borings B-12 and B-13. In boring B-14, advanced in the former Tank F location, the upper 13 feet of overburden was classified as fill, likely due to its placement here following removal of Tank F. Beneath the fill layer, a coarse to fine sand layer varying in thickness from approximately three to ten feet was observed. A coarse sand and gravel layer ranging from approximately 1 foot to greater than 13 feet was generally observed underlying the coarse to fine sand. Auger and split-spoon refusal were not encountered in these borings. Groundwater was observed at approximately 10 feet, 12 feet, and 9 feet bgs in borings B-12, B-13, and B-14, respectively, at the time of drilling. Based upon the soil descriptions above, groundwater was observed within the fine to coarse sand layer in borings B-12 and B-13, and within the fill material in boring B-14.

Figure 8 summarizes VOC headspace screening responses measured with the PID during borehole advance and also indicates the approximate depth of the water table

Table 6
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
GROUNDWATER TREATABILITY ANALYTICAL RESULTS

Site Location	Sampling Location	TOC (mg/l)	COD (mg/l)	BOD 5-day (mg/l)	Nitrate Nitrogen (mg/l)	Total Phosphorus (mg/l)	Total Hardness (mg/l)	Total Fe (mg/l)	Total Mn (mg/l)	Dissolved Fe (mg/l)	Dissolved Mn (mg/l)
Tank Farm Area	GZA-102S	140	590	350	<0.10	1.5	160	53	4.4	39	4.3
	GZA-102R2	0.86	50	<47	0.83	<0.010	220	0.30	0.07	0.16	0.069
	GZA-103S	45	150	<47	<0.10	27	140	92	2.5	20	1.6
	GZA-103R1	21	94	<47	<0.10	4.2	200	24	5.8	22	5.3
	GZA-103R2	14	45	<47	<0.10	0.089	160	9.1	3.1	8.2	2.9
	GZA-7	71	320	<47	<0.10	0.80	130	110	6.5	12	2.6
	RW-1	38	420	<47	<0.10	9.9	330	28	2.9	12	4.2
Tank F Area	GZA-101R	3.9	54	<45	<0.10	<0.010	450	0.36	0.46	0.082	0.009
Tank K Area	WE-1	21	110	<47	0.40	9.3	230	140	2.4	5.0	0.87
	WE-2	59	380	99	<0.10	3.6	160	99	3.2	25	2.4
	WE-3	19	160	<47	0.12	3.8	340	210	6.2	35	4.2
	WE-4S	45	250	56	<0.10	11	270	160	6.0	31	4.3
	WE-4D	4.2	43	<47	0.50	9.6	450	340	6.5	2.8	2.3
Eastern Parking Lot Area	GZA-105R	1.3	12	<47	<0.10	8.8	130	0.68	0.68	0.62	1.1

Legend:
TOC = Total Organic Carbon
COD = Chemical Oxygen Demand
BOD = Biological Oxygen Demand
Fe = Iron
Mn = Manganese

observed at the time of drilling. Results indicated headspace screening responses were less than or equal to 1.5 ppm in samples from all three borings except for one sample from 12 to 14 feet bgs in boring B-14, where a headspace response of six ppm was observed. This sample was collected at the base of the fill as it graded into the underlying coarse to fine sand. Based upon visual observations and the low headspace screening results in this area, soil samples were not submitted for laboratory analysis.

4.2.2 Groundwater Sampling Results

Groundwater samples were collected from monitoring point GZA-101R and analyzed in the field for pH and specific conductance after purging the monitoring point. Table 4 summarizes results of pH and specific conductance measurements. Results indicate that the pH, reported at 11.36, and the specific conductance of 2,500 micromhos/centimeter (umhos/cm) were higher than typically observed for groundwater elsewhere on site. These results may be indicative of grout within the monitoring well, may be due to the geochemistry of the surrounding bedrock, or may be related to prior reports which indicated Tank F accepted caustic wastes as part of a metal finishing process.

Groundwater samples collected from GZA-101R were also submitted for analysis for TPHs, TOC, COD, BOD, nitrate, phosphorus, total hardness, total and dissolved iron, and total and dissolved manganese. Review of data validation parameters indicated that sample holding times, and results of MS/MSD, method blanks, and laboratory control sample analyses were within acceptable limits. Therefore, data qualification actions were not determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these groundwater samples and raw analytical and QA/QC data are provided in Appendix C. Table 5, which summarizes TPH concentrations detected in the groundwater sample analyzed from this monitoring well, indicates TPH concentrations were not reported above method detection limits of 2 mg/l. Groundwater treatability parameters from GZA-101R are summarized in Table 6. Concentrations of parameters were generally within anticipated levels for groundwater in the region.

4.3 TANK K AREA RESULTS

4.3.1 Hydraulic Conductivity Testing

Table 7 summarizes results of hydraulic conductivity testing conducted at monitoring wells WE-1, WE-2, WE-3, WE-4S, and WE-4D. Estimated hydraulic conductivities ranged from approximately 4 to 11 feet per day (fpd) or 1.4×10^{-3} to 3.8×10^{-3} centimeters per second (cm/s). Significant differences in results between the monitoring wells screened in the fine to coarse sand unit as compared to monitoring well WE-4D, screened in the lower sand and gravel, were not observed. Results are consistent with the range of hydraulic conductivities typically anticipated for these types of geologic strata. These results are also consistent with results of prior in-situ hydraulic conductivity tests conducted at PZ-7, PZ-8, and PZ-9 (Figure 3), which ranged from approximately 2 to 12 fpd (7.0×10^{-4} to 4.2×10^{-3} cm/sec. Raw data for the hydraulic conductivity test analyses are provided in Appendix B.

4.3.2 Soil Sampling Results

Borings advanced in this area, B-5 through B-11 (Figure 3), ranged in depth from approximately 12 to 30 feet bgs. Three strata were generally encountered in these borings. The upper four to six feet bgs was described as a fill material consisting primarily of medium dense to very dense, brown, coarse to fine sand with little to some gravel. This strata is underlain by six to eight feet of medium dense to dense, gray, fine to coarse sand with varying amounts of gravel, silt, and organic fragments. An odor and sheen were observed in saturated samples from this stratum. This stratum, in turn, is underlain by approximately 17 feet of medium dense to very dense, olive brown to gray, coarse to fine sand and gravel. Bedrock was not cored during advance of these borings. However, based upon auger refusal and results of prior bedrock investigations in this area, the depth to bedrock is estimated to be approximately 30 feet bgs in this area. Boring logs are provided in Appendix A. The classifications discussed above are consistent with prior observations made in the area during drilling of borings GZA-5 and PZ-7 (Figure 3). At the time of drilling, groundwater was observed at approximately six feet bgs in the strata consisting of medium dense to dense, gray, fine to coarse sand with varying amounts of gravel, silt, and organic fragments.

Results of moisture content and grain size analyses conducted on an unsaturated sample from two to four feet bgs in boring WE-2 (GEW-SS-WE2-005) are provided in

Table 7
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
SUMMARY OF HYDRAULIC CONDUCTIVITY RESULTS[2]
TANK K AREA

Monitoring Well	Stratum Description	Estimated Hydraulic Conductivity (ft/day)
WE-1	Fine to Coarse Sand	10.5 ft/day
WE-2[1]	Fill (Fine to Coarse Sand) Fine to Coarse Sand	11.1 ft/day 7.6 ft/day
WE-3	Fine to Medium Sand, Little Silt	9.8 ft/day
WE-4S	Fine to Medium Sand, Little Silt	4.2 ft/day
WE-4D	Sand and Gravel	5.4 ft/day

Notes:

1. Two strata tested.
2. See Appendix B for calculations.

Appendix D. Data from these tests indicates a moisture content of approximately 13% and confirm the soil classification for the sample submitted.

Figure 8 summarizes VOC headspace screening responses measured with the PID during borehole advance and also indicates the approximate depth of the water table observed at the time of drilling. Results indicated headspace screening responses were generally less than 4 ppm in samples from borings advanced north, south, and west of the former Tank K location, excluding one sample in which seven ppm total VOCs were detected. East of the tank location, soil headspace responses ranged from 2 to 320 ppm. Highest responses were observed in borings WE-2 and WE-4D (Figure 3) within the upper two strata described previously. Screening responses were observed to decrease with depth to two ppm in the sand and gravel stratum encountered in boring WE-4D. Headspace screening responses in samples collected from boring B-7, located approximately 150 feet east of the Tank K location (Figure 3), were each less than one ppm.

Based upon visual observations and headspace screening results in this area, an unsaturated soil sample (GEW-SS-WE2-005) from two to four feet bgs in boring WE-2 and a saturated soil sample (GEW-SS-WE4D-004) from six to eight feet bgs in boring WE-4D were submitted for laboratory analyses for VOCs and TPHs. The unsaturated sample was also submitted for TOC analysis to provide data for assessing VOC soil/water partitioning. Review of data validation parameters indicated that sample holding times, method blanks, and results of MS/MSD, lab control samples, and surrogate recovery analyses were within acceptable limits. Therefore, no data qualification actions were determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these soil samples and raw analytical and quality assurance/quality control (QA/QC) data are provided in Appendix C. Table 2 summarizes compounds detected in soil samples analyzed. Analytical results for the unsaturated sample (GEW-SS-WE2-005) indicated the presence of total xylenes, toluene, and ethylbenzene in concentrations of 22 mg/kg, 177 mg/kg, and 15 mg/kg, respectively. TPHs were also reported at 730 mg/kg in this sample. Results of the TOC analysis indicated approximately one percent TOC in the sample analyzed. In the saturated sample (GEW-SS-WE4D-004), total xylenes, toluene, ethylbenzene, and benzene were reported at respective concentrations of 1,740 mg/kg, 450 mg/kg, 240 mg/kg, and 12 mg/kg. TPHs were also reported present at 6,300 mg/kg in this sample.

Table 3 summarizes results of the TPH fingerprint analysis conducted on the WE-2 soil sample discussed above. Data indicate that an indeterminate heavy weight petroleum hydrocarbon was detected in this sample in a concentration of 1,300 mg/kg.

4.3.3 Groundwater Sampling Results

Groundwater samples were collected from monitoring wells WE-1, WE-2, WE-3, WE-4S, and WE-4D and analyzed in the field for pH and specific conductance after purging the monitoring well. Table 4 summarizes results of pH and specific conductance measurements. Results indicate pH values within anticipated levels for groundwater in this region. Specific conductance values were generally within the range expected for an industrial area, excluding samples from WE-3 and WE-4S, which were slightly elevated.

Groundwater samples collected from the monitoring wells discussed above were also submitted for analysis for VOCs, and treatability parameters including TOC, COD, BOD, nitrate, phosphorus, total hardness, total and dissolved iron, and total and dissolved manganese. Review of data validation parameters indicated that sample holding times, and results of MS/MSD, method blanks, field blanks, trip blanks, surrogate recoveries, and laboratory control sample analyses were within acceptable limits. The RPD was calculated for compounds identified as a result of a blind duplicate groundwater sample collected from monitoring well WE-2 and submitted for VOC analysis. Results indicated that the RPDs for benzene, toluene, ethylbenzene, and total xylenes (due to co-elution of the xylene isomers) were 23%, 13%, 22%, and 17%, respectively. Although the RPDs for benzene and ethylbenzene are slightly higher than a typically accepted 20% window, based upon results of the other RPDs, combined with other QA/QC results discussed previously, data qualification actions were not determined to be necessary.

relative % difference

Table 1 summarizes laboratory analyses conducted on these groundwater samples and raw analytical and QA/QC data are provided in Appendix C. Table 5 summarizes VOC concentrations detected in groundwater samples analyzed. Analytical results indicate that VOCs were not present above detection limits in groundwater from monitoring wells WE-1 and WE-3 (Figure 3). In general, VOCs identified in groundwater from this area consisted of benzene, toluene, ethylbenzene, and xylenes (BTEX). BTEX compounds were observed at highest concentrations in monitoring wells screened in the upper overburden material where total BTEX concentrations of duplicate samples at WE-2 ranged between 48,300 ug/l and 56,400 ug/l. At monitoring well WE-4D, total BTEX concentrations were reported at 255 ug/l. In most samples, toluene and total xylenes appear to be present in the highest concentrations. At WE-4S, located approximately 80 feet east of the Tank K Area, total BTEX concentrations were approximately 33,000 ug/l.

Groundwater treatability parameters from monitoring wells WE-1, WE-2, WE-3, WE-4S, and WE-4D are summarized in Table 6. Results for total and dissolved iron, TOC, COD, and five-day BOD indicate that groundwater in the vicinity of WE-2, WE-4S, and WE-4D has been impacted. Concentrations of total hardness, nitrate nitrogen, and total and dissolved manganese were generally within anticipated levels for groundwater in the region.

4.3.4 Potentiometric Monitoring

A summary of monitoring well elevation and potentiometric data collected on September 19, 1991 and September 30, 1991 in the Tank K Area is provided in Table 8 and shown in Figure 9. Results are consistent with prior potentiometric data, excluding the datum from PZ-7S which is approximately 0.1 foot higher than expected. This may be due to measurement error or to a localized condition near this piezometer.

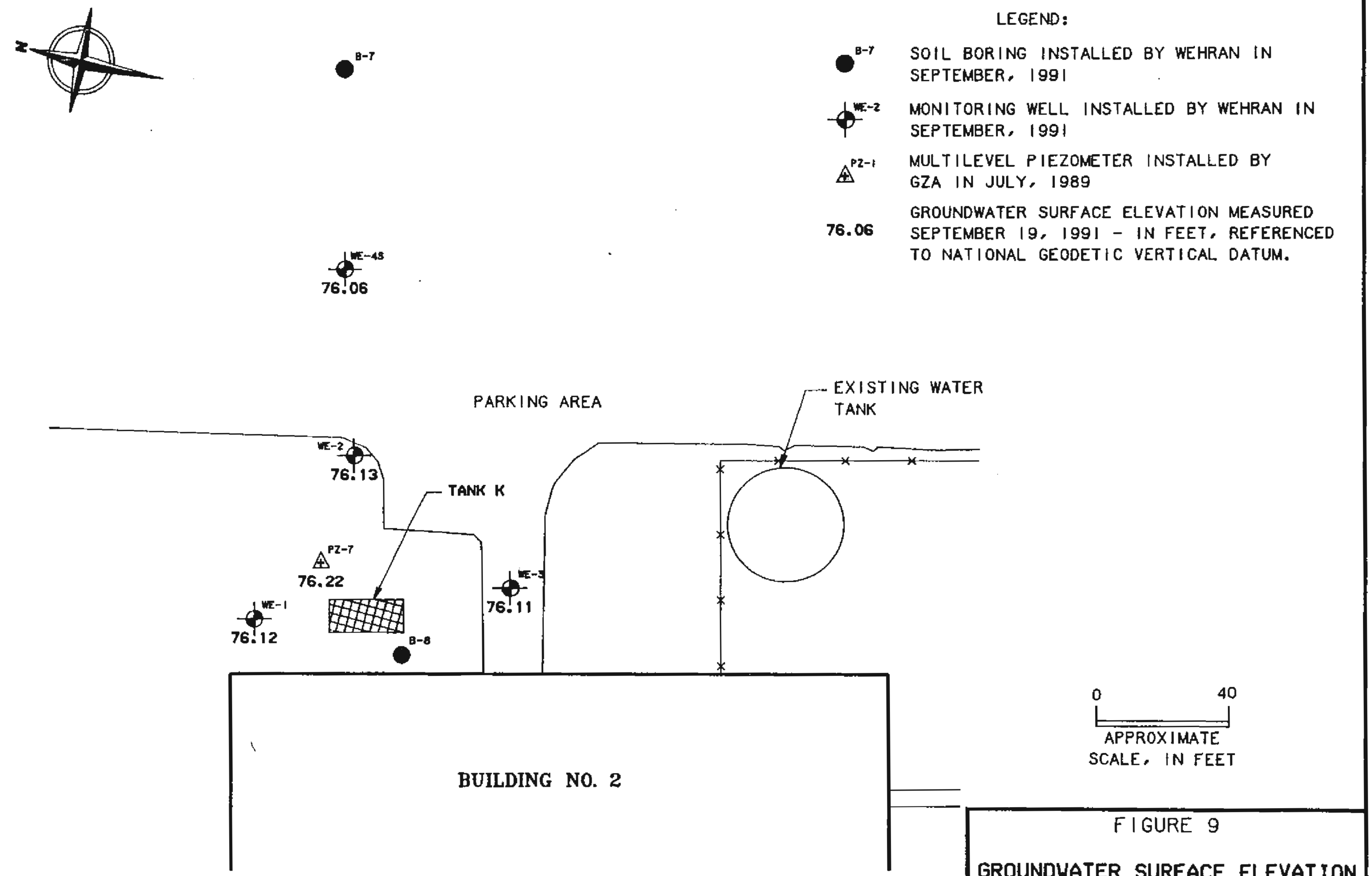
4.3.5 Oil/Water Interface Measurements

Results of measurements to assess the potential for separate phase product in the vicinity of the newly installed monitoring wells indicated that separate phase product was not observed in any of the newly installed monitoring wells either during installation or approximately two weeks following installation.

4.4 EASTERN PARKING LOT AREA RESULTS

4.4.1 Soil Sampling Results

Borings advanced in this area, B-1 through B-4 (Figure 3), ranged in depth from approximately eight to nine feet bgs. Three strata were generally encountered in the borings in this area. The upper three to five feet bgs was described as a fill material consisting primarily of dense, brown, fine to coarse sand with little to some gravel. This strata is underlain by one to two feet of loose to dense, brown to black, fine to medium sand with varying amounts of gravel, silt, and organic fragments. This stratum, in turn, is underlain by at least three feet of medium dense to dense, gray-brown to brown, fine to



BASE ENLARGED FROM DRAWING ENTITLED "ENVIRONMENTAL SAMPLING LOCATIONS AND MONITORING POINTS" BY WEHRAN ENGINEERING.

WehranEnviroTech

FIGURE 9

**GROUNDWATER SURFACE ELEVATION
IN TANK K AREA -
SEPTEMBER 19, 1991**

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

Table 8
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
SUMMARY OF MONITORING WELL ELEVATION AND POTENTIOMETRIC DATA
TANK K AREA

Monitoring Well/ Piezometer	Ground Surface Elevation (1)	Screen Depth (2)	Screen Elevation	Top of PVC Casing Elevation	September 19, 1991		September 30, 1991	
					Depth to Water (3)	Groundwater Elevation	Depth to Water (3)	Groundwater Elevation
WE-1	82.3	3-13	69.3-79.3	82.07	5.95	76.12	5.10	76.97
WE-2	80.6	2-12	68.6-78.6	80.34	4.21	76.13	3.32	77.02
WE-3	81.1	3-13	68.1-78.1	80.56	4.45	76.11	3.65	76.91
WE-4S	80.4	3-13	67.4-77.4	79.96	3.90	76.06	3.15	76.81
WE-4D	80.4	20-30	50.4-60.4	79.96	3.94	76.02	3.22	76.74
PZ-7S	81.4	0-10	71.4-81.4	81.24	5.02	76.22	NM[4]	NM
PZ-7D	81.4	21.9-26.9	54.5-59.5	81.35	5.22	76.13	NM	NM
PZ-7R	81.4	35.5-40.5	40.9-45.9	81.29	5.15	76.14	NM	NM

Notes:

1. All elevations are in feet above National Geodetic Vertical Datum.
2. Screen depths are in feet below ground surface.
3. Depths to water are in feet below top of PVC casing.
4. NM - not measured.

coarse sand with some gravel. Auger refusal was not encountered during advance of these borings. Boring logs are provided in Appendix A. The classifications discussed above are consistent with prior observations made during drilling of several borings in the area. At the time of drilling, groundwater was observed at approximately five to six feet bgs in the lower of the three strata described above.

Figure 8 summarizes VOC headspace screening responses measured with the PID during borehole advance and also indicates the approximate depth of the water table observed at the time of drilling. Groundwater was not observed in borings B-3 or B-4 at the time of drilling. Results indicated headspace screening responses were less than one ppm in samples from borings B-1 and B-3 (Figure 3). Soil headspace responses in borings B-2 and B-4 ranged from less than 1 ppm in the upper two strata to 260 ppm in the lower, saturated fine to coarse sand unit.

Based upon visual observations and headspace screening results in this area, three unsaturated soil samples from approximately four to six feet bgs in borings B-1 (GEW-SS-B1-001), B-2 (GEW-SS-B2-002), and B-4 (GEW-SS-B4-003) (Figure 3) were submitted for laboratory analyses for TPH. In addition, the samples from B-2 and B-4 were also submitted for VOC analyses. Review of data validation parameters indicated that sample holding times, method blanks, and results of MS/MSD, laboratory control samples, and surrogate recovery analyses were within acceptable limits and no data qualification actions were determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these soil samples and raw analytical and quality assurance/quality control (QA/QC) data are provided in Appendix C. Table 2 summarizes compounds detected in soil samples analyzed. Analytical results for the VOC analysis conducted on sample B-2 indicated the presence of acetone and total xylenes at concentrations of 1,100 ug/kg and 1,360 ug/kg, respectively. In sample B-4, 41 ug/kg of acetone was reported. TPHs were also detected at 26,000 mg/kg and 83 mg/kg in samples B-2 and B-4, respectively, and were not identified above detection limits of 75 mg/kg in the sample from boring B-1.

Table 3 summarizes results of the two TPH fingerprint analyses conducted on the B-2 and B-4 soil samples discussed above. Results indicate 13,000 mg/kg and 49 mg/kg of Stoddard solvent were identified in these samples, respectively.

4.4.2 Groundwater Sampling Results

Groundwater samples were collected from monitoring points DP-5, DP-6, GZA-105R, and PZ-3 and analyzed in the field for pH and specific conductance after purging the monitoring point. Table 4 summarizes results of pH and specific conductance measurements. Results indicate pH values within anticipated levels for groundwater in this region, excluding the sample from GZA-105R where a pH of 9.08 was observed. Since this monitoring point was completed as a Barcad, the elevated pH is not likely to be due to grout or cement in the well and is currently unexplained. Specific conductance values were also within the range expected for an industrial area.

Groundwater samples collected from the monitoring points discussed above were also submitted for analysis for TPHs. GZA-105R was also sampled for treatability parameters including TOC, COD, BOD, nitrate, phosphorus, total hardness, total and dissolved iron, and total and dissolved manganese. Separate phase product was also observed in GZA-105S above the water table. Therefore, the aqueous phase beneath this product was sampled and submitted for TPH fingerprint analysis. Review of data validation parameters indicated that sample holding times, and results of MS/MSD, method blanks, field blanks, trip blanks, and laboratory control sample analyses were within acceptable limits, excluding one laboratory control sample for BOD which was approximately 1% out of the commonly accepted 20% window. Therefore, based upon other data validation results, data qualification actions were not determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these groundwater samples and raw analytical and QA/QC data are provided in Appendix C. Table 5 summarizes TPH concentrations detected in groundwater samples analyzed. Analytical results indicate that TPHs were not present above detection limits in groundwater from monitoring points DP-5, GZA-105R, and PZ-3 (Figure 3). However, TPHs were present in the sample from DP-6 at a concentration of 420 mg/l. TPH fingerprint analytical results are summarized in Table 3. Results of the aqueous sample submitted for TPH fingerprint analysis from GZA-105S indicated that Stoddard solvent was identified as a separate phase in this sample and in the sample from DP-6 at 280 mg/l.

Groundwater treatability parameters from GZA-105R are summarized in Table 6. Concentrations were generally within anticipated levels for groundwater in the region.

4.4.3 Oil/Water Interface Measurements

Results of measurements to assess potential for separate phase product indicated that no separate phase product was observed in monitoring points GZA-102S, DP-6, or PZ-3. However, approximately one-half foot of separate phase product was observed in monitoring well GZA-105S.

4.5 WETLANDS AREA RESULTS

4.5.1 Sediment Sampling Results

Wetlands sediment samples were collected from zero to two feet bgs at five locations, designated WL-1 through WL-5 (Figure 3), and were submitted for laboratory analyses for VOCs, TPHs, ABNs, and priority pollutant metals. Review of data validation parameters indicated that sample holding times, method blanks, field blanks, trip blanks, and results of MS/MSD and surrogate recovery analyses were within acceptable limits. Therefore, no data qualification actions were determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these soil samples and raw analytical and quality assurance/quality control (QA/QC) data are provided in Appendix C. Table 2 summarizes compounds detected in sediment samples analyzed. Analytical results for the VOC analyses indicated that acetone was the VOC identified at the highest concentrations in each of the five samples analyzed, in concentrations ranging from 7 ug/kg to 720 ug/kg. Other VOCs identified included 190 ug/kg of methyl ethyl ketone in the sample from WL-4 and 35 ug/kg, 38 ug/kg, and 35 ug/kg of 1,1-dichloroethane, ethylbenzene, and total xylenes, respectively, in the sample from WL-2.

Table 3 summarizes results of the three TPH fingerprint analyses conducted on the sediment samples from WL-1, WL-2, and WL-3. Results indicate that, due to relatively high dilutions required to analyze these samples, the laboratory was unable to characterize the TPH identified in these samples.

Tables 9 and 10 summarize results of ABN and priority pollutant metals analyses conducted on the sediment samples from locations WL-1 through WL-5. Results indicated that ABNs were not detected in samples from WL-1 and WL-2 above detection limits. Bis(2-ethyl hexyl)phthalate was detected in samples from WL-3 and WL-4 in concentrations of 0.6 and 4 mg/kg, respectively. The sample from WL-5 contained the greatest number of

Table 9
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
ACID/BASE NEUTRAL EXTRACTABLE COMPOUNDS (ug/kg)
DETECTED IN SEDIMENT-WETLANDS AREA

common lab contaminant.

Sampling Location	Benzo (a) anthracene	Benzo (a) pyrene	Chrysene	Bis (2-ethylhexyl) phthalate	Fluoranthene	Phenanthrene	Pyrene
WL-1	<2000	<2000	<2000	<2000	<2000	<2000	<2000
WL-2	<2000	<2000	<2000	<2000	<2000	<2000	<2000
WL-3	<300	<300	<300	600	<300	<300	<300
WL-4	<1000	<1000	<1000	4000	<1000	<1000	<1000
WL-5	500	600	1000	<300	2100	1000	1000

Table 10
GE - AEROSPACE
WILMINGTON/NORTH READING, MASSACHUSETTS
PRIORITY POLLUTANT METALS DETECTED IN SEDIMENT (mg/kg)
WETLANDS AREA

Sampling Location	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
WL-1	<25	3.8	<0.85	3.06	5.4	340	130	20	89
WL-2	<34	4.0	<1.1	<3.4	8.8	920	<110	37	250
WL-3	13	<4.2	0.30	1.2	12	9.4	<28	8.7	24
WL-4	38	12	<1.2	6.9	12	26	140	16	140
WL-5	18	11	0.85	2.5	22	15	59	18	35

ABNs identified, with benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, and pyrene detected in concentrations ranging from 0.5 mg/kg to 2.1 mg/kg.

Based upon anticipated background levels of metals in sediment in the area, concentrations of copper from sampling locations WL-1 and WL-2 appeared to be slightly higher than expected (Table 10). No other significant findings from the priority pollutant metals analyses were observed.

4.5.2 Surface Water Sampling Results

Surface water samples were collected from sampling points WL-1 through WL-5 and analyzed in the field for pH and specific conductance. Table 4 summarizes results of pH and specific conductance measurements. Results indicate pH and specific conductance values within anticipated levels for surface water in an industrial area.

Samples collected from the locations discussed above were also submitted for VOC analyses. Review of data validation parameters indicated that sample holding times, method blanks, field blanks, trip blanks, and results of MS/MSD, laboratory control samples, and surrogate recovery analyses were within acceptable limits. Therefore, no data qualification actions were determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these surface water samples and raw analytical and QA/QC data are provided in Appendix C. Table 5 summarizes VOC concentrations detected in the samples analyzed. Analytical results indicate that VOCs were not present above detection limits in samples from locations WL-1, WL-2, and WL-4 (Figure 3). Vinyl chloride, 1,1-dichloroethane, and trichloroethene were reported at concentrations of 10 ug/l, 6 ug/l, and 5 ug/l, respectively, in the sample from WL-3 while acetone was identified in the sample from WL-5 at 10 ug/l. TPHs were not reported above detection limits in any of the five samples analyzed.

unusual
in
surface
H_2O

4.6 OUTFALL AREA RESULTS

4.6.1 Sediment Sampling Results

Sediment samples were collected at the two outfall locations from 0 to 1.5 feet and from 1.5 to 3 feet bgs at six locations, designated S-1 through S-6 (Figure 3). Samples from the upper 1.5 feet were designated "A", while samples from the lower zone were designated "B".

Figure 8 summarizes VOC headspace screening responses measured with the HNu PID after a sample was collected. Results indicated headspace screening responses were less than one ppm in samples S-1A/1B through S-3A/3B collected from the Outfall 002 Area and from samples S-6A/6B from the Outfall 001 Area (Figure 3). Soil headspace responses in samples S-4A/4B and S-5A/5B ranged from 3 ppm to 80 ppm.

Based upon headspace screening results, two sediment samples from each area were submitted for laboratory analyses for TPHs. Samples from both the upper and lower sampling zones were submitted. Review of data validation parameters indicated that sample holding times, method blanks, and results of MS/MSD and laboratory control samples were within acceptable limits. Therefore, no data qualification actions were determined to be necessary.

Table 1 summarizes laboratory analyses conducted on these sediment samples and raw analytical and quality assurance/quality control (QA/QC) data are provided in Appendix C. Table 2 summarizes compounds detected in sediment samples analyzed. Analytical results indicated that TPHs were detected at 610 mg/kg in the sample from location S-5A. For other samples submitted, the laboratory reported that TPHs were not identified above method detection limits. However, the detection limits were raised for these analyses due to the low percentage of solids in the matrix. Based upon information from the analytical laboratory, although TPHs were reported as not detected in these samples, it is likely that TPHs are present at concentrations close to the detection limit.

Table 3 summarizes results of the TPH fingerprint analyses conducted on the sediment samples from the four samples submitted for TPH analyses. Results indicate that, due to relatively high dilutions required to analyze these samples, the laboratory was unable to characterize the TPHs identified in these samples.

5.0 DISTRIBUTION OF OIL AND HAZARDOUS MATERIALS

The nature of oil and hazardous materials previously identified in soil, sediment, surface water, and groundwater at the site was discussed in Section 4.0 and in the GZA Phase II report. This section describes the distribution of the oil and hazardous materials based on data collected during both this and prior investigations.

In order to provide a basis for discussing the distribution of oil and hazardous materials on site and to maximize use of available data, Wehran combined data as presented in the Phase II report by GZA with information collected during this supplemental investigation. No validation of the data, however, presented or referenced in the Phase II report or validation of the methods used to collect them was conducted as part of this supplemental investigation. It must be recognized that the integration of the data from this and prior investigations is subject to some limitations. For example, temporal changes in surface or subsurface conditions may have occurred between 1989 and 1991 and sampling and analytical methods may have varied over this time period.

Seven suspected areas of contamination were assessed as part of this supplemental investigation. Results have indicated that, of the seven areas assessed, there are three primary impacted areas on site. These include the Tank Farm Area, the Tank K Area, and the Eastern Parking Lot Area. Data indicate that the two Outfall Areas and the Wetlands Area contain TPHs and relatively lower concentrations of VOCs, ABNs, and priority pollutant metals. However, it is unlikely these latter three areas act as sources of contamination. Concentrations of VOCs identified in overburden groundwater near Tank F as compared to those reported in bedrock, combined with results of headspace screening and visual observations made during advance of borings B-12 through B-14, (Figure 3) indicates that soils in this area are unlikely a significant source of the VOC contamination identified here. If Tank F, which appeared to have been installed in overburden material, had been a significant source of VOCs, higher concentrations of VOCs would have been expected in the soil samples collected and analyzed during removal of the tank. Thus this area is also unlikely to be a current source of contamination.

But ~ 5 ppm TVOCs detected in GW from GZA-101R in tank F area during previous analyses.

Analytical data have shown three primary types of contamination on site. These include chlorinated hydrocarbons, TPH, and BTEX compounds. In addition, styrene was reported in some groundwater samples analyzed by GZA. In order to illustrate the

Also ~ 5ppm in BR at STM-10

distribution of these contaminants on site, Wehran constructed plan view maps and hydrogeologic cross-sections illustrating these three primary compound classes. Styrene was included with the chlorinated hydrocarbons in this approach, however, it should be noted that styrene concentrations were based upon gas chromatograph analyses and, therefore, ranges of concentrations were reported; a mass spectrophotometer was not used in the styrene analyses.

5.1 TANK FARM AREA/EASTERN PARKING LOT AREA

The Tank Farm Area appears to have been impacted by three different contaminant types including chlorinated hydrocarbons, BTEX compounds, and TPH. Figure 10 illustrates a plan view of groundwater in overburden and bedrock in which chlorinated hydrocarbons and styrene were reported. Figure 11 provides a similar illustration for TPH and BTEX compounds in groundwater.

Figures 12 and 13, respectively, illustrate hydrogeologic cross-sections through the Tank Farm Area with estimated isoconcentration lines for these same compounds. The data illustrated on these figures indicate that the Tank Farm may be the source of contaminant releases to groundwater for most of the contaminants observed on site, with the exception of BTEX compounds seen in the Tank K Area, as discussed in Section 5.3. Figure 8 indicates that soil headspace screening responses within the overburden fill material in the Tank Farm Area were among the highest observed during this investigation and were also observed to increase significantly beneath the water table. Comparison of unsaturated and saturated soil samples analyzed from boring B-16 in this area (Table 2) indicated increased concentrations of VOCs with depth into the saturated zone. The VOC concentrations observed in the unsaturated soil sample from B-16 (Table 2) and the groundwater sample from GZA-103S (Table 5) are relatively low, indicating that VOCs in the unsaturated zone may be due to diffusion from the saturated zone. However, soil concentrations from the saturated overburden sample collected at B-16 indicate significantly higher VOC concentrations compared to those of the unsaturated sample collected approximately four feet above it. Based upon this data, saturated overburden soils in the Tank Farm Area appear to have been impacted by VOC contamination. Compounds identified in overburden saturated soil (Table 2) were primarily petroleum hydrocarbons consisting of toluene and

Also, appears there was a separate release of Stoddard sol. in PZ2 area xylenes, which are less dense than water, although trichlorofluoromethane, denser than water, was also reported present.

As discussed in the GZA Phase II report, the bedrock in this area may have been removed in order to construct the Tank Farm. Reference to Figures 12 and 13 indicates that the highest concentrations of chlorinated hydrocarbons (30,000 ug/l) in this area were observed in groundwater from GZA-103R1, which is screened in the bedrock. This information is also consistent with the increase in VOC concentrations observed with depth to the bedrock in this area. Concentrations of chlorinated hydrocarbons were observed to decrease between GZA-103R1 and the deeper bedrock monitoring point GZA-103R2. Therefore, based upon this data and assuming conditions have not changed considerably since these data were collected, this appears to be the most significant area of chlorinated hydrocarbon contamination on site.

Figure 13 provides a cross-section of total BTEX isoconcentration lines beneath the site. Analytical data indicate that one of the two most concentrated areas of BTEX compounds on site was identified in the vicinity of GZA-103R1, similar to the area of chlorinated hydrocarbons discussed above. Concentrations of BTEX compounds were also observed to decrease between monitoring points GZA-103R1 and GZA-103R2.

In general, concentrations of the chlorinated hydrocarbons and BTEX compounds in groundwater appear to decrease significantly outward from the Tank Farm Area in both overburden and bedrock groundwater. However, as shown in Figure 10, it is not clear if overburden or bedrock groundwater in the area between the Tank Farm and GZA-101, beneath Buildings 1 and 1A, has been impacted by VOCs. Based upon groundwater flow patterns discussed in the GZA Phase II report, contaminant transport in groundwater westerly from the Tank Farm Area would not be expected. To the east of the Tank Farm Area, chlorinated hydrocarbons have been detected adjacent to the Wetlands Area and at GZA-14 and GZA-14A. As shown in Figures 10 and 11, VOC concentrations were generally observed to increase with depth in most site monitoring wells, with the higher concentrations of VOCs primarily observed in bedrock groundwater samples.

possible indoor air impacts?

as well as at several other loc. in wetlands

The TPHs shown in the Tank Farm and Eastern Parking Lot Areas in Figure 10 have been identified by TPH fingerprint analyses to consist primarily of Stoddard solvent. The highest concentrations of dissolved TPHs (650 mg/l) were observed at monitoring point PZ-2S, although they were also observed between approximately 4 mg/l and 7 mg/l in samples collected from monitoring points GZA-103S and GZA-7 (Table 5). During the GZA Phase II investigation, the highest concentration of dissolved TPHs in groundwater was observed in GZA-103S at 99 mg/l. In addition, 420 mg/l of dissolved Stoddard solvent was detected at monitoring point DP-6 during this supplemental investigation. Results of field observations and analysis of a sample collected at GZA-105S indicated that separate phase Stoddard solvent was present in this well with apparently a one-half foot thickness floating on top of the water table (Table 3). Approximately one foot of separate phase product was also observed above the water table in PZ-2S. These data indicate that there may have been a release of Stoddard solvent to groundwater in the vicinity of the Tank Farm, however, it is likely that a more significant release occurred in the area of PZ-2S. Soil headspace screening results from borings B-1 through B-4 indicated concentrations of approximately 200 ppm in soil samples collected from near the water table in boring B-2. In addition, up to 260 ppm responses in soil headspace screening were observed in samples collected from boring B-4. Headspace screening responses were less than 1 ppm in samples collected from borings B-1 and B-3. Soil sample analytical results indicated the highest TPH concentrations in samples collected from B-2 and B-16 (Table 2), while relatively lower concentrations were reported in samples from B-1 and B-4. Dissolved TPHs were reported at concentrations of approximately 4 mg/l to 5 mg/l in a groundwater sample and duplicate collected from GZA-102S. Dissolved TPHs were not reported above detection limits in groundwater samples collected from GZA-103R1, GZA-103R2, RW-1, GZA-101R, DP-5, PZ-3, and GZA-105R.

The observations discussed above are also consistent with prior analytical data and field observations made by GZA in November 1990 (GZA, 1990a) and during the GZA Phase II investigation. Therefore, as shown in Figure 13, data indicate that there is a lens of TPHs, primarily consisting of Stoddard solvent, in the area between the Tank Farm and approximately B-1 and B-3 to the east, the drainage line for Outfall 001 to the north, and B-4 to the south.

Headspace screening responses from unsaturated soils in the Tank Farm/Eastern Parking Lot Areas generally were significantly lower than responses from saturated samples. Locations where responses in unsaturated media were observed, however, were relatively closely correlated with locations where relatively high concentrations of VOCs were observed in the saturated zone. This would be an expected result since the only areas of release of contaminants to the unsaturated zone were likely at the Tank Farm and in the area of PZ-2S because the remainder of the general area is paved, as discussed in Section 6.0. Therefore, residually contaminated soils in the unsaturated zone due to contaminant releases are likely to be present in the area of PZ-2S and possibly near the Tank Farm, while elsewhere in these areas, soil contamination in this zone is likely due to diffusion or fluctuations of the water table and not a result of surface releases.

5.2 TANK F AREA

Results of headspace screening conducted on soil samples from this area did not indicate the presence of significant VOC contamination. Prior groundwater analytical results from GZA-101 indicated that concentrations of chlorinated hydrocarbons increased significantly between overburden and bedrock groundwater. Based upon observations and screening results during removal of Tank F, overburden VOC contamination was not evident in this area. Therefore, it is possible that the relatively low concentrations of chlorinated hydrocarbons reported in overburden groundwater samples from GZA-101S (29 ug/l), GZA-101M (13 ug/l), and GZA-101D (213 ug/l), may be due to diffusion from the underlying, fractured bedrock in which higher concentrations of chlorinated hydrocarbons were reported in groundwater from GZA-101R (4,976 ug/l). The latter concentration in GZA-101R cannot be explained based upon the east-northeast bedrock groundwater flow directions previously reported during the GZA Phase II investigation. If correct, the bedrock groundwater flow direction reported may indicate an upgradient source of these chlorinated hydrocarbons approximately west of Tank F. Alternatively, this bedrock groundwater quality could be due to local anomalies in groundwater flow.

*

— with exact same contaminants as found in Tank Farm area?

In addition to the anomalous VOC data reported from the Tank F Area, Table 4 indicates results of pH and specific conductance testing on the sample collected from GZA-101R to be 11.36 and 2500, respectively. While these results may be due to measurement errors, they may also indicate the presence of non-volatile compounds in bedrock groundwater from GZA-101R (i.e., the Sharpener's Pond diorite), the potential presence of bentonite or grout that may have entered the Barcad in this zone, the geochemistry of the bedrock, or affects from potential releases of caustic solutions that were reported to be stored in Tank F. Results of groundwater from GZA-101R analyzed for priority pollutant metals during the GZA Phase II investigation indicated copper was detected at 0.02 mg/l, which is below the May 1991 Massachusetts drinking water guidelines of 1.3 mg/l.

5.3 TANK K AREA

Results in the Tank K Area indicate that unsaturated soil and saturated soil have been impacted by BTEX compounds, likely from gasoline releases in the area of the former underground storage tank. Although separate phase product was not observed in this area and the former depths of Tank K and its piping are not known, analytical results of the soil sample submitted from boring WE-2 (Table 2) suggest that VOCs have impacted unsaturated soils in this area. As indicated in Figures 8 and 10 and in Table 2, overburden groundwater and saturated soils appear to have been impacted in a relatively small area between approximately the former tank location and between WE-4S/4D and B-7. Based upon results of BTEX compounds reported in groundwater in this area, combined with headspace screening results at WE-1 and WE-3, the horizontal extent of contamination in the north-south direction in this area is anticipated to be fairly narrow. ?

Prior results have also indicated the presence of BTEX compounds in relatively low concentrations in bedrock groundwater from PZ-7R. Reference to Figure 6 and Table 8 indicates that groundwater flow is expected to be primarily horizontal toward the east in this area. Headspace screening results from boring WE-4D (Figure 8) and gas chromatograph analytical results of water samples from the PZ-7 Barcads indicated significant decreases in BTEX concentrations in soil and groundwater samples with depth at this location. In addition, BTEX compounds are less dense than water. Therefore, although the vertical extent of BTEX compounds in bedrock groundwater in this area is not known at this time, releases from Tank K would be expected to be largely limited to upper portions of overburden groundwater downgradient of the release.

5.4 OUTFALL AREAS

Analytical data collected during this and previous investigations (GZA, 1990a) indicate that sediment near Outfalls 001 and 002 has been impacted by TPHs. However, results do not indicate a well-defined pattern of impacted sediment adjacent to Outfall 001. This may be due to random releases of TPHs from the outfalls or groundwater discharge and subsequent migration and sorption to sediment due to prevailing surface water flow patterns. Although the extent of sediment impacted by TPHs adjacent to Outfall 001 is not currently defined, TPH concentrations in sediment appear to decrease significantly just beyond the Outfall Area.

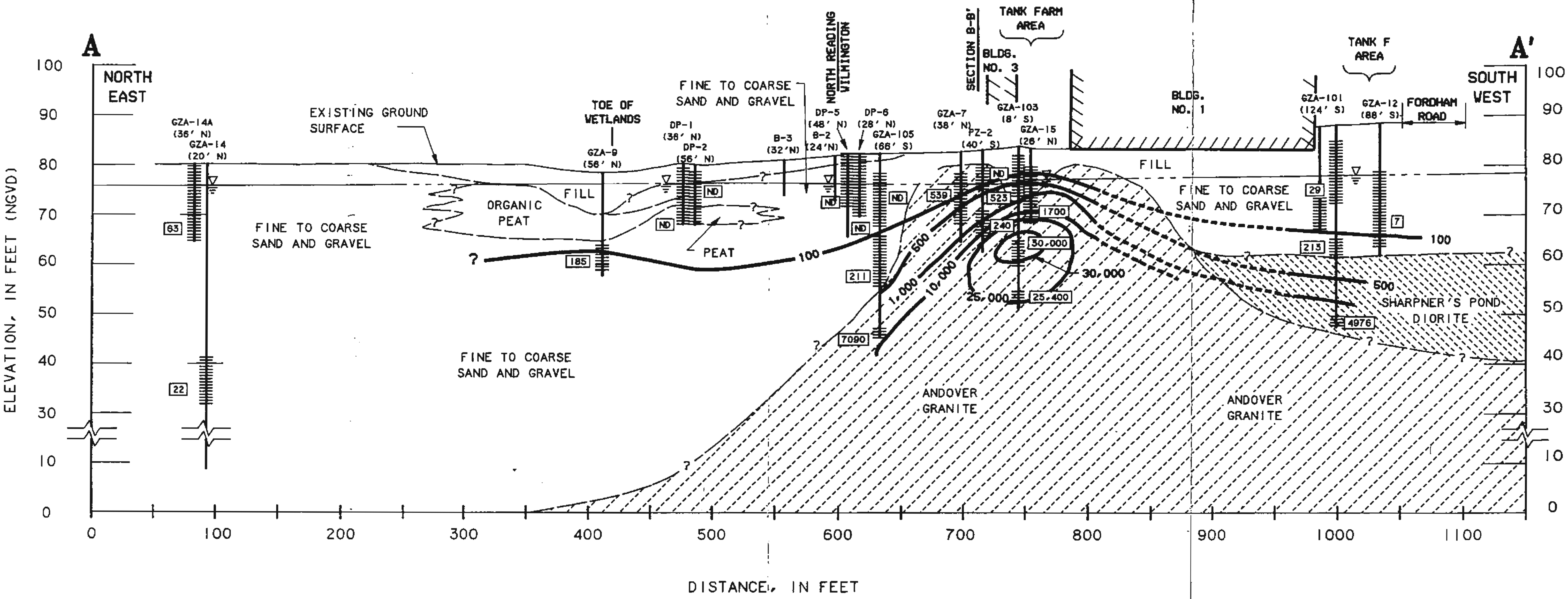
Headspace screening responses were compared to analytical results as a qualitative means of assessing TPH contamination. Results from sample S-5A (Table 2) indicated 610 mg/kg TPHs present in sediment while the headspace screening response from this sample was 80 ppm. Based upon this information, combined with the results described by GZA (GZA, 1990a), the extent of TPH-impacted sediment near Outfall 002 appears to be within the area approximately west of sampling locations S-1A/1B, S-2A/2B, and S-3A/3B. It must be noted that this interpretation is based upon comparison of headspace screening and analytical results, some of which had elevated detection limits due to the relatively low percentage of solids in the samples.

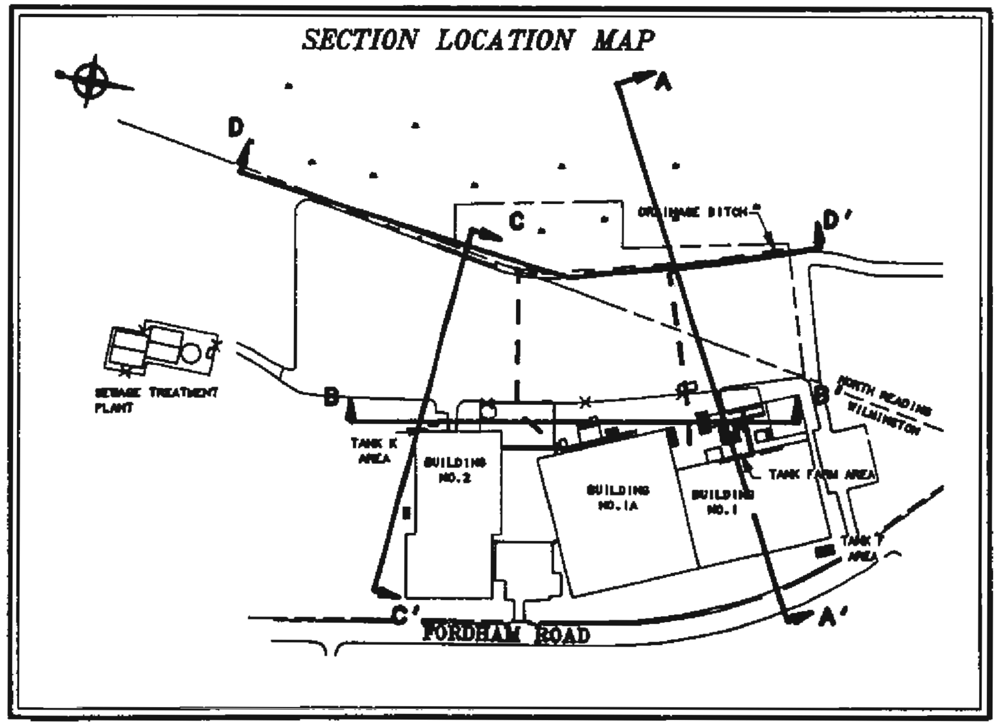
5.5 WETLANDS AREA

Results from the Wetlands Area indicate that TPHs were not detected in surface water samples from the wetlands sampling locations (Table 5) and TPHs were detected in sediment samples. The absence of TPHs in surface water samples above detection limits may be due to high retention of TPHs to sediment or organic materials. Data shown in Table 2 indicate that TPH concentrations in sediments tend to decrease toward the south at the locations sampled.

Chlorinated hydrocarbons, acetone, aromatic hydrocarbons, and methyl ethyl ketone were reported in surface water and sediment from the wetlands sampling locations. Significant trends by compound type or location for sediment samples in which these compounds were reported were not observed (Table 2). However, results of surface water sample analyses (Table 5) indicated that most VOCs identified in these samples were also in sediment from location WL-3.

Table 9 summarizes ABNs detected in wetlands sediment. Results indicate that the majority of ABNs identified were at location WL-5. The majority of the compounds identified were not ~~been~~ reported in groundwater samples analyzed as part of the GZA Phase II investigation, excluding bis(2-ethylhexyl)phthalate. Results of priority pollutant metals analyses indicated that the elevated concentrations of copper discussed in Section 4.0 were at locations WL-1 and WL-2.




SECTION LOCATION MAP

LEGEND:

GZA-5	MONITORING WELL/BORING LOCATION
(16'N)	OFFSET IN FEET AND DIRECTION FROM CROSS-SECTION
╫	SCREENED INTERVAL
▽	APPROXIMATE WATER TABLE SURFACE OCTOBER 30, 1989
——	GEOLOGIC CONTACT
1700	TOTAL CHLORINATED HYDROCARBON CONCENTRATION IN GROUNDWATER (μg/l) (AS OBSERVED BY GZA, 1989)
ND	NOT DETECTED
—1,000- - -	LINE OF EQUAL TOTAL CHLORINATED HYDROCARBON CONCENTRATION, (AS OBSERVED BY GZA, 1989), CONTOUR INTERVAL VARIES
NGVD	NATIONAL GEODETIC VERTICAL DATUM

NOTE:
CONCENTRATION ISOCONS SHOWN INCLUDE INTERPOLATION DUE TO OFFSET DISTANCES.

VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 80'

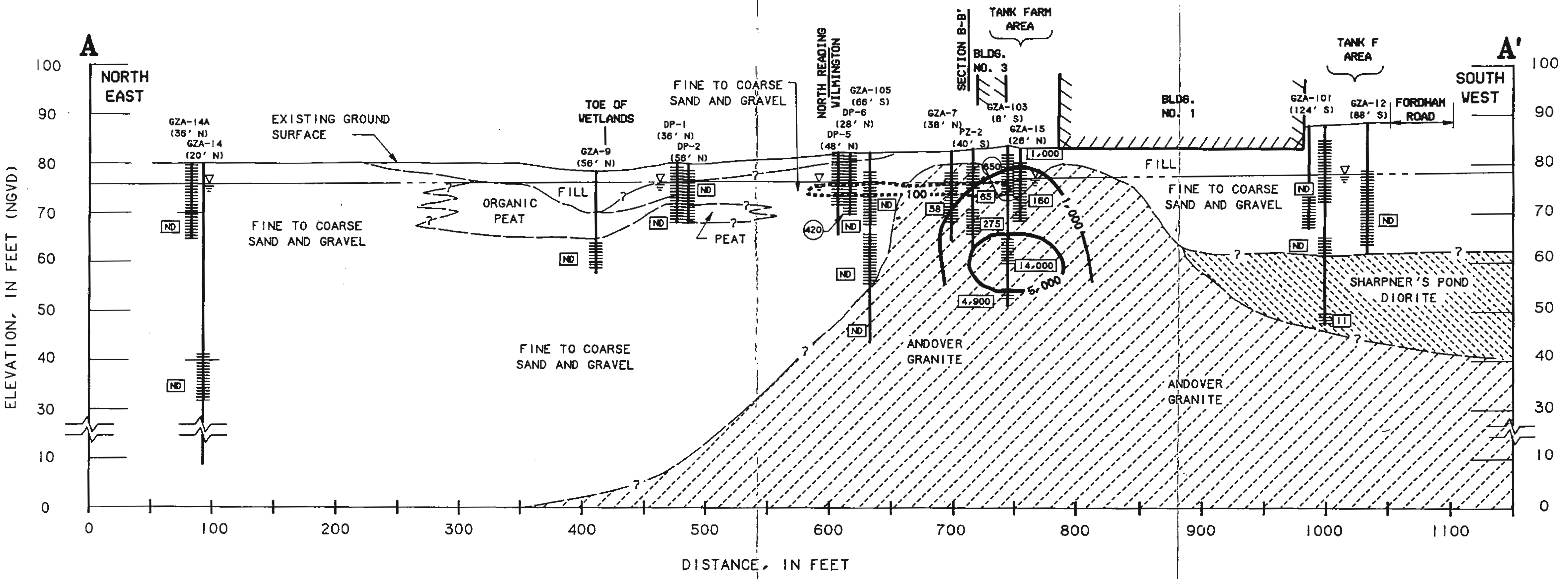
FIGURE 12

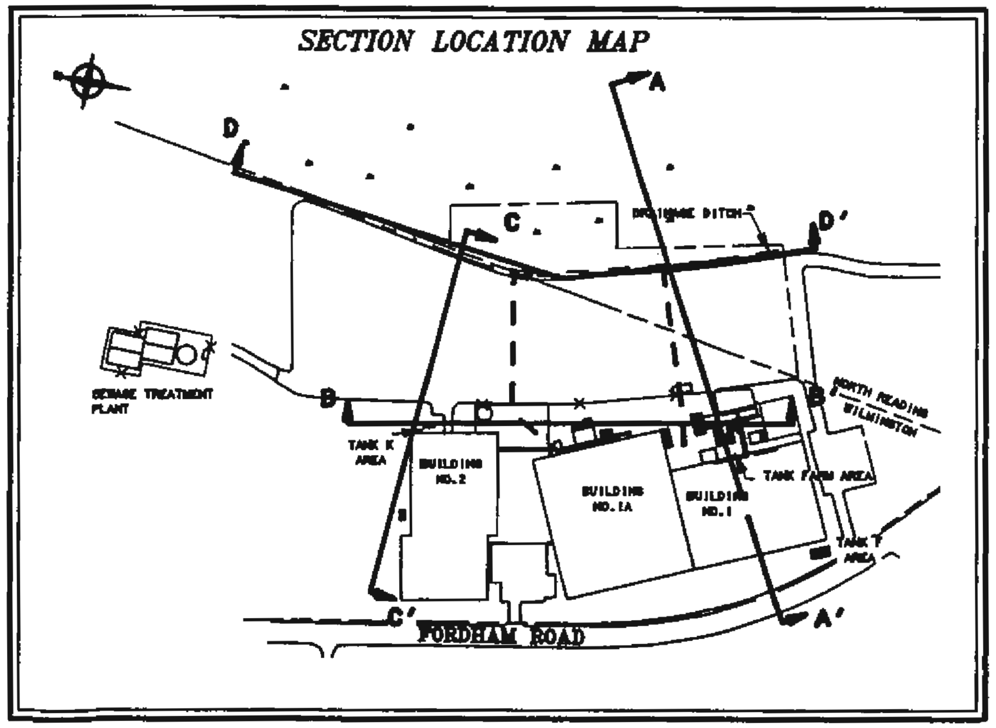
ESTIMATED TOTAL CHLORINATED HYDROCARBON CONCENTRATIONS IN OVERBURDEN AND BEDROCK

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

OCM: (01501 01 HG) SECTION A-A CONTAM DWG: LL109135

WEHRAN PROJECT NO. 01501.01





NOTE:
CONCENTRATION ISOCONS SHOWN INCLUDE INTERPOLATION DUE TO OFFSET DISTANCES.

LEGEND:

GZA-5 (16'N)	MONITORING WELL LOCATION OFFSET IN FEET AND DIRECTION FROM CROSS-SECTION
‡	SCREENED INTERVAL
—▽—	APPROXIMATE WATER TABLE SURFACE OCTOBER 30, 1989
— — —	GEOLOGIC CONTACT
BTEX	BENZENE, TOLUENE, ETHYLBENZENE AND TOTAL XYLENES
TPH	TOTAL PETROLEUM HYDROCARBONS
(420)	TPH CONCENTRATION IN GROUNDWATER (mg/l) (AS OBSERVED BY WEHRAN, 1991)
14,000	TOTAL BTEX CONCENTRATION IN GROUNDWATER (µg/l) (AS OBSERVED BY GZA, 1989)
......100	LINE OF EQUAL TPH CONCENTRATION, (mg/l), (AS OBSERVED BY WEHRAN, 1991)
—1,000	LINE OF EQUAL BTEX CONCENTRATION IN GROUNDWATER, (µg/l), (AS OBSERVED BY GZA, 1989), CONTOUR INTERVAL VARIES
NGVD	NATIONAL GEODETIC VERTICAL DATUM

VERTICAL SCALE: 1" = 20'
HORIZONTIAL SCALE: 1" = 80'

FIGURE 13

ESTIMATED TPH AND BTEX CONCENTRATIONS IN OVERBURDEN AND BEDROCK

GENERAL ELECTRIC - AEROSPACE
WILMINGTON/N. READING, MASSACHUSETTS

OCM:(01501.01.HG)TOTAL PETRO HYDROCARBONS DWG:ML109141

6.0 CONTAMINANT FATE AND TRANSPORT

This section discusses the fate and transport of contaminants identified at the site based upon groundwater, surface water, soil, and sediment analytical data and information concerning site physical characteristics presented in previous sections.

Based upon the extent of contamination observed at the site combined with historical information, three primary impacted areas on site were identified, those being the Tank Farm Area, the Eastern Parking Lot Area, and the Tank K Area.

Also STM-10 + 6ZA-101R bedrock

wetlands to lesser extent

6.1 CONTAMINANT RELEASES

6.1.1 Tank Farm Area

Based upon analytical data, it is reasonable to assume that an historical release of chlorinated hydrocarbons and BTEX compounds may have occurred in the vicinity of the Tank Farm. The reported prior use of the tanks in this area was for the storage of methanol, waste oil, jet fuel, and Stoddard solvent. Therefore, the source of the chlorinated hydrocarbons in this area is not known. While low percentages of chlorinated hydrocarbons in the liquids previously stored in the tanks could produce the concentrations observed, evidence of this occurrence is not available. Since the tanks have been removed from the site, the principal sources of contamination releases have been removed. However, it appears that there may be residually impacted soils in the overburden fill material. It is likely that contaminants in these soils have been subjected to environmental decay since the tanks were removed. Primary decay mechanisms include percolation (which dissolves contaminants and transports them to groundwater), groundwater flow (which dissolves and transports contaminants from impacted areas by advection), and to a lesser extent, volatilization (in which a fraction of VOCs form a vapor phase in unsaturated soil pore space and ultimately migrate to the atmosphere). Because each of these processes results in the reduction of contaminant mass in the impacted areas, both the extent and magnitude of impacts associated with these areas would be expected to decline in the future.

Some of the higher concentrations of chlorinated hydrocarbons in groundwater in the Tank Farm Area represent low percentages of the water solubility limits of some compounds identified. Both the concentrations and location of the chlorinated and BTEX compounds identified in bedrock groundwater could indicate the potential for separate phase product to have been released from the tanks and to have migrated into the surrounding bedrock. If so, it is possible that chemical gradients or density gradients may have been instrumental in the migration of these compounds following their release. The presence of separate phase product was not observed in RW-1 or GZA-103S during this investigation. The monitoring point with the highest concentrations of these compounds, GZA-103R1, is completed with a Barcad in which oil/water interface measurements could not be obtained. Therefore, the absence or the potential presence of separate phase liquids in bedrock in the Tank Farm Area has not been confirmed.

6.1.2 Eastern Parking Lot Area

It appears that a release of Stoddard solvent likely occurred in the vicinity of piezometer PZ-2S. Although specific information is not available to corroborate this, it is reasonable to assume this based upon analytical data. In addition, since the parking area is paved (and therefore relatively impermeable to TPHs), the separate phase product observed in borings in the parking lot would likely have ~~to~~ originated in an area where it could have reached the water table. This would likely be a grassed area, such as near PZ-2S or the Tank Farm. Since there appears to have been relatively higher concentrations of TPHs detected in soil and water near the PZ-2S area as compared to the Tank Farm Area, both during this and the GZA Phase II investigation, it appears that the deduction of a release of Stoddard solvent near PZ-2S is reasonable.

Based upon analytical data and field observations, TPHs potentially released in the area of PZ-2S have dispersed across the top of the water table within the approximate area illustrated in Figure 13. Since TPHs are less dense than water, this would be expected. Although present as a separate phase product, dissolution of TPHs from the separate phase is likely to be occurring, contributing to the dissolved TPHs observed in groundwater approximately downgradient from the separate phase. In addition, since TPHs are floating on top of the water table, fluctuations in the elevation of the water table will cause smearing of TPHs within the zone of fluctuation and the capillary fringe. This allows TPHs to sorb to the soil matrix, creating a zone of residually contaminated soil above the water table. Due to the relatively impermeable nature of the paved parking area above the majority of the separate phase product and the limited availability for recharge by percolation due to the pavement, it is likely that the TPHs sorbed to unsaturated soil particles in this manner remain in this state until the water table rises again causing dissolution of the TPHs to the aqueous phase. This sorption/desorption process would be an on-going contaminant release mechanism and is likely the reason for the relatively high concentrations of TPHs observed in the unsaturated soil sample analyzed from boring B-2 (Table 2).

6.1.3 Tank K Area

As discussed previously, it appears that both unsaturated and saturated soils have been impacted within a relatively localized area near the former Tank K Area. Separate phase product was not observed in monitoring wells in this area, however concentrations of BTEX compounds identified in groundwater from WE-2 are in the range of low percentages of water solubility limits for these compounds. This indicates the potential for separate phase BTEX compounds, likely from gasoline, to have been released here. Based upon analytical results, field observations, and the relatively localized area impacted, it appears that the volume of product released may have been relatively small. Furthermore, due to the relatively shallow depth to groundwater in the area (Figure 8) and because the area above the former tank location is grassed (Figure 3), it is possible that the release has dispersed in a relatively thin film on top of the water table and may be fluctuating as the water table is recharged by percolation. As with the Tank Farm, since the tank and piping have been removed from the site, the principal source of contaminant releases has been removed and the extent and magnitude of impacts associated with this area would be expected to decline in the future.

6.2 CONTAMINANT MIGRATION PATHWAYS

As discussed in the GZA Phase II report (GZA, 1990), the site is located in an area that may have been influenced by groundwater withdrawals associated with the previous operation of the Stickney well. Therefore, it is possible that historical conditions may have created contaminant migration pathways that no longer exist at the site and therefore, may not be relevant for ~~elevation~~ evaluation? of current remedial objectives. Accordingly, the discussion below addresses contaminant migration pathways that were determined to be relevant under current conditions.

6.2.1 Tank Farm Area

Dissolved contaminants released in the Tank Farm Area would be subjected to two migration pathways. For contaminants near the ground surface, volatilization may be possible. Of greater significance, however, is contaminant migration in groundwater. The majority of the contaminant mass released here is likely transported in a dissolved phase in the general direction of groundwater flow. The fact that the ground surface in this area is currently grassed or bare soil also allows percolation to recharge the area and contribute to contaminant dissolution and migration. Based upon the site hydrogeology described previously, dissolved contaminants from the Tank Farm Area that are not attenuated would undergo advective transport in groundwater into the overburden. Since the tanks were located within a depression in the bedrock (that may have been created to construct the Tank Farm) it appears that dissolved contaminants could migrate from the surrounding overburden fill into the surrounding, fractured bedrock. Where present at greater depths within bedrock, dissolved VOCs would be expected to flow outward from this area dependent upon the local fracture patterns, joints, and interconnectivity of these structural features, toward areas of lower local hydraulic head. Therefore, it is possible that dissolved VOCs may be migrating outward from the overburden fill material, through the bedrock knob underlying this area, and then back into overburden material to the east of the Tank Farm. However, review of data from four potentiometric measurement programs conducted between August 1989 and March 1990 indicate that the bedrock potentiometric surface fluctuated during this period with reversals in the hydraulic gradient observed. Therefore, these potentiometric data indicate that bedrock groundwater flow and therefore potential migration of dissolved VOCs in bedrock groundwater is currently unresolved.

6.2.2 Eastern Parking Lot Area

Separate phase product consisting primarily of Stoddard solvent is present on top of the water table in the Eastern Parking Lot Area. The presence of pavement above the majority of this product reduces the likelihood of a significant migration pathway to the atmosphere, however, components of the TPHs with high vapor pressures may migrate within the unsaturated zone beneath the paved surfaces. Due to the greater viscosity of this product as compared to water and its tendency to sorb to the soil matrix, it is not expected to migrate a significant rate as compared to the estimated groundwater flow rate. However, dissolved TPHs resulting from this separate phase product would be expected to be advected in the general direction of groundwater flow, subject to attenuation due to sorption to the soil matrix.

6.2.3 Tank K Area

In the Tank K Area, the shallow depth to groundwater and the presence of the grassed area above the former tank location suggest that vapor phase transport ending with volatilization to the atmosphere may be a viable migration pathway in this area. In addition, dissolved VOCs would be expected to migrate generally in a horizontal direction with advective groundwater flow, also subject to attenuation by sorption to the soil matrix. As discussed previously, the ability for shallow groundwater to be recharged in this area may contribute to VOC migration due to percolation and dissolution of VOCs sorbed to unsaturated soil particles.

6.2.4 Outfall and Wetlands Areas

The primary contaminant transport mechanism at the site is believed to be advective groundwater flow. However, based upon previous data, it appears that the outfalls may have served as migration pathways for the TPHs observed in sediment at the outfall locations. In addition, the gravel packs surrounding the drainage lines and surface water within the wetlands also may function as migration pathways for contaminated groundwater or surface water that has migrated to these areas from upgradient impacted areas. One potential example of this would be the ABNs and VOCs identified in the wetlands samples discussed previously but not reported in groundwater samples between the on-site buildings and the wetlands. Although the primary uses of the ABN compounds are either organic synthesis or as research chemicals, it is not clear if these specific compounds were used previously at the GE facility.

have these areas been tested for ABNs?

6.3 CONTAMINANT FATE

Based upon data obtained to date, the hydrogeologic relationship between the overburden and the wetlands is not completely understood. Therefore, the fate of contaminants migrating in groundwater cannot be completely assessed at this time. However, it is possible that some overburden groundwater may discharge to the wetlands near the Eastern Parking Lot. If so, VOCs would be expected to volatilize once they reached the surface water. VOC concentrations observed in the surface water samples collected at the toe of the wetlands indicate that the mass of VOCs released to the atmosphere under this scenario is not likely to be significant. In addition, based upon the sorption characteristics of the TPHs and ABNs identified in sediment in the Wetlands and Outfall Areas, these compounds are likely to remain strongly sorbed to sediment, with minimal volatilization to the atmosphere.

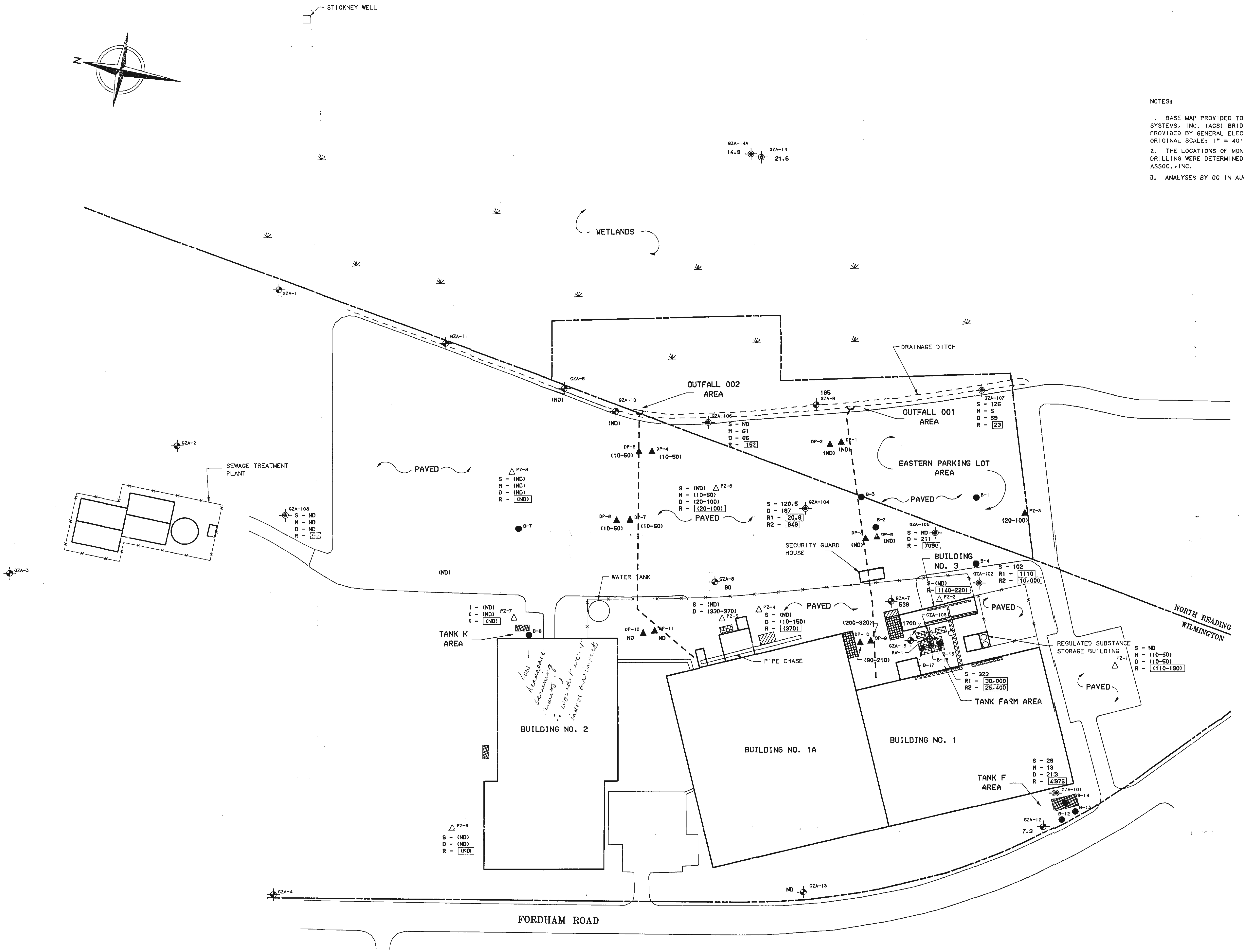
7.0 REFERENCES

Bouwer, Herman; 1989; "The Bouwer and Rice Slug Test - An Update"; Ground Water; v. 27; n. 3; pp. 304-309

Bouwer, Herman and R.C. Rice; 1976; "A Slug Test For Determining Hydraulic Conductivity of Unconfined Aquifers With Completely Or Partially Penetrating Wells"; Water Resources Research; v. 12; n. 3; pp. 423-428.

GZA; 1990; "Phase II Report, 50 Fordham Road Property, Wilmington/North Reading, Massachusetts"; GZA File No. 7650.54; April.

GZA; 1990a; "Evaluation of Petroleum Distribution, Employee Parking Lot and Drainage Outfall Areas, 50 Fordham Road Property, Wilmington, Massachusetts"; GZA File No. 7650.55; November.



NOTES:

1. BASE MAP PROVIDED TO WEHRAN ENGINEERING BY AUTOMATED COMPLIANCE SYSTEMS, INC. (ACS) BRIDGEWATER, NJ. ACS MAP DEVELOPED FROM PLAN PROVIDED BY GENERAL ELECTRIC COMPANY ENTITLED "SITE PLAN", UNDATED, ORIGINAL SCALE: 1" = 40'.

2. THE LOCATIONS OF MONITORING WELLS INSTALLED BY GZA AND BY GUILD DRILLING WERE DETERMINED BY SURVEY PERFORMED BY DANA F. PERKINS & ASSOC., INC.

3. ANALYSES BY GC IN AUGUST, 1989 AND BY GC/MS IN NOVEMBER, 1989.

LEGEND:

⌖ GZA-10	MONITORING WELLS INSTALLED BY GZA DRILLING, INC. FROM NOV., 1986 TO MAY 1987.
⌖ GZA-14	MONITORING WELLS INSTALLED BY GUILD DRILLING, INC. IN MAY, 1987.
△ PZ-1	MULTI-LEVEL PIEZOMETER INSTALLED BY GZA DRILLING, INC. IN JULY AND AUGUST 1989.
▲ PZ-3	SINGLE-LEVEL PIEZOMETER INSTALLED BY GZA DRILLING, INC. IN JULY AND AUGUST 1989.
▲ DP-1	DRAINLINE PIEZOMETER INSTALLED BY GZA DRILLING, INC. IN JULY 1989.
⌖ GZA-101	MULTI-LEVEL MONITORING WELL CLUSTER INSTALLED BY GZA, DRILLING, INC. IN SEPTEMBER AND OCTOBER 1989.
⌖ RW-1	RECOVERY WELL INSTALLED BY CLEAN HARBORS, INC. IN NOVEMBER, 1990
>- - - -	DRAINLINE OUTFALL
—x—	CHAINLINK FENCE
— - —	PROPERTY LINE
▩	FLOWMETER TEST STANDPIPE CHASES
▦	DRYDRUM STORAGE AREA
▨	UNDERGROUND STORAGE TANK LOCATION-EXISTING TANK
▩	UNDERGROUND STORAGE TANK LOCATION-REMOVED TANK
21.6	TOTAL CHLORINATED HYDROCARBONS AND STYRENE CONCENTRATION IN OVERBURDEN GROUNDWATER, IN PARTS PER BILLION (ppb).
4976	TOTAL CHLORINATED HYDROCARBONS AND STYRENE CONCENTRATION IN BEDROCK GROUNDWATER, IN PARTS PER BILLION (ppb).
S,M,D,R	DENOTES SCREENED ZONE OF WELL COUPLET, SEE WELL CONSTRUCTION LOGS FOR DETAILS.
( )	DENOTES ANALYSIS BY GAS CHROMATOGRAPH. NO PARENTHESES INDICATES ANALYSIS BY GAS CHROMATOGRAPH/MASS SPECTROPHOMETER.
ND	NOT DETECTED, SEE REPORT FOR DETECTION LIMITS

OCM:(01501.01.HG)CHS IN SOIL WATER DWG:ML109139

WehranEnviroTech

		DATE
DESIGN BY:	ESW	
DRAWN BY:	ML	
CHECKED BY:	ESW	
SUPV. BY:	BJC	
APP'VD BY:	CFM	

Scales
0 80 160
SCALE IN FEET

PHASE II SUPPLEMENTAL INVESTIGATION
GENERAL ELECTRIC - AEROSPACE
WILMINGTON/NORTH READING MASSACHUSETTS

FIGURE 10
CHLORINATED HYDROCARBONS AND STRYENE
CONCENTRATIONS IN GROUNDWATER

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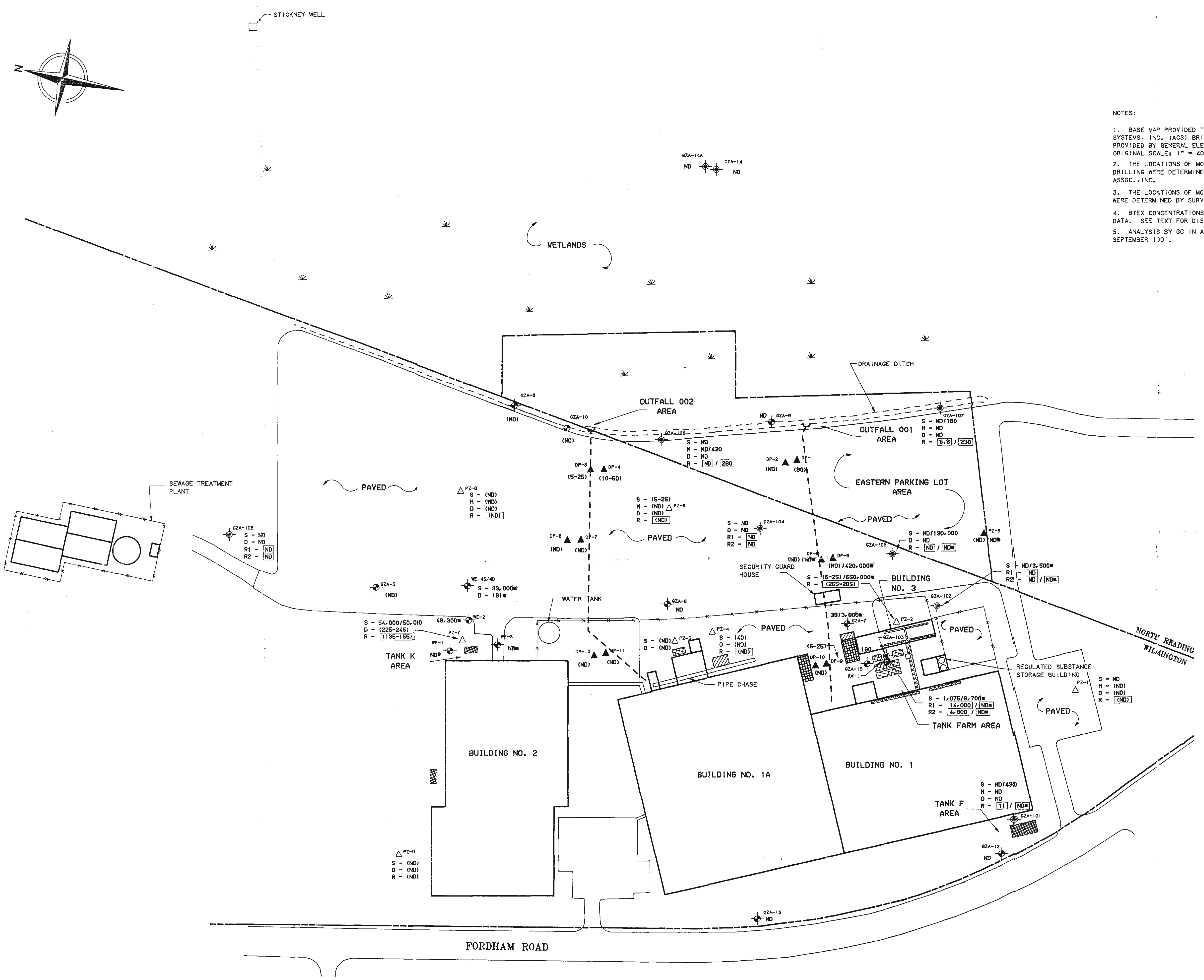

NOTES:

1. BASE MAP PROVIDED TO WEHRAN ENGINEERING BY AUTOMATED COMPLIANCE SYSTEMS, INC. (ACS) BRIDGEWATER, NJ. ACS MAP DEVELOPED FROM PLAN PROVIDED BY GENERAL ELECTRIC COMPANY ENTITLED "SITE PLAN", UNDATED, ORIGINAL SCALE: 1" = 40'.

2. THE LOCATIONS OF MONITORING WELLS INSTALLED BY GZA AND BY GUILD DRILLING WERE DETERMINED BY SURVEY PERFORMED BY DANA F. PERKINS & ASSOC., INC.

3. THE LOCATIONS OF MONITORING WELLS INSTALLED BY WEHRAN ENGINEERING WERE DETERMINED BY SURVEY PERFORMED BY WEHRAN ENGINEERING.

4. BTEX CONCENTRATIONS SHOWN ARE BASED UPON 1989 AND 1991 ANALYTICAL DATA. SEE TEXT FOR DISCUSSION AND LIMITATIONS.

5. ANALYSIS BY GC IN AUGUST 1989 AND BY GC/MS IN NOVEMBER 1989 AND SEPTEMBER 1991.

LEGEND:

GZA-1	MONITORING WELL INSTALLED BY GZA DRILLING, INC. FROM NOV., 1986 TO MAY, 1987.
GZA-10	MONITORING WELLS INSTALLED BY GZA DRILLING, INC. FROM NOV., 1986 TO MAY 1987.
GZA-14	MONITORING WELLS INSTALLED BY GUILD DRILLING, INC. IN MAY, 1987.
△ PZ-1	MULTI-LEVEL PIEZOMETER INSTALLED BY GZA DRILLING, INC. IN JULY AND AUGUST 1989.
▲ PZ-3	SINGLE-LEVEL PIEZOMETER INSTALLED BY GZA DRILLING, INC. IN JULY AND AUGUST 1989.
▲ DP-1	DRAINLINE PIEZOMETER INSTALLED BY GZA DRILLING, INC. IN JULY 1989.
GZA-101	MULTI-LEVEL MONITORING WELL CLUSTER INSTALLED BY GZA, DRILLING, INC. IN SEPTEMBER AND OCTOBER 1989.
RW-1	RECOVERY WELL INSTALLED BY CLEAN HARBORS, INC. IN NOVEMBER, 1990
≻- - -	DRAINLINE OUTFALL
—×—	CHAINLINK FENCE
— — —	PROPERTY LINE
▨	FLOWMETER TEST STANDPIPE CHASES
▦	DRYDRUM STORAGE AREA
▨	UNDERGROUND STORAGE TANK LOCATION-EXISTING TANK
▩	UNDERGROUND STORAGE TANK LOCATION-REMOVED TANK
BTEX	BEZENENE, TOLUENE, ETHYLBENZENE AND XYLENE
TPH	TOTAL PETROLEUM HYDROCARBONS
1,075/6,700	TOTAL BTEX/TPH CONCENTRATIONS IN OVERBURDEN GROUNDWATER, IN PARTS PER BILLION (ppb)
230	TOTAL BTEX CONCENTRATIONS IN BEDROCK GROUNDWATER, IN PARTS PER BILLION (ppb)
S,M,D,R	DENOTES SCREENED ZONE OF WELL COUPLET, SEE WELL CONSTRUCTION LOGS FOR DETAILS
( )	DENOTES ANALYSIS BY GAS CHROMATOGRAPH. NO PARENTHESES INDICATES ANALYSIS BY GAS CHROMATOGRAPH/MASS SPECTROPHOTMETER.
ND	NOT DETECTED, SEE REPORT FOR DETECTION LIMITS
■	DENOTES 1991 DATA, ALL OTHER DATA COLLECTED IN 1989

OCM: (01501.01.HG)BTEX IN SOIL WATER DWG:ML109140

181777

WehranEnviroTech

		DATE
DESIGN BY:	ESW	
DRAWN BY:	ML	
CHECKED BY:	ESW	
SUPV. BY:	BJC	
APP'VD BY:	CFM	

Scales
0 80 160
SCALE IN FEET

PHASE II SUPPLEMENTAL INVESTIGATION

GENERAL ELECTRIC - AEROSPACE

WILMINGTON/NORTH READING MASSACHUSETTS

FIGURE 11

BTEX AND TPH CONCENTRATIONS IN GROUNDWATER

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