REPORT

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE
Site ID # 3-36-035

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

VOLUME I
REMEDIAL INVESTIGATION

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Department of Environmental Conservation
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Tuxedo Waste Disposal Site

Orange County, New York
Site I.D. No. 3-36-035

Volume I
Remedial Investigation
November 1991

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EXECUTIVE SUMMARY

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As part of the State of New York's program to remediate hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) entered into a contract with Metcalf & Eddy of New York, Inc. (M&E) to undertake a Remedial Investigation and Feasibility Study (RI/FS) for the Tuxedo Waste Disposal Site, aka the Barone/Sacco Dump Site, located in the Town of Tuxedo, Orange County, New York. This document, entitled "Remedial Investigation/Feasibility Study Report for the Tuxedo Waste Disposal Site," presents a detailed description of the activities and results of the field investigation program of the RI, as well as the results of the FS covering all three phases of the multi-phased RI/FS as part of a multi-phased RI/FS. The RI work was directed toward completing the characterization of the nature and extent of the contamination at the site and providing data needed to complete the feasibility study.

This report consists of two volumes plus appendices. This report, Volume 1, discusses the RI activities. Appendices to the RI are in Volume 2, and Volume 3 contains the FS and appendices to the FS.

The objectives of the Phase I RI/FS were to obtain the information needed to perform the feasibility study, determine whether additional investigative or interim remedial measures are needed, and determine if the list of potential remedial alternatives identified during Task 2, is complete.

Site investigation activities and studies conducted during this phase of the RI program included:

- Site survey
- Installation of five additional groundwater monitoring wells (two fractured bedrock, two competent bedrock, one overburden)

- Sampling and analysis of groundwater from existing and newly installed wells
- Seven subsurface soil borings and sampling
- Sampling and analysis of Ramapo River water and sediment
- Perimeter soil gas survey
- Magnetometer survey
- Radiation survey
- Soil temperature survey
- Baseline emissions estimate including recording of meteorological data and limited ambient air monitoring for hydrogen sulfide (H_2S)
- Baseline health risk assessment
- Habitat based assessment

In addition, seven interim remedial measures (IRMs) to address site security and improve surface drainage were completed.

Results of the 1990 M&E Phase I Remedial Investigation are summarized below. In general, they are consistent with previous investigations at the site.

- The increased risk of cancer to potential off-site receptors due to emissions of soil gas from the site is less than three in one million, based on EPA risk factors. The increased risk of cancer at the locations of present residences is less than one in one million, based on EPA risk factors.
- No significant chronic non cancer health risk is indicated based on modeled maximum off-site concentrations of contaminants.
- Modeled ambient hydrogen sulfide concentrations indicate a nuisance odor problem in the area.
- Groundwater underlying the site has been contaminated by metals and low levels of organic compounds. Groundwater contamination in the overburden deposits is migrating eastward to the Ramapo River, and limited data indicates it is migrating vertically downward into the fractured bedrock portion of the aquifer system.
- The water quality of the Ramapo River is marginally being affected by the site. Groundwater contaminated by several metals and low

concentrations of volatile and semi-volatile organic compounds is migrating from the site and discharging into the Ramapo River. This is evidenced by elevated levels of certain metals and semi-volatile organic compounds detected in river sediment samples collected along the river bank at mid-site and downstream sampling locations.

- Surface runoff is entering the landfill through a damaged section of drain pipe and the drain pipe feed area.

Based on the results of the RI, additional sampling efforts are recommended for the existing monitoring wells and the Ramapo River to develop a sufficient data base to predict trends and potential contaminant plume movements.

SECTION 1

1.0 INTRODUCTION

1.1 PURPOSE OF STUDY AND REPORT

As part of the State of New York's program to remediate hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) entered into a contract with Metcalf & Eddy of New York, Inc. to undertake a Remedial Investigation and Feasibility Study (RI/FS) for the Tuxedo Waste Disposal Site, aka the Barone/Sacco Dump Site, located in the Town of Tuxedo, Orange County, New York. The site identification number for this New York State Class 2 Superfund Site is 3-36-035. The RI/FS for this site was performed with funds allocated under the 1986 Environmental Quality Bond Act.

The Purpose of an RI/FS is to perform: 1) a Remedial Investigation (RI) to determine the nature and extent of contamination at the site and the risk to public health and the environment; and 2) a Feasibility Study (FS) which will identify and evaluate mitigation alternatives and recommend a long-term remedial action plan, if necessary. Services provided by Metcalf & Eddy (M&E) are defined by Tasks 2, 3, and 4 of M&E's June, 1990, Project Work Plan for conducting a phased RI/FS. The work included Remedial Investigation and Feasibility Study activities, in three phases, implementation of Interim Remedial Measures (IRMs), and health and environmental risk assessments.

In the first phase of the study, M&E carried out RI work (Phase I RI) to characterize the site contamination and provide data needed to perform the feasibility study. Site contamination was initially the subject of a Phase II Site Investigation Study prepared by Lawler Matusky & Skelly (LMS) in 1989. M&E's Phase I RI involved review and analysis of existing information on the site as well as a field sampling program to investigate soil, soil gas, air, groundwater, surface water, and surface water sediment at and in the vicinity of the site. This study phase characterized contamination of environmental media, as well as defined extent of media contamination, migration pathways, and exposed populations.

As part of the Phase I FS, M&E's review of site conditions, based on information from Tasks 2 through 4 in the Project Work Plan, determined whether the list of proposed remedial alternatives identified in Task 2 for the site was complete.

The Health Risk Assessment prepared by M&E was based on a baseline emissions estimate (BEE) for volatile organic compounds and hydrogen sulfide. The emissions were ascribed to specific sections of the landfill site and incorporated into the Industrial Source Complex - Short Term (ISCST) computer model to determine potential short-term and long-term health impacts in the area around the site.

The second phase of the study was the preliminary screening of remedial alternatives identified in the Phase I FS and incorporation of the results into a Phase II FS. This screening included a lifetime review on treatment technologies and a reassessment of remedial objectives for the Tuxedo site.

This document, representing Phase III of the study, describes the activities and results of the field investigation program of the Phase I RI, including validated data from the RI field sampling and the results of the Phase I and II FS as part of a multi-phased RI/FS program. A summary of the key elements of the Phase II Site Investigation Survey report prepared by LMS is included. The entire LMS report is included by reference along with a summary of all recent data taken by NYSDEC prior to the inception of the M&E RI/FS work in June, 1990, and the results and conclusions from Tasks 2, 3, and 4. Volumes I and II of this report cover the RI and its appendices. Volume 3 covers the FS and its appendices.

1.2 REPORT ORGANIZATION

Section 1.0 provides a general description of the site background and history that led to undertaking this RI/FS program. Included is an overview of the nature and extent of the chemical contamination, including media and contaminants of concern as documented by previous investigations. In addition, this section provides a brief listing of Interim Remedial Measures (IRMs) to be implemented at the site.

Section 2.0 describes the regional characteristics of the study area surrounding the Tuxedo Waste Disposal Site including topography and surface drainage, geology and hydrogeology, and demography and land use.

Section 3.0 describes the field activities and investigative methods used during the RI field activities, including topographic surveying, soil boring and sampling, bedrock coring, monitoring well installation, groundwater sampling, surface water and sediment sampling, geophysical, radiation, temperature, perimeter soil gas and baseline emission surveys, and habitat assessment.

Section 4.0 presents results of the RI field activities, including data validation and usability analyses. Analytical results are provided for the soil, groundwater, and surface water and sediment samples collected during the RI. This section describes the site specific topography, geology and hydrogeology. In addition, the results of the physical surveys, the baseline emission estimate field activities, and the habitat based assessment are presented.

Section 5.0 discusses the nature and extent of contamination at the site in the various environmental media.

Section 6.0 discusses contaminant fate and transport. This section provides the models used to develop the Baseline Risk Assessment. The primary focus is on groundwater and air pathways of migration. Site specific meteorological data are also presented.

Section 7.0 provides a baseline assessment of the public health and environmental risks and concerns related to the site contaminants found in the study. Contaminants of concern are identified along with potential routes of exposure. Reassessment of target clean-up levels is also addressed in this section.

Section 8.0 reviews the IRMs completed during this phase of the project.

Section 9.0 summarizes the Remedial Investigation. It includes site contamination, contaminant transport, associated risks, and reassessment of target clean-up levels for each media. Data limitations are discussed as well as any additional data requirements. Conclusions and recommendations are presented.

Appendices - Certain subtask reports of the Remedial Investigation are too extensive or detailed to include in the main body of this document. Therefore, abstracted portions of these works are included in the main text, and the entire subtask reports are included as appendices. These include:

- Habitat Based Assessment
- Magnetometer Survey
- Perimeter Soil Gas Survey
- Baseline Emissions Estimate

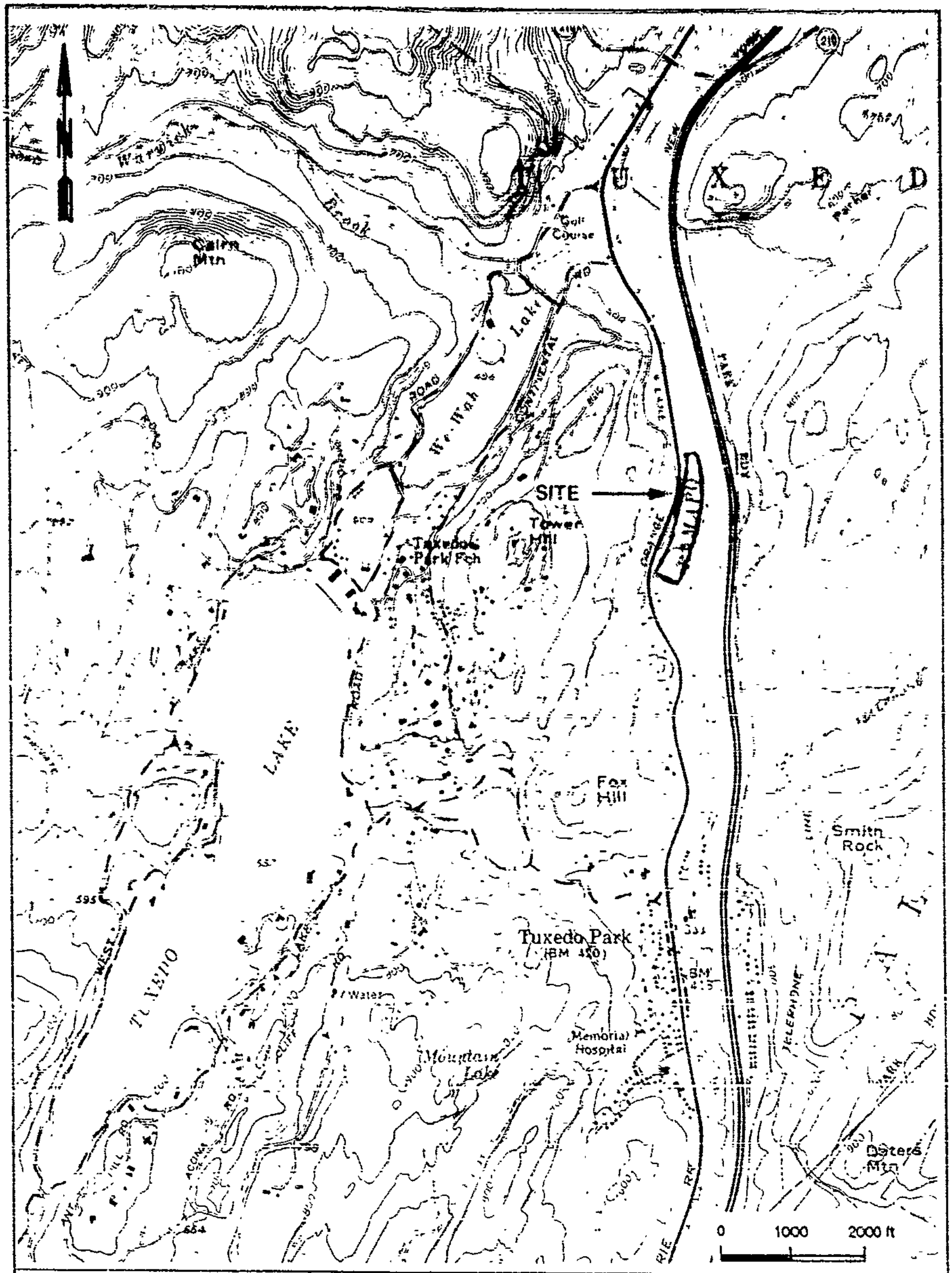
The following appendices provide supplemental or supporting data and information:

- Health Risk Information
- Data on Groundwater and Surface Water Conditions
- Boring Logs
- Monitoring Well Completion Diagrams

1.3 SITE BACKGROUND

1.3.1 Site Description

The Tuxedo Waste Disposal Site is a 12-acre landfill located in the Town of Tuxedo, Orange County, New York. As shown in Figure 1-1, the site is located along Route 17 within 200 feet of the Ramapo River (Latitude 41° 12' 36" N, Longitude 74° 11' 02" W). The site is privately owned and is also known as the Barone Demolition Landfill. The site is a purported construction and demolition debris landfill that began operation in February 1987 and has received hazardous waste. In addition, the site is known to be the source of odor problems that have resulted in citizen complaints.



Metcalf & Eddy of New York, Inc.

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

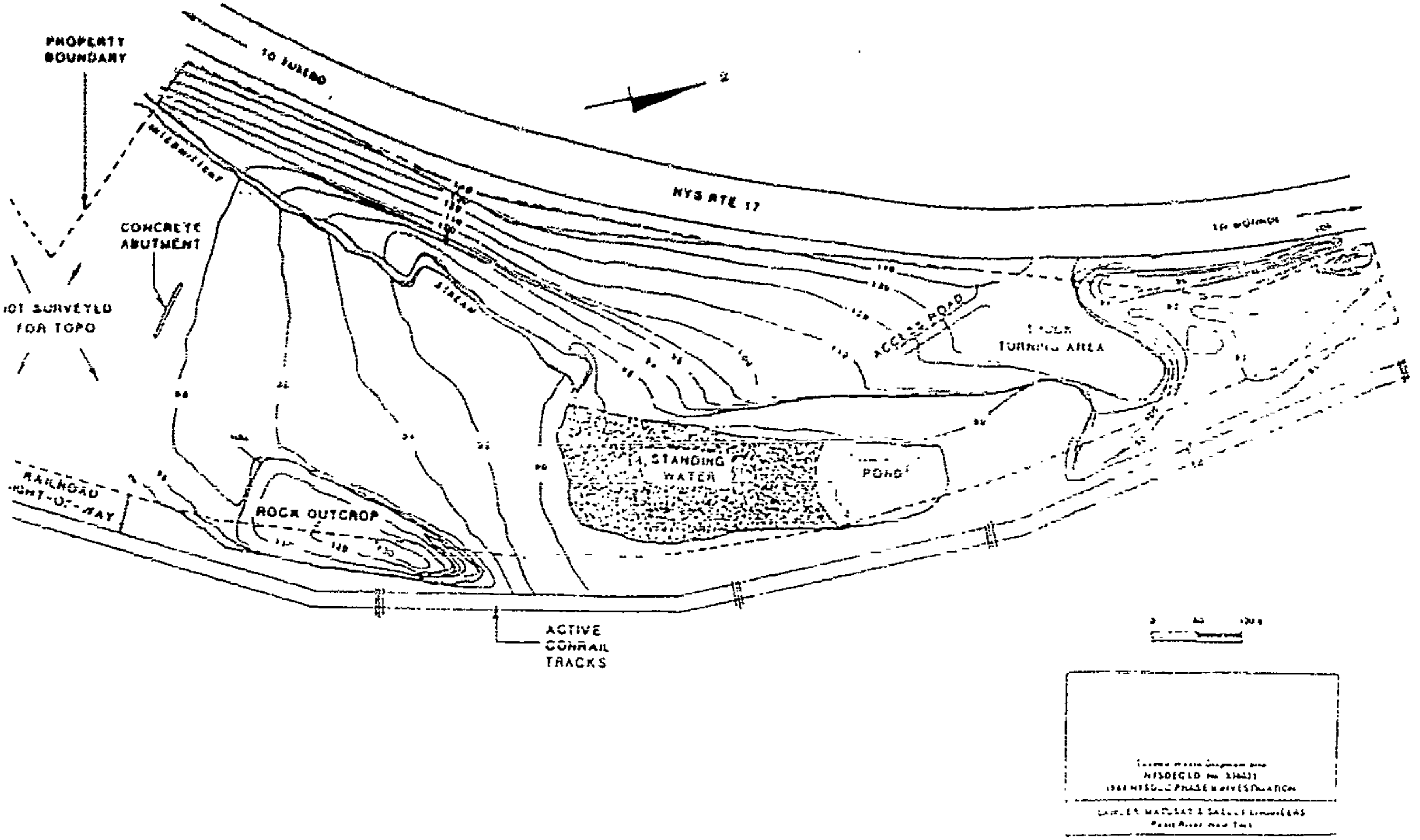
FIGURE 1-1
SITE LOCATION MAP

1.3.2 Site History

The site history information that follows was extracted from Volume 2 of the Project Work Plan Summary NYSDEC Phase II Report. In March 1987, the New York State Department of Environmental Conservation (NYSDEC) inspected the site and found improper landfill practices including disposal of waste materials which were not construction and demolition (C&D) debris. Waste materials were also disposed on an adjacent property owned by the Georgia Institute of Technology Foundation. In October 1987, a court-ordered temporary restraining order prohibited further disposal on the site and required the placement of cover material over the existing waste material to control odors. Figures 1-2 and 1-3 are pre-fill and post-fill topographic maps.

Additional historical information is summarized chronologically as follows:

1959	Anthony Cucolo Corp. purchased the property
1961	Thruway Asphalt Co. purchased the property
1985	Mr. Renard Barone, Esq., of Tuxedo and Mr. Sarkin Khourouzian of Sloatsburg, New York purchased the property.
February, 1987	Operation as a purported construction and demolition (C&D) debris landfill began. The landfill operation was managed by Mr. Frank Sacco.
March 17, 1987	A NYSDEC Forest Ranger first observed the landfilling operation.
March 18, 1987	NYSDEC representatives (Forest Ranger and Assistant Sanitary Engineer) first inspected the site and observed the dumping of non-C&D waste including plastics, tires, clothing, rugs, cardboard, paper, foam rubber and white goods. Mr. Frank Sacco was advised of a violation of the C&D exemption and operating with a lift height greater than 10 feet. The site was ordered closed and a summons was issued.
March 23, 1987	A NYSDEC Forest Ranger observed continuing dumping and advised Mr. Barone of continuing violations.



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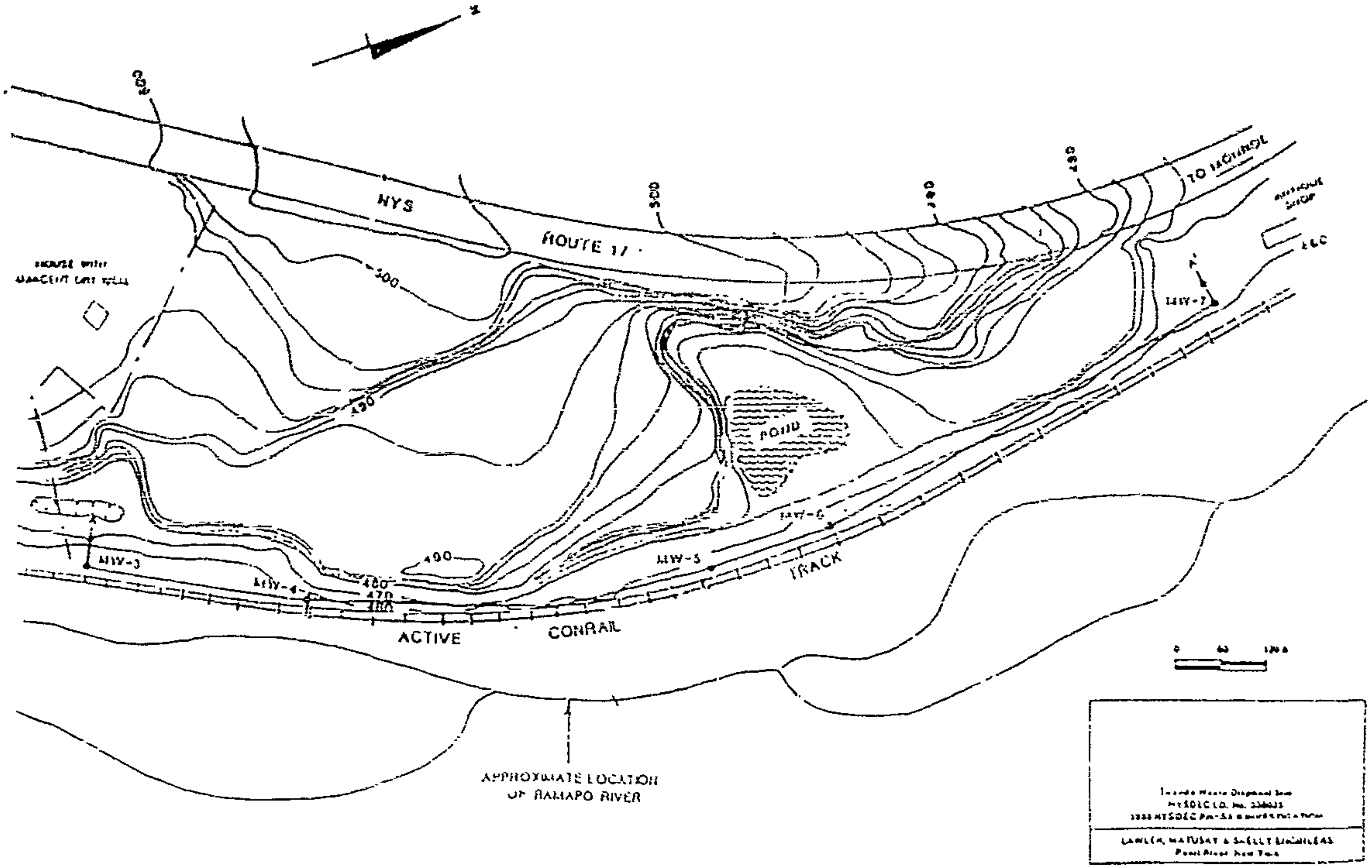
TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 1-2
PRE-FILL TOPOGRAPHIC MAP



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TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 1-3
POST-FILL TOPOGRAPHIC MAP

March 24, 1987	A NYSDEC Forest Ranger observed continuing dumping and a meeting was held between NYSDEC and Mr. Barone, with his attorney and his consultant.
March 27 to May 7, 1987	On twelve occasions, NYSDEC officials observed evidence of the disposal of non C&D wastes including plastics, paper, tires, metal goods, cloth products, white goods, cardboard and household garbage.
April, 1987	Site odors were reported.
April 3, 1987	A NYSDEC Environmental Conservation Officer served a Stop Work Order to the site representative.
August 25, 1987	A NYSDEC Forest Ranger observed evidence of hospital waste disposal.
September, 1987	The New York State Attorney General requested a temporary restraining order.
October 7, 1987	A temporary restraining order was issued by state court which halted dumping.
October 14, 1987	Data revealed that cover material contained low concentrations of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs).
October 27, 1987	NYSDEC groundwater and surface water data available.
November 17-18, 1987	Ambient air, gas vents, landfill material and sludge sample analyses completed.
January-October 1988	Surface water sampled by the North Jersey District Water Supply Commission.
June 16, 1988	Ambient air sampling performed by New York State Department of Health (NYSDOH).
March 23, 1988	Ambient air and gas vent sampling performed by NYSDEC
April 7, 1988	NUS completes Preliminary Assessment of site for EPA.
April 28, 1988	NYSDOH groundwater sampling completed.
May 4, 1988	NYSDEC contract signed with Lawler, Matusky and Skelly Engineers (LMS) to perform Phase II investigations for 20 sites. The Tuxedo Site is designated as No 1 priority.

June 16, 1988	LMS site reconnaissance and limited ambient air sampling. NYSDOH to perform more extensive air sampling. Phase II Investigation Work Plan sent to the Town of Tuxedo.
June, 1988	Sampling by LMS for Phase II site investigation is initiated.
August 2, 1988	Initial test trench excavated. Work postponed until larger backhoe mobilized to site.
August 9-10, 1988	Additional test trenches excavated (3) and waste samples collected.
August 10, 1988	Sampling of cover material and landfill material completed by NYSDEC.
September 15, 1988	Sampling of ambient air, cover material and landfill material by the Georgia Institute of Technology Foundation.
November 7-8, 1988	Groundwater, surface water and sediment resampled by NYSDEC staff and LMS.
March 17, 1989	Site is classified as a "2" by the NYSDEC Bureau of Hazardous Site Control Director
March 31, 1989	LMS submitted Phase II Investigation Report to NYSDEC.
August 23, 1989	Groundwater and surface water sampled by NYSDEC.
October 30, 1989	NYSDEC issued Work Assignment for M&E to prepare a Project Management Work Plan for additional investigations, immediate remedial work and feasibility study.
February 2, 1990	NYSDEC authorized M&E to proceed with the preparation of a Final Work Plan for the Remedial Investigation/ Feasibility Study (RI/FS).

1.4 PREVIOUS INVESTIGATIONS

The following information is taken from Volume 2 of the Project Work Plan Summary NYSDEC Phase II Report. It summarizes the results of previous site investigations and is based on the Phase II Investigation report prepared by LMS in March 1989.

1.4.1 Air

Air emissions related to the Tuxedo Waste Disposal Site were sampled several times prior to 1990 due to odor complaints and the concern regarding exposure to air emissions. Previous air sampling conducted at natural site vents indicated the presence of both volatile organic compounds (VOCs) and hydrogen sulfide (H_2S) in the air emissions. However, air sampling conducted at or beyond site boundaries did not indicate off-site migration of air contaminants. Nevertheless, air contaminants were clearly being released from the site. Although measurable levels of H_2S were not detected off-site during sampling events, the odor problems continued as a nuisance to people in the vicinity of the site. A preliminary assessment documented a population of 440 within one mile of the site.

1.4.2 Groundwater

The analytical results of groundwater sampling conducted prior to M&E's 1990 undertaking of the Phase I RI indicated that no organic compounds were present above detection limits in groundwater at the site. However, several metals were detected at elevated concentrations indicating a site impact on groundwater quality. Comparison of the metals concentrations collected during two earlier sampling events suggests that these concentrations were generally increasing.

1.4.3 Surface Water

Data collected prior to 1990 suggests that the Ramapo River has received contamination from the site as well as possibly from an upstream source. The analytical results indicated that elevated concentrations of metals were found in surface water samples, and elevated levels of metals and semi-volatile organic compounds, consisting mainly of polycyclic aromatic hydrocarbons (PAHs), were detected in surface water sediment samples collected at mid-site and downstream sampling locations. However, similar concentrations detected at the "background" sample location made it difficult to identify the site as the sole source of contamination.

1.4.4 Soil Gas

In addition to methane gas, previous soil gas testing detected benzene, toluene, ethylbenzene and ethylene volatile fractions. Several soil gas samples contained levels of H_2S that exceeded 2,000 ppm.

1.4.5 Soil

The analytical results of cover material samples collected prior to the M&E Phase I RI indicated that PCBs and PAHs were found at maximum concentrations of 1.04 mg/kg (ppm) and 2.0 mg/kg (ppm), respectively. In addition, soil samples were taken in trenches and test pit excavations. The analytical results of samples collected during these earlier investigations identified elevated concentrations of semi-volatile organic compounds (mainly PAHs), volatile organic compounds (VOCs), PCBs (maximum PCB concentration of 3.0 ppm) and metals. The highest metal concentrations, detected in percentage ranges, included calcium (3.4 to 9.2 percent), iron (1.37 to 3.92 percent) and lead (.05 to .22 percent). Also, aluminum, magnesium, potassium and zinc were detected in the 0.1 to 1.0 percentage range. However, analytical results at the time did not warrant the classification of the materials as hazardous wastes. The initial findings of these investigations also indicated the presence of petroleum contaminated soils, Stoddard solvent, and PAH containing materials (railroad ties) resulting from past disposal practices at the site.

1.5 MEDIA AND CONTAMINANTS OF CONCERN

The contaminants of concern in each media were identified from previous investigations and are summarized in Table 1-1. Hydrogen sulfide, methane and VOCs are contaminants of concern in air. VOCs are also contaminants of concern in soil and groundwater. Semi-volatile organic compounds and metals are contaminants of concern in soil, groundwater, surface water, and sediment. PCBs are contaminants of concern in soils. Contaminants of concern were addressed in detail in two sections of the M&E June 1990 Project Work Plan:

- Summary Analysis - Potential Remedial Alternatives - Volume 3

TABLE 1-1 MEDIA AND CONTAMINANTS OF CONCERN					
Contaminants of Concern	Media				
	Air and Soil Gas	Soil	Groundwater	Surface Water	Surface Water Sediment
Hydrogen Sulfide	X				
Methane	X				
Volatile Organic Compounds	X	X	X		
Semi-volatile Organic Compounds		X	X	X	X
Metals		X	X	X	X
PCBs		X			

- Summary NYSDEC Phase II Report and Related Information - Volume 2

1.6 Interim Remedial Measures (IRMS)

Some site issues identified from previous investigations were addressed prior to implementing final remedial alternatives at the Tuxedo Waste Disposal Site Specific interim remedial measures (IRMs) implemented to deal with these site issues and to mitigate potential site hazards fall into two basic categories:

- Site Security
- Drainage Improvements

1.6.1 Site Security

The following IRMs were developed in the Work Plan to reduce or eliminate the possibility of unauthorized entry and/or contaminant exposure at the site:

- Installation of approximately 210 feet of fencing and a gate at the west entry road to the site to deter public vehicular access.
- Security measures including: 1) installation of steel reinforcing bars at the ends of the drainage pipe that crosses the southern portion of the site to prevent humans and animals from entering the pipe, and 2) securing the manhole cover at the manhole.

1.6.2 Drainage Improvements

These activities were intended to reduce standing water on the site and to reduce the flow of off-site drainage onto the site. These improvements included:

- Drainage of ponded water in the central portion of the site and the filling, grading and seeding of the regraded basin to eliminate standing water and control seepage and erosion.
- Inspection and hydraulic slug testing of the existing 24-inch corrugated metal drain pipe which runs beneath the southern portion of the site. The work was performed to evaluate the integrity of

the pipe and determine the need for and feasibility of repairing the pipe. Additional work was done to improve the culvert inlet to the pipe.

- Evaluating the need for diverting runoff from the west of Route 17 to reduce run-on to the site.
- Clearing the existing drainage swale at the north end of the site, thereby reducing surface water flow into the landfill.

1.6.3 Other

During the 1990 site activities, NYSDEC requested that M&E prepare a Fire Contingency Plan to address potential hazards resulting from a subsurface fire at the site.

Section Two

SECTION 2

2.0 REGIONAL CHARACTERISTICS

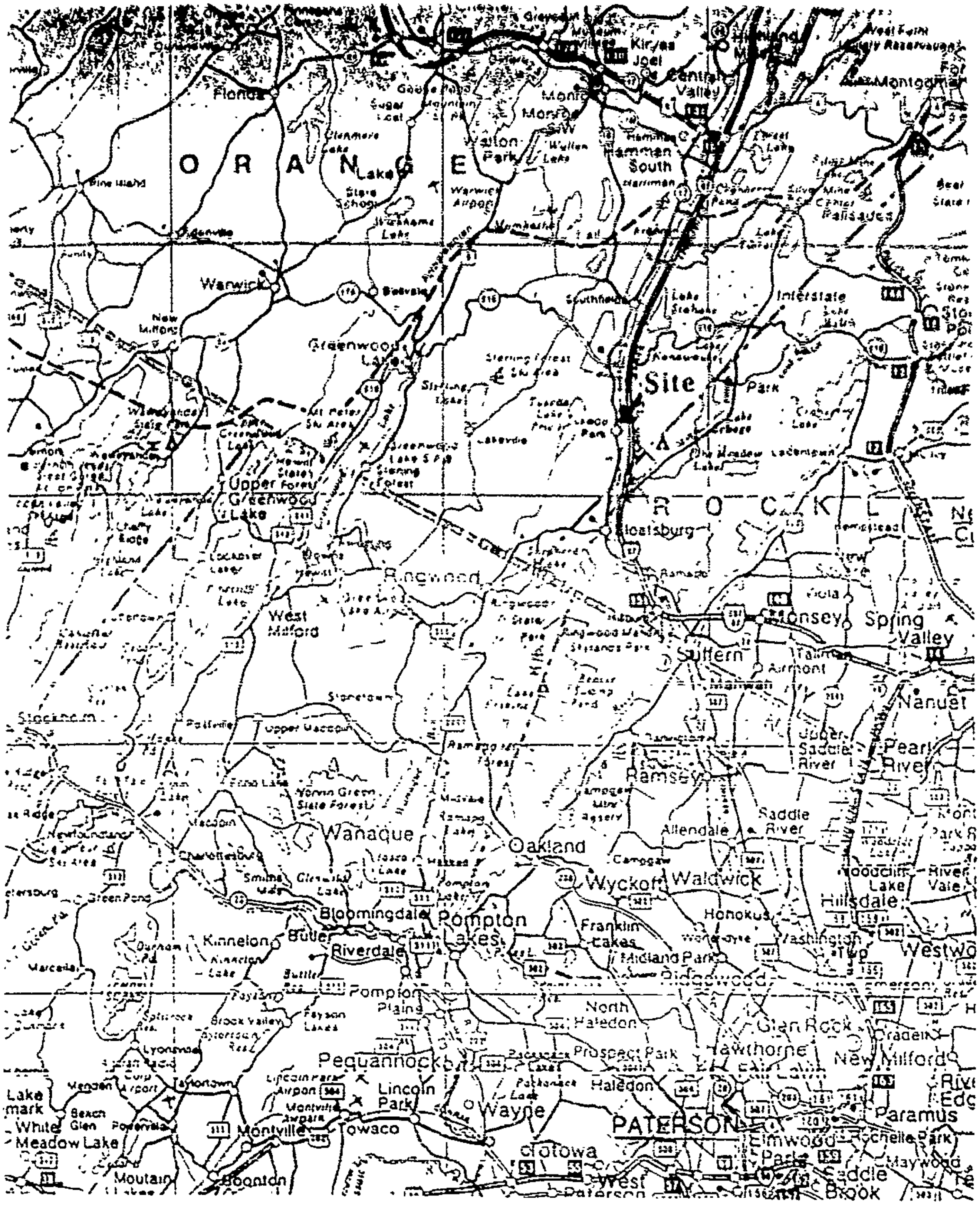
2.1 TOPOGRAPHY AND SURFACE DRAINAGE

The Tuxedo Waste Disposal Site is located within the New England Upland Physiographic Province. The natural processes of weathering and erosion have formed the topography and surface drainage visible in this area today. Topography throughout the region forms characteristic northeast-southwest trending ridges. This regional topographic trend is believed to be a subdued imprint of the bedrock geology. In this region, areas underlain by foliated geology are marked by narrow parallel ridges, and areas of more massive rock make poorly defined broad uplands. Valleys mark zones of less resistant rock and shearing along faults. Glaciation has modified the topography by scouring ridges to create outcrops of bedrock and filling the valleys to make bedrock outcrops uncommon in low lying regions (New York State Museum and Science Service, 1989).

The Ramapo River flows from north to south through the study area. The surface drainage and topographic regimes east and west of the river provide natural positive flow to the Ramapo River through various drainage tributaries. Regional surface drainage within the Ramapo River drainage basin has been previously described as dendritic (Lawler, Matusky & Skelly, March 1989). Within the study area, the Ramapo River is designated as Class A surface water, based on current New York State Surface Water Classification Guidelines.

2.2 DEMOGRAPHY AND LAND USE

The Tuxedo Waste Disposal Site is located along Route 17 in the Town of Tuxedo, Orange County, New York (see Figure 2-1). The site is located in the southeastern part of the county, close to the Rockland County border and approximately 4.5 miles from the New Jersey State border. The 1990 Census lists the population of the Town of Tuxedo as 3,023 people, distributed over an area of 47.5 sq. miles, which corresponds to a population density 63.7 per sq. mile.



Scale in Miles (Approximate)

Scale: 0 5 10

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TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 2-1
REGIONAL LOCATION MAP

Development in the immediate vicinity of the site is limited to isolated establishments along Route 17. Some residential/commercial establishments are within 1/4 mile of the site North of the site, these include the Duck Cedar Inn on the west side of Route 17 and antique shops located on property adjacent to the site Property owned by Georgia Tech lies immediately south of the main portion of the site A residential community on Stevens Lane is approximately 1/4 mile southwest of the landfill

Other concentrations of residential/business development are located at least half a mile from the landfill. The Village of Tuxedo Park, one-half mile west of the site, is a low-density residential area in the center of the Town of Tuxedo It contains Tuxedo Lake, Wee Wah Lake, residences, schools, and a Village Hall. According to 1990 Census figures (New York State Department of Economic Development, February 1991), Tuxedo Park has a population of 06 distributed over a 2.7 sq. mile area (population density of 263.4 per sq. mile)

Approximately one mile south of the site is the Town of Tuxedo central business district, which includes a railroad station, Town offices, police station, and shops along Route 17. Sloatsburg is the next nearest development to the south It is located in Rockland County approximately three miles from the site.

Laurel Ridge and Clinton Woods are communities within Tuxedo located approximately two miles directly northwest of the landfill. These residential areas, which include the Indian Kills Reservoir, are centered around State Route 17A (210) and County Route 84.

The Red Apple Rest, approximately two miles north of the site, is a restaurant, gift shop, and gas station. The nearest residential community to the north is Southfields, a locality approximately 2½ miles from the site within the Town of Tuxedo. It includes a post office and development centered on the intersection of Route 17 and County Route 19. Arden, another locality within the Town of Tuxedo, is approximately five miles north-northeast of the landfill.

Harriman State Park encompasses areas east of the site. Visitors to the park would likely be at least one-half mile from the site. The nearest residences to the east are at least two miles away.

An active railroad exists between the site and the Ramapo River. The railroad is a single-track line owned by Conrail. Both Conrail and Metro North Commuter Railroad use the line. Metro North provides passenger service of approximately sixteen trains per day operating on a schedule between 5:30 AM and 10:30 PM. Conrail provides freight service, which does not have a fixed schedule and operates 24 hours per day. Approximately two freight trains per day pass the site. Although some of the trains and schedules are provided by NJ Transit, Metro North is responsible for the commuter service when the trains enter New York.

As shown in Figure 1-1, the site lies between two north-south roadways: 1) Route 17, a 4-lane state highway bordering the site on the west; and 2) NYS Thruway (I-87), a 6-lane state highway passing approximately 500 feet east of the site. The nearest east-west route that intersects Route 17 is State Route 17A (210) and County Route 106, 1½ miles north of the site.

2.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

As stated in Section 2.1, the site lies within the Hudson Highlands extension of the New England Upland Physiographic Province. Bedrock in the region is comprised of ancient igneous and mesomorphic rocks altered by past geologic events.

Generally, the ascension of geologic materials from bedrock to the surface begins with unweathered bedrock followed by fractured and sometimes partially weathered bedrock, which grades into the residual soils and glacial tills of the area. Each layer's thickness is highly variable and is dependent on the resistance of the particular rock type to natural weathering processes, geologic events at a specific site, and the effects of erosion and deposition during recent times. The general understanding of these typical conditions is important in evaluating the geology and hydrogeologic conditions at a specific site in the Hudson Highlands Additional geologic information can be found in the 1989 LMS Report.

Regional overburden deposits consist of recent alluvial deposits, outwash sand and gravel, and glacial till Recent alluvial deposits are generally confined to floodplains within the valleys In the larger valleys, these deposits are typically overlain by silt resulting from frequent flooding. Typical thicknesses of these alluvial deposits generally range from 3 to 30 feet

Outwash sands and gravels are the result of preglacial fluvial deposition. Generally finer in texture with increasing distance from the glacial border, these well rounded and stratified deposits range in thickness from 6 to 60 feet

Glacial till generally constitutes the majority of overburden deposits within the region. Deposited beneath and along the border of the glacier ice, these deposits usually consist of a poorly sorted clay, silt, sand, gravel and cobbles. Their occurrence ranges from abundant, well rounded diverse lithologies in valley tills to relatively angular, more limited lithologies in upland tills. The till deposits tend to contain increasing sand content in areas underlain by gneiss and sandstone

The hydrogeology and groundwater generally occur under confined conditions within this physiographic province. Groundwater flow in this province is strongly dependent on the three-dimensional configuration of geologic deposits through which flow takes place. In this area the groundwater surface is very likely to be a subdued replica of the ground surface topography.

SECTION 3

3.0 DESCRIPTION OF FIELD ACTIVITIES

3.1 TOPOGRAPHIC SURVEY & SAMPLING GRID

3.1.1 Purpose

As part of the RI/FS, a topographic survey was performed by YEC, Inc. of Valley Cottage, NY, a Licensed Land Surveyor registered in New York State. A survey base map and grid system were developed for the site. The objectives of the field survey were to simplify data management and standardize maps, drawings, and other information pertinent to the RI/FS and future site operations. Horizontal and vertical controls were established at locations surrounding the site. These elevations were tied into USGS datum points, and the contour elevations on the topographic maps were referenced to Mean Sea Level (MSL). The surveying program was an integral part of the following field activities:

- Subsurface analyses utilizing monitoring well location and elevation.

- A horizontal grid system across the site to provide specific sampling stations for a magnetometer survey, radiation testing, soil gas characterization, and soil temperature monitoring.

3.1.2 Preliminary Field Survey

To establish elevations and geographical coordinates for RI activities, a preliminary field survey was conducted at the site to locate and tie into existing benchmark(s) and/or monument(s) and establish an accurate control network based on the LMS survey performed for the Phase II Investigation. Grid lines were established with X,Y coordinates marked across the site in 100' x 100' spacing. Wooden survey stakes with fluorescent paint were positioned at each 100' grid line intersection and labelled. The resultant map showing the grid system provided sampling locations for several of the RI activities (see Figure 4-1). The field survey provided an update of the present topographic configuration of the landfill, including all vertical measurements for contours in elevations referenced to mean sea level, and provided documentation for any discrepancies with previous surveys.

3.1.3 Secondary Field Survey

Following installation of the M&E RI series of monitoring wells, a second field survey was conducted to establish monitoring well coordinates and elevations. The existing MW series of seven wells were resurveyed, and the updated well coordinates and elevations were plotted on the site map. In addition, a permanent staff gauge was placed in the Ramapo River at the mid-site sampling location to provide a permanent location for water level measurements.

3.1.4 Method

The field survey followed New York State standards for surveying and was performed in accordance with M&E Work Plan and Contract Specifications. Horizontal measurements were made with an Electric Distance Meter (EDM) or steel tape. Vertical measurements were performed with a transit and staff. Steel reinforcing rod was used to mark grid stations at locations surrounding the site.

3.1.5 Quality Assurance/Quality Control

The field survey work was performed in the manner described in the Field Activities Plan and Project Work Plan dated June, 1990. The final survey map is shown in Figure 3-1. All final horizontal points were reduced to plane coordinates, and all vertical points are referenced to mean sea level.

3.2 SOIL BORING AND BEDROCK CORING

3.2.1 Purpose

Seven borings were completed along the downgradient slope of the landfill to delineate the top of competent bedrock and were used to develop a cross-section. Boreholes were advanced down to the top of the bedrock as determined by split-

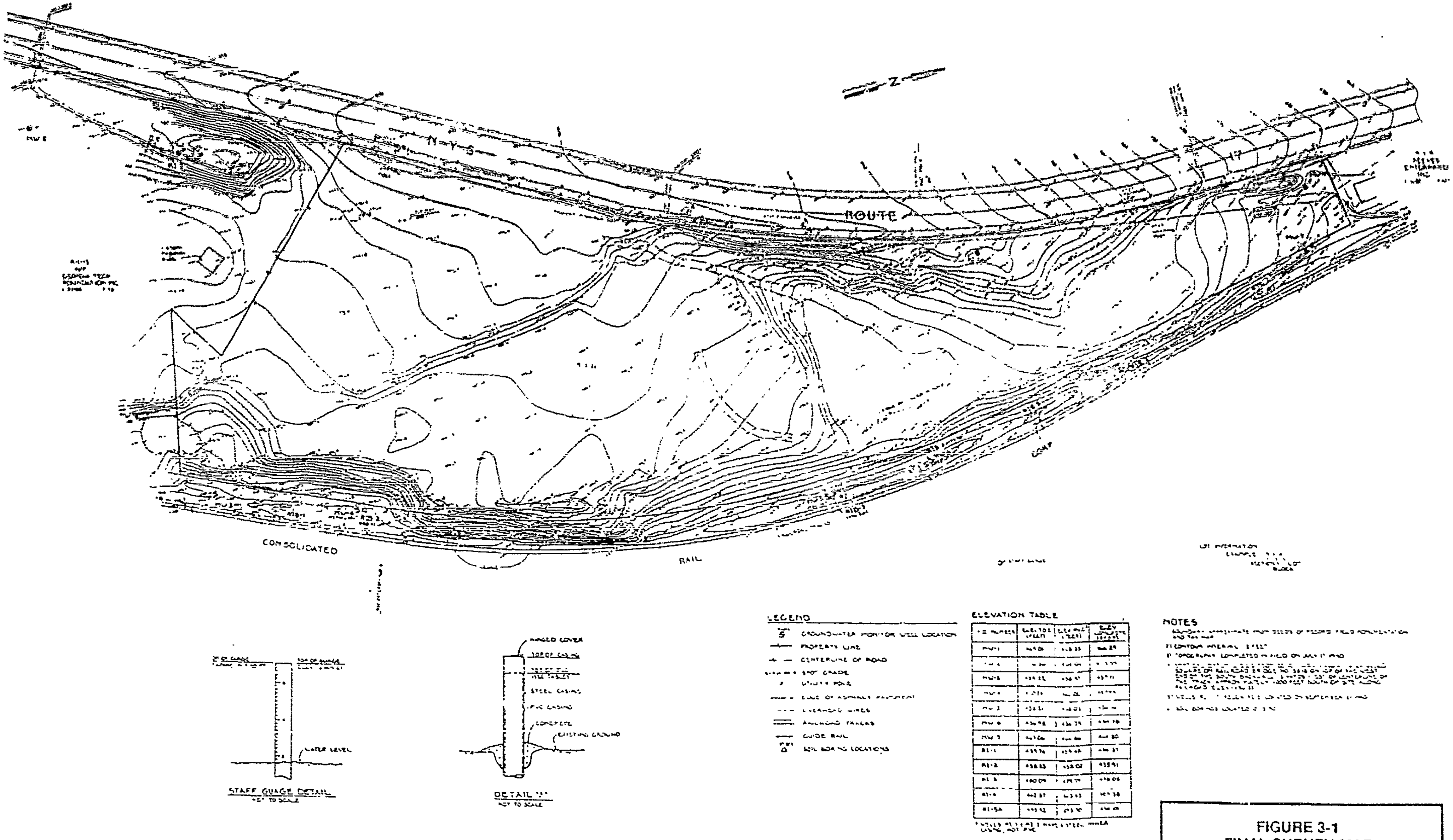

FIGURE 3-1
FINAL SURVEY MAP
TUXEDO WASTE DISPOSAL SITE
TOWN OF TUXEDO, ORANGE COUNTY, NEW YORK
SOURCE: YEC, Inc., Valley Cottage, New York

spoon refusal and then confirmed by rock coring. The locations of these borings, which were spaced on a north-south line running along the eastern border of the site, appear in Figure 3-2. Borings provide detailed information on the subsurface conditions (overburden and bedrock) necessary for evaluating remedial alternatives proposed for the site. This investigation was conducted to obtain information for characterizing the physical environment beneath the site and evaluating the soil and bedrock along the eastern border of the site.

3.2.2 Drilling Methods/Borehole Soil Sampling Procedure

Tools used for the drilling included hollow auger sections, hollow auger head and drive cap, center rod column and rod-to-cap adaptor. Upon completion of a five-foot increment of drilling, an additional section of hollow auger and center rod was added. Drilling progressed in five-foot increments. Sampling was accomplished by removing the center rod and inserting the split-spoon sampler through the hollow stem of the auger.

The borings were performed by a licensed driller who operated the truck-mounted hollow stem auger drill rig. Drilling and sampling operations were performed under the technical direction of an M&E geologist who maintained continuous logs of the borings and visually classified the soils encountered.

Bedrock coring was completed during the field investigation in conjunction with groundwater monitoring well installations. Borehole advancement through the overburden was completed using 4-1/4 inch ID hollow stem augers to bedrock refusal. Continuous monitoring of combustible gases and organic vapors was performed during borehole advancement using an Industrial Scientific Combustible Gas Meter and HNu Systems Model P-101, 10.2 eV portable photoionizer. During auger advancement, soil samples were collected using a split barrel sampler at permitting depths, typically five-foot intervals.

Following contact with bedrock, a temporary NX casing was advanced through the augers and seated into bedrock to prevent overburden materials from entering the borehole. Continuous coring of the bedrock was completed using an N-series, double tube 3-inch OD core barrel fitted with a diamond cutting head.

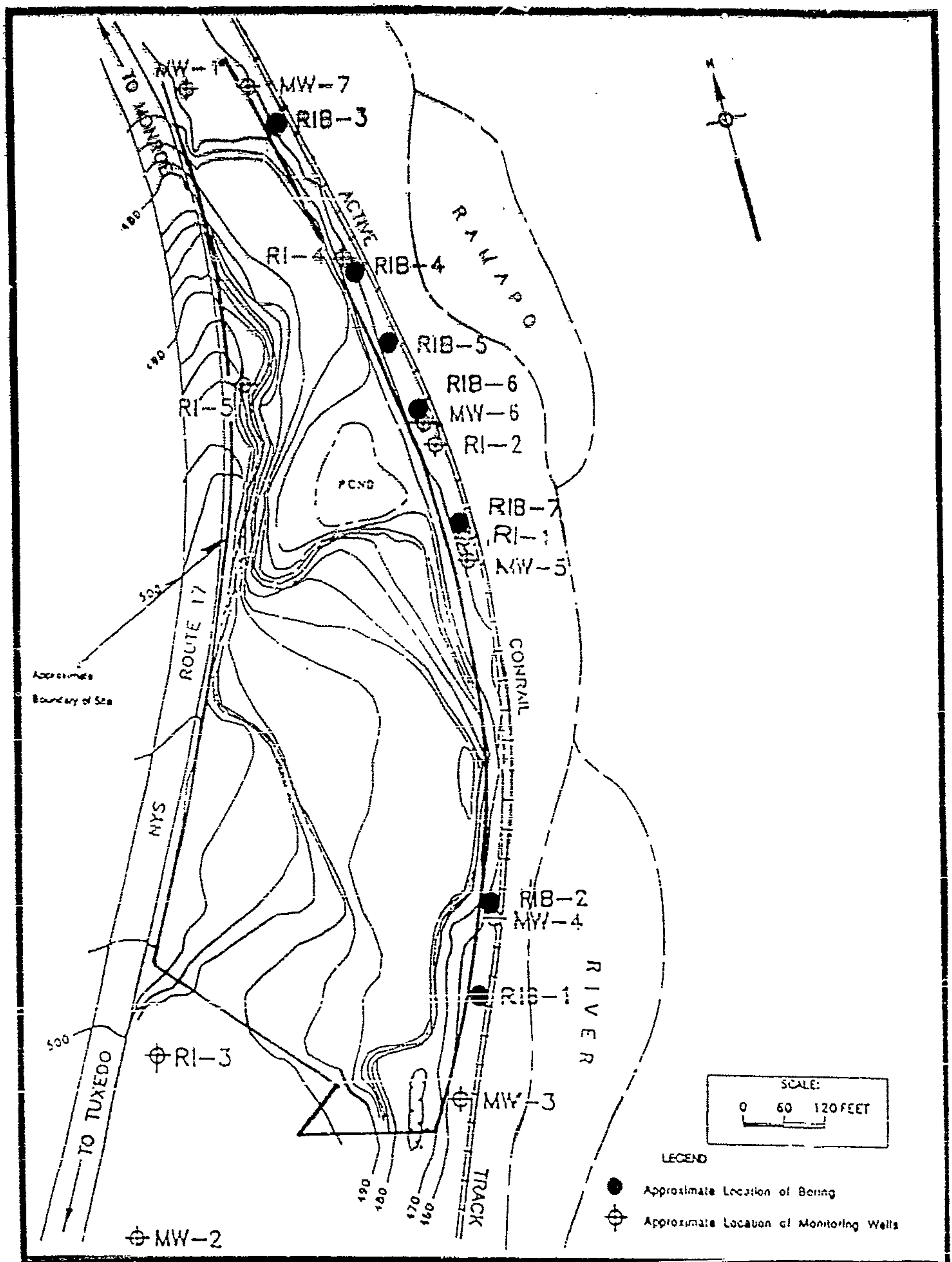

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FIGURE 3-2
SOIL BORING AND
MONITORING WELL LOCATION MAP

Advancement of the core barrel progressed until competent rock was encountered or twenty feet of weathered bedrock was penetrated, whichever occurred first.

Core recovered during each run was removed from the core barrel, field scanned for organic vapors and placed in labelled wooden core boxes. The field geologist inspected each core run for rock quality designation, rock type, hardness, weathering, degree and attitude of joint discontinuities, coatings/infillings, presence of healed joint discontinuities and mechanical fractures induced by drilling. In addition to written descriptions, all core was photodocumented following borehole completion. Boring logs completed for each of the seven borings appear in Appendix E

3.2.3 Packer Testing

Bedrock zones within each borehole were hydraulically tested with an inflatable double packer assembly. The number of zones tested in each boring was dependent upon the depth at which competent bedrock was encountered. For example, borings in which competent bedrock was not encountered provided three zones for permeability testing. Borings which encountered competent bedrock in the initial core run did not provide a sufficient exposed bedrock length to perform representative permeability testing. Zones within each borehole were isolated by pressurizing the inflatable packers with nitrogen gas. Zones were tested at 5 and 10 psi above hydrostatic conditions. Calculation of hydrostatic pressures were based on borehole depth and height of the water column above the zone to be tested. The data from the testing program were evaluated utilizing a model developed to estimate hydraulic conductivity from Hvorslev (1951). Packer testing is discussed further in Section 4.4 with the results of field activities and field groundwater measurements.

3.3 GROUNDWATER WELL INSTALLATION AND CONSTRUCTION

3.3.1 Purpose

Five additional groundwater monitoring wells were installed during the RI field program to supplement existing water quality data at varying depths within the local groundwater regime. These wells also helped characterize hydrologic properties of the fractured bedrock in greater detail than the previous LMS Phase II investigation.

3.3.2 Well Installation Dates

Well installation commenced during the first week of July 1990 and was completed the second week of September 1990. Figure 3-2 showed the locations of these five newly installed RI wells, in addition to the existing seven (MW) groundwater monitoring wells. Modifications from the well locations proposed in the Project Work Plan resulted mainly from accessibility restrictions caused by the steep landfill slope abutting an active railroad track. Temporary roadways were constructed using fill material to provide access to all downgradient well locations. Due to the close proximity of the downgradient wells to the railroad right-of-way, a Conrail flagman was required during rig placement, drilling, and installation of the downgradient monitoring wells

3.3.3 Drilling and Installation

All well construction and subsurface boring was performed by General Borings Inc. using a Deidrich Model D-120 or a Mobile Drill Model B-53 rotary drill rig. All site monitoring wells can be categorized into one of three different groups: overburden, fractured bedrock (spanner) and competent bedrock wells. Monitoring Well Completion Diagrams for the wells appear in Appendix F.

3.3.4 Overburden Wells

An overburden monitoring well, designated as RI-4, was installed along the downgradient perimeter of the landfill (see Figure 3-2). Borehole advancement through the overburden was completed using temporary 6-inch casing spun down to the bedrock. Cuttings within the casing were removed using a tricone roller bit and potable water. Two five-foot sections of rock core were advanced to confirm the characteristics of the bedrock. Upon completion, the corehole was filled to the top of rock with grout. A two-foot thick sand pack was placed on top of the bedrock interface.

Well construction materials included ten feet of two-inch schedule 40, PVC well screen, factory slotted to 0 10 inch, which was threaded to schedule 40 solid PVC riser pipe. During well construction, the temporary casing was withdrawn in sections to allow the annular space between the well and the borehole to be filled with sand pack and/or grout. Due to the relatively shallow completion depth, sand pack was free poured slowly to avoid bridging and completed two feet above the well screen. A one-foot bentonite seal was placed above the sand pack and the remaining annular space was tremie grouted to the surface.

3.3.5 Fractured Bedrock (Spanner) Wells

Two fractured bedrock (spanner) monitoring wells, designated as R1-2 and R1-3, were installed at downgradient and upgradient well locations shown in Figure 3-2. Borehole advancement through the overburden for R1-2 was completed using 8-inch hollow stem augers to a depth of 64 5 feet. A temporary 6-inch casing was spun through the augers and seated into the bedrock.

Rock coring was completed through the temporary casing using an M-series double tube 4 X 5-1/2 inch core barrel fitted with a diamond cutting head. Core barrel advancement through the bedrock continued into the competent bedrock for 7 feet. A three-inch thick sand pack was placed at the base of the borehole.

Well construction materials included ten feet of four-inch, 0 010 inch slot, type 304, wire-wrapped, continuous slot stainless steel well screen placed in the borehole opposite the weathered bedrock/overburden interface. The well screen was centered in the borehole using a stainless steel centralizer. Four-inch, flush joint, threaded type 304 stainless steel riser was used to complete the well to grade.

Sand pack was installed using a tremie pipe and completed a minimum of two feet above the screened interval. A minimum one-foot bentonite seal was placed above the sand. The six-inch temporary casing was withdrawn in sections to allow the annular space between the casing and hollow stem augers to be filled with sand. Following sand pack installation, the temporary casing was removed from inside the auger. The auger was then withdrawn in sections to allow the annular space between the well and the borehole to be filled with sand pack and grout mix.

Monitoring well RI-3 was installed in the southwest corner of the site as an upgradient fractured bedrock well. Overburden in this portion of the site was characterized as having many large cobbles and boulders which prevented the 4-1/4 inch hollow stem auger from advancing completely to bedrock. Upon advancing the auger to refusal, NW casing was advanced through the refusal depth. Coring identified the refusal as a large boulder approximately three feet in diameter. Rather than abandon the borehole, NW casing was advanced through the boulder and seated into the bedrock at 22.5 feet. Rock coring was completed through the temporary casing using an NQ double tube core barrel fitted with a diamond cutting head. Upon completion of all drilling, bentonite pellets were added to seal the borehole to the base of the weathered bedrock. A two-inch thick sand pack was then placed below the base of the monitoring well screen.

Monitoring well construction materials included ten feet of two-inch schedule 40, 0.010 inch slot factory slotted PVC well screen placed into the borehole opposite the weathered bedrock overburden interface. Two-inch, flush joint threaded schedule 40 solid PVC riser was used to complete the well up to grade. A sand pack was completed two feet above the screened interval. A two-foot bentonite seal was placed above the sand pack.

The temporary casing was withdrawn in sections to allow the annular space between the casing and the borehole to be filled with sand pack. Following sand pack installation, the temporary casing was removed from inside the auger. The auger was then withdrawn in sections to allow the annular space between the well and the borehole to be filled with sand pack and grout mix.

3.3.6 Competent Bedrock Well

Two competent bedrock monitoring wells designated as RI-5 and RI-1 were installed at upgradient and downgradient locations, respectively, as shown in Figure 3-2. Monitoring well RI-1 was installed as a downgradient competent bedrock monitoring well. Borehole advancement through the overburden was completed using eight-inch

ID hollow stem augers to a depth of 51 feet. Using a 600 pound hammer, eight-inch ID permanent casing was advanced to the top of bedrock through the pilot hole created by the augers. Cuttings within the casing were removed using a tricone roller bit and light bentonite drilling fluid. The roller bit was then advanced two feet into bedrock to create a socket for the permanent casing thereby isolating the overburden from the borehole.

Due to the bedrock nature and resistance to conventional roller bit techniques, well construction was modified to ensure a proper grout seal. Borehole advancement through the bedrock was completed using an M-series, double tube 4 x 5-1/2 inch core barrel fitted with a diamond bit. A two-inch Type 304 stainless steel inner casing, equipped with stainless steel centralizers spaced approximately ten feet apart, was advanced to the base of the core run. A three-foot bentonite seal was placed at the base of the hole and allowed to expand around the casing. The remaining annular space was tremie grouted to the surface and allowed to [illegible]. Following [illegible], the open borehole monitoring interval was completed using an A-series double tube 1.5 inch core barrel fitted with a diamond bit. The monitoring interval was advanced to a completion depth of 94 feet.

Monitoring well RI-5 was installed along the western perimeter of the landfill. Borehole advancement through the bedrock commenced from grade on an exposed bedrock outcrop. An M-series double tube 4 x 5-1/2 inch core barrel equipped with a diamond bit was advanced to a completion depth of 82 feet. Using a tremie pipe, a two-inch thick sand pack was placed at the base of the borehole. Well construction materials included twenty feet of two-inch, schedule 40, 0.010 inch slot factory slotted PVC well screen threaded to schedule 40 solid PVC riser. Sand pack was installed using a tremie pipe and completed two feet above the screened interval. A bentonite seal was placed above the sand pack and the remaining annular space between the PVC riser was tremie grouted to grade.

3.3.7 Protective Cover and Surface Well Seal

All newly installed RI monitoring wells were fitted with a locking steel protective cover to seal the well at the ground surface and protect the well from damage or vandalism. Each protective cover is equipped with a side vented, locking cap and secured with a padlock.

At the base of each protective casing, a surface well seal was constructed by mounding concrete around the casing. The purpose of this surface seal was to secure the casing in the ground and provide positive drainage of surface water away from the monitoring well.

3.3.8 Monitoring Well Development

All existing site wells were developed by a combination of pumping and bailing until the wells produced water free of silt and clay materials. Prior to actual development, the static water level and total well depth were recorded. The volume of water removed during development, temperature, pH, conductivity, and physical observations made during well development were recorded.

3.3.9 Quality Assurance/Quality Control

All equipment used to install the groundwater monitoring wells was decontaminated in accordance with the Quality Assurance Project Plan (QAPP) approved by NYSDEC. In addition to decontamination protocol, a sample of water used during borehole advancement was collected and submitted for full TCL analysis. This sample was designated SW-1-0-0790. Results are presented in Section 4 (see Table 4-26).

3.4 GROUNDWATER SAMPLING

3.4.1 Purpose

A full TCL sampling program was completed for all twelve monitoring wells during October 1990. Data obtained from this sampling event supplements the existing database on contaminant concentrations in monitoring wells on the site.

3.4.2 Sampling Procedures

Sampling procedures for the collection of representative groundwater samples were outlined in the Quality Assurance Project Plan (QAPP) approved by the NYSDEC prior to the project (Metcalf and Eddy, June 1990). Following removal of the protective well cover at each location, the headspace within the monitoring well was tested for the presence of organic vapors with a portable photoionization meter

Using an electronic sounding device to obtain the static water table elevation the required purge volumes were calculated and recorded on Monitoring Well Sampling Worksheets. For each well volume purged, physical parameters were monitored to ensure representative groundwater samples

Following removal of the final purge volume, samples were collected and analyzed using a Solomat photometric turbidity meter. Monitoring wells which produced water samples with NTU values below 50 were sampled immediately following well purging. Wells with water quality above 50 NTU were allowed to settle until NTU values were below the 50 NTU value as requested by NYSDEC. Samples were placed in appropriate containers, labelled and preserved as required. Other parameters (temperature, pH, conductivity, chloride, and dissolved oxygen) were measured from the final aliquot prior to securing the well

3.4.3 Groundwater Analysis

Field Measurements

Monthly sampling of groundwater was performed on all monitoring wells to observe seasonal trends in water table elevation and to monitor physical parameters in selected wells. Physical parameters monitored each month included water table elevation, temperature, pH, conductivity, chloride and dissolved oxygen. Equipment used to monitor monthly physical parameters included an Orion Model SA 230 temperature/pH meter, Fisher Scientific Model 150 conductivity meter, Hach Digital Titrator Chloride Test Kit, and a Lamotte Dissolved Oxygen Test Kit Each field instrument requiring calibration was standardized according to the manufacturer's specifications. Table 3-1 summarizes the results of the monthly physical parameters for the monitoring wells and will be discussed further in Section 4 of this report.

TABLE 3-1
MONTHLY GROUNDWATER ELEVATIONS AND PHYSICAL PARAMETERS

WELL ID	PARAMETERS	SEPT 1990	OCT 1990	NOV 1990	DEC 1990	JAN 1991	FEB 1991
MW-1	ELEV. (FT)	448.43	[illegible]	448.18	[illegible]	[illegible]	447.31
	TEMP (°C)	11.4	11.8	11.8		13.0	
	pH	5.91	6.07	6.10		5.92	
	COND (uhmos)	100	165	[illegible]		240	
	DISS O$_2$ (ppm)	7.10	5.0	5.7		5.5	
	CHLORIDE (mg/l)	40.0	30.0	25.4		42	
MW-2	ELEV (FT)	476.19	[illegible]	477.81	481.20	NS	476.64
	TEMP (°C)	12.0	15.8	9.5		NS	
	pH	7.76	7.82	7.80		NS	
	COND (uhmos)	100	148	175		NS	
	DISS O$_2$ (ppm)	3.0	1.8	5.0		NS	
	CHLORIDE (mg/l)	6.9	6.4	[illegible]		NS	
MW-3	ELEV (FT)	441.07	440.82	441.55	443.52	[illegible]	[illegible]
	TEMP (°C)	[illegible]	[illegible]	12.5	13.0	10.8	11.4
	pH	5.96	5.64	6.30	5.81	6.24	6.33
	COND (uhmos)	1075	180	1520	1200	940	1200
	DISS O$_2$ (ppm)	3.7	0.6	3.0	6.2	5.8	7.4
	CHLORIDE (mg/l)	[illegible]	37.2	39.9	30.8	30	28.5
MW-4	ELEV (FT)	443.36	441.53	444.62	452.81	448.21	[illegible]
	TEMP (°C)	18.5	18.2	17.3		12.8	
	pH	6.96	6.08	6.30		6.33	
	COND (uhmos)	705	1070	967		380	
	DISS O$_2$ (ppm)	1.6	0.7	1.3		4.0	
	CHLORIDE (mg/l)	68.2	74.6	67.7		35	
MW-5	ELEV (FT)	447.90	447.10	447.62	449.85	446.50	446.58
	TEMP (°C)	22.2	21.0	19.8		15.7	
	pH	6.47	6.30	6.30		6.78	
	COND (uhmos)	1670	900	1600		2000	
	DISS O$_2$ (ppm)	3.7	ND	ND		ND	
	CHLORIDE (mg/l)	[illegible]	34.4	48.2		24	
MW-6	ELEV (FT)	447.29	447.00	447.55	448.74	[illegible]	445.35
	TEMP (°C)	24.2	22.9	20.0	18.4	15.1	14.5
	pH	6.51	6.50	6.46	6.45	6.62	6.54
	COND (uhmos)	1700	2040	1700	1585	1750	1800
	DISS O$_2$ (ppm)	0.4	ND	ND	3.4	ND	ND
	CHLORIDE (mg/l)	144.4	NS	37.6	[illegible]	[illegible]	[illegible]
MW-7	ELEV (FT)	[illegible]	446.72	[illegible]	[illegible]	[illegible]	[illegible]
	TEMP (°C)	14.1	[illegible]	14.0	13.2	12.9	12.5
	pH	6.00	6.00	6.00	5.98	6.13	6.07
	COND. (uhmos)	340	425	495	450	380	500
	DISS. O$_2$ (ppm)	0.05	2.6	2.1	2.6	5.0	2.7
	CHLORIDE (mg/l)	30.1	77.2	30.0	26.0	25	42.7
RI-1	ELEV (FT)	NS	447.17	447.57	448.74	448.83	445.72
	TEMP (°C)	NS	15.7	14.0	10.5	[illegible]	11.5
	pH	NS	7.30	7.30	6.90	6.93	[illegible]
	COND (uhmos)	NS	420	411	485	[illegible]	475
	DISS. O$_2$ (ppm)	NS	1.0	1.8	1.4	2.2	[illegible]
	CHLORIDE (mg/l)	NS	32.8	30.5	35.7	39	30.0
RI-2	ELEV (FT)	NS	447.07	447.90	448.78	443.67	446.15
	TEMP (°C)	NS	14.5	11.9	12.4	12.3	11.4
	pH	NS	6.30	5.10	5.02	5.17	5.00
	COND (uhmos)	NS	460	420	440	370	360
	DISS. O$_2$ (ppm)	NS	0.9	2.1	1.9	[illegible]	4.0
	CHLORIDE (mg/l)	NS	41.6	[illegible]	48.5	42	27.5
RI-3	ELEV (FT)	NS	458.02	456.34	460.54	453.39	457.69
	TEMP (°C)	NS	13.7	10.7	11.3	10.3	9.2
	pH	NS	6.10	6.10	5.64	5.78	5.83
	COND (uhmos)	NS	115	92	90	70	90
	DISS. O$_2$ (ppm)	NS	1.9	6.5	7.2	11.5	9.4
	CHLORIDE (mg/l)	NS	3.2	9.6	15.2	5.0	[illegible]
RI-4	ELEV (FT)	NS	447.91	448.56	450.55	449.40	444.96
	TEMP (°C)	NS	20.8	15.8		16.1	
	pH	NS	11.57	[illegible]		9.60	
	COND (uhmos)	NS	1000	660		[illegible]	
	DISS O$_2$ (ppm)	NS	NS	2.0		3.5	
	CHLORIDE (mg/l)	NS	NS	14.9		[illegible]	
RI-5A	ELEV (FT)	454.40	453.80	454.63	455.71	NS	453.45
	TEMP (°C)	12.7	12.4	10.8	10.7	NS	10.5
	pH	9.72	9.90	10.2	9.17	NS	10.04
	COND (uhmos)	[illegible]	290	324	250	NS	280
	DISS O$_2$ (ppm)	0.02	NS	6.0	3.9	NS	4.4
	CHLORIDE (mg/l)	25.0	NS	18.7	16.2	NS	13.5
RAMAPO RIVER	ELEV (FT)	NS	446.87	447.34	448.07	447.72	447.77

Laboratory Analysis

Samples collected from each of the twelve site monitoring wells during the October, 1990 annual sampling event were submitted to RECRA Environmental Lab for full TCL analysis Data validation was performed by New York Testing Labs, an independent lab subcontracted to perform this task. The data for the October 1990 TCL sampling event is presented in Section 4

3.4.4 Quality Assurance/Quality Control

To eliminate the potential for cross-contamination between monitoring wells, dedicated sampling equipment was used for each well monitoring location. Dedicated bailers were decontaminated and stored in pre-cleaned, labelled PVC sleeves following each use. Nylon cord, tubing, and latex gloves were disposed of following use at each sampling location.

Decontamination of all non-dedicated sampling equipment was performed in accordance with protocols established by NYSDEC

Quality Assurance/Quality Control samples (trip blanks, equipment blanks, duplicate samples, matrix spike/matrix spike duplicate samples) were collected to monitor the potential introduction of contaminants from sources both in the field and the laboratory. The analytical results of the QA/QC samples are presented in Section 4.

Samples collected for laboratory analysis were shipped under chain of custody within 24 hours of sample collection.

3.5 SURFACE WATER AND SEDIMENT SAMPLING

3.5.1 Purpose

Six surface water and five sediment samples were collected from the Ramapo River during October 1990 and analyzed for TCL parameters. Data obtained from this sampling event supplements the existing database on contaminant concentrations found in the Ramapo River.

3.5.2 Gauging Station Installation

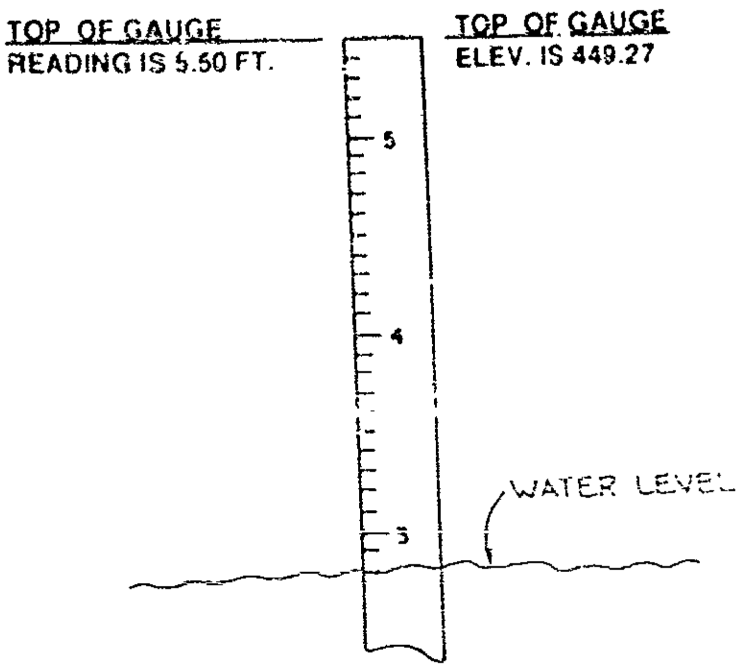
A permanent river staff gauge was installed within the Ramapo River to monitor flood stages within the river and their effect on water table elevations beneath the site. The permanent staff gauge is positioned near the RIW/RI5-2 sampling location and can be seen from the bank of the river. The gauge was surveyed relative to USGS elevation datum. A diagram of the staff gauge appears in Figure 3-3.

3.5.3 Surface Water Sampling

Six surface water samples were collected from the Ramapo River in conjunction with the annual October, 1990 groundwater sampling event. Sample locations at upstream, mid-site, and downstream locations were selected to coincide with the SW-1, 2, and 4 sampling locations chosen during the previous Phase II investigation (Figure 4-6 shows the locations). At each location, samples were collected at the river bank and at a mid-river location. Surface water samples were collected in accordance with the <u>Field Activity Plan</u> prepared for NYSDEC (Metcalf and Eddy, June 1990). The analytical results for the samples are contained in Section 4.

3.5.4 Sediment Sampling

Five sediment samples were collected from the Ramapo River directly beneath each surface water sampling location. No upstream mid-river sediment sample could be obtained due to the river velocity, which prevented sediment deposition at this location. Sediment samples were collected with a Wildco stainless steel sediment sampler in accordance with the Field Activity Plan prepared for NYSDEC (Metcalf and Eddy, June 1990). The analytical results of the surface water sediment samples are contained in Section 4.



STAFF GAUGE DETAIL

NOT TO SCALE

M&E **Metcalf & Eddy**	TUXEDO WASTE DISPOSAL SITE ORANGE COUNTY, NEW YORK	FIGURE 3 3 STAFF GAUGE DETAIL

3.5.5 Quality Assurance/Quality Control

Equipment decontamination was performed in accordance with protocols established by NYSDEC Quality Assurance/Quality Control samples were collected for each medium of interest to monitor the potential introduction of contaminants from sources both in the field and in the laboratory An equipment blank was collected through the sampler to monitor the effectiveness of the decontamination procedure.

3.6 GEOPHYSICAL SURVEY

3.6.1 Purpose

A geophysical survey was performed by Gartner Lee, Inc. to identify the possible locations of any buried metal drums and tanks. The magnetometer/gradiometer survey techniques used are well established, indirect sensing techniques for non-destructive subsurface reconnaissance exploration Because these instruments utilize indirect methods, they are subject to inherent limitations and ambiguities Targets such as buried drums, buried tanks, transformers, conduits, utilities, etc., are detectable only if they produce recognizable anomalies of patterns against the background geophysical data collected.

Much of the Tuxedo Waste Disposal Site is vegetated with grasses, with some brush and trees located along the southeastern toe of the landfill. Metallic debris, reinforcement bar, and other debris protrude from the ground surface at numerous locations across the site. A large bulldozer was located in the southeastern portion of the site. A smaller bulldozer, augers, and other drilling equipment were located in the northern portion of the site. On-site personnel were unable to move the large bulldozer during the geophysical investigation.

The study methodology, equipment, techniques and a summary of the results are discussed in the subsections that follow

3.6.2 Methodology

Reference Grid

A survey reference grid, as discussed in Section 3.1, was established prior to the geophysical survey. The survey grid was staked at 100 foot centers with 2 x 2 inch wooden stakes. To facilitate accurate station location, Gartner Lee and Metcalf & Eddy personnel staked 20-foot increments along the lines. All staked areas were surveyed except in areas of dense brush and/or steep slopes and the recently filled-in pond.

Equipment and Survey Techniques

A GEM GSM-19 Overhauser Magnetometer/Gradiometer was used to measure the total field magnetic (measured in units of gammas) and vertical gradient (measured in units of gammas per meter) at each station. Data were collected at 10-foot increments along lines spaced 20 feet apart. All readings were recorded with the primary and secondary sensors oriented north and elevated approximately 88 inches (224 cm) and 113 inches (288 cm), respectively, above surface. A second GEM GSM-19 Overhauser Magnetometer was utilized as a base station to monitor the drift of the earth's magnetic field at the site. The base station magnetometer was time synchronized with the field magnetometer, taken to a wooded area south of the site believed to be free of metals, and configured to automatically collect data at 10-second and 30-second intervals.

Both magnetometers were calibrated, tuned, and synchronized following procedures specified in the operations manual. The total field and gradient data of the field magnetometer were automatically stored in solid state memory during the survey. Upon completion of the survey, both systems were interfaced to a portable computer, and the data transferred and archived on a floppy disk for subsequent processing and interpretation.

The drift observed on August 8th and 9th, 1990 was due to perturbations of the earth's magnetic field as a result of solar storm and sunspot activity. Sunspots and solar storms can render magnetic surveying useless by introducing an erratic drift that cannot be corrected without possibly introducing a level of error that exceeds target values. In anticipation of erratic drift the Space Environmental Agency was contacted for five-day geomagnetic forecasts to ensure that magnetometer surveys could be performed effectively Forecasted drift values for the above dates were approximately 0-20 gammas and classified as quiet to unsettled geomagnetic conditions. A profile of actual drift data observed over the length of the survey are presented as Figure 3-4

3.7 RADIATION SURVEY

3.7.1 Purpose

A radiation survey was performed on August 6, 1990, to determine if any measured radiation levels exceeded normal background readings.

3.7.2 Equipment

The monitoring instrument was a Ludlum Model 3 Survey Meter with a four linear scale meter face The detector used was a Model 44-9 Particle G-M Detector

3.7.3 Methodology

Radiation readings were taken at surrounding locations outside the site to determine background levels. Readings were taken with the detector unit connected to the recorder. The assembly was tilted so the detector was horizontal with respect to the ground, with the detector held 6 inches above the ground, and the entire instrument assembly was enclosed in a plastic bag for protection from precipitation. Readings were recorded on the site at each grid location on the 100-foot grid discussed in Section 3.1.

3.7.4 Quality Assurance/Quality Control (QA/QC)

The monitoring instrument had been given a 2 point per scale calibration within ± 10% (of the true value) using a high energy gamma source. The calibration was

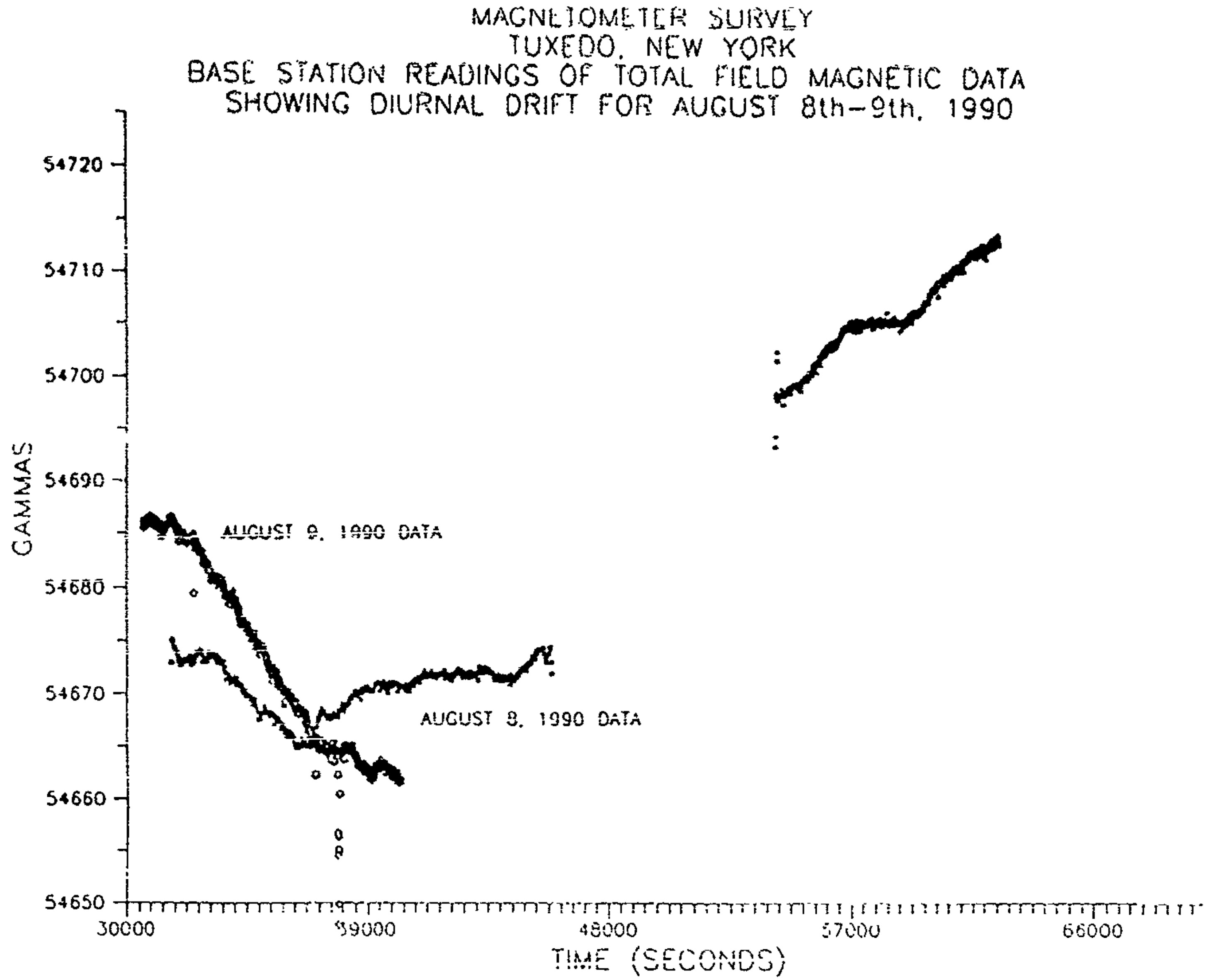


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FIGURE 3-4
BASELINE MAGNETIC DATA

carried out by the manufacturer before and after use. This conformed with the QA/QC section of the Work Plan, and this calibration and source conform with the manufacturer's recommendation

3.7.5 Field Calibration

The monitoring instrument was checked before and after use with a low level radioactive check source of 1400 CPM. At both times, the instrument read 1400 CPM and did not have to be field calibrated

3.8 TEMPERATURE SURVEY

3.8.1 Purpose

A soil temperature survey was performed on August 28, 1990 to locate areas of elevated ground temperature which could be indicative of accelerated decomposition or a possible landfill fire.

3.8.2 Methodology

Field personnel calibrated and numbered six 24-inch, Reotemp temperature probes prior to sampling. Six probes were inserted into the soil together at one location at the same depth. The temperatures were compared, and the probes were calibrated to a mean reading. In addition, a seventh probe was reserved to measure ambient air temperature at each sampling location.

The temperature survey was conducted across the site on the 100 x 100 foot grid. At each sampling station, one 24-inch Reotemp temperature probe was installed in a pilot hole, created by a 1/4 inch diameter stainless steel rod, to the full probe depth of 24 inches, soil conditions permitting. After the sixth temperature probe was installed, M&E field personnel returned to the first probe to record the soil temperature. This procedure allowed time for each temperature probe to equilibrate and register soil temperature. At each sampling location, the time, soil temperature, ambient air temperature, weather, temperature probe number, and other observations that could influence the data were recorded in the field book. As a post sampling check, the six temperature probes were stored overnight in the same location in the trailer. The following morning, the respective probes gave temperature readings within one degree of each other.

3.9 PERIMETER SOIL GAS SURVEY

3.9.1 Purpose

The objective of this task was to determine whether subterranean toxic and/or explosive gases (or vapors) are migrating beyond the site boundary. This task can also help indicate lateral migration of volatile contaminants in groundwater and soils.

3.9 2 Technical Concept

Soil gas surveys are performed on sites that are suspected of VOC contamination in soil and/or groundwater beneath the site. Volatile organic chemicals released at a site initially migrate vertically and laterally away from the source of contamination into the soils. If a sufficient quantity of contaminant is released, migration may proceed downward to groundwater where migration may continue within the aquifer, creating a contaminant plume. Soil gas sampling and analysis is carried out to semi-quantify the concentrations of gaseous contaminant(s) that may exist in the air-filled pores within the vadose zone originating from contaminated soil and/or a contaminated groundwater plume.

Volatile chemicals dissolved in soil-pore water and groundwater undergo a partitioning into the gaseous phase based on the physicochemical properties of the specific contaminant. Henry's Law suggests that the concentration of chemicals in soil-pore water and groundwater (where concentrations are higher) achieve an equilibrium with the air-filled pores within unsaturated soils (where concentrations are lower). Thus, a contaminant plume in the soil-pore water and groundwater leaves a unique gaseous "fingerprint" in the overlying soil. Evaluation of relative soil gas concentrations of VOCs in the vadose zone can be used to delineate the boundaries and extent of plume migration and to determine the approximate point sources of contamination at a site.

3.9.3 Methodology

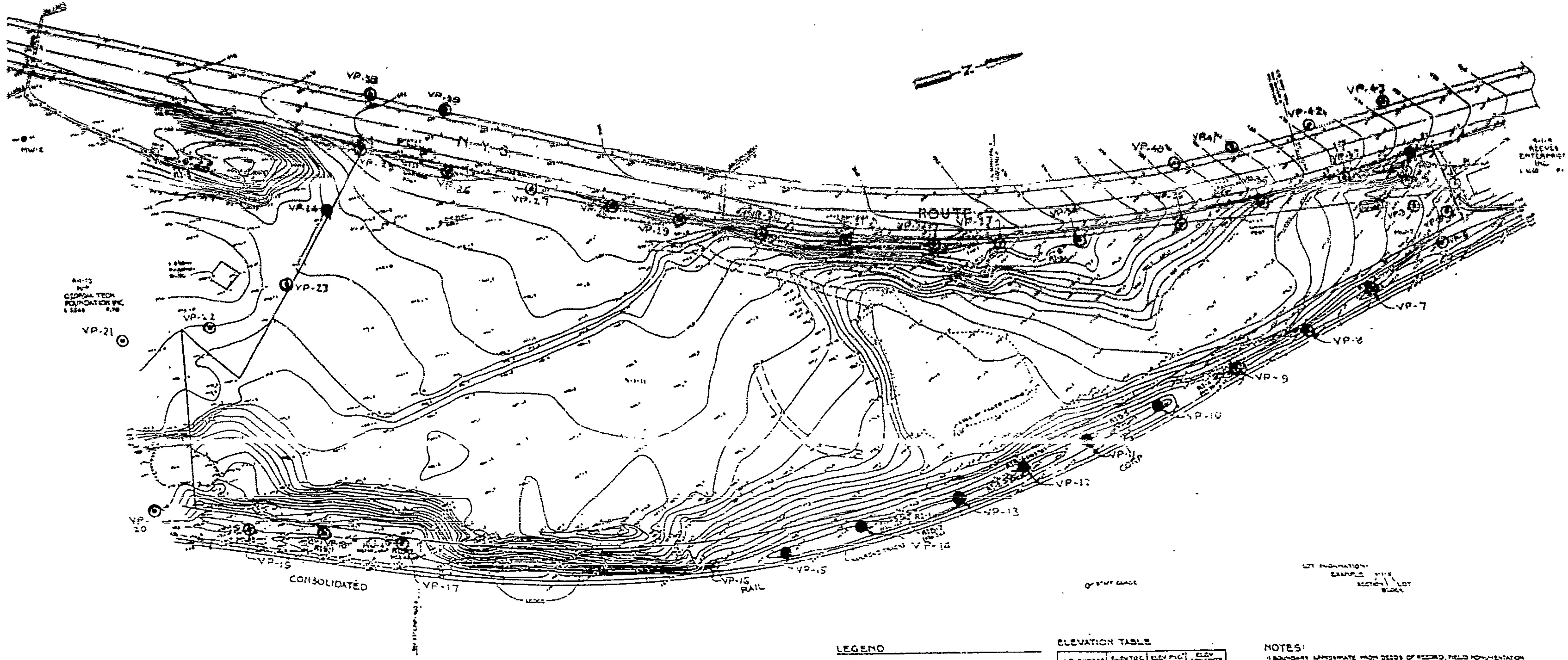
Various field screening instruments facilitate the measuring of soil gas concentrations in extracted soil gas samples Typically, gas analyzers equipped with flame ionization detectors (FIDs) such as an OVA, photoionization detectors (PIDs) such as an HNu or Photovac TIP, Combustible Gas Indicators (CGIs) such as an Explosimeter or Bacharach Sentinel Meter, portable field gas chromatographs (FGCs), and Draeger tubes are used to perform gas analyses on-site. Comparisons of relative instrument responses to measured background conditions over an array of test locations are used to determine the apparent boundaries of a subsurface volatile organic discharge or plume. The following sections outline the method and procedures employed in the collection and analysis of soil gas samples at the Tuxedo Waste Disposal Site

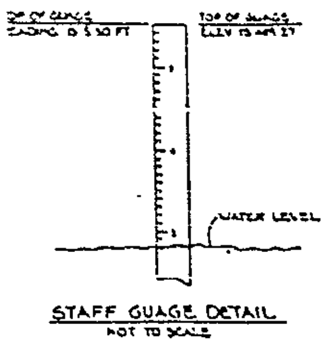
3.9 4 Procedures

The work encompassed a single soil gas sampling event. Forty-three probes were driven to a depth of 4 to 5 feet below grade around the perimeter of the site. Soil probes were located at 100-foot intervals with reference to surveyed grid stations about the perimeter of the site, as described in Section 3.1. Figure 3-5 shows the probe locations around the site. Sampling was conducted during falling barometric conditions in accordance with Volume 5 of the June 1990 Project Plan

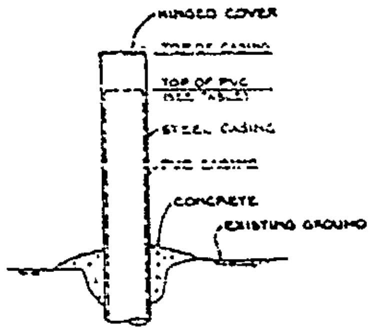
The survey method involves driving a 6-foot long soil gas probe 5 feet into the soil. The soil gas probe consists of a steel shaft, a loosely fitting, replaceable drive point, and a top drive mandrel. Using a manual slide hammer, the probes were assembled and driven to a depth of 5 feet or until refusal. A mechanized hammer was not used due to the potential for releasing petroleum oils into the soil during operation.

The drive point was pushed out with a thin steel rod while the pipe was withdrawn, using a mechanical jack, to expose a 2-foot linear section of soil. This provided an adequate area of subsurface soil from which a gas sample could be easily withdrawn.





STAFF GUAGE DETAIL
NOT TO SCALE



DETAIL "A"
NOT TO SCALE

LEGEND

- GROUNDWATER MONITOR WELL LOCATION
- PROPERTY LINE
- CENTERLINE OF ROAD
- SPOT GRADE
- UTILITY POLE
- EDGE OF ASPHALT PAVEMENT
- OVERHEAD WIRES
- RAILROAD TRACKS
- GUIDE RAIL
- SOIL BORING LOCATIONS

◉ - SOIL GAS VAPOR PROBE LOCATION

● -PROBE LOCATIONS WITH ELEVATED METHANE LEVELS (>1,000 ppm on OVA)

ELEVATION TABLE

I.D. NUMBER	ELEV. T.O.C. (FEET)	ELEV. PVC* (FEET)	ELEV. CONCRETE (FEET)
MW-1	469.01	468.33	466.59
[illegible]	[illegible]	[illegible]	[illegible]
MW-3	459.22	458.97	457.11
MW-4	463.24	460.06	462.99
MW-5	438.81	438.03	436.46
MW-6	456.93	456.79	454.70
MW-7	467.06	466.86	464.90
RI-1	459.74	459.40	456.35
RI-2	458.23	458.02	455.91
RI-3	480.09	479.79	478.02
RI-4	462.87	462.45	459.36
RI-5A	495.92	495.70	494.01

* WELLS RI-1 & RI-2 HAVE A STEEL RISER CASING, NOT PVC

NOTES:

1) BOUNDARY APPROXIMATE FROM DEEDS OF RECORD, FIELD MONUMENTATION AND TAX MAP
2) CONTOUR INTERVAL - 2 FEET
3) TOPOGRAPHY COMPLETED IN FIELD ON JULY 17, 1990
4) [illegible] SQUARE ON RAILROAD BRIDGE NO. 3818 ON TOP OF THE WEST END OF THE SOUTH BACKWALL, 3 YARDS WEST OF CENTERLINE OF THE TRACK APPROXIMATELY 1000 FEET SOUTH OF SITE ALONG RAILROAD. ELEV 456.33
5) WELLS RI-1 THROUGH RI-5 LOCATED ON SEPTEMBER 21, 1990
6) SOIL BORINGS LOCATED 12-13-90

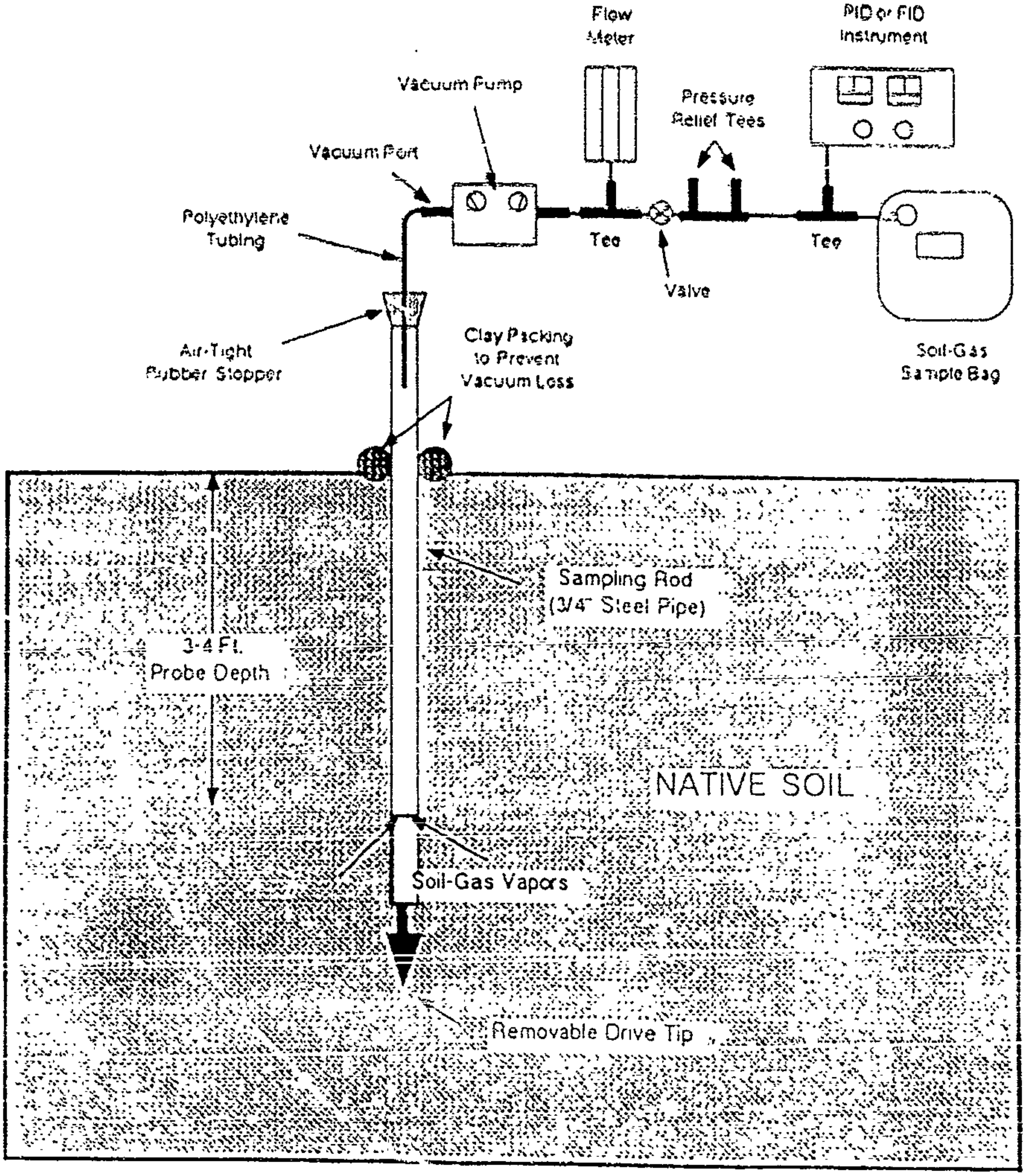
FIGURE 3-5
PERIMETER SOIL GAS SURVEY
LOCATION MAP

Environmentally inert modelling clay was packed at the interface between the probe stem and the ground surface to prevent intrusion of ambient air into the sampling system. The top mandrel was then replaced with a 1-hole, air-tight rubber stopper fitted with a discharge hose constructed of polyethylene material An electric vacuum pump was then connected to the discharge hose on the probe, and pumping proceeded until the equivalent of four probe volumes of gas were purged from the adjacent soil

After approximately five minutes, the pump was shut off, and a representative soil gas sample was withdrawn through the pipe and pumped into a specially designed Tedlar sample bag. This strategy is designed to remove ambient air initially present within the pipe during installation and to purge vapors already existing within adjacent soil pores, permitting a "fresh" sample to be obtained for analysis The number of probe volumes purged to obtain a representative sample was determined from a pilot study carried out at probe station VP-3 where a maximum instrument response was noted after four probe volumes had been removed prior to analysis

During sampling, the tubing connecting the sample bag to the discharge end of the pipe was fitted with a series of "tee's" to connect field screening instruments in line with the gas stream for real-time analysis. A pressure relief tee was installed at the leading end of the sample tubing to relieve excessive pressure in the system during pumping, providing a more stable flow condition during analysis. Figure 3-6 shows the soil gas probe sampling method employed on all probes during this field exercise.

Instruments used for real-time analysis of soil gas during this study included a Foxboro Model 128 OVA (FID) equipped with a carbon pre-filter, a Photovac TIP (PID), and a Bacharach Sentinel Gas Analyzer (CGI, O_2 and H_2S). Draeger tubes were used intermittently during the field exercise as a means of identifying specific contaminants and their associated concentrations.



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ORANGE COUNTY, NEW YORK

FIGURE 3-6
SOIL GAS PROBE ASSEMBLY

3.9.5 Quality Control/Quality Assurance (QA/QC)

Documentation

Field notes included sampling stations, gas log sheets, observations, site personnel, weather conditions, date and time of sampling, daily logs, and calibration check sheets.

Equipment Checks

Prior to driving the probe, the integrity of gas fittings attached to the probe was tested by blocking off the tip and applying a vacuum. A leak should be suspected if the system fails to hold a vacuum of 70 centibars for less than one minute.

The background concentration contributed by the entire sampling system was also tested before driving the first probe. With the probe assembled above ground, an ambient air sample was taken and tested. If the system background concentration measured significantly greater than the ambient concentration, the tubing and bag would be replaced and the probe decontaminated. This procedure was repeated before proceeding with collection of soil gas samples.

System Checks

After ensuring that all fittings and the sample bags were clean and airtight, the probe system was checked by connecting a gas standard bag at one end of a probe shaft and applying a vacuum at the opposite end. The PID, FID, and CGI were connected inline with the discharge tube of the vacuum pump. When gas was detected, the vacuum was turned off, permitting each instrument's internal pump to continue sampling/analyzing the gas stream. Instrument response very closely indicated the concentrations of the gas standards used, and therefore the system was judged effective and ready for field use.

Field Equipment Decontamination Procedures

An M&E site engineer inspected and certified the cleanliness of all field equipment before use. Precautions were taken to obtain soil gas samples representative of in-situ conditions. Each Tedlar sample bag was flushed with ultra zero air. Tedlar bags were also checked for leaks prior to sampling. Sampling probes, tubing, and any other equipment which came into contact with the soil samples were cleaned prior to each use. All such items were cleaned before beginning work at each probe and before each sampling event.

The decontamination procedure included an initial pressurized steam cleaning with an appropriate phosphate-free detergent, and rinsing with potable water followed by a triple rinse of distilled water and air drying. Field decontamination was performed by, or under the direction of, the M&E site engineer.

3.10 Baseline Emission Estimate

3.10.1 Purpose

A baseline emissions estimate was undertaken to determine emissions of soil gas contaminants to the atmosphere. The results were used to evaluate potential health risks from release of soil contaminants. The 1990 M&E field program was undertaken to supplement the limited information reported on atmospheric releases in the 1988 LMS Phase II investigation report. The 1990 field testing program performed by Alliance Technologies Corporation, as a subcontractor to M&E, included the following subtasks:

- Preliminary Investigarion
- Extractive Gas Survey
- Sweep Gas Survey
- Flux Chamber Sampling
- Hydrogen Sulfide Ambient Air Monitoring
- Meteorological Monitoring

The baseline emission estimate was prepared by M&E based on data reported by LMS, as well as fieldwork, analysis and calculations done by Alliance Technologies Corporation, Lowell, MA. The Alliance report is included as Appendix I

3.10.2 Objectives

The air monitoring was designed to produce a limited data base of air emissions from the Tuxedo Waste Disposal Site for the selection of remedial alternatives. The field testing was done to provide information on the characteristics of the emissions (approximate emission rates and composition) and areas in which high emissions can be expected. Specific objectives were to estimate emission rates for the site for the following parameters:

- Specific VOCs;
- Hydrogen sulfide (H_2S);
- Methane;
- Total non-methane hydrocarbons (TNMH).

3.10.3 Description of Survey Instruments

Sampling activities consisted of a preliminary site walkover survey, an extractive gas survey, a sweep gas survey, flux chamber sampling, ambient air monitoring, and meteorological monitoring. With the exceptions of the ambient air and meteorological monitoring, measurements during the other sampling activities consisted of OVA, HNu, H_2S, and on-site GC measurements. On-site GC was not done during the flux chamber sampling. Each of these instruments is described briefly below before discussing particular sampling events.

Organic Vapor Analyzer (OVA)

Air measurements were conducted using a Foxboro Century Model 108 Organic Vapor Analyzer (OVA). The instrument contains a flame ionization detector and is sensitive to methane and non-methane organics. Before each sampling event, the OVA was calibrated with known methane standards. Data from the OVA was read as "ppm methane".

HNu

An HNu model PI-101 was used to monitor the air emissions for non-methane organics. The unit contains a photoionization detector capable of ionizing all compounds whose ionization potential is less than that of the lamp, which was 10.7 electron volts. The unit is calibrated as "ppm benzene". The unit was calibrated in the morning on each sampling day with a known concentration of isobutylene. Isobutylene has the same response factor as benzene but lower toxicity.

H_2S Monitor

Alliance used a Portable Neotronics Model 102 Hydrogen Sulfide analyzer. The unit was calibrated at the Alliance office prior to the field work.

Photovac 10S70 Gas Chromatograph

The Photovac is a field portable GC equipped with a photoionization detector. On each sampling day, a standard was run to establish a calibration curve. Standards were prepared in a Tedlar bag filled with 20 liters of nitrogen to which known liquid amounts of each compound of interest were injected and allowed to volatilize. If ppb range standards were desired, an aliquot of gas was removed from the original bag and injected into a second bag for further dilution.

Samples and standards were injected into the GC with a 250 μl gas-tight syringe. Retention times of each compound were determined from the standards. The Photovac can print out compound names and concentrations for each sample injected. This calculation is based upon a one-point calibration.

3.10.4 Preliminary Site Survey

The preliminary survey consisted of walking the site and taking OVA, HNu and H_2S readings at ground level. Alliance took seventeen measurement points (see Figure 4-12).

3.10.5 Extractive Gas Survey

Extractive gas sampling was conducted on a 100-foot grid of points throughout the entire landfill area (see Figures 4-13 and 4-14). The extractive gas sampling device consisted of a hollow aluminum probe which was crimped and perforated at one end. At the opposite end, a one-foot length of Teflon tubing was attached by Swagelock fittings. The tubing passed a "T" joint which acted as a sampling port for the continuous, survey-type instruments (OVA, HNu, and H_2S monitors). The tubing on the other side of the "T" was connected to a sampling pump which was set at a sampling rate of 1 liter/minute.

The extractive soil gas sampling was accomplished by hammering a solid steel rod to a depth of one foot. The rod was then removed, and the hollow sampling probe was inserted into the hole and allowed to equilibrate for five minutes. To eliminate dilution of the soil gas sample with ambient air, native surface soil was compressed at the opening of the hole around the hollow probe. A sidestream of the effluent was screened with the OVA, HNu, and H_2S monitors. Sample collection for field GC analysis was performed by withdrawing aliquots of sample gas from a "T" joint outfitted with a teflon-lined silicon septum using a gas-tight syringe and then immediately injecting the syringe contents into the field GC. The sample was collected from the effluent emissions stream. Organics were identified and quantified based upon comparisons to the standards. As a quality control measure, every 10th sample was injected into the GC in duplicate.

3.10.6 Sweep Gas Survey

Sweep gas probe sampling was conducted at twenty-five points on the landfill, as directed by M&E and NYSDEC personnel, based upon previous studies conducted at the landfill and the extractive gas survey previously performed. The sampling points are shown in Figure 4-15.

The sampling device for the sweep gas survey was similar to that used for the extractive gas effort. However, modifications allowed introduction of a sweep gas, as well as exposure of soil, to permit measurement of volatile species flux rates. First, the sweep gas sampling hole was created by hammering a solid steel rod to a depth of approximately one foot into the ground. The rod was then removed and a hollow aluminum probe, open at the bottom end, was inserted approximately three inches into the [illegible]-inch deep hole. At the opposite end of the probe, two lengths of Teflon tubing were attached. One of the Teflon lines (a 1/8" sweep gas feed) was run down through the probe to within 1 inch of the bottom of the hole to deliver a steady flow of Zero Grade Air at approximately 1 liter/minute Flows were metered with a magnehelix gauge. The second tubing line carried effluent gas from the probe to a sampling pump that withdrew air at a rate equal to the inflow of Zero Grade Air.

To minimize dilution of the sweep gas sample with ambient air, native surface soil was compressed around the hollow probe. At least three sampling probe volumes were purged prior to sample collecting to ensure that the probe and assembly had been flushed with sweep/sample gas. A sidestream of the effluent was prescreened with the OVA, HNu, and H_2S monitors. Field GC analysis was performed by using a gas-tight syringe to withdraw an aliquot of the sample gas from the sampling stream through a teflon lined silicon septum, then immediately injecting it into the field GC

3.10.7 Flux Chamber Sampling

Flux chamber sampling was conducted at six landfill locations chosen by M&E and NYSDEC (see Figure 4-16). Each location was cleared of all debris and vegetation so the chamber could sit on a cleared surface. The flux chambers were embedded one inch into the ground. A Zero gas supply was attached to the ring inside the chamber, which contained small, evenly spaced holes to disperse gas uniformly throughout the chamber. The purge rate was set to 5 liters/minute. The sample line was connected to a sampling "T" and a pump. Because the sampling "T" was equipped with a locking quick-connect, no monitor was necessary for the system The suction pump was operated at a flow rate of 5 liters/minute to match the inlet purge rate. A thermocouple was placed inside the flux chamber to continuously monitor temperature. The free volume inside the flux chamber was approximately 32 liters.

With the chamber set in place, four volumes of purge gas were passed through the system, which required approximately 30 minutes. After completion of the purge cycle, OVA measurements were made from the sampling "T". When reasonably steady readings were observed by the OVA, two duplicate samples were collected in stainless steel canisters. These samples were sent to a laboratory for analysis by EPA Method 25C. This analysis provided methane, non-methane, and carbon dioxide fractions in the collected samples.

To collect the canister samples, a rotameter was placed in line between the canister and the sampling "T " The air flow was regulated to collect the sample over a 10-minute period. Between the rotameter and the tank, another "T" was placed in this line. A mercury manometer was installed in the line to measure initial and final pressures in the tank

During sampling on October 4, 1991, stainless steel canister samples were collected while evacuating the chamber with a sampling pump During sampling on October 18th, canister samples were collected without using the pump

Discrepancies in OVA readings raised significant questions concerning the accuracy and value of the sampling method. Alliance determined that the internal pump in the OVA could not draw against the slight negative pressure in the sample line created by the sampling pump. The over 29 inches of vacuum in the stainless steel canisters was sufficient, however, to draw against the slight vacuum created by the pump and can be considered valid. After evacuation, a sample tank was attached to the sample "T" and was allowed to fill over a period of 10 minutes until the pressure in the tank registered 0 inches of mercury Alliance used a mercury manometer attached to the tank to monitor changes in pressure.

3.10.8 Hydrogen Sulfide Ambient Air Monitoring

Hydrogen sulfide sampling was conducted at ten locations, using procedures outlined in ASTM Method 701 "Determination of Hydrogen Sulfide Content of the Atmosphere." The sampling procedure entailed drawing a known volume of air through two midget impingers containing an alkaline suspension of cadmium hydroxide. Approximately 180 liters of air were drawn through the impingers over an eight-hour period. The resulting sample solution containing cadmium sulfide from the reaction was analyzed at a laboratory by a spectrophotometric method. The ten locations are listed in Table 4-38.

3.10.9 Meteorological Monitoring

Alliance installed a trailer at the site to house meteorological equipment. A 10 meter tower was constructed at the site Wind direction, wind speed and air temperature were recorded on a continuous basis for ninety days

3.11 HABITAT BASED ASSESSMENT

3.11.1 Purpose

The objectives of the Habitat Based Assessment were to identify any significant biological resources and habitats on or immediately adjacent to the site, to evaluate the effects of past waste disposal activities on the biota, to assess impacts of the existing conditions and to determine possible remediation alternatives, if applicable.

3.11.2 Methodology

Phase I of the Habitat Based Assessment involved the following tasks.

- Identification of biological resources using vegetation mapping and field surveys of wildlife.
- Review of published surveys and other material pertinent to plants and animals using the site.
- Identification of ARARs required for site-specific mitigation measures at federal, state, county and municipal levels.

Phase II of the Habitat Based Assessment involved qualitative evaluation of the site's impacts on biota based on on-site and off-site sampling of water and sediments. The evaluation guidelines are outlined in Step I of NYSDEC's "Habitat Based Assessment - Guidance Document for Conducting Environmental Risk Assessments at Hazardous Waste Sites" (March, 1990).

3.11.3 Field Surveys

Field surveys of the Tuxedo Waste Disposal Site were carried out on September 10, and October 11-12, 1990 The purpose of the initial field survey on September 10th was to

- Verify the presence and location of on-site vegetation communities shown on an aerial photograph taken April 23, 1990
- Record wildlife species, or their signs, observed on-site during the survey

A follow-up survey was carried out on October 11-12 to collect data on plants and wildlife on the site and adjacent off-site areas.

Section Four

SECTION 4

4.0 RESULTS OF FIELD ACTIVITIES

4.1 TOPOGRAPHIC SURVEY & SAMPLING GRID

The topographic survey and sampling grid simplifies data management and standardizes maps, drawings, and other site specific information. The field activities discussed in Section 3.1 produced a horizontal grid across the site which provided specific and repeatable sampling stations for the air emissions estimates, magnetometer survey, radiation testing, soil gas characterization and temperature monitoring. Grid lines were made with X, Y coordinates marked at 100' x 100' intervals. Oak survey stakes were positioned at each intersection and labelled. The topographic survey and sampling grid is shown in Figure 4-1.

4.2 SITE GEOLOGY

The Tuxedo Waste Disposal Site is underlain by Precambrian gneisses of the Hudson Highland Massif. The common metamorphic assemblages associated with the massif include biotite granite gneiss. Quartz plagioclase gneiss is found extensively interlayered with amphibolite layers in almost all cores from this site. Rock outcrops on-site generally strike northeast-southwest and dip to the southwest. Rock coring during the remedial investigation agrees with the rock types and structural trend described in reference material and previous site work. All new site borings cored into the bedrock encountered various forms of gneiss.

The site's geology is a combination of natural geologic materials and significant alterations of the site by past activities. As a result of this alteration in the original site topography, a large area of waste fill was placed across the site in the lower elevations. The thickness of the waste fill material ranges from non-existent where rock outcrops to several tens of feet in areas where previous drainage channels were located. It appears that a drainage channel was used for landfilling. This combination of a naturally developed soil overburden and human site alteration resulted in a wide range of possible subsurface conditions at any particular location within the Tuxedo Waste Disposal Site.

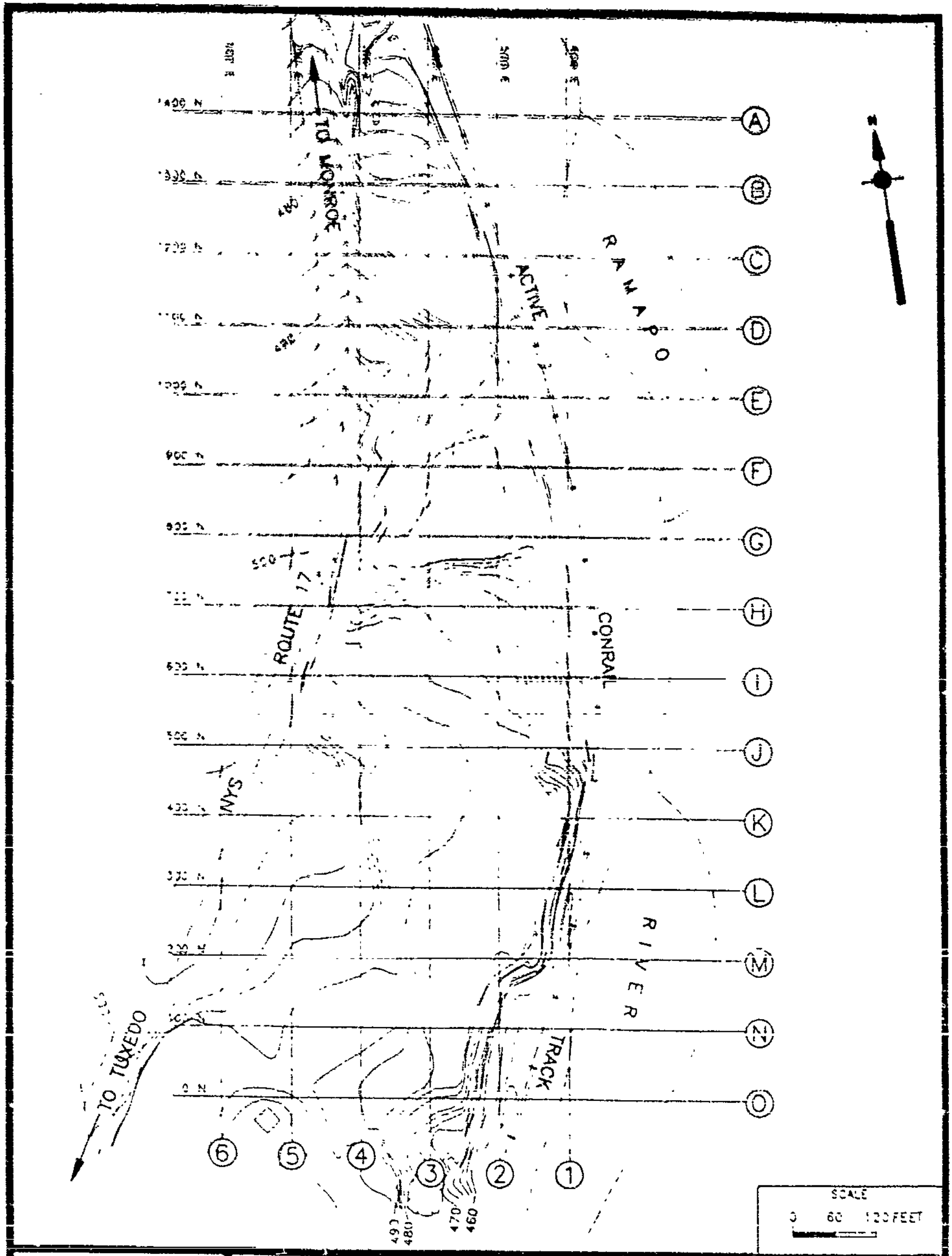

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FIGURE 4-1
TOPOGRAPHIC SURVEY AND
SAMPLING GRID

The drilling and sampling program completed at the site encountered each layer described in Section 2.1 of this report in various thicknesses. Careful inspection of the samples enabled the delineation of waste fill material, glacial till and residual soils, partially weathered rock, fractured rock, and sound rock. Using these data, a subsurface geologic cross-section was constructed and is presented in Figure 4-2 in a pocket in the back of the report. Figures 4-2a, 4-2b, 4-2c, and 4-2d show the post-fill cross sections prepared by LMS as part of their Phase II investigation.

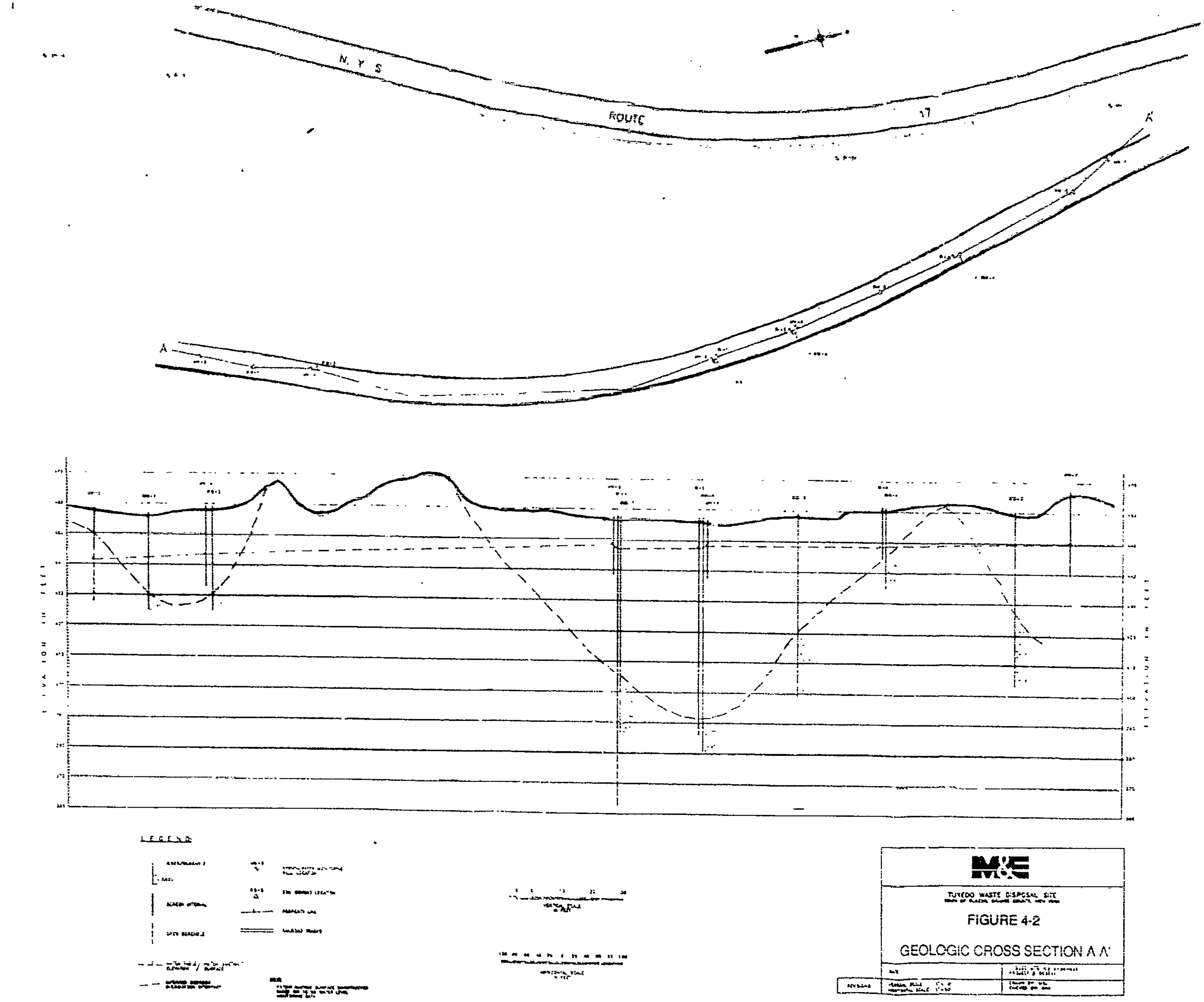
4.3 SITE HYDROGEOLOGY

The hydrogeologic regime within the Tuxedo Waste Disposal Site is composed of three distinct and interrelated flow systems. The uppermost flow system includes the surface water drainage and an unconsolidated formation of alluvial or glacially derived tills. This system overlies a fractured bedrock flow system which overlies a bedrock flow system.

During the LMS Phase II Investigation, seven monitoring wells were installed. Five were installed into the overburden material, one was installed into bedrock, and one spanned both bedrock and overburden. Each overburden monitoring well was installed as a partially penetrating well into the unconfined aquifer and designed to intercept the upper portion of the aquifer.

The average hydraulic conductivity of 3.69 x 10^{-2} cm/sec for the overburden material was obtained from slug tests calculations by LMS performed in seven monitoring wells during the Phase II Investigation of 1988. The individual hydraulic conductivity values are shown in Table 4-1.

Since installation of upgradient overburden wells to compare with wells along the trucks was not possible, the actual horizontal gradient and velocity of groundwater through the overburden are difficult to determine. However, an average gradient across the site of $3x10^{-2}$ ft/ft was estimated as discussed in



M&E

TUXEDO WASTE DISPOSAL SITE

FIGURE 4-2

GEOLOGIC CROSS SECTION A A'

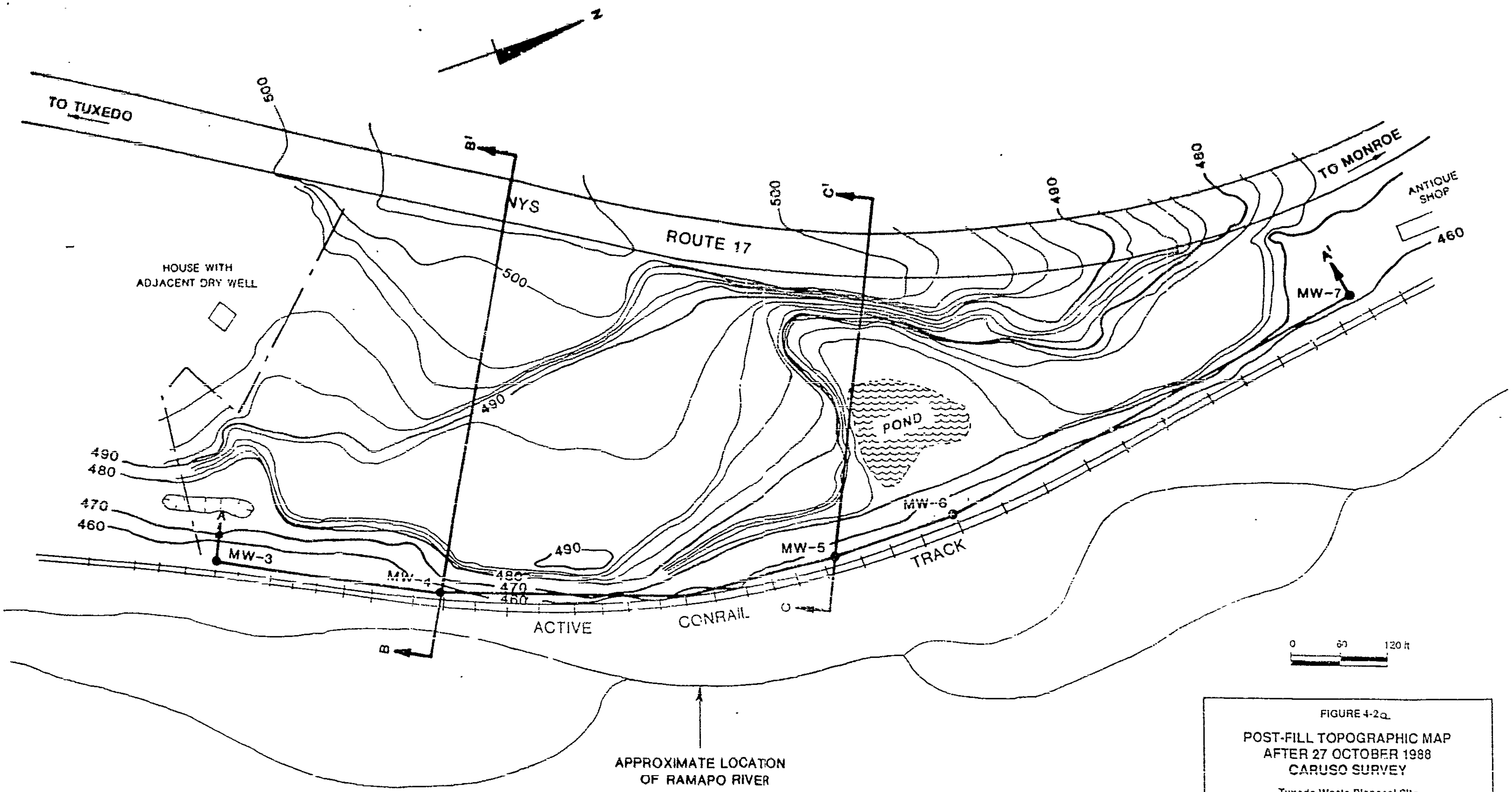
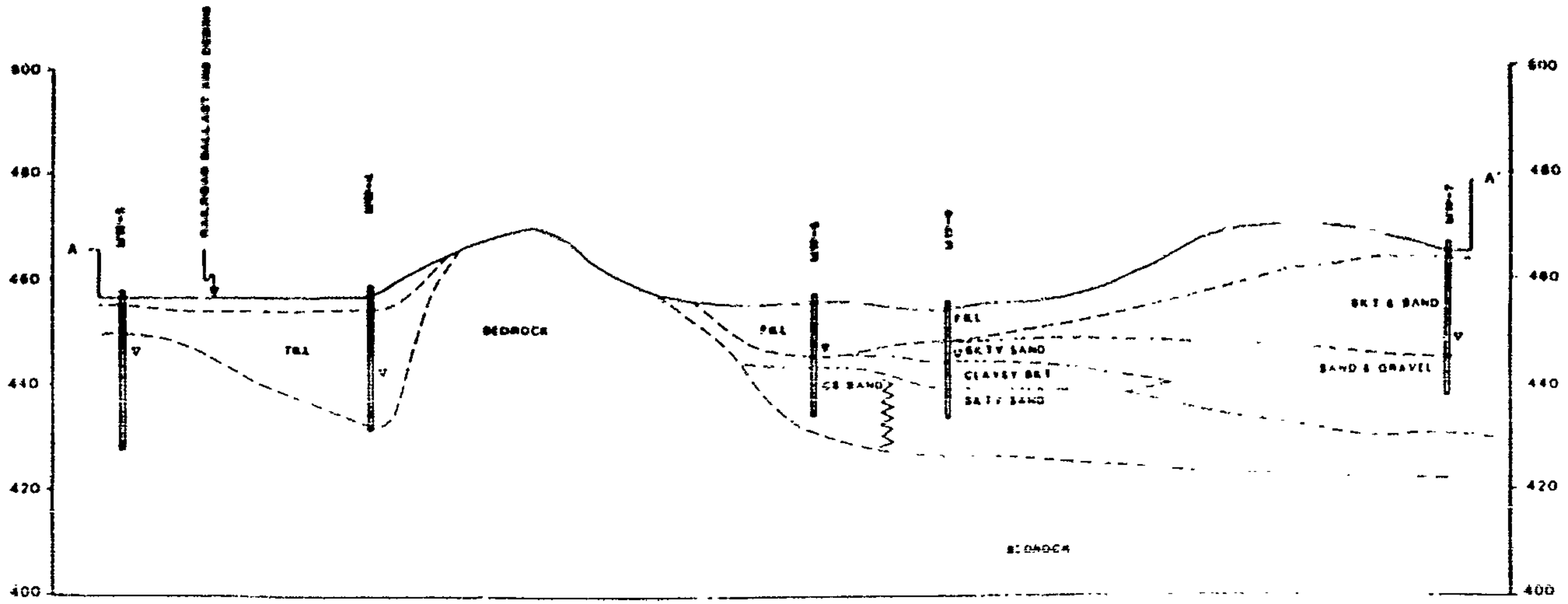


FIGURE 4-2a

POST-FILL TOPOGRAPHIC MAP
AFTER 27 OCTOBER 1988
CARUSO SURVEY

Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York



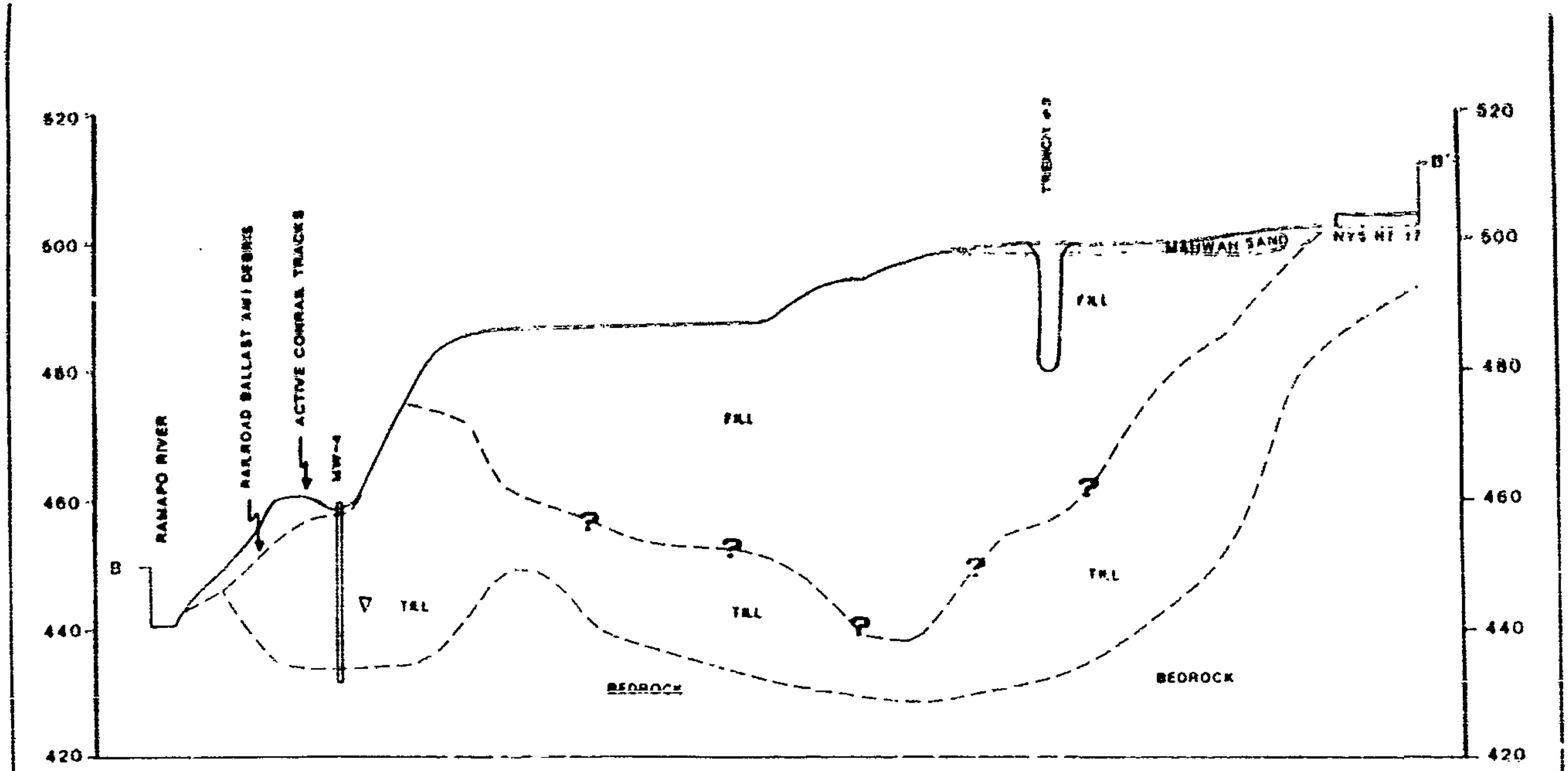
SCALE: 1" 370

FIGURE 4-2b

POST-FILL CROSS SECTION
A-A'

Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York



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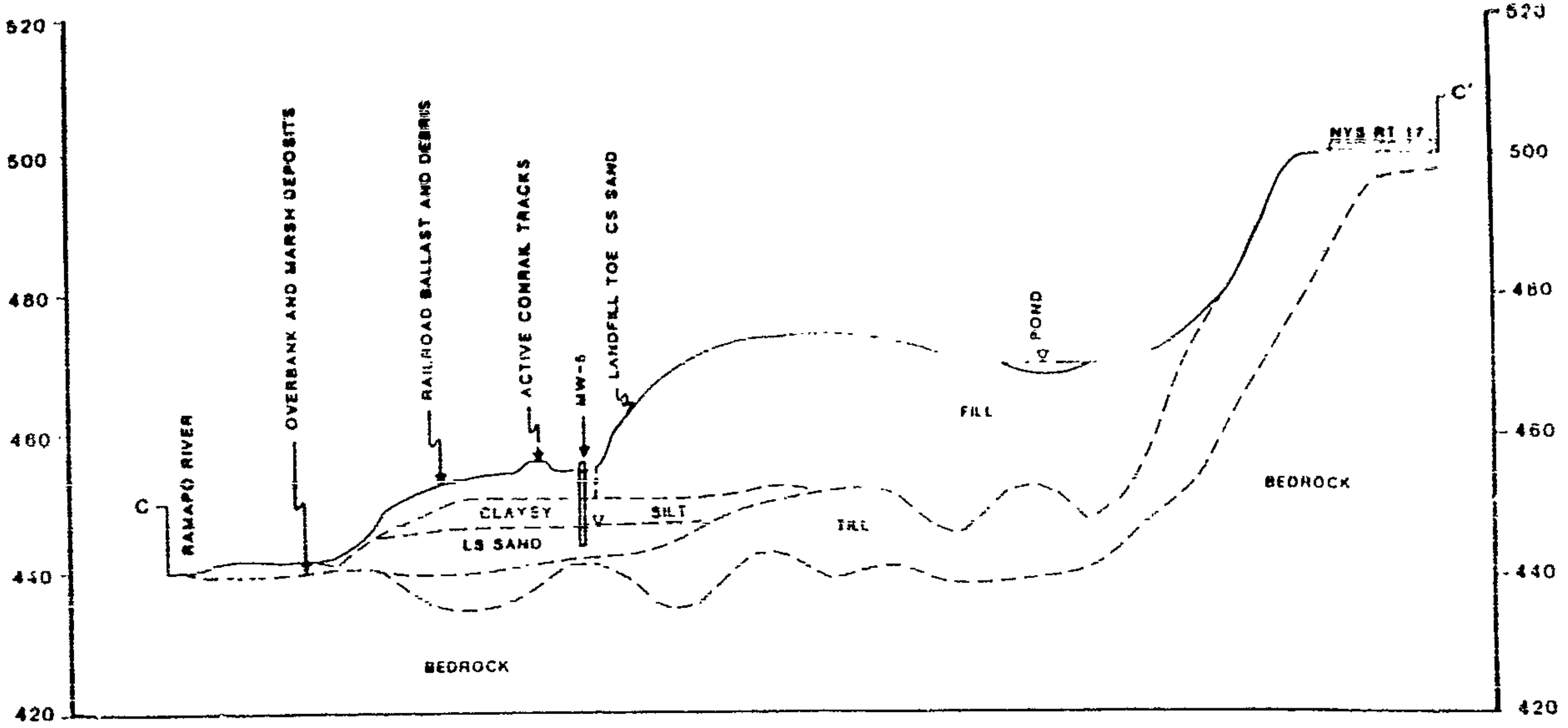
NOTE: Because of sand and gravel excavation, there are areas of fill and bedrock contact. Areas of saturated fill exist (see Section 3.2).

FIGURE 4-2c

POST-FILL CROSS SECTION
B-B'

Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York



SCALE: 1" 320

FIGURE 4-2d

POST-FILL CROSS SECTION
C-C'

Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

TABLE 4-1
SLUG TEST RESULTS
HYDRAULIC CONDUCTIVITY ESTIMATES

WELL	HYDRAULIC CONDUCTIVITY[1] (meters/day)	SCREENED STRATA
MW-1	5.2	Sands
MW-2	2.6×10^{6}	Bedrock
MW-3	1×10^{2}	Bedrock
MW-4	4.3	Cobbles, boulders, sand
MW-5	3.7	Sand, gravel, cobbles
MW-6	5.6	Sand, silt, gravel
MW-7	$1\ 7 \times 10^{1}$	Gravel, sand

(1) Average hydraulic conductivity for overburden material (MW-1, MW-4, MW-5, MW-6 and MW-7) 7 16 meters/day = $1.76E0^{2}$ g/d/ft²

Source: LMS Phase II Investigation Report, 1989

Section 4.4. This gradient and the hydraulic conductivity estimate in Table 4-1 were used to estimate a groundwater flow rate at the site. Flow velocity was calculated using the relationship

$$V = \frac{Ki}{n_e}$$

where

V = flow velocity
K = hydraulic conductivity
i = gradient
N_e = effective porosity

Assuming an effective porosity of 30 percent in the overburden material, an average gradient across the site of 3×10^{-2} ft/ft, and a hydraulic conductivity of 7.16 meters/day (23.5 ft/day), a horizontal flow velocity of approximately 860 ft/year in the overburden material can be estimated for the site.

Five additional monitoring wells were installed at the site by M&E, four of which are in the lower portion of the aquifer flow system, which includes the underlying fractured bedrock and consolidated bedrock. Seven borings were advanced across the site to characterize the subsurface bedrock conditions. Generally, rock core that exhibited a Rock Quality Designation (RQD) below 80 percent was referred to as fractured rock. Rock core with an RQD value greater than 80 percent was termed sound rock.

Characterization of a fractured bedrock aquifer system is difficult because groundwater flow through fractured media is complicated by boundary conditions, localized flow, and fracture orientations. To evaluate the bedrock portion of the aquifer system, discrete bedrock zones within each monitoring well and boring were isolated and tested using the inflatable packer system described in Section 3.2.3 of this report. Ten packer tests were conducted during drilling operations in open boreholes, prior to well construction, to measure bulk hydraulic conductivity. The data are shown in Table 4-40 at the end of this section.

The packer testing data were used to determine hydraulic conductivity. M&E estimated hydraulic conductivity of the fractured rock at five locations at various depths using a model from Hvorslev (1951) and assuming that isotropic conditions exist. The results for individual borings are presented in Table 4-2. The average hydraulic conductivity estimate for the fractured rock was calculated as 1.73×10^1 g/d/ft^2. This estimate is in agreement with values cited in the literature for metamorphic rock.

The hydraulic conductivity was calculated using the Packer Test Formula(1) which follows:

$$K = \frac{Q}{2 \Pi \times L \times P} \times \ln\left(\frac{L}{R}\right)$$

Where:

Q - Flow rate (ft^3/D)
L - Test interval length (ft)
R - Radius of hole - 0.125 ft
P - Pressure (ft)

The capacity of the fractures to transport water varies with each location, thus, the conductivity will vary. Variations will also occur with any field testing procedure, especially in fractured rock. The hydraulic conductivity estimate at RIB-3 for the test zone 37.8 feet to 42.8 feet is unusually high. This could be due in part to highly weathered or fractured rock conditions in the test zone. Two locations, RIB-5 and RIB-7, show a decrease in hydraulic conductivity with increasing depth. This indicates that fractures at the site decrease in size and number with depth.

In summary, review of the M&E RI data in conjunction with past LMS hydraulic conductivity estimates indicates that two hydrogeologic units exist at the study area: the soil/overburden material and fractured rock. Average hydraulic conductivity estimates are 3.69×10^{-2} cm/sec for the overburden material and 1.73×10^1 g/d/ft^2 for the fractured rock.

---

(1)Reference: Design of Small Dams, Bureau of Reclamation 1987

TABLE 4-2

FRACTURED BEDROCK HYDRAULIC CONDUCTIVITY ESTIMATES

Boring No	Test Interval		Average Hydraulic Conductivity [1] (over 15 minutes) (g/d/ft^2)
	Depth (ft)	Elevation (ft MSL)	
RIB-3	37.8-42.8	440.3 - 435.3	3.98E01
RIB-3	42.8-47.8	435.3 - 430.3	8.25E00
RIB-3	47.8-52.8	430.3 - 425.3	1.49E01
RIB-4	18.1-23.1	441.3 - 436.3	No Flow[2]
RIB-5	42.3-47.8	451.2 - 446.2	9.59E00
RIB-5	47.8-52.8	446.2 - 441.2	4.35E00
RIB-5	52.8-57.8	441.2 - 436.2	6.37E-01
RIB-6	67.9-72.9	338.1 - 383.1	7.07E00
RIB-7	55.8-60.8	400.5 - 395.5	7.02E01
RIB-7	60.8-65.8	395.5 - 390.5	7.72E-01

(1) Average Hydraulic conductivity estimate for the fractured rock is 1.73E01 g/d/ft^2

(2) No flow occurred during the testing.

Two geologic formations beneath the site have been identified through this RI an unconsolidated and a consolidated water bearing formation Both of these water bearing formations are considered to be one aquifer system and have been impacted by the Tuxedo Waste Disposal Site contaminant releases. The upper portions of the aquifer discharge directly to the Ramapo River along the eastern boundary of the site

Groundwater flow directions and rates are influenced by local gradients created by site topography, geologic structure and aquifer usage Recharge to the aquifer is derived from precipitation and infiltration of surface water Although the primary component of groundwater and surface water flow is horizontal, vertical migration of water occurs as a result of natural gradients between the porous materials. Vertical migration of surface water and groundwater is also influenced by anthropogenic structures including existing well installations, the site's cover material and diversion of surface runoff from the north swale away from the site.

Groundwater flow within the unconsolidated overburden formation is controlled by intergranular porosity. Direction of flow is variable and generally follows the topography to the river. Groundwater flow within the consolidated bedrock is controlled by joints and fractures. Discontinuities within the fractured bedrock create a series of distinct flow units within the bedrock Groundwater flow velocity in the bedrock is variable and is a function of the connected joint and fracture units.

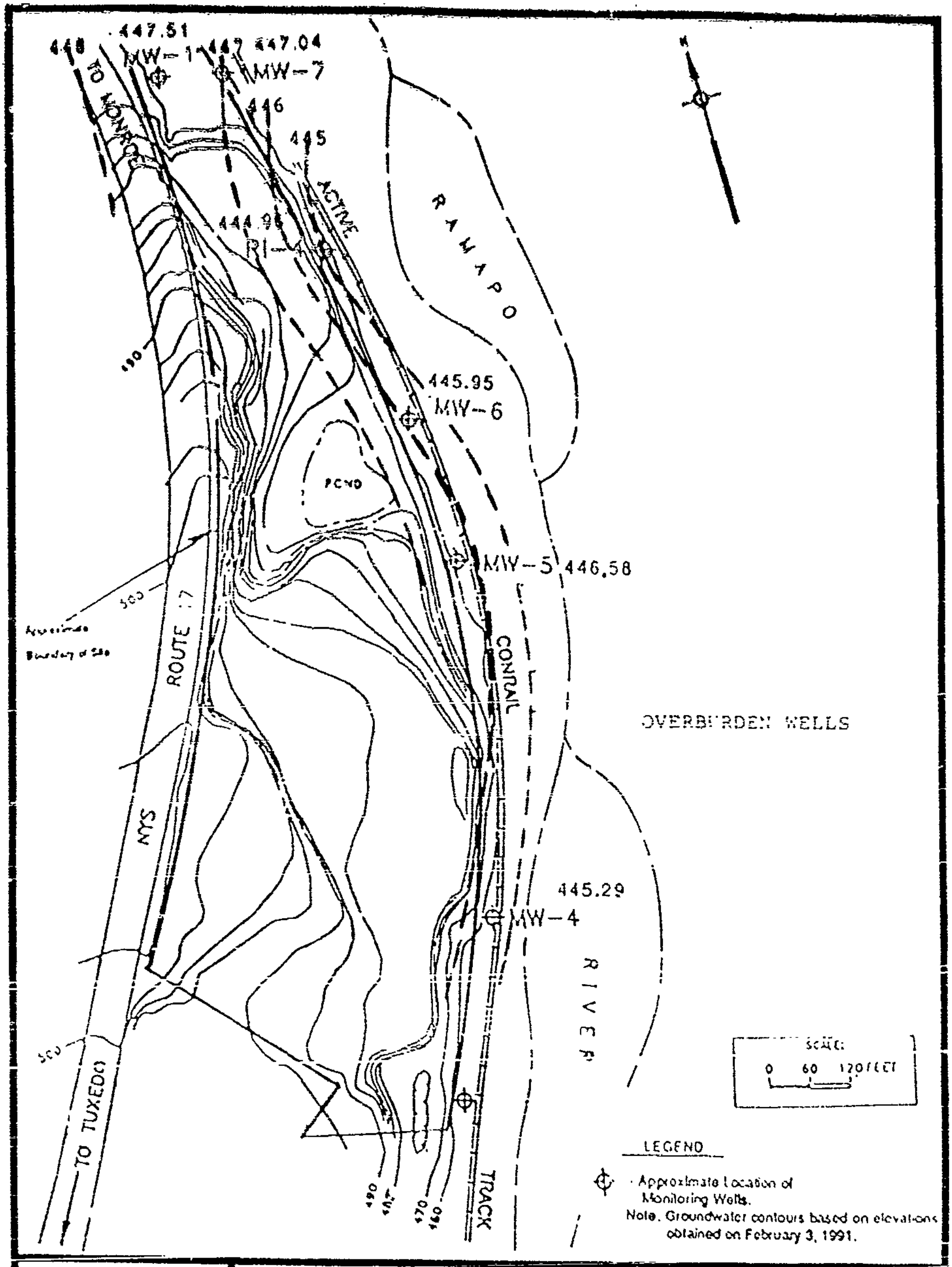
The proper evaluation of vertical hydraulic gradients in groundwater requires at least two closely spaced wells screened at different depths. Only one well pair (MW-5/RI-1) constructed in the overburden and bedrock aquifers, respectively, fulfills this criterion at the site. Analysis of the potentiometric surface in MW-5 and RI-1 indicate a downward vertical gradient representing movement of water from the overburden aquifer to the bedrock. Well pair MW-6/RI-2, approximately 140 feet north of MW-5 and RI-1, is constructed in the overburden and at the interface of the overburden and bedrock (part overburden/bedrock), respectively (commonly referred to as a spanner well). Comparison of the potentiometric surface in these two wells indicates an upward vertical movement of groundwater. However, because RI-2 is not truly screened in bedrock, it is questionable or unclear whether the bedrock aquifer has a true upward vertical component at this location. A possible explanation for this anomaly may be the existence of higher or lower permeability or hydraulic conductivity and the inherent hydraulic characteristics within each aquifer such as variations in homogeneity and isotropy. This discussion assumes that the original well survey elevations and water level measurements are correct.

In the vicinity of the Tuxedo Waste Disposal site, the relationship between the potentiometric surface in the overburden and bedrock aquifers and the Ramapo River indicates that the Ramapo acts as a discharge point for groundwater. However, water level measurements during the spring and summer are recommended to verify the hydraulic relationship with the Ramapo during these months.

4.4 FIELD GROUNDWATER/SURFACE WATER MEASUREMENTS

Six complete sets of groundwater level data have been recorded and were presented in Table 3-1. Water level readings were obtained at each on-site well at the first of every month starting in September of 1990 and ending in February of 1991. The readings were obtained with an electronic water level indicator which was decontaminated after each use to avoid cross-contamination of the wells. All water levels in all monitoring wells showed an increase from September to December and a decrease from December to February. Long-term groundwater levels have not been recorded and cannot be evaluated at this time.

The most recent groundwater level readings (February 3, 1991) were used to construct two groundwater contour maps. Figure 4-3 shows the approximate groundwater contours for the (overburden) shallow site monitoring wells. A potentiometric surface map (Figure 4-4) for the (bedrock) deep site monitoring well locations shows the approximate water level contours. The horizontal groundwater flow gradient across the Tuxedo Waste Disposal Site can be estimated from the two groundwater contour maps. The gradient throughout the site varies, but an overall average horizontal gradient is estimated at $3x10^{-2}$ ft/ft.



Note. Groundwater contours based on elevations obtained on February 3, 1991.

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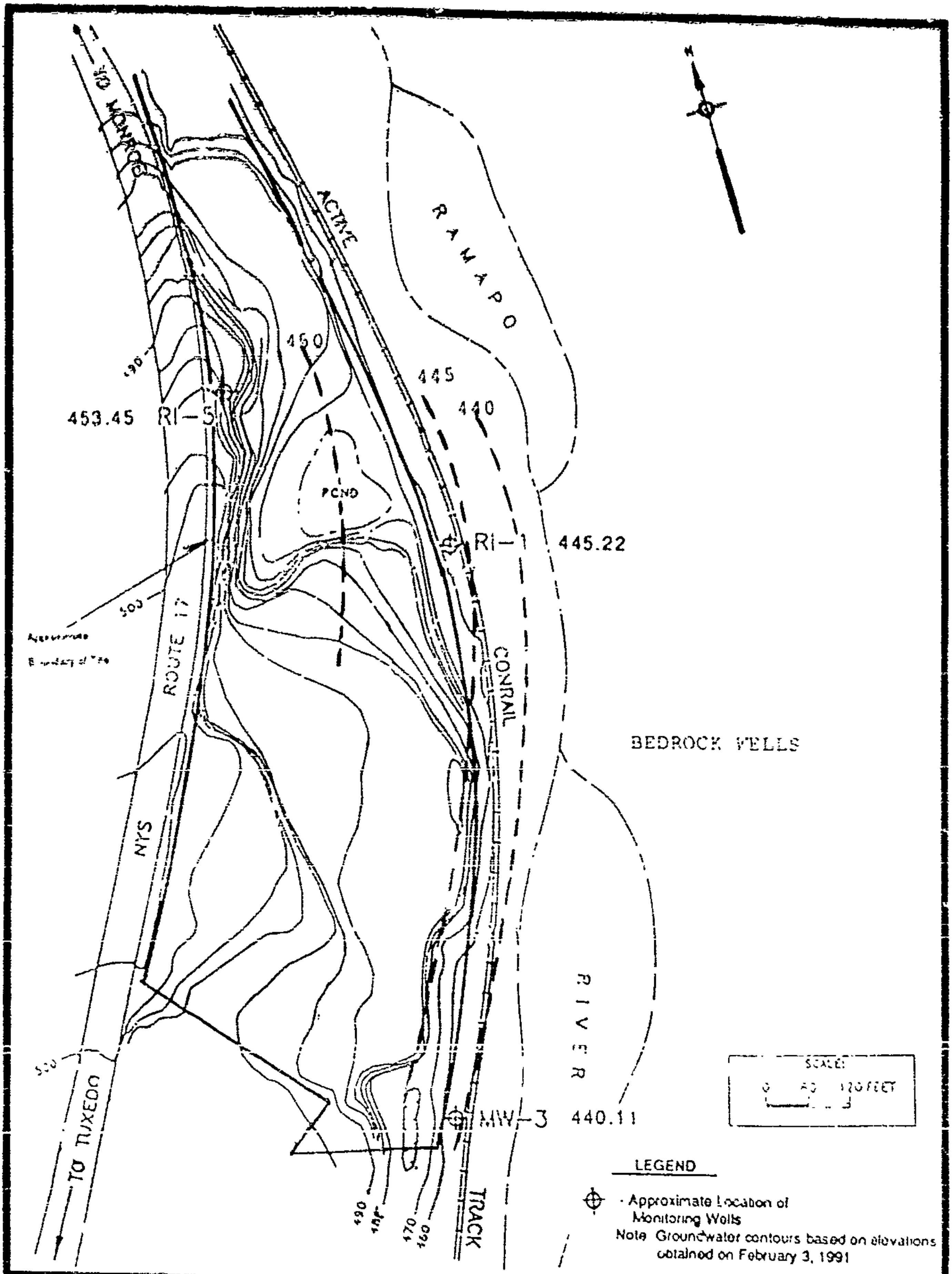
TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 4-3
GROUNDWATER CONTOUR MAP (FEBRUARY 1991)



Note Groundwater contours based on elevations obtained on February 3, 1991

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ORANGE COUNTY, NEW YORK

FIGURE 4-4
GROUNDWATER CONTOUR MAP (FEBRUARY 1991)

Although the vertical flow cannot be assessed with any degree of accuracy over the entire site, monthly monitoring data at two well pairs (Figure 4-5) show a downward flow gradient. A downward vertical gradient of approximately 0.028 ft/ft was calculated at well pairs MW-3/RI-1 and MW-4/MW-3.

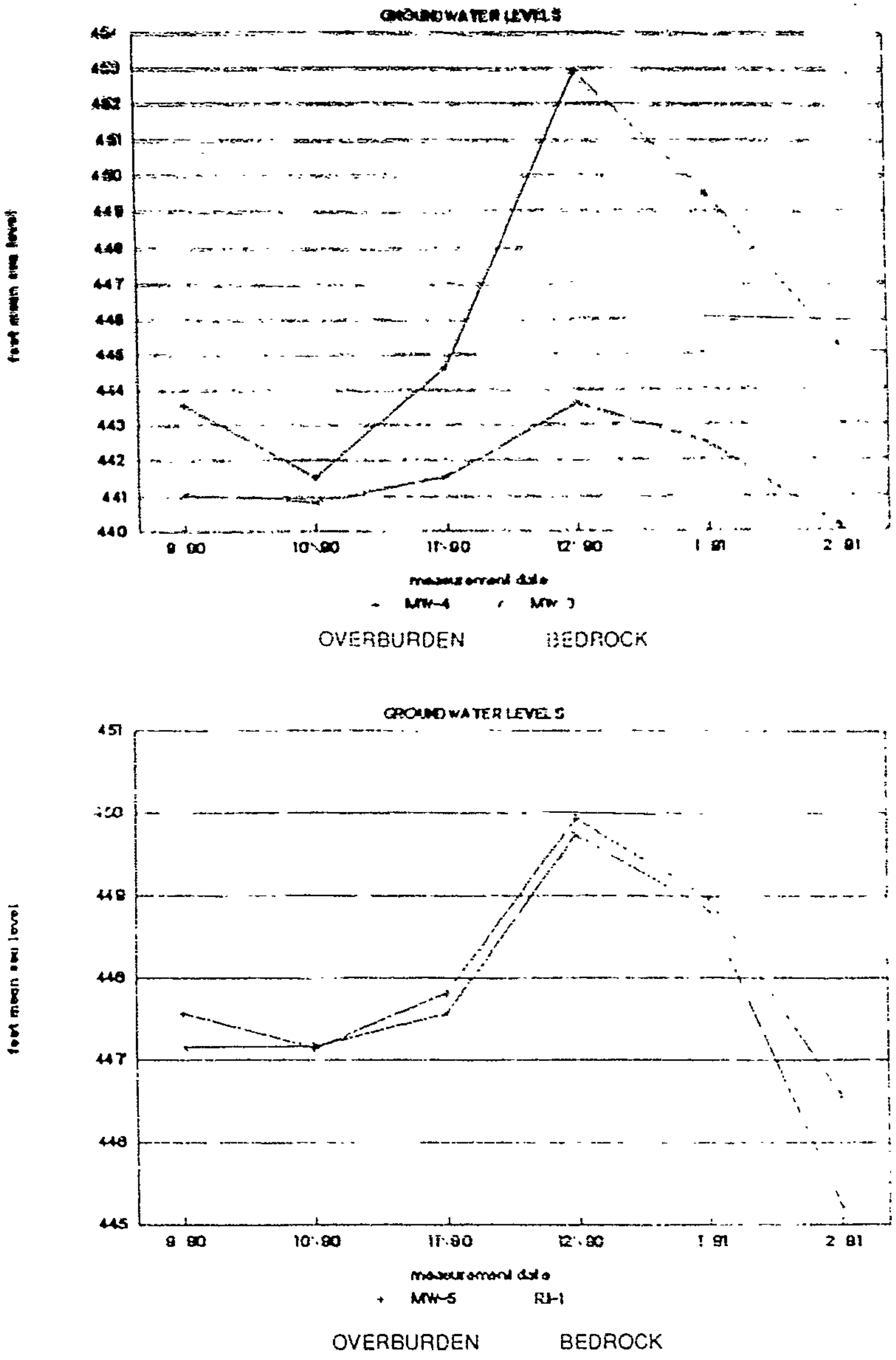
At the location of well pairs MW-6/RI-2, just east of the pond, spanner well RI-2 showed a higher groundwater level than overburden well MW-6. This is not conclusive evidence of an upward vertical gradient from the bedrock aquifer to the overburden since water in the screened zone of RI-2 represents a composite pressure head in both the overburden and bedrock aquifers as opposed to only the bedrock. However, these water levels in RI-2 in comparison to MW-6 indicate an upward vertical movement of ground water which would decrease the potential for downward migration of contaminants. Therefore, the most likely direction of contaminant migration is a horizontal movement to the Ramapo River.

Surface water levels, recorded monthly to determine fluctuations in the Ramapo River, were shown in Table 3-1 for the monitoring period from October 1990 through February of 1991. The trend was similar to the trend observed for groundwater. Surface water levels increased from October to December and decreased from December to February.

4.5 LABORATORY ANALYSIS RESULTS

The analytical results of samples collected by M&E in 1990 and 1991 during the Phase I RI field program are presented in tabular form in this section. The laboratory analyses were performed by RECRA Laboratories in Amherst, NY, and data was validated by NYTest, in Port Washington, NY. The data presented in this section include: 1) inorganics (metals) for 1990 and 1991, and 2) volatile organic compounds (1990 and 1991) and semi-volatile organic compounds (1990). No PCB's or pesticides were detected in the analyzed samples; however, detection limits for analysis of these constituents are presented for several of the media tested.

The tabulated data also include the analytical results of quality



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TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 4-5
MEASURED GROUNDWATER LEVELS
FOR TWO WELL PAIRS

assurance/quality control (QA/QC) samples such as trip blanks and equipment blanks, and the specific detection limits, where appropriate. QA/QC procedures for sample labeling, storage, holding times, shipment, and laboratory analysis are described in the Quality Assurance Project Plan (QAPP) contained in Appendix III of the Final Work Plan, dated June 20, 1990. Two types of data were tabulated.

- Numeric values presented alone
- Numeric values followed by qualifying letters U, B, J or a combination thereof

The numeric values without qualifying letters are valid data values. The significance of the letter qualifiers is as follows:

U - Undetected

B - Analyte found in blank

J - Estimated value - below valid detection limit of specific method

Due to the large numbers of tables in the subsections that follow, all remaining tables have been placed at the end of Section 4.

4.5.1 Groundwater

Groundwater samples taken by M&E in 1990 and 1991 were obtained from two sets of monitoring wells including: 1) existing wells, and 2) new monitoring wells that were installed by M&E in 1990 as part of the Phase I RI. The analytical results of the 1990 groundwater samples are presented in Tables 4-3 through 4-14 at the end of Section 4. The analytical results of the 1991 groundwater samples are presented in Appendix B of this report.

4.5.2 Surface Water and Sediment

Surface water and sediment samples were obtained from the Ramapo River. Two types of media were sampled:

1) Ramapo River water

2) Ramapo River sediment

Samples were taken at three locations along the river:

1) Downstream R1W1
2) Mid-site R1W2
3) Upstream R1W3

At each of the above locations (shown in Figure 4-6), the samples were taken at two different sampling points. One sample was obtained at a point near the western bank, and a second sample was taken near the middle of the river (MID), if possible. Sediment samples were taken in close proximity to the water samples. The location of the midstream/mid-site (R1W2) riverbank (BANK) sample was based on the location of a leachate seep observed emanating from the landfill. The analytical results of surface water and sediment samples are presented in Tables 4-15 through 4-25 at the end of Section 4.

4.5.3 Soil

Soils extracted during soil boring operations were field scanned with an organic vapor monitor. At each boring, the soil sample with the highest total organic vapor reading was submitted for laboratory analysis. In the absence of detected organic vapor levels, the sample at the soil-water interface was submitted for laboratory analysis. The soil boring sample data lists the depth interval for each boring, if applicable, from which the respective soil sample was taken. The analytical results of these soil samples are presented in the Tables 4-26 through 4-30 at the end of this section.

4.6 DATA USABILITY AND VALIDATION

The Gradient Corporation in Cambridge, MA, completed a data usability study for the laboratory data associated with the Tuxedo investigation. The analyses were performed by Recra Environmental, Inc. (Recra) and the associated data validation results were provided by Nytest Environmental, Inc. (Nytest). Groundwater, surface sediments and soils were analyzed for volatile organics, semi-volatile organics, pesticides, and inorganics in accordance with 1989 NYSDEC-ASP requirements. There was no detection of pesticides or polychlorinated biphenyls in the samples. No serious quality control (QC) deficiencies were noted by

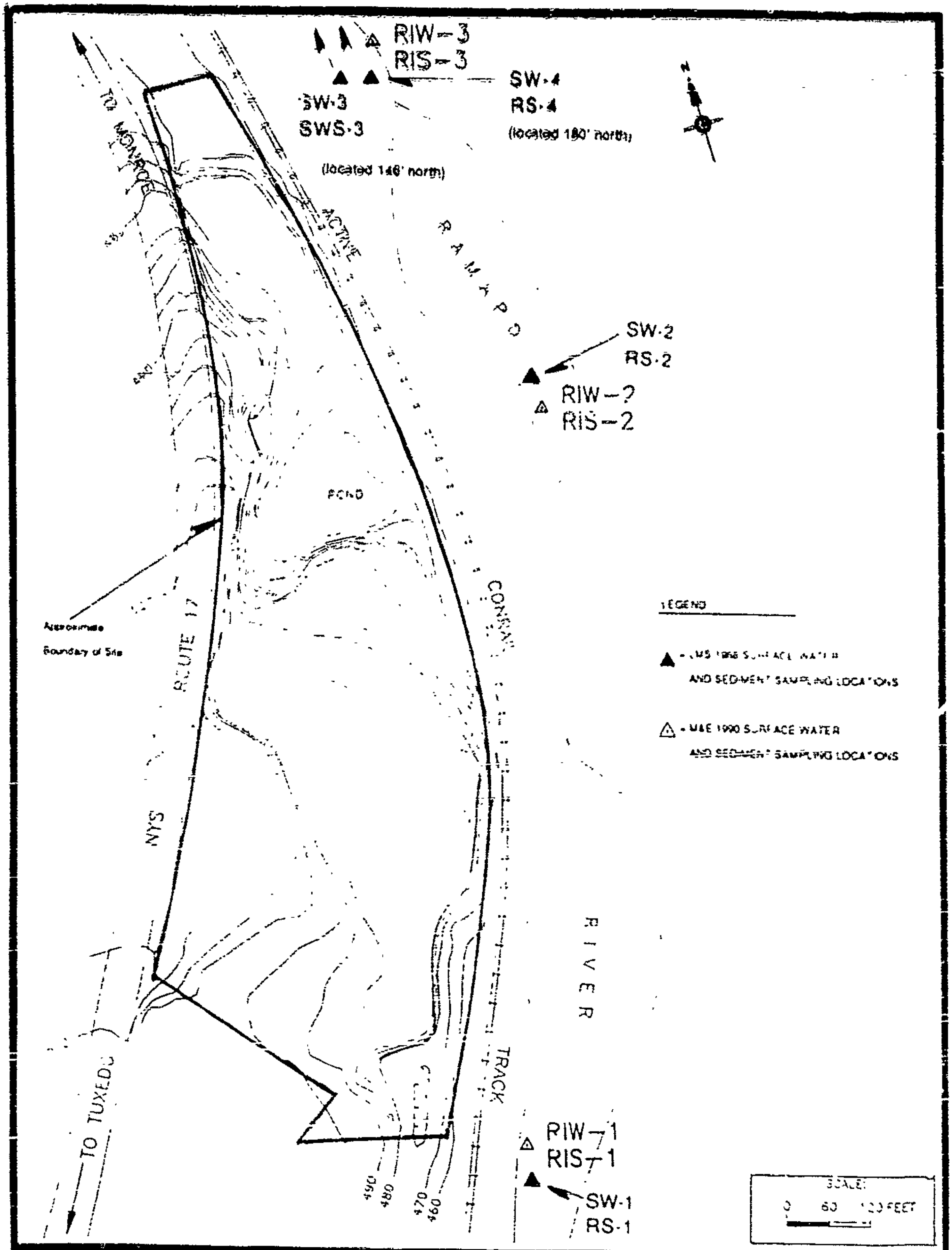

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FIGURE 4-6
SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

Nytest. All pesticide data has been deemed usable. Therefore, this section will focus on summarizing volatile organic, semi-volatile organic, and trace metals analyses.

4.6.1 Groundwater and Surface Water

Volatile Organics

The following ground water samples and associated field QC samples were reported by Recra in SDG 043 and 044.

GW-MW-1-1090
GW-MW-02-1090
GW-MW-03-1090
GW-MW-04-1090
GW-MW-05-1090
GW-MW-06-1090
GW-MW-07-1090
GW-MW-08-1090
GW-RI-01-1090
GW-RI-02-1090
GW-RI-03-1090
GW-RI-04-1090
GW-R -5A-1090
GW-EB-01-1090 (Equipment Blank)
GW-TB-01-1090 (Trip Blank)
GW-TB-02-1090 (Trip Blank)
GW-TB-03-1090 (Trip Blank)
GW-TB-04-1090 (Trip Blank)
GW-TB-05-1090 (Trip Blank)

Samples GW-MW-06-1090 and GW-MW-08-1090 were field duplicates. A comparison of the positive detects is provided in Table 4-39 at the end of this section.

In addition, the following samples were reported in SDG 046 for volatiles and metals only:

GW-MW-01-1091
GW-MW-03-1091
GW-MW-04-1091
GW-MW-05-1091
GW-MW-06-1091
GW-MW-07-1091
GW-EB-01-1091 (Equipment Blank)
GW-RI-01-0191
GW-RI-02-0191
GW-RI-03-0191
GW-RI-04-0191
GW-RI-06-0191
GW-TB-01-0191 (Trip Blank)
GW-TB-02-0191 (Trip Blank)

GW-RI-06-0191 is a field duplicate of GW-RI-02-0191. A comparison of these results is presented in Table 4-39 at the end of this section.

QC results for volatile organic analyses were acceptable. All instrument tuning and calibration criteria were met No holding times were exceeded. Methylene chloride, acetone, and toluene were detected in method or field blanks and should be considered questionable, and thus invalid. All other results, including non-detects, are usable.

SDG046 contained the data from a second round (1/91) of sampling of the same wells from SDG043 (collected 10/90) With the exception of the blank contaminant compounds, all volatile organic analysis results from SDG043 and SDG046 were comparable The low levels of chloroform and benzene found in several samples are usable

Semi-Volatile Organics

QC results for twelve of the fourteen semi-volatile organic analyses were also found to be acceptable All instrument tuning and calibration criteria were met.

The acid fraction results for sample MW-06 are rejected The laboratory encountered problems with the recoveries of acid matrix spike compounds in sample MW-06 The acid surrogate recoveries for this sample, the associated matrix spike, and matrix spike duplicate were also low (less than 10%), this is likely due to a matrix effect. The acid results (all non-detects) are invalid as the matrix effect prevented proper analysis of these compounds.

The semi-volatile results for MW-08 are also invalid due to extraction past the holding time. The sample was originally extracted within holding times, but had poor surrogate recoveries. The re-extracted sample analysis did have acceptable surrogate recoveries, and these results were the only ones reported. The matrix effect noted in sample MW-06 is assumed to be the cause of the poor recoveries during the initial analysis. All other semi-volatile results are usable.

Pesticides/PCBs

There were no positive detects of pesticides or polychlorinated biphenyls in the samples. All pesticides data has been deemed usable.

Metals/Cyanide

The data is questionable, but usable as estimated values. The data validation performed by Nytest identified several non-compliant areas in the data packages, including incorrect spiking levels (for antimony, arsenic, lead, manganese, nickel, and zinc) and non-compliant analytical spike solution concentrations for the furnace analyses (arsenic, lead, thallium, and selenium). There were also problems during calibrations, such as low recoveries of the 2xCRDL standard for the ICP analyses for nickel, silver, copper, and cadmium. The data is questionable, but usable as estimated values. The non-detected results and results near the detection limit are most suspect and should be used with caution.

The lead results in SDG 046 have been rejected due to high levels of lead in the equipment blank GW-EB-01-0191. All sample results were within a factor of 3 of the blank lead concentration of 23 micrograms per liter.

A detailed comparison of the metals results between SDG 043 and SDG 046 was not undertaken due to possible seasonal variations. However, the analyses of both field duplicate pairs demonstrated high precision by the laboratory and the field team.

4.6.2 Soil Borings

The following soil samples and associated field QC samples were reported by Recra in Sample Delivery Groups (SDG) 040, 041, and 042:

RIB-1
RIB-2
RIB-3
RIB-4
RIB-5,12-14
RIB-6
RIB-7
SW-TB-1-0790 (Trip Blank)
SW-1-0-0790 (Drilling Fluid)

SW-TB-1-0790 and SW-1-0-0790 were aqueous samples.

Volatile Organics

The QC results for volatile organic analyses were found to be acceptable. All instrument tuning and calibration criteria were met. No holding times were exceeded. Methylene chloride, acetone, toluene, and 1,1,1-trichloroethane were detected in method, holding, and/or trip blanks and should be considered questionable and thus invalid.

Semi-Volatile Organics

Most QC results for five of the seven semi-volatile organic analyses were found to be acceptable. All instrument tuning and calibration criteria were met. No holding times were exceeded. Although some minor violations of the matrix spike and surrogate spike recoveries occurred, these results are acceptable. In general, the recoveries were just outside the acceptable range, with a positive bias (high recovery rather than under recovery). Di-n-butyl phthalate was detected in an associated method blank. Therefore, the reported values for this compound in RIB-4 and RIB-7 are invalid. The method blank associated with samples RIB-3 and RIB-5 did not contain di-n-butyl phthalate; the positive values of this compound in RIB-3 and RIB-5 are usable. The remaining detected compounds were either polynuclear aromatic hydrocarbons (PAH) or phthalate acid esters, and this data is usable.

Pesticides

There were no positive detects of pesticides or polychlorinated biphenyls in the samples. All pesticides data has been deemed usable.

Metals/Cyanide

The data validation performed by Nytest indicated that the metals data is questionable, but usable as estimated values. The non-detected results and results near the detection limit are most suspect, and should be used with caution.

The data validation performed by Nytest identified several non-compliant areas in the data packages. The laboratory adjusted the final digestate volume for soils to 100 ml instead of the contractually required 200 ml. The lab also used non-compliant post-digest spike analytical spike solution concentrations for the furnace atomic absorption analyses. Further review indicated that obvious matrix effects such as poor reproducibility and variable spike recoveries, were encountered during the analyses. In general, the recoveries were lower than the acceptable recovery ranges. This indicates a negative bias, which would result in the under-estimation of concentrations, and the possibility of false negatives as actual concentrations approached the instrument detection limits. This is not uncommon for the analysis of metals in soil. The data is questionable, but usable as estimated values. The non-detected results and results near the detection limit are most suspect, and should be used with caution.

Only the drilling fluid sample (SW-1-0-0790) was analyzed for cyanide. The result (non-detect) is usable.

4.6.3 Surface Water and Surface Water Sediment

The following sediment and surface water samples and associated field QC samples were reported by Recra in SDG 044.

Sediments

SD-RIS-01-1090 (BANK)
SD-RIS-01-1090 (MID)
SD-RIS-02-1090 (BANK)
SD-RIS-02-1090 (MID)
SD-RIS-03-1090 (BANK)
SD-EB-01-1090 (Equipment Blank)
SD-TB-01-1090 (Trip Blank)

Surface Waters

SW-RIW-01-1090 (BANK)
SW-RIW-01-1090 (MID)
SW-RIW-02-1090 (BANK)
SW-RIW-02-1090 (MID)
SW-RIW-03-1090 (BANK)
SW-RIW-03-1090 (MID)
SW-EB-01-1090 (Equipment Blank)
SW-TB-01-1090 (Trip blank)
SW-TB-02-1090 (Trip Blank)

Volatile Organics

QC results for volatile organic analyses were acceptable. All instrument tuning and calibration criteria were met. No holding times were exceeded. Methylene chloride, acetone, and toluene were detected in method or field blanks and should be considered questionable and thus invalid. The only other positive detect was 2-butanone in sample RIS2 (BANK). This value and all non-detect results are usable.

Semi-Volatile Organics

Most QC results for semi-volatile organic analyses were acceptable. All instrument tuning and calibration criteria were met. Although some minor violations of the matrix spike and/or surrogate recoveries occurred, these results are generally acceptable.

The surface water samples were all acceptable. No positive values were reported.

Bis(2-ethylhexyl)phthalate was detected in a method blank at 55 µg/Kg. All positive values of this compound are suspect, and therefore invalid. PAH, phenol, and benzoic acid were detected in the sediment samples. The associated sediment equipment blank (SD-ED-01-1090) contained all acid matrix spike compounds. Although this was noted by Nytest in the data validation report, the presence of the compounds has not been reconciled. The acid results for this equipment blank have been deemed unusable. No action is necessary for the related sample.

The associated sediment equipment blank (SD-EB-01-1090) contained all acid matrix spike compounds. Although this was noted by Nytest in the data validation report, the presence of the compounds has not been reconciled. The acid results for this equipment blank have been deemed unusable. No action is necessary for the related samples.

Pesticides

There were no positive detects of pesticides or polychlorinated biphenyls in the samples. All pesticide data has been deemed usable.

Metals/Cyanide

The data validation performed by Nytest indicated that the data is questionable, but usable as estimated values. The data performed by Nytest identified several non-compliant areas in the data packages, including improper final digestate volumes and non-compliant analytical spike solution concentrations. Further review indicated obvious matrix effects were encountered during the analysis of the sediment samples, such as poor reproducibility and variable spike recoveries.

4.6.4 SUMMARY

Pesticides/PCBs:	All data are usable.
Volatile Organics:	All data are usable, with the exception of methylene chloride, acetone, and toluene values in all samples, which are invalid due to blank contamination. The values for 1,1,1-trichloroethane are invalid in the soil boring samples due to blank contamination.
Semi-Volatile Organics:	All data are usable, except for the acid results of sample MW-06 and all results of MW-08. The di-n-butyl phthalate values in sample RIB-4 and RIB-7 are invalid due to blank contamination. The bis-(2-ethylhexyl)phthalate results for sediment samples are invalid for the same reason.
Metals/Cyanide:	All cyanide results are usable. All metals results are usable as estimated values, except for the lead results in the groundwater samples from January 1991 (SDG 046), which are invalid. The combination of TO matrix effects, non-compliant methods, and other problems prevent a more detailed description of usability.

Gradient's data usability report states that all metals data for all the samples should be used as estimated values. The reasons are: 1) incorrect final digestate volume, 2) incorrect spiking concentrations, and 3) poor spike recoveries. Recra Environmental, Inc. explained that staff did not follow protocol for final digestate volumes and spiking concentration because they could get better recovery at low concentrations. The poor spike recoveries were due to matrix interference on the soil boring and river sediment samples, but no matrix interference occurred on the groundwater or river water samples.

The implications of the estimated metals data are as follows:

- the data are usable (except for the few exceptions noted in the report
- the data for samples not analyzed according to protocol are estimated, but the values are not changed
- data that are undetected or near the detection limit are in a gray area where some values should be slightly higher or slightly lower, but not changed dramatically

The table of duplicate samples shows good quality of the metals data in general, and deficiencies are not sufficient to warrant resampling

4.7 GEOPHYSICAL SURVEY RESULTS

4.7.1 Limitations of Method

Factors affecting the magnetometer's response include the amount of ferrous metal present, the degree of oxidation, the orientation of the buried target, and the degree of induced versus permanent magnetism of the target. These factors can result in a large variation in the magnetometer's response, making quantitative analysis of results (i.e., depth and size of target) difficult. However, the results of the magnetometer/gradiometer survey should prove useful for targeting follow-up investigations.

Large amounts of metallic debris near the surface of the landfill may have created large anomalies that obscured the deeper metallic targets. For example, one pound of iron buried 1.5 feet below surface will produce an anticipated anomaly of approximately 150 gammas. In comparison, 1,000 pounds of iron buried 65 feet below surface (the approximate bottom of the landfill) may only produce a response of 4 to 5 gammas. If the targets are buried 40 to 70 feet below surface, and the rear surface of the landfill contains large amounts of reinforcement bar and other metallic debris, the success of the survey may be limited.

4.7.2 Data Maps

The total field magnetic data and vertical gradient data were color contoured and are presented as Figures 4-7 and 4-8, respectively. The total field magnetic data was then high band pass filtered in an attempt to remove the effects of the near surface metallic debris These data were color contoured and are presented as Figure 4-9.

The observed color contoured response produced by buried metals as one crosses directly over them in a south to north direction is data high or "peak" (represented as shades of deep red and purple) followed by a data low or "trough" (represented as shades of deep blue). At the Tuxedo site, the earth's magnetic field inclination is approximately 70 north. This magnetic field inclination may cause the observed anomalous response, shown on the color contoured map, which is offset from the actual buried metallic target. Areas relatively free of metals represent background conditions and are displayed as shades of greens and yellows on the color contour maps.

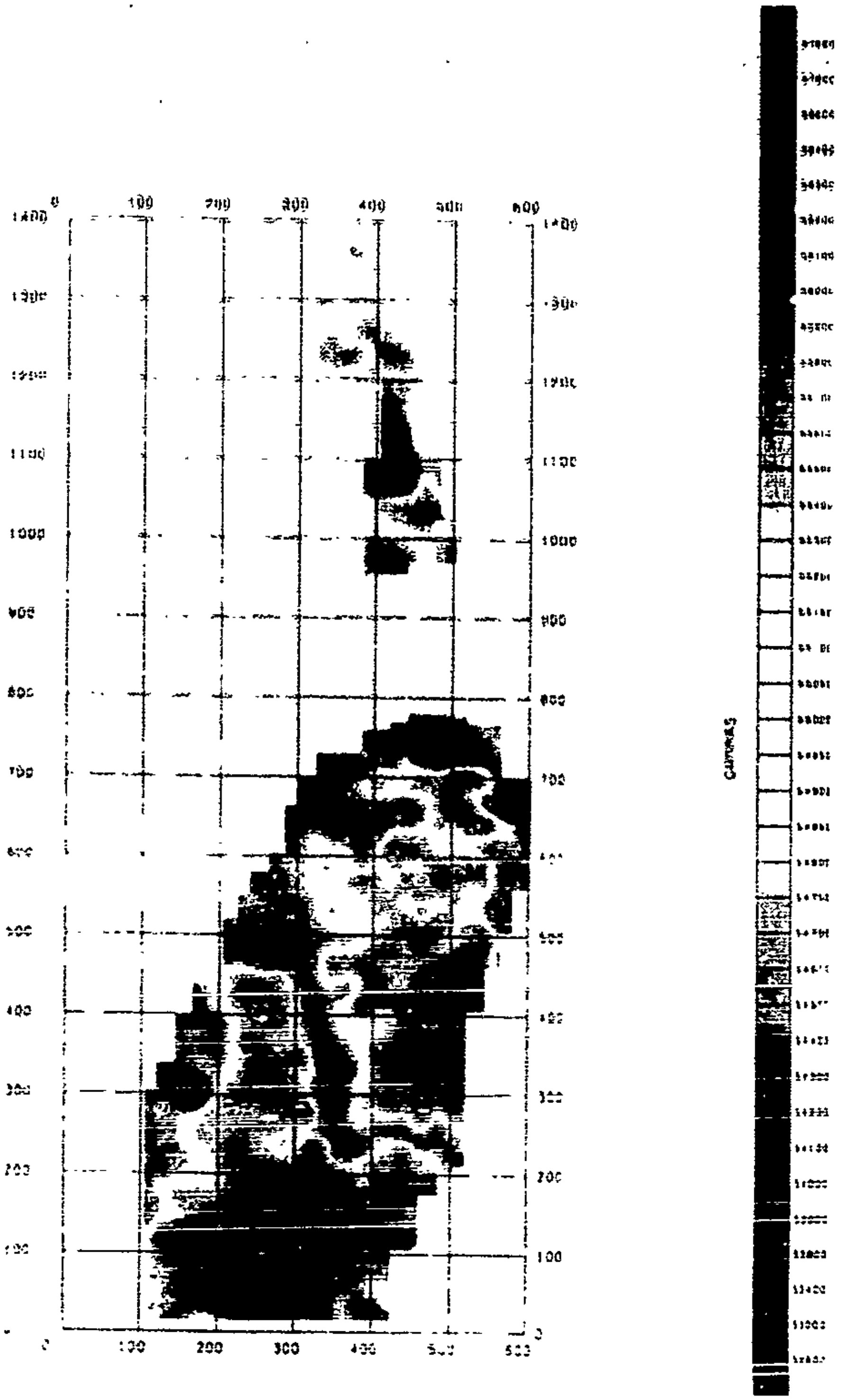
Total Field Magnetic Data

The total field magnetic data were edited, corrected for drift, and plotted as individual profile lines for interpretation. Data were corrected to a base value of 54,670 gammas. The data were then color contoured in units of gammas, allowing for a complete and rapid illustration of detected anomalous areas. The following lettered total field magnetic anomalies were observed across the site (see Figure 4-7):

(A) This anomaly, represented in shades of deep red and purple, is thought to represent surface metals observed at this location.

(B) This large anomaly, represented in shades of red and deep purple, may represent a large area of buried metals. The observed anomalous response may be indicative of near surface metallic debris or large metallic objects buried to a depth of ± 30 feet. These buried metals may be associated with those of anomaly A.

(C) This small anomaly, represented by shades of deep reds and purples, may indicate near surface metallic debris or large metallic objects



SCALE 1 : 1,800

FIGURE 4-[illegible]
TOTAL FIELD MAGNETIC DATA

GEOPHYSICAL SURVEY RESULTS
COLOR CONTOURS

TUXEDO LANDFILL SITE

TUXEDO NEW YORK

REF GARTNER LEE INC
NIAGARA FALLS NEW YORK

PRESENTATION BY
DATAPLOTTING SERVICES

Metcalf & Eddy
of New York, Inc.

buried to a depth of approximately ± 15 feet. These buried metals may be associated with those of Anomaly B.

(D,T) These strong responses, represented in shades of deep blue, are associated with two large bulldozers parked on-site. The bulldozers created an extremely strong anomalous response which caused an error in the gridding algorithm.

(E,V) These anomalous areas represented in shades of yellow and orange may indicate near surface metallic debris. These anomalies may also represent areas of deeper buried metallic objects.

(F) This linear north-south trending anomaly, represented in shades of blue, may be due to a buried pipe or utility line. This anomaly may also represent a trenched area that contains metallic objects

(G) This linear east-west anomaly, represented in shades of light blue and green, may represent the trench that contains a deeply buried storm sewer pipe across the site. The storm sewer outfall is near the eastern extent of this anomaly

(H) This large anomaly, represented in shades of deep reds and purples, may show an area of metallic debris disposal. It is located along the slope at the landfill's eastern edge where reinforcement bar and other metallic debris protrude from the ground. This anomaly could result from near surface metallic debris and/or deeper metallic objects buried to a depth of approximately ± 30 feet. The railroad tracks east of this anomaly also could have contributed to the instrument's response.

(I,K,L,N,O,P,S) These small anomalies, represented in shades of oranges and reds, may represent near surface metallic debris or larger metallic objects buried to depths of approximately ± 10 feet.

(J) This large anomaly, in shades of deep blue, may be associated with anomaly F. It was near overhead power lines, and the areal extent and estimated depth could not be determined.

(M) This large anomaly, represented in shades of deep blues, may represent an area of near surface metal. It was on a steep slope along the eastern edge of the landfill where large amounts of metallic debris were present and protruding from the ground surface. Some interference from the railroad tracks located due east of the magnetometer survey may also account for the results.

(Q) This northeast-southwest trending anomaly, represented as shades of deep blue, is most likely due to the overhead power lines that parallel Route 17 west of the magnetometer survey area.

(R) This large anomaly, represented as shades of deep blue, was along the northern edge of the landfill, near the filled pond. It may represent an area of large metallic objects buried to a depth of ± 30 feet or near surface metallic objects and debris.

(U) This anomaly resulted from drilling equipment (augers, rods, etc.) located at the ground surface.

Vertical Gradient Data and Filtered Data

The vertical gradient data were edited and plotted as individual profile lines for interpretation. The data were then color contoured in units of gammas/meter for a complete and rapid illustration of detected anomalous areas (see Figure 4-8). The gradient data appear to be more representative of the near surface metallic debris than the total field magnetic data. This is apparent in the "blocky" appearance of the color contour map as shown in Figure 4-8.
To remove some effects of near surface metals, the data were filtered using a 19-point high band pass filter with a 200-foot amplitude. The filtered data were then plotted as profile lines and color contoured for rapid illustration of detected anomalies (see Figure 4-9). The following lettered vertical gradient anomalies were observed across the site as shown in Figure 4-9:

(A) This anomaly, represented by shades of deep reds and purples, probably represents surface metals noted at this location.

(B,C,D,I,J,K,L,M,N,P,Q,R,S,T,U,V,X,Z,AB,AC,AE) These numerous small anomalies, represented as deep reds and purples with associated deep blues, may represent near surface metallic debris.

(E) This large anomaly, represented in shades of deep red and purple, may represent a large area of buried metals. It may be indicative of near surface metallic debris or large metallic objects buried to a depth of ±30 feet.

(F,AD) These anomalies represent the two bulldozers parked on-site.

(G) This linear east-west anomaly, represented in shades of light blue and green, may represent a trench that contains a deeply buried storm sewer pipe. The storm sewer outfall is near the eastern extent of this anomaly.

(H) This north-south trending anomaly, in shades of blues, may represent a buried utility line, pipe, or trench that contains metallic objects. The filtered total field magnetic data displays the anomalies as being less linear, suggesting that this may be groups

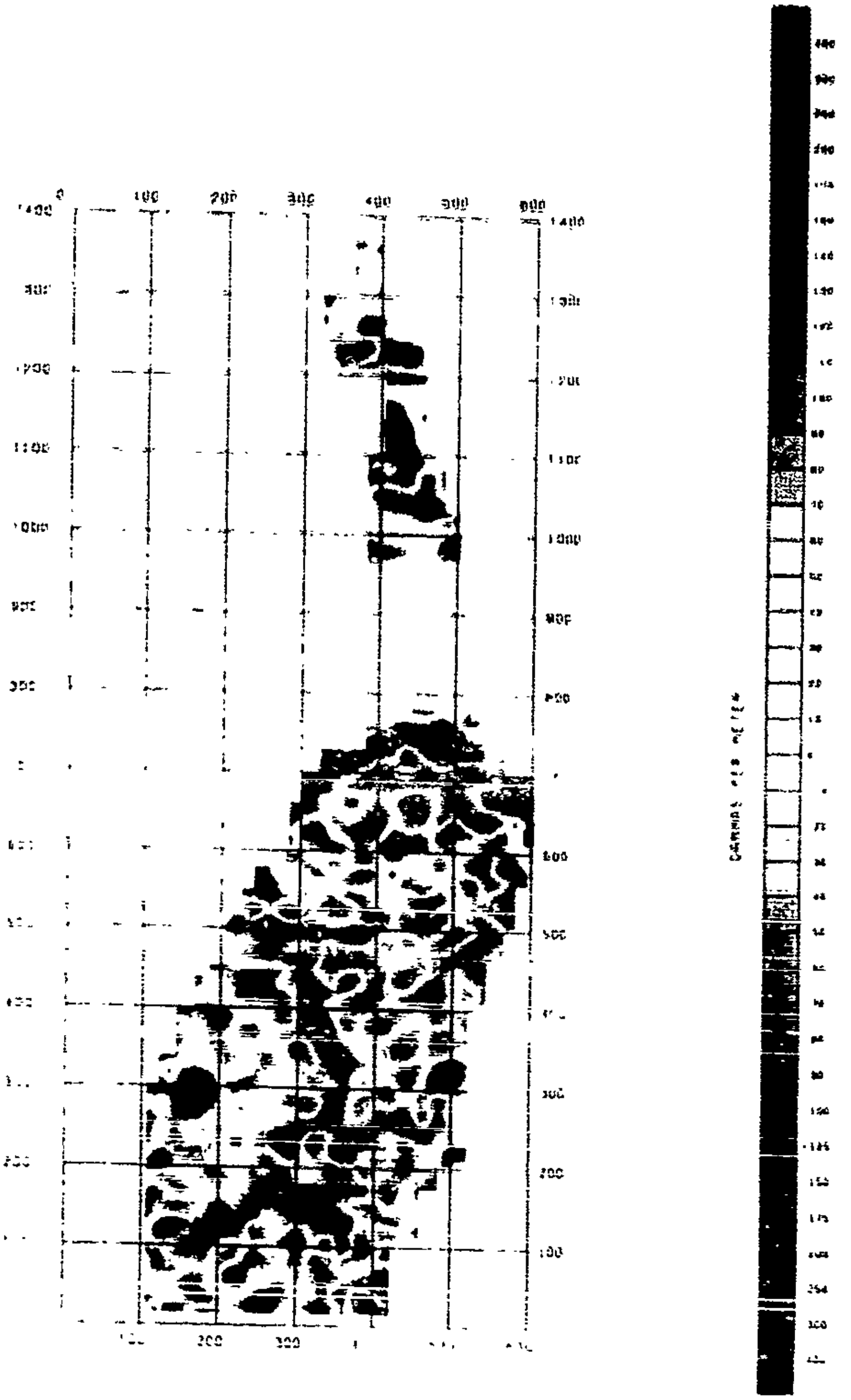


FIGURE 4 8
VERTICAL GRADIENT MAGNETIC DATA

GEOPHYSICAL SURVEY RESULTS
COLOR CONTOURS

TUXEDO LANDFILL SITE
TUXEDO, NEW YORK

REF GARTNER LEE INC
NIAGARA FALLS, NEW YORK

PRESENTATION BY
DATAPLOTTING SERVICES

Metcalf & Eddy of New York, Inc.

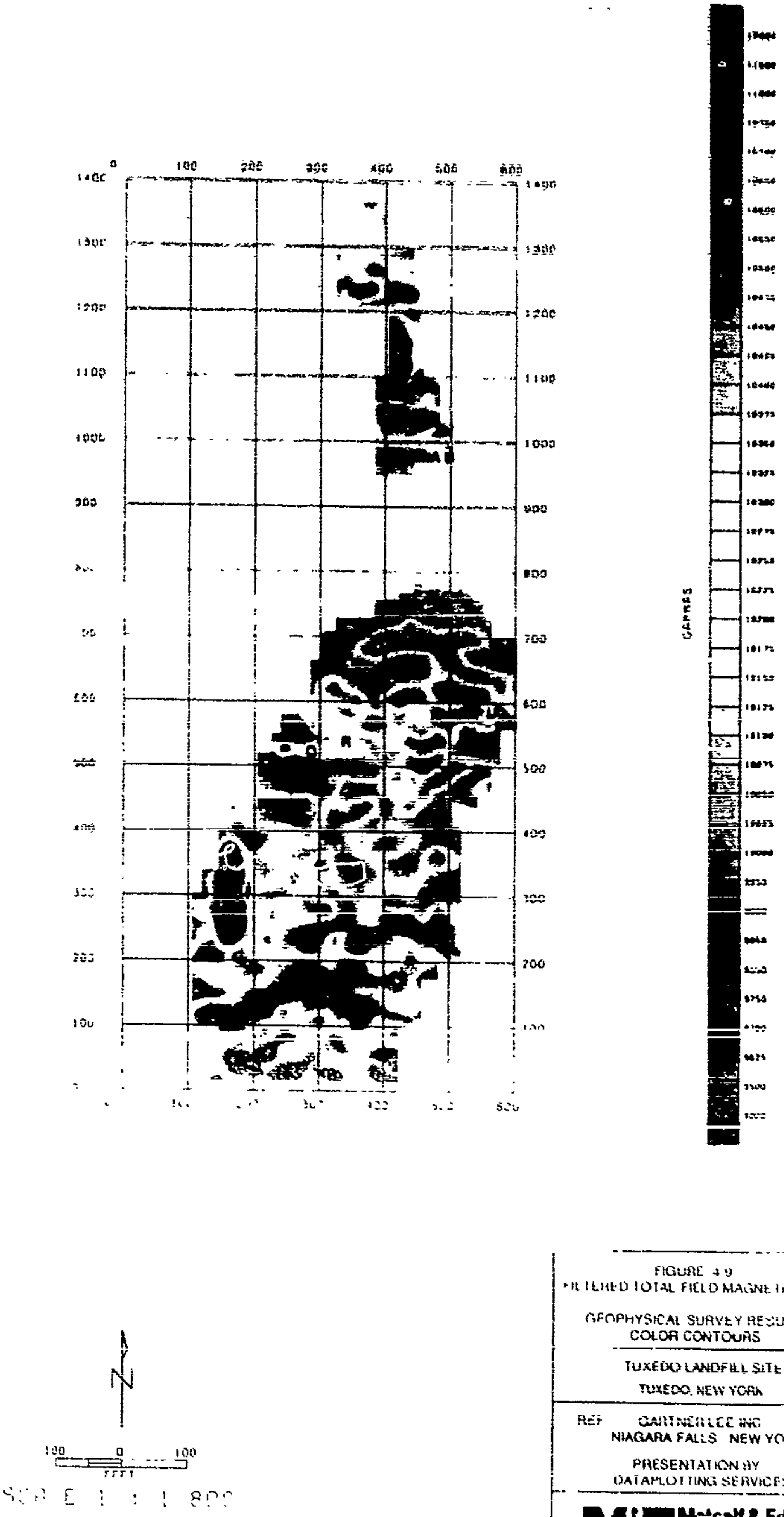


FIGURE 4.9
FILTERED TOTAL FIELD MAGNETIC DATA

GEOPHYSICAL SURVEY RESULTS
COLOR CONTOURS

TUXEDO LANDFILL SITE

TUXEDO, NEW YORK

REF GARTNER LEE INC
NIAGARA FALLS NEW YORK

PRESENTATION BY
DATAPLOTTING SERVICES

Metcalf & Eddy of New York, Inc.

of buried metallic objects.

(O) This large anomaly, represented in shades of blue, may be associated with anomaly H. It was near overhead power lines and buried utilities such that the areal extent and estimated depth could not be determined.

(W) This large anomaly, represented in shades of blue, may be an area of near surface metallic debris on a steep slope along the eastern edge of the landfill. During the survey, large amounts of metallic debris were protruding from the ground surface in this area. Some interference may also have occurred from the railroad track one east of the magnetometer.

(Y) This large anomaly, represented as shades of deep blue, was located along the northern edge of the landfill near the filled pond. It may represent an area large metallic objects buried to a depth of 30± feet or near surface metallic objects and debris.

(AA) This anomaly, represented in shades of deep blue, is probably due to overhead power lines and buried utilities that parallel Route 17.

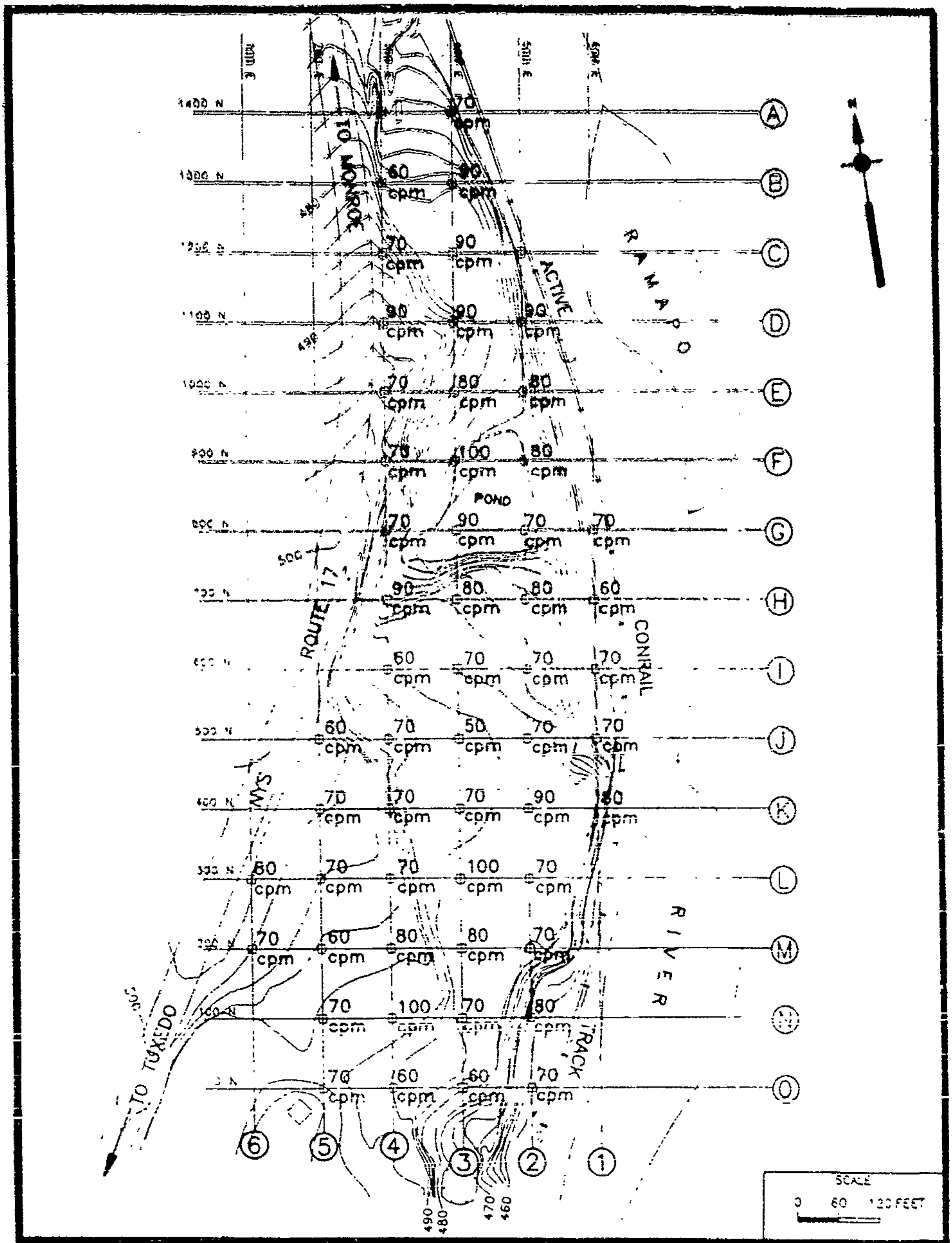
4.7.3 Conclusions

The magnetometer/gradiometer survey indicates the site contains large amounts of near surface metallic debris. Several large anomalies (Anomalies B, F, H, J, M, and R of Figure 4-7) may represent extensive areas of buried metallic objects. Further investigation of these areas would be required to obtain additional information.

Other areas of the landfill may contain buried metallic objects that could not be identified due to the presence of surface and near surface metals and/or their depth of burial. The landfill could be further investigated for the presence of buried metals by using supplemental geophysical techniques, historical aerial photography, test pits and/or boreholes.

4.8 RADIATION SURVEY RESULTS

As described in Section 3.7, a radiation survey was performed to determine radiation levels across the site. Background radiation levels ranged from 50 to 130 CPM, averaging approximately 90 CPM. On-site radiation levels ranged from 50 CPM to 100 CPM, averaging approximately 80 CPM. The on-site readings fell within the range of background readings. Figure 4-10 shows the locations and



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ORANGE COUNTY, NEW YORK

FIGURE 4-10
RADIATION SURVEY TEST LOCATION MAP

values of the readings taken.

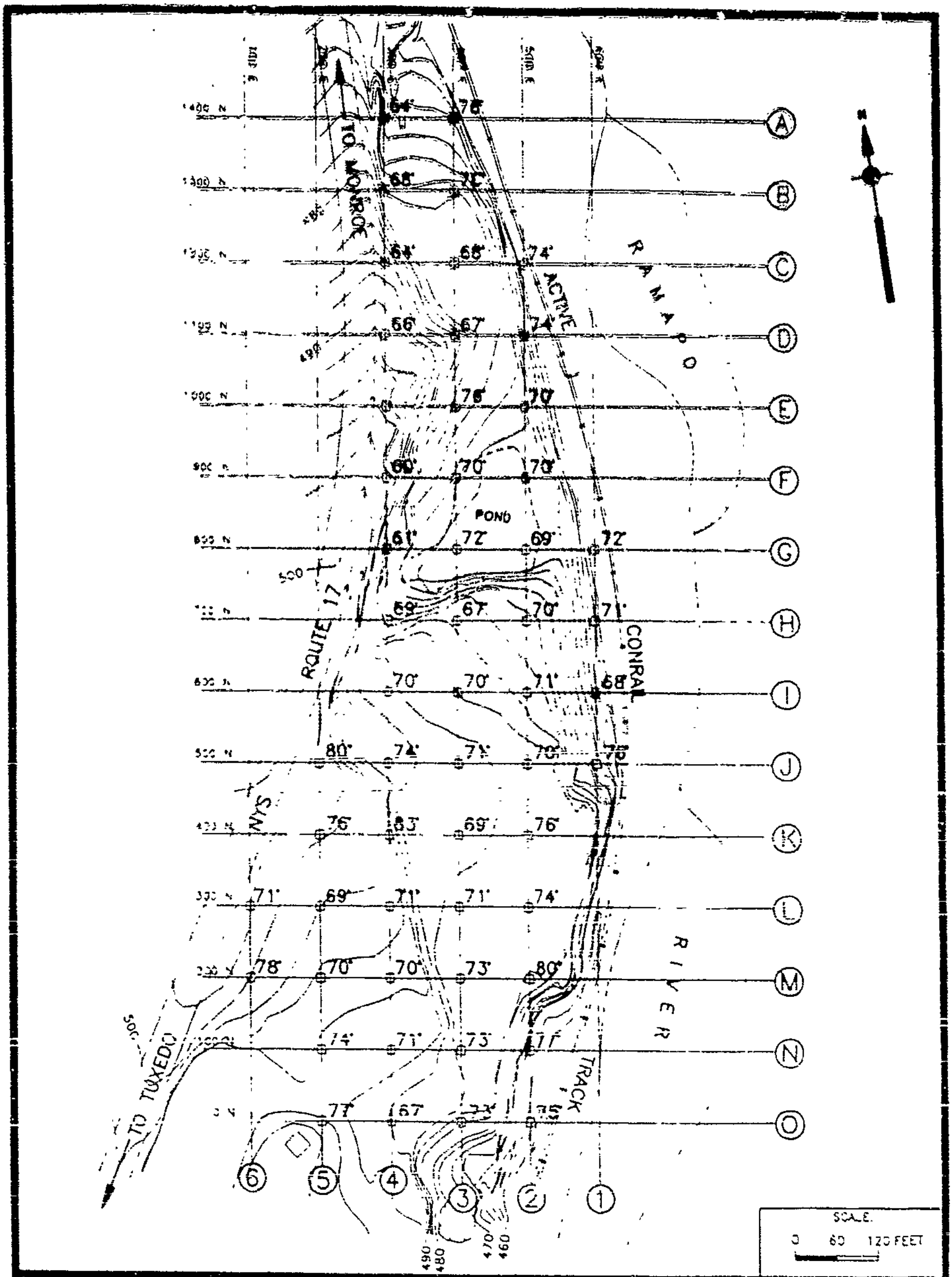
4.9 TEMPERATURE SURVEY RESULTS

The results of the temperature survey are shown in Table 4-31 at the end of this section. Soil temperatures ranged from 60° to 83°F with an average soil temperature 71.5°F. The soil probe location map, (Figure 4-11), depicts the surveyed locations and associated soil temperatures. Since no areas on the grid showed a pattern that could easily be contoured, contours were not drawn.

In general, soil temperatures were lower on the northwest portions of the site, where the depth of landfill material is shallower, than on other sections of the site. However, this pattern also reflects the time of day when the probes were inserted, as well as the morning cloud cover. The north sections of the site were surveyed in the morning, when air temperatures were 71°F, followed by surveying of mid-site sections in the early afternoon and southern sections in the late afternoon when air temperatures were in the mid-80's, and effects of solar radiation were greater. No discernable pattern between soil and air temperatures was observed. This was an expected result because ambient air temperatures will respond to changing meteorological conditions more quickly than soil temperatures. Thus, the increase in air temperature that occurred during the survey period would not be marched by corresponding increases in soil temperatures. This would explain why most soil probes measured temperatures significantly lower than the corresponding ambient air temperatures.

Some additional soil probes recorded temperatures similar to the ambient air temperatures. The significance of this cannot be determined. It could be due to a variety of factors. Several soil probes indicated temperatures higher than corresponding ambient air temperatures. This could be due to effects of solar radiation on the soil surface, as well as other site specific variables.

At many locations, obstructions in the soil prevented the pilot holes for the soil probes from extending the intended 24 inches. In some cases, however, after hammering the stainless steel rod as deep as possible, field personnel were able to push the probe down an additional distance. This distance was recorded as "inches of penetration" under the heading of other observations in Table 4-31.



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ORANGE COUNTY, NEW YORK

FIGURE 4-11
TEMPERATURE SURVEY
SOIL PROBE LOCATION MAP

The total depth of the soil probe "after penetration" was also recorded under this heading. Although some of the probes could not be inserted to the full 24" depth, no temperature pattern as a function of depth is evident.

The insertion and removal times of the soil probes were recorded as well as the air temperatures associated with each event. To determine whether ambient air temperature probe readings were affected by direct sunlight, the meteorological station air temperatures for all recording times are included in Table 4-31. Overall weather conditions as well as observations regarding shade of the test locations were also recorded.

In spite of the uncertainties inherent in analyzing the soil temperatures, several readings are noteworthy and may be indicative of elevated temperatures associated with subsurface landfill decomposition. The sites are discussed below.

- A3 and B3: Both of these sites had soil temperatures of 76°F, which was 5° higher than the air temperature of 71.2° under cloudy conditions, when exposure to sunlight would have been an unlikely contributing factor. In contrast, probes at A4 and B4, inserted at nearby locations at almost the same time, recorded temperatures of 64° and 67.5°, respectively. The high temperatures for A3 and B3 are therefore considered to be indicative of a potential hot spot.

- E3: Although the weather was sunny and the air temperature had increased to 77 9°, this soil temperature (76°) was 6° higher than the one placed at E2 just a few minutes earlier. This may be significant.

- J1: The reading of 76° was 6° higher than the probe placed at nearby location J2 just a few minutes later. Thus, the high temperature for J1 may be significant. The weather conditions were sunny with an air temperature of 84.5° for both probes.

- J5: The soil temperature of 80° is higher than surrounding soil temperatures of 74° for probes inserted at similar times under similar weather conditions. Ambient air temperature was 84.8°F.

- K2, K4, K5: Under sunny conditions, with an air temperature of 84 8°F, these probes registered soil temperatures of 76° to 82.5°. In contrast, the probe at K3 registered a soil temperature of 69°F at the same time of day.

- M2, M6: Soil temperatures at these probes were 78° and 80°, compared with temperatures of 70 to 73° at nearby locations. Air temperature was 83.8°.

- N2: The probe at this location registered a soil temperature of 77°F compared with lower temperatures for other probes placed nearby at the same time of day. This location is next to M6, where a similar soil temperature of 78° was recorded. Air temperature was 83°F.

- O5: The soil temperature of 77°F is in contrast with the temperature of 67° recorded at the same time at location O4. Both sites were in shade. The air temperature was 83.0°F.

In conclusion, the results of the temperature survey indicate several possible locations of subsurface heating and combustion. Based on a comparison of probes placed in the same vicinity and at the same times of day, all soil probes that registered temperatures of at least 76° may be indicative of subsurface activity and probe locations with temperatures of 80° or more may be an even more likely indication of subsurface heating. However, numerous variables, such as changes in ambient air temperature, possible influence by direct solar radiation, etc., could also be a significant factor in the high readings. Therefore, the results of the soil temperature analysis are considered inconclusive.

4.10 PERIMETER SOIL GAS SURVEY RESULTS AND DISCUSSION

4.10.1 Results

Forty-three soil vapor probes were installed along the perimeter of the site during July 11-13, 1990. Sampling and analysis were coincident with falling barometric conditions (30.2 - 29.0 inches of mercury) during the field activities. Thirty-seven soil probes situated at north-south and east-west locations (VP-1 - VP-37) were sampled and tested during July 17-20, 1990 for total organic vapor, methane, hydrogen sulfide, lower explosive limit, and carbon monoxide. Soil gas was tested with the OVA #128, Photovac TIP, and Bacarach CGI.

Elevated levels of methane (OVA > 1000 ppm) and LEL were detected in VP-11 through VP-14 and in VP-24. For VP-11 through VP-14, measured LEL readings ranged between 64-100%. Since soil intrusive activities could present fire or explosion risks, subsequent boring operations in these areas were carefully monitored. The presence of H_2S (1-8 ppm) was also recorded at these probe locations. Low levels of total organic vapor were detected at varying locations around the site. VP-26 through VP-30 showed the highest levels of organic vapor. This may be a result of the proximity to the adjacent highway.

In summary, no methane gas was detected along the west or north sides of the site. Elevated levels of methane were recorded along the south and east sides. Organic vapors detected along the highway may be a result of highway runoff None of the probes located on the west side of Route 17 were tested during the July sampling event.

4.10.2 Discussion

Sampling and analysis of soil vapor was postponed during the week of July 9-13, 1990 due to an extended period of rainfall with a slightly rising barometric conditions During this time, field activities were limited to installation of all vapor probes without sampling and field testing of the system design. Actual sampling and analysis commenced the following week during falling barometric conditions.

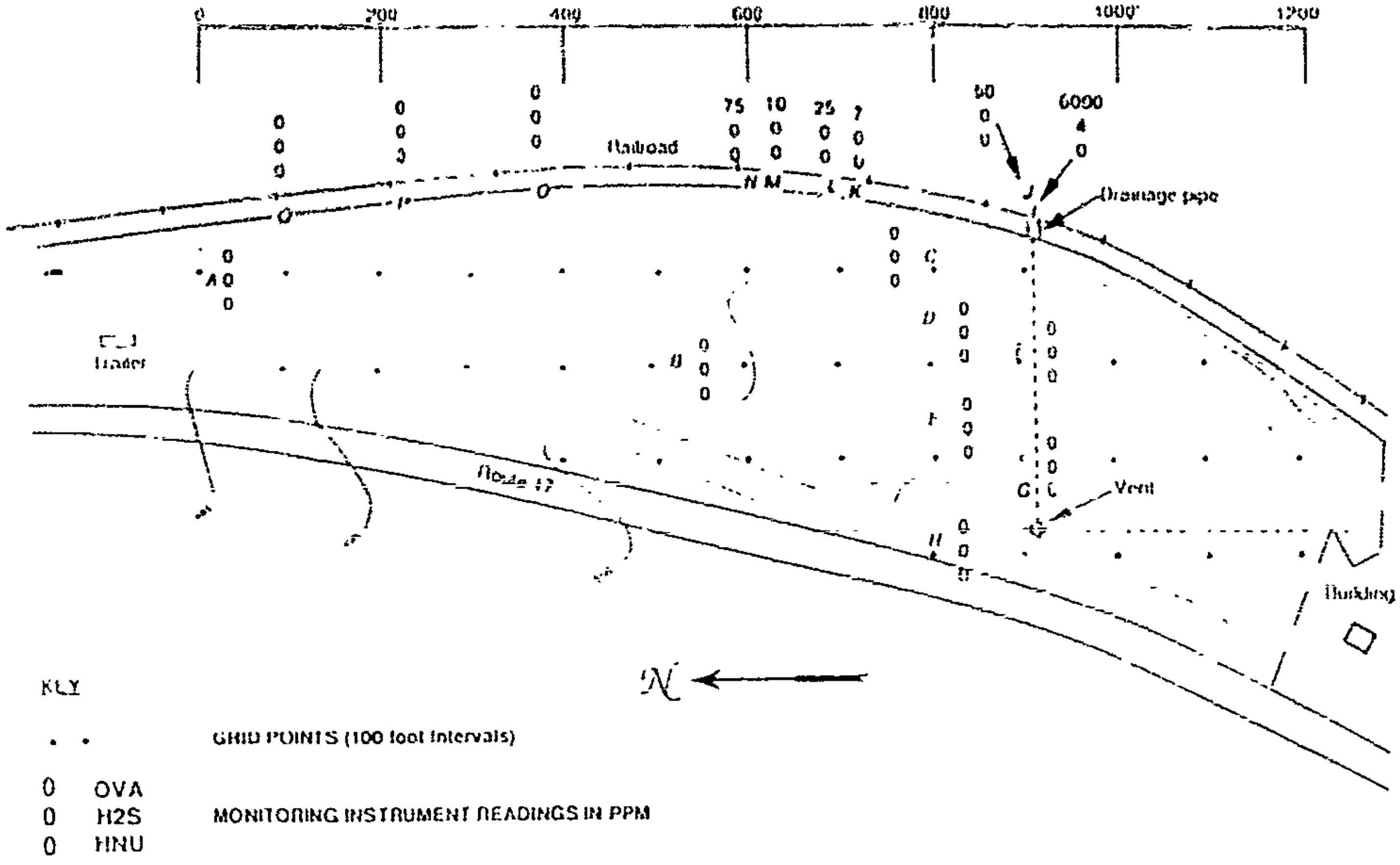
4.11 BASELINE EMISSION ESTIMATE

4.11.1 Preliminary Survey

Seventeen points were sampled throughout the landfill for the preliminary non-intrusive soil gas survey. Figure 4-12 shows approximate points where measurements were made and the contaminant levels detected. Hydrogen sulfide was detected at a concentration of 4 ppm near the drainage pipe outfall on the eastern edge of the site. No non-methane hydrocarbons were detected with the Hnu. OVA measurements indicated high methane emissions in the southeast corner of the site where a drainpipe exits from underneath the landfill. The OVA did not detect significant levels of methane at any other points on the landfill.

4.11.2 Extractive Gas Survey

The results of the OVA, Hnu. and H_2S monitoring at each location are summarized in Table 4-32 at the end of this section. In addition to the survey-type measurements, Alliance conducted on-site Gas Chromatographic (GC) analysis at



All locations, dimensions and property boundaries are approximate only

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ORANGE COUNTY, NEW YORK

FIGURE 4 12
PRELIMINARY NON-INTRUSIVE SOIL GAS SURVEY RESULTS

each sampling point using a Photovac 10S70. On-site GC results are summarized in Table 4-33 at the end of this section Extractive gas sampling was done on a 100-foot grid pattern throughout the landfill. The PID indicated no significant concentrations of non-methane hydrocarbons, which was corroborated by on-site GC analysis.

The sampling locations are shown on Figures 4-13 and 4-14 Figure 4-13 also shows methane concentrations observed with the OVA. Measured hydrogen sulfide concentrations are shown in Figure 4-14. The 1988 LMS survey indicated a subsurface quantity of hydrogen sulfide at levels greater than 2,000 ppm using Draeger Tubes. The current study, performed at shallower depths, used a portable Neotronics hydrogen sulfide monitor

4.11.3 Sweep Gas Survey

Based on results from the 1988 LMS study and the extractive gas survey, M&E and NYSDEC selected twenty-five sampling points to conduct sweep gas probe measurements. OVA, HNu, and hydrogen sulfide portable monitor results are summarized in Table 4-34 and on-site GC analysis results are summarized in Table 4-35 at the end of Section 4. Significant levels of hydrogen sulfide were detected in one blowhole (Site XII) on the landfill. The Hnu showed a reading of 9 ppm in the blowhole A map showing detected methane, non-methane organics, and H_2S is presented as Figure 4-15.

Flux rates calculated from contaminant levels measured in the sweep gas survey were considerably higher than comparable flux rates from the flux chamber study for certain contaminants reviewed. All available data is included in the modeled grid zone tables in Attachment B of Appendix A.

4.11.4 Flux Chamber Sampling

Flux chamber sampling was performed at six locations on the landfill (Figure 4-16). Alliance sampled the first three locations on October 4, 1990 and the remaining three locations on October 18, 1990. Analyses for all TO-14 compounds were performed on samples collected in stainless steel canisters. The flux chamber sampling results are summarized in Tables 4-36 and 4-37 at the end of

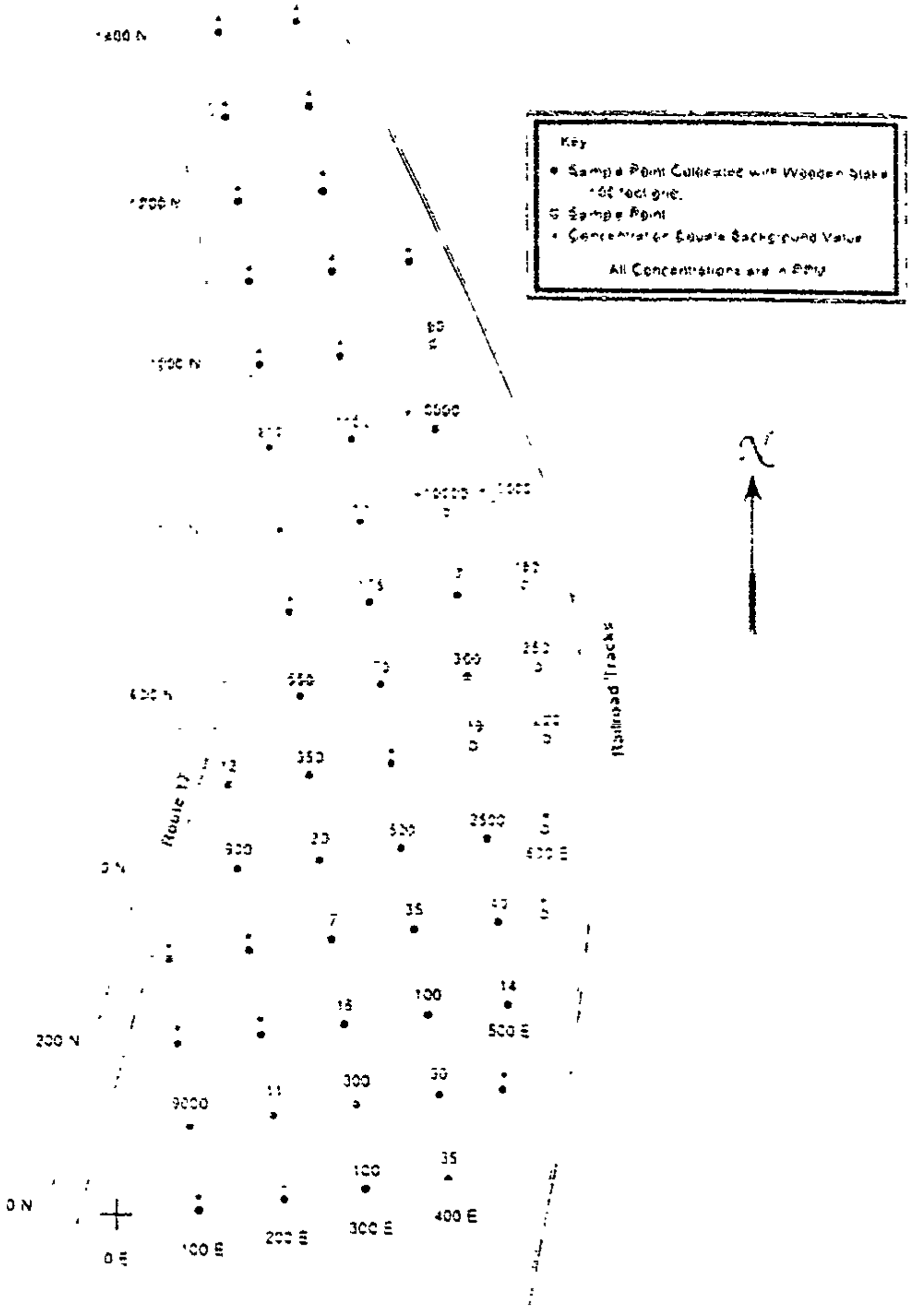

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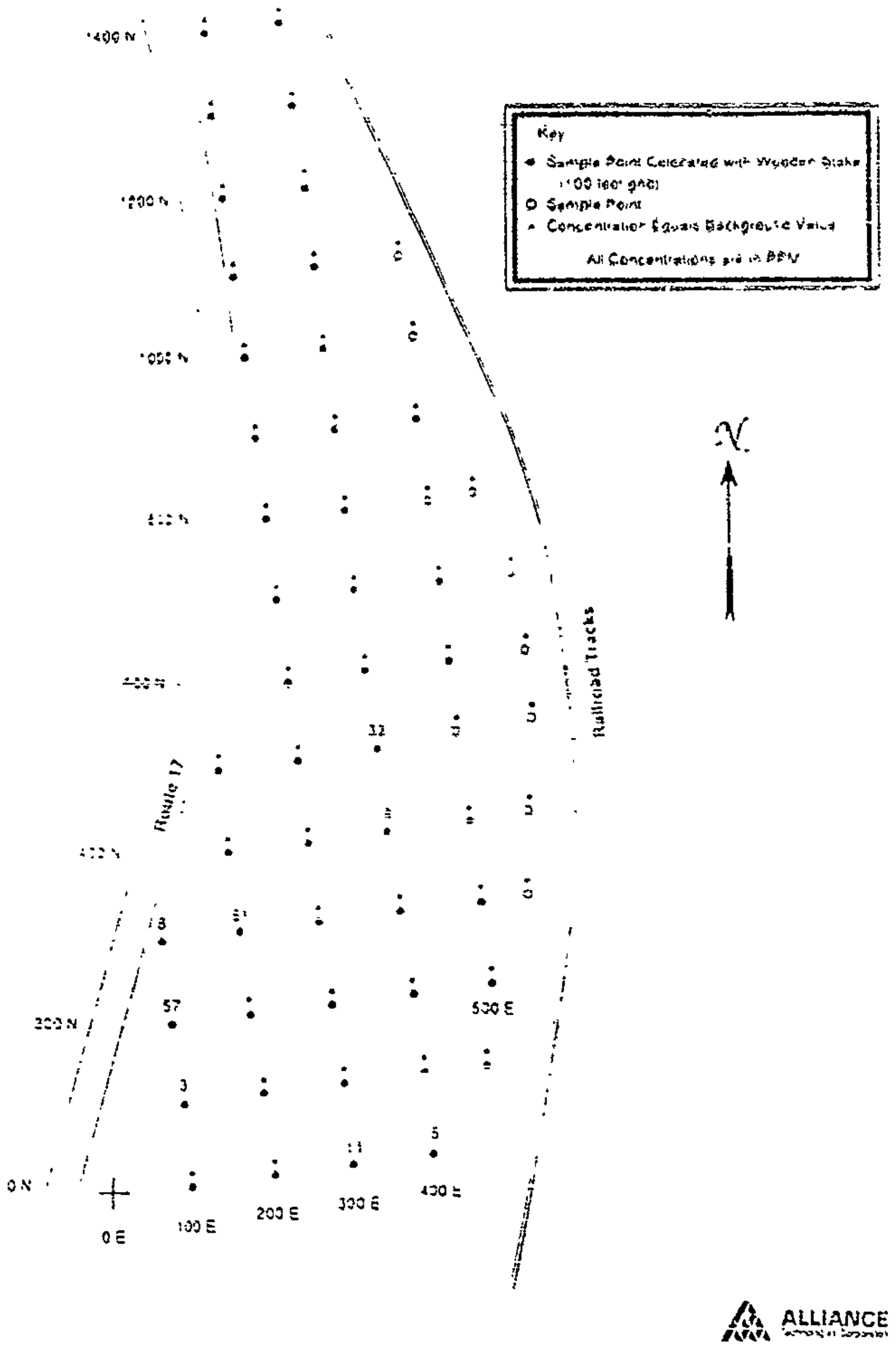
FIGURE 4-13
EXTRACTIVE GAS SURVEY OVA RESULTS



M&E **Metcalf & Eddy**	TUXEDO WASTE DISPOSAL SITE ORANGE COUNTY, NEW YORK	FIGURE 4-14 EXTRACTIVE GAS SURVEY- HYDROGEN SULFIDE RESULTS

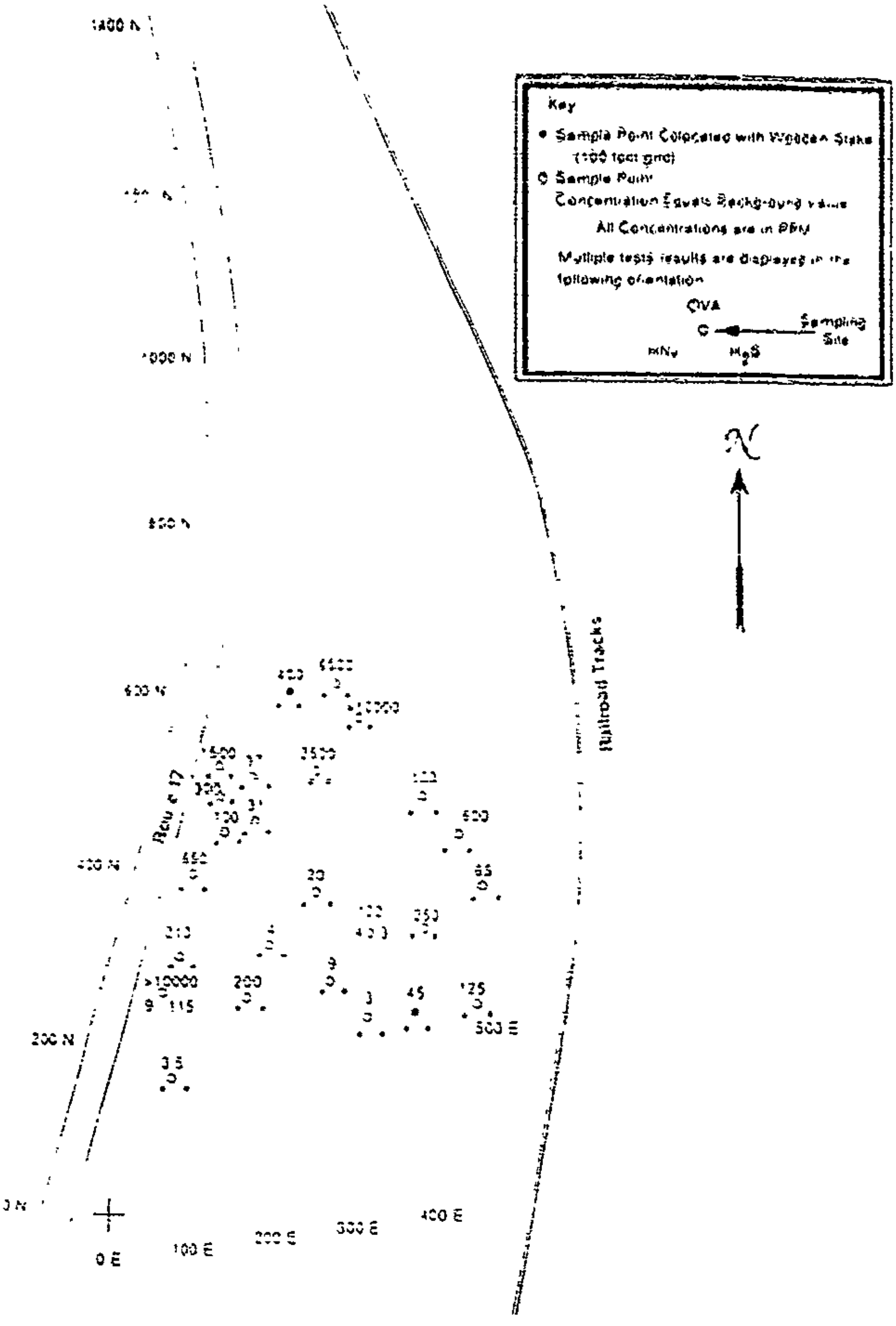


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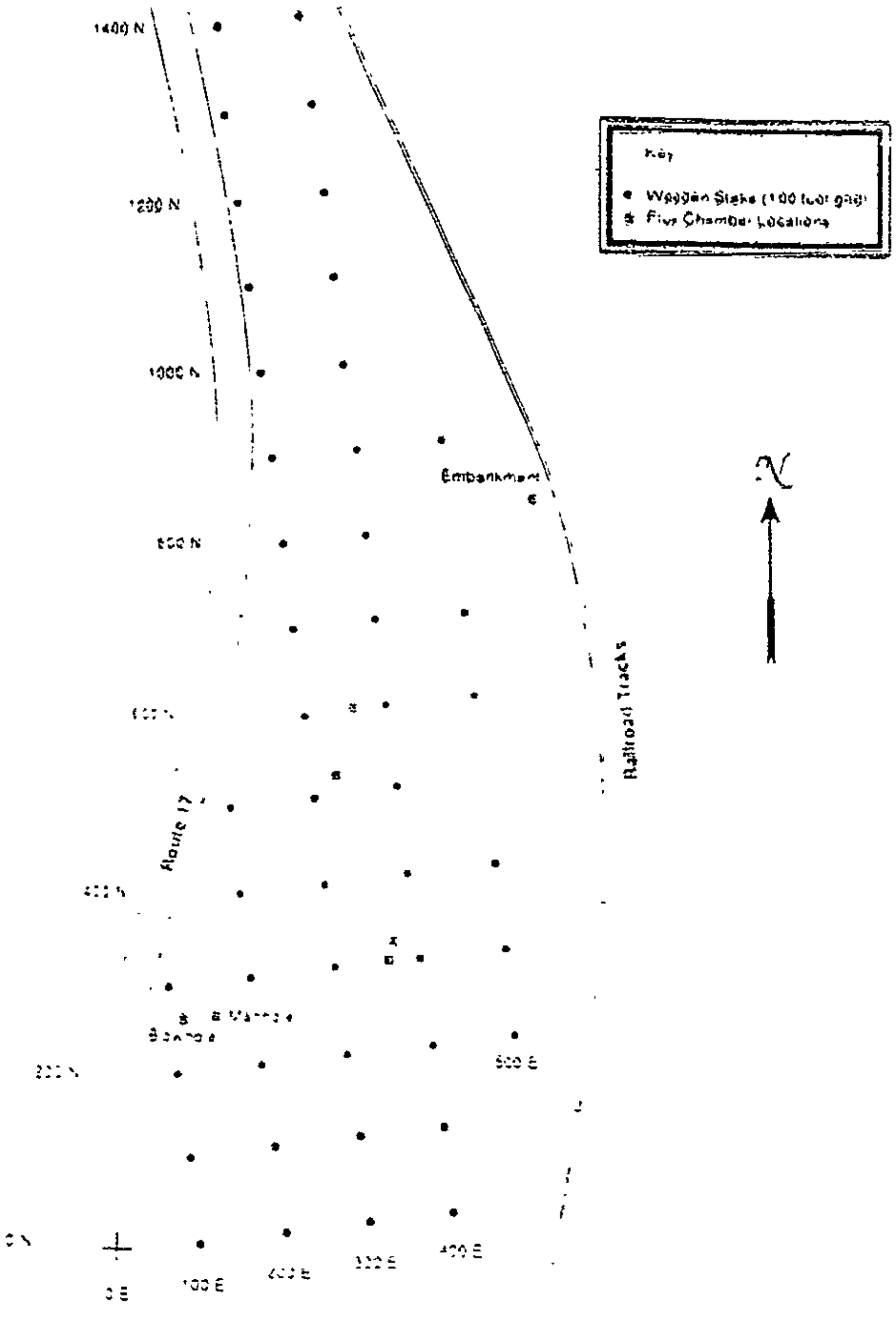
FIGURE 4-15
SWEEP GAS SURVEY-OVA
HYDROGEN SULFIDE AND Hnu RESULTS



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ORANGE COUNTY, NEW YORK

FIGURE 4-16
FLUX CHAMBER LOCATIONS

this section. The two tables are presented by date

The data shows significant methane and other emissions from the three samples collected during the October 18th sampling event. Significant carbon dioxide emissions were observed in all six samples. The only significant TO-14 hit was trichlorofluoromethane from the flux chamber sample collected on the embankment near the railroad tracks.

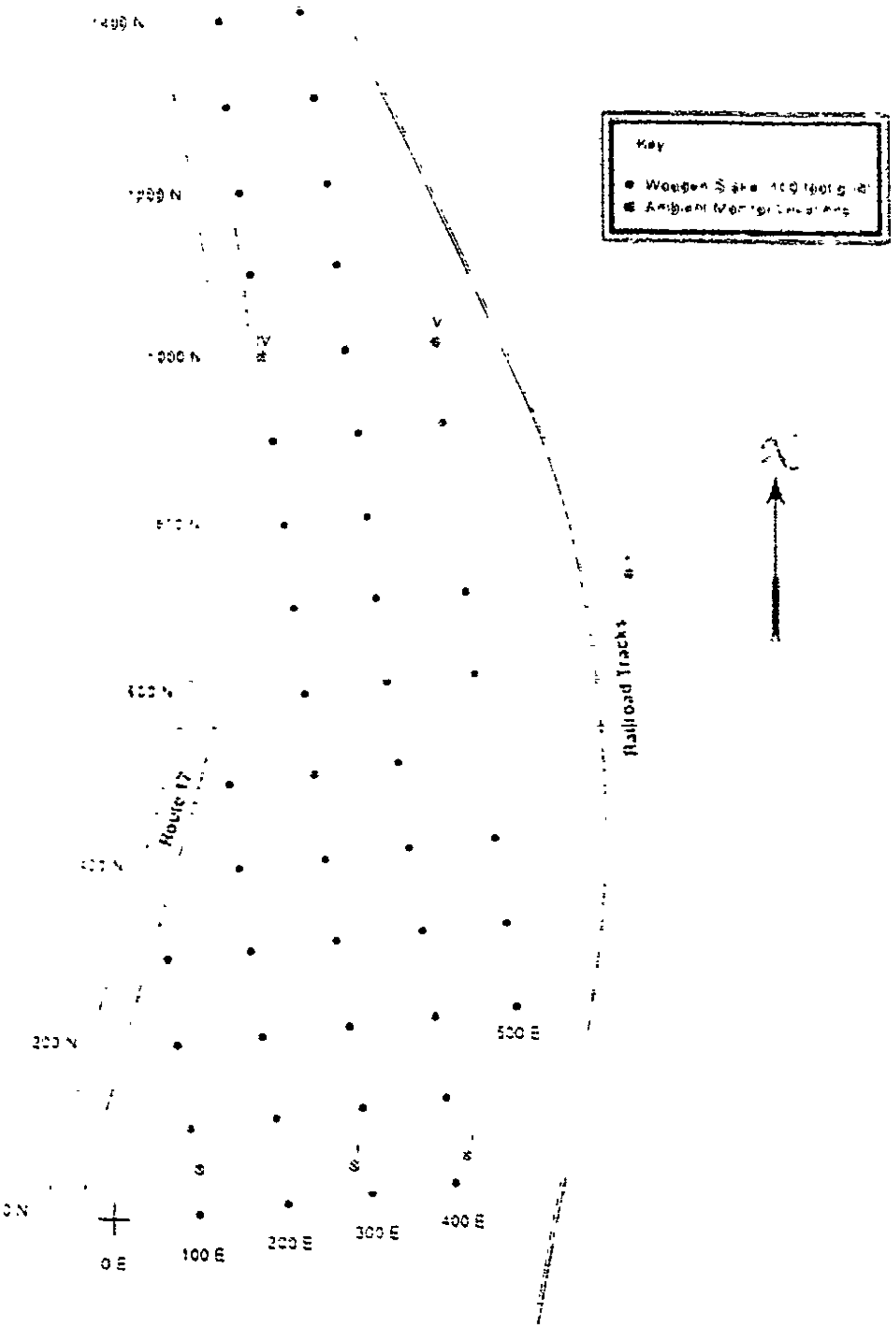
4.11.5 Hydrogen Sulfide Ambient Air Monitoring

The results of the H_2S air monitoring are summarized in Table 4-38 at the end of Section 4. H_2S ambient air monitoring was done at ten different locations over an eight-hour period. On-site locations are shown in Figure 4-17. Three samples were taken at the south end of the landfill, two samples were taken at the north end of the landfill, and one sampling location was on the northeastern side of the landfill between the railroad tracks and the Ramapo River. For the off-site locations, one sample was taken at the Duck Cedar Inn north and west of the landfill, and three samples were taken some distance south of the landfill in the Town of Tuxedo at the police station, the IGA grocery and the Gatehouse Antique Shop.

No hydrogen sulfide was detected at any of the landfill locations. H_2S was detected north of the site and in the Town of Tuxedo, but the detected amounts were only slightly above the detection limit of the analytical method.

4.11.6 Meteorological Monitoring

Monitoring data included wind speed, wind direction, and temperature. A wind rose showing the meteorological pattern for the period of August 15 through November 16, 1990 is presented as Figure 4-18 Sixty-seven complete days of data were obtained during the ninety-day period. Additional monitoring was carried out to provide a total of 90 days of complete data. This information will be evaluated and incorporated into the analysis, as appropriate, when it becomes available. Additional details are in Appendix I.



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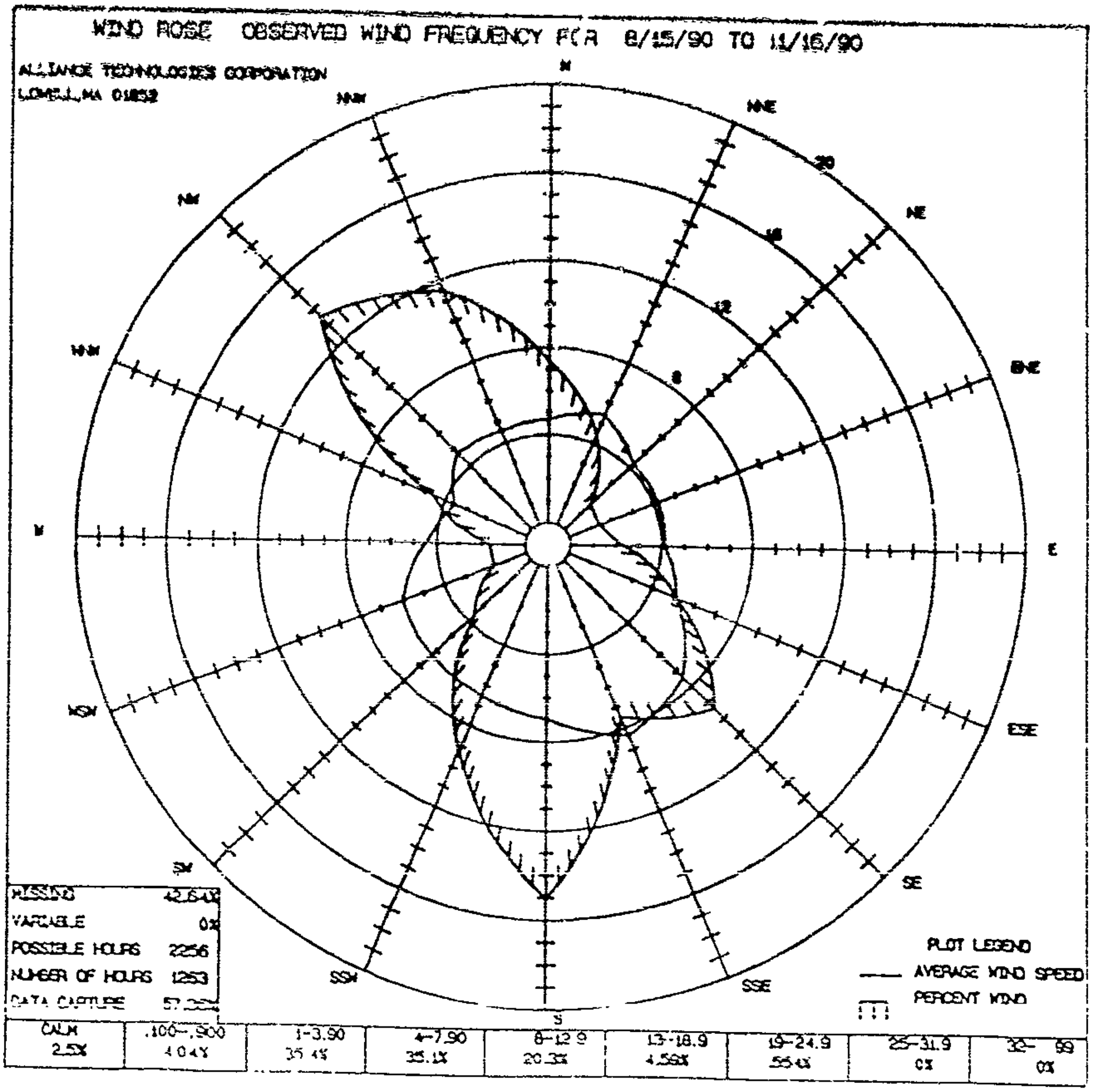
ORANGE COUNTY, NEW YORK

FIGURE 4-17
HYDROGEN SULFIDE MONITORING RESULTS



WIND ROSE OBSERVED WIND FREQUENCY FOR 8/15/90 TO 11/16/90

ALLIANCE TECHNOLOGIES CORPORATION
LOWELL,MA 01852

MISSING	42.64%
VARIABLE	0%
POSSIBLE HOURS	2256
NUMBER OF HOURS	1253
DATA CAPTURE	57.36%

PLOT LEGEND
—— AVERAGE WIND SPEED
┬┬┬ PERCENT WIND

CALM	.100-.900	1-3.90	4-7.90	8-12.9	13-18.9	19-24.9	25-31.9	32- 99
2.5%	4.04%	35.4%	35.1%	20.3%	4.56%	.554%	0%	0%

M&E Metcalf & Eddy	TUXEDO WASTE DISPOSAL SITE ORANGE COUNTY, NEW YORK	FIGURE 4-18 TUXEDO, NEW YORK WIND ROSE (8/15/90 TO 11/16/90)

4.11.7 Comparative Analysis

To determine whether the Alliance data could be used directly to develop the Baseline Emission Estimate, the results obtained by the various test methods were compared Alliance performed three types of soil gas measurements Extractive Gas Survey, Sweep Gas Probes, and Flux Chamber Sampling The results of these three methods were compared by selecting common test locations, where possible, or else closest test locations from the survey grid

Two types of instruments, an FID and a PID, were used to detect the presence of organic and inorganic compounds during the Extractive Gas and Sweep Gas surveys Many organics, including methane, were detectable in the survey phase by the OVA, an FID instrument. Non-methane organics and some non-organics were detectable by the HNu, which is a PID

Further analysis of soil gas to identify individual components was performed for the two survey methods using either a field gas chromatograph (GC) or a collected sample for laboratory analysis (flux chamber Analytical results were reported as ppm (field GC) or ppb (laboratory) In addition to soil gas concentrations, flux emission rates were calculated for the sweep gas survey, and flux chamber tests were based on the exposed soil area and sweep gas rates.

A comparison of survey instrument results (positive hits on the OVA) for the Extractive Soil Gas and Sweep Gas tests showed the two methods to be in poor agreement. Some of the sweep gas results were considerably higher than comparative extractive gas values. Field GC compound identification also was not consistent between the methods, though similar compound classes were identified; e.g. chlorinated aliphatics Where the same compounds were identified, agreement was generally within an order of magnitude and some of the values were in reasonable good agreement.

A comparison of compounds identified in the Sweep Gas method and the Flux Chamber analyses showed similar disparities. In addition, Sweep Gas concentrations were generally much higher than the laboratory results for samples from the Flux

Chamber. A comparison of calculated soil gas fluxes for the Flux Chamber and Sweep Gas tests, where the same compounds were detected by both methods, showed poor agreement

The Alliance data was not used directly for the Baseline Emissions Estimate because the values were inconsistent and no test method appeared to be more representative than the others Therefore, a conservative estimate of emissions was developed based upon review of all available soil gas data, including values from the LMS Phase II investigation.

4.12 HABITAT BASED ASSESSMENT

The field survey, review of literature and contacts with public agencies indicated no evidence of threatened or endangered species or habitats on-site. Appendix C includes a list of observed vegetation and wildlife species on and around the site.

TABLE 4-3
INORGANIC CONSTITUENTS DETECTED IN EXISTING WELLS

SITE: TOLEDO WASTE DISPOSAL SITE
CASE NO 005040, SDG NO 04

SAMPLE NUMBER:			GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6
SAMPLE LOCATION:			MW1	MW2	MW3	MW4	MW5	MW6
LABORATORY NUMBER:			0567	[illegible]	0574	0575	[illegible]	[illegible]
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (ug/L, ppb)						
ALUMINUM	P	200	1300.00	10600.00	269.00	1520.00	2750.00	[illegible]
ANTIMONY	P	60	10.00 U	[illegible]	10.00 U	16.00 U	[illegible]	10.00 U
ARSENIC	P	[illegible]	[illegible]	[illegible]	1.00 U	[illegible]	[illegible]	[illegible]
BARIUM	P		[illegible]	[illegible] B	31.00 B	[illegible] B	[illegible] B	[illegible] B
BERYLLIUM	P	5	[illegible] U	[illegible] U	5.00 U	[illegible] U	[illegible] U	[illegible] U
CADMIUM	P	5	5.00 U	[illegible]	5.00 U	[illegible] U	[illegible]	[illegible]
CALCIUM	P	5000	19500.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHROMIUM	P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COBALT	P	[illegible]	[illegible] U	[illegible] U	[illegible] U	[illegible] U	[illegible] U	[illegible] U
COPPER	P	25	[illegible]	[illegible] B	[illegible]	[illegible] B	[illegible]	[illegible]
IRON	P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LEAD	F	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MAGNESIUM	P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MANGANESE	P	15	[illegible]	[illegible]	59	[illegible]	[illegible]	[illegible]
MERCURY	CV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] U	[illegible]	[illegible]
NICKEL	P	40	[illegible] U	[illegible] U	45.00	[illegible]	[illegible]	[illegible]
POTASSIUM	P	5000	[illegible] B	[illegible]	11500.00	[illegible]	[illegible]	[illegible]
SELENIUM	F	5	[illegible] U	[illegible] U	[illegible]	[illegible]	[illegible]	[illegible] U
SILVER	P	[illegible]	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
SODIUM	P	5000	[illegible]	6220.00	65650.00	50960.00	45330.00	[illegible]
THALLIUM	F	10	5.00 U	6.00 U	5.00 U	5.00 U	5.00 U	[illegible]
VANADIUM	P	50	20.00 U	20.00 U	20.00 U	[illegible] U	[illegible] U	[illegible] U
ZINC	P	20	25.00	51.00	22.00	25.00	81.00	61.00
CYANIDE	C	10	10.00 U	10.00 U	29.00	10.00 U	10.00 U	[illegible] U

TABLE 4 3 (continued)
INORGANIC CONSTITUENTS DETECTED IN EXISTING WELLS

SITE: TOLEDO WASTE DISPOSAL SITE
CASE NO 005040, SDG NO. 042

SAMPLE NUMBER:			GWMW7	GWMW8	[illegible]
SAMPLE LOCATION:			MW7	MW8 DUP	EQUIP BLK
LABORATORY NUMBER:			0568	0696	0645
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (ug/L, ppb)			
ALUMINUM	P	200	2530.00	1170.00	50.00 U
ANTIMONY	P	60	30.00 U	30.00 U	30.00 U
ARSENIC	F	10	3.00 U	17.00	3.00 U
BARIUM	P	200	50.00 U	150.00 B	[illegible]
BERYLLIUM	P	5	5.00 U	5.00 U	[illegible]
CADMIUM	P	5	5.00 U	[illegible]	[illegible]
CALCIUM	P	5000	[illegible]	[illegible]	[illegible]
CHROMIUM	P	10	11.00 U	15.00	[illegible]
COBALT	P	50	[illegible] U	[illegible]	[illegible]
COPPER	P	25	14.00 B	[illegible]	[illegible]
IRON	P	100	[illegible]	34400.00	[illegible]
LEAD	F	5	3.00 U	[illegible]	[illegible]
MAGNESIUM	P	5000	[illegible]	88500.00	200.00 U
MANGANESE	P	15	132.00	12500.00	5.00 U
MERCURY	CV	0.2	0.20 U	0.20 U	0.20 U
NICKEL	P	40	30.00 U	175.00	30.00 U
POTASSIUM	P	5000	2090.00 B	33500.00	[illegible]
SELENIUM	F	5	5.00 U	5.00 U	5.00 U
SILVER	P	10	5.00 U	5.00 U	5.00 U
SODIUM	P	5000	45000.00	137000.00	[illegible] B
THALLIUM	F	10	5.00 U	5.00 U	5.00 U
VANADIUM	P	50	20.00 U	30.00 U	10.00 U
ZINC	P	20	45.00	53.00	10.00 U
CYANIDE	C	10	10.00 U	10.00 U	10.00 U

TABLE 4-4
VOLATILE ORGANIC COMPOUNDS DETECTED IN EXISTING WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005049, SDG NO. 043

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWMW8	GWEB1
SAMPLE LOCATION:		MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW6 DUP	EQUIP BLK
LABORATORY NUMBER:		0567	0687	0576	0575	0686	0691	0568	0690	0643
COMPOUND	CRQL									
Acetone	10	10 U	4 J	10 U	10 U	10 U	4 J	10 U	17	10 U
Chloroform	5	8	5 U	5 U	5 U	5 U	5 U	9	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	1 J	5 U	5 U	0.5 J	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.6 J
DILUTION FACTOR:		1	1	1	1	1	1	1	[illegible]	[illegible]
DATE SAMPLED:		10/4/90	10/10/90	10/3/90	10/5/90	10/9/90	10/10/90	10/4/90	[illegible]	10/9/90
DATE RECEIVED:		10/5/90	10/11/90	10/8/90	10/6/90	10/10/90	10/11/90	10/5/90	10/11/90	10/10/90
DATE ANALYZED:		10/8/90	10/12/90	10/10/90	10/10/90	10/11/90	10/12/90	10/9/90	[illegible]	10/11/90

TABLE 4-4 (continued)
VOLATILE ORGANIC COMPOUNDS DETECTED IN EXISTING WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 003040, SDG NO. 043

SAMPLE NUMBER:		GWTB01	GWTB02	GWTB03	GWTB04	GWTB05
SAMPLE LOCATION:		TRIP BLK	TRIP BLK	TRIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:						
COMPOUND	CRQL					
Acetone	10	10 U	10 U	11 B	10 U	2 BJ
Chloroform	5	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	0.5 BJ
DILUTION FACTOR:		1	1	1	1	1
DATE SAMPLED:		--	--	--	--	-
DATE RECEIVED:		10/3/90	10/4/90	10/10/90	10/10/90	10/11/90
DATE ANALYZED:		10/8/90	10/16/90	10/11/90	10/11/90	10/12/90

TABLE 4-5
SAMPLE SPECIFIC DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS FOR EXISTING WELL SAMPLE ANALYSES

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWMW8	GWEB1	GWTB1
SAMPLE LOCATION		MW1	MW7	MW3	MW4	MW5	MW6	MW7	MW4 DUP	EQUIP BLK	TRIP BLK
LABORATORY NUMBER:		0347	0457	0376	0575	0446	0491	0348	0490	0443	
COMPOUND	CRQL										
Chloromethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5	5 U
Chloroform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	[illegible]	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	[illegible]	5 U	5 U	[illegible]	5 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1	1	1
DATE SAMPLED:		10/4/90	10/10/90	10/5/90	10/5/90	10/9/90	10/10/90	10/4/90	10/10/90	[illegible]	[illegible]
DATE RECEIVED:		10/5/90	10/11/90	10/8/90	10/8/90	10/10/90	10/11/90	10/5/90	10/11/90	[illegible]	[illegible]
DATE ANALYZED:		10/5/90	10/12/90	10/10/90	10/10/90	10/11/90	10/12/90	10/5/90	10/11/90	[illegible]	10/5/90

TABLE 4-5 (continued)
SAMPLE SPECIFIC DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS FOR EXISTING WELL SAMPLE ANALYSES

SITE: TULLOS WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GW162	GW163	GW164	GW165
SAMPLE LOCATION:		TRIP BLK	TRIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:					
COMPOUND	CRQL				
Chloromethane	10	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U	5 U	5 U
Chloroform	5	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U
Chlorobenzene	5	5 U	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U	5 U
DILUTION FACTOR:		1	1	1	1
DATE SAMPLED:		--	--	--	--
DATE RECEIVED:		10/11/90	10/6/90	10/11/90	10/11/90
DATE ANALYZED:		10/13/90	10/10/90	10/11/90	10/13/90

TABLE 4-6
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN EXISTING WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWMW8	GWEB1
SAMPLE LOCATION:		MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW6 DUP	EQUIP BLK
LABORATORY NUMBER:		0567	0687	0576	0575	0646	0691	0568	0690	0685
COMPOUND	CRQL									
Bis(2-ethylhexyl)phthalate	10	10 U	7 J	11 U	12 U	11 U	12 U	16 U	11 UJ	10 U
DILUTION FACTOR:		1	1	1.11	1.18	1.11	1.24	1.64	1.1	1
DATE SAMPLED:		10/5/90	10/11/90	10/4/90	10/4/90	10/13/90	10/11/90	10/5/90	10/11/90	10/10/90
DATE EXTRACTED:		10/10/90	10/12/90	10/10/90	10/10/90	10/18/90	10/12/90	10/10/90	10/18/90	10/12/90
DATE ANALYZED:		10/11/90	10/15/90	10/11/90	10/11/90	10/23/90	10/15/90	10/11/90	10/22/90	10/15/90

TABLE 4-7
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR EXISTING WELL SAMPLE ANALYSES

SITE: [illegible] WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 045

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWMW8
SAMPLE LOCATION:		MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8
LABORATORY NUMBER:		0567	0687	0576	0575	0646	0671	0568	0670
COMPOUND	CRQL								
Phenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
bis(2-Chloroethyl) ether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2-Chlorophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
1,3-Dichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
1,4-Dichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Benzyl Alcohol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
1,2-Dichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2-Methylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
bis(2-Chloroisopropyl) ether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
4-Methylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
N-Nitroso-di-n-propylamine	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Hexachloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Nitrobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Isophorone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2-Nitrophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,4-Dimethylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Benzoic Acid	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
bis(2-Chloroethoxy)methane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,4-Dichlorophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
1,2,4-Trichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Naphthalene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
4-Chloroaniline	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Hexachlorobutadiene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
4-Chloro-3-Methylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2-Methylnaphthalene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Hexachlorocyclopentadiene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,4,6-Trichlorophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,4,5-Trichlorophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
2-Chloronaphthalene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2-Nitroaniline	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
Dimethylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Acenaphthylene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,6-Dinitrotoluene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
3-Nitroaniline	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
Acenaphthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,4-Dinitrophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
4-Nitrophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
Dibenzofuran	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
2,4-Dinitrotoluene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Diethylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
4-Chlorophenyl-Phenylether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Fluorene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
4-Nitroaniline	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
4,6-Dinitro-2-Methylphenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UR
N-nitrosodiphenylamine(1)	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
4-Bromophenyl-Phenylether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR
Hexachlorobenzene	10	10 U	10 U	10	[illegible]	[illegible]	[illegible]		[illegible]

TABLE 4-7 (continued)
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR EXISTING WELL SAMPLE ANALYSES

SITE: TUXEDO WASTE DISPOSAL SITE
ASC NO 003040, SDG NO 043

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWMW8
SAMPLE LOCATION:		MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8
LABORATORY NUMBER:		0567	0687	0574	0575	0644	0691	0568	0690
COMPOUND	CRQL								
Pentachlorophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UJ
Phenanthrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Di-n-butylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Butylbenzylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
3,3'-Dichlorobenzidine	20	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 UJ
Benzo(a)anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Chrysene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
bis(2-ethylhexyl)phthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Di-n-octylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Benzo(b)fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Benzo(k)fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Benzo(a)pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Indeno(1,2,3-cd)pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Dibenz(a,h)anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Benzo(g,h,i)perylene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		[illegible]/9/93	10/11/93	10/9/93	10/8/93	10/13/93	10/11/93	[illegible]	[illegible]
DATE EXTRACTED:		10/10/93	10/12/93	10/10/93	10/19/93	10/18/93	10/12/93	[illegible]	10/13/93
DATE ANALYZED:		10/11/93	10/13/93	10/11/93	10/22/93	10/23/93	10/15/93	[illegible]	[illegible]

TABLE 4-8
SAMPLE SPECIFIC DETECTION LIMITS FOR PESTICIDES/PCB'S FOR EXISTING WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWMW8
SAMPLE LOCATION:		MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW6 DUP
LABORATORY NUMBER:		0567	0687	0576	0575	0666	0691	0566	0690
COMPOUND	CRQL								
alpha-BHC	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
beta-BHC	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
delta-BHC	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
gamma-BHC(Lindane)	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
Heptachlor	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
Aldrin	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
Heptachlor Epoxide	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
Endosulfan I	0.05	0.05 U	0.05 U	0.06 U	0.06 U	0.07 U	0.06 U	0.05 U	0.05 U
Dieldrin	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
4,4'-DDE	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
Endrin	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
Endosulfan II	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
4,4'-DDD	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
Endosulfan Sulfate	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
4,4'-DDT	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
Methoxychlor	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
Endrin Ketone	0.1	0.10 U	0.10 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U
alpha-Chlordane	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
gamma-Chlordane	0.5	0.50 U	0.52 U	0.55 U	0.60 U	0.72 U	0.63 U	0.53 U	0.53 U
Toxaphene	1.0	1.00 U	1.04 U	1.10 U	1.20 U	1.43 U	1.25 U	1.05 U	1.05 U
Aroclor-1016	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
Aroclor-1221	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
Aroclor-1232	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
Aroclor-1242	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
Aroclor-1248	0.5	0.50 U	0.52 U	0.55 U	0.59 U	0.72 U	0.63 U	0.53 U	0.53 U
Aroclor-1254	1.0	1.00 U	1.04 U	1.10 U	1.20 U	1.43 U	1.25 U	1.05 U	1.05 U
Aroclor-1260	1.0	1.00 U	1.04 U	1.10 U	1.20 U	1.43 U	1.25 U	1.05 U	1.05 U
DILUTION FACTOR:		1	1.04	1.1	1.2	1.43	1.25	1.052	1.052
DATE SAMPLED:		10/5/90	10/11/90	10/6/90	10/6/90	10/13/90	10/11/90	10/5/90	10/11/90
DATE EXTRACTED:		10/10/90	10/12/90	10/10/90	10/12/90	10/18/90	10/12/90	10/10/90	10/12/90
DATE ANALYZED:		10/18/90	10/19/90	10/19/90	10/19/90	11/1/90	10/19/90	10/18/90	10/19/90

TABLE 4-9
INORGANIC CONSTITUENTS DETECTED IN NEW WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 0050-0, SDG NO. 043

SAMPLE NUMBER:			GWR11	GWR12	GWR13	GWR14	GWR15A	GWFB1
SAMPLE LOCATION:			RI 1	RI 2	RI 3	RI 4	RI 5A	EQUIP BLK
LABORATORY NUMBER:			0644	0643	0688	0689	0569	0645
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (ug/L, ppb)						
ALUMINUM	P	200	344.00	485.00	1160.00	2640.00	557.00	50.00 U
ANTIMONY	P	60	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U
ARSENIC	F	10	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
BARIUM	P	200	50.00 U	50.00 U	58.00 B	50.00 U	50.00 U	50.00 U
BERYLLIUM	P	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
CADMIUM	P	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
CALCIUM	P	5000	58700.00	41850.00	12400.00	47100.00	32700.00	404.00 B
CHROMIUM	P	10	10.00	17.00	13.00	10.00 U	10.00 U	10.00 U
COBALT	P	50	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U
COPPER	P	25	23.00 B	124.00	41.00	11.00 B	10.00 B	10.00 U
IRON	P	100	176.00	1770.00	9820.00	3411.00	481.00	20.00 U
LEAD	P	5	3.00 U	11.00	3.00	1927.00	3.00 U	3.00 U
MAGNESIUM	P	5000	8530.00	10300.00	5100.00	1220.00 B	5430.00	200.00 U
MANGANESE	P	15	13.00 B	1220.00	148.00	87.00	138.00	5.00 U
MERCURY	CV	0.2	0.30	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
NICKEL	P	40	30.00 U	115.00	30.00 U	30.00 U	30.00 U	30.00 U
POTASSIUM	P	5000	1720.00 B	2270.00 B	2900.00 B	20100.00	3240.00 B	300.00 U
SELENIUM	F	10	5.00 U	50.00 U	5.00 U	5.00 U	5.00 U	5.00 U
SILVER	P	10	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
SODIUM	P	5000	14000.00	23400.00	7010.00	107000.00	14600.00	608.00 B
THALLIUM	F	10	5.00 U	5.00 U	6.00 U	6.00 U	5.00 U	5.00 U
VANADIUM	P	50	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U
ZINC	P	20	44.00	110.00	39.00	110.00	25.00	10.00 U
CYANIDE	[illegible]	10	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U

TABLE 4-10
VOLATILE ORGANIC COMPOUNDS DETECTED IN NEW WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 04?

SAMPLE NUMBER:		GWRI-1	GWRI-2	GWRI-3	GWRI-4	GWRI-5A	GWEB1	GWTB1	GWTB2
SAMPLE LOCATION:		RI 1	RI 2	RI 3	RI 4	RI 5A	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		0644	0643	0688	0689	0569	0645		
COMPOUND	CRQL								
Methylene Chloride	5	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U	32	10 U	10 U	10 U	10 U
Chloroform	5	2 J	11	5 U	5	4 J	5 U	5 U	5 U
Toluene	5	5 U	0.8 J	5 U	0.6 J	5 U	0.6 J	5 U	5 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10/9/90	10/9/90	10/10/90	10/10/90	10/4/90	10/9/90	-	--
DATE RECEIVED:		10/10/90	10/10/90	10/11/90	10/11/90	10/5/90	10/10/90	10/5/90	10/6/90
DATE ANALYZED:		10/11/90	10/11/90	10/12/90	10/12/90	10/6/90	10/11/90	10/6/90	10/10/90

TABLE 4-10 (continued)
VOLATILE ORGANIC COMPOUNDS DETECTED IN NEW WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GW103	GW104	GW105
SAMPLE LOCATION:		TRIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:				
COMPOUND	CRQL			
Methylene Chloride	5	5 U	5 U	5 U
Acetone	10	11 B	10 U	6 BJ
Chloroform	5	5 U	5 U	5 U
Toluene	5	5 U	5 U	0.5 BJ

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DILUTION FACTOR:	1	1	1
DATE SAMPLED:	--	--	--
DATE RECEIVED:	10/10/90	10/10/90	10/10/90
DATE ANALYZED:	10/11/90	10/11/90	10/13/90

TABLE 4-11
SAMPLE SPECIFIC DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS FOR NEW WELL ANALYSIS

SITE: TOLEDO WASTE DISPOSAL SITE
CASE NO. 00304C, SDG NO. 043

SAMPLE NUMBER:		GWR1 1	GWR1 2	GWR1 3	GWR1 4	GWR1-5A	GWEB1	GWTB1	GWTB2	GWTB3
SAMPLE LOCATION:		R1 1	R1 2	R1 3	R1 4	R1 5A	EQUIP BLK	TRIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		0444	0443	0448	0457	0367	0445			
COMPOUND	CRQL									
Chloromethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5 U	5	5 U	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

DILUTION FACTOR:	1	1	1	1	1	1	1	1	1
DATE SAMPLED:	10/9/90	10/9/90	10/10/90	10/10/90	10/4/90	10/9/90	--		-
DATE RECEIVED:	10/12/90	10/10/90	10/11/90	10/11/90	10/5/90	10/13/90	10/5/90	10/6/90	10/10/90
DATE ANALYZED:	10/11/90	10/11/90	10/12/90	10/12/90	10/6/90	10/11/90	10/6/90	10/12/90	10/11/90

TABLE 4-11 (continued)
SAMPLE SPECIFIC DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS FOR NEW WELL ANALYSES

SITE: [illegible] WASTE DISPOSAL [illegible]
CASE NO [illegible], SDG NO [illegible]

SAMPLE NUMBER:		[illegible]	[illegible]
SAMPLE LOCATION:		TRIP BLK	TRIP BLK
LABORATORY NUMBER:			
COMPOUND	CRQL		
Chloromethane	10	10 U	10 U
Bromomethane	10	10 U	10 U
Vinyl Chloride	10	10 U	10 U
Chloroethane	10	10 U	10 U
Methylene Chloride	5	5 U	5 U
Acetone	10	10 U	10 U
Carbon Disulfide	5	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U
Chloroform	5	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U
2-Butanone	10	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U
Vinyl Acetate	10	10 U	[illegible]
Bromodichloromethane	5	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U
cis 1,3-Dichloropropene	5	5 U	5 U
Trichloroethene	5	5 U	5 U
Dibromochloromethane	5	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U
Benzene	5	5 U	5 U
trans 1,3-Dichloropropene	5	5 U	5 U
Bromoform	5	5 U	5 U
4-Methyl-2-pentanone	10	10 U	[illegible]
2-Hexanone	10	10 U	[illegible]
Tetrachloroethene	5	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U
Toluene	5	5 U	5 U
Chlorobenzene	5	5 U	5 U
Ethylbenzene	5	5 U	5 U
Styrene	5	5 U	5 U
Total Xylenes	5	5 U	5 U

DILUTION FACTOR:	1	[illegible]
DATE SAMPLED:		
DATE RECEIVED:	[illegible]	[illegible]
DATE ANALYZED:	[illegible]/11/92	[illegible]

TABLE 4-12
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN NEW WELLS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005060, SDG NO. 063

SAMPLE NUMBER:		GWR11	GWR12	GWR13	GWR14	GWR15A	GWEB1
SAMPLE LOCATION:		RI 1	RI 2	RI 3	RI 4	RI 5A	EQUIP BLK
LABORATORY NUMBER:		0644	0643	0688	0689	0569	0645
COMPOUND	CRQL						
Phenol	10	12 U	10 U	10 U	4 J	10 U	10 U
Naphthalene	10	12 U	10 U	10 U	17	10 U	10 U
2-Methylnaphthalene	10	12 U	10 U	10 U	9 J	10 U	10 U
Acenaphthene	10	12 U	10 U	10 U	28	10 U	10 U
Dibenzofuran	10	12 U	10 U	10 U	6 J	10 U	10 U
Fluorene	10	12 U	10 U	10 U	8 J	10 U	10 U
Phenanthrene	10	12 U	10 U	10 U	13	10 U	10 U
Chrysene	10	12 U	10 U	8 J	11 U	10 U	10 U
DILUTION FACTOR:		1.2	1	1	1.11	1.04	1
DATE SAMPLED:		10/10/90	10/10/90	10/11/90	10/11/90	10/5/90	10/10/90
DATE EXTRACTED:		10/18/90	10/12/90	10/12/90	10/12/90	10/10/90	10/12/90
DATE ANALYZED:		10/23/90	10/15/90	10/15/90	10/15/90	10/11/90	10/15/90

TABLE 4 13
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR NEW WELLS ANALYSES

SITE: TOLEDO WASTE DISPOSAL SITE
CASE NO. 003040, SDG NO. [illegible]

SAMPLE NUMBER:		GWR11	GWR12	GWR13	GWR14	GWR15A	GWT01
SAMPLE LOCATION:		RI 1	RI 2	RI 3	RI 4	RI 5A	EQUIP BLK
LABORATORY NUMBER:		0644	0643	0688	0685	0569	0645
COMPOUND	CRQL						
Phenol	10	10 U	10 U	10 U	11 U	10 U	10 U
bis(2-Chloroethyl) ether	10	10 U	10 U	10 U	11 U	10 U	10 U
2-Chlorophenol	10	10 U	10 U	10 U	11 U	10 U	10 U
1,3-Dichlorobenzene	10	10 U	10 U	10 U	11 U	10 U	10 U
1,4-Dichlorobenzene	10	10 U	10 U	10 U	11 U	10 U	10 U
Benzyl Alcohol	10	10 U	10 U	10 U	11 U	10 U	10 U
1,2-Dichlorobenzene	10	10 U	10 U	10 U	11 U	10 U	10 U
2-Methylphenol	10	10 U	10 U	10 U	11 U	10 U	10 U
bis(2-Chloroisopropyl) ether	10	10 U	10 U	10 U	11 U	10 U	10 U
4-Methylphenol	10	10 U	10 U	10 U	11 U	10 U	10 U
N-Nitroso-di-n-propylamine	10	10 U	10 U	10 U	11 U	10 U	10 U
Hexachloroethane	10	10 U	10 U	10 U	11 U	10 U	10 U
Nitrobenzene	10	10 U	10 U	10 U	11 U	10 U	[illegible]
Isophorone	10	10 U	10 U	10 U	11 U	10 U	[illegible]
2-Nitrophenol		10 U	10 U	10 U	11 U	10 U	10 U
2,4-Dimethylphenol	10	10 U	10 U	10 U	11 U	10 U	10 U
Benzoic Acid	50	50 U	50 U	50 U	56 U	52 U	50 U
bis(2-Chloroethoxy)methane	10	10 U	10 U	10 U	11 U	10 U	10 U
2,4-Dichlorophenol	10	10 U	10 U	10 U	11 U	10 U	10 U
1,2,4-Trichlorobenzene	10	10 U	10 U	10 U	11 U	10 U	10 U
Naphthalene	10	10 U	10 U	10 U	11 U	10 U	10 U
4-Chloroaniline	10	10 U	10 U	10 U	11 U	10 U	10 U
Hexachlorobutadiene	10	10 U	10 U	10 U	11 U	10 U	10 U
4-Chloro-3-Methylphenol	10	10 U	10 U	10 U	11 U	10 U	10 U
2-Methylnaphthalene	10	10 U	10 U	10 U	11 U	10 U	10 U
Hexachlorocyclopentadiene	10	10 U	10 U	10 U	11 U	10 U	10 U
2,4,6-Trichlorophenol	10	10 U	10 U	10 U	11 U	10 U	10 U
2,4,5-Trichlorophenol	50	50 U	50 U	50 U	56 U	52 U	50 U
2-Chloronaphthalene	10	10 U	10 U	10 U	11 U	10 U	10 U
2-Nitroaniline	50	50 U	50 U	50 U	56 U	52 U	50 U
Dimethylphthalate	10	10 U	10 U	10 U	11 U	10 U	10 U
Acenaphthylene	10	10 U	10 U	10 U	11 U	10 U	10 U
2,6-Dinitrotoluene	10	10 U	10 U	10 U	11 U	10 U	10 U
3-Nitroaniline	50	50 U	50 U	50 U	56 U	52 U	50 U
Acenaphthene	10	10 U	10 U	10 U	11 U	10 U	10 U
2,4-Dinitrophenol	50	50 U	50 U	50 U	56 U	52 U	50 U
4-Nitrophenol	50	50 U	50 U	50 U	56 U	52 U	50 U
Dibenzofuran	10	10 U	10 U	10 U	11 U	10 U	10 U
2,4-Dinitrotoluene	10	10 U	10 U	10 U	11 U	10 U	10 U
Diethylphthalate	10	10 U	10 U	10 U	11 U	10 U	10 U
4-Chlorophenyl Phenylether	10	10 U	10 U	10 U	11 U	10 U	10 U
Fluorene	10	10 U	10 U	10 U	11 U	10 U	10 U
4-Nitroaniline	50	50 U	50 U	50 U	56 U	52 U	50 U
4,6-Dinitro-2-Methylphenol	50	50 U	50 U	50 U	56 U	52 U	50 U
N-Nitrosodiphenylamine(1)	10	10 U	10 U	10 U	11 U	10 U	10 U
4-Bromophenyl-Phenylether	10	10 U	10 U	10 U	11 U	10 U	10 U
Hexachlorobenzene	10	10 U	10 U	10 U	11 U	10 U	10 U

SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR NEW WELLS ANALYSES

SITE: TUTTOS WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GWRI1	GWRI2	GWRI3	GWRI4	GWRI5A	GWEB1
SAMPLE LOCATION:		RI 1	RI 2	RI 3	RI 4	RI 5A	EQUIP BLK
LABORATORY NUMBER:		0644	0643	0488	0659	0569	0645
COMPOUND	CRQL						
Pentachlorophenol	50	50 U	50 U	50 U	56 U	52 U	50 U
Phenanthrene	10	10 U	10 U	10 U	11 U	10 U	10 U
Anthracene	10	10 U	10 U	10 U	11 U	10 U	10 U
Di-n-butylphthalate	10	10 U	10 U	10 U	11 U	10 U	10 U
Fluoranthene	10	10 U	10 U	10 U	11 U	10 U	10 U
Pyrene	10	10 U	10 U	10 U	11 U	10 U	10 U
Butylbenzylphthalate	10	10 U	10 U	10 U	11 U	10 U	10 U
3,3'-Dichlorobenzidine	20	20 U	20 U	20 U	22 U	21 U	20 U
Benzo(a)anthracene	10	10 U	10 U	10 U	11 U	10 U	10 U
Chrysene	10	10 U	10 U	10 U	11 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	10	10 U	10 U	10 U	11 U	10 U	10 U
Di-n-octylphthalate	10	10 U	10 U	10 U	11 U	10 U	10 U
Benzo(b)fluoranthene	10	10 U	10 U	10 U	11 U	10 U	10 U
Benzo(k)fluoranthene	10	10 U	10 U	10 U	11 U	10 U	10 U
Benzo(a)pyrene	10	10 U	10 U	10 U	11 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10	10 U	10 U	10 U	11 U	10 U	10 U
Dibenz(a,h)anthracene	10	10 U	10 U	10 U	11 U	10 U	10 U
Benzo(g,h,i)perylene	10	10 U	10 U	10 U	11 U	10 U	10 U
DILUTION FACTOR:		1	1	1	1.11	1.04	1
DATE SAMPLED:		10/10/90	10/10/90	10/11/90	10/11/90	10/5/90	10/10/90
DATE EXTRACTED:		10/13/90	10/12/90	10/12/90	10/12/90	10/10/90	10/12/90
DATE ANALYZED:		10/23/90	10/15/90	10/15/90	10/15/90	10/11/90	10/15/90

TABLE 4-14
SAMPLE SPECIFIC DETECTION LIMITS FOR PESTICIDES/PCB'S FOR NEW WELL ANALYSES

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 043

SAMPLE NUMBER:		GWR11	GWR12	GWR13	GWR14	GWR15A	GWREB
SAMPLE LOCATION:		RI 1	RI 2	RI 3	RI 4	RI 5A	EQUIP BLK
LABORATORY NUMBER:		0644	0643	0688	0689	0569	0645
COMPOUND	CRQL						
alpha-BHC	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
beta-BHC	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
delta-BHC	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
gamma-BHC(Lindane)	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
Heptachlor	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
Aldrin	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
Heptachlor Epoxide	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
Endosulfan I	0.05	0.06 U	0.05 U	0.06 U	0.05 U	0.05 U	0.05 U
Dieldrin	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
4,4'-DDE	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
Endrin	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
Endosulfan II	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
4,4'-DDD	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
Endosulfan Sulfate	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
4,4'-DDT	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
Methoxychlor	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Endrin Ketone	0.1	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.10 U
alpha-Chlordane	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
gamma-Chlordane	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Toxaphene	1.0	1.25 U	1.00 U	1.17 U	1.08 U	1.05 U	1.04 U
Aroclor-1016	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Aroclor-1221	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Aroclor-1232	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Aroclor-1242	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Aroclor-1248	0.5	0.63 U	0.50 U	0.59 U	0.54 U	0.53 U	0.52 U
Aroclor-1254	1.0	1.25 U	1.00 U	1.17 U	1.08 U	1.05 U	1.04 U
Aroclor-1260	1.0	1.25 U	1.00 U	1.17 U	1.08 U	1.05 U	1.04 U
DILUTION FACTOR:		1.25	1	1.17	1.08	1.05	1.04
DATE SAMPLED:		10/13/90	10/10/90	11/8/90	11/8/90	10/5/90	10/10/90
DATE EXTRACTED:		10/18/90	10/12/90	11/12/90	11/12/90	10/10/90	10/12/90
DATE ANALYZED:		10/31/90	10/19/90	11/17/90	11/17/90	10/19/90	10/19/90

TABLE 4-17
INORGANIC CONSTITUENTS DETECTED IN RIVER WATER

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 009040, SDG NO. 044

SAMPLE NUMBER: SAMPLE LOCATION: LABORATORY NUMBER:			SWRIW1 RIW1 (BANK) 0728	SWRIW1 RIW1 (MID) 0729	SWRIW2 RIW2 (BANK) 0730	SWRIW2 RIW2 (MID) 0731	SWRIW3 RIW3 (BANK) 0732	SWRIW3 RIW3 (MID) 0733	SWLB1 EQUIP BLK 0734
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (ug/L, ppb)							
ALUMINUM	P	200	149.00 B	58.00 B	235.00	50.00 U	14.00 B	59.00 B	50.00 U
ANTIMONY	P	60	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U
ARSENIC	F	10	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
BARIUM	P	200	50.00 U	50.00 U	50.00 U	50.00 U	50.00 U	50.00 U	50.00 U
BERYLLIUM	P	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
CADMIUM	P	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
CALCIUM	P	5000	31200.00	26600.00	21900.00	26600.00	28600.00	28600.00	200.00 U
CHROMIUM	P	10	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	11.00	10.00 U
COBALT	P	50	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U
COPPER	P	25	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U
IRON	P	100	326.00	264.00	425.00	140.00	312.00	209.00	20.00 U
LEAD	F	5	4.00	3.00 U	3.00	3.00 U	3.00 U	3.00	3.00 U
MAGNESIUM	P	5000	8430.00	7170.00	5940.00	7170.00	7770.00	7770.00	250.00 U
MANGANESE	P	15	92.00	65.00	96.00	62.00	99.00	65.00	5.00 U
MERCURY	CV	0.2	0.20 U	0.20 U	0.20 U	0.70	0.20 U	0.20 U	0.20 U
NICKEL	P	40	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U
POTASSIUM	P	5000	3200.00 B	3190.00 B	2380.00 B	2840.00 B	3260.00 B	3230.00 B	300.00 U
SELENIUM	F	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
SILVER	P	10	5.00 B	15.00	25.00	14.00	7.00 B	8.00 B	15.00
SODIUM	P	5000	47000.00	39000.00	34000.00	39000.00	44000.00	47000.00	331.00
THALLIUM	F	10	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U
VANADIUM	P	50	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U	30.00 U
ZINC	P	20	10.00 U	16.00 B	20.00	10.00 U	13.00 B	11.00 B	10.00 U
CYANIDE	C	10	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U

TABLE 4-16
VOLATILE ORGANIC COMPOUNDS DETECTED IN RIVER WATER

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:		SWRIV1	SWRIV1	SWRIV2	SWRIV2	SWRIV3	SWRIV3	SWEB1	SWTB1	SWTB2
SAMPLE LOCATION:		RIV 1 (BANK)	RIV 1 (MID)	RIV 2 (BANK)	RIV 2 (MID)	SWRIV 3 (BANK)	SWRIV 3 (MID)	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		0728	0729	0730	0731	0732	0733	0734		
COMPOUND	CRQL									
Toluene	5	0.5 BJ	0.6 BJ	0.6 BJ	5 U	5 U	0.7 BJ	0.6 BJ	0.6 BJ	0.6 BJ
DILUTION FACTOR:		1	1	1	1	1	1	1	1	1
DATE SAMPLED:		10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/10/90	10/10/90	10/9/90
DATE RECEIVED:		10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/11/90	10/11/90	10/11/90
DATE ANALYZED:		10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/12/90	10/12/90	10/12/90

TABLE 4-17
SAMPLE SPECIFIC DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS FOR RIVER WATER ANALYSES

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:		SWRIV1	SWRIV1	SWRIV2	SWRIV2	SWRIV3	SWRIV3	SWEB1	SWTB1	SWTB2
SAMPLE LOCATION:		RIV 1 (BANK)	RIV 1 (MID)	RIV 2 (BANK)	RIV 2 (MID)	SWRIV 3 (BANK)	SWRIV 3 (MID)	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		0728	0729	0730	0731	0732	0733	0734		
COMPOUND	CRQL									
Chloromethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1	1
DATE SAMPLED:		10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/10/90	10/9/90
DATE RECEIVED:		10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/11/90	10/10/90
DATE ANALYZED:		10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/11/90	10/11/90

TABLE 4-13
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS IN RIVER WATER

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO 009040, SDG NO. 044

SAMPLE NUMBER: SAMPLE LOCATION: LABORATORY NUMBER:		SWRIV1 RIV1 (BANK) 0728	SWRIV1 RIV1 (MID) 0729	SWRIV2 RIV2 (BANK) 0730	SWRIV2 RIV2 (MID) 0731	SWRIV3 RIV3 (BANK) 0732	SWRIV3 RIV3 (MID) 0733	SWEB1 EQUIP BLK 0734
COMPOUND	CRQL							
Phenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl) ether	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzyl Alcohol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl) ether	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
N-Nitroso-di-n-propylamine	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzoic Acid	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
bis(2-Chloroethoxy)methane	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-Methylphenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
2-Chloronaphthalene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
Dimethylphthalate	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
Acenaphthene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
4-Nitrophenol	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
Dibenzofuran	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-Phenylether	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
4,6-Dinitro-2-Methylphenol	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
N-nitrosodiphenylamine(1)	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl Phenylether	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10	[illegible]	[illegible]	[illegible]	10 U	10	[illegible]	10

TABLE 4-18 (continued)
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC ORGANIC COMPOUNDS IN RIVER WATER

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:		SWR1W1	SWR1W1	SWR1W2	SWR1W2	SWR1W3	SWR1W3	SWEB1
SAMPLE LOCATION:		R1W1 (BANK)	R1W1 (MID)	R1W2 (BANK)	R1W2 (MID)	R1W3 (BANK)	R1W3 (MID)	EQUIP BLK
LABORATORY NUMBER:		0726	0729	0730	0731	0732	0733	0734
COMPOUND	CRQL							
Pentachlorophenol	50	60 U	50 U	50 U	50 U	50 U	50 U	50 U
Phenanthrene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	20	24 U	20 U	20 U	20 U	20 U	20 U	20 U
Benzo(a)anthracene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-octylphthalate	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10	12 U	10 U	10 U	10 U	10 U	10 U	10 U
DILUTION FACTOR:		1.2	1	1	1	1	1	1
DATE SAMPLED:		10/10/90	10/10/90	10/10/90	10/10/90	10/10/90	10/10/90	10/10/90
DATE EXTRACTED:		10/16/90	10/16/90	10/16/90	10/16/90	10/16/90	10/16/90	10/16/90
DATE ANALYZED:		10/22/90	10/22/90	10/24/90	10/24/90	10/24/90	10/24/90	10/24/90

TABLE 4-19

SAMPLE SPECIFIC DETCTION LIMITS FOR PESTICIDES/PCB'S FOR RIVER WATER ANALYSES

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. G0506G, SDG NO. 044

SAMPLE NUMBER:		SWRIW1	SWRIW1	SWRIW2	SWRIW2	SWRIW3	SWRIW3	SWEB01
SAMPLE LOCATION:		RIW1 (BANK)	RIW1 (MID)	RIW2 (BANK)	RIW2 (MID)	RIW3 (BANK)	RIW3 (MID)	(EQUIP BLK
LABORATORY NUMBER:		0728	0729	0730	0731	0732	0733	0734
COMPOUND	CRQL							
alpha-BHC	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
beta-BHC	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
delta-BHC	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-BHC(Lindane)	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Aldrin	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor Epoxide	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan I	0.05	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Dieldrin	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
4,4'-DDE	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
Endrin	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
Endosulfan II	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
4,4'-DDD	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
Endosulfan Sulfate	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
4,4'-DDT	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
Methoxychlor	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Endrin Ketone	0.1	0.13 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U
alpha-Chlordane	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
gamma-Chlordane	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Toxaphene	1.0	1.25 U	1.05 U	1.00 U	1.00 U	1.00 U	1.05 U	1.09 U
Aroclor-1016	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Aroclor-1221	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Aroclor-1232	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Aroclor-1242	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Aroclor-1248	0.5	0.63 U	0.53 U	0.50 U	0.50 U	0.50 U	0.53 U	0.55 U
Aroclor-1254	1.0	1.25 U	1.05 U	1.00 U	1.00 U	1.00 U	1.05 U	1.09 U
Aroclor-1260	1.0	1.25 U	1.05 U	1.00 U	1.00 U	1.00 U	1.05 U	1.09 U
DILUTION FACTOR:		1.25	1.05	1	1	1	1.05	1.09
DATE SAMPLED		10/10/90	10/10/90	10/10/90	10/10/90	10/10/90	10/10/90	10/10/90
DATE EXTRACTED.		10/16/90	10/16/90	10/16/90	10/16/90	10/16/90	10/16/90	10/16/90
DATE ANALYZED.		10/19/90	10/20/90	10/20/90	10/20/90	10/20/90	10/20/90	10/20/90

TABLE 4-20
INORGANIC CONSTITUENTS DETECTED IN RIVER SEDIMENT

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:			SDRIS1	SDRIS1	SDRIS2	SDRIS2	SDRIS3	SDEB1
SAMPLE LOCATION:			RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	EQUIP BLK *
LABORATORY NUMBER:			0754	0755	0756	0759	0760	0762
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (MG/KG, ppb)						
ALUMINUM	P	-	7830.00	6710.00	11000.00	8510.00	7850.00	160.00 B
ANTIMONY	P	6000	1.60 U	1.70 U	2.70 U	1.70 U	1.70 U	10.00 U
ARSENIC	F	1000	2.05	[illegible]	1.90 B	1.90	3.50	5.00 U
BARIUM	P	20000	44.50	31.10	64.60	50.60	37.70	50.00 U
BERYLLIUM	P	500	0.83 U	0.59 U	1.40 U	0.87 U	0.59 U	5.00 U
CADMIUM	P	500	4.50	10.70	6.80	9.70	11.10	5.00 U
CALCIUM	P	-	2780.00	1280.00	3260.00	2200.00	1100.00	210.00 B
CHROMIUM	P	1000	10.40	10.60	14.60	10.90	10.40	10.00 U
COBALT	P	5000	7.40	8.50	5.80 B	15.10	10.70	20.00 U
COPPER	P	2500	24.50	11.10	51.10	77.70	16.40	10.00 U
IRON	P	---	12600.00	18200.00	9750.00	14600.00	19500.00	47.00 B
LEAD	F	500	31.40	14.50	75.70	29.50	16.50	3.00 U
MAGNESIUM	P	--	2340.00	3290.00	7590.00	5050.00	3770.00	300.00 U
MANGANESE	P	- -	188.00	427.00	707.00	393.00	880.00	5.00 U
MERCURY	CV	20	0.48	0.10 U	1.40	0.30	0.37	0.20 U
NICKEL	P	4000	17.20	20.40	24.00	20.90	31.40	30.00 U
POTASSIUM	P	- -	678.00 B	728.00	838.00 B	863.00 B	844.00	300.00 U
SELENIUM	F	500	0.81 U	0.59 U	1.30 U	0.87 U	0.59 U	5.00 U
SILVER	P	1000	1.30 B	0.81 B	1.60 B	1.10 B	0.81	10.00
SODIUM	P	---	292.00 B	179.00 B	512.00 B	275.00 B	188.00 B	331.00 B
THALLIUM	F	1000	0.98 U	0.71 U	1.60 U	1.00 U	0.71 U	6.00 U
VANADIUM	P	5000	17.10	19.50	28.10	20.20	23.30	30.00 U
ZINC	P	2000	88.30	65.80	131.00	107.00	78.20	11.00 B
CYANIDE	C	4000	1.20	0.46 U	1.10 U	0.69 U	0.47	10.00 U

* EQUIPMENT BLANK UNITS ARE IN UG/L

TABLE 4-21
VOLATILE ORGANIC COMPOUNDS DETECTED IN RIVER SEDIMENT

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:		SDR151	SDR151	SDR312	SDR152	SDR153	SDEB01	SDTB01
SAMPLE LOCATION:		RIS 1 (BANK)	RIS 1 (MID)	RIS 2 (BANK)	RIS 2 (MID)	RIS 3 (BANK)	EQUIP BLK	TRIP BLK
LABORATORY NUMBER:		0754	0755	0756	0759	0760	0747	
COMPOUND	CRQL							
Methylene Chloride	5	9 U	6 U	19 U	7 U	6 U	0.8 J	5 U
Acetone	10	19 B	17 B	220 B	48 B	12 U	14	2 J
2-Butanone	10	17 U	17 U	26 J	14 U	12 U	10 U	10 U
Toluene	5	9 U	0.7 BJ	3 BJ	7 U	6 U	1 BJ	0.6 BJ
DILUTION FACTOR:		1.7	1.2	3.8	1.4	1.2	1	1
DATE SAMPLED:		10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/10/90	10/10/90
DATE RECEIVED:		10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/11/90	10/11/90
DATE ANALYZED:		10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/11/90	10/11/90

TABLE 4-22
SAMPLE SPECIFIC DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS FOR RIVER WATER SEDIMENT ANALYSIS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:		SDR1S1	SDR1S1	SDR1S2	SDR1S2	SDR1S3	SDEB01	SDTB01
SAMPLE LOCATION:		RIS 1 (BANK)	RIS 1 (MID)	RIS 2 (BANK)	RIS 2 (MID)	RIS 3 (BANK)	EQUIP BLK	TRIP BLK
LABORATORY NUMBER:		0754	0755	0756	0759	0760	0747	
COMPOUND	CRQL							
Chloromethane	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Bromomethane	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Vinyl Chloride	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Chloroethane	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Methylene Chloride	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Acetone	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Carbon Disulfide	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,1-Dichloroethene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,1-Dichloroethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,2-Dichloroethene(total)	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Chloroform	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,2-Dichloroethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
2-Butanone	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
1,1,1-Trichloroethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Carbon Tetrachloride	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Vinyl Acetate	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Bromodichloromethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,2-Dichloropropane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
cis-1,3-Dichloropropene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Trichloroethene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Dibromochloromethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,1,2-Trichloroethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Benzene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
trans-1,3-Dichloropropene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Bromoform	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
4-Methyl-2-pentanone	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
2-Hexanone	10	17 U	12 U	38 U	14 U	12 U	10 U	10 U
Tetrachloroethene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Toluene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Chlorobenzene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Ethylbenzene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Styrene	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
Total Xylenes	5	9 U	6 U	19 U	7 U	6 U	5 U	5 U
DILUTION FACTOR:		1.7	1.2	3.8	1.4	1.2	1	1
DATE SAMPLED:		10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	--
DATE RECEIVED:		10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/13/90	10/13/90
DATE ANALYZED:		10/15/90	10/15/90	10/15/90	10/15/90	10/15/90	10/15/90	10/15/90

TABLE 4-23
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN RIVER SEDIMENT

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005080, SDG NO. 044

SAMPLE NUMBER:		SDRIS1	SDRIS1	SDRIS2	SDRIS2	SDRIS3	SDEB1	SDEB1-RE
SAMPLE LOCATION:		RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	EQUIP BLK*	EQUIP BLK*
LABORATORY NUMBER:		0754	0755	0756	0759	0760	0747	0747
COMPOUND	CRQL							
Phenol	330	120 J	110 J	730 J	750 J	1554 U	41	39
2-Chlorophenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	72	73
Benzoic Acid	1600	190 J	7360 U	360 J	10672 U	7536 U	52 U	52 U
Naphthalene	330	2112 U	1518 U	3432 U	2201 U	460 J	10 U	10 U
4-Chloro-3-Methylphenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	72	70
2-Methylnaphthalene	330	2112 U	1518 U	3432 U	2201 U	180 J	10 U	10 U
Acenaphthylene	330	2112 U	1518 U	3432 U	2201 U	95 J	10 U	10 U
Acenaphthene	330	2112 U	1518 U	3432 U	2201 U	690 J	10 U	10 U
4-Nitrophenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	29 J	29 J
Dibenzofuran	330	2112 U	1518 U	3432 U	2201 U	380 J	10 U	10 U
Fluorene	330	2112 U	1518 U	3432 U	2201 U	910 J	10 U	10 U
Pentachlorophenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	32 J	27 J
Phenanthrene	330	290 J	1518 U	640 J	420 J	6600	10 U	10 U
Anthracene	330	2112 U	1518 U	3432 U	2201 U	800 J	10 U	10 U
Fluoranthene	330	680 J	1518 U	1800 J	620 J	5500	10 U	10 U
Pyrene	330	610 J	1518 U	1500 J	550 J	5200	10 U	10 U
Benzo(a)anthracene	330	2112 U	1518 U	860 J	260 J	2200	10 U	10 U
Chrysene	330	470 J	1518 U	1100 J	260 J	2100	10 U	10 U
Bis(2-ethylhexyl)phthalate	330	130 BJ	96 BJ	470 BJ	560 BJ	79 BJ	10 U	10 U
Benzo(b)fluoranthene	330	520 J	1518 U	1300 J	320 J	2600	10 U	10 U
Benzo(k)fluoranthene	330	240 J	1518 U	550 J	110 J	1000 J	10 U	10 U
Benzo(a)pyrene	330	240 J	1518 U	630 J	190 J	1800	10 U	10 U
Indeno(1,2,3-cd)pyrene	330	150 J	1518 U	440 J	2201 U	980 J	10 U	10 U
Dibenz(a,h)anthracene	330	2112 U	1518 U	3432 U	2201 U	140 J	10 U	10 U
Benzo(g,h,i)perylene	330	130 J	1518 U	380 J	2201 U	760 J	10 U	10 U
DILUTION FACTOR:		6.4	4.6	10.4	6.67	4.71	1	1
DATE SAMPLED:		10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90
DATE EXTRACTED:		10/17/90	10/17/90	10/17/90	10/17/90	10/17/90	10/18/90	10/18/90
DATE ANALYZED:		11/9/90	11/9/90	11/10/90	11/9/90	11/9/90	10/23/90	10/26/90

* EQUIPMENT BLANK IS IN UG/L.

TABLE 4 24
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR RIVER SEDIMENT ANALYSIS

SITE: TOLEDO WASTE DISPOSAL SITE
CASE NO. 00504D, SDG NO. E44

SAMPLE NUMBER:		SDR151	SDR151	SDR152	SDR152	SDR153	SDEB14	SDEB14-RE
SAMPLE LOCATION:		R151 (BANK)	R151 (MID)	R152 (BANK)	R152 (MID)	R153 (BANK)	EQUIP BLK	EQUIP BLK
LABORATORY NUMBER:		0754	0755	0756	0759	0760	0747	0747
COMPOUND	CRQL							
Phenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
bis(2-Chloroethyl) ether	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2-Chlorophenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
1,3-Dichlorobenzene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
1,4-Dichlorobenzene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Benzyl Alcohol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
1,2-Dichlorobenzene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2-Methylphenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
bis(2-Chloroisopropyl) ether	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
4-Methylphenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
N-Nitroso-di-n-propylamine	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Hexachloroethane	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Nitrobenzene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Isophorone	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2-Nitrophenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,4-Dimethylphenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Benzoic Acid	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
bis(2-Chloroethoxy)methane	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,4-Dichlorophenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
1,2,4-Trichlorobenzene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Naphthalene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
4-Chloroaniline	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Hexachlorobutadiene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
4-Chloro-3-Methylphenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2-Methylnaphthalene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Hexachlorocyclopentadiene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,4,6-Trichlorophenol	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,4,5-Trichlorophenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
2-Chloronaphthalene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2-Nitroaniline	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
Dimethylphthalate	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Acenaphthylene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,6-Dinitrotoluene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
3-Nitroaniline	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
Acenaphthene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,4-Dinitrophenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
4-Nitrophenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
Dibenzofuran	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
2,4-Dinitrotoluene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Diethylphthalate	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
4-Chlorophenyl-Phenylether	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Fluorene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
4-Nitroaniline	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
4,6-Dinitro-2-Methylphenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
N-nitrosodiphenylamine(1)	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
4-Bromophenyl-Phenylether	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Hexachlorobenzene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U

TABLE 4-24 (continued)
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR RIVER SEDIMENT ANALYSIS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005046, SDG NO. 044

SAMPLE NUMBER:		SDRIS1	SDRIS1	SDRIS2	SDRIS2	SDRIS3	SDEB1*	SDEB1-RE
SAMPLE LOCATION:		RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	EQUIP BLK	EQUIP BLK
LABORATORY NUMBER:		0754	0755	0756	0759	0760	0747	0747
COMPOUND	CRQ.							
Pentachlorophenol	1600	10240 U	7360 U	16640 U	10672 U	7536 U	52 U	52 U
Phenanthrene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Anthracene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Di-n-butylphthalate	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Fluoranthene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Pyrene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Butylbenzylphthalate	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
3,3'-Dichlorobenzidine	660	4224 U	3036 U	6864 U	4402 U	3109 U	21 U	21 U
Benzo(a)anthracene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Chrysene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Di-n-octylphthalate	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Benzo(b)fluoranthene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Benzo(k)fluoranthene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Benzo(a)pyrene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Dibenz(a,h)anthracene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
Benzo(g,h,i)perylene	330	2112 U	1518 U	3432 U	2201 U	1554 U	10 U	10 U
DILUTION FACTOR:		6.4	4.6	10.4	6.67	4.71	1	1
DATE SAMPLED:		10/13/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90
DATE EXTRACTED:		10/17/90	10/17/90	10/17/90	10/17/90	10/17/90	10/18/90	10/18/90
DATE ANALYZED:		11/9/90	11/9/90	11/13/90	11/9/90	11/9/90	10/23/90	10/26/90

* EQUIPMENT BLANK IS IN UG/L.

TABLE 4-25
SAMPLE SPECIFIC DETECTION LIMITS FOR PESTICIDES/PCB'S FOR RIVER SEDIMENT ANALYSES

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 003049, SDG NO. 044

SAMPLE NUMBER:		SDR151	SDR151	SDR152	SDR152	SDR153	SDEB01
SAMPLE LOCATION:		R151 (BANK)	R151 (MID)	R152 (BANK)	R152 (MID)	R153 (BANK)	EQUIP BLK
LABORATORY NUMBER:		0754	0755	0756	0759	0760	0747
COMPOUND	CRQ.						
alpha-BHC	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
beta-BHC	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
delta-BHC	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
gamma-BHC(Lindane)	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
Heptachlor	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
Aldrin	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
Heptachlor Epoxide	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
Endosulfan I	8.0	26 U	18 U	42 U	26 U	19 U	0.05 U
Dieldrin	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
4,4'-DDE	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
Endrin	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
Endosulfan II	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
4,4'-DDD	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
Endosulfan Sulfate	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
4,4'-DDT	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
Methoxychlor	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Endrin Ketone	16.0	51 U	37 U	83 U	53 U	38 U	0.10 U
alpha-Chlordane	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
gamma-Chlordane	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Toxaphene	160.0	512 U	368 U	832 U	528 U	384 U	1.0 U
Aroclor-1016	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Aroclor-1221	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Aroclor-1232	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Aroclor-1242	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Aroclor-1248	80.0	256 U	184 U	416 U	264 U	192 U	0.52 U
Aroclor-1254	160.0	512 U	368 U	832 U	528 U	384 U	1.0 U
Aroclor-1260	160.0	512 U	368 U	832 U	528 U	384 U	1.0 U
DILUTION FACTOR:		3.2	2.3	5.2	3.3	2.4	1.0
DATE SAMPLED:		10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90
DATE EXTRACTED:		10/17/90	10/17/90	10/17/90	10/17/90	10/17/90	10/19/90
DATE ANALYZED:		11/1/90	11/1/90	11/1/90	11/1/90	11/1/90	11/1/90

* EQUIPMENT BLANK IS IN UG/L.

TABLE 4-26
INORGANICS DETECTED IN SOIL BORINGS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 040, 041, 042

SAMPLE NUMBER: SAMPLE LOCATION: LABORATORY NUMBER:			RIB-1 RIB-1 (15-17) 9672	RIB-2 RIB-2 (25-27) 9494	RIB-3 RIB-3 8586	RIB-4 RIB-4 (15-17) 8693	RIB-5 RIB-5 8672	RIB-6 RIB-6 (22-24) 9340	RIB-7 RIB-7 (15-17) 8755	SW-1-0-0790 DRILLING FLUID HOSE# 8375
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (MG/KG, PPM)								
ALUMINUM	P	--	3860.00	7900.00	15400.00	4830.00	9030.00	6740.00	16100.00	173.00 B
ANTIMONY	F	6000	1.00 U	0.51 U	0.94 U	0.56 U	1.10 U	0.56 U	0.65 U	5.00 B
ARSENIC	F	1000	1.30	1.30	2.50	2.30	1.70	2.20	0.59 U	5.00 U
BARIUM	P	20000	166.00	31.80	45.40	31.40	32.50	21.50	43.80	4.00 B
BERYLLIUM	F	500	0.29 B	0.60	1.00	0.46 B	0.61	0.39 B	0.89	3.00 U
CADMIUM	P	500	5.80	0.59 U	1.30	0.55 U	1.10	0.53 U	1.10	5.00 U
CALCIUM	P	---	1070.00	2200.00	1670.00	2290.00	2800.00	1170.00	2660.00	114000.00
CHROMIUM	P	1000	52.60	22.10	25.60	15.50	17.90	10.80	20.30	10.00 U
COBALT	P	5000	3.70	7.70	17.60	9.70	8.60	[illegible]	7.50	9.00 U
COPPER	P	2500	20.40	24.20	22.00	24.10	23.50	13.50	25.40	16.00 B
IRON	P	---	5740.00	18800.00	25700.00	18500.00	19200.00	18700.00	17500.00	263.00
LEAD	P	500	76.30	8.80	17.00	8.10	6.70	7.30	10.40	3.00 U
MAGNESIUM	P	--	971.00	3330.00	3640.00	3730.00	3700.00	3340.00	3590.00	1800.00 B
MANGANESE	P	---	40.70	431.00	870.00	345.00	219.00	228.00	212.00	13.00 B
MERCURY	CV	20	0.12 U	0.11 U	0.10 U	0.20	0.11 U	0.10	0.14	0.20 U
NICKEL	P	4000	7.10	30.80	24.50	16.80	16.70	17.20	21.50	15.00 U
POTASSIUM	P	--	729.00	1350.00	774.00	1140.00	915.00	602.00	1690.00	684.00 B
SELENIUM	F	500	0.52 U	0.51 U	0.48 U	0.56 U	0.61 U	0.56 U	0.59 U	5.00 U
SILVER	P	1000	0.34 U	0.83 U	3.80	0.78 U	0.83 U	0.73 U	0.83 U	3.00 U
SODIUM	P	---	259.00 B	235.00 B	172.00 B	149.00 B	311.00 B	120.00 B	220.00 B	4650.00 B
THALLIUM	F	1000	0.52 U	0.51 U	0.48 U	0.56 U	0.61 U	0.56 U	0.59 U	5.00 U
VANADIUM	P	5000	12.00	23.50	38.10	16.70	27.60	15.80	35.80	7.00 B
ZINC	P	2000	39.20	55.60	66.00	56.30	59.10	46.20	65.70	114.00
CYANIDE	C	4000	--	--	--	--	--	--	--	10.00 U

The units for sample SW-1-0-0790 are ug/L.

TABLE 4-27
VOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL BORINGS

SAMPLE NUMBER:		RIB-1	RIB-2	RIB-3	RIB-4	RIB-5	RIB-6	RIB-7	SW-1-0-0790 *	SW-TB-1-0790 *
SAMPLE LOCATION:		RIB-1 (15-17)	RIB-2 (20-22)	RIB-3	RIB-4 (15-17)	RIB-5	RIB-6 (22-24)	RIB-7 (15-17)	DRILLING FLUID HOSE	TRIP BLANK
LABORATORY NUMBER:		9657	9494	8386	8695	8677	9360	8735	8375	1324
COMPOUND	CRQL									
Methylene Chloride	5	5 U	5 U	0.6 J	2 BJ	1 J	2 J	1 BJ	5 U	5 U
Acetone	10	11 B	15 B	10 BJ	7 J	4 BJ	6 BJ	14 B	4 BJ	24 B
Chloroform	5	5 U	5 U	5 U	7 J	5 U	5 U	5 U	110	5 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	7	5 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	1 J	5 U	5 U	1 BJ	1 BJ	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.6 J	5 U
2-Hexanone	10	10 U	11 U	11 U	11 U	11 U	11 U	10 U	10 U	10 U
Toluene	5	0.8 J	0.9 J	[illegible] BJ	1 BJ	5 U	0.9 BJ	0.7 BJ	1 BJ	1 BJ
DILUTION FACTOR:		1	1	1	1.1	1	[illegible]	0.97	1	1
DATE SAMPLED:		8/22/90	8/21/90	7/24/90	8/2/90	7/27/90	8/24/90	8/3/90	7/20/90	7/20/90
DATE RECEIVED:		8/23/90	8/22/90	7/25/90	8/3/90	7/28/90	8/25/90	8/6/90	7/21/90	7/21/90
DATE ANALYZED:		8/24/90	8/31/90	7/30/90	8/6/90	7/30/90	8/28/90	8/8/90	7/25/90	7/25/90

* Units for SW-1-0-0790 and SW-TB-1-0790 are ug/l

TABLE 4-28
SAMPLE SPECIFIC DETECTION LIMITS FOR VOATILE ORGANIC COMPOUNDS IN SOIL BORINGS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 044

SAMPLE NUMBER:		RIB-1	RIB-2	RIB-3	RIB-4	RIB-5	RIB-6	RIB-7	SW-1-0-0790 *	SW-TB-1-0790 *
SAMPLE LOCATION:		RIB-1 (15-17)	RIB-2 (25-27)	RIB-3	RIB-4 (15-17)	RIB-5	RIB-6 (22-24)	RIB-7 (15-17)	DRILLING FLUID HOSE	TRIP BLANK
LABORATORY NUMBER:										
COMPOUND	CRQL									
Chloromethane	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	11 U	10 U	11 U	16 U	16 U	13 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1 Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2 Dichloroethene(total)	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	5	5 U	5 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	11 U	10 U	11 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1	1
DATE SAMPLED:		8/22/90	8/21/90	7/24/90	8/2/90	7/27/90	8/24/90	8/7/90	7/20/90	7/20/90
DATE RECEIVED:		8/23/90	8/22/90	7/25/90	8/3/90	7/28/90	8/25/90	8/8/90	7/21/90	7/21/90
DATE ANALYZED:		8/24/90	8/23/90	7/30/90	8/4/90	7/30/90	8/28/90	8/8/90	7/25/90	7/25/90

* Units for SW-1-0-0790 and SW-TB-1-0790 are ug/L.

TABLE 4-29
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL BORINGS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 040, 041, 042

SAMPLE NUMBER:		RIB-1	RIB-2	RIB-3	RIB-4	RIB-5	RIB-6	RIB-7
SAMPLE LOCATION:		RIB-1 (15-17)	RIB 2 (25-27)	RIB-3 (10-12)	RIB-4 (15-17)	RIB-5	RIB-6 (22-24)	RIB-7 (15-17)
LABORATORY NUMBER:		9622	9494	8386	8695	8627	9340	8755
COMPOUND	CRQL							
Phenanthrene	330	726 U	759 U	703 U	55 J	792 U	693 U	875 U
Anthracene	330	726 U	759 U	703 U	726 U	792 U	693 U	875 U
Di-n-butylphthalate	330	726 U	759 U	1100	4400 B	140 J	693 U	99 J
Fluoranthene	330	726 U	759 U	703 U	72 J	792 U	693 U	82 J
Pyrene	330	726 U	759 U	703 U	55 J	792 U	693 U	50 J
Butylbenzylphthalate	330	726 U	759 U	703 U	200 J	792 U	693 U	[illegible] J
Bis(2-ethylhexyl)phthalate	330	[illegible] J	150 J	130 J	130 J	150 J	43 J	840
DILUTION FACTOR		2.2	2.3	2.13	2.2	2.4	2.1	2.5
DATE SAMPLED:		8/22/90	8/21/90	7/23/90	8/2/90	7/27/90	8/24/90	8/3/90
DATE EXTRACTED:		8/27/90	8/24/90	7/26/90	8/6/90	7/31/90	8/28/90	8/9/90
DATE ANALYZED:		9/4/90	9/7/90	8/2/90	8/13/90	8/9/90	9/5/90	8/14/90

TABLE 4-30
SAMPLE SPECIFIC DETECTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR SOIL BORINGS

SITE: [illegible] WASTE DISPOSAL SITE
CASE NO. 00D040, SDG NO. 040, 041, 047

SAMPLE NUMBER:		RIB 1	RIB 2	RIB 3	RIB 4	RIB 5	RIB 6	RIB 7
SAMPLE LOCATION:		RIB 1 (15-17)	RIB 2 (20-22)	RIB 3 (10-12)	RIB 4 (15-17)	RIB-5	RIB 6 (22-24)	RIB-7 (15-17)
LABORATORY NUMBER:		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9340	[illegible]
COMPOUND	CRQL							
Phenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
bis(2-Chloroethyl) ether	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2-Chlorophenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
1,3-Dichlorobenzene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
1,4-Dichlorobenzene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Benzyl Alcohol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
1,2-Dichlorobenzene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2-Methylphenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
bis(2-Chloroisopropyl) ether	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
4-Methylphenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
N-Nitroso-di-n-propylamine	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Hexachloroethane	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Nitrobenzene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Isophorone	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2-Nitrophenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,4-Dimethylphenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Benzoic Acid	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
bis(2-Chloroethoxy)methane	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,4-Dichlorophenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
1,2,4-Trichlorobenzene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Naphthalene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
4-Chloroaniline	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Hexachlorobutadiene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
4-Chloro-3-Methylphenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2-Methylnaphthalene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Hexachlorocyclopentadiene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,4,6-Trichlorophenol	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,4,5-Trichlorophenol	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
2-Chloronaphthalene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2-Nitroaniline	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
Dimethylphthalate	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Acenaphthylene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,6-Dinitrotoluene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
3-Nitroaniline	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
Acenaphthene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,4-Dinitrophenol	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
4-Nitrophenol	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
Dibenzofuran	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
2,4-Dinitrotoluene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Diethylphthalate	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
4-Chlorophenyl-Phenylether	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Fluorene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
4-Nitroaniline	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
4,6-Dinitro-2-Methylphenol	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
N-nitrosodiphenylamine(1)	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
4-Bromophenyl-Phenylether	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Hexachlorobenzene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U

TABLE 4-30 (continued)
SAMPLE SPECIFIC DETCTION LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS FOR SOIL BORINGS

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 040, 041, 042

SAMPLE NUMBER:		RIB-1	RIB-2	RIB-3	RIB-4	RIB-5	RIB-6	RIB-7
SAMPLE LOCATION:		RIB-1 (15-17)	RIB-2 (25-27)	RIB-3 (10-12)	RIB-4 (15-17)	RIB-5	RIB-6 (22-24)	RIB-7 (15-17)
LABORATORY NUMBER:		9672	9494	6386	6495	6477	9360	8755
COMPOUND	CRQL							
Pentachlorophenol	1600	3520 U	3680 U	3408 U	3520 U	3840 U	3360 U	4000 U
Phenanthrene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Anthracene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Di-n-butylphthalate	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Fluoranthene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Pyrene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Butylbenzylphthalate	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
3,3'-Dichlorobenzidine	660	1452 U	1518 U	1406 U	1452 U	1584 U	1386 U	1650 U
Benzo(a)anthracene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Chrysene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
bis(2-ethylhexyl)phthalate	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Di-n-octylphthalate	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Benzo(b)fluoranthene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Benzo(k)fluoranthene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Benzo(a)pyrene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Indeno(1,2,3-cd)pyrene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Dibenz(a,h)anthracene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
Benzo(g,h,i)perylene	330	726 U	759 U	703 U	726 U	792 U	693 U	825 U
DILUTION FACTOR:		2.2	2.3	2.13	2.2	2.4	2.1	2.5
DATE SAMPLED:		8/22/90	8/21/90	7/23/90	8/2/90	7/27/90	8/24/90	8/7/90
DATE EXTRACTED:		8/27/90	8/24/90	7/26/90	8/6/90	7/31/90	8/28/90	8/9/90
DATE ANALYZED:		9/4/90	9/7/90	8/2/90	8/13/90	8/9/90	9/5/90	8/14/90

TABLE 4-31 TEMPERATURE SURVEY RESULTS

LOCATION	TIME (INSERT/ REMOVAL)	SOIL TEMP (°F)	MET STA. AIR TEMP* (°F)	WEATHER	PROBE	OTHER OBSERVATIONS
A3	1010/1047	76	71.2	Cloudy	1	3" Penetration 24" Deep
A4	1015/1049	64	71.2	Cloudy	2	24" Deep
B3	1025/1051	76	71.2	Cloudy	3	4" Penetration 13" Deep
B4	1030/1053	67.5	71.2	Cloudy	4	1" Penetration
C2	1045/1057	74	71.2	Sunny	5	1" Penetration 24" Deep
C3	1040/1055	68	71.2	Cloudy	6	0" Penetration 24" Deep
C4	1100/1135	64	77.9	Sunny	1	2" Penetration 24" Deep
D2	1103/1137	74	77.9	Sunny	2	1" Penetration 20" Deep
D3	1106/1138	67	77.9	Sunny	3	3/4" Penetration 9" Deep
D4	1117/1139	66	77.9	Sunny	4	0" Penetration 15" Deep
E2	1127/1140	70	77.9	Sunny	5	4" Penetration 20" Deep
E3	1130/1142	76	77.9	Sunny	6	0" Penetration 16" Deep
F2	1310/1338	70	83.3	Sunny	1	2" Penetration 22" Deep
F3	1315/1340	70	83.3	Sunny	2	2" Penetration 17" Deep
F4	1321/1341	60	83.3	"	3	1" Penetration 22" Deep
G1	1337/1343	72	83.3	"	4	3" Penetration 24" Deep
G2	1329/1341	69	83.3	"	5	3" Penetration 24" Deep

TABLE 4-31 (Continued)

LOCATION	TIME (INSERT/ REMOVAL)	SOIL TEMP (°F)	MET STA. AIR TEMP$^{(a)}$ (°F)	WEATHER	PROBE	OTHER OBSERVATIONS
G3	1327/1342	72	83.3	"	6	3" Penetration 24" Deep
G4	1345/1415	61	83.3	"	1	In Shade 4" Penetration 24" Deep
H1	1353/1420	71	83.3	"	2	4" Penetration 24" Deep
H2	1356/1419	70	83.3	"	3	0" Penetration 20" Deep
H3	1402/1417	67	83.3	"	4	2" Penetration 22" Deep
H4	1406/1415	69	83.3	"	5	In Shade 1" Penetration 19" Deep
I1	1411/1422	68	83.3	"	6	4" Penetration 24" Deep
I2	1427/1520	71	84.5	"	1	0" Penetration 10" Deep
I3	1437/1520	70	84.5	"	2	0" Penetration 20" Deep
I4	1441/1521	70	84.5	"	3	6" Penetration 21" Deep
J1	1450/1526	76	84.5	"	4	1" Penetration 22" Deep
J2	1451/1524	70	84.5	"	5	
J3	1500/1542	71	84.8	"	6	
J4	1527/1543	74	84.8	"	1	0" Penetration 12" Deep
J5	1532/1541	80	84.8	"	2	0" Penetration 8" Deep
K1			84.8			Bedrock
K2	1545/1604	76	84.8	"	6	0" Penetration 14" Deep

TABLE 4-31 (Continued)

LOCATION	TIME (INSERT/ REMOVAL)	SOIL TEMP (°F)	MET STA. AIR TEMP(a) (°F)	WEATHER	PROBE	OTHER OBSERVATIONS
K3	1542/1602	69	84.8	"	5	3" Penetration 12" Deep
K4	1541/1600	82.5	84.8	"	4	4" Penetration 24" Deep
K5	1535/1543	76	84.8	"	3	0" Penetration 12" Deep
L2	1552/1606	74	84.8	"	1	1" Penetration 12" Deep
L3	1553/1607	71	84.8	"	3	0.5" Penetration 15" Deep
L4	1555/1608	71	84.8	"	2	1" Penetration 15" Deep
L5	1609/1640	69	83.0	"	1	0" Penetration 18" Deep
L6	1611/1642	71	83.0	"	2	2" Penetration 18" Deep
M2	1700/1714	80	83.0	"	1	0" Penetration 18" Deep
M3	1627/1647	73	83.0	"	6	0" Penetration 12" Deep
M4	1625/1646	70	83.0	"	5	0" Penetration 18" Deep
M5	1615/1645	70	83.8	"	4	0" Penetration 11" Deep
M6	1615/1644	78	83.0	"	3	0" Penetration 10" Deep
N2	1707/1715	77	83.0	"	2	0" Penetration 16" Deep
N3	1710/1716	73	83.0	"	3	0" Penetration 15" Deep
N4	1711/1717	71	83.0	"	4	2" Penetration 18" Deep
N5	1718/1725	74	83.0	"	5	In Shade 0" Penetration 18" Deep

TABLE 4-31 (Continued)

LOCATION	TIME (INSERT/ REMOVAL)	SOIL TEMP (°F)	MET STA. AIR TEMP(3) (°F)	WEATHER	PROBE	OTHER OBSERVATIONS
02	1725/1730	75	83.0	"	3	8" Penetration 18" Deep
03	1722/1728	73	83.8	"	2	In Shade 0" Penetration 13" Deep
04	1721/1727	67	83.0	"	1	In Shade 2" Penetration 14" Deep
05	1720/1726	77	83.0	"	6	In Shade 0" Penetration 15" Deep

(3) Air temperature at the time of probe removal at nearest hourly reading.

TABLE 4-32
EXTRACTIVE SOIL GAS SURVEY RESULTS (AUGUST 15-16, 1990)

Location ID	Grid Location	OVA ppm	H2S ppm	HNu ppm
A	1200N, 400E	BKG	BKG	BKG
B	1000N, 500E	50	BKG	BKG
C	800N, 500E	>10000	BKG	BKG
D	800N, 400E	20	BKG	BKG
E	800N, 560E	>10000	BKG	BKG
F	700N, 500E	7	BKG	BKG
G	700N, 600E	180	BKG	BKG
H	600N, 600E	250	BKG	BKG
I	500N, 600E	200	BKG	4
J	500N, 400E	BKG	12	BKG
K	500N, 200E	12	BKG	BKG
L	400N, 200E	900	BKG	9
M	300N, 200E	BKG	61	BKG
N	300N, 300E	7	BKG	BKG
O	300N, 100E	BKG	6	BKG
P	200N, 100E	BKG	57	BKG
Q	200N, 200E	BKG	BKG	BKG
R	100N, [illegible]00E	9000	3	BKG
S	0N, 300E	100	11	BKG
T	100N, 300E	300	BKG	BKG
U	200N, 400E	100	BKG	BKG
V	200N, 500E	14	BKG	BKG
W	300N, 500E	40	BKG	BKG
X	400N, 500E	2500	BKG	BKG
Y	400N, 400E	500	8	BKG
Z	600N, 400E	70	BKG	BKG
13	500N, 300E	350	BKG	BKG
14	600N, 300E	550	BKG	BKG
15	600N, 500E	300	BKG	BKG
16	500N, 500E	19	BKG	BKG
17	400N, 300E	20	BKG	BKG
18	300N, 400E	35	BKG	BKG
19	100N, 400E	30	BKG	BKG
20	0N, 400E	35	5	4
21	0N, 200E	BKG	BKG	BKG
22	0N, 100E	BKG	BKG	BKG
23	100N, 200E	11	BKG	9
24	200N, 300E	16	BKG	BKG
25	100N, 480E	BKG	BKG	BKG
26	300N, 550E	BKG	BKG	BKG
27	400N, 575E	BKG	BKG	BKG
28	700N, 300E	BKG	BKG	BKG
29	700N, 400E	175	BKG	BKG
30	800N, 300E	6	BKG	BKG
31	900N, 500E	>10000	BKG	BKG
32	900N, 400E	1100	BKG	BKG
33	900N, 300E	800	BKG	BKG
34	1000N, 300E	BKG	BKG	2
35	1100E, 300E	BKG	BKG	BKG
36	1000N, 400E	BKG	BKG	BKG
37	1100N, 400E	BKG	BKG	BKG
38	1100N, 500E	BKG	BKG	BKG
39	1200N, 300E	BKG	BKG	BKG
40	1300N, 300E	BKG	BKG	BKG
41	1300N, 400E	BKG	BKG	BKG
42	1400N, 400E	BKG	BKG	BKG
43	1400N, 300E	BKG	BKG	BKG

TABLE 4-33 PHOTOVAC GC RESULTS FROM EXTRACTIVE GAS SURVEY (ppb)
August 15-16, 1990

Location ID	Methylene Chloride	Benzene	Toluene	Trans-Dichloro Ethylene	Trichloro Ethylene	Ethyl Benzene	Perchloro Ethylene
A	0.41	0.04					
B			0.59				
C			0.05				
E	1.10						
G	1.25	0.03					
H				0.03	0.03		
I	4.21	0.06		0.04			
J	0.72	0.01		0.01			
K	0.45			0.14		0.07	
L		0.06					0.01
M	0.55			0.10		0.01	
N	1.45			0.08			
O	0.70			0.10		0.01	
P	1.04			0.12			
Q	1.15	0.06	0.01	0.09			
R	1.19	0.06	0.01	0.13			
S	0.39			0.08			
T	0 68			0.04		0.02	
U	1.34			0.06			
V	0.43			0.06			
W	0.44			0.09		0.01	
X	0.50			0.02		0.01	
Y	2.26		0.03			0.06	0.01
Z	0.63	0.01	0.02		0.02	0.10	0.01
13	1.29	0.05				0.01	
14	1.60	0.03		0.05		0.10	
15	0.40					0.02	
16	0.53	0.01					

TABLE 4-33 (Continued)

Location ID	Methylene Chloride	Benzene	Toluene	Trans-Dichloro Ethylene	Trichloro Ethylene	Ethyl Benzene	Perchloro Ethylene
17	0.31						
18	0.35					0.01	
19	0.40						
20	1.01	0.20	0.08	0.23			
21	0.41				0.01	0.09	
22	0.41						
23	0.34						
24	0.43			0.10			
25	0.47			0.08			
26	0.46			0.05			
27	0.53			0.19			
28	0.49	0.03		0.24			
29	0.62	0.03		0.24			
30	0.51	0.03		0.25		0.02	
31	0.48	0.02		0.18		0.06	
32	0.67			0.53			
33	0.65	0.05		0.43		0.01	
34	0.45			0.17		0.01	
35	0.58	0.06		0.22		0.02	
36	0.56	0.05		0.19			
37	0.64						
38	0.64						
39	0.64	0.04		0.34			
40	0.65						
41	0.66	0.06		0.25			
42				0.58		0.12	
43	0.24						

TABLE 4 - 34
SWEEP GAS SURVEY RESULTS (October 3-4, 1990)

Location ID	Grid Location	OVA ppm	H2S ppm	HNu ppm
I	600N, 300E	400	BKG	BKG
II	600N, 360E	6500	BKG	BKG
III	560N, [illegible]80E	>10000	BKG	BKG
IV	500N, 320E	2500	BKG	BKG
V	450N, 440E	100	BKG	BKG
VI	400N, 480E	600	BKG	BKG
VII	340N, 500E	65	BKG	BKG
VIII	300N, 420E	250	BKG	BKG
IX	300N, 360E	1000	3	4
X	200N, 400E	45	BKG	BKG
XI	200N, 480E	125	BKG	BKG
XII	260N, 100E	>10000	115	9
XIII	160N, 100E	3.5	BKG	BKG
XIV	300N, 120E	210	BKG	BKG
XV	400N, 160E	650	BKG	BKG
XVI	440N, 200E	100	BKG	BKG
XVII	480N, 200E	300	BKG	BKG
XVIII	520N, 200E	1500	BKG	BKG
XIX	500N, 240E	17	BKG	BKG
XX	450N, 230E	31	BKG	BKG
XXI	350N, 300E	20	BKG	BKG
XXII	300N, 240E	4	BKG	BKG
XXIII	240N. 200E	200	BKG	BKG
(IV	240N, 300E	9	BKG	BKG
XV	200N, 340E	3	BKG	BKG

TABLE 4-35 PHOTOVAC GC RESULTS FROM SWEEP GAS SURVEY (ppb)
October 3-4, 1990

Location ID	Methylene Chloride	Benzene	Toluene	Trans-Dichloro Ethylene	Trichloro Ethylene	Ethyl Benzene	Perchloro Ethylene
I							0.03
II							0.06
III					0.03	0.03	0.07
IV	0.27						
V	0.08		0.01				0.02
VI	2.05					0.04	
VII	1.38		0.06			0.24	
VIII	ND						
IX			0.02		0.02	0.03	0.09
X	1.47	0.03			0.11		
XI	1.59		0.07				0.14
XII		0.28	0.01		0.06	0.15	0.03
XIII					0.12	0.09	0.04
XIV						0.03	0.01
XV					0.04	0.03	
XVI	ND						
XVII					0.03	0.02	
XVIII					0.05		0.02
XIX	ND						
XX	1.49						
XXI	1.03		0.35				
XXII	1.75		0.05			0.26	0.05
XXIII	0.04		0.02			0.26	0.08
XXIV						0.02	0.04
XXV						0.01	0.03

TABLE 4-36
FLUX CHAMBER EMISSION RESULTS (OCTOBER 4, 1990)

(ug/m^2/min)

Compound	Site II 600 N 360 E	Site III 520 N 120 E	Site IX 300 N 360 E
Benzene	1.04	1.02	0.51
Dichlorodifluoromethane	0.14	0.13	0.14
Methylene Chloride	0.46	1.13	0.34
o,m + p Xylenes	0.08	0.12	0.08
Toluene	0.52	0.53	0.37
Trichloroethene	0.27	0.27	0.21
1,1,1-Trichloroethane	0.15	1.00	0.18
1,1-Dichloroethene	0.09	0.00	0.08
Trichlorofluoromethane	0.00	0.00	0.15
Methane	134	115	77
Non-Methane Hydrocarbon	77	19	346
Carbon Dioxide	42097	31256	879803

TABLE 4-37

FLUX CHAMBER EMISSION RESULTS (OCTOBER 18, 1990)

$(ug/m^2/min)$

Compound	Embankment Near Wells RI-2 & MW-6	Manhole 260 N 150 E	Blowhole Near Route 17
Benzene	2.12	1.24	1.50
Dichlorodifluoromethane	ND	0.18	ND
Ethyl Benzene	1.09	4.08	0.24
Freon 113	44.97	ND	ND
Methylene Chloride	2.72	0.49	0.71
m + p Xylenes	3.23	0.56	0.42
o Xylenes	1.07	0.27	0.20
Styrene	2.17	ND	ND
Toluene	9.14	1.42	1.47
Trichloroethene	ND	0.38	0.44
1,1,1-Trichloroethane	4.70	0.21	0.26
Trichlorofluoromethane	241.77	ND	0.15
Vinyl Chloride	ND	0.03	ND
1,4 Dichlorobenzene	ND	0.10	ND
1,2,4 Trimethylbenzene	ND	0.25	ND
Methane	1440	13851	7123
Non-Methane Hydrocarbons	442	154	192
Carbon Dioxide	1005318	214495	124459

TABLE 4-38
HYDROGEN SULFIDE AMBIENT AIR MONITORING RESULTS

SAMPLING LOCATION	CONCENTRATION (µg/m3)
I 100 E, 50 N	< 1.63
II 280 E, 30 N	< 1.59
III 420 E, 30 N	< 1.52
IV 300 E, 1000 N	< 1.73
V 500 E, 1000 N	< 1.48
VI 600 N, Across Railroad Tracks	< 1.66
VII Police Station 1.4 M South	< 1.60
VIII IGA Grocery 1.6 M South	< 1.72
IX Gatehouse Antiques 1.7 M South	1.91
X Duck Cedar Inn 0.1 M North	2.88

TABLE 4-39
FIELD DUPLICATE RESULTS IN μG/L (PPB)

Parameter	GW-MW-06-1090	GW-MW-08-1090	Relative Percent Difference
Pesticides/PCBs:	ND	ND	--
Semi-volatile Organics:	ND	ND	--
Volatile Organics:			
Benzene	ND	0.5 J	--
Metals:			
Aluminum	1,240	1,120	10.2 %
Arsenic	10	10	0.0 %
Barium	156	150	3.9 %
Cadmium	21	16	27.0 %
Calcium	285,000	276,000	3.2 %
Chromium	14	15	6.9 %
Iron	31,800	30,400	4.5 %
Lead	4.0	6.0	40.0 % *
Magnesium	91,500	88,500	3.3 %
Manganese	12,900	12,500	3.2 %
Nickel	60	128	72.3 % *
Potassium	34,900	33,500	4.1 %
Sodium	142,000	137,000	3.6 %
Zinc	61	53	14.0

	GW-RI-02-0191	GW-RI-06-0191	Relative Percent Difference
Volatile Organics			
Chloroform	0.9 J	0.8 J	11.8 %
Metals:			
Aluminum	316.	297.	6.2 %
Calcium	41,300.	40,900.	1.0 %
Copper	49.	48.	2.1 %
Iron	795.	714.	10.7 %
Magnesium	10,400.	10,300.	1.0 %
Manganese	871.	866.	0.6 %
Nickel	60.	55.	8.7 %
Potassium	1.870.	1,810	3.3 %
Sodium	25,800.	25,300.	2.0 %
Zinc	45.	44.	2.3 %

Notes:

Acceptable precision is relative percent difference of 30%, or absolute difference of twice the Contract Required Detection Limit (CRDL) if values are less than five times the CRDL (*).

ND	Not detected
--	Not calculated

TABLE 4-40

TUKEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB 3	37.84	47.84	5	9.99	6.75	13.50	22.0	0.125	41.690	47.09	8.511	1	3.689	47.853	2600.013	47.7415	
RIB 3	37.84	42.84	5	9.99	6.75	12.90	22.0	0.125	38.486	47.09	7.857	1	3.689	49.362	2484.456	44.2253	
RIB 3	37.84	42.84	5	9.99	6.75	13.50	22.0	0.125	41.690	47.09	8.511	1	3.689	47.853	2600.013	47.7415	
RIB 3	37.84	42.84	5	9.99	6.75	11.50	22.0	0.125	31.010	47.09	6.331	1	3.689	52.883	2214.825	36.8010	
RIB 3	37.84	42.84	5	9.99	6.75	13.00	22.0	0.125	39.020	47.09	7.966	1	3.689	49.111	2503.716	44.7963	
RIB 3	37.84	42.84	5	9.99	6.75	13.10	26.0	0.125	39.554	47.09	8.075	1	3.689	58.086	2522.975	38.1641	
RIB 3	37.84	42.84	5	9.99	6.75	13.00	26.5	0.125	39.020	47.09	7.966	1	3.689	59.490	2503.716	36.9804	
RIB 3	37.84	42.84	5	9.99	6.75	13.30	26.5	0.125	40.622	47.09	8.293	1	3.689	58.736	2561.494	38.3197	39.8259
RIB 3	37.84	42.84	5	9.99	6.75	13.00	26.0	0.125	39.020	47.09	7.966	1	3.689	58.357	2503.716	37.7115	
RIB 3	37.84	42.84	5	9.99	6.75	12.75	26.0	0.125	37.952	47.09	7.748	1	3.689	58.840	2455.567	36.6701	
RIB 3	37.84	42.84	5	9.99	6.75	11.40	22.0	0.125	31.010	47.09	6.331	1	3.689	52.883	2195.566	36.4810	
RIB 3	37.84	42.84	5	9.99	6.75	12.10	22.0	0.125	34.214	47.09	6.985	1	3.689	51.374	2330.382	39.8583	
RIB 3	37.84	42.84	5	9.99	6.75	11.60	22.0	0.125	31.544	47.09	6.440	1	3.689	52.631	2234.085	37.2984	
RIB 3	37.84	42.84	5	9.99	6.75	11.60	22.0	0.125	31.544	47.09	6.440	1	3.689	52.631	2234.085	37.2984	
RIB 3	37.84	42.84	5	9.99	6.75	11.60	22.0	0.125	31.544	47.09	6.440	1	3.689	52.651	2234.085	37.2984	
RIB 3	42.84	47.84	5	9.99	1.75	3.50	23.0	0.125	3.355	47.09	0.685	1	3.689	63.212	674.077	9.3701	
RIB 3	42.84	47.84	5	9.99	1.75	3.60	23.0	0.125	3.526	47.09	0.720	1	3.689	63.131	693.337	9.6501	
RIB 3	42.84	47.84	5	9.99	1.75	3.60	23.0	0.125	3.526	47.09	0.720	1	3.689	63.131	693.337	9.6501	
RIB 3	42.84	47.84	5	9.99	1.75	3.30	24.0	0.125	3.013	47.09	0.615	1	3.689	65.680	635.559	8.5027	
RIB 3	42.84	47.84	5	9.99	1.75	3.30	23.0	0.125	3.013	47.09	0.615	1	3.689	63.373	635.559	8.8122	
RIB 3	42.84	47.84	5	9.99	1.75	3.60	28.0	0.125	3.526	47.09	0.720	1	3.689	74.664	693.337	8.1595	

Table 4-40, cont'd

TUXEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB-3	42.84	47.84	5	9.99	1.75	3.50	27.5	0.125	3.355	47.09	0.685	1	3.689	73.592	674.077	8.0485	
RIB-3	42.84	47.84	5	9.99	1.75	3.50	28.0	0.125	3.355	47.09	0.685	1	3.689	74.745	674.077	7.9243	8.2479
RIB-3	42.84	47.84	5	9.99	1.75	3.50	28.0	0.125	3.355	47.09	0.685	1	3.689	74.745	674.077	7.9243	
RIB-3	42.84	47.84	5	9.99	1.75	3.50	28.0	0.125	3.355	47.09	0.685	1	3.689	74.745	674.077	7.9243	
RIB-3	42.84	47.84	5	9.99	1.75	2.90	23.0	0.125	2.371	47.09	0.484	1	3.689	63.675	558.571	7.7073	
RIB-3	42.84	47.84	5	9.99	1.75	2.80	23.0	0.125	2.242	47.09	0.458	1	3.689	63.736	539.262	7.4344	
RIB-3	42.84	47.84	5	9.99	1.75	2.30	23.0	0.125	1.597	47.09	0.326	1	3.689	64.040	442.965	6.0779	
RIB-3	42.84	47.84	5	9.99	1.75	3.50	23.0	0.125	3.355	47.09	0.685	1	3.689	63.212	674.077	9.3701	
RIB-3	42.84	47.84	5	9.99	1.75	2.70	23.0	0.125	2.113	47.09	0.431	1	3.689	63.797	520.003	7.1621	
RIB-3	47.84	52.84	5	9.99	7.78	7.15	25.0	0.125	13.459	58.12	3.442	1	3.689	67.496	1377.044	17.9267	
RIB-3	47.84	52.84	5	9.99	7.78	6.75	28.0	0.125	12.325	58.12	3.106	1	3.689	75.192	1300.006	15.1918	
RIB-3	47.84	52.84	5	9.99	7.78	6.30	28.0	0.125	10.657	58.12	2.685	1	3.689	76.161	1213.339	13.9985	
RIB-3	47.84	52.84	5	9.99	7.78	6.60	27.5	0.125	11.658	58.12	2.937	1	3.689	74.426	1271.117	15.0070	
RIB-3	47.84	52.84	5	9.99	7.78	6.00	28.0	0.125	9.656	58.12	2.433	1	3.689	76.743	1155.561	13.2309	
RIB-3	47.84	52.84	5	9.99	7.78	6.00	28.0	0.125	9.656	58.12	2.433	1	3.689	76.743	1155.561	13.2309	
RIB-3	47.84	52.84	5	9.99	7.78	7.00	32.0	0.125	12.992	58.12	3.274	1	3.689	84.030	1348.155	14.0973	
RIB-3	47.84	52.84	5	9.99	7.78	7.20	31.0	0.125	13.659	58.12	3.442	1	3.689	81.336	1386.673	14.9805	
RIB-3	47.84	52.84	5	9.99	7.78	7.30	32.0	0.125	13.993	58.12	3.526	1	3.689	83.449	1405.933	14.8040	14.9426
RIB-3	47.84	52.84	5	9.99	7.78	7.40	32.0	0.125	14.326	58.12	3.610	1	3.689	83.255	1425.192	15.0417	
RIB-3	47.84	52.84	5	9.99	7.78	7.20	32.0	0.125	13.659	58.12	3.442	1	3.689	83.642	1386.673	14.5674	
RIB-3	47.84	52.84	5	9.99	7.78	6.90	29.0	0.125	12.658	58.12	3.190	1	3.689	77.304	1328.895	15.1050	
RIB-3	47.84	52.84	5	9.99	7.78	4.70	28.5	0.125	5.687	58.12	1.433	1	3.689	80.203	905.190	9.9171	
RIB-3	47.84	52.84	5	9.99	7.78	5.64	28.5	0.125	8.322	58.12	2.097	1	3.689	78.672	1086.227	12.1321	

Table 4-40, cont'd

TUXEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB-3	47.84	52.84	5	9.99	7.78	5.75	28.0	0.125	8.989	58.12	2.265	1	3.689	77.131	1107.413	12.6159	
RIB-3	47.84	52.84	5	9.99	7.78	5.70	28.5	0.125	8.655	58.12	2.181	1	3.689	78.478	1097.783	12.2915	
RIB-4	18.13	23.13	NO FLOW AT 15 OR 20 PSI														
RIB-5	42.25	47.75	5	10.12	1.85	5.10	26.0	0.125	6.654	47.10	1.359	1	3.689	56.838	982.227	15.1848	
RIB-5	42.25	47.75	5	10.12	1.85	4.85	26.0	0.125	6.109	47.10	1.247	1	3.689	69.064	934.079	11.8840	
RIB-5	42.25	47.75	5	10.12	1.85	4.65	29.0	0.125	5.687	47.10	1.161	1	3.689	76.183	895.560	10.3293	
RIB-5	42.25	47.75	5	10.12	1.85	2.70	26.0	0.125	2.113	47.10	0.431	1	3.689	70.946	520.003	6.4403	
RIB-5	42.25	47.75	5	10.12	1.85	3.10	26.0	0.125	2.671	47.10	0.545	1	3.689	70.684	597.040	7.4220	
RIB-5	42.25	47.75	5	10.12	1.85	4.45	31.0	0.125	5.265	47.10	1.075	1	3.689	80.995	857.041	9.2978	
RIB-5	42.25	47.75	5	10.12	1.85	4.45	31.0	0.125	5.265	47.10	1.075	1	3.689	80.995	857.041	9.2978	
RIB-5	42.25	47.75	5	10.12	1.85	4.50	31.0	0.125	5.265	47.10	1.075	1	3.689	80.995	866.671	9.4022	9.5880
RIB-5	42.25	47.75	5	10.12	1.85	4.55	31.0	0.125	5.476	47.10	1.118	1	3.689	80.895	876.301	9.5184	
RIB-5	42.25	47.75	5	10.12	1.85	4.45	31.0	0.125	5.265	47.10	1.075	1	3.689	80.995	857.041	9.2978	
RIB-5	42.25	47.75	5	10.12	1.85	3.90	26.0	0.125	4.039	47.10	0.825	1	3.689	70.039	751.115	9.4237	
RIB-5	42.25	47.75	5	10.12	1.85	3.70	26.0	0.125	3.697	47.10	0.755	1	3.689	70.200	712.596	8.9194	
RIB-5	42.25	47.75	5	10.12	1.85	3.85	26.0	0.125	4.039	47.10	0.825	1	3.689	70.039	741.485	9.3024	
RIB-5	42.25	47.75	5	10.12	1.85	3.75	26.0	0.125	3.868	47.10	0.790	1	3.689	70.120	722.226	9.0504	
RIB-5	42.25	47.75	5	10.12	1.85	3.75	26.0	0.125	3.868	47.10	0.790	1	3.689	70.120	722.226	9.0504	
RIB-5	47.75	52.75	5	10.12	7.75	2.55	28.0	0.125	1.984	58.00	0.499	1	3.689	81.304	491.113	5.3077	
RIB-5	47.75	52.75	5	10.12	7.75	2.15	28.0	0.125	1.468	58.00	0.369	1	3.689	81.603	414.076	4.4587	
RIB-5	47.75	52.75	5	10.12	7.75	2.10	28.0	0.125	1.339	58.00	0.337	1	3.689	81.678	404.446	4.3510	

Table 4-40, cont'd

TUXEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB-5	47.75	52.75	5	10.12	7.75	2.12	28.0	0.125	1.339	58.00	0.337	1	3.689	81.678	408.298	4.3924	
RIB-5	47.75	52.75	5	10.12	7.75	2.08	28.0	0.125	1.339	58.00	0.337	1	3.689	81.678	400.595	4.3096	
RIB-5	47.75	52.75	5	10.12	7.75	2.45	33.0	0.125	1.855	58.00	0.466	1	3.689	92.912	471.854	4.4624	
RIB-5	47.75	52.75	5	10.12	7.75	2.44	33.0	0.125	1.726	58.00	0.434	1	3.689	92.987	469.928	4.4446	
RIB-5	47.75	52.75	5	10.12	7.75	2.51	33.0	0.125	1.855	58.00	0.466	1	3.689	92.912	483.410	4.5717	4.3577
RIB-5	47.75	52.75	5	10.12	7.75	2.45	33.0	0.125	1.855	58.00	0.466	1	3.689	92.912	471.854	4.4624	
RIB-5	47.75	52.75	5	10.12	7.75	2.45	33.0	0.125	1.855	58.00	0.466	1	3.689	92.912	471.854	4.4624	
RIB-5	47.75	52.75	5	10.12	7.75	2.00	28.0	0.125	1.210	58.00	0.304	1	3.689	81.753	385.187	4.1400	
RIB-5	47.75	52.75	5	10.12	7.75	2.00	28.0	0.125	1.210	58.00	0.304	1	3.689	81.753	385.187	4.1400	
RIB-5	47.75	52.75	5	10.12	7.75	1.90	28.0	0.125	1.115	58.00	0.280	1	3.689	81.808	365.928	3.9304	
RIB-5	47.75	52.75	5	10.12	7.75	1.90	28.0	0.125	1.115	58.00	0.280	1	3.689	81.808	365.928	3.9304	
RIB-5	47.75	52.75	5	10.12	7.75	1.90	28.0	0.125	1.115	58.00	0.280	1	3.689	81.808	365.928	3.9304	
RIB-5	52.75	57.75	5	10.12	2.75	0.35	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	67.408	0.7217	
RIB-5	52.75	57.75	5	10.12	2.75	0.31	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	59.704	0.6392	
RIB-5	52.75	57.75	5	10.12	2.75	0.29	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	55.852	0.5980	
RIB-5	52.75	57.75	5	10.12	2.75	0.35	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	67.408	0.7217	
RIB-5	52.75	57.75	5	10.12	2.75	0.33	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	63.556	0.6805	
RIB-5	52.75	57.75	5	10.12	2.75	0.35	35.0	0.125	0.000	58.00	0.000	1	3.689	93.601	67.408	0.6328	
RIB-5	52.75	57.75	5	10.12	2.75	0.36	35.0	0.125	0.000	58.00	0.000	1	3.689	93.601	69.334	0.6509	
RIB-5	52.75	57.75	5	10.12	2.75	0.36	35.0	0.125	0.000	58.00	0.000	1	3.689	93.601	69.334	0.6509	0.6370
RIB-5	52.75	57.75	5	10.12	2.75	0.33	35.0	0.125	0.000	58.00	0.000	1	3.689	93.601	63.556	0.5966	
RIB-5	52.75	57.75	5	10.12	2.75	0.37	35.0	0.125	0.000	58.00	0.000	1	3.689	93.601	71.260	0.6690	
RIB-5	52.75	57.75	5	10.12	2.75	0.31	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	59.704	0.6392	

Table 4-40, cont'd

TUXEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	Ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB-5	52.75	57.75	5	10.12	2.75	0.30	31.0	0.125	0.000	58.00	0.000	1	3.689	84.375	57.778	0.6017	
RIB 5	52.75	57.75	5	10.12	2.75	0.29	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	55.852	0.5980	
RIB 5	52.75	57.75	5	10.12	2.75	0.28	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	53.926	0.5774	
RIB 5	52.75	57.75	5	10.12	2.75	0.28	30.0	0.125	0.000	58.00	0.000	1	3.689	82.068	53.926	0.5774	
RIB 6	67.86	72.86	5	7.50	1.75	3.45	35.0	0.125	3.270	72.11	1.022	1	3.689	87.623	664.448	6.6631	
RIB 6	67.86	72.86	5	7.50	1.75	3.50	35.0	0.125	3.355	72.11	1.049	1	3.689	87.562	674.077	6.7644	
RIB 6	67.86	72.86	5	7.50	1.75	3.45	35.0	0.125	3.270	72.11	1.022	1	3.689	87.623	664.448	6.6631	
RIB 6	67.86	72.86	5	7.50	1.75	3.50	34.0	0.125	3.355	72.11	1.049	1	3.689	85.255	674.077	6.9474	
RIB 6	67.86	72.86	5	7.50	1.75	3.45	34.0	0.125	3.270	72.11	1.022	1	3.689	85.317	664.448	6.8432	
RIB 6	67.86	72.86	5	7.50	1.75	4.35	40.0	0.125	4.949	72.11	1.547	1	3.689	97.946	837.782	7.5159	
RIB-6	67.86	72.86	5	7.50	1.75	4.30	40.0	0.125	4.843	72.11	1.514	1	3.689	98.022	828.152	7.4237	
RIB-6	67.86	72.86	5	7.50	1.75	4.15	40.0	0.125	4.527	72.11	1.415	1	3.689	98.250	799.263	7.1481	7.0720
RIB-6	67.86	72.86	5	7.50	1.75	4.30	40.0	0.125	4.843	72.11	1.514	1	3.689	98.022	828.152	7.4237	
RIB-6	67.86	72.86	5	7.50	1.75	4.20	40.0	0.125	4.632	72.11	1.448	1	3.689	98.174	808.893	7.2398	
RIB-6	67.86	72.86	5	7.50	1.75	3.70	35.0	0.125	3.697	72.11	1.156	1	3.689	87.315	712.596	7.1711	
RIB-6	67.86	72.86	5	7.50	1.75	3.60	35.0	0.125	3.526	72.11	1.102	1	3.689	87.438	693.337	6.9675	
RIB-6	67.86	72.86	5	7.50	1.75	3.70	35.0	0.125	3.697	72.11	1.156	1	3.689	87.315	712.596	7.1711	
RIB-6	67.86	72.86	5	7.50	1.75	3.70	35.0	0.125	3.697	72.11	1.156	1	3.689	87.315	712.596	7.1711	
RIB-6	67.86	72.86	5	7.50	1.75	3.60	35.0	0.125	3.526	72.11	1.102	1	3.689	87.438	693.337	6.9675	
RIB-7A	55.84	60.84	5	6.00	1.82	16.50	28.0	0.125	60.620	60.16	15.811	1	3.689	35.936	[illegible]	77.7019	
RIB-7A	55.84	60.84	5	6.00	1.82	16.30	28.0	0.125	59.164	60.16	15.431	1	3.689	36.812	3137.274	74.9536	
RIB-7A	55.84	60.84	5	6.00	1.82	16.30	28.0	0.125	59.164	60.16	15.431	1	3.689	36.812	3137.274	74.9536	

Table 4-40, cont'd

TUXEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB-7A	55.84	60.84	5	6.00	1.82	16.30	28.0	0.125	59.164	60.16	15.431	1	3.689	36.812	3139.274	74.9336	
RIB 7A	55.84	60.84	5	6.00	1.82	16.30	28.0	0.125	59.164	60.16	15.431	1	3.689	36.812	3139.274	74.9336	
RIB 7A	55.84	60.84	5	6.00	1.82	17.20	33.0	0.125	65.716	60.16	17.140	1	3.689	44.403	3312.609	65.5527	
RIB 7A	55.84	60.84	5	6.00	1.82	17.25	33.0	0.125	66.080	60.16	17.235	1	3.689	44.184	3322.238	66.0691	
RIB-7A	55.84	60.84	5	6.00	1.82	17.55	33.0	0.125	68.264	60.16	17.804	1	3.689	42.870	3380.016	69.2783	70.2265
RIB-7A	55.84	60.84	5	6.00	1.82	16.60	33.0	0.125	61.348	60.16	16.001	1	3.689	47.031	3197.052	59.7311	
RIB 7A	55.84	60.84	5	6.00	1.82	17.40	33.0	0.125	67.172	60.16	17.520	1	3.689	43.527	3351.127	67.6495	
RIB-7A	55.84	60.84	5	6.00	1.82	16.00	28.0	0.125	56.980	60.16	14.861	1	3.689	38.126	3081.496	71.0196	
RIB 7A	55.84	60.84	5	6.00	1.82	15.80	28.0	0.125	55.524	60.16	14.482	1	3.689	39.002	3042.978	68.5567	
RIB-7A	55.84	60.84	5	6.00	1.82	15.90	28.0	0.125	56.252	60.16	14.671	1	3.689	38.564	3062.237	69.7742	
RIB-7A	55.84	60.84	5	6.00	1.82	15.80	28.0	0.125	55.524	60.16	14.482	1	3.689	39.002	3042.978	68.5567	
RIB 7A	55.84	60.84	5	6.00	1.82	15.90	28.0	0.125	56.252	60.16	14.671	1	3.689	38.564	3062.237	69.7742	
RIB 7A	60.84	65.84	5	6.00	1.86	0.25	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	48.148	0.5490	
RIB-7A	60.84	65.84	5	6.00	1.86	0.23	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	44.297	0.5051	
RIB-7A	60.84	65.84	5	6.00	1.86	0.22	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	42.371	0.4831	
RIB-7A	60 84	65.84	5	6.00	1.86	0.24	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	46.222	0.5271	
RIB-7A	60.84	65.84	5	6.00	1.86	0.24	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	46.222	0.5271	
RIB-7A	60.84	65.84	5	6.00	1.86	0.60	35.0	0.125	0.000	65.20	0.000	1	3.689	88.591	115.556	1.1461	
RIB-7A	60.84	65.84	5	6.00	1.86	0.59	35.0	0.125	0.000	65.20	0.000	1	3.689	88.591	113.630	1.1270	
RIB-7A	60.84	65.84	5	6.00	1.86	0.65	35.0	0.125	0.000	65.20	0.000	1	3.689	88.591	125.186	1.2416	0.7721
RIB 7A	60.84	65.84	5	6.00	1.86	0.67	35.0	0.125	0.000	65.20	0.000	1	3.689	88.591	129.038	1.2799	
RIB-7A	60.84	65.84	5	6.00	1.86	0.69	35.0	0.125	0.000	65.20	0.000	1	3.689	88.591	132.890	1.3181	
RIB 7A	60.84	65.84	5	6.00	1.86	0.25	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	48.148	0.5490	

Table 4-40, cont'd

TUXEDO WASTE DISPOSAL SITE
PACKER TEST DATA REDUCTION

BORING	TEST INTERVAL FROM (ft)	TO (ft)	TEST LENGTH (ft)	DEPTH TO WATER (ft)	GAGE HEIGHT (ft)	TOTAL TAKE (gallons)	GAGE PRESSURE (psi)	RADIUS OF HOLE (ft)	FRICTION LOSS (ft)	LENGTH OF PIPE (ft)	FRICTION LOSS (psi)	TEST TIME (min)	Ln(L/r)	TOTAL PRESSURE (ft)	FLOW (ft^3/day)	HYDRAULIC CONDUCTIVITY (g/d/ft^2)	AVERAGE HYDRAULIC CONDUCTIVITY (OVER 15 MINUTES) (g/d/ft^2)
RIB 7A	60.84	65.84	5	6.00	1.86	0.26	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	50.074	0.5710	
RIB 7A	60.84	65.84	5	6.00	1.86	0.29	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	55.852	0.6369	
RIB 7A	60.84	65.84	5	6.00	1.86	0.27	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	52.000	0.5930	
RIB 7A	60.84	65.84	5	6.00	1.86	0.24	30.0	0.125	0.000	65.20	0.000	1	3.689	77.058	46.222	0.5271	

SECTION 5

5.0 NATURE AND EXTENT OF CONTAMINATION

This section includes a summary and interpretation of the analytical results of groundwater, surface water and sediment, and soil samples, as well as soil gas and air monitoring data, collected during the Phase II Investigation performed by Lawler, Matusky and Skelly Engineers and the Phase I Remedial Investigation conducted by Metcalf and Eddy.

Chemical data for groundwater and surface water and air monitoring data from the two investigations have been compared to current regulatory levels including Ambient Water and Air Quality Standards and New York State Maximum Contaminant Levels. The New York State Standards used include the standards and guidance values for groundwater (Class GA) and surface water (Class A) established in the NYSDEC "Technical and Operational Guidance Series (TOGS) - Ambient Water Quality Standards and Guidance Values", the standards or MCLs for drinking water supplies adopted by the New York State Department of Health (NYSDOH), and the ambient air standards and guidelines contained in NYSDEC Air Guide 1 This section also includes a survey of background groundwater and surface water conditions based on data received from the Orange County Office of Community Development and the Hackensack Water Company. NYSDEC sediment criteria guidance values were used to evaluate surface water sediment data.

The interpretations and conclusions related to groundwater and surface water quality, soil analyses, and air quality are based on the chemical data from three sampling events, one in 1988 by LMS and the second and third in 1990 and 1991 by M&E. The lack of a statistical database limits the determination of trends and limits a comprehensive assessment of the site.

Four sources of information were used to prepare this portion of the report. The first source was the LMS report submitted to NYSDEC in March 1989, which included the results of extensive sampling of several media at the Tuxedo Waste Disposal Site including groundwater, soil and the Ramapo River, as well as soil gas and air monitoring data. Another source of information was the data obtained from previous sampling events performed at and near the site by other agencies and consulting firms. This data and the LMS report were reviewed by M&E and summarized in a report entitled, "Summary NYSDEC Phase II Report and Related Information, Tuxedo Waste Disposal Site." This report was submitted to NYSDEC as part of the Project Work Plan in June 1990. The final sources of information were data obtained from sampling events performed by M&E and Alliance Technologies during the Phase I RI sampling program in late 1990 and early 1991, as part of the RI/FS.

As presented in Section 4.5, samples analyzed as part of the M&E Phase I RI conducted in 1990 included:

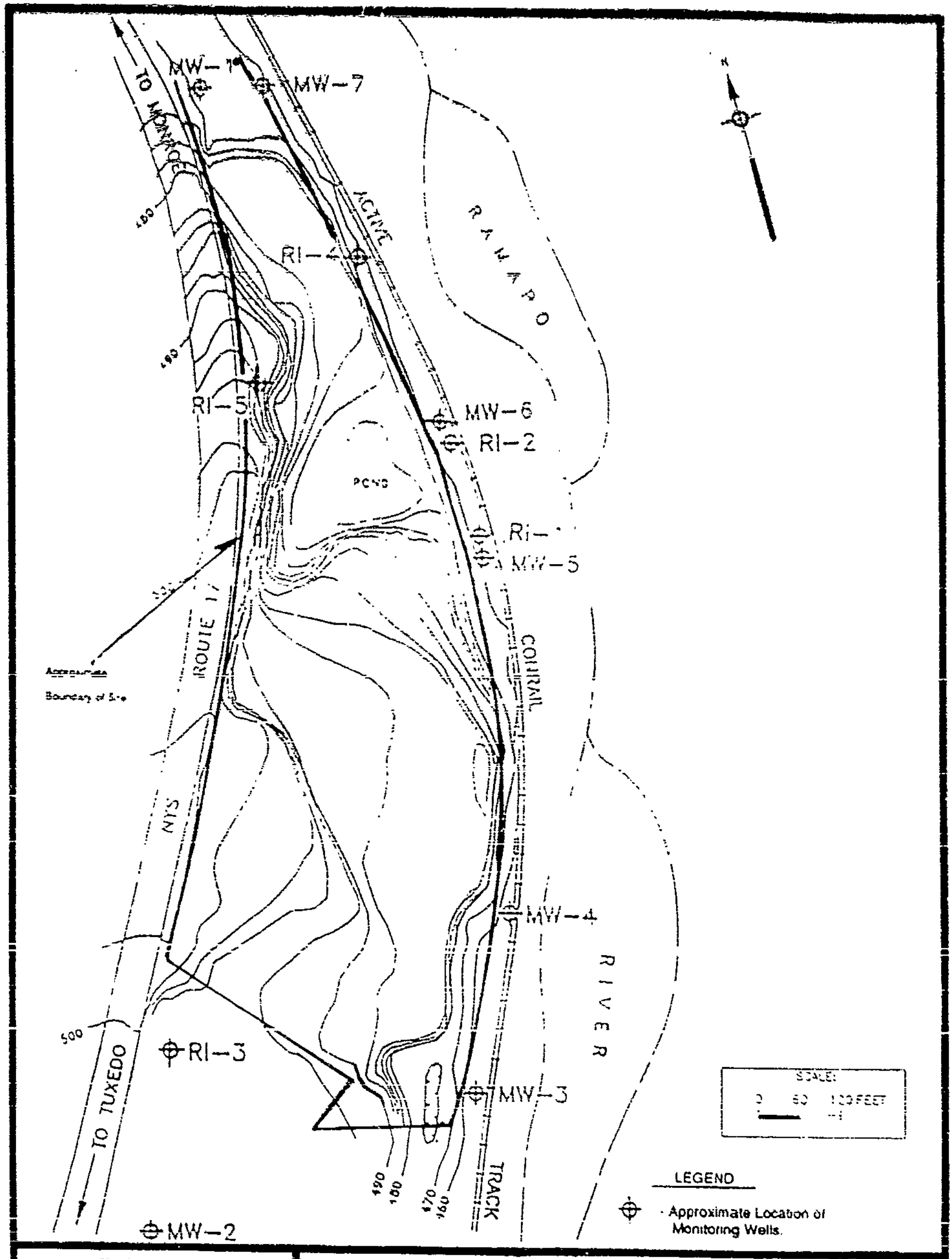
- Soil samples from borings
- Groundwater samples from monitoring wells
- Ramapo River water samples
- Ramapo River sediment samples

A second round of groundwater samples was also collected and analyzed as part of the M&E phase I RI conducted in 1991. In addition, soil gas emissions are characterized based on the Baseline Emissions Estimate field work. The soil gas survey results were presented and discussed in Section 4.11.

5.1 GROUNDWATER

Groundwater is a media of concern at the Tuxedo Landfill Waste Disposal Site because off-site groundwater wells are used for drinking water supply and groundwater is also a pathway for contaminant transport into the Ramapo River along the eastern site boundary. The antique shops north of the site, where there is a withdrawal well, are up or sidegradient to the contaminant plume from the site. As of 1988, testing indicated no contamination in this well. However, the well was not tested in 1990.

Monitoring wells were installed along the perimeter of the site as part of the Phase II Investigation by LMS and during the Phase I RI conducted by M&E as part of this RI/FS. Figure 5-1 shows the locations of these monitoring wells. These



M&E
Metcalf & Eddy

FIGURE 5-1
MONITORING WELL LOCATIONS

wells were used to determine the hydraulic (hydrogeologic) characteristics and groundwater quality beneath the site.

The first seven wells were installed by LMS during July and August of 1988 (MW-1 through MW-7). Well MW-2 is located upgradient of the site and MW-1 appears to be upgradient with respect to the direction of groundwater flow. Wells MW-3 through MW-7 are considered downgradient wells.

In July and August of 1990, M&E installed five wells (RI-1 through RI-5) to supplement the groundwater sampling data from the LMS overburden wells M&E installed a total of five upgradient and downgradient monitoring wells including two wells in competent bedrock, two spanner wells installed in fractured bedrock, and an additional downgradient overburden well. Section 3.3 of this report describes installation of these new monitoring wells. A summary of these wells is given below:

WELL	TYPE	LOCATION
RI-4	overburden	downgradient
RI-2	fractured bedrock	downgradient
RI-3	fractured bedrock	upgradient
RI-1	competent bedrock	downgradient
RI-5	competent bedrock	upgradient

In 1988, LMS sampled the original seven monitoring wells. The samples were analyzed for volatile and semi-volatile organic compounds, pesticides, PCB's and metals. In October 1990, M&E sampled the seven previously installed wells and the five newly installed wells. All of the samples were analyzed for volatile organic compounds, semi-volatile organic compounds, pesticides, PCB's and inorganic constituents (metals). In January 1991, M&E resampled some of the wells (MW-1, MW-3, MW-7 and RI-1 - RI-4). All of the samples were analyzed for volatile organic compounds and inorganic constituents (metals). The analytical results of two sampling events in 1988 were described in the LMS report; however, one of the sampling events was rejected because of a lack of data reliability. Consequently, only the results from the November 1988 LMS sampling event will be presented for comparison to the analytical results of the samples collected by M&E in October 1990, and January 1991.

5.1.1 Organic Compounds

The LMS data indicated that no volatiles, semi-volatiles or pesticides were found above the detection limits in the samples obtained from the seven monitoring wells in 1988. Tables 5-1A and 5-1B summarize the analytical results of the M&E (1990 and 1991) groundwater sampling data for organic compounds. Tables 5-1A and 5-1B list only those compounds detected in the samples and shows that no pesticides or PCB's and very few organic compounds were detected. The 1991 data was not analyzed for semi-volatile organics, pesticides or PCB's.

Figure 5-2A depicts the organic compounds found in each of M&E's monitoring wells during the 1990 sampling. Monitoring well RI-4 contained the greatest number and highest concentrations of organic contaminants. Seven semi-volatile organic compounds (phenol, naphthalene, 2-methylnapthalene, acenaphthene, dibenzofuran, fluorene and phenanthrene) and four volatile organic compounds (acetone, chloroform, methylene chloride and toluene) were detected in the sample from well RI-4 Of these compounds, phenol, napthalene and acenaphthene were found at concentrations exceeding groundwater standards and guidance values. Results are summarized below.

- Phenol was detected at a concentration (4 μg/l) exceeding its groundwater standard (1 μg/l) for well RI-4.
- Naphthalene was found at a level (12 μg/l) in contravention of its groundwater guidance value (10 μg/l) in well RI-4
- Acenaphthene was detected at a concentration (28 μg/l) in excess of its groundwater guidance value (20 μg/l) in well RI-4.
- The sample from well MW-5 contained benzene at a level (1 μg/l) that contravened its groundwater standard (Not Detectable).
- Chrysene was detected at a concentration (8 μg/l) exceeding its groundwater standard (0.002 μg/l) in the sample from well RI-3. However, RI-3 is an upgradient well.

Table 5 1A

TUXEDO LANDFILL WASTE DISPOSAL SITE

MSI (1990) GROUNDWATER MONITORING WELL SAMPLING DATA

ANALYTICAL RESULTS VOLATILE AND SEMIVOLATILE ORGANIC COMPOUNDS

	Contract	New Wells					Old Wells							NYSDEC CLASS GA	
	Detection	9 Oct 90	9-Oct 90	10 Oct 90	4 Oct 90	5 Oct 90	5 Oct 90	11 Oct 90	6 Oct 90	6 Oct 90	13 Oct 90	11 Oct 90	5 Oct 90	GROUNDWATER STANDARDS AND GUIDANCE VALUES	NYSDOH DRINKING WATER STANDARDS
	Limits	RI 1	RI 2	RI 3	RI 4	RI 5A	MW1	MW2	MW3	MW4	MW5	MW6	MW 7		
SEMIVOLATILE COMPOUNDS	ug/l	ug/L	ug/L	ug/L	ug/L	ug/l	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Phenol	10	ND	ND	ND	4 J	ND	ND	ND	ND	ND	ND	ND	ND	1 S	50
Naphthalene	10	ND	ND	ND	12	ND	ND	ND	ND	ND	ND	ND	ND	10 G	50
2 Methylnaphthalene	10	ND	ND	ND	9 J	ND	ND	ND	ND	ND	ND	ND	ND	50 S	50
Acenaphthene	10	ND	ND	ND	28	ND	ND	ND	ND	ND	ND	ND	ND	20 G	50
Dibenzofuran	10	ND	ND	ND	6 J	ND	ND	ND	ND	ND	ND	ND	ND	50 S	50
Fluorene	10	ND	ND	ND	8 J	ND	ND	ND	ND	ND	ND	ND	ND	50 G	50
Phenanthrene	10	ND	ND	ND	12	ND	ND	ND	ND	ND	ND	ND	ND	50 S	50
Chrysene	10	ND	ND	6 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	.2 G	50
Bis(2 ethylhexyl)phthalate	10	ND	ND	ND	ND	ND	ND	2 J	ND	ND	ND	ND	ND	50 S	50

	Contract	New Wells					Old Wells							NYSDEC CLASS GA	
	Detection	9-Oct 90	9-Oct-90	10-Oct 90	4 Oct-90	5 Oct 90	5 Oct 90	11 Oct 90	6 Oct 90	6 Oct 90	13 Oct 90	11 Oct 90	5 Oct 90	GROUNDWATER STANDARDS AND GUIDANCE VALUES	NYSDOH DRINKING WATER STANDARDS
	Limits	RI 1	RI 2	RI 3	RI 4	RI 5A	MW1	MW2	MW3	MW4	MW5	MW6	MW 7		
VOLATILE COMPOUNDS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Acetone	10	ND	ND	ND	32	ND	ND	4 J	ND	ND	ND	8 J	ND	50 S	50
Benzene	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	1 J	ND	ND	N S	5
Chloroform	5	2 J	11	ND	5	4 J	8	ND	ND	ND	ND	ND	4	100 S	100
Methylene Chloride	5	ND	ND	ND	1 J	ND	ND	ND	ND	ND	ND	ND	ND	5 S	5
Toluene	5	ND	0 8J	ND	0 6J	ND	ND	ND	ND	ND	ND	ND	ND	5 S	5

N= Not Detectable

S= Standard

G= Guidance Value

ND= Not Detected

-- = Not available

NS= Not sampled

J= Value estimated below contract detection limit

B= Compound also found in blank.

E= Compound exceeded calibration range

* = Exceeds or equals NYSDEC Class GA Groundwater Standards/Guidance Values and/or NYSDOH Drinking Water Standards

Table 5 10

TUXEDO LANDFILL WASTE DISPOSAL SITE

M&E (1991) GROUNDWATER MONITORING WELL SAMPLING DATA

ANALYTICAL RESULTS VOLATILE ORGANIC COMPOUNDS

	Contract	New Wells						Old Wells						NYSDEC CLASS GA	
	Detection	10 Jan 91	9 Jan 91	8 Jan 91	10 Jan 91	10 Jan 91	8 Jan 91		9 Jan 91	9 Jan 91	9 Jan 91	9 Jan 91	10 Jan 91	GROUNDWATER STANDARDS AND	NYSDOH DRINKING WATER
	Limits	RI 1	RI 2	RI 3	RI 4	RI 5A	MW1	MW2	MW3	MW4	MW5	MW6	MW 7	GUIDANCE VALUES	STANDARDS
VOLATILE COMPOUNDS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	10	ND	ND	ND	ND	NS	NS	NS	ND	ND	7 J	ND	ND	50 G	50
Benzene	5	ND	ND	ND	ND	NS	ND	NS	ND	ND	0.7 J	ND	ND	[illegible]	5
Chloroform	5	ND	0.9 J	ND	0.6 J	NS	4 J	NS	ND	ND	ND	ND	4 J	100 S	100
Methylene Chloride	5	ND	0.7 J	ND	[illegible]	NS	ND	NS	ND	ND	ND	ND	ND	5 S	5
Toluene	5	ND	ND	ND	ND	NS	ND	NS	ND	ND	ND	ND	ND	5 S	5
Vinyl Chloride	10	ND	ND	ND	NS	NS	ND	NS	ND	ND	0.6 J	ND	ND	2 S	2

N= Not Detectable

S= Standard

G= Guidance Value

ND= Not Detected

- = Not available

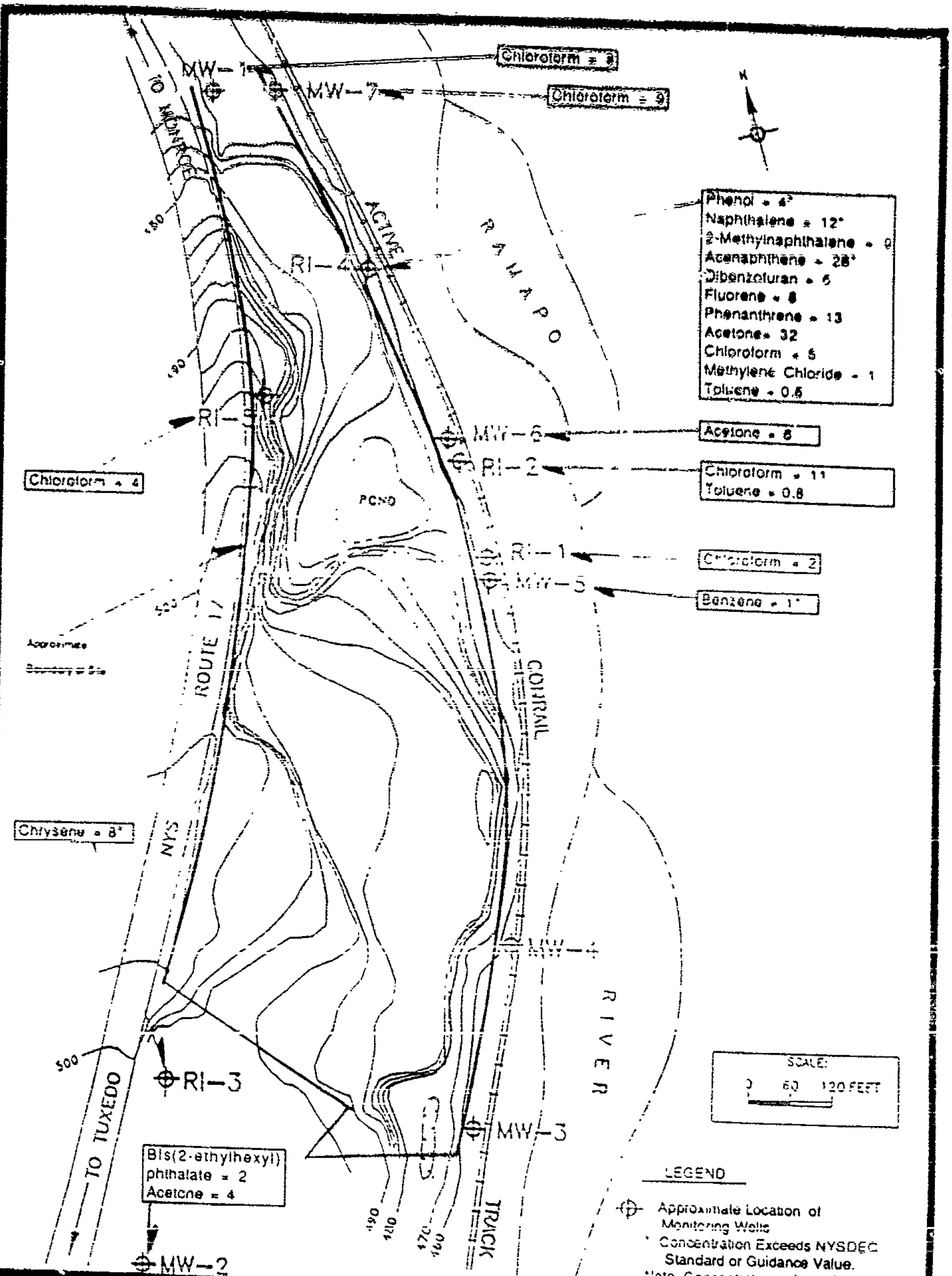
NS= Not sampled

J= Value estimated below contract detection limit

B= Compound also found in blank

E= Compound exceeded calibration range

= Exceeds or equals NYSDEC Class GA Groundwater Standards/Guidance Values and/or NYSDOH Drinking Water standards



LEGEND

-⊕- Approximate Location of Monitoring Wells

* Concentration Exceeds NYSDEC Standard or Guidance Value.

Note. Concentrations shown in ug/L.

Metcalf & Eddy of New York, Inc.

FIGURE 5-2A
ORGANIC COMPOUNDS DETECTED
IN MONITORING WELLS (1990)

- Chloroform was found at low levels in several wells including RI-2 (11 µg/l), RI-4 (5 µg/l), MW-1 (8 µg/l) and MW-7 (9 µg/l).

Based on the data usability report discussed in Section 4.6, some of the volatile organic data (methylene chloride, acetone and toluene) were determined to be invalid.

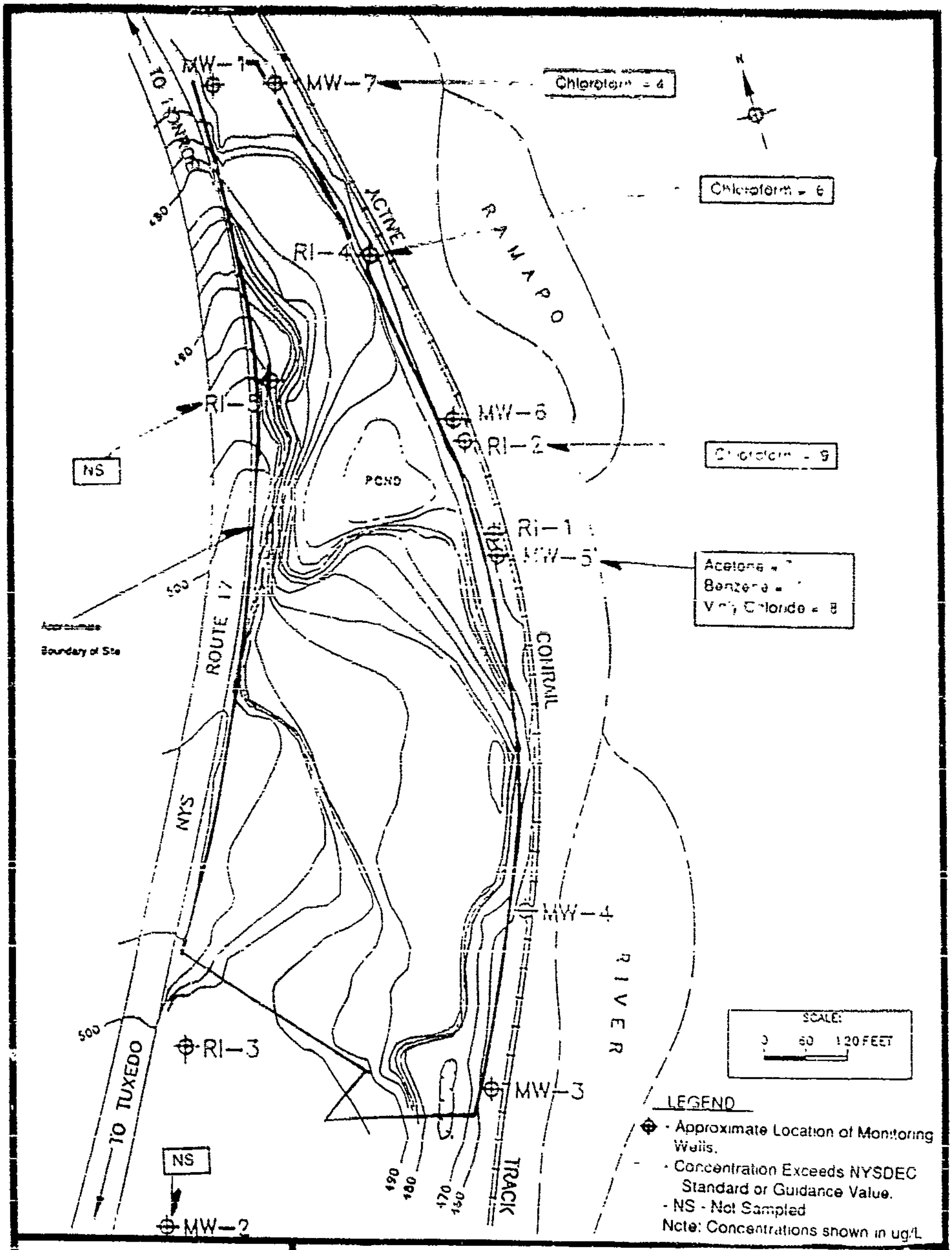
The 1991 data, as shown in Figure 5-2B and summarized in Table 5-1B, found some of the same volatile organic compounds (acetone, chloroform, methylene chloride and benzene) that were found in the 1990 data. In addition, vinyl chloride also showed up in one well (MW-5). This well had the most contaminants. However, the concentrations in all of the wells were low, and none exceeded groundwater standards and guidance values. All of the concentrations are usable as estimated values based on the data usability study. Results are summarized below:

- Methylene chloride was found at low levels in two wells, RI-2 (.7µg/l) and RI-4 (1µg/l)
- Chloroform was found at low levels in several wells, RI-2 (.9 µg/l), RI-4 (.6 µg/l), MW-1 (4 µg/l) and MW-7 (4 µg/l).
- Vinyl chloride, acetone and benzene were found in MW-5 at .8 µg\l, 7µg/l and .7 µg\l, respectively.

5.1.2 Metals

Table 5-2 summarizes the analytical results of the LMS (1988) groundwater sampling data for inorganic constituents (metals). The LMS data from 1988 showed that high concentrations of several metals, including arsenic, iron, magnesium, manganese, and sodium, were detected in samples from monitoring wells located at the Tuxedo Waste Disposal Site. As shown in Figure 5-3A, these metals were found individually or in combination with each other at levels exceeding New York State standards or guidance values in samples from each of the wells existing in 1988. Findings are summarized below.

- Arsenic was detected at a level (26 µg/l) in excess of its groundwater standard (25 µg/l) in the sample from well MW-6



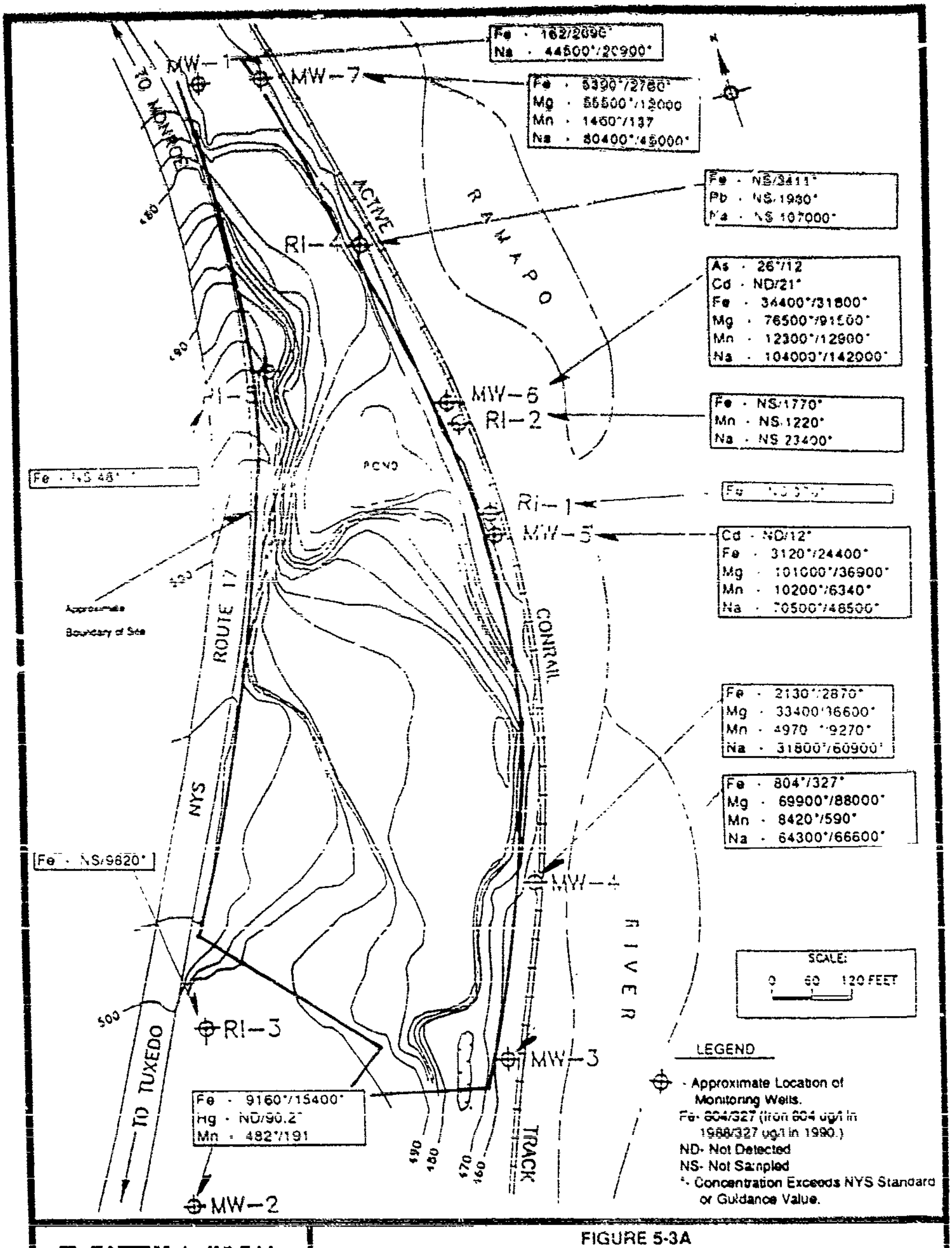
Metcalf & Eddy of New York, Inc.

FIGURE 5-2B
ORGANIC COMPOUNDS DETECTED
IN MONITORING WELLS (1991)

Table 5 2
TUXEDO LANDFILL WASTE DISPOSAL SITE
LMS (1988) GROUNDWATER MONITORING WELL SAMPLING DATA
ANALYYICAL RESULTS INORGANIC CONSTITUENTS

Parameter	Contract Detection Limits ug/L	1 Nov 88 MW-1 ug/L	1-Nov 88 MW-2 ug/L	1 Nov 88 MW-3 ug/L	1 Nov 88 MW 4 ug/L	1 Nov 88 MW 5 ug/L	1-Nov 88 MW-6 ug/L	1 Nov 88 MW-6DUP ug/L	1 Nov-88 MW-7 ug/L	Background Average * ug/L	NYSDEC CLASS GA GROUNDWATER STANDARDS AND GUIDANCE VALUES ug/L	NYSDOH DRINKING WATER STANDARDS ug/L
Aluminum	40	47J	5430	484	945	200	187J	122J	2970	70		--
Arsenic	2	2 9J	ND	1 7J	2 1J	3 8J	26	23	1 8J	ND	25 S	50
Barium		4 6J	71J	85J	78J	87J	157J	160J	75J	ND	1000 S	1000
Beryllium		ND	1 8J	ND	ND	ND	ND	ND	2 7J	---	3 G	---
Cadmium	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	10 S	10
Calcium	1000	9430	11100	197000	126000	315000	221000	211000	172000	21600		
Chromium	2	ND	10	ND	ND	ND	ND	ND	ND	ND	50 S	50
Cobalt		6 3J	22J	8 8J	4 0J	4 8J	6 2J	6	5 4J	---	--	---
Copper	5	32	64	32	32	64	33	46	27	11	200 S	1000
Iron	20	162	9160	804	2130	3120	34400	33000	5300	28	300 S	300
Lead	1	1 2J	5 1	ND	ND	ND	ND	ND	1.5	ND	25 S	50
Magnesium	1000	2530J	6000	69900	33400	101000	76500	72900	65500	7200	35000 G	----
Manganese	3	13J	482	8420	4970	10200	12300	11600	1460	40	300 S	300
Mercury	0 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	2 S	2
Nickel	8	ND	28J	ND	ND	ND	ND	ND	ND	ND	---	---
Potassium	1000	ND	ND	ND	ND	20100	25400	23900	ND	1000	--	--
Sodium	1000	44500	10300	64300	31800	70500	104000	99900	80400	30200	20000 S	--
Vanadium		5 8J	18J	6 9J	6 5J	5 9J	125	11J	11J		--	---
Zinc	4	E	E	E	E	E	E	E	E	6	300 S	5000

* Average of 10 monitoring wells in Sloatsburg, NY Data from 1988
ND = Not Detected
--- = Not available
NS = Not Sampled
NA = Not Analyzed for that component
J = Value estimated below contract detection limit
B = Compound also found in blank
E = Error in analysis. Spike sample recovery not within control limits
S= Standard
G= Guidance Value
=Exceeds or equals NYSDEC Class GA Groundwater Standards/Guidance Values and/or NYSDOH Drinking Water Standards



Metcalf & Eddy of New York, Inc.

FIGURE 5-3A
WELLS CONTAINING METAL CONCENTRATIONS EXCEEDING NEW YORK STATE STANDARDS AND GUIDANCE VALUES (1988/1990)

- Iron was found at concentrations exceeding its groundwater and drinking water standard (300 μg/l) in samples from wells MW-2 (9,160 μg/l), MW-3 (804 μg/l), MW-4 (2,130 μg/l), MW-5 (3,120 μg/l), MW-6 (34,400 μg/l) and MW-7 (5,390 μg/l)

- Magnesium was detected at levels in excess of its groundwater guidance value (35,000 μg/l) in samples from wells MW-3 (69,900 μg/l), MW-4 (33,400 μg/l), MW-5 (101,000 μg/l), MW-6 (76,500 μg/l) and MW-7 (55,500 μg/l)

- Manganese was found at concentrations in contravention of its groundwater and drinking water standard (300 μg/l) in samples from wells MW-2 (482 μg/l), MW-3 (8,420 μg/l), MW-4 (4,970 μg/l), MW-5 (10,200 μg/l), MW-6 (12,300 μg/l) and MW-7 (1,460 μg/l).

- Sodium was detected at levels exceeding its groundwater standard (20,000 μg/l) in samples from wells MW-1 (44,500 μg/l), MW-3 (64,300 μg/l), MW-4 (31,800 μg/l), MW-5 (70,500 μg/l), MW-6 (104,000 μg/l) and MW-7 (80,400 μg/l)

- Beryllium was found at elevated concentrations in the samples from wells MW-2 (1.8 μg/l) and MW-7 (2.7 μg/l); however, these levels were below the groundwater guidance value (3 μg/l) for this metal, and MW-2 is an upgradient well

Table 5-3A summarizes the analytical results of the M&E (1990) groundwater sampling data for inorganic constituents (metals). The M&E data from 1990 also indicate that high concentrations of metals, including arsenic, cadmium, iron, lead, magnesium, manganese, mercury, and sodium, were detected in samples from monitoring wells located at the site. The 1990 M&E metals data is usable as estimated values. The results are as follows:

- Arsenic was found at an elevated level (12 μg/l) in the sample from well MW-6; however, this concentration was below the groundwater and drinking water standards of 25 μg/l and 50 μg/l, respectively

- Cadmium was detected at levels in excess of its groundwater and drinking water standard (10 μg/l) in the samples from wells MW-5 (12 μg/l) and MW-6 (21 μg/l). Cadmium was also found at an elevated concentration (7 μg/l) in the sample from upgradient well MW-2; however, this level did not exceed the standard.

- Iron was detected at levels in contravention of its groundwater and drinking water standard (300 μg/l) in samples from wells MW-1 (2,690 μg/l), MW-2 (15,400 μg/l) (upgradient), MW-3 (327 μg/l), MW-4 (2,870 μg/l), MW-5 (24,400 μg/l), MW-6 (31,800 μg/l), MW-7 (2,780 μg/l), RI-1 (376 μg/l), RI-2 (1,770 μg/l), RI-3 (9,820 μg/l) (upgradient), RI-4 (3,411 μg/l) and RI-5 (481 μg/l).

Table 9.4A
TUXEDO LANDFILL WASTE DISPOSAL SITE
M&E (1990) GROUNDWATER MONITORING WELL SAMPLING DATA
ANALYTICAL RESULTS INORGANIC CONSTITUENTS

	Contract Detection Limits	New Wells					Old Wells									
		10 Oct 90	10 Oct 90	8 Nov 90	8 Nov 90	6 Oct 90	6 Oct 90	11 Oct 90	6 Oct 90	6 Oct 90	13 Oct 90	11 Oct 90	6 Oct 90	Background	NYSDEC CLASS GA GROUNDWATER STANDARDS AND GUIDANCE VALUES	NYSDOH DRINKING WATER STANDARDS
		RI-1	RI-2	RI-3	RI-4	RI-5A	MW1	MW2	MW3	MW4	MW5	MW6	MW7	Average*		
Parameter	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Aluminum	200	344	469	7180	2640	607	1300	10600	269	1920	2750	1240	7530	76		
Arsenic	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17	ND	ND	25 S	50
Barium	200	ND	ND	588	ND	ND	ND	1048	518	778	648	1508	ND	ND	1000 S	1000
Cadmium	5	ND	ND	ND	ND	ND	ND	7	ND	ND	15	21	ND	ND	10 S	10
Calcium	5000	58300	41800	12400	47100	32700	19500	26200	230000	13490	128000	269000	55300	21600		
Chromium	10	10	17	13	ND	ND	ND	22	ND	ND	ND	14	ND	ND	50 S	50
Copper	25	238	124	41	118	106	ND	238	79	168	60	ND	148	11	200 S	1000
Iron	100	374	1770	8820	3411	481	2860	13400	327	2870	24400	31600	7789	74	300 S	300
Lead	5	ND	11	3	1980	ND	7	9	ND	ND	5	4	ND	ND	25 S	50
Magnesium	5000	8630	10300	5100	17700	5430	47700	10900	36000	36600	36600	91300	17000	[illegible]	35000 G	
Manganese	15	130	1220	148	87	136	173	191	390	9370	6340	17900	137	40	300 S	300
Mercury	0.2	0.3	ND	ND	ND	ND	0.2	0.2	ND	ND	0.3	ND	ND	ND	2 S	2
Nickel	40	ND	115	ND	ND	ND	ND	ND	48	131	100	60	ND	ND		
Potassium	5000	17200	32700	29000	26100	32400	8120	5320	13600	5600	17700	34700	25000	1000		
Sodium	5000	14000	23400	7010	107000	14600	20900	6730	66600	60900	48500	142000	45000	32200	20000 S	
Zinc	20	44	110	69	116	25	26	51	52	25	81	61	45	5	300 S	5000

* Average of 10 monitoring wells in Sloatsburg, NY. Data from 1984
ND = Not Detected
\- = Not available
NS = Not Sampled
NA = Not Analyzed for that compound
J = Value estimated below contract detection limit
B = Compound also found in blank
E = Element exceeded calibration range
= Exceeds or equals NYSDEC Class GA Groundwater Standards/Guidance Values and/or NYSDOH Drinking Water Standards
S= Standard
G= Guidance Value

- Lead was found at a concentration (1,980 μg/l) in excess of its groundwater standard (25 μg/l) and drinking water standard (50 μg/l) in the sample from well RI-4.

- Magnesium was detected at levels exceeding its groundwater guidance value (35,000 μg/l) in the samples from wells MW-3 (88,000 μg/l), MW-4 (36,600 μg/l), MW-5 (36,900 μg/l) and MW-6 (91,500 μg/l).

- Manganese was found at concentrations in contravention of its groundwater and drinking water standard (300 μg/l) in the samples from wells MW-3 (590 μg/l), MW-4 (9,270 μg/l), MW-5 (6,340 μg/l), MW-6 (12,900 μg/l) and RI-2 (1,220 μg/l).

- Mercury was detected at a level (90.2 μg/l) exceeding its groundwater and drinking water standard (2 μg/l) in the sample from upgradient well MW-2.

- Sodium was found at concentrations in excess of its groundwater standard (20,000 μg/l) in the samples from wells MW-1 (20,900 μg/l), MW-3 (66,600 μg/l), MW-4 (60,900 μg/l), MW-5 (48,500 μg/l), MW-6 (142,000 μg/l), MW-7 (45,000 μg/l), RI-2 (23,400 μg/l) and RI-4 (107,000 μg/l).

- Chromium was detected at an elevated level (25 μg/l) in the sample from upgradient well MW-2, and copper was found at an elevated concentration (124 μg/l) in the sample from well RI-2; however the levels did not exceed the groundwater and drinking water standard (50 μg/l) for chromium and the groundwater standard (200 μg/l) and drinking water standard (1,000 μg/l) for copper.

Table 5-3B and Figure 5-3B summarizes the analytical results of the M&E (1991) groundwater sampling data for inorganic constituents (metals). The M&E data from 1991 also indicates that concentrations of metals, including arsenic, cadmium, chromium, iron, lead, magnesium, manganese and sodium, were detected in samples from monitoring wells located at the site. The 1991 M&E metals data is usable as estimated values. The results are as follows:

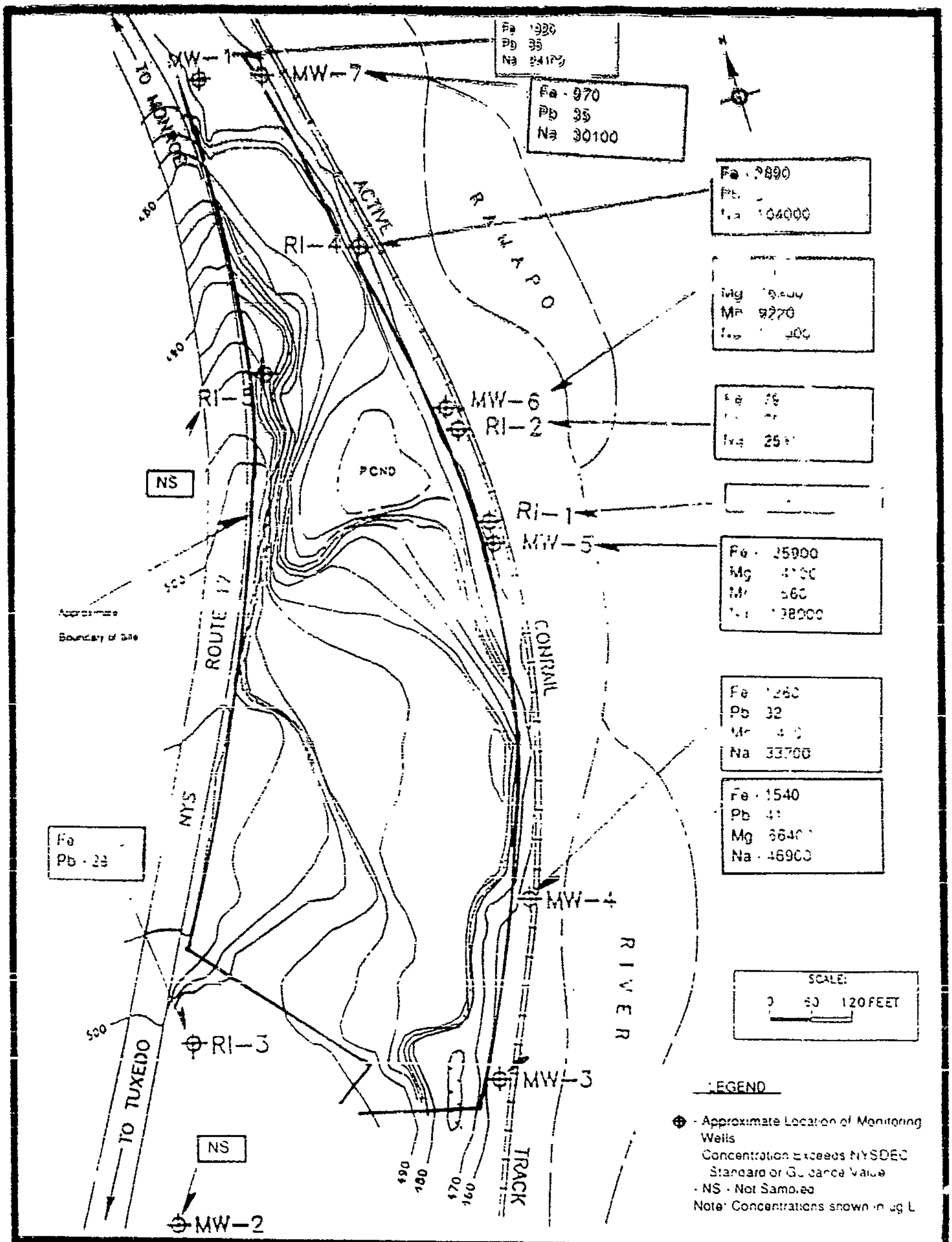
- Arsenic was found at an elevated level (7 μg/l) in the sample from well MW-5; however, it was also found in the blank. In addition, this concentration is well below the groundwater and drinking water standards of 25 μg/l and 50 μg/l, respectively.

- Cadmium was found at an elevated level (5 μg/l) in the sample from well RI-1; however this level did not exceed the groundwater and drinking water standard of 10 μg/l.

Table 5-39
[illegible] LANDFILL WASTE DISPOSAL SITE
[illegible] 1991 GROUNDWATER MONITORING WELL SAMPLING DATA
ANALYTICAL RESULTS INORGANIC CONSTITUENTS

	Contract Detection Limits	New Wells					Old Wells								NYSDEC CLASS GA GROUNDWATER STANDARDS AND GUIDANCE VALUES	NYSDOH DRINKING WATER STANDARDS
		10 Jan 91	9 Jan 91	8 Jan 91	10 Jan 91		8 Jan 91		9 Jan 91	9 Jan 91	9 Jan 91	9 Jan 91	8 Jan 91	Background		
		RI 1	RI 2	RI 3	RI 4	RI 5A	MW1	MW2	MW3	MW4	MW5	MW6	MW7	Average		
Parameter	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Aluminum	200	366	310	1000	1030	NS	640	NS	1000	624	758	651	668	70		
Arsenic	40	ND	ND	ND	ND	NS	ND	NS	ND	ND	76	ND	ND	ND	25 S	50
Barium	300	ND	ND	ND	ND	NS	ND	NS	668	ND	1530	1778	ND	ND	1000 S	1000
Cadmium	5	5	ND	ND	ND	NS	ND	NS	ND	NS	ND	ND	ND	ND	10 S	10
Calcium	5000	67100	41500	7790	58800	NS	25900	NS	181000	58500	218000	757000	45600	21000		
Chromium	10	ND	ND	ND	ND	NS	ND	NS	ND	ND	17	ND	ND	ND	50 S	50
Copper	25	ND	49	140	100	NS	118	NS	160	100	91	140	68	11	200 S	1000
Iron	100	772	745	1650	2800	NS	1950	NS	3540	1240	25900	19600	570	28	300 S	300
Lead	5	24	75	28	57	NS	35	NS	41	32	24	74	35	ND	25 S	50
Magnesium	5000	2830	10400	2250	1120	NS	5760	NS	66400	13500	44100	76300	9471	7200	35000 G	
Manganese	15	18	871	28	111	NS	136	NS	510	2450	6560	8220	51	40	300 S	300
Mercury	0.2	ND	ND	ND	ND	NS	ND	NS	ND	ND	ND	ND	ND	ND	2 S	2
Nickel	40	ND	46	ND	ND	NS	ND	NS	ND	310	88	137	ND	ND		
Potassium	5000	16000B	18700	11000B	23000	NS	11100B	NS	13700	46300	40000	26100	13870	1000		
Sodium	5000	17800	25800	4100	104000	NS	24100	NS	45900	33200	198000	113000	30100	30200	20000 S	
Zinc	20	32	45	188	168	NS	188	NS	158	168	30	31	158	6	300 S	5000

* Average of 10 monitoring wells in Sloatsburg, NY. Data from 1988
ND = Not Detected
- = Not available
NS = Not Sampled
NA = Not Analyzed for that component
J = Value estimated below contract detection limit
B = Compound also found in blank
E = Element exceeded calibration range
= Exceeds or equals NYSDEC Class GA Groundwater Standards/Guidance Values and/or NYSDOH Drinking Water Standards
S= Standard
G= Guidance Value



Metcalf & Eddy of New York, Inc.

FIGURE 5-3B
WELLS CONTAINING METAL CONCENTRATIONS EXCEEDING NEW YORK STATE STANDARDS AND GUIDANCE VALUES (1991)

- Chromium was found at a concentration of 12 μg/l in MW-5; however, this level does not exceed the groundwater and drinking water standard (50 μg/l) for chromium.

- Copper was found at a few of the wells sampled; however all levels were below the groundwater standard (200 μg/l) and drinking water standard (100μg/l).

- Iron was detected at levels in excess of its groundwater and drinking water standard (300 μg/l) in samples from wells MW-1 (1,970 μg/l), MW-3 (1,540 μg/l), MW-4 (1,260 μg/l), MW-5 (25,900 μg/l) MW-6 (19,600 μg/l), MW-7 (970 μg/l), RI-2 (795 μg/l) RI-3 (1,650 μg/l) and RI-4 (2,890 μg/l). It was also found in RI-1 at 272 μg/l, which is below the groundwater and drinking water standard.

- Lead was found at levels in excess of its groundwater standard (25 μg/l) and drinking water standard (50 μg/l) in several wells including RI-2 (75 μg/l), RI-3 (28 μgl), RI-4 (31 μg/l), MW-1 (35 μg/l), MW-3 (41 μg/l) MW-4 (32 μg/l) and MW-7 (35 μg/l). It was also found in the other wells sampled; however, those levels were below the groundwater and drinking water standards.

- Magnesium was detected at levels exceeding its groundwater guidance value (35,000 μg/l) in the samples from wells MW-3 (66,[illegible] μg/l), MW-5 (84,100 μg/l) and MW-6 (76,300 μg/l). It was also found in all other wells sampled; however, levels detected did not exceed the groundwater guidance value

- Manganese was found in all wells sampled; however, its groundwater and drinking water standard (300 μg/l) was only exceeded in MW-4 (2,420 μg/l), MW-5 (6,560 μg/l), MW-6 (9,220 μg/l) and RI-2 (866 μg/l).

- Sodium was found at concentrations in excess of its groundwater standard (20,000 μg/l) in the samples from wells MW-1 (24,100 μg/l), MW-3 (46,900 μg/l), MW-4 (33,200 μg/l), MW-5 (198,000 μg/l), MW-6 (113,000 μg/l), MW-7 (30,100 μg/l), RI-2 (25,800 μg/l) and RI-4 (104,000 μg/l). It was also found in the other wells sampled.

In summary, the analytical results for the samples obtained by LMS in 1988 (see Table 5-2) compared to the samples taken by M&E in 1990 (see Table 5-3A) indicate that groundwater concentrations of some heavy metals (cadmium, aluminum, chromium, lead, mercury, nickel) have increased between 1988 and 1990. In general, the M&E data taken in 1991 shows no significant changes in groundwater concentrations of some heavy metals, with the exception of mercury and lead. No mercury was found in any of the 1991 samples. The number of wells containing lead increased; however, all of the concentrations reported from these wells were an order of magnitude lower than the highest value reported in the 1990 data.

Based on the findings of the data usability report which is discussed in Section 4.6 of this report, the M&E 1990 and 1991 metals data were determined to be usable as estimated values. Because the metals data are usable only as estimated values, no statistical analyses were performed to determine the direction and magnitude of any trends. However, a qualitative comparison was carried out for the MW series of seven groundwater monitoring wells because data was taken from these wells during both the LMS and M&E studies. Only down-gradient wells (MW-3, MW-4, MW-5, MW-6, and MW-7) were considered for the analysis. MW-3 was eliminated because its construction is not adequately documented and data for certain samples from this well appear anomalous (e.g. sodium and potassium levels). For the other wells, MW-4, MW-5, MW-6, and MW-7, aluminum and nickel showed the strongest patterns of concentration increase for 1988-1991. In the 1990 data specific wells showed increases in cadmium, chromium, lead, and mercury, based primarily on non-detects in the 1988 LMS study. However, arsenic, barium, calcium, and copper tended to decrease. The 1991 data (MW-4 - MW-7) also showed similar trends with exceptions of mercury and cadmium, which were not found in any of the samples analyzed. In addition, more wells were found to contain lead at an increased level.

A qualitative comparison of the M&E 1990 and 1991 data taken from the new wells (RI-1, RI-2, RI-3, RI-4 and RI-5A) was considered for this analysis. RI-5A was eliminated because it was not sampled in 1991. For the other wells, aluminum, iron, mercury, nickel and zinc showed some decrease. However, cadmium and lead tended to increase.

As discussed previously, levels of organic compounds have also increased in groundwater. In 1988, no organic compounds were found at detectable levels; however, in 1990 several volatile and semi-volatile organic compounds were detected, and in 1991 several volatile organic compounds were found. For the downgradient wells (MW-4, MW-5, MW-6, and MW-7), benzene and chloroform were detected (one hit each) in the 1990 samples but not in the 1988 results. In addition, vinyl chloride was detected in one well during the 1991 sampling. However, three chlorinated VOCs and one semi-volatile organic appeared in the earlier study but were not detected in 1990. A comparison of the M&E 1990 and 1991 data taken from the new wells RI-1, RI-2, RI-3 and RI-4 (RI-4A was not sampled in 1991) detected chloroform in a few of the wells during both rounds of samplings. No tentatively identified semi-volatile compounds were found in either the 1990 or 1991 samples.

The inorganic contaminants found in groundwater at the Tuxedo Waste Disposal Site (see Tables 5-2 and 5-3A and 5-3B) were compared to background data from 10 drinking water supply wells sampled in 1988 in the Sloatsburg area (see Table 5-4). Sloatsburg is approximately three miles south of the site, downstream along the Ramapo River. The well sampling locations and copies of the original analytical data summary reports are included in Appendix B. Comparing the analytical results of the samples taken at the Tuxedo Waste Disposal Site to the average background concentrations from the Sloatsburg wells indicates that groundwater at the site contains aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium and zinc at levels that exceed background concentrations. In addition, mercury was also detected at concentrations that exceeded background levels in samples from four wells at the site in 1990. However, no mercury was found in the groundwater wells sampled in 1991. No analytical results were available for organic compounds from the M&E 1990 data. However, based on the 1991 M&E data, the foregoing analyses do not support a conclusion that contaminant levels have measurably increased at the site during the period from 1988 to 1991. Analytical results from the M&E 1991 data for volatile organic compounds show that these contaminants may be decreasing.

5.1.3 Temperature

The 1990 M&E Work Plan, Volume 2, noted that groundwater temperatures measured in monitoring wells on the east side (downgradient) of the landfill were elevated compared to those on the west (or upgradient) side. This observation appeared to indicate that the downgradient groundwater temperature was elevated due to reactions taking place within the landfill. The groundwater temperature change was presented as evidence that groundwater was being effected by changes occurring in the landfill.

Table 5-4

TUXEDO LANDFILL WASTE DISPOSAL SITE

BACKGROUND CONCENTRATIONS OF INORGANIC CONSTITUENTS IN GROUNDWATER

SLOATSBURG DRINKING WATER SUPPLY WELLS

	22 Mar 88	22 Mar 88	12 Jul 88	12 Jul 88	22 Mar 88	22 Mar 88	17 Feb 88	15-Aug-89	22 Mar 88	17-Feb-89	Background	Background	NYSDEC GROUNDWATER STANDARDS AND GUIDANCE VALUES	NYSDOH DRINKING WATER STANDARD
	Well #4	Well #5	Well #3	Well #4	Well #5	Well #6	Well #7	Well #8	Well #9	Well #10	Average	Average		
Parameter	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l
Aluminum	0.07	0.06	0.04	0.05	0.07	0.07	0.08	0.03	0.06	0.11	0.07	70	-	
Arsenic	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	25 (S)	50
Barium	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	1000 (S)	1000
Cadmium	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	10 (S)	10
Calcium	22	21	24	24	18	17	21	20	22	27	21.6	21600	-	
Chromium	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	50 (S)	50
Copper	0.01	0.01	ND	ND	0.01	0.01	0.01	0.01	0.02	0.03	0.01	11	200 (S)	1000
Iron	0.01	0.03	ND	ND	0.07	0.01	ND	0.02	0.1	0.04	0.03	28	300 (S)	300
Lead	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	25 (S)	50
Magnesium	6	7	8	5	7	7	5	10	6	11	7.20	7200	35000 (G)	-
Manganese	0.01	0.01	0.02	ND	0.21	0.01	ND	0.01	0.01	0.12	0.04	40	300 (S)	300
Mercury	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	2 (S)	2
Nickel	NA	NA	ND	ND	NA	NA	ND	ND	NA	ND	ND	ND	—	
Potassium	NA	NA	1	1	NA	NA	1	1	NA	1	1.00	1000		
Sodium	NA	NA	29	33	NA	NA	22	38	NA	33	30.20	30200	20000 (S)	—
Zinc	ND	ND	ND	ND	0.02	0.01	ND	0.01	0.02	ND	0.01	6	300 (S)	5000
pH	7	7.1	6.8	6.7	7	6.9	6.8	6.9	6.5	6.9			-	---

(S) = Standard

(G) = Guidance Value

NA = Not Analyzed for that component

ND = Not Detected

\- = Not available

Groundwater temperature was measured at the landfill each month between September 1990 and February 1991 to monitor any changes. The results of this monitoring are presented in Table 5-5. Based on the new data, elevated groundwater temperatures are still present at the east side of the landfill. For example, in November 1990, the average groundwater temperature in the upgradient wells was 10.6 degrees C compared with 16.1 degrees C in the downgradient wells. Overall, the new data illustrates that the groundwater temperature at the landfill was decreasing over the six-month monitoring period This observation may be related to seasonal changes since the temperatures were measured through the fall and winter seasons.

5.2 SURFACE WATER AND SEDIMENT (RAMAPO RIVER)

Two surface water bodies of concern were originally identified as the Ramapo River and an intermittent stream which previously flowed across the site. The Ramapo River is classified by NYSDEC as a Class A surface water and is a potential source of drinking water supply. The intermittent stream is not addressed in this report because it was diverted during the landfilling operations.

5.2.1 Surface Water Quality

The surface water quality of the Ramapo River in the vicinity of the site was evaluated based on analytical data obtained from the LMS Phase II Investigation in 1988 and the M&E Phase I RI in 1990. During the LMS Phase II Investigation, surface water samples were obtained from the Ramapo River on two occasions (August and November 1988). Only the November 7, 1988 data is presented in this report; the August 4, 1988 data was rejected because of data reliability problems. As was shown in Figure 4-6, the surface water (and sediment) samples were collected by LMS at four locations including one upstream location (SW-3), one downstream location (SW-1), a mid-site location adjacent to the landfill (SW-2), and a background location near the railroad tracks (SW-4). The background sample location near the railroad tracks may not truly represent background conditions because the railroad tracks could be a potential source of contamination (Metcalf & Eddy 1990). Figure 4-6 also showed the M&E surface

TABLE 5-5

MONTHLY GROUNDWATER TEMPERATURE DATA*

Well Number	Location	September 1990	October 1990	November 1990	December 1990	January 1991	February 1991
MW-1	U	11.4	11.9	11.5	NM	12.6	NM
MW-2	U	12	12.9	9.3	NM	NM	NM
MW-3	D	14.6	16.1	12.9	NM	10.8	11.4
MW-4	D	14.6	18.2	17.3	NM	12.9	NM
MW-5	D	18.2	21	19.8	NM	15.7	NM
MW-6	D	22.3	23.9	20	16.4	15.1	14.5
MW-7	D	14.1	13.8	14	13.2	12.9	12.5
RI-1	D	NM	15.7	14	10.5	14.6	11.6
RI-2	D	NM	14.5	11.9	10.4	12.3	11.4
RI-3	U	NM	13.7	10.7	11.3	10.3	9.2
RI-4	D	NM	20.7	18.8	NM	16.1	NM
RI-5	U	12.7	12.4	10.8	10.7	NM	10.5

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*	-	Temperatures shown in degrees Celsius
NM		Not Measured
U	-	Upgradient
D	-	Downgradient

water (and sediment) sample locations. These sampling points included one upstream location (RIW-3/RIS-3), one mid-site location (RIW-2/RIS-2), and one downstream location (RIW-1/RIS-1).

Organic Compounds

Organic compounds were not detected in surface water samples obtained from the Ramapo River during either of the sampling programs performed by LMS and M&E.

Metals

Table 5-6 summarizes the metals data from the LMS November 1988 sampling event along with the results from the M&E 1990 sampling event on October 11, 1990. Standards and guidance values in the table are based on public health considerations No significant conclusions can be drawn from the LMS data since metal concentrations were not consistently higher at the mid-site or downstream sampling locations However, the samples obtained from locations SW-2 (mid-site) and SW-3 (upstream) as well as SW-4 (background/upstream) contained levels of iron that exceeded the surface water standard (300 μg/l).

The M&E 1990 raw data indicate that aluminum, calcium, iron, lead, magnesium and sodium were detected in marginally greater concentrations in samples obtained downstream of the landfill at the bankside collection points than they were in upstream samples. However, the results for silver and were invalid because similar levels of this metal was also found in sample blanks. Based on further evaluation of data in the usability report, the remaining metals were determined to be usable as estimated values.

Iron was the only metal that was found at concentrations in excess of its standard, based on human health criteria. Iron concentrations in samples from river bank collection points at downstream location RI-W1 (326 μg/l), mid-site location RI-W2 (425 μg/l) and upstream location RI-W3 (312 μg/l) were in contravention of the surface water standard (300 μg/l). One aluminum sample exceeded the NYSDEC aquatic standard for ionic aluminum. Although not detected at levels exceeding standards, the elevated concentration of mercury (0.7 μg/l)

Table 5-6

TUXEDO LANDFILL WASTE DISPOSAL SITE

SURFACE WATER SAMPLING DATA

ANALYTICAL RESULTS-INORGANIC CONSTITUENTS

M&E DATA

		Downstream		Midstream		Upstream		LMS 1988 Data				LMS 1988 Data					
	Contract	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	Nov-88	Nov-88	Nov-88	Nov-88	Bkgd	Bkgd	1990	NYSDEC CLASS A		
	Detection	RIW1	RIW1	RIW2	RIW2	RIW3	RIW3	SW 1	SW 2	SW 3	SW 4	Average	Average	Background	SURFACE WATER		
	Limits	Bank	Mid	Bank	Mid	Bank	Mid	Downstream	Midstream	Upstream	Background	Upstream	Downstream	Average*	STANDARDS	GUIDANCE	TYPE
Parameter	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L		
Aluminum	200	1490	588	235	ND	148	595	1353J	733	105J	99J	243	218		100		A,S
Arsenic	10	ND	ND	ND	ND	ND	ND	ND	1.9J	ND	ND				50		
Barium	200	ND	ND	ND	ND	ND	ND	14J	14J	15J	15J				1000		H
Beryllium	5	ND	ND	ND	ND	ND	ND	ND	1.1J	ND	ND					3	H
Calcium	5000	31200	26600	21900	26000	28400	28600	17000	7000	17000	30400						
Chromium	10	ND	ND	ND	ND	ND	11	ND	ND	ND	ND				50		H
Cobalt	50	ND	ND	ND	ND	ND	ND	ND	4.0J	3.0J	2.8J				5		A
Copper	25	ND	ND	ND	ND	ND	ND	22	37	27	30	6	6		200		H
Iron	100	398	204	425	140	312	202	294	388	321	341			160	300		H,A
Lead	5	4	ND	3	ND	ND	3	1.1J	2.4	3.3J	3.3J	16	19	-	50		H
Magnesium	5000	8460	7190	5065	7170	7770	7770	45501J	47300J	50003J	8100				35000		H
Manganese	15	92	85	96	62	93	65	53	48	41	102			40	300		H
Mercury	0.2	ND	ND	ND	0.7	ND	ND	NA	NA	NA	NA				2	0.2	H,A
Potassium	5000	3200	3150	2390	2540	3250	3230	ND	ND	ND	ND						
Selenium	5	ND	ND	ND	ND	ND	ND	ND	3.4J	2.5	ND				10		H,S
Silver	10	58	13	25	14	76	68	NA	NA	NA	NA		-		50.0		H,A
Sodium	5000	47000	39000	34000	39000	44000	42000	23500	24400	23700	32900	58281	4450				
Zinc	20	ND	158	20	ND	136	110	E	E	E	E	53	45		300		H,A

ND = Not Detected

-- = Not available

NS = Not Sampled

NA = Not Analyzed for that component

J = Value estimated below detection limit

B = Compound also found in blank

E = Compound exceeded calibration range

* = Average taken from 3 Ramapo River sampling locations in Sloatsburg, NY

Each sampling point was measured once a month throughout 1990

= Exceeds NYSDEC Class A Surface Water Standards

Type

A = Aquatic

H = Human

[illegible]

S = Acid Soluble

in the sample from the middle of the river at mid-site location RI-W2 did exceed a NYSDEC guidance value for aquatic species.

Comparing the 1988 data to the 1990 data shows that calcium, magnesium, manganese, potassium, silver and sodium have apparently increased in samples obtained from locations mid-site and downstream of the landfill. Conversely, the low levels of arsenic, barium, beryllium, cobalt, copper and selenium found in 1988 decreased to not detectable in 1990. Both sets of data indicate that no inorganic constituents were detected at levels that exceeded present NYSDEC Class A surface water standards except for iron.

Regional background surface water quality data is also shown in Table 5-6. As shown in the table, the only regional background data available in 1990 were the results of samples analyzed for iron and manganese from samples collected at three sampling points in the Ramapo River in Sloatsburg. Compared to these values, concentrations of iron and manganese were found to be elevated in all but one sample collected near the Tuxedo Waste Disposal Site.

5.2.2 Surface Water Sediment

Surface water sediment samples were collected from the Ramapo River by LMS on November 7, 1988 at an upstream location (RS-4), a mid-site location (RS-2) near the middle of the landfill, a downstream location (RS-1) and at a background location (SWS-3). The background location was chosen to investigate whether other local sources, such as the rail bed, could be contributing contaminants to the river. Surface water sediment samples were collected from the Ramapo River by M&E on October 10, 1990 at three locations: one downstream location (RI-S1), one mid-site location (RI-S2), and one upstream location (RI-S3). Samples were obtained from two separate points (at stream bank and at middle of stream) at locations RI-S1 and RI-S2. Figure 4-6 showed the surface water sediment sample locations for both the LMS and M&E sampling events.

Organic Compounds

The 1988 and 1990 analytical results for volatile and semi-volatile organic compounds in surface water sediments are summarized in Table 5-7. The LMS 1988 sampling results show that only one volatile organic compound (benzene) was detected at a low concentration (3 µg/kg) in the sample from upstream location RS-4. Although acetone and methylene chloride were found in all of the samples, both of these compounds were found in the sample blanks and are common laboratory contaminants.

The M&E 1990 data indicates that only two volatile organic compounds, 2-butanone and toluene, were detected. Toluene and 2-butanone were found at low levels in the stream bank sample at mid-site location RI-S2, and toluene was detected in the middle of the stream at downstream location RI-S1. Although toluene was found in these samples, it was also detected in the sample blanks.

None of the sample concentrations exceeded the NYSDEC sediment guidelines. (The only applicable value found based on human health residues is for benzene). A discussion of NYSDEC sediment guidelines is presented in Section 7.3.

Numerous semi-volatile organic compounds were found in the samples obtained by LMS in 1988 and M&E in 1990. Twenty-one different semi-volatile organic compounds were found in various samples (except for RS-4) in the 1988 and 1990 sampling events. Almost all of the semi-volatiles detected were base neutral compounds.

In 1988, the highest levels of semi-volatiles were (with the exception of bis(2-ethylhexyl)phthalate) in the samples from the downstream (RS-1) and background (SWS-3) locations. Eleven different compounds were detected in the sample from RS-1. The compounds with the highest levels detected in the sample from RS-1 were fluoranthene (560 µg/kg) and benzo(b,k)fluoranthene (1500 µg/kg). Eight different compounds were detected in the sample from SWS-3. The compounds with the highest levels detected in the SWS-3 sample were pyrene (850 µg/kg), fluoranthene (850 µg/kg) and benzo(b,k)fluoranthene (1,640 µg/kg). The compound with the highest level detected in the RS-2 sample was benzo(b,k)fluoranthene

Table 5 7

TUXEDO LANDFILL WASTE DISPOSAL SITE
SURFACE WATER SEDIMENT SAMPLING DATA
ANALYTICAL RESULTS-VOLATILE AND SEMIVOLATILE ORGANIC COMPOUNDS

		M&E DATA					LMS DATA			
	Contract	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11 Oct 90	Nov 88	Nov 88	Nov 88	Nov 88
	Detection	RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	RS-1	RS 2	SWS 3	RS 4
	Limits	Downstream	Downstream	Midstream	Midstream	Upstream	Downstream	Downstream	Background	Upstream
VOLATILES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Methylene Chloride	5	U	U	U	U	U	16 B	49 B	41 B	12 B
Acetone	10	19 B	17 B	220 B	48 B	U	23 B	150 B	39 AB	42 B
2-Butanone	10	U	U	28 J	U	U	ND	ND	ND	ND
Benzene	5	U	U	U	U	U	ND	ND	ND	3 A
Toluene	5	U	0 7 BJ	3 BJ	U	U	ND	ND	ND	ND
TOTAL VO		19	17 7	251	48	0	39	199	80	57

		M&E DATA					LMS DATA			
	Contract	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct 90	Nov 88	Nov 88	Nov 88	Nov 88
	Detection	RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	RS-1	RS-2	SWS 3	RS 4
	Limits	Downstream	Down stream	Midstream	Midstream	Upstream	Downstream	Downstream	Background	Upstream
SEMIVOLATILES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Phenol	330	120J	110J	230J	250J	U	NA	NA	NA	NA
Benzoic Acid	1600	190 J	U	380 J	U	U	ND	ND	ND	ND
Naphthalene	330	U	U	U	U	480 J	86 A	ND	ND	ND
2-Methylnaphthalene	330	U	U	U	U	180	75 J	ND	ND	ND
Acenaphthylene	330	U	U	U	U	95 J	NA	NA	NA	NA
Acenaphthene	330	U	U	U	U	690 J	NA	NA	NA	NA
Dibenzofuran	330	U	U	U	U	380 J	63 J	ND	ND	ND
Fluorene	330	U	U	U	U	910 J	NA	NA	NA	NA
Phenanthrene	1600	280 J	U	640 J	420 J	6600	280 A	180 A	ND	ND
Anthracene	330	U	U	U	U	800 J	ND	ND	490 A	ND
Fluoranthene	330	680 J	U	1800 J	620 J	5800	560	400 A	820 A	ND
Pyrene	330	610 J	U	1500 J	550 J	5200	450 A	400 A	850 A	ND
Benzo(a)anthracene	330	U	U	860 J	260 J	2200	350 A	230 A	480 A	ND
Chrysene	330	470 J	U	1100 J	260 J	2100	490 A	480 A	600 A	ND
Bis(2-ethylhexyl)phthalate	330	130 BJ	96 BJ	470 BJ	560 BJ	79 BJ	130 A	680 A	650 A	ND
Benzo(b)fluoranthene	330	520 J	U	1300 J	320 J	2600	1500 X	780 AX	1640 AX	ND
Benzo(k)fluoranthene	330	240 J	U	550 J	110 J	1000 J	X	AX	AX	ND
Benzo(a)pyrene	330	240 J	U	630 J	190 J	1800	260 A	230 A	420 A	ND
Indeno(1,2,3-cd)pyrene	330	150 J	U	440 J	U	980 J	NA	NA	NA	NA
Dibenzo(a,h)anthracene	330	U	U	U	U	140 J	NA	NA	NA	NA
Benzo(g,h,i)perylene	330	130 J	U	380 J	U	760 J	NA	NA	NA	NA
TOTAL BN	...	3760	206	10280	3540	32794	4245	3380	5950	0

A - Estimated concentration, compound present below method detection limit.
B - Compound found in blank.
ND = Not Detected
... = Not available
NS . Not Sampled
VO = Volatile Organics: NJDEP Soil Action Level is 1000 ug/kg total in soil

BN - Base Neutrals NJDEP Soil Action Level is 10000 ug kg total in soil
NA = Not Analyzed (for that component)
J = Value estimated below contract detection limit
U = Below contract detection limit.
X - Indistinguishable isomers, Benzo(b,k)fluoranthene

(780 μg/kg). None of the samples in 1988 contained concentrations of semi-volatiles that exceeded NYS sediment guidelines (based on human health residues).

The results from M&E's 1990 sampling event show that the highest levels of semi-volatiles were found in the stream bank at mid-site location RI-S2 and the stream bank at upstream location RI-S3 Thirteen different compounds were detected in the stream bank sample from location RI-S2. The compounds detected at the highest levels in the stream bank sample from RI-S2 were fluoranthene (1,800 μg/kg), pyrene (1,500 μg/kg), benzo(b)fluoranthene (1,300 μg/kg) and chrysene (1,100 μg/kg). Nineteen different compounds were found in the sample from the stream bank at location RI-S3. The compounds detected at the highest levels in the sample from RI-S3 were phenanthrene (6,600 μg/kg), fluoranthene (5,800 μg/kg), pyrene (5,200 μg/kg), benzo(b) fluoranthene (2,600 μg/kg), benzo(a)anthracene (2,200 μg/kg), chrysene (2,100 μg/kg), benzo(a)pyrene (1,800 μg/kg) and benzo(k)fluoranthene (1,000 μg/kg).

Concentrations of four PAHs in the upstream bank sample exceeded NYS sediment guidelines (based on human health residues). These contaminants are benzo(a)anthracene, chrysene, benzo(b)flouranthene, and benzo(a)pyrene. The high levels of PAHs in the upstream sample could be due to possible contamination from the railroad and roadway runoff.

Based on findings contained in the data usability report discussed in Section 4.6 of this report, several volatile and semi-volatile organic compounds (methylene chloride, acetone and toluene and bis(2-ethylhexylphthalate) were determined to be invalid.

Metals

The analytical results for inorganic constituents of the LMS November 1988 and M&E October 1990 surface water sediment sampling are summarized in Table 5-8. No NYS sediment guidelines based on human health residues were identified. NYS

Table 5-8

TUXEDO LANDFILL WASTE DISPOSAL SITE
SURFACE WATER SEDIMENT SAMPLING DATA
ANALYTICAL RESULTS-INORGANIC CONSTITUENTS

	M & E DATA					LMS DATA				
	13-OCT-90	12-OCT-90	12-OCT-90	12-OCT-90	12-OCT-90	Nov - 88	Nov - 83	Nov - 88	Nov - 86	NYS
	RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	RS-1	RS-2	SWS-3	RS-4	SEDIMENT
PARAMETER	Downstream	Downstream	Midstream	Midstream	Upstream	Downstream	Midstream	Background	Upstream	GUIDELINES
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ALUMINUM	7830 00	6710 00	11000 00	8510 00	7850 00	4320 f	23900 f	17200 f	16100 f	
ARSENIC	2.00	1.40	1.9 B	1.90	3.50	6.6	[7.1]	[6.5]	[2 6]	5
BARIUM	44.00	31.10	64.60	50.60	37.70	72	[181]	[96]	[46]	
BERYLLIUM	U	U	U	U	U	0 7	[2.3]	[1.6]	[0 6]	
CADMIUM	6.50	10.70	6.60	9.20	11.10	ND	ND	ND	ND	0.8
CALCIUM	2280.00	1380.00	3240.00	2200 00	1100.00	2180	5680	8030	[1280]	
CHROMIUM	10.40	10.60	14.60	10.90	10.40	8.1	34	25	25	26
COBALT	7.00	8.50	5.9 B	10.10	10.70	[3.6]	[15]	[12]	[5.4]	
COPPER	24.50	11.10	51.10	22.70	16.40	57 f	95 f	95	15 f	19
IRON	12800.00	19200.00	9750.00	16000.00	19500.00	24200	31100	22500	29400	2.4%
LEAD	31.40	14.30	75.70	29.50	16 50	42 f	91 f	82	12 f	27
MAGNESIUM	2540.00	3290.00	2590.00	3050.00	3730.00	1630 L	5950 L	4360 L	3380 L	
MANGANESE	168.00	427.00	707.00	393.00	880.00	215	626	154	192	428
MERCURY	0.48	U	1.40	0.30	0.32	0.19	1.8	1.9	ND	0.11
NICKEL	12.20	20.40	24.00	20.90	31.40	[11]	[41]	[26]	14	22
POTASSIUM	628.00 B	728.00	868.00 B	863.00 B	844.00	ND	ND	ND	ND	
SILVER	1.30 B	0.81 B	1.60 B	1.10 B	0.81	ND	ND	ND	ND	
SODIUM	292.00 B	179.00 B	512.00 B	275.00 B	188.00 B	NO	[2510]	ND	[552]	
VANADIUM	17.10	19.50	28.10	20.20	23.30	[15]	[45]	41	38	
ZINC	88.30	85.80	131.00	107.00	78 20	81	414	328	74	85
CYANIDE	1.20	U	U	U	0 47	NA	NA	NA	NA	

B = Compound found in blank.
f = Lab QC duplicate analysis not within control limits.
NA = Not Analyzed.
ND = Not Detected.

U = Not detected.
[ ] = Below contract detection limit but above instrument detection limit.
L = Value estimated or not reported due to presence of interference.
☐ = Exceeds NYS Guidance Values

sediment guidelines for protection of benthic organisms are discussed in Section 7.2.5.

In general, the 1990 M&E data for river sediment samples taken near the west river bank show that several metals, including arsenic, cadmium, cobalt, iron, magnesium, manganese, and nickel, had higher upstream concentrations than their respective mid-site and downstream values However, the concentrations of twelve metals, including aluminum, barium, calcium, chromium, copper, lead, mercury, potassium, silver, sodium, vanadium, and zinc, were highest in the sample from the river bank sample at mid-site location RI-S2. These results are not surprising since the mid-site river bank location is near an apparent leachate seep emanating from the site

Of the M&E samples that were taken in the middle of the river, the highest concentrations of metals were found at mid-site location RI-S2. For all but four metals, the middle of the river sediment sample concentrations were higher at mid-site sampling location RI-S2 compared to the respective downstream locations. This is consistent with the results reported above for sediment samples taken near the river bank. Because of flow conditions, a sediment sample could not be taken in the middle of the river at upstream location RI-S3.

5.2.3 Trends

A trend analysis based on statistical techniques would be inconclusive because the small number of points for each site would result in a wide confidence interval. In addition, the data lacks consistency and analyzing such data would not be meaningful.

For purposes of comparing the 1988 LMS data with the 1990 M&E data, river water and sediment were screened in the following manner:

1. Downstream samples (BANK AND MID) from 1990 were compared to the downstream sample from 1988.
2. Midstream samples were handled in a similar manner.
3. The 1990 upstream samples were compared to the 1988 upstream and Background samples.
4. Contaminants were identified whose 1990 concentrations in both the Downstream and Midstream sample groups exceeded comparable values for 1988.

5. Of the above identified contaminants, additional compounds were screened out if significant concentrations were found in the upstream or background samples.

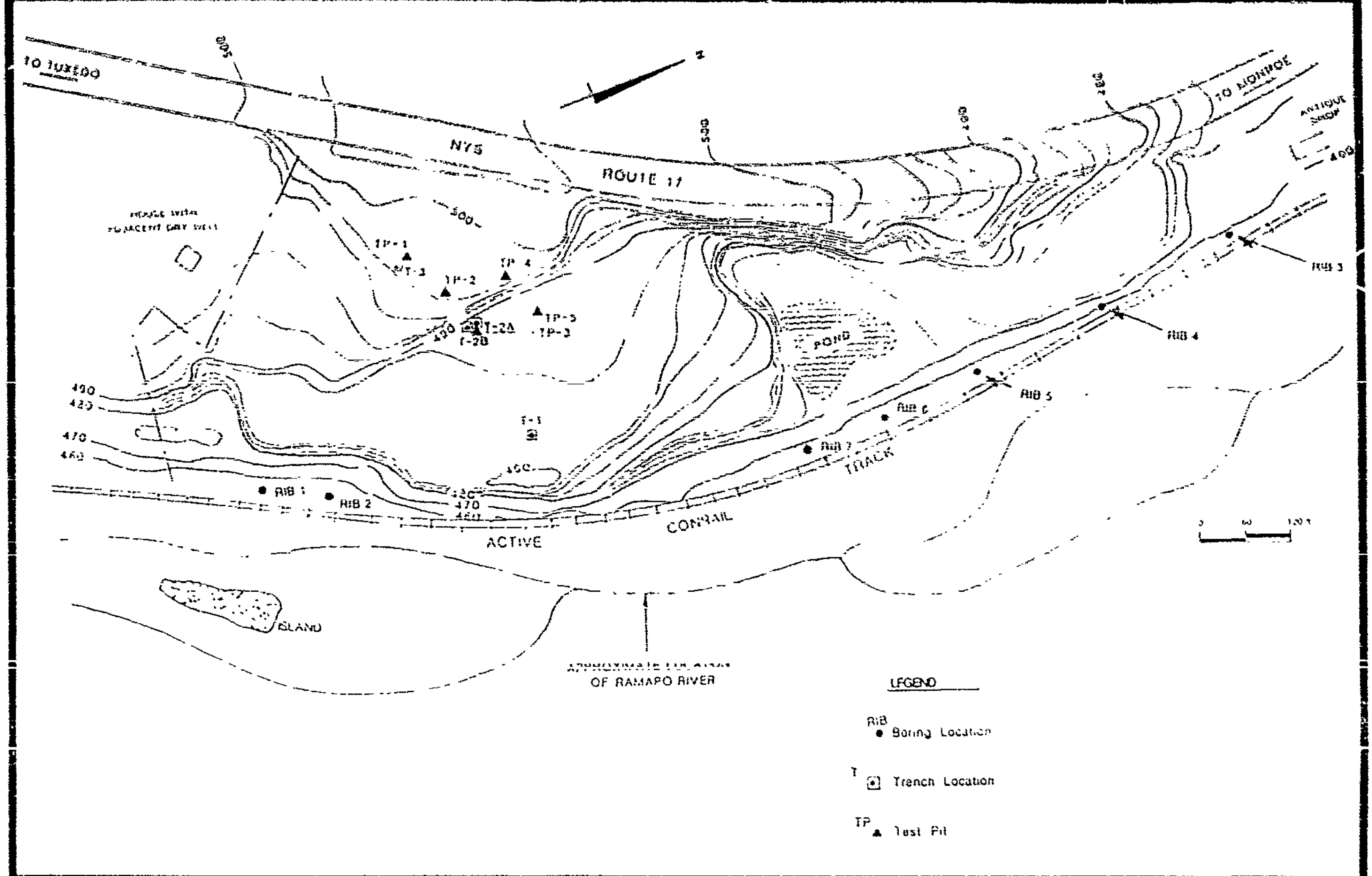
For river water, only silver showed a consistent increase in downstream and midstream samples from 1988-1990 (without upstream sources). One 1990 water sample showed the presence of mercury.

For sediment, silver and cadmium showed increases from 1988-1990 based on the above screening criteria. The only organic in sediment showing a similar increase was benzoic acid.

5.3 SOIL

Soil samples were obtained and analyzed as part of the Phase II Investigation by LMS and during the Phase I RI conducted by M&E as part of this RI/FS During the LMS Phase II Investigation (1988), trenches and test pits were excavated to identify many types of buried municipal refuse at the site. Soil samples were taken at each of the trench and test pit locations shown in Figure 5-4. During the M&E Phase I RI (1990), soil samples were obtained at borings located along the perimeter of the site. The locations of these borings are also shown in Figure 5-4.

As part of the LMS Phase II Investigation, three trenches were excavated. Two samples from each trench were collected and analyzed for the target compound list (TCL) organic compounds (volatiles and semi-volatiles) and inorganic constituents (see Table 5-9). Percent solids, EP toxicity, metals, ignitability and reactivity tests were also performed on these samples. In addition, two samples were obtained from each of the five test pits. All ten of these samples were analyzed for TCL volatile and semi-volatile organic compounds, pesticides, and PCBs (see Table 5-10). The samples were also tested for hazardous waste characteristics and EP toxicity. Selected samples were analyzed for Toxicity Characteristic Leaching Procedure (TCLP) chemicals and dioxin.



M&E
Metcalf & Eddy

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 5-4
TRENCH, TEST PIT AND BORING SAMPLE LOCATION

TABLE 5-9
LMS August 1988 Trench Sample Data Summary

All semivolatile organics data are estimates only. They cannot be used quantitatively.

Tuxedo WD Site NYSDEC I.D. No. 336035

Parameter	T-1 S-A	T-1 S-B	T-2 S-A	T-2 S-B	T-3 S-A	T-3 S-B
SEMIVOLATILES						
Phenol	ND	1,500 a	m	ND	850 a	2,200 a
1,4-Dichlorobenzene	ND	540 a	m	ND	ND	ND
4-Methylphenol	ND	ND	m	ND	550 a	2,400 a
Benzoic Acid	ND	ND	m	ND	1,400 a	1,800 a
Naphthalene	14,000	7,700	m	13,000 a	8,600	15,000
2-Methylnaphthalene	7,900	3,000 a	m	7,100 a	3,900 a	4,800
Acenaphthene	14,000	6,800	m	15,000 a	5,600	9,100
Dibenzofuran	9,300	4,700	m	10,000	3,700 a	5,300
Acenaphthylene	ND	ND	m	4,700	ND	ND
4-chloro-3-Methylphenol	ND	ND	m	670 a	ND	ND
Bis(2-chloroethyl)ether	ND	ND	m	730 a	ND	ND
Fluorene	12,000	8,500	m	18,000	6,300	7,800
Phenanthrene	31,000	53,000	m	80,000 k, n	29,000	43,000
Anthracene	7,400	13,000	m	28,000	7,300	12,000
Di-n-butylphthalate	1,400 ba	1,900 ba	m	1,500 ba	5,500 b	2,200 ba
Fluoranthene	28,000	58,000	m	64,000	34,000	40,000
Pyrene	24,000	52,000	m	43,000	23,000 a	38,000
Butylbenzylphthalate	2,600 a	2,100 a	m	4,000 a	8,100	8,200
Benzo(a)anthracene	11,000	27,000	m	23,000	16,000	20,000
Chrysene	12,000	27,000	m	24,000	17,000	22,000

All data in ug/kg.

a - Estimated concentration, compound present below method detection level. b - Found in blank.

ND - Not detected at analytical detection level, see Appendix D for detection levels.

m - Data unusable since sample not run within 12 hours of an acceptable GC/MS tune and reanalysis was done outside of sample holding time.

k - Result for this compound is reported at higher dilution since original analysis exceeded calibration range of equipment.

n - Qualified data. Estimated quantity since reanalyzed outside of holding time.

Source: LMS Phase II Investigation Report, 1989

TABLE 8-9 (continued)
LMS August 1988 Trench Sample Data Summary

All semivolatile organics data are estimates only. They cannot be used quantitatively.
Tuxedo WD Site NYSDEC I.D. No. 336035

Parameter	T-1 S-A	T-1 S-B	T-2 S-A	T-2 S-B	T-3 S-A
SEMIVOLATILES (con't)					
Bis(2-ethylhexyl)phthalate	7,600 b	8,000 b	m	13,000 b	11,000 b
Di-n-octylphthalate	3,600 a	3,800 a	m	ND	740 a
Benzo(b)fluoranthene	8,800	24,000	m	19,000	14,000
Benzo(a)pyrene	8,100	23,000	m	18,000	14,000
Indeno(1,2,3-cd)pyrene	4,200 a	12,000	m	11,000	8,400
Dibenzo(a,h)anthracene	ND	5,900	m	2,600 a	2,300 a
Benzo(g,h,i)perylene	4,600 a	13,000	m	12,000	9,300
Tentatively Identified Compounds					
4-methyl-3-penten-2-one	20,000 baj	200,000 baj	m	70,000 baj	100,000 baj
1,8-Dimethyl-Naphthalene	4,000 a	ND	m	ND	ND
1,2-Dimethyl-Naphthalene	ND	ND	m	ND	ND
1-Methyl-Naphthalene	ND	ND	m	ND	ND
2-Ethenyl-Naphthalene	ND	ND	m	ND	ND
Benzo(b)thiophene	ND	ND	m	ND	ND
Butanoic acid	ND	ND	m	ND	40,000 a
Dibenzothiophene	ND	30,000 a	m	40,000 a	ND
Benzo(e)pyrene	ND	50,000 a	m	ND	ND
alpha-Pinene	ND	ND	m	ND	ND
1,1'-Biphenyl	ND	ND	m	20,000 a	ND
2,5-Dibenzonobutaoic acid	ND	ND	m	ND	ND
4-methoxyl-4-methyl-2-pentanone	ND	ND	m	ND	30,000 a
Unknown	12,000 a (1)	70,000 a (2)	m	750,000 a (5)	1,100,000 a (3)
Unknown	109,000 ba (2)	1,110,000 ba (3)	m	ND	1,100,000 ba (3)
Unknown hydrocarbon	55,000 a (11)	570,000 a (10)	m	670,000 a (10)	800,000 a (10)
Unknown methyl-benzene isomer	3,000 a (1)	ND	m	ND	ND
Unknown methyl-naphthalene isomer	2,000 a (1)	ND	m	20,000 a	ND
Unknown dimethyl-naphthalene isomer	ND	ND	m	20,000 a	40,000 a

All data in ug/kg.

a - Estimated concentration, compound present below method detection level. b - Found in blank. (8) - Number of compounds in group total.

ND - Not detected at analytical detection level, see Appendix D for detection levels. NR - Not run.

j - Non TCL is suspected; aldo-condensation product.

m - Data unusable since sample not run within 12 hours of an acceptable GC/MS tune.

Source: LMS Phase II Investigation Report, 1989

TABLE 5-9 (continued)
LMS August 1988 Trench Sample Data Summary

Tuxedo WD Site NYSDEC I.D. No. 336035

Parameter	T-1 S-A	T-1 S-B	T-2 S-A	T-2 S-B	T-3 S-A
METALS					
Lead	473,000 f	320,000 f	697,000 f	655,000 f	1,170,000 f
OTHER PARAMETERS					
Cyanide	1,900 f	1,100 f	3,300 f	1,800 f	3,300 f
Phenolics	ND	ND	ND	ND	ND
% Solids	68.5	82.2	73.2	79.5	79.5

All data in ug/kg.

f - Duplicate analysis not within control limits.

ND - Not detected.

Source: LMS Phase II Investigation Report, 1989

Table 5-10

- LMS (1988) TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A		3B
LABORATORY	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-26	SH336035-36	SH336035-27	SH336035-37	SH336035-28	SH336035-28DL	SH336035-38
PARAMETER							
TCL Volatiles (ug/kg or ppb)							
Methylene chloride	328	95	9J	77	44	NR	110
Acetone	1,300E	870	190	5708	63	NR	1,400E
Carbon disulfide	42	37J	20	ND	66	NR	41
1,2-Dichloroethene (total)	ND	ND	10J	ND	10J	NR	ND
2-Butanone	240	320	45	110	ND	NR	280
Trichloroethene	ND	ND	18	ND	8J	NR	ND
Benzene	ND	ND	6J	ND	ND	NR	ND
4-Methyl-2-pentanone	51J	ND	29	ND	21J	NR	ND
Tetrachloroethene	ND	ND	ND	ND	13J	NR	ND
Toluene	77	110	110	35	78	NR	49
Ethylbenzene	40	60	86	20J	55	NR	35
Total xylenes	150	260	310	64	230	NR	150
Volatile TICs (ug/kg)							
C10H16 Isomer	860J (3)	ND	990J (3)	ND	1,240J (3)	NR	ND
Unknown	ND	1,250J (3)	ND	263J (2)	ND	NR	915J (3)
TCL Semivolatiles (ug/kg)							
Phenol	ND	ND	390J	ND	ND	ND	ND
Benzyl alcohol	ND	ND	370J	ND	ND	ND	ND
4-Methylphenol	5,500J	ND	370J	ND	4200J	ND	3400
Naphthalene	2,2000	3200	5900	17000	270000E	ND	23000
2-Methylnaphthalene	6,100J	ND	2400J	3700	42000	27000JD	8300
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	1,400J	ND	1600J	ND	2400J	3000JD	ND
Acenaphthene	9200	ND	2000J	2400	46000	41000D	16000
Dibenzofuran	6,000J	ND	2200J	1700	40000	390000	13000
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND
Fluorene	10000	ND	4000	2800	52000	480000	17000
Phenanthrene	56000	9700	26000	18000	220000	2000000	53000E
Anthracene	12000	2000	5200	3800	42000	400000	15000
Di-n-butylphthalate	ND	2400	ND	ND	ND	9600JB	2400
Fluoranthene	59000	13000	25000	24000	140000	1600000	50000E
Pyrene	44000	11000	22000	19000	120000	870000	42000E
Butylbenzylphthalate	5700J	31000	5200	2200	67000	580000	3200
Benzo(a)anthracene	25000	5500	9400	8900	34000	340000	15000
Bis(2-ethylhexyl)phthalate	52000	28000B	20000	55000BE	21000	18000JD	22000B
Chrysene	22000	5100	10000	8200	33000	350000	16000
Benzo(b)fluoranthene	20000	4800	16000X	6400	34000X	43000X	11000
Benzo(k)fluoranthene	21000	3200	16000X	6000	34000X	43000X	8000

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

Source: LMS Phase II Investigation Report, 1989

Table 5-10 (continued)

LMS (1988) TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A		3B
LABORATORY	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-26	SH336035-36	SH336035-27	SH336035-37	SH336035-28	SH336035-28DL	SH336035-38
PARAMETER							
TCL Semivolatiles (ug/kg or ppb) (Cont.)							
Benzo(a)pyrene	19000	4500	9400	6600	16000	18000JD	8400
Indeno(1,2,3-cd)pyrene	14000	2400	5600	3100X	11000J	5000JD	3400
Dibenzo(a,h)anthracene	ND	ND	1900J	ND	ND	ND	ND
Benzo(g,h,i)perylene	13000	2400	4600	3000X	9700J	3600JD	2800X
Di-n-octylphthalate	ND	1900	ND	1700	ND	ND	830J
Semivolatile TICs (ug/kg)							
C10H16 Isomer	23000J	ND	6600J	ND	60000J	45000JD	ND
C10H16 Isomer	13000J	ND	ND	ND	ND	27000JD	ND
Benzene proprionic acid	92000J	ND	ND	ND	ND	ND	ND
C12H16O2 Isomer	11000J	ND	ND	ND	ND	ND	ND
4H-Cyclopenta[def] phenanthrene	8700J	ND	5900J	ND	34000J	32000JD	ND
Hexadecanoic acid	24000J	ND	ND	ND	ND	ND	ND
Sulfur, mol. (S8)	460000J	ND	26000J	ND	400000J	290000JD	ND
Unknowns	14000J (2)	29800J (10)	ND	34000J (6)	279000J (5)	666000JD (6)	51900J (7)
Unknown alkanoic acid	11000J	ND	ND	ND	ND	ND	ND
Unknown branched alkane	9600J	ND	ND	ND	ND	ND	ND
C17H12 Aromatic isomer	20600J (2)	ND	11000J (2)	ND	28000J	ND	ND
Unknown alkane	79000J (4)	5900J (3)	35100J (4)	ND	87000J (4)	151000JD (4)	7600J (3)
Unknown phthalate	71000J	ND	8600J	ND	ND	ND	ND
Benzo(j)fluoranthene	9200J	ND	ND	ND	ND	ND	ND
Benzo(e)pyrene	14000J	ND	4300J	ND	ND	ND	ND
1-Methyl-1-(methylethyl) benzene	ND	ND	3000J	ND	ND	20000JD	ND
C11H24 Isomer	ND	ND	41000J	ND	ND	ND	ND
C10H18 Isomer	ND	ND	3000J	ND	ND	ND	ND
Methylphenanthrene/anthracene	ND	ND	3500J	ND	ND	ND	ND
Docosane	ND	ND	7100J	ND	ND	ND	ND
Tetracosane	ND	ND	13000J	ND	ND	ND	ND
C18H12 & C18H10 Aromatic isomers	ND	ND	15000J	ND	ND	20000JD	ND
Pentacosane	ND	ND	17000J	58000J (3)	28000J	23000JD	ND
Hexacosane	ND	ND	ND	ND	42000J	25000JD	ND
Unknown adipate	ND	ND	ND	ND	56000J	ND	ND
Benzo(b)thiophene	ND	ND	ND	ND	20000J	ND	ND
1-Methylnaphthalene	ND	ND	ND	ND	23000J	21000JD	ND
C11H24 Isomer	ND	ND	ND	ND	60000J	ND	ND
Bicyclo[2.2.1]heptan-2-one, trimethyl isomer	ND	ND	ND	1900J	ND	20000JD	ND

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

Source: LMS Phase II Investigation Report, 1989

Table 5-10 (continued)
LMS (1988) TEST PIT DATA SUMMARY

Tuxedo WO Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A		3B
LABORATORY	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-26	SH336035-36	SH336035-27	SH336035-37	SH336035-28	SH336035-28DL	SH336035-38
PARAMETER							
Semivolatile TICs (ug/kg or ppb) (Cont.)							
Dibenzothiophene	ND	ND	ND	ND	ND	ND	ND
9H-Carbazole	ND	ND	ND	ND	ND	ND	ND
Benzo[B]naphtho[2,3-D]furan	ND	ND	ND	ND	ND	ND	ND
9H-Fluorene-carbonitrile isomer and unknown alkane	ND	ND	ND	ND	ND	ND	ND
C12H9N Isomer	ND	ND	ND	ND	ND	ND	ND
2-Phenylnaphthalene	ND	ND	ND	ND	ND	ND	ND
Octanoic acid	ND	10400J (2)	ND	73600J (9)	ND	ND	55400J (4)
Unknown hydrocarbon	ND	13200J (2)	ND	ND	ND	ND	12200J (2)
Unknown ketone	ND	6000J (2)	ND	ND	ND	ND	39800J (2)
Unknown PAH	ND	1400J	ND	ND	ND	ND	11000J
Unknown substituted benzene	ND	ND	ND	9300J	ND	ND	ND
5-Hexen-2-one, 5-methyl	ND	ND	ND	2600J	ND	ND	ND
3-Heptanone,2,4-dimethyl	ND	ND	ND	1300J	ND	ND	ND
Limonene	ND	ND	ND	1300J	ND	ND	ND
1,2-Ethanediol, monoacetate	ND	ND	ND	2000J	ND	ND	ND
1,4-Methanonapthalene, 1,4-	ND	ND	ND	3200J	ND	ND	ND
Heptadecane, 2,6-dimethyl	ND	ND	ND	20000J	ND	ND	ND
Pentatriacontane	ND	ND	ND	12000J	ND	ND	ND
Heptadecane, 2,6-dimethyl	ND	ND	ND				
Pesticides/PCBs ug/kg							
Dieldrin	ND	ND	ND	NR	ND	ND	20
Aroclor 1242	ND	1000	ND	970	ND	ND	640
Aroclor 1260	ND	200	ND	350	ND	ND	500

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

Source: LMS Phase II Investigation Report, 1989

Table 5-10 (continued)

LMS (1988) TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	4A		4B	5A	5B	1A		1B	
LABORATORY	ENSECO	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-29	SH336035-29DL	SH336035-39	SH336035-30	SH336035-40	SH336035-28MS	SH336035-28MSD	SH3360-36MS	SH3360-36MSD
PARAMETER									
TCL Volatiles (ug/kg or ppb)									
Methylene chloride	15	ND	140	10J	220	91B	84B	99	110
Acetone	320	ND	730B	360	1300B	1100	1700E	930	970
Carbon disulfide	14	ND	ND	ND	ND	10J	14J	ND	ND
1,2-Dichloroethene (total)	9J	ND	ND	11J	ND	ND	ND	ND	ND
2-Butanone	110	ND	91	130	ND	220	320	390	400
Trichloroethene	8J	ND	ND	10J	ND	ND	ND	ND	ND
Benzene	7J	ND	ND	7J	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	76	ND	ND	68	ND	46J	62	ND	ND
Tetrachloroethene	5J	ND	ND	3J	ND	ND	ND	ND	ND
Toluene	160	ND	57	160	64	ND	ND	ND	ND
Ethylbenzene	62	ND	23J	55	54	26J	28J	42J	41J
Total xylenes	190	ND	78	180	190	110	120	210	220
Volatile TICs (ug/kg)									
C10H16 Isomer	710J (3)	ND	ND	650J (3)	ND	NA	NA		
Unknown	ND	ND	50J	ND	530J (2)	ND	ND	NA	NA
TCL Semivolatiles (ug/kg)									
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	3500	7600J	5200J	2600	5000
Naphthalene	15000	13000JD	4400	1800	12000	32000	18000	5300	7000
2-Methylnaphthalene	7200J	4800JD	2000	4400	3500	14000	7100J	ND	2300
Dimethylphthalate	ND	ND	ND	ND	ND	1000J	1200J	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	4900J	1600J	ND	ND
Acenaphthene	24000	21000JD	2700	1900J	2200	ND	ND	ND	ND
Dibenzofuran	20000	16000JD	2600	960J	1600	22000	9200	1600X	2500X
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	35000	29000D	3700	1100J	ND	29000	14000	2200	3600
Phenanthrene	300000E	230000D	17000	5600	4500	26000E	85000	1300	26000
Anthracene	60000	48000D	2500	1900J	ND	54000	21000	2700	4900
Di-n-butylphthalate	ND	98000JDB	990J	ND	1100	ND	2500J	4300	4100
Fluoranthene	360000E	300000D	23000	11000	6600	28000E	90000	16000	370J0E
Benzoic acid	ND	ND			1400JX			ND	ND

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

Source: LMS Phase II Investigation Report, 1989

Table 6-10 (continued)
LMS (1988) TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	4A		4B	5A	5B	1A		1B	
LABORATORY	ERSECO	ERSECO	VERSAR	ERSECO	VERSAR	ERSECO	ERSECO	VERSAR	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-29	SH336035-29DL	SH336035-39	SH336035-30	SH336035-40	SH336035-28MS	SH336035-28MSD	SH3360-30MS	SH3360-30MSD
PARAMETER									
TCL Semivolatiles (ug/kg or ppb) (Cont.)									
Pyrene	330000E	2000000	26000	9800	6000	ND	ND	Y	Y
Butylbenzylphthalate	200000	1400000	2600	5400	2700	4300J	5400J	20000	17000
Benzo(a)anthracene	130000	1100000	12000	4400	3300	100000	33000	6600	18000
Bis(2-ethylhexyl)phthalate	50000	350000D	430000BE	13000	460000BE	13000	18000	870000BE	160000BE
Chrysene	140000	1100000	11000	5000	3300	93000	30000	6500	17000
Benzo(b)fluoranthene	200000X	2000000XD	12000	6900X	3700	150000X	46000X	6500	17000
Benzo(k)fluoranthene	200000X	2000000XD	7300	6900X	2600	150000X	46000X	3800	11000
Benzo(a)pyrene	120000	990000	9100	4600	3200	83000	27000	5500	15000
Indeno(1,2,3-cd)pyrene	25000	310000	4200	ND	1500	26000	13000	2700	6700
Dibenzo(a,h)anthracene	11000J	90000JD	ND	ND	ND	6500J	3400J	ND	2300
Benzo(g,h,i)perylene	22000	230000	3600	ND	1700	20000	11000	2700	5800
Di-n-octylphthalate	ND	ND	1800	ND	2400	ND	ND	7400	3600
Semivolatile TICs (ug/kg)									
C10H16 Isomer	ND	19000JD	ND	5500J	ND	NA	NA	NA	NA
C10H16 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
Benzene proprionic acid	ND	ND	ND	ND	ND	NA	NA	NA	NA
C12H16O2 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
4H-Cyclopenta[def] phenanthrene	36000J	30000JD	ND	ND	ND	NA	NA	NA	NA
Hexadecanoic acid	ND	ND	ND	ND	ND	NA	NA	NA	NA
Sulfur, mol. (S8)	200000J	110000JD	ND	382700J (2)	ND	NA	NA	NA	NA
Unknowns	38000J (2)	450000JD (4)	25680J (8)	22900J (6)	72200J (9)	NA	NA	NA	NA
Unknown alkanoic acid	ND	ND	ND	12300J (2)	ND	NA	NA	NA	NA
Unknown branched alkane	ND	ND	ND	ND	ND	NA	NA	NA	NA
C17H12 Aromatic isomer	ND	78000JD (3)	ND	ND	ND	NA	NA	NA	NA
Unknown alkane	130000J (4)	48000JD (3)	8100J (4)	16100J (5)	4800J (2)	NA	NA	NA	NA
Unknown phthalate	ND	ND	ND	11600J (2)	ND	NA	NA	NA	NA
Benzo(j)fluoranthene	15000J	ND	ND	ND	ND	NA	NA	NA	NA
Benzo(e)pyrene	41000J	ND	ND	ND	ND	NA	NA	NA	NA
1-Methyl-1-(methylethyl) benzene	ND	ND	ND	ND	ND	NA	NA	NA	NA
C11H24 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
C10H18 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
Methyl phenanthrene/ anthracene	32000J (2)	15000JD	ND	ND	ND	NA	NA	NA	NA
Docosane	ND	ND	ND	ND	ND	NA	NA	NA	NA

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit
X - Coeluted.
D - Compound detected in diluted sample.

Source: LMS Phase II Investigation Report, 1988

Table 5-10 (continued)

LMS (1988) TEST PIT DATA SUMMARY

Tuxedo NY Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	4A		4B	5A	5B	1A		1B	
LABORATORY	ERSECO	ERSECO	VERSAR	ERSECO	VERSAR	ERSECO	ERSECO	VERSAR	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-29	SH336035-29DL	SH336035-39	SH336035-30	SH336035-40	SH336035-20MS	SH336035-20MSD	SH33360-36MS	SH33360-36MSD
PARAMETER									
Semivolatile TICs (ug/kg or ppb) (Cont.)									
Tetracosane	ND	ND		ND		NA	NA	NA	NA
C18H12 & C18H10 Aromatic isomers	27000J	22000JD		ND		NA	NA	NA	NA
Pentacosane	ND	ND	ND	ND	ND	NA	NA	NA	NA
Hexacosane	ND	ND		ND		NA	NA	NA	NA
Unknown adipate	ND	ND		ND		NA	NA	NA	NA
Benzo(b)thiophene	ND	ND		ND		NA	NA	NA	NA
1-Methylnaphthalene	ND	ND		2100J		NA	NA	NA	NA
C11H24 Isomer	ND	ND		ND		NA	NA	NA	NA
Bicyclo[2.2.1]heptan-2-one, trimethyl isomer			ND	ND	ND	NA	NA	NA	NA
Dibenzothiophene	14000J	ND		ND		NA	NA	NA	NA
9H-Carbazole	25000J	ND		ND		NA	NA	NA	NA
Benzo[B]naphtho[2,3-D]furan	15000J	40000JD		ND		NA	NA	NA	NA
9H-Fluorene-carbonitrile isomer and unknown alkane	23000J	ND		ND		NA	NA	NA	NA
C12H9N Isomer	ND	21000JD		ND		NA	NA	NA	NA
2-Phenylnaphthalene	ND	15000JD		ND		NA	NA	NA	NA
Octanoic acid	ND	ND		3500J		NA	NA	NA	NA
Unknown hydrocarbon	ND	ND	13100J (5)	ND	336000J (9)	ND	ND	NA	NA
Unknown ketone	ND	ND	12800J (3)	ND	8300J (2)	ND	ND	NA	NA
Unknown PAH	ND	ND	7500J (2)	ND	1700J	ND	ND	NA	NA
Unknown substituted benzene	ND	ND	ND	ND	ND	ND	ND	NA	NA
5-Hexen-2-one, 5-methyl	ND	ND	ND	ND	NDL	ND	ND	NA	NA
3-Heptanone, 2,4-dimethyl	ND	ND	ND	ND	ND	ND	ND	NA	NA
Limonene	ND	ND	ND	ND	ND	ND	ND	NA	NA
1,2-Ethanediol, monoacetate	ND	ND	ND	ND	ND	ND	ND	NA	NA
1,4-Methanonapthalene, 1,4-	ND	ND	ND	ND	ND	ND	ND	NA	NA
Heptadecane 2,6-dimethyl	ND	ND	ND	ND	ND	ND	ND	NA	NA
Pesticides/PCBs (ug/kg)									
Dieldrin	ND	ND	285	ND	33	ND	ND	ND	ND
Aroclor 1242	ND	ND	550	ND	500	ND	ND	3300	3000
Aroclor 1260	ND	ND	240	ND	170	ND	ND	740	1100

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

Source: LMS Phase II Investigation Report, 1989

Table 5-10 (continued)
LMS (1988) TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B
LABORATORY	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO
NYSDEC SAMPLE I.D. No.	SH336035-11	SH336035-12	SH336035-13	SH336035-14	SH336035-15	SH336035-16	SH336035-17	SH336035-18	SH336035-19	SH336035-20
PARAMETER										
TCL Metals (ug/kg or ppb)										
Aluminum	6480000	8920000	6000000	6400000	7920	7750000	6670000	5510000	9450000	7530000
Antimony	9100AN	NDN	11800AN	11000AN	13600AN	11100AN	18800N	16300AN	10100AN	16700AN
Arsenic	4200	4300	3900+	11400	6700	8500	18500	4600	4200S	9000S
Barium	741000*	575000*	571000*	684000*	2200000*	311000*	486000*	1700000*	532000*	1120000*
Beryllium	340A	360A	400A	310A	490A	430A	420A	310A	490A	430A
Cadmium	ND	6100*	4600*	1600*	1500*	1700*	2600*	3000*	5300*	4900*
Calcium	49600000	34000000	91700000	54500000	87900000	48900000	80200000	86900000	34600000	57000000
Chromium	42900	46800	25900	37800	29100	27700	23500	30900	83800	49000
Cobalt	8000A	14200	5100A	7500A	6600A	8200A	5500A	5900A	12800	11300A
Copper	1520000*	239000*	44700*	175000*	629000*	106000*	66400*	87900*	236000*	304000*
Iron	18500000	31800000	14100000	27400000	17200000	21900000	16600000	13700000	39900000	35600000
Lead	582000*	868000*	523000*	2160000*	697000*	722000*	511000*	714000*	857000*	1710000*
Magnesium	7230000	7550000	6460000	6640000	8740000	5720000	9340000	8650000	5520000	7850000
Manganese	335000*N	512000*N	295000*N	266000*N	312000N*	336000N*	432000N*	256000N*	704000N*	434000N*
Mercury	1000	2200	700	1100	900	1000	800	700	1600	1900
Nickel	39100	63200	18000	23300	24500	26600	18200	18900	76800	94500
Potassium	1280000	1070000A	1240000A	1230000A	1650000	1200000A	1440000	1440000	784000A	1420000A
Selenium	ND	ND	ND	610A	ND	ND	ND	ND	ND	NDW
Silver	2300A	1300A	8200	1100A	1500A	ND	1600A	1300A	1200A	4400
Sodium	705000A	962000A	326000A	309000A	758000A	410000A	647000A	848000A	368000A	1160000A
Vanadium	29600	43900	56100	32300	33600	22700	32400	21400	46300	56300
Zinc	890000E*	1410000E*	531000E*	1450000E*	1560000E*	534000E*	738000E*	1180000E*	210000E*	344000UE*
Cyanide	1500	ND	ND	ND	1800	1300	680	ND	2000	2100
Total Solids %	78.9	84.4	73.0	76.0	74.4	77.7	73.9	72.2	79.6	70.1
Dioxins (ug/kg or ppb)	[SH336035-21]		[SH336035-22]							
1,2,3,4,6,7,8HCDD	1.5	NR	ND	NR	NR	NR	NR	NR	NR	NR
HCDD	3.1	NR	ND	NR	NR	NR	NR	NR	NR	NR
OCDD	27.0	NR	9.1	NR	NR	NR	NR	NR	NR	NR

ND - Not detected.
A - Below contract required detection limits.
N - Spiked sample recovery not within limits.
E - Reported value is an estimate because of the presence of an interference.
W - Spike for furnace AA not within limits.
S - Value determined by method of standard additions (MSA).
* - Duplicate analyses not within control limits for all values.
\+ - Correlation for MSA is less than 0.995.
NR - Not run.

Source: LMS Phase II Investigation Report, 1989

During the M&E Phase 1 RI, soil samples were collected from seven borings. All of these samples were analyzed for volatile and semi-volatile organic compounds (see Table 5-11) and inorganic constituents (see Table 5-12).

5.3.1 Organic Compounds

The volatile organic analyses of the LMS (1988) trench samples did not pass QA/QC standards and therefore were not usable for interpretation. The semi-volatile organic analyses did not meet QA/QC requirements; however the data are considered to be estimations and can be used qualitatively. The results are summarized below.

- Polycyclic aromatic hydrocarbons (PAHs) including pyrene, fluorene, anthracene, benzo(a)pyrene, chrysene and others comprised most of the semi-volatile organic compounds found in the samples Total PAH concentrations ranged from 177,300 µg/kg in Trench-1A (T-1) to 382,400 µg/kg in Trench-2B (T-2). PAHs are present in coal tars used to preserve railroad ties, which were found in abundance at the site. Also, coal tars are used in asphalts, roofing material, and road oils.

- Phthalate acid esters (PAEs) were also detected in high concentrations (ranging from 15,200 to 44,000 µg/kg). PAEs are generally used as plasticizers and are commonly found where large quantities of plastics are present such as in landfills. However, some are common laboratory contaminants and were found in method blanks.

- Dibenzofuran was also detected at elevated concentrations (ranging from 3,700 to 10,000 µg/kg). This compound is a component of coal tars and coal tar distillation residues.

- Hydrocarbon compounds and unknown TIC hydrocarbons were found at high concentrations (55,000 to 800,000 µg/kg) indicating large quantities of these compounds present in the fill materials.

The test pit samples obtained by LMS contained high levels of volatile and semi-volatile organic compounds. The major groups of volatile organic compounds were ketones (such as acetone, 2-butanone and 4-methyl-2-pentanone), mono-aromatics or BTX compounds (such as benzene, toluene, xylene and ethylbenzene) and chlorinated ethenes (such as dichloroethene, trichloroethene and tetrachloroethene). Results are as follows:

Table 5-11
TUXEDO WASTE DISPOSAL SITE
NUS (1990) SOIL BORING SAMPLING DATA
ANALYTICAL RESULTS-VOLATILE AND SEMIVOLATILE ORGANIC COMPOUNDS

VOLATILES	CRQL	RIB-1 (15-17) ug/kg	RIB-2 (25-27) ug/kg	RIB-3 (10-12) ug/kg	RIB-4 (15-17) ug/kg	RIB-5 ug/kg	RIB-6 (22-24) ug/kg	RIB-7 (15-17) ug/kg
Methylene Chloride	5	U	U	0.6 J	6 BJ	1 J	2 J	1 BJ
Acetone	10	11 B	15 B	U	3 J	4 BJ	6 BJ	14 B
Chloroform	5	U	U	U	2 J	U	U	U
1,1,1-Trichloroethane	5	U	U	U	1 J	U	U	1 BJ
cis-1,3-Dichloropropene	5	U	U	U	U	U	U	U
2-Hexanone	10	U	U	U	U	U	U	U
Toluene	5	0.8 J	0.9 J	1 BJ	1 BJ	U	0.9 BJ	0.7 BJ
Total VO	--	11.8	15	1.6	13	5	8.9	16.7

SEMIVOLATILES	CRQL	RIB-1	RIB-2	RIB-3	RIB-4	RIB-5	RIB-6	RIB-7
Phenanthrene	330	U	U	U	55 J	U	U	U
Anthracene	330	U	U	U	U	U	U	U
Di-n-butylphthalate	330	U	U	1100	4400 B	140 J	U	99 J
Fluoranthene	330	U	U	U	72 J	U	U	U
Pyrene	330	U	U	U	55 J	U	U	50 J
Butylbenzylphthalate	330	U	U	U	700 J	U	U	91 J
Bis(2-ethylhexyl)phthalate	330	170 J	150 J	120 J	130 J	150 J	63 J	840
TOTAL BN	.	170	155	1220	5412	290	63	1080

VO = Volatile Organics:
BN = Base Neutrals:
U = Below contract detection limit.
B = Compound found in blank.
J = Value estimated below contract detection limit.

Table 5 17
TUXEDO WASTE DISPOSAL SITE
RAI (1990) SOIL BORING SAMPLING DATA
ANALYTICAL RESULTS-INORGANIC CONSTITUENTS

INORGANICS		CONTRACT DETECTION LIMITS (UG/KG, ppb)	RIB-1 (15-17') mg/kg	RIB-2 (25-27') mg/kg	RIB-3 (10-12') mg/kg	RIB-4 (15-17') mg/kg	RIB-5 mg/kg	RIB-6 (22-24') mg/kg	RIB-7 (15-17') mg/kg
ALUMINUM	P	---	3860.00	7950.50	15420.00	6830.00	9020.00	6240.00	14100.00
ANTIMONY	P	6000	1.00 U	0.51 U	0.46 U	0.52 U	1.35 U	0.56 U	0.63 U
ARSENIC	P	1000	1.50	1.50	2.55	2.20	1.73	2.20	3.58 U
BARIUM	P	20000	106.00	24.80	43.40	31.40	32.50	23.60	63.80
BERYLLIUM	P	500	0.27 B	0.40	1.00	0.46 B	0.41	0.39 B	0.89
CADMIUM	P	500	5.90	0.59 U	1.30	0.53 U	1.13	0.52 U	[illegible]
CALCIUM	P		1070.00	2200.00	1620.00	2250.00	2800.00	1130.00	2660.00
CHROMIUM	P	1000	52.60	22.10	25.00	15.50	17.80	10.90	20.50
COBALT	P	5000	3.70	7.70	12.50	8.55	3.60	6.60	7.55
COPPER	P	2500	20.40	24.20	22.00	28.10	23.50	10.50	25.40
IRON	P	---	5310.00	18000.00	25700.00	18500.00	19200.00	18700.00	17500.00
LEAD	P	500	26.30	8.80	12.00	8.10	6.70	7.30	10.40
MAGNESIUM	P	---	971.00	3300.00	3640.00	3710.00	2700.00	3340.00	3590.00
MANGANESE	P	---	40.70	423.00	870.00	345.00	219.00	228.00	212.00
MERCURY	CV	20	0.12 U	0.11 U	0.10 U	0.20	0.11 U	0.10	0.14
NICKEL	P	4000	7.10	20.60	24.50	16.80	15.70	17.20	21.50
POTASSIUM	P	---	729.00	1350.00	771.00	1140.00	815.00	602.00	1090.00
SELENIUM	P	500	0.52 U	0.51 U	0.45 U	0.56 U	0.51 U	0.56 U	0.59 U
SILVER	P	1000	0.34 U	0.85 U	3.80	0.78 U	0.82 U	0.73 U	0.82 U
SODIUM	P		259.00 B	232.00 B	[illegible] B	149.00 B	[illegible] B	[illegible] B	226.00 B
THALLIUM	P	1000	0.52 U	0.51 U	0.48 U	0.55 U	[illegible] U	0.56 U	0.59 U
VANADIUM	P	5000	12.00	23.50	28.10	9.70	17.50	15.80	35.80
ZINC	P	2000	39.20	55.60	66.00	56.30	59.10	46.20	65.70

B = Found in blank.
U = Not detected.
I = Exceeds NJDEP Soil Action Level.

- Test Pit-3B (TP-3) and Test Pit-1A (TP-1) samples contained the highest levels of total volatile organic compounds 2,065 µg/kg and 1,939 µg/kg total VOCs, respectively.
- Semi-volatile organic compounds, specifically PAHs, were found in very high levels in all of the test pit samples. Samples contained levels of total semi-volatiles ranging from 194,000 µg/kg in TP-1B to 2,853,000 µg/kg in TP-4A.
- PCBs were found in all five samples at low concentrations ranging from 670 µg/kg in TP-5B to greater than 1,200 µg/kg in TP-1B.
- The pesticide dieldrin was detected in three of the five samples.
- Dioxin was found in the samples from TP-1A (27 µg/kg of octachlorodibenzo-p-dioxin and 3.1 µg/kg of heptachlorodibenzo-p-dioxin) and TP-2A (9.1 µg/kg of octachlorodibenzo-p-dioxin).

The analytical results of the soil boring samples obtained by M&E indicated that low levels of volatile and semi-volatile organic compounds were found (Table 5-11). The highest concentrations of total organic compounds were found in the sample from RIB-7 (16.7 µg/kg). However, many compounds detected in the samples were also found in blanks. The highest concentration of total semi-volatiles was found in the sample from RIB-4 (5,412 µg/kg). PAH and PAE compounds were the major contaminants found in the soil boring samples.

Based on the findings contained in the data usability report discussed in Section 4.6 of this report, several volatile and semi-volatile organic compounds (methylene chloride, acetone, toluene, 1,1,1 trichloroethane and di-n-butylphthalate) were determined to be invalid.

5.3.2 Metals

All of the metals analyses (except lead) of the LMS (1988) trench samples were rejected by NYSDEC and deemed unusable. All of the samples contained lead; the highest level (1,170 mg/kg) was found in the sample from T-3. The source of these elevated lead concentrations may be from gasoline contaminated soil disposed of at the site. Cyanide was found at fairly high concentrations (1.1 to 3.3 mg/kg). In addition, as mentioned earlier, trench samples were also tested for EP toxicity. Although all of the levels of metals were below the EP toxicity levels for classification of wastes as hazardous, the high lead concentrations would fail the test for EP Toxicity if the current EP toxicity level of 0.05 mg/l is reduced to the proposed levels of 0.015 or 0.01 mg/l.

The test pit samples obtained by LMS contained relatively high levels of cadmium, copper, lead, mercury, silver, and zinc. The analytical results of the soil boring samples obtained by M&E (Table 5-12) indicated that cadmium was found in the sample from RIB-1 at a concentration of 5.8 mg/kg.

Based on the findings contained in the data usability report discussed in Section 4.6 of this report, the metals data was determined to be usable as estimated values.

5.4 AIR EMISSIONS - BASELINE EMISSION ESTIMATE

Emissions of airborne toxic contaminants from landfills accompany the landfill generated gases resulting from the anaerobic decomposition of fill materials. Landfill gas emission rates were calculated from the estimated equivalent quantities of carbonaceous fill material which might decompose over a 70-year period. Estimates of fill material quantities were based on surveys involving geophysical techniques, soil borings, and historic data. The following discussion summarizes the assumptions, methodologies and selection of data used for the health risk assessment.

5.4.1 Landfill Gas Generation Rate

Approximately 476,500 cubic yards of material were deposited in the Tuxedo Waste Disposal Site (LMS 1989). The majority of this material is assumed to be construction demolition (C&D) waste. Deposition of medical, hazardous and solvent waste materials has also been reported, but has not been quantified. The amount of such non-construction demolition waste is thought to be small relative to the amount of construction demolition waste. For purposes of gas generation rates, a density of 1.05 tons per cubic yard was used, and all material was therefore assumed to be equivalent in gas generation potential to municipal waste.

The landfill was divided into ten square subsections as shown in Figure 5-5. The subsections, which are used for air dispersion modeling, represent location-specific gas compositions and generation sources resulting from the heterogeneous placement of deposited materials. The estimated waste quantities in the ten subsections are shown in Table 5-13.

Municipal landfills typically generate 2,800 to 3,000 cubic feet of landfill gas per ton of disposed material (USEPA, 1984; USEPA, 1990a; USEPA, 1990b, Stafford 1991). A conservative approach was used by assuming a gas generation rate of 3,000 cubic feet of gas per ton. However, rather than assuming a variable yearly gas generation rate, a 70-year constant gas generation period was assumed. These assumptions result in an estimated gas release rate that may be high since C&D waste typically would contain materials with an aggregate lower organic carbon content (e.g. wall board, concrete fragments) which would tend to decompose more slowly than municipal garbage. Table 5-13 shows the estimated emission rate of landfill gas from each subsection. Appendix A presents the calculation method used to estimate the gas emission and contaminant emission rates from each landfill subsection.

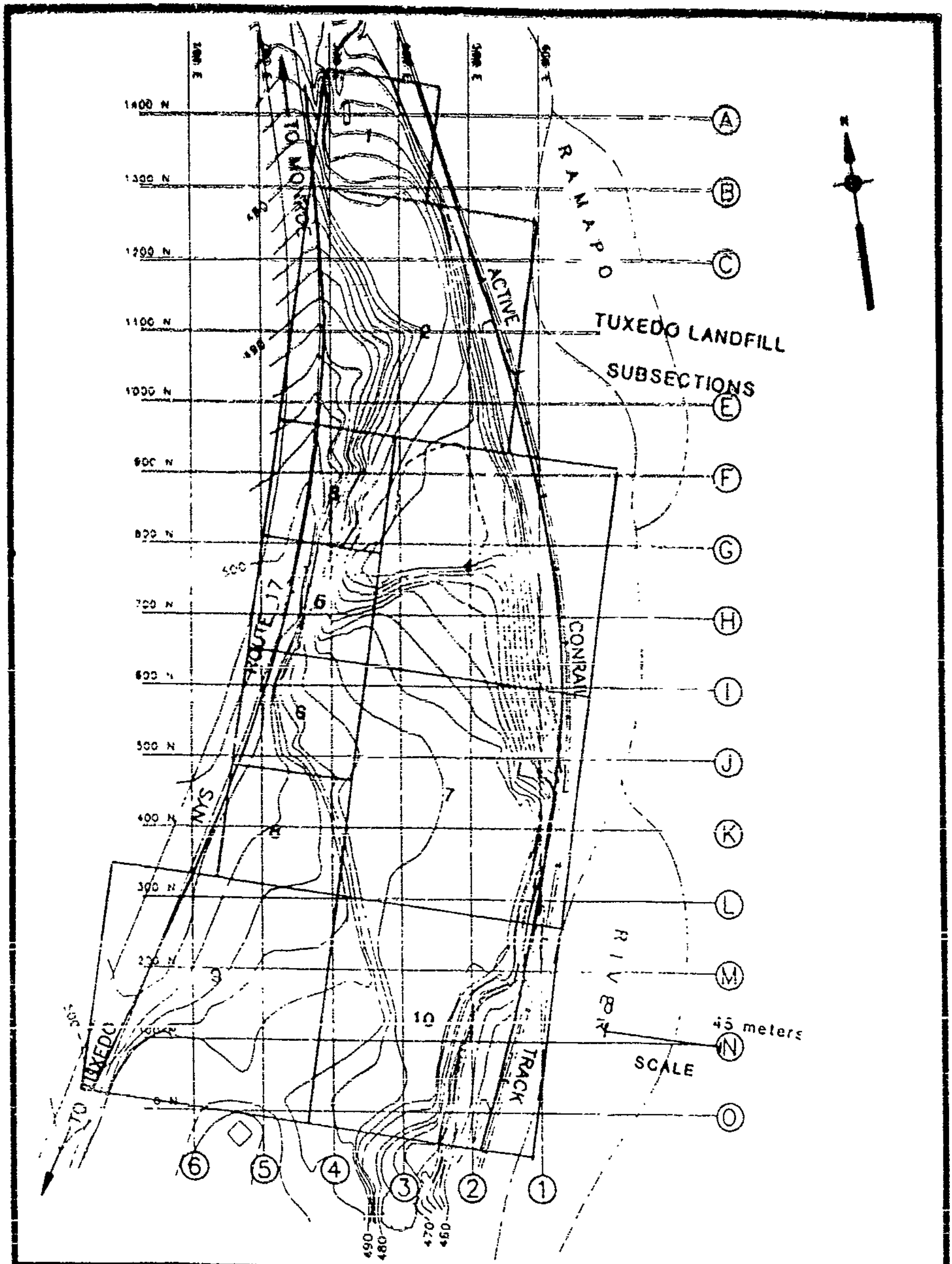
5.4.2 Air Monitoring

Limited off-site ambient air sampling for hydrogen sulfide was conducted. The results are presented in Section 4.12. VOC sampling was attempted but not completed due to weather and equipment problems.

5.4.3 Odor Nuisance

Based on field measurements, a significant amount of hydrogen sulfide gas is being generated at the site. The H_2S is believed to result from decomposition of gypsum in construction debris deposited in the landfill.

Modeling techniques discussed in Sections 6.0 and 7.0 of this report predict average ambient hydrogen sulfide concentrations of 7.8 $\mu g/m^3$ (0.0056 ppm) near the site. Hydrogen sulfide has a reported very low odor threshold value of



M&E
Metcalf & Eddy

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 5-5
TUXEDO LANDFILL SUBSECTIONS

TABLE 5-13 - GAS GENERATION RATES FROM TUXEDO LANDFILL SUBSECTIONS(1)

Landfill Subsection	Estimated Volume, cubic yards(2)	Estimated Weight of Materials, tons(3)	Estimated Gas Generation Rate, million cubic feet/year(4)	Cubic Feet Hour
1	7,440	7,812	0.34	38
2	22,322	23,438	1.00	114
3	11,162	11,720	0.50	57
4	211,640	222,222	9.52	1,087
5	18,602	19,532	0.84	96
6	26,042	27,344	1.18	134
7	89,286	93,750	4.02	459
8	17,411	18,282	0.79	89
9	33,483	35,157	1.5	172
10	39,063	41,016	1.75	201
Total	476,451	500,273	21.44	2,447

Notes:

(1) Landfill subsections represent square areas used for dispersion modeling.

(2) Volumes estimated based on soil borings and geophysical studies.

(3) Weight based on 1.05 tons per cubic yard.

(4) Gas Generation Rate based on 3000 cubic feet per ton for 70 years.

0.0005-0.005 ppm (Leonardos et al., 1969). The prevailing wind pattern would tend to transport airborne contaminants to areas north and south of the site along Route 17. Under conditions of poor vertical mixing, H_2S would constitute an odor nuisance in the immediate area which would be evident to large numbers of motorists passing the site.

SECTION 6

6.0 CONTAMINANT FATE AND TRANSPORT

6.1 POTENTIAL PATHWAYS OF MIGRATION

Past disposal activities at the site led to contamination of all media. The soil samples showed heavy metals, volatile organics, and semi-volatile organic compounds. Downgradient groundwater wells show the presence of metals contamination, and one downgradient well at the northern end of the site has also shown limited organics contamination. Measured emissions to the atmosphere include methane, hydrogen sulfide, and volatile organic compounds as well as carbon dioxide. The principal pathways of contaminant migration from the site are via air and water. There are also potential secondary pathways such as through site vegetation and wildlife entering onto the site

The air pathways include releases of gases and vapors directly, as well as transport of windborne fugitive dust. Since most of the site is covered with clean fill, contaminant transport via windborne dust should be minimal.

The water pathways for potential contaminant migration consist of surface run-off and groundwater flow. Surface run-off from storm water on the site should present minimal contamination transport for the following reasons.

- Except for a small exposed area of landfill waste at the southeastern corner, the site is covered with clean fill.
- An area of ponded water was drained, filled, and regraded as an IRM to eliminate standing water onsite.
- Surface run-on the north end of the site was improved as an IRM.

One problem related to surface run-on does exist at the southern end of the site. Storm water entering the site through a ravine at the southwest corner is supposed to be channeled through a subsurface drain pipe running through a southern portion of the site. Testing and inspection showed this drain pipe to be badly damaged. Test results indicate that storm water entering the pipe would infiltrate the landfill and become part of the groundwater system.

Groundwater flow is a potential contaminant migration pathway. It is discussed in more detail in Section 6.3.1.

In addition, the Ramapo River represents a potential release point for contaminated groundwater. The river provides two potential media for contaminant transport: first, there is the river water itself; second, contaminated river sediment and bank soil can be entrained by the flowing current. This is discussed further in Section 6.3.2.

6.2 CONTAMINANT PERSISTENCE

The persistence of a chemical contaminant species at a site is a function of its chemical and physical properties, its physical state, the media with which it is in contact, and destructive processes to which it is exposed. Contaminant material may be degraded and altered by chemical and biological processes in situ, and it may be released to other media and thereby subjected to other transport processes. An additional and important factor which affects contaminant persistence is the degree to which the contaminant is adsorbed by soil, since this directly affects its release to other media.

Volatile organic compounds can appear as soil gases which are ultimately released to the atmosphere. These materials are also soluble to greater or lesser degrees in groundwater, which can also serve as a medium of transport.

Some chlorinated organics, such as trichloroethylene, are subject to hydrolysis or dehalogenation reactions in the soil. Toluene, an aromatic, is subject to microbial degradation (Olsen, 1990).

Polyaromatic hydrocarbons, which are semi-volatiles, tend to be persistent. They are not highly volatile, generally have low solubility in water, and are usually resistant to biological degradation. Pyrene, for example, has been reported as a material with low mobility (Olsen, 1990).

Two other soil gas contaminants, methane and hydrogen sulfide, are generated in the landfill by anaerobic reactions of the waste materials deposited there. Methane and hydrogen sulfide gases appear as soil gases and are released to the atmosphere. In addition, hydrogen sulfide may dissolve in groundwater, and it may also react with metallic ions in the soil to form insoluble and fairly immobile sulfides.

Some of the metals contamination at the site, such as lead, iron and aluminum, may exist in an elemental state as part of the debris. Their persistence, as such, would be a function of the chemical properties of the environment with which they are in contact. The main metal compounds present at the site are probably oxides or hydroxides, although the presence of hydrogen sulfide makes metal sulfide salts a possibility. Solubility of these metal salts in groundwater is a function of their respective chemical properties, and the temperature and pH of the groundwater. In general, sulfide salts of heavy metals tend to be less soluble than hydroxides.

6.3 CONTAMINANT MIGRATION

Contaminant migration may occur through both waterborne and airborne pathways.

6.3.1 Groundwater

At the Tuxedo Waste Disposal Site, high groundwater gradients and conductivities in the overburden deposits, calculated from the limited available data, generally relate to high groundwater velocities which enhance contaminant migration. This is evidenced by the elevated metals concentrations that were detected in samples from the downgradient monitoring wells (see Figure 5-3).

Groundwater flow directions and rates at the site are influenced by localized gradients created by variations in site topography, landfill materials, and geologic deposits. The pathways of flow for groundwater at the landfill are not homogenous due to the different types of unconsolidated soils including clays, sands and gravels, as well as consolidated deposits or bedrock. The groundwater flow appears to be horizontal based on data from the monitoring wells as discussed in Section 3. The landfill cover limits infiltration of surface run-on into the landfill materials. In general, groundwater contamination in the overburden deposits is migrating eastward to the Ramapo River. The possibility that contaminated groundwater is also migrating vertically and reaching points east of the river in a deeper regional flow system is not supported by the available data.

6.3.2 Surface Water

The Ramapo River is being marginally affected by contaminant migration. Groundwater contaminated by metals and semi-volatile organic compounds appears to be migrating from the Tuxedo Waste Disposal Site in an easterly direction and discharging into the Ramapo River. This is evidenced by elevated levels of metals found in river water samples collected along the river bank at mid-site and downstream sampling locations, as well as elevated levels of metals and semi-volatile organic compounds detected in river sediment samples obtained along the river bank at mid-site and downstream sample locations. In addition, a leachate seep appears to be emanating from the landfill site near the river bank. River water and sediment samples obtained at the mid-site sampling location near this apparent seep contained elevated levels of contaminants. Elevated levels of some contaminants, however, were also found in samples obtained upstream of the site. Therefore, contamination from a possible upstream source may also be contributing to the contamination in the river near the landfill site.

Contaminant migration into the river surface water may also occur if contaminated sediment is disturbed, suspended, and transported downstream. This can occur during high flow, high velocity conditions when the contaminated sediment may be scoured from the river bank and/or river bed and become entrained and deposited further downstream.

Current data indicate that the release of contaminants from the site to the Ramapo River is not significantly affecting the water quality of the river water at the present time. Analysis of data from the 1988 LMS study and the 1990 (M&E) do not establish a trend of increasing contamination from the Tuxedo site. With continued evolution of the landfill, however, the threat to the Ramapo River may increase. This longer-term trend may be monitored by continued groundwater and surface water sampling and analysis.

6.3.3 Soils

Windborne fugitive dust containing contaminated soil particles from a landfill surface is a potential pathway for off-site contaminant migration. However, the surface of the Tuxedo Waste Disposal Site is covered with a cap of imported clean soils, and therefore this pathway is not likely to contribute to any significant transport of chemical contaminants from the landfill.

6.3.4 Ambient Air

Potential inhalation of gas emitted from the landfill is a source of concern. EPA's Industrial Source Complex Model, a computer based Gaussian dispersion model, was used to simulate potential airborne contaminant concentrations and provide primary input data for subsequent health risk assessments. This section describes the data inputs used in the model. Both short-term and long-term concentrations were estimated for hydrogen sulfide. Long-term concentrations were estimated for other volatile landfill contaminants.

Climatology

New York State climatological summaries and descriptions from the 1930s through the 1970s were reviewed (NOAA 1983). The continental flow is the dominating climatic condition in the region. In addition, the climate of the Tuxedo area is influenced by three major air masses. Air from the northern interior of the continent is typically cool and dry. Prevailing winds from the south and southwest bring warm, moist air. Inland flows from the North Atlantic Ocean produce a cool, cloudy and damp maritime influence.

The prevailing wind in New York State is generally from the west. However, a coastal component does result in southerly winds. Northerly winds may occur during winter storm conditions. The wind rose for the Tuxedo Waste disposal site shows that winds are predominantly from the northwest and south, which is partly due to the effect of elevated terrain east and west of the site.

Precipitation is typically fairly uniform throughout the year, with the lowest amounts typically occurring during winter months. Clear conditions occur most frequently during the fall. In the fall season, most of the precipitation is associated with tropical storm events.

Meteorological Data

The dispersion modeling techniques that were applied in the airborne health risk assessment required the construction of hourly meteorological data sets. On-site meteorological data, consisting of wind speed, wind direction, and ambient temperature, were used with assumed values for atmospheric stability and mixing height. The values were incorporated into the Industrial Source Complex Short Term (ISCST) model as the source input data set.

Surface measurements of wind speed, wind direction and temperature were obtained from the on-site meteorological monitoring station during the period from August, through November, 1990. This resulted in 67 days of data which could be used for modeling purposes. Additional monitoring, carried out to ensure 90 days of usable data, will be evaluated and incorporated into the analysis as appropriate when it becomes available.

A wind rose constructed for the period of August 15 to November 16, 1990, was shown as Figure 4-18. During this period, northwesterly and southerly winds predominated because of the topography surrounding the site. High wind episodes were rare during the period of record. High wind episodes generally result in greater dispersion and lower concentrations from area sources and were not considered for the model.

Since site-specific values were not available, upper air data for mixing heights were obtained from average annual values as reported by Holzworth (Holzworth, Office of USEPA, Washington, DC 1972) Mixing heights typically would not have a significant effect on the atmospheric transport of gaseous emissions from ground level area sources such as landfills

Atmospheric stability values were estimated based on Turner's procedure (Turner, 1976). For modeling purposes, clear skies were assumed for the entire period. Consequently, daylight hours were considered unstable and nighttime hours were considered stable A transition was effected during daybreak and nightfall hours to represent changes between those two periods. Stability classes A and F were excluded from the modeling inputs Stability class A was omitted, as a conservative measure because it provides the greatest degree of beneficial vertical mixing and pollutant dispersion. Stability class F was excluded because it was judged to be overly conservative and unrealistic, given the site characteristics. These characteristics include proximity to a state highway, where passing vehicles contribute to turbulence at ground level, and an apparent high variance in nighttime wind direction which would contra-indicate the use of an F stability class for dispersion modeling Table 6-1 shows estimated atmospheric stabilities used in the dispersion model.

Air Dispersion Modeling

The EPA-preferred models for air quality impacts associated with potentially toxic landfill emissions are the Industrial Source Complex Long-Term (ISCLT) model for seasonal and annual predictions and the Industrial Source Complex Short-Term (ISCST) model for the shorter averaging periods (U.S. Environmental Protection Agency, 1986b, 1989c) However, with adequate meteorological data, ISCST can also be used for long-term estimates. The ISC models are based on diffusion equations using Gaussian distributions and can be used to simulate an area source

The ISCST model with the flat terrain mode was applied to estimate impacts from the Tuxedo Waste Disposal Site. Because the landfill emissions are at ground level, vertical dispersion can occur in only one direction (upward). Therefore, the maximum contaminant concentration within the pollutant plume will be close to ground level and will occur close to the emission source (i.e., at the

TABLE 6-1 HOURLY ATMOSPHERIC STABILITY CLASS

TIME OF DAY, HOUR	PASQUILL STABILITY CLASS
0000 AM - 0600 AM	5
0700	4
0800	3
0900 - 1500	2
1600	3
1700 - 1800	4
1900 - 2300	5

property boundary). Given this fact, no differences in modeled concentrations would be likely with the complex terrain option. Conversations with EPA's Office of Air Quality Planning and Standards confirmed that the choice of the flat terrain mode was a technically reasonable approach (U S Environmental Protection Agency, 1991). The selected ISCST Model Options are listed in Table 6-2

An arbitrary grid of discrete receptor points was established for use in modeling pollutant concentrations The receptor points were placed every 100 meters from the boundary of the Tuxedo Waste Disposal Site to a distance of one kilometer, and thereafter at one kilometer intervals out to approximately five kilometers (3 miles). No receptor points were located within on the landfill or within 100 meters of the landfill boundaries because model results are not considered reliable within 100 meters of a source.

The landfill area was divided into ten square subsections, as was shown in Figure 5-5, to represent location-specific gas composition resulting from the heterogeneous placement of disposed materials and to facilitate dispersion modeling The estimated waste quantities in each of the ten square landfill subsections are shown in Table 5-13.

For modeling purposes, the emission rates of toxic substances from each landfill subsection were based on the estimated gas quantities generated from each subsection and the measured concentration of each identified toxic substance in the soil gas in the subsection.

Data used to develop emission inputs included both maximum and average emission rates. The maximum emission rate for each identified gaseous contaminant in each landfill subsection was based on the highest concentration of that contaminant detected during the various analytical phases of the project. The average emission rate was calculated as follows: First, for each subsection of the landfill, the data set(s) with the highest overall contaminant levels for each contaminant was selected; the average concentrations for the specific contaminants were then computed from the selected data set(s).

TABLE 6 - 2
ISCST MODEL OPTIONS FOR AIR QUALITY DISPERSION MODELING

*** AIR TOXICS MAXIMUM CANCER HRA FOR TUXEDO LANDFILL***

CALCULATE (CONCENTRATION=1,DEPOSITION=2)	ISW(1) = 1
RECEPTOR GRID SYSTEM (RECTANGULAR=1 OR 3, POLAR=2 OR 4)	ISW(2) = 1
DISCRETE RECEPTOR SYSTEM (RECTANGULAR=1,POLAR=2)	ISW(3) = 1
TERRAIN ELEVATIONS ARE READ (YES=1,NO=0)	ISW(4) = 0
CALCULATIONS ARE WRITTEN TO TAPE (YES=1,NO=0)	ISW(5) = 0
LIST ALL INPUT DATA (NO=0,YES=1,MET DATA ALSO=2)	ISW(6) = 2

COMPUTE AVERAGE CONCENTRATION (OR TOTAL DEPOSITION)WITH THE FOLLOWING TIME PERIODS

HOURLY (YES=1,NO=0)	ISW(7) = 0 EXCEPT H2S = 1
2-HOUR (YES=1,NO=0)	ISW(8) = 0
3 HOUR (YES=1,NO=0)	ISW(9) = 0
4-HOUR (YES=1,NO=0)	ISW(10) = 0
6 HOUR (YES=1,NO=0)	ISW(11) = 0
8-HOUR (YES=1,NO=0)	ISW(12) = 0
12 HOUR (YES=1,NO=0)	ISW(13) = 0
24-HOUR (YES=1,NO=0)	ISW(14) = 0
PRINT 'N'-DAY TABLE(S) (YES=1,NO=0)	ISW(15) = 1

PRINT THE FOLLOWING TYPES OF TABLES WHOSE TIME PERIODS ARE SPECIFIED BY ISW(7) THROUGH ISW(14)

DAILY TABLES (YES=1,NO=0)	ISW(16) = 0
HIGHEST & SECOND HIGHEST TABLES (YES=1,NO=0)	ISW(17) = 0
MAXIMUM 50 TABLES (YES=1,NO=0)	ISW(18) = 0
METEOROLOGICAL DATA INPUT METHOD (PRE-PROCESSED=1,CARD=2)	ISW(19) = 2
RURAL-URBAN OPTION (RU.=0,UR. MODE 1=1,UR. MODE 2=2,UR. MODE 3=3)	ISW(20) = 0
WIND PROFILE EXPONENT VALUES (DEFAULTS=1,USER ENTERS=2,3)	ISW(21) = 1
VERTICAL POT. TEMP. GRADIENT VALUES (DEFAULTS=1,USER ENTERS=2,3)	ISW(22) = 1
SCALE EMISSION RATES FOR ALL SOURCES (NO=0,YES>0)	ISW(23) = 0
PROGRAM CALCULATES FINAL PLUME RISE ONLY (YES=1,NO=2)	ISW(24) = 1
PROGRAM ADJUSTS ALL STACK HEIGHTS FOR DOWNWASH (YES=2,NO=1)	ISW(25) = 1
PROGRAM USES BUOYANCY INDUCED DISPERSION (YES=1,NO=2)	ISW(26) = 1
CONCENTRATIONS DURING CALM PERIODS SET = 0 (YES=1,NO=2)	ISW(27) = 2
REG. DEFAULT OPTION CHOSEN (YES=1,NO=2)	ISW(28) = 2 (NOT AVAILABLE FOR CARD IMAGE MET)

TYPE OF POLLUTANT TO BE MODELLED (1=S02,2=OTHER)	ISW(29) = 2
DEBUG OPTION CHOSEN (YES=1,NO=2)	ISW(30) = 0
ABOVE GROUND (FLAGPOLE) RECEPTORS USED (YES=1,NO=0)	ISW(31) = 0

Table 6-3 presents the emission rate in units of lbs/hr, unit risk factor (if applicable), NYSAGC values, and an area based emission rate for each contaminant in each subsection based on the highest average concentration. Table 6-4 is a comparable tabulation based on the maximum contaminant concentrations and represents a maximum emission rate. The unit risk factors were obtained from the USEPA and the Integrated Risk Information System (IRIS) database.

Emission inputs used for modeling the carcinogenic health effects were determined by multiplying estimated emissions for each contaminant by its unit risk (slope) factor. The sum of the above for all substances within each landfill subsection was used as the emission rate for that landfill subsection. The ISCST model was then used to predict the estimated average and maximum potential cancer risks due to airborne emissions from the site This approach produced model output units representing potential cancer risk at each modeled receptor grid point.

The concentrations of identified chronically toxic contaminants from the landfill were similarly estimated for the modeled receptor points. Some of the contaminants included in the analysis of chronically toxic contaminants have both carcinogenic and non-carcinogenic effects.

Section 7 presents the results of the modeling.

TABLE 6-3 AVERAGE(1) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK(2) FACTOR	ACC(3) ($\mu g/m^3$)		EMISSION RATE (gm/sec/m^2 X 10^9)
					PROPOSED	CURRENT	
1	38	toluene	0.625	--	7,500	8,929	3.77
		ethylbenzene	2,143	--	1,450	1,036	12.92
		hydrogen sulfide	5.950	--	0.01 PPM		35.89
2	114	1,2-dichloroethylene	20.238	--	1,800	790,000	30.50
		trichloroethylene	1.875	1.3X 10^{-6}	0.45	900	2.83
		tetrachloroethylene	0.595	5.8X10^{-7}	0.075	1,116	0.89
		benzene	1.400	5.3X10^{-5}	0.12	100	2.14
		toluene	6.667	--	7,500	8,929	10.06
		ethylbenzene	6.905	--	1,450	1,036	10.42
		xylenes	12.113	--	1,450	1,036	18.24
		methylene chloride	0.149	1.0X10^{-6}	27	167	0.24
		hydrogen sulfide	59.554	--	0.01 PPM		89.73
3	57	1,2-dichloroethylene	0.295	--	1,800	790,000	1.79
		trichloroethylene	0.298	1.3x10^{-6}	0.45	900	1.79
		benzene	0.295	5.3x10^{-5}	0.12	100	1.79
		toluene	0.363	--	7,500	8,929	2.20
		ethylbenzene	0.113	--	1,450	1,036	0.68
		xylenes	1.238	--	1,450	1,036	7.47

TABLE 6-3 AVERAGE[1] TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^6)	UNIT RISK[2] FACTOR	AGC[3] ($\mu g/m^3$)		EMISSION RATE (gm/sec/m^2 X 10^9)
					PROPOSED	CURRENT	
4	1087	1,2-dichloroethylene	311.90	--	1,800	790,000	470.03
		trichloroethylene	47 62	$1.3x10^{-6}$	0 45	900	71.76
		tetrachloroethylene	4.76	$5.8x10^{-7}$	0.075	1,116	7.17
		benzene	31 55	$5.3x10^{-5}$	0 12	100	47.53
		toluene	108.04	--	7.500	8,929	162.80
		ethylbenzene	61.90	--	1,450	1,036	93.28
		xylenes	161.31	--	1,450	1,036	243.09
		1,1,1-trichloroethane	0.15	--	38,000	45,238	0.24
		trichlorofluromethane	7.95	--	--	--	11.96
		styrene	0 07	$5.7x10^{-7}$	517	716	0.12
		freon (113)	1.49	--	90,476	---	2.23
		methylene chloride	2.20	$1.0x10^{-6}$	27	1,167	3.33
5	96	1,2-dichloroethylene	36.67	-	1,800	790,000	221.01
		trichloroethylene	3.63	$1.3x10^{-6}$	0.45	900	21.88
		tetrachloroethylene	0.83	$5.8x10^{-7}$	0.075	1,116	5.03
		benzene	1.82	$5.3x10^{-5}$	0.12	100	10.95
		toluene	21.90	--	7,500	8,929	132.02
		ethylbenzene	11.22	--	1,450	1,036	67 62

TABLE 6-3 AVERAGE(1) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK(2) FACTOR	ACC(3) ($\mu g/m^3$)		EMISSION RATE (gm/sec/m^2 X 10^9)
					PROPOSED	CURRENT	
6	134	1,2-dichloroethylene	46.22	--	1,800	790,000	278.60
		trichloroethylene	14.38	$1.3X10^{-6}$	0.45	900	86.64
		tetrachloroethylene	0.01	$5.8X10^{-7}$	0.075	1,116	0.07
		benzene	1.88	$5.3X10^{-5}$	0.12	100	11.31
		toluene	19.40	--	7,500	8,929	116.96
		ethylbenzene	14.97	--	1,450	1,036	90.24
		xylenes	35.42	--	38,000	45,238	213.48
		1,1,1-trichloroethane	0.01	--	27	1,167	0.05
		dichlorofluoromethane	0.01	--			0.006
		methylene chloride	0.15	$1.0X10^{-6}$			0.09
7	459	1,2-dichloroethylene	74.79	--	1,800	790,000	112.71
		trichloroethylene	28.15	$1.3X10^{-6}$	0.45	900	42.46
		tetrachloroethylene	2.41	$5.8X10^{-7}$	0.075	1,116	3.63
		benzene	5.30	$5.3X10^{-5}$	0.12	100	7.97
		toluene	103.00	--	7,500	8,929	155.24
		ethylbenzene	39.76	--	1,450	1,036	59.91
		xylenes	100.92	--	38,000	45,238	152.08
		1,1,1-trichloroethane	0.006	--	--	--	0.009
		trichlorofluoromethane	0.005		--	--	0.009
		dichlorofluoromethane	0.005	--	360	--	0.006
		1,1-dichloroethene	0.003	$2.2X10^{-5}$	27	1,167	0.006
		methylene chloride	9.23	$1.0X10^{-6}$	0.01 PPM	--	13.90
		hydrogen sulfide	90.12	--			135.80

TABLE 6.3 AVERAGE(1) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK(2) FACTOR	AGC(3) ($\mu g/m^3$)		EMISSION RATE ($gm/sec/m^2$ X 10^9)
					PROPOSED	CURRENT	
8	89	1,2-dichloroethylene	46.93	--	1,800	790,000	282.92
		trichloroethylene	25.12	1.3×10^{-6}	0.45	900	151.40
		tetrachloroethylene	4.08	5.8×10^{-7}	0.75	1,116	24.58
		benzene	0.89	5.3×10^{-5}	0.12	100	5.39
		toluene	24.85	--	7,500	8,929	149.79
		ethylbenzene	5.51	--	1,450	1,036	33.18
		xylenes	14.08	--	1,450	1,036	84.67
		methylene chloride	3.87	1.0×10^{-6}	27	1,167	23.33
9	172	1,2-dichloroethylene	41.21	--	1,800	790,000	63.00
		trichloroethylene	2.62	1.3×10^{-6}	0.45	900	3.96
		tetrachloroethylene	0.92	5.8×10^{-7}	0.075	1,116	1.40
		benzene	2.44	5.3×10^{-5}	0.12	100	3.69
		toluene	30.59	--	7,500	8,929	46.10
		ethylbenzene	12.98	--	1,450	1,036	19.55
		xylenes	33.24	--	1,450	1,036	50.09
		1,1,1-trichloroethane	0.008	--	38,000	45,238	0.01
		trichlorofluromethane	0.005	--	--	--	0.009
		dichlorofluoromethane	0.006	--	--	--	0.009
		1,4-dichlorobenzene	0.003	--	714	1,000	0.005
		methylenechloride	0.33	1.0×10^{-6}	27	1,167	0.51
		vinyl chloride	0 003	7.0×10^{-6}	0.4	--	0.004
		hydrogen sulfide	128.89	--	0.01 PPM	--	646.28

TABLE 6-3 AVERAGE[1] TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK[2] FACTOR	AGC[3] ($\mu g/m^3$)		EMISSION RATE (gm/sec/m^2 X 10^9)
					PROPOSED	CURRENT	
10	201	1,2-dichloroethylene	11.04	--	1,800	790,000	16.63
		trichloroethylene	4.17	1.3×10^{-6}	0.45	900	6.28
		tetrachloroethylene	1.34	5.8×10^{-7}	0.075	1,116	2.02
		benzene	1.34	5.3×10^{-5}	0.12	100	1.93
		toluene	32.83	--	7,500	8,929	49.46
		ethylbenzene	6.07	--	1,450	1,036	9.14
		xylenes	19.97	--	1,450	1,036	30.09
		methylene chloride	14.64	1.0×10^{-6}	27	1,167	22.07
		hydrogen sulfide	121.73	--	0.01 PPM	--	183.43

NOTES:

[1] Average of highest sample group within the landfill subsection

[2] Unit Risk Factor is the upperbound likelihood of developing cancer from exposure of 1 $\mu g/m^3$ for a continuous period of 70 years

[3] AGC - Ambient Guideline Concentration, NYSDEC Airguide 1, 1989.

TABLE 6-4 MAXIMUM(1) (WORST CASE) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK(2) FACTOR	AGC(3) ($\mu g/m^3$)		EMISSION RATE (gm/sec/M^2 x 10^9)
					PROPOSED	CURRENT	
1	38	toluene	0.625	--	7,500	8,929	3.65
		ethylbenzene	2.14	--	1,450	1,036	12.92
		hydrogen sulfide	11.04	--	0.01 PPM	--	66.55
2	114	1,2-dichloroethylene	35.20	--	1,800	790,000	53.07
		trichloroethylene	3.07	$1.3X\ 10^{6}$	0.45	900	4.61
		tetrachloroethylene	0.60	$5.8X10^{7}$	0.075	1,116	0.09
		benzene	1.61	$5.3X10^{5}$	0.12	100	2.41
		toluene	12.86	--	7,500	8,929	19.38
		ethylbenzene	9.29	--	1,450	1,036	14.00
		xylenes	16.67	--	1,450	1,036	25.12
		methylene chloride	0.18	$1.0X10^{-6}$	27	1,167	0.27
		hydrogen sulfide	75.60	--	0.01 PPM	--	113.93
3	57	1,2-dichloroethylene	0.30	$2.2x10^{5}$	1,800	790,000	1.79
		trichloroethylene	0.30	$1.3x10^{-6}$	0.45	900	1.79
		benzene	0.30	$5.3x10^{5}$	0.12	100	1.79
		toluene	0.36	--	7,500	8,929	2.20
		ethylbenzene	0.11	--	1,450	1,036	0.66
		xylenes	1.24	--	1,450	1,036	7.47

TABLE 6-4 MAXIMUM[1] (WORST CASE) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK[2] FACTOR	AGC[3] ($\mu g/m^3$)		EMISSION RATE (gm/sec/M^2 x 10^9)
					PROPOSED	CURRENT	
4	1087	1,2-dichloroethylene	1140.77	--	1,800	790,000	1719.10
		trichloroethylene	173.40	1.3×10^{-6}	0.45	900	261.30
		tetrachloroethylene	7.14	5.8×10^{-7}	0.075	1,116	10.77
		benzene	43.75	5.3×10^{-5}	0.12	100	65.92
		toluene	233.33	--	7,500	8,929	351.61
		ethylbenzene	127.68	--	1,450	1,036	192.41
		xylenes	319.94	--	1,450	1,036	482.14
		1,1,1-trichloroethane	0.15	--	38,000	45,238	0.24
		trichlorofluromethane	7.95	--	--	--	11.96
		styrene	0.07	5.7×10^{-7}	512	716	0.12
		freon (113)	1.49	--	90,476	--	2.23
		methylene chloride	3.04	1.0×10^{-6}	27	1,167	4.58
5	96	1,2-dichloroethylene	36.67	--	1,800	790,000	221.00
		trichloroethylene	3.63	1.3×10^{-6}	0.45	900	21.88
		tetrachloroethylene	0.83	5.8×10^{-7}	0.075	1,116	5.03
		benzene	1.82	5.3×10^{-5}	0.12	100	10.95
		toluene	21.90	--	7,500	8,929	132.02
		ethylbenzene	11.22	--	1,450	1,036	67.62
		xylenes	27.02	--	1,450	1,036	162.89

TABLE 6-4 MAXIMUM(1) (WORST CASE) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK(2) FACTOR	ACC(3) ($\mu g/m^3$)		EMISSION RATE (gm/sec/M^2 x 10^7)
					PROPOSED	CURRENT	
6	134	1,2-dichloroethylene	46.22	--	1,800	790,000	278.60
		trichloroethylene	20.42	1.3X10^{-6}	0 45	900	123.07
		tetrachloroethylene	0 01	5.8X10^{-7}	0 075	1,116	0.07
		benzene	1 88	5.3X10^{-5}	0 12	100	11.31
		toluene	33.90	--	7,500	8,929	204.35
		ethylbenzene	26.93	--	1,450	1,036	162.35
		xylenes	59.23	--	38,000	45,238	357.00
		1,1,1-trichloroethane	0.008	--	27	1,167	0.05
		dichlorofluoromethane	0.001	--	--	--	0.006
		methylene chloride	0.15	1.0X10^{-6}	--	--	0.09
7	459	1,2-dichloroethylene	135.03	--	1,800	790,000	203.48
		trichloroethylene	58.84	1.3X10^{-6}	0.45	900	88.66
		tetrachloroethylene	2.41	5 8X10^{-7}	0 075	1,116	3.63
		benzene	6.43	5.3X10^{-5}	0.12	100	9.70
		toluene	197.95	--	7,500	8,929	298.30
		ethylbenzene	64.17	--	1,450	1,036	96.70
		xylenes	156.82	--	38,000	45,238	235.42
		1,1,1-trichloroethane	0.006	--	--	--	0.009
		trichlorofluoromethane	0.005	--	--	--	0.009
		dichlorofluoromethane	0.005	--	360	--	0.006
		1,1-dichloroethene	0.003	2.2X10^{-5}	27	1,167	0.006
		methylene chloride	18.64	1.0X10^{-6}	0.01 PPM	--	29.61
		hydrogen sulfide	90.12	--			135.80

TABLE 6-4 MAXIMUM(1) (WORST CASE) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK(2) FACTOR	AGC(3) ($\mu g/m^3$)		EMISSION RATE (gm/sec/M^2 x 10^9)
					PROPOSED	CURRENT	
8	89	1,2-dichloroethylene	99.61	--	1,800	790,000	600.45
		trichloroethylene	42.17	$1.3x10^{-6}$	0.45	900	254.70
		tetrachloroethylene	5.86	$5.8x10^{-7}$	0.075	1,116	35.33
		benzene	1.13	$5.3x10^{-5}$	0.12	100	6.82
		toluene	60.86	--	7,500	8,929	366.88
		ethylbenzene	8.51	--	1,450	1,036	51.31
		xylenes	23.81	--	1,450	1,036	143.51
		methylene chloride	4.17	$1.0x10^{-6}$	27	1,167	25.12
9	172	1,2-dichloroethylene	41.82	--	1,800	790,000	63.00
		trichloroethylene	2.62	$1.3x10^{-6}$	0.45	900	3.96
		tetrachloroethylene	1.40	$5.8x10^{-7}$	0.075	1,116	2.11
		benzene	2.44	$5.3x10^{-5}$	0.12	100	3.69
		toluene	30.60	--	7,500	8,929	46.10
		ethylbenzene	12.98	--	1,450	1,036	19.55
		tylenes	33.24	--	1,450	1,036	50.09
		1,1,1-trichloroethane	0.009	--	38,000	45,238	0.012
		trichlorofluromethane	0.005	--	--	--	0.009
		dichlorofluoromethane	0.006	--	--	--	0.009
		1,4-dichlorobenzene	0.003	--	714	1,000	0.006
		methylenechloride	0.45	$1.0x10^{-6}$	27	1,167	0.68
		vinyl chloride	0.003	$7.0x10^{-6}$	0.4	--	0.004
		hydrogen sulfide	2124.11	--	0.01 PPM	--	320.01

TABLE 6-4 MAXIMUM[1] (WORST CASE) TOXIC EMISSIONS FROM THE TUXEDO WASTE DISPOSAL SITE

SUB-SECTION	GAS RATE (cfh)	CONTAMINANT	EMISSION (lb/hr x 10^4)	UNIT RISK[2] FACTOR	AGC[3] ($\mu g/m^3$) PROPOSED	AGC[3] ($\mu g/m^3$) CURRENT	EMISSION RATE (gm/sec/M² x 10^9)
10	201	1,2-dichloroethylene	35.95	--	1,800	190,000	54.17
		trichloroethylene	8.36	$1.3x10^{-4}$	0.45	900	12.59
		tetrachloroethylene	2.71	$5.8x10^{-7}$	0.075	1,116	4.08
		benzene	1.52	$5.3x10^{-5}$	0.12	100	2.29
		toluene	127.23	--	7,500	8,929	191.73
		ethylbenzene	11.78	--	1,450	1,036	17.77
		xylenes	24.32	--	1,450	1,036	44.85
		methylene chloride	15 24	$1.0x10^{-6}$	27	1,167	26.49
		hydrogen sulfide	121.73	--	0.01	--	183.43

NOTES:

[1] Highest value from all samples within the landfill subsection

[2] Unit Risk Factor is the upperbound likelihood of developing cancer from exposure of 1 $\mu g/m^3$ for a continuous period of 70 years

[3] AGC - Ambient Guideline Concentration, NYSDEC Airguide 1, 1989.

SECTION 7

7.0 BASELINE RISK ASSESSMENT

7.1 PUBLIC HEALTH ASSESSMENT

7.1.1 General

Baseline public health risk assessments provide an evaluation of the potential threat to human health in the absence of any remedial action. They provide the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions. In general, the objectives of a baseline risk assessment may be attained by identifying and characterizing the following:

- Toxicity and levels of hazardous substances present in relevant media (e.g., air, groundwater, soil, surface water, sediment, and biota)
- Environmental fate and transport mechanisms within specific environmental media such as physical, chemical, and biological degradation processes and hydrogeological conditions
- Potential human receptors
- Potential exposure routes and extent of actual or expected exposure
- Extent of expected impact or threat, and the likelihood of such impact or threat occurring (i.e., risk characterization)
- Level(s) of uncertainty associated with the above items.

7.1.2 Exposure Assessment

An exposure assessment evaluates the potential exposure of the human population to the identified contamination. It assesses potential exposure pathways with regard to the population-at-risk.

Exposure Routes

At the Tuxedo Waste Disposal Site, the exposure routes considered are

- Off-site and on-site dermal contact
- Soil ingestion
- Plant ingestion
- Surface water contact and ingestion
- Fish ingestion
- Groundwater ingestion and contact
- Inhalation

The primary exposure routes are direct inhalation of air contaminants, dermal contact with contaminated soil, and drinking or washing with contaminated groundwater or surface water. Secondary exposure routes, such as soil, and plant ingestion, should lead to only limited exposure due to the presence of a well established landfill cover of clean soil

Off-Site and On-Site Dermal Exposure. Deposition of windborne fugitive dust containing soil particles from the landfill's surface could conceivably result in exposures to soil contaminants. However, except for a small area in the southeastern corner, the surface of the landfill is covered with a cover of imported clean soil. Dermal exposure to landfill surface material would not likely contribute to a significant exposure to chemical constituents in the landfill. Except for a small excavated area where landfill wastes are exposed, the soil cover on the site would minimize on-site dermal exposure to site chemical contaminants.

Soil Ingestion. Soil ingestion may occur via several mechanisms, the most severe being that of childhood pica. Since the Tuxedo Landfill has a clean cover, ingestion of soil contaminated with landfill materials is not a likely pathway for health risk concern.

Plant Ingestion. Exposure through ingestion of produce grown off-site would depend on the extent to which the produce has been contaminated and on ingestion rates. Off-site transport of contaminated particulates would not be expected since a clean cover has been placed over the landfilled materials. Another potential contamination pathway would be via irrigation of food crops with contaminated well water. Since contamination is not known to have spread to off-site wells, this risk is not considered significant at the present time. Therefore, consumption of produce grown off-site is not a likely route of exposure.

Any vegetation grown on the Tuxedo Waste Disposal Site would be subject to root uptake of contaminants. Since the landfill is covered with clean soil, and no edible vegetation is produced on-site for direct human consumption, the only pathway would be a secondary route through human consumption of animals which have fed on site vegetative cover. This was judged to be a negligible exposure route.

Surface Water Exposure. Continued evolution of the landfill may increase the likelihood of surface water contamination in the nearby Ramapo River. The Ramapo River is designated as a Class A surface water, which means it can be used as a drinking water source. The North Jersey District Water Supply Commission draws some of its water from the Ramapo River at a point approximately 22 miles downstream from Tuxedo. However, available evidence indicates the landfill is not significantly affecting the river's water quality with regard to human risk factors at present.

Fish Ingestion. The Ramapo River is a recreational fishing area. Fish have the potential to concentrate most of the metals of concern. Current data on river water quality does not indicate levels of metals, or other contaminants of concern in the surface water. However, levels of some PAHs in an upstream sediment sample did exceed NYS guidance values for human health residues. Given the limited data on surface water sediments, no analysis of fish was performed.

Groundwater. Groundwater is a media of concern at the Tuxedo Waste Disposal Site because it is a pathway for contaminant transport into the Ramapo River. Groundwater in the overburden deposits at the site is contaminated with metals and organics which have been detected in samples from monitoring wells. In general, groundwater contamination in the overburden deposits is migrating eastward to the Ramapo River, and limited data indicate it is also migrating vertically downward into the fractured bedrock portion of the aquifer system.

The immediate threat to groundwater quality does not necessarily indicate a potential threat of human exposure because no one is using the on-site groundwater as a drinking water source. Aside from the potential for contamination at the side gradient well on the antique shop property, no downgradient wells have been identified.

Inhalation. Inhalation of gases and vapors emitted from the landfill represents a primary potential route of exposure to receptors both on-site and off-site. Inhalation of windborne fugitive dust containing soil particles from the landfill is considered to represent a minimal risk because contaminated materials are covered with a clean soil cap.

Landfill gases emitted directly into the air will tend to disperse downwind according to meteorological conditions in the vicinity of the site. Risks from long-term exposure may be greatest for people living in the area. Risks from short-term exposures may be greatest for people who are closest to the site, which would include nearby workers as well as residents, due to the higher concentrations that would be found close to the site. Risks from short-term exposures by people driving past the site are expected to be negligible, given the anticipated emission rates and short exposure periods.

Populations-at-Risk

The 1990 Census shows populations of 3,023 for the Town of Tuxedo and 706 for the Village of Tuxedo Park. The estimated distribution of population in the vicinity of the site is shown below.

Distance (miles)	Population
0.00-0.25	12
0.25-0.50	72

0.50-1.00	356
1.00-4.00	5,232
Total	5,672

Some residential/commercial establishments are within 1/4 mile of the site. These include the Duck Cedar Inn and antique shops immediately north of the site and an abandoned structure on property owned by the Georgia Technology Institute Foundation immediately south of the site. A residential community in the vicinity of Stevens Lane is about 1/4 mile from the landfill.

Other concentrations of residential/business development are at least half a mile from the landfill. The closest, one-half mile west of the site, is the Village of Tuxedo Park. This municipality is a low-density residential area in the center of the Town of Tuxedo. It contains Tuxedo Lake, Wee Wah Lake, residences, schools, and the Village Hall

Harriman State Park covers areas east of the site. Visitors to the park would likely be at least one-half mile from the site. Additional information on demographics and land use was presented in Section 2.2.

Exposure Assessment Summary

Only scenarios involving groundwater exposure and inhalation appear to have the potential for health risks at the present time Although some evidence indicates that the landfill is the source of generally increasing amounts and types of contaminants in groundwater, comparative or trend data is not adequate to support a public health assessment. Inhalation of the identified gases and vapors emitted from the landfill is a potential exposure route. For inhalation exposures, information is sufficient to proceed with the next step in the public health assessment.

7.1.3 Toxicity Assessment

Listed below is selected representative toxicological information regarding site contaminants of concern. It should not be considered a comprehensive report of the toxiological properties of these materials. The information is taken from Sax (1984) and U.S. Environmental Protection Agency (January 1990). Copies of data sheets from the NIOSH Guide to Chemical Hazards (U.S. Department of Health and Human Services, June 1990) are included in Appendix A An additional reference is the project Health and Safety Plan, Appendix J; Final Work Plan, Volume 6, June 1990.

Gases

Hydrogen sulfide is the primary gas of concern. Hydrogen sulfide is a colorless gas, heavier than air, with the odor of rotten eggs. It is soluble in water. One's sense of smell becomes rapidly fatigued in atmospheres containing hydrogen sulfide concentrations of 100 ppm or more and therefore may not provide reliable warning of the continued presence of the gas

Exposure to high concentrations of 1000 to 2000 ppm can cause immediate death. Death or permanent injury may also occur after very short exposure to smaller quantities. Hydrogen sulfide acts directly on the nervous system, resulting in paralysis of the respiratory center. Signs and symptoms of exposure are as follows:

- eye contact -- painful conjunctivitis, sensitivity to light, tearing, clouding of vision
- inhalation (low concentrations) -- runny nose, loss of smell, labored breathing, shortness of breath
- skin contact -- pain, redness
- other symptoms -- profuse salivation, nausea, vomiting, diarrhea, giddiness, headache, dizziness, confusion, rapid breathing, rapid heart rate, sweating, weakness, sudden collapse, unconsciousness, and death due to respiratory paralysis

Volatile Organic Compounds

1,2-Dichloroethylene. As a liquid, it is colorless, has a sweet pleasant odor, and sinks in liquid. It is harmful if swallowed. If inhaled as a vapor, it will cause dizziness, nausea, vomiting, or difficult breathing.

Benzene Benzene is a clear, colorless liquid with a characteristic aromatic odor. It is used to make other chemicals, as a solvent, and as a gasoline additive. It is lighter than water and insoluble in water. Its vapors are heavier than air. The vapors are irritating to eyes, nose, and throat. If inhaled, it will cause headache, difficult breathing, or loss of consciousness. As a liquid, it is irritating to skin and eyes and is harmful if swallowed. Benzene is also considered carcinogenic.

Chloroform. Chloroform is a clear, colorless heavy liquid with a characteristic odor. It is used as a solvent, to make other chemicals, as a fumigant, and for other uses. It is heavier than water and slightly soluble in water. It can cause illness by inhalation, skin absorption and/or ingestion

Chloroform is classified as moderately toxic. The probable oral lethal dose for humans is 0.5 to 5 g/kg for a 150 lb person. The mean lethal dose is probably near one fluid ounce. It is a suspected human carcinogen. It also depresses the central nervous system and irritates the gastrointestinal tract. It has caused rapid death attributable to cardiac arrest and delayed death from liver and kidney damage. Symptoms of acute exposure include fainting sensation, vomiting, dizziness, salivation, nausea, fatigue, and headache. Other symptoms are respiratory depression, coma, kidney damage, and liver damage. Eye contact with the liquid form causes tearing and conjunctivitis. Symptoms of chronic exposure include loss of appetite, hallucinations, moodiness, and physical and mental sluggishness.

Ethyl Benzene. Ethyl benzene is a clear, colorless liquid with an aromatic odor. It is used as a solvent and to make other chemicals. It is lighter than water and insoluble in water. Its vapors are heavier than air. The vapors are irritating to eyes, nose, and throat. If inhaled, it will cause dizziness or difficult breathing. The liquid form will burn skin and eyes, and is harmful if swallowed.

Toluene. Toluene is used in automotive fuels, as a solvent, and to make other chemicals. It may be present as a clear colorless liquid with a characteristic aromatic odor. It is lighter than water and insoluble in water. In liquid form, toluene is irritating to skin and eyes. If swallowed, it will cause nausea, vomiting, or loss of consciousness. Its vapors are heavier than air. In its vapor form, it is irritating to eyes, nose, and throat. If inhaled, it will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness.

Trichloroethylene. This is a clear, colorless volatile liquid with a chloroform-like odor. It is used as a solvent, fumigant, in the manufacture of other chemicals, and for many other uses. It is heavier than water and is slightly soluble in water. As a vapor, it is irritating to eyes, nose, and throat. If inhaled, it will cause nausea, vomiting, difficult breathing, or loss of consciousness. As a liquid, it is irritating to skin and eyes If swallowed, it will cause nausea, vomiting, difficult breathing, or loss of consciousness. Trichloroethylene is also considered carcinogenic.

Xylene. Xylene is a clear colorless liquid with a characteristic aromatic odor. It is used as a solvent and to make other chemicals It is lighter than water and insoluble in water. Vapors are heavier than air. Xylene may be poisonous if inhaled or absorbed through the skin. Vapors may cause dizziness or suffocation. Contact may irritate or burn skin and eyes.

Semi-Volatile Organic Compounds

Phenol. Phenol is a white, crystalline mass which turns pink or red if not perfectly pure. It has a burning taste and distinctive odor. In acute phenol poisoning, the primary effect is on the central nervous system. Absorption from spilling phenolic solutions on the skin may be very rapid, and death results from collapse within 30 minutes to several hours. Where death is delayed, damage to the kidneys, liver, pancreas, and spleen, as well as edema of the lungs may result. Symptoms develop rapidly, frequently within 15 to 20 minutes following skin contact. Headache, dizziness, muscular weakness, dimness of vision, ringing in the ears, irregular and rapid breathing, weak pulse, and dyspnea may all develop, and may be followed by loss of consciousness, collapse, and death.

Chronic poisoning, following prolonged exposures to low concentrations of phenol vapor or mist, results in digestive disturbances (vomiting, difficulty in swallowing, excessive salivation, diarrhea, loss of appetite), nervous disorders (headache, fainting, dizziness, mental disturbances) and skin eruptions. Chronic poisoning may terminate fatally in cases where extensive damage to the kidneys or liver has occurred.

Naphthalene. This is a white crystalline material with volatile flakes and an aromatic odor. It is irritating to skin and eyes in both solid and liquid forms. It is moderately toxic by ingestion and inhalation, and may cause chronically toxic effects.

Polyaromatic Hydrocarbons (Acenaphthene, Chrysene, Benzopyrene, Fluoranthene, Anthracene). These chemicals are found in coal tar, coal tar pitch, and creosote. The properties and symptoms vary with the specific compound. They are considered to be carcinogenic Skin contact can result in dermatitis. Inhalation can cause bronchitis. These materials are irritating to the eyes.

Heavy Metals

Copper Compounds. Copper chloride and sulfate have been reported as causing irritation of the skin and conjunctivae which may be on an allergic basis. Cuprous oxide is irritating to the eyes and upper respiratory tract. Discoloration of the skin is often seen in persons handling copper. The ingestion of a large quantity of copper sulfate has caused vomiting, gastric pain, dizziness, exhaustion, anemia, cramps, convulsions, shock, coma and death. Symptoms attributed to damage to the nervous system and kidney have been recorded, jaundice has been observed and, in some cases, the liver has been enlarged.

Manganese Compounds. Chronic manganese poisoning is a clearly characterized disease which results from the inhalation of fumes or dusts of manganese. Exposure to heavy concentrations of dusts or fumes for as little as three months may produce the condition, but usually cases develop after one to three years of exposure. The central nervous system is the chief site of damage. Chronic manganese poisoning begins with languor and sleepiness, followed by weakness in the legs and the development of a stolid, mask-like face. Then muscular twitchings appear Individuals exposed to dusts and fumes of manganese have been reported to suffer from a much higher incidence of upper respiratory infections and pneumonia.

Silver Compounds. The absorption of silver compounds into the circulation and the subsequent deposition of the reduced silver in various tissues of the body may result in the production of the skin and mucous membranes - a condition known as argyria.

Zinc Compounds. Zinc is not inherently a toxic element. There is no cumulative effect to the inhalation of zinc fumes. Soluble salts of zinc have a harsh metallic taste; small doses can cause nausea and vomiting, while larger doses cause violent vomiting and purging.

Cadmium Compounds. The inhalation of fumes or dusts of cadmium primarily affects the respiratory tract: the kidneys may also be affected Even brief exposure to high concentrations may result in pulmonary edema and death. In fatal cases, fatty degeneration of the liver and acute inflammatory changes in the kidneys have been noted. Ingestion of cadmium results in a gastrointestinal type of poisoning resembling food poisoning in its symptoms: sudden nausea, salivation, vomiting and diarrhea, and abdominal pain and discomfort. Symptoms begin almost immediately after ingestion. Inhalation of dust or fumes may cause dryness of the throat, cough, headache, a sense of constriction in the chest, shortness of breath (dyspnea) and vomiting. Symptoms are usually delayed for some hours after exposure.

Lead Compounds. When lead is ingested, much of it passes through the body unabsorbed and is eliminated in the feces. When lead is inhaled, absorption takes place easily from the respiratory tract and symptoms tend to develop more quickly. Lead is a cumulative poison. Increasing amounts build up in the body and eventually a point is reached where symptoms and disability occur.

Lead produces a brittleness of the red blood cells so that they hemolyze with slight trauma. In addition to its effect on the red cells of the blood, lead produces a damaging effect on the organs or tissues with which it comes in contact No specific or characteristic lesion is produced. Autopsies of deaths attributed to lead poisoning and experimental work on animals have shown pathological lesion of the kidneys, liver, male gonads, nervous system, blood vessels and other tissues.

Lead poisoning commonly follows prolonged exposure to lead or its compounds. The common clinical types of lead poisoning may be classified according to their clinical picture as: (a) alimentary, (b) neuromotor, and (c) encephalic. Some cases may show a combination of clinical types The alimentary type occurs most frequently, and is characterized by abdominal discomfort or pain. Other complaints are constipation and/or diarrhea, loss of appetite, metallic taste, nausea and vomiting, lassitude, insomnia, weakness, joint and muscle pains, irritability, headache and dizziness.

In the neuromuscular type, the chief complaint is weakness. Gastroenteric symptoms are usually present. Joint and muscle pains are likely to be severe. Headache, dizziness and insomnia are frequently prominent.

Lead encephalopathy is the most severe poisoning. It follows rapid and heavy lead absorption. Organic lead compounds, such as tetraethyl lead, are absorbed rapidly through the skin as well as through the lungs, and are selectively absorbed by the central nervous system. Concentrations in the central nervous system are reached only when the workplace is heavily contaminated with vapor, fume and dust. Encephalopathy begins abruptly, and there is usually stupor, progressing to coma, with or without convulsion, and often terminating in death. In milder cases, there may be symptoms of headache, dizziness, somnolence and insomnia.

Mercury Compounds, Inorganic. Mercury is a general protoplasmic poison; after absorption it circulates in the blood and is stored in the liver, kidneys and spleen and bone. In poisoning, the chief effect is upon the central nervous system and upon the mouth and gums. Colitis has been reported frequently. The organic mercury compounds, like the organic lead compounds, appear to have an affinity for he lipoid-containing organs, resulting in disturbances of the central nervous system. The cardinal symptoms of industrial mercury poisoning are stomatitis, tremors, and psychic disturbances.

Tremor and psychic disturbances are commonly seen in the slow, chronic form of the poisoning. Muscles of the face, hands and arms are chiefly affected. The psychic disturbance includes such changes as loss of memory, insomnia, lack of confidence, irritability, vague fears and depression.

Elemental mercury is probably not absorbed through the gastrointestinal tract, but many mercury compounds are. A number of mercury compounds can cause skin irritations and can be absorbed through the skin; they are strong allergens.

Arsenic Compounds. Poisoning from arsenic compounds may be acute or chronic. Acute poisoning usually results from swallowing arsenic compounds; chronic poisoning from either swallowing or inhalation.

Acute arsenic poisoning (from ingestion) results in marked irritation of the stomach and intestines with nausea, vomiting and diarrhea. In severe cases the vomitus and stools are bloody and the patient goes into collapse and shock with weak, rapid pulse, cold sweats, coma and death.

Chronic arsenic poisoning, whether through ingestion or inhalation, may manifest itself in many different ways. There may be disturbances of the digestive system such as loss of appetite, cramps, nausea, constipation or diarrhea. Liver damage may occur, resulting in jaundice. Disturbances of the blood, kidneys and nervous system are not infrequent. Arsenic can cause a variety of skin abnormalities including itching and pigmentation. Arsenic is also considered carcinogenic.

7.1.4 Air Pathway Risk Characterization

The purpose of the air pathway risk characterization is to develop a quantitative estimate of potential health risks based on estimated air pathway exposure and relevant health effects criteria. Based on the Exposure Assessment and a review of calculated air emissions, the air pathway appears to represent a potential risk to public health on- and off-site. The potential for adverse health effects from exposure to chemical contaminants in landfill gas emissions was evaluated for three distinct categories. The first category is the potential cancer risk evaluation and includes the calculated population cancer burden (theoretical number of potential cancer cases) based on the calculated potential lifetime risk of contracting cancer as a result of (70-year) exposure to the target chemical emissions (referred to as the excess cancer risk). The second category includes chronic noncarcinogenic health effects from long-term exposure to chronically toxic substances. The third category is the possible acute effects which might result from short-term exposure to maximum predicted hydrogen sulfide emissions under modeled dispersion conditions.

Dispersion modeling was described in Section 6 and was performed for the average and maximum emission rates previously listed in Tables 6-3 and 6-4. The discussion that follows focuses on the predicted chemical contaminant concentrations at the modeled potential receptor points. These concentrations constitute the basis for the health risk assessment.

The highest off-site concentrations from the average emissions are presented in Table 7-1, and the highest off-site concentrations from the maximum emissions are presented in Table 7-2. Short-term hydrogen sulfide concentrations were also computed.

Potential Cancer Risk Evaluation

The potential cancer risk evaluation calculated the potential risk associated with inhalation exposure to carcinogens based on the predicted concentration multiplied by a cancer potency factor (CPF), or slope factor, for all contaminants combined. Only contaminants with quantifiable unit risk factors

TABLE 7-1
AVERAGE PREDICTED OFF-SITE CONCENTRATIONS ($\mu g/m^3$) COMPARED TO AGCs

CONTAMINANT	PREDICTED CONCENTRATION ($\mu g/m^3$)	AGC[1]	
		PROPOSED ($\mu g/m^3$)	CURRENT ($\mu g/m^3$)
1,2 dichloroethylene	0.48	1,880	790,000
trichloroethylene	0.10	0.45	900
tetrachloroethylene	0.011	0.075	1,116
benzene	0.044	0.12	100
toluene	0.25	7,500	8,929
ethylbenzene	0.13	1,036	1,450
xylenes	0.33	1,036	1,450
1,1,1 trichloroethane	0.064	38,000	45,238
styrene	0.031	512	716
freon 113	0.58	17,905	--
methylene chloride	0.028	27	1167
vinyl chloride	0.001	0.4	0.4
hydrogen sulfide (one hour)	7.8	--	13.9[2]

Notes:

(1) AGC - NYSDEC Ambient Guideline Concentration

(2) 13.9 $\mu g/m^3$ = 0.01 ppm; the NYSDEC 1-hour maximum

TABLE 7-2
MAXIMUM PREDICTED OFF-SITE CONCENTRATIONS COMPARED TO AGCs

CONTAMINANT	PREDICTED CONCENTRATIONS ($\mu g/m^3$)	AGC[1]	
		PROPOSED ($\mu g/m^3$)	CURRENT ($\mu g/m^3$)
1,2 dichloroethylene	3.5	1,880	790,000
trichloroethylene	0.27	0.45	900
tetrachloroethylene	0.015	0.075	1,116
benzene	0.060	0.12	100
toluene	0.62	7,500	8,929
ethylbenzene	0.23	1,036	1,450
xylenes	0.56	1.036	1,450
1,1,1 trichloroethane	0.064	38,000	45,238
styrene	0.031	512	716
freon 113	0.58	17,905	--
methylene chloride	0.043	27	1,167
vinyl chloride	0.001	0.4	0.4
hydrogen sulfide (one-hour)	29.1	--	13.9[2]

Notes:

[1] AGC - NYSDEC Ambient Guideline Concentration

[2] 13.9 ug/m^3 - 0.01 ppm, the NYSDEC 1-hour maximum

listed in the IRIS (US Environmental Protection Agency, 1989a) database were considered. These risk factors were shown in Tables 6-3 and 6-4.

To preserve significant figures, the source strength, which consisted of the sum of the estimated emission of each contaminant multiplied by its unit risk factor, was multiplied by 1,000,000. Thus, the model outputs directly presented the predicted cancer incidence per million exposed population at each potential receptor point.

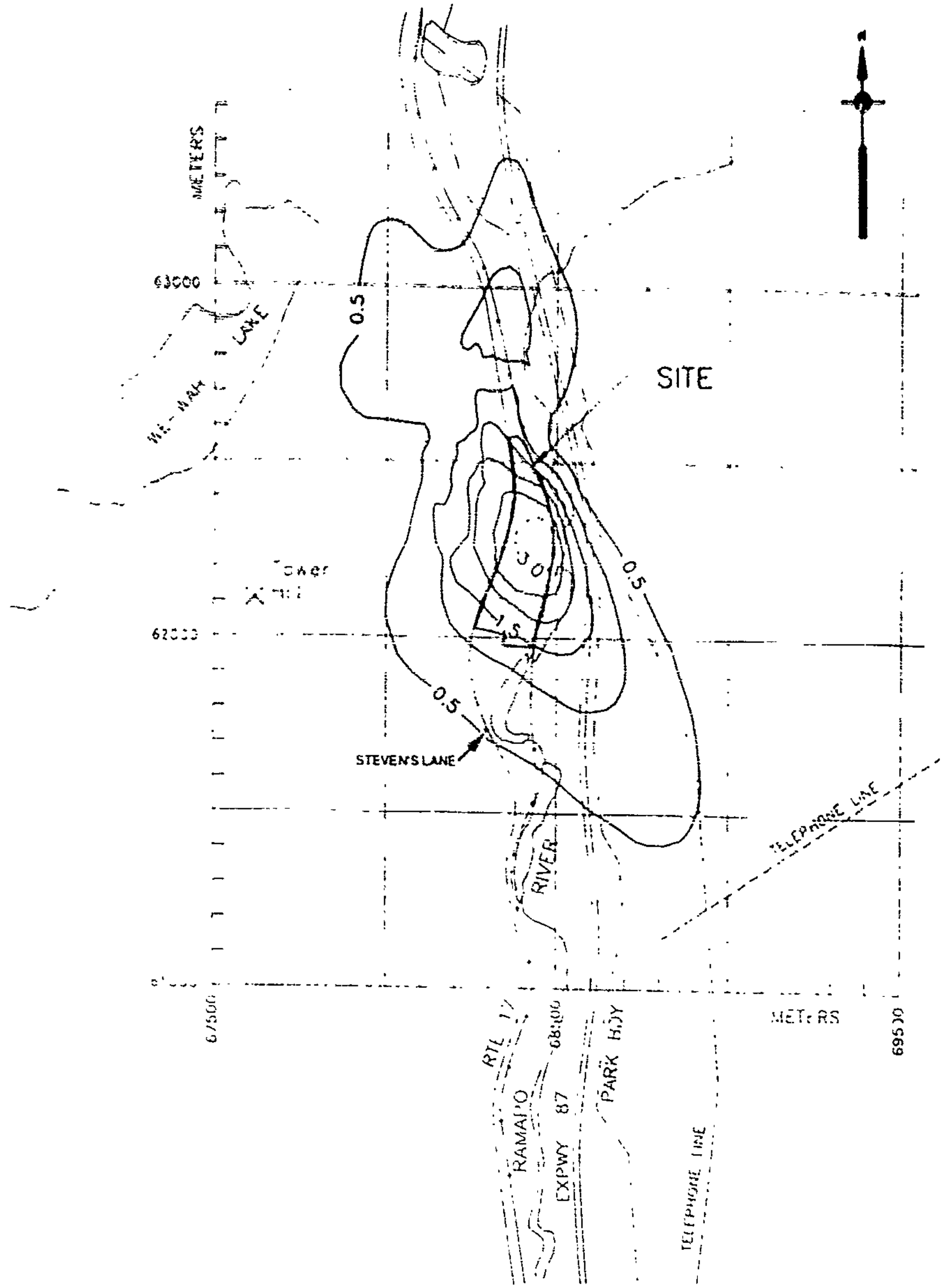
The excess cancer risk that could potentially result from exposure to airborne chemical contaminants was estimated based on the dose of a chemical contaminant and its the carcinogenic potency (upper bound 95th percentile). Carcinogenic health effects were conservatively assumed to be additive. Two exposure scenarios were used to estimate the lifetime excess cancer risk to the potentially maximum exposed individual (MEI) based on average and maximum exposure assumptions, respectively.

Inhalation CPFs were not adjusted for exposure duration (less than 24-hours per day, 7 days per week for 70 years). It was also conservatively assumed that chemical contaminants identified as carcinogenic via inhalation exposure routes were completely utilized (100 percent uptake by the target organ) for the individual.

The highest estimate in each model run represents the maximum exposed individual (MEI) potential cancer risk per million exposed population. The MEIs for the average and maximum emissions were 2.4 and 3.0 per million exposed population respectively.

The calculated risks identified by EPA methodology as potential cancer risks per million were plotted on contours overlaying the site. The average and maximum potential cancer cases per million exposed individuals over a 70-year exposure period are displayed in Figures 7-1 and 7-2. The spatial distribution of the modeled concentrations closely follows the alignment of prevailing winds.

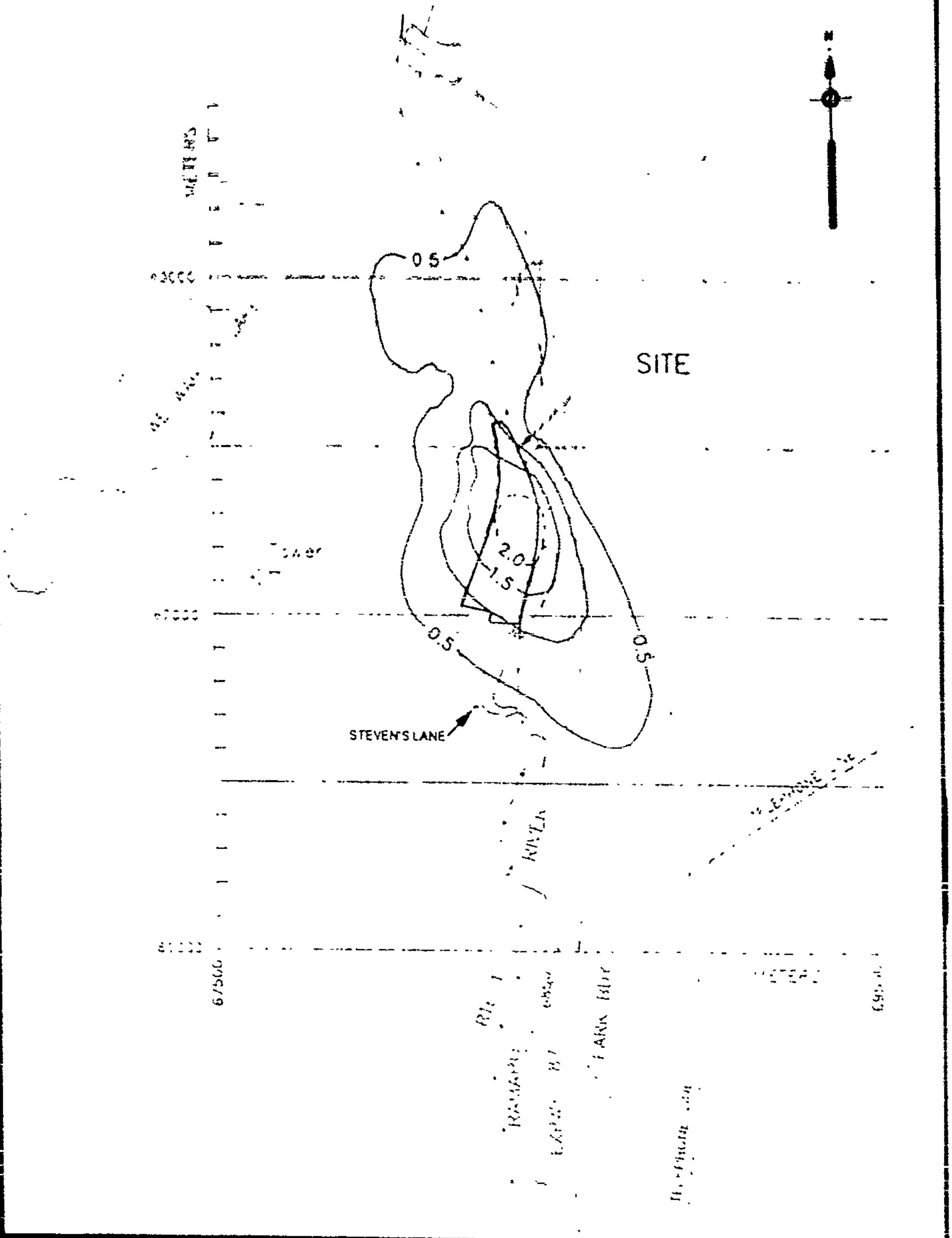
The greatest potential health risks would obviously occur nearest the site.



M&E
Metcalf & Eddy

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 7-1
AIR EXPOSURE MODEL MAXIMUM
POTENTIAL CANCER PER MILLION



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Metcalf & Eddy

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 7-2
AIR EXPOSURE MODEL AVERAGE
POTENTIAL CANCER PER MILLION

Results of the cancer risk evaluation show that the calculated worst-case upper-bound excess cancer risk would be 3.0×10^{-6}, which is within the normally acceptable level of 1.0×10^{-4} to 1.0×10^{-7} for Superfund sites. The upper-bound excess cancer risk from average emissions was calculated to be 2.4×10^{-6} These exposure scenarios are modeled at 100 meters from the source The isopleth lines running through the site are an artifact of the plotting program, since the closest modeled location for a potential receptor was located 100 meters from the site.

The estimated cancer risk potentials for individual contaminants are shown in Figures 7-3 and 7-4, based on predicted average and maximum contaminant concentrations, respectively. Averages are based on the maximum average value observed for each pollutant. However, the sum of these individual risks does not represent the total predicted cancer risks listed above, because the contaminant concentrations shown in Tables 7-3 and 7-4 do not necessarily occur at the same potential receptor locations.

Chronic Noncarcinogenic Health Effects

Noncarcinogenic chronic health effects were evaluated in relation to calculated average and worst-case landfill gas emission scenarios. Chemical contaminants which were examined for long-term chronic health effects included noncarcinogenic health effects of 1,2-dichloroethylene, trichloroethylene, tetrachloroethylene, benzene, toluene, ethylbenzene, xylenes, 1,1,1-trichloroethylene, styrene, freon (113), 1,1-dichloroethene, methylene chloride and vinyl chloride. Of these compounds, trichloroethylene, tetrachloroethylene, benzene, styrene, 1,1-dichloroethene, methylene chloride and vinyl chloride also exhibit carcinogenic effects and were included in the airborne cancer risk assessment.

Using modeling techniques analogous to those employed for carcinogens (but without the unit cancer risk factor), the concentrations of each identified chronically toxic noncarcinogenic constituent from the landfill were also estimated. The off-site concentrations from the average emissions are presented in Table 7-1 and the highest off-site concentrations from the maximum emissions are presented in Table 7-2. Short-term (one-hour maximum) hydrogen sulfide

TABLE 7-3
ESTIMATED EXCESS CANCER RISK BASED ON PREDICTED AVERAGE OFF-SITE CONCENTRATIONS

	PREDICTED CONCENTRATION ($\mu g/m^3$)	CARCINOGENIC UNIT RISK FACTOR	CARCINOGENIC RISK X 10^6
trichloroethylene	0.10	1.3 X 10^{-6}	0.13
tetrachloroethylene	0.011	5.8 X 10^{-7}	0.01
benzene	0.044	5.3 X 10^{-5}	2.33
styrene	0.031	5.7 X 10^{-7}	0.02
methylene chloride	0.028	1.0 X 10^{-6}	0.03
vinyl chloride	0.001	7 X 10^{-6}	0.00

TABLE 7-4
ESTIMATED EXCESS CANCER RISK BASED ON PREDICTED MAXIMUM OFF-SITE CONCENTRATIONS

	PREDICTED CONCENTRATION ($\mu g/m^3$)	CARCINOGENIC UNIT RISK FACTOR	CARCINOGENIC RISK X 10^6
trichloroethylene	0.27	1.3 X 10^{-6}	0.35
tetrachloroethylene	0.015	5.8 X 10^{-7}	0.01
benzene	0.060	5.3 X 10^{-5}	3.18
styrene	0.031	5.7 X 10^{-7}	0.02
methylene chloride	0.043	1.0 X 10^{-6}	0.04
vinyl chloride	0.001	7 X 10^{-6}	0.01

concentrations were also computed in a similar manner and are shown on those same two tables

Chronic noncarcinogenic health effects were evaluated by comparing inhalation intake levels to NYSDEC AGCs for the average and maximum emissions scenarios (see Tables 7-1 and 7-2) The results indicate that no current or proposed AGCs for chronic exposure would be exceeded for average or maximum emission scenarios for the individual contaminants evaluated. The hydrogen sulfide standard is for short-term acute exposure and is addressed in the next subsection. NYS does not list a criterion for chronic exposure to hydrogen sulfide. Recently, the State of California (California Air Pollution Control Officers Association, (CAPCOA). January 1991) proposed a chronic use guideline for H_2S of 42 $\mu g/m^3$. This value, however, is greater than the NYS acute short-term standard and is therefore inapplicable here.

To determine the cumulative chronic effects of toxic air contaminants, a Hazard Index was compiled. The Hazard Index is the sum of the ratios of the contaminant concentrations in air to chronic, non-carcinogenic inhalation reference concentrations. This is predicated on an assumption that the contaminants have a common target organ or affect a common physiological system. Reference concentrations for the contaminants of issue were obtained from IRIS (US Environmental Protection Agency, 1991) and HEAST (U.S. Environmental Protection Agency, September 1990) where available. Reference concentrations for additional contaminants were obtained from CAPCOA guidelines (January, 1991). Since none of the above references listed a value for 1,2 dichloroethylene, the NYSDEC proposed AGC value was used for this material.

Maximum predicted concentrations from Table 7-2 and the above-cited reference concentrations were used to calculate the highest or maximum predicted Hazard Index. The value listed for hydrogen sulfide is the modeled maximum longer term concentration, which is considered the appropriate value to assess potential chronic effects. As shown in Table 7-5, the Hazard Index for predicted concentrations of toxic air contaminants was significantly less than 1.0. This indicates that the additive effect of potentially chronic toxins on a specific organ or systemic function does not represent a significant health risk.

TABLE 7-5 MAXIMUM PREDICTED OFF-SITE LONG-TERM CONCENTRATIONS COMPARED TO CHRONIC NON-CARCINOGENIC REFERENCE CONCENTRATIONS FOR INHALATION EXPOSURE (RFCs)

CONTAMINANT	PREDICTED CONCENTRATION µg/m^3	RfC µg/m^3	MAXIMUM PREDICTED HAZARD INDEX
1,2 dichloroethylene	1.5	1880 (N)	$<10^{-3}$
trichloroethylene	0.27	640 (C)	$<10^{-3}$
tetrachloroethylene	0.015	35 (C)	$<10^{-3}$
benzene	0.060	71 (C)	$<10^{-3}$
toluene	0.62	2000 (H)	$<10^{-3}$
ethylbenzene	0.23	1000 (I)	$<10^{-3}$
xylenes	0.56	300 (H)	1.9×10^{-3}
1,1,1 trichloroethane	0.064	1000 (H)	$<10^{-4}$
styrene	0.031	700 (C)	$<10^{-4}$
freon 113	0.58	27000 (H)	$<10^{-4}$
methylene chloride	0.043	3000 (H)	$<10^{-4}$
vinyl chloride	0.001	26 (C)	$<10^{-4}$
hydrogen sulfide	2.7	42 (C)	6.4×10^{-2}

Hazard Index $<10^{-1}$

Notes:

(N) New York State Air Guide - 1, NYSDEC 1989, Proposed AGC

(C) Air Toxics "Hotspots" Program - Risk Assessment Guidelines. Cal. Air Pollution Control Officers Assoc. (CAPCOA), Jan. 1991.

(H) Health Effects Assessment Summary Tables (HEAST) OERR 9200.6-303 (90-4), Sept., 1990.

(I) Integrated Risk Information System (IRIS) EPA Data Base

Acute Health Effects: Hydrogen Sulfide

Acute health effects were evaluated for hydrogen sulfide emissions. Both the maximum and average estimated short-term (1-hour) atmospheric concentrations from previously discussed models were compared to the NYS hydrogen sulfide 1-hour ambient air quality standard of 0.01 ppm (13.9 μg/m³).

As shown in Tables 7-1 and 7-2, the maximum predicted hydrogen sulfide concentration is 29.1 μg/m³, and the average is 7.8 μg/m³. The maximum predicted hydrogen sulfide concentration does exceed the 1-hour NYS standard of 13.9 ug/m³ (0.001 ppm). However, a review of applicable health effects criteria indicate that no observable health effects would result from hydrogen sulfide exposures below the 10 ppm (14,000 μg/m³) OSHA standards. Hydrogen sulfide at 300 ppm (420,000 μg/m³) is considered immediately dangerous to life and health. Based on these results, there appears to be no significant acute health risk associated with off-site exposure to the estimated maximum 1-hour peak hydrogen sulfide events.

7.1.5 Summary of Public Health Risks

This public health assessment has estimated the potential health risks associated with exposure to potentially toxic contaminants from the Tuxedo Waste Disposal Site. A comprehensive multi-pathway exposure scenario was investigated. Potential adverse health risk impacts from inhalation of landfill gas emissions were identified using the ISCST computer model. No evidence was obtained which indicated adverse site-related health effects could be attributed to other pathways of exposure at the present time.

Seep from the railroad track bed was initially observed and reported in 1988 (LMS 1989). Aside from possible impacts on river water and sediment conditions, no other pathways for human exposure to the contaminated groundwater have been identified.

The results of cancer health risk assessments based on EPA methodology and chronic exposure health risk assessments fall within regulatory guidelines for both maximum and average emission scenarios. The potential excess cancer risk and population cancer burden resulting from exposure to downwind emissions were estimated based on the results of the dispersion modeling analysis and chemical specific unit cancer potency factors. Chronic noncarcinogenic health effects were evaluated using the results of dispersion modeling analysis and comparisons with State AGCs and reference dose concentrations. Short-term acute effects for hydrogen sulfide were compared with the State 1-hour ambient standard.

Available data is inconclusive regarding whether landfill derived contaminant concentrations in groundwater at the site are increasing. Although the contaminated groundwater discharges to the Ramapo River, the concentrations of contaminants have not caused significant degradation of the surface water quality. Off-site sources of groundwater currently or potentially used as drinking water supplies are not contaminated by compounds migrating from the site. However, a well on adjoining property, which was sampled in 1988 and found to be free of contamination, was not resampled in 1990. As a precaution, the owner has been advised by NYSDOH to use the water only for washing and other non-drinking uses.

Many conservative assumptions were applied in the estimate of risk from airborne contaminants. For example, the quantities of toxic airborne contaminants emanating from the Tuxedo Waste Disposal Site were based on field sampling data reported by LMS in 1989 and by Alliance in 1990. However, limited ambient air quality monitoring conducted to date, as reported in Sections 1.4 and 6.2 of this report, has not detected off-site concentrations of toxic air contaminants near the predicted levels, except for an H_2S odor nuisance. Therefore, actual health effects of off-site air toxics are likely to be below those predicted due to the conservative assumptions used as the basis for this analysis: the tendency for the ISCST dispersion model to overpredict results from area sources, the type and amount of material in the landfill, the landfill gas generation rate, and the toxicity data used.

Some other assumptions applied were:

- The upper bound 95th percentile cancer risk was applied to the cancer unit risk factors, which includes the upper 5% of the population most susceptible to cancer.

- A 70-year, 24-hour per day exposure was assumed for cancer risk assessments, which overestimates potential exposure

- The results were considered cumulative for the most vulnerable target organ, although chemical specific target organs might be different for different compounds.

A variety of uncertainties are inherent in the analysis. These include:

- Accuracy of the toxicological data
- Location and size of the population actually exposed to various concentration levels
- Susceptibility of individuals to effects of contaminant exposure
- Duration of population exposures
- Interaction of the uncertainty factors above.

7.1.6 Potential Future Uses

The following conditions currently existing at the site impact considerations of potential future uses:

- Methane, a flammable gas, and hydrogen sulfide, a toxic gas, are being generated by the fill. Releases of gas to the atmosphere presumably also contain low levels of toxic volatile organic contaminants present in the soil or fill.

- Groundwater in the site overburden, and possibly in the fractured bedrock, shows evidence of site contamination.

- The cover layer at the site is variable in thickness, reportedly as thin as six inches in some locations. The initial cover layer contained low levels of PCBs. Metal objects and debris protrude above the cover surface, presenting potential physical hazards to persons on the site.

Future site conditions cannot be established until remediation goals for the site have been established by NYSDEC. Present site conditions present possible health and fire hazards for soil intrusive activities which might be required for construction, installation of facilities, re-grading, etc. Installing an enclosed structure on the site could potentially collect flammable and toxic soil gases released from the fill. The present thin cover and physical hazards projecting through the cover in some places warrants restrictions on access to the site.

7.2 RESULTS OF HABITAT ASSESSMENT

This section summarizes the Habitat Based Assessment in Appendix C. A preliminary survey of the site on September 10, 1990 and a follow-up survey on October 11-12, 1990 documented observed vegetation present on-site and wildlife using the site and adjacent off-site areas No rare, threatened, or endangered species or habitats are known to occur in the general area of the site. The NYSDEC Significant Habitat Unit has no record of endangered, threatened, or special concern wildlife species, rare plant, animal or natural community occurrences, or other significant habitats, on or adjacent to the site.

7.2.1 Vegetation

After the landfill was closed and covered in 1987, plants invaded the site from surrounding areas. Weedy species and various species of grasses, Asters and Goldenrods became established throughout the landfill area and are dominant at the present time. Woody species, including shrubs, vines and trees, are confined to the peripheral areas of the site. Vegetation north, west, and south of the site consists mainly of Oak-Sugar Maple forest, and the area along the floodplain of the Ramapo River, adjacent to the eastern boundary of the site, is dominated by Red Maple, Eastern Sycamore and American Elm. Scrub-shrub wetlands consisting mostly of Willow and Buttonbush occur along the western edge of the Ramapo River.

7.2.2 Wetlands/Floodplains

No designated wetlands are within the site boundaries at the present time. Land adjacent to the river is subject to flooding. Although land between the river and the railroad is extremely swampy in some areas, all of the landfill lies above the 100-500 year floodplain and is not likely to be flooded

7.2.3 Wildlife Habitat/Site Description

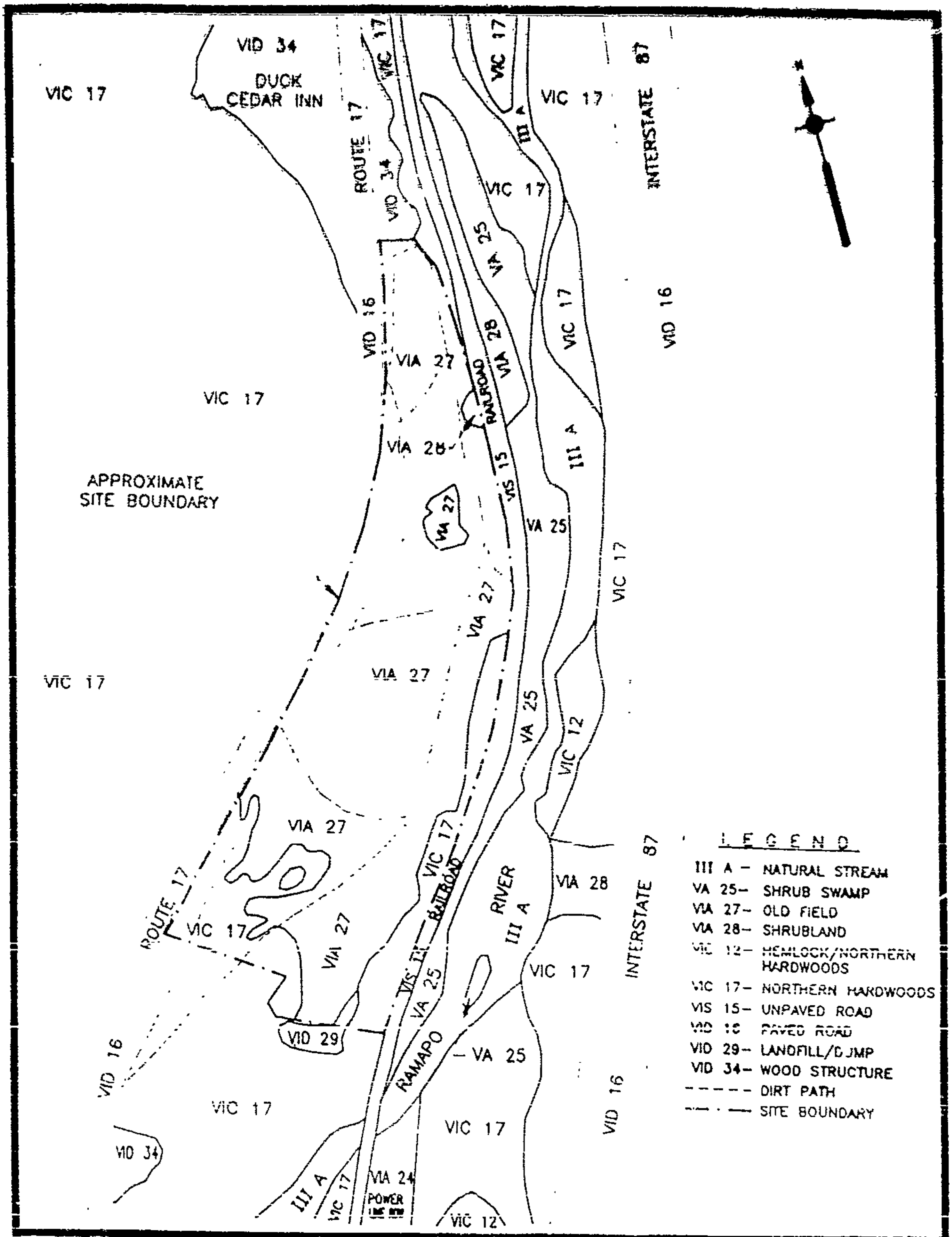
General vegetation/wetland areas and types were delineated using available aerial photography, and the resulting map (Figure 7-3) was field checked. In general, on-site wildlife habitat was dominated by successional old field, with small patches of deciduous forest occurring on the western and eastern site edges. Vegetation includes vines (e.g., poison ivy, honeysuckle, blackberry), trees (e.g., maple, oak, cedar), and weeds and grasses (e.g., ragweed, asters, evening primrose, foxtail, goldenrod, mullein). Trees and vines are concentrated on the border of the site. The interior is mostly open field Visible refuse was relatively uncommon on the soil surface, except on the southeastern edge of the landfill area, where construction refuse was observed in an excavated area.

Off-site habitat types consisted of deciduous forest to the west (across Route 17) and south, and deciduous forest and human dominated landscapes to the north. East of the site lies an active railroad/power line right-of-way, the Ramapo River and Interstate 87.

The Ramapo River, where it passes the site, alternates between narrow areas with rapid flow and rocky substrate (riffles) and areas of slow flow and mucky substrate (pools). Water depth in the riffle areas appeared to be 5 to 6 feet; depth in the pool areas was not determined but is generally deeper. The river is reportedly populated by trout and used by local anglers. An oily sheen was visible on the water surface adjacent to the extreme northern portion of the site.

7.2.4 Wildlife Observations

Fourteen species of birds were observed on, or flying over the site. In addition, a gull was observed flying over the river, and numerous sparrows/larks were repeatedly flushed from the grass. Mourning doves and American goldfinches were the most numerous species observed. A large number of Canada geese (at



M&E
Metcalf & Eddy

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 7-3
VEGETATION MAP

least 20) are regularly observed on-site. During the survey, tracks and defecation from Canada geese were observed on the eastern edge of the site.

Three species of mammals, in addition to a pair of domestic dogs, were observed either visually or by sign. White-tailed deer tracks of 9 to 10 animals were observed in the old field area south of the trailer and were also common all along the railroad right-of-way. A single deer was observed being chased by the two dogs mentioned above. The carcass of a deer which appeared to have been hit by a train, was found off-site on the railroad bridge near the southern site boundary. The deer apparently use the site for foraging and resting. The railroad tracks provide a travel corridor enabling the deer to reach both the site and access points to the Ramapo River.

Only one woodchuck burrow was observed, and it was located off-site in the forested area near the river. The carcass of a very recently killed woodchuck was discovered on-site in the old field area. One gray squirrel leaf nest was observed near the northern edge of the site. The numerous oaks in the deciduous forests on and near the site provide large quantities of mast for squirrels and other wildlife. Observations of river otter in the Ramapo River were also reported.

Numerous butterflies of at least three species, as well as bees, beetles, crickets, other ground insects, and spiders were observed. Searches under rocks and logs revealed no reptiles or amphibians.

7.2.5 Environmental Risk Assessment

Significant Biological Resources and Habitats

No significant biological resources or habitats were identified on or adjacent to the site. NYSDEC indicated that no rare, endangered, or threatened species are recorded for the Tuxedo area.

Effect of Past Waste Disposal Activities on Biota

The NYSDEC Ambient Water Quality Standards and Guidance Values used in this report were developed for fresh surface water classes for protection of aquatic life. Analyses of water and sediment samples from the Ramapo River, adjacent to the site, indicate that several contaminants of concern are present, based on the NYSDEC Ambient Water Quality Standards and Guidance Values (NYSDEC, September 1990) and Division of Fish and Wildlife Sediment Criteria (NYSDEC, December, 1989).

River Water

As shown in Table 7-6, metals contamination of river water exceeded NYS standards or guidelines for protection of aquatic species for four metals: aluminum, iron, mercury, and silver. A chromium sample was at the allowable level for hexavalent chromium, but the sampling point was mid-river upstream and therefore presumably not site-influenced. The findings are summarized below

- An elevated aluminum level, exceeding the standard, was determined for the bank sample at the mid-site (RIW2) location.
- Iron concentrations in river water were higher in the bank samples than mid-river samples and exceeded NYS standards. This was also observed in the sampling location upstream of the site.
- One river water sample showed the presence of mercury. It was detected at the mid-river, mid-site location (RIW2). The corresponding bank water sample did not show the presence of mercury, but the bank sediment did show an elevated level of this metal.
- Elevated silver levels, exceeding the standard, were detected in the bank and mid-river samples, at a mid-site location (RIW2) and the downstream mid-river sample (RIW1).

River Sediment

Guidance values for river sediment were issued by the NYSDEC Division of Fish and Wildlife in 1989. Their use in this report is discussed in Section 7.3. As shown in Table 7-7, metals contamination of river sediment exceeded NYS guidelines for protection of aquatic species for seven metals: cadmium, copper lead, manganese, mercury, nickel, zinc, and silver. Four of these metals,

Table 7-6

TUXEDO LANDFILL WASTE DISPOSAL SITE

SURFACE WATER SAMPLING DATA

STANDARDS AND GUIDANCE VALUES FOR PROTECTION OF AQUATIC SPECIES

M&E DATA

		Downstream		Mid site		Upstream			NYSDEC CLASS A
	Contract	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	1990	SURFACE WATER
	Detection	RUW1	RUW1	RUW2	RUW2	RUW3	RUW3	Background	STANDARDS AND
	Limits	Bank	Mid	Bank	Mid	Bank	Mid	Average (a)	GUIDANCE VALUES
Parameter	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	FOR AQUATIC SPECIES ug/l
Aluminum	200	1490	580	**235**	ND	140	590		100 (S)*
Chromium	10	ND	ND	ND	ND	ND	11		11 (S)**
Iron	100	**326**	204	**425**	140	**312**	700	160	300 (S)
Lead	5	4	ND	3	ND	ND	3		(S)***
Mercury	0.2	ND	ND	ND	**0.7**	ND	ND		0.2 (G)
Silver	10	58	**13**	**25**	**14**	78	88		0.01 (S)*
Zinc	20	ND	160	20	ND	130	110		30 (S)

ND = Not Detected

\- = Not available

NS = Not Sampled

NA = Not Analyzed for that component

J = Value estimated below detection limit

B = Compound also found in blank

(G) = Guidance value

(S) = Standard

(a) = Average taken from 3 Ramapo River sample locations in Sloatsburg sampled once per month

= Exceeds NYSDEC Class A Surface Water Standards for aquatic species

* Ne[illegible]

** Value cited is for hexavalent chromium. Standard for trivalent chromium equals exp (0.819[ln (ppm hardness)] + 1.561)

*** Value equals exp (1.266[ln (ppm hardness)] - 4.661)

Table 7.7

INORGANICS IN SURFACE WATER SEDIMENTS COMPARED WITH NYSDEC SEDIMENT GUIDANCE VALUES

	M & E DATA					NJDEP
	13-OCT-90	12-OCT-90	12-OCT-90	12-OCT-90	13-OCT-90	NYSDEC
	RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	GUIDANCE
PARAMETER	Downstream	Downstream	Midstream	Midstream	Upstream	VALUES
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	ug/g
ALUMINUM	7830.00	6710.00	11000.00	8510.00	7650.00	...
ARSENIC	2.00	1.40	1.9 B	1.90	3.50	5
BARIUM	44.00	31.10	64.60	50.60	37.70	...
BERYLLIUM	U	U	U	U	U	...
CADMIUM	6.50	10.70	6.60	9.20	11.10	0.8
CALCIUM	2280.00	1380.00	3240.00	2200.00	1100.00	...
CHROMIUM	10.40	10.60	14.60	10.00	10.40	26
COBALT	7.00	8.50	5.9 B	10.10	10.70	...
COPPER	24.50	11.10	51.10	22.70	16.40	19
IRON	12800.00	19200.00	9750.00	16000.00	19500.00	24000
LEAD	31.40	14.30	75.70	29.50	16.50	27
MAGNESIUM	2540.00	3290.00	2590.00	3050.00	3730.00	...
MANGANESE	168.00	427.00	707.00	393.00	880.00	428
MERCURY	0.48	U	1.40	0.30	0.32	0.11
NICKEL	12.20	20.40	24.00	20.90	31.40	22
POTASSIUM	628.00 B	728.00	868.00 B	863.00 B	844.00	...
SILVER	1.30 B	0.81 B	1.60 B	1.10 B	0.81	...
SODIUM	292.00 B	179.00 B	512.00 B	275.00 B	188.00 B	...
VANADIUM	17.10	19.50	28.10	20.20	23.30	...
ZINC	88.30	85.80	131.00	107.00	78.20	85

B = Compound found in blank.

! = Lab QC duplicate analysis not within control limits.

NA = Not Analyzed

ND = Not Detected.

U = Not detected.

[ ] = Below contract detection limit but above instrument detection limit.

L = Value estimated or not reported due to presence of interference.

☐ = Exceeds NYSDEC Guidance Value for Protection of Fish and Wildlife copper, lead, mercury and zinc, were highest in the bank sediment at mid-site location RIS2 The highest levels for the other three metals, cadmium, manganese, and nickel, were highest in the upstream bank samples (RIS3)

No New York State sediment guidance values based upon aquatic toxicity were identified for the five volatile organic contaminants identified in Ramapo River sediment samples (see Table 7-7). New York State sediment guidance values based upon aquatic toxicity for four semi-volatile organic contaminants found in Ramapo River sediment samples are shown in Table 7-8. None of the M&E sediment samples exceeded these guidance values.

Conclusion

The following conclusions are related to potential effects of site contamination on aquatic species in the Ramapo river While a definitive pattern of landfill effects on river water quality is difficult to show, some evidence indicates that the landfill may be affecting metals levels at the mid-site river bank sampling location. The landfill also appears to be affecting metals levels in sediments at mid-site (bank and mid-river) and downstream (bank) sampling locations. However, upstream bank sediment samples also showed metals contamination. No sediment samples showed significant organics contamination.

7.3 REASSESSMENT OF TARGET CLEAN-UP LEVELS (STATE CRITERIA AND GUIDANCE - SCG'S)

Volume 3 of the Project Work Plan, April 1990, includes the development of Remedial Action Objectives. Based on extensive review of available data on contaminant levels in the media of concern, as well as relevant identified state promulgated standards and guidance values (SCG's), a summary table of Target Contaminants and SCG's was developed and presented in Table 1-A of that document.

These target clean-up goals have been reassessed based on:

- Levels of contaminants measured in the various site media
- Public health standards and risk factors
- Ecological considerations
- Other relevant factors, standards, and contaminant detection limits.

TABLE 7-8
SEMIVOLATILE ORGANICS IN SURFACE WATER SEDIMENTS COMPARED WITH NYSDEC SEDIMENT GUIDANCE VALUES

	Contract Detection Limits	M&E DATA					NYSDEC GUIDANCE VALUE (AQUATIC TOXICITY)
		11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	11-Oct-90	
		RIS1 (BANK)	RIS1 (MID)	RIS2 (BANK)	RIS2 (MID)	RIS3 (BANK)	
		Downstream	Downstream	Midstream	Midstream	Upstream	
SEMIVOLATILES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	
Phenol	330	120J	110J	230J	250J	U	7.0
Acenaphthene	330	U	U	U	U	690J	8468
Phenanthrene	1600	280J	U	640J	420J	660	1612
Bis 2 ethylhexylphthalate	330	130BJ	96BJ	470BJ	550BJ	79BJ	1389

A = Estimated concentration; compound present below method detection limit.
B = Compound found in blank.
ND = Not Detected
--- = Not available
NS = Not Sampled
NA = Not Analyzed (for that component)
J = Value estimated below contract detection limit.
U = Below contract detection limit.
X = Indistinguishable isomers; Benzo(b,k)fluoranthene.
= Exceeds NYSDEC Guidance Value for Protection of Fish and Wildlife-Aquatic Toxicity

One set of guidance values not identified or addressed in the Project Work Plan is the NYSDEC, Division of Fish and Wildlife Sediment Criteria (December 1989). Two separate tabulations are included in this document: one for organics and one for metals. The criteria for developing the metals guidance values were based on toxicity to benthic organisms. Three separate criteria for organics are shown: aquatic toxicity basis, human health residue basis, and wildlife residue basis. The organics criteria are based on the total organic carbon contest of the soil. Discussions with NYSDEC and the Soil Conservation Service indicated that Otisville sand and gravel, typical of the site area, would have an organic content of 2 to 4%. The lower value of 2% was used to be conservative. Total organic carbon was assumed to represent 58% of the organic matter (California Department of Health Services, 1986). These values were used to calculate the respective guidance values for organic chemicals.

7.3.1 Public Health - Standards and Risk Factors

This section discusses air quality, groundwater, surface water, soils, and surface water sediments.

Air Quality

The Baseline Risk Assessment performed for the Tuxedo site determined that, at the present time, the primary potential health risks are associated with inhalation of landfill gas emissions. The volatile organic air contaminants estimated to represent the highest potential cancer risk (Table 7-4) are benzene and trichloroethylene. The air contaminants estimated to represent the highest potential risk from chronic exposures (Table 7-5) are hydrogen sulfide and xylenes. Based on air dispersion modeling, the air contaminants predicted with the highest off-site concentrations are hydrogen sulfide, 1,2-dichloroethylene, toluene, freon 113, xylenes, trichloroethylene, and ethyl benzene.

Table 1-A, of Volume 3 of the Project Work Plan lists SCG's for three identified air contaminants of concern at the site: toluene, trichloroethylene, and carbon tetrachloride. Of the three air contaminants listed in the Work Plan,

trichloroethylene is estimated to represent a potential cancer risk, and toluene is predicted to be present in relatively large off-site concentrations in comparison to other containments, although not estimated to represent a specific health risk. Based on the Baseline Emission Estimate, off-site exposures to carbon tetrachloride were determined to be negligible.

Listed below are the air contaminants identified as having the highest off-site concentrations and/or representing the highest potential health risks, along with NYSDEC standards or proposed guidelines.

Air Contaminant	**NYSDEC Standard or Proposed Guideline ($\mu g/m^3$)**
benzene	0.12 G
1,2-dichloroethylene	1,880 G
ethyl benzene	1,036 G
freon 113	17,905 G
hydrogen sulfide	13.9 S
toluene	7,500 G
trichloroethylene	0.45 G
xylenes	1,036 G

G - NYSDEC Proposed Guideline (AirGuide-1)
S - NYSDEC 1-Hour Standard (AirGuide-1)

Groundwater

Contaminants in groundwater samples taken by LMS and by M&E at some monitoring wells exceed NYS groundwater standards or guidance values for arsenic, iron, magnesium, manganese, sodium, cadmium, mercury, lead, phenol, naphthalene, benzene, chrysene, chloroform and acenaphthene. A data validation and usability assessment indicated that values reported for metals are tentative and should only be considered estimated values.

The applicable documented State Criteria and Guidance Values (SCGs) are listed as follows:

Groundwater Contaminant	SCG (μg/1)	Contract[1] Detection Limits (μg/l)
Arsenic	25	2/40
Iron	300	20/100
Magnesium	35,000	1,000/5,000
Manganese	300	3/15
Sodium	20,000	1,000/5,000
Cadmium	10	1/5
Lead	25	1/5
Mercury	2	0.1/0.2
Phenols	1	10
Acenaphthene	20	10
Benzene	0	5
Naphthalene	10	10
Chloroform	100	5
Chrysene	0.002	10

Surface Water

In surface water, iron was the only metal detected at a concentration level in excess of its standard. The surface water standard is 300 μg/l and M&E's contract detection limit is 20 ug/l. Some low levels of silver and mercury were detected.

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[1] Contract Detection Limits from Tables 5-1, 5-2 and 5-3. Where two values are given, the first is for the LMS Phase II study and the second is for the M&E RI/FS.

Surface Water Sediments

For surface water sediments, four semi-volatile organics (PAHs) in an upstream bank sample exceeded NYSDEC Sediment guidelines based on human health residues. These contaminants are benzo(a)anthracene, chrysene, benzo(b)fluoranthene, and benzo(a)pyrene.

Surface Water Sediment Contaminant	NYSDEC Guidance Value Human Health (Residue Basis) (µg/kg)	Contract Detection Limits[1] (µg/kg)
Benzo(a)anthacene	15.1	330
Chrysene	15.1	330
Benzo(b)fluoranthene	15.1	330
Benzo(a)pyrene	15.1	330

7.3.2 Ecological Considerations

An Environmental Risk Assessment, Section 7.2.5, concluded that the following metals were present in Ramapo River water at levels which could be potentially harmful to aquatic species aluminum, iron, mercury, and silver. The chromium level in one river water sample was elevated but appears to be non-site related. Table 1-A of Volume 3 of the Work Plan addresses SPSGVs for aluminum and iron.

---

[1] Contract detection limits from Table 4-20.

The following NYSDEC standards should be considered to protect sensitive aquatic species:

Metals	SCG (µg/l)	Contract(2) Detection Limits (µg/l)
Aluminum	100*	40
Iron	300	20
Mercury	0.2	0.1
Silver	0.1(2)	2

However, the indicated upstream concentrations of both iron and silver will preclude compliance with these proposed SCGs.

NYSDEC guidelines for river sediment for protection of aquatic species were exceeded by seven metals as listed below.

Contaminant	NYS Guidance Value (µg/kg)	Contract Detection Limit (µg/kg)
Cadmium	0.8	5
Copper	19	25
Lead	27	5
Manganese	428	15
Mercury	0.11	0.2
Nickel	22	40
Zinc	85	20

---

[2] Contract Detection Limits from Table 5-6

[3] Ionic Species

7.3.5 Other Relevant Standards

Hydrogen sulfide releases have resulted in an odor nuisance at the Tuxedo site and surrounding areas. Modeling of estimated H_2S releases is consistent with these observations. Calculated off-site maximum H_2S concentrations exceed the NYS 1-hour average standards of 0.01 ppm for hydrogen sulfide.

Toxic Gas	NYS Standard
Hydrogen Sulfide	13.9 ug/m^3 (0 01 ppm)

7.3.4 Contract Detection Limits

Water Quality

Proposed SCG values along with contract detection limits are listed for groundwater in Section 7.3.1. Except for arsenic, benzene, phenols and naphthalene, all proposed SCG's are at least two times their respective M&E contract detection limits. With the exception of ionic silver, the proposed SCG values for metals in surface water listed in Section 7.3 2 are compatible with M&E contract detection limits. Proposed guidance values for PAHs in river sediments are more than an order of magnitude below the contract detection limits.

Air Quality

The detection limits of ambient air sampling methods for organics commonly used by commercial test laboratories may not be able to attain the ambient air guidelines levels for TCE, and benzene (Pace Laboratories, 1991). NYSDEC recommends EPA Methods TO-1 (tenax) and TO-2 (carbon) with thermal desorption and GCMS to attain the required detection limits. An alternate procedure (EPA Method TO-14) employs an evacuated stainless steel canister (NYSDEC, 1991). Hydrogen sulfide can be sampled by conventional NIOSH methods using an impinger (containing cadmium hydroxide suspension) at 0.8 ppb (NYSDEC, 1991).

SECTION 8

8.0 INTERIM REMEDIAL MEASURES COMPLETED

The following IRMs, unless otherwise indicated, were performed by General Borings, Inc., Construction Division, as a subcontractor to and under the supervision of M&E

8.1 FILLING OF POND

An on-site pond was drained and filled during the period from 7/2/90 to 7/10/90. This IRM was preformed to eliminate erosion, ponding of surface water, and subsequent percolation into the fill materials. The impounded water was pumped to a higher elevation on the southern portion of the site. No significant inflow of water resulted from seepage. Twelve-hundred and fifty (1,250) cubic yards of soil was then used to fill and grade the pond depression to allow proper runoff. The filled area was covered with hay and seeded with grass, which provided vegetative cover within a short period of time.

8.2 FENCE INSTALLATION

Approximately two-hundred (200) feet of eight-foot high, No. 9 gauge, two-inch mesh, galvanized chain link fence was installed across the access road entrance on the west side of the site, to limit vehicular access from Route 17. The posts were installed on 7/15/90 and 7/16/90 by General Borings Inc. Crestwood Fence, Inc. installed the wire mesh. Two and three-eighths (2-3/8) inch O.D. line posts, 2 7/8 inch O.D. pull posts and 4 inch O.D. gate posts were used. The gate itself is twenty feet wide and has a latch, padlock, and ground pinch.

8.3 DRAINAGE PIPE SLUG TEST AND CAMERA INSPECTION

On 7/18/90, a slug test was performed on the 24-inch corrugated metal pipe running beneath the landfill to determine if water can leak from the pipe into the landfill. To perform the test, three thousand (3,000) gallons of water were fed to the pipe inlet. The total measured discharge from the east end of the pipe was 57 gallons (2% of the input).

The interior of the pipe was videotaped on 12/20/90 by T.V Ferret Inc., with M&E and NYSDEC representatives present. This examination was performed to observe the integrity of the pipe's interior and to determine if the pipe can be repaired for use in the site drainage scheme. The pipe was observed to be in good condition from the south inlet to the manhole, but damaged in the section from the manhole to the east discharge. A detailed review of the inspection tape is shown in Table 8-1.

Although several crushed sections were observed in the pipe east of the manhole, no ruptures were observed in the inspected sections. However, at least fifty feet of pipe directly east of the manhole could not be inspected because the collapsed sections did not permit camera passage.

8.4 DRAINAGE PIPE SECURITY

Four (4) inch mesh gratings of welded #4 rebar were banded over the inlet and outlet of the drain pipe on 7/13/90 to prevent children and animals from entering the pipe. The existing manhole cover and frame were removed and replaced with a new lockable frame and cover. This was also done for security reasons.

8.5 DRAINAGE IMPROVEMENTS

8.5.1 Ravine - South End

The swale entrance to the culvert inlet at the south of the site improved during 7/31/90 to 8/1/90 to eliminate the ponding occurring there and to prevent seepage directly into the landfill. Grading was done to realign approximately 100 feet of the ditch leading to the drainage pipe and to create an earthen dam behind the pipe where it enters the landfill. The last exposed section of the inlet pipe was removed, reduced in length to six feet, and reinstalled. This effectively

TABLE 8-1
TELEVISION INSPECTION OF 24-INCH CORRUGATED METAL PIPE

VIDEOTAPED ON 12/20/90 BY T.V. FERRE

T.V. INSPECTION OF 24" CORRUGATED PIPE THROUGH TUXEDO WASTE DISPOSAL SITE

SITE I.D. #

TAPE LOCATION	PIPE LOCATION (FOOTAGE)	DESCRIPTION OF VIDEOTAPE
0→26	0→2	Run #2 (MH to Railroad, heading east). The top of the pipe is caved in more than half way down, making penetration by the camera impossible
26→31	0	Camera inside manhole, facing north, showing no inlets or outlets
		Run # 1 (MH to stream, heading south)
31→48	2→5	Pipe is good.
	5→9	Pipe is not broken or punctured, but top is depressed, making pipe oblong (1'x 3' instead of 2'x 2')
50→95	9→46	Pipe is good again, not perfectly round though. At tape (75) & footgage (32) there is a lot of corrosion. The pipe is oblong & twisted, but not broken or punctured.
95→107	46→61	No corrosion. Pipe is almost round.
107→113	61→70	Oblong, some corrosion. Whereas the running water previously ran fast & shallow, the water here is deeper & slower moving.
113→127	70→90	Oblong, some corrosion. Frequent curves & twists in the pipe alignment. Some are vertical, most are horizontal.
127→138	90→97	Pipe is good.
138→141	97→100	Aligument twisted. Corrosion.
141→154	100-113	Pipe in excellent condition. Water runs slower & is deeper than usual in this run

TABLE 8-1 (continued)
TELEVISION INSPECTION OF 24-INCH
CORRUGATED METAL PIPE

VIDEOTAPED ON 12/20/90 BY T.V. FERRE

T.V. INSPECTION OF 24" CORRUGATED PIPE
THROUGH TUXEDO WASTE DISPOSAL SITE

SITE I.D #

TAPE LOCATION	PIPE LOCATION (FOOTAGE)	DESCRIPTION OF VIDEOTAPE
154→159	113→125	Water running faster & shallower again.
159→174	125→140	Pipe in excellent condition. Water running slower & deeper.
174→179	140→143	Alignment curved & jagged.
179→188	143→153	Pipe in excellent condition.
188→202	Footage not shown	Alignment curved, water depth 33% of pipe, running slow
202→230		Large dents in pipe, no apparent punctures or breaks. Water is deep (at tape location 214→217) and camera is underwater
230→255		Pipe is good and round Water not deep.
	205	End of pipe, at grating.
		Run #2 (railroad exit to manhole, heading west)
255→270	0→14	Pipe in excellent condition. Water is shallow.
270→289	14→33	Alignment is curved.
289→317	33→357	Very corroded. Water depth 40% of pipe and calm. At 48', the pipe was badly collapsed, but no breaks or punctures were seen in the pipe.
317→323	57→67	The camera went underwater. There is a lot of sediment.
323→	67→85	Pipe is good. Corrosion noted.
	85→94	Pipe corroded, heavily collapsed (40% compressed, or caved in). No visible breaks or punctures.
	94→100	Pipe in fair condition.

TABLE 8-1 (continued)
TELEVISION INSPECTION OF 24-INCH CORRUGATED METAL PIPE

VIDEOTAPED ON 12/20/90 BY T.V. FERRE

T.V. INSPECTION OF 24" CORRUGATED PIPE
THROUGH TUXEDO WASTE DISPOSAL SITE

SITE I.D. #

TAPE LOCATION	PIPE LOCATION (FOOTAGE)	DESCRIPTION OF VIDEOTAPE
	100→110	Water depth 35% of pipe. Then the camera momentarily went under water again.
	110→127	Pipe in fair condition. Water is shallower.
	127→140	Pipe is oblong with observed corrosion. Water is shallow.
	140→160	The water is deeper. The pipe contains large dents, but no breaks or punctures are visible.
	160→184	Pipe is oblong & not corroded. At 173', the pipe was crushed, but the camera made it through. No breaks or punctures were visible.
	184→190	Water depth 30% of pipe.
	190→223	Pipe in good condition. Water is shallow and flowing well.
	223→227	Pipe still good. However, the water is deeper.
480→511	227-250	Pipe has numerous dents, and the alignment is curved. The water is shallow and flowing at a good rate.
511→	250→300	Water depth increasing until the water is very high in the pipe and the camera is submerged. There is a lot of sediment.
	300→312	High water and sediment conditions continuing. Condition of pipe is deteriorated, but no visible breaks or punctures are observed. At 312', the camera cannot pass through the crushed pipe.

eliminated about fourteen feet of the inlet pipe. A 24-inch metal pipe skirt was then attached to the pipe. Two layers of heavy gauge polyethylene were installed under the base of the pipe entrance, running under the pipe (for about six feet) and then rising up above the pipe where the earthen dam was installed. This was done to prevent water from entering the landfill from beneath the pipe

8.5.2 Swale - North End

The swale on the north end of the site was improved on 7/24/90 to prevent on-site soil erosion and resulting percolation of water into the landfill Approximately 172 feet of swale were cleaned starting from a point near the discharge pipe adjacent to Route 17 and continuing around the west and north sides of the trailer heading toward the railroad tracks. The swale was relined with approximately 172 feet of geo-membrane fabric and topped with three inches of 1½ inch stone In addition, an additional 400 square feet of trench was brushed and reswaled from the east end of the lined swale to the railroad tracks.

8.6 SURFACE DRAINAGE EVALUATION

M&E evaluated drainage patterns and flows to determine the best methods for preventing run-on to the site. Estimates of stormwater run-on to the site were made based on the sizes of two identified drainage areas to the south and southwest, respectively. The capacity of an existing storm pipe under Stevens Lane is inadequate to accept present storm flows. Improvements to the drainage system to the south would be required to manage the additional runoff volume resulting from diverting storm water away from the site.

The feasibility of repairing or replacing the damaged drain pipe running under the site should be explored because diverting all the water now draining to the pipe may not be feasible. Some water may also be draining to the pipe inlet area, which is a natural retention basin, thus bypassing the pipe and leaching into the landfill. An alternative approach to repairing the existing drain pipe would be to leave both the pipe and the gully which feeds it at the southern end of the site in their existing conditions while permitting storm water runoff from the 4.5 acre drainage basin to the south to partially infiltrate into the site groundwater system. However, the ramifications of this approach should be evaluated.

8.7 FIRE CONTINGENCY PLAN

As requested by NYSDEC, an additional IRM was the to development of a site Fire Contingency Plan This contingency plan was developed to protect the community and environment surrounding the Tuxedo Waste Disposal Site in the event of a subsurface fire incident. Focusing primarily on a subsurface fire incident, which would require assistance from other government agencies the plan had two objectives:

- to provide background and other information pertinent to developing and understanding the plan, and
- to provide a plan outlining appropriate actions to be taken by local, state, federal and private responders during a fire incident.

The Fire Contingency Plan - Tuxedo Waste Disposal Site was submitted as a separate document in May, 1991.

SECTION 9

9.0 REMEDIAL INVESTIGATION SUMMARY

9.1 GENERAL

The objectives of the Phase 1 RI/FS were to investigate the nature and sources of site contamination, including the extent of contamination in the various media, and to evaluate health and environmental risks associated with the contamination; and to obtain the information needed to perform the feasibility study. Additional objectives were to determine whether additional investigative or interim remedial measures are needed, and whether the list of potential remedial alternatives identified during Task 2 (Volume 3, Summary Analysis, Potential Remedial Alternatives) is complete.

The following conclusions are based on the evaluation of findings from previous studies, including the LMS Phase II investigation, and the remedial investigation conducted by Metcalf and Eddy.

- The increased risk of cancer to potential off-site receptors due to emissions of soil gas from the site is less than three in one million, based on EPA risk factors. The increased risk of cancer at the locations of present residences is less than one in one million, based on EPA risk factors.
- No significant potential for chronic non-cancer health risks is indicated based on individual and additive effects of modeled maximum off-site concentrations of contaminants.
- Modeled emissions of hydrogen sulfide indicate that worst case emissions exceed the NYS standard.
- There is evidence that the Ramapo River is marginally being affected by transport of site contamination that may affect sensitive aquatic species in the immediate area.
- Site drainage problems have been confirmed.
- The data and summary findings of the M&E remedial investigation are consistent with earlier data and findings.

A summary of findings for each environmental medium of interest is presented below based on the information in Sections 5, 6, and 7 of this report.

9.2 GROUNDWATER

9.2.1 Nature and Extent of Contamination

Groundwater samples obtained by M&E from eight downgradient monitoring wells contained levels of metals and organic compounds that exceeded NYS groundwater standards or guidance values for cadmium, iron, lead, magnesium, manganese, sodium, benzene, phenol, naphthalene, and acenaphthene. In addition, a sample from well RI-3 in the southwest corner of the site (upgradient) contained levels of chrysene and iron that exceeded NYS standards or guidance values. Samples from upgradient wells RI-5, MW-1 and MW-2 contained iron concentrations that exceeded standards. Also, the samples from MW-1 and MW-2 contained sodium and mercury, respectively, at levels that exceeded standards. Selenium, previously reported by LMS at an estimated value, was not detected in M&E's 1990 samples. The analytical results of the groundwater sampling event conducted during the M&E's remedial investigation indicated the following:

Organic Compounds

Organic Compounds that were detected and found at levels exceeding standards and/or guidance values are indicated with an asterisk in Table 9-1. Although acetone, methylene chloride, and toluene were detected in groundwater samples, a data validation and usability assessment indicates that these compounds were also found in sample blanks at levels indicating that they are most likely laboratory contaminants.

Metals

Metals that were found at elevated levels significantly above background levels or exceeding standards and guidance values (asterisk) are indicated in Table 9-2. The validity of some of the metals data is questionable, but the values may be used as estimated values.

TABLE 9-1
ORGANIC CONTAMINANTS IN GROUNDWATER

Well Location	Organic Contaminants
RI-1	Chloroform
RI-2	Chloroform
RI-3	Chrysene*
RI-5, MW-1, MW-7	Chloroform
RI-6	Semi-volatiles: Phenol**, Naphthalene*, 2-Methylnaphthalene, Acenapthene*, Dibenzofuran, Fluorene, Phenanthrene Volatiles: Chloroform
MW-5	Benzene*
MW-2	Bis (2-ethylhexyl) phthalate

**The following exceeded NYS groundwater standards or guidance values.

TABLE 9-2

METALS CONTAMINANTS IN GROUNDWATER

Well Location	Metals Contaminants
RI-1	Iron*
RI-2	Copper, Iron*, Lead, Manganese*, Nickel, Sodium*, Zinc
RI-3	Iron*
RI-4	Iron*, Lead*, Sodium*, Zinc
RI-5	Iron*
MW-1	Iron*, Sodium*
MW-2	Cadmium, Chromium, Iron*, Mercury*
MW-3	Iron*, Magnesium*, Manganese*, Sodium*
MW-4	Iron*, Magnesium*, Manganese*, Nickel, Sodium*
MW-5	Cadmium*, Iron*, Magnesium*, Nickel, Manganese*, Sodium*
MW-6	Arsenic, Cadmium*, Iron*, Magnesium*, Manganese*, Sodium*
MW-7	Iron*, Sodium*

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* Exceeded NYS groundwater standards or guidance values.

9.2.2 Contaminant Fate and Transport

Groundwater represents a potential migration pathway for contamination off-site. At the Tuxedo site, the high groundwater gradients and conductivities in the overburden deposits result in high groundwater velocities which enhance contaminant migration. Although the primary component of groundwater flow is horizontal, vertical migration of water is indicated by the natural gradients between the porous soil and rock material.

9.2.3 Risk Assessment

Groundwater is a medium of concern at the site because it is a pathway for contaminant transport into the Ramapo River. Although groundwater in the site's overburden deposits is contaminated with metals and organics, as detected in monitoring wells, the immediate threat to groundwater quality does not necessarily indicate a potential threat of human exposure off-site. Aside from the potential for contamination at the well on the antique shop property, which is not used for potable water, no downgradient wells have been identified.

9.3 SURFACE WATER QUALITY

9.3.1 Nature and Extent of Contaminant

Organic compounds were not detected in surface water samples obtained from the Ramapo River during M&E's sampling program. The M&E 1990 data indicates that aluminum, calcium, iron, lead, magnesium, and sodium were detected in marginally greater concentrations in samples obtained mid-site and downstream of the landfill. The highest levels of aluminum, iron, silver, and zinc were found in the samples obtained near the river bank at the mid-site location. Iron concentrations in samples from the river bank collection points at downstream location RI-W1, mid-site location RI-W2, and upstream location RI-W3 were in contravention of the surface water standard. An elevated concentration of mercury was also indicated at mid-site location RI-W2. Because preliminary data validation and usability assessments found some of the metals data questionable, the values detected for metals should be considered estimated, rather than actual, values.

9.3.2 Contaminant Fate and Transport

The Ramapo River is the only surface water affected by contaminant migration from the landfill. The migration and discharge of contaminated groundwater to the river is evidenced by the elevated levels of certain metals found in the river water and elevated levels of metals and semi-volatile organic compounds detected in river sediment (see Section 9.4) samples collected along the bank at mid-site and downstream sampling locations. A leachate seep appeared to be emanating from the landfill site near the river bank, and the river water and sediment samples obtained near this seep contained elevated levels of contaminants. Although background and upstream sources of some contaminants may be contributing factors, the mid-site levels are indicative of contamination migration from the landfill.

9.3.3 Risk Assessment

As a Class A surface water, the Ramapo River is suitable for drinking water supply. Although potable water for communities along the river in New York State is obtained from groundwater sources, the North Jersey District Water Supply Commission draws some of its water from the Ramapo River at a point approximately 22 miles downstream from the Tuxedo site. Available data indicates that, at present the landfill is not significantly affecting the river's water quality with regard to human risk factors.

The river is also a recreational fishing area. Class A surface water standards for protection of aquatic life are contravened for aluminum[4], iron, and mercury. Metals potentially can become concentrated in fish tissue.

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[4] The standards cited in Table 7-4 are for ionic species.

9.4 SURFACE WATER SEDIMENT

9.4.1 Nature and Extent of Contamination

Twenty-one semi-volatile organic contaminants were found in various concentrations in samples tested. Most of them were polycyclic aromatic hydrocarbons (base neutral compounds). The highest levels of semi-volatiles were found in the samples from the stream banks at upstream location RI-S3 and mid-site location RI-S2. The upstream samples contained levels of four (4) semi-volatiles in excess of NYS Guidance Values (human health residue basis) for PAHs

River water sediment samples taken in 1990 showed elevated levels of cadmium, copper, lead, manganese, mercury, nickel and zinc with respect to guidance values for protection of aquatic species. Mercury and lead were elevated with respect to human health considerations. However, some of these metals concentrations must be treated as estimated values, based on preliminary data validation and usability assessment results.

9.4.2 Contaminant Fate and Transport

Contaminants in the river water sediments can become disturbed during periods of high flow, high velocity conditions, when the contaminated sediment may be entrained, suspended, and transported in the surface water to downstream locations.

9.4.3 Risk Assessment

Sediment contained PAH levels above NYS Guidelines (human health residue basis). Fish have the potential to concentrate metals of concern detected in sediments. Examination of fish tissue was not in the scope of the present program.

9.5 SOILS

9.5.1 Nature and Extent of Contamination

The nature and levels of soil contamination found by M&E reflect the fact that borings for the M&E RI work were performed only at [illegible]d the site periphery. The analytical results indicated that low levels of volatile and semi-volatile organic compounds were present. Polycyclic aromatic hydrocarbons (PAHs) and phthalatic acid esters (PAEs)(1) were the major organic contaminants found in the soil boring samples. The highest concentrations of total organic compounds were found in the sample from RIB-7. The highest concentration of total semi-volatiles were found in the sample from RIB-4.

9.5.2 Contaminant Fate and Transport

Emissions of volatile organic soil contaminants are discussed in Section [illegible]. Migration of non-volatile soil contaminants into the air is considered negligible because the landfill is covered with a cover of clean soil. However, contaminants from materials within the landfill are a major factor affecting groundwater contamination.

9.5.3 Risk Assessment

Contaminated soils do not constitute a likely direct pathway for public health risk.

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[1] Preliminary data validation and usability assessment indicated that the value for a PAE, di-n-butylphthalate, is not usable

9.6 AIR

9.6.1 Nature and Extent of Contamination

The nature and extent of air contaminants were calculated using a Baseline Emissions Estimate based on estimated soil gas generation rates and contaminant levels measured during various site investigations. Off-site concentrations of air contaminants were modeled for worst case and average case scenarios. Maximum and average concentrations for the air contaminants with the highest modeled off-site concentrations are listed in Table 9-3.

9.6.2 Contaminant Fate and Transport

Air contaminant transport was addressed in the modeled ambient air concentrations previously discussed. Modeled concentrations presented in Section 7 are for the minimum modeled distance from the source, 100 meters. Concentrations will diminish with distance from the site and follow prevailing wind direction. The immediate topography of this area influences wind direction into a NW-S pattern.

9.6.3 Risk Assessment

A cancer risk evaluation based on EPA methodologies showed that the calculated worst-case upper-bound excess cancer risk would be 3.0×10^{-6}, which is within the normally acceptable limits for a Superfund site. The upper-bound excess cancer risk from average emissions was calculated to be 2.4×10^{-6}. This exposure scenario is modeled at 100 meters from the site. Benzene is the primary contaminant contributing to the estimated excess cancer risks.

Chronic health effects were modeled and evaluated for calculated average and worst-case landfill gas emission scenarios. Soil gas contaminants examined for long-term chronic health included of 1,2-dichloroethylene, trichloroethylene, tetrachloroethylene, benzene, toluene, ethylbenzene, xylenes, 1,1,1-trichloroethylene, styrene, freon (113), 1,1-dichloroethene, methylene

TABLE 9-3

CONTAMINANTS IN AIR WITH HIGHEST MODELED OFF-SITE CONCENTRATIONS

CONTAMINANT	MAXIMUM CONCENTRATION ($\mu g/m^3$)	AVERAGE CONCENTRATION ($\mu g/m^3$)
1-2 Dichloroethylene	1.5	0.48
Xylene	0.56	0.33
Toluene	0.62	0.25
Hydrogen sulfide - 1 hour	29.1	7.8

G = NYSDEC Proposed Guideline (AirGuide-1)
S = NYSDEC 1-Hour Standard (AirGuide-1)

chloride, and vinyl chloride. The results indicate that no current or proposed state guidelines or standards would be exceeded for average or maximum emission scenarios for the individual contaminants evaluated.

To determine the cumulative chronic effects of toxic air contaminants, a Hazard Index was compiled based on EPA methodology. The Hazard Index used was the sum of the ratios of the maximum modeled contaminant concentrations in air to the chronic, non-carcinogenic inhalation reference concentrations. The calculated index value was below 1.0, which is an acceptable level of risk.

To evaluate acute health effects, estimated maximum and average hydrogen sulfide emissions were modeled for one-hour exposure scenarios. The maximum predicted hydrogen sulfide concentration exceeds the 1-hour NYS standard (0.01 ppm). However, a review of applicable health effects criteria indicates that no observable health effects would result from hydrogen sulfide exposure below the 10 ppm (14,000 $\mu g/m^3$) OSHA standards. Hydrogen sulfide releases have resulted in an odor nuisance at the Tuxedo site and surrounding areas, and modeled estimated H_2S releases are consistent with these observations.

9.7 RECOMMENDATIONS

The following additional site investigation work is recommended in conjunction with implementation of a remedial action plan:

- A pilot gas extraction system should be designed and installed on-site to provide design data for a full remedial action for soil gas contaminants. Such a pilot system would:
    - provide better definition of the nature and levels of soil gas contamination in the test area,
    - provide quantitative measurements of soil gas evolution rates,
    - provide data for estimating soil characteristics with respect to air/vapor permeability, and
    - provide information about subsoil contamination that might affect a gas extraction system.

- Additional sampling efforts should be conducted in the existing monitoring wells and the Ramapo River to develop a sufficient data base to predict trends and potential contaminant plume movements until the groundwater remediation alternative is implemented.

- The feasibility of diverting stormwater run-on and infiltration should be evaluated. Based on the IRM performed in Task 3, run-on to the southwestern corner of the site should be diverted south. Improvements to the south would be needed to manage the additional volume of runoff.

- During implementation of the remedy, ambient air monitoring as appropriate should be performed to insure protection of the community

SECTION 10

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ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
BEE	Baseline Emissions Estimate
C&D	Construction and Demolition
CGI	Combustible Gas Indicator
EPA	United States Environmental Protection Agency
FS	Feasibility Study
GC	Gas Chromatograph
IRM	Interim Remedial Measure
LMS	Lawler, Matusky, & Skelly Engineers
M&E	Metcalf & Eddy, Inc.
MSL	Mean Sea Level
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RQD	Rock Quality Designation
SCG	State Criteria and Guidance Values
TIC	Tentatively Identified Compounds
USGS	United States Geological Survey
VOC	Volatile Organic Compound

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New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX A

HEALTH RISK INFORMATION

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

APPENDIX A

This Appendix contains three sections as follows:

Attachment A: Landfill Gas Generation and Emissions

Attachment B: Air Contaminants

Attachment C: Toxic Exposure Health Risk

ATTACHMENT A:

Landfill Gas Generation and Emissions

ATTACHMENT A
CALCULATIONS

A 1 Estimate of Gas Generation Rate from Landfill Subsection

Gas generation is based on the following assumptions

- 3000 lb/ton of landfill material
- 1.5 tons per cubic yard of landfill material
- 70-year gas generation rate

Q - gas generation rate, CFH
W - landfill weight per subsection

then

$$Q = \frac{W\ (tons)\ x\ 3,000\ cf/ton}{70\ years\ x\ 8,760\ hours/yr}$$

For Landfill Subsection No 4;

$$W = 148,153\ yd^3 = 222,229\ tons$$

$$Q = \frac{222,229\ tons\ x\ 3,000\ cf/ton}{70\ years\ x\ 8,760\ hours/yr.}$$

$$Q = 1087\ cfm$$

A.2 Estimate of Landfill Subsection Emission Rate

$E_{(i)}$ = emission rate for substance i, lb/hr
Q = landfill subsection gas emission rate CFH
C_i = concentration of substance i, ppm
MW_i = molecular weight of substance i.

then,

$$E_{(i)} = \frac{Q(i) \times C(i) \times MW}{379\ (\text{cu-ft/lb-mole}) \times 1{,}000{,}000}$$

Example:

Landfill Subsection 4, 1,2-Dichloroethylene (DCE)

Q = 1087 CFH
C_{DCE} = 420 ppm
MW_{DCE} = 97.0

$$E_i = \frac{1{,}087\ \text{CFH} \times 420\ \text{ppm} \times 97}{379\ (\text{cu-ft/lb-mole}) \times 1{,}000{,}000}$$

$$E_i = 0.117\ \text{lb/hr}$$

A.3 Estimate of Model Input Souice Strength

Source strength, for substance i,

$$S_i = \frac{E_i}{A} \times 0.126$$

Where S_i = gm/sec/m^2

E_i = the emission rate, lb/hr

A = area of source, M^2

TABLE - APPENDIX A-1
MOLECULAR WEIGHTS OF LANDFILL GASES

SUBSTANCE	MOLECULAR WEIGHT
Toluene	92.4
Hydrogen Sulfide	34.0
1,2 Dichloroethylene	97.0
Trichloroethylene	131.4
Tetrachloroethylene	166.0
Benzene	78.0
Ethylbenzene	106.0
Xylenes	106.2
1,1,1 Trichloroethane	133.4
Trichlorofluoromethane	[illegible]
Styrene	104.2
Freon 113	[illegible]
Methylene Chloride	85.0
Dichlorofluoromethane	[illegible]
1,4-Dichlorobenzene	147.0
Vinyl Chloride	62.5

ATTACHMENT B:

Air Contaminants

GRID LOCATION: 1

	CAS #	QUANTITY UNITS	METHOD	DATE	AVG	MAX
1,1,1-trichloroethane	00071-55-6					
trichlorofluoromethane						
dichlorofluoromethane						
tetrachloroethylene	00079-00-5					
carbon tetrachloride	00056-23-5					
benzene						
toluene	00108-88-3	6.8 ppm		JULY 1988	6.80	6.8
1,2-dichloroethylene	00540-54-0					
trichloroethylene	00079-01-6					
1,2,4-trimethylbenzene						
para-dichlorobenzene						
trans-dichlorobenzene						
trans, 1,2-dichloroethene	00156-60-5					
1,1 dichloroethene	00075-35-4					
styrene	00100-42-5					
freone (113)	00076-13-1					
methane						
ethylbenzene	00100-41-4	20 ppm		JULY 1988	20.00	20
methyl-ethyl ketone	00078-93-3					
methylene-chloride	00075-09-2					
stoddard solvent						
H2S	007783-06-4	322 ppm 175 ppm 3 ppm		JULY 1988 JULY 1988 JULY 1988	166.67	322
CO2	00124-38-9					
vinyl chloride	00075-01-4					
total xylenes	01330-20-7					
total VOC's						
unknowns		10 ppm		JULY 1988	10.00	10

GRID LOCATION: 2

	CAS #	QUANTITY	UNITS	METHOD	DATE	AVG	MAX
1,1,1-trichloroethane	00071-55-6						
trichlorofluoromethane							
dichlorofluoromethane							
tetrachloroethylene	00079-00-5	1.2	ppm		JULY 1988		
carbon tetrachloride	00556-23-5						
benzene		0.04	ppm	GC	AUGUST 15-16, 1990		
		0.06	ppm	GC	AUGUST 15-16, 1990		
		0.05	ppm	GC	AUGUST 15-16, 1990		
		0.04	ppm	GC	AUGUST 15-16, 1990		
		0.06	ppm	GC	AUGUST 15-16, 1990	0.05	0.06
		4.9	ppm		JULY 1988		
		6.8	ppm		JULY 1988		
toluene	00108-88-3	0.59	ppm	GC	AUGUST 15-16, 1990	0.59	0.59
		18	ppm		JULY 1988		
		46	ppm		JULY 1988		
		7.8	ppm		JULY 1988		
1,2-dichloroethylene	00540-54-0	120	ppm		JULY 1988		
		18	ppm		JULY 1988		
trichloroethylene	00079-01-6	7.7	ppm		JULY 1988		
		15	ppm		JULY 1988		
1,2,4-trimethylbenzene							
para-dichlorobenzene							
trans-dichlorobenzene		0.17	ppm	GC	AUGUST 15-16, 1990		
		0.22	ppm	GC	AUGUST 15-16, 1990		
		0.19	ppm	GC	AUGUST 15-16, 1990		
		0.34	ppm	GC	AUGUST 15-16, 1990		
		0.25	ppm	GC	AUGUST 15-16, 1990	0.23	0.34
trans, 1,2-dichloroethene	00156-60-5						
1,1 dichloroethene	00075-35-4						
styrene	00100-42-5						
freon (113)	00076-13-1						
methane							
ethyl benzene	00100-41-4	0.01	ppm	GC	AUGUST 15-16, 1990		
		0.02	ppm	GC	AUGUST 15-16, 1990	0.02	
		29	ppm		JULY 1988		
		14	ppm		JULY 1988		
methyl-ethyl ketone	00078-93-3						
methylene-chloride	00075-09-2	0.41	ppm	GC	AUGUST 15-16, 1990		
		0.45	ppm	GC	AUGUST 15-16, 1990		
		0.58	ppm	GC	AUGUST 15-16, 1990		
		0.56	ppm	GC	AUGUST 15-16, 1990		
		0.64	ppm	GC	AUGUST 15-16, 1990		
		0.64	ppm	GC	AUGUST 15-16, 1990		
		0.65	ppm	GC	AUGUST 15-16, 1990		
		0.66	ppm	GC	AUGUST 15-16, 1990		
		0.64	ppm	GC	AUGUST 15-16, 1990	0.58	0.66
stoddard solvent							
H2S	007783-06-4	732	ppm		JULY 1988		
		562	ppm		JULY 1988		
		10	ppm		JULY 1988		
		734	ppm		JULY 1988		
					JULY 1988		
CO2	00124-38-9				JULY 1988		
					JULY 1988		
vinyl chloride	00075-01-4				JULY 1988		
					JULY 1988		
total xylenes	01330-20-7	50	ppm		JULY 1988		
		25	ppm		JULY 1988		
		38	ppm		JULY 1968		

Total VOC's	50 ppm	OVA	
Unknowns	30 ppm		JULY 1988
	25 ppm		JULY 1988
	170 ppm		JULY 1988
	185 ppm		JULY 1988

GRID LOCATION: 5

	CAS #	QUANTITY	UNITS	METHOD	DATE	AVG	MAX
total VOC'S		600	ppm	OVA	AUGUST 15 To,1990	600	600
1,1,1 trichloroethane	00071 55-6						
trichlorofluoromethane							
dichlorofluoromethane							
tetrachloroethylene	00079-00 5						
carbon tetrachloride	00556-23-5						
benzene		2.5	ppm		JULY 1988	2.5	2.5
toluene	00108-88-3	2.6	ppm		JULY 1988	2.6	2.6
1,2-dichloroethylene	00540-54-0	2	ppm		JULY 1988	2	2
trichloroethylene	00079-01-6	1	ppm		JULY 1988	1	1
1,2,4-trimethylbenzene							
para dichlorobenzene							
trans-dichlorobenzene							
trans, 1,2-dichloroethene	00156-60-5						
1,1 dichloroethene	00075-35-4						
styrene	00100-42-5						
freon (113)	00076-13-1						
methane							
ethylbenzene	00100-41-4	0.7	ppm		JULY 1988	0.7	0.7
methyl-ethyl ketone	00078-93-3						
methylene-chloride	00075-09-2						
stoddard solvent							
H2S	007783-06-4						
CO2	00124-38-9						
vinyl chloride	00075-01-4						
total xylenes	01330-20-7	7.7	ppm		JULY 1988	7.7	7.7
unknowns		25	ppm		JULY 1988	25	25

A - 1

```
GRID LOCATION:         4
                                        QUANTITY  UNITS       METHOD  DATE                                AVG        MAX
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                           CAS #

total VOC's (PPM)                            100 PPM          OVA     AUGUST 15-16, 1990
                                           10000 PPM          OVA     AUGUST 15-16, 1990
                                           10000 PPM          OVA     AUGUST 15-16, 1990
                                           10000 PPM          OVA     AUGUST 15-16, 1990
                                              20 PPM          OVA     AUGUST 15-16, 1990
                                             175 PPM          OVA     AUGUST 15-16, 1990
                                               7 PPM          OVA     AUGUST 15-16, 1990
                                             180 PPM          OVA     AUGUST 15-16, 1990          3810.25      10000

1,1,1-trichloroethane      00071-55-6        4.7 ug/M^2/min           OCTOBER 18,1990                 4.7        4.7

trichlorofluoromethane                    241.77 ug/M^2/min           OCTOBER 18,1990              241.77     241.77

dichlorofluoromethane

tetrachloroethylene        00079-00-5        0.4 ppm                  JULY 1988
                                             1.5 ppm                  JULY 1988                      0.95        1.5

carbon tetrachloride       00056-23-5

benzene                                     2.32 ug/M^2/min           OCTOBER 18,1990                2.32       2.32
                                            0.03 PPM          GC      AUGUST 15-16, 1990
                                            0.05 PPM          GC      AUGUST 15-16, 1990             0.04       0.05
                                             9.2 ppm                  JULY 1988
                                             4.9 ppm                  JULY 1988
                                             4.9 ppm                  JULY 1988
                                             7.4 ppm                  JULY 1988                       6.6        9.2

toluene                    00108-88-3       9.14 ug/M^2/min           OCTOBER 18,1990                9.14       9.14
                                            0.05 PPM          GC      AUGUST 15-16, 1990             0.05       0.05
                                              88 ppm                  JULY
                                              14 ppm                  JULY
                                              81 ppm                  JULY 1988
                                              18 ppm                  JULY 1988
                                             3.1 ppm                  JULY 1988                     40.82        3.1

1,2-dichloroethylene       00540-59-0        410 ppm                  JULY 1988
                                              31 ppm                  JULY 1988
                                               4 ppm                  JULY 1988
                                             3.5 ppm                  JULY 1988                   112.125        410

trichloroethylene          00079-01-6         46 ppm                  JULY 1988
                                             1.8 ppm                  JULY 1988
                                             5.5 ppm                  JULY 1988
                                             1.8 ppm                  JULY 1988
                                             7.7 ppm                  JULY 1988                     12.56         46

1,2,4-trimethylbenzene




para-dichlorobenzene

trans-dichlorobenzene

trans, 1,2-dichloroethen00156-60-5          0.53 PPM          GC      AUGUST 15-16, 1990
                                            0.43 PPM          GC      AUGUST 15-16, 1990             0.48       0.53

1,4-dichlorobenzene                    ND

1,1-dichloroethene         00075-35-4

styrene                    00100-42-5       2.17 ug/M^2/min           OCTOBER 18,1990                2.17       2.17

freone (113)               00076-13-1      44.97 ug/M^2/min           OCTOBER 18,1990               44.97      44.97

methane                                     1440 ug/M^2/min           OCTOBER 18,1990                1440       1440

non-methane hydrocarbons                     442 ug/M^2/min           OCTOBER 18,1990                 442        442

ethyl-benzene (ug/m2/min00100-41-4          1.09 ug/M^2/min           OCTOBER 18,1990                1.09       1.09
                                            0.01 PPM          GC      AUGUST 15-16, 1990             0.01       0.01
                                              42 ppm                  JULY 1988
                                              20 ppm                  JULY 1988
                                              10 ppm                  JULY 1988
                                             9.5 ppm                  JULY 1988                    20.375         42

methyl-ethyl ketone        00078-93-3

methylene-chloride         00075-09-2       2.72 ug/M^2/min           OCTOBER 18,1990                2.72       2.72
                                             1.1 PPM          GC      AUGUST 15-16, 1990
                                            1.25 PPM          GC      AUGUST 15-16, 1990
                                            0.67 PPM          GC      AUGUST 15-16, 1990
                                            0.65 PPM          GC      AUGUST 15-16, 1990           0.9175       1.25
```

stoddard solvent					
h2s	007783-06-4				
co2	00124-38-9	1005318 ug/m^2/min	OCTOBER 18,1990	1005318	1005318
vinyl chloride	00075-01-4	ND			
total xylenes	01330-20-7	3.23 ug/m^2/min	OCTOBER 18,1990		
		1.07 ug/m^2/min	OCTOBER 18,1990	2.15	3.23
		76 ppm	JULY 1988		
		16 ppm	JULY 1988		
		44 ppm	JULY 1988		
		23.5 ppm	JULY 1988		
		105 ppm	JULY 1988	52.96	105
unknowns		400 ppm	JULY 1988		
		60 ppm	JULY 1988		
		120 ppm	JULY 1988		
		120 ppm	JULY 1988		
		675 ppm	JULY 1988	275	675

```
GRID LOCATION:          5

                                                 QUANTITY UNITS  METHOD   DATE          AVG       MAX
==========================================================================================================
                                  CAS #

1,1,1-trichloroethane          00071-55-6
trichlorofluoromethane
dichlorofluoromethane
carbon tetrachloride           00056-23-5
benzene                                             9.2 ppm               JULY 1988     9.2       9.2
toluene                        00108-88-3            94 ppm               JULY 1988      94        94
1,2-dichloroethylene           00540-59-0           150 ppm               JULY 1988     150       150
trichloroethylene              00079-01-6            11 ppm               JULY 1988      11        11
1,2,4-trimethylbenzene
para-dichlorobenzene
trans-dichlorobenzene
trans, 1,2-dichloroethene      00156-60-5
1,1 dichloroethene             00075-35-4
styrene                        00100-42-5
freone (113)                   00076-13-1
methane
ethylbenzene                   00100-41-4            42 ppm               JULY 1988      42        42
methyl-ethyl ketone            00078-93-3
methylene-chloride             00075-09-2
stoddard solvent
H2S                            07783-06-4

CO2                            00124-38-9
vinyl chloride                 00075-01-4




total xylenes                  01330-20-7           101 ppm               JULY 1988     101       101
total [illegible]
unknowns                                            335 ppm               JULY 1988     335       335
```

GRID LOCATION: 6

	CAS #	QUANTITY	UNITS	METHOD	DATE	SUM	MAX
total VOC's (PPM)		1500	ppm		OCT 3,1990		
		37	ppm		OCT 3,1990	768.50	1500
		400	ppm		AUGUST 15-16,1990		
		2500	ppm		AUGUST 15-16,1990		
		300	ppm		AUGUST 15-16,1990		
		550	ppm		AUGUST 15-16,1990		
		350	ppm		AUGUST 15-16,1990		
		12	ppm		AUGUST 15-16,1990	685.33	2500
	SG	82103	ug/m2/min	OVA	OCTOBER 3-4, 1990	42064.00	82103
	SG	2025	ug/m2/min	OVA	OCTOBER 3-4, 1990		
1,1,1-trichloroethane	00071-55-6	1	ug/m2/min	GC/FLUX	OCT. 4, 1990	1.00	1
trichlorofluoromethane							
dichlorofluoromethane		0.13	ug/m2/min	GC/FLUX	OCT. 4, 1990	0.13	0.13
tetrachloroethylene	00079-00-5	9	ug/m2/min	GC FLUXBOX	OCT. 3-4, 1990	9.00	9
		0.02	ppm	GC PHOTOVAC	OCT. 3-4, 1990	0.02	0.02
carbon tetrachloride	00056-23-5						
benzene		1.02	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	1.02	1.02
		6.8	ppm		JULY 1988	6.8	6.8
toluene	00108-88-3	0.53	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	0.53	0.53
		104	ppm		JULY 1988		
		15	ppm		JULY 1988	59.5	104
1,2-dichloroethylene	00540-59-0	135	ppm		JULY 1988	135	135
trichloroethylene	00079-01-6	0.27	ug/m2/min	GC FLUXBOX	OCT. 4, 1990		
		22	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	11.14	22
		0.05	ppm	GC PHOTOVAC	OCT. 3-4, 1990	0.05	0.05
		44	ppm		JULY 1988		
		18	ppm		JULY 1988	31	44
1,2,4-trimethylbenzene							
para-dichlorobenzene							
trans-dichlorobenzene							
trans, 1,2-dichloroethen	00156-60-5	0.14	ppm	GC	AUGUST 15-16, 1990	0.14	0.14
1,4-dichlorobenzene							
1,1-dichloroethene	00075-35-4						
styrene	00100-42-5						
freone (113)	00076-13-1	44.97	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	44.97	44.97
methane		115	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	115.00	115
non-methane hydrocarbons		19	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	19.00	19
ethyl-benzene (ug/m2/min	00100-41-4	0.07	ppm	GC	AUGUST 15-16, 1990	0.07	0.07
		72	ppm		JULY 1988		
		8.1	ppm		JULY 1988	26.72	72
methyl-ethyl ketone	00078-93-3						
methylene-chloride	00075-09-2	1.13	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	1.13	1.13
		0.45	ppm	GC	AUGUST 15-16, 1990	0.45	0.45
stoddard solvent							
H2S	007783-06-4						
CO2	00124-38-9	31256	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	31256.00	31256
vinyl chloride	00075-01-4						
total xylenes	01330-20-7	0.12	ug/m2/min	GC FLUXBOX	OCT. 4, 1990	0.12	0.12
		158	ppm		JULY 1988		
		31	ppm		JULY 1988	94.50	158
unknowns		7140	ppm		JULY 1988		
		1995	ppm		JULY 1988	4567.50	7140

GRID LOCATION: 7

	CAS #	QUANTITY	UNITS	METHOD	DATE	AVG	MAX
Total VOC's (PPM)	[illegible]	6500	ppm	OVA	OCT 3-4, 1990		
	[illegible]	10000	ppm	OVA	OCT 3-4, 1990		
	[illegible]	100	ppm	OVA	OCT 3-4, 1990		
	[illegible]	600	ppm	OVA	OCT 3-4, 1990		
	[illegible]	65	ppm	OVA	OCT 3-4, 1990		
	[illegible]	250	ppm	OVA	OCT 3-4, 1990		
	[illegible]	100	ppm	OVA	OCT 3-4, 1990	2516.43	10000
		250	ppm	OVA	AUG 15-16, 1990		
		300	ppm	OVA	AUG 15-16, 1990		
		70	ppm	OVA	AUG 15-16, 1990		
		200	ppm	OVA	AUG 15-16, 1990		
		19	ppm	OVA	AUG 15-16, 1990		
		2500	ppm	OVA	AUG 15-16, 1990		
		500	ppm	OVA	AUG 15-16, 1990		
		40	ppm	OVA	AUG 15-16, 1990		
		35	ppm	OVA	AUG 15-16, 1990	434.89	2500
Flux rates for OVA	[illegible]	21896	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	[illegible]	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	[illegible]	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	136839	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	7474	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	32841	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	3558	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	13684	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	54735	ug/M^2/min	OVA	OCT 3-4, 1990		
Flux rates for OVA	[illegible]	1095	ug/M^2/min	OVA	OCT 3-4, 1990	117343.40	355780
1,1,1-trichloroethane	00071-55-6	0.15	ug/M^2/min	FLUX	OCT. 4, 1990		
		0.18	ug/M^2/min	FLUX	OCT. 4, 1990	0.17	0.18
trichlorofluoromethane		0.15	ug/M^2/min	FLUX	OCT. 4, 1990	0.15	0.15
dichlorodifluoromethane		[illegible]	ug/M^2/min	FLUX	OCT. 4, 1990		
		[illegible]	ug/M^2/min	FLUX	OCT. 4, 1990	[illegible]	[illegible]
tetrachloroethylene (perchloroethylene)	00079-03-5	0.01	ppm	GC	AUGUST 15-16, 1990		
		0.01	ppm	GC	AUGUST 15-16, 1990	0.01	0.01
		17	ug/M2/min	GC	OCTOBER 3-4, 1990		
		33	ug/M2/min	GC	OCTOBER 3-4, 1990		
		37	ug/M2/min	GC	OCTOBER 3-4, 1990		
		12	ug/M2/min	GC	OCTOBER 3-4, 1990		
		49	ug/M2/min	GC	OCTOBER 3-4, 1990	29.60	49
		0.03	ppm	GC	OCTOBER 3-4, 1990		
		0.06	ppm	GC	OCTOBER 3-4, 1990		
		0.07	ppm	GC	OCTOBER 3-4, 1990		
		0.02	ppm	GC	OCTOBER 3-4, 1990		
		0.09	ppm	GC	OCTOBER 3-4, 1990	0.05	0.09
		1.2	ppm		JULY 1988		
		1.2	ppm		JULY 1988	1.20	1.2
carbon tetrachloride	00056-23-5						
benzene		1.04	ug/M^2/min	FLUX	OCT. 4, 1990		
		0.51	ug/M^2/min	FLUX	OCT. 4, 1990	0.78	1.04
		0.06	ppm	GC	AUGUST 15-16, 1990		
		0.01	ppm	GC	AUGUST 15-16, 1990		
		0.01	ppm	GC	AUGUST 15-16, 1990		
		0.05	ppm	GC	AUGUST 15-16, 1990		
		0.03	ppm	GC	AUGUST 15-16, 1990		
		0.01	ppm	GC	AUGUST 15-16, 1990		
		0.03	ppm	GC	AUGUST 15-16, 1990		
		0.03	ppm	GC	AUGUST 15-16, 1990		
		0.03	ppm	GC	AUGUST 15-16, 1990		
		0.02	ppm	GC	AUGUST 15-16, 1990	0.03	0.06
		6.2	ppm		JULY 1988		
		4.9	ppm		JULY 1988		
		6.2	ppm		JULY 1988		
		6.8	ppm		JULY 1988		
		3.7	ppm		JULY 1988	5.56	6.8

toluene	00108-88-3	0.52 ug/M^2/min	FLUX	OCT. 4, 1990		
		0.37 ug/M^2/min	FLUX	OCT. 4, 1990	0.45	0.52
		0.03 ppm	GC	AUGUST 15-16, 1990		
		0.03 ppm	GC	AUGUST 15-16, 1990	0.03	0.03
		3 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		18 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		7 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		110 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	34.50	110
		0.01 ppm	GC	OCTOBER 3-4, 1990		
		0.06 ppm	GC	OCTOBER 3-4, 1990		
		0.03 ppm	GC	OCTOBER 3-4, 1990		
		0.35 ppm	GC	OCTOBER 3-4, 1990	0.11	0.35
		95 ppm		JULY 1988		
		120 ppm		JULY 1988		
		177 ppm		JULY 1988		
		94 ppm		JULY 1988		
		88 ppm		JULY 1988		
		26 ppm		JULY 1988		
		45 ppm		JULY 1988	92.14	177
1,2-dichloroethylene	00540-54-0	58 ppm		JULY 1988		
		115 ppm		JULY 1988		
		80 ppm		JULY 1988		
		75 ppm		JULY 1988		
		13 ppm		JULY 1988		
		50 ppm		JULY 1988		
		55 ppm		JULY 1988	63.71	115
trichloroethylene	00079-01-6	0.27 ug/M^2/min	FLUX	OCT. 4, 1990		
		0.21 ug/M^2/min	FLUX	OCT. 4, 1990		
		15 ug/M^2/min	FLUX	OCT. 4, 1990		
		9 ug/M^2/min	FLUX	OCT. 4, 1990	6.12	15
		0.03 PPM	GC	AUGUST 15-16, 1990		
		0.02 PPM	GC	AUGUST 15-16, 1990	0.03	0.03
		0.03 PPM	GC	OCT.3-4, 1990		
		0.02 PPM	GC	OCT.3-4, 1990	0.03	0.03
		5.1 PPM		JULY 1988		
		37 PPM		JULY 1988		
		33 PPM		JULY 1988		
		3.1 PPM		JULY 1988		
		13 PPM		JULY 1988		
		[illegible] PPM		JULY 1988		
		13 PPM		JULY 1988	17.74	15
1,2,4-trimethylbenzene						
para-dichlorobenzene						
trans-dichlorobenzene						
trans, 1,2-dichloroethene00156-60-5		0.03 ppm	GC	AUGUST 15-16, 1990		
		0.04 ppm	GC	AUGUST 15-16, 1990		
		0.01 ppm	GC	AUGUST 15-16, 1990		
		0.08 ppm	GC	AUGUST 15-16, 1990		
		0.09 ppm	GC	AUGUST 15-16, 1990		
		0.02 ppm	GC	AUGUST 15-16, 1990		
		0.05 ppm	GC	AUGUST 15-16, 1990		
		0.03 ppm	GC	AUGUST 15-16, 1990		
		0.19 ppm	GC	AUGUST 15-16, 1990		
		0.24 ppm	GC	AUGUST 15-16, 1990		
		0.24 ppm	GC	AUGUST 15-16, 1990		
		0.25 ppm	GC	AUGUST 15-16, 1990		
		0.18 ppm	GC	AUGUST 15-16, 1990	0.11	0.25
1,4-dichlorobenzene						
1,1-dichloroethene	00075-35-4	0.09 ug/M^2/min	FLUX	OCT. 4, 1990		
		0.08 ug/M^2/min	FLUX	OCT. 4, 1990	0.09	0.09
styrene	00100-42-5					
freone (113)	00076-13-1					
methane		141 ug/M^2/min	FLUX	OCT. 4, 1990	141.00	141
non methane hydrocarbons		423 ug/M^2/min	FLUX	OCT. 4, 1990	423.00	423

ethyl-benzene (ug/m2/min)	00100-41-4	0.01 ppm	GC	AUGUST 15-16, 1990		
		0.01 ppm	GC	AUGUST 15-16, 1990		
		0.06 ppm	GC	AUGUST 15-16, 1990		
		0.1 ppm	GC	AUGUST 15-16, 1990		
		0.03 ppm	GC	AUGUST 15-16, 1990		
		0.1 ppm	GC	AUGUST 15-16, 1990		
		0.02 ppm	GC	AUGUST 15-16, 1990		
		0.01 ppm	GC	AUGUST 15-16, 1990		
		0.02 ppm	GC	AUGUST 15-16, 1990		
		0.06 ppm	GC	AUGUST 15-16, 1990	0.04	0.06
		12 ug/M^2/min	GC/FLUX	OCTOBER 3-4, 1990		
		15 ug/M^2/min	GC/FLUX	OCTOBER 3-4, 1990		
		87 ug/M^2/min	GC/FLUX	OCTOBER 3-4, 1990		
		10 ug/M^2/min	GC/FLUX	OCTOBER 3-4, 1990	31.00	87
		0.03 ppm	GC	OCTOBER 3-4, 1990		
		0.04 ppm	GC	OCTOBER 3-4, 1990		
		0.24 ppm	GC	OCTOBER 3-4, 1990		
		0.03 ppm	GC	OCTOBER 3-4, 1990	0.08	0.24
		35 ppm		JULY 1988		
		50 ppm		JULY 1988		
		45 ppm		JULY 1988		
		36 ppm		JULY 1988		
		29 ppm		JULY 1988		
		7.2 ppm		JULY 1988		
		15 ppm		JULY 1988	31.03	50
methyl-ethyl ketone	00078-93-3					
methylene-chloride	00075-09-2	0.46 ug/M^2/min	FLUX	OCT. 4, 1990		
		0.34 ug/M^2/min	FLUX	OCT. 4, 1990	0.40	0.46
		4.21 ppm	GC	AUGUST 15-16, 1990		
		0.72 ppm	GC	AUGUST 15-16, 1990		
		1.45 ppm	GC	AUGUST 15-16, 1990		
		0.44 ppm	GC	AUGUST 15-16, 1990		
		0.5 ppm	GC	AUGUST 15-16, 1990		
		2.26 ppm	GC	AUGUST 15-16, 1990		
		0.63 ppm	GC	AUGUST 15-16, 1990		
		1.29 ppm	GC	AUGUST 15-16, 1990		
		1.6 ppm	GC	AUGUST 15-16, 1990		
		0.4 ppm	GC	AUGUST 15-16, 1990		
		1.3 ppm	GC	AUGUST 15-16, 1990		
		0.31 ppm	GC	AUGUST 15-16, 1990		
		0.35 ppm	GC	AUGUST 15-16, 1990		
		0.46 ppm	GC	AUGUST 15-16, 1990		
		0.53 ppm	GC	AUGUST 15-16, 1990		
		0.49 ppm	GC	AUGUST 15-16, 1990		
		0.62 ppm	GC	AUGUST 15-16, 1990		
		0.51 ppm	GC	AUGUST 15-16, 1990		
		0.48 ppm	GC	AUGUST 15-16, 1990	0.94	4.21
		78 ug/M2/min	GC/FLUX	OCTOBER 3-4, 1990		
		23 ug/M2/min	GC/FLUX	OCTOBER 3-4, 1990		
		596 ug/M2/min	GC/FLUX	OCTOBER 3-4, 1990		
		402 ug/M2/min	GC/FLUX	OCTOBER 3-4, 1990		
		299 ug/M2/min	GC/FLUX	OCTOBER 3-4, 1990	279.60	596
		0.27 ppm	GC	OCTOBER 3-4, 1990		
		0.08 ppm	GC	OCTOBER 3-4, 1990		
		2.05 ppm	GC	OCTOBER 3-4, 1990		
		1.38 ppm	GC	OCTOBER 3-4, 1990		
		1.03 ppm	GC	OCTOBER 3-4, 1990	0.96	2.05
H2S	007783-06-4	32 ppm	H2S	AUGUST 15-16, 1990		
		8 ppm	H2S	AUGUST 15-16, 1990	20.00	32
		219 ppm		JULY 1988	219	219
CO2	00124-38-9	42097 ug/M2/min	FLUX	OCT. 4, 1990		
		379803 ug/M2/min	FLUX	OCT. 4, 1990	-50950.00	379803
vinyl chloride	00075-01-4					
total xylenes	01330-20-7	0.08 ug/M2/min	FLUX	OCT. 4, 1990		
		0.08 ug/M2/min	FLUX	OCT. 4, 1990	0.08	0.08
		86 ppm		JULY 1988		
		109 ppm		JULY 1988		
		122 ppm		JULY 1988		
		104 ppm		JULY 1988		
		61 ppm		JULY 1988		
		15.3 ppm		JULY 1988		
		52 ppm		JULY 1988	78.47	122
unknowns		270 ppm		JULY 1988		
		4570 ppm		JULY 1988		
		4655 ppm		JULY 1988		
		4123 ppm		JULY 1988		
		3558 ppm		JULY 1988		
		690 ppm		JULY 1988		
		2117 ppm		JULY 1988	2854.71	4655

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	CAS #	QUANTITY	UNITS	METHOD	DATE	AVG	MAX
total VOC'S	[illegible]	31	ppm	OVA	OCTOBER 3-4, 1990		
	[illegible]	100	ppm	OVA	OCTOBER 3-4, 1990		
	[illegible]	650	ppm	OVA	OCTOBER 3-4, 1990		
	[illegible]	20	ppm	OVA	OCTOBER 3-4, 1990	200.25	650
		900	ppm	OVA	AUGUST 15-16, 1990		
		20	ppm	OVA	AUGUST 15-16, 1990	460.00	900
	[illegible]	11494	ug/m2/min	OVA	OCTOBER 3-4, 1990		
	[illegible]	35578	ug/m2/min	OVA	OCTOBER 3-4, 1990		
	[illegible]	5474	ug/m2/min	OVA	OCTOBER 3-4, 1990		
	[illegible]	10421	ug/m2/min	OVA	OCTOBER 3-4, 1990		
	[illegible]	1697	ug/m2/min	OVA	OCTOBER 3-4, 1990		
	[illegible]	219	ug/m2/min	OVA	OCTOBER 3-4, 1990	11813.83	35000
1,1,1-trichloroethane	00071-55-6						
trichlorofluoromethane							
dichlorofluoromethane							
tetrachloroethylene	00079-00-5	6	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		28	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	17.00	28
		0.01	PPM	GC	AUGUST 15-16, 1990		
		0.05	PPM	GC	AUGUST 15-16, 1990	0.03	0.05
		5.8	PPM		JULY 1988		
		15	PPM		JULY 1988	10.4	15
carbon tetrachloride	00556-23-[illegible]						
benzene		0.06	PPM	GC	AUGUST 15-16, 1990	0.06	0.06
		5.2	PPM		JULY 1988		
		4.3	PPM		JULY 1988		
		4.3	PPM		JULY 1988	4.93	5.2
toluene	00108-88-3	16	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	16	16
		0.05	PPM	GC	OCTOBER 3-4, 1990	0.05	0.05
		275	PPM		JULY 1988		
		50	PPM		JULY 1988		
		18	PPM		JULY 1988	114.33	275
1,2 dichloroethylene	00540-59-0	140	PPM		JULY 1988		
		40	PPM		JULY 1988		
		435	PPM		JULY 1988	205	435
trichloroethylene	00079-01-6	19	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		13	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	9.53	19
		0.04	PPM	GC	OCTOBER 3-4, 1990		
		0.03	PPM	GC	OCTOBER 3-4, 1970	0.04	0.04
		136	PPM		JULY 1988		
		81	PPM		JULY 1988		
		26	PPM		JULY 1988	81	136
1,2,4-trimethylbenzene							
para-dichlorobenzene							
trans-dichlorobenzene							
trans, 1,2-dichloroethene trans-dichloroethlene	00156-60-5	0.1	PPM	GC	AUGUST 15-16, 1990	0.1	0.1
1,4-dichlorobenzene							
1,1-dichloroethene	00075-35-4						
styrene	00100-42-5						
freone (113)	00076-13-1						
methane							
non-methane hydrocarbons							

ethyl-benzene	00100-41-4	0.01	PPM	GC	AUGUST 15-16, 1990	0.01	0.01
		13	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		11	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		7	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		96	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	31.75	96
		0.05	PPM	GC	OCTOBER 3-4, 1990		
		0.03	PPM	GC	OCTOBER 3-4, 1990		
		0.02	PPM	GC	OCTOBER 3-4, 1990		
		0.26	PPM	GC	OCTOBER 3-4, 1990	0.09	0.26
		34	PPM		JULY 1988		
		18	PPM		JULY 1988		
		14	PPM		JULY 1988	22	34
methyl-ethyl ketone	00078-93-3						
methylene-chloride	00075-09-2	0.55	PPM	GC	AUGUST 15-16, 1990	0.55	0.55
		509	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		432	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	470.50	509
		1.49	PPM	GC	OCTOBER 3-4, 1990		
		1.75	PPM	GC	OCTOBER 3-4, 1990	0.75	1.75
H2S	007783-06-4						
CO2	00124-38-9						
vinyl chloride	00075-01-4						
total xylenes	01330-20-7	95	PPM		JULY 1988		
		59	PPM		JULY 1988		
		14	PPM		JULY 1988	56	95
unknowns		4300	PPM		JULY 1988		
		3037	PPM		JULY 1988		
		1663	PPM		JULY 1988	3000	4300

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	CAS #		QUANTITY	UNITS	METHOD	DATE	AVG	MAX
Total VOC's		SG	10000	PPM	OVA	OCTOBER 3-4, 1990		
		SG	200	PPM	OVA	OCTOBER 3-4, 1990		
		SG	3.5	PPM	OVA	OCTOBER 3-4, 1990		
		SG	4	PPM	OVA	OCTOBER 3-4, 1990		
		SG	210	PPM	OVA	OCTOBER 3-4, 1990	2083.50	10000
			9000	PPM	OVA	AUGUST 15-16, 1990		
			11	PPM	OVA	AUGUST 15-16, 1990	4505.50	9000
		SG	547534	ug/m2/min	OVA	OCTOBER 3-4, 1990		
		SG	192	ug/m2/min	OVA	OCTOBER 3-4, 1990		
		SG	10947	ug/m2/min	OVA	OCTOBER 3-4, 1990		
		SG	2402	ug/m2/min	OVA	OCTOBER 3-4, 1990	140268.75	547534
1,1,1 trichloroethane	00071-55-6		0.21	ug/m2/min	FLUX	OCT. 18, 1990		
			0.26	ug/m2/min	FLUX	OCT. 18, 1990	0.24	0.26
trichlorofluoromethane			0.15	ug/m2/min	FLUX	OCT. 18, 1990	0.15	0.15
dichlorofluoromethane			0.18	ug/m2/min	FLUX	OCT. 18, 1990	0.18	0.18
tetrachloroethylene	00079-00-5		16	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
			24	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
			43	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	27.67	43
			0.08	PPM	GC	OCTOBER 3-4, 1990		
			0.03	PPM	GC	OCTOBER 3-4, 1990		
			0.04	PPM	GC	OCTOBER 3-4, 1990	0.05	0.08
carbon tetrachloride	00056-23-5							
benzene			1.24	ug/m2/min	FLUX	OCT. 18, 1990		
			1.5	ug/m2/min	FLUX	OCT. 18, 1990	1.37	1.5
			0.06	PPM	GC	OCTOBER 3-4, 1990		
			0.01	PPM	GC	OCTOBER 3-4, 1990		
			0.06	PPM	GC	OCTOBER 3-4, 1990		
			0.28	PPM	GC	OCTOBER 3-4, 1990	0.10	0.28
			74	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	74.00	74
			3.1	PPM		JULY 1988	3.10	3.1
[illegible]ene	00108-88-3		0.01	PPM	GC	OCTOBER 3-4, 1990		
			0.02	PPM	GC	OCTOBER 3-4, 1990	0.02	0.02
			4	ug/m2/min	FLUX	OCT. 18, 1990		
			1.42	ug/m2/min	FLUX	OCT. 18, 1990		
			1.47	ug/m2/min	FLUX	OCT. 18, 1990	2.30	4
			73	PPM		JULY 1988	73.00	73
1,2-dichloroethylene	00540-54-0		95	PPM		JULY 1988	95.00	95
trichloroethylene	00079-01-6		0.38	ug/m2/min	FLUX	OCT. 18, 1990		
			0.44	ug/m2/min	FLUX	OCT. 18, 1990	0.41	0.44
			28	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
			53	ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	40.50	53
			0.06	PPM	GC	OCTOBER 3-4, 1990		
			0.12	PPM	GC	OCTOBER 3-4, 1990		
			0.01	PPM	GC	OCTOBER 3-4, 1990	0.06	0.12
			0.25	ug/m2/min	FLUX	OCT. 18, 1990	0.25	0.25
			4.4	PPM		JULY 1988	[illegible]	[illegible]
1,2,4-trimethylbenzene								
para-dichlorobenzene								
trans-dichlorobenzene								
trans, 1,2-dichloroethene	00156-60-5		0.1	PPM	GC	OCTOBER 3-4, 1990		
			0.12	PPM	GC	OCTOBER 3-4, 1990		
			0.09	PPM	GC	OCTOBER 3-4, 1990		
			0.13	PPM	GC	OCTOBER 3-4, 1990	0.11	0.13
1,4-dichlorobenzene			0.1	ug/m2/min	FLUX	OCT. 18, 1990	0.10	0.1
1,1-dichloroethene	00075-35-4							
styrene	00100-42-5							
freon (113)	00076-13-1							

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methane		13881 ug/m2/min	FLUX	OCT. 18, 1990		
		7123 ug/m2/min	FLUX	OCT. 18, 1990	10502.00	13881
non-methane hydrocarbons		154 ug/m2/min	FLUX	OCT. 18, 1990		
		192 ug/m2/min	FLUX	OCT. 18, 1990	173.00	192
ethyl-benzene (ug/m2/min)	00100-41-4	4.08 ug/m2/min	FLUX	OCT. 18, 1990		
		0.24 ug/m2/min	FLUX	OCT. 18, 1990	2.16	4.08
		56 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		33 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990		
		96 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	61.67	96
		0.01 PPM	GC	OCTOBER 3-4, 1990		
		0.08 PPM	GC	OCTOBER 3-4, 1990		
		0.26 PPM	GC	OCTOBER 3-4, 1990		
		0.15 PPM	GC	OCTOBER 3-4, 1990		
		0.09 PPM	GC	OCTOBER 3-4, 1990	0.12	0.26
		27 PPM		JULY 1988	27	27
methyl-ethyl ketone	00078-93-3					
methylene-chloride	00075-09-2	0.7 PPM	GC	OCTOBER 3-4, 1990		
		1.04 PPM	GC	OCTOBER 3-4, 1990		
		1.15 PPM	GC	OCTOBER 3-4, 1990		
		1.19 PPM	GC	OCTOBER 3-4, 1990		
		0.41 PPM	GC	OCTOBER 3-4, 1990		
		0.41 PPM	GC	OCTOBER 3-4, 1990		
		0.34 PPM	GC	OCTOBER 3-4, 1990		
		0.04 PPM	GC	OCTOBER 3-4, 1990	0.66	1.19
		10 ug/m2/min	GC/FLUX	OCTOBER 3-4, 1990	10.00	10
H2S (PPM)	007783-06-4	57 PPM	H2S	OCTOBER 3-4, 1990		
		8 PPM	H2S	OCTOBER 3-4, 1990		
		41 PPM	H2S	OCTOBER 3-4, 1990		
		3 PPM	H2S	OCTOBER 3-4, 1990		
		13769 PPM	H2S	OCTOBER 3-4, 1990	2775.60	13769
		1.63 ug/m2/min	H2S AMBIENT	OCTOBER 3-4, 1990	1.63	1.63
CO2	00124-38-9	214495 ug/m2/min	FLUX	OCT.18,1990		
		124459 ug/m2/min	FLUX	OCT.18,1990	169477.00	214495
vinyl chloride	00075-01-4	0.08 ug/m2/min	FLUX	OCT.18,1990	0.08	0.08
total xylenes	01330-20-7	0.83 ug/m2/min	FLUX	OCT.18,1990		
		0.62 ug/m2/min	FLUX	OCT.18,1990	0.73	0.83
		69 PPM		JULY 1988	69.00	69
unknowns		4301 PPM		JULY 1988	4301.00	4301

GRID LOCATION 10

	CAS #		QUANTITY	UNITS	METHOD:	DATE:	AVG	MAX
total VOC's (PPM)		SG	9	PPM	OVA	OCTOBER 3-4, 1990		
		SG	3	PPM	OVA	OCTOBER 3-4, 1990		
		SG	45	[illegible]	OVA	OCTOBER 3-4, 1990		
		SG	125	[illegible]	OVA	OCTOBER 3-4, 1990	45.5	125
			100	PPM	OVA	AUGUST 15-16, 1990		
			14	PPM	OVA	AUGUST 15-16, 1990		
			16	PPM	OVA	AUGUST 15-16, 1990		
			300	PPM	OVA	AUGUST 15-16, 1990		
			30	PPM	OVA	AUGUST 15-16, 1990		
			100	PPM	OVA	AUGUST 15-16, 1990		
			35	PPM	OVA	AUGUST 15-16, 1990	85	300
		SG	2463	ug/M^2/min	OVA	OCTOBER 3-4, 1990		
		SG	6842	ug/M^2/min	OVA	OCTOBER 3-4, 1990		
		SG	493	ug/M^2/min	OVA	OCTOBER 3-4, 1990		
		SG	164	ug/M^2/min	OVA	OCTOBER 3-4, 1990	2490.5	6842
1,1,1-trichloroethane	00071-55-6							
trichlorofluoromethane								
dichlorofluoromethane								
tetrachloroethylene	00079-00-5		22	ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990		
			18	ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990		
			82	ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	40.67	82
			0.04	PPM	GC	OCTOBER 3-4, 1990		
			0.03	PPM	GC	OCTOBER 3-4, 1990		
			0.14	PPM	GC	OCTOBER 3-4, 1990	0.07	0.14
			1.2	PPM		JULY 1988		
			1.2	PPM		JULY 1988	1.2	1.2
carbon tetrachloride	00056-23-5							
benzene			0.2	PPM	GC	AUGUST 15-16, 1990	0.2	0.2
			7	ug/M^2/min	GC FLUXBOX	OCTOBER 3-4 1990	7	7
			0.03	PPM	GC	OCTOBER 3-4, 1990	0.03	0.03
			3.7	PPM		JULY 1988		
			2.5	PPM		JULY 1988	3.1	3.7
toluene	00108-88-3		0.08	PPM	GC	AUGUST 15-16, 1990	0.08	0.08
			21	ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	21	21
			0.07	PPM	GC	OCTOBER 3-4, 1990	0.07	0.07
			260	PPM		JULY 1988		
			4.7	PPM		JULY 1988		
			3.6	PPM		JULY 1988		
			57	PPM		JULY 1988		
			10	PPM		JULY 1988	67.06	260
1,2-dichloroethylene	00540-59-0		3	PPM		JULY 1988		
			5.5	PPM		JULY 1988		
			70	PPM		JULY 1988		
			7.5	PPM		JULY 1988	21.5	70
trichloroethylene	00079-01-6		49	ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	49	49
			0.11	PPM	GC	OCTOBER 3-4, 1990	0.11	0.11
			3.3	PPM		JULY 1988		
			4.4	PPM		JULY 1988		
			4.4	PPM		JULY 1988		
			12	PPM		JULY 1988	6.025	12
1,2,4-trimethylbenzene								
para-dichlorobenzene								
trans-dichlorobenzene								
trans, 1,2-dichloroethene	00156-60-5		0.08	PPM	GC	AUGUST 15-16, 1990		
			0.04	PPM	GC	AUGUST 15-16, 1990		
			0.06	PPM	GC	AUGUST 15-16, 1990		
			0.06	PPM	GC	AUGUST 15-16, 1990		
			0.23	PPM	GC	AUGUST 15-16, 1990		
			0.1	PPM	GC	AUGUST 15-16, 1990		
			0.08	PPM	GC	AUGUST 15-16, 1990	0.09	0.23

1,4-Dichlorobenzene						
1,1-Dichloroethene	00075-35-4					
Styrene	00100-42-5					
Freon (113)	00076-13-1					
Methane						
Non-methane hydrocarbons						
ethyl-benzene (ug/m2/min)	00100-41-4	0.02 PPM	GC	AUGUST 15-16, 1990	0.02	0.02
		6 ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	6	6
		4 ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	4	4
		0.02 PPM	GC	OCTOBER 3-4, 1990		
		0.01 PPM	GC	OCTOBER 3-4, 1990	0.015	0.02
		5.4 PPM		JULY 1988		
		14 PPM		JULY 1988		
		21 PPM		JULY 1988		
		2.7 PPM		JULY 1988	10.775	21
methyl-ethyl ketone	00078-93-3					
methylene-chloride	00075-09-2	0.39 PPM	GC	AUGUST 15-16, 1990		
		0.68 PPM	GC	AUGUST 15-16, 1990		
		1.34 PPM	GC	AUGUST 15-16, 1990		
		0.43 PPM	GC	AUGUST 15-16, 1990		
		0.4 PPM	GC	AUGUST 15-16, 1990		
		1.01 PPM	GC	AUGUST 15-16, 1990		
		0.43 PPM	GC	AUGUST 15-16, 1990		
		0.47 PPM	GC	AUGUST 15-16, 1990	0.64	1.34
		426 ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	426	426
		1.47 PPM	GC	OCTOBER 3-4, 1990		
		1.59 PPM	GC	OCTOBER 3-4, 1990	1.53	1.59
Stoddard solvent		463 ug/M^2/min	GC FLUXBOX	OCTOBER 3-4, 1990	463	463
H2S (PPM)	007783-06-4	5 PPM	H2S	OCTOBER 3-4, 1990		
		11 PPM	H2S	OCTOBER 3-4, 1990	8	11
		676 PPM		JULY 1988	676	676
CO2	00124-38-9					
vinyl chloride	00075-01-4					
total xylenes	01330-20-7	22.6 PPM		JULY 1988		
		23 PPM		JULY 1988		
		61 PPM		JULY 1988	35.53	61
Unknowns		998 PPM		JULY 1988		
		920 PPM		JULY 1988		
		3636 PPM		JULY 1988		
		151 PPM		JULY 1988	1426.25	3636

ATTACHMENT C:

Toxic Exposure Health Risk

NIOSH OCCUPATIONAL CARCINOGENS

NIOSH has identified numerous chemicals that should be treated as occupational carcinogens even though OSHA has not identified them as such. In determining their carcinogenicity NIOSH uses a classification outlined in 29 CFR 1990.103, which states in part:

> Potential occupational carcinogen means any substance, or combination or mixture of substances, which causes an increased incidence of benign and/or malignant neoplasms, or a substantial decrease in the latency period between exposure and onset of neoplasms in humans or in one or more experimental mammalian species as the result of any oral, respiratory or dermal exposure, or any other exposure which results in the induction of tumors at a site other than the site of administration. This definition also includes any substance which is metabolized into one or more potential occupational carcinogens by mammals.

NIOSH has not identified thresholds for carcinogens that will protect 100% of the population. NIOSH usually recommends that occupational exposures to carcinogens be limited to the lowest feasible concentration. To ensure maximum protection from carcinogens through the use of respiratory protection, only the most reliable and protective respirators are recommended. These include (1) a self-contained breathing apparatus (SCBA) that has a full facepiece and is operated in a positive-pressure mode, or (2) a supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in a pressure-demand or other positive-pressure mode.

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties		Incompatibilities and reactivities	Measurement method (See Table 1)	Personal protection and sanitation (See Table 3)		Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards				
					MW, BP, SOL, Fl.P, IP, Sp.Gr, flammability	VP, FRZ, UEL, LEL						Route	Symptoms (See Table 5)	First aid (See Table 6)		Target organs (See Table 5)
Chromium(II) and (III) compounds (as Cr)	Synonyms vary depending upon the specific Cr(II) or Cr(III) compound	NIOSH/OSHA 0.5 mg/m³ See Appendix C ACGIH See Appendix C	N.E.	Appearance and odor vary depending upon the specific compound	Properties vary depending upon the specific compound		Water	Filter, Acid, AA, III [#7024]	Clothing Goggles Wash Change Remove	Repeat Any poss Prompt contam N.R. Prompt non-imperv contam	NIOSH/OSHA 2.5 mg/m³: DM 5 mg/m³: DMXSQ†/SA†/SCBA† 12.5 mg/m³: PAPRDM†/SA:CF† 25 mg/m³: HiEF/PAPRTHiE†/SCBAF/SAF 250 mg/m³: SAF:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Ing Con	Sens derm	Eye Skin Breath Swallow	Irr immed Water flush prompt Resp support Medical attention immed	Skin
Lead (as Pb) Pb 7439-92-1 (Metal) OF7525000 (Metal) 2291 53 (soluble cmpds)	Metal: Lead metal, Plumbum [Note: OSHA considers "Lead" to mean metallic Pb, all inorganic Pb cmpds (Pb oxides and Pb salts), and a class of organic Pb cmpds called soaps. All other organic Pb cmpds are excluded from this definition.]	NIOSH 0.100 mg/m³ [Air concentration to be maintained so that worker blood lead remains <0.060 mg/100 g of whole blood.] OSHA [1910.1025] 0.050 mg/m³	700 mg/m³	Metal: A heavy, ductile, soft gray solid	MW: 207.2 BP: 3164°F Sol: Insoluble Fl.P: NA IP: NA Sp.Gr: 11.34 (Metal) Metal: Noncombustible Solid in bulk form	VP: 0 mm (approx) MLT: 621°F UEL: NA LEL: NA	Strong oxidizers, hydrogen peroxide, acids	Filter, HNO_3/H_2O_2, AA, III [#7082]	Clothing Goggles Wash Change Remove	Repeat Reason prob Daily N.R. Prompt non-imperv contam	OSHA 0.5 mg/m³: SA/HiE/SCBA 1.25 mg/m³: PAPRHiE/SA:CF 2.5 mg/m³: HiEF/PAPRTHiE/SCBAF/SAF/SAT:CF 50 mg/m³: SA:PD,PP 100 mg/m³: SAF:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh Ing Con	Weak, lass, insom; facial pallor; pal eye, anor, low-wgt, malnut; constip, abdom pain, colic; anemia; gingival lead line; tremor; para wrist, ankles; encephalopathy; nephropathy; irrit eyes; hypotension	Eye Skin Breath Swallow	Irr immed Soap flush prompt Resp support Medical attention immed	GI tract, CNS, kidneys, blood, gingival tissue
Manganese compounds (as Mn) Mn 7439-96-5 (Metal) OO9275000 (Metal)	Metal: Colloidal manganese, Manganese-55 Synonyms of other compounds vary depending upon the specific compound	NIOSH 1 mg/m³ ST 3 mg/m³ OSHA C 5 mg/m³	N.E.	Metal: A lustrous, brittle, silvery solid	MW: 54.9 BP: 3564°F Sol: Insoluble Fl.P: ? IP: NA Sp.Gr: 7.20 Combustible Solid	VP: 0 mm (approx) MLT: 2271°F UEL: ? LEL: ?	Oxidizers [Note: Will react with water or steam to produce hydrogen.]	Filter, Acid, ICP, III [#7300 Elements]	Clothing Goggles Wash Change Remove	N.R. N.R. N.R. N.R. N.R.	NIOSH 10 mg/m³: DMXSQ*/SA/SCBA 25 mg/m³: PAPRDM/SA:CF 50 mg/m³: HiEF/PAPRTHiE/SCBAF/SAF/SAT:CF 1000 mg/m³: SA:PD,PP 2000 mg/m³: SAF:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh Ing	Parkinson's; asthenia, insom, mental conf; metal fume fever: dry throat, cough, tight chest, dysp, rales, flu-like fever; low-back pain; vomit; mal; fig	Breath Swallow	Resp support Medical attention immed	Resp sys, CNS, blood, kidneys
Zinc oxide fume ZnO 1314-13-2 ZH4810000	None	NIOSH/OSHA 5 mg/m³ ST 10 mg/m³	N.E.	Fine, white, odorless particulate dispersed in air	MW: 81.4 BP: ? Sol: Insoluble Fl.P: NA IP: NA Sp.Gr: 5.61 Noncombustible Solid	VP: 0 mm (approx) MLT: 3587°F UEL: NA LEL: NA	Chlorinated rubber (at 419°F)	Filter, none, XRD, III [#7502]	Clothing Goggles Wash Change Remove	N.R. N.R. N.R. N.R. N.R.	NIOSH/OSHA 50 mg/m³: DMFu/SA/SCBA 125 mg/m³: PAPRDMFu/SA:CF 250 mg/m³: HiEF/PAPRTHiE/SAT:CF/SCBAF/SAF 2500 mg/m³: SA:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh	Sweet metallic taste, dry throat, cough, chills, fever, tight chest, dysp, rales, reduced pulm func, head, blurred vision, musc cramps, low back pain, nau, vomit, fig, lass, mal	Breath	Resp support	Resp sys
Cadmium dust (as Cd) Cd 7440-43-9 EU9800000 2570 53	Metal: none Synonyms of other compounds vary depending upon the specific compound	NIOSH Ca See Appendix A Reduce exposure to lowest feasible concentration OSHA 0.2 mg/m³ C 0.6 mg/m³	Ca [50 mg/m³]	Metal: Silver-white, blue-tinged, lustrous, odorless solid	MW: 112.4 BP: 1409°F Sol: Insoluble Fl.P: NA IP: NA Sp.Gr: (Metal) 8.65 Metal: Noncombustible Solid in bulk form, but will burn in powder form	VP: 0 mm (approx) MLT: 610°F UEL: NA LEL: NA	Strong oxidizers; elemental sulfur, selenium & tellurium	Filter, Acid, AA, III [#7048]	Clothing Goggles Wash Change Remove Provide	N.R. Any poss CdCl₂ Daily (reason prob) After work if any poss contam N.R. Eyewash CdCl₂	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh Ing	Pulm edema, dysp, cough, chest tight, subs pain, head, chills, musc aches, nau, vomit, diarr; anos, emphy, prot, mild anemia; [carc]	Eye Skin Breath Swallow	Irr immed Soap wash Resp support Medical attention immed	Resp sys, kidneys, prostate, blood
Arsenic, inorganic compounds (as As) As 7440-38-2 (Metal) CG0525000 (Metal) 1558 53 (Metal)	Metal: Arsenia Synonyms of other compounds vary depending upon the specific compound [Note: OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite & all inorganic compounds containing arsenic except ARSINE.]	NIOSH Ca See Appendix A C 0.002 mg/m³ [15-min] OSHA [1910.1018] 0.010 mg/m³	Ca [100 mg/m³]	Metal: Silver-gray or tin-white, brittle, odorless solid	MW: 74.9 BP: Sublimes Sol: Insoluble Fl.P: NA IP: NA Sp.Gr: 5.73 Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame	VP: 0 mm (approx) MLT: 1135°F (Sublimes) UEL: NA LEL: NA	Strong oxidizers, bromine azide [Note: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.]	Filter, Acid, AA, III [#7900]	Clothing Goggles Wash Change Remove Provide	Any poss Any poss Immed contam/daily After work if reason prob contam Immed contam Eyewash, quick drench	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFAGHiE/SCBAE	Inh Abs Con Ing	Ulceration of nasal septum, derm, GI disturbances, peri neur, resp irrit, hyperpig of skin, [carc]	Eye Skin Swallow	Irr immed (15 min) Soap wash immed Medical attention immed	Liver, kidneys, skin, lungs, lymphatic sys
Iron oxide dust and fume (as Fe) Fe_2O_3 1309-37-1 NO7525000 1376 37	Ferric oxide	NIOSH 5 mg/m³ OSHA 10 mg/m³	N.E.	Reddish-brown solid [Note: Exposure to fume may occur during the arc welding of iron.]	MW: 159.7 BP: ? Sol: Insoluble Fl.P: NA IP: NA Sp.Gr: 5.24 Noncombustible Solid	VP: 0 mm (approx) MLT: 2664°F UEL: NA LEL: NA	Calcium hypochlorite	Filter, none, XRF, III [#7200 Welding & Brazing Fume]	Clothing Goggles Wash Change Remove	N.R. N.R. N.R. N.R. N.R.	NIOSH 50 mg/m³: DMFu/SA/SCBA 125 mg/m³: PAPRDMFu/SA:CF 250 mg/m³: HiEF/PAPRTHiE/SCBAF/SAF/SAT:CF 5000 mg/m³: SA:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh	Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis	Breath	Resp support	Resp sys
Copper fume (as Cu) CuO/Cu 7440-50-8 (Cu) 1317-38-0 (CuO) GL5350000 (Cu)	CuO: Black copper oxide, Copper monoxide, Copper(II) oxide, Cupric oxide Cu: none	NIOSH/OSHA 0.1 mg/m³	N.E.	Finely divided black particulate dispersed in air [Note: Exposure may occur in copper & brass plants and during the welding of copper alloys.]	MW: 79.5 BP: Decomposes Sol: Insoluble Fl.P: NA IP: NA [Note: See Copper Dusts & Mists for properties of Cu.] Sp.Gr: 6.4 (CuO) CuO: Noncombustible Solid	VP: 0 mm (approx) MLT: 1879°F (Decomposes) UEL: NA LEL: NA	Acetylene	Filter, Acid, AA, III [#7029]	Clothing Goggles Wash Change Remove	N.R. N.R. N.R. N.R. N.R.	NIOSH/OSHA 1 mg/m³: DMFu/SA/SCBA 2.5 mg/m³: PAPRDMFu/SA:CF 5 mg/m³: HiEF/PAPRTHiE/SCBAF/SAF/SAT:CF 200 mg/m³: SAF:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh Con	Metal fume fever: chills, musc ache, nau, fever, dry throat, cough, weak, lass; irrit eyes, upper resp tract; metallic or sweet taste; discoloration skin, hair	Breath	Resp support	Resp sys, skin, eyes; incr risk with Wilson's disease
Silver (metal dust and soluble compounds, as Ag) Ag 7440-22-4 (Metal) VW3500000 (Metal)	Metal: Silver metal Synonyms of soluble compounds vary depending upon the specific compound	NIOSH/OSHA 0.01 mg/m³	N.E.	Metal: White, lustrous solid	MW: 107.9 BP: 3632°F Sol: Insoluble Fl.P: NA IP: NA Sp.Gr: 10.49 (Metal) Metal: Noncombustible Solid, but flammable in form of dust or powder	VP: 0 mm (approx) MLT: 1761°F UEL: NA LEL: NA	Acetylene, ammonia, hydrogen peroxide, bromoazide, chlorine trifluoride, ethyleneimine, oxalic acid, tartaric acid	Filter, Acid, ICP, III [#7300 Elements]	Clothing Goggles Wash Change Remove Provide	Reason prob Any poss Prompt contam After work if reason prob contam Prompt non-imperv contam Eyewash	NIOSH/OSHA 0.25 mg/m³: SA:CF†/PAPRHiE† 0.5 mg/m³: HiEF/SCBAF/SAF 20 mg/m³: SAF:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: HiEF/SCBAE	Inh Ing Con	Blue-gray eyes, nasal septum, throat, skin; irrit skin, ulceration; GI dist	Eye Skin Breath Swallow	Irr immed Water flush Resp support Medical attention immed	Nasal septum, skin, eyes

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties		Incompatibilities and reactivities	Measurement method (See Table 1)	Personal protection and sanitation (See Table 3)	Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards			
					MW, BP, SOL, Fl.P, IP, Sp.Gr, flammability	VP, FRZ, UEL, LEL					Route	Symptoms (See Table 5)	First aid (See Table 6)	Target organs (See Table 5)
Chloroform $CHCl_3$ 67-66-3 FS9100000 1888 55	Methane trichloride Trichloromethane 1 ppm = 4.96 mg/m³	NIOSH Ca See Appendix A ST 2 ppm (9.78 mg/m³) [60-min] OSHA 2 ppm (9.78 mg/m³)	Ca [1000 ppm] ACGIH A2	Colorless liquid with a pleasant odor	MW 119.4 BP 143°F Sol(77°F) 0.5% Fl.P NA IP 11.42 eV Sp.Gr 1.48 Noncombustible Liquid	VP 160 mm FRZ -82°F UEL NA LEL NA	Strong caustics; chemically-active metals such as aluminum or magnesium powder, sodium & potassium; strong oxidizers [Note: When heated to decomposition, forms phosgene gas.]	Char CS_2 GC/FID III [#1003, Halogenated Hydrocarbons]	Clothing Reason prob Goggles Reason prob Wash Prompt wet Change N.R. Remove Prompt non-imperv contam	NIOSH ¥ SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Dizz, mental dullness, nau, disorientation, head, ftg, anes, hepatomegaly; irrit eyes, skin; [carc]	Eye Irr immed Skin Soap wash prompt Breath Resp support Swallow Medical attention immed	Liver, kidneys, heart, eyes, skin
1,2-Dichloroethylene $ClCH{=}CHCl$ 540-59-0 KV9360000 1150 29	Acetylene dichloride cis-Acetylene dichloride trans-Acetylene dichloride sym-Dichloroethylene 1 ppm = 4.03 mg/m³	NIOSH/OSHA 200 ppm (790 mg/m³)	4000 ppm	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor	MW 97.0 BP 118-140°F Sol 0.4% Fl.P 36°F IP 9.65 eV Sp.Gr(77°F) 1.27 Class IB Flammable Liquid	VP 180-264 mm FRZ -57 to -115°F UEL 12.8% LEL 5.6%	Strong oxidizers, strong alkalis, potassium hydroxide, copper	Char CS_2 GC/FID III [#1003, Halogenated Hydrocarbons]	Clothing Repeat Goggles Reason prob Wash Prompt wet Change N.R. Remove Immed wet (flamm)	NIOSH/OSHA 1000 ppm: PAPROV*/CCRFOV 4000 ppm: SA:CF*/GMFOV/SCBAF/SAF § SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, resp sys; CNS depres	Eye Irr immed Skin Soap wash prompt Breath Resp support Swallow Medical attention immed	Resp sys, eyes, CNS
Benzene C_6H_6 71-43-2 CY1400000 1114 27	Benzol Phenyl hydride 1 ppm = 3.25 mg/m³	NIOSH Ca See Appendix A 0.1 ppm ST 1 ppm OSHA [1910.1028] 1 ppm ST 5 ppm	Ca [3000 ppm] ACGIH A2	Colorless to light-yellow liquid with an aromatic odor [Note: A solid below 42°F.]	MW 78.1 BP 176°F Sol 0.07% Fl.P 12°F IP 9.24 eV Sp.Gr 0.88 Class IB Flammable Liquid	VP 75 mm FRZ 42°F UEL 7.8% LEL 1.2%	Strong oxidizers, many fluorides & perchlorates, nitric acid	Char CS_2 GC/FID III [#1500, Hydrocarbons] [Note: Measurements may also be made with a portable GC NIOSH #3700.]	Clothing Repeat Goggles Reason prob Wash Prompt wash soap Change N.R. Remove Immed wet (flamm)	NIOSH ¥ SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Irrit eyes, nose, resp sys; gidd; head, nau, staggered gait; ftg, anor, lass; derm; bone marrow depres; [carc]	Eye Irr immed Skin Soap wash prompt Breath Resp support Swallow Medical attention immed	Blood, CNS, skin, bone marrow, eyes, resp sys
Ethyl benzene $CH_3CH_2C_6H_5$ 100-41-4 DA0700000 1175 26	Ethylbenzol Phenylethane 1 ppm = 4.41 mg/m³	NIOSH/OSHA 100 ppm (435 mg/m³) ST 125 ppm (545 mg/m³)	2000 ppm	Colorless liquid with an aromatic odor	MW 106.2 BP 277°F Sol 0.01% Fl.P 55°F IP 8.76 eV Sp.Gr 0.87 Class IB Flammable Liquid	VP(79°F) 10 mm FRZ -139°F UEL 6.7% LEL 1.0%	Strong oxidizers	Char CS_2 GC/FID III [#1501, Aromatic Hydrocarbons]	Clothing Repeat Goggles Reason prob Wash Prompt contam Change N.R. Remove Immed wet (flamm)	NIOSH/OSHA 1000 ppm: PAPROV*/SA*/SCBA*/CCROV* 2000 ppm: GMFOV/SCBAF/SAF § SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, muc memb; head; derm; narco; coma	Eye Irr immed Skin Water flush prompt Breath Resp support Swallow Medical attention immed	Eyes, upper resp sys, skin, CNS
Trichloroethylene $ClCH{=}CCl_2$ 79-01-6 KX4550000 1710 74	Ethylene trichloride Triclene, Trichloroethene 1 ppm = 5.46 mg/m³	NIOSH Ca See Appendix A 25 ppm OSHA 50 ppm (270 mg/m³) ST 200 ppm (1080 mg/m³)	Ca [1000 ppm]	Colorless liquid (unless dyed blue) with a chloroform-like odor	MW 131.4 BP 189°F Sol(77°F) 0.1% Fl.P 90°F IP 9.45 eV Sp.Gr 1.46 Class IC Flammable Liquid, but burns with difficulty	VP 58 mm FRZ -99°F UEL(77°F) 10.5% LEL(77°F) 8%	Strong caustics & alkalis; chemically-active metals such as barium, lithium, sodium, magnesium, titanium & beryllium	Char CS_2 GC/FID III [#1022]	Clothing Repeat Goggles Reason prob Wash Prompt wet Change N.R. Remove Prompt non-imperv wet	NIOSH ¥ SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Head, vert; vis dist; tremors, som, nau, vomit; irrit eyes; derm; card arrhy, pares; [carc]	Eye Irr immed Skin Soap wash prompt Breath Resp support Swallow Medical attention immed	Resp sys, heart, liver, kidneys, CNS, skin
Xylenes (o-, m-, p-isomers) $C_6H_4(CH_3)_2$ 1330-20-7 ZE2100000 1307 27	o-: 1,2-Dimethylbenzene, o-Xylol m-: 1,3-Dimethylbenzene, m-Xylol p-: 1,4-Dimethylbenzene, p-Xylol 1 ppm = 4.41 mg/m³	NIOSH/OSHA 100 ppm (435 mg/m³) ST 150 ppm (655 mg/m³)	1000 ppm	Colorless liquids with an aromatic odor [Note: Pure p-xylene is a solid below 56°F.]	MW 106.2 BP 292/269/281°F Sol Insoluble Fl.P 63/84/81°F IP 8.56/8.56/8.44 eV Sp.Gr 0.88/0.86/0.86 Class IB Flammable Liquid (o) Class IC Flammable Liquids (m,p)	VP 7-9 mm FRZ -13/-54/56°F UEL 6.7/7.0/7.0% LEL 1.1/1.1/1.1%	Strong oxidizers	Char CS_2 GC/FID III [#1501, Aromatic Hydrocarbons]	Clothing Repeat Goggles Reason prob Wash Prompt contam Change N.R. Remove Immed wet (flamm)	NIOSH/OSHA 1000 ppm: CCROV*/PAPROV*/SA*/SCBA* § SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Dizz, excitement, drow, inco, staggering gait; irrit eyes, nose, throat; corneal vacuolization; anor, nau, vomit, abdom pain; derm	Eye Irr immed Skin Soap wash prompt Breath Resp support Swallow Medical attention immed	CNS, eyes, GI tract, blood, liver, kidneys, skin
Naphthalene $C_{10}H_8$ 91-20-3 QJ0525000 1334 32	Naphthalin Tar camphor, White tar	NIOSH/OSHA 10 ppm (50 mg/m³) ST 15 ppm (75 mg/m³)	500 ppm	Colorless to brown solid with an odor of mothballs [Note: Shipped as a molten solid.]	MW 128.2 BP 424°F Sol 0.003% Fl.P 174°F IP 8.12 eV Sp.Gr 1.15 Combustible Solid, but will take some effort to ignite	VP 0.08 mm MLT 176°F UEL 5.9% LEL 0.9%	Strong oxidizers, chromic anhydride	Char CS_2 GC/FID III [#1501, Aromatic Hydrocarbons]	Clothing Repeat Goggles Reason prob Wash Prompt contam Change After work if reason prob contam Remove Prompt non-imperv contam	NIOSH/OSHA 100 ppm: CCROVDM*/SA*/SCBA* 250 ppm: SA:CF*/PAPROVDM* 500 ppm: CCRFOVHiE/SCBAF/SAF § SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOVHiE/SCBAE	Inh Abs Ing Con	Eye irrit, head, conf, excitement, mal, nau, vomit, abdom pain, irrit bladder; profuse sweat; jaun, hema, hemog, renal shutdown; derm	Eye Irr immed Skin Molten flush immed; Sol-Liq soap wash prompt Breath Resp support Swallow Medical attention immed	Eyes, blood, liver, kidneys, skin, RBC, CNS
Coal tar pitch volatiles (benzene soluble fraction) 65996-93-2 GF8655000	Synonyms vary depending upon the specific compound (e.g., benzo(a)pyrene, phenanthrene, acridine, chrysene, anthracene & pyrene) [Note: NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar products.]	NIOSH Ca See Appendix A 0.1 mg/m³ (cyclohexane-extractable fraction) See Appendix C OSHA 0.2 mg/m³	Ca [700 mg/m³] ACGIH A1	Black or dark-brown amorphous residue	Properties vary depending upon the specific compound Combustible Solid		Strong oxidizers	Filter Benzene Grav III [#5023]	Clothing Reason prob Goggles Reason prob Wash Daily, reason prob Change After work if reason prob contam Remove N.R.	NIOSH ¥ SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOVHiE/SCBAE	Inh Con	Derm, bron, [carc]	Eye Irr immed Skin Soap wash Breath Resp support	Resp sys, bladder, kidneys, skin
Phenol C_6H_5OH 108-95-2 SJ3325000 1671 55 (solid) 2312 55 (molten) 2821 55 (soln)	Carbolic acid Hydroxybenzene Monohydroxy benzene Phenyl alcohol Phenyl hydroxide	NIOSH 5 ppm (19 mg/m³) C 15.6 ppm (60 mg/m³) [15-min] [skin] OSHA 5 ppm (19 mg/m³) [skin]	250 ppm	Colorless to light-pink crystalline solid with a sweet, acrid odor [Note: Phenol liquefies by mixing with about 8% water.]	MW 94.1 BP 359°F Sol(77°F) 9% Fl.P 175°F IP 8.50 eV Sp.Gr 1.06 Combustible Solid	VP 0.4 mm MLT 109°F UEL ? LEL 1.8%	Strong oxidizers, calcium hypochlorite, aluminum chloride, acids	XAD-7, Methanol HPLC/UVD OSHA [#32]	Clothing Any poss Goggles Any poss Wash Immed contam Change After work if any poss contam Remove Immed non-imperv contam Provide Eyewash, quick drench	NIOSH/OSHA 50 ppm: CCROVDM/SA/SCBA 125 ppm: SA:CF/PAPROVDM 250 ppm: SCBAF/SAF/CCRFOVHiE/GMFOVHiE/PAPRTOVHiE § SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOVHiE/SCBAE	Inh Abs Ing Con	Irrit eyes, nose, throat; anor, low wgt, weak, musc ache, pain; dark urine; cyan; liver, kidney damage; skin burns; derm; ochronosis; tremor, convuls, twitch	Eye Irr immed Skin Soap wash immed Breath Resp support Swallow Medical attention immed	Liver, kidneys, skin
Hydrogen sulfide H_2S 7783-06-4 MX1225000 1053 13	Hydrosulfuric acid Sewer gas, Sulfuretted hydrogen 1 ppm = 1.42 mg/m³	NIOSH C 10 ppm (15 mg/m³) [10-min] OSHA 10 ppm (14 mg/m³) ST 15 ppm (21 mg/m³)	300 ppm	Colorless gas with a strong odor of rotten eggs. [Note: Sense of smell becomes rapidly fatigued & can NOT be relied upon to warn of the continuous presence of H_2S. Shipped as a liquefied compressed gas.]	MW 34.1 BP -77°F Sol 0.4% Fl.P NA (Gas) IP 10.46 eV Flammable Gas	VP >1 atm FRZ -122°F UEL 44.0% LEL 4.0%	Strong oxidizers, strong nitric acid, metals	Dry tube/Mol sieve Thermal desorp, GC/FPD, II(5) [P&CAM #296]	Clothing: Prevent skin freezing Goggles: Reason prob Wash: N.R. Change: N.R. Remove: Immed wet (flamm)	NIOSH/OSHA 100 ppm: SA*/SCBA* 250 ppm: SA:CF* 300 ppm: SCBAF/SAF § SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFS/SCBAE	Inh Ing Con	Apnea, coma, convuls; irrit eyes, conj, pain, lac, photo, corneal vesic; irrit resp sys; dizz, head, ftg, irrity, insom; GI dist	Eye Irr immed Skin Water flush immed Breath Resp support	Resp sys, eyes

Appendix B

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX B

DATA ON GROUNDWATER AND SURFACE WATER CONDITIONS

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

APPENDIX B

This Appendix contains two sections as follows:

Attachment A: Background Groundwater and Surface Water Quality Data

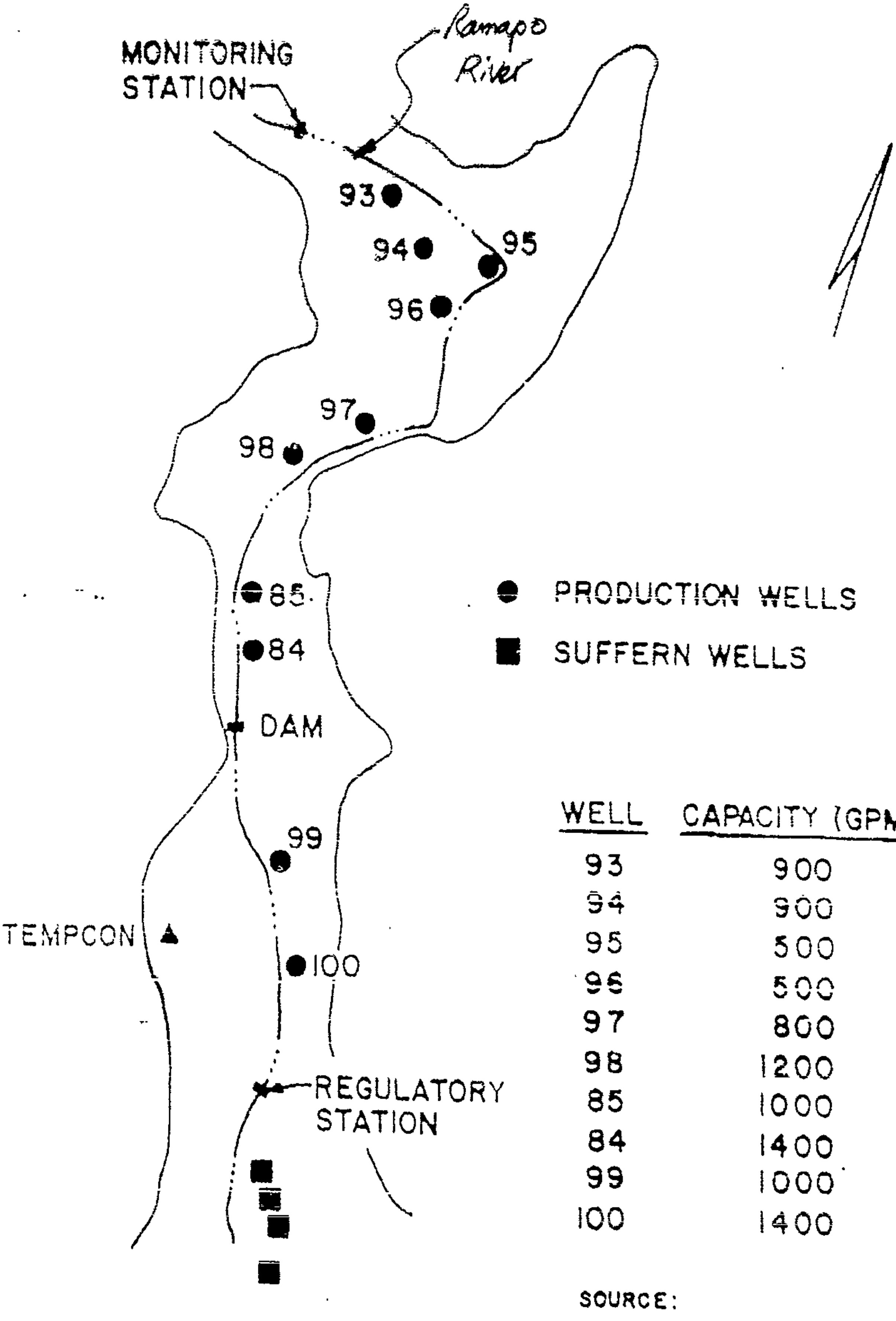
Attachment B: Laboratory Results of January 1991, Groundwater Sample Analyses

ATTACHMENT A:

Background Groundwater and Surface Water Quality Data

LAYOUT OF RAMAPO RIVER VALLEY WELL FIELDS

FIGURE No. 1



WELL	CAPACITY (GPM)
93	900
94	900
95	500
96	500
97	800
98	1200
85	1000
84	1400
99	1000
100	1400

SOURCE:
LEGGETTE, BRASHEARS
& GRAHAM, INC.

ANALYTICAL LABORATORIES
200 ELM STREET
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number .. 70473
Sample Identification ... Spring Valley Well 84-Ramapo Valley Well Field
Collection Date ... 3/22/88 Collector .. AR

pH	7.0	Color (CU)	3
Turbidity (NTU)	0.1	Chlorine, Free	ND
		Total	ND
Temperature (F)	52	Fluoride	--
Alkalinity, CaCO3	42		
Carbon Dioxide, Free	9	Solids, Suspended	ND
Chloride	76	Volatile	20
Hardness, CaCO3	80	Total	176
Calcium, Ca	22		
Magnesium, Mg	6	Conductivity (Micromhos/cm)	384
Potassium, K	--		
Silica, SiO2	--		
Sodium, Na	--	Dissolved Oxygen	--
Sulfate, SO4	16		
Ammonia, Free, N	0.02	M.B.A.S.	--
Nitrite, N	ND	Phosphate, o-P	0.03
Nitrate, N	1.21	t-P	0.07
Aluminum, Al	0.07	Lead, Pb	--
Arsenic, As	--	Manganese, Mn	0.01
Barium, Ba	--	Mercury, Hg	--
Cadmium, Cd	--	Nickel, Ni	--
Chromium, Cr	--	Selenium, Se	--
Copper, Cu	0.01	Silver, Ag	--
Iron, Fe	0.01	Zinc, Zn	ND

Total Coliform Organisms, as MPN index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.
Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.
The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within Appendix A.

ANALYTICAL LABORATORIES
200 ELM STREET,
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number ... 70474
Sample Identification ... Spring Valley Well 85-Ramapo Valley Well Field
Collection Date ... 3/22/88 Collector ... AR

---

pH	7.1	Color (CU)	3
Turbidity (NTU)	0.1	Chlorine, Free	ND
		Total	ND
Temperature (F)	48	Fluoride	--
Alkalinity, CaCO3	34		
Carbon Dioxide, Free	5	Solids, Suspended	ND
Chloride	63	Volatile	ND
Hardness, CaCO3	80	Total	130
Calcium, Ca	21		
Magnesium, Mg	7	Conductivity (Micromhos/cm)	360
Potassium, K	--		
Silica, SiO2	--		
Sodium, Na	--	Dissolved Oxygen	--
Sulfate, SO4	13		
Ammonia, Free, N	0.02	M.B.A.S.	--
Nitrite, N	ND	Phosphate, o-P	0.05
Nitrate, N	1.02	t-P	0.07
Aluminum, Al	0.09	Lead, Pb	--
Arsenic, As	--	Manganese, Mn	0.01
Barium, Ba	--	Mercury, Hg	--
Cadmium, Cd	--	Nickel, Ni	--
Chromium, Cr	--	Selenium, Se	--
Copper, Cu	0.01	Silver, Ag	--
Iron, Fe	0.03	Zinc, Zn	ND

Total Coliform Organisms, as MPN Index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.
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The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within **Appendix A.**

HACKENSACK WATER COMPANY
ANALYTICAL LABORATORIES
200 ELM STREET,
HARDELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number ... 701280
Sample Identification . Spring Valley Well 53-Ramapo Valley Well Field
Collection Date ... 7/12/88 Collector ... ML

---

pH	. 6.8	Color (CU)	.. 5
Turbidity (NTU)	.. 0.1	Chlorine, Free	. ND
		Total	. ND
Temperature (F)	.. 62	Fluoride	. ND
Alkalinity, CaCO3	.. 50		
Carbon Dioxide, Free	10	Solids Suspended	ND
Chloride	. 50	Volatile	.. 76
Hardness, CaCO3	74	Total	. 229
Calcium, Ca	24		
Magnesium, Mg	3	Conductivity	
Potassium, K	1	(Micromhos/cm)	. 369
Silica, SiO2	--		
Sodium, Na	.. 29	Dissolved Oxygen	.. --
Sulfate, SO4	... 16		
Ammonia, Free, N	.. 0.02	M.B.A.S.	... ND
Nitrite, N	.. ND	Phosphate, o-P	... 0.02
Nitrate, N	... 0.97	t-P	... 0.06
Aluminum, Al	... 0.04	Lead, Pb	... ND
Arsenic, As	.. ND	Manganese, Mn	0.02
Barium, Ba	... ND	Mercury, Hg	... ND
Cadmium, Cd	... ND	Nickel, Ni	... ND
Chromium, Cr	... ND	Selenium, Se	... ND
Copper, Cu	... ND	Silver, Ag	... ND
Iron, Fe	... ND	Zinc, Zn	... ND

Total Coliform Organisms, as MPN Index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.
Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.
The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within Appendix A.

HACKENSACK WATER COMPANY
ANALYTICAL LABORATORIES
200 ELM STREET,
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number ... 701278

Sample Identification ... Spring Valley Well 94-Ramapo Valley Well Field

Collection Date ... 7/12/88 Collector .. ML

---

pH	6.7	Color (cu)	3
Turbidity (NTU)	0.5	Chlorine, Free	ND
		Total	ND
Temperature (F)	62	Fluoride	ND
Alkalinity, CaCO3	42		
Carbon Dioxide, Free	17	Solids, Suspended	ND
Chloride	57	Volatile	78
Hardness, CaCO3	80	Total	242
Calcium, Ca	24		
Magnesium, Mg	5	Conductivity	
Potassium, K	1	(Micromhos/cm)	357
Silica, SiO2	--		
Sodium, Na	29	Dissolved Oxygen	--
Sulfate SO4	18		
Ammonia, Free, N	0.02	M.B.A.S.	ND
Nitrite N	ND	Phosphate, o-P	0.04
Nitrate, N	0.90	t-P	0.04
Aluminum, Al	0.05	Lead, Pb	ND
Arsenic, As	ND	Manganese, Mn	ND
Barium, Ba	ND	Mercury, Hg	ND
Cadmium, Cd	ND	Nickel, Ni	ND
Chromium, Cr	ND	Selenium, Se	ND
Copper, Cu	ND	Silver, Ag	ND
Iron, Fe	ND	Zinc, Zn	ND

Total Coliform Organisms, as MPN Index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.

Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.

The nomenclature "**ND**" represents analytes that are not detected, or analytical detection limits as expressed within **Appendix A.**

HACKENSACK WATER COMPANY
ANALYTICAL LABORATORIES
200 ELM STREET,
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number ... 70477
Sample Identification ... Spring Valley Well 95-Ramapo Valley Well Field
Collection Date ... 3/22/88 Collector .. AR

---

pH	... 7.0	Color (CU)	... 4
Turbidity (NTU)	... 0.4	Chlorine, Free	... ND
		Total	... ND
Temperature (F)	... 41	Fluoride	.. --
Alkalinity, CaCO3	.. 42		
Carbon Dioxide, Free	... 7	Solids, Suspended	.. ND
Chloride	.. 92	Volatile	... 6
Hardness, CaCO3	.. 76	Total	.. 126
Calcium, Ca	... 18		
Magnesium, Mg	.. 7	Conductivity (Micromhos/cm)	. 300
Potassium, K	.. --		
Silica, SiO2	... --		
Sodium, Na	... --	Dissolved Oxygen	.. --
Sulfate, SO4	... 10		
Ammonia, Free, N	... 0.02	M.B.A.S.	... --
Nitrite, N	... ND	Phosphate, o-P	... ND
Nitrate, N	... 0.76	t-P	... 0.05
Aluminum, Al	... 0.07	Lead, Pb	... --
Arsenic, As	... --	Manganese, Mn	... 0.21
Barium, Ba	... --	Mercury, Hg	... --
Cadmium, Cd	... --	Nickel, Ni	... --
Chromium, Cr	... --	Selenium, Se	... --
Copper, Cu	... 0.01	Silver, Ag	... --
Iron, Fe	... 0.07	Zinc, Zn	... 0.02

Total Coliform Organisms, as MPN Index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.
Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.
The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within Appendix A.

HACKENSACK WATER COMPANY
ANALYTICAL LABORATORIES
200 ELM STREET,
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number .. 70478
Sample Identification .. Spring Valley Well 96-Ramapo Valley Well Field
Collection Date . 3/22/88 Collector .. AR

---

pH	6.9	Color (CU)	3
Turbidity (NTU)	0.1	Chlorine, Free	ND
		Total	ND
Temperature (F)	45	Fluoride	--
Alkalinity, $CaCO_3$	22		
Carbon Dioxide, Free	6	Solids, Suspended	ND
Chloride	17	Volatile	6
Hardness, $CaCO_3$	70	Total	124
Calcium, Ca	17		
Magnesium, Mg	7	Conductivity	
Potassium, K	--	(Micromhos/cm)	288
Silica, SiO_2	--		
Sodium, Na	--	Dissolved Oxygen	--
Sulfate, SO_4	12		
Ammonia, Free, N	0.02	M.B.A.S.	--
Nitrite, N	ND	Phosphate, o-P	0.06
Nitrate, N	0.95	t-P	0.06
Aluminum, Al	0.07	Lead, Pb	--
Arsenic, As	--	Manganese, Mn	0.01
Barium, Ba	--	Mercury, Hg	--
Cadmium, Cd	--	Nickel, Ni	--
Chromium, Cr	--	Selenium, Se	--
Copper, Cu	0.01	Silver, Ag	--
Iron, Fe	0.01	Zinc, Zn	0.01

Total Coliform Organisms, as MPN Index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.

Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.

The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within Appendix A.

HACKENSACK WATER COMPANY
ANALYTICAL LABORATORIES
200 ELM STREET,
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number . 70166
Sample Identification . Spring Valley Well 97 - Ramapo Well Field
Collection Date . 2/17/88 Collector . RQ

---

pH	6.8	Color (CU)	5
Turbidity (NTU)	0.3		
		Sodium Na	22
Alkalinity (CaCO3)	32	Potassium K	1
Carbon Dioxide (Free)	2	Fluoride	ND
Chloride	58	Solids, Suspended	ND
Hardness (CaCO3)	74	Volatile	30
Calcium Ca	21	Total	150
Magnesium Mg	5	Conductivity	
Silica SiO2	ND	Micromhos/cm	232
Ammonia, Free (N)	.02		
Nitrite (N)	ND	Phosphate, o-P	--
Nitrate (N)	.99	t-P	ND
Aluminum, Al	.08	Lead, Pb	ND
Arsenic, As	ND	Manganese, Mn	ND
Barium, Ba	ND	Mercury, Hg	ND
Cadmium, Cd	ND	Nickel, Ni	ND
Chromium, Cr	ND	Selenium, Se	ND
Copper, Cu	.01	Silver, Ag	ND
Iron, Fe	ND	Zinc, Zn	ND

Total Coliform Organisms, as MPN Index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.
Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.
The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within Appendix A.

ANALYTICAL LABORATORIES
200 ELM STREET,
ORADELL, NJ 07649

ANALYTICAL SUMMARY

Lab Number .. 70481
Sample Identification .. Spring Valley Well 99-Ramapo Valley Well Field
Collection Date .. 3/22/88 Collector . AR

pH	. 6 5
Turbidity (NTU)	.. 0.3
Temperature (F)	.. 48
Alkalinity, CaCO3	.. 34
Carbon Dioxide, Free	. 23
Chloride	... 57
Hardness, CaCO3	.. 80
Calcium, Ca	. 22
Magnesium, Mg	... 5
Potassium, K	.. --
Silica, SiO2	.. --
Sodium, Na	... --
Sulfate, SO4	.. 12
Ammonia, Free, N	... 0.02
Nitrite, N	... ND
Nitrate, N	... 1.55
Aluminum, Al	... 0.09
Arsenic, As	... --
Barium, Ba	... --
Cadmium, Cd	... --
Chromium, Cr	... --
Copper, Cu	.. 0.02
Iron, Fe	... 0.10

Color (CU)	... 3
Chlorine, Free	... ND
Total	... ND
Fluoride	... --
Solids, Suspended	.. ND
Volatile	... 6
Total	.. 176
Conductivity (Micromhos/cm)	300
Dissolved Oxygen	.. --
M.B.A.S.	... --
Phosphate, o-P	... ND
t-P	... ND
Lead, Pb	... --
Manganese, Mn	... 0.01
Mercury, Hg	... --
Nickel, Ni	... --
Selenium, Se	... --
Silver, Ag	... --
Zinc, Zn	... 0.02

Total Coliform Organisms, as MPN index per 100mL ... ND

Louis A. Briganti
Chief Chemist

Results are expressed in mg/L, unless otherwise stated.
Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.
The nomenclature "ND" represents analytes that are not detected, or analytical detection limits as expressed within Appendix A.

HACKENSACK WATER COMPANY
ANALYTICAL LABORATORIES

200 ELM STREET,
GRADELL, NJ 07640

ANALYTICAL SUMMARY

Lab Number . 70167
Sample Identification . Spring Valley Well 100 - Ramapo Well Field
Collection Date .. 2/17/88 Collector RQ

---

pH	6.9	Color (CU)	7
Turbidity (NTU)	2.0		
		Sodium ,Na	53
Alkalinity (CaCO3)	42	Potassium ,K	1
Carbon Dioxide (Free)	2	Fluoride	ND
Chloride	88	Solids, Suspended	ND
Hardness (CaCO3)	114	Volatile	50
Calcium ,Ca	27	Total	196
Magnesium ,Mg	11	Conductivity micromhos/cm	333
Silica,SiO2	ND		
Ammonia, Free(N)	.02	Phosphate, o-P	--
Nitrite (N)	ND	t-P	ND
Nitrate (N)	1.44		
Aluminum , Al	.11	Lead, Pb	ND
Arsenic, As	ND	Manganese, Mn	.12
Barium , Ba	ND	Mercury, Hg	ND
Cadmium, Cd	ND	Nickel, Ni	ND
Chromium , Cr	ND	Selenium , Se	ND
Copper , Cu	.03	Silver , Ag	ND
Iron, Fe	.04	Zinc, Zn	ND

Total Coliform Organisms, as MPN index per 100mL ... ND

Louis A. Briganti
Chief Chemist

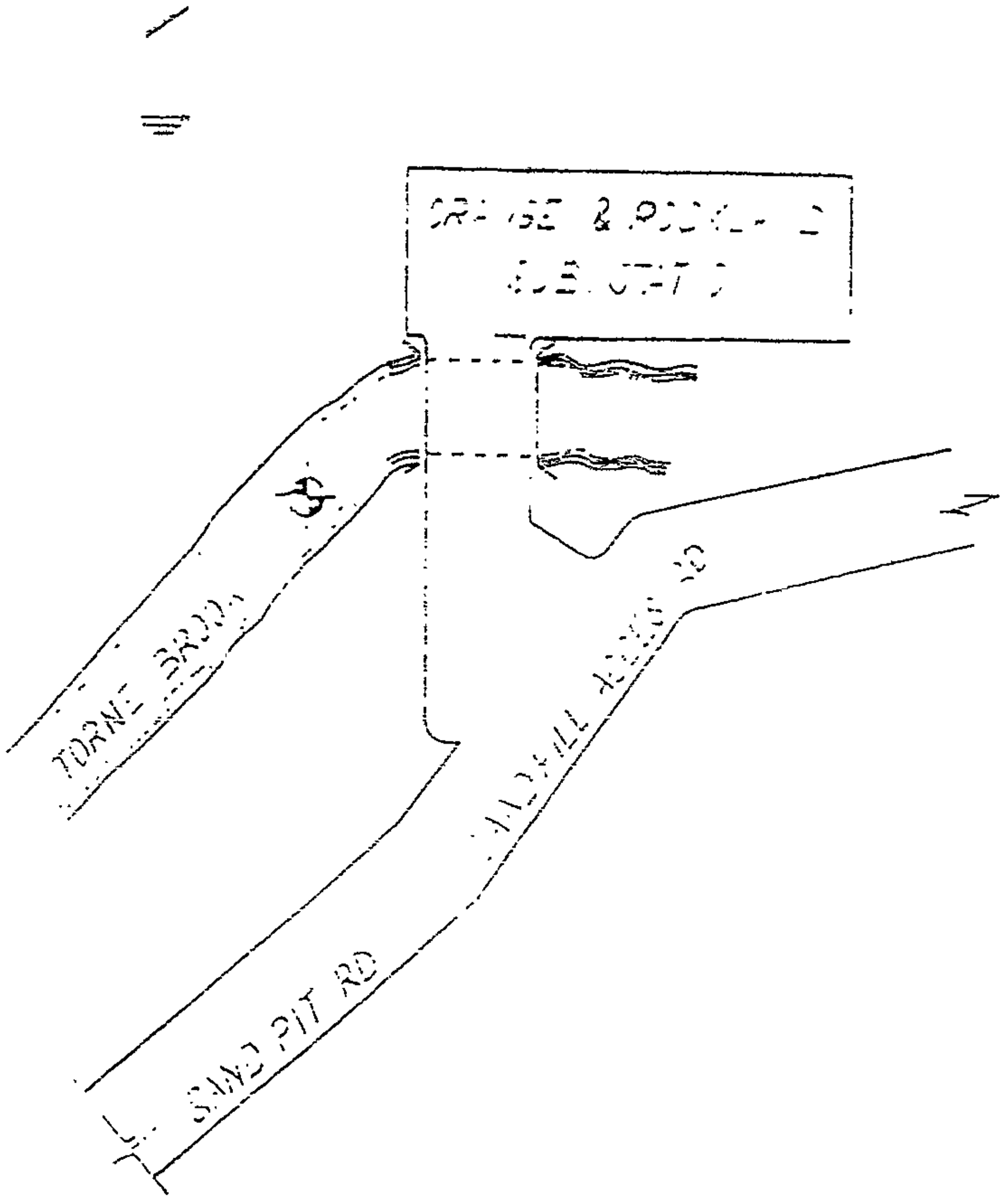
Results are expressed in mg/L, unless otherwise stated.
Analyses are performed in accordance with the latest edition of "Standard Methods for the examination of Water and Wastewater" and/or USEPA approved methodology.
The nomenclature "ND" represents analyses that are not detected, or analytical detection limits as expressed within Appendix A.

HACKENSACK WATER COMPANY

Watershed Sampling Stations
Identification Number and Location
(as of January 1981)

amapo River Basin

tation No.	Location
[redacted]	[redacted]
[redacted]	[redacted]
752	Torne Brook, upstream from sanitary landfill, Ramapo, N.Y.
740	Ramapo River, south of the Ramapo Booster Station, at the downstream monitoring gauging station weir, in Hillburn, N.Y.
760	Ramapo River, north of the Ramapo Booster Station, 500 feet south of the upstream monitoring gauging station, in Hillburn, N.Y.



Station 752

Torne Brook @ [illegible]

~ 50' S/of O & R's fence

& 100' W/of access RD

Hillburn

Pg.43 - MAP 4 - 04

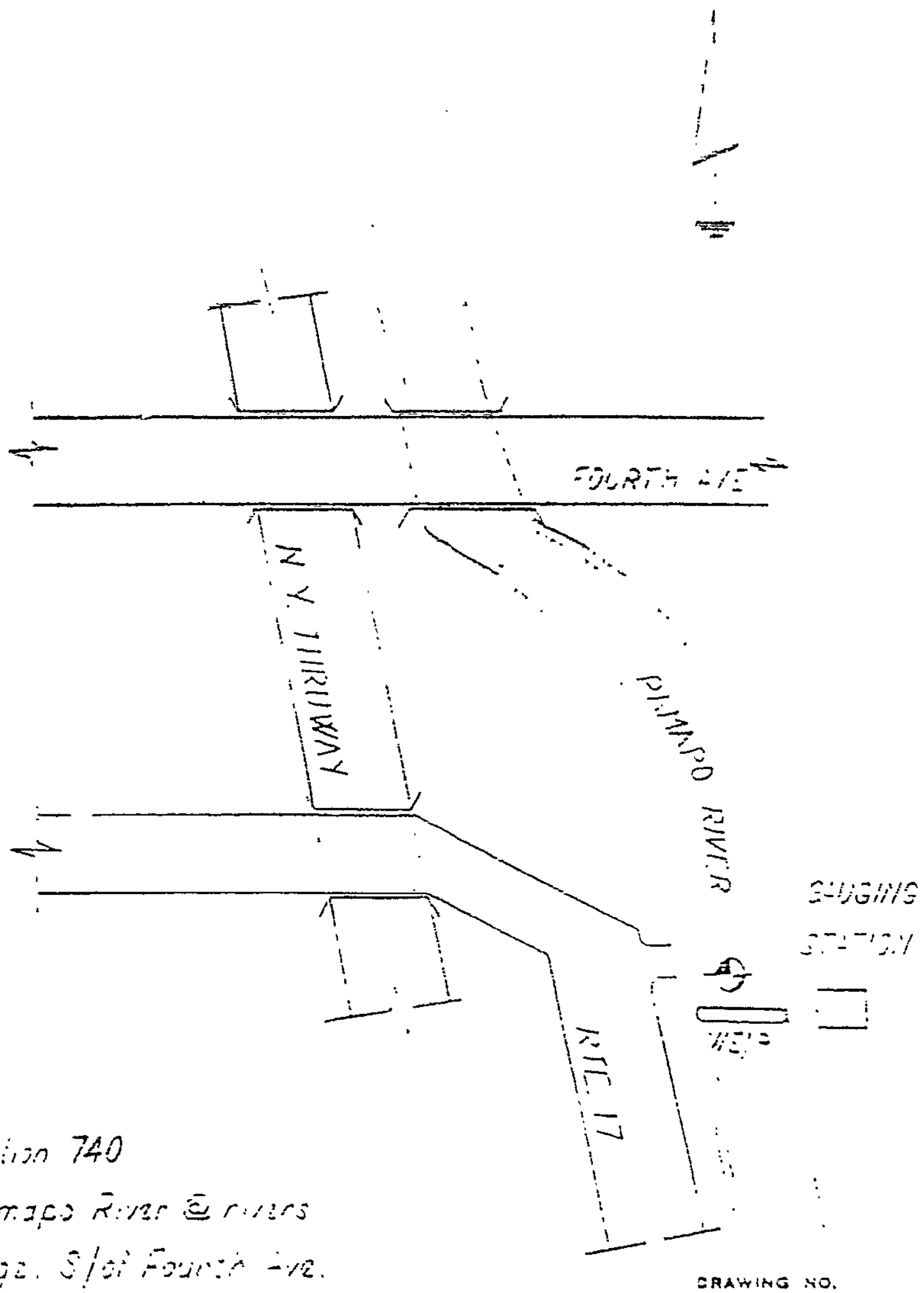
DRAWING NO.

SPRING VALLEY WATER COMPANY INCORPORATED
WEST NYACK, N. Y.

WATER SHED
SAMPLING STATION
752

SCALE	DATE
DR BY	CKD. BY	APP'D BY

TECH-REPRO Inc.



Station 740
Ramapo River @ rivers
gage. S/of Fourth Ave.
& E/of RTE 17
Hillburn

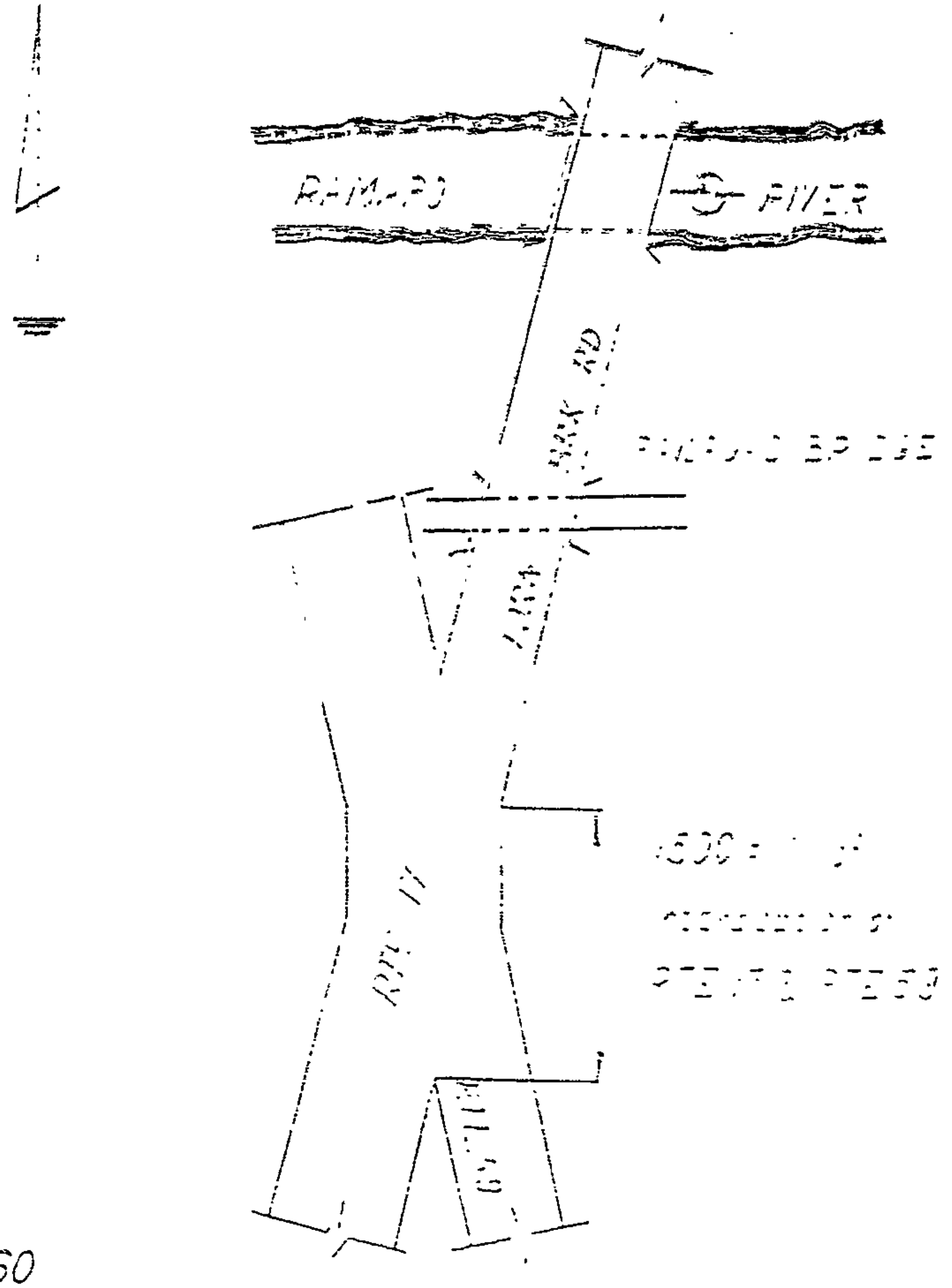
Pg.48 - MAP 4. D-2

DRAWING NO.

SPRING VALLEY WATER COMPANY INCORPORATED
WEST NYACK, N.Y.

WATER SHED
SAMPLING STATION
740

SCALE
DATE
DR. BY
CKD. BY
APPD. BY



Station 760
Ramapo River @ rivers
edge S/E of bridge
Ramapo

Pg. 48 -MAP 4 -C11

DRAWING NO.

SPRING VALLEY WATER COMPANY INCORPORATED
WEST NYACK, N.Y.

WATER SHED
SAMPLING STATION NO
760

SCALE.	DATE

DR BY	CKD. BY	APPD BY

HACKENSACK WATER COMPANY
WATERSHED SAMPLES REPORT

[illegible] 1990

```
[illegible]      pH  Clr [illegible] Turb Alk [illegible]          NO3  oPO4 [illegible]  Al  Fe  Mn  Cu  Cr  Cd  TSS  DO  BOD COD [illegible]
--- --- ---- ---- --- --- --- ---- --- --- --- ---- ---- ----- ---- ---- --   ---- ---- ---- ---- ---- --- --- ---- --- --- -----
[illegible] STATION 740

JAN  [illegible]      7.0   8  N   .6  22  78  88   .2 <.01   .25       .07         .10  .03                      3.2
FEB  [illegible]      7.3   8  N   .5  24  57  74   .1 <.01   .22                   .06  .03                     14.0
MAR  [illegible]      7.6  15  N   .6  24  42  52  <.1  .05   .52       .05         .08  .03                     13.0
APR  [illegible]      7.3  15  N  1.8  26  31  46  <.1  .04   .54       .13         .12  .03                     10.9
JUN  [illegible]      7.5  18  N  2.2  50  59  74   .2 <.01  1.44       .15         .13  .04                      9.2
JUL  [illegible]      6.9  22  N  3.3  56  55  85  <.1 <.01   .42       .06         .19  .08                      9.2
AUG  [illegible]      7.7  29  N  1.5  45  43  66   .2 <.01  1.27       .03         .19  .14                      8.8
SEP  [illegible]      7.7  20  N  1.9  50  45  66  <.1 <.01  2.25       .22         .15  .04                      9.6
OCT  [illegible]      7.1  35  N  4.2  20  22  38  <.1 <.01   .26       .10         .55  .22                      6.9
NOV  [illegible]      7.8  18  N  1.4  22  30  56   .2  .02   .27       .13         .09  .02                     11.5
```

AVERAGE .11 .21 .06 10.5

02.11.91 01:25 PM *HACKENSACK WATER LAB P02

HACKENSACK WATER COMPANY

WATERSHED SAMPLES REPORT

THE YEAR: 1990

SAMPLE TYPE: STATION 757

	Tmp	TC12	FC12	pH	Clr	Odr	Turb	Alk	Cl	Hrd	NH3	NO2	NO3	oPO4	TPO4	MBAS	Al	Fe	Mn	Cu	Zn	Na	TSS	DO	BOD	COD	MPN
JAN	[illegible]			7.3	3	1E	.3	8	12	32	<.1	.01	.04		<.01			.09	<.02					4.3			
MAR	12			7.2	5	N	.3	28	7	56	<.1	.06	<.01		.02			.03	<.01					12.0			
APR	8			6.9	7	N	.5	2	2	16	<.1	.03	.04		.03			.05	.03					11.5			
JUN	[illegible]			7.5	6	N	.4	10	4	40	<.1	<.01	.1[illegible]		<.01			.1[illegible]	<.01					10.0			
JUL	[illegible]			7.7	7	N	.4	10	3	26	<.1	<.01	.07		.11			.13	.03					9.0			
AUG	16			7.7	7	N	.3	11	[illegible]	16	<.1	.02	<.05		.17			.09	<.01					9.5			
SEP	[illegible]			7.3	4	N	.3	16	4	28	<.1	.03	.15		.22			.07	<.[illegible]					10.2			
OCT	15			7.0	18	N	.5	6	5	14	.1	.02	.16		<.01			.17	.05					7.4			
NOV	[illegible]			7.7	7	N	.7	6	3	15	<.1	.02	.9		<.01			.04	.02					11.0			
																		.08	[illegible]								

Glenand

HACKENSACK WATER COMPANY

WATERSHED SAMPLES REPORT

[illegible] YEAR: 1990

[illegible] STATION [illegible]

		Tmp	[illegible]	[illegible]	pH	Clr	Odr	Turb	Alk	Cl	Hrd	NH3	NO2	NO3	PO4	SPCN	MBAS	As	Fe	Mn	Cu	Zn	Hg	TSS	DO	BOD	COD	MPN
[illegible]	[illegible]				7.0	7	N	.7	28	71	60	1	.02	75		.07			.17	.06					2.6			
[illegible]	[illegible]				7.4	13	N	.6	28	57	66	<.1	<.01	[illegible]					.12	.03					11.2			
[illegible]	[illegible]				7.6	15	N	[illegible]	28	41	16	.1	.05	55		.05			.18	.3					13.0			
[illegible]	[illegible]				7.2	19	N	1.4	24	28	50	<.1	.02	.61		.11			.15	.04					10.6			
[illegible]	[illegible]				7.8	18	N	.6	54	61	7[illegible]	<.1	.02	.11		.17			.13	.14					6.6			
[illegible]	[illegible]				7.8	20	N	3.6	53	55	7[illegible]	.1	<.01	1.20		.12			.22	.05					5.5			
[illegible]	[illegible]				7.7	20	N	1.8	45	42	71	.3	.01	1.27		.31			.29	.06					4.4			
[illegible]	[illegible]				7.5	17	N	.2	54	52	64	<.1	<.01	2.48		.24			.13	.05					9.5			
[illegible]	[illegible]				7.2	25	N	6.5	30	24	64	<.1	<.01	20		.14			.83	.22					7.2			
[illegible]	[illegible]				7.7	18	N	1	36	32	56	.2	.04	.30		.15			.10	.02					12.0			
																			[illegible]	[illegible]								

Averaged 3 sample pts

[illegible] metals

Fe = 0.16 mg/l .10 mg/l

Mn = 0.04 mg/l [illegible]

ATTACHMENT B:

Laboratory Results of January, 1991, Groundwater Sample Analyses

INORGANIC ANALYSIS FOR NEW GROUNDWATER WELLS (UG/L)

SITE: TUALCO WASTE DISPOSAL SITE
CASE NO. 005081, SDG NO. 046

SAMPLE NUMBER:			GWR11	GWR12	GWR13	GWR14	GWR16	GW[illegible]
SAMPLE LOCATION:			RI 1	RI 2	RI 3	RI 4	RI 2 DUP	EQUIP BLK
LABORATORY NUMBER:			2704	2641	2626	2705	2642	2707
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (ug/L, ppb)						
ALUMINUM	P	200	244.00	216.00	1500.00	1516.00	297.00	56.00 U
ANTIMONY	P	60	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
ARSENIC	[illegible]	10	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
BARIUM	P	200	50.00 U	50.00 U	50.00 U	50.00 U	50.00 U	50.00 U
BERYLLIUM	P	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
CADMIUM	P	5	5.00	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
CALCIUM	P	5000	47100.00	41500.00	7790.00	88800.00	49900.00	200.00 U
CHROMIUM	P	10	10.00 U	10.00 U	10.00 U	10.00 U	17.00 U	10.00 U
COBALT	[illegible]	50	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U	20.00 U
COPPER	[illegible]	25	5.00 U	45.00	14.00 B	14.00 B	48.00	5.00 U
IRON	P	100	377.00	795.00	1650.00	2590.00	714.00	40.00 U
LEAD	[illegible]	5	24.00	56.00	28.00	21.50	75.00	11.00
MAGNESIUM	P	5000	7890.00	10400.00	2350.00	7700.00	10100.00	200.00 U
MANGANESE	P	15	18.00	571.00	28.00	111.00	844.00	5.00 U
MERCURY	[illegible]	0.2	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
NICKEL	P	40	20.00 U	50.00	20.00 U	20.00 U	55.00	20.00 U
POTASSIUM	P	5000	1000.00 B	1020.00 B	1100.00 B	23400.00	1810.00 B	200.00 U
SELENIUM	F	5	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
SILVER	P	10	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
SODIUM	P	5000	17000.00	25800.00	4100.00	104000.00	25300.00	207.00 B
THALLIUM	F	10	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
VANADIUM	P	50	[illegible]	[illegible]	50.00 U	20.00 U	50.00 U	20.00 U
ZINC	P	20	[illegible]	45.00	18.00 B	15.00 B	44.00	10.00 U

INORGANIC ANALYSIS FOR EXISTING GROUNDWATER WELLS (UG/L)

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. [illegible], SDG NO. 046

SAMPLE NUMBER:			GWMW1	GWMW[illegible]	GWMW4	GWMW5	GWMW6	GWMW7	GWEB01
SAMPLE LOCATION:			MW1	MW[illegible]	MW4	MW5	MW6	MW7	EQUIPBLK
LABORATORY NUMBER:			2637	[illegible]	2637	[illegible]	2640	2633	7703
INORGANIC ELEMENTS		CONTRACT DETECTION LIMITS (ug/L, ppb)							
ALUMINUM	P	200	[illegible]	1000.00	[illegible]	[illegible]	[illegible]	668.00	50.00 U
ANTIMONY	P	60	5.00 U	5.00 U	5.00 U	[illegible]	[illegible]	[illegible]	5.00 U
ARSENIC	P	10	5.00 U	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.00 U
BARIUM	P	200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50.00 U
BERYLLIUM	P	5	[illegible]	5.00 U	[illegible]	5.00 U	[illegible]	[illegible]	5.00 U
CADMIUM	P	5	5.00 U	5.00 U	[illegible]	[illegible]	[illegible]	[illegible]	5.00 U
CALCIUM	P	[illegible]	24000.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	200.00 U
CHROMIUM	P	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.00 U
COBALT	P	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20.00 U
COPPER	P	25	[illegible]	19.00 B	[illegible]	[illegible]	11.00 B	[illegible]	5.00 U
IRON	P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LEAD	[illegible]	5	[illegible]	41.00	[illegible]	[illegible]	[illegible]	3.30	[illegible]
MAGNESIUM	P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MANGANESE	[illegible]	15	[illegible]	158.00	[illegible]	[illegible]	[illegible]	[illegible]	3.00 U
MERCURY	CV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.20 U
NICKEL	[illegible]	40	[illegible]	[illegible]	[illegible]	23.00	[illegible]	[illegible]	[illegible]
POTASSIUM	P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SELENIUM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.00 U
SILVER	P	5	[illegible]	[illegible]	5.00 U	5.00 U	5.00 U	[illegible]	[illegible]
SODIUM	P	[illegible]	[illegible]	[illegible]	[illegible]	198000.00	[illegible]	[illegible]	[illegible]
THALLIUM	F	[illegible]	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	[illegible]	5.00 U
VANADIUM	P	[illegible]	[illegible]	[illegible]	[illegible]	10.00 U	10.00 U	[illegible]	10.00 U
ZINC	P	20	18.00 B	18.00 B	[illegible]	[illegible]	[illegible]	19.00 B	10.00 U

NEW GROUNDWATER WELL VOLATILE ORGANIC ANALYSIS(UG/L)

G.T.I., [illegible] WASTE DISPOSAL SITE
CASE NO. [illegible], SDG NO. [illegible]

SAMPLE NUMBER:		GW-1	GW-2	GW-3	GW-4	GW-[illegible]	GW-[illegible]	GW-[illegible]	GW-[illegible]
SAMPLE LOCATION:		W-1	W-2	W-3	W-4	W-2 DUP	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		[illegible]	15950	[illegible]	60016	[illegible]	[illegible]	15930	[illegible]
COMPOUND	CRQL								
Methylene Chloride	5	5 U	[illegible]	5 U	[illegible]	[illegible]	5 U	[illegible]	5 U
Acetone	10	10 U	10 U	10 U	10 U	10 U	[illegible]	[illegible]	[illegible]
1,2-Dichloropropane	5	5 U	[illegible]	5 U	5 U	[illegible]	5 U	[illegible]	[illegible]
Chloroform	5	5 U	[illegible]	5 U	[illegible]	[illegible]	[illegible]	[illegible]	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	[illegible]	5 U	[illegible]
DILUTION FACTOR:		[illegible]	[illegible]	1	1	1	1	1	1
DATE SAMPLED:		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
DATE RECEIVED:		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DATE ANALYZED:		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SAMPLE SPECIFIC DETECTION LIMITS OF NEW GROUNDWATER WELLS VOLATILE ORGANIC ANALYSIS(UG/L)

SITE: TOLEDO WASTE DISPOSAL SITE
CASE NO. [illegible], SDG NO. 046

SAMPLE NUMBER:		GWRI 1	GWRI 2	GWRI 3	GWRI 4	GWRI 6	GWEB01	GWTB1	GWTB2
SAMPLE LOCATION		RI 1	RI 2	RI 3	RI 4	RI 7 DUP	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		59948	15950	15960	60016	16010	59946	15930	59936
COMPOUND	CRQL								
Chloromethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	10	[illegible]	15 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	[illegible]
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene (total)	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
~~1,2-Dichloroethane~~	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
~~1,1,1-Trichloroethane~~	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	[illegible]	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene		5 U	[illegible]		5	[illegible]	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	U	[illegible]	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	5 U	[illegible]	[illegible]	[illegible]
Total Xylenes	5	5 U	5 U	5 U	5 U	5 U	5 U	5	5 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		1/10/91	1/9/91	1/8/91	1/10/91	1/9/91	1/10/91	--	--
DATE RECEIVED:		1/11/91	1/10/91	1/10/91	1/11/91	1/11/91	1/11/91	1/10/91	1/11/91
DATE ANALYZED:		1/11/91	1/11/91	1/11/91	1/11/91	1/11/91	1/11/91	1/11/91	1/11/91

SAMPLE SPECIFIC DETECTION LIMITS FOR EXISTING GROUNDWATER WELLS VOLATILE ORGANIC ANALYSIS (UG/L)

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO 005080, SDG NO 04[illegible]

SAMPLE NUMBER:		GWMW1	GWMW2	GWMW4	GWMW5	GWMW6	GWMW7	GWEB01	GWTB01	GWTB2
SAMPLE LOCATION:		MW1	MW3	MW4	MW5	MW6	MW7	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		15948	160[illegible]5	1597[illegible]	16120	16130	15980	59946	15930	59936
COMPOUND	CRQL									
Chloromethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Acetone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Chloroform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Chlorobenzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Ethylbenzene	[illegible]	5 U	[illegible]	5	5 U	5 U	5 U	5	[illegible]	5 U
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 U	5 U
Total Xylene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5 U	[illegible]	5 U	10 U	5 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1	1
DATE SAMPLED:		1/8/91	1/9/91	1/9/91	1/9/91	1/9/91	1/8/91	1/10/91		-
DATE RECEIVED:		1/10/91	1/10/91	1/10/91	1/10/91	1/10/91	1/10/91	1/11/91	1/10/91	1/11/91
DATE ANALYZED:		1/11/91	1/11/91	1/11/91	1/14/91	1/14/91	1/11/91	1/11/91	1/11/91	1/11/91

EXISTING GROUNDWATER WELLS VOLATILE ORGANIC ANALYSIS(UG/L)

SITE: TUXEDO WASTE DISPOSAL SITE
CASE NO. 005040, SDG NO. 046

SAMPLE NUMBER:		GWMW1	GWMW3	GWMW4	GWMW5	GWMW6	GWMW7	GWEB01	GWTB01	GWTB02
SAMPLE LOCATION:		MW1	MW3	MW4	MW5	MW6	MW7	EQUIP BLK	TRIP BLK	TRIP BLK
LABORATORY NUMBER:		[illegible]	16020	15970	16120	16130	15980	59946	15930	59936
COMPOUND	CRQL									
Vinyl Chloride	10	10 U	10 U	10 U	0.8 J	10 U	10 U	10 U	10 U	10 U
Acetone	10	10 U	10 U	10 U	7 J	10 U	10 U	4 BJ	10 U	9 BJ
Chloroform	5	4 J	5 U	5 U	5 U	5 U	4 J	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.8 J	1 J
Benzene	5	5 U	5 U	5 U	0.7 J	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.9 BJ
DILUTION FACTOR:		1	1	1	1	1	1	1	1	1
DATE SAMPLED:		1/8/91	1/9/91	1/9/91	1/9/91	1/9/91	1/8/91	1/15/91		
DATE RECEIVED:		[illegible]	1/10/91	1/10/91	1/10/91	1/10/91	1/10/91	1/16/91	1/10/91	[illegible]
DATE ANALYZED:		1/11/91	1/10/91	1/11/91	1/14/91	1/10/91	1/11/91	1/17/91	1/15/91	[illegible]

WELL SAMPLING WORKSHEET

Job Name Texedi Job No [illegible] Samplers ______

Well ID SW-MW-02 Date Sampled ______ Time Start ______ End ______

Casing Diameter ______ inches ÷ 12 = ______ (d) ft

Well secured upon arrival? Y/N

Depth of well from T.O.C ______ ft

Standing water (gal) = ______

Depth of water from T.O.C ______ ft

x ______ well volumes

Feet of standing water ______ (h) ft

= ______ gallons to purge

Standing Water Volume $= \pi [(d)^2 \div 4] (h)$

$= 3.14 [(\_\_\_ ft)^2 \div 4] (\_\_\_ ft) \times 7.48 \text{ gal/ft}^3 = \_\_\_\_\_\_$ gals

PID Readings (ppm)

Breathing ______

Well ______

Purging method ______ Purge Time Start ______ End ______

		pH	Conductivity	Temperature, (C)
1 well volume =	gal			
2 well volume =	gal			
3 well volume =	gal			
Final volume =	gal			

Sample Collection Time Start ______ End ______ Bailer ID# ______

Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum ______

Describe color: colorless black brown orange red ______

Describe appearance: turbid silty sand clay floaters sheen

clear multi phased foaming slimy algae ______

Organic Layer? ______ Length? ______ Samples preserved? ______

Comments ______

WELL SAMPLING WORKSHEET

Job Name Tuxedo Job No [illegible] Samplers [illegible]

Well ID 3W-MW-03 Date Sampled 1 7 91 Time Start [illegible]03 End 1040

Casing Diameter 3 inches = .12 - 0.23 cu/ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C. [illegible] ft Standing water (gal) = 5.2

Depth of water from T.O.C. 10.[illegible] ft x 3 well volumes

Feet of standing water [illegible] (h) ft 14.2 = gallons to purge 15.6

Standing Water Volume	$= \pi [(d)^2 \div 4] (h)$
	$= 3.14 [(\text{[illegible]} ft)^2 \div 4]$ (.42 ft) x 7.48 gal/ft^3 = ____ gals

PID Readings (ppm)

Breathing

Well

Purging method [illegible] Purge Time Start [illegible]55 End 1040

			pH	Conductivity	Temperature, (C)
1 well volume =	5.2	gal	6.13	560	9.[illegible]
2 well volume =		gal	6.5	145	11.8
3 well volume =	15.6	gal	6.24	340	[illegible].3
Final volume =		gal			

Sample Collection Time Start ____ End ____ Bailer ID# [illegible]

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum ____

Describe color: [✓ colorless] black brown orange red ____

Describe appearance: [✓ turbid] silty sand clay floaters sheen

clear muddy gassed foaming slimy algae ____

Organic Layer? none Length? ____ Samples preserved? ____

Comments Chloride = 30 mg/L

Dissolved O_2 = 9.8 mg/L

Turbidity = 79.0 We waited 10 minutes and

took another sample for turbidity which

was 53.2

WELL SAMPLING WORKSHEET

Job Name [illegible] Job No [illegible] Samplers ______

Well ID [illegible] Date Sampled ______ Time Start [illegible] End [illegible]

Casing Diameter [illegible] inches ÷ 12 = [illegible] (d) ft Well secured upon arrival? Y/N

Depth of well from T O C ______ ft 2.7 Standing water (gal) = [illegible] 2.7

Depth of water from T O C [illegible] ft 10 x 3 well volumes

Feet of standing water [illegible] (h) ft 15.35 = [illegible] gallons to purge

Standing Water Volume $= \pi [(d)^2 \div 4] (h)$

$= 3.14 [($ [illegible] $\text{ft})^2 \div 4]$ 5.35 ft) x 7.48 gal/ft^3 = 2.7 gals

PID Readings (ppm)

Breathing ______

Well ______

Purging method ______ Purge Time Start 925 End 1030

			pH	Conductivity	Temperature, (C)
1 well volume =	3	gal	[illegible]	350	12.3
2 well volume =	3	gal	[illegible]	[illegible]	[illegible]
3 well volume =	[illegible]	gal	[illegible]	[illegible]	[illegible]
Final volume =		gal			

Sample Collection Time Start ______ End ______ Bailer ID# ______

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum ______

Describe color: [✓ colorless] black brown orange red ______

Describe appearance: turbid silty sand clay floaters sheen

clear multiphased foaming slimy algae ______

Organic Layer? none Length? ______ Samples preserved? ______

Comments [illegible] = 35 mg/L

Dissolved O$_2$ = 4.0 mg/L

[illegible] = 42.7 mg/L

WELL SAMPLING WORKSHEET

Job Name Tuxedo Job No [illegible] Samplers ED, EF, MN

Well ID TW-MW-05 Date Sampled 1/9/91 Time Start 1050 End ~~[illegible]~~ 1135

Casing Diameter 2 inches ÷ 12 = 0.16 (d) ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C. [illegible] ft Standing water (gal.) = 1.8

Depth of water from T.O.C. 9.65 ft x 3 well volumes

Feet of standing water 10.75 (h) ft = 5.4 gallons to purge

Standing Water Volume $= \pi[(d)^2 \div 4](h)$

$= 3.14\,[(\_\_\_\_ ft)^2 \div 4]\,(\_\_\_\_ ft) \times 7.48\ gal/ft^3 = \_\_\_\_\_\_$ gals

PID Readings (ppm)

Breathing

Well

Purging method [illegible] Purge Time Start 1100 End 1130

			pH	Conductivity	Temperature. (C)
1 well volume =	1.8	gal	6.77	2000	14.5
2 well volume =	1.8	gal	6.77	2000	16.3
3 well volume =	1.3	gal	6.76	2000	15.7
Final volume =		gal			

Sample Collection Time Start End Bailer ID#

Sample Characteristics (Circle all applicable)

Describe odor: none [✓ sulfide] fishy musty [✓ petroleum]

Describe color: colorless black [✓ brown] orange red

Describe appearance: [✓ turbid] silty sand clay floaters [✓ sheen]
clear multi phased foaming slimy algae

Organic Layer? Length? Samples preserved?

Comments Fe [illegible] = 24 mg/L
Dissolved Fe = < 10 mg/L
Turbid. = ~~74~~ 33 21 44
1st 2nd 3rd well
volume volume volume

WELL SAMPLING WORKSHEET

Job Name Tuxedo Job No [illegible] Samplers [illegible] MN

Well ID [illegible]MW-C6 Date Sampled [illegible] Time Start [illegible] End ~~[illegible]~~ 1415

Casing Diameter 2 inches = 12 - 0.16 (d)ft Well secured upon arrival? [✓ Y]/N

Depth of well from T O C 13.7 ft Standing water (gal) = .8

Depth of water from T O C 8.55 ft x 3 well volumes

Feet of standing water 5.15 (h) ft = 2.4 gallons to purge

Standing Water Volume $= \pi [(d)^2 \div 4] (h)$
$= 3.14 [(\_\_\_\_ ft)^2 \div 4] (\_\_\_\_ ft) \times 7.48 \text{ gal/ft}^3 = \_\_\_\_\_\_$ gals

PID Readings (ppm)

Breathing

Well

Purging method [illegible] Purge Time Start [illegible] End 1200

			pH	Conductivity	Temperature, (C)
1 well volume =	.8	gal	6.64	2000	16.5
2 well volume =	1.3	gal	6.62	[illegible]	15.9
3 well volume =	1.8	gal	6.62	1900	16.5
Final volume =	1.8	gal	6.63	1750	15.1

Sample Collection. Time Start End Bailer ID#

Sample Characteristics (Circle all applicable)

Describe odor: none [✓ sulfide] fishy musty petroleum

Describe color: colorless black [✓ brown] orange red

Describe appearance: [✓ turbid] silty sand clay floaters [✓ sheen]
clear multiphased foaming slimy algae

Organic Layer? Length? Samples preserved?

Comments Ferrous Fe = ~~.30~~ 116 mg/L
Dissolved O2 = < 1.0 mg/L
Turbidity = 60 ~~1st~~ 2nd well volume
170 3rd well volume
Turbidity for first well volume wasn't taken.
77.5 NTU Turbidity - 1400 when the sample was
taken ~~[illegible]~~ two hours of waiting after purging.
[illegible]

WELL SAMPLING WORKSHEET

Job Name Tuzola Job No 0050UC Samplers [illegible] N. EP

Well ID SW-MW-07 Date Sampled 1/8/91 Time Start 1435 End 1530

Casing Diameter 2 inches = 12 - .16 (d)ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C 34.45 ft Standing water (gal) = 1.8

Depth of water from T.O.C. 17.55 ft x 3 well volumes

Feet of standing water 16.90 (h)ft = 9 gallons to purge

Standing Water Volume = π [(d)^2 ÷ 4] (h)
= 3.14 [(____ft)^2 ÷ 4] (____ ft) x 7.48 gal/ft^3 = ________ gals

PID Readings (ppm)

Breathing ________

Well ________

Purging method [illegible] Purge Time Start 1455 End 1525

			pH	Conductivity	Temperature, (C)
1 well volume =	5	gal	6.02	350	12.6
2 well volume =	9	gal	6.07	350	12.8
3 well volume =	13	gal	6.13	370	12.9
Final volume =		gal			

Sample Collection Time Start ________ End ________ Bailer ID# ________

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum ________

Describe color: [✓ colorless] black brown orange red ________

Describe appearance: turbid silty sand clay floaters sheen
[✓ clear] multiphased foaming slimy algae ________

Organic Layer? ________ Length? ________ Samples preserved? ________

Comments Dissolved O2 - ~~5.5~~ 5.0 ~~mg/L~~
Chloride = 25 mg/L

WELL SAMPLING WORKSHEET

Job Name [illegible] Job No 005040 Samplers [illegible] EF MN

Well ID [illegible] Date Sampled [illegible] Time Start 710 End

Casing Diameter inches ÷ 12 = .17 (d)ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C 27.2 ft Standing water (gal) = 11.16

Depth of water from T.O.C 10.65 ft × [illegible] well volumes

Feet of standing water 16.55 (h)ft [illegible] = 33.48 gallons to purge

Standing Water Volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(.17\ ft)^2 \div 4]$ (16.55 ft) x 7.48 gal/ft^3 = 10.7 gals

[illegible] 11.16

PID Readings (ppm)

Breathing

Well

Purging method Purge Time Start End

			pH	Conductivity	Temperature, (C)	Turb
1 well volume =	~~[illegible]~~ 11.16	gal	7.37	500	12.2	~~142~~ 234
2 well volume =		gal				
3 well volume =		gal				
Final volume =		gal				

Sample Collection Time Start End Bailer ID#

Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum

Describe color: colorless black brown orange red

Describe appearance: turbid silty sand clay floaters sheen

clear multiphased foaming slimy algae

Organic Layer? Length? Samples preserved?

Comments [illegible] 1" DIAMETER

Chloride =

Dissolved O =

[illegible] after one well volume

b[illegible] Fill.

WELL SAMPLING WORKSHEET

Job Name [illegible] Job No [illegible] Samplers [illegible] P MN

Well ID [illegible] Date Sampled [illegible] Time Start 925 End 1055

Casing Diameter 2 inches ÷ 12 = [illegible] (d)ft. Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C [illegible] ft Standing water (gal) - 11.16

Depth of water from T.O.C [illegible] ft x 3 well volumes

Feet of standing water [illegible] (h) ft [illegible] = 33.48 gallons to purge

Standing Water Volume = π [(d)^2 ÷ 4] (h)
= 3.14 [(.167 ft)^2 ÷ 4] ([illegible] ft) x 7.48 gal/ft^3 = 7.17 gals
6.937
Tot'l 11.16

PID Readings (ppm)

Breathing

Well

Purging method [illegible] Purge Time Start 925 End 1045

			pH	Conductivity	Temperature, (C)	Turb.
1 well volume =	[illegible]	gal	7.66	356	13.8	17.
2 well volume =	11.16	gal	~~6.78~~ 6.78	~~336~~ 336	~~15.8~~ 12.3	~~[illegible]~~ 19.7
3 well volume =	11.16	gal	6.73	326	11.6	14.
Final volume =		gal				

Sample Collection Time Start End Bailer ID#

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum

Describe color: [✓ colorless] black brown orange red

Describe appearance: turbid silty sand clay floaters sheen
[✓ clear] multiphased foaming slimy algae

Organic Layer? Length? Samples preserved?

Comments Chloride = 50 mg/L
Dissolved O$_2$ = [illegible]

WELL SAMPLING WORKSHEET

Job Name Taxel[illegible] Job No [illegible] Samplers E[illegible], EP MN

Well ID GW-~~MW~~ RI-02 Date Sampled 11/?/91 Time Start 15[illegible] End 1605

Casing Diameter 4 inches = ~~[illegible]~~ (d) ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C 70.64 ft Standing water (gal) = 3[illegible].3

Depth of water from T.O.C [illegible].35 ft x 3 well volumes

Feet of standing water 61.29 (h) ft = 11[illegible]8 gallons to purge

Standing Water Volume	$= \pi[(d)^2 \div 4](h)$
	$= 3.14[(\_\_\ \mathrm{ft})^2 \div 4]$ 61.2 ft) x 7.48 gal/ft³ = 39.13 gals

PID Readings (ppm)

Breathing ____

Well ____

Purging method [illegible] pump Purge Time Start 1517 End 1537

			pH	Conductivity	Temperature. (C)	Time
1 well volume =	20	gal	6.15	370	12.0	20
2 well volume =	[illegible]	gal	6.15	[illegible]	12.3	27
3 well volume =	40	gal	6.17	370	12.3	47
Final volume =		gal				

Sample Collection. Time Start ____ End ____ Bailer ID# ____

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum ____

Describe color: colorless black [✓ brown] orange red ____

Describe appearance: [✓ turbid] silty sand clay floaters sheen
clear multiphased foaming slimy algae ____

Organic Layer? ____ Length? ____ Samples preserved? ____

Comments [illegible] = 42 mg/L
Dissolved O2 = 7.6 mg/L

GW-RI-06-0191 is a duplicate of GW-RI-02-0191.

WELL SAMPLING WORKSHEET

Job Name Tuxedo Job No [illegible] Samplers [illegible]

Well ID [illegible] Date Sampled [illegible] Time Start 1550 End 1710

Casing Diameter 2 inches ÷ 12 = .17 (d) ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C 30 ft Standing water (gal) = 1.63

Depth of water from T.O.C 20.4 ft × 3 well volumes

Feet of standing water 10' (h) ft = 4.9 5 gallons to purge

Standing Water Volume = $\pi [(d^2 \div 4] (h)$
= $3.14 [(\_\_\_ ft)^2 \div 4] (\_\_\_ ft) \times 7.48 gal/ft^3$ = 1.63 gals

PID Readings (ppm)
Breathing
Well

Purging method [illegible] Purge Time Start 1600 End 1630

			pH	Conductivity	Temperature, (C)
1 well volume =	1.63	gal	5.53	80	10.9
2 well volume =	1.63	gal	← n [illegible]	[illegible]	→
3 well volume =	1.63	gal	5.74	70	10.0
Final volume =	1.63	gal	5.78	70	10.3

Sample Collection Time Start End Bailer ID#

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum

Describe color: colorless black brown orange red grey

Describe appearance: [✓ turbid] silty sand clay floaters sheen clear multiphased foaming cloudy algae very turbid, [illegible] material

Organic Layer? Length? Samples preserved?

Comments Dissolved O2 = .5 mg/L
Chloride = 50 mg/L

WELL SAMPLING WORKSHEET

Job Name [illegible] Job No [illegible] Samplers [illegible] EF MN

Well ID [illegible]-04 Date Sampled [illegible] Time Start 1615 End

Casing Diameter 2 inches ÷ 12 = .17 (d) ft Well secured upon arrival? Y/N

Depth of well from T.O.C. [illegible] ft 16.72 Standing water (gal.) = .44 g

Depth of water from T.O.C. 14.00 ft x ______ well volumes

Feet of standing water 2.72 (h) ft = 1.32 gallons to purge

Standing Water Volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(.17\ ft)^2 \div 4]$ (2.72 ft) x 7.48 gal/ft^3 = 0.44 gals

PID Readings (ppm)

Breathing

Well

Purging method Bailer Purge Time Start 1615 End 1705

			pH	Conductivity	Temperature. (C)	Turb
1 well volume =	0.44	gal	9.74	750	16.7	359
2 well volume =	0.44	gal	9.67	760	17.0	222
3 well volume =	0.44	gal	9.60	760	16.1	490
Final volume =		gal				

Sample Collection Time Start ______ End ______ Bailer ID# ______

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum ______

Describe color: colorless black [✓ brown] orange red ______

Describe appearance: [✓ turbid] silty sand clay floaters sheen clear multiphased foaming slimy algae ______

Organic Layer? ______ Length? ______ Samples preserved? ______

Comments [illegible]oride = 13[illegible] mg/l

Dissolved O_2 = 3.5 mg/l

WELL SAMPLING WORKSHEET

Job Name [illegible] Job No [illegible] Samplers [illegible]

Well ID [illegible] Date Sampled [illegible] 01 Time Start ____ End [illegible]40

Casing Diameter ____ inches ÷ 12 = [illegible] (d) ft Well secured upon arrival? [✓ Y]/N

Depth of well from T.O.C. 30.[illegible] ft Standing water (gal.) = ~~[illegible]~~ 2.0

Depth of water from T.O.C. [illegible] ft x 5 well volumes

Feet of standing water 11.55 (h) ft = 10.0 gallons to purge

Standing Water Volume	$= \pi [(d)^2 \div 4] (h)$ $= 3.14 [(\_\_\_ ft)^2 \div 4] (\_\_\_ ft) \times 7.48 gal/ft^3 = \_\_\_\_\_\_$ gals

PID Readings (ppm)

Breathing ____

Well ____

Purging method Bailer Purge Time Start 1400 End 1430

			pH	Conductivity	Temperature. (C)
1 well volume =	2.0	gal	~~[illegible]~~ 5.76	200 [illegible]	13.1
2 well volume =	[illegible]	gal	5.54	[illegible]	12.9
3 well volume =	[illegible]	gal	5.72	246	12.6
Final volume =		gal			

Sample Collection Time Start ____ End ____ Bailer ID# ____

Sample Characteristics (Circle all applicable)

Describe odor: [✓ none] sulfide fishy musty petroleum ____

Describe color: [✓ colorless] black brown orange red ____

Describe appearance: turbid silty sand clay floaters sheen
[✓ clear] multiphased foaming shiny algae ____

Organic Layer? None Length? ____ Samples preserved? ____

Comments [illegible] 5.5 mg/L
[illegible] = 22 mg/L

WELL SAMPLING WORKSHEET

Job Name [illegible] Job No [illegible] Samplers ES EP MN

Well ID [illegible] Date Sampled [illegible] Time Start 825 End 1215

Casing Diameter 2 inches ÷ 12 = [illegible] (d) ft Well secured upon arrival? [✓ Y]/N

Depth of well from T O C [illegible] ft Standing water (gal) = [illegible]

Depth of water from T O C [illegible] ft x 3 well volumes

Feet of standing water 2.70 (h) ft = 1.32 gallons to purge

PID Readings (ppm)

Breathing ______

Well ______

Standing Water Volume = $\pi[(d^2 \div 4](h)$

= 3.14 [([illegible] ft)^2 ÷ 4] (___ ft) x 7.48 gal/ft^3 = ______ gals

Purging method [illegible] Purge Time Start [illegible] End 850

			pH	Conductivity	Temperature. (C)	[illegible]
1 well volume =	[illegible]	gal	[illegible]	[illegible]	7.8	[illegible]
2 well volume =	[illegible]	gal	[illegible]	[illegible]	[illegible]	[illegible]
3 well volume =	[illegible]	gal	[illegible]	740	17.4	343
Final volume =		gal				

Sample Collection Time Start ______ End ______ Bailer ID# ______

Sample Characteristics (Circle all applicable)

Describe odor. [✓ none] sulfide fishy musty petroleum ______

Describe color: colorless black brown orange red grey

Describe appearance: [✓ turbid] silty sand clay floaters sheen clear multiphased foaming slimy algae ______

Organic Layer? ______ Length? ______ Samples preserved? ______

Comments [illegible] = 35 mg/L

Dissolved O_2 = 7.4 mg/L

Turbidity at 1100 = 74 NTU

Turbidity at 1215 = 67 NTU

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX C

HABITAT BASED ASSESSMENT

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

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HABITAT BASED ASSESSMENT

PRELIMINARY REPORT

TUXEDO WASTE DISPOSAL SITE
TUXEDO, NEW YORK

I. INTRODUCTION

The objectives of the Habitat Based Assessment are to identify any significant biological resources and habitats on or immediately adjacent to the site, to evaluate where possible the effect of past waste disposal activities on the biota, to assess impacts of the existing condition and possible remediation alternatives as outlined in the workplan.

Phase I involves the following tasks:

1. Identification of biological resources using vegetation mapping and field surveys of wildlife,

2. A review of published surveys and other material pertinent to plants and animals using the site,

3. Identification of ARARs required for site-specific mitigation measures at federal, state, county and municipal levels.

Phase II involves the following tasks:

1. A qualitative evaluation of impacts on the biota from past waste disposal activities through sampling water and sediments at sampling locations on and off-site.

2. A quantitative evaluation of impacts on the biota, including tissue sampling, if judged necessary and directed by NYSDEC.

The guidelines used are those outlined in Step 1 of NYSDEC's "Habitat Based Assessment - Guidance Document for Conducting Environmental Risk Assessments at Hazardous Waste Sites" (TAGM #4025, March, 1990)

II. CURRENT ECOLOGICAL CONDITIONS

A. Biological Resources

Field surveys of the Tuxedo Waste Disposal Site (Figure 1) were carried out on September 10, and October 11-12, 1990. Staff included Alice Belling (Project Biologist), Ed Powers (Field Support) of M&E of New York, Inc., and Bill Kappieman (Terrestrial Biologist) from the Wakefield office.

Prior to entering the site, M&E staff members reviewed the Health and Safety Plan (HASP), and suited up in Level D personal protection equipment.

The purpose of the initial field survey was to:

(i) Verify the presence and location of vegetation communities on site, as documented on an aerial photograph of the site taken on April 23, 1990;

(ii) Record wildlife species, or their signs, observed on site during the survey;

(iii) Identify potential field sampling locations for data collection, for Phase II of field work, if required by NYSDEC;

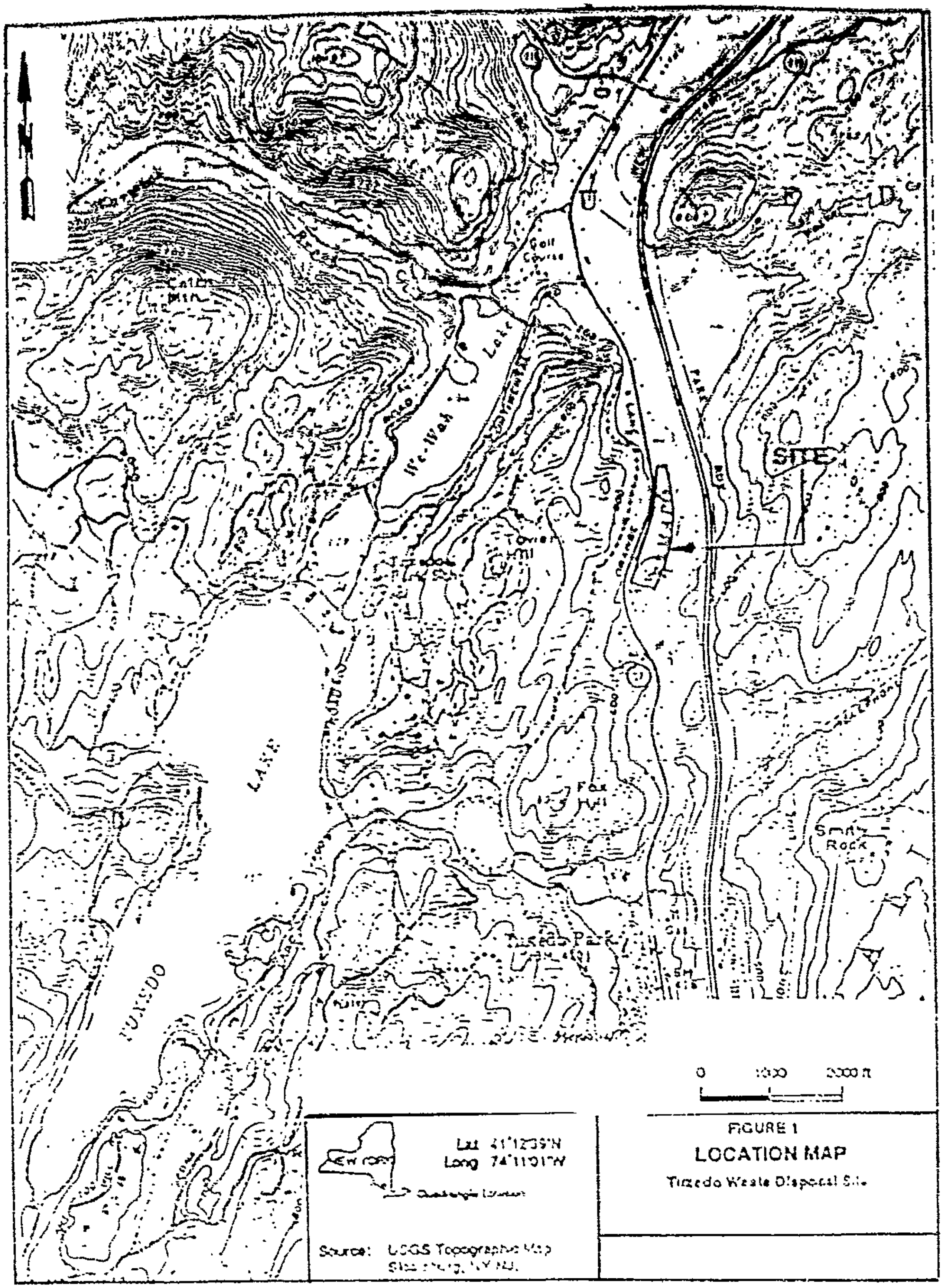


Figure 1 - Location of Tuxedo site, Tuxedo, New York.

After a preliminary survey of the site on September 10, 1990, by the Project Biologist, a second survey was carried out on October 11-12 by Alice Belling (Plant Biologist) and Bill Kappleman (Wildlife Biologist) to collect data on plants present and wildlife using the site and adjacent offsite areas.

1. Vegetation

After the landfill was closed and covered in 1987, plants invaded the site from surrounding areas. Weedy species, including Ragweed, Spotted Knapweed, Queens Anne's Lace, Birdfoot Trefoil, Evening Primrose, Dandelion, Mullein and various species of grasses, Asters and Goldenrods became established throughout the landfill area and are the dominant species at the present time.

A list of species observed on site on October 11-12 is shown in Table 1. Woody species, including shrubs, vines and trees, are confined to the peripheral areas of the site. Tartarian Honeysuckle and Staghorn Sumac are the most prominent shrub species, and Red Cedar, Cottonwood and Sugar Maple dominate the forest species.

Vegetation to the north, west and south of the site consists mainly of Oak-Sugar Maple forest, and the area along the floodplain of the Ramapo River, adjacent to the eastern boundary of the site, is dominated by Red Maple, Eastern Sycamore and American Elm. Scrub-shrub wetlands consisting mostly of Willow (<u>Salix</u> Sp.) and Buttonbush (<u>Cephalanthus Occidentalis</u>) occur along the western edge of the Ramapo River.

2. **Wetlands**

A survey of the area indicates that there are no wetlands present on site.

3. Wildlife

The site was surveyed on October 11, 1990, and offsite areas surveyed on October 12, 1990. Selected portions of Route 17, passing next to and 0.5 miles north and south of the site, were searched for road-killed animals on the evening of October 11 and the morning of Friday, October 12, 1990.

a. Weather Conditions

The afternoon of Thursday, October 11 was mostly cloudy (90% cloud cover) and mild, with temperatures in the mid-75s F. There was a strong breeze (20 - 75 miles per hour, calming to 5 - 10 mph in late afternoon) blowing from the south. The ground was mostly dry, although patches of mud were evident in locations with exposed dirt, due to precipitation the previous night.

b. Wildlife Habitat/Site Description

General vegetation/wetland areas and types were delineated using available aerial photography, and the resulting map (Figure 2) was field checked during the site visit. In general, on-site wildlife habitat was dominated by successional old field, with small patches of deciduous forest occurring on the western and eastern site edges.

There was considerable relief to the on-site terrain, with the steepest slopes occurring on the eastern and western site boundaries, as well as in the southern portion of the site. A drain and three large-diameter pipes were present at the property boundary adjacent to the Georgia Technology Institute property, and a strong petroleum odor was detected. The other end of the drain system, which passes under the landfill, occurs next to the railroad tracks on the eastern site edge. Landfill leachate flows west to east through this system, and during high precipitation periods, likely reaches the Ramapo River.

Visible refuse was relatively uncommon on the soil surface, except on the southern edge of the landfill area, where large amounts of construction refuse was observed. This exposed refuse appeared to have been placed in part of an abandoned quarry and the refuse formed part of a very steep slope.

Off-site habitat types consisted of deciduous forest to the west (across Route 17) and south, and deciduous forest and man-dominated landscapes to the north. East of the site lie an active railroad/power line right-of-way, the Ramapo River, and Interstate 87. Scrub-shrub wetlands, dominated by buttonbush (Cephalanthus occidentalis), lie between the railroad/power line right-of-way and the Ramapo River. The area between the river and Interstate 87 consists of patches of mixed deciduous forest and rocky outcrops.

TABLE 1. TUXEDO PLANT LIST

SCIENTIFIC NAME	COMMON NAME
TREES	
Acer rubrum	Red maple
A. saccharum	Sugar maple
Ailanthus altissima	Tree of heaven
Betula populifolia	Gray birch
Fraxinus americana	White ash
Juniperus virginiana	Red cedar
Platanus occidentalis	Eastern sycamore
Populus deltoides	Cottonwood
Prunus serotina	Black cherry
Q. rubra, var. borealis	Red oak
Ulmus americana	American elm
SHRUBS and VINES	
Lonicera tatarica	Tartarian honeysuckle
Rhus typhina	Staghorn sumac
Rubus sp.	Blackberry
Smilax rotundifolia	Greenbriar
Toxicodendron radicans	Poison ivy

TABLE 1. TUXEDO PLANT LIST

SCIENTIFIC NAME	COMMON NAME
HERBS	
Achillea millefolium	Yarrow
Allium vineale	Wild onion
Ambrosia artemisiifolia	Ragweed
Andropogon virginicus	Broom sedge
Artemisia vulgaris	Mugwort
Asclepias syriaca	Milkweed
Astor novi-belgii	NY aster
Aster [illegible]	Bushy aster
Brassica [illegible]	Yellow [illegible]
Carex sp.	Sedge
Centaurea maculosa	Spotted knapweed
Chelidonium majus	Celandine
Chrysanthemum leucanthemum	Ox-eye daisy
Cyperus [illegible]	Umbrella sedge
Daucus carota	Queen Anne's lace
Echinochloa crusgalli	Barnyard grass
Eragrostis megastachya	Lovegrass
Erigeron philadelphicus	Philadelphia fleabane
Juncus tenuis	Path rush
Lespedeza capitata	Bush clover
Lotus corniculatus	Birdfoot trefoil
Nepeta cataria	Catnip
Oenothera biennis	Common evening primrose
O. Parviflora	Small-flowered evening primrose
Panicum lanuginosum	Panic grass
Plantago major	Broadleaved plantain

TABLE 1. TUXEDO PLANT LIST

SCIENTIFIC NAME	COMMON NAME
HERBS (contd.)	
Poa pratensis	Kentucky bluegrass
Polygonum persicaria	Lady's thumb
Rudbeckia hirta	Blackeyed Susie
Rumex obtusifolia	dock
Setaria Faberi	Foxtail grass
Solidago graminifolia	Narrow-leaved goldenrod
Solidago sp.	Goldenrod
Taraxicum officinalis	Dandelion
Toxicodendron radicans	Poison ivy
Trifolium repens	White clover
Trifolium rubrum	red clover
Verbascum thapsus	Mullein

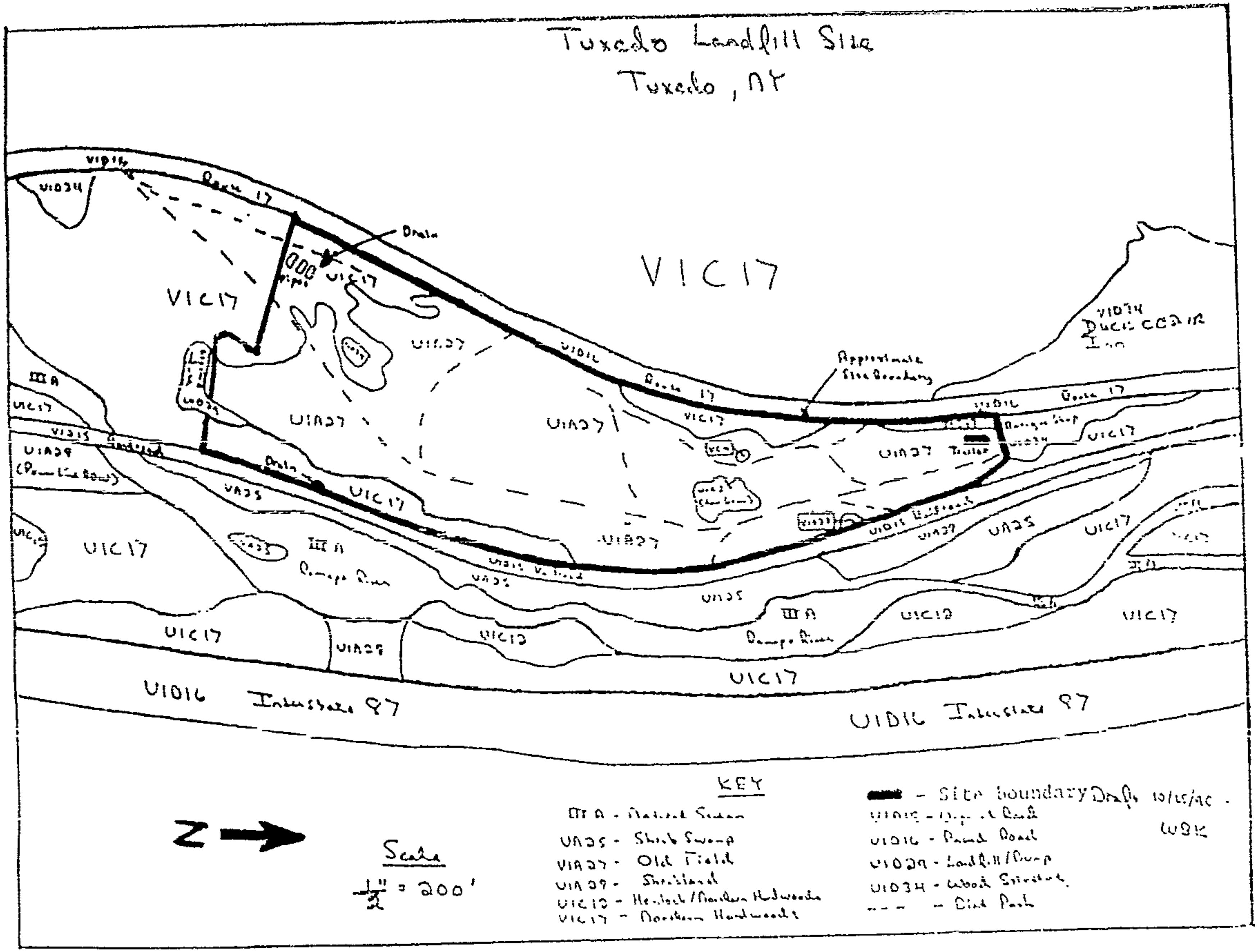


Figure 2 - General vegetation, wetlands and wildlife habitat types in vicinity of site.

The Ramapo River, where it passes the site, alternates between narrow areas with rapid flow and rocky substrate (riffles) and areas of slow flow and mucky substrate (pools). Water depth in the riffle areas appeared to be 5 to 6 feet; depth in the pool areas could not be determined. The river is reported to be populated by trout and used by local anglers. An oily sheen was visible on the water surface adjacent to the extreme northern portion of the site.

c. Wildlife Observations

A total of 14 species of birds were observed on, or flying over, the site (Table 2). In addition, a gull (species unknown) was observed flying over the river, and numerous sparrows/larks (species unknown) were repeatedly flush from the grass. Mourning doves (*Zenaida macroura*) and American goldfinches (*Carduelis tristis*) were the most numerous species observed. Tracks and defecation from a large number of Canada geese (*Branta canadensis*) were observed in the soft mud of the dirt path on the eastern edge of the site. Observations by other personnel indicate that the area was used by approximately 20 geese during the morning of the survey.

Three species of mammals, in addition to a pair of domestic dogs, were observed either visually or by sign (Table 2). White-tailed deer (*Odocoileus virginianus*) tracks of 9 to

10 animals were observed in the old field area south of the trailer and were also common all along the railroad right-of-way. A visual observation of a single deer, being chased by the two dogs mentioned above, was noted. The carass of a deer, which appeared to have been hit by a train, was found offsite on the railroad bridge over the Ramapo River, near the southern site boundary.

It appears that white-tailed deer use the river to forage and drink, the railroad right-of-way as a travel corridor, and the site for foraging and resting. Several areas within the taller grass of the on-site old field habitat showed signs (matted grass) of moderate usage (about a dozen animals) by bedding deer. On-site personnel report frequent sightings of deer on-site and along the river.

Only one woodchuck (*Marmota monax*) burrow was observed, and this was located off-site in the forested area near the river. The carcass of a very recently killed woodchuck was discovered on-site in the old field area. One gray squirrel (*Sciurus carolinensis*) leaf nest was observed near the northern edge of the site. The numerous oaks in the deciduous forests on and near the site provide large quantities of mast for squirrels and other wildlife. On-site personnel also report observations of river otter (*Lutra canadensis*) in the Ramapo River and "coyote" (*Canis latrans*). While the former observation is likely to be dependable, the latter observation is questionable.

Other terrestrial wildlife typical of old field habitats was observed including numerous butterflies of at least three species, bees, beetles, crickets, other ground insects, and spiders. Searches under rocks and logs revealed no reptiles or amphibians.

The bird list compiled should be considered a minimum count of species present at this time of the year due to the brief survey period and the environmental conditions encountered (strong winds).

B. Species of Special Concern

No rare, threatened or endangered species or habitats are known to occur in the general area of the site. (See Attachment 1)

C. Review of Pertinent Literature

The field survey, review of literature, and contacts with public agencies indicated no evidence of threatened or endangered species or habitats on or around the site.

TABLE 2 - WILDLIFE SPECIES OBSERVED

SCIENTIFIC NAME	COMMON NAME
BIRDS	
Branta canadenis	Canada goose
Larus spp.	Gull spp.
Buteo jamaicensis	Red-tailed hawk
Cathartes aura	Turkey vulture
Falco sparverius	American kestrel
Zenaida macroura	Mourning dove
Corvus brachyrhynchos	American crow
Cyanocitta cristata	Blue jay
Parus atricapillus	Black-capped chickadee
Dendroica palmarum	Palm warbler
Quiscalus quiscula	Common grackle
Sturnus vulgaris	European starling
Cardinalis cardinalis	Northern cardinal
Carduelis tristis	American goldfinch
Spizella passerina	Chipping sparrow
	Sparrow spp.
MAMMALS	
Sciurus carolinensis	Gray squirrel
Marmota monax	Woodchuck
Odocoileus virginianus	White-tailed deer

III. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR's)

The following ARAR's may be applicable to fish and wildlife resources on and adjacent to the site:

1. NY Freshwater Wetlands Act
2. NY Regulated Streams
3. NY Natural Heritage Program
4. NY Water Quality Standards
5. NY Groundwater Quality Standards
6. Clean Water Act, Section 404, Dredge and Fill Program
7. Clean Water Act, National Pollutant Discharge Elimination System (NPDES) Permit Program
8. Executive Order 11990 - Wetlands Protection
9. Clean Air Act/NYS Air Quality Control Program
10. Fish and Wildlife Coordination Act
11. Endangered Species Act
12. Migratory Bird Treaty Act

The proposed remediation alternative will be evaluated against the guidelines for each of the above statutes when site-specific mitigation measures are reviewed for the project.

IV. EVALUATION OF IMPACTS

A. Environmental Contamination

The only obvious effect of contamination evident in the terrestrial flora was a mutated plant of Oenothera biennis (abnormally thick stem) on the steep slope on the south-east portion of the site. No gross effects from contaminants in the land fill were evident in the fauna observed on site during the survey. Possible contamination from the drain system to terrestrial

organisms in the offsite ravine, and aquatic organisms in the river, is of potential concern and should be investigated further.

B. Recommendations

Based upon signs of potential contamination from landfill leachate of the Ramapo River, aquatic surveys should be considered to document any possible effects to aquatic organisms. Late summer/early fall would be the best time to conduct such surveys.

Additional tasks which should be considered in Phase II in addition to tissue sampling are as follows:

a. Completion of evaluation of wildlife habitats on site.

b. Survey of off-site wildlife habitats within a half-mile and/or two mile radius of the site.

c. Survey of aquatic habitats in the adjacent Ramapo river, a maximum distance of 9 miles downstream from the site.

d. Survey of local information sources, such as government agencies, colleges, natural history groups, for information on other fish and wildlife studies in the general area.

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX D

PRELIMINARY DRAINAGE STUDY FOR AREA TRIBUTARY TO 24" CORRUGATED METAL PIPE

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

NEW YORK STATE

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF HAZARDOUS WASTE REMEDIATION

PRELIMINARY DRAINAGE STUDY OF AREA TRIBUTARY TO 24" CORRUGATED METAL PIPE ENTERING LANDFILL @ SOUTH END

Tuxedo Waste Disposal Site
Phased Remedial Investigation/Feasibility Study
Site I.D. No. 3-36-035

Prepared By: Metcalf & Eddy of New York, Inc.

INTRODUCTION

The Tuxedo site is located between Tower Hill, a steep hillside to the west of Rt 17, and the Ramapo River, to the east. This topographic condition facilitates the leaching of water through the landfill and into the river The flow of contaminated water to the river can be abated by intercepting this water before it flows into the landfill. The purpose of this preliminary study is to address that portion of the water that enters the landfill at a 24 in. corrugated metal pipe located at the south end of the landfill. A slug test was performed on this pipe to determine if water was leaking from it into the landfill.

DISCUSSION

First it was observed that the daily flow of water leading to the 24 in. pipe did not flow into the pipe, but rather under it, and into the landfill. Only during storm conditions did water in the ponded area around the pipe entrance rise above the invert, allowing flow into the pipe. During a recent slug test only 58 gallons of the 3,000 gallons fed into this pipe was discharged from the other end, near the river. This showed that 98% of the water entering the pipe on the south end, could leach through the landfill. A subsequent videotaping of the pipe interior showed significant damage in the run from the manhole to the railroad. Figure 1 shows the areas, A_0 & A_1, which are tributary to this pipe, and which would discharge 42 cubic feet per second (CFS) of water during a 10-year storm. (A 10-year storm is the worst storm, in terms of rainfall intensity, that the area could be expected to receive in a ten year period. See Attachment 1). The pipe itself, if it were in good condition, could carry a maximum of 17 CFS. (Attachment 2).

It appears that the runoff from Area A_0 could be easily diverted south to the ditch flowing to Stevens Lane (see Figure 1). However, the 15 in. diameter

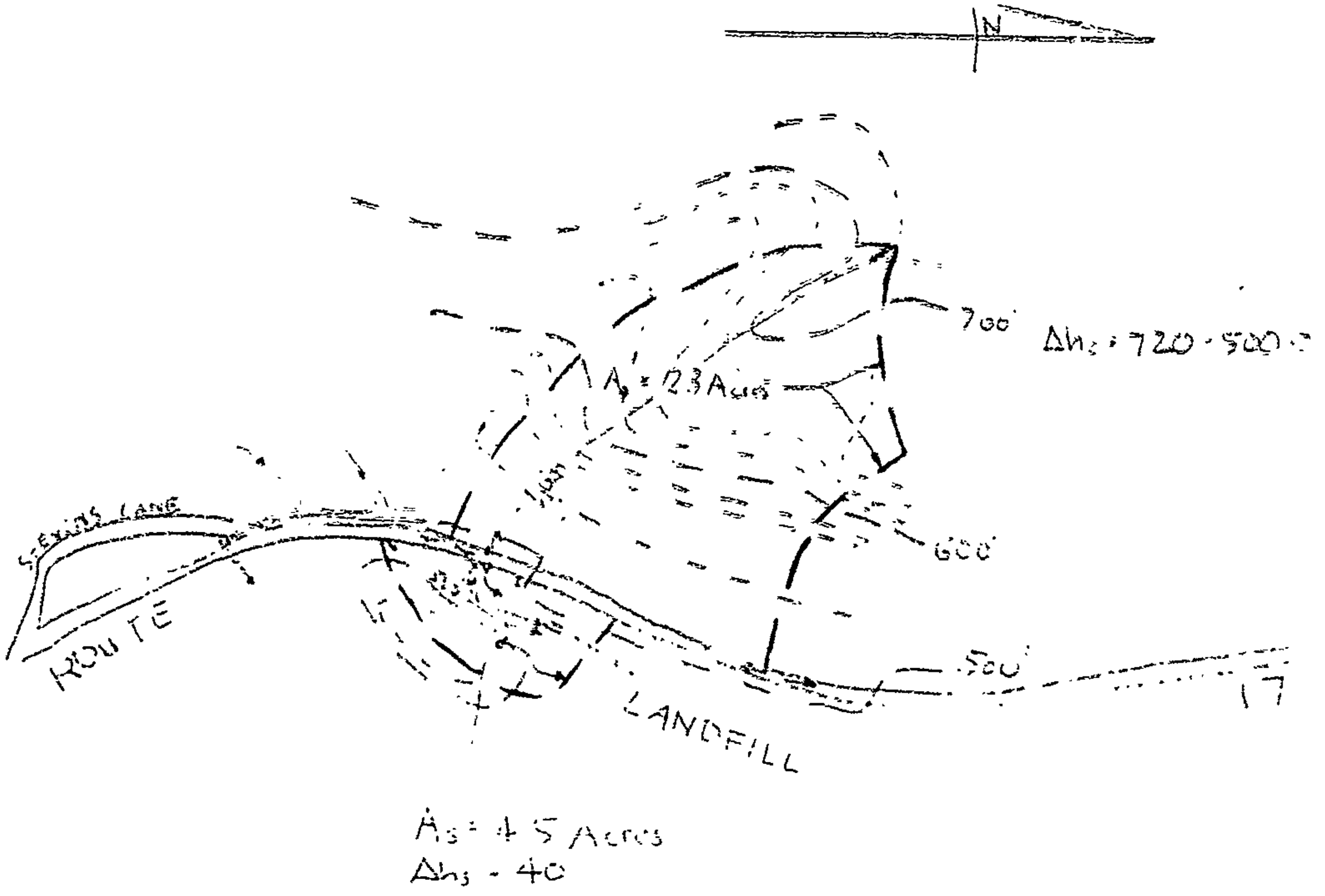


FIG. 1 - TRIBUTARY AREAS TO TUXEDO LANDFILL

pipe under Stevens Lane is inadequate to accept the flow which currently goes to it, and the area floods during storm periods. Furthermore the slope of this pipe is restricted, due to the relative elevations of the 2 ft. diameter pipe crossing Route 17, which it feeds, and that of the road (Stevens Lane), above it. Because of this, the culvert area under Stevens Lane would have to be enlarged laterally. The runoff from Area A, however, could not easily be diverted, because it is lower than the surrounding areas.

It may be possible to effectively line the damaged pipe section which runs beneath the landfill. Although it would carry less than its present 17 CFS capacity, and much less than the potential 42 CFS which could discharge to it, a reconditioned pipe would provided a clean pathway for the water to bypass the landfill. Any excess water would pond at the mouth of the pipe. This ponding area is presently a natural retention basin, and could be used as one, if it were lined to prevent seepage into the landfill.

RECOMMENDATION

The feasibility of repairing or replacing the damaged drain pipe running under the site should be explored because diverting all the water now draining to the pipe may not be feasible.

It is also probable that some of the water draining to the pipe is still by-passing the pipe and leaching through the landfill since that was the natural route before the temporary IRM work addressing this problem was performed.

The pipe inlet area forms a natural retention basin and should be evaluated for use as such. If the pipe can be successfully repaired or replaced, it should then be hydraulically tested for leakage and flow capacity. This information would enable a retention basin to be designed. If the designed basin volume is compatible with the physical area surveyed, the basin could be graded and lined. The result would be a system that could divert most or all of the water presently draining to it, without any significant portion leaching through the landfill

An alternative approach to repairing the existing drain pipe would be to leave both the pipe and the gully which feeds it at the southern end of the site in their existing conditions while permitting storm water runoff from the 4 5-acre drainage basin to the south to infiltrate into the site groundwater system. The ramifications of this approach would have to be evaluated.

This can then be combined with diversion of all or part of the water draining to the site from the west side of Rt. 17. Diverting this water would entail surveying the streams and piping on the west side of Route 17 prior to redesigning the drainage system. Proposed changes to the Rt. 17 drainage system would require approval by local agencies and NYSDOT.

ATTACHMENT 1

RUN-OFF CALCULATIONS

The time of concentration (t_c) is determined using the Kirpich Chart (see Fig. 2). The rainfall intensity (R) is determined from Figure 3. The rational formula, (Q-RxAxC), is then used to determine the runoff flow(Q) in cubic feet/sec. (CFS). Based on a runoff coefficient(C) of 30% (0.3) for virgin forest, the following drainage flows are calculated for the areas shown in Figure 1.

1) Q_n - 23 X 5.2 X 0.3 - 36 CFS

2) Q_s - 4 5 X 6.2 X 0 3 - 8.4 CFS

3) Q_t - 27.5 X 5.0 X 0.3 - 42 CFS

ATTACHMENT 2

PIPE CAPACITY

The capacity of a 24" corrugated steel pipe, is determined from the Manning formula:

$$Q = a \; x \; \frac{1.486}{n} \; x \left(\frac{a}{p}\right)^{2/3} x \;\; S^{1/2}$$

Where a (the cross-sectional area) $= \pi r^2 = 3.14$ ft.^{2}

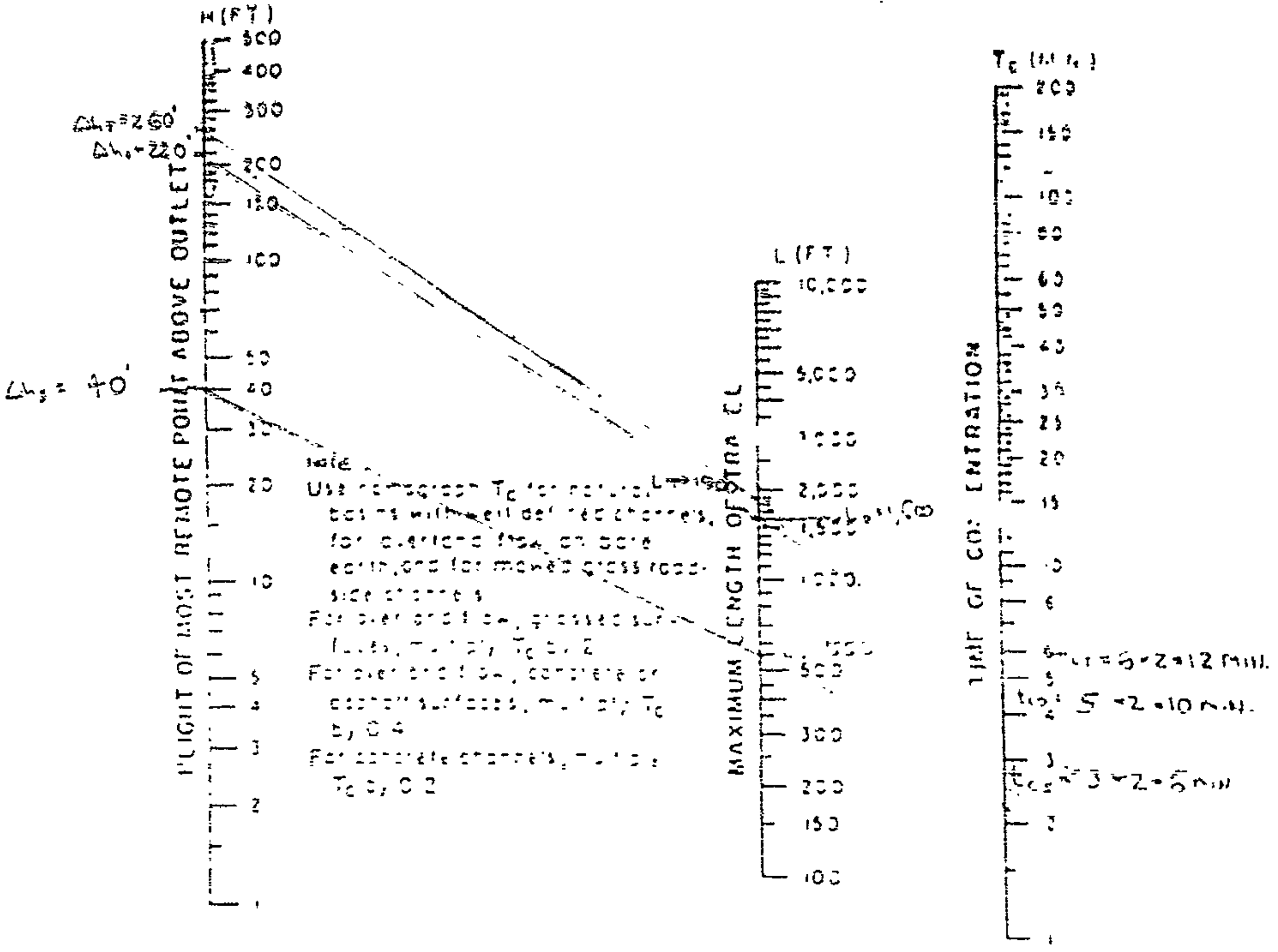
n (roughness coefficient), for corr. pipe in fair condition = 0.027

p (wetted perimeter) = 2 πr = 6.28 ft.

and

s (slope) = 0.025 (slope of pipe, flattest run, from MH to RR)

$$Q = 3.14 \; x \; \frac{1.486}{0.027} \; x \left(\frac{3.14}{6.28}\right)^{2/3} x \; 0.025 = 17 \; CFS$$



Note:

Use nomograph T_c for natural basins with well defined channels, for overland flow on bare earth, and for mowed grass roadside channels.

For overland flow, grassed surfaces, multiply T_c by 2.

For overland flow, concrete or asphalt surfaces, multiply T_c by 0.4.

For concrete channels, multiply T_c by 0.2.

Based on study by P. Z. Kirpich,
Civil Engineering, Vol 10, No 6, June 1940, p 362

FIG. 2 – TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

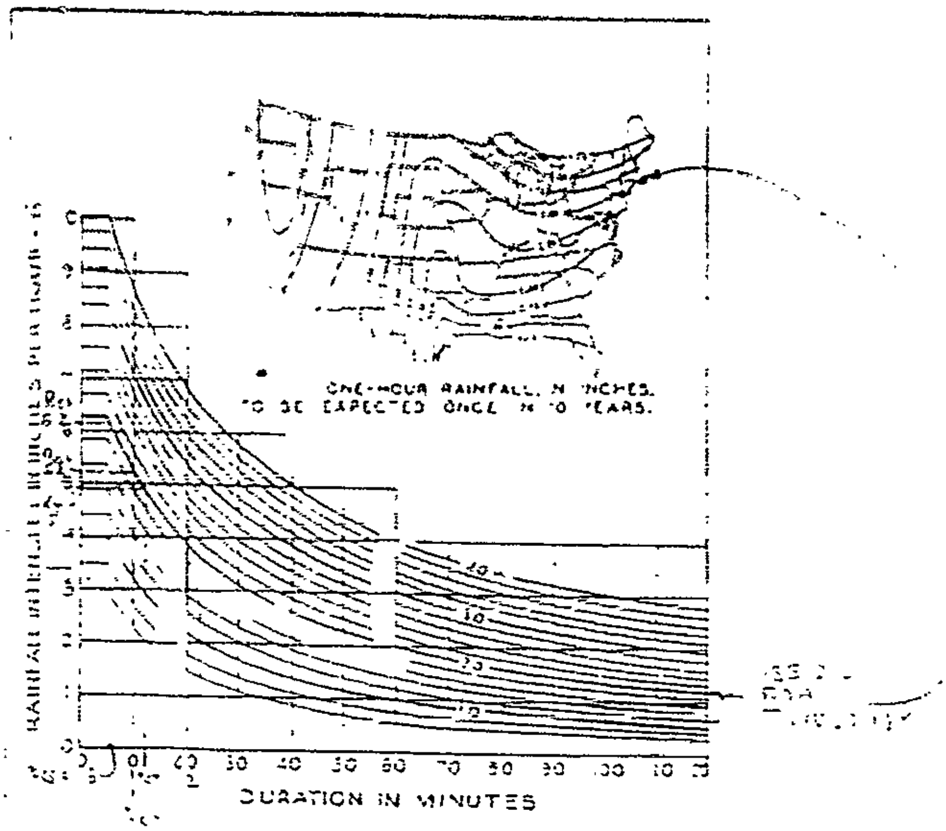


FIG.3-VALUES OF RAINFALL INTENSITY-DURATION+

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*Reproduced from Miscellaneous Publication No. 204, U.S. Dept of Agriculture by David L. Yarnell.
+Adapted from Engineering Manual of the War Department, July 1942.

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX E

BORING LOGS FOR REMEDIAL INVESTIGATION SUBSURFACE BORINGS

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

BORING RIB-1

JOB NUMBER [illegible]	CLIENT NYSDEC DIV HAZ WASTE	PAGE [illegible] OF [illegible]
LOCATION [illegible] WASTE DISPOSAL SITE	START DATE 8 / 22 / 90 FINISH DATE 8 / 22 / 90	

DRILLING COMPANY [illegible]	DRILLING RIG MOBILE DRILL [illegible]	DRILLING METHOD HOLLOW STEM AUGER	SAMPLING METHOD 2" SPLIT SPOON SAMPLER

DRILLER [illegible]	GEOLOGIST [illegible]	GROUND SURFACE ELEVATION [illegible]

DEPTH (FEET)	SAMPLE DEPTH	RQD %	RECOVERY	SAMPLER TYPE	RUN #	OVA READING	ELEVATION	LITHOLOGY
								B[illegible] ASH [illegible] COAL, WITH POORLY GRADED FINE SAND, SOME ORGANIC VEGETATION
	[illegible]			SPLIT SPOON		[illegible] PPM		LT BROWN CLAY WITH [illegible] SOME MED [illegible] GRAVEL, MOIST [illegible] BLOW COUNTS [illegible]
	[illegible]					[illegible] PPM		BROWN SAND WITH [illegible] COUNTS [illegible]
								[illegible]
	[illegible]		[illegible]			[illegible] PPM		BROWN [illegible] LITTLE CLAY BLOW COUNTS [illegible]
[illegible]	[illegible]		[illegible]			[illegible] PPM		BROWN CLAY WITH [illegible] AND [illegible] GRAVEL, BLOW COUNTS [illegible]
	[illegible]		[illegible]					NO RECOVERY [illegible] COUNTS [illegible]
[illegible]	[illegible]			NX CORE BARREL			[illegible]	[illegible] BEDROCK [illegible] [illegible] [illegible] WEATHERED [illegible] [illegible] [illegible] JOINTS [illegible] AND [illegible] JOINT ATTITUDE [illegible] DEGREES FROM HORIZONTAL WITH FEW [illegible] DEGREE FRACTURES SOME JOINTS SLIGHTLY [illegible] ALONG [illegible] SURFACE RUN CONTAINS FEW HEALED FRACTURES [illegible] DEGREES FROM HORIZONTAL
[illegible]	[illegible]		[illegible]				423.22	[illegible]

METCALF & EDDY, INC.

BORING RIB-2

JOB NUMBER [illegible]
CLIENT NYSDEC DIV HAZ WASTE
PAGE [illegible] OF [illegible]
LOCATION TUXEDO WASTE DISPOSAL SITE
START DATE 8/30/90
FINISH DATE 8/31/90
DRILLING COMPANY [illegible]
DRILLING RIG MOBILE DRILL B-53
DRILLING METHOD HOLLOW STEM AUGER
SAMPLING METHOD 2" SPLIT SPOON SAMPLER
DRILLER [illegible]
GEOLOGIST [illegible]
GROUND SURFACE ELEVATION [illegible]

DEPTH IN FEET	SAMPLING DEPTH	RQD %	RECOVERY	SAMPLE INFORMATION			ELEVATION (FT)	LITHOLOGY
				SAMPLER TYPE	RUN #	OVA READING		
								BROWN SILT WITH WELL GRADED SAND BLACK SILT WITH WELL GRADED SAND SOME SUBROUNDED GRAVEL INCREASING IN SIZE AND CONTENT WITH DEPTH
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		BROWN WELL GRADED SAND WITH SILT [illegible] ROUNDED GRAVEL BLOW COUNTS [illegible] 16 14 15
	[illegible]		[illegible]			[illegible]		[illegible]
						[illegible]		[illegible]
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]	[illegible]		[illegible]			[illegible]		[illegible] BLOW COUNTS [illegible]
				[illegible]			[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]		[illegible]			HARD UNWEATHERED MEDIUM TO COARSE GRAINED GRANITE [illegible] GNEISS BANDED WITH [illegible] GRAINED QUARTZ [illegible] JOINTS [illegible] WITH CHLORITE [illegible] OF CORE RUN [illegible] JOINT ATTITUDE [illegible] DEGREES FROM HORIZONTAL CORE [illegible] MINERAL FOLIATION [illegible] HORIZONTAL
15								
							[illegible]	[illegible]

METCALF & EDDY, INC.

BORING RIB-3

JOB NUMBER 905080	CLIENT NYSDEC DIV HAZ WASTE	PAGE 2 OF 2	
LOCATION TUXEDO WASTE DISPOSAL SITE	START DATE [illegible] / 90 FINISH DATE [illegible] / 90		
DRILLING COMPANY GENERAL BORINGS IN[illegible]	DRILLING RIG MOBILE DRILL B 57	DRILLING METHOD HOLLOW STEM AUGER	SAMPLING METHOD [illegible] SPLIT SPOON SAMPLER
DRILLER [illegible]	GEOLOGIST [illegible]	GROUND SURFACE ELEVATION [illegible]	

DEPTH (FEET)	SAMPLE NUMBER	RQD %	RECOVERY %	SAMPLE INFORMATION			ELEVATION (FT)	LITHOLOGY
				SAMPLER TYPE	RUN #	OVA READING		
	[illegible]	[illegible]	[illegible]	NQ CORE BARREL	[illegible]			44.0 HARD SL[illegible] WEATHERED MEDIUM TO COARSE GRAINED GRAN[illegible] WITH [illegible] COARSE GRAINED QUARTZ [illegible] STAINED [illegible] DEGREES [illegible] HORIZONTAL [illegible] MINERAL [illegible]
								46.0 [illegible] STAINED [illegible] HORIZONTAL [illegible] CONTAINS [illegible] DEGREE HEALED FRACTURE [illegible] MINERAL [illegible] STAINING
								51.0 [illegible] WEATHERED [illegible] GRANITIC GNEISS [illegible] STAINED JOINT [illegible] DEGREES FROM HORIZONTAL [illegible] CONTAINS [illegible] DEGREE HEALED [illegible] MINERAL [illegible] HORIZONTAL
							[illegible]	56.0 [illegible]

METCALF & EDDY, INC.

BORING RIB-4

JOB NUMBER [illegible]
CLIENT NYSDEC DIV HAZ WASTE
PAGE 1 OF 1
LOCATION [illegible] WASTE DISPOSAL SITE
START DATE 8 / 2 / 90
FINISH DATE 8 / 2 / 90
DRILLING COMPANY [illegible]
DRILLING RIG MOBILE DRILL B-[illegible]
DRILLING METHOD HOLLOW STEM AUGER
SAMPLING METHOD [illegible]
DRILLER [illegible]
GEOLOGIST M. [illegible]
GROUND SURFACE ELEVATION 459.14

DEPTH IN FEET	SAMPLE DEPTH	RQD %	RECOVERY	SAMPLE INFORMATION: SAMPLER TYPE	SAMPLE INFORMATION: RUN #	SAMPLE INFORMATION: OVA READING	ELEVATION IN FEET	LITHOLOGY
								BROWN SILT WITH WELL GRADED SAND SOME ROUNDED GRAVEL INCREASING WITH DEPTH
	[illegible]		[illegible]	[illegible] SPLIT SPOON		[illegible] PPM		NO RECOVERY ADVANCE AUGERS [illegible] AND RESAMPLE [illegible] COUNTS [illegible] BROWN WELL GRADED SAND WITH [illegible] AND [illegible] COBBLES [illegible] BROWN WELL GRADED SAND WITH [illegible]
[illegible]	[illegible]		[illegible]			[illegible] PPM		BROWN WELL GRADED SAND WITH [illegible] GRAVEL [illegible] BLOW COUNTS [illegible]
	15.5-20.5	[illegible]	[illegible]	NX CORE BARREL			443.64	15.5 - BEDROCK REFUSAL [illegible] HARD SLIGHTLY WEATHERED MEDIUM TO COARSE GRAINED GRANITIC GNEISS [illegible] AND REMINERALIZED WITH QUARTZ [illegible] DEGREES FROM HORIZONTAL RUN CONTAINS [illegible] DEGREE WELL HEALED FRACTURES [illegible] MINERAL FOLIATION [illegible] DEGREES FROM HORIZONTAL
	20.5-25.5	[illegible]	[illegible]		2			20.5 HARD SLIGHTLY WEATHERED MEDIUM TO COARSE GRAINED GRANITIC GNEISS BANDED WITH [illegible] GRAINED QUARTZ BIOTITE GNEISS JOINTS [illegible] SLIGHTLY STAINED AND REMINERALIZED WITH CHLORITE [illegible] 0-30 DEGREES FROM HORIZONTAL WITH FEW 30-4[illegible] DEGREE FRACTURES RUN CONTAINS [illegible] DEGREE WELL HEALED FRACTURES MINERAL FOLIATION [illegible] DEGREES FROM HORIZONTAL
							433.64	25.5' TD

METCALF & EDDY, INC.

BORING RIB-5

JOB NUMBER [illegible]	**CLIENT** NYSDEC DIV HAZ WASTE	**PAGE** [illegible] OF 2	
LOCATION TUXEDO WASTE DISPOSAL SITE	**START DATE** [illegible] / 27 / 90 **FINISH DATE** [illegible] / 90		
DRILLING COMPANY GENERAL BORINGS [illegible]	**DRILLING RIG** MOBILE DRILL B-53	**DRILLING METHOD** HOLLOW STEM AUGER	**SAMPLING METHOD** 2" SPLIT SPOON SAMPLER
DRILLER [illegible]	**GEOLOGIST** [illegible]	**GROUND SURFACE ELEVATION** [illegible]	

[illegible]	[illegible]	RQD %	RECOVERY	SAMPLE INFORMATION			[illegible]	LITHOLOGY
				SAMPLER TYPE	RUN #	OVA READING		
								GRAVEL BASE ROADWAY
	[illegible]		[illegible]	[illegible]				NO RECOVERY ADVANCE AUGERS [illegible] AND RESAMPLE BLOW COUNTS [illegible]
	[illegible]		[illegible]			[illegible] PPM		BLACK WELL GRADED SAND WITH [illegible] BLOW COUNTS [illegible]
	[illegible]					[illegible] PPM		[illegible] BROWN WELL GRADED SAND WITH [illegible] SOME [illegible] GRAVEL [illegible]
	[illegible]		[illegible]			[illegible] PPM		BROWN [illegible] REFUSAL BLOW COUNTS [illegible]
	[illegible]		[illegible]			[illegible] PPM		BROWN POORLY GRADED [illegible] SAND WITH [illegible] ROUNDED GRAVEL BLOW COUNTS [illegible]
	[illegible]		12			[illegible] PPM		BROWN POORLY GRADED COARSE SAND WITH SUBROUNDED-ROUNDED FINE GRAVEL SOME [illegible] BLOW COUNTS [illegible]
	[illegible]		[illegible]			[illegible] PPM		BROWN POORLY GRADED COARSE SAND WITH SUB[illegible] ROUNDED FINE GRAVEL BLOW COUNTS [illegible]
	27-29		18"			180 PPM		WASH SAMPLE ADVANCE AUGERS TO 30 AND RESAMPLE
	[illegible]-32		[illegible]			[illegible] PPM		BROWN WELL GRADED SAND WITH SUBROUNDED FINE GRAVEL SOME SUBROUNDED GRAVEL BLOW COUNTS [illegible]
	[illegible]		4			[illegible] PPM		BROWN POORLY GRADED MEDIUM TO FINE SAND WITH ROUNDED FINE GRAVEL BLOW COUNTS [illegible]
							[illegible]	37.5' BEDROCK REFUSAL GRANITIC GNEISS
	40.2-45.2	54	98%	NO CORE BARREL	1			40.2' HARD SLIGHTLY WEATHERED, MEDIUM TO COARSE GRAINED GRANITIC GNEISS JOINT DISCONTINUITIES TYPICALLY STAINED AND SILTED JOINT ATTITUDE TYPICALLY 20-40 DEGREES FROM HORIZONTAL RUN CONTAINS HEALED FRACTURES WITH [illegible] DEGREE ATTITUDE POSSIBLE SHEAR DISCONTINUITY NOTED IN CORE RUN MINERAL FOLIATION [illegible] DEGREES FROM HORIZONTAL
	45.2-50.2	38	100%	↓	2			45.2' HARD, SLIGHTLY WEATHERED MEDIUM TO COARSE GRAINED BIOTITE RICH GRANITIC GNEISS JOINT DISCONTINUITIES TYPICALLY STAINED SILTED AND PITTED JOINT ATTITUDE TYPICALLY 10-30 DEGREES FROM HORIZONTAL WITH [illegible]

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BORING RIB-5

JOB NUMBER 005040	CLIENT NYSDEC DIV HAZ WASTE	PAGE 2 OF 2	
LOCATION TUXEDO WASTE DISPOSAL SITE	START DATE [illegible] / 27 / 90 FINISH DATE [illegible] / 30 / 90		
DRILLING COMPANY GENERAL BORINGS INC	DRILLING RIG MOBILE DRILL B-53	DRILLING METHOD HOLLOW STEM AUGER	SAMPLING METHOD 2" SPLIT SPOON SAMPLER
DRILLER [illegible]	GEOLOGIST M. JACAOBRANC	GROUND SURFACE ELEVATION [illegible]	

DEPTH IN FEET	SAMPLE DEPTH	RQD %	RECOVERY	SAMPLE INFORMATION: SAMPLER TYPE	RUN #	OVA READING	ELEVATION (FEET)	LITHOLOGY
								DEGREE [illegible] HEALED FRACTURES NOTED IN CORE [illegible] MINERALIZATION AT [illegible] DEGREES FROM HORIZONTAL.
	[illegible]	10	100%	NQ CORE BARREL	1			50.2
								HARD, SLIGHTLY WEATHERED, [illegible] GRAINED, BIOTITE [illegible] GRANITIC [illegible] STAINED [illegible] AND [illegible] FRACTURES [illegible] DEGREES FROM HORIZONTAL [illegible] DEGREES FROM HORIZONTAL.
	[illegible]	[illegible]	100%	↓	2			55.0
								[illegible] WEATHERED [illegible] STAINED [illegible] MINERALIZED [illegible] DEGREES FROM HORIZONTAL [illegible] DEGREES [illegible] CORE [illegible] HORIZONTAL.
							[illegible]	60.0

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BORING RIB-6

JOB NUMBER 905040	CLIENT NYSDEC DIV HAZ WASTE	PAGE 1 OF 2	
LOCATION TUXEDO WASTE DISPOSAL SITE	START DATE 3 / 23 / 90 FINISH DATE 3/ 28 / 90		
DRILLING COMPANY [illegible]	DRILLING RIG [illegible]	DRILLING METHOD HOLLOW STEM AUGER	SAMPLING METHOD 2" SPLIT SPOON SAMPLER
DRILLER [illegible]	GEOLOGIST M JACAPRARO	GROUND SURFACE ELEVATION [illegible]	

DEPTH (FEET)	SAMPLE DEPTH	ROD #	RECOVERY	SAMPLE INFORMATION			ELEVATION	LITHOLOGY
				SAMPLER TYPE	RUN #	OVA READING		
				2" SPLIT SPOON				MISCELLANEOUS FILL WOOD BRICK CLOTH PAPER WIRE
	[illegible]		[illegible]					NO RECOVERY CUTTINGS SUGGEST BLACK WELL GRADED SAND WITH SILT SUBANGULAR GRAVEL INCREASING IN SIZE AND CONCENTRATION WITH DEPTH BLOW COUNTS [illegible]
	[illegible]		[illegible]			[illegible] PPM		BROWN CLAY MODERATE PLASTICITY WITH [illegible] GRADED SAND MOIST REFUSAL BLOW COUNTS [illegible]
	[illegible]		2			[illegible] PPM		BROWN WELL GRADED SAND WITH [illegible] GRAVEL WET [illegible] BLOW COUNTS [illegible]
	[illegible]		4			[illegible] PPM		BROWN POORLY GRADED COARSE SAND WITH SILT
								DK BROWN SILT WITH POORLY GRADED FINE SAND SOME SUBROUNDED FINE GRAVEL INCREASING IN SIZE AND CONC WITH DEPTH BLOW COUNTS [illegible]
	[illegible]-24		[illegible]			14 PPM		GREY BROWN POORLY GRADED FINE SAND WITH SILT CLAY LAMINATES FE STAINED BLOW COUNTS [illegible]
	[illegible]					17 PPM		BROWN POORLY GRADED [illegible] SAND WITH [illegible] STAINED LAMINATES BLOW COUNTS [illegible]
	32-34		4			LT 1 PPM		BROWN WELL GRADED SAND WITH SILT SOME SUBROUNDED SUBANGULAR GRAVEL BLOW COUNTS [illegible] 14 10
	[illegible]		24"			2 PPM		BROWN WELL GRADED SAND WITH [illegible] BLOW COUNTS [illegible]
	42-44		2"			LT 1 PPM		BROWN WELL GRADED SAND WITH SUBROUNDED GRAVEL WITH SILT BLOW COUNTS 37 19 16 14
								DENSE [illegible] 44 ft
	[illegible]		4			1 PPM		BROWN WELL GRADED SAND WITH SILT SOME SUBANGULAR GRAVEL BLOW COUNTS 21 15 9 10

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BORING RIB-6

JOB NUMBER [illegible]	CLIENT NYSDEC DIV HAZ WASTE	PAGE 2 OF 2
LOCATION TUXEDO WASTE DISPOSAL SITE	START DATE [illegible] 23 / 90 FINISH DATE 8/ 29 / 90	
DRILLING COMPANY GENERAL BORINGS INC	DRILLING RIG DEIDRICH D-120	DRILLING METHOD HOLLOW STEM AUGER
SAMPLING METHOD [illegible] SPLIT SPOON SAMPLER	DRILLER [illegible]	GEOLOGIST M. [illegible]
GROUND SURFACE ELEVATION 455.98		

DEPTH IN FEET	SAMPLE INTERVAL	ROD #	RECOVERY	SAMPLE INFORMATION: SAMPLER TYPE	RUN #	OVA READING	ELEVATION IN FEET	LITHOLOGY
[illegible]	[illegible]		[illegible]	[illegible] SPOON		[illegible] PPM		BROWN WELL GRADED SAND WITH SILT, SOME SUBROUNDED GRAVEL [illegible]
	[illegible]		[illegible]			[illegible] PPM		BROWN WELL GRADED SAND WITH SILT, [illegible] GRAVEL [illegible]
							[illegible]	64.8 [illegible]
	[illegible]	[illegible]	[illegible]	NQ CORE BARREL	[illegible]			65.0 HARD [illegible] QUARTZ [illegible] IRON STAINED AND [illegible] SHEAR DISCONTINUITY [illegible] DEGREES FROM HORIZONTAL [illegible] FRACTURES [illegible] DEGREE FRACTURES [illegible] DEGREES FROM HORIZONTAL
	[illegible]	[illegible]	[illegible]		[illegible]			70.0 HARD [illegible] BANDED [illegible] QUARTZ [illegible] IRON STAINED AND SLIGHTLY [illegible] WITH SOME CHLORITE REMINERALIZATION, POSSIBLE SHEAR DISCONTINUITY PRESENT [illegible] TYPICALLY 20-40 DEGREES FROM HORIZONTAL [illegible] CONTAINS POORLY DEFINED WELL HEALED FRACTURES [illegible] 30 DEGREES FROM HORIZONTAL
							380.98	75.0 [illegible]

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BORING RIB-7

JOB NUMBER 005040	**CLIENT** NYSDEC DIV HAZ WASTE	**PAGE** [illegible] OF 2	
LOCATION TUXEDO WASTE DISPOSAL SITE	**START DATE** 8/ 06 / 90 **FINISH DATE** 8/ 07 / 90		
DRILLING COMPANY [illegible]	**DRILLING RIG** [illegible]	**DRILLING METHOD** HOLLOW STEM AUGER	**SAMPLING METHOD** [illegible] SPLIT SPOON SAMPLER
DRILLER [illegible]	**GEOLOGIST** M [illegible]	**GROUND SURFACE ELEVATION** [illegible]	

DEPTH (FEET)	SAMPLING DEPTH	RQD %	RECOVERY	SAMPLER TYPE	RUN #	OVA READING	ELEVATION (FT)	LITHOLOGY
								MISCELLANEOUS FILL WOOD BRICK PLASTIC
[illegible]	[illegible]		12"	2" SPLIT SPOON		[illegible] PPM		BROWN SILT WITH WELL GRADED SAND AND [illegible] WET AND BLOW COUNT [illegible]
[illegible]	[illegible]		12"			[illegible] PPM		DENSE GREY CLAY [illegible] PLASTIC [illegible] ROUNDED GRAVEL MOTTLING [illegible] BLOW COUNTS 40 47 100/3
	[illegible]		[illegible]			[illegible]		[illegible] RETURNS BLOW COUNTS [illegible]
20	20-22		11"			<1 PPM		GREY POORLY GRADED MEDIUM TO FINE SAND WITH [illegible] BLOW COUNTS 17 9 4 3
[illegible]	25-27		0"					NO RECOVERY ADVANCE AUGERS 2' AND RESAMPLE BLOW COUNTS 16 57 34 22
	27-29		[illegible]			<1 PPM		BROWN POORLY GRADED COARSE SAND WITH [illegible] FINE GRAVEL BLOW COUNTS [illegible]
30	[illegible]		9"			<1 PPM		SUBROUNDED FINE GRAVEL WITH POORLY GRADED COARSE SAND AND COBBLES BLOW COUNTS 40 [illegible]
35	35-37		24"			<1 PPM		BROWN POORLY GRADED MEDIUM SAND WITH LAMINATES OF BROWN POORLY GRADED FINE SAND BLOW COUNTS [illegible] 22
[illegible]	[illegible]		12"			[illegible] PPM		BROWN WELL GRADED SAND WITH [illegible] GRAVEL BLOW COUNTS [illegible]
45	45-47		0"					NO RECOVERY ADVANCE AUGERS 2' AND RESAMPLE BLOW COUNTS 19 21 21 29
	47-49		0"					NO RECOVERY CUTTINGS SUGGEST SAND AND GRAVEL ADVANCE AUGERS TO 50
[illegible]								

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BORING RIB-7

JOB NUMBER [illegible]

CLIENT NYSDEC DIV HAZ WASTE

PAGE 2 OF 2

LOCATION TUXEDO WASTE DISPOSAL SITE

START DATE [illegible]

FINISH DATE [illegible]

DRILLING COMPANY [illegible]

DRILLING RIG [illegible]

DRILLING METHOD HOLLOW STEM AUGER

SAMPLING METHOD [illegible] SPLIT SPOON SAMPLER

DRILLER [illegible]

GEOLOGIST [illegible]

GROUND SURFACE ELEVATION [illegible]

DEPTH (FEET)	SAMPLE DEPTH	RQD %	RECOVERY	SAMPLE INFORMATION			ELEVATION (FT)	LITHOLOGY
				SAMPLER TYPE	RUN #	OVA READING		
[illegible]	[illegible]		4	[illegible] SPOON		[illegible] PPM		WASH SAMPLE, ADVANCE AUGERS, AND RESAMPLE. BLOW COUNTS 69 100/2"
							[illegible]	50.92' BEDROCK REFUSAL GRANITIC GNEISS
	[illegible]	[illegible]	[illegible]	NQ CORE BARREL	[illegible]			51.3' HARD WEATHERED MEDIUM TO COARSE GRAINED GRANITIC GNEISS JOINT DISCONTINUITIES HEAVILY STAINED AND [illegible] JOINT ATTITUDE TYPICALLY AT [illegible] DEGREES FROM HORIZONTAL WITH SOME 80-90 DEGREE FRACTURES [illegible] CONTAINS 80 DEGREE HEALED FRACTURES [illegible] WEATHERED [illegible] FOLIATION [illegible] DEGREES FROM HORIZONTAL
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			
	[illegible]	[illegible]	[illegible]		[illegible]			54.3' HARD [illegible] WEATHERED [illegible] GRANITIC GNEISS JOINT DISCONTINUITIES TYPICALLY STAINED AND [illegible] JOINT ATTITUDE TYPICALLY [illegible] DEGREES FROM HORIZONTAL WITH FEW 80 DEGREE FRACTURES PRESENT POSSIBLE SHEAR DISCONTINUITY PRESENT CORE CONTAINS [illegible] AND 90 DEGREE [illegible] HEALED FRACTURES MINERAL [illegible] AT [illegible] DEGREES FROM HORIZONTAL
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			59.3' HARD SLIGHTLY WEATHERED FINE TO COARSE GRAINED GRANITIC GNEISS BANDED WITH [illegible] GRAINED BIOTITE GNEISS JOINT DISCONTINUITIES [illegible] REBROKEN HEALED FRACTURES [illegible] QUARTZ JOINT DISCONTINUITY [illegible] SED WITH CHLORITE JOINT ATTITUDE TYPICALLY 20-30 DEGREES WITH FEW 80-90 DEGREE FRACTURES POSSIBLE SHEAR DISCONTINUITY AT BASE OF RUN CORE CONTAINS NUMEROUS HEALED FRACTURED MINERAL FOLIATION [illegible] DEGREES FROM HORIZONTAL
								64.3' HARD SLIGHTLY WEATHERED MEDIUM TO COARSE GRAINED QUARTZ-BIOTITE GNEISS JOINT DISCONTINUITIES TYPICALLY STAINED AND [illegible] JOINT ATTITUDE TYPICALLY [illegible] DEGREES FROM HORIZONTAL [illegible] AND PARALLEL TO [illegible] MINERAL FOLIATION 30 DEGREES FROM HORIZONTAL
							386.96	69.3' TD

METCALF & EDDY, INC.

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX F

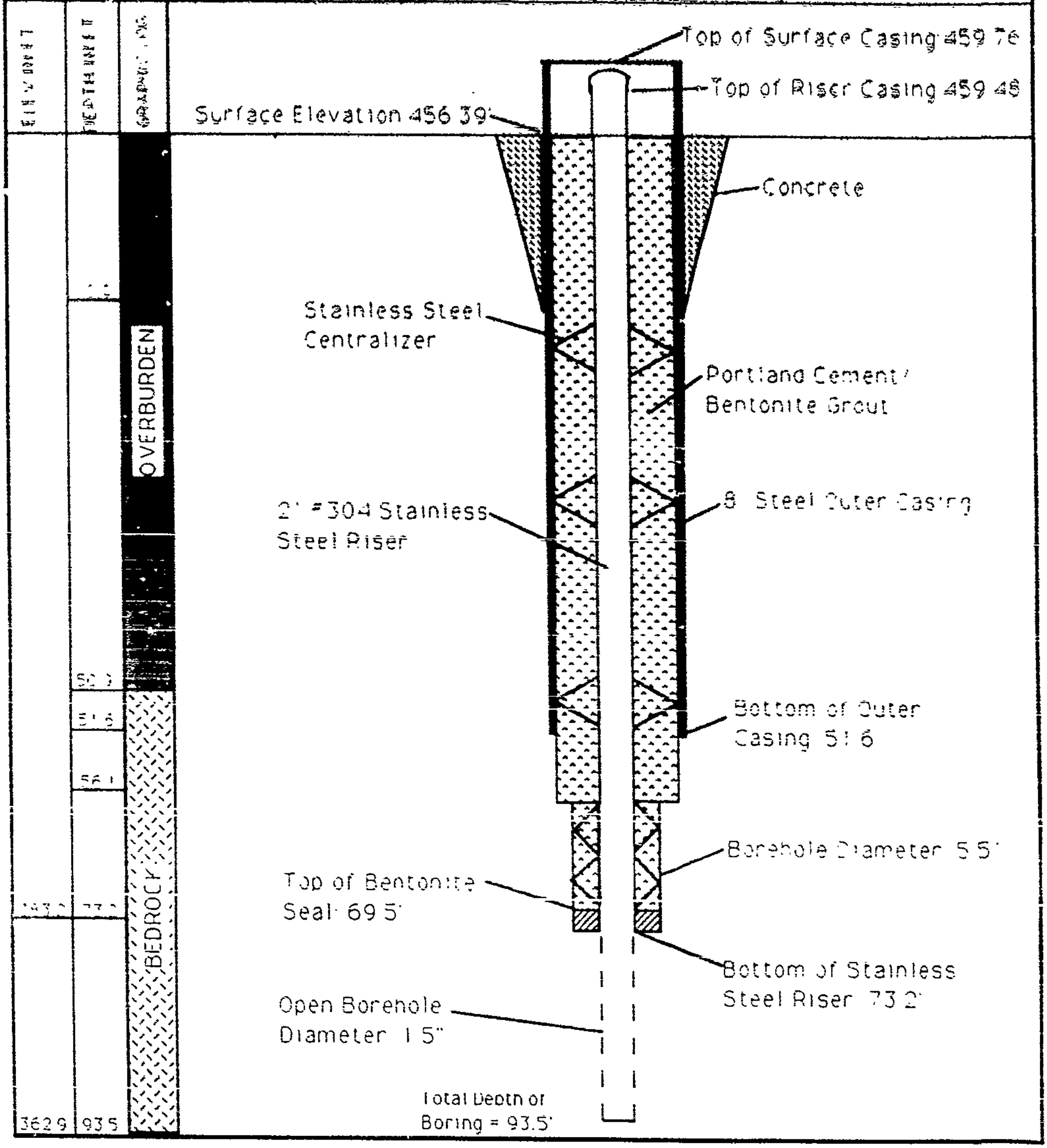
MONITORING WELL COMPLETION DIAGRAMS

NOVEMBER 1991

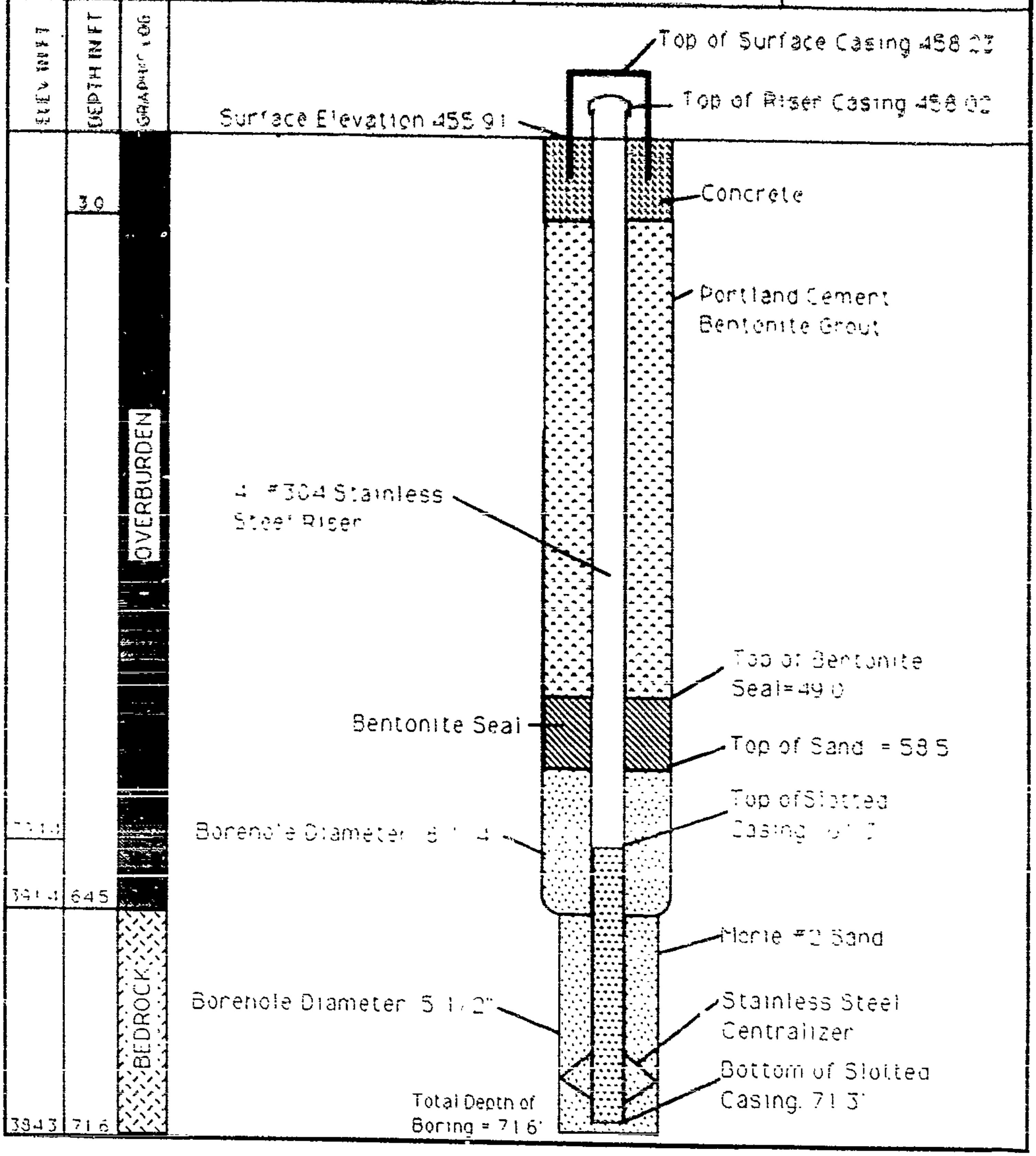
Prepared By:

Metcalf and Eddy of New York, Inc.

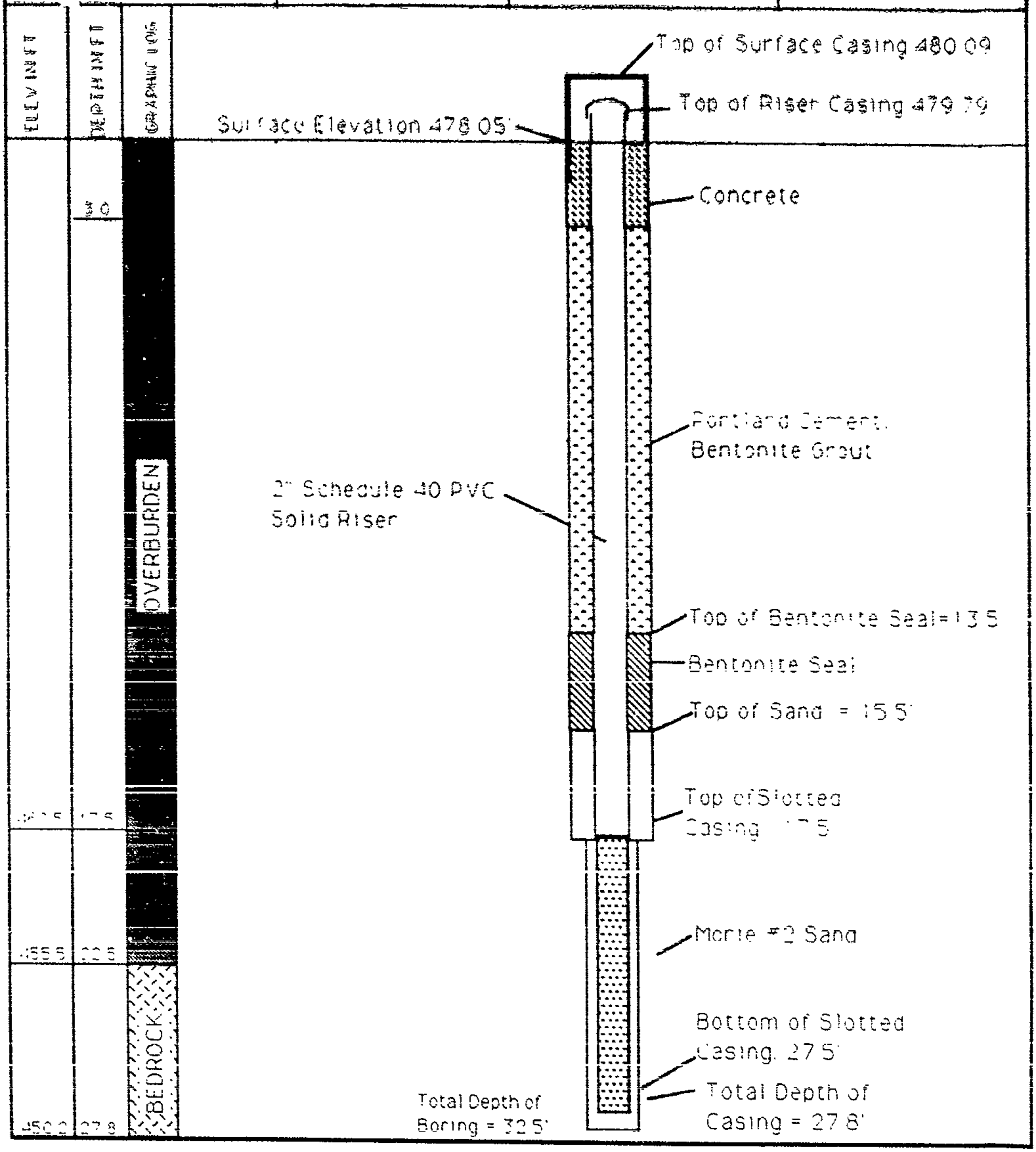
BORING/WELL NO RI-1	DRILLING DATE START 8/15/90 FINISH 9/17/90	FIELD GEOLOGIST M JACAPRARO CHECKED BY	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N Y	WELL CASING TYPE 2" #304 STAINLESS STEEL	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER [illegible]	SURFACE ELEV 456 39'	WELL ELEV (TOC) 459 48'	DRILLING METHOD 8 1/4' ID HSA / AX CORE



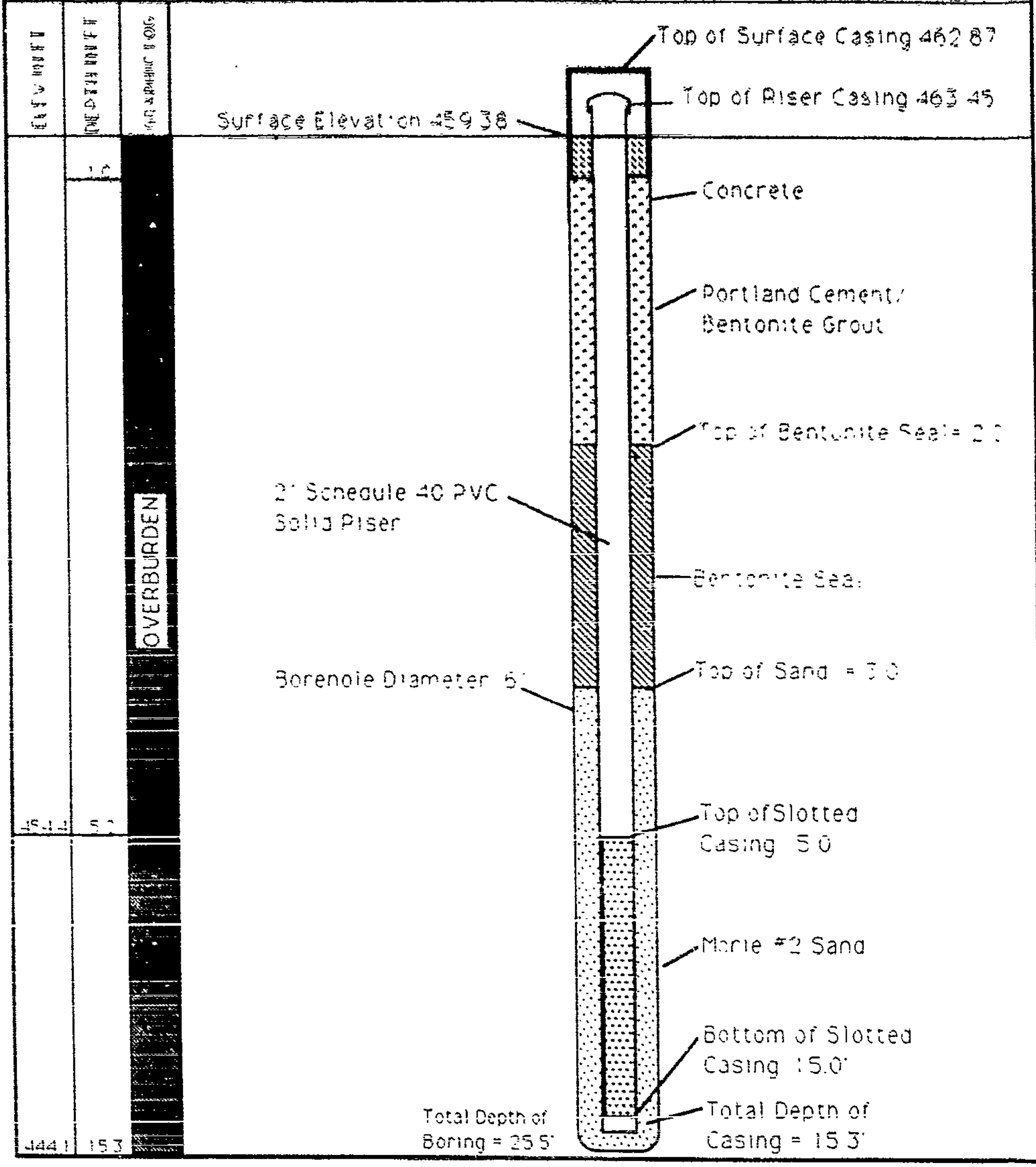
BORING/WELL NO RI-2	DRILLING DATE START 9/05/90 FINISH 9/08/90	FIELD GEOLOGIST M JACAPRARO CHECKED BY	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N Y	WELL CASING TYPE 4' #304 STAINLESS STEEL	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 005040	SURFACE ELEV 455 91	WELL ELEV (TOC) 458 02	DRILLING METHOD HOLLOW STEM AUGER



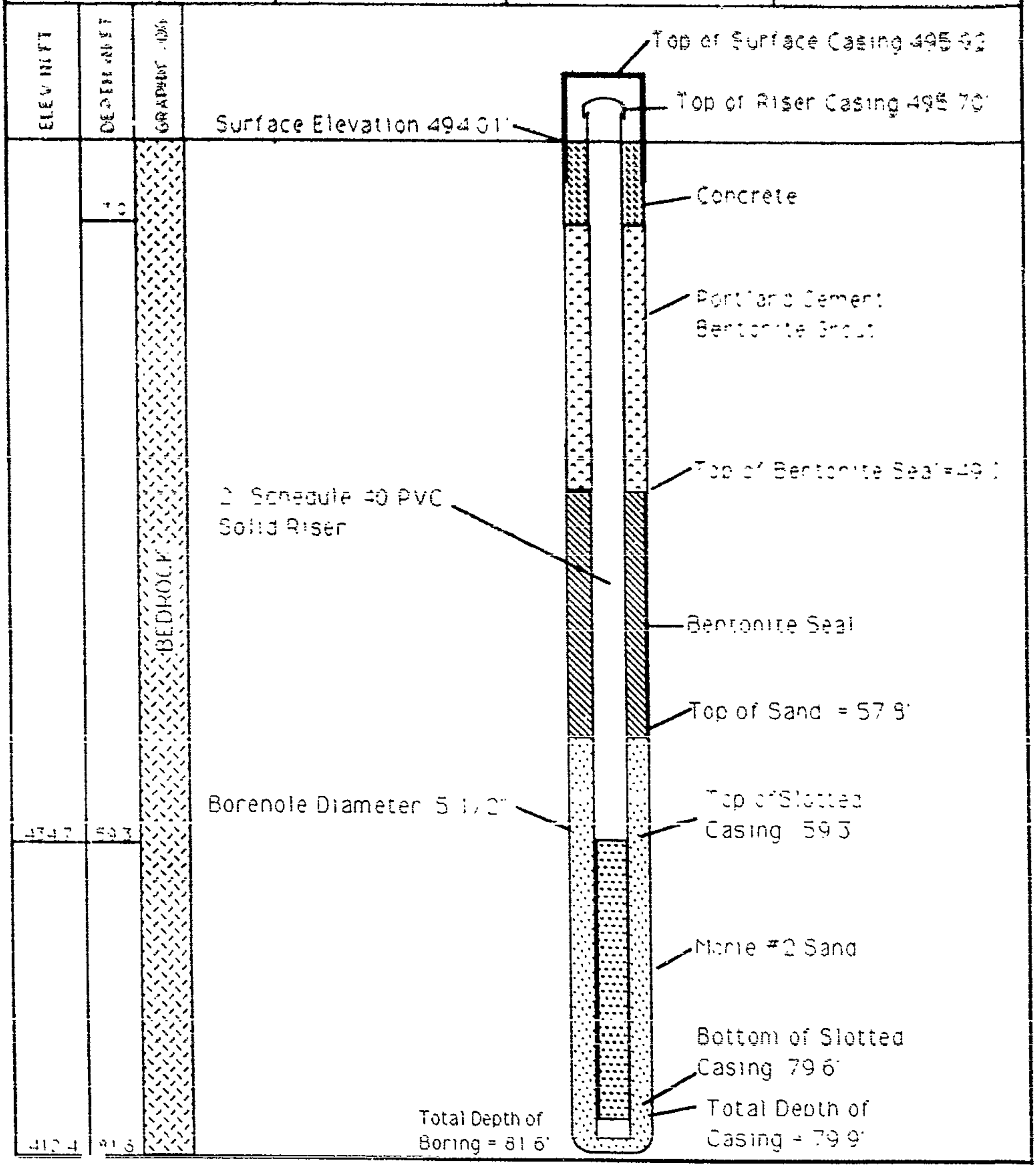
BORING/WELL NO RI-3	DRILLING DATE START 9/13/90 FINISH 9/18/90	FIELD GEOLOGIST M JACAPRARO CHECKED BY	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N Y	WELL CASING TYPE 2" FJT SCHEDULE 40 PVC	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER C05C40	SURFACE ELEV 478 05	WELL ELEV (TOC) 479 79	DRILLING METHOD 4 1/4' ID HSA / NQ CORE



BORING/WELL NO **RI-4**	DRILLING DATE START 8/03/90 FINISH 8/03/90	FIELD GEOLOGIST M JACAPRARO CHECKED BY	**METCALF & EDDY**
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N Y	WELL CASING TYPE 2" FJ* SCHEDULE 40 PVC	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 005040	SURFACE ELEV 459 38	WELL ELEV (TOC) 463 45	DRILLING METHOD 6" CASING/ROLLER BIT



BORING/WELL NO **RI-5**	DRILLING DATE START 7/12/90 FINISH 7/23/90	FIELD GEOLOGIST M JACAPRARO CHECKED BY	**METCALF & EDDY**
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N Y	WELL CASING TYPE 2" FJT SCHEDULE 40 PVC	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 10F040	SURFACE ELEV 494 01	WELL ELEV (TOC) 495 70	DRILLING METHOD 4 X 5 1/2 CORE BARREL



New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX G

MAGNETOMETER SURVEY
AUGUST 7 - 9, 1990

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

Gartner Lee, Inc.

[illegible] Main Street
Niagara Falls, NY [illegible]
[illegible] 285 [illegible]
(716) 285 5448

Professional Services
Environmental
Management

September 10, 1990 GLI 90-809

Mr. William Deininger
Project Manager
Metcalf & Eddy of New York, Inc.
303 South Broadway
Suite 318N
Tarrytown, NY 10591

Dear Mr. Deininger:

Re: Magnetometer Survey, Tuxedo, New York

We are pleased to provide Metcalf and Eddy of New York, Inc. with this report summarizing the results of our August 7 through 9, 1990 magnetometer/ gradiometer survey at the above noted site.

1.0 PURPOSE AND BACKGROUND INFORMATION

It is our understanding that the property owner operated a landfill at the site that accepted construction and demolition debris. It is also believed that the property owner may have accepted tank trucks and steel drums possibly containing hazardous materials at the landfill site. The purpose of the geophysical investigation was to locate and delineate the possible presence of buried steel tank trucks and clusters of steel drums potentially located at depths of 70 feet or less.

The site is located in a river valley in southeastern New York State. The site is bounded by an active railroad along the eastern property boundary, Route 17 and a sharp topographic rise along the western property boundary, a wooded area to the south of the property and an antique shop at the northern property boundary. Much of the site is vegetated with grasses with some brush and trees located along the southeastern toe of the landfill. Metallic debris, reinforcement bar and other debris were observed protruding from the ground surface at numerous locations across the site. A large bulldozer was located in the southeastern portion of the site and a smaller bulldozer, augers and other drilling equipment were located in the northern portion of the site. On-site personnel were unable to move the large bulldozer during the geophysical investigation.

Magnetometer/gradiometer survey techniques are well established, indirect sensing techniques for non-destructive subsurface reconnaissance exploration. As these instruments utilize indirect methods, they are subject to inherent limitations and ambiguities. Targets such as buried drums, buried tanks, transformers, conduits, utilities, etc., are detectable only if they produce recognizable anomalies or patterns against the background geophysical data collected.

Details of the study methodology, equipment and techniques and a summary of the results are discussed in the following paragraphs.

2.0 METHODOLOGY

2.1 Reference Grid

A survey reference grid was established by a sub-contractor to Metcalf & Eddy prior to the initiation of the geophysical survey. The survey grid was staked at 100 foot centers with 2 x 2 inch wooden stakes. To facilitate accurate station location, Gartner Lee and Metcalf & Eddy personnel staked 10 foot increments along lines spaced 100 to 200 feet apart depending upon the line of sight.

Data were collected at 10 foot increments along lines spaced 20 feet apart with a GEM GSM-19 Overhauser Magnetometer/Gradiometer. All staked areas were surveyed except areas of dense brush and/or steep slopes and the in-filled pond located in the center of the site. At the request of on-site Metcalf & Eddy personnel, the in-filled pond area was not surveyed

2.2 Equipment and Survey Techniques

A GEM GSM-19 Overhauser Magnetometer/Gradiometer was used to measure the total field magnetic (measured in units of gammas) and vertical gradient (measured in units of gammas per meter) data at each station. All readings were recorded with the primary and secondary sensors oriented north and elevated approximately 88 inches (224 cm) and 113 inches (288 cm) respectively above surface. A second GEM GSM-19 Overhauser Magnetometer was utilized as a base station to monitor the diurnal drift of the earths magnetic field at the site. The base station magnetometer was time synchronized with the field magnetometer, taken to a wooded area south of the site believed to be free of metals and configured to automatically collect data at 10 and 30 second intervals.

Both magnetometers were calibrated, tuned and synchronized following procedures specified in the operations manual. The total field and gradient data of the field magnetometer were automatically stored in solid state memory during the survey. Upon completion of the survey, both systems were interfaced to a portable computer and the data were transferred and archived on a floppy disk for subsequent processing and interpretation.

The diurnal drift observed on August 8th and 9th, 1990 was due to perturbations of the earth's magnetic field as a result of solar storm and sunspot activity. Sunspots and solar storms can render magnetic surveying useless by introducing an erratic drift that cannot be corrected without possibly introducing a level of error that exceeds target values. In anticipation of erratic diurnal drift, the Space Environmental Agency was contacted for five day geomagnetic forecasts to ensure that magnetometer surveys could effectively be performed. Forecasted drift values for the above dates were approximately 0-20 gammas and classified as quiet to unsettled geomagnetic conditions. A profile of actual diurnal drift data observed over the length of the survey are presented as Figure 4.

3.0 RESULTS

The presence of large amounts of near surface metallic debris at the landfill may have created significantly large anomalies such that deeper metallic targets may not have been observed. This is best illustrated by the comparison of 1 pound of iron buried about 1.5 feet below surface will produce an anticipated anomaly of approximately 150 gammas. In comparison, 1,000 pounds of iron buried about 65 feet below surface (the approximate bottom of the landfill) may only produce a response of 4 to 5 gammas. If the targets are buried to a depth of 40 to 70 feet below surface and the near surface of the landfill contains large amounts of reinforcement bar and other metallic debris, the success of the survey may be limited.

Other factors that will effect the magnetometers response are the amount of ferrous metal present, the degree of oxidation, the orientation of the buried target and the degree of induced verses permanent magnetism of the target. These several factors can result in a large variation in the response of the magnetometer making quantitative analysis of results difficult (ie. depth and size of target). As was stated in our proposal letter dated April 27, 1990, Gartner Lee had initial reservations regarding the effectiveness of mapping metallic targets, buried to depths as great as 70 feet, in a construction and demolition landfill with any geophysical technique. However, the results of the magnetometer/gradiometer survey should prove useful for targeting follow-up investigations.

As with any remote sensing technique, the anomalies identified during a geophysical survey should be further investigated by other techniques such as historical aerial photography, supplemental geophysical techniques, test pitting and/or test boring.

The total field magnetic data and vertical gradient data were color contoured and are presented as Figures 1 and 2. The total field magnetic data were then high pass filtered in an attempt to remove the effects of the near surface metallic debris. These data were color contoured and are presented as Figure 3.

The observed color contoured response produced by buried metals as you traverse directly over them in a south to north direction is a data high or "peak" (represented as shades of deep red and purple) followed by a data low or "trough" (represented as shades of deep blue). When viewing the results of the survey it should be noted that The earth's magnetic field inclination at the Tuxedo site is approximately 70° north. The magnetic field inclination may cause the observed anomalous response shown on the color contoured map to be offset from the actual buried metallic target.

Areas relatively free of metals which represent background conditions are displayed as shades of greens and yellows on the color contour maps.

3.1 Total Field Magnetic Data

The total field magnetic data were edited, corrected for diurnal drift and plotted as individual profile lines for interpretation. Data were corrected to a base value of 54,670 gammas. The data were then color contoured in units of gammas allowing for a complete and rapid illustration of detected anomalous areas (Figure 1). The following lettered total field magnetic anomalies were observed at the site:

(A) This anomaly, represented in shades of deep red and purple, is thought to represent surface metals noted at this location.

(B) This large anomaly, represented shades of red and deep purple, may represent a large area of buried metals. The observed anomalous response may be indicative of near surface metallic debris or large metallic objects buried to a depth of ±30 feet.

(C) This small anomaly, represented by shades of deep reds and purples, may be indicative of near surface metallic debris or large metallic objects buried to a depth of approximately ±15 feet. These buried metals may be associated with those of Anomaly B.

(D,T) These strong responses, represented in shades of deep blue, are associated with the presence of a two large bulldozers parked on-site. The presence of the bulldozers created an extremely strong anomalous response. The strong anomalous response caused an error in the gridding algorithm such that the values had to be manipulated by hand.

(E,V) These anomalous areas represented in shades of yellow and orange, may be indicative of near surface metallic debris. These anomalies may also represent areas of deeper buried metallic objects.

(F) This linear north-south trending anomaly, represented in shades of blue, may be due to a buried pipe or utility. This anomaly may also represent a trenched area that contains metallic objects.

(G) This linear east west anomaly, represented in shades of light blue and green, may represent the trench that contains the deeply buried storm sewer pipe. It is thought that the storm sewer outfall is near the eastern extent of this anomaly.

(H) This large anomaly, represented in shades of deep reds and purples, may represent an area of metallic debris disposal. This anomaly was located along the slope of the eastern edge of the landfill where it was noted that areas of reinforcement bar and other metallic debris were protruding from the ground surface. Railroad tracks were also present east of this anomaly and could have contributed to the instruments response. This anomaly could be a result of near surface metallic debris and/or deeper metallic object buried to a depth of approximately ±30 feet.

(I,K,L,N,O,P,S) These small anomalies represented in shades of oranges and reds, may represent near surface metallic debris or larger metallic objects buried to depths of approximately ±10 feet.

(J) This large anomaly, represented as shades of deep blue, may be associated with Anomaly F. This anomaly was in the vicinity of overhead power lines such that the areal extent and estimated depth could not be determined.

(M) This large anomaly, represented in shades of deep blues, may represent an area of near surface metals. This anomaly was located on a steep slope along the eastern edge of the landfill. It was noted during the survey that large amounts of metallic debris was present protruding from the surface within the vicinity. Some interference may also have been realized from railroad tracks located east of the magnetometer survey.

(Q) This northeast-southwest trending anomaly, represented as shades of deep blue, is most likely due to the presence of overhead power lines that parallel Route 17 located west of the surveyed area.

(R) This large anomaly, represented as shades of deep blue, was located along the northern edge of the landfill, near the in-filled pond. This anomaly may represent an area of large metallic objects buried to a depth of ±30 feet or near surface metallic objects and debris.

(U) This anomaly is due to the presence of drilling equipment (augers, rods, etc.) located at surface.

3.2 Vertical Gradient Data and Filtered Data

The vertical gradient data were edited and plotted as individual profile lines for interpretation. The data were then color contoured in units of gammas/meter for a complete and rapid illustration of detected anomalous areas (Figure 2)

The gradient data appears to be more representative of the near surface metallic debris than the total field magnetic data. This is apparent in the "blocky" appearance of the color contour map.

In an attempt to remove some of the effects of the near surface metals, the data were filtered using a 19 point high pass filter with a 200 foot amplitude. The filtered data were plotted as profile lines and color contoured for rapid illustration of detected anomalies (Figure 3). The following lettered anomalies were observed at the site:

(A) This anomaly, represented by shades of deep reds and purples, is probably represents surface metals noted at this location.

(B,C,D,I,J,K,L,M,N,P,Q,R,S,T,U,V,X,Z,AB,AC,AE) These small anomalies, represented as deep reds and purples with associated deep blues, may represent near surface metallic debris.

(E) This large anomaly, represented in shades of deep red and purple, may represent a large area of buried metals. The observed anomalous response may be indicative of near surface metallic debris or large metallic objects buried to a depth of ±30 feet.

(F,AD) These anomalies represent the presence of two bulldozers parked on-site and associated surface metals.

(G) This linear east west anomaly, represented in shades of light blue and green, may represent a trench that contains a deeply buried storm sewer pipe. It is thought that the storm sewer outfall is near the eastern extent of this anomaly.

(H) This north-south trending anomaly, represented in shades of blues, may represent a buried utility, pipe or trench that contains buried metallic objects. The filtered total field magnetic data displays the anomalies as being less linear suggesting that they may be groups of buried metallic objects.

(O) This large anomaly, represented in shades of blue, may be associated with Anomaly H. This anomaly was in the vicinity of overhead power lines and buried utilities such that the areal extent and estimated depth could not be determined.

(W) This large anomaly, represented in shades of blue, may represent an area of near surface metallic debris. This anomaly was located on a steep slope along the eastern edge of the landfill. It was noted that during the survey that large amounts of metallic debris were present protruding from the surface within the vicinity. Some interference may also have been realized from railroad tracks located east of the magnetometer survey.

(Y) This large anomaly, represented as shades of deep blue, was located along the northern edge of the landfill, near the in-filled pond. This anomaly may represent an area of large metallic objects buried to a depth of ±30 feet or near surface metallic objects and debris.

(AA) This anomaly, represented in shades of deep blue, is probably due to the presence of overhead power lines and buried utilities that parallel Route 17.

4.0 CONCLUSIONS

It was apparent from the results of the magnetometer/gradiometer survey that the site contains large amounts of near surface metallic debris. Several large anomalies (Anomalies B, F, H, J, M and R of Figure 1) should be further investigated. These anomalies may represent extensive areas of buried metallic objects.

As stated above, other areas of the landfill may contain buried metallic objects that could not be identified due to the presence of surface and near surface metals and/or their depth of burial. The landfill should be further investigated for the presence of buried metals by using supplemental geophysical techniques, historical aerial photography, test pits and/or boreholes.

If there are any questions or comments regarding this report please do not hesitate to contact our office. We would like to take this opportunity to thank Metcalf & Eddy for involving our firm in this most interesting project.

Yours very truly,

GARTNER LEE, INC.

Thomas E Jordan

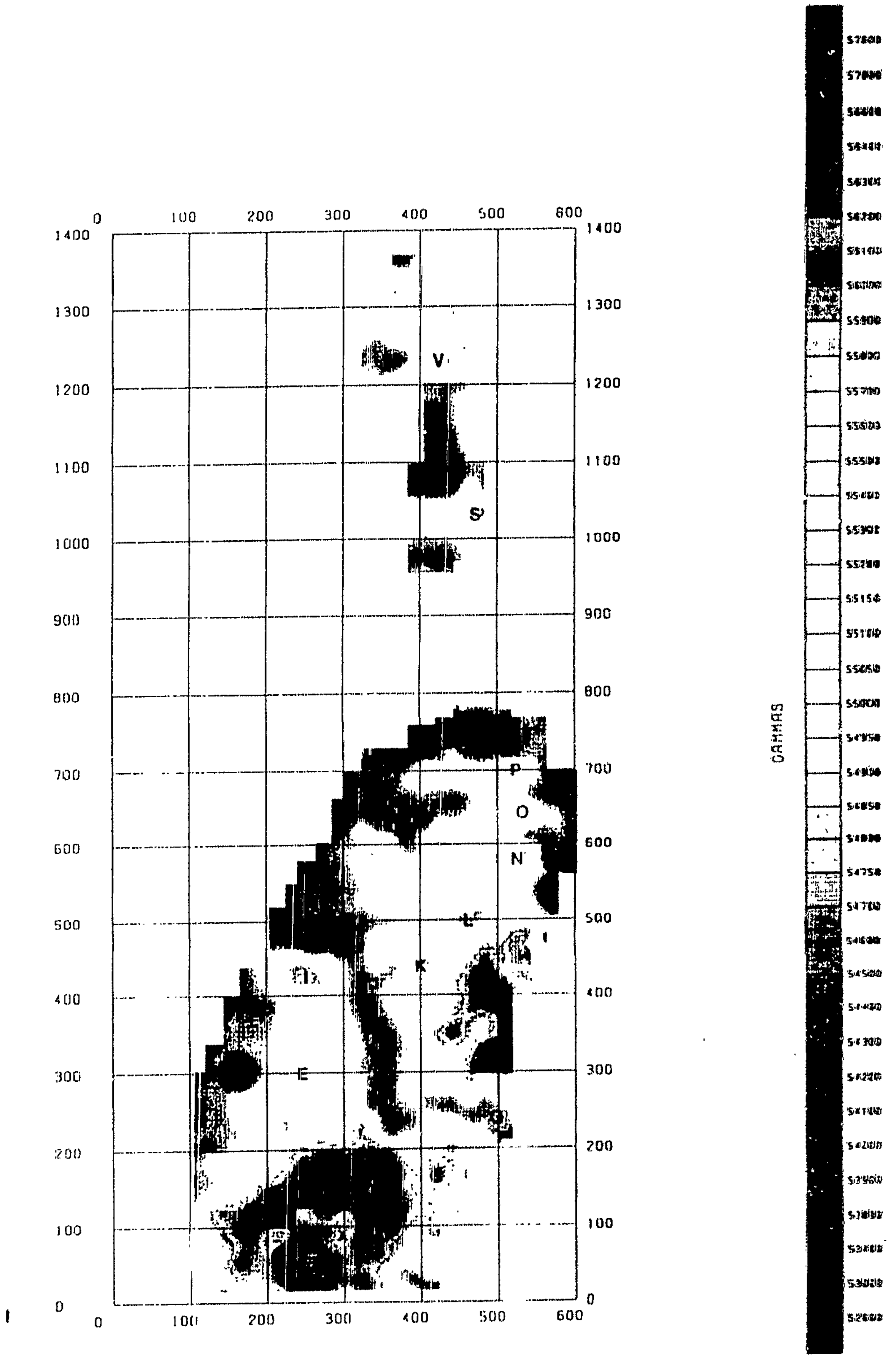
Thomas E. Jordan, M.S.
Hydrogeologist/Geophysicist

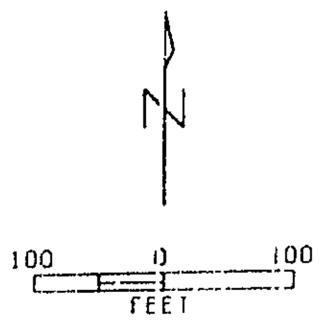
David D. Slaine, M.S.
Principal
Hydrogeologist/Geophysicist

TEJ/DDS:pmk

Attachment

FIGURES





SCALE 1 : 1 800

Figure 1

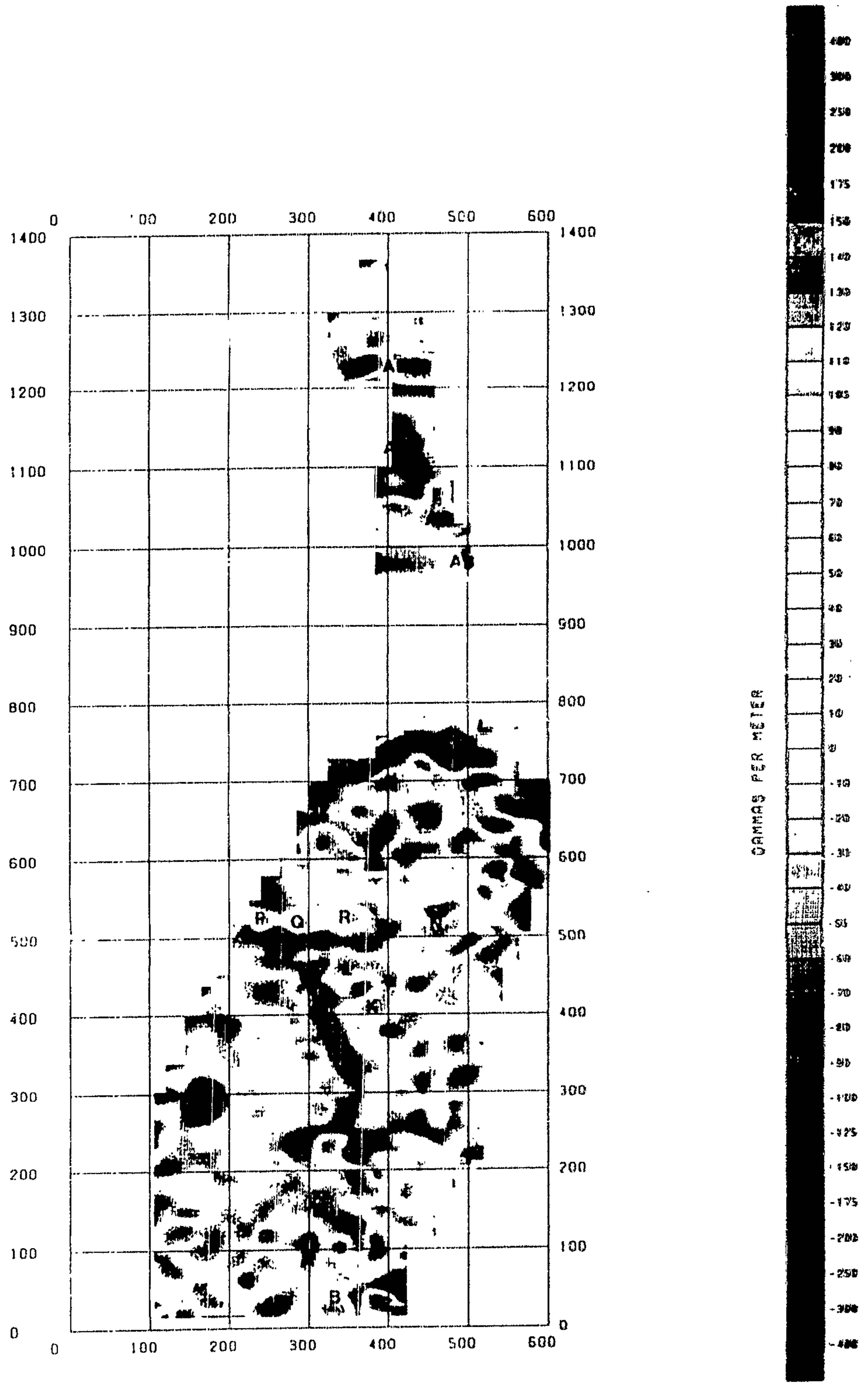
GEOPHYSICAL SURVEY RESULTS
COLOR CONTOURS
OF
TOTAL FIELD MAGNETIC DATA

TUXEDO LANDFILL SITE
TUXEDO, NEW YORK

GARTNER LEE INC.

DATE: AUG. 1990 SCALE: 1 INCH = 150 FEET

PRESENTATION BY DATAPLOTTING SERVICES



SCALE 1 : 1 800

Figure 2

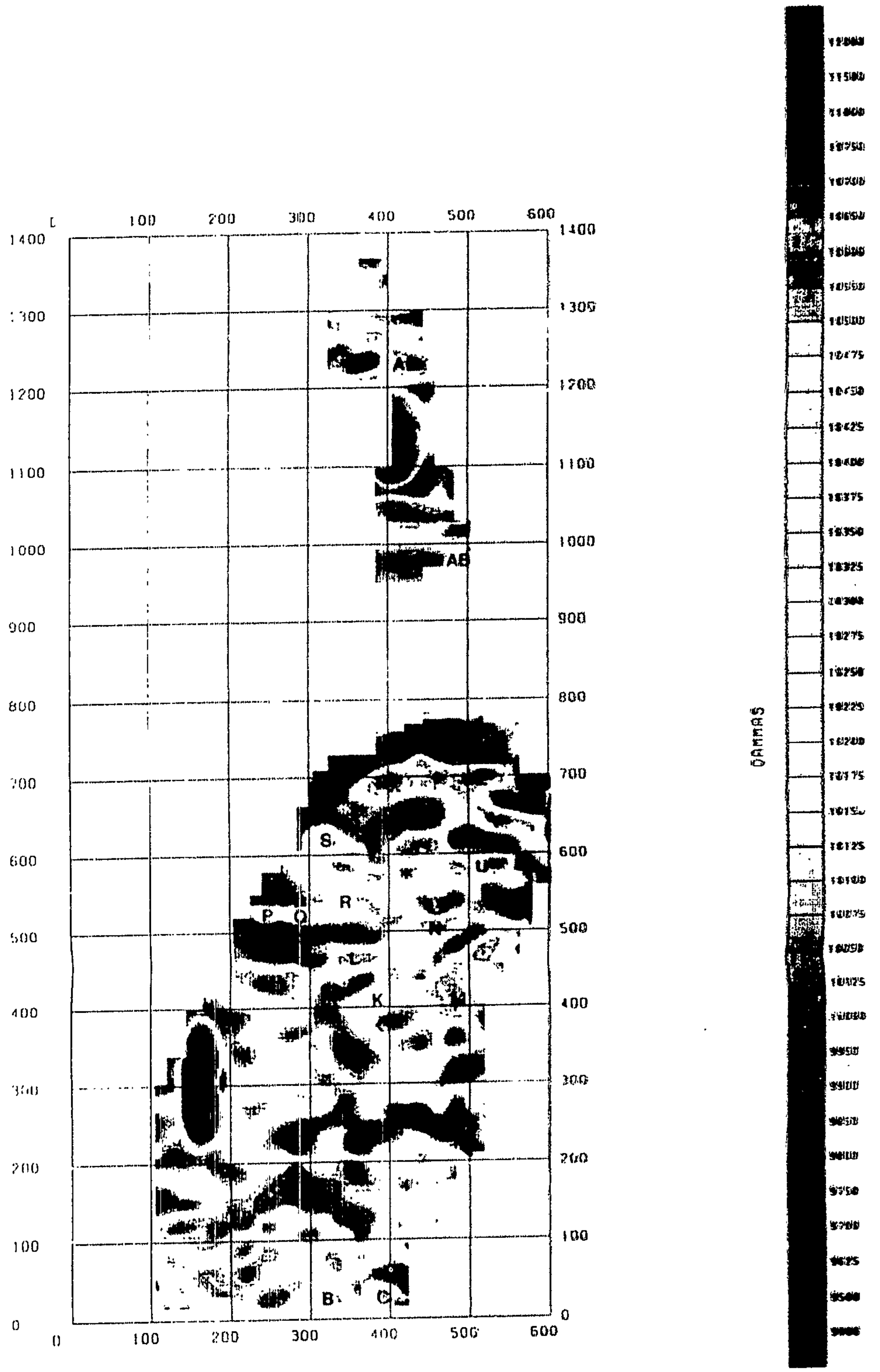
GEOPHYSICAL SURVEY RESULTS
COLOR CONTOURS
OF
VERTICAL GRADIENT MAGNETIC DATA
(UNITS - GAMMAS PER METER)

TUXEDO LANDFILL SITE
TUXEDO, NEW YORK

GARTNER LEE INC.
[illegible]
[illegible]

DATE: AUG. 1992 SCALE: 1 INCH = 150 FEET

PRESENTATION BY DATAPLOTTING SERVICES



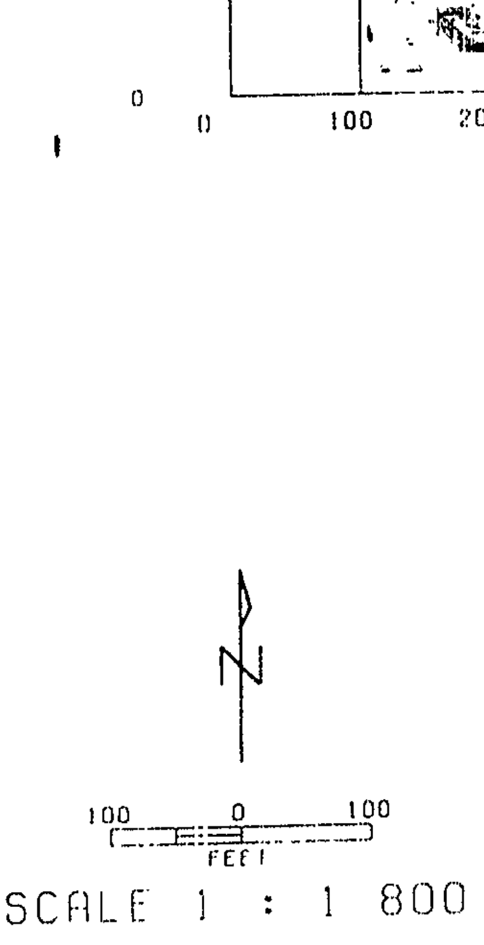


Figure 3

GEOPHYSICAL SURVEY RESULTS
COLOR CONTOURS
OF
FILTERED TOTAL FIELD MAGNETIC DATA
([illegible] - [illegible])

TUXEDO LANDFILL SITE
TUXEDO, NEW YORK

GARTNER LEE INC.
[illegible]
[illegible]

DATE: AUG. 1990   SCALE: 1 INCH = 150 FEET

PRESENTATION BY DATAPLOTTING SERVICES

Appendix H

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX H

PERIMETER SOIL GAS SURVEY JULY 11 - 13,1990

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

PERIMETER SOIL GAS SURVEY

TASK SUMMARY
TUXEDO, NEW YORK
CONTRACT #005040

A total of 43 soil vapor probes were installed along the perimeter of the site during July 11-13, 1990. Six probes were located on the west side of Route #17. Each probe was situated approximately 36 inches below grade and sealed at the surface with native modeling clay. The top of each probe was capped immediately after installation.

Heavy rain and a rising barometric pressure condition prohibited the sampling program to proceed during the fist week. However, a steady decrease in barometric pressure (30.2 - 29.0) occurred the following week which allowed for sampling and testing of the soil vapor probes.

All 37 soil vapor probes situated at north-south and east-west locations around the site were sampled and tested for Total Organic Vapor, Methane, Hydrogen Sulfide, Lower Explosive Limit, and Carbon Monoxide. Soil gas was tested by the OVA #128, Photovac TIP, and Bacarach CGI.

Both real-time and tedlar bag readings were recorded for each sample point. Soil gas samples were taken between the 36-12 inch depth interval. Each soil vapor probe was purged and immediately sampled. Careful calibration and field quality control were conducted throughout sampling program.

Elevated levels of methane and LEL were detected in VP-10 through VP-14 and in VP-24. The presence of H2S (1ppm) was also recorded at these probes locations. Low levels of Total Organic Vapor were detected at varying locations around the site. VP-26 through VP-30 showed the highest levels of organic vapor. This may be a result of the proximity to the adjacent highway.

In summary, no landfill gas was detected along the west nor north side of the site. Elevated levels of methane were recorded along the south and east side. Organic vapors detected along the highway may be a result of highway runoff. None of the probes located on the west side of Route #17 were tested during the July sampling event.

6.0 PERIMETER SOIL GAS PROBE SURVEY

6.1 GENERAL

The objective of this task is to determine whether explosive gases are migrating beyond the site boundary at depth A soil gas probe survey along all four sides of the site will be performed to investigate varying subsurface conditions

6.2 PLAN

The work will be conducted on three (3) separate events, two of which are optional for the NYSDEC to approve, during which soil gas probes will be driven to a depth of 3-5 feet below grade and gas samples collected and analyzed by field screening instruments. The gas analyzers to be used include OVA (with and without filter), PID (HNu), Combustible gas indicator, and Dreager tubes Soil probe locations will be at 100 foot grid stations about the perimeter of the site Additional samples may be required at North, East, South and West, boundries, both sides of Route 17 and other points as directed by NYSDEC The three sampling events will be established as follows

1. Declining barometric pressures
2. Normal barometric pressures (optional)
3. Frost condition (optional)

Because it is difficult to complete a full campaign during declining barometric pressure conditions, it may be that the declining barometric pressure event may have to be completed in parts over a few periods of declining barometric pressure

The frost condition could be used to estimate whether capping without venting could significantly drive explosive gases laterally offsite

6.3 METHOD

The soil gas probe survey method involves driving a pipe five feet into the soil. The pipe is pulled back two feet to expose a two-foot section of soil. Soil gas is then withdrawn through the pipe and pumped into a specially designed sample bag. The sample normally represents the soil conditions within a few feet vertically and horizontally from the probe tip Following the retrieval of the soil gas sample, the probe is removed from the ground The tubing connected to the sample bag will be fitted to the taps of OVA (with and without filter, and PID field instruments for gas measurements (see figures 6.1 and 6.2)   Exhibit D contains Standard Operating Procedures (SOP) for conducting soil gas analysis

Figure 9.1 Field LogBook Soil Gas Sampling Data Form

Date ______________ Location ______________

Samplers, Pumps, Analyzers, Used ______________

____

____

Description of sampling location ______________

____

____

Weather (temperature, barometric pressure, general weather description)

____

____

Soil Gas parameters measurements:

Air pump flow rate ______________

Depth of probe ______________

Time of purging: start ________ finish ________

Soil gas volume purged ______________

Background air conditions ______________

Instrument response (3 readings) ______________

Average instrument response ______________

Air monitoring (list equipment used as well as the measured response):

In soil gas well ______________

In personnel breathing area ______________

Sample area description ______________

____

____

Field preservation ______________

Decontamination:

Soil gas probe ______________

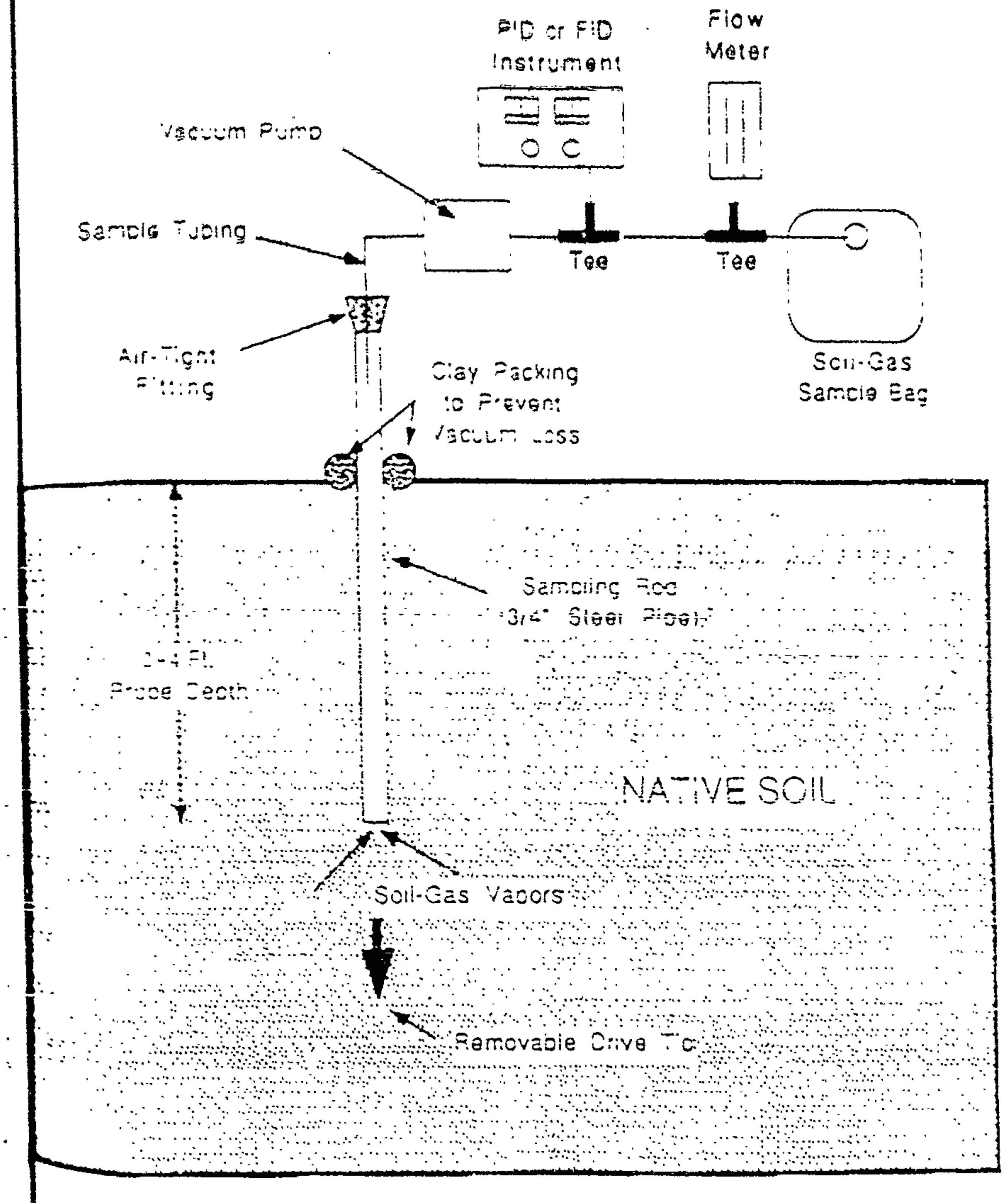
Permanent well point sampler ______________

Signature (of field team personnel taking data entry) ________

____

---

gure 6 2 Diagram of Soil-Gas Probe Sampling Method



The soil gas probe consists of a steel shaft, a loosely fitting, replaceable point, and a top drive mandrel. The probe will be assembled and driven to feet five with a manual or mechanized hammer. Care should be taken not to introduce petroleum lubricants into the probe if a mechanized hammer is being used. While pushing out the probe point with a thin rod, the probe is withdrawn one to two feet using a mechanical jack. This exposes an adequate area of soil from which a gas sample can be easily withdrawn. The top mandrel is then replaced with a one-hole rubber stopper into which a tube will be inserted. This tubing will be connected to the intake of an oilless manual or electric vacuum pump. The pump discharge is connected to a nonleaking Tedlar sample bag.

6.4 QUALITY CONTROL/QUALITY ASSURANCE (QA/QC)

6.4.1 Documentation

Field notes will include sampling stations, gas log sheets, observations, site personnel, weather conditions, date and time of sampling, daily logs, calibration check sheets.

6.4.2 Equipment Checks

Prior to driving the probe, the integrity of gas fittings attached to the probe will be tested by blocking off the tip and applying a vacuum. A leak should be suspected if the system fails to hold a vacuum of 70 centibars for less than one minute.

The background concentration contributed by the entire sampling system will also be tested prior to driving the first probe. With the probe assembled above ground, an ambient air sample will be taken and tested. If the system background concentration is significantly greater than the ambient concentration, the tubing and bag will be replaced and the probe decontaminated. Then, the background concentration will again be tested before proceeding with collection of soil gas sampling.

6.4.3 Field Equipment Decontamination Procedures

M&E site engineer will inspect and certify the cleanliness of each and all pieces of field equipment before its use. Precautions will be taken to obtain soil gas samples representative of in-situ conditions. Tedlar bags will be checked for leaks and contamination prior to sampling.

Sampling probes and tips, tubing, and any other equipment which will come into contact with the soil samples will be freshly cleaned prior to each use. All such items will be cleaned prior to beginning work at each probe, and before each sampling event.

The decontamination procedure will include washing with an appropriate phosphate-free detergent, rinsing with potable water, steam cleaning, followed by a triple rinse of distilled water and air drying. Field decontamination will be performed by, or under the direction of, the M&E site engineer.

6.5 WASTE MANAGEMENT

Disposable materials such as H&S protective items and sampling bags and tips will be put into plastic trash bags and placed in DOT-approved 55-gallon capacity steel drum(s). The lid of the drum will be tightly secured. These drums will be onsite at a designated location over the course of the RI project.

6.6 HEALTH AND SAFETY

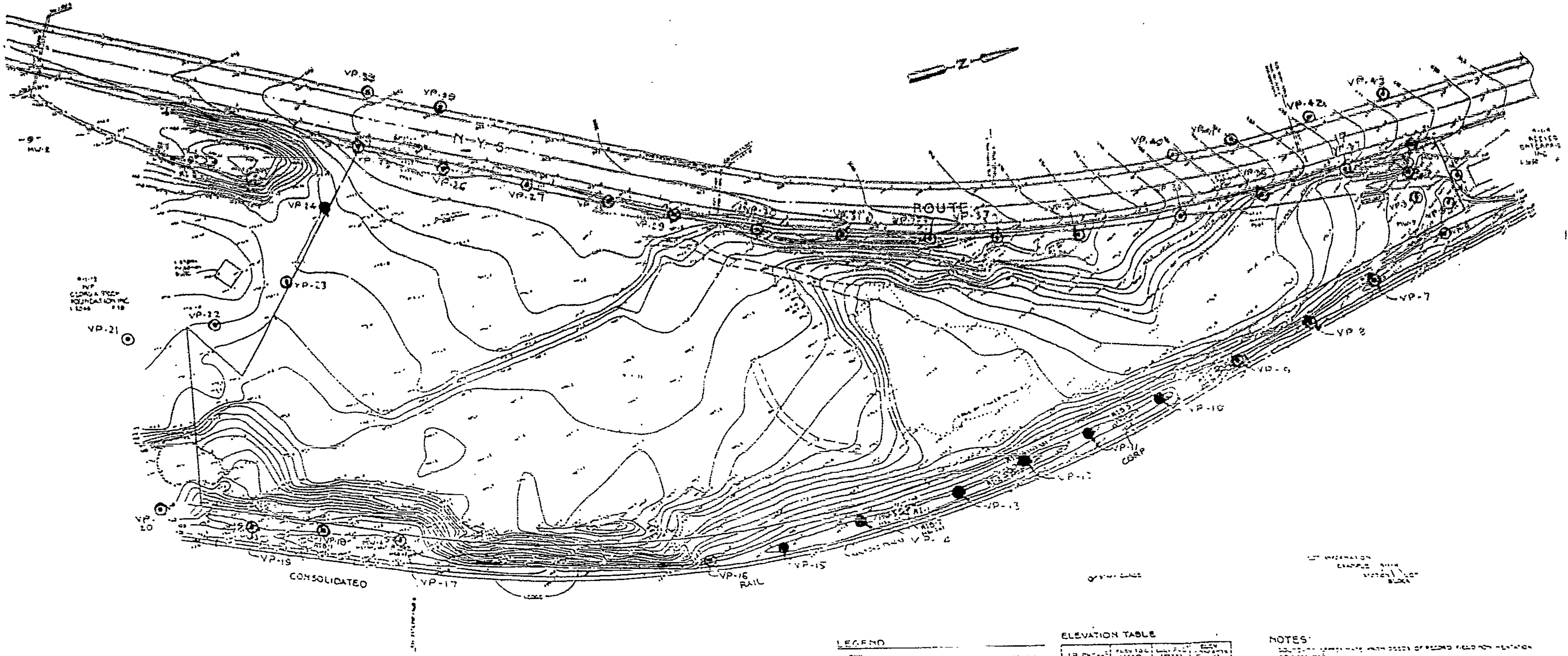
The personal protective equipment required to perform this survey will be level "D" at a minimum and should be modified as required by the airborne chemical/particulars action level upgrades identified in the site Health and Safety Plan.

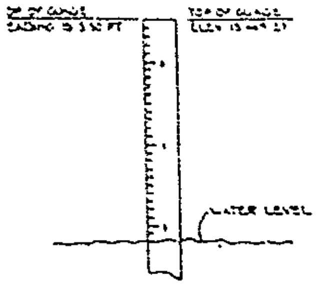
6.7 PERSONNEL

A two (2) person field crew will perform the soil gas probe survey. Personnel will be certified in the training and medical requirements under OSHA Regulation 29 CFR 1910.120.

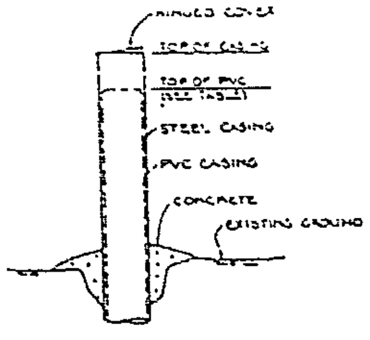
6.8 PERMITS AND APPROVALS

Before commencing any field survey, M&E will notify NYSDEC for permission to enter upon the site for purposes of conducting a soil gas probe survey.





STAFF GAUGE DETAIL
NOT TO SCALE



DETAIL "A"
NOT TO SCALE

LEGEND

⊙	GROUNDWATER MONITOR WELL LOCATION
	PROPERTY LINE
	CENTERLINE OF ROAD
	SPOT GRADE
	UTILITY POLE
	EDGE OF ASPHALT PAVEMENT
	OVERHEAD WIRES
	RAILROAD TRACKS
	GUIDE RAIL
△	SOIL BORING LOCATIONS
◉	SOIL GAS VAPOR PROBE LOCATION
●	PROBE LOCATIONS WITH ELEVATED METHANE LEVELS (>1,000 ppm on OVA)

ELEVATION TABLE

I.D. NUMBER	ELEV. T.O.C. (FEET)	ELEV. PVC (FEET)	ELEV. GROUND (FEET)
MW-1	459.01	458.33	446.29
MW-2	502.30	502.06	499.99
MW-3	459.22	458.9	457.11
MW-4	460.24	460.06	457.99
MW-5	458.81	458.03	456.16
MW-6	456.98	456.79	454.76
MW-7	467.06	466.86	464.60
RI-1	459.76	459.40	456.39
RI-2	458.83	458.02	455.91
RI-3	480.09	479.79	478.05
RI-4	462.87	463.45	459.56
RI-5A	499.92	498.96	496.06

* WELLS RI-1 & RI-3 HAVE A STEEL INNER CASING, NOT PVC

NOTES:

1) [illegible]
2) CONTOUR INTERVAL 2 FEET
3) TOPOGRAPHY COMPLETED IN FIELD ON JULY [illegible]
4) VERTICAL DATUM [illegible]
5) WELLS RI-1 THROUGH RI-5 LOCATED ON SEPTEMBER [illegible]
6) SOIL BORINGS LOCATED [illegible]

PERIMETER SOIL GAS SURVEY
LOCATION MAP

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-17-90
Page 1 of 37

Description of sampling location: VP-1
Personnel onsite: DAB, DS

Weather
Temperature: 80 °F
Barometric pressure: 30.21
General condition: Humid & Sunny
Wind direction: No wind

Soil type
Size: Silt w/ clay
Grading: Poor
Color: Brn
Moisture: V moist
Density:
Porosity: Low
Character: Fine soils

Soil Gas Parameters/Measurements:
Air pump flow rate: Hand Pump - 8 Pumps = 3 vols ([illegible])
Probe depth: 3 FT   All @ 3 FT
Time of purging: start: 10:00   finish: 10:15
Soil gas volume purged: 3 x (765 ml) = 2295 L
Background air reading: 0 TIP   [illegible] = 8 ppm
TIP response 3 readings: 1 0.2 TIP   2 5 ppm [illegible]   3 [illegible]
BG = 8 ppm
Average response: 3.1 ppm TIP   BG = 13 [illegible] 8 ppm

H2S response: 0   Cal/standard:
OVA reading BG: 4 ppm: 56   Cal/standard: BG [illegible] 62
Other O_2: 14.26   Cal/standard:
FID response: Cal/standard:
LEL: 0
CO: 0

Decontamination
Soil gas probe: ok
Tubing: |
Pump: |
Other:

REMARKS: [illegible] at or below BG

SOIL GAS SAMPLING DATA

Project: Parameter Soil Gas Survey

METCALF & EDDY, INC.

Contract: No. 005040

Location: Tuxedo N.Y.

Date: 7-17-90

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Description of sampling location VP-2

Personnel onsite DS & DMB [illegible]

Weather

Temperature

Barometric pressure

General condition

Wind direction

Soil Type

Size F-M SD AND SILT

Grading MOD

Color BRN

Moisture V MOIST

Density

Porosity LOW

Character SANDY SOIL w/ SILT

Soil Gas Parameters/mesurements:

Air pump flow rate HAND PUMP - 2 PUMPS = 3 secs

Probe depth 36 [illegible] to 54

Time of purging: start: 1615 finish: 1620

Soil gas volume purged 2 2×5 [illegible]

Background air reading 0

PID response 1 35 2 OVA = NT 3

3 readings

Average response [illegible] 21 max

H2S response 0 Cal/standard:

OVA reading 0 Cal/standard:

Other O2 [illegible] Cal/standard:

F.C.G response Cal/standard:

LEL 0

CO 0

Decontamination

Soil gas probe OK

Tubing

Pump

Other

REMARKS: NT = NOT TESTED (OVA NOT FUNCTIONING)

LATER READING ON OVA FROM TEDLAR BAG =0

SOIL GAS SAMPLING DATA

Project: Perameter Soil Gas Survey

Contract: No. 005049

Location: Tuxedo N.Y.

Date: 7-18-90

MECALF & EDDY, INC.

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Description of sampling location: VP [illegible]

Personnel onsite: DS & DMB

Weather

Temperature: [illegible]°F

Barometric pressure: 30.1

General condition: HOT

Wind direction: MOD [illegible] MPH NW

Soil type

Size: SAND [illegible] SILT W/ SOME [illegible]

Grading: POOR

Color: DK [illegible]

Moisture: [illegible]

Density:

Porosity: [illegible]

Character: [illegible]

Soil Gas Parameters/mesurements:

PURGING / REAL-TIME READINGS

Air pump flow rate: [illegible]

Probe depth: [illegible]

Time of purging: start: [illegible] finish: [illegible]

Soil gas volume purged: [illegible]

Background air reading: [illegible]

TIP response 1 [illegible] 2 [illegible] 3 [illegible]

3 readings

Average response: [illegible]

SAMPLING TEDLAR

H2S response: [illegible] Cal/standard:

OVA reading [illegible]: [illegible] Cal/standard:

Other [illegible]: [illegible] Cal/standard:

F.C.G response Cal/standard:

Decontamination

Soil gas probe: OK

Tubing: |

Pump: |

Other:

REMARKS: NOTE INITIAL MEASUREMENT [illegible] ON TEDLAR BAG [illegible] 7-17-90 [illegible] THESE HIGH READING WERE NOT CONFIRMED ON 7-18-90

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey

Contract: No. 905040

Location: Tuxedo N.Y.

Date: 7-17-90

METCALF & EDDY, INC.

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Description of sampling location: VP 4

Personnel onsite: DS [illegible]

Weather

Temperature: 75°F

Barometric pressure: 30.1

General condition: SUNNY

Wind direction: 5-7 mph N

Soil type

Size: SILT - F-M SAND

Grading: [illegible]

Color: BRN

Moisture: V MOIST

Density:

Porosity: [illegible]

Character: FINE [illegible]

Soil Gas Parameters/Mesurements:

READINGS

Air pump flow rate: HAND PUMP - [illegible] = 5 [illegible]

Probe depth: 3 FT 2 FT [illegible]

Time of purging: start: 16 40 ([illegible]) finish: [illegible]) 7 = 10

Soil gas volume purged: 2 295 [illegible] ([illegible])

Background air reading: [illegible]

TIP response 3 readings: 1 35 [illegible] 2 [illegible] 3 [illegible]

Average response ± 10%: [illegible]

BAG

H2S response: 0 Cal/standard:

OVA reading BG = 13: 13 = 0 Cal/standard:

Other O2: 18-4 L Cal/standard:

F.C.G response: Cal/standard:

CO 0

LEL 0

Decontamination

Soil gas probe: cc

Tubing

Pump

Other

REMARKS: ND ON ANY INSTRUMENTS

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tukeda N.Y.
Date: 7-18-90

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Description of sampling location: VP 5 [illegible] (2.5 [illegible])
Personnel onsite: DS + DMB

Weather
Temperature: ± 50 °F
Barometric pressure: 30.1
General condition: Sunny & Humid
Wind direction: None

Soil Type
Size: M-F SAND & SILT
Grading: M.D.
Color: Dk Brn
Moisture: S. Moist
Density:
Porosity: [illegible]
Character:

Soil Gas Parameters/Measurements:

Purging Monitoring [illegible]

Air pump flow rate: Hand Pump - 8 pumps = 3 [illegible]
Probe depth: 3' 7' [illegible]
Time of purging: start: 1340 finish: 1347
Soil gas volume purged: 2.245 [illegible] (3 [illegible])
Background air reading: 0.2 TIP
TIP response 3 readings: 1 2.1 mg/L 2 6 [illegible] 3 [illegible]
Average response: 4.2 [illegible]

Sampling [illegible]

H2S response: 0 Cal/standard:
OVA reading 13 BC: 13 = ND Cal/standard:
Other O2: 17.1 % Cal/standard:
F.C.S response Cal/standard:
LEL [illegible]
CO 0

Decontamination
Soil gas probe: OK
Tubing: /
Pump: /
Other:

REMARKS: AFTER RE ZERO CAL AND THEN RESAMPLING - LEL & O2 [illegible] READING WAS POSS ERROR

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tukwila [illegible]
Date: 7-25 90

METCALF & EDDY, INC.

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Description of sampling location: VP-6 [illegible]
Personnel onsite: DS DMB

Weather
Temperature: ~75°F
Barometric pressure: 30.1
General condition: Sunny / Humid
Wind direction: None

Soil type
Size: CLAY SILT W/SOME F SAND
Grading: Med
Color: BRN
Moisture: V. MOIST
Density:
Porosity: Low
Character:

Soil Gas Parameters/Mesurements:

[illegible]

Air pump flow rate: HNU) Pump - 5 Purges = 5 secs
Probe depth: 3.3' [illegible]
Time of purging: start: :300 finish: :305
Soil gas volume purged: [illegible] (3L)
Background air reading: 0
TIP response 3 readings: 1 13 max 2 0 [illegible] 3 [illegible]
Average response [illegible]: 48

Sampling Technique

H2S response: 0.1 ppm Cal/standard:
OVA reading [illegible]: 15 ppm - 2 ppm Cal/standard:
Other O_2: 7.7% Cal/standard:
F.C.G response: Cal/standard:
LEL 1%
CO 0

Decontamination
Soil gas probe: CR
Tubing
Pump
Other

REMARKS: SLI INCREASE OVA & TIP

SOIL GAS SAMPLING DATA

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: [illegible] N.Y.
Date: 2-19-90

MECALF & EDDY, INC.

Page 7 of 37

Description of sampling location: VT 7
Personnel onsite:

Weather
Temperature: [illegible]
Barometric pressure: 29.44
General condition: [illegible]
Wind direction: NONE

Soil type
Size: F. SAND
Grading: [illegible]
Color: [illegible] BRN
Moisture: MOIST
Density:
Porosity: LOW
Character:

Soil Gas Parameters/Mesurements:
Air pump flow rate: HAND PUMP & PUMP [illegible]
Probe depth: 3 FT 2 FT [illegible]
Time of purging: start: [illegible] finish: [illegible]
Soil gas volume purged: 3x (765 ml) = 2.295 L
Background air reading: [illegible] TIP
TIP response: 1 [illegible] 2 [illegible] 3 [illegible]
3 readings
Average response: 37 [illegible] TIP.

H2S response: 0 Cal/standard:
OVA reading [illegible]: 0 Cal/standard:
Other O2: [illegible] Cal/standard:
F.C.G response: Cal/standard:

Decontamination
Soil gas probe: OK
Tubing:
Pump:
Other:

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey

Contract: No. 005040

Location: Tuxedo N.Y.

Date: 7-18-86

METCALF & EDDY, INC.

Page 3 of 37

Description of sampling location: VP-8

Personnel onsite: DS & DMP

Weather

Temperature: 90°F

Barometric pressure: 29.94

General condition: Hot

Wind direction: None

Soil type

Size: MED - COARSE SAND AND GRAVEL

Grading: GOOD

Color: Brn

Moisture: MOIST

Density:

Porosity: GOOD

Character:

Soil Gas Parameters/Measurements:

Air pump flow rate: [illegible]

Probe depth: [illegible]

Time of purging: start: [illegible] finish: [illegible]

Soil gas volume purged: [illegible]

Background air reading: [illegible]

HNU response 3 readings: 1 [illegible] 2 [illegible] 3 [illegible]

Average response: 32 [illegible] .57 ppm

H2S response: 0 Cal/standard:

OVA reading: [illegible] Cal/standard:

Other O_2: 20% Cal/standard:

F.C.G response: Cal/standard:

LEL 0

O2 0

Decontamination

Soil gas probe: OK

Tubing:

Pump:

Other:

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

Project: Perimeter Soil [illegible] Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-19-90

MECALF & EDDY, INC.

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Description of sampling location: VP 9
Personnel onsite: DS + DMB

Weather
Temperature: [illegible]
Barometric pressure: 29.94
General condition: HOT
Wind direction: NONE

Soil Type
Size: MED - COARSE SAND & GRAVEL
Grading: GOOD
Color: BRN
Moisture: MOIST
Density:
Porosity: GOOD
Character:

Soil Gas Parameters/Measurements:
Air pump flow rate: [illegible] - 3 [illegible]
Probe depth: 36 [illegible]
Time of purging: start: 12:45 finish: 1:15
Soil gas volume purged: [illegible]
Background air reading: 0.4 [illegible]
TIP response 1 20 TA 2 [illegible] 3 [illegible]
3 readings
Average response: 49 TIP = 43 ppm

H2S response: 0 Cal/standard:
OVA reading: 21 = 0 ppm Cal/standard:
Other O_2: 21% Cal/standard:
F.C.G response Cal/standard:
LEL 0
Decontamination CO 0
Soil gas probe: OK
Tubing:
Pump:
Other:

REMARKS:

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 9-18-90
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Description of sampling location: VP 10
Personnel onsite: DS & DMB

Weather
Temperature: + 90 °F
Barometric pressure: 29.9 v
General condition: HOT
Wind direction: NONE

Soil Type
Size: FINE SAND w/SOME CLAY-SILT
Grading: POOR
Color: BRN
Moisture: MOIST
Density:
Porosity: [illegible]
Character:

Soil Gas Parameters/measurements:
Air pump flow rate: HAND HELD V pump - 3.5/5
Probe depth: 36" 24" pullup
Time of purging: start: 16 50 finish: 0 57
Soil gas volume purged: 0.25 L 3.0
Background air reading: 0 TIP
TIP response 1 0 TIP 2 OVA = >1,000 ppm 3
3 readings
Average response 0 7 24: 1 0 ppm TIP: 0 7 [illegible]

H2S response: 0 Cal/standard:
OVA reading: 0 Cal/standard:
Other O_2: 10 % Cal/standard:
F.C.S response: Cal/standard:
CO: 5 ppm
LEL: 0

Decontamination
Soil gas probe:
Tubing:
Pump:
Other:

REMARKS: OVA ZERO READING FROM TEDLAR BAG MAY BE A RESULT OF LOW O2 CONTENT. REAL-TIME READING SHOW >1000 ppm METHANE ON OVA

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tukowe N.Y.
Date: 7-17-9[illegible]

Page 11 of [illegible]

Description of sampling location: VP 11
Personnel onsite: [illegible]

Weather
Temperature: [illegible]90°F
Barometric pressure: 29.94
General condition: HOT
Wind direction: SW [illegible]

Soil type
Size: FINE - MED. SAND
Grading: [illegible]
Color: BRN
Moisture: MOIST
Density:
Porosity: [illegible]
Character:

Soil Gas Parameters/Measurements:
Air pump flow rate: HAND PUMP [illegible]
Probe depth: 36" [illegible]
Time of purging: start: 4:25 finish: [illegible]
Soil gas volume purged: [illegible]
Background air reading: [illegible]
TIP response: 1 [illegible] 2 [illegible] ppm 3 [illegible]
3 readings
Average response [illegible] [illegible] ppm [illegible] ppm [illegible] TIP

H2S response: 8 ppm Cal/standard:
OVA reading: [illegible] ppm Cal/standard:
Other [illegible]: [illegible] Cal/standard:
F.C.G response Cal/standard:
LEL 70 %
[illegible] [illegible] ppm

Decontamination
Soil gas probe: ok
Tubing:
Pump:
Other:

REMARKS: HOT - POSSIBLE methane

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7.19.90

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Description of sampling location: 1P [illegible]
Personnel onsite: DS & DWP

Weather
Temperature: [illegible]
Barometric pressure: 29.94
General condition: Hot & sunny
Wind direction: None

Soil type
Size: [illegible]
Grading: [illegible]
Color: BRN
Moisture: [illegible]
Density:
Porosity: [illegible]
Character:

Soil Gas Parameters/Measurements:
Air pump flow rate: [illegible]
Probe depth: 3 [illegible]
Time of purging: start: [illegible] finish: [illegible]
Soil gas volume purged: [illegible]
Background air reading: [illegible]
TIP response
3 readings
1 [illegible] 2 [illegible] 3 [illegible]
Average response: [illegible]

H2S response: 7 ppm Cal/standard:
OVA reading: [illegible] Cal/standard:
Other O_2: [illegible] Cal/standard:
F.C.S response: [illegible] Cal/standard:

Decontamination
Soil gas probe: [illegible]
Tubing
Pump
Other

REMARKS: About [illegible] 220 ppm [illegible]

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-19-90

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Description of sampling location [illegible]
Personnel onsite [illegible]

Weather
Temperature [illegible]
Barometric pressure [illegible]
General condition [illegible]
Wind direction [illegible]

Soil type
Size [illegible]
Grouping [illegible]
Color [illegible]
Moisture [illegible]
Density
Porosity [illegible]
Character

Soil Gas Parameters/Measurements:
Purging Real Time Mode
Air pump flow rate [illegible]
Probe depth 3' [illegible]
Time of purging: start: 1540 finish: [illegible]
Soil gas volume purged [illegible]
Background air reading [illegible]
TIP response 1 [illegible] 2 [illegible] 3 [illegible]
3 readings
Average response [illegible]

Sampling Real Time
H2S response [illegible] Cal/standard:
OVA reading [illegible] Cal/standard:
Other [illegible] Cal/standard:
F.C.S response Cal/standard:
LEL [illegible]
5 ppm

Decontamination
Soil gas probe ok
Tubing
Pump
Other

REMARKS: HOT - excess methane

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey

Contract: No. 005048

Location: [illegible] N.Y.

Date: 7 13 [illegible]

MECALF & EDDY, INC.

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Description of sampling location [illegible]

Personnel onsite [illegible]

Weather

Temperature [illegible]

Barometric pressure 29.9[illegible]

General condition Sunny

Wind direction [illegible] wind SW

Soil type

Size Fine sand & silt

Grading [illegible]

Color [illegible]

Moisture moist

Density

Porosity [illegible]

Character

Soil Gas Parameters/Measurements:

Air pump flow rate [illegible]

Probe depth 36" [illegible]

Time of purging: start: [illegible] finish: [illegible]

Soil gas volume purged [illegible]

Background air reading [illegible]

TIP response 1 [illegible] 2 [illegible] 3 [illegible]

3 readings

Average response [illegible]

H2S response [illegible] Cal/standard:

OVA reading [illegible] Cal/standard:

Other [illegible] Cal/standard:

F.I.D response Cal/standard:

[illegible] 577 [illegible]

Decontamination

Soil gas probe OK

Tubing

Pump

Other

REMARKS: Hot – excessive methane

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-19-90
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Description of sampling location: VP 15
Personnel onsite: DS & DMB

Weather
Temperature: 70 °F
Barometric pressure: 30.24
General condition: [illegible]
Wind direction: 0-2 mph

Soil type
Size: MED. - COARSE SAND & GRAVEL
Grading: MXD
Color: BRN
Moisture: MOIST
Density:
Porosity: MXD
Character:

Soil Gas Parameters/Measurements:
Air pump flow rate: HAND PUMP - 8 pumps = 3 L
Probe depth: 32" [illegible]
Time of purging: start: 1127 finish: 1144
Soil gas volume purged: 3 vol = 2.34 L
Background air reading: 2.1 TIP CH4 < 2
TIP response 3 readings: 1 40 TIP 2 CH4 [illegible] 3 O2 [illegible]
Average response: 14 TIP (BELOW BACKGROUND)

H2S response: 3 ppm Cal/standard:
OVA reading: PASS Cal/standard:
Other O_2: [illegible] % Cal/standard:
FOC response Cal/standard:
CO2: [illegible] %
CO: 50 ppm

Decontamination
Soil gas probe: OK
Tubing:
Pump:
Other:

REMARKS: RETEST W/ [illegible] ISO : TIP [illegible] INITIAL READING
H2S = 0
TIP = 0

SOIL GAS SAMPLING DATA

Project: Parameter Soil Gas Survey
Contract: No. 905046
Location: Tuxedo N.Y.
Date: 7-19-94

MECALF & EDDY, INC.

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Description of sampling location: VP 16
Personnel onsite: DMB + DS

Weather
Temperature: + 80°F
Barometric pressure: 30.04
General condition: Hot & Humid
Wind direction: mod. wind SW

Soil type
Size: coarse med. sand & gravel
Grading: Med. Grad.
Color: Lt. Brn
Moisture: moist
Density:
Porosity: Med
Character:

Soil Gas Parameters/measurements:
Purging Real Time Readings
Air pump flow rate: Hand pump 4 pumps = [illegible]
Probe depth: 54" 24 [illegible]
Time of purging: start: 1104 finish: 1125
Soil gas volume purged: [illegible] = 2.275 l
Background air reading: .3 OVA 2.8
TIP response 3 readings: 1 1.9 tip 2 [illegible] 3 [illegible]
Average response 2.86: 5.1 tip = [illegible] net

Sampling Real Time
H2S response: 0 Cal/standard:
OVA reading 2.8: .8 = 0 net Cal/standard:
Other O2: 20.2 % Cal/standard:
F.C.G response: Cal/standard:
LEL: 0
CO: 0

Decontamination
Soil gas probe: LC
Tubing:
Pump:
Other:

REMARKS: NOT DETECTED -

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tukede N.Y.
Date: 7-19-90

Page 17 of 37

Description of sampling location: VP 17
Personnel onsite: DJ + DHB

Weather
Temperature: 7 PC 65 °F
Barometric pressure: 30.04
General condition: hot
Wind direction: None

Soil type
Size: Fine [illegible] [illegible] [illegible] [illegible]
Grading: [illegible]
Color: [illegible]
Moisture: [illegible]
Density:
Porosity: [illegible]
Character:

Soil Gas Parameters/Mesurements:
Air pump flow rate: HAND PUMP [illegible]
Probe depth: 36" 24" [illegible]
Time of purging: start: 1050 finish: [illegible]
Soil gas volume purged: [illegible]
Background air reading: 2.3 TIP OVA 0.0 [illegible]
TIP response 3 readings: 1 7.5 TIP 2 [illegible] 3 [illegible]
Average response / 9 8 [illegible]: 6.0 = [illegible]

H2S response: 1 ppm Cal/standard:
OVA reading / 1 2 [illegible]: 12 [illegible] Cal/standard:
Other O_2: [illegible] % Cal/standard:
F.C.G response: Cal/standard:
LEL: 0
CO: 5 ppm

Decontamination
Soil gas probe: OK
Tubing:
Pump:
Other:

REMARKS: NEAR DRAIN PIPE OUTLET [illegible] [illegible] present
strong [illegible] odor

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey

Contract: No. 005040

Location: Tuxedo N.Y.

Date: 7-19-90

METCALF & EDDY, INC.

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Description of sampling location: VP-18

Personnel onsite: MOIST DS & DMB

Weather

Temperature: ±90°F

Barometric pressure: 30.04

General condition: HOT

Wind direction: NONE

Soil type

Size: SILT & CLAY

Grading: POOR

Color: DK BRN

Moisture: MOIST

Density:

Porosity: LOW

Character:

Soil Gas Parameters, measurements:

Air pump flow rate: HAND PUMP : 8 pump = 3 vols

Probe depth: 36" 18 purge

Time of purging: start: 1025 finish: 1040

Soil gas volume purged: 3 vol = 2.295 l

Background air reading: 2.4 TIP OVA 11 BG

TIP response 3 readings: 1 3.0 TIP 2 OVA 11 3 H2S 0.1ppm

Average response 2.7 BG: 4.7ppm = 2.0ppm NET

H2S response: 0.1ppm Cal/standard:

OVA reading 11 BG: 11 = 0 NET Cal/standard:

Other O_2: 18.0% Cal/standard:

F.C.G response Cal/standard:

LEL 1%

CO 0

Decontamination

Soil gas probe: ok

Tubing:

Pump:

Other:

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Perameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-19-90

Page 19 of 37

Description of sampling location: VP - 19
Personnel onsite: DS & DMB

Weather
Temperature: ±80°F
Barometric pressure: 30.04
General condition: HOT
Wind direction: NONE

Soil type
Size: FINE SAND & SILT
Grading: MOD
Color: MED BRN
Moisture: [illegible] MOIST
Density:
Porosity: LOW
Character:

Soil Gas Parameters/Mesurements:

PURGING REAL TIME READING

Air pump flow rate: HAND PUMP - 8 PUMPS = 3 cal/s
Probe depth: 30" 18 PULL
Time of purging: start: .010 finish: .020
Soil gas volume purged: 3 [illegible] = 2.245 l
Background air reading: 0 TIP OVA 1.8 LEL = 0 O_2 = 19%
TIP response 3 readings: 1 2.6 TIP 2 OVA 1.1 3 H_2S = 0 CO = 0

SAMPLING [illegible]

Average response, 9.86: 3.2 = 1.3 NET
H2S response: 0 Cal/standard:
OVA reading, 7.36: 1.7 = 0 NET Cal/standard:
Other O_2: 21% Cal/standard:
F.C.G response: Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: OK
Tubing: |
Pump: |
Other:

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-17-90

METCALF & EDDY, INC.

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Description of sampling location: VP-20
Personnel onsite: Dmk + DJ

Weather
Temperature: + 80°F
Barometric pressure: 30.06
General condition: Sunny & Humid
Wind direction: None

Soil type
Size: Silt & Clay
Grading: Poor
Color: Dk Brown
Moisture: V. Moist
Density:
Porosity: Low
Character: Similar to [illegible] Soil

Soil Gas Parameters/mesurements:

Ambient Real Time Analysis

Air pump flow rate: HAND PUMP - 5 [illegible] - 3 [illegible]
Probe depth: 36" 24" [illegible]
Time of purging: start: 945 finish: 1000
Soil gas volume purged: 3 x 1 = 3 [illegible]
Background air reading: 2.4 TIP OVA = 0.06
TIP response 3 readings: 1 2.5 TIP 2 OVA = 0 3 H2S = · O2 = 20.9
Average response 2.5 -2.5 = 0.1 NET ppm

Sampling Tedlar Bags

H2S response: 0-1 ppm Cal/standard:
OVA reading 0.04: 0.1 = 0 ppm Cal/standard:
Other O2: 20.9% Cal/standard:
P.C.G response Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: CR
Tubing
Pump
Other

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-30-[illegible]

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Description of sampling location: VP-21
Personnel onsite: DMB [illegible] ED Powers

Weather
Temperature: ±90°F
Barometric pressure: 29.92
General condition: Sunny
Wind direction: ~5 mph west

Soil type
Size: Fine Sand
Grading: Poor
Color: Dk Brn
Moisture: Moist.
Density:
Porosity: Low
Character: Adjacent to outcrop on SE side of site

Soil Gas Parameters/Measurements:

Purging Readings

Air pump flow rate: Hand pump - 2 pumps = 3.0 L
Probe depth: 3' [illegible]
Time of purging: start: 1130 finish: 1145
Soil gas volume purged: 3.0 L = 2 [illegible]
Background air reading: 0.6 TIP [illegible]
TIP response 3 readings: 1 0.3 TIP 2 0.0 [illegible] 3 H_2S - 0 / LEL = 0

Sampling Readings

Average response [illegible]: 1.0 [illegible] ppm Net TIP
H2S response: 0 Cal/standard:
OVA reading / IBU: 11 = ND Cal/standard:
Other O_2: [illegible] Cal/standard:
F.I.D response: Cal/standard:
LEL 0
Decontamination CO 0
Soil gas probe: ok
Tubing
Pump
Other

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey

Contract: No. 005040

Location: Tuxedo N.Y.

Date: 7-20-90

MECALF & EDDY, INC.

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Description of sampling location: VP-22

Personnel onsite: DMB & ED [illegible]

Weather

Temperature: 85°F

Barometric pressure: 29.92

General condition: HOT

Wind direction: 5 mph SW

Soil type

Size: COARSE SAND & GRAVEL

Grading: MOD

Color: BRN

Moisture:

Density:

Porosity: MOD

Character: COMPACTED - ALONG DIRT ROAD

Soil Gas Parameters/Measurements:

Purging Real Time [illegible]

Air pump flow rate: HAND PUMP - 4 PUMPS = 3 vols

Probe depth: 27" 17" [illegible]

Time of purging: start: 11 15 finish: 11 30

Soil gas volume purged: 3 vols ≈ 2295 [illegible]

Background air reading: 1.2 TIP OVA 5 BG

TIP response 3 readings: 1 4.2 TIP 2 [illegible] = .5(ND) 3 [illegible]

Average response 0 TBG: 3.7 TIP = 0 NET

Sampling Tedlar Bag

H2S response: 0 Cal/standard:

OVA reading 7 BG: 7 = 0 NET Cal/standard:

Other O2: [illegible] % Cal/standard:

F.C.S response: Cal/standard:

LEL: 0

CO: 0

Decontamination

Soil gas probe: CL

Tubing:

Pump:

Other:

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-20-90

MECALF & EDDY, INC.

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Description of sampling location: VP 23
Personnel onsite: DMB & ED [illegible]

Weather
Temperature
Barometric pressure
General condition
Wind direction

Soil type
Size
Grading
Color
Moisture
Density
Porosity
Character

Soil Gas Parameters/Mesurements:

Real-Time Reading

Air pump flow rate: Hand 2 ml - D pumps - 3.75
Probe depth: 50' 24' pullup
Time of pumping: start: 10 20 finish: 10 25
Soil gas volume purged: 3 vols = 2.255 l
Background air reading: 1.9 TIP OVA = 4 BG
TIP response 3 readings: 1 71 TIP 2 80 OVA 3 H2S = 0 LEL = 6%
Average response @ 5 BG: 90 = 85 ppm NET TIP

Sampling Tedlar Bag

H2S response: 1 ppm Cal/standard:
OVA reading @ 2 BG: 2 ppm Cal/standard:
Other O2: 6 2 % Cal/standard:
F.C.3 response Cal/standard:
LEL 14
CH4 15 ppm

Decontamination
Soil gas probe: ok
Rod
Pump
Other

REMARKS: O2 deficient, methane recorded during real-time testing - however testing from Tedlar bag detected no methane

SOIL GAS SAMPLING DATA

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-20-90

MECALF & EDDY, INC.

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Description of sampling location: VP 24
Personnel onsite: DMB & ED Powers

Weather
Temperature: +80°F
Barometric pressure: 29.92
General condition: Hot
Wind direction: None

Soil Type
Size: MED FNE SAND & SILT
Grading: SLI - MED
Color: BRN
Moisture: MOIST
Density:
Porosity: LOW
Character:

Soil Gas Parameters/Mesurements:

Purging Readings

Air pump flow rate: HAND AMP - 8 Pumps - 3.0 L
Probe depth: 27" 12" pull-up
Time of purging: start: 1000 finish: 1015
Soil gas volume purged: 3 vols = 2 L
Background air reading: -0, TIP OVA = 12/14 BG
TIP response 3 readings: 1 36 TIP 2 OVA = 700 3 H_2S = 0 LEL = 0
Average response 1.6 BG: 50 = 44 ppm NET TIP

Sampling Readings BG

H2S response: 0 - 1 ppm Cal/standard:
OVA reading & BG: >1000 Cal/standard: BG after OVA = 8 ppm
Other O_2: 13% Cal/standard:
F.C.G response Cal/standard:
LEL 7%
CO 3 ppm

Decontamination
Soil gas probe:
Tubing:
Pump:
Other:

REMARKS: H_2S odor, AMBIENT AIR OVA = 3.8 ppm ckd w/zero air OVA = 12, detected 2.6 ppm methane HOT AREA.

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005048
Location: Tukeme N.Y.
Date: 7-20-90

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Description of sampling location: VP 25
Personnel onsite: DMB + ED [illegible]

Weather
Temperature: +80°F
Barometric pressure: 29 92
General condition: SUNNY
Wind direction: NO WIND

Soil type
Size: MED SAND AND GRAVEL
Grading: MOD
Color: MED BRN
Moisture: SLI MOIST
Density:
Porosity: MOD
Character:

Soil Gas Parameters/Measurements:

Reading Bkg · Time Readings

Air pump flow rate: HAND PUMP - 8 PUMPS = 3 [illegible]
Probe depth: 32" 24' [illegible]
Time of purging: start: 0930 finish: 0950
Soil gas volume purged: 3vol = 2245 l
Background air reading: 0 TIP OVA = 1 BG
TIP response 3 readings: 1 8 5 ppm TIP 2 38 OVA 3 H_2S = 0 ppm
Average response 0 BG: 1 ppm TIP.

Summa TEDLAR BAG

H2S response: 0 Cal/standard:
OVA reading 1.3 BG: 14 = 0 1 Cal/standard:
Other O_2: 14.5% Cal/standard:
F.C.D response: Cal/standard:
LEL: 0
CO: 0

Decontamination
Soil gas probe: ok
Tubing
Pump
Other

REMARKS: HWAY TRAFFIC POSS AFFECTED. OVA = 4ppm contaminati

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 505040
Location: Tuxedo N.Y.
Date: 7-18-90

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Description of sampling location: VP-26
Personnel onsite: DS & DMB

Weather
Temperature: 70°F
Barometric pressure: 30.4
General condition: NICE
Wind direction: NONE

Soil type
Size: MED SAND & GRAVEL
Grading: WELL
Color: BRN
Moist: MOIST
Density:
Porosity: AVG
Character:

Soil Gas Parameters/Mesurements:

[illegible] Real-Time Readings

Air pump flow rate: HAND PUMP Bflop = 3 vols
Probe depth: 42" 24" pullup
Time of purging: start: 1400 finish: 1420
Soil gas volume purged: 3 vol = 2245
Background air reading: 5.7 TIP OVA = 1.84
TIP response: 1 13 TIP 2 OVA - 2 ppm 3
3 readings
Average response 4784 35.5 = 30.8 ppm NET TIP

Sample Tedlar Bag

H2S response: 0 Cal/standard:
OVA reading O2: 0.0 (BG 8.6ppm) Cal/standard:
Other O2: 20.9% Cal/standard:
F.C.G response Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: ok
Tubing: |
Pump: |
Other:

REMARKS: ~50 FT. Due west of manhole

SOIL GAS SAMPLING DATA

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-18-90

MECALF & EDDY, INC.

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Description of sampling location: VP 27
Personnel onsite: DS + DMB

Weather
Temperature: 70°F
Barometric pressure: 30 v
General condition: NICE
Wind direction: NONE

Soil type
Size: GRAVEL, MED SAND, SOME SILT
Grading: WELL
Color: BRN - LT BRN
Moisture: SL (DRY) MOIST
Density:
Porosity: HIGH
Character:

Soil Gas Parameters/Measurements:

PURGING REAL TIME READING

Air pump flow rate: HAND PUMP - 8 PUMPS = 3.0 L
Probe depth: 43' 2v" pulled
Time of purging: start: 845 finish: 855
Soil gas volume purged: 3.0 L = 2.245 L
Background air reading: 2.8 TIP OVA 0.0 BG
TIP response 1 11.7 TIP 2 [illegible] 3 [illegible]
3 readings

TEDLAR SAMPLE BAG.

Average response 40 BG 25.1 TIP = 211 ppm NET

H2S response: 0 Cal/standard:
OVA reading 0 BAG: 0 Cal/standard:
Other O_2: 14.3% Cal/standard:
F.I.D response: Cal/standard:
LEL: 0
Decontamination CO: 0

Soil gas probe: ok
Tubing: |
Pump: |
Other: |

REMARKS: VOC detected on TIP - poss non H2O compounds

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-18 90

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Description of sampling location: VP 28
Personnel onsite: DS + DMB

Weather
Temperature: ±75°F
Barometric pressure: 30.4
General condition: FAIR
Wind direction: NONE

Soil Type
Size: MED SAND, GRAVEL, SOME SILT
Grading: WELL
Color: BRN
Moisture: MOIST
Density:
Porosity: MED
Character:

Soil Gas Parameters/Measurements:
PURGING NEAR -[illegible]
Air pump flow rate: HAND PUMP - 8 PUMPS = 3.05
Probe depth: 36" 24" pull-up
Time of purging: start: 1825 finish: 1835
Soil gas volume purged: 3 vol = 2.295 l
Background air reading: 3.7 TIP OVA = .9 02
TIP response 3 readings: 1 18.6 TIP 2 OVA = 0 3 H_2S = 0

SAMPLE ~~AFTE~~ TEDLAR BAG ETC.
Average response 3.834 36.2 ppm TIP - 32.9 NET
H2S response: 0 Cal/standard:
OVA reading: 0 Cal/standard:
Other O_2: .4 6 % Cal/standard:
F.C.G response: Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: OK
Tubing
Pump
Other

REMARKS: 32.9 ppm TIP of VOC excluding H_2S.

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-18-90

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Description of sampling location: VP 29
Personnel onsite: DS + DMR

Weather
Temperature: + 75°F
Barometric pressure: 30.04
General condition: Nice
Wind direction: None

Soil type
Size: FINE SAND - SILT + SOME GRAVEL
Grading: m.D
Color: Dr BRN
Moisture: + moist
Density:
Porosity: low
Character:

Soil Gas Parameters/mesurements:

PURGING RDG TIME READING

Air pump flow rate: HAND PUMP - 6 PUMPS = 3 ws
Probe depth: 42" 24" purge
Time of purging: start: 1752 finish: 1805
Soil gas volume purged: 3 vol = 2 LGS Q
Background air reading: 6.1 TIP OVA = 3 / BG.
TIP response 3 readings: 1 11.4 TIP 2 OVA = 0 3 H2S = 0 LEL = 0-1%
Average response 5 2 BG: 22.4 = 17.2 ppm NET

SAMPLE READING OVA

H2S response: 0 Cal/standard:
OVA reading 2 2 BG: - (BG - 3C) Cal/standard:
Other O2: 20.8 Cal/standard:
P.C.D response Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: ck
Tubing:
Pump:
Other:

REMARKS: 17.2 ppm Tip reading

SOIL GAS SAMPLING DATA

METCALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: [illegible] N.Y.
Date: 7-18-90
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Description of sampling location: VP-30
Personnel onsite: DS & DAB

Weather
Temperature: 78 °F
Barometric pressure: 30.04
General condition: HUMID
Wind direction: NONE

Soil type
Size: FINE SAND & SILT, SOME CLAY
Grading: POOR
Color: DK RED
Moisture: V. MOIST
Density:
Porosity: LOW
Character:

Soil Gas Parameters/Measurements:

PURGING REAL-TIME READS

Air pump flow rate: HAND PUMP - [illegible] - 3 L/S
Probe depth: 41"
Time of purging: start: 1730 finish: 1745
Soil gas volume purged: 3 vols = 1.295 l
Background air reading: 4.2 TIP OVA = 1.0 CO - 0 ppm
TIP response 3 readings: 1 8 TIP 2 OVA = 1.1 3 $H_2S = 0$ $O_2 = 24.4\%$

SAMPLING TEDLAR BAG

Average response 3 + BG: 15 ppm = 11.6 ppm NET TIP
H2S response: 0 Cal/standard:
OVA reading 2 + BG: 2.1 = Background Cal/standard:
Other O_2: 20% Cal/standard:
F.C.G response Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: OK
Tubing: |
Pump: |
Other: |

REMARKS: TIP READS 11.6 ppm above background

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: [illegible]

Page 21 of [illegible]

Description of sampling location [illegible]
Personnel onsite [illegible]

Weather
Temperature [illegible]
Barometric pressure [illegible]
General condition [illegible]
Wind direction [illegible] N [illegible]

Soil type
Size [illegible]
Grading [illegible]
Color [illegible]
Moisture [illegible]
Density
Porosity [illegible]
Character

Soil Gas Parameters/mesurements:
Air pump flow rate [illegible]
Probe depth 4' 24' [illegible]
Time of purging: start: 449 finish: [illegible]
Soil gas volume purged [illegible]
Background air reading [illegible]
TIP response 1 7+ TIP 2 [illegible] 3 [illegible]
3 readings
Average response TIP [illegible]

H2S response — Cal/standard:
OVA reading [illegible] Cal/standard:
Other O2 [illegible] Cal/standard:
F.C.G response Cal/standard:
LEL [illegible]
CO [illegible]

Decontamination
Soil gas probe [illegible]
Tubing
Pump
Other

REMARKS:

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-18 '90
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Description of sampling location: VP 32
Personnel onsite: [illegible] & [illegible]

Weather
Temperature: ~ 90°F
Barometric pressure: 30.10
General condition: HOT
Wind direction: NONE

Soil type
Size: SILT & FINE SAND, SOME CLAY
Grading: POOR
Color: BROWN
Moisture: SL. MOIST - WET
Density:
Porosity: LOW
Character:

Soil Gas Parameters/mesurements:
Air pump flow rate: HAND [illegible] 8 [illegible]
Probe depth: 40 26 [illegible]
Time of purging: start: 1425 finish: [illegible]30
Soil gas volume purged: [illegible]
Background air reading: 2.4 TIP OVA [illegible]
TIP response 1 40 TIP 2 [illegible] 3 [illegible]
3 readings
Average response [illegible] 6.1 [illegible] ppm NET TIP

H2S response: 0 Cal/standard:
OVA reading [illegible]: ND Cal/standard:
Other O2: 19.6 Cal/standard:
F.C.G response: Cal/standard:
LEL 0
CO 0

Decontamination
Soil gas probe: ok
Tubing:
Pump:
Other:

REMARKS: NOT DETECTED

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Peremeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-15-96

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Description of sampling location: VP-[illegible]
Personnel onsite:

Weather
Temperature: 80 °F
Barometric pressure: 30 in
General condition: [illegible]
Wind direction: [illegible]

Soil type
Size: [illegible] & silt
Grading: [illegible]
Color: [illegible]
Moisture: [illegible] - wet
Density:
Porosity: [illegible]
Character:

Soil Gas Parameters/measurements:
Air pump flow rate: [illegible]
Probe depth: 3.8' [illegible]
Time of purging: start: 1407 finish: 1420
Soil gas volume purged: [illegible]
Background air reading: 2.7 TIP [illegible]
TIP response 1 3.4 TIP 2 0.8 [illegible] 3 H2O - [illegible]
3 readings
Average response [illegible]

H2S response: 0 Cal/standard:
OVA reading [illegible] Cal/standard:
Other O_2 [illegible] Cal/standard:
F.C.G response Cal/standard:
LEL 0%
CO 0
Decontamination
Soil gas probe: [illegible]
Tubing:
Pump:
Other:

REMARKS:

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7 17 90

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Description of sampling location VP-34
Personnel onsite [illegible]

Weather
Temperature 80 °F
Barometric pressure 30.40
General condition Sunny
Wind direction SW [illegible]

Soil type
Size MED SD & SILT
Grading MED
Color BRN
Moisture V. MOIST - WET
Density
Porosity Low
Character

Soil Gas Parameters/Measurements:
Air pump flow rate [illegible]
Probe depth [illegible]
Time of purging: start: 440 finish: 450
Soil gas volume purged [illegible]
Background air reading [illegible]
TIP response 1 [illegible] 2 [illegible] 3 [illegible]
3 readings
Average response [illegible] ppm

H2S response 1 ppm Cal/standard:
OVA reading [illegible] Cal/standard:
Other [illegible] 17.6 % Cal/standard:
F.C.G response Cal/standard:
LEL [illegible]

Decontamination
Soil gas probe OK
Tubing
Pump
Other

REMARKS: 2FT AWAY FM TELEPHONE [illegible]

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005048
Location: Tuxedo N.Y.
Date: [illegible]

Page [illegible] of [illegible]

Description of sampling location: [illegible]
Personnel onsite: [illegible]

Weather
- Temperature: [illegible]
- Barometric pressure: [illegible]
- General condition: [illegible]
- Wind direction: [illegible]

Soil type
- Size: [illegible]
- Grading: [illegible]
- Color: [illegible]
- Moisture: [illegible]
- Density:
- Porosity: [illegible]
- Character:

Soil Gas Parameters/Mesurements:
- Air pump flow rate: [illegible]
- Probe depth: [illegible]
- Time of purging: start: [illegible] finish: [illegible]
- Soil gas volume purged: [illegible]
- Background air reading: [illegible]
- PID response: 1 [illegible] 2 [illegible] 3 [illegible]
- 3 readings
- Average response: [illegible]

- H2S response: [illegible] Cal/standard:
- OVA reading: [illegible] Cal/standard:
- Other: [illegible] Cal/standard:
- F.C.G response: Cal/standard:

Decontamination
- Soil gas probe: [illegible]
- Tubing:
- Pump:
- Other:

REMARKS: A [illegible] truck [illegible] the [illegible] of the [illegible] Sampling location [illegible]

SOIL GAS SAMPLING DATA

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: [illegible]

Page [illegible] of [illegible]

Description of sampling location [illegible]
Personnel onsite [illegible]

Weather
Temperature [illegible]
Barometric pressure [illegible]
General condition [illegible]
Wind direction [illegible]

Soil type
Size [illegible]
Grading [illegible]
Color [illegible]
Moisture [illegible]
Density
Porosity low
Character

Soil Gas Parameters/Mesurements:
Air pump flow rate [illegible]
Probe depth [illegible]
Time of purging: start: [illegible] finish: [illegible]
Soil gas volume purged [illegible]
Background air reading [illegible]
PID response 1 [illegible] 2 [illegible] 3 [illegible]
3 readings
Average response [illegible]

H2S response [illegible] Cal/standard:
OVA reading [illegible] Cal/standard:
Other [illegible] Cal/standard:
F.C.G response Cal/standard:

Decontamination
Soil gas probe [illegible]
Tubing
Pump
Other

REMARKS: [illegible]

SOIL GAS SAMPLING DATA

Project: Peremeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: [illegible]

MECALF & EDDY, INC.

Page [illegible] of [illegible]

Description of sampling location: [illegible]
Personnel onsite: [illegible]

Weather
- Temperature: [illegible]
- Barometric pressure: [illegible]
- General condition: [illegible]
- Wind direction: [illegible]

Soil type
- Size: [illegible]
- Grading: [illegible]
- Color: [illegible]
- Moisture: [illegible] WET
- Density:
- Porosity: [illegible]
- Character:

Soil Gas Parameters/Mesurements:
- Air pump flow rate: [illegible]
- Probe depth: [illegible]
- Time of purging: start: [illegible] finish: [illegible]
- Soil gas volume purged: [illegible]
- Background air reading: [illegible]
- TIP response 3 readings: 1 [illegible] 2 [illegible] 3 [illegible]
- Average response: [illegible]
- H2S response: [illegible] Cal/standard:
- OVA reading: [illegible] Cal/standard:
- Other: [illegible] Cal/standard:
- F.C.G response: [illegible] Cal/standard:

Decontamination: [illegible]
- Soil gas probe: [illegible]
- Tubing:
- Pump:
- Other:

REMARKS: NOT DETECTED

DAILY FIELD OPERATION LOG

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7 [illegible] 92

Page ____ Of ____

Description of sampling location: SITE TRAILER
Personnel onsite: [illegible] D'BENAL BILL D, MIKE L, ED [illegible], MARTY H
[illegible] BARNES - DEC

TIME	FIELD OPERATION
9 [illegible]	ARRIVE ONSITE
	UNLOAD EQUIPMENT - REVIEW H&S PLAN
[illegible]	[illegible]
1 [illegible]	WALK THROUGH AROUND PARAMETER
[illegible]	[illegible] PROBES
[illegible]	LUNCH
[illegible]	SURVEY N NORTH LINE -
4 [illegible]	INSTALL PROBES -
[illegible]	STAKED [illegible] ALONG [illegible] FROM NORTH TO SOUTH
	END OF DAY

REMARKS:

DAILY FIELD OPERATION LOG

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7 12 90

Page 2 Of

Description of sampling location - HEAVY RAIN
Personnel onsite MARTY, MIKE, DMB, DSprague

TIME	FIELD OPERATION
8:30	ARRIVE ON SITE
	INSTALL PROBES ALONG RR TRACK - 14 PROBES
12:30	LUNCH
1:00	INSTALL 14 PROBES ALONG WEST SIDE ALONG ROAD #17.
4 pm	[illegible] ACCESS of more S.V equipment
	25 [illegible] [illegible] APPARATUS
5:30	END OF DAY

REMARKS:

DAILY FIELD OPERATION LOG

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7 13 - 90 Fri.
Page 3 Of

Description of sampling location [illegible]
Personnel onsite [illegible], Dave, Mike, GD

TIME	FIELD OPERATION
8:30	ARRIVE ONSITE
	DECON REMAINING PROBES
10:00	INSTALL REMAINING PROBES ALONG SOUTH SIDE
	OF SITE AND ALONG WEST SIDE [illegible]
11:00	[illegible]
12:45	CONT INSTALLATION
1400	SURVEY IN ALL PROBES ON SITE
	47 TOTAL PROBES -
16:00	COMPLETE INSTALLATION & SURVEY
	END OF DAY

REMARKS:

DAILY FIELD OPERATION LOG

[illegible]

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005048
Location: Yukemo N.Y.
Date: 7-16-96
Page 1 Of

Description of sampling location: - [illegible]
Personnel onsite: [illegible], [illegible], [illegible] AND [illegible]

TIME	FIELD OPERATION
[illegible]	ARRIVE ON SITE
	CALIBRATE [illegible] [illegible] EQUIPMENT
	WAITING ON [illegible] [illegible] [illegible] [illegible] ([illegible] [illegible]) [illegible] [illegible] [illegible] [illegible]
[illegible]	SYSTEM CHECK - DETERMINE [illegible] [illegible] AND AFFECT ON SAMPLING
	[illegible] - [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
	[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
	150 ppm ON TIP [illegible] MEASUREMENT [illegible] [illegible] [illegible] BAR
	OVA FLAME OUT
[illegible]	END OF DAY

REMARKS:

DAILY FIELD OPERATION LOG

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7 [illegible]

Page 5 of

Description of sampling location [illegible] 32 1
Personnel onsite [illegible]

TIME	FIELD OPERATION
8 am	Arrive on site
	Calibrate monitor [illegible], check pump flow
9:50	Called Mack – got [illegible]
[illegible]	Sampled [illegible]
	[illegible]
	Did not detect any elevated gas [illegible] from [illegible]
[illegible]	– [illegible] – [illegible] lightning [illegible]
[illegible]	Called [illegible] – decided to [illegible]
[illegible]	Sample [illegible] 2 –
[illegible]	[illegible]
	slight [illegible]
[illegible]	[illegible]
[illegible]	– End of day

REMARKS:

DAILY FIELD OPERATION LOG

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tukede N.Y.
Date: 7-18 9[illegible]

MECALF & EDDY, INC.

Page ______ Of ______

Description of sampling location: [illegible]
Personnel onsite: [illegible], [illegible], [illegible], DS, GD, DMB

TIME	FIELD OPERATION
8 [illegible]	ARRIVE ONSITE
	[illegible] [illegible] [illegible] [illegible] - Sampling [illegible] [illegible]
	[illegible] [illegible] [illegible] of monitoring instruments
8 [illegible]	DS helps Math [illegible] [illegible].
	TIP Cal 52 isobut
	C Reset
	51 isobut
	TIP [illegible] 70 C ppm BTX = 10 ppm each, 3 components STANDARD
	[illegible]: TIP reads 51 ppm of isobut.
	45 ppm BTX.
	→ [illegible] [illegible] [illegible] [illegible]
	[illegible] 100 ppm methane -
	[illegible]: only [illegible] H_2S & high [illegible] of LEL
[illegible]	[illegible] [illegible] [illegible] [illegible] BTX. [illegible]
[illegible]	[illegible] [illegible] [illegible] [illegible]
	Sample [illegible] 4 - 6 & [illegible] [illegible] SS
	[illegible] [illegible] [illegible] [illegible]
[illegible]	[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
	[illegible]
[illegible]	[illegible] [illegible] [illegible] [illegible] [illegible]
2[illegible]	[illegible] [illegible] - [illegible] of [illegible]
	[illegible] [illegible] [illegible] [illegible] methane per [illegible]

REMARKS:

DAILY FIELD OPERATION LOG

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-19-96

Page ____ Of ____

Description of sampling location: Fence, Boundary
Personnel onsite: JS + MB

TIME	FIELD OPERATION
[illegible]	Arrive on site BP = 30.02
	dropping from yesterday evening which was
	7-18-96 → 30.17
	[illegible]
	[illegible]
[illegible]	[illegible]

REMARKS:

DAILY FIELD OPERATION LOG

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005048
Location: Tukwila W.A.
Date: [illegible]

Page ____ Of ____

Description of sampling location [illegible]
Personnel onsite [illegible]

TIME	FIELD OPERATION
	[illegible]
	[illegible]
	[illegible] [illegible] VP 24 - VP 26
	[illegible] had nothing.
	A ENGLISH Truck [illegible] LANDFILL [illegible]
	TO BE [illegible] VP [illegible] location [illegible] underground drum
	[illegible] that was [illegible] on [illegible].
[illegible]	Completed Sampling
[illegible]	[illegible] Tedlar bags w/ FCC
	[illegible]

REMARKS:

DAILY FIELD OPERATION LOG

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-23-[illegible]
Page ______ Of ______

Description of sampling location: [illegible] [illegible]
Personnel onsite: [illegible] [illegible] [illegible]

TIME	FIELD OPERATION
[illegible]	Arrive [illegible] [illegible] [illegible]
	Check [illegible] [illegible] [illegible] on west side
	of [illegible] ? [illegible] [illegible] [illegible] The soil conditions.
	It appears that the soils are [illegible] [illegible]
	for sampling probes [illegible] [illegible] [illegible]
	[illegible] [illegible] [illegible] [illegible] [illegible]
	[illegible] [illegible] [illegible] [illegible] [illegible] 10" [illegible] [illegible]
	[illegible] [illegible] [illegible] @ 5 [illegible] [illegible]
	It is recommended that [illegible] [illegible] [illegible]
	[illegible] [illegible] [illegible] [illegible] when the soil
	is dry and during [illegible] [illegible]
	[illegible]

REMARKS:

SOIL GAS INSTRUMENTATION CALIBRATION

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-11-90

Page 1 Of 1

INSTRUMENT	OVA	TIP	H2S /[illegible]	F.G.C.
Model No.	128	PHOTOVAC	Bacharach Sentinel 4 Cal 3-9-90	
CALIBRATION GAS:				
Manufacturer	Century			
Identification (Lot#)				
Concentration	[illegible]	95.5 ppm		
Reading/Adjustment	✓	50 ppm		
Ultra Zero Air:				
Manufacture				
Identification (Lot#)				
Reading/Adjustment	0	[illegible]		
Time Calibrated:	1100	1045	10 45	
Calibrated By:	[illegible]	D. Spencer	Ed Burns	

Calibration Check		OVA	TIP	H2S	F.G.C.
1	Time:				
	By:				
2	Time:				
	By:				
3	Time:				
	By:				
4	Time:				
	By:				
5	Time:				
	By:				
6	Time:				
	By:				
7	Time:				
	By:				
8	Time:				
	By:				
9	Time:				
	By:				
10	Time:				
	By:				

REMARKS: walk through along perimeter of site
all equipment is ok

SOIL GAS INSTRUMENTATION CALIBRATION

MECALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 905040
Location: Tuxedo N.Y.
Date: [illegible]

Page [illegible] of 6

INSTRUMENT	OVA	TIP	HPS	F.G.C.
Model No.	128GC	[illegible]	[illegible]	
CALIBRATION GAS:				
Manufacturer	[illegible]			
Identification (Lot#)				
Concentration	[illegible]		[illegible]	
Reading/Adjustment	100ppm	[illegible]		
Ultra Zero Air:				
Manufacture		Scott		
Identification (Lot#)				
Reading/Adjustment	0	0		
Time Calibrated:	1630	1530	[illegible]	
Calibrated By:	[illegible]	[illegible]	[illegible]	

Calibration Check		OVA	TIP	HPS	F.G.C.
1	Time:				
	By:				
2	Time:				
	By:				
3	Time:				
	By:				
4	Time:				
	By:				
5	Time:				
	By:				
6	Time:				
	By:				
7	Time:				
	By:				
8	Time:				
	By:				
9	Time:				
	By:				
10	Time:				
	By:				

REMARKS: single standard calibration using 100ppm methane - electronic [illegible] calibration

SOIL GAS INSTRUMENTATION CALIBRATION

METCALF & EDDY, INC.

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-17-90

Page 3 of 6

INSTRUMENT	OVA	TIP	H2S [illegible]	F.G.C.
Model No.	120	Thermo		
CALIBRATION GAS:				
Manufacturer			[illegible]	
Identification (Lot#)				
Concentration	100 ppm	75		
Reading/Adjustment	[illegible]	[illegible]		
Ultra Zero Air:				
Manufacture		Scott		
Identification (Lot#)				
Reading/Adjustment	0	0		
Time Calibrated:	8 30	~~DS~~ 8 15	8 20	
Calibrated By:	DS	DAB	DS	

Calibration Check					
1	Time:				
	By:				
2	Time:				
	By:				
3	Time:				
	By:				
4	Time:				
	By:				
5	Time:				
	By:				
6	Time:	[illegible]	[illegible]		
	By:	DS	DS		
7	Time:				
	By:				
8	Time:				
	By:				
9	Time:				
	By:				
10	Time:				
	By:				

REMARKS:

SOIL GAS INSTRUMENTATION CALIBRATION

Project: Perimeter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-13-90

METCALF & EDDY, INC.

Page 4 Of 6

INSTRUMENT	OVA	TIP	H2S	F.G.C.
Model No.	128	Photvac	[illegible]	
CALIBRATION GAS:				
Manufacturer			[illegible]	
Identification (Lot#)				
Concentration	100	95		
Reading/Adjustment	100	52		
Ultra Zero Air:				
Manufacture	[illegible]	[illegible]		
Identification (Lot#)				
Reading/Adjustment	0	0		
Time Calibrated:	8:30	9:30	[illegible]	
Calibrated By:	DS	DS	DS	

Calibration Check

1	Time:				
	By:				
2	Time:				
	By:				
3	Time:				
	By:				
4	Time:				
	By:				
5	Time:	1400	1400		
	By:	DS	DS		
6	Time:				
	By:				
7	Time:				
	By:				
8	Time:				
	By:				
9	Time:				
	By:				
10	Time:				
	By:				

REMARKS:

SOIL GAS INSTRUMENTATION CALIBRATION

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tuxedo N.Y.
Date: 7-19-90

METCALF & EDDY, INC.

Page 4 of 6

INSTRUMENT	OVA	TIP	HNU C/C	F.O.C.
Model No.	Foxborough	Photovac	[illegible]	
CALIBRATION GAS:				
Manufacturer		Alph..		
Identification (Lot#)		/		
Concentration	[illegible] ppm	107		
Reading/Adjustment	[illegible] ppm	[illegible]		
Ultra Zero Air:				
Manufacture	[illegible]	[illegible]		
Identification (Lot#)	[illegible]			
Reading/Adjustment	[illegible]	0		
Time Calibrated:	[illegible]	[illegible]		
Calibrated By:	[illegible]	[illegible]		

		OVA	TIP	HNU C/C	F.O.C.
Calibration Check					
1	Time:				
	By:				
2	Time:				
	By:				
3	Time:				
	By:				
4	Time:	1000	1000		
	By:	DS	DJ		
5	Time:				
	By:				
6	Time:				
	By:				
7	Time:				
	By:				
8	Time:				
	By:				
9	Time:				
	By:				
10	Time:				
	By:				

REMARKS:

SOIL GAS INSTRUMENTATION CALIBRATION

MECALF & EDDY, INC.

Project: Parameter Soil Gas Survey
Contract: No. 005040
Location: Tukedo N.Y.
Date: 7 - 20 - 90

Page 6 Of [illegible]

INSTRUMENT	OVA	TIP	NZS	F.G.C.
Model No.	[illegible]	Photo[illegible]	[illegible]	
CALIBRATION GAS:				
Manufacturer				
Identification (Lot#)				
Concentration	100	[illegible]		
Reading/Adjustment	[illegible]	[illegible]		
Ultra Zero Air:				
Manufacture				
Identification (Lot#)				
Reading/Adjustment	[illegible]	0		
Time Calibrated:	[illegible]	5:30	[illegible]	
Calibrated By:	[illegible]	[illegible]	DBS	

Calibration Check

		OVA	TIP	NZS	F.G.C.
1	Time:				
	By:				
2	Time:				
	By:				
3	Time:				
	By:				
4	Time:				
	By:				
5	Time:	[illegible]	[illegible]	[illegible]	[illegible]
	By:				
6	Time:				
	By:				
7	Time:				
	By:				
8	Time:				
	By:				
9	Time:				
	By:				
10	Time:				
	By:				

REMARKS:

New York State
Department of Environmental Conservation
Division of Hazardous Waste Remediation

TUXEDO WASTE DISPOSAL SITE

Site ID # 3-36-035

PHASE I
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

APPENDIX I

BASELINE EMISSIONS ESTIMATE INTERIM DATA REPORT

by Alliance Technologies Corp
November, 1990

NOVEMBER 1991

Prepared By:

Metcalf and Eddy of New York, Inc.

BASELINE EMISSIONS ESTIMATE FOR TUXEDO WASTE DISPOSAL SITE

Interim Data Report

November 1990

ALLIANCE
Technologies Corporation

BASELINE EMISSIONS ESTIMATE FOR TUXEDO WASTE DISPOSAL SITE TUXEDO PARK, ORANGE COUNTY, NEW YORK.

Interim Data Report

Prepared for

METCALF AND EDDY OF NEW YORK, INC
60 East 42nd Street
New York, N Y 10165

Metcalf and Eddy Subcontract No 90-005019-001
Work Assignment - (D002406-1)
(Alliance 2-093-001-0-0000-X)

November 1990

ALLIANCE TECHNOLOGIES CORPORATION
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
(508) 970-5600

ALLIANCE

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1.0 INTRODUCTION

Alliance Technologies Corporation was retained by Metcalf and Eddy of New York Inc. to perform a Baseline Emissions Estimate (BEE) of air emissions originating from the Tuxedo Waste Disposal Site in Tuxedo Park, Orange County, New York. The BEE is being conducted in three tasks:

1. Development of a Project Management Work Plan,
2. Development of a Final Work Plan; and
3. Field measurements for the BEE.

Task 3, which itself is being conducted in 2 phases, was designed to make use of four techniques to air emissions:

a. A preliminary survey using hand held instruments and taking measurements at gridded points throughout the landfill.
b. A survey of the site using punch bar extractive and swept soil gas probes
c. Isolation flux chambers at six points on the landfill and
d. Upwind/downwind monitors on the perimeter of the site as well as off-site

Meteorological monitoring for wind speed and direction was also conducted

To date, the preliminary survey, extractive gas punch bar survey, and one set of swept gas, flux chamber and ambient monitoring (of two sets planned) have been conducted. Activities were conducted on the following dates:

Preliminary Survey	31 July 1990
Extractive Soil Gas Survey	15-17 August 1990
Swept Probe Soil Gas Survey	3-4 October 1990
Hydrogen Sulfide Ambient Air Sampling	3 October 1990
Flux Chamber Measurements (first 3 points)	4 October 1990
Flux Chamber Measurements (second 3 points)	18 October 1990
Meteorological Monitoring	15 August - 15 November 1990

This document reports on data gathered during these activities

1.1 Background

The potential for air emissions from the Tuxedo Waste Disposal Site in Orange County New York, has been shown through three observations

- Air and vent sampling data collected by NYSDEC on 17-18 November 1987 indicate that emissions of such VOCs as toluene, ethylbenzene, perchloroethylene, benzene, trichloroethylene, trans-1,2-dichloroethylene, 1,1-dichloroethane, and methylene chloride are being emitted from two vents and two soil gas vents on the landfill While the sampling program was designed to indicate some sources of emissions, no emission rates or gas generation rates were determined

- Odors have been noted emanating from the site, indicating formation and release of common landfill gases such as hydrogen sulfide

- Sampling conducted by NYSDEC of both soils and soil gas indicate the presence of volatile organic species which are highly likely to be contained in any VOC release from the site

As remediation of the site is being planned, two factors necessitated further characterization of air emissions from the site:

- The need for information on gas generation rates to evaluate remedial alternatives A viable option to waste removal may be containment of the landfill If chosen, it will be necessary to create further information on the release rate and characteristics of the gas for future maintenance treatment. Needed information includes identification and quantitation of major constituents and release rates

- The proximity of receptors both off-site and on-site during remedial activities combined with the potentially hazardous nature of air emissions from the site (i.e., containing toxic or possibly explosive compounds or presence at potentially explosive levels) may create a health or safety hazard at the site. Some characterization of air releases will provide data to allow some assessment of the risk to residents or workers associated with the remedial alternatives under evaluation. This estimation can also be used to determine the need for longer term on-site, off-site or fenceline monitoring.

Given these needs, an air monitoring study was considered to be warranted at this site. However, some constraints and limitations were placed on the study

- Financial restraints limited the size and scope of the investigation. These restrictions limited the number of flux chamber measurements (the method of choice for determining release rates) to twelve (i.e., 6 sampling points on 2 occasions).

- Although guidance on use of Flux Chambers has been developed (EPA 600 8-86/008 Feb. 1986), the limitation on the number of sampling points would not allow total conformance. Alliance followed other aspects of guidance as closely as possible given program limitations, however, the error associated with the number of samples collected was large relative to programs in which closer conformance to the guidance was demonstrated

1.2 Objectives

Given these needs and limitations, the air monitoring portion of this study was designed to produce a limited data base of air emissions from the Tuxedo Waste Disposal Site for use in providing rudimentary input into the selection process for remedial alternatives The data includes information on the characteristics of the emissions (approximate emission rates and composition) and areas in which high emissions can be expected Specific data objectives were to provide a rough estimation of emission rates from the site for the following parameters:

- Specific VOCs:
- H_2S
- Methane:
- Total non-methane hydrocarbons (TNMH).

The primary source of site specific data used in designing the sampling strategy was sampling and analytical data included in Chapter 4 (Site Assessment) of **Engineering Investigations at Inactive Hazardous Waste Sites -- Phase II Investigation Tuxedo Waste Disposal Site** While this information is useful in indicating some parameters for monitoring, its use is limited

2.0 SAMPLING PROCEDURES

Sampling activities consisted of a preliminary site walkover, an extractive gas survey, a sweep gas survey, flux chamber sampling ambient air monitoring and meteorlogical monitoring With the exceptions of the ambient air and meteorlogical monitoring, measurements during the other sampling activities consisted of OVA, HNu, H_2S and on-site GC measurements. On-site Gc was not done during the flux chamber sampling Each of these sampling methods are described briefly below before discussing particular sampling events.

2.1 Organic Vapor Analyzer (OVA)

Air measurements were conducted using a Foxboro Century Model 108 Organic Vapor Analyzer (OVA) The instrument contains a flame ionization detector and is sensitive to methane and non-methane organics. Prior to the start of each sampling event, the OVA was calibrated with known methane standards Calibration consisted of filling a small tedlar bag with a known concentration of methane. The OVA was then attached to the bag and the concentration was read Span knobs were adjusted until the OVA read the same as standard Data from the OVA was read as ppm methane

2.2 HNu

An HNu model PI-101 was used to monitor the air streams for the presence of non-methane organics The unit contains a photo-ionization detector capable of ionizing all compounds whose ionization potential is less than the power of the lamp. Methane has a high ionization potential and is not detected by the HNu. The unit is calibrated as ppm benzene The unit was calibrated the morning on each day that sampling events were to occur Calibration consisted of filling a small tedlar bag with a known concentration of isobutylene, which is then analyzed by the HNu. Span knobs are then adjusted until the HNu reads the same as the standard. Isobutylene has the same response factor as benzene and is used for calibration due to its lower toxicity.

2.3 H_2S Monitor

Alliance used a Portable Neotronics Model 102 Hydrogen Sulfide analyzer Calibration of the unit was performed at the Alliance office prior to going out into the field

2.4 Photovac 10S70 Gas Chromatograph

The Photovac is a field portable GC equipped with a photo-ionization detector. Each day of sampling a standard was run to establish a calibration curve. Standards were prepared by filling a tedlar bag with 20 liters of nitrogen. Known liquid amounts of each compound of interest were injected into the bag and allowed to volatilize. If ppb range standards were desired. a further dilution of the bag was performed by removing an aliquot from the tedlar bag and injecting it into the second bag. This second bag was then allowed to equilibrate

Samples and standards were injected into the GC using a 250 ul gas tight syringe. Retention times of each compound were determined from the standards. The Photovac is designed to print out compound names and concentrations for each sample injected This calculation is based upon a one point calibration

2.5 Preliminary Site Survey

The preliminary survey consisted of walking the site and taking OVA, HNu and H_2S readings at ground level. Alliance took a total of seventeen measurements points .

2.6 Extractive Gas Survey

Extractive gas sampling was conducted on a 100 foot grid points throughout the entire landfill area. The extractive gas sampling device consisted of a hollow aluminum probe which was crimped and perforated at one end. At the opposite end, a one foot length of Teflon tubing was attached by Swagelock fittings. The tubing passed a "T" joint which acted as a sampoling port for the continuous, survey type instruments (OVA, HNu and H_2S monitors) The tubing on the other side of the "T" was connected to a personnel sampling pump. The pump was set at a sampling rate of 1 liter/minute

The extractive soil gas sampling was accompolished by hammering a solid steel rod to a depth of one foot. The rod was then removed and the hollow sampling probe was inserted into the hole and allowed to equilibrate for five minutes To eliminate dilution of the soil gas sample with ambient air native surface soil was compressed at the opening of the hole around the hollow probe A sidestrem of the effluent was screened with the OVA, HNu and H_2S monitors Sample collection for field GC analysis was facilitated by withdrawing ~~aliquots of of sample gas using a gas-tight syringe and then immediately injecting the~~ syringe into the field GC The sample was collected from the effluent stream from a T joint outfitted with a teflon-lined silicon septum. Organics were identified and quantified based upon comparisons to the standard ran at the beginning of the day. As a quality control measure every 10 sample was injected into the GC in duplicate.

2.7 Sweep Gas Probes

Sweep gas probe sampling was conducted at twenty-five points on the landfill The points sampled were determined by M&E and NYSDEC personnel based upon previous studies conducted at the landfill and the extractive gas survey previously performed.

The sampling device for the sweep gas survey was similar to that used for the extractive gas effort, with some modifications to allow introduction of a sweep gas and exposure of soil to allow a measurement of volatile species flux rates. A hollow aluminum probe, open at the bottom end, was placed approximately three inches deep into a 12 inch hole formed by driving a solid steel bar into the ground. At the opposite end of the probe, two lengths of Teflon tubing were attached. One of the Teflon lines (a 1/8" sweep gas feed) was run to within 1" of the bottom of the hole to deliver a steady flow of Zero Grade Air (at approximately 1 liter/minute) to the bottom of the hole. Flows were metered with a magnehelix. The remaining line carried effluent gas through the 1/4" tubing to a "T" joint. A personnel sampling pump was attached to the other side of the "T" and withdrew air at a rate equal to the inflow of Zero grade air.

The sweep gas sampling was accompolished by hammering a solid steel rod to a depth of approximately one foot into the ground. The rod was then removed and the hollow probe assembly described above was inserted into the hole. To minimize dilution of the sweep gas sample with ambient air, native surface soil was compressed at the opening of the hole around the hollow probe. At least three sampling probe volumes were purged prior to sample collection to ensure that the probe and tubing had been flushed with sweep sample gas. A sidestream of the effluent was prescreened with the OVA, HNu and H_2S monitors. Sample collection for field GC analysis was facilitated by withdrawing aliquots of the sample gas using a gas-tight syringe which was the immediately injected into the field GC. The sample was collected from the effluent sampling stream from the "T" joint outfitted with a teflon lined silicon septum.

Flux rates from the sweep gas probes were calculated from the following equation

$$Ex = (Cx \cdot Q) / (3.14 \cdot D \cdot L)$$

where

Ex - Emission rate of compound x (ug/cm^2/sec),

Cx - Concentration of compound x (ug/liter),

Q - Sweep air flow rate (liters/second),

D - Diameter of the punch probe (cm) and

L - Length of the perforated area of the punch probe (cm)

2.8 Flux Chambers

Flux chamber sampling was conducted at six locations on the landfill. Locations were chosen by M&E and NYSDEC personnel. At each location, the area was cleared of all debris and any vegetation was removed so that the chamber could sit on a cleared surface. The flux chambers were embedded one inch into the ground. A zero gas supply was provided and was attached to the ring inside the chamber. The ring inside the chamber contained small holes evenly spaced around the chamber so that purge gas would be introduced uniformly throughout the chamber. When running the purge rate was set at 5 liters/minute. The sample line was attached to an extractive pump. A sample "T" was placed in the line between the flux chamber and the pump. The sample "T" was equipped with a locking quick connect so that a monitor did not need to be continuously connected to the system. When the extractive pump was running, the pump ran at a flow rate of 5 liters/minute to balance the inlet purge rate. A thermocouple was placed inside the flux chamber to continuously monitor temperature. The dead space inside the flux chambers is approximately 32 liters.

When the chamber was set in place, sampling consisted of allowing the purge gas to purge four volumes of the inside of the flux chamber through the sytem. Purging took approximately 30 minutes. After completion of the thirty minute purge cycle OVA measurements were made from the sample "T". When reasonably steady readings were observed by the OVA, sampling into stainless steel canisters began. Original plans called for collecting one stainless steel canister and analyzing it for TO-14 compounds and collecting a tedlar bag sample and analyzing it onsite for non-methane hydrocarbons using a Byron analyzers. A Byron analyzer was not avaliable to the program for on-site work. Therefore, in place of a tedlar bag sample, a second stainless steel cannister sample was collected. This sample was sent to a laboratory for analysis by EPA Method 25C. This analysis provided methane, non-methane and carbon dioxide fractions in the collected samples.

To collect the canister samples, a rotometer was placed in line between the canister and the sample "T" to the flux chamber. The rotometer allowed the flow to be regulated to the canister so that a sample was collected over a period of 10 minutes. Between the rotometer and the tank another "T" was placed in this line. This "T" was connected to a mercury manometer so that initial and final pressures in the tank could be recorded.

Flux rates from the flux chambers were calculated using the following equation

$$Ex = (Yx * MWx * Q) / (24.04 * A)$$

where.

Ex = emission rate of compound x (ug/M2/min).

Yx = concentration of compound x in canister (ppm(v/v)).

MWx = molecular weight of compound x;

Q = flow rate of air into the chamber (5 liters/minute).

24.04 = Molar volume of gas at 20 C;

A = surface area enclosed by the chamber (square meters)

2.9 Hydrogen Sulfide Ambient Air Monitoring

Hydrogen sulfide sampling was conducted at ten locations. The sampling procedure entailed pulling a known volume of air through two midget impingers. Sampling was done following the procedures outlined in ASTM Method 701 "Determination of Hydrogen Sulfide Content of the Atmosphere". The midget impingers contained a alkaliline suspension of cadmium hydroxide. Approximately, 180 liters of sample was pulled through the impingers over an eight hour period. H_2S forms cadmium sulfide when sampled in this matter. The resulting solution was then analyzed at a laboratory by a spectrphotometric method.

2.10 Meteorological Monitoring

Alliance transported a trailer to the site to serve as a place to set up meteorlogical station for a ninety days. A 10 meter tower was constructed at the site. Wind direction, wind speed and temperature were recorded on a continuous basis for ninety days.

3.0 RESULTS

3.1 Preliminary Survey

The results of the site walkover are summarized in Table 1. Seventeen points were sampled throughout the landfill. Figure 1 shows approximate points where measurements were made. Hydrogen sulfide was detected at one location at a concentration of 4 ppm Non-methane hydrocarbons were not detected with the HNu. OVA measurements indicated high methane emissions in the southeast corner of the landfill where a drainpipe exits from underneath the landfill The OVA did not detect significant levels of methane at any other points on the landfill.

3.2 Extractive Gas Punch Bar Survey

The results of the OVA, HNu and H_2S monitoring at each location are summarized in Table 2. In addition to the survey type measurements, Alliance conducted onsite Gas Chromatographic (GC) analysis at each sampling point using a Photovac 10S70. On-site GC results are summarized in Table 3 Extractive gas sampling was done on a 100 ft grid pattern throughout the landfill The PID indicated no significant concentrations of non-methane hydrocarbons emitted from the landfill On-site GC analysis corroborated these findings

Methane concentrations observed with the OVA are shown in Figure 2 Measured hydrogen sulfide concentrations are shown in Figure 3. The 1988 LMS survey indicated a subsurface quantity of hydrogen sulfide at levels greater than 2000 ppm, using Draegor Tubes with an upper quantitation limit of 2000 ppm. The current study, performed at shallower depths, used a portable Neotronics Hydrogen Sulfide monitor.

In comparing this work to the study performed in 1988 by LMS using extractive gas survey techniques, it can be seen that concentrations closer to the surface of the landfill are significantly lower that those in deeper layers. The LMS study, for instance indicated significant concentrations of benzene, toluene, ethylbenzene, xylenes (BTEX) and chloroetheylene compounds at depths of four to six feet. Alliance's findings at one foot depths indicate that no significant levels of BTEX or chloroethylene compounds are migrating to shallower depths and most probably are not being emitted through the surface area of area of the landfill. Hydrogen sulfide, found at at eight locations with the highest concentration observed being 61 ppm, was found at significantly lower concentrations than reported by LMS. This did, however, corroborate geographically with the LMS data in that all detected quantities of hydrogen sulfide were within the area defined by the LMS study as a "hot" area for hydrogen sulfide. Methane data cannot be correlated with the 1988 LMS survey, because methane data was not collected

3.3 Sweep Gas Survey

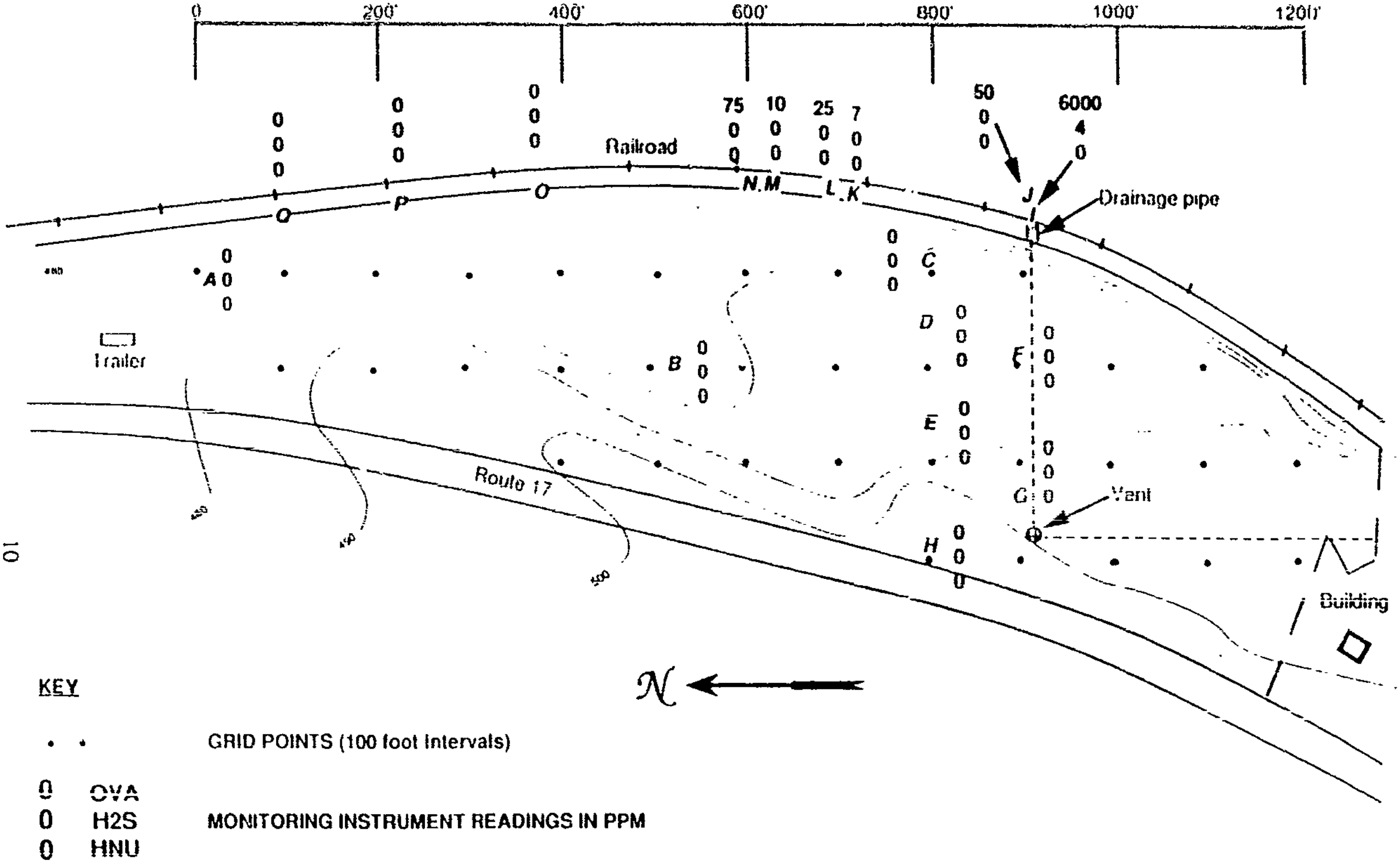
Based upon data obtained during the 1988 LMS study and the results of the extractive gas survey, M&E and NYSDEC chose twenty-five sampling points to conduct swept gas probe

Table 1. Preliminary Survey Results
July 31, 1990

Location ID*	OVA ppm	H2S ppm	HNu ppm
A	BKG	BKG	BKG
B	BKG	BKG	BKG
C	BKG	BKG	BKG
D	BKG	BKG	BKG
E	BKG	BKG	BKG
F	BKG	BKG	BKG
G	BKG	BKG	BKG
H	BKG	BKG	BKG
I	6000	4	**
J	50	BKG	**
K	7	BKG	**
L	25	BKG	**
M	10	BKG	**
N	75	BKG	**
O	BKG	BKG	**
P	BKG	BKG	**
Q	BKG	BKG	**

* = Approximate location of each point is shown in Figure 1.

** = HNu not operational when doing these points



All locations, dimesions and property boundaries are approximate only.

Figure 1. Tuxedo Landfill air monitoring results.

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Table 2. Extractive Soil Gas Survey Results
August 15-16,1990

Location ID	Grid Location	OVA ppm	H2S ppm	HNu ppm
A	1200N, 400E	BKG	BKG	BKG
B	1000N, 500E	50	BKG	BKG
C	800N, 500E	>10000	BKG	BKG
D	800N, 400E	20	BKG	BKG
E	800N, 560E	>10000	BKG	BKG
F	700N, 500E	7	BKG	BKG
G	700N, 600E	180	BKG	BKG
H	600N, 600E	250	BKG	BKG
I	500N, 600E	200	BKG	4
J	500N, 400E	BKG	32	BKG
K	500N, 200E	12	BKG	BKG
L	400N, 200E	900	BKG	9
M	300N, 200E	BKG	61	BKG
N	300N, 300E	7	BKG	BKG
O	300N, 100E	BKG	8	BKG
P	200N, 100E	BKG	57	BKG
Q	200N, 200E	BKG	BKG	BKG
R	100N, 100E	9000	3	BKG
S	0N, 300E	100	11	BKG
T	100N, 300E	300	BKG	BKG
U	200N, 400E	100	BKG	BKG
V	200N, 500E	14	BKG	BKG
W	300N, 500E	40	BKG	BKG
X	400N, 500E	2500	BKG	BKG
Y	400N, 400E	500	8	BKG
Z	600N, 400E	70	BKG	BKG
13	500N, 300E	350	BKG	BKG
14	600N, 300E	550	BKG	BKG
15	600N, 500E	300	BKG	BKG
16	500N, 500E	19	BKG	BKG
17	400N, 300E	20	BKG	BKG
18	300N, 400E	35	BKG	BKG
19	100N, 400E	30	BKG	BKG
20	0N, 400E	35	5	4
21	0N, 200E	BKG	BKG	BKG
22	0N, 100E	BKG	BKG	BKG
23	100N, 200E	11	BKG	9
24	200N, 300E	16	BKG	BKG
25	100N, 480E	BKG	BKG	BKG
26	300N, 550E	BKG	BKG	BKG

Table 2. Cont'd

Location ID	Grid Location	OVA ppm	H2S ppm	HNu ppm
27	400N, 575E	BKG	BKG	BKG
28	700N, 300E	BKG	BKG	BKG
29	700N, 400E	175	BKG	BKG
30	800N, 300E	6	BKG	BKG
31	900N, 500E	>10000	BKG	BKG
32	900N, 400E	1100	BKG	BKG
33	900N, 300E	800	BKG	BKG
34	1000N, 300E	BKG	BKG	2
35	1100E, 300E	BKG	BKG	BKG
36	1000N, 400E	BKG	BKG	BKG
37	1100N, 400E	BKG	BKG	BKG
38	1100N, 500E	BKG	BKG	BKG
39	1200N, 300E	BKG	BKG	BKG
40	1300N, 300E	BKG	BKG	BKG
41	1300N, 400E	BKG	BKG	BKG
42	1400N, 400E	BKG	BKG	BKG
43	1400N, 300E	BKG	BKG	BKG

Table 3. Photovac GC Results from Extractive Gas Survey, August 15-16, 1990

Location ID	Compound	Concentration (ppm)
A	Methylene Chloride	0.41
	Benzene	0.04
B	Toluene	0.59
C	Toluene	0.05
E	Methylene Chloride	1.10
G	Methylene Chloride	1.25
	Benzene	0.03
H	Trans-Dichloro Ethylene	0.03
	Trichloro Ethylene	0.03
I	Methylene Chloride	4.21
	Trans-Dichloro Ethylene	0.04
	Benzene	0.06
J	Methylene Chloride	0.72
	Trans-Dichloro Ethylene	0.01
	Benzene	0.01
K	Methylene Chloride	0.45
	Trans-Dichloro Ethylene	0.14
	Ethyl Benzene	0.07
L	Benzene	0.06
	Perchloro Ethylene	0.01
M	Methylene Chloride	0.55
	Trans-Dichloro Ethylene	0.10
	Ethyl Benzene	0.01
N	Methylene Chloride	1.45
	Trans-Dichloro Ethylene	0.08
O	Methylene Chloride	0.70
	Trans-Dichloro Ethylene	0.10
	Ethyl Benzene	0.01
P	Methylene Chloride	1.04
	Trans-Dichloro Ethylene	0.12

Table 3. Cont'd

Location ID	Compound	Concentration (ppm)
Q	Methylene Chloride	1.15
	Trans-Dichloro Ethylene	0.09
	Benzene	0.06
	Toluene	0.01
R	Methylene Chloride	1.19
	Trans-Dichloro Ethylene	0.13
	Benzene	0.06
	Toluene	0.01
S	Methylene Chloride	0.39
	Trans-Dichloro Ethylene	0.08
T	Methylene Chloride	0.68
	Trans-Dichloro Ethylene	0.04
	Ethyl Benzene	0.02
U	Methylene Chloride	1.34
	Trans-Dichloro Ethylene	0.06
V	Methylene Chloride	0.43
	Trans-Dichloro Ethylene	0.06
W	Methylene Chloride	0.44
	Trans-Dichloro Ethylene	0.09
	Ethyl Benzene	0.01
X	Methylene Chloride	0.50
	Trans-Dichloro Ethylene	0.02
	Ethyl Benzene	0.01
Y	Methylene Chloride	2.26
	Toluene	0.03
	Perchloro Ethylene	0.01
	Ethyl Benzene	0.06
Z	Methylene Chloride	0.63
	Benzene	0.01
	Trichloro Ethylene	0.02
	Toluene	0.02
	Perchloro Ethylene	0.01
	Ethyl Benzene	0.10

Table 3. Cont'd

Location ID	Compound	Concentration (ppm)
13	Methylene Chloride	1.29
	Benzene	0.05
	Ethyl Benzene	0.01
14	Methylene Chloride	1.60
	Trans-Dichloro Ethylene	0.05
	Benzene	0.03
	Ethyl Benzene	0.10
15	Methylene Chloride	0.40
	Ethyl Benzene	0.02
16	Methylene Chloride	0.53
	Benzene	0.01
17	Methylene Chloride	0.31
18	Methylene Chloride	0.35
	Ethyl Benzene	0.01
19	Methylene Chloride	0.40
20	Methylene Chloride	1.01
	Trans-Dichloro Ethylene	0.23
	Benzene	0.20
	Toluene	0.08
21	Methylene Chloride	0.41
	Trichloro Ethylene	0.01
	Ethyl Benzene	0.08
22	Methylene Chloride	0.41
23	Methylene Chloride	0.34
24	Methylene Chloride	0.43
	Trans-Dichloro Ethylene	0.10
25	Methylene Chloride	0.47
	Trans-Dichloro Ethylene	0.08
26	Methylene Chloride	0.46
	Trans-Dichloro Ethylene	0.05
27	Methylene Chloride	0.53
	Trans-Dichloro Ethylene	0.19
28	Methylene Chloride	0.49
	Trans-Dichloro Ethylene	0.24
	Benzene	0.03

Table 3. Cont'd

Location ID	Compound	Concentration (ppm)
29	Methylene Chloride	0.62
	Trans-Dichloro Ethylene	0.24
	Benzene	0.03
30	Methylene Chloride	0.51
	Trans-Dichloro Ethylene	0.25
	Benzene	0.03
	Ethyl Benzene	0.02
31	Methylene Chloride	0.48
	Trans-Dichloro Ethylene	0.18
	Benzene	0.02
	Ethyl Benzene	0.06
32	Methylene Chloride	0.67
	Trans-Dichloro Ethylene	0.53
33	Methylene Chloride	0.65
	Trans-Dichloro Ethylene	0.43
	Benzene	0.05
	Ethyl Benzene	0.01
34	Methylene Chloride	0.45
	Trans-Dichloro Ethylene	0.17
	Ethyl Benzene	0.01
35	Methylene Chloride	0.58
	Trans-Dichloro Ethylene	0.22
	Benzene	0.06
	Ethyl Benzene	0.02
36	Methylene Chloride	0.56
	Trans-Dichloro Ethylene	0.19
	Benzene	0.05
37	Methylene Chloride	0.64
38	Methylene Chloride	0.64
39	Methylene Chloride	0.64
	Trans-Dichloro Ethylene	0.34
	Benzene	0.04
40	Methylene Chloride	0.65
41	Methylene Chloride	0.66
	Trans-Dichloro Ethylene	0.25
	Benzene	0.06
42	Trans-Dichloro Ethylene	0.58
	Ethyl Benzene	0.12
43	Methylene Chloride	0.24

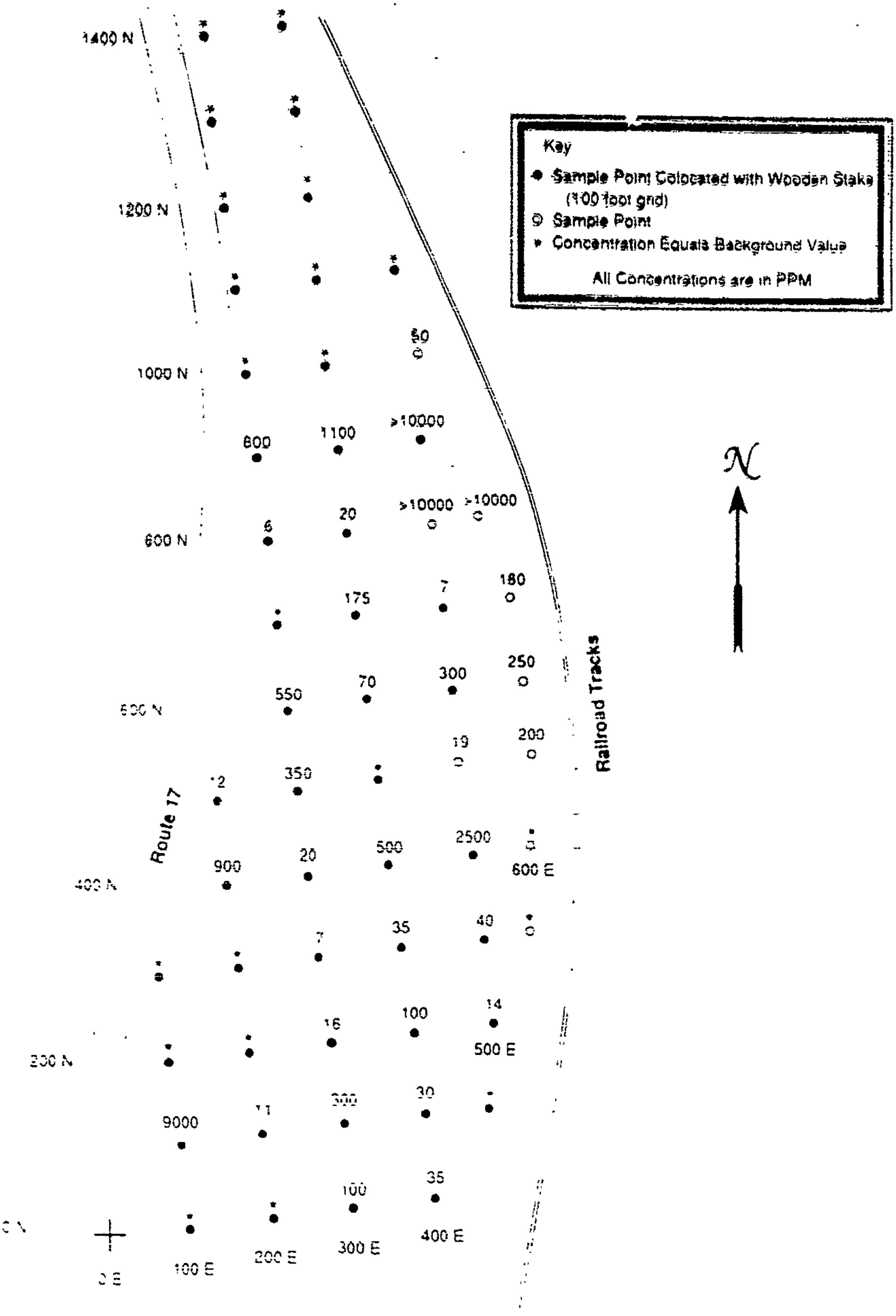

Figure 2. Extractive gas survey—OVA results.

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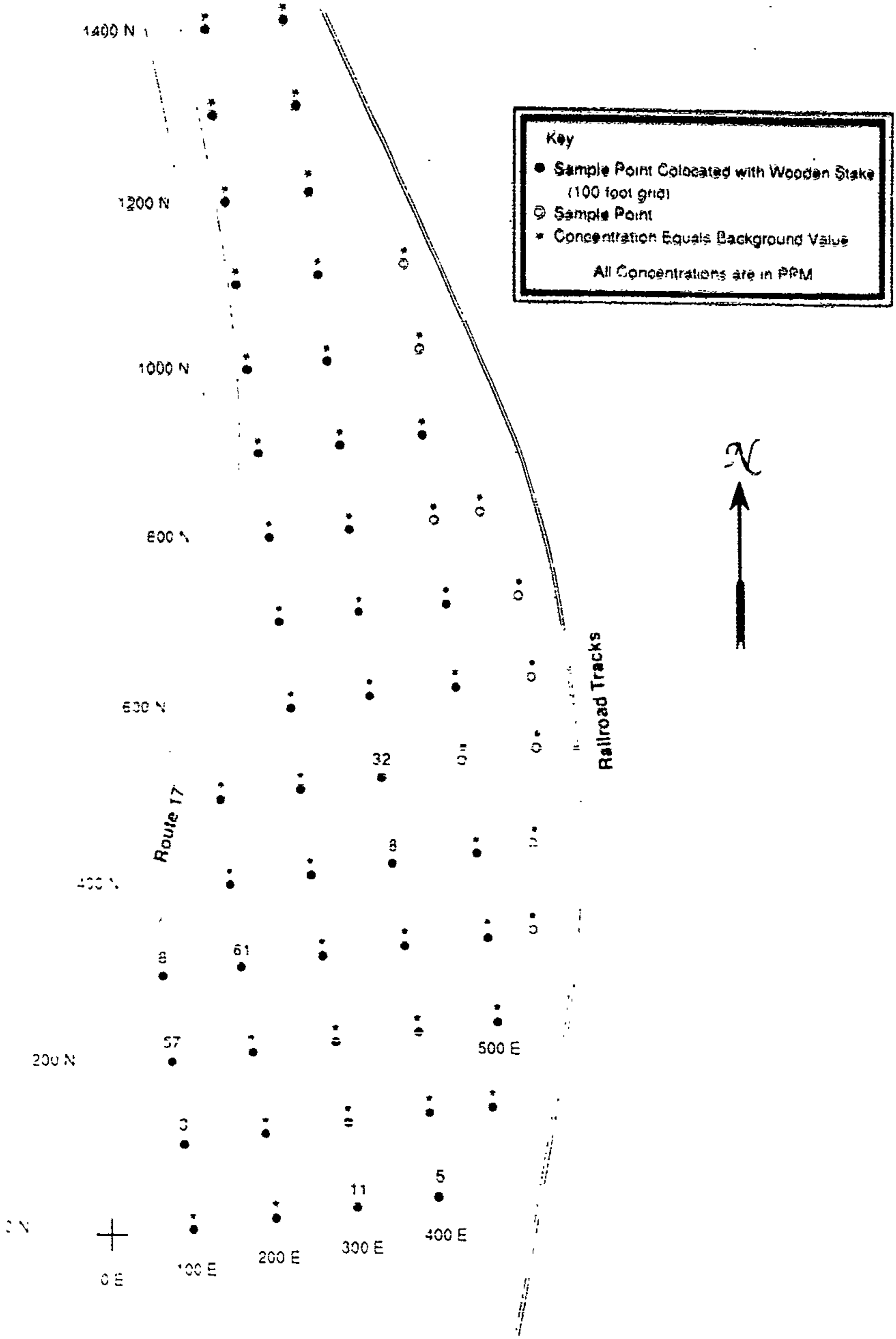


Figure 3. Extractive gas survey—H_2S results.

measurements. OVA, HNu and hydrogen sulfide portable monitor results are summarized in Table 4. On-site GC analysis results are summarized in Table 5. Hydrogen sulfide was detected only in one blowhole (Site XII) on the landfill. The HNu did provide a slight positive reading of 9 ppm in the blowhole. Otherwise, non-methane hydrocarbons were not detected at any of the other locations On-site GC analysis corroborated this observation A map showing detected methane and H_2S is presented as Figure 4. Table 6 is a conversion of OVA, HNu and hydrogen sulfide results to flux rates in µg/M2/min following the calculations provided in the scope of work Table 7 is a conversion of the on-site GC results into flux rates in µg/M2/min.

3.4 Flux Chambers

Flux chamber sampling was performed at six locations on the landfill (Figure 5). Alliance first conducted flux chamber sampling on on October 4, 1990, which was cancelled after sampling three points due to rain Alliance sampled the remaining three points on October 18, 1990.The reuits of the flux chamber sampling are summarized in Tables 8 and 9 The two tables are presented by date.

Analysis for all TO-14 compounds was performed on stainless steel cannisters collected during the sampling Tables 8 and 9 include calculations for only those compounds detected

The data shows significant methane and emissions from the three samples collected during the October 18 sampling event. Significant carbon dioxide emissions were observed on all six samples. The only significant TO-14 hit was trichlorofluoromethane from the flux chamber sample collected on the embankment near the railroad tracks.

During sampling on October 4, 1990 stainless steel canister samples were collected while a sampling pump was used to evacuate the chamber. During sampling on October 18 canister samples were collected without this pump The reason for the change in procedure is discussed below.

In the course of conducting the flux chamber sampling, significant questions arose concerning the accuracy and value of the sampling method. This controversy originated from data obtained in the field from flux chamber sample that was placed directly over a blowhole This sampling event was conducted during the second round of sampling on October 18. When an OVA was placed directly into the blowhole methane emissions in excess of 10,000 ppm were observed. When the OVA was attached to the sample T connected to the flux chamber, no methane emissions were observed when the pump was running. When the sampling pump was turned off, significant methane emissions were observed by the OVA. Based upon this preliminary field information, Alliance chose to collect the second round of stainless steel canisters without the sampling pump running

Alliance concludes that the reason the OVA did not register a reading when the sampling pump was running was beacause the internal pump in the OVA could not pull against the slight negative pressure in the sample line created by the sampling pump. The vacuum of the stainless steel cannisters was sufficient to pull against the slight vacum created by the pump and can be considered valid. The tanks were evacuated to over 29 inches of

Table 4. Sweep Gas Survey Results
October 3-4, 1990

Location ID	Grid Location	OVA ppm	H2S ppm	HN3 ppm
I	600N, 300E	400	BKG	BKG
II	600N, 360E	6500	BKG	BKG
III	560N, 380E	>10000	BKG	BKG
IV	500N, 320E	2500	BKG	BKG
V	450N, 440E	100	BKG	BKG
VI	400N, 480E	600	BKG	BKG
VII	340N, 500E	65	BKG	BKG
VIII	300N, 420E	250	BKG	BKG
IX	300N, 360E	1000	3	4
X	200N, 400E	45	BKG	BKG
XI	200N, 480E	125	BKG	BKG
XII	260N, 100E	>10000	115	9
XIII	160N, 100E	3.5	BKG	BKG
XIV	300N, 120E	210	BKG	BKG
XV	400N, 160E	650	BKG	BKG
XVI	440N, 200E	100	BKG	BKG
XVII	480N, 200E	300	BKG	BKG
XVIII	520N, 200E	1500	BKG	BKG
XIX	500N, 240E	37	BKG	BKG
XX	450N, 230E	31	BKG	BKG
XXI	360N, 300E	20	BKG	BKG
XXII	300N, 240E	4	BKG	BKG
XXIII	240N, 200E	200	BKG	BKG
XIV	240N, 300E	9	BKG	BKG
XV	200N, 340E	3	BKG	BKG

Table 5. Photovac GC Results from Sweep Gas Survey October 3-4, 1990

Location ID	Compound	Concentration (ppm)
I	Perchloro Ethylene	0.03
II	Perchloro Ethylene	0.06
III	Trichloro Ethylene	0.03
	Perchloro Ethylene	0.07
	Ethyl Benzene	0.03
IV	Methylene Chloride	0.27
V	Methylene Chloride	0.08
	Toluene	0.01
	Perchloro Ethylene	0.02
VI	Methylene Chloride	0.05
	Ethyl Benzene	0.04
VII	Methylene Chloride	1.38
	Toluene	0.06
	Ethyl Benzene	0.24
VIII	ND	
IX	Trichloro Ethylene	0.02
	Toluene	0.02
	Perchloro Ethylene	0.09
	Ethyl Benzene	0.03
X	Methylene Chloride	1.47
	Benzene	0.03
	Trichloro Ethylene	0.11
XI	Methylene Chloride	1.59
	Toluene	0.07
	Perchloro Ethylene	0.14
XII	Benzene	0.28
	Trichloro Ethylene	0.06
	Toluene	0.01
	Perchloro Ethylene	0.03
	Ethyl Benzene	0.15
XIII	Trichloro Ethylene	0.12
	Perchloro Ethylene	0.04
	Ethyl Benzene	0.09

Table 5. Cont'd

Location ID	Compound	Concentration (ppm)
XIV	Perchloro Ethylene	0.01
	Ethyl Benzene	0.03
XV	Trichloro Ethylene	0.04
	Ethyl Benzene	0.03
XVI	ND	
XVII	Trichloro Ethylene	0.03
	Ethyl Benzene	0.02
XVIII	Trichloro Ethylene	0.05
	Perchloro Ethylene	0.02
XIX	ND	
XX	Methylene Chloride	1.49
XXI	Methylene Chloride	1.21
	Toluene	0.35
XXII	Methylene Chloride	1.75
	Toluene	0.05
	Perchloro Ethylene	0.05
	Ethyl Benzene	0.26
XXIII	Methylene Chloride	0.04
	Toluene	0.02
	Perchloro Ethylene	0.08
	Ethyl Benzene	0.26
XXIV	Perchloro Ethylene	0.04
	Ethyl Benzene	0.02
XXV	Perchloro Ethylene	0.03
	Ethyl Benzene	0.01

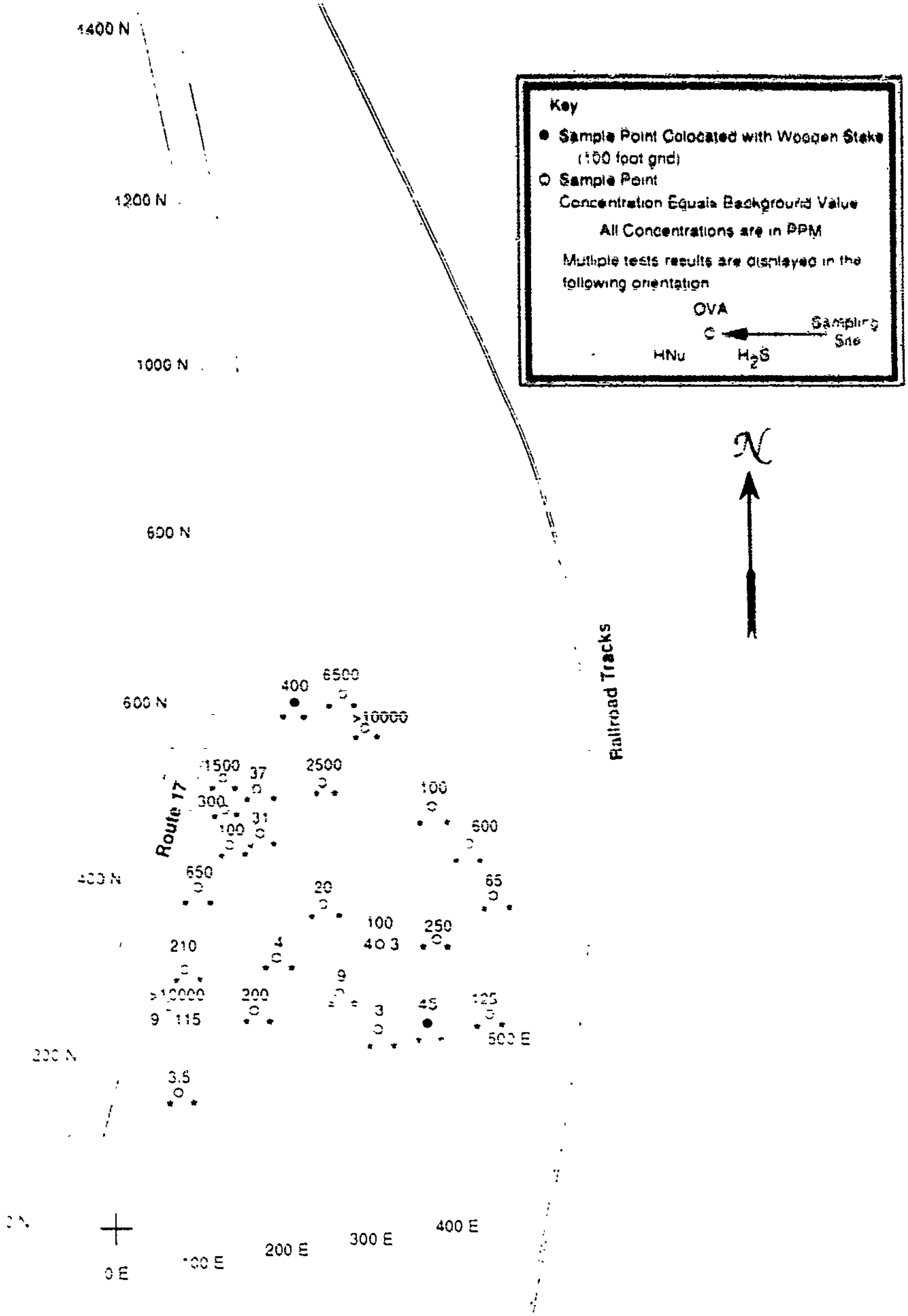


Figure 4. Sweep gas survey—OVA, H_2S and HNu results.

Table 6. Sweep Gas Survey Calculated Flux Rates for the OVA, HNu and H2S Monitors

Location ID	Grid Location	OVA (ug/M2/min)	H2S (ug/M2/min)	HNu (ug/M2/min)
I	600N, 300E	21894	0	0
II	600N, 360E	355780	0	0
III	560N, 380E	> 547534	0	0
IV	500N, 320E	136839	0	0
V	450N, 440E	5474	0	0
VI	400N, 480E	32841	0	0
VII	340N, 500E	3558	0	0
VIII	300N, 420E	13684	0	0
IX	300N, 360E	54735	352	1067
X	200N, 400E	2463	0	0
XI	200N, 480E	6842	0	0
XII	260N, 100E	> 547534	13769	2402
XIII	160N, 100E	192	0	0
XIV	300N, 120E	11494	0	0
XV	400N, 160E	35578	0	0
XVI	440N, 200E	5474	0	0
XVII	480N, 200E	16421	0	0
XVIII	520N, 200E	82103	0	0
XIX	500N, 240E	2025	0	0
XX	450N, 230E	1697	0	0
XXI	360N, 300E	1095	0	0
XXII	300N, 240E	219	0	0
XXIII	240N, 200E	10947	0	0
XIV	240N, 300E	493	0	0
XV	200N, 340E	164	0	0

Table 7. Calculated Flux Rates from Photovac GC During the Sweep Gas Survey, October 3-4, 1990

Location ID	Compound	Flux Rate (ug/M2/min)
I	Perchloro Ethylene	17
II	Perchloro Ethylene	33
III	Trichloro Ethylene	15
	Perchloro Ethylene	37
	Ethyl Benzene	12
IV	Methylene Chloride	78
V	Methylene Chloride	23
	Toluene	3
	Perchloro Ethylene	12
VI	Methylene Chloride	576
	Ethyl Benzene	15
VII	Methylene Chloride	402
	Toluene	18
	Ethyl Benzene	87
VIII	ND	
IX	Trichloro Ethylene	5
	Toluene	7
	Perchloro Ethylene	49
	Ethyl Benzene	10
X	Methylene Chloride	426
	Benzene	7
	Trichloro Ethylene	49
XI	Methylene Chloride	463
	Toluene	21
	Perchloro Ethylene	82
XII	Benzene	74
	Trichloro Ethylene	28
	Toluene	4
	Perchloro Ethylene	16
	Ethyl Benzene	56
XIII	Trichloro Ethylene	53
	Perchloro Ethylene	24
	Ethyl Benzene	33

Table 7. Cont'd

Location ID	Compound	Flux Rate (ug/M2/min)
XIV	Perchloro Ethylene	6
	Ethyl Benzene	12
XV	Trichloro Ethylene	19
	Ethyl Benzene	12
XVI	ND	
XVII	Trichloro Ethylene	13
	Ethyl Benzene	[illegible]
XVIII	Trichloro Ethylene	12
	Perchloro Ethylene	9
XIX	ND	
XX	Methylene Chloride	432
XXI	Methylene Chloride	299
	Toluene	[illegible]
XXII	Methylene Chloride	509
	Toluene	16
	Perchloro Ethylene	28
	Ethyl Benzene	96
XXIII	Methylene Chloride	11
	Toluene	5
	Perchloro Ethylene	43
	Ethyl Benzene	96
XXIV	Perchloro Ethylene	22
	Ethyl Benzene	2
XXV	Perchloro Ethylene	14
	Ethyl Benzene	4

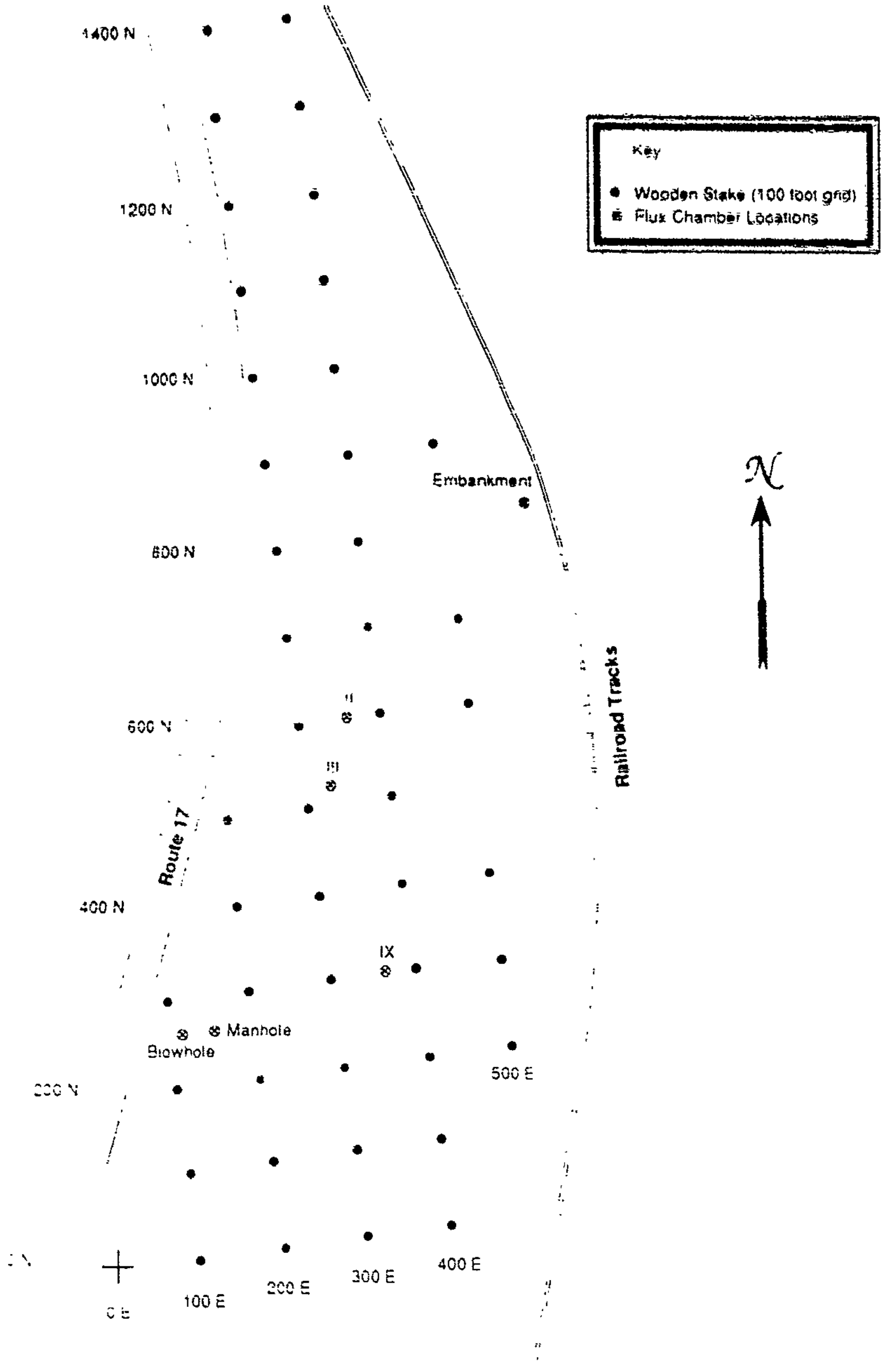


Figure 5. Flux chamber locations.

Table 8. Flux Chamber Emission Results from Sampling Conducted on October 4, 1990 in ug/M2/min

Compound	Site II 600 N 360 E	Site III 520 N 320 E	Site IX 300 N 360 E
Benzene	1.04	1.02	0.51
Dichlorodifluoromethane	0.14	0.13	0.14
Methylene Chloride	0.46	1.13	0.34
o,m + p Xylenes	0.08	0.12	0.08
Toluene	0.52	0.53	0.37
Trichloroethene	[illegible]	0.27	0.21
1,1,1-Trichloroethane	0.15	1.00	0.18
1,1-Dichloroethene	0.09	0.00	0.08
Trichlorofluoromethane	0.00	0.00	0.15
Methane	134	115	77
Non-Methane Hydrocarbon	77	19	346
Carbon Dioxide	42097	31256	879803

Table 9. Flux Chamber Emission Results from Sampling Conducted on October 18, 1990 in ug/M2/min

Compound	Embankment Near Wells RI-2 & MW-6	Manhole 260 N 150 E	Blowhole Near Route 17
Benzene	2.12	1.24	1.50
Dichlorodifluoromethane	ND	0.18	ND
Ethyl Benzene	1.09	4.08	0.24
Freon 113	44.97	ND	ND
Methylene Chloride	2.72	0.49	0.71
m + p Xylenes	3.23	0.56	0.42
o Xylenes	1.07	0.27	0.20
Styrene	2.17	ND	ND
Toluene	9.14	1.42	1.47
Trichloroethene	ND	0.38	0.44
1,1,1-Trichloroethane	4.70	0.21	0.26
Trichlorofluoromethane	241.77	ND	0.15
Vinyl Chloride	ND	0.08	ND
1,4 Dichlorobenzene	ND	0.10	ND
1.2.4 Trimethylbenzene	ND	0.25	ND
Methane	1440	13881	7123
Non-Methane Hydrocarbons	442	154	192
Carbon Dioxide	1005318	214495	124459

mercury After evacuation, the tank was attached the sample "T" and was allowed to fill over a period of 10 minutes until the pressure in the tank registered 0 inches of mercury Alliance used a mercury manometer attached to the tank to record changes in pressure

To confirm this conclusion regarding the OVA sampling, Alliance conducted two confirmation experiments The first entailed filling a tedlar bag with approximately 20 liters of compressed air and injecting 200 µls of acetone into the bag. The acetone was allowed to volatilize The concentration in the bag was checked directly with an OVA The OVA read a concentration in excess of 10,000 ppm. After completing this step, the sampling pump was attached to the tedlar bag with a sampling "T" in line. The pump was turned on and the OVA was attached to the sample "T". The OVA did not register a positive response while the pump was running. When the pump was turned off the OVA quickly measured a concentration in excess of 10,000 ppm. When the pump was turned back on the OVA dropped back to zero Clearly, the OVA pump is incapable of pulling against the vacum created by the sampling pump.

Alliance conducted a second experiment to determine the effect of an extractive pump on the collected samples Alliance created a simulated landfill and installed a flux chamber sampling system over the surface A soil surface was established with a Mettler balance capable of reading to the nearest 0 001g, contained within. A watch glass was placed on the balance and a known amount of hexane was added to the watch glass The Metler balance was then covered with the flux chamber. The flux chamber was embedded about an inch into the soil, consistent with the field sampling technique. Purge gas was applied to the flux chamber at a rate of 5 liters per minute. In one scenario the extractive pump was allowed to run at a rate of 5 liters per minute thereby balancing the inlet flow of purge gas In the second scenario, the pump was not run. In both scenarios, the flux chamber was purged for thirty minutes prior to collecting samples.

During the fluxing cycles on both scenarios the evaporation rate of hexane from the watch glass was observed to be consistent, indicating that the pump has little or no effect on flux rates of compounds from the surface being sampled.

At the end of the thirty minute equilibration period, samples were collected from the sample "T" into a tedlar bag A magnehelic pressure guage was placed between the sample "T" and the bag to observe pressure drops, therefore verifying sample collection The tedlar bags were collected using an evacuated lung technique. Under this system, the bag is placed in a rigid container. The rigid container is evacuated with a pump, creating a vacum To equalize the pressure, the bag inflates by pulling in air from the sample stream Samples were collected using the extractive pump and without the pump.

Using the weight loss observed per unit of time, expected concentrations in the sample can be calculated as follows.

$$C = (24.04 * W * e6)/(86 * P * t)$$

where: C = concentration in ppm(v/v)

24.04 = volume of one mole of gas at 20 C in liters

W = weight loss of hexane in watchglass (grams)

e6 = conversion to ppm

86 = molecular weight of hexane

P = purge rate of Zero gas (5 lpm)

t = time of purge cycle in minutes

Concentrations in the tedlar bags determined by GC were compared to the calculated concentrations. Results were 80% of calculated with the pump and 65% of calculated without the pump. Information provided in **<u>Evaluation of the Flux Chamber Method for Measuring Volatile Organic Emissions from Surface Impoundments (Sept. 1989)</u>** negative biasis such as was observed during this experiment are normal. Therefore, Alliance feels that all flux chamber sampling done with the stainless steel canisters is valid either with or without the extractive pump. OVA readings taken out of the sample 'T' are invalid

Data from this flux simulation as well as a summary of the above referenced article can be found in the appendix. Raw analytical data from the TO-14 analysis and Method 25C analysis of the stainless steel canisters can also be found in the appendices

3.5 Hydrogen Sulfide Ambient Air Monitoring

The results of the H_2S ambient air monitoring are summarized in Table 10. Sampling was done at ten different locations over an eight hour period. On-site locations are shown in Figure 6. Three samples were taken at the south end of the landfill. Two samples were taken at the North end of the landfill. One location was on the northeast side of the landfill between the railroad tracks and the Ramapo river. One sample was taken at the Duck Cedar Inn just North of the landfill and three samples were taken south of the landfill in the town of Tuxedo. The three locations in Tuxedo were at the police station, the IGA grocery and the Gatehouse Antique Shop. Hydrogen sulfide was not detected at any of the locations on the landfill or south of the landfill in the town of Tuxedo. A slight level of H1 2 was detected North of the site. However, the amount detected is slightly above the detection limit of the analytical method.

3.6 Meteorological Monitoring

A wind rose showing the meteorlogical pattern for the period of August 15 through November 15, 1990 is presented as figure 7. The digitized results of the meteorlogical data is included in the Appendix. Sixty complete days of data were obtained during the ninety day period. Monitoring was done for wind speed, wind direction and temperature.

Table 10. Hydrogen Sulfide Ambient Air Monitoring Results, October 3, 1990

Sampling Location	Concentration (ug/M3)
I 100 E, 50 N	<1.63
II 280 E, 30 N	<1.59
III 420 E, 30 N	<1.52
IV 300 E, 1000N	<1.73
V 500 E, 1000 N	<1.48
VI 600 N, Across Railroad Tracks	<1.66
VII Police Station 1.4 M South	<1.60
VIII IGA Grocery 1.6 M South	<1.72
IX Gatehouse Antiques 1.7 M South	1.91
X Duck Cedar Inn 0.1 M North	2.83

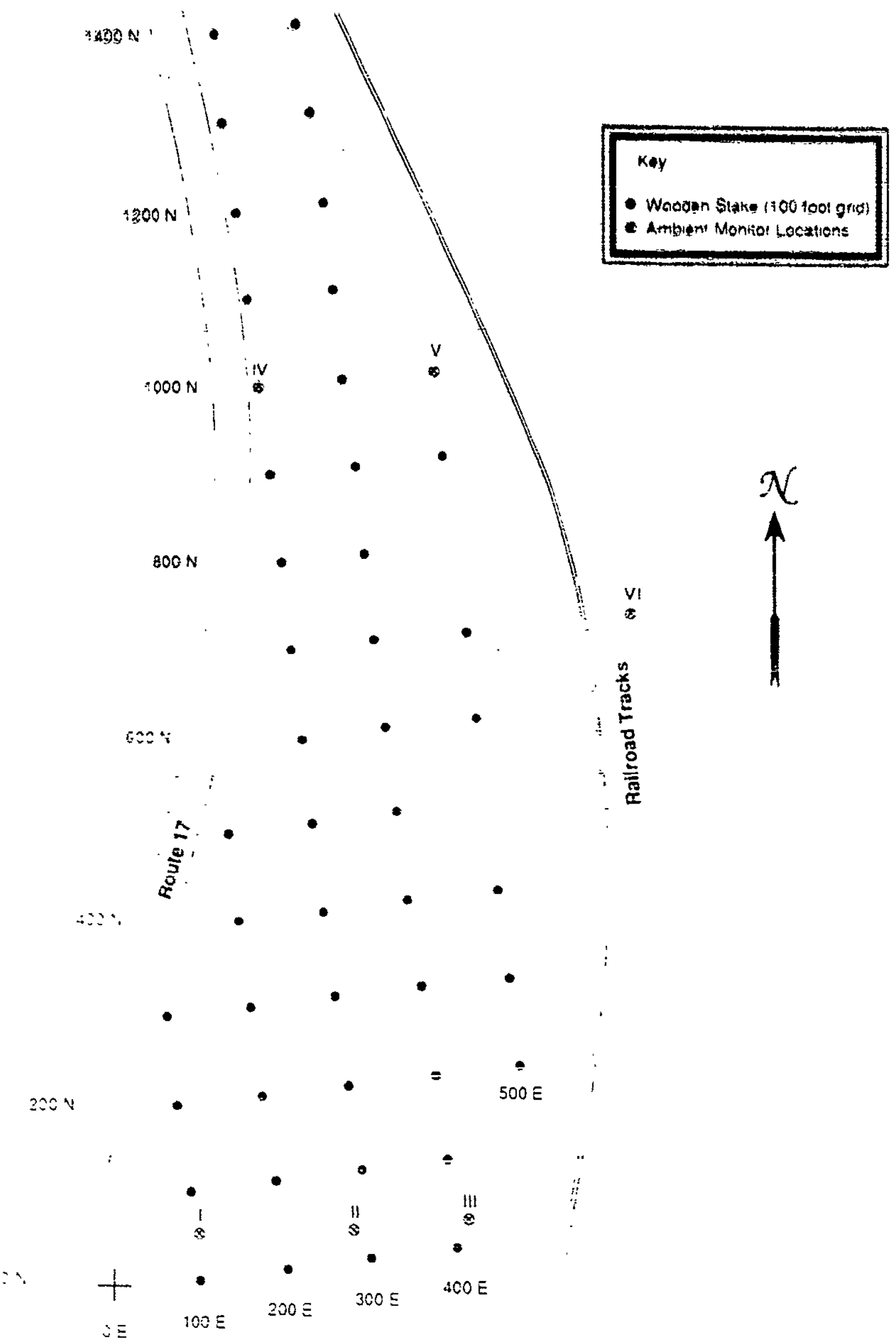
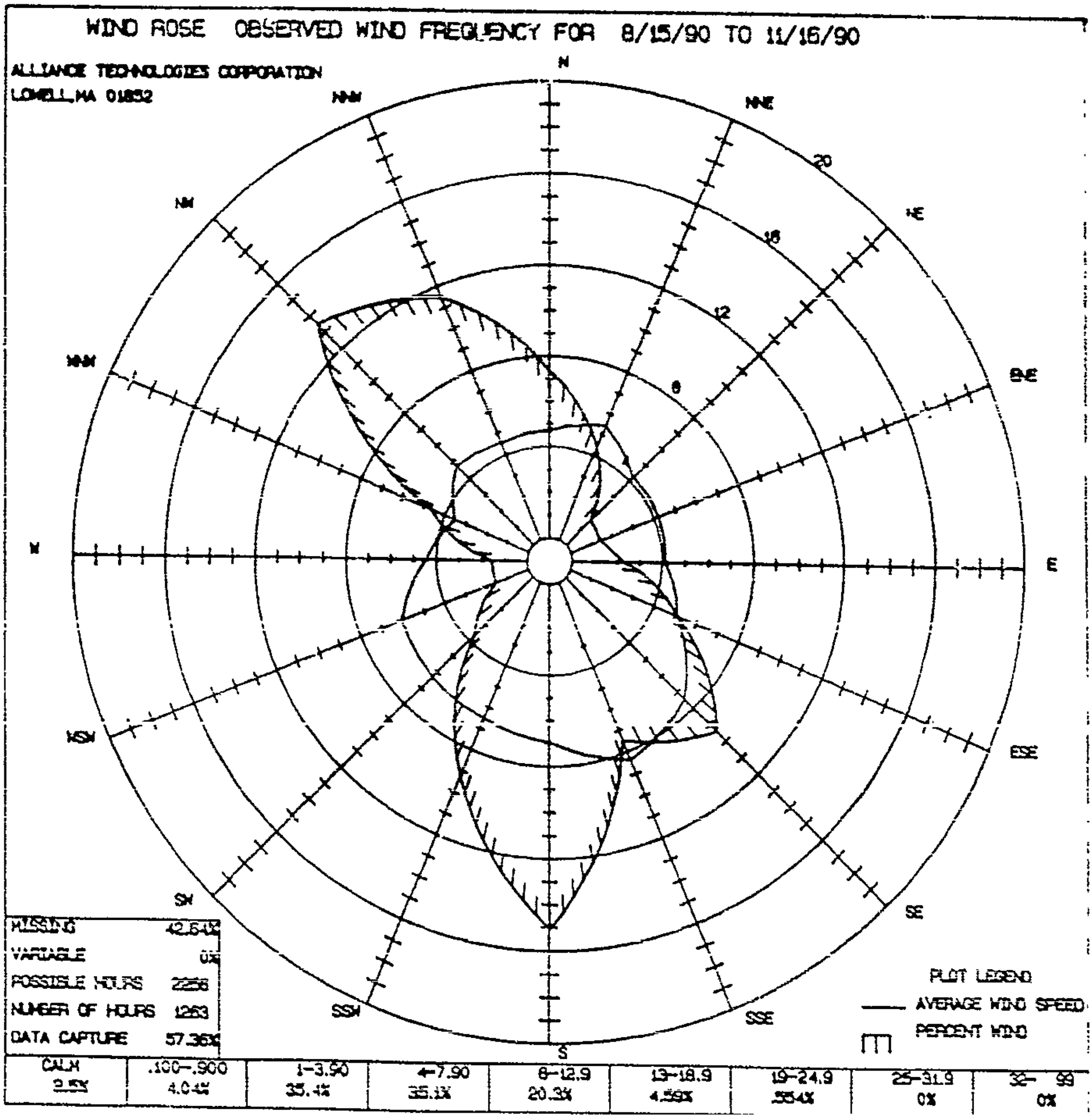


Figure 6. H_2S Ambient monitoring locations.

ALLIANCE Technologies Corporation

Figure 7. Tuxedo Park Wind Rose, August 15
through November 16, 1990



APPENDIX

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model	P4000				
Pump Serial No.	B036				
Calibration Device	Bubble Tube				
Date	10/3/90				
Location	Tuxedo Park II				
Clock Time	Start	8:45 am	Stop	4:45 pm	
Temperature	Initial	15°C °C	Final		°C
Atmospheric Pressure	Initial	30.15 mm Hg	Final	29.85	mm Hg
Relative Humidity	Initial	%	Final		%
Vapor Pressure					
Collection Media	Midget Impingers				
Calibrated by	C. O'Leary				

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	15.43	100 ml		
2	15.51	100 ml		
3	15.52	100 ml		
Average	15.49	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	14.96	100 ml		
2	15.06	100 ml		
3	14.97	100 ml		
Average	14.99	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ______________ %

D. VOLUME SAMPLED

Volume = ______________ L @ 25°C and 760 mmHg

Notes:

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model	P4000			
Pump Serial No.	A997			
Calibration Device	Bubble Tube			
Date	10/3/90			
Location	Tuxedo Park III			
Clock Time	Start 8:52		Stop 4:52pm	
Temperature	Initial 18°C	°C	Final	°C
Atmospheric Pressure	Initial 30.15	mm Hg	Final 29.89	mm Hg
Relative Humidity	Initial	%	Final	%
Vapor Pressure				
Collection Media	Midget Impingers			
Calibrated by	C. Cleary			

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	14.68	100 ml		
2	14.74	100 ml		
3	14.71	100 ml		
Average	14.71	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	14.65	100 ml		
2	14.40	100 ml		
3	14.54	100 ml		
Average	14.53	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ______________ %

D. VOLUME SAMPLED

Volume = ______________ L @ 25°C and 760 mmHg

Notes:

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model P4000

Pump Serial No. A629

Calibration Device Bubble Tube

Date 10/3/90

Location Tuxedo Park IV

Clock Time Start 10:09 am Stop 6:09 am

Temperature Initial 23°C °C Final °C

Atmospheric Pressure Initial 30.15 mm Hg Final 29.97 mm Hg

Relative Humidity Initial % Final %

Vapor Pressure

Collection Media Midget Impingers

Calibrated by C O'Leary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	14.88	100 ml		
2	14.98	100 ml		
3	14.99	100 ml		
Average	14.95	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	Pump Not Running			
2	Stopped between			
3	5:00pm. & 6:00pm			
Average	Checked & running @ 5:00pm			

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = %

D. VOLUME SAMPLED

Volume = L @ 25°C and 760 mmHg

Notes:

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model P4000

Pump Serial No. A630

Calibration Device Bubble Tube

Date 10/3/90

Location Tuxedo Park V

Clock Time Start 10:00 am Stop 6:00 pm

Temperature Initial 23°C °C Final °C

Atmospheric Pressure Initial 30.15 mm Hg Final 29.97 mm Hg

Relative Humidity Initial % Final %

Vapor Pressure

Collection Media Midget Impingers

Calibrated by C. Cleary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	14.24	100 ml		
2	13.94	100 ml		
3	13.85	100 ml		
Average	14.01	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	14.41	100 ml		
2	14.43	100 ml		
3	14.48	100 ml		
Average	14.44	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ______ %

D. VOLUME SAMPLED

Volume = ______ L @ 25°C and 760 mmHg

Notes:

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model P4000

Pump Serial No. A626

Calibration Device Bubble Tube

Date 10/3/90

Location Tuxedo Park VI

Clock Time Start 10:22am Stop 6:22

Temperature Initial 28°C °C Final °C

Atmospheric Pressure Initial 30.15 mm Hg Final 29.97 mm Hg

Relative Humidity Initial % Final %

Vapor Pressure

Collection Media Midget Impingers

Calibrated by C. O'Leary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	15.70	100 ml		
2	15.67	100 ml		
3	15.70	100 ml		
Average	15.69	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	16.30	100ml		
2	16.31	100ml		
3	16.25	100ml		
Average	16.29	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ____________ %

D. VOLUME SAMPLED

Volume = ____________ L @ 25°C and 760 mmHg

Notes:

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model Alpha I

Pump Serial No. 07594

Calibration Device Bobble Tube

Date 10/3/90

Location Tuxedo Park VII - Police Station

Clock Time **Start** 11:48am **Stop** 7.48 pm

Temperature **Initial** 25°C °C **Final** °C

Atmospheric Pressure **Initial** 30.11 mm Hg **Final** 30.11 mm Hg

Relative Humidity **Initial** % **Final** %

Vapor Pressure

Collection Media Midget Impingers

Calibrated by C. O'Leary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	15.95	100 ml		
2	15.32	100 ml		
3	15.13	100 ml		
Average	15.47	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	15.29	100 ml		
2	15.30	100 ml		
3	15.35	100 ml		
Average	15.31	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ____ %

D. VOLUME SAMPLED

Volume = ____ L @ 25°C and 760 mmHg

Notes:

Police Station is 1.4 miles from the landfill

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model	Alpha 1			
Pump Serial No.	07575			
Calibration Device	Bubble Tube			
Date	10/3/90			
Location	Tuxedo Park VIII - I&H Grocery			
Clock Time	Start 12:15 pm		Stop 8:15 pm	
Temperature	Initial 24°C	°C	Final	°C
Atmospheric Pressure	Initial 30.11	mm Hg	Final 30.11	mm Hg
Relative Humidity	Initial	%	Final	%
Vapor Pressure				
Collection Media	Midget Impingers			
Calibrated by	C. Cleary			

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	15.25	100 ml		
2	15.50	100 ml		
3	15.51	100 ml		
Average	15.42	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	17.69	100 ml		
2	17.56	100 ml		
3	17.97	100 ml		
Average	17.74	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ______ %

D. VOLUME SAMPLED

Volume = ______ L @ 25°C and 760 mmHg

Notes:

I&H Grocery is 1.6 miles from the landfill.

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model Alpha 1
Pump Serial No. 07828
Calibration Device Bubble Tube
Date 10/3/90
Location Tuxedo Park TX - Gatehouse Antiques
Clock Time Start 12:00 Stop 9:06pm
Temperature Initial 24°C °C Final °C
Atmospheric Pressure Initial 30.1 mm Hg Final 30.1 mm Hg
Relative Humidity Initial % Final %
Vapor Pressure
Collection Media Midget Impingers
Calibrated by C. O'Leary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	15.74	100 ml		
2	15.74	100 ml		
3	15.53	100 ml		
Average	15.67	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	16.73	100 ml		
2	16.83	100 ml		
3	16.60	100 ml		
Average	16.72	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ____________ %

D. VOLUME SAMPLED

Volume = ____________ L @ 25°C and 760 mmHg

Notes:

Gatehouse Antiques is 1.7 miles from the landfill.

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model: Alpha 2
Pump Serial No.: 2012
Calibration Device: Bubble Tube
Date: 10/3/90
Location: Tuxedo Park I - Duck Cakes Inc
Clock Time: Start 13 30 Stop 9:30
Temperature: Initial 25°C °C Final °C
Atmospheric Pressure: Initial 27.45 mm Hg Final 30.05 mm Hg
Relative Humidity: Initial % Final %
Vapor Pressure:
Collection Media: Midget Impingers
Calibrated by: C C Leary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrate Q_i(std) (ml/min)
1	21.36	100 ml		
2	20.96	100 ml		
3	20.88	100 ml		
Average	21.07	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrate Q_f(std) (ml/min)
1	Pump running too slow			
2	to calibrate			
3				
Average				

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ____________ %

D. VOLUME SAMPLED

Volume = ____________ L @ 25°C and 760 mmHg

Notes:

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model: P4000

Pump Serial No.: A630

Calibration Device: Bubble Tube

Date: 10/4/90

Location: Tuxedo Park X - Duck Cedar Inn

Clock Time: Start 10:30 am Stop 3:30 pm

Temperature: Initial ____ °C Final ____ °C

Atmospheric Pressure: Initial 29.8 mm Hg Final 29.51 mm Hg

Relative Humidity: Initial ____ % Final ____ %

Vapor Pressure: ____

Collection Media: Midget Impingers

Calibrated by: C. O'Leary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrat Q_i(std) (ml/min)
1	15.50	100 ml		
2	15.16	100 ml		
3	15.70	100 ml		
Average	15.45	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrat Q_f(std) (ml/min)
1	15.82	100 ml		
2	15.41	100 ml		
3	15.92	100 ml		
Average	15.88	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ____ %

D. VOLUME SAMPLED

Volume = ____ L @ 25°C and 760 mmHg

Notes:

Midget Impingers

Execs Pak I

$\frac{100\ ml}{14.22} \times 60\ sec = 421.9$

$\frac{100\ ml}{17.47} \times 60\ sec = 343.5$

$382.7 \times 60\ min = \frac{1000}{22962} = 22.96\ L/hr$ 183.7 L/8 hours

Exedc Pak II

$\frac{100\ ml}{15.49} \times 60\ sec = 387.4$

$\frac{100\ ml}{14.99} \times 60\ sec = 400.3$

$393.9 \times 60\ min = \frac{2363}{1000} = 23.63\ L/hr$ 189.0 L/8 hours

Exedc Pak III

$\frac{100\ ml}{14.71} \times 60\ sec = 407.9$

$\frac{100\ ml}{14.53} \times 60\ sec = 412.9$

$410.4 \times 60\ min = \frac{2462}{1000} = 24.62\ L/hr$ 197 L/8 hours

Tuxedo Park IV

$\frac{100\ \text{ml}}{14\ 95} \times 60\ \text{sec} = 401.3$

Ai Final

$401.3 \times 60\ \text{min} = \frac{2408}{1000} = 24.08\ \text{L/hr}$ 192.6 L / 8 hours (1st)

Tuxedo Park II

$\frac{100\ \text{ml}}{14.01} \times 60\ \text{sec} = 428.3$

$\frac{100\ \text{ml}}{14.44} \times 60\ \text{sec} = 415.5$

$421.9 \times 60\ \text{min} = \frac{25321}{1000} = 25.31\ \text{L/hr}$ 202.5 L / 8 hours

Tuxedo Park III

$\frac{100\ \text{ml}}{15.29} \times 60\ \text{sec} = 392.4$

$\frac{100\ \text{ml}}{16.29} \times 60\ \text{sec} = 368.3$

$375.4 \times 60\ \text{min} = \frac{2252}{1000} = 22.52\ \text{L/hr}$ 180.2 L / 8 hours

Tuxedo Park VII

$$\frac{100\ ml}{15.47} \times 60\ sec = 387.9$$

$$\frac{100\ ml}{15.31} \times 60\ sec = 391.9$$

$$389.9 \times 60\ min = \frac{2339}{1000} = 23.39\ L/hr$$ 187.1 L / 8 hours

Tuxedo Park VII

$$\frac{100\ ml}{15.42} \times 60\ sec = 389.1$$

$$\frac{100\ ml}{17.74} \times 60\ sec = 338.2$$

$$363.7 \times 60\ min = \frac{2182}{1000} = 21.82\ L/hr$$ 174.6 L / 8 hours

Tuxedo Park IX

$$\frac{100\ ml}{15.07} \times 60\ sec = 382.9$$

$$\frac{100\ ml}{16.72} \times 60\ sec = 358.9$$

$$370.9 \times 60\ min = \frac{2225}{1000} = 22.25\ L/hr$$ 178 L / 8 hours

Tuxedo Park X - 10/3/90

$\frac{100 \text{ ml}}{21.07} \times 60 \text{ sec} = 284.8$

No Final

$284.8 \times 60 \text{ min} = \frac{17089}{1000} = 17 \text{ L/hr}$ 136 L/8 hours [illegible]

Tuxedo Park I - 10/4/90

$\frac{100 \text{ ml}}{15.45} \times 60 \text{ sec} = 388.4$

$\frac{100 \text{ ml}}{15.88} \times 60 \text{ sec} = 377.8$

$383.1 \times 60 \text{ min} = \frac{22991}{1000} = 22.99 \text{ L/hr}$ 183.9 L/8 hours

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Alliance Technologies Corporation
Boott Mills South
Foot of John Street
Lowell, MA 01852
Attn: Mr. Sean O'Brien

Date: October 29, 1990

P.O. Number: A5505

This is the Certificate of Analysis for the following samples:

Client Project ID: Alliance Technologies Corporation
Date Received: October 9, 1990
Work Order: X0-10-110
Number of Samples: 3
Sample Type: Canister

I. Introduction

Three canister samples arrived at ITAS Cincinnati on October 9, 1990. The samples were sent for analytical work in support of monitoring work for the Alliance Technologies Corporation. The samples were labeled as follows:

Canister # Site # II-2
Canister # Site # III-2
Canister # Site # IX-2

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analysis requested was the TO14 List of Volatile Organics.

Aliquots of the sample were concentrated cryogenically and analyzed by Gas Chromatography/Mass Spectrometry.

Reviewed and Approved by:

Timothy E Sander
For.

Alan Zaffiro
GC/MS Team Leader
010110

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

Client: Alliance Technologies Corporation
Work Order: X0-10-110
·01011003

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID:	Canister	Date Analyzed:	10/17/90
Canister ID:	Site # II-2 290	Dilution Factor:	2
Lab No.:	01		

Compound	PPB	Detection Limit
Benzene	8.3	0.4
Benzyl chloride	ND	0.8
Bromomethane	ND	0.6
Carbon tetrachloride	ND	0.4
Chlorobenzene	ND	0.4
Chloroethane	ND	1.0
Chloroform	ND	0.6
Chloromethane	ND	0.8
Dichlorodifluoromethane	0.70	0.4
Ethylbenzene	ND	0.4
Freon 113 (1)	ND	0.4
Methylene chloride	3.4	0.4
m+/or p-Xylenes	0.50	0.4
cis-1,2-Dichloroethylene	ND	0.6
cis-1,3-Dichloropropene	ND	0.8
o-Xylene	ND	0.4
Styrene	ND	0.4
Tetrachloroethene	ND	0.4
Toluene	3.5	0.4
Trichloroethene	1.3	0.4
trans-1,3-Dichloropropene	ND	1.4
Vinyl chloride	ND	0.6
1,1,1-Trichloroethane	0.68	0.6
1,1,2,2-Tetrachloroethane	ND	0.4
1,1,2-Trichloroethane	ND	0.6
1,1-Dichloroethane	ND	0.6
1,1-Dichloroethene	0.57	0.6
1,2-Dibromoethane	ND	0.4
1,2-Dichloroethane	ND	0.4
1,2-Dichloropropane	ND	0.6
1,3-Dichlorobenzene	ND	0.2
1,4-Dichlorobenzene	ND	0.2
Freon 114 (2)	ND	0.4
Hexachlorobutadiene	ND	0.4
Trichlorofluoromethane	ND	0.4
1,2,4-Trichlorobenzene	ND	0.4
1,2,4-Trimethylbenzene	ND	0.4
1,2-Dichlorobenzene	ND	0.2
1,3,5-Trimethylbenzene	ND	0.4

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: XO-10-110
01011004

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID:	Canister	Date Analyzed:	10/17/90
Canister ID:	Site # III-2	Dilution Factor:	2
	289		
Lab No.:	02		

Compound	PPB	Detection Limit
Benzene	8.2	0.4
Benzyl chloride	ND	0.8
Bromomethane	ND	0.6
Carbon tetrachloride	ND	0.4
Chlorobenzene	ND	0.4
Chloroethane	ND	1.0
Chloroform	ND	0.6
Chloromethane	ND	0.8
Dichlorodifluoromethane	0.68	0.4
Ethylbenzene	ND	0.4
Freon 113 (1)	ND	0.4
Methylene chloride	8.3	0.4
m+/or p-Xylenes	0.71	0.4
cis-1,2-Dichloroethylene	ND	0.6
cis-1,3-Dichloropropene	ND	0.8
o-Xylene	ND	0.4
Styrene	ND	0.4
Tetrachloroethene	ND	0.4
Toluene	3.6	0.4
Trichloroethene	1.3	0.4
trans-1,3-Dichloropropene	ND	1.4
Vinyl chloride	ND	0.6
1,1,1-Trichloroethane	4.7	0.6
1,1,2,2-Tetrachloroethane	ND	0.4
1,1,2-Trichloroethane	ND	0.6
1,1-Dichloroethane	ND	0.6
1,1-Dichloroethene	ND	0.6
1,2-Dibromoethane	ND	0.4
1,2-Dichloroethane	ND	0.4
1,2-Dichloropropane	ND	0.6
1,3-Dichlorobenzene	ND	0.2
1.4-Dichlorobenzene	ND	0.2
Freon 114 (2)	ND	0.4
Hexachlorobutadiene	ND	0.4
Trichlorofluoromethane	ND	0.4
1,2,4-Trichlorobenzene	ND	0.4
1,2,4-Trimethylbenzene	ND	0.4
1,2-Dichlorobenzene	ND	0.2
1,3,5-Trimethylbenzene	ND	0.4

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: XO-10-110
01011005

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID:	Canister	Date Analyzed: 10/17/90
Canister ID:	Site # IX-2 297	Dilution Factor: 2
Lab No.:	03	

Compound	PPB	Detection Limit
Benzene	4.1	0.4
Benzyl chloride	ND	0.8
Bromomethane	ND	0.6
Carbon tetrachloride	ND	0.4
Chlorobenzene	ND	0.4
Chloroethane	ND	1.0
Chloroform	ND	0.6
Chloromethane	ND	0.8
Dichlorodifluoromethane	0.74	0.4
Ethylbenzene	ND	0.4
Freon 113 (1)	ND	0.4
Methylene chloride	2.5	0.4
m+/or p-Xylenes	0.48	0.4
cis-1,2-Dichloroethylene	ND	0.6
cis-1,3-Dichloropropene	ND	0.8
o-Xylene	ND	0.4
Styrene	ND	0.4
Tetrachloroethene	ND	0.4
Toluene	2.5	0.4
Trichloroethene	1.0	0.4
trans-1,3-Dichloropropene	ND	1.4
Vinyl chloride	ND	0.6
1,1,1-Trichloroethane	0.83	0.5
1,1,2,2-Tetrachloroethane	ND	0.4
1,1,2-Trichloroethane	ND	0.6
1,1-Dichloroethane	ND	0.6
1,1-Dichloroethene	0.51	0.5
1,2-Dibromoethane	ND	0.4
1,2-Dichloroethane	ND	0.4
1,2-Dichloropropane	ND	0.6
1,3-Dichlorobenzene	ND	0.2
1,4-Dichlorobenzene	ND	0.2
Freon 114 (2)	ND	0.4
Hexachlorobutadiene	ND	0.4
Trichlorofluoromethane	0.67	0.4
1,2,4-Trichlorobenzene	ND	0.4
1,2,4-Trimethylbenzene	ND	0.4
1,2-Dichlorobenzene	ND	0.2
1,3,5-Trimethylbenzene	ND	0.4

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: XO-10-110
G1011002

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID: Canister
Canister ID:

Date Analyzed: 10/17/90
Dilution Factor: 1

Lab No.:

Compound	Method Blank PPB	Detection Limit
Benzene	ND	0.2
Benzyl chloride	ND	0.4
Bromomethane	ND	0.3
Carbon tetrachloride	ND	0.2
Chlorobenzene	ND	0.2
Chloroethane	ND	0.5
Chloroform	ND	0.3
Chloromethane	ND	0.4
Dichlorodifluoromethane	ND	0.2
Ethylbenzene	ND	0.2
Freon 113 (1)	ND	0.2
Methylene chloride	ND	0.2
m+/or p-Xylenes	ND	0.2
cis-1,2-Dichloroethylene	ND	0.3
cis-1,3-Dichloropropene	ND	0.4
o-Xylene	ND	0.2
Styrene	ND	0.2
Tetrachloroethene	ND	0.2
Toluene	ND	0.2
Trichloroethene	ND	0.2
trans-1,3-Dichloropropene	ND	0.7
Vinyl chloride	ND	0.3
1,1,1-Trichloroethane	ND	0.3
1,1,2,2-Tetrachloroethane	ND	0.2
1,1,2-Trichloroethane	ND	0.3
1.1-Dichloroethane	ND	0.3
1,1-Dichloroethene	ND	0.3
1,2-Dibromoethane	ND	0.2
1,2-Dichloroethane	ND	0.2
1,2-Dichloropropane	ND	0.3
1,3-Dichlorobenzene	ND	0.1
1,4-Dichlorobenzene	ND	0.1
Freon 114 (2)	ND	0.2
Hexachlorobutadiene	ND	0.2
Trichlorofluoromethane	ND	0.2
1,2,4-Trichlorobenzene	ND	0.2
1,2,4-Trimethylbenzene	ND	0.2
1,2-Dichlorobenzene	ND	0.1
1,3,5-Trimethylbenzene	ND	0.2

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: X0-10-110
0101101

IT ANALYTICAL SERVICES
CINCINNATI, OH

Quality Assurance Data

Surrogate Recovery, Percent

Client Sample ID	Lab No.	d4-1,2-dichloro-ethane	d8-Toluene	p-Bromo-fluoro-benzene
Canister # Site # II-2	01	105	100	100
Canister # Site # III-2	02	98	99	94
Canister # Site # IX-2	03	102	102	99
Method Blank 10/17		98	101	103

XO 10-110

CHAIN OF CUSTODY RECORD

PO. 14565

CONTRACT NO 2-093-001-0000-0-3	**ANALYSES**
SAMPLERS (Signatures)	

Sample Code	Date	Source Description	Container Size	Container G/P	Volatile Organics	Extractable Org	Pesticides/PCBs	Trace Elements	Cyanide	Phenols	TO-14									COMMENTS
Site #T1-2		Site 2 Sample 2									X									
Site #M-2		Site 2-Sample 2									X									
Site #13-2		Site 2-Sample 2									X									

Relinquished by	Date/Time 10-8	Received by	Relinquished by:	Date/Time	Received by:
Relinquished by	Date/Time	Received by:	Relinquished by:	Date/Time	Received by:
Relinquished by	Date/Time	Received by:	REMARKS: Please Return Tanks!		

TO-14

ALLIANCE
Technologies Corporation

IT INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Alliance Technologies Corporation
Boott Mill South
Foot of John Street
Lowell, MA 08152
Attn: Mr. Sean O'Brien

Date: October 28, 1990

P.O. Number: A5505

This is the Certificate of Analysis for the following samples:

Client Project ID:	Alliance Technologies Corporation
Date Received:	October 9, 1990
Work Order:	X0-10-109
Number of Samples:	12
Sample Type:	Liquid

I. Introduction

Twelve liquid samples arrived at ITAS Cincinnati on October 9, 1990. The samples were sent for analytical work in support of monitoring work for the Alliance Technologies Corporation. The samples were collected on October 4, 1990 and were labeled as follows:

Liquid # I
Liquid # II
Liquid # III
Liquid # IV
Liquid # V
Liquid # VI
Liquid # VII
Liquid # VIII
Liquid # IX
Liquid # X
Liquid # XA
Blank - H2S

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analysis requested was hydrogen sulfide. The samples were analyzed according to the procedures outlined in Method ASTM 701.

Reviewed and Approved by:

Ken Mueller

Ken Mueller
Inorganic Group Leader
010109

Client: Alliance Technologies Corporation
Work Order: X0-10-109
01010901

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results

Client Sample ID	Lab No.	Total Volume, ml	Total Hydrogen Sulfide, ug
Liquid # I	01	15.0	<0.3
Liquid # II	02	13.8	<0.3
Liquid # III	03	14.8	<0.3
Liquid # IV	04	11.0	<0.3
Liquid # V	05	13.9	<0.3
Liquid # VI	06	15.0	[illegible]
Liquid # VII	07	11.0	<0.3
Liquid # VIII	08	11.0	<0.3
Liquid # IX	09	16.9	0.34
Liquid # X	10	17.9	0.36
Liquid # XA	11	20.0	0.53
Blank - H2S	12	36.0	<0.02 mg/L

IT INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Alliance Technologies Corporation
Boott Mills South
Foot of John Street
Lowell, MA 08152
Attn: Mr. Sean O'Brien

Date: November 14, 1990

P.O. Number: A5505

This is the Certificate of Analysis for the following samples:

Client Project ID:	Alliance Technologies Corporation
Date Received:	October 23, 1990
Work Order:	X0-10-235
Number of Samples:	3
Sample Type:	Canister

I. Introduction

Three canister samples arrived at ITAS Cincinnati on October 23, 1990. The samples were sent for analytical work in support of monitoring work for the Alliance Technologies Corporation. The samples were labeled as follows:

Canister # Enbankment Tank 2
Canister # Manhole-Tank # 2
Canister # Site # 12-Tank # 2

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analysis requested was the TO14 List of Volatile Organics.

Aliquots of the sample were concentrated cryogenically and analyzed by Gas Chromatography/Mass Spectrometry.

Reviewed and Approved by:

C. Craig Crume

C. Craig Crume
Project Manager
010235

Client: Alliance Technologies Corporation
Work Order: X0-10-235
01023503

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics
Client ID: Enbankment # Tank 2
Canister ID: 288

Date Analyzed: 11/01/90
Dilution Factor: 20

Lab No.: 01

Compound	01	Detection Limit
Benzene	17	4
Benzyl chloride	ND	8
Bromomethane	ND	6
Carbon tetrachloride	ND	4
Chlorobenzene	ND	4
Chloroethane	ND	10
Chloroform	ND	6
Chloromethane	ND	8
Dichlorodifluoromethane	ND	4
Ethylbenzene	6.4	4
Freon 113 (1)	150	4
Methylene chloride	20	4
m+/or p-Xylenes	19	4
cis-1,2-Dichloroethylene	ND	6
cis-1,3-Dichloropropene	ND	8
o-Xylene	6.3	4
Styrene	13	4
Tetrachloroethene	ND	4
Toluene	62	4
Trichloroethene	ND	4
trans-1,3-Dichloropropene	ND	14
Vinyl chloride	ND	6
1,1,1-Trichloroethane	22	6
1,1,2,2-Tetrachloroethane	ND	4
1,1,2-Trichloroethane	ND	6
1,1-Dichloroethane	ND	6
1,1-Dichloroethene	ND	6
1,2-Dibromoethane	ND	4
1,2-Dichloroethane	ND	4
1,2-Dichloropropane	ND	6
1,3-Dichlorobenzene	ND	2
1,4-Dichlorobenzene	ND	2
Freon 114 (2)	ND	4
Hexachlorobutadiene	ND	4
Trichlorofluoromethane	1100	4
1,2,4-Trichlorobenzene	ND	4
1,2,4-Trimethylbenzene	ND	4
1,2-Dichlorobenzene	ND	2
1,3,5-Trimethylbenzene	ND	4

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: X0-10-235
01023504

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID: Manhole Tank #2
Canister ID: 291
Date Analyzed: 10/25/90
Dilution Factor: 2

Lab No.: 02

Compound		Detection Limit
Benzene	9.9	0.4
Benzyl chloride	ND	0.8
Bromomethane	ND	0.6
Carbon tetrachloride	ND	0.4
Chlorobenzene	ND	0.4
Chloroethane	ND	1
Chloroform	ND	0.6
Chloromethane	ND	0.8
Dichlorodifluoromethane	0.92	0.4
Ethylbenzene	2.4	0.4
Freon 113 (1)	ND	0.4
Methylene chloride	3.6	0.4
m+/or p-Xylenes	3.3	0.4
cis-1,2-Dichloroethylene	ND	0.6
cis-1,3-Dichloropropene	ND	0.8
o-Xylene	1.6	0.4
Styrene	0.34	0.4
Tetrachloroethene	0.33	0.4
Toluene	9.6	0.4
Trichloroethene	1.8	0.4
trans-1,3-Dichloropropene	ND	1.4
Vinyl chloride	0.83	0.6
1,1,1-Trichloroethane	0.99	0.6
1,1,2,2-Tetrachloroethane	ND	0.4
1,1,2-Trichloroethane	ND	0.6
1,1-Dichloroethane	ND	0.6
1,1-Dichloroethene	ND	0.6
1,2-Dibromoethane	ND	0.4
1,2-Dichloroethane	ND	0.4
1,2-Dichloropropane	ND	0.6
1,3-Dichlorobenzene	ND	0.2
1,4-Dichlorobenzene	0.41	0.2
Freon 114 (2)	ND	0.4
Hexachlorobutadiene	ND	0.4
Trichlorofluoromethane	ND	0.4
1,2,4-Trichlorobenzene	ND	0.4
1,2,4-Trimethylbenzene	1.3	0.4
1,2-Dichlorobenzene	ND	0.2
1,3,5-Trimethylbenzene	ND	0.4

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: X0-10-235
01023505

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID: Site #12 Tank #2
Canister ID: 295

Date Analyzed: 11/01/90
Dilution Factor: 3

Lab No.: 03

Compound		Detection Limit
Benzene	12	0.6
Benzyl chloride	ND	1.2
Bromomethane	ND	0.9
Carbon tetrachloride	ND	0.6
Chlorobenzene	ND	0.6
Chloroethane	ND	1.5
Chloroform	ND	0.9
Chloromethane	ND	1.2
Dichlorodifluoromethane	ND	0.6
Ethylbenzene	1.4	0.6
Freon 113 (1)	ND	0.6
Methylene chloride	5.2	0.6
m+/or p=Xylenes	2.5	0.6
cis-1,2-Dichloroethylene	ND	0.9
cis-1,3-Dichloropropene	ND	1.2
o-Xylene	1.2	0.6
Styrene	ND	0.6
Tetrachloroethene	ND	0.6
Toluene	10	0.6
Trichloroethene	2.1	0.6
trans-1,3-Dichloropropene	ND	2.1
Vinyl chloride	ND	0.9
1,1,1-Trichloroethane	1.2	0.9
1,1,2,2-Tetrachloroethane	ND	0.6
1,1,2-Trichloroethane	ND	0.9
1,1-Dichloroethane	ND	0.9
1,1-Dichloroethene	ND	0.9
1,2-Dibromoethane	ND	0.6
1,2-Dichloroethane	ND	0.6
1,2-Dichloropropane	ND	0.9
1,3-Dichlorobenzene	ND	0.3
1,4-Dichlorobenzene	ND	0.3
Freon 114 (2)	ND	0.6
Hexachlorobutadiene	ND	0.6
Trichlorofluoromethane	0.69	0.6
1,2,4-Trichlorobenzene	ND	0.6
1,2,4-Trimethylbenzene	ND	0.6
1,2-Dichlorobenzene	ND	0.3
1,3,5-Trimethylbenzene	ND	0.6

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: X0-10-235
01023501

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics

Client ID:	Canister	Date Analyzed: 10/25/90
Canister ID:		Dilution Factor: 1

Lab No.: Compound	Method Blank PPB	Detection Limit
Benzene	ND	0.2
Benzyl chloride	ND	0.4
Bromomethane	ND	0.3
Carbon tetrachloride	ND	0.2
Chlorobenzene	ND	0.2
Chloroethane	ND	0.5
Chloroform	ND	0.3
Chloromethane	ND	0.4
Dichlorodifluoromethane	ND	0.2
Ethylbenzene	ND	0.2
Freon 113 (1)	ND	0.2
Methylene chloride	ND	0.2
m+/or p-Xylenes	ND	0.2
cis-1,2-Dichloroethylene	ND	0.3
cis-1,3-Dichloropropene	ND	0.4
o-Xylene	ND	0.2
Styrene	ND	0.2
Tetrachloroethene	ND	0.2
Toluene	ND	0.2
Trichloroethene	ND	0.2
trans-1,3-Dichloropropene	ND	0.7
Vinyl chloride	ND	0.3
1,1,1-Trichloroethane	ND	0.3
1,1,2,2-Tetrachloroethane	ND	0.2
1,1,2-Trichloroethane	ND	0.3
1,1-Dichloroethane	ND	0.3
1,1-Dichloroethene	ND	0.3
1,2-Dibromoethane	ND	0.2
1,2-Dichloroethane	ND	0.2
1,2-Dichloropropane	ND	0.3
1,3-Dichlorobenzene	ND	0.1
1,4-Dichlorobenzene	ND	0.1
Freon 114 (2)	ND	0.2
Hexachlorobutadiene	ND	0.2
Trichlorofluoromethane	ND	0.2
1,2,4-Trichlorobenzene	ND	0.2
1,2,4-Trimethylbenzene	ND	0.2
1,2-Dichlorobenzene	ND	0.1
1,3,5-Trimethylbenzene	ND	0.2

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: X0-10-235
01023502

IT ANALYTICAL SERVICES
CINCINNATI, OH

Method TO-14 Volatile Organics
Client ID: Canister
Canister ID:
Date Analyzed: 11/01/90
Dilution Factor: 1

Lab No.:

Compound	Method Blank PPB	Detection Limit
Benzene	ND	0.2
Benzyl chloride	ND	0.4
Bromomethane	ND	0.3
Carbon tetrachloride	ND	0.2
Chlorobenzene	ND	0.2
Chloroethane	ND	0.5
Chloroform	ND	0.3
Chloromethane	ND	0.4
Dichlorodifluoromethane	ND	0.2
Ethylbenzene	ND	0.2
Freon 113 (1)	0.25	0.2
Methylene chloride	ND	0.2
m+/or p-Xylenes	ND	0.2
cis-1,2-Dichloroethylene	ND	0.3
cis-1,3-Dichloropropene	ND	0.4
o-Xylene	ND	0.2
Styrene	ND	0.2
Tetrachloroethene	ND	0.2
Toluene	ND	0.2
Trichloroethene	ND	0.2
trans-1,3-Dichloropropene	ND	0.7
Vinyl chloride	ND	0.3
1,1,1-Trichloroethane	ND	0.3
1,1,2,2-Tetrachloroethane	ND	0.2
1,1,2-Trichloroethane	ND	0.2
1,1-Dichloroethane	ND	0.3
1,1-Dichloroethene	ND	0.3
1,2-Dibromoethane	ND	0.2
1,2-Dichloroethane	ND	0.2
1,2-Dichloropropane	ND	0.3
1,3-Dichlorobenzene	ND	0.1
1,4-Dichlorobenzene	ND	0.1
Freon 114 (2)	ND	0.2
Hexachlorobutadiene	ND	0.2
Trichlorofluoromethane	ND	0.2
1,2,4-Trichlorobenzene	ND	0.2
1,2,4-Trimethylbenzene	ND	0.2
1,2-Dichlorobenzene	ND	0.1
1,3,5-Trimethylbenzene	ND	0.2

(1) 1,1,2-Dichloro-1,2,2-trifluoroethane
(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane
ND = Not Detected

Client: Alliance Technologies Corporation
Work Order: X0-10-235
01023506

IT ANALYTICAL SERVICES
CINCINNATI, OH

Quality Assurance Data

Surrogate Recovery, Percent

Client Sample ID AIR LIMITS	Lab No.	d4-1,2-dichloro-ethane 89-110	d8-Toluene 92-107	p-Bromo-fluoro-benzene 78-117
Canister # Enbankment Tank # 2	01	97	118 (1)	80
Canister # Enbankment Tank # 2	01 Dil	94	111 (1)	86
Canister # Enbankment Tank # 2	01 Re	98	115 (1)	88
Canister # Manhole Tank # 2	02	104	113 (1)	94
Canister # Site 12 - Tank # 2	03	100	97	101
Method Blank 10/25		107	105	92
Method Blank 11/01		99	92	101

(1) Surrogate recoveries outside internal acceptance limits. Re-analyses confirm a matrix effect, possibly due to the high level of CO2 present.

XO-70 [illegible]

CHAIN OF CUSTODY RECORD

P-T

CONTRACT NO: [illegible]

SAMPLERS (Signatures)

Sample Code	**Date**	**Source Description**	**Container Size**	**Container G/P**	Volatile Organics	Extractable Org.	Pesticides/PCBs	Trace Elements	Cyanide	Phenols	[illegible]									**COMMENTS**
Contaminated	[illegible]	Tank #2	[illegible]							X										
[illegible]		Tank #2	[illegible]							X										
[illegible]	[illegible]	Tank #2	[illegible]							X										

Relinquished by	**Date/Time** [illegible]	**Received by** [illegible]	**Relinquished by**	**Date/Time**	**Received by:**
Relinquished by	**Date/Time**	**Received by**	**Relinquished by:**	**Date/Time**	**Received by:**
Relinquished by:	**Date/Time**	**Received by:**	**REMARKS:**		

1041

ALLIANCE
Technologies Corporation

RESEARCH
TRIANGLE
LABORATORIES

METHOD 25 REPORT

prepared for

ALLIANCE TECHNOLOGIES CORPORATION

by

RESEARCH TRIANGLE LABORATORIES, INC.

Gene Mull
Chemist

John Y. Morimoto, Ph.D.
Chemist

RTL ID# 90-370

November 13, 1990

1612 Carpenter Fletcher Road • Durham, North Carolina 27713 • (919) 544-5775 • FAX (919) 544
A Member of the Andersen Technology Group

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 TABLE OF RESULTS

Name: Alliance Technologies Corporation ID #90-109-370 Date: 11/12/90

#	Sample Description	Concentrations (ppmC)						Mass Conc (mgC/cu.m)
		CO	CH4	CO2	Noncon-densibles	Conden-sibles	TGNMO	
1		0	75	14281	23	0	23	11
2		0	723	3047	8	0	8	4
3		0	371	1768	10	0	10	5

RESEARCH TRIANGLE LABORATORIES, INC.

COMMENTS ON THE ANALYSES

Report #90-109-370

All samples:

Since the barometric pressure was not supplied, 760 mmHg was used. There is some discrepancy between the tank pressure calculated using that value and the after-connection tank pressure we measured:

Sample	Your Pressure	Your Temp.	Our Pressure	Our Temp.
1	760.0	21.1	758	[illegible]
2	760.0	21.1	730	26
3	760.0	21.1	727	26

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 EXPERIMENTAL PROCEDURE

Calibration

A propane calibration gas mixture of 82 ppm CO, 68 ppm CH_4, 2.07% CO_2, and 75 ppm propane is injected via a 1-mL sampling loop into the analyzer. The injections are repeated until three integrated areas indicate reasonable agreement. A 1.18% CO_2 standard is run daily with the same requirement. The average daily response factors must agree within 5% of the RF(CO_2) and the RF(NMO) from the initial performance check.

Daily Performance Checks are performed at the beginning of each work day. Calibrations are performed daily or between customer sets of samples, whichever comes first. Additionally, a System Background Check is performed between each set of samples. Duplicate injections of 1.0% CO_2 are made after the final sample each day.

Response factors (average integrated area/concentration in ppmC) are calculated daily from the initial triplicate injections.

Analysis

Each trap is stored under dry ice until just prior to analysis and is flushed of CO_2 by passing zero air through it at -78 °C and via the CO_2 NDIR to the sample tank. Flushing is continued until no NDIR response is noted. The trap is baked at 200 °C with zero air flushing through the trap and via the oxidation catalyst and the NDIR into the collection vessel. Collection is continued until no NDIR response is noted. The trap is transferred to an oven set at 350 °C and baking is continued for 30 minutes. This ensures the cleanliness of the trap for a subsequent sampling. The trap is taken out of the oven and allowed to cool; it is then capped and stored for shipment.

The sample tank is analyzed by injecting an aliquot via a 1-mL sample loop into the GC column, which is held at 85 °C to elute the CO+CH_4 and then the CO_2 which is passed to the oxidation catalyst, reduction catalyst, and FID. The column is then backflushed at 195 °C to elute the organic fraction. The collection vessel is analyzed identically. In both cases, triplicate injections are made. The sample tank is pumped for 5 minutes (to less than 5 mmHg) and air is then allowed in via a paper fiber filter; this procedure is repeated. The tank is pumped 10 minutes and allowed to stand overnight. The tank is then connected to a pressure gauge to test for leaks (maximum permissible leak rate = 10 mmHg/day). If the tank passes the leak test, it is filled with zero air to slightly greater than atmospheric pressure and stored for shipment.

Calculations

Calculations are done in accord with EPA Method 25 procedures. A sample calculation is provided using client/RTL data.

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 SAMPLE CALCULATION

Note: All pressure values have been converted when necessary to mm Hg and all temperature values to Kelvin

Name: Alliance Technologies Corporation   ID #90-109-370   Date: 11/12/90

Sample # 1

DATA

Tank new 284   Volume (cu.m) = 0.004494

Trap

Collection Vessel: Volume (cu.m) = 0 [illegible]

	Pressure (mm Hg)	Temp.(K)		Pressure (mm Hg)	Temp.(K)
Presampling	20.0	294.3			
Postsampling	760.0	294.3			
Final	1055.0	295.2	Final	0.0	273.2

Calibration Data

	CO2	Backflush
Response Factor (area units/ppmC)	901.5	885.1
Blank (ppmC)	8.3	
Blank Area (area units)		5327

Areas:

CO	0	0	0
CH4	47,470	48,017	47,666
CO2	9,083,800	9,052,000	9,037,000
Noncondensibles	19,902	19,949	18,481
Condensibles	0	0	0

CALCULATIONS

Measured Concentrations, corrected for blank:

Cm(CO) = Area(CO)/RF(CO2)
= 0 /901.5 = 0.0
= 0 /901.5 = 0.0
= 0 /901.5 = 0.0

Cm(CH4) = Area(CH4)/RF(CO2)
= 47470 /901.5 = 52.7
= 48017 /901.5 = 53.3
= 47666 /901.5 = 52.9

Cm(CO2) = Area(CO2)/RF(CO2)
= 9083800 /901.5 = 10076.3
= 9052000 /901.5 = 10041.0
= 9037000 /901.5 = 10024.4

```
Cm(Noncondensibles) = [Area(Noncondensibles) - Blank Area(NMO)]/RF(NMO)
                    = ( 19902  -  5327)/885.1 =    16.5
                    = ( 19949  -  5327)/885.1 =    16.5
                    = ( 18481  -  5327)/885.1 =    14.9

Cm(Condensibles) = Area(Condensibles)/RF(CO2) - Blank(CO2)
                 = 0 /901.5 -  8.3 =    -8.3
                 = 0 /901.5 -  8.3 =    -8.3
                 = 0 /901.5 -  8.3 =    -8.3
```

Pressure-Temperature Ratio, Q(i) = P(i)/T(i):

```
postsampling tank: Q(1) =  760 / 294 2611 = 2.58274
presampling tank:  Q(2) =  20 / 294.2611 = 6.796685E-02
final tank:        Q(3) =  1055 / 295.15 = 3.574454
final CV:          Q(4) =  0 / 273 15 = 0

Volume Sampled (dscm) = 0.3857 x Tank Volume x [Q(1)-Q(2)]
                      = 0.3857 x .004494  x [2.5827 - 0 0680
                      = 0.004359
```

Averages and % Relative Standard Deviations (%RSD) of Cm's are ...
(%RSD of C = %RSD of Cm)

Calculated Concentrations:

```
C(CO) = Q(3)/[Q(1)-Q(2)] x Cm(CO)
      = 3.5745/(2.5827 - 0.0680) x      0.0 =      0.0

C(CH4) = Q(3)/[Q(1)-Q(2)] x Cm(CH4)
       = 3.5745/(2.5827 - 0.0680) x     52.9 =     75.2

C(CO2) = Q(3)/[Q(1)-Q(2)] x Cm(CO2)
       = 3.5745/(2.5827 - 0.0680) x  10047.3 =  14281.0

C(Noncondensibles) = Q(3)/[Q(1)-Q(2)] x Cm(Noncondensibles)
                   = 3.5745/(2.5827 - 0.0680) x     15.9 =     22.7

C(Condensibles)
    = Volume(CV)/Volume(Tank) x Q(4)/[Q(1)-Q(2)] x Cm(Condensibles)
    = 0.004551/0 004494 x 0.0000/(2.5827 - 0.0680) x     -8 3 =     0.0

Total Gaseous Non-Methane Organics(TGNMO)=C(Noncondensibles)+C(Condensibles)
                                          =     22.7 +      0.0
                                          =     22.7


Mass Concentration = 0.4993 x TGNMO
                   = 0.4993 x    22.7 =    11.3
```

DUPONT PUMPS

CALIBRATION AND SAMPLING DATA SHEET

Instrument Model P4000

Pump Serial No. B029

Calibration Device Bubble Tube

Date 10/3/90

Location Tuxedo Park I

Clock Time Start 8:27am Stop 4:27pm

Temperature Initial 15°C °C Final °C

Atmospheric Pressure Initial 30.1 mm Hg Final 29.85 mm Hg

Relative Humidity Initial % Final %

Vapor Pressure

Collection Media Midget Impingers

Calibrated by C. OLeary

A. INITIAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_i (ml/min)	Standard Flowrat Q_i(std) (ml/min)
1	14.21	100 ml		
2	14.25	100 ml		
3	14.21	100 ml		
Average	14.22	100 ml		

B. FINAL READINGS

Reading No.	Time (sec)	Distance Traveled (ml)	Actual Flowrate, Q_f	Standard Flowrat Q_f(std) (ml/min)
1	17.89	100 ml		
2	17.36	100 ml		
3	17.15	100 ml		
Average	17.47	100 ml		

C. % DIFFERENCE - Initial versus Final Flowrates

% Difference = ______ %

D. VOLUME SAMPLED

Volume = ______ L @ 25°C and 760 mmHg

Notes:

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 SAMPLE QA/QC DATA & CALIBRATION CHECK/A

5.1.1 Carrier Gas and Auxiliary Oxygen Blank (1/3/90)

$CO + CH_4 + CO_2 + NMO = 0$ ppm   Requirement: < 5 ppm

5.1.2 Catalyst Efficiency Check (1/4/90)

$CO_2 = 9982$ ppmC   Requirement: $CO_2 = 10000 \pm 200$ ppmC

5.1.3 System Performance Check (1/4/90)

	Average Percent Recovery	%RSD
50 uL hexane/decane	107.6/103.6	0.1/0.5
10 uL hexane/decane	102.1/103.2	0.5/0.9
Requirement	100 ± 10%	< 5

5.2.1 Oxidation Catalyst Efficiency Check (1/5/90)

FID Response with Reduction Catalyst Out = 0.25%
Requirement < 1%

5.2.2 Reduction Catalyst Efficiency Check (1/5/90)

Response of CO_2 with Oxidation Catalyst and Reduction Catalyst operative was 100.3% of response with catalyst out.

Requirement 100 ± 5%

5.2.3 Analyzer Linearity Check and NMO Calibration (1/2/90)

$\overline{RF}$ values agree within 2.5% Requirement: within 2.5%
%RSD values for triplicates < 2% " < 2%
except Propane 4th Dilution (22 ppmc) %RSD = 2.4%

(deviation by Gene Mull, Manager and Joseph Adamovic, Laboratory Manager)

$$\frac{\overline{RF}(NMO)}{RF(CO_2)} = 1.015 \qquad \text{Requirement: } \frac{RF(NMO)}{RF(CO_2)} = 1.0 \pm 0.1$$

5.2.4 System Performance Check (1/5/90-4/10/90)

	Measured Value	Expected Value	Requirement
Propane Mix	75.0 ppm	75.0 ppm	± 5%
Hexane	55.4 ppm	55.2 ppm	± 5%
Toluene	54.9 ppm	54.5 ppm	± 5%
Methanol	* ppm	ppm	± 5%

* Methanol is currently being analyzed.

5.3 NMO Analyzer Daily Calibration

Triplicate injections of a mixture containing propane and high-level CO_2 are made at the beginning of each set of samples or every 24 hours, whichever comes first.

Requirements *: $DRF(NMO) = [RF(NMO) = 915] \pm 5\%$
$DRF(CO_2) = [RF(CO_2) = 862] \pm 5\%$

* Original calibration values were 91.5 and 86.2; on 5/30/90, electrometer range was lowered by a factor of 10, increasing each response factor by a factor of 10.

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 DATA REPORT

Name: Alliance Technologies Corporation   ID #90-109-370   Date: 11/12/90

Sample # 1

TANK new 284   TRAP   COLLECTION VESSEL.

Tank Volume (cu.m) - 0.004494

Collection Vessel Volume (cu.m) - 0.004551

	Pressure (mm Hg)	Temp.(K)		Pressure (mm Hg)	Temp
Presampling	20.0	294.3			
Postsampling	760.0	294.3			
Final	1055.0	295.2	Final	0.0	273.2

Volume Sampled (dscm) - 0.004359

Calibration Data

	CO2	Backflush
Response Factor (area units/ppmC)	901.5	885.1
Blank (ppmC)	8.3	
Blank Area (area unit.)		5327

Areas:

CO	0	0	0
CH4	47,470	48,017	47,666
CO2	9,083,800	9,052,000	9,037,000
Noncondensibles	19,902	19,943	18,481
Condensibles	0	0	0

Concentrations (ppmC).

		%RSD
CO	0.0000	0.0000
CH4	75.2358	0.5808
CO2	14280.9900	0.2638
Noncondensibles	22.6705	5.9100
Condensibles	0.0000	0.0000
TGNMO	22.6705	

(= 11.3194 mgC/cu.m)

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 DATA REPORT

```
Name  Alliance Technologies Corporation           ID #90-109-370  Date  11/12/90


Sample # 2

TANK new 292.                                    TRAP       COLLECTION VESSEL
   Volume (cu.m) - 0.004502                                    Volume (cu.m) - 0.004551

                     Pressure    Temp.(K)                        Pressure   Temp.(K)
                     (mm Hg)                                      (mm Hg)
     Presampling       20.0       294.3
     Postsampling     760.0       294.3
     Final           1139.0       299.2              Final           0.0      273 2

   Volume Sampled (dscm) - 0.004367

Calibration Data.
                                                  CO2    Backflush
   Response Factor (area units/ppmC)             901.5    885.1
   Blank (ppmC)                                    8.3
   Blank Area (area units)                                5327

Areas:
   CO                                0            0             0
   CH4                         430,810      430,260       429,800
   CO2                       1,817,200    1,812,400     1,812,800
   Noncondensibles               9,100       10,169        10,200
   Condensibles                      0            0             0

Concentrations (ppmC):                          %RSD
   CO                            0.0000         0.0000
   CH4                         722.6556         0.1175
   CO2                        3046.7680         0.1468
   Noncondensibles               7.6908        13.9308
   Condensibles                  0.0000         0.0000
   TGNMO                         7.6908
                                           (=      3.8400 mgC/cu.m)
```

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 DATA REPORT

Name: Alliance Technologies Corporation ID #90-109-370 Date: 11/12/90

Sample # 3

TANK new 286. TRAP COLLECTION VESSEL.

Volume (cu.m) = 0.004492

	Pressure (mm Hg)	Temp.(K)
Presampling	24.0	294.3
Postsampling	760.0	294.3
Final	1065.0	298.2

COLLECTION VESSEL. Volume (cu.m) = 0.004551

	Pressure (mm Hg)	Temp.(K)
Final	0.0	273 2

Volume Sampled (dscm) = 0.004333

Calibration Data:

	CO2	Backflush
Response Factor (area units/ppmC)	901.5	885.1
Blank (ppmC)	8.3	
Blank Area (area units)		5327

Areas.

CO	0	0	0
CH4	234,990	234,600	233,310
CO2	1,116,800	1,116,700	1,114,800
Noncondensibles	10,121	12,751	11,400
Condensibles	0	0	0

Concentrations (ppmC).		%RSD
CO	0.0000	0.0000
CH4	371.1730	0.3753
CO2	1768.1020	0.1010
Noncondensibles	9.8377	21.5707
Condensibles	0.0000	0.0000
TGNMO	9.8377	

(= 4.9120 mgC/cu.m)

RESEARCH
TRIANGLE
LABORATORIES

METHOD 25 REPORT

prepared for

ALLIANCE TECHNOLOGIES

by

RESEARCH TRIANGLE LABORATORIES, INC.

Gene Mull
Chemist

John Y. Morimoto, Ph.D.
Chemist

RTL ID# 90-348

October 22, 1990

1612 Carpenter Fletcher Road • Durham, North Carolina 27713 • (919) 544-5775 • FAX. (919) 544-5772
A Member of the Andersen Technology Group

RESEARCH TRIANGLE LABORATORIES, INC.
METHOD 25 TABLE OF RESULTS

Name: Alliance Technologies ID #90-109-348 Date 10/19/90

Project ID: Flux

#	Sample Description	Concentrations (ppmC)						Mass
		CO	CH4	CO2	Noncondensibles	Condensibles	TGNMO	Conc. (mgC/cu.m)
1	Site II- Sample 1	8	7	598	4	0	4	2
2	Site III- Sample 1	8	6	444	1	0	1	0
3	Site IX- Sample 1	10	4	12498	18	0	18	9

RESEARCH TRIANGLE LABORATORIES, INC.

COMMENTS ON THE ANALYSES

Report #90-109-348

Sample #3: There was a leak at the Quick-connect fitting, which was noted after the tank was pressurized prior to analysis. The leak was repaired and the tank repressurized. The final pressure listed in the report is corrected for this loss: initial pressurization, ca. 1000 mmHg, leak to 763 mmHg, and final pressurization, 1050 mmHg [1000 x 1050/763].

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 EXPERIMENTAL PROCEDURE

Calibration

A propane calibration gas mixture of 82 ppm CO, 68 ppm CH_4, 2.07% CO_2, and 75 ppm propane is injected via a 1-mL sampling loop into the analyzer. The injections are repeated until three integrated areas indicate reasonable agreement. A 1.18% CO_2 standard is run daily with the same requirement. The average daily response factors must agree within 5% of the RF(CO_2) and the RF(NMO) from the initial performance check.

Daily Performance Checks are performed at the beginning of each work day. Calibrations are performed daily or between customer sets of samples, whichever comes first. Additionally, a System Background Check is performed between each set of samples. Duplicate injections of 1.0% CO_2 are made after the final sample each day.

Response factors (average integrated area/concentration in ppmC) are calculated daily from the initial triplicate injections.

Analysis

Each trap is stored under dry ice until just prior to analysis and is flushed of CO_2 by passing zero air through it at -78 °C and via the CO_2 NDIR to the sample tank. Flushing is continued until no NDIR response is noted. The trap is baked at 200 °C with zero air flushing through the trap and via the oxidation catalyst and the NDIR into the collection vessel. Collection is continued until no NDIR response is noted. The trap is transferred to an oven set at 350 °C and baking is continued for 30 minutes. This ensures the cleanliness of the trap for a subsequent sampling. The trap is taken out of the oven and allowed to cool; it is then capped and stored for shipment.

The sample tank is analyzed by injecting an aliquot via a 1-mL sample loop into the GC column, which is held at 85 °C to elute the $CO+CH_4$ and then the CO_2 which is passed to the oxidation catalyst, reduction catalyst, and FID. The column is then backflushed at 195 °C to elute the organic fraction. The collection vessel is analyzed identically. In both cases, triplicate injections are made. The sample tank is pumped for 5 minutes (to less than 5 mmHg) and air is then allowed in via a paper fiber filter; this procedure is repeated. The tank is pumped 10 minutes and allowed to stand overnight. The tank is then connected to a pressure gauge to test for leaks (maximum permissible leak rate = 10 mmHg/day). If the tank passes the leak test, it is filled with zero air to slightly greater than atmospheric pressure and stored for shipment.

Calculations

Calculations are done in accord with EPA Method 25 procedures. A sample calculation is provided using client/RTL data.

RESEARCH TRIANGLE LABORATORIES, INC.
METHOD 25 SAMPLE CALCULATION

Note All pressure values have been converted when necessary to mm Hg and all temperature values to Kelvin

Name: Alliance Technologies ID #90-109-348 Date 10/19/90

Project ID: Flux

Sample # 1 Site II- Sample 1

D A T A

Tank new 287:
Volume (cu.m) - 0.004512

	Pressure (mm Hg)	Temp.(K)
Presampling	13.6	294.4
Postsampling	745.6	288.3
Final	1057.0	299.2

Trap

Collection Vessel
Volume (cu.m) - .004551

	Pressure (mm Hg)	Temp.(K)
Final	0.0	273.2

Calibration Data:

	CO2	Backflush
Response Factor (area units/ppmC)	898.5	876.8
Blank (ppmC)	13.0	
Blank Area (area units)		4503

Areas:

CO	4,931	4,547	6,509
CH4	2,946	4,544	6,824
CO2	380,090	382,247	396,245
Noncondensibles	7,420	8,024	6,352
Condensibles	0	0	0

C A L C U L A T I O N S

Measured Concentrations, corrected for blank:

Cm(CO) - Area(CO)/RF(CO2)
- 4931 /898.5 - 5.5
= 4547 /898.5 - 5.1
- 6509 /898.5 - 7.2

Cm(CH4) - Area(CH4)/RF(CO2)
- 2946 /898.5 - 3.3
- 4544 /898.5 - 5.1
- 6824 /898.5 - 7.6

Cm(CO2) - Area(CO2)/RF(CO2)
- 380090 /898.5 - 423.0
- 382247 /898.5 - 425.4
- 396245 /898.5 - 441.0

```
    Cm(Noncondensibles) - [Area(Noncondensibles) - Blank Area(NMO)]/RF(NMO)
                          - ( 7420  -  4503)/876.8 -     3.3
                          - ( 8024  -  4503)/876.8 -     4.0
                          - ( 6352  -  4503)/876.8 -     2.1

    Cm(Condensibles) - Area(Condensibles)/RF(CO2) - Blank(CO2)
                     - 0 /898.5 - 13.0 -   -13.0
                     = 0 /898.5 - 13.0 -   -13.0
                     - 0 /898.5 - 13 0 -   -13.0
```

<u>Pressure-Temperature Ratio, Q(i) - P(i)/T(i)</u>:

```
    postsampling tank: Q(1) -  745.6 / 288.3167 - 2.586046
    presampling tank   Q(2) -  13.59998 / 294.4278 - 4.619123E-02
    final tank:        Q(3) -  1057 / 299.15 - 3.533345
    final CV:          Q(4) -  0 / 273.15 - 0

    Volume Sampled (dscm) - 0.3857 x Tank Volume x [Q(1)-Q(2)]
                          - 0.3857 x .004512  x [2.5860 - 0.0462]
                          - 0.004420
```

Averages and % Relative Standard Deviations (%RSD) of Cm's are calculated.
(%RSD of C - %RSD of Cm)

<u>Calculated Concentrations</u>:

```
   C(CO) - Q(3)/[Q(1)-Q(2)] x Cm(CO)
         - 3.5333/(2.5860 - 0.0462) x      5.9 -      8.3

   C(CH4) - Q(3)/[Q(1)-Q(2)] x Cm(CH4)
          - 3.5333/(2.5860 - 0.0462) x      5.3 -      7.4

   C(CO2) - Q(3)/[Q(1)-Q(2)] x Cm(CO2)
          = 3.5333/(2.5860 - 0.0462) x    429.8 -    597.9

   C(Noncondensibles) - Q(3)/[Q(1)-Q(2)] x Cm(Noncondensibles)
                      - 3.5333/(2.5860 - 0.0462) x      3.2 -      4.4

   C(Condensibles)
       - Volume(CV)/Volume(Tank) x Q(4)/[Q(1)-Q(2)] x Cm(Condensibles)
       - 0.004551/0.004512 x 0.0000/(2.5860 - 0.0462) x    -13.0 -      0.0

   Total Gaseous Non-Methane Organics(TGNMO)-C(Noncondensibles)+C(Condensibles)
                                            -      4.4 +      0.0
                                            -      4.4


   Mass Concentration - 0.4993 x TGNMO
                      - 0.4993 x     4.4 -     2.2
```

RESEARCH TRIANGLE LABORATORIES, INC.

METHOD 25 SAMPLE QA/QC DATA & CALIBRATION CHECK/A

5.1.1 Carrier Gas and Auxiliary Oxygen Blank (1/3/90)

$CO + CH_4 + CO_2 + NMO = 0$ ppm   Requirement: < 5 ppm

5.1.2 Catalyst Efficiency Check (1/4/90)

$CO_2 = 9982$ ppmC   Requirement: $CO_2 = 10000 \pm 200$ ppmC

5.1.3 System Performance Check (1/4/90)

	Average Percent Recovery	%RSD
50 uL hexane/decane	107.6/103.6	0.1/0.5
10 uL hexane/decane	102.1/103.2	0.5/0.9
Requirement	100 ± 10%	< 5

5.2.1 Oxidation Catalyst Efficiency Check (1/5/90)

FID Response with Reduction Catalyst Out = 0.25%

Requirement < 1%

5.2.2 Reduction Catalyst Efficiency Check (1/5/90)

Response of CO_2 with Oxidation Catalyst and Reduction Catalyst operative was 100.3% of response with catalyst out.

Requirement 100 ± 5%

5.2.3 Analyzer Linearity Check and NMO Calibration (1/2/90)

$\overline{RF}$ values agree within 2.5%   Requirement: within 2.5%
%RSD values for triplicates < 2%   "   < 2%
except Propane 4th Dilution (22 ppmc) %RSD = 2.4%

(deviation by Gene Mull, Manager and Joseph Adamovic, Laboratory Manager)

$\frac{RF(NMO)}{RF(CO_2)} = 1.015$ Requirement: $\frac{RF(NMO)}{RF(CO_2)} = 1.0 \pm 0.1$

5.2.4 System Performance Check (1/5/90-4/10/90)

	Measured Value	Expected Value	Requirement
Propane Mix	75.0 ppm	75.0 ppm	± 5%
Hexane	55.4 ppm	55.2 ppm	± 5%
Toluene	54.9 ppm	54.5 ppm	± 5%
Methanol	* ppm	ppm	± 5%

* Methanol is currently being analyzed.

5.3 NMO Analyzer Daily Calibration

Triplicate injections of a mixture containing propane and high-level CO_2 are made at the beginning of each set of samples or every 24 hours, whichever comes first.

Requirements *: $DRF(NMO) = [RF(NMO) = 915] \pm 5\%$
$DRF(CO_2) = [RF(CO_2) = 862] \pm 5\%$

* Original calibration values were 91.5 and 86.2; on 5/30/90, electrometer range was lowered by a factor of 10, increasing each response factor by a factor of 10.

RESEARCH TRIANGLE LABORATORIES, INC.
METHOD 25 DATA REPORT

Name: Alliance Technologies   ID #90-109-348 Date: 10/19/90

Project ID: Flux

Sample # 3   Site IX- Sample 1

TANK new 293:   TRAP   COLLECTION VESSEL:

Volume (cu.m) = 0.004524   Volume (cu.m) = 0.004551

	Pressure (mm Hg)	Temp.(K)		Pressure (mm Hg)	Temp.(K)
Presampling	11.6	294.8			
Postsampling	745.6	288.4			
Final	1376.0	300.2	Final	0.0	273.2

Volume Sampled (dscm) = 0.004442

Calibration Data:

	CO2	Backflush
Response Factor (area units/ppmC)	898.5	876.8
Blank (ppmC)	13.0	
Blank Area (area units)		4503

Areas:

CO	4,568	4,755	4,935
CH4	2,566	2,096	1,979
CO2	6,239,712	6,239,133	6,228,973
Noncondensibles	13,228	11,842	14,477
Condensibles	0	0	0

Concentrations (ppmC):		%RSD
CO	9.5256	3.8612
CH4	4.4368	14.0349
CO2	12498.4900	0.0969
Noncondensibles	17.8262	15.1866
Condensibles	0.0000	0.0000
TGNMO	17.8262	

(= 8.9006 mgC/cu.m)

RESEARCH TRIANGLE LABORATORIES, INC.
METHOD 25 DATA REPORT

Name: Alliance Technologies ID #90-109-348 Date: 10/19/90

Project ID: Flux

Sample # 1 Site II- Sample 1

TANK new 287 | TRAP | COLLECTION VESSEL

Volume (cu.m) - 0.004512

Collection Vessel Volume (cu m) - [illegible]51

	Pressure (mm Hg)	Temp.(K)
Presampling	13.6	294.4
Postsampling	745.6	288.3
Final	1057.0	299 2

Collection Vessel:

	Pressure (mm Hg)	Temp.(K)
Final	0.0	[illegible]

Volume Sampled (dscm) - 0.004420

Calibration Data

	CO2	Backflush
Response Factor (area units/ppmC)	698.5	876.8
Blank (ppmC)	13.0	
Blank Area (area units)		4503

Areas:

CO	4,931	4,547	6,509
CH4	2,946	4,544	6,824
CO2	380,090	382,247	396,245
Noncondensibles	7,420	8,024	6,352
Condensibles	0	0	0

Concentrations (ppmC):		%RSD
CO	8.2510	19.5119
CH4	7.3875	40.8475
CO2	597.9497	2.2711
Noncondensibles	4.3828	30.6503
Condensibles	0.0000	0 0000
TGNMO	4.3828	

(= 2.1883 mgC/cu.m)

CHAIN OF CUSTODY RECORD

CONTRACT NO 2-093-001-0000-0-3

SAMPLERS (Signatures)

Sample Code	Date	Source Description	Container		ANALYSES															COMMENTS
			Size	G/P	Volatile Organics	Extractable Org.	Pesticides/PCBs	Trace Elements	Cyanide	Phenols	M2SC									
Site #II-1		Site 2 - Sample #1								X										
Site #III-1		Site 3 - Sample #1								X										
Site # IX-1		Site 9 - Sample #1								X										

Relinquished by Skip Smith	**Date/Time** 10-2	**Received by**	**Relinquished by.**	**Date/Time**	**Received by**
Relinquished by	**Date/Time**	**Received by:**	**Relinquished by:**	**Date/Time**	**Received by.**
Relinquished by	**Date/Time** 10/9/80 10:00	**Received by:**	**REMARKS:** PLEASE RETURN VIALS		

№ 3820

ALLIANCE
Technologies Corporation

ALLIANCE
Technologies Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone (508) 970-5600
Fax (508) 453-1985

JOB NO. Emission Flux Chamber Test
PROJECT Sampler Pump Purging
SUBJECT

SHEET ____ OF ____
BY J. GABRIEL
DATE 11/21/90
CH'K BY ____
DATE CH'K ____
R'K CH'K BY ____

Purge Rate Compressed Air = 5 L/min

Sampling Pump Rate = 5L/min

Time	Temp	Hexane Weight (g)	Weight Loss (g/min)
0	67.1	24.210	
10	67.7	22.450	0.176
20	67.9	20.746	0.170
30	68.3	19.059	0.169
45	68.4	16.540	0.167
55	68.5	14.975	0.166
60	68.4	14.058	0.164
		ave.	0.169

Expected Concentration

$C = (2404 \cdot 0.169 \cdot 1 \times 10^6)/(86 \cdot 5 \cdot 1)$

$= 9448$ PPM

measured Hexane in bag = 7287

Recovery % = (7287/9448) x 100 = 78%

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Telephone (508) 970-5600
Fax (508) 452 1995

SHEET ____ OF ____
BY S. O'Brien
DATE 11/21/90
CH'K BY ____
DATE CH'K ____
S'K CH'K BY ____

JOB NO. Simulated Exp. Chamber Tests
PROJECT Sample Pump Not Running
SUBJECT ____

Purge Rate Compressed air = 5 L/min

Sampling Pump Rate = 0 L/min

Time	Temp	Hexane Weight (g)	Weight Loss (g/min)
0	68.6	13.721	
11	68.5	11.832	0.172
15	68.3	11.056	0.157
20	68.3	10.284	0.160
30	68.4	8.579	0.170
36	68.3	7.573	0.168
42	68.2	6.582	0.165
47	68.2	5.765	0.163
			avg. 0.169

Expected Concentration

$C = (24.04 \cdot 0.169 \cdot 10^6)/(86 \cdot 5)$

$= 9448$ PPM

Measured Hexane in Bag = 5915 PPM

Recovery % $(5915/9448) \cdot 100 = 63\%$

[illegible]

[illegible] [illegible] / 2CL = [illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	7,362,000	[illegible]

[illegible] [illegible] / 2CL = [illegible]

Run 14	Run 5	Run 10	Average
[illegible]	[illegible]	7,045,000	7,033,000

[illegible] [illegible] / 2CL = [illegible]

[illegible]	[illegible]	[illegible]	Average
[illegible]	[illegible]		7,255,000

Pump-on Eng

Run	Run 20	Run 21	Average	[illegible]
[illegible]	[illegible]	9,150,000	9,150,000	[illegible]

Pump-off Eng

Run 22	Run 23	Run 24	Average	PPM
7,480,000	[illegible]	7,000,000	7,293,000	5,915

United States
Environmental Protection
Agency

Research and Development

Atmospheric Research and
Exposure Assessment Laboratory
Research Triangle Park NC 27711

EPA/600/S3-89/008 Sept 1989

Project Summary

Evaluation of the Flux Chamber Method for Measuring Volatile Organic Emissions from Surface Impoundments

A. R. Gholson, J. R. Albritton, and R. K. M. Jayanty

The overall objective of this research program was to estimate the precision and accuracy of the flux chamber method for measuring volatile organic emissions from open liquid bodies of waste during the treatment, storage, and disposal of hazardous waste.

A simulated surface impoundment was constructed so that the accuracy and variability of the method could be measured under controlled environmental conditions. Flux chamber operational parameters of sweep flow rate, sampling time, sweep flow position, and flux chamber depth were studied to determine their effect on precision and accuracy. Environmental factors of wind velocity, solar intensity, emission rate, and chemical composition were investigated. Precision of the method in the field was evaluated at two hazardous waste treatment, storage, and disposal facilities. One was a wastewater treatment facility at a chemical plant, and the other was a waste stabilization facility.

This Project Summary was developed by EPA's Atmospheric Research and Exposure Assessment Laboratory Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

During the treatment, storage, and disposal of hazardous waste, volatile organic compounds (VOCs) are released into the environment via the atmosphere. Under the 1984 Resource Conservation and Recovery Act Amendments, the U.S. Environmental Protection Agency (U.S. EPA) is required to promulgate regulations for controlling these air emissions at hazardous waste treatment, storage, and disposal facilities (TSDFs). To support the regulatory process, analytical methods are required to measure or predict the emissions of VOCs from TSDFs, and the accuracy and precision of these methods should be well-characterized.

The U.S. EPA's Office of Solid Waste has been involved in the activities to regulate the emission of organic pollutants into the environment from the handling, storage, and treatment of hazardous waste. One such activity involves a program to deal with emissions from impoundments and holding ponds at hazardous waste TSDFs. While participating in this program, the U.S. EPA's Atmospheric Research and Exposure Assessment Laboratory at Research Triangle Park, North Carolina, and the Research Triangle Institute, have undertaken to validate an isolation chamber device for measuring rates of emission from liquid surfaces.

The flux chamber method is an isolation chamber method that has been used to measure air emissions from surface impoundments, land farms, landfills, and contaminated soils. Emission measurements made with the flux chamber are providing a data base for regulatory decision making, validating predictive air emission models, and assessing risk at Superfund cleanup sites. This report defines the quality of the data that can be obtained by using the flux chamber method to measure emissions from non-aerated surface impoundments and open tanks.

A combination of controlled laboratory experiments and field evaluations was performed to estimate the method's accuracy and precision. The influence of method parameters and environmental conditions was investigated to determine their effect on accuracy and precision. Single-compound and multicompound emissions were investigated in the laboratory with a simulated surface impoundment. Field evaluations were performed at two different sites on a range of liquid waste mixtures.

Procedures

For this evaluation, four flux chambers were constructed. Figure 1 shows the flux chamber and ancillary equipment required to make an emission measurement. The flux chamber encloses a portion of a liquid surface and a sweep flow of organic free inert gas is passed through the chamber. After the sweep flow and surface emissions reach a steady state, a gas sample is collected from the chamber and the emission rate is calculated by using the following equation:

$$E = FC A \qquad (1)$$

where

F = the sweep flow rate in flux chamber
E = the emission rate
C = the gas concentration of emitted species
A = area of surface enclosed

The flux chamber method was evaluated under controlled conditions in a surface impoundment simulator (SIS) shown in Figure 2. The SIS allowed multiple flux chamber measurements to be made under identical conditions to estimate method precision, and a true emission rate could be measured with the SIS to estimate method accuracy.

Gas samples were collected from the flux chamber or SIS by using a grab sampling method with glass syringe or a 10-min integrated sample with evacuated stainless steel canisters. Concentrations greater than 1 ppmV were analyzed by using a gas sampling valve and less than 1 ppmV by using cryogenic or solid adsorbent concentrations. All analyses were performed by gas chromatography with a flame ionization detector or an electron capture detector.

Laboratory Experiments

The laboratory experiments consisted of an initial parametric study, a precision and accuracy study, and an investigation into the negative bias found during the precision and accuracy study. The flux chamber parameters of sweep flow rate, sweep flow inlet height, sampling time, and chamber depth were studied to both validate the performance of the flux chamber and to find the optimum operating conditions.

The precision and accuracy of the flux chamber was measured at three different sweep flow rates, during the day and at night, under conditions of high and low emission rates, and with a single volatile compound and three volatile compounds. The precision was estimated by calculating the standard deviation of duplicate measurements by using the following equation:

$$SD = \sqrt{\sum_{i=1}^{i=n} \frac{(X_{1i} - X_{2i})^2}{2n}} \qquad (2)$$

where

SD = standard deviation
X_{1i} = emission rate calculated by using the first chamber
X_{2i} = emission rate calculated by using the second chamber
n = number of replicate measurements

The accuracy was estimated by determining the percent bias between the average of the duplicate flux chambers and the average of the measured emission in the SIS before and after the flux chamber measurement.

A series of experiments were performed to determine the cause of the negative bias found for the flux chamber during the precision and accuracy study. One was designed to determine if the equilibrium gas-phase concentration was being approached in the flux chamber, causing a suppression in the emission. The second experiment was an investigation into the effect wind velocity and solar radiation have on the accuracy. The third experiment was conducted to observe the effect the flux chamber had on the liquid surface flow, which may be a controlling factor in the emission process.

Field Experiments

The flux chamber method was evaluated at two sites in the field to determine the precision of the method under field conditions. The two sites chosen for the evaluation varied greatly in their design, purpose, and environmental conditions. Site One was a wastewater treatment facility for a chemical manufacturer in the Southeast; its field evaluation was performed during December. Site Two was a waste stabilization treatment facility in the Midwest accepting liquid and sludge waste from a variety of industries; its field evaluation was made during June.

Four sets of emission measurements were made at each site, which consisted of measurements at two locations and at two separate times during the day. Each set of emission measurements was composed of data from four replicate flux chambers. Canister samples were collected and sent back to the laboratory for detailed analysis.

This data was statistically analyzed by using the NESTED approach, available with the Statistical Analysis System software package. Total method variance was determined, and the variance component due to the flux chamber, samples collection and storage, and instrumental analysis was determined.

Results and Discussion

Laboratory Experiments

The initial parametric and flow studies showed that the flux chambers and the SIS were operating as designed. Complete mixing of the emission and sweep gas was occurring in both the flux chamber and the SIS before sample analysis and the flow rate could be accurately measured for both. Varying the sweep flow rate was found to have little effect on the measured emission rate between 2 L/min and 10 L/min. At flows lower than 2 L/min, the measured emission rate dropped significantly. The optimum sampling time was determined to be between 15 and 40 min at a sweep flow of 5 L/min. Grab sample collection at 20 and 30 min or collecting an integrated sample between 20 and 30 min was recommended and used for the rest of the study. Flux chamber depth and height of the sweep inlet were found to have no effect on the measured emission over the ranges studied.

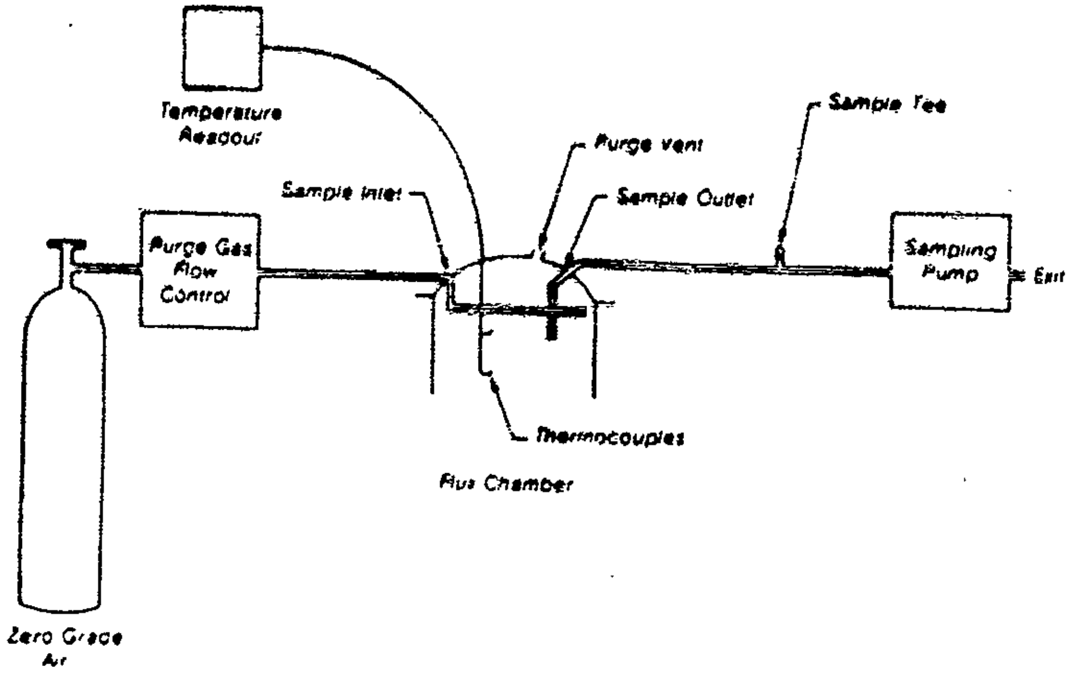

Figure 1 Schematic of flux chamber and support equipment

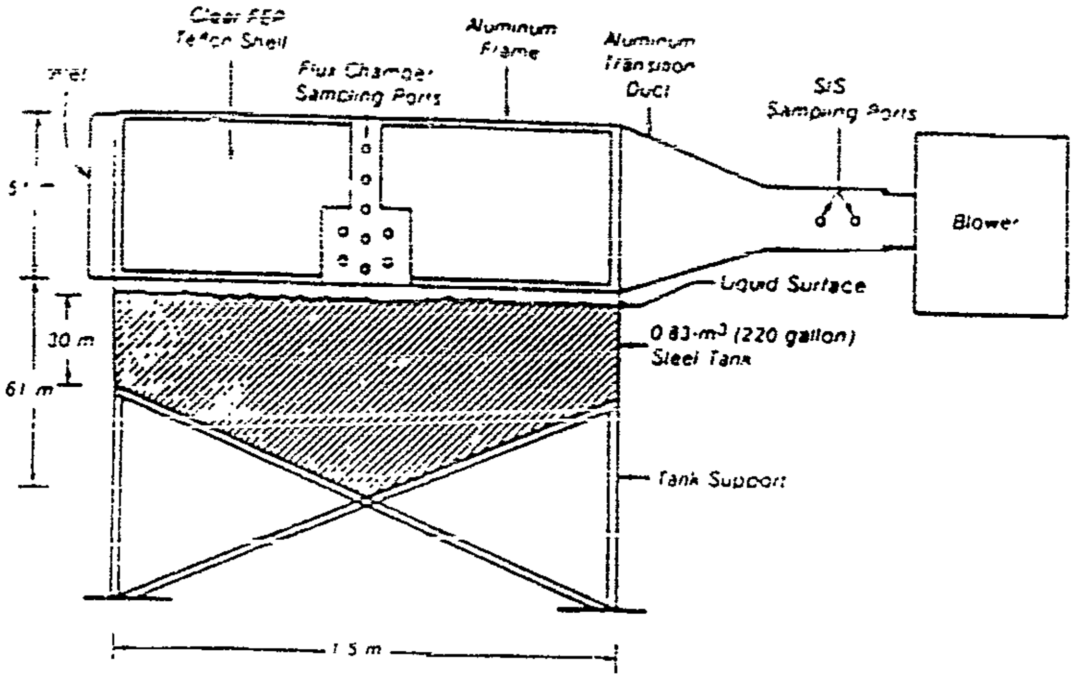

Figure 2 Diagram of the surface impoundment simulator

Precision and accuracy results for the single component (1,1,1-trichloroethane) are shown in Table 1. The precision was excellent for all the conditions studied; the lowest variability was at the highest sweep flow rate and at night. The accuracy was not as good as the precision. A negative bias of between 45 and 67 percent was found for all conditions except for a sweep flow of 2 L/min, which had a significantly greater bias of -82 percent. The greater bias at the lower flow rate indicates a need for higher flow rates to prevent suppression of the emission rate due to concentration buildup in the chamber.

Table 2 shows the results for the three-component precision and accuracy study. Again the bias was negative; however, the values were significantly different for each compound. Methyl ethyl ketone had the greatest bias (-68) and 1,1,1-trichloroethane had the lowest (-21), which was significantly different than that for 1,1,1-trichloroethane alone (Table 1). Toluene had an intermediate bias, and the bias of the sum of the three components (total organic) emission was found to match that of the single-component study.

It was proposed that the negative bias could be due to three mechanisms: (1) concentration buildup in the chamber resulting in the gas-liquid equilibrium controlling the emission rate rather than kinetic processes, (2) interference of the flux chamber on environmental conditions, such as wind velocity and solar radiation, which may affect the emission rate, (3) the flux chamber physically disrupting the natural surface turbulence which could be controlling the emission rate.

The experimental results show that concentration buildup accounts for a small percentage of the total negative bias at a sweep flow rate of 5 L/min. Wind velocity and solar radiation had no effect on the bias over the range studied. The natural turbulence and surface flow pattern were affected by the flux chamber, but the amount or extent of the effect on emission rate could not be determined because of the complex relationship between liquid-phase transfer coefficient and the emission rate.

Field Experiments

Detailed precision analysis of flux chamber measurements at two field sites revealed that the precision was dependent on the sample collection and storage method. Because of the difficulty of making four simultaneous flux chamber measurements, some data points had to be omitted or were questionable.

At Site One, the precision was excellent for the stable compounds, but the variability was much higher for the more reactive compounds. Table 3 shows the coefficient of variations for the surface impoundments. The data shows that the measurement component of the variance was responsible for the major portion of the total variability. The measurement variability was separated into sampling and analytical variability, and at least 95 percent of the measurement variability was due to sampling, which includes sample collection and storage. The actual flux chamber variability is the difference between the total and the measurement variability. From the QC results of Site One it was determined that 2-heptanol, aniline, and nitrobenzene were not stable in the stainless steel canisters.

Table 4 shows the variance analysis results for the field study at Site Two. All the compounds were stable, and the measurement component variance was approximately 50 percent of the total variance. The analysis component of variability was only a small fraction of the total variance.

Conclusions

The results of the laboratory and field evaluation of the flux chamber method indicate that liquid surface emission measurements can be made with very good precision and that operational and environmental parameters have only a minor effect on the precision and accuracy. A compound-dependent negative bias ranging from 40 to 80 percent was evident during the laboratory studies. The source of this bias was investigated, but no definitive cause was determined.

The laboratory evaluation revealed that the flux chamber precision for a single compound was less than 3 percent relative standard deviation under the ideal conditions of optimal sweep flow rate, steady solar conditions, and moderate-high emission rates. For the three-component study, precision was between and 13 percent relative standard deviation. Precision was only slightly influenced by sweep flow rates higher than 2 L/min, emission rate, and solar radiation. Sweep flow rates of lower than L/min should not be used for chambers of this design because of increased variability and poor accuracy.

Precisions estimated for the field evaluations were higher than those found in the laboratory study. The coefficients of variation ranged from 3.5 to 19 percent for stable compounds when questionable flux chamber values were omitted. Variances as great as 30 percent were found when all flux chamber measurements were included. The added 10 percent variation caused by technical problems with the chamber illustrates the difficulty of performing flux chamber measurements in the field, especially when four measurements are being made simultaneously. Sample collection and storage accounted for 50 to 100 percent of the total variability, with instrumental analysis contributing less than 5 percent of the total. Variability between flux chambers accounted for the remaining percentage of the total variability. When the variation due to sample collection and storage (which was required only for the field studies) is removed, the precision for the

Table 1. Precision and Accuracy Estimate for 1,1,1-Trichloroethane

Grouping	*Number*	*Percent RSD*[a]	*Average Bias (% ± 90% CL)*[b]
5 L/min, high emission	9	3.0	-45 ± 6.4
5 L/min, low emission	3	2.9	-67 ± 17
2 L/min	3	4.1	-82 ± 9.5
10 L/min	3	1.4	-49 ± 8.0
5 L/min, nighttime	3	1.5	-57 ± 21

[a] RSD is the pooled relative standard deviation.
[b] CL is the confidence limit.

Table 2. Precision and Accuracy Estimates for Three Component Emission Measurement

Compound	Number of Replicates	Precision (%RSD[a])	Average Bias (% ± 90% CL[b])
Methyl ethyl ketone	9	5.7	-58 ± 3.1
1,1,1-Trichloroethane	9	11	-21 ± 6.0
Toluene	9	12	-38 ± 4.4
Total organic	9	6.6	-41 ± 3.3

[a]RSD is the pooled relative standard deviation
[b]CL is the confidence limit

Table 3 Results of Variation Analysis for Surface Impoundment Emission Measurements at Site One

Compound	Coefficient of Variation (Percent)	
	Total	Measurement
Methylal	6.04	4.71
Chloroform*	5.24	5.14
Toluene	9.25	7.85
2-heptanone	50.8	50.8
Aniline	33.0	33.0
Nitrobenzene	45.7	42.4

*ECO results used in analysis

Table 4 Results of Variation Analysis for the Primary Runoff Tank Emission Measurements at Site Two

Compound	Coefficient of Variation (Percent)		
	Total	Measurement	Analysis
Acetone	13.1	6.72	0.32
1-Propanol	14.1	7.92	2.24
1-Butanol	14.7	7.03	0.74
Toluene	15.1	9.58	0.17
o-Xylene	18.0	14.5	5.87
Methylene chloride*	15.5	6.02	0.34
Tetrachloroethylene*	19.0	6.01	0.08
Total organics	14.7	7.3	0.05

*ECO results used in analysis

field study matched that in the laboratory study.

The negative bias during the laboratory studies is believed to be due to changes in the liquid turbulence caused by the flux chamber. Little change in the bias was detected over the range of wind velocities and solar intensities studied during this evaluation. Visible changes were noted in the liquid turbulence when the flux chambers were placed on the liquid surfaces. This change in turbulence and the magnitude of the change may be due to the large size of the flux chamber in relation to the experimental surface impoundment and the enclosure above it. The bias found for this study may not be valid for real conditions, where the impact of the flux chamber would be considerably smaller because of the larger relative size of both the liquid surface and the air parcel surrounding it.

Recommendations

The flux chamber method was found to be a reliable method for measuring VOC emissions from surface impoundments. Relative values for emission rates could be precisely determined and compared to other sources by using the flux chamber. Quantitative studies are needed to compare the effects of the flux chamber on surface turbulence in the field to those in the simulated surface impoundment to determine if the negative bias found in the laboratory is also present in the field.

Further method development may also be needed to improve the measurement variability found. To measure the emission rate of reactive VOCs such as nitrobenzene and aniline new measurement techniques for the flux chamber method are required.

Similar evaluations are needed to investigate the use of the flux chamber for measuring the rate of VOC emissions from other hazardous waste treatment, storage, and disposal facilities such as land farms, landfills, and aerated surface impoundments. Other potential uses of the flux chamber should be investigated. Flux chambers could be used to evaluate potential emission reduction measures such as oil layers, protective barriers, and waste stabilization. Locating, mapping, and assessing the volatile emissions from leaking underground storage tanks by using flux chambers should be investigated. The flux chamber method may also be useful to measure the flux of toxic compounds in the indoor environment.

[illegible]

ALLIANCE TECHNOLOGIES CORPORATION
BOOTT MILLS SOUTH · FOOT OF JOHN STREET
LOWELL, MA 01852
(508) 970-5600

RUN 21 NOV 1990
WIND SPEED (MPH)

LEAST SIGNIFICANT DIGIT 1000

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WS	90227																		2	0	0	4	6	0	0	081590	2	6	0	
WS	90228	0							11	13	22	28	41	54	52	41	22	24	19	13	11	11	11	6	2	081690	21	54	0	
WS	90229	2	2	4	4	8	0	4	6	19	19	19	26	37	41	52	60	58	58	54	54	56	54	56	62	081790	31	62	0	7
WS	90230	60	67	84	101	114	103	116	108	113	114	95	75	52	43	37	34	28	11	4	6	7	4	15	6	081890	58	116	2	13
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WS	90232	7	84	86	88	99	86	86	95	71	58	54	56	62	56	60	58	67	75	69	75	80	80	71	86	082090	74	99	54	177
WS	90233	95	103	101	93	95	86																			082190	96	103	86	57
WS	90236											77	77	73	67	75	73	77	69	65	54	58	69	43	28	082490	65	77	28	90
WS	90237	19																								082590	19	19	19	1
WS	90242													88	77	75	75	65								083090	76	88	65	38
WS	90250													88	75	90										090790	84	90	75	25
WS	90251				93	95	95	84	88	93	84	90	86	75	71	86	71	69	69	56	45	45	45	45	45	090890	73	95	45	15
WS	90252	45	39	39	39	39	41	39	39	45	62	103	114	99	84	73	65	88	84	80	62	47	45	56	60	090990	62	114	39	148
WS	90253	56	58	49	54	58	45	45	52	47	58	84	88	77	67	67	54	47	45	45	45	43	45	47	49	091090	55	88	43	13
WS	90254	45	47	47	45	49	45	41	45	49	52	60	58	65	67	49	45	49	43	43	39	43	43	43	47	091190	48	67	39	115
WS	90255	43	45	45	45	45	45	43	45	54	82	108	112	105	103	101	95	93	58	54	56	60	65	60	54	091290	67	112	43	1616
WS	90256	54							62	65	65	71	77	80	69	75	69	69	60	49	54	58	56	58		091390	64	80	49	1091
WS	90265										105	93	84	80	73	97	95	67	49	54	49	47	43	45	90	092290	71	105	43	1071
WS	90266	52	45	47	49	60	60	62	60	65	67	73	97	90	99	108	123	112	80	56	49	49	52	49	47	092390	69	123	45	16
WS	90267	47	47	45	49	62	75	56	49	69	80	58	90	88	82	77	82	82	67	49	45	49	41	49	47	092490	65	90	41	151
WS	90268	52	47	43	39	43	45	41	43	47	65	97	95	114	133	123	105	73	60	54	47	47	49	49	49	092590	66	133	39	1
WS	90269	47	47	47	45	47	43	49	49	52	58	123	114	56	54	86	116	110	67	49	47	45	47	47	[illegible]	092690	64	123	43	1
WS	90270	49	52	47	47	47	43	49	58	65	65	54	69	67	56	62	56	47	41	47	41	41	39	4	43	092790	51	69	39	1
WS	90271	47	49	45	45	54	47	54	52	49	54	84	108	105	90	88	90	90	69							092890	68	108	45	12
WS	90275														155	153	144	146	130	90	56	60	54	62	62	100290	101	155	54	111

LLIANCE TECHNOLOGIES CORPORATION
OOT MILLS SOUTH   FOOT OF JOHN STREET
WELL, MA 01852
508) 970 5600

WIND SPEED (MPH)

LEAST SIGNIFICANT DIGIT .   1000

YRDAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MODDYY	PA	HI	LO	TOTAL
90276	73	47	45	41	45	43	41	37	11	32	34	37	52	45	60	22	6	4	0	0	0	0	0	20	100390	29	73	0	695
90277	0	0	0	0	0	0	0	4	11	13	37	67	108	93	86	69	54	60	41	54	54	34	22	26	100490	35	108	0	833
90278	24	22	19	24	24	28	39	56	67	77	67	77	84	90	86	84	80	84	84	67	65	71	60	58	100590	60	90	19	1437
90279	34	26	17	15	22	19	24	28	26	29	22	22	24	22	22	47	34	24	26	45	56	0	22	7	100690	28	56	15	671
90280	34	15	22	19	24	24	28	34	39	82	105	99	97	105	121	118	121	105	95	99	75	62	49	4	100790	67	121	15	[illegible]
90281	30	22	19	22	32	32	30	26	28	24	19	26	37	28	34	32	32	30	26	19	22	22	19	22	100890	26	37	19	633
90282	22	22	19	19	26	26	26	47	49	45	41	60	82	88	97	90	93	93	95	84	93	77	56	34	100990	58	97	19	1384
90283	28	26	26	28	22	26	22	24	22	28	22	24	28	26	30	26	24	26	22	24	22	24	26	24	101090	25	30	22	600
90284	22	22	19	19	26	26	24	24	41	67	62	54	67	67	82	86	97	93	52	30	56	67	60	[illegible]	101190	51	97	19	[illegible]
90285	30	22	24	24	26	26	22	22	24	24	77	90	88	69	86	[illegible]	39	24	19	26	34	22	26	[illegible]	101290	40	90	19	[illegible]
90286	86	75	45	52	65	41	34	34	49	43	56	52	71	77	77	93	[illegible]	45	28	37	43	29	28	24	101390	53	93	24	1271
90287	22	28	22	22	22	52	54	56	45	45	47	41	56	62	54	43	28	19	22	22	24	28	26	[illegible]	101490	36	62	19	[illegible]
90288	24	19	19	17	19	26	28	24	26	60	65	69	73	84	95	82	71	43	19	19	22	26	19	22	101590	40	95	17	971
90289	30	19	17	22	32	32	34	37	32	52	49	49	62	75	67	71	47	22	15	19	19	26	22	19	101690	36	75	15	[illegible]
90290	22	17	19	17	22	19	26	24	19	47	90	131	157	148	121	108	99	49	22	19	22	19	28	19	101790	53	157	17	1264
90291	24	34	65	69	77	86	90	88	105	157	170	155	152	166	185	200	192	211	219	198	62	49	45	60	101890	119	219	24	[illegible]
90292	60	62	86	75	90	82	80	71	69	69	90	95	101	103	125	136	105	73	54	11	26	41	54	22	101990	74	136	11	1780
90293	26	30	34	37	28	30	32	22	22	65	56	47	54	60	47	30	26	15	6	9	15	15	15	15	102090	30	65	6	728
90294	4	4	4	9	2	2	0	2	0	9	60	93	110	101	97	99	99	69	32	9	11	9	17	9	102190	35	110	0	851
90295	9	9	11	6	4	9	4	11	11	9	30	54	67	58	71	67	77	37	9	6	6	11	11	9	102290	25	77	4	596
90296	11	15	11	11	13	4	6	9	6	11	60	52	45	41	45	60	90	69	54	97	105	82	62	60	102390	42	105	4	1019
90297	67	77	77	84	84	101	88	116	116	153	127	129	105	88	103	90	73	43	39	56	45	41	22	19	102490	81	153	19	1943
90298	22	28	26	26	28	28	26	30	43	54	88	75	71	69	62	69	77	62	43	54	67	67	73	[illegible]	102590	52	88	22	[illegible]
90299	75	80	54	77	101	121	123	97	127	161	159	168	185	194	192	170	161	146	148	148	48	133	136	118	102690	134	194	54	[illegible]
90300	110	110	99	84	65	97	105	90	93	103	73	69	65	67	49	39	24	22	17	24	22	19	22	19	102790	62	110	17	1487

ALLIANCE TECHNOLOGIES CORPORATION
BOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852
(508) 970 5600

WIND SPEED (MPH)

LEAST SIGNIFICANT DIGIT 1000

ID	YRDAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MMDDYY	AV	HI	LO	TOTAL
[illegible]	90301	22	24	28	28	24	56	56	37	41	41	43	69	65	54	41	47	47	54	56	60	69	95	90	121	102890	53	121	22	[illegible]
15	90302	142	127	103	103	88	99	146	161	148	153	146	164	170	181	179	140	110	103	86	45	54	56	60	65	102990	118	181	45	[illegible]
[illegible]	90303	56	28	22	19	24	28	22	24	37	65	60	62	47	49	45	43	[illegible]	30	24	19	17	26	32	[illegible]	103090	36	65	17	[illegible]
15	90304	22	24	28	32	28	24	30	75	71	94	93	60	65	67	54	52	24	28	32	28	28	[illegible]	24	28	103190	43	93	22	104
15	90305	26	19	22	24	19	22	22	22	26	43	71	67	71	73	60	54	28	24	22	24	19	22	24	19	110190	34	73	17	[illegible]
15	90306	22	22	26	28	30	30	34	32	30	32	60	54	69	77	77	71	58	56	43	34	24	19	22	22	110290	41	77	19	[illegible]
15	90307	22	28	28	26	26	30	28	26	45	97	84	69	65	54	58	54	30	26	24	28	30	22	34	22	110390	40	97	22	[illegible]
15	90308	24	28	26	32	32	37	34	28	26	37	37	60	60	49	60	56	43	45	26	28	28	22	19	24	110490	36	60	19	[illegible]
[illegible]	90309	24	30	22	26	34	32	28	37	60	60	54	67	82	82	110	121	121	112	99	95	114	116	101	116	110590	75	121	22	[illegible]
	90310	112	112	105	118	95	95	99	93	101	121	129	122	157	148	142	133	129	125	90	88	86	62	75	86	110690	110	157	62	[illegible]
[illegible]	90311	43	88	110	90	45	34	28	30	52	56	49	56	41	54	65	41	26	32	24	17	19	19	22	32	110790	45	110	17	[illegible]
[illegible]	90312	45	86	105	110	101	112	101	75	69	95	99	99	97	99	97	90	77	22	32	45	15	22	9	0	110890	41	112	0	[illegible]
[illegible]	90313	0	0	0	0	0	2	0	0	0	7	26	43	112												110990	14	112	0	[illegible]
	90316													144	118	129	144	148	133	103	77	84	90	97	101	111290	114	148	77	[illegible]
[illegible]	90317	146	129	125	116	110	95	97	97	129	133	166	155	164	133	159	142	153	125	110	97	118	95	97	95	111390	124	166	95	[illegible]
[illegible]	90318	80	108	69	75	95	105	73	125	133	112	153	123	93	97	75	62	37	37	28	26	30	19	34	24	111490	76	153	19	[illegible]
[illegible]	90319	22	24	17	24	19	26	30	30	32	26	58	56	54	54	54	49	41	26	41	28	22	24	26	22	111590	34	58	17	[illegible]
[illegible]	90320	19	22	24	24	30	28	30	28	22	49	69	88	86												111690	40	88	19	[illegible]

ALLIANCE TECHNOLOGIES CORPORATION
FOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852
(508) 970 5600

WIND DIRECTION (DEGREES)

LEAST SIGNIFICANT DIGIT 1.0000

ID	YRDAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MMDDYY	DA	HI	LO	TOTA
6	90227																		308	292	311	312	309	306	305	81590	306	312	292	
6	90228	306	311	300	287	282	288	272	306	308	7	35	89	109	345	143	133	187	217	35	8	342	353	334	340	81690	328	353	7	
6	90229	335	332	325	327	320	306	305	328	0	315	195	301	58	358	349	351	22	353	0	19	47	26	127	348	81790	347	358	0	
6	90230	0	103	144	142	154	166	164	164	162	161	172	176	210	44	9	5	1	22	340	338	326	326	128	8	81890	101	340	0	
6	90231	350	323	280	285	293	304	320	309	316	325	339	344	343	318	321	314	317	317	324	320	322	322	324	326	81990	319	350	280	
6	90232	316	323	323	318	327	323	321	330	345	336	352	345	340	319	326	327	340	327	326	320	320	314	314	313	82090	326	352	313	
6	90233	316	315	318	317	316	307																			82190	315	318	307	
6	90236											324	327	352	346	340	333	338	340	332	336	330	331	331	332	82490	334	352	327	
6	90237	321																								82590	321	321	321	
6	90242													338	8	351	354	310	281	47	356	339	334	334	340	83090	344	356	2	
6	90243	357	330	[illegible]	335	340	321	328	356	344	8	16	343	28	15	345	34	290	273	353	335	332	332	326	319	83190	341	356	8	
6	90244	324	325	328	329	323	326	325	336	358	33	68	6	64	130	167	160	191	219	304	13	347	346	13	25	90190	351	358	6	
6	90245	18	7	351	5	352	337	338	330	20	41	356	16	56	49	45	146	246	330	352	356	343	334	357	[illegible]	90290	1	357	5	
6	90246	333	349	26	354	323	314	326	340	345	352	312	330	335	332	319	317	317	322	334	346	324	317	327	330	90390	332	354	26	
6	90247	337	341	337	331	337	336	333	335	358	105	134	122	95	137	161	151	192	211	44	359	352	[illegible]	2	[illegible]	90490	21	359	2	
6	90248	140	146	104	158	47	38	4	110	149	149	141	40	51	32	4	110	157	168	332	6	12	11	356	28	90590	72	356	4	
6	90249	354	2	348	340	342	353	343	353	336	5	11	69	142	96	114	168	123	234	100	45	33	81	19	49	90690	31	354	2	
6	90250	65	126	176	174	158	137	137	161	146	149	151	152	121	157	133	87	19	13	30	12	352	330	350	337	90790	108	352	12	
6	90251	324	324	324	329	327	324	327	336	346	351	331	28	48	39	100	84	140	150	126	352	340	338	346	333	90890	356	352	28	
6	90252	330	321	314	303	328	329	310	312	353	109	124	140	170	170	160	133	152	166	154	149	146	137	144	149	90990	157	353	109	
6	90253	140	151	113	170	154	51	338	323	64	349	332	329	348	18	5	344	341	273	46	10	343	346	344	334	91090	359	349	5	
6	90254	357	321	326	331	331	329	325	323	335	2	24	359	57	346	340	352	219	241	339	344	333	350	347	2	91190	338	359	2	
6	90255	16	355	37	40	95	99	349	114	149	151	158	159	164	147	164	152	173	200	255	73	114	159	153	2	91290	126	355	2	
6	90256	16	18	359	355	358	3	5	339	337	335	328	335	333	350	122	173	177	217	35	18	348	343	329	343	91390	352	359	[illegible]	
	0257	343	342	342	348	44	40	357	355	146	137	146	153	163	165	159	158	152	154	158	136	157	167	166	161	91490	136	357	40	

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ALLIANCE TECHNOLOGIES CORPORATION                                                       WIND DIRECTION (DEGREES)
FOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852                                                                        LEAST SIGNIFICANT DIGIT .    1.0000
(508) 970 5600

ID YRDAY   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  MMDDYY  DA  HI  LO TOTAL

1B 90258 161 162 163 165 146  70 173 161 129 119 110  87  68  48  22  18   9  45 352 334 357 335 341 324   91590  73 357  18
1B 90259 330 338 325 337  21 127 320  44  54 326 314 344 348 339 338 328 328 318 324 340 326 334 316 333   91690 340 348  21
1B 90260 327 335 332 328 323 319 324 347 350 348 326                                 345 337 337 328 343   91790 334 350 319
1B 90261 341 329 357   4  25  32  48  28  21   3 359 357  13  16 342 345  10  33  65 332 327 345 335 [illegible]   91890   4 357 [illegible]
1B 90262 322 319 314 319 312 317 329 335 351 100 132 134 137 151 157 140 115  17 133 156 141 149  98 157   91990 108 351  17
1B 90263 151 111 114  17 331 332 347 350   8                                                               92090  19 350   8
1B 90265                                     156 159                                                       92290 157 159 156
1B 90275                                                     353 347 326 325 351 326  93  51  58  78 132  100290  13 353  58
1B 90276 134 357 311 329 335 318 316 323  32 108 130 126 136 135 136 129 129 143   3 320 302 318 313 302  100390   9 357   3
1B 90277 308 307 327  56 332   5  91 120 120 115 129 147 150 160 164 147 141 143 137 115   8  57 345 [illegible]  100490  96 345   5
1B 90278 151 158 152 185 176 152 155 143 134 126 102 118 135 125 108 131 138 130 120 113 119 139 157 152  100590 138 185 102
1B 90279 174 165 179 359  77 345  10 336 330  37 106  24 113  72 100 137 121  94 127 133 129 117 114 112  100690  96 359  10
1B 90280 169 295 355 145  96 349 113 108  92 136 139 136 143 159 155 154 153 152 160 141 148 159 158 137  100790 138 355  92
1B 90281 200  11  19 101 170  91 111  15 350 358 355 115 169   2 117 129 121 121 108 342   8  61  51  40  100890  69 355   2
1B 90282 328 351 325 339 339  51  71 132 128 135 141 149 134 149 143 153 153 164 153 161 152 164 177 135  100990 142 359  51
1B 90283 220 344 359 336 353 343 337 169 329 352 343 341  30  29  72 342   3  28  39  13  90  41  38 344  101090   6 359   3
1B 90284 340 348 330 335 332  68  37  12 135 143 155 147 144 132 158 147 158 153 160 152 154 164 163 171  101190 133 348  12
1B 90285 118   8  48   4 341 355 342 339 333 157 162 159 170 175 153 149 124 299 342 312 177 347 334 134  101290  37 355   4
1B 90286 161 163 173 171 167 175 165 156 167 168 169 163 156 166 161 163 163 180 160 150 155 144   9  21  101390 160 180   9
1B 90287 356 326 357 341 353 328 322 329 327 336 336 344   5 349 337  32  38 341 337 329 319 347 342 352  101490 342 356   5
1B 90288 352 340 335 335 337   4 333 358  89 149 103 124  87 352 343  22  20  49  16 331 337 320 327 313  101590   1 358   4
1B 90289 312 325 334 323 311 300 314 308 328 335   6  51  17  32  37  26  35  64   3 317 311 314 319 321  101690 343 355   3
1B 90290 326 325 313 320 308 315 313 341   0 110 135 137 140 153 152 152 153 162 211   5  56   5   9   0  101790   9 341   0
1B 90291 351 152 [illegible] 154 139 156 157 150 146 151 153 149 161 169 [illegible] 159 159 161 173 164 150 160 157 154  101890 156 351 139
1B 90292 144 135 [illegible] 131 138 136 125 128 109  66  72  30  41  16 [illegible] 354   9 352 337 328 356 328   6  64  101990  59 358   6
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ALLIANCE TECHNOLOGIES CORPORATION                                                      WIND DIRECTION (DEGREES)
FOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852                                                                       LEAST SIGNIFICANT DIGIT       1.0000
(508) 970-5600

ID YRDAY    1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24 MMDDYY  DA  HI  LO TOTAL

0  90293   71  49 116 172 147 354 343  24   6 344 334 340 340 326 324 314 289 326 320 306 314 313 318 327 102090 339 354   6
0  90294  [illegible]  11 [illegible] 302 302 320 321 326  17  96 120 132 137 141 145 159 154 155 173 333   7   9 346 326 102190 351 346   7
0  90295    6 353   2  10 357  19 336 338 337 346 140 156 148 142 149 149 154 156 189 338 358  35  98 115 102290 [illegible] 358   2
0  90296   21 358 339 349 359 330 331 337 354  47  36  36 136 187 187  26  30  29  50  25  23  30 186 188 102390  21 359  21
0  90297  186 204 219 220 239 196 232 217 228 222 223 208 247 232 218 221 226 234 189 230 207 199 205 197 102490 217 247 186
0  90298  219 196 193 187 205 205 211 194 186 197 193 197 200 230 201 194 189 181 196 190 183 182 185 191 102590 196 239 181
0  90299  185 188 186 187 187 182 181 186 180 181 183 183 183 182 180 181 180 182 184 184 183 184 192 185 102690 183 192 180
0  90300  182 184 182 184 194 200 183 184 183 183 198 207 207 203 224  49  73 205 190 191 190 205 218 284 102790 194 284  49
1  90301  346 287 335 309 208  15  18 352  15  27  21   7  11  15 354 291 339 276 312 250 277 216 214 201 102890 325 354   7
1  90302  195 216 215 202 191 187 183 187 191 189 186 184 189 188 188 193 194 206 231 228 211 189 212 222 102990 193 231 183
1  90303  223  11  11 279 200 210 213 231 244 276 311 300 292 319 338  33  35 327 345 210 207 180 198 197 103090 264 345  11
1  90304  293 198 210 187 183 182 187 189 205 188 180 211 212 210 225 182 242 196 193 195 187 185 181 185 103190 198 293 180
1  90305  187 187 183 181 205 200 195 224 240   4   3 359 358 358   7  24  24 316 340 210 196 222 191 194 110190 230 359 [illegible]
1  90306  201 218 193 188 187 194 180 182 233 313 350 306   2   4   1  15  28  33  15 357 283 239 260 261 110290 279 357   1
1  90307  216 199 192 223 212 212 202 208 197 214 234 246 287 262 288 236 276 354 198 204 181 191 204 201 110390 222 354 181
1  90308  198 201 204 188 186 191 191 197 222 330 270 341 338 331 354  18  31  45 248 258 225 212 232 246 110490 241 354  18
1  90309  223 204 220 205 191 216 201 205 187 185 250 351  13 357  19  12  19  20  22  27  21  23  29  27 110590 340 357  12
1  90310   22  33  31  15 355   3 347 344 336 265 258 254 230 228 221 220 207 205 225 211 211 234 199 196 110690 259 355   3
1  90311  212 187 191 229 233 277 230 260 221 235 273 226 207 225 234 244 269 240 311 197 184 189 232 254 110790 230 311 184
1  90312  294 222 218 209 214 205 202 210 215 192 170 165 164 163 172 164 165 180 184 185 246 180 233 337 110890 197 337 163
1  90313  219 190 184 180 181 193 199 183 194 292 310 320 335                                             110990 217 335 180
1  90316                                              206 246 263 229 216 215 223 227 224 229 257 251  22 111290 229 279 206
   90317  206 215 [illegible] 206 218 222 211 224 208 190 188 185 211 235 215 209 200 194 190 202 202 196 192 189 111390 204 235 185
1  90318  189 199 198 186 194 202 230 207 194 187 182 190 196 204 270 245   3 353 213 196 190 195 209 225 111490 205 353   3
1  90319  219 191 [illegible] 308 196 183 183 187 209 220 261 245 325 351 352  20   2 359   3 315 340 192 192 224 111590 251 352   2
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ALLIANCE TECHNOLOGIES CORPORATION                                                         WIND DIRECTION (DEGREES)
BOOTT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852                                                                          LEAST SIGNIFICANT DIGIT      1.0000
(508) 970-5600

ID YRDAY   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24 MMDDYY  DA  HI  LO TOTAL

D  90320 203 197 189 189 187 181 194 191 241 357   7 357                                                111690 205 357   7
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ALLIANCE TECHNOLOGIES CORPORATION                                  TEMPERATURE (DEGREES F)
BOOTT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852                                                   LEAST SIGNIFICANT DIGIT .      1000
(508) 970-5600

ID YRDAY   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24 MMDDYY  DA  HI  LO TOTAL

BP 90277 491 497 503 494 500 521 555 591 609 627 661 685 709 724 703 679 682 673 679 667 621 582 548 536 100490 605 724 491 14526
BP 90278 530 530 518 515 521 533 545 533 585 624 694 712 715 727 739 730 724 703 655 597 585 582 561 552 100590 613 739 515 14710
BP 90279 539 530 533 530 527 521 527 527 567 657 745 782 809 827 839 836 755 730 673 624 600 582 576 573 100690 645 839 521 15479
BP 90280 567 573 545 533 524 521 515 515 594 664 745 794 809 815 821 817 782 733 679 645 618 600 591 576 100790 648 821 515 15550
BP 90281 564 570 573 576 576 573 588 600 624 694 721 776 809 812 791 785 779 755 736 706 700 697 691 676 100890 682 812 564 16372
BP 90282 676 676 645 627 627 624 612 606 609 621 673 736 779 794 812 812 797 776 736 715 697 691 679 667 100990 695 812 606 16687
BP 90283 661 655 645 639 630 615 612 633 658 679 688 718 761 773 782 770 758 736 715 709 712 706 685 679 101090 697 782 612 16719
BP 90284 676 673 664 655 645 658 673 679 688 709 733 761 767 761 755 752 748 733 724 718 712 709 709 706 101190 709 767 645 17008
BP 90285 703 688 682 664 655 645 645 664 700 718 742 745 748 748 761 755 739 718 703 691 697 697 694 694 101290 704 761 645 16897
BP 90286 712 694 694 697 700 706 709 700 694 712 715 724 739 733 730 739 748 730 715 715 712 721 721 694 101390 715 748 694 17173
BP 90287 679 676 670 664 667 682 682 682 685 712 712 745 755 767 773 764 730 685 642 612 606 606 603 588 101490 685 773 588 16387
BP 90288 582 573 567 555 555 548 555 567 618 676 730 739 752 742 721 712 682 661 612 555 539 530 503 476 101590 615 752 476 14758
BP 90289 461 442 436 436 436 442 445 458 545 609 627 648 658 670 682 679 645 606 548 512 485 476 458 455 101690 536 682 436 12859
BP 90290     421 406     406     424 421 491 591 655 679 694 697 709 718 703 670 624 585 548 536 548 548 101790 575 718 406 12074
BP 90291 561 603 633 639 645 658 667 661 670 682 703 712 727 730 715 706 700 682 673 676 609 579 570 548 101890 656 730 548 [illegible]
BP 90292 515 494 479 473 479 488 482 491 509 536 536 524 524 524 542 539 524 518 509 470 467 482 482 464 101990 502 542 464 12051
BP 90293 458 448 424 406     421 424 424 485 506 552 594 612 618 645 645 585 552 506 455 430 424 406     102090 501 645 406 11020
BP 90294     376     364                     445 518 579 615 630 652 652 652 636 615 576 521 497 488 506 512 102190 546 652 364  9834
BP 90295 512 509 491 485 479 482 491 506 533 576 627 655 661 673 685 685 670 652 639 642 630 615 615 609 102290 588 685 479 141[illegible]
BP 90296 612 615 618 618 624 615 612 612 612 609 606 612 627 642 633 636 633 636 639 645 661 667 661 659 102390 629 667 606 15084
BP 90297 639 627 627 621 627 612 591 570 552 545 561 561 567 582 597 609 603 588 567 536 548 536 509 485 102490 578 639 485 13866
BP 90298 470 452 448 439 430 424 430 427 436 491 533 555 579 603 621 636 609 579 545 512 509 500 494 494 102590 509 636 424 12216
BP 90299 488 467 470 470 473 479 488 494 491 488 485 485 494 506 503 488 482 479 476 467 464 455 464 433 102690 479 506 433 11489
    0300 421 397 394 388 376 364 370 373 388 427 455 482 506 533 552 561 521 497 442 406 382 373 352 348 102790 430 561 348 10308
     301 348 348 352 358 361 367 397 412 445 473 482 485 482 500 542 536 536 491 503 500 482 470 461 461 102890 450 542 348 10[illegible]
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ID	PARAMETER	FACTOR	DATES	AVERAGE	HIGH	LOW	TOTAL	HOURS
WS	WIND SPEED (MPH)	100	8/15/90 - 11/16/90	5.7	21.9	0	8274.0	1446
WD	WIND DIRECTION (DEGREES)	1.000	8/15/90 - 11/16/90	347	359	0		1653
TMP	TEMPERATURE (DEGREES F)	.100	8/15/90 - 11/12/90	61.0	88.2	27.9	128128.8	2099

10-10-104

CHAIN OF CUSTODY RECORD

P.O. A5175

CONTRACT NO: 2-093-201-P000-1-3

SAMPLERS (Signatures) Gregg Arnold

Sample Code	Date	Source Description	Container Size	Container G/P	Volatile Organics	Extractable Org.	Pesticides/PCBs	Trace Elements	Cyanide	Phenols	H_2S									COMMENTS
I	10-8-10	SITE 1		P							X									ASTM 701
II		SITE 2									X									
III		SITE 3									X									
IV		SITE 4									X									
V		SITE 5									X									
VI		SITE 6									X									
VII		SITE 7									X									
VIII		SITE 8									X									
IX		SITE 9									X									
X		SITE 10									X									
XA		SITE 10A									X									
BLANK		BLANK-H_2S									X									

Relinquished by Gregg Arnold	**Date/Time** 10-8	**Received by** Brenda N. Burgess
Relinquished by	**Date/Time**	**Received by**
Relinquished by	**Date/Time**	**Received by:**

Relinquished by:	**Date/Time**	**Received by:**
Relinquished by	**Date/Time**	**Received by:**

REMARKS: Method ASTM 701

№ 1665

ALLIANCE
Technologies Corporation

CHAIN OF CUSTODY RECORD

RTL

CONTRACT NO 2-089-001

SAMPLERS (Signatures) Caren O'Leary

Sample Code	Date	Source Description	Container Size	Container G/P	Volatile Organics	Extractable Org	Pesticides/PCBs	Trace Elements	Cyanide	Phenols	25C									COMMENTS
Embankment	10/22	Tank #1	Tank								X									
Manhole	10/22	Tank #1	Tank								X									
Site #12	10/22	Tank #1	Tank								X									

Relinquished by	Date/Time	Received by	Relinquished by	Date/Time	Received by
Caren J. O'Leary	11/22/90				
Relinquished by	**Date/Time**	**Received by:**	**Relinquished by:**	**Date/Time**	**Received by:**
Relinquished by	Date/Time	Received by: 10/23/90 10:30 AM	**REMARKS.** Rec'd in good condition		

Nº 1040

ALLIANCE
Technologies Corporation

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ALLIANCE TECHNOLOGIES CORPORATION                                                       TEMPERATURE (DEGREES F)
BOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852                                                                        (LEAST SIGNIFICANT DIGIT .      1000
( [illegible] ) 970 5600

ID  MMDAY   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24 MMDDYY  DA  HI  LO TOTA

HP  90302 464 461 442 474 421 418 427 427 439 458 476 482 491 494 494 491 488 479 461 445 430 417 406 400 102990 451 494 400 [illegible]
HP  90303 403 400 364 330 330 327 330 370 433 503 527 567 600 621 630 609 588 548 491 461 448 430 433 448 103090 465 630 327 11151
HP  90304 476 482 494 467 439 421 412 427 515 552 585 603 624 627 630 585 557 500 458 418 394 379 370 358 103190 490 630 358 [illegible]
HP  90305 357 347 342 342 364 391 412 430 509 561 576 609 630 636 661 655 627 579 577 503 488 476 464 445 110190 497 661 342 11921
HP  90306 436 433 427 424 418 418 421 458 558 661 727 752 739 748 745 721 682 639 567 533 512 494 488 464 110290 561 752 418 [illegible]
HP  90307 461 461 455 452 448 448 455 488 624 712 724 757 764 785 776 755 709 648 600 570 545 527 527 500 110390 591 785 448 14186
HP  90308 503 500 485 476 467 458 455 467 539 645 730 724 715 724 718 691 655 609 561 548 527 503 491 470 110490 569 730 455 [illegible]
HP  90309 467 458 452 452 461 470 470 491 548 579 627 627 630 652 642 627 600 585 576 570 573 588 594 585 110590 555 652 452 [illegible]
HP  90310 582 588 603 603 564 545 542 533 542 536 545 545 548 548 548 542 533 515 503 488 482 455 455 45[illegible] 110690 535 603 452 [illegible]
HP  90311 430 436 430 421 409 400 379 400 476 485 509 521 527 515 503 497 491 485 482 473 464 461 458 458 110790 465 527 379 [illegible]
HP  90312 452 439 433 430 430 427 418 424 455 442 458 464 458 473 467 448 433 415 406 406 385 373 367 330 110890 426 473 330 [illegible]
HP  90313 327 306 294 288 282 279 291 300 388 458 464 476 494 497 500 503 500 485 473 467 467 452 445 452 110990 412 503 279 [illegible]
HP  90314 458 461 458 479 509 518 545 552 548 545 555 573 588 555 494 476 485 491 488 485 491 494 482 461 111090 508 588 458 12191
HP  90315 464 461 448 442 445 433 439 427 433 430 445 467 479 482 473 470 455 445 473 491 506 512 509 436 111190 461 512 427 [illegible]
HP  90316 418 388 385 373 370 361 361 370 412 418 430 436                                                 111290 394 436 361 [illegible]
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ALLIANCE TECHNOLOGIES CORPORATION                                                                   TEMPERATURE (DEGREES F)
BOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852                                                                                    LEAST SIGNIFICANT DIGIT -      1000
(508) 970 5600

ID YRDAY   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24 MMDDYY  DA  HI  LO TOTAL

HP 90227                                                                     773 736 703 664 630 618 617  81590 677 773 617  4736
HP 90228 609 609 594 585 576 579 585 621 733 821 836 845 845 847 867 855 830 791 767 736 694 673 661 652  81690 717 867 576 17206
HP 90229 636 624 618 615 612 606 624 648 742 870 848 861 861 864 876 879 842 797 773 752 733 712 703 688  81790 739 879 606 17744
HP 90230 685 682 676 673 670 670 661 673 739 780 818 842 852 861 864 852 833 815 785 759 724 700 688 694  81890 750 864 661 1800
HP 90231 706 709 709 694 688 685 688 697 715 718 679 642 648 647 642 677 677 624 621 606 606 606 606 591  81990 657 718 591 15776
HP 90232 591 594 588 588 585 585 594 615 633 645 661 667 664 670 673 670 673 661 661 658 658 664 652 652  82090 638 673 585 15302
HP 90233 648 636 630 618 606 591 588 591 588 588 603 612 627 645 670 685 673 679 682 673 658 652 655 655  82190 636 685 588 15265
HP 90234 648 647 653 667 664 642 633 667 700 697 697 724 748 745 752 755 755 742 715 700 695 679 670 667  82290 694 755 633 16657
HP 90235 664 658 658 664 661 661 655 652 658 655 655 655 667 670 676 664 655 655 661 664 670 676 670 667  82390 662 676 652 15891
HP 90236 667 670 670 670 667 679 679 679 685 691 700 721 712 718 712 718 721 721 718 721 721 712 715 706  82490 699 721 667 16777
HP 90237 709 709 712 706 709 709 703 703 721 727 755 755 770 788 818 842 827 791 758 730 712 691 679 667  82590 737 842 667 17691
HP 90238 664 658 658 664 664 670 685 688 724 812 879 870 858 870 873 882 842 791 773 733 706 691 679 673  82690 749 882 658 [illegible]
HP 90239 667 648 642 639 630 627 633 658 739 806 855 867 873 870 736 761 764 758 752 727 730 761 724 679  82790 731 873 627 1754
HP 90240 682 676 667 652 642 639 636 648 688 712 712 779 812 833 845 848 830 785 761 736 724 721 724 697  82890 727 848 636 17449
HP 90241 670 676 658 655 648 642 630 642 703 764 788 809 821 815 827 827 818 770 730 706 694 685 655 633  82990 719 827 630 [illegible]
HP 90242 618 597 576 567 576 564 561 585 700 770 800 797 827 827 836 830 773 730 706 667 639 612 594 576  83090 680 836 561 16320
HP 90243 579 576 555 561 558 552 552 573 664 733 776 803 839 830 839 827 776 733 709 667 652 636 615 600  83190 675 839 552 16205
HP 90244 594 576 558 545 548 558 561 579 673 755 830 809 830 833 821 827 794 758 727 691 679 670 658 639  90190 688 833 545 1651
HP 90245 653 624 618 615 621 615 612 624 694 770 809 848 858 861 861 873 833 773 758 755 752 721 691 655  90290 728 873 612 17474
HP 90246 630 618 612 603 600 606 630 630 670 703 703 700 721 742 755 752 730 718 700 661 630 603 600 594  90390 665 755 594 15911
HP 90247 582 570 564 552 542 530 524 539 655 712 709 724 733 748 736 758 733 697 664 627 609 585 573 594  90490 636 758 524 15260
HP 90248 591 594 600 591 585 600 591 606 658 667 727 764 794 770 761 761 767 752 724 715 712 712 703 688  90590 685 794 585 1644
HP 90249 679 676 661 648 642 642 639 642 68  776 761 809 818 812                                         90690 706 818 639  9887
   90250                                             779 821 809 809 818 800 776 748 733 712 709 700 673  90790 761 821 673  9897
   90251 650 621 609 594 570 548 536 536 570 612 653 658 664 685 676 682 655 679 612 564 539 515 507  94  90890 599 685 494 14379
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ALLIANCE TECHNOLOGIES CORPORATION
BOOT MILLS SOUTH - FOOT OF JOHN STREET
LOWELL, MA 01852
(508) 970-5600

TEMPERATURE (DEGREES F)

LEAST SIGNIFICANT DIGIT .1000

PID	YRDAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MMDDYY	DA	HI	LO	TOTAL
TMP	90252	488	473	464	461	458	455	448	476	591	655	664	670	658	652	645	655	658	645	652	652	652	645	645	639	90990	588	670	448	1410
TMP	90253	639	645	639	642	639	642	642	645	664	679	712	752	788	803	830	824	752	724	706	676	645	636	630	609	91090	690	830	609	[illegible]
TMP	90254	603	603	597	594	562	573	579	600	694	727	827	845	852	876	839	871	770	767	739	706	691	667	658	655	91190	706	876	573	[illegible]
TMP	90255	652	636	630	636	630	618	627	642	676	715	739	767	755	779	794	800	812	788	776	745	721	715	709	688	91290	710	812	618	[illegible]
TMP	90256	685	676	667	664	664	658	645	645	661	685	764	843	861	824	839	852	827	782	752	730	694	667	648	639	91390	723	861	639	[illegible]
TMP	90257	639	627	633	636	639	661	667	664	685	721	748	752	733	739	767	782	736	706	724	715	706	718	715	712	91490	701	782	627	[illegible]
TMP	90258	709	709	709	706	694	652	648	652	658	682	721	727	745	742	736	745	739	715	673	655	630	636	636	600	91590	688	745	600	[illegible]
TMP	90259	591	585	585	576	548	524	515	515	579	652	648	661	645	661	648	679	652	652	627	618	609	603	588	579	91690	606	679	515	1454
TMP	90260	567	558	536	539	542	521	497	497	570	588	594	576	585	594	603	594	588	567	564	539	530	518	506	500	91790	554	603	497	[illegible]
TMP	90261	497	494	494	482	470	461	442	433	497	558	588	597	612	636	655	658	648	639	606	561	518	494	473	473	91890	541	658	433	[illegible]
TMP	90262	467	452	442	427	424	421	415	418	433	521	579	618	624	621	[illegible]	624	627	594	576	573	576	594	600	606	91990	555	627	415	[illegible]
TMP	90263	606	606	612	606	606	600	585	585	579	603	648	667	670	664	664	664	655	652	645	630	603	564	536	491	92090	614	670	491	1474
TMP	90264	485	464	464	461	445	433	436	482	588	664	691	676	667	691	694	679	658	630	606	573	545	533	533	527	92190	566	694	433	[illegible]
TMP	90265	524	524	536	539	542	545	555	564	579	591	603	615	627	630	636	642	642	642	648	645	645	633	621	606	92290	597	648	524	[illegible]
TMP	90266	573	548	530	512	503	506	500	500	570	630	645	648	648	645	655	645	627	600	570	561	545	533	500	476	92390	569	655	476	[illegible]
TMP	90267	470	467	452	482	500	494	473	467	520	555	579	597	597	591	606	627	618	591	555	518	497	494	473	461	92490	551	627	452	[illegible]
TMP	90268	455	442	439	424	421	415	412	436	524	588	639	673	682	694	697	694	670	639	615	582	564	555	524	515	92590	553	697	412	[illegible]
TMP	90269	515	506	494	497	497	494	503	518	567	633	623	679	700	715	706	706	685	664	624	597	570	561	548	533	92690	591	715	494	[illegible]
TMP	90270	530	530	530	512	512	524	524	524	555	603	673	712	745	755	764	752	685	652	612	582	564	552	530	518	92790	602	764	512	1444
TMP	90271	518	509	503	497	494	497	497	497	567	661	715	745	755	758	770	758	730	700	664	624	600	591	576	570	92890	617	770	494	[illegible]
TMP	90272	570	564	545	548	555	555	555	552	582	652	700	742	767	762	779	767	755	733	700	661	639	633	618	606	92990	648	779	545	1554
TMP	90273	603	597	597	600	603	606	606	615	627	648	670	697	727	727	724	727	727	721	697	642	594	600	603	597	93090	648	727	594	1555
TMP	90274	588	564	555	542	533	518	503	488	552	591	606	636	648	667	661	639	624	600	564	530	506	494	485	476	100190	565	667	476	[illegible]
[illegible]	90275	476	488	497	491	512	518	515	521	609	645	642	642	661	661	645	636	621	609	585	527	488	467	455	458	100290	557	661	455	[illegible]
	90276	455	439	421	418	415	409	406	415	476	558	636	685	697	709	709	697	670	650	594	539	518	512	494	488	100390	541	709	406	[illegible]