AECOM Environment

Prepared for:
Superfund Standby Program
NYSDEC
625 Broadway
Albany, New York 12233

Prepared by:
AECOM
Latham, New York
Project 60323116
July 2011

Site Management Plan
Tuxedo Waste Disposal Site
Site No. 336035
Tuxedo, New York
Orange County
FINAL

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Revisions to Final Approved Site Management Plan:

Revision #	Submitted Date	Summary of Revision	NYSDEC Approval Date
1	June 13, 2019	Updated site contacts list and data; updated references to destroyed MW-7 and PMP-1; updated summary of Remedial Actions; added 2018 emerging contaminants data; other editorial changes	June 13, 2019

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List of Acronyms

AECOM	AECOM Technical Services Northeast, Inc.
ASP	Analytical Services Protocol
AWQS/GV	Ambient Water Quality Standards and Guidance Values
bgs	below ground surface
C&D	Construction and Demolition
CCR	Construction Completion Report
COC	Contaminant of Concern
CSM	Conceptual Site Model
DER	Division of Environmental Remediation
DO	Dissolved Oxygen
DUSR	Data Usability Summary Report
EC	Engineering Control
EWP	Excavation Work Plan
GVS	Gas Vent Station
H_2S	Hydrogen Sulfide
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
IC	Institutional Control
LEL	Lower Explosive Limit
LTM	Long-Term Monitoring
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
M&M	Maintenance and Monitoring
ng/L	nanograms per liter
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance and Monitoring
ORP	Oxidation-Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon

PCB	Polychlorinated Biphenyl
PCMM	Post-Closure Monitoring and Maintenance
PFAS	Per- and Polyfluorinated Alkyl Substances
PFC	Perfluorinated Chemical
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
PID	Photoionization Detector
PMP	Perimeter Monitoring Point
ppm	parts per million
PRR	Periodic Review Report
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act of 1976
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
SMP	Site Management Plan
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
µg/L	micrograms per liter
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Engineering Certification

I certify that I am currently a New York State registered professional engineer and that this Site Management Plan for the Tuxedo Waste Disposal Site (Site Number 336035) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation (DER-10).

Respectfully submitted,
AECOM Technical Services Northeast, Inc.

June 13, 2019

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Registered Professional Engineer
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Date

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1.0 Introduction and Description of Remedial Program

1.1 Introduction

This document is required as an element of the remedial program at the Tuxedo Waste Disposal Superfund Site (hereinafter referred to as the "Site") under the New York State Superfund Standby Program, which is administered by the New York State Department of Environmental Conservation (NYSDEC). Refer to **Figure 1** for the Site Location Map. After being identified as a waste disposal facility for nonexempt wastes and added to the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites as a Class 2a site (Site No. 336035), the Site was remediated in accordance with the February 1992 Record of Decision (ROD). The primary sources of contamination remain controlled with an engineered final cover equipped with a passive gas collection system.

1.1.1 General

Construction and demolition material mixed with hazardous waste were deposited at the Site in 1987. Investigations completed prior to 1992 indicated that the contamination most likely originated from acceptance of wastes impacted by petroleum products and industrial solvents. Groundwater contaminated with heavy metals and organic compounds is present beneath the Site, which is hydraulically connected to the Ramapo River. Methane and hydrogen sulfide gas released into ambient air from waste decomposition was also identified as a source of contamination. The presence of these contaminants was considered a significant risk to public health and the environment, which resulted in remedial action.

Pursuant to the ROD, waste from the southeast corner of the Site was excavated, relocated to the center of the Site, and consolidated with impacted soil. The waste material and impacted soil were regraded and an engineered final cover was installed, which was equipped with a passive gas collection and treatment system.

The boundaries of the two properties which comprise the approximately 12-acre Site are displayed on **Figure 2**. The metes and bounds are defined in the current property deeds (**Appendix A**), which were recorded in October 1985 (Parcel No. 9-1-11) and January 1995 (Parcel No. 9-1-13) with the Orange County Clerk.

Following completion of the remedial work required per the ROD, combustible gas continues to emanate from the Site to the atmosphere in a controlled manner due to the presence of the gas collection system. In addition, groundwater contamination remains beneath the Site. These are hereafter referred to as "remaining contamination." This Site Management Plan (SMP) was prepared to manage remaining contamination at the Site until the NYSDEC determines that either adequate attenuation of contamination has been achieved, or there is sufficient evidence that a threat of off-site migration of contaminants to the Ramapo River no longer exists. All reports associated with the Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State.

This SMP is prepared by AECOM Technical Services Northeast, Inc. (AECOM) on behalf of the NYSDEC, in accordance with the requirements in "Technical Guidance for Site Investigation and

Remediation - DER-10" (NYSDEC, May 2010) and other guidelines provided by the NYSDEC. This SMP addresses the means for implementing the Institutional Controls (ICs) and Engineering Controls (ECs) that are required by the ROD.

1.1.2 Purpose

The Site contains contamination left after completion of the remedial action. ECs (i.e., an engineered final cover, passive gas collection and ventilation system, surface water diversion system, and fencing) were incorporated into the Site remedy to control exposure to remaining contamination and to ensure the protection of public health and the environment. An IC in the form of a deed restriction/environmental easement is required per the ROD. Easements for each property comprising the Site are currently under development by the NYSDEC. Environmental easement(s) will be necessary for this document to be considered complete and, therefore, all references within this document going forward will be present tense.

An easement granted to the NYSDEC and recorded with the Orange County Clerk will require compliance with this SMP and all ECs and ICs placed on the Site. The ICs place restrictions on site use and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. More specifically, the ICs limit use of the property to prevent any activities that could damage or compromise the integrity of the engineered final cover and gas collection system.

This SMP specifies the methods necessary to ensure compliance with all ECs and ICs required by the ROD for contamination that remains at the Site. Once this plan is approved by the NYSDEC and compliance with this plan is required by the grantor of the environmental easement and the grantor's successors and contractors, this SMP may only be revised with the approval of the NYSDEC.

This SMP provides a detailed description of all procedures required to manage remaining contamination at the Site after completion of the Remedial Actions, including: (1) implementation and management of all ECs/ICs; (2) media monitoring; (3) operation and maintenance of all treatment, collection, containment, or recovery systems; (4) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports (PRRs); and (5) defining criteria for termination of site management operations.

To address these needs, this SMP includes two plans: (1) an EC/IC Plan for implementation and management of all EC/ICs; and (2) a Maintenance and Monitoring (M&M) Plan for implementation of Site monitoring and passive EC maintenance activities.

This plan also includes a description of PRRs for the periodic submittal of data, information, recommendations, and certifications to the NYSDEC.

It is important to note that:

- This SMP details the Site-specific implementation procedures required by the ROD and environmental easement. Failure to properly implement the SMP is a violation of the ROD and environmental easement; and
- Failure to comply with this SMP is also a violation of New York State Environmental Conservation Law 6 NYCRR Part 375 (NYSDEC, December 2006) and the ROD for the Site, and thereby subject to applicable penalties.

1.1.3 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. In accordance with the environmental easement for the Site, the NYSDEC will provide a notice of any approved changes to the SMP, and append these notices to the SMP retained in NYSDEC files.

1.2 Site Background

1.2.1 Site Location and Description

The Site is a former waste disposal facility located in the Town of Tuxedo, Orange County, New York (**Figure 1**). The Site consists of approximately 12 acres situated along State Route 17, in a rural area approximately one mile north of the Village of Tuxedo Park. The Site is located between State Route 17 (to the west) and an active rail line currently owned by the Metro-North Railroad to the east (**Figure 2**). The New York State Thruway (I-87) is located approximately 250 feet to the east of the rail line. The Site lies on two separate parcels of land with distinct landowners. A majority of the Site is situated on a 12.2-acre parcel owned jointly by Renard Barone and Sarkis Khourouzian. The remainder of the Site is located in the northwestern corner of a 7.9-acre parcel formerly owned by the Georgia Tech Foundation (the property was sold to Robert Iazzetti in 1994). The parcels are identified as Section 9 Block 1 Lot 11 and Section 9 Block 1 Lot 13, respectively, on the Town of Tuxedo tax map. For the purpose of this SMP, portions of the two parcels will together be referred to as the Site, and will be distinguished from one another when necessary.

1.2.2 Site History

Prior to 1985, the Site was used as a sand and gravel mine, providing aggregate to a bituminous concrete plant. The Thruway Asphalt Company operated the mine and plant through 1985, when parcel number 9-1-11 was sold to Renard Barone and Sarkis Khourouzian (**Figure 2**). Beginning in February 1987, Barone and Khourouzian authorized Frank Sacco to use the Site as a construction and demolition debris landfill until the NYS Department of Law terminated disposal activities in October 1987 following inspections and discovery of the disposal of nonexempt solid wastes. These operations violated the solid waste regulations in place at the time. During disposal operations, the Site amassed approximately 500,000 cubic yards of waste. In an effort to abide by a court order and to control objectionable odors emanating from the Site, soil from an industrial site in Mahwah, New Jersey was used as cover material. Subsequent analysis determined the cover material was contaminated with low concentrations of polychlorinated biphenyls (PCBs).

In December 1987, the Site was added to the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites as a Class 2a site (Site No. 336035). This designation means that disposal of hazardous waste has been confirmed, and the presence of such hazardous waste or its components or breakdown products represents a significant threat to public health or the environment.

Concurrently, the presence of an illegal landfill on the former Georgia Tech Foundation property, parcel number 9-1-13 (**Figure 2**), was recognized and incorporated into the investigation and classification of the main parcel.

Site investigations and a feasibility study were completed between 1988 and 1991. A ROD was issued in February 1992 to address impacted soil, refuse, groundwater and landfill gas on the Site and surface water and sediment within the Ramapo River. The selected remedies per the ROD consisted of excavation of refuse from the southeast corner of the Site and consolidation into the main area;

installation of an engineered final cover equipped with a gas collection layer; installation of a passive gas treatment system; construction of a surface water diversion system; implementation of site use restrictions; and monitoring of groundwater, surface water and sediment, and air emissions to determine the effectiveness of the remedial program.

Remedial activities were completed in conformance with the ROD. Beginning in October 1995, the remedial program was initiated by the excavation of refuse, consolidation of refuse and soil, and reclamation of soil from the southeast corner of the Site to the center of the landfill. Upon completion of the consolidation activities, an engineered final cover with a gas collection layer, gas treatment system using activated carbon, and a surface water diversion system were installed.

In 1996, after completion of the remedial action, the NYSDEC reclassified the Site as Class 4, which is defined as a site that has been properly closed but requires continued site management, consisting of operation, maintenance and monitoring (OM&M).

1.2.3 Geologic Conditions

Published geologic maps and reports indicate that this region is located in the New England Upland Physiographic Province, and that the bedrock at the Site consists of Precambrian Gneiss of the Hudson Highland Massif (biotite granite gneiss). All rock cores collected during the Remedial Investigation (RI) show quartz plagioclase gneiss interlayered with amphibolite.

The Site is located in the Ramapo River Valley. The Ramapo River is located between the rail line and the New York State Thruway. The Ramapo River Valley is described as having steep grades with abrupt elevation changes as seen in the area to the west of the Site, where the land rises approximately 300 feet along the Ramapo River Valley wall. The Ramapo River is a Class A stream at this location, flowing to the south. According to the Phase II investigation report, the river has a direct hydraulic connection with the groundwater beneath the Site.

The Site is a gentle hillside at the base of a steeply graded slope with dense tree cover. State Route 17 separates the Site from the steep slope. The north-northeast portions of the Site are a gently sloping hillside with bedrock outcrops, which transitions into a steep slope to the rail line. The summit of the Site has a moderate grade and is covered with grass.

Previous investigation of the Site states that before the remedial actions were implemented, the depth to bedrock ranged from 0 to approximately 70 feet below ground surface (bgs), with bedrock deepest and fill material thickest at the center of the Site. Bedrock outcrops in the northern and eastern portions of the Site, located just west of the rail line, dip to the southwest. The unconsolidated materials above the bedrock are highly variable in thickness and are comprised of construction and demolition (C&D) debris, recent alluvial deposits, outwash sand and gravel, and glacial till. Groundwater depth beneath the Site ranges from approximately 8 to 40 feet bgs. Groundwater flow occurs within two separate water-bearing units: unconsolidated soil and weathered bedrock; and unweathered, competent bedrock. Permeability studies from the Phase II investigation and results from the RI show connectivity between the two water-bearing units, resulting in one aquifer system. According to the historical data, the natural direction of groundwater flow from the upper unconsolidated water-bearing unit is generally from the relatively high elevations west of the Site to the east, toward the Ramapo River. Groundwater flow direction in the competent bedrock is less defined due to natural irregularities in the bedrock (e.g., joints, fractures, and discontinuities). The water table at the perimeter of the Site is relatively shallow and is present in the unconsolidated layer.

AECOM measured the depth-to-groundwater in each monitoring well during the last groundwater sampling event, which occurred in June 2009. The measurements were used to calculate groundwater elevations (**Table 1**). Due to the presence of the waste material prior to well installation, groundwater contour maps for the aquifers beneath the Site could not be developed. The composition and construction of the landfill prohibits the natural flow of groundwater beneath and surrounding the Site.

Geologic cross-sections of pre-remedy conditions from the Phase II investigation are provided in **Appendix B**. A Conceptual Site Model (CSM) was prepared to illustrate current Site conditions, based on available data (**Figure 3**).

1.3 Summary of Remedial Investigation Findings

A Phase II investigation and Remedial Investigation/Feasibility Study (RI/FS) were performed to characterize the nature and extent of contamination at the Site. The results are described in detail in the following submittals:

- Lawler, Matusky & Skelly Engineers. 1989. “Engineering Investigations at Inactive Hazardous Waste Sites, Phase II Investigation, Tuxedo Waste Disposal Site, Site No. 336035, Tuxedo, Orange County.” March 1989.
- Metcalf & Eddy of New York, Inc. 1991. “Tuxedo Waste Disposal Site, Site ID #3-36-035, Remedial Investigation and Feasibility Study.” November 1991.
- NYSDEC. 1992. “New York State Superfund Record of Decision, Tuxedo Waste Disposal Site, Orange County, New York, Site Number 3-36-035.” February 1992.
- NYSDEC. 2004. “New York State Long Term Monitoring Plan, Tuxedo Waste Disposal Site, Orange County, New York, Site Number 3-36-035.” December 2004.

Based on the results of the Phase II investigation, the Tuxedo Waste Disposal Site was reclassified from Class 2a to Class 2, which indicates that the presence of hazardous waste had been confirmed and that action was required to mitigate the threat to human health and the environment. An RI/FS was deemed necessary to expand on the Phase II results, and to further define the nature and extent of contamination to enable development of remedial alternatives.

Results from the 1989 Phase II investigation and 1991 RI are summarized below. Site-related contaminants of concern (COCs) were identified in the ROD for each media type, including air, soil gas, soil, groundwater, surface water, and sediment. A full list of COCs per media type is presented in Table 1 of the ROD in **Appendix C**.

1.3.1 Ambient Air

The ROD indicates that hydrogen sulfide, methane, and volatile organic compounds (VOCs) are the COCs in air. Specific VOCs included toluene, trichloroethylene, carbon tetrachloride, 1,2-dichloroethane, xylene, benzene, ethylbenzene, Freon 113 and chloroform.

On-site ambient air sampling was performed during Phase II intrusive activities and normal site conditions. Additionally, emissions into ambient air were monitored from gas vents, where elevated concentrations of hydrogen sulfide (300 parts per million [ppm]) and organic vapors (methane and VOCs at 70 ppm) were detected. Ambient air sampling indicated the likelihood of off-site migration of

methane and hydrogen sulfide at reduced concentrations; however, off-site VOC migration was not identified.

No hydrogen sulfide was detected from samples collected at six locations on the Site during the RI.

1.3.2 Soil

The ROD states that soil contamination includes VOCs, semi-volatile organic compounds (SVOCs), metals, and PCBs. Specific metals included aluminum, arsenic, cadmium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, selenium, silver, and zinc. Specific VOCs included toluene, trichloroethylene, carbon tetrachloride, 1,2-dichloroethane, xylene, benzene, ethylbenzene, Freon 113 and chloroform. Specific SVOCs included fluoranthene, pyrene, chrysene, phenols, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, bis-2-ethylhexylphthalate, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene.

Soil samples of fill material collected during the Phase II trenching and test pitting programs contained elevated concentrations of VOCs, SVOCs, and metals. Maximum concentrations of contaminants were as follows: 2.2 milligrams per kilogram (mg/kg) total VOCs; 382 mg/kg total Polycyclic Aromatic Hydrocarbons (PAHs); 2,853 mg/kg total SVOCs; 4 mg/kg PCBs; 0.033 mg/kg pesticides; 800 mg/kg unidentified hydrocarbons; 2,160 mg/kg lead; and 3.3 mg/kg cyanide. Elevated concentrations of metals were reported in samples, including calcium (9.2%), iron (3.98%), and 0.1 to 1% of aluminum, magnesium, potassium, and zinc. Overall, one sample failed Resource Conservation and Recovery Act (RCRA) hazardous waste thresholds for lead toxicity (8.1 milligrams per liter [mg/L]), reactivity (reactive sulfide concentration of 34,100 hydrogen sulfide [H_2S]/kg), and ignitability. A split sample for the lead toxicity characteristic leaching procedure (TCLP) analysis was non-detect. Dioxin was encountered at 0.091 mg/kg, below the United States Environmental Protection Agency (US EPA) recommended cleanup value for commercial/industrial usage.

Analytical testing of waste sludge reported 60 mg/kg total VOCs and 200 mg/kg PAHs. The Phase II report concluded that the waste material contained high concentrations of lead leachate and organic compounds (e.g., gasoline, coal tar, wood preservatives, fuel oil, tars, and Stoddard solvent).

The landfill cover material was tested for priority pollutants and exhibited a maximum total PCB concentration of 1.2 mg/kg and 7 mg/kg PAHs.

During the RI, soil samples were collected from seven perimeter soil borings that were later converted into groundwater monitoring wells. No VOCs, SVOCs, or metals were reported in excess of then-current standards.

1.3.3 Site-Related Groundwater

The ROD states that groundwater contamination includes VOCs, SVOCs, and metals. Specific metals included aluminum, arsenic, cadmium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, selenium, silver, and zinc. Specific VOCs included toluene, trichloroethylene, carbon tetrachloride, 1,2-dichloroethane, xylene, benzene, ethylbenzene, Freon 113 and chloroform. Specific SVOCs included fluoranthene, pyrene, chrysene, phenols, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, bis-2-ethylhexylphthalate, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene.

During the Phase II investigation, VOCs, SVOCs, and pesticides were not detected in groundwater samples collected from the seven wells (MW-1 through MW-7) installed around the perimeter of the Site. Metals were detected at concentrations greater than area background levels in the on-site monitoring wells. Metals reported in excess of groundwater standards include: arsenic (26 micrograms per liter [µg/L]), iron (34,400 µg/L), magnesium (101,000 µg/L), manganese (12,300 µg/L), selenium (24 µg/L), and sodium (104,000 µg/L).

RI data identified detectable concentrations of VOCs; however, none of these compounds were reported above standards. Three SVOCs (phenol, naphthalene, and acenaphthene) were reported at concentrations marginally above groundwater standards. RI groundwater data identified the following metals in excess of groundwater standards: cadmium (21 µg/L), iron (31,800 µg/L), lead (1,980 µg/L), magnesium (91,500), manganese (12,900 µg/L), and sodium (198,000 µg/L).

1.3.4 Surface Water

The ROD states that surface water contamination includes SVOCs and metals. Specific metals included aluminum, arsenic, cadmium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, selenium, silver, and zinc. Specific SVOCs included fluoranthene, pyrene, chrysene, phenols, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, bis-2-ethylhexylphthalate, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene.

No VOCs, pesticides/PCBs, or SVOCs were detected in the four surface water samples collected during the Phase II investigation. Metals were detected, but were not significantly greater than the results of the background upstream samples, except zinc. Zinc concentrations were reported at 47,125 µg/L versus a standard of 300 µg/L. Iron was above the surface water standard in both the upstream and downstream locations.

During the RI, three surface water samples were collected near the Site from the Ramapo River (upstream, mid-site, and downstream). No VOCs or SVOCs were detected in any of the samples. Several metals (aluminum, calcium, iron, lead, magnesium, and sodium) were detected at marginally greater concentrations in the downstream sample than the sample collected upstream of the Site. Iron (425 µg/L) was the only metal reported to exceed the human health-based Ambient Water Quality Standards and Guidance Values (AWQS/GV) of 300 µg/L. One sample analyzed for aluminum reported a concentration in excess of the NYSDEC aquatic standard for ionic aluminum, and one sample analyzed for mercury reported a concentration in exceedance of the NYSDEC standard for aquatic species.

1.3.5 Sediment

The ROD states that sediment contamination includes SVOCs and metals. Specific metals included aluminum, arsenic, cadmium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, selenium, silver, and zinc. Specific SVOCs included fluoranthene, pyrene, chrysene, phenols, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, bis-2-ethylhexylphthalate, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene.

Sediment samples were collected from four locations along the Ramapo River during the Phase II investigation. These samples were collected from upstream, mid-site (location closest to landfill), downstream, and a background location. No VOCs, pesticides, or PCBs were detected in the sediment samples. Tentatively identified SVOCs related to petroleum products were detected in the sediment samples collected from the downstream location. Some metals concentrations were

detected in the downstream samples at higher levels than the samples collected from the upstream and background locations, suggesting influence by the landfill.

Three locations were sampled along the Ramapo River during the RI. No VOCs were detected in excess of sediment criteria. Four PAHs [benzo(a)anthracene, chrysene, benzo(b)fluoranthene, and benzo(a)pyrene] were detected in the upstream sample at concentrations in excess of sediment guidelines for human health impacts, but not in the mid-site or downstream samples.

Sediment samples collected from the west bank of the Ramapo River at the upstream location reported concentrations of several metals including arsenic, cadmium, cobalt, iron, magnesium, manganese, and nickel to be greater than at the mid-site and downstream locations. Several other metals (aluminum, barium, calcium, chromium, copper, lead, mercury, potassium, silver, sodium, vanadium, and zinc) were detected at greater concentrations in the mid-site location than the downstream samples. Cadmium, copper, lead, manganese, mercury, nickel, and zinc were reported at concentrations in excess of sediment criteria in at least one location.

1.3.6 Site and Perimeter Soil Gas

The ROD indicates that hydrogen sulfide, methane, and VOCs are the COCs in soil gas. Specific compounds are identified in Table 1 of the ROD.

Soil gas data collected during the Phase II investigation indicated that low concentrations of VOCs associated with petroleum and chlorinated solvents were present across the entire Site. The highest concentrations of petroleum-related constituents were located in the central and south-central portions of the Site. Hydrogen sulfide was detected in nine out of ten soil sample points with concentrations greater than 2,000 ppm or 2,840 milligrams per cubic meters (mg/m^3), suggested in the RI to be from the decomposition of gypsum contained in the construction debris. Maximum total VOC concentrations were reported at 2,948 mg/m^3 (686 ppm). Additionally, significantly elevated concentrations of unidentified organic compounds were reported, with a maximum concentration of 32,200 mg/m^3 (7,140 ppm).

A soil gas survey of the perimeter of the Site was not performed during the Phase II investigation.

RI soil gas sampling activities were performed along the site perimeter. Elevated concentrations of methane were detected at greater than 1,000 ppm in several of the monitoring points. Additionally, monitoring of the lower explosive limit (LEL) ranged from 64 to 100%. The maximum hydrogen sulfide concentrations reported were 8 ppm.

1.4 Summary of Remedial Actions

Per the ROD, the site-specific remedial action objectives (RAOs) included:

- Prevention of unacceptable health risks to exposed populations from airborne contaminants;
- Prevent unacceptable environmental risks due to exposure to site-related contaminants;
- Close the site in conformance with applicable regulations;
- Protect surface water and sediments from contamination which would adversely affect its uses; and

- Eliminate the odor nuisance emanating from the Site.

The Site was remediated in accordance with the following design and construction documents:

- NYSDEC. 1992. “New York State Superfund Record of Decision, Tuxedo Waste Disposal Site, Orange County, New York, Site Number 3-36-035.” February 1992.
- Clough, Harbour & Associates. 1996. “New York State Superfund Contract Post-Closure Monitoring and Maintenance Manual, Tuxedo Waste Disposal Site, Site No. 3-36-035, Work Assignment No. D002676-3.” Revised August 1996.
- Clough, Harbour & Associates. 1998. “Amended New York State Superfund Contract Post-Closure Monitoring and Maintenance Manual, Tuxedo Waste Disposal Site, Site No. 3-36-035, Work Assignment No. D002676-3.” Revised August 1998.
- NYSDEC. 2004. “New York State Long Term Monitoring Plan, Tuxedo Waste Disposal Site, Orange County, New York, Site Number 3-36-035.” December 2004.

The following is a summary of the Remedial Actions performed at the Site:

- Excavation of refuse, consolidation of refuse and soil, and reclamation of soil from the southeast corner of the Site.
- Construction and maintenance of an engineered final cover with a passive collection layer to prevent human exposure to contaminated soil and fill remaining at the Site.
- A passive gas collection and treatment system using activated carbon was installed after the installation of the engineered final cover. In 1998, active mini-blowers were installed at select gas vent stations and utilized until they were replaced with passive, stainless steel wind turbine ventilators in 2005. Additional ventilators have been installed between 2005 and 2010. The activated carbon drums were removed in August 2008.
- A surface water diversion system was designed and built when the engineered final cover was constructed at the Site.
- In 2007, two areas of slumping were identified on the eastern side of the Site. Site conditions were further investigated and a corrective action was implemented and completed in September 2008.
- In 2011, four areas containing landfill cap depressions resulting from down-slope barrier protection soil erosion were identified on the eastern side of the Site. Landfill cap reconstruction and drainage improvements were designed and implemented during 2012, and a Construction Completion Report (CCR) summarizing the work was issued in March 2013.

1.4.1 Remaining Contamination

Source material (waste fill) and contaminated soil were not removed from the Site and are present beneath the cap in thicknesses up to 70 feet. These materials were consolidated and contained beneath the engineered final cover. For the purposes of providing a baseline for post-remedial site conditions, groundwater monitoring data from 2000 and 2001 and landfill gas monitoring data from 2010 were used. The previous long-term monitoring plan established for the site reduced monitoring to metals concentrations in groundwater, and hydrogen sulfide and methane concentrations at the gas ventilation stations (GVSs) and perimeter monitoring points (PMPs).

Table 2 presents analytical results for metals in groundwater monitoring wells sampled in 2000 and 2001. More recent data has been provided to the NYSDEC in Groundwater Monitoring Reports and Periodic Review Report(s). Iron, manganese, and sodium are the metals most consistently reported above standards.

Groundwater sampling of select wells site-wide for emerging contaminants took place in September 2018. Samples were tested for 1,4-dioxane and per- and polyfluorinated alkyl substances (PFAS), emerging contaminants for which the Site had not been previously assessed. As shown in **Table 3**, analytical results indicated that 1,4-dioxane was not detected, or detected at levels below the 1 microgram per liter (µg/L) maximum contaminant level (MCL) currently proposed by the New York State Department of Health (NYSDOH). Perfluorooctanoic acid (PFOA) or perfluorooctanesulfonic acid (PFOS) were reported above the MCL currently proposed by the NYSDOH (10 nanograms per liter [ng/L] for each compound) in wells MW-3, MW-5 and RI-4. Additional investigation is required to assess whether any impacts have extended beyond the site boundaries.

2.0 Engineering and Institutional Control Plan

2.1 Introduction

2.1.1 General

Since contaminated soil and groundwater exists beneath the Site, EC/ICs are required to protect human health and the environment. This Engineering and Institutional Control Plan (EC/IC Plan) describes the procedures for the implementation and management of all EC/ICs at the Site. The EC/IC Plan is subject to revision by the NYSDEC.

2.1.2 Purpose

The purpose of the EC/IC Plan is to provide:

- A description of all EC/ICs on the Site;
- The basic implementation and intended role of each EC/IC;
- A description of the key components of the ICs as set forth in the ROD and environmental easement;
- A description of the features to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of EC/ICs; and
- Any other provisions necessary to identify or establish methods for implementing the EC/ICs required by the Site remedy, as determined by the NYSDEC.

2.2 Engineering Controls

The Site has the following ECs:

- An engineered final cover;
- A passive landfill gas collection and ventilation system is incorporated into the cover;
- A surface water diversion system that drains runoff away from the landfill;
- A chain link fence with a locked gate is present at the driveway to restrict vehicular access. The fence is equipped with the appropriate signage; and
- Gas and groundwater monitoring networks.

2.2.1 Engineering Control Systems

Engineered Final Cover

Exposure to source material and remaining soil contamination at the Site is prevented by an engineered final cover system placed over the waste material. This cover system was designed to comply with 6 NYCRR Part 360 requirements and is comprised of a 12-inch soil gas venting layer, high density polyethylene (HDPE) geomembrane barrier, geosynthetic drainage layer, 24-inch soil barrier protection layer, and six-inch topsoil layer (**Figure 3**). Record drawings are provided in **Appendix D**. Procedures for the inspection and maintenance of this protective cover are provided in the M&M Plan included in Section 3.0 of this SMP. Features to be evaluated include:

- Condition of cover soil and vegetation (i.e., inspection for erosion/disturbance);
- Settlement and subsidence of the cover system;
- Integrity of flexible geomembrane liner; and
- Leachate seepage.

No disturbance of the engineered final cover is acceptable without proper approval and coordination with the NYSDEC.

Surface Water Diversion System

The surface runoff control system for the Site includes various components such as: drainage swales, catch basins, culverts, stone outfalls, and erosion control mats. The combination of these types of devices is intended to control surface run-on and runoff at the Site and on surrounding lands resulting from a 100-year, 24-hour storm event. Additionally, the system is intended to reduce infiltration of precipitation and subsequent generation of leachate. Record drawings of the surface water diversion system are provided in **Appendix D**. Procedures for the inspection and maintenance of this protective cover are provided in the M&M Plan included in Section 3.0 of this SMP. Features to be evaluated during periodic inspection and review include the condition of runoff control structures (e.g., flow restriction, damage, and settlement).

Combustible Gas Collection System

The soil gas venting layer within the engineered final cover is fitted with a network of horizontal and vertical pipes for collection and distribution of combustible gas (hydrogen sulfide and methane) generated at the Site through volatilization of chemicals within waste material and decomposition of organic waste materials. This passive gas collection system ventilates the combustible gas from 12 GVSs located throughout the Site. Thirteen PMPs were originally located around the Site to ensure combustible gas is not being released beyond the boundaries of the engineered final cover. However, PMP-1, located near the gate to the site, appears to have been destroyed in 2018. The locations of the GVSs and PMPs are shown on **Figure 2**. The system is intended to control build-up of gases beneath the protective cover by ensuring proper ventilation, prevent the underground migration of gases away from the site, and control odors and emissions, as necessary. The GVSs were designed and placed based on soil gas sampling data and the PMPs were designed and placed based on proximity to the cover and even distribution. Record drawings of the cover system are provided in **Appendix D**.

In 1999, active mini-blowers were installed and operated at three GVSs (GVS-7, GVS-9, and GVS-12) due to the build-up of gases beneath the cover; however, after periods of unreliable operation, they were removed. In 2005 and 2006, six passive wind turbine ventilators were installed at GVS-2, GVS-4, GVS-6, GVS-8, GVS-9, and GVS-11. In 2010, three additional ventilators were installed at GVS-1, GVS-3, and GVS-5. Refer to **Appendix E** for information and specifications for the ventilators.

The EC was originally designed to treat the gas through activated carbon to remove hydrogen sulfide and VOCs; however, subsequent monitoring indicated that carbon treatment was not necessary and could be eliminated. The vessels and fencing surrounding each GVS were removed in 2007. No revisions were made to the original record drawings.

Procedures for operating and maintaining the passive gas collection system are documented in the M&M Plan (Section 3.0 of this SMP). Features to be evaluated during periodic inspection and review are:

- Condition and integrity of gas vent stations and perimeter monitoring points;
- Ventilator performance (i.e., need for maintenance); and
- Landfill gas emissions.

2.2.2 Remedial Process Closure Requirements

Generally, remedial processes are considered to be completed when effectiveness monitoring indicates that the remedy has achieved the RAOs identified in the ROD (listed in Section 1.4 of this SMP). The framework for determining when remedial processes are complete is provided in Section 6.4 of DER-10 (NYSDEC, May 2010). Due to feasibility, the remedy for this Site did not address the principal threat at the site via active treatment, but instead addressed the principal pathways of concern thereby mitigating the threat.

The ECs at the Site are considered permanent controls and the quality and integrity of these systems will be inspected at regular intervals, indefinitely. The Post-Closure Monitoring and Maintenance (PCMM) Manual indicates that post-closure maintenance and monitoring will be conducted for a minimum of 30 years. Future potential for delisting the Site and discontinuing or reducing inspection, maintenance, and monitoring of the ECs/ICs will be evaluated during the Periodic Review Process and is subject to approval by the NYSDEC and NYSDOH.

2.3 Institutional Controls

Per the ROD, the site remedy includes the placement of use restrictions on the site "to ensure that the integrity of the remedy is not damaged or compromised. This will include restrictions on excavations into the cover or any other activities that would reduce the effectiveness of the remedy (e.g., interference with the gas collection system)." The intent of the ICs is to:

- Implement, maintain and monitor EC systems;
- Prevent future exposure to remaining contamination by containing and controlling disturbances of the subsurface contamination; and
- Limit the use and development of the Site to those activities which do not interfere with the effectiveness of the remedy or allow for exposure to contaminants.

Adherence to the ICs on the Site is a requirement of the ROD and environmental easement and will be implemented under this SMP. The ICs for the Site include:

- Compliance with the environmental easement and this SMP by the Grantor and the Grantor's successors and assigns;
- All ECs must be operated and maintained as specified in this SMP;
- All ECs on the Controlled Property must be inspected at a frequency and in a manner defined in the SMP;
- Groundwater, air emissions, and other environmental or public health monitoring must be performed as defined in this SMP;
- Maintaining restricted access to the Site remedial components and posting of warning notifications and contact information; and
- Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in this SMP.

ICs identified in the SMP may not be discontinued without an amendment to or extinguishment of the environmental easement for the Controlled Property.

The Site has a series of ICs in the form of Site restrictions. Adherence to these ICs is required by the ROD and the environmental easement. Site restrictions that apply to the Controlled Property are:

- All future activities on the property that will disturb remaining contaminated material must be conducted in accordance with this SMP. No intrusive activities or excavation may be conducted at the Site without the consent of the NYSDEC;
- The use of the groundwater underlying the property is prohibited without treatment rendering it safe for intended use; and
- Vegetable gardens and farming are prohibited on the Site.

2.3.1 Excavation Work Plan

In the event that any intrusive work which may encounter or disturb remaining contamination at the Site is proposed in the future, an Excavation Work Plan (EWP) must be submitted to the NYSDEC.

Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in the Health and Safety Plan (HASP) prepared for the Site in accordance with DER-10, and 29 CFR 1910, 29 CFR 1926, and all other applicable Federal, State, and local regulations. Any intrusive construction work will be performed in compliance with these documents and included in the periodic inspection and certification reports (Section 3.6).

The EWP must include provisions for the structural integrity of excavations, proper disposal of excavation de-water, control of runoff from open excavations into remaining contamination, and for structures that may be affected by excavations (e.g., building foundations and bridge footings). The site owner will ensure that site development activities will not interfere with, or otherwise impair or compromise, the ECs described in this SMP.

2.4 Inspections and Notifications

2.4.1 Periodic Inspections

Inspections of all remedial components installed at the Site will be conducted at the frequency specified in the SMP M&M Plan schedule (Section 3.5). A comprehensive Site-wide inspection will be conducted annually, regardless of the frequency of the PRR. The inspections will determine and document the following:

- Whether ECs continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this SMP and the environmental easement;
- Achievement of remedial performance criteria;
- Sampling and analysis of appropriate media during monitoring events;
- If Site records are complete and up-to-date; and
- If any changes have been made to the remedial or monitoring system, or if changes are necessary.

Inspections will be conducted in accordance with the procedures set forth in the M&M Plan (Section 3.0). The reporting requirements are outlined in the Reporting Section (Section 3.6).

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the Site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the Site by a qualified environmental professional as determined by the NYSDEC.

2.4.2 Notifications

Notifications will be submitted by the property owner and/or an entity responsible for Site maintenance to the NYSDEC (see Section 2.5.1) as needed for the following reasons:

- 60-day advance notice of any proposed changes in site use that are required under the terms of 6 NYCRR Part 375 and/or the Environmental Conservation Law.

- Notice within 48 hours of any damage or defect to the foundations or structures that reduces or has the potential to reduce the effectiveness of other ECs and likewise any action to be taken to mitigate the damage or defect.
- Verbal notice by noon of the day following any emergency, such as a fire, flood, or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action shall be submitted to the NYSDEC within 45 days and shall describe and document actions taken to restore the effectiveness of the ECs.
- 30-day advance notice of any proposed ground intrusive activities, so that an appropriate excavation and/or material management plan may be developed.

Any change in the ownership of the Site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser has been provided with all approved work plans and reports, including this SMP.
- Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing.

Notifications will be made to Robert Strang, Remedial Section D, Bureau E, NYSDEC Division of Environmental Remediation, 625 Broadway, Albany, New York 12233. In the event that the NYSDEC develops a centralized notification system, that system will be used instead.

2.4.3 Evaluation and Reporting

The results of inspections and Site monitoring data will be evaluated as part of the EC/IC certification to confirm that the:

- EC/ICs are in place, are performing properly, and remain effective;
- M&M Plan is being implemented; and
- Site remedy continues to be protective of public health and the environment.

2.5 Contingency Plan

Emergencies may include injury to personnel, fire or explosion, environmental release, or serious weather conditions.

Non-sparking tools are necessary for all invasive activities. As a precaution, potential ignition sources (mowers, vehicles, etc.) should be maintained at a safe distance from gas vents.

No development is allowed within the limits of the Site and no intrusive activities will be allowed that will disturb the remedy. If adjacent areas are to be developed, NYSDEC personnel will require notice at least 60 days in advance of the proposed change in site use and a work plan will be required 30 days in advance for assessing and managing any potentially impacted material.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by telephone to the NYSDEC Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spill hotline within two hours. These findings will be included in daily and periodic reports.

If previously unidentified contaminant sources are found during subsurface excavations or development-related construction, excavation activities will be suspended until the appropriate equipment is mobilized to address the condition, and any new health and safety issues are addressed.

In such event, sampling will be performed on product, sediment, groundwater and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. A sampling and analysis plan must be provided to the NYSDEC for review and approval.

2.5.1 Emergency Telephone Numbers

In the event of any environmental situation or unplanned occurrence requiring assistance, the Owner or Owner's representative(s) should contact the appropriate party from the contact list below. For emergencies, appropriate emergency response personnel should be contacted. Prompt contact should also be made to the qualified environmental professional. Contact numbers are provided in the below tables.

Emergency Contact Numbers	
Police/Fire	911
DigSafely New York	(800) 962-7962 or 811 (3-day notice required for utility markout)
Poison Control Center	(800) 222-1222
National Response Center	(800) 424-8802
NYSDEC Spills Hotline	(800) 457-7362
Town of Tuxedo Town Hall	(845) 351-4411

Note: Contact numbers are subject to change and should be updated as necessary.

Site Contact Numbers	
Robert Strang, NYSDEC Project Manager	(518) 402-8642
Robbin Petrella, D&B ENGINEERS AND ARCHITECTS, P.C.	(516) 364-9890 ext. 3049
James Magda, TRC	(315) 671-4049

Note: Contact numbers are subject to change and should be updated as necessary.

2.5.2 Maps and Directions to Nearest Health Facility

The hospital nearest the Site is Good Samaritan Hospital located in Suffern, New York. The hospital is approximately 9.2 miles from the Site.

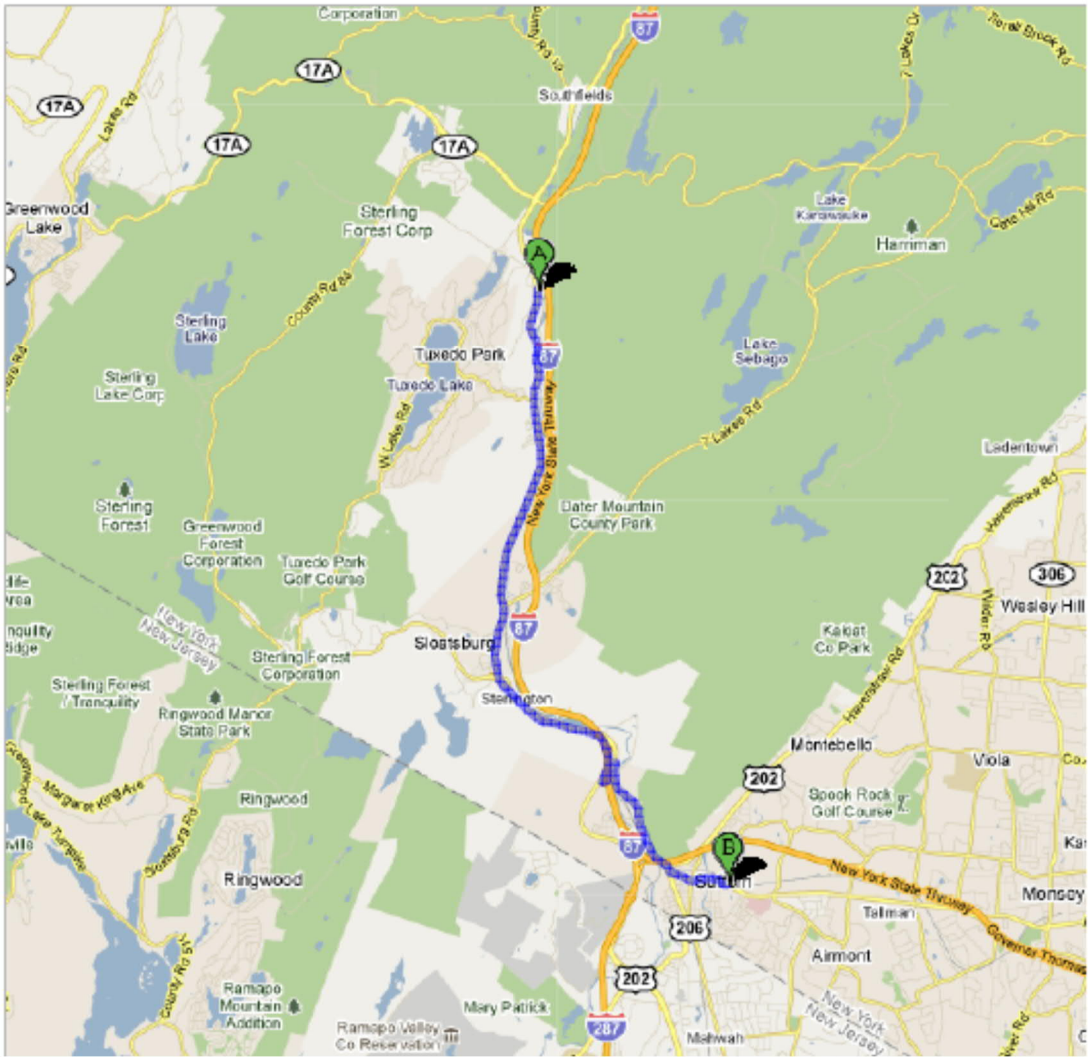
Site Location:	State Route 17, Tuxedo, New York 10987
Nearest Hospital Name:	Good Samaritan Hospital
Hospital Location:	255 Lafayette Avenue, Suffern, New York 10901
Hospital Telephone:	(845) 368-5000
Total Distance:	9.2 miles
Total Estimated Time:	14 minutes

Driving directions and a map to the hospital are provided on the following page:

NY-17 S

1.	Head **south** on **NY-17 S** toward **Stevens Ln** About 6 mins	go 5.9 mi total 5.9 mi
2.	Take the **NY-17 S/I-87 S/New York Thruway** ramp to **I-287**	go 0.3 mi total 6.2 mi
3.	Merge onto **I-87 S/NY-17 S** Toll road	go 0.3 mi total 6.5 mi
4.	Take exit **15A** for **NY-17** toward **NY-59/Sloatsburg/Suffern** Toll road	go 0.2 mi total 6.7 mi
5.	Turn right at **State Hwy 17** About 1 min	go 0.3 mi total 7.0 mi
6.	Turn right at **NY-59 E/Orange Turnpike** Continue to follow NY-59 E About 3 mins	go 1.5 mi total 8.5 mi
7.	Turn left at **Lafayette Ave** About 2 mins	go 0.7 mi total 9.2 mi

Good Samaritan Hospital, Lafayette Ave, Suffern, NY 10901



2.5.3 Response Procedures

In the event of any release of material or other emergency, the fire department and other emergency response groups will be notified immediately by telephone and provided with site hazard information. The emergency telephone number list is found in Section 2.5.1. The site contacts listed in the section will also be notified. Local responders will be notified via 911. The Fire Department would be the first responders. If the incident requires Hazardous Materials response, 911 should be called and the appropriate emergency response personnel will be contacted.

Evacuation Plan

In the event of an explosion and/or fire, all site personnel shall assemble at a safe distance upwind of the affected area. Minimum response procedures include notification of emergency services and site contacts. Re-entry should not occur until site conditions are deemed safe. Subsequent to the event, an incident investigation should be performed and any recommended corrective actions addressed. If breathing zone/perimeter monitoring activities determine that the following chemical action levels have been exceeded, then site personnel will cease operations and immediately evacuate the site, consult with a health and safety professional, and revisit health and safety protocols to properly protect themselves from site hazards prior to re-entry to the Site (e.g., increase level of personal protective equipment).

- VOCs: Consistent readings of greater than 5 ppm on a photoionization detector (PID)
- Hydrogen Sulfide: 10 ppm
- Methane: >10% of the LEL or 0.51% on a GEM™ 2000 Landfill Gas Monitor.

Spills

Based on site conditions, a spill situation is considered unlikely. In the event of a petroleum release (e.g., equipment leak from contractor), the release will be cleaned up in a timely fashion per applicable guidance and reported to the NYSDEC Spill Hotline.

Amendments to the Contingency Plan

Amendments to the contingency plan should be made subsequent to any incident investigation and changes should be approved by NYSDEC personnel.

Medical Emergencies

Medical emergencies are addressed in the site HASP. Appropriate first aid will be administered, and if necessary, the injured individual will be sent to the designated medical facility. An ambulance will be summoned, if needed. The cause of the accident will be determined and corrected prior to continuing operations. First aid kits are maintained in all AECOM owned or leased vehicles at all times.

Training

All individuals performing work on-site will attend an initial 40-hour health and safety training course and annual 8-hour refresher training for conducting work at hazardous waste sites. These courses

satisfy the initial and follow-up training requirements of 29 CFR 1910.120 (OSHA regulation of hazardous waste site activities).

All individuals are required to read, sign and comply with the site HASP at all times when performing work on the Site.

3.0 Maintenance and Monitoring Plan

3.1 Introduction

3.1.1 General

The M&M Plan describes the measures for evaluating the performance and effectiveness of the remedy to contain and mitigate contamination at the Site. This plan includes requirements for general site maintenance, monitoring and maintenance of the passive engineering control components at the site (i.e., engineered final cover, associated gas collection/ventilation system, surface water diversion system), and monitoring of all affected Site media identified below. This M&M Plan may only be revised with the approval of the NYSDEC. The complete 1996 PCMM Manual prepared by Clough, Harbour, and Associates, which contains system record drawings, is provided as **Appendix D**. Some modifications have been made since 1996; therefore, this SMP M&M Plan is intended to summarize the site management requirements going forward.

3.1.2 Purpose

This M&M Plan describes the methods to be used for:

- Sampling and analysis of all appropriate media (e.g., groundwater, landfill gas);
- Assessing compliance with applicable NYSDEC standards, criteria and guidance, particularly AWQS/GV;
- Assessing achievement of the remedial performance criteria;
- Evaluating site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment;
- Maintenance and monitoring of Site ICs and ECs; and
- Preparing the necessary reports for the various maintenance and monitoring activities.

To adequately address these issues, this M&M Plan provides information on:

- Sampling locations, protocol, and frequency;
- Information on all designed monitoring systems (e.g., well logs, gas vent stations, perimeter monitoring points);
- Field monitoring requirements;
- Analytical sampling program requirements;
- Maintenance and monitoring reporting requirements;
- Quality Assurance and Quality Control (QA/QC) requirements;
- Inspection and maintenance requirements for ICs, ECs, and monitoring network;
- Monitoring well decommissioning procedures; and

- Annual inspection and periodic review and certification.

3.2 General Site Maintenance

General site monitoring and maintenance requirements include:

- Fencing/Gate: The Site security fencing that is present along the access road, including the gate, shall be inspected periodically to ensure they are in good condition and secure. Any damage that is observed shall be recorded and repaired as soon as possible by restoration or replacement of the damaged materials. Any disturbed or eroded soil below the fence line shall be filled and vegetation restored to ensure security of the Site.
- Signage: All signs posted on the Site shall be inspected periodically. Any signs that are determined to be missing shall be replaced as soon as possible. Any sign that has been damaged beyond legibility shall be replaced as soon as possible. If it is determined that a new sign is necessary at the site, the sign shall be posted as soon as possible. All damage to signage shall be promptly repaired.
- Access Road: The Site access road shall be inspected annually to ensure its integrity. The most likely problems with the roads over the site include rutting of the road surface and erosion of road materials. When rutting advances to the point where standing water is observed on the roadways, the surface shall be regraded and compacted until firm and uniform. Areas where road materials have eroded shall be repaired by placing, grading, and compacting additional soil material.
- Vermin/Vectors: A vermin/vector inspection will be completed annually. The premises must be free of pest infestations (e.g., insects, rodents, small animals) that may cause a nuisance or hazard or impact the effectiveness of the remedy or the integrity of individual components. If inspections indicate that such an infestation has occurred, a qualified professional exterminator will be procured to mitigate the problem and any necessary repairs to the ECs should be made, as appropriate.

3.3 Engineering Control Maintenance and Monitoring

3.3.1 Engineered Final Cover System

The engineered final cover system is described in Section 2.2. Maintenance and monitoring of the cover includes the following:

- Surface coverage: The cover system shall be inspected for erosion or disturbed vegetation. Where loss of cover soils or vegetation is noted, repairs shall be made by removing existing topsoil (if any) and then placing and compacting new fill materials to create a uniformly sloping surface compatible with the surrounding grade. Fill materials shall have similar gradation and characteristics as the existing cover soils directly below the topsoil. At completion of filling, stockpiled or new topsoil shall be placed on disturbed areas. All disturbed surfaces shall be fertilized, seeded, and mulched, and temporary erosion control devices such as hay bales or erosion mats shall be used as necessary until vegetation is re-established. Records shall be kept of all observed damage to the cover system, as well as all subsequent repairs to the cover system.
- Vegetative cover: Periodic mowing of the vegetative cover shall be conducted. The grass cover shall be mowed when its height exceeds 12 inches, and should not be permitted to

exceed a height of 18 inches. Based on these guidelines and observations made during the regular site inspections, the NYSDEC shall be notified when mowing is required. The NYSDEC will utilize its own staff for mowing of the grass cover. Mowing is typically required four times per year during the growing season. Equipment of appropriate size and weight shall be used to avoid the creation of ruts and other damage to the cover system surface. Staff shall use care during mowing/vegetation removal and shall immediately report any impacts to site equipment (e.g., PMPs, GVSs, and monitoring wells) or damage to the landfill cover to the NYSDEC Project Manager.

- Settlement: The surface of the cover system must be regularly inspected for areas of settlement and subsidence (e.g., sinking or collapse). These areas shall be noted and repaired as soon as possible to prevent ponding of water on, and infiltration into the cover system. Repairs will occur by removing existing topsoil and then placing and compacting additional fill materials to create a uniformly sloping surface compatible with the surrounding grade, enhancing surface runoff. Fill materials shall have similar gradation and characteristics as the cover soils directly under the topsoil. At completion of filling, the topsoil shall be replaced on disturbed areas. All disturbed surfaces shall be fertilized, seeded, and mulched, and temporary erosion control devices such as hay bales or erosion mats shall be used until vegetation is re-established. Where abrupt and deep areas of settlement are found, the geomembrane barrier must also be inspected, as described in the following item. Records shall be kept of all damage and corresponding repairs. All areas of settlement shall be recorded and visually monitored after repair.
- Flexible Membrane Liner: The geomembrane liner at the Site must be inspected for damage if large, abrupt differential surface deformation is observed (e.g., a steep-sided sinkhole created by collapse of a large void in the waste under the cap system). In areas where such features are discovered in the cover system, the geomembrane shall be exposed to verify its integrity. If damage (e.g., rips or tears) is noted, the geomembrane shall be repaired by welding a patch over the damaged area. The patch shall be constructed using a geomembrane of the same material and thickness as the cap geomembrane. Repair of the geomembrane shall be completed by a qualified professional experienced in the installation of geomembrane materials. All welded seams shall be tested using a vacuum box or other approved method. The soil cover system overlying the geomembrane shall be replaced in kind, using soil materials with similar gradation and characteristics as the existing cover soils. Records shall be kept of all geomembrane repairs, including appropriate QA/QC testing results.
- Leachate Seepage: The surface of the landfill cover system and the lands immediately adjacent to the cover system shall be inspected regularly for leachate seepage. If leachate seepage is observed, the cover system in the vicinity of the seep must be inspected for erosion, settlement, and possible damage to the geomembrane barrier. Should damage to the geomembrane be confirmed, the damaged area will be repaired by qualified personnel (as described in the previous item) and the leachate seep will be monitored. If no geomembrane damage is confirmed or if leachate seepage does not dissipate after repair of any geomembrane damage, the leachate will be sampled during the regular environmental monitoring events and the seepage intensity monitored. The NYSDEC will evaluate subsequent analytical data and site inspection reports to determine what corrective actions should be taken. If necessary, the leachate will be collected and disposed off-site.

3.3.2 Gas Collection/Ventilation System

The gas collection/ventilation system is described in Section 2.2. The system includes twelve (12) GVSs, thirteen (13) PMPs, and nine (9) wind turbine ventilators. Maintenance and monitoring of the system includes the following:

- Regular inspection of the gas venting system shall include checking all vents for any physical damage (e.g., infiltration of surface water or groundwater, sediment accumulation, biofouling, damage by mowers), blockages inside the vents, and settlement or movement of the vent riser pipes.
- Any physical damage to a gas vent shall be repaired by replacement of the damaged part or section. Blockages in a vent shall be cleared by use of a non-metallic snake tool. When significant settlement or movement of a gas vent riser is observed, the geomembrane boot at the gas vent shall be inspected for possible tears. If necessary, repair of the geomembrane boot shall be completed by a qualified professional experienced in the installation of geomembrane materials. All welded seams shall be tested using a vacuum box or other approved method.
- The effectiveness of the gas collection/ventilation system should be evaluated by monitoring methane and hydrogen sulfide concentrations at the GVSs and PMPs.
- Passive wind turbine ventilators should be inspected and serviced periodically. The ventilators should be lubricated to decrease surface friction and to prevent seizure. If necessary, turbines shall be replaced.

Figure 4 displays the data collected during the September 2010 sampling event, while **Figure 5** provides updated data and information about the GVSs and PMPs collected in January 2019.

3.3.3 Surface Water Diversion System

The surface water diversion system is described in Section 2.2. Maintenance and monitoring of the system includes the following:

- All runoff control structures shall be inspected periodically to identify any erosion, siltation, settlement, or any other restriction of flow that would impede their effectiveness.
- All eroded or settled areas within drainage courses shall be repaired by replacing and compacting eroded material or placing additional compacted material, followed by reseeding to prevent additional erosion. In areas where drainage courses are rip-rap lined, additional lining material may be required.
- Excess silt, debris, or other materials found to be causing blockage in drainage courses, culverts or other structures shall be removed to allow for proper drainage.
- Records shall be kept of all deficiencies and corrective actions.

3.4 Media Monitoring Program

The following sections describe the details of Monitoring Plan procedures for affected media at the Site. The primary affected media is groundwater. The following summarizes the current media monitoring program:

- Collection of select monitoring well depth-to-groundwater measurements and collection of groundwater samples for Target Analyte List (TAL) Metals analysis;
- Emissions of combustible gases are monitored as a product of Site contamination and decomposition of waste material; and
- Leachate analysis, as necessary.

3.4.1 Groundwater Monitoring

Groundwater monitoring will be performed on a periodic basis to assess the performance of the remedy.

The network of monitoring wells was installed to monitor both upgradient and downgradient groundwater conditions at the Site. The network of on-site wells has been designed primarily based on the following criteria:

- Historical analytical results identifying contamination in excess of standards;
- Anticipated contaminant plume migration; and
- Adequate assessment of overburden and bedrock groundwater conditions and contaminant distribution towards the Ramapo River.

The locations of on-site wells are shown on **Figure 2** and a conceptual model of the Site is provided as **Figure 3**. Well construction logs are included as **Appendix F** and construction details are summarized in **Table 1**, along with groundwater elevations recorded in June 2009.

A discussion of site geology is presented in Section 1.2.3. In general, the shallow overburden wells (MW-1, MW-4, MW-5, MW-6, MW-7, and RI-4) are or were screened within recent alluvial deposits, outwash sand and gravel, and glacial till, with screen depths ranging from 5 to 27 feet bgs in ten-foot lengths. Depth-to-groundwater within the overburden wells ranged from 16.65 (RI-4) to 26.16 (MW-4) feet bgs during the June 2009 sampling event. The composition and construction of the landfill prohibits the natural flow of groundwater beneath and surrounding the Site. According to the RI/FS Report and the ROD, the natural direction of groundwater flow from the upper unconsolidated water-bearing unit is generally from the relatively high elevations west of the Site to the east, toward the Ramapo River. The bedrock wells (MW-2, MW-3, RI-1, and RI-5A) are either open holes with risers (i.e., no screen attached to the riser) or screened, at depths ranging from 12 to 73.2 feet bgs, based on the highly variable bedrock surface elevation. The range in depth-to-groundwater in these bedrock wells was 11.03 to 24.58 feet bgs in June 2009. The overall bedrock groundwater flow direction is less defined due to natural irregularities in the bedrock (e.g., joints, fractures, and discontinuities).

In 2000 and 2001, groundwater samples were collected from Site monitoring wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, RI-1, RI-2, and RI-4 and submitted for laboratory analysis of VOCs, SVOCs, PCBs, and TAL metals. These results represent the baseline post-remedial groundwater quality conditions. Only metals were detected in the groundwater samples above the applicable NYS AWQS/GV. **Table 2** presents groundwater analytical results for metals in Site monitoring wells. Iron, manganese and sodium exceeded their respective AWQS in the majority of samples. Chromium exceedances were exhibited in the samples from monitoring well RI-2. No other metals were detected above the AWQS/GV within that time period.

The 1996 PCMM Manual indicated that groundwater samples should be analyzed for iron, manganese, magnesium, and lead. The 2004 Long-Term Monitoring (LTM) Plan prepared by the NYSDEC modified the list and indicated that the COCs for wells MW-1 to MW-7 were aluminum, arsenic, chromium, iron, manganese, magnesium, mercury and zinc.

Groundwater samples from all Site monitoring wells will be collected every two years and analyzed for TAL metals. Results will be compared to NYSDEC AWQS/GV. If wells are replaced or new wells are installed, the SMP should be modified to incorporate the new wells into the monitoring plan (e.g., update figures, provide baseline data, and attach boring/construction logs).

All Site monitoring wells will be sampled indefinitely unless modified with the approval of the NYSDEC. The SMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Data deliverables for the groundwater monitoring program are specified below.

Sampling Protocol

All monitoring well sampling activities will be recorded in a field book and on the Monitoring Well Purging/Sampling Forms presented in **Appendix G**. These forms and the Annual Site-Wide Inspection Checklist (also in **Appendix G**) will serve as inspection forms for the groundwater monitoring well network.

Prior to sampling each well, air quality will be measured around the capped well and at the well once it is opened. A depth-to-groundwater measurement and a depth-to-well bottom measurement will be taken using a water level indicator. The instrument will be sprayed down with a mixture of spring water and Liquinox® and then rinsed with distilled water before each use. Each monitoring well will be purged of three times the volume of water present in the water column at the time of measurement. Purge water will be discharged directly to the ground. Wells will be purged and sampled using a submersible pump (e.g., Grundfos Redi-Flo2 Pump® or equivalent) and dedicated, Teflon-lined polyethylene tubing or a disposable polyethylene bailer depending on the volume of water to be removed prior to sampling. Following sampling, the submersible pump will be decontaminated between each use in a Liquinox® bath and distilled water rinse.

During purging and prior to collecting groundwater samples, temperature, conductivity, specific conductance, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, color and odor of the water and other pertinent information is to be recorded on the Monitoring Well Purging/Sampling Forms (**Appendix G**). If, after removal of three well volumes, turbidity measurements are greater than 50 nephelometric turbidity units (NTU), additional effort will be expended to reduce the turbidity of the sample prior to collection (e.g., employ slower purge method, remove additional well volumes, etc.).

If the sample turbidity remains higher than 50 NTU, two samples will be collected for that well in order to assess the dissolved fraction of the contaminants; one for filtered analysis and one for unfiltered analysis. The following method will be used for sample collection:

- Request additional sets of unpreserved bottleware for all samples to allow collection of extra sample volume;
- Collect two sample sets at locations where turbidity is greater than 50 NTU;

- Indicate on chain of custody which samples need to be preserved (turbidity < 50 NTU); and
- Indicate on chain of custody which samples need to be filtered (turbidity > 50 NTU).

The laboratory will preserve samples after filtration.

All samples are to be collected in bottles provided by the NYSDEC ELAP-certified analytical laboratory. All samples shall be packed on ice and submitted to the laboratory with a completed Chain of Custody for analysis of TAL Metals by US EPA Method 6010.

All documents and data are to be submitted in electronic format to the NYSDEC Division of Environmental Remediation. The Department will not approve a final report unless, and until, all documents and data generated in support of that report have been submitted in accordance with the electronic submission protocols.

Information on the format of data submissions can be found at:
http://www.dec.ny.gov/chemical/62440.html.

Information on document submissions can be found at:
http://www.dec.ny.gov/regulations/2586.html.

Emerging Contaminants Sampling

Prior to sampling each well for emerging contaminants (1,4-dioxane and/or PFAS), depth-to-groundwater and depth to bottom measurements shall be taken using a water level indicator. The indicator shall be decontaminated with a Liquinox® and spring water rinse and sprayed with distilled water before each use. The wells shall be purged with a peristaltic pump, dedicated high-density polyethylene tubing and dedicated silicone tubing using low-flow methods, or by another method deemed acceptable by the NYSDEC using non-perfluorinated chemical (PFC) containing materials. The field sampling team must follow appropriate protocols in order to prevent cross-contamination by PFC-containing materials during sampling.

Water quality parameters including temperature, conductivity, specific conductivity, DO, ORP, pH, turbidity, color, and odor, shall be measured and recorded on the monitoring well purging/sampling forms (**Appendix G**) until the field parameters stabilize, unless low-flow sampling is not performed.

All emerging contaminants samples are to be collected per standard operating procedures in bottles provided by an NYSDEC ELAP-certified analytical laboratory capable of analyzing the samples using US EPA Method for 8270D SIM for 1,4-dioxane and US EPA Method 537 (modified) for the 21-analyte PFAS list. All samples shall be packed on ice and submitted to the laboratory with a completed Chain of Custody. A New York State Analytical Services Protocol (ASP) “B” deliverable package shall be requested from the laboratory for emerging contaminant samples.

All documents and data are to be submitted in electronic format to the NYSDEC Division of Environmental Remediation, as indicated above. The results of the first emerging contaminants sampling event are presented on **Figure 6**.

Monitoring Quality Assurance/Quality Control

All sampling and analysis of TAL Metals will be performed in accordance with the requirements of the Generic Quality Assurance Project Plan (QAPP; AECOM, May 2010), except as noted below:

- No Category B deliverables will be requested and no data validation will be performed on site management data unless necessary to support a site closure recommendation; instead, a ASP "A" deliverable package is required for analysis of TAL Metals.
- No field duplicates, trip blanks, matrix spikes, or matrix spike duplicates will be collected as part of the sampling event.
- Sample identification will include the monitoring well ID and a reference to the sample date (e.g., MW- # MMDDYY).

Unless otherwise directed by the NYSDEC, emerging contaminant sample data must be validated and a Data Usability Summary Report (DUSR) must be prepared by a third-party reviewer to validate the emerging contaminant laboratory results.

Monitoring Well Repairs, Replacement, and Decommissioning

If excessive biofouling or silt accumulation occurs in the on-site monitoring wells, which will be assessed with depth-to-well bottom measurements over time, the wells will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced (as per the Monitoring Plan) if an event renders the wells unusable. Monitoring wells may be properly decommissioned and eliminated from the Monitoring Program with NYSDEC approval.

Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity, overall performance, and unforeseen events such as well destruction due to local redevelopment of the Site.

The NYSDEC will be notified prior to any repair or decommissioning of monitoring wells for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent Periodic Review Report. Well decommissioning without replacement will be done only with prior approval by the NYSDEC. Well abandonment will be performed in accordance with the Groundwater Monitoring Well Decommissioning Policy (NYSDEC, November 2009). Monitoring wells that are decommissioned because they have been rendered unusable will be replaced with a similar well at a nearby location approved by the NYSDEC.

In October 2018, well MW-7 was determined to be broken beneath the ground surface and obstructed below that. MW-7 requires replacement in order to remain a functional part of the monitoring well network. If possible, the existing MW-7 shall be properly decommissioned during replacement activities in accordance with this section.

3.4.2 Combustible Gas Monitoring

A post-closure gas monitoring program was initiated to verify that decomposition gases generated at the Site are controlled by the gas collection and ventilation system to avoid hazards to the health and safety of the public and the environment or property. The gas monitoring program includes measurement of the concentrations of methane and hydrogen sulfide. The baseline or action levels for VOCs, hydrogen sulfide, and methane detected at the site perimeter are 5 ppm (with a PID), 10 ppm (with a landfill gas meter), and greater than 10% of the LEL (0.51% on the landfill gas meter), respectively.

Upon detection of methane or other explosive gas levels exceeding the LEL (5% methane by volume, 4% H_2S by volume) at the Site perimeter or beyond the property boundary, the NYSDEC shall be notified immediately in order to take all steps necessary to ensure the safety and protection of health and property. There is no threshold for acceptable gas concentrations at GVSs within the waste boundary.

Combustible gas monitoring will be performed on a quarterly basis at all GVSs and PMPs to assess the performance of the remedy, with one event performed during a winter month when there is a likelihood of frost and the potential for snow cover.

Adjustments were made to the collection/ventilation system components and the monitoring approach between 2005 and 2010; therefore, for the purposes of this SMP, the September 2010 data will be considered the baseline data for post-remediation. Older data is available in the Periodic Review Report(s).

Combustible gas will be monitored until the criteria for completion of remediation are met, per Section 2.2.2. Review of data and approval by the NYSDEC will determine whether additional GVSs will be equipped with wind turbine ventilators or capped. The monitoring frequency may be modified with the approval of the NYSDEC. The SMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Sampling Protocol

All combustible gas monitoring activities will be recorded in a field book and on the Combustible Gas Monitoring/Sampling Form provided in **Appendix G**. This form will serve as the inspection form for the combustible gas monitoring points at the Site.

Each GVS and PMP will be measured for methane and hydrogen sulfide using a GEM™ 2000 Landfill Gas Monitor or equivalent meter for approximately three to five minutes. The highest reading for methane and hydrogen sulfide during the sampling interval will be recorded in the field book and monitoring form. The methane concentration will be recorded in percent by volume and hydrogen sulfide will be recorded in ppm, as displayed on the instrument.

If possible, the combustible gas investigation should be conducted when wind conditions are at a minimum and when atmospheric pressure is low, which maximizes the potential for gas migration from the Site and helps ensure its detection, if present.

A portable gas detection instrument designed to detect the presence of methane or other specified combustible decomposition gases in air must be utilized. Currently, a GEM™ 2000 Landfill Gas Monitor is used to detect methane and hydrogen sulfide at the sampling points. The instrument must be calibrated prior to use with the appropriate calibration gas and following the manufacturer's specifications.

Should any reading at the PMPs exceed 25% of the LEL for gases of concern (e.g., methane and hydrogen sulfide), additional soil gas readings shall be taken to define the extent of the high concentration of explosive gas. This method shall not be used over the capped portion of the Site, as there are no action levels associated with combustible gas concentrations measured from the GVS.

Ambient methane, hydrogen sulfide, and VOC concentrations will also be measured in the breathing zone at each PMP along the property boundary. Upon detection of gases above their baseline or

action levels at or beyond the property boundary, the NYSDEC shall be notified immediately to ensure the safety and protection of health and property. The baseline or action levels for VOCs, hydrogen sulfide, and methane detected in ambient air are 5 ppm, 10 ppm, and greater than 10% of the LEL (0.51% on the meter), respectively.

The results from all monitoring events will be evaluated and adjustments will be made as required to ensure that gas is properly collected and vented.

Combustible Gas Monitoring Point Repairs and Replacement

Repairs and/or replacement of GVSs and PMPs should be performed based on assessments of structural integrity, overall performance, and unforeseen events such as destruction of the monitoring point from grass mowing activities. Damage to the GVSs/PMPs can also occur through infiltration of surface water or groundwater, sediment accumulation, biofouling, and site maintenance activities.

The NYSDEC will be notified prior to any repair or replacement of any monitoring point, and the replacement process will be documented and provided in the subsequent PRR. Monitoring points will be reinstalled in the nearest available location as approved by the NYSDEC.

PMP-1 (near the gate to the site) has not been located since mid-2018, and was likely cut off or removed at or below the ground surface. The perimeter monitoring point may be re-installed at the direction of the NYSDEC in accordance with this section.

3.4.3 Leachate

If routine inspection identifies the existence of leachate seeps, then the leachate shall be collected in laboratory-supplied bottleware and submitted for analysis of TAL Metals, consistent with the groundwater monitoring program. All samples shall be packed on ice and submitted to the laboratory with a completed Chain of Custody for analysis of TAL Metals by US EPA Method 6010. No Category B deliverables will be requested and no data validation will be performed on site management data unless necessary to support remedial completion; instead, a New York State ASP “A” deliverable package will be required.

All data are to be submitted in electronic format to the NYSDEC Division of Environmental Remediation. The Department will not approve a final report until all data generated in support of that report have been submitted in accordance with the electronic submission protocols.

3.4.4 Other Media

If any other media (e.g., surface water/sediment) is to be collected and analyzed as a result of periodic review or discovery of new information, then a sampling and analysis plan shall be presented to the NYSDEC. If ongoing monitoring occurs, the SMP should be modified to incorporate the requirements.

3.5 Monitoring and Inspection Schedule

The schedule of maintenance and monitoring events is provided in the table below. The frequency of events will be maintained as specified until otherwise approved by the NYSDEC and NYSDOH. Unscheduled inspections and/or sampling may take place when a suspected failure of the remedial

systems has been reported or an emergency occurs that is deemed likely to affect the operation of the EC/ICs. Features to be monitored include, but are not limited to, the following:

Monitoring and Inspection Schedule			
Monitoring Program	Frequency	Matrix/System	Analysis/ Assessment
Media/EC	Biennial	Groundwater Quality	TAL Metals
Media/EC	Quarterly	Landfill Gas Emissions Monitoring	Methane, Hydrogen Sulfide, VOCs
ICs	Quarterly	Fencing/Gate Inspection	Integrity/Security (Visual)
ICs	Quarterly	Signage Inspection	Integrity (Visual)
EC/ICs	Quarterly	Cover Inspection, Grass Mowing (seasonal)	Integrity/Access (Visual)
ECs	Quarterly	Runoff Control Structures Inspection (seasonal)	Integrity (Visual)
ECs	As Needed	Flexible Membrane Liner Repairs Inspection (seasonal)	Integrity (Visual)
ECs	Quarterly	Groundwater Monitoring Network Inspection (seasonal)	Integrity (Visual)
ECs	Quarterly	Gas Venting System Inspection	Integrity
ECs	Quarterly	Leachate Seepage (seasonal)	Presence of Seeps (Visual)/ TAL Metals if observed
ECs	Annually	Vermin and Vector Observations	Infestation/ Damage (Visual)
ICs	Annually	Vehicle Access Road	Condition (Visual)
ECs/ICs	Annually	Comprehensive Site-wide Inspection	Visual

3.6 Reporting Requirements

Forms and any other information generated during regular monitoring events and inspections will be kept with the project file. All forms, and other relevant reporting formats used during the monitoring/

inspection events, will be (1) subject to approval by the NYSDEC and (2) submitted on a periodic basis in the PRR or separate status reports. Specifically, combustible gas data will be submitted in the PRR, and a Groundwater Monitoring Report will be prepared subsequent to each groundwater monitoring event. The table below provides information on the reporting frequency.

Schedule of Monitoring/Inspection Reports	
Task	Reporting Frequency
Groundwater Monitoring Report	Biennially
Gas Monitoring Reports	Included in PRR, unless corrective actions are required.
Maintenance/Inspection Reports	Included in PRR, unless a change of use is observed or damage to an EC is observed that impacts the remedy effectiveness.
Site-Wide Inspection	Included in the PRR, unless corrective actions are required.
Periodic Review Report	Triennially

3.6.1 Maintenance/Inspection Reporting

Maintenance and monitoring documentation will be completed during each event and provided to the NYSDEC as part of the PRR, unless corrective action is warranted. Documentation shall be as described below:

Routine Maintenance

Checklists or forms (see **Appendix G**) will be completed during each routine maintenance event. Checklists/forms will include, but not be limited to, the following information:

- Date of event;
- Name, company, and position of personnel conducting maintenance activities;
- Description of the maintenance activities performed;
- Any modifications to the system;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and
- Other relevant supporting documentation, as appropriate.

Non-Routine Maintenance

During each non-routine maintenance event, a form will be completed which will include, but not be limited to, the following information:

- Date of event;
- Name, company, and position of personnel conducting maintenance activities;
- Presence of leaks/damage;
- Date of repair;
- Other repairs or adjustments made to the system;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and
- Other relevant supporting documentation, as appropriate.

3.6.2 Annual Site-Wide Inspection

Site-wide inspections will be performed once per year and after all severe weather conditions that may affect ECs or ICs. During these inspections, an inspection form will be completed (**Appendix G**). The form will be included in the PRR. The form will compile sufficient information to assess the following:

- Compliance with all ICs, including Site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General site conditions at the time of the inspection;
- Site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection;
- Compliance with permits and schedules included in the Operation and Maintenance Manual; and
- Confirmation that site records are up-to-date.

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the Site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the Site by a qualified environmental professional as determined by the NYSDEC.

3.6.3 Groundwater Monitoring Data Reporting

Groundwater monitoring reports will be prepared and submitted subsequent to each groundwater monitoring event. This report will include, at a minimum:

- Date of event;
- Personnel conducting sampling;

- Description of the activities performed;
- Type of samples collected and list of wells sampled;
- Copies of all field forms completed (e.g., sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;
- Copies of all laboratory data sheets and the required laboratory data deliverables required for all points sampled (to be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and
- A determination as to whether the groundwater quality and/or conditions have changed since the last reporting event where groundwater monitoring well data was provided.

All documents and data are to be submitted in electronic format to the NYSDEC Division of Environmental Remediation. The Department will not approve a final report unless, and until, all documents and data generated in support of that report have been submitted in accordance with the electronic submission protocols.

3.6.4 Periodic Review Reporting

PRRs will be prepared and submitted to the NYSDEC once every three years, 45 days prior to the end of the certification period. In the event that the Site is further subdivided into separate parcels with different ownership, a single PRR will be prepared that addresses the Site as described in **Appendix A**. The report will be prepared in accordance with NYSDEC DER-10. Media sampling results will also be incorporated into the PRR. The report will include:

- Identification and assessment of all ECs/ICs required by the remedy for the Site;
- Results of the required annual site inspections and severe condition inspections, if applicable;
- All applicable inspection forms and other records generated for the Site during the reporting period in electronic format;
- A summary of any discharge monitoring data and/or information generated during the reporting period with comments and conclusions;
- Data summary tables and graphical representations of COCs by media (groundwater, soil vapor), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted. Tables and charts may include a presentation of past data as part of an evaluation of contaminant concentration trends;
- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted electronically in a NYSDEC-approved format;
- A Site evaluation, which includes the following:
    - The compliance of the remedy with the requirements of the site-specific ROD;

  - The operation and the effectiveness of all remedial components, including identification of any needed repairs or modifications;
  - Any new conclusions or observations regarding Site contamination based on inspections or data generated by the M&M Plan for the media being monitored;
  - Recommendations regarding any necessary changes to the remedy and/or M&M Plan; and
  - The overall performance and effectiveness of the remedy.
- A performance summary for the ECs during the calendar year, including information such as:
  - A description of damages and repairs;
  - A summary of the maintenance and monitoring inspections; and
  - Comments, conclusions, and recommendations based on data evaluation.

The PRR will be submitted, in electronic format, to the NYSDEC Central Office.

3.7 Corrective Measures Plan

If any component of the remedy is found to have failed or is no longer protective of human health or the environment, a corrective measures plan will be submitted to the NYSDEC for approval. This plan will explain the problem and provide the details and schedule for performing work necessary to correct it. Unless an emergency condition exists, no work will be performed unless the corrective measures plan is approved by the NYSDEC.

4.0 References

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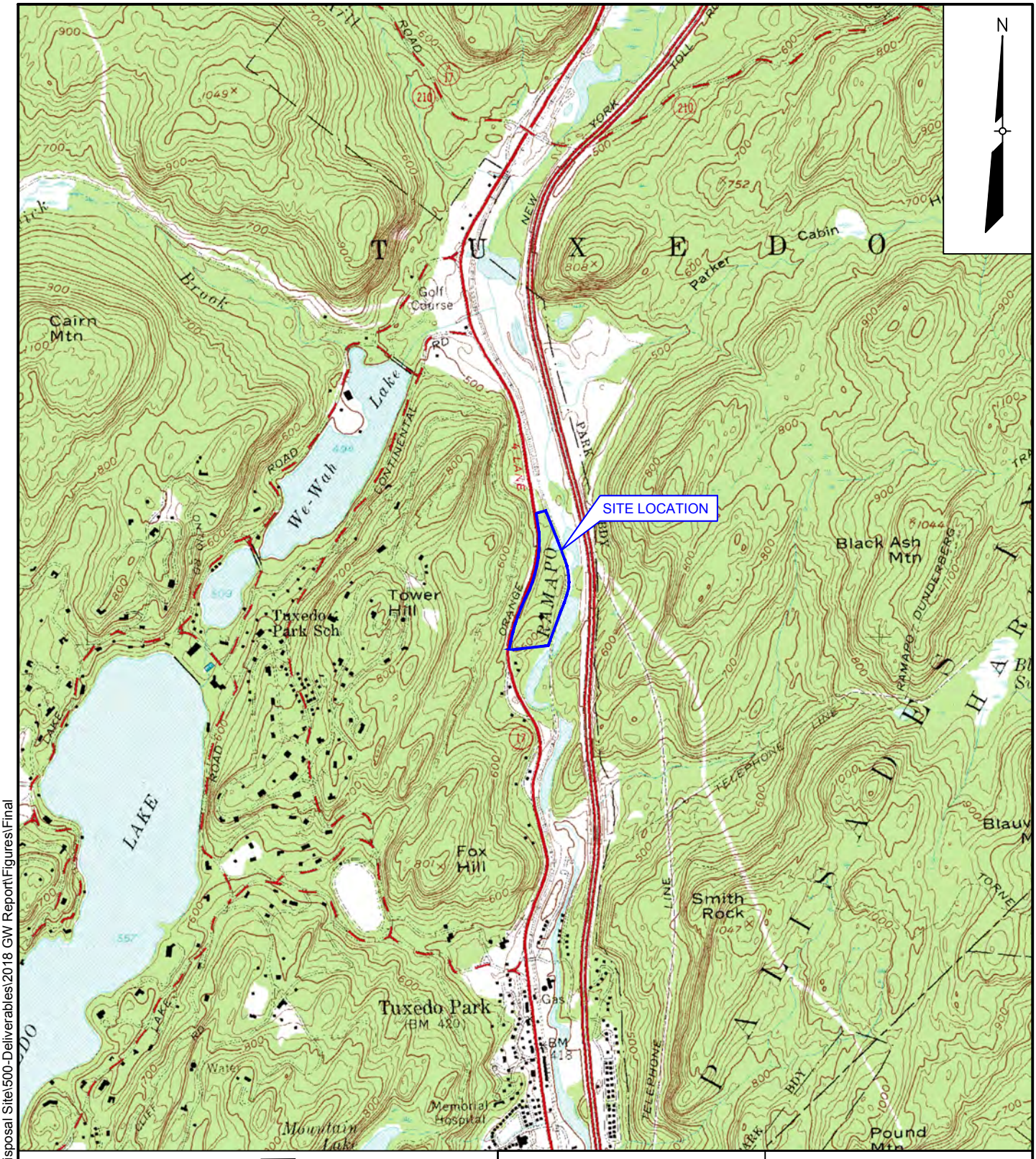
Figures



0 1000 2000 4000

SCALE IN FEET

NOTE: MAP DERIVED FROM U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, SLOATSBURG, NY-NJ, DATED 1955.

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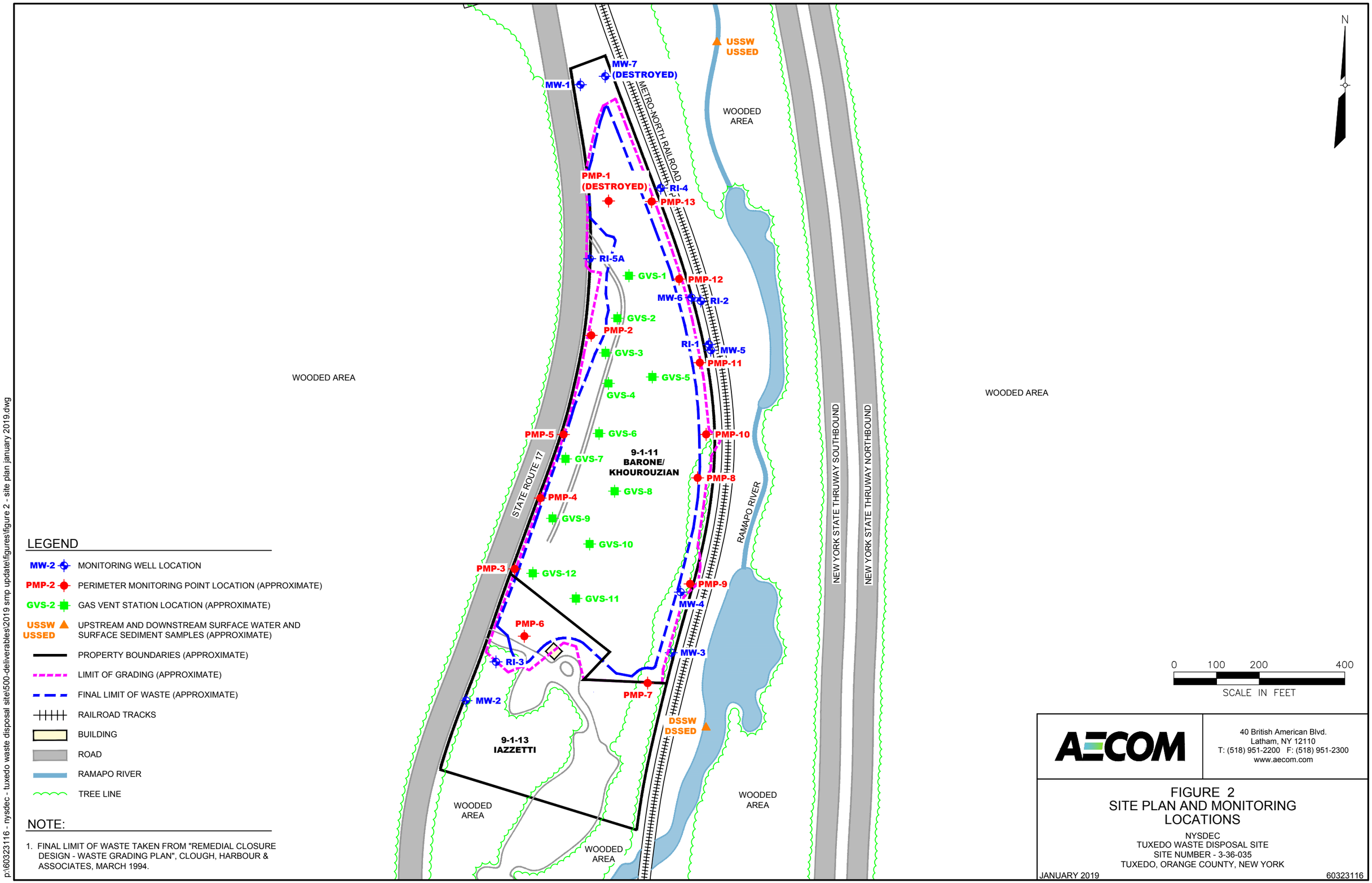
FIGURE 1
SITE LOCATION MAP

NYSDEC
TUXEDO WASTE DISPOSAL SITE
SITE NUMBER - 3-36-035
TUXEDO, ORANGE COUNTY, NEW YORK

FEBRUARY 2019

60323116

P:\60323116 - NYSDEC - Tuxedo Waste Disposal Site\500-Deliverables\2018 GW Report\Figures\Final



LEGEND

- MW-2 — MONITORING WELL LOCATION
- PMP-2 — PERIMETER MONITORING POINT LOCATION (APPROXIMATE)
- GVS-2 — GAS VENT STATION LOCATION (APPROXIMATE)
- USSW / USSED — UPSTREAM AND DOWNSTREAM SURFACE WATER AND SURFACE SEDIMENT SAMPLES (APPROXIMATE)
- PROPERTY BOUNDARIES (APPROXIMATE)
- LIMIT OF GRADING (APPROXIMATE)
- FINAL LIMIT OF WASTE (APPROXIMATE)
- RAILROAD TRACKS
- BUILDING
- ROAD
- RAMAPO RIVER
- TREE LINE

NOTE:

1. FINAL LIMIT OF WASTE TAKEN FROM "REMEDIAL CLOSURE DESIGN - WASTE GRADING PLAN", CLOUGH, HARBOUR & ASSOCIATES, MARCH 1994.

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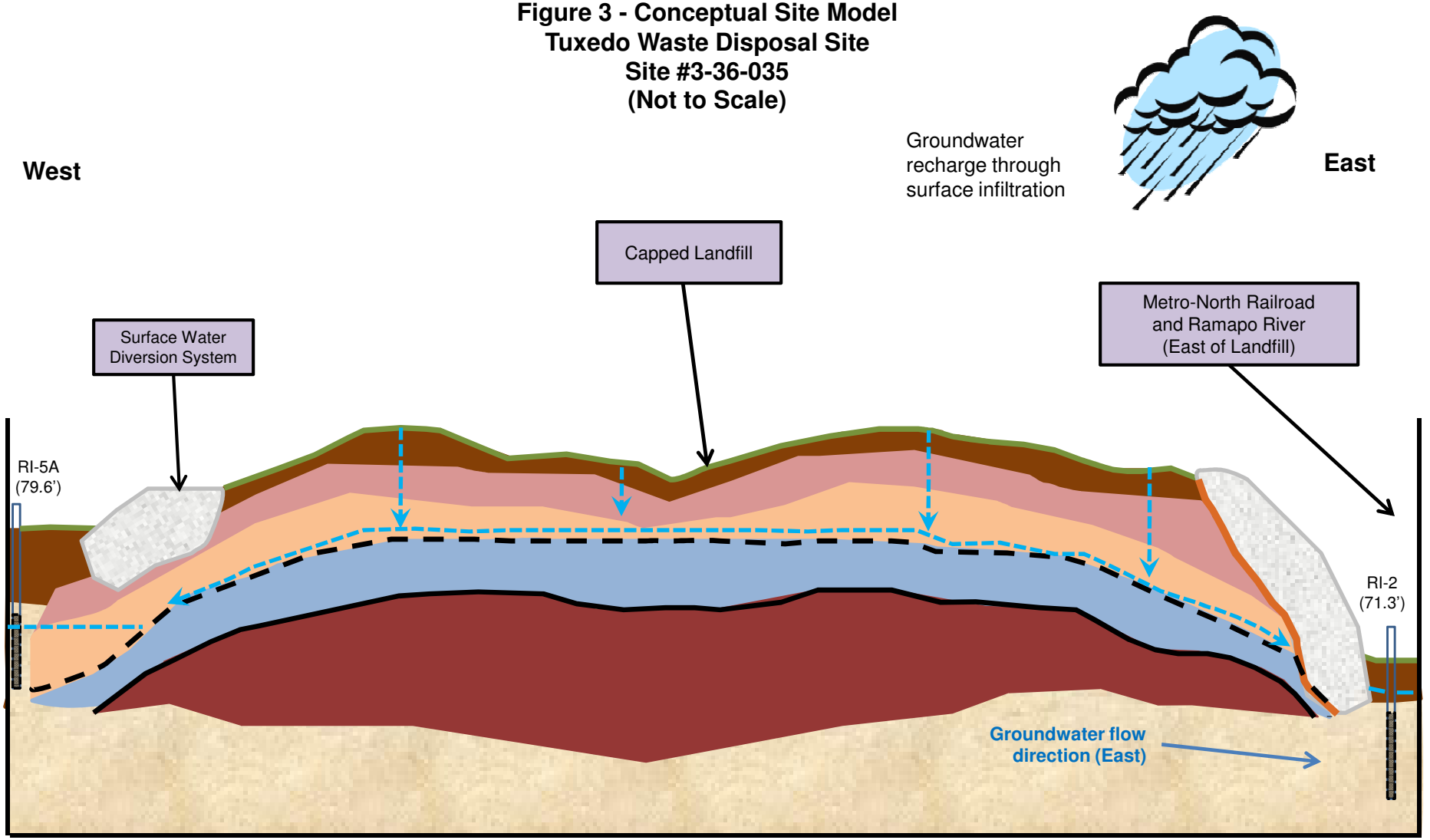
FIGURE 2
SITE PLAN AND MONITORING LOCATIONS

NYSDEC
TUXEDO WASTE DISPOSAL SITE
SITE NUMBER - 3-36-035
TUXEDO, ORANGE COUNTY, NEW YORK

JANUARY 2019 60323116

p:\60323116 - nysdec - tuxedo waste disposal site\500-deliverables\2019 smp update\figures\figure 2 - site plan january 2019.dwg

Figure 3 - Conceptual Site Model
Tuxedo Waste Disposal Site
Site #3-36-035
(Not to Scale)

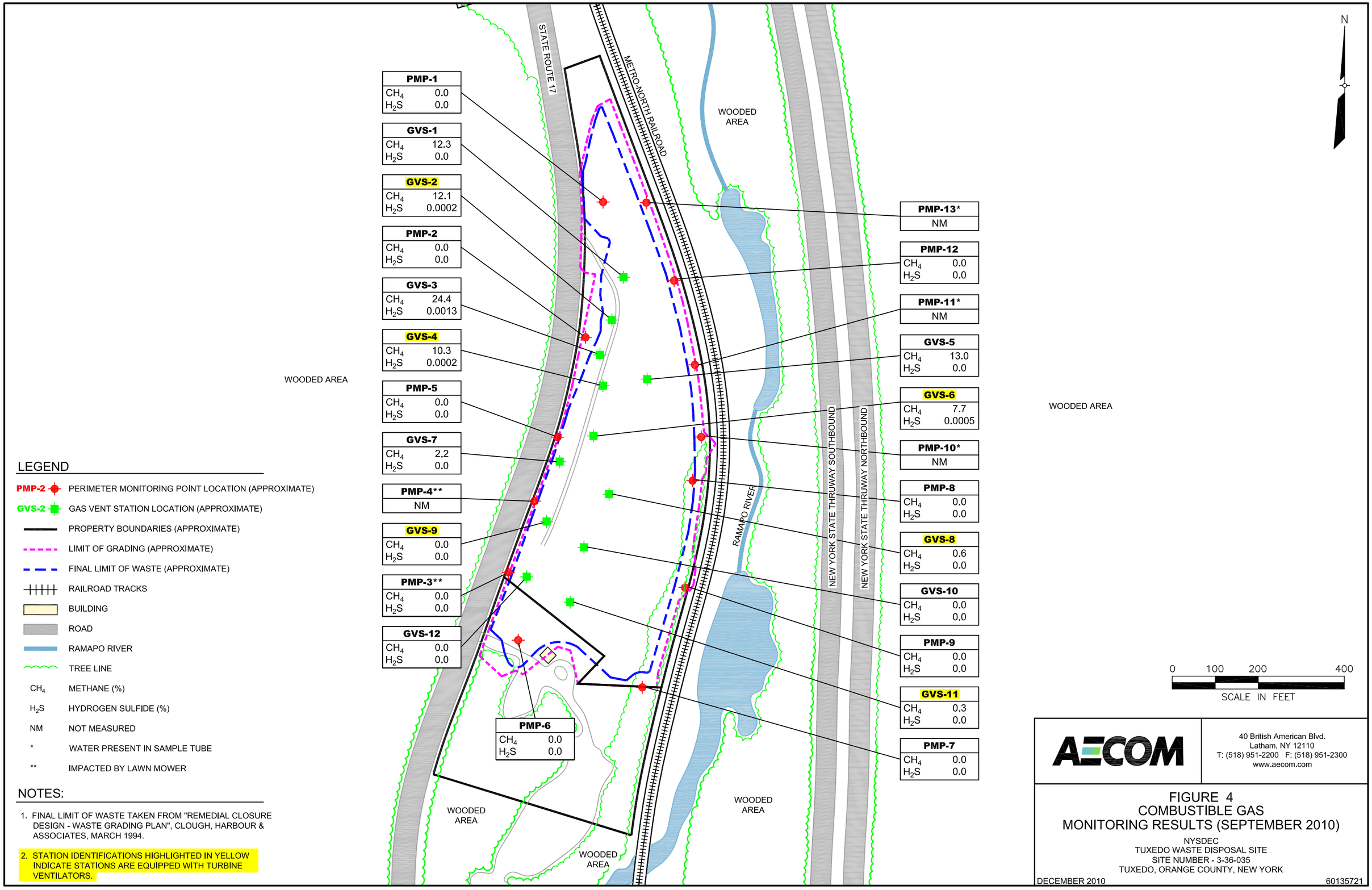


Notes:

1. Developed from information collected during the June 2009 groundwater sampling event and the Remedial Investigation and Feasibility Study (Metcalf & Eddy, December 1991).
2. (79.6') – Indicates original bottom of slotted casing depth (feet below ground surface).

AECOM

- Infiltration and Diversion
- 6" Topsoil/Overburden
- 12" Select Fill
- 12" Barrier Protection Layer
- 12" Gas Vent Layer
- Waste (varies from 3-70 feet in depth)
- Bedrock - Gneiss
- Geonet/Geotextile Composite
- Geotextile
- Non-Woven Geotextile
- Grass



LEGEND

- PMP-2 — PERIMETER MONITORING POINT LOCATION (APPROXIMATE)
- GVS-2 — GAS VENT STATION LOCATION (APPROXIMATE)
- PROPERTY BOUNDARIES (APPROXIMATE)
- LIMIT OF GRADING (APPROXIMATE)
- FINAL LIMIT OF WASTE (APPROXIMATE)
- RAILROAD TRACKS
- BUILDING
- ROAD
- RAMAPO RIVER
- TREE LINE
- CH_4 METHANE (%)
- H_2S HYDROGEN SULFIDE (%)
- NM NOT MEASURED
- * WATER PRESENT IN SAMPLE TUBE
- ** IMPACTED BY LAWN MOWER

NOTES:

1. FINAL LIMIT OF WASTE TAKEN FROM "REMEDIAL CLOSURE DESIGN - WASTE GRADING PLAN", CLOUGH, HARBOUR & ASSOCIATES, MARCH 1994.
2. STATION IDENTIFICATIONS HIGHLIGHTED IN YELLOW INDICATE STATIONS ARE EQUIPPED WITH TURBINE VENTILATORS.

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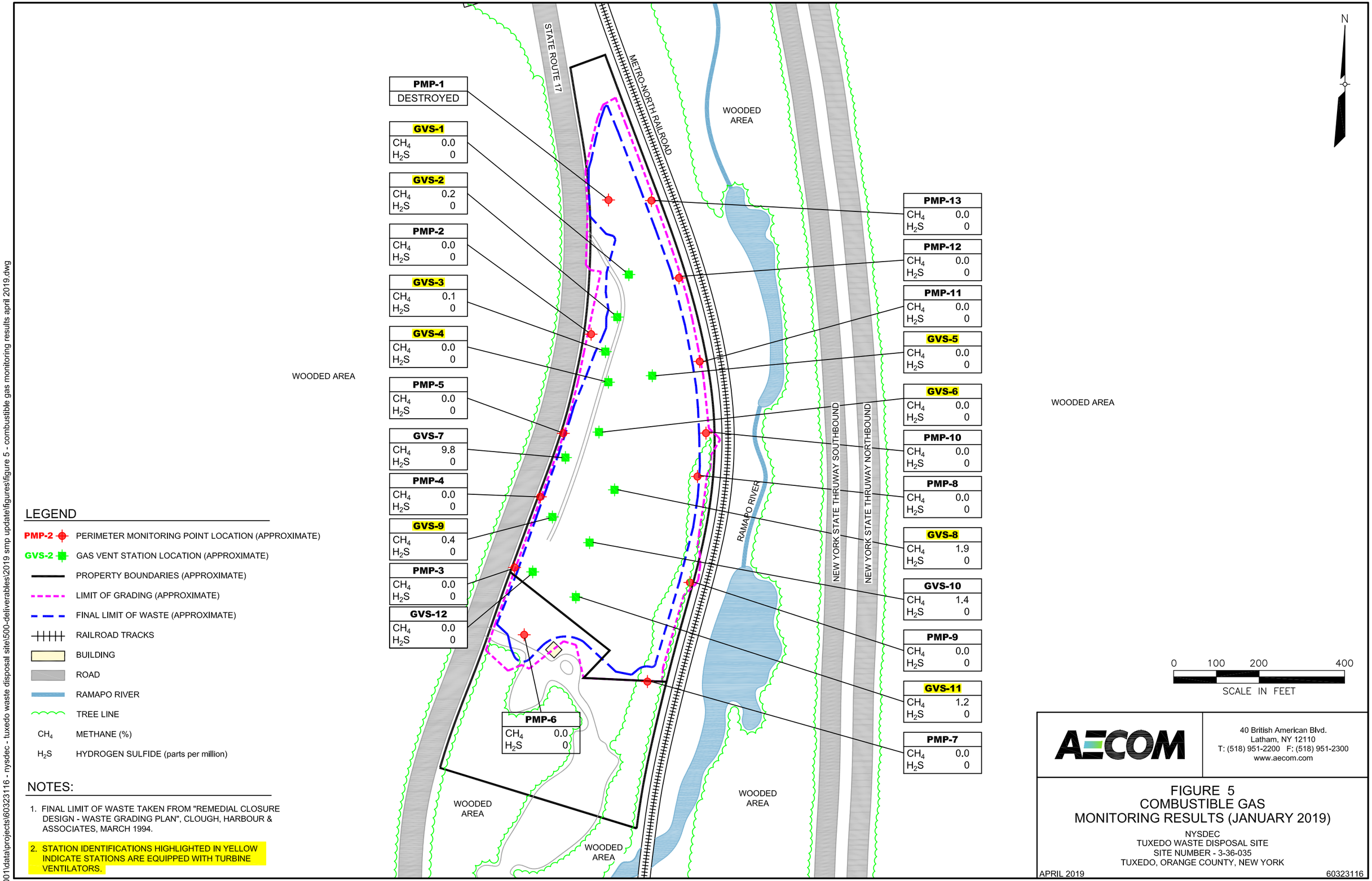
FIGURE 4
COMBUSTIBLE GAS MONITORING RESULTS (SEPTEMBER 2010)

NYSDEC
TUXEDO WASTE DISPOSAL SITE
SITE NUMBER - 3-36-035
TUXEDO, ORANGE COUNTY, NEW YORK

DECEMBER 2010 60135721



LEGEND

- PMP-2 — PERIMETER MONITORING POINT LOCATION (APPROXIMATE)
- GVS-2 — GAS VENT STATION LOCATION (APPROXIMATE)
- PROPERTY BOUNDARIES (APPROXIMATE)
- LIMIT OF GRADING (APPROXIMATE)
- FINAL LIMIT OF WASTE (APPROXIMATE)
- RAILROAD TRACKS
- BUILDING
- ROAD
- RAMAPO RIVER
- TREE LINE
- CH_4 METHANE (%)
- H_2S HYDROGEN SULFIDE (parts per million)

NOTES:

1. FINAL LIMIT OF WASTE TAKEN FROM "REMEDIAL CLOSURE DESIGN - WASTE GRADING PLAN", CLOUGH, HARBOUR & ASSOCIATES, MARCH 1994.
2. STATION IDENTIFICATIONS HIGHLIGHTED IN YELLOW INDICATE STATIONS ARE EQUIPPED WITH TURBINE VENTILATORS.

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FIGURE 5
COMBUSTIBLE GAS MONITORING RESULTS (JANUARY 2019)

NYSDEC
TUXEDO WASTE DISPOSAL SITE
SITE NUMBER - 3-36-035
TUXEDO, ORANGE COUNTY, NEW YORK

APRIL 2019 60323116

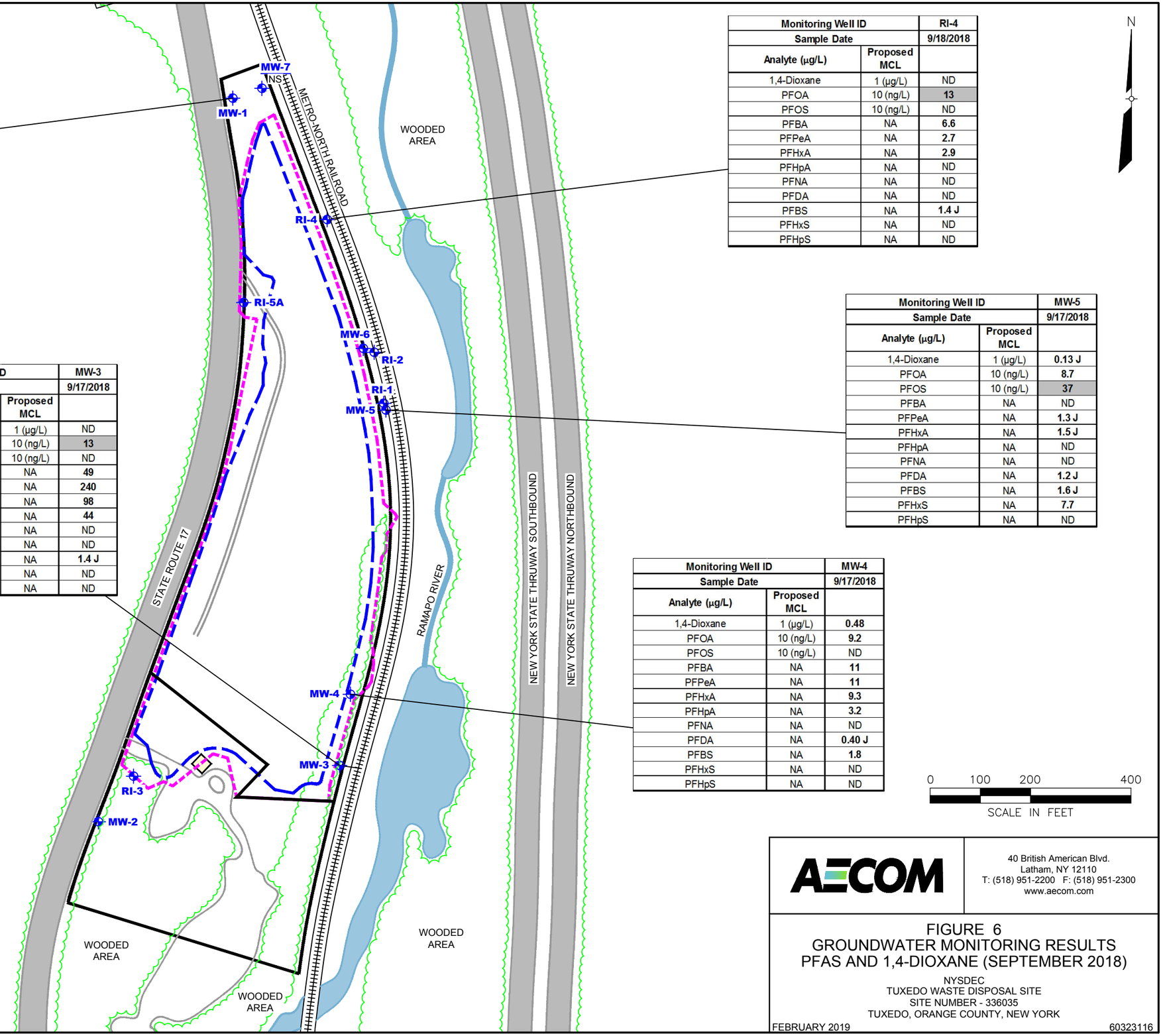
Monitoring Well ID		MW-1
Sample Date		9/18/2018
Analyte	Proposed MCL	
1,4-Dioxane	1 (µg/L)	ND
PFOA	10 (ng/L)	**6.4**
PFOS	10 (ng/L)	ND
PFBA	NA	ND
PFPeA	NA	**1.0 J**
PFHxA	NA	**0.99 J**
PFHpA	NA	ND
PFNA	NA	ND
PFDA	NA	ND
PFBS	NA	**0.20 J**
PFHxS	NA	ND
PFHpS	NA	ND

Monitoring Well ID		RI-4
Sample Date		9/18/2018
Analyte (µg/L)	Proposed MCL	
1,4-Dioxane	1 (µg/L)	ND
PFOA	10 (ng/L)	**13**
PFOS	10 (ng/L)	ND
PFBA	NA	**6.6**
PFPeA	NA	**2.7**
PFHxA	NA	**2.9**
PFHpA	NA	ND
PFNA	NA	ND
PFDA	NA	ND
PFBS	NA	**1.4 J**
PFHxS	NA	ND
PFHpS	NA	ND

Monitoring Well ID		MW-5
Sample Date		9/17/2018
Analyte (µg/L)	Proposed MCL	
1,4-Dioxane	1 (µg/L)	**0.13 J**
PFOA	10 (ng/L)	**8.7**
PFOS	10 (ng/L)	**37**
PFBA	NA	ND
PFPeA	NA	**1.3 J**
PFHxA	NA	**1.5 J**
PFHpA	NA	ND
PFNA	NA	ND
PFDA	NA	**1.2 J**
PFBS	NA	**1.6 J**
PFHxS	NA	**7.7**
PFHpS	NA	ND

Monitoring Well ID		MW-3
Sample Date		9/17/2018
Analyte	Proposed MCL	
1,4-Dioxane	1 (µg/L)	ND
PFOA	10 (ng/L)	**13**
PFOS	10 (ng/L)	ND
PFBA	NA	**49**
PFPeA	NA	**240**
PFHxA	NA	**98**
PFHpA	NA	**44**
PFNA	NA	ND
PFDA	NA	ND
PFBS	NA	**1.4 J**
PFHxS	NA	ND
PFHpS	NA	ND

Monitoring Well ID		MW-4
Sample Date		9/17/2018
Analyte (µg/L)	Proposed MCL	
1,4-Dioxane	1 (µg/L)	**0.48**
PFOA	10 (ng/L)	**9.2**
PFOS	10 (ng/L)	ND
PFBA	NA	**11**
PFPeA	NA	**11**
PFHxA	NA	**9.3**
PFHpA	NA	**3.2**
PFNA	NA	ND
PFDA	NA	**0.40 J**
PFBS	NA	**1.8**
PFHxS	NA	ND
PFHpS	NA	ND



LEGEND

- MW-2 — MONITORING WELL LOCATION
- PROPERTY BOUNDARIES (APPROXIMATE)
- LIMIT OF GRADING (APPROXIMATE)
- FINAL LIMIT OF WASTE (APPROXIMATE)
- RAILROAD TRACKS
- BUILDING
- ROAD
- RAMAPO RIVER
- TREE LINE
- NS — NOT SAMPLED
- ND — NOT DETECTED
- NA — NOT APPLICABLE
- J — ESTIMATED CONCENTRATION
- MCL — NEW YORK STATE DEPARTMENT OF HEALTH PROPOSED MAXIMUM CONTAMINANT LEVEL
- µg/L — MICROGRAMS PER LITER
- ng/L — NANOGRAMS PER LITER

NOTE:

1. FINAL LIMIT OF WASTE TAKEN FROM "REMEDIAL CLOSURE DESIGN - WASTE GRADING PLAN", CLOUGH, HARBOUR & ASSOCIATES, MARCH 1994.
2. **BOLD** RESULTS INDICATE DETECTION ABOVE METHOD DETECTION LIMITS.
3. **BOLD** AND HIGHLIGHTED RESULTS INDICATE AN EXCEEDANCE OF THE PROPOSED MCL.

0 100 200 400

SCALE IN FEET

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FIGURE 6
GROUNDWATER MONITORING RESULTS PFAS AND 1,4-DIOXANE (SEPTEMBER 2018)

NYSDEC
TUXEDO WASTE DISPOSAL SITE
SITE NUMBER - 336035
TUXEDO, ORANGE COUNTY, NEW YORK

FEBRUARY 2019 60323116

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Tables

Table 1
Well Details and
Groundwater Elevations (June 2009)

Tuxedo Waste Disposal Site
Site No. 3-36-035
Tuxedo, Orange County, New York

Well ID	Well Construction	Well Type	Measuring Point Elevation (ft.)	Well Depth (ft. bgs)	Screened Interval (ft. bgs)		June 30, 2009	
					TOS	BOS	Depth to Water (ft. bgs)	GW Elevation (ft.)
MW-1	4" Steel Surface Casing 2" PVC Riser and Screen	Overburden	468.40	NM	17	27	NM	NA
MW-2	4" Steel Surface Casing 2" PVC Riser and Screen	Bedrock	480.06	89.65	25	90	24.58	455.48
MW-3	6" Steel Cutter Casing 3" PVC Riser with no Screen	Bedrock	459.00	30.05	12	29*	13.57	445.43
MW-4	4" Steel Surface Casing 2" PVC Riser and Screen	Overburden	460.07	26.16	14.5	24.5	9.59	450.48
MW-5	4" Steel Surface Casing 2" PVC Riser and Screen	Overburden	448.81	19.40	8	18	8.40	440.41
MW-6	4" Steel Surface Casing 2" PVC Riser and Screen	Overburden	456.83	18.40	7.5	17.5	8.25	448.58
MW-7	4" Steel Surface Casing 2" PVC Riser and Screen	Overburden	466.93	NM	16	26	NM	NA
RI-1	8" Steel Cutter Casing 2" Steel Riser with no Screen	Bedrock	459.48	93.63	73.2	93.5*	11.03	448.45
RI-2	6" Steel Surface Casing 4" Steel Riser and Screen	Interface	458.02	72.60	61.3	71.3	9.05	448.97
RI-3	6" PVC Surface Casing 2" PVC Riser and Screen	Interface	479.79	44.60	17.5	27.5	36.42	443.37
RI-4	4" Steel Surface Casing 2" PVC Riser and Screen	Overburden	463.45	16.65	5	15	13.51	449.94
RI-5A	4" Steel Surface Casing 2" PVC Riser and Screen	Bedrock	495.70	NM	59.3	79.6	NM	NA

Notes:
Measuring Point Elevation is at top of PVC casing
NA - Not Available
NM - Not Measured
bgs - below ground surface
GW - groundwater
TOS - Top of Screen
BOS - Bottom of Screen
* - Boring depth; Open Hole Well

Table 2
Groundwater Analytical Results -
TAL Metals and Mercury
(2000 to 2001)

Tuxedo Waste Disposal Site
Site No. 3-36-035
Tuxedo, Orange County, New York

Monitoring Well ID		MW-1				MW-2				MW-3				MW-4				MW-5			
Sample Date		10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001
Analyte (µg/L)	**AWQS or GV**																				
Aluminum	NA	NS	130B	U	NS	528	300	92B	NS	1,140	210	260	410	489	U	78B	320	3,900	340	160B	170B
Antimony	3	NS	U	U	NS	U	U	U	NS	U	U	U	U	U	U	U	U	U	U	U	U
Arsenic	25	NS	U	U	NS	U	U	U	NS	U	U	U	U	U	U	U	U	9.2B	U	U	U
Barium	1,000	NS	U	U	NS	14.7B	U	U	NS	28.6B	U	U	U	23.7B	U	U	U	104B	U	U	U
Beryllium	3 (GV)	NS	U	U	NS	U	U	U	NS	U	U	U	U	U	U	U	U	0.79B	U	U	U
Cadmium	5	NS	U	U	NS	U	U	U	NS	U	U	U	U	U	U	U	U	U	U	U	U
Calcium	NA	NS	18,000	9,700	NS	24,600	29,000	27,000	NS	41,300	22,000	42,000	41,000	39,500	39,000	43,000	40,000	92,000	110,000	99,000	97,000
Chromium	50	NS	U	U	NS	3.0B	U	U	NS	U	U	U	U	U	U	U	U	7.0B	U	U	U
Cobalt	NA	NS	U	U	NS	4.7B	U	U	NS	U	U	U	U	U	U	U	U	5.5B	U	U	U
Copper	200	NS	U	U	NS	2.5B	U	U	NS	5.2B	U	U	U	6.3B	U	U	U	101	63	U	26
Iron	300	NS	**330**	55B	NS	**757**	**380**	160	NS	**1,740**	180	**410**	**650**	**830**	83B	94B	**570**	**17,400**	**5,900**	**2,700**	**3,700**
Lead	25	NS	U	U	NS	2.3B	U	U	NS	2.6B	U	U	U	2.1B	U	U	U	11.7	5.7	U	U
Magnesium	35,000 (GV)	NS	4,700B	2,400B	NS	5,530	7,000	6,200	NS	9,850	5,400	10,000	9,300	10,700	11,000	11,000	10,000	24,000	16,000	25,000	22,000
Manganese	300	NS	26	U	NS	36.2	34	31	NS	81.3	7.5B	42	36	**324**	71	76	**350**	**3,210**	290	**3,800**	**2,600**
Mercury	0.7	NS	U	U	NS	U	U	U	NS	U	U	U	U	U	U	U	U	0.56	U	U	U
Nickel	100	NS	U	U	NS	U	U	U	NS	2.4B	U	U	U	U	U	U	U	6.7B	U	U	U
Potassium	NA	NS	U	U	NS	1,380BE	U	U	NS	3,570BE	U	U	U	3,530BE	U	U	U	8,470E	7,000	6,000	5,700
Selenium	10	NS	U	U	NS	2.8UW	U	U	NS	2.8UW	U	U	U	2.8UW	U	U	U	2.8UW	U	U	U
Silver	50	NS	U	U	NS	3.0UN	U	U	NS	3.0UN	U	U	U	3.0UN	U	U	U	3.0UN	U	U	U
Sodium	20,000	NS	**40,000**	**29,000**	NS	3,560B	5,000B	3,900B	NS	**25,200**	**39,000**	**32,000**	**34,000**	**22,500**	**39,000**	**30,000**	**28,000**	**22,600**	11,000	**23,000**	**21,000**
Thallium	0.5 (GV)	NS	U	U	NS	U	U	U	NS	U	U	U	U	U	U	U	U	U	U	U	U
Vanadium	NA	NS	U	U	NS	3.1B	U	U	NS	2.3B	U	U	U	U	U	U	U	8.7B	U	U	U
Zinc	2,000 (GV)	NS	U	U	NS	9.7B*	U	U	NS	15.6B*	U	U	U	23.8*	U	U	U	58.8*	10.0B	U	10B

Notes:
All data presented in micrograms per liter (µg/L).
U - Analyte was analyzed for, but not detected.
B - The reported value is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).
E - Indicates an estimated value because of the presence of interference.
W - Post digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.
N - Spiked sample recovery not within control limits.
* - Duplicate analysis not within control limits.
AWQS - New York State Ambient Water Quality Standards (TOGs 1.1.1); GV - guidance value.
NA - No standard or guidance value exists for the analyte.
NS - Not sampled
BOLD font in shaded cell - indicates exceedance of AWQS or GV.

Table 2
Groundwater Analytical Results -
TAL Metals and Mercury
(2000 to 2001)

Tuxedo Waste Disposal Site
Site No. 3-36-035
Tuxedo, Orange County, New York

Monitoring Well ID		MW-6				RI-1				RI-2				RI-4			
Sample Date		10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001	10/26/2000	5/1/2001	8/2/2001	10/30/2001
Analyte (µg/L)	AWQS or GV																
Aluminum	NA	725	U	U	U	718	140B	100B	100B	96.3B	U	U	82B	5,960	3,600	90B	320
Antimony	3	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Arsenic	25	11.7	U	U	U	U	U	U	U	U	U	U	U	3.8B	U	U	U
Barium	1,000	47.7B	U	U	U	10.6B	U	U	U	11.2B	U	U	U	101B	U	U	U
Beryllium	3 (GV)	0.21B	U	U	U	U	U	U	U	U	U	U	U	0.24B	U	U	U
Cadmium	5	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Calcium	NA	92,700	110,000	98,000	120,000	50,800	74,000	57,000	54,000	19,700	43,000	32,000	30,000	90,400	64,000	95,000	120,000
Chromium	50	1.2B	U	U	U	3.4B	U	U	U	**130**	11	U	**64**	8.3B	U	U	U
Cobalt	NA	U	U	U	U	U	U	U	U	U	U	U	U	16.3B	U	U	U
Copper	200	30.3	U	U	U	13.4B	U	U	U	4.1B	U	U	U	37.4	90	U	U
Iron	300	**15,300**	**8,900**	**5,900**	**5,600**	**752**	190	70B	90B	**804**	260	110	**870**	**11,600**	**12,000**	240	**1,200**
Lead	25	5	U	U	U	U	U	U	U	U	U	U	U	10	12	U	U
Magnesium	35,000 (GV)	12,800	17,000	15,000	16,000	7,160	11,000	8,800	7,900	6,010	13,000	9,700	8,800	11,600	8,600	11,000	13,000
Manganese	300	**2,050**	**1,600**	**1,900**	**2,300**	7.9B	8.0B	U	U	79.4	64	43	87	**1,500**	**1,200**	**390**	**350**
Mercury	0.7	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Nickel	100	U	U	U	U	6.2B	U	U	U	41	U	U	U	24.5B	U	U	U
Potassium	NA	3,770BE	U	U	U	2,860BE	U	U	U	1,390BE	U	U	U	28,500E	18,000	19,000	23,000
Selenium	10	2.8UW	U	U	U	2.8UW	U	U	U	2.8UW	U	U	U	2.8UW	U	U	U
Silver	50	3.0BN	U	U	U	3.0UN	U	U	U	3.0UN	U	U	U	3.0UN	U	U	U
Sodium	20,000	3,840	7,000	4,100B	6,500	18,500	**28,000**	19,000	19,000	**25,400**	**56,000**	**44,000**	**43,000**	16,400	17,000	18,000	**21,000**
Thallium	0.5 (GV)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Vanadium	NA	2.1B	U	U	U	U	U	U	U	U	U	U	U	10.4B	U	U	U
Zinc	2,000 (GV)	25.5*	U	U	U	22*	U	U	U	30.7*	U	U	14B	67.3*	85	U	U

Notes:
All data presented in micrograms per liter (µg/L).
U - Analyte was analyzed for, but not detected.
B - The reported value is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).
E - Indicates an estimated value because of the presence of interference.
W - Post digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.
N - Spiked sample recovery not within control limits.
* - Duplicate analysis not within control limits.
AWQS - New York State Ambient Water Quality Standards (TOGs 1.1.1); GV - guidance value.
NA - No standard or guidance value exists for the analyte.
NS - Not sampled
BOLD font in shaded cell - indicates exceedance of AWQS or GV.

Table 3
Groundwater Analytical Results - PFAS and 1,4-Dioxane
(September 2018)

Tuxedo Waste Disposal Site
Site No. 336035
Tuxedo, Orange County, New York

Analyte	NYSDOH Proposed MCL[1]	Monitoring Well/Sample ID								
		MW-1	DUP-1 (MW-1)	MW-3	MW-4	MW-5	RI-4	Field Blank	Equipment Blank	Field Blank
		9/18/2018	9/18/2018	9/17/2018	9/17/2018	9/17/2018	9/18/2018	9/17/2018	9/17/2018	9/18/2018
Semivolatile Organic Compounds (µg/L)										
1,4-Dioxane	1	ND	ND	ND	**0.48**	**0.13 J**	ND	--	--	--
Fluorinated Alkyl Substances (ng/L)										
Perfluorooctanoic acid (PFOA)	10	**6.4**	**6.6**	**13**	**9.2**	**8.7**	**13**	ND	ND	ND
Perfluorooctanesulfonic acid (PFOS)	10	ND	ND	ND	ND	**37**	ND	ND	ND	ND
Perfluorobutanoic acid (PFBA)	--	ND	ND	**49**	**11**	ND	**6.6**	ND	ND	ND
Perfluoropentanoic acid (PFPeA)	--	**1.0 J**	**0.98 J**	**240**	**11**	**1.3 J**	**2.7**	ND	ND	ND
Perfluorohexanoic acid (PFHxA)	--	**0.99 J**	**0.93 J**	**98**	**9.3**	**1.5 J**	**2.9**	ND	ND	ND
Perfluoroheptanoic acid (PFHpA)	--	ND	ND	**44**	**3.2**	ND	ND	ND	ND	ND
Perfluorononanoic acid (PFNA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorodecanoic acid (PFDA)	--	ND	ND	ND	**0.40 J**	**1.2 J**	ND	ND	ND	ND
Perfluoroundecanoic acid (PFUnA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorododecanoic acid (PFDoA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorotridecanoic acid (PFTriA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorotetradecanoic acid (PFTeA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorobutanesulfonic acid (PFBS)	--	**0.20 J**	ND	**1.4 J**	**1.8**	**1.6 J**	**1.4 J**	ND	ND	ND
Perfluorohexanesulfonic acid (PFHxS)	--	ND	ND	ND	ND	**7.7**	ND	ND	ND	ND
Perfluoroheptanesulfonic acid (PFHpS)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorodecanesulfonic acid (PFDS)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorooctane sulfonamide (FOSA)	--	ND	**1.4 J**	ND	ND	ND	ND	ND	ND	ND
N-Methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	--	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
[1] New York State Department of Health (NYSDOH) Proposed Maximum Contaminant Level (MCL)
ND - Not detected at the reporting limit (RL).
Detected concentrations are in bold font.
J - Result is less than the RL but greater than or equal to the Method Detection Limit (MDL) and the concentration is an approximate value.
B - Compound was found in the laboratory method blank and sample.
µg/L - micrograms per liter
ng/L - nanograms per liter
Results greater than the NYSDOH Proposed MCL are shaded in gray

Appendix A

IC/EC Certification, Deeds, and Environmental Easement

Enclosure 1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Site Management Periodic Review Report Notice
Institutional and Engineering Controls Certification Form

Site Details **Box 1**

Site No. 336035

Site Name Tuxedo Waste Disposal Site

Site Address: Route 17 Zip Code: 10987
City/Town: Tuxedo
County: Orange
Allowable Use(s) (if applicable, does not address local zoning):
Site Acreage: 12.0
Owner: ~~GEORGIA TECH~~
~~, 225 North Ave Atlanta Georgia, ZZ 30332~~

Reporting Period: December 01, 1996 to November 16, 2006

Owners on Record:
1) *** MULTIPLE SITE OWNERS ***
Acoma Road, P.O. Box 515
Tuxedo Park, NY 10987
2) Georgia Tech. Foundation c/o
King & Spaulding, 2500 Trust Co. Tower
Atlanta, GA 30303
3) Mr. Sarkis Khourouzian
7 Ann Place, Sloatsburg, NY 10974
4) Renard Barone
PO Box 656, Tuxedo Park, NY 10987
5) *** MULTIPLE SITE OWNERS ***
425 Park Ave., New York, NY 10022-1906

Box 2

Verification of Site Details

	YES	NO
1. Is the information in Box 1 correct?	☐	☒
If NO, are changes handwritten above or included on a separate sheet?	☒	
2. Has some or all of the site property been sold, subdivided, merged, or undergone a tax map amendment during this Reporting Period?	☐	☒ Property Deeds Attached
If YES, is documentation or evidence that documentation has been previously submitted included with this certification?	☐	
3. Have any federal, state, and/or local permits (e.g., building, discharge) been issued for or at the property during this Reporting Period?	☐	☒
If YES, is documentation (or evidence that documentation has been previously submitted) included with this certification?	☐	
4. If use of the site is restricted, is the current use of the site consistent with those restrictions?	☒	☐
If NO, is an explanation included with this certification?	☐	
5. For non-significant-threat Brownfield Cleanup Program Sites subject to ECL 27-1415.7(c), has any new information revealed that assumptions made in the Qualitative Exposure Assessment regarding offsite contamination are no longer valid?	☐	☐ N/A
If YES, is the new information or evidence that new information has been previously submitted included with this Certification?	☐	
6. For non-significant-threat Brownfield Cleanup Program Sites subject to ECL 27-1415.7(c), are the assumptions in the Qualitative Exposure Assessment still valid (must be certified every five years)?	☐	☐ N/A
If NO, are changes in the assessment included with this certification?	☐	

SITE NO. 336035 **Box 3**

Description of Institutional Controls

Parcel	Institutional Control
S_B_L Image: **9-1-13**	Landuse Restriction

Box 4

Description of Engineering Controls

Parcel	Engineering Control
S_B_L Image: **9-1-13**	Cover System

Attach documentation if IC/ECs cannot be certified or why IC/ECs are no longer applicable. (See instructions)

Control Description for Site No. 336035

Parcel: 9-1-13

Notes:
1) Parcel 9-1-13 is currently owned by R. Iazzetti, while Parcel 9-1-11 is owned by R. Barone and S. Khourouzian (refer to the attached deeds). Neither property deed indicates the existence of any land use restrictions. However, the cover system over the landfill limits access to contaminated materials, and chain link fencing along the Route 17 (western) side of the Site makes unauthorized access by vehicle somewhat difficult.
2) As shown on Figure 2 ("Site Plan and Monitoring Locations"), the Landfill Cover System appears to be present over portions of both properties.

Box 5

Periodic Review Report (PRR) Certification Statements

1. I certify by checking "YES" below that:

   a) the Periodic Review report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

   b) to the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and the information presented is accurate and compete.

YES	NO
☒	☐

2. If this site has an IC/EC Plan (or equivalent as required in the Decision Document), for each Institutional or Engineering control listed in Boxes 3 and/or 4, I certify by checking "YES" below that all of the following statements are true:

   (a) the Institutional Control and/or Engineering Control(s) employed at this site is unchanged since the date that the Control was put in-place, or was last approved by the Department;

   (b) nothing has occurred that would impair the ability of such Control, to protect public health and the environment;

   (c) access to the site will continue to be provided to the Department, to evaluate the remedy, including access to evaluate the continued maintenance of this Control;

   (d) nothing has occurred that would constitute a violation or failure to comply with the Site Management Plan for this Control; and

   (e) if a financial assurance mechanism is required by the oversight document for the site, the mechanism remains valid and sufficient for its intended purpose established in the document.

YES	NO
☐	☐

3. If this site has an Operation and Maintenance (O&M) Plan (or equivalent as required in the Decision Document);

   I certify by checking "YES" below that the O&M Plan Requirements (or equivalent as required in the Decision Document) are being met.

YES	NO
☐	☐

4. If this site has a Monitoring Plan (or equivalent as required in the remedy selection document);

   I certify by checking "YES" below that the requirements of the Monitoring Plan (or equivalent as required in the Decision Document) is being met.

YES	NO
☐	☐

IC CERTIFICATIONS
SITE NO. 336035

Box 6

SITE OWNER OR DESIGNATED REPRESENTATIVE SIGNATURE

I certify that all information and statements in Boxes 2 and/or 3 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I _____ at _____,
print name print business address

am certifying as _____(Owner or Remedial Party)

for the Site named in the Site Details Section of this form.

_____ _____
Signature of Owner or Remedial Party Rendering Certification Date

IC/EC CERTIFICATIONS

Box 7

QUALIFIED ENVIRONMENTAL PROFESSIONAL (QEP) SIGNATURE

I certify that all information in Boxes 4 and 5 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I Carsten H. Floess at 40 British American Blvd., Latham, NY 12110,
print name print business address

am certifying as a Qualified Environmental Professional for the New York State Department of Environmental Conservation

(Owner or Remedial Party) for the Site named in the Site Details Section of this form.

_____ _____ _____
Signature of Qualified Environmental Professional, for the Owner or Remedial Party, Rendering Certification Stamp (if Required) Date

ORANGE COUNTY CLERK'S OFFICE RECORDING PAGE
THIS PAGE IS PART OF THE INSTRUMENT – DO NOT REMOVE

TYPE NAME(S) OF PARTY(S) TO DOCUMENT: BLACK INK

GEORGIA TECH FOUNDATION, INC
TO
RONALD IAZZETTI

SECTION 9 BLOCK 1 LOT 18

RECORD AND RETURN TO:
(Name and Address)

H.V. ABSTRACT CORP.
43 MAPLE AVENUE
NEW CITY, N.Y. 10956
914-634-8794/5

THERE IS NO FEE FOR THE RECORDING OF THIS PAGE

ATTACH THIS SHEET TO THE FIRST PAGE OF EACH

RECORDED INSTRUMENT ONLY

DO NOT WRITE BELOW THIS LINE

INSTRUMENT TYPE: DEED ✓ MORTGAGE ____ SATISFACTION ____ ASSIGNMENT ____ OTHER ____

PROPERTY LOCATION

___ 2089 BLOOMING GROVE (TN)
___ 2001 WASHINGTONVILLE (VLG)
___ 2289 CHESTER (TN)
___ 2201 CHESTER (VLG)
___ 2489 CORNWALL (TN)
___ 2401 CORNWALL (VLG)
___ 2800 CRAWFORD (TN)
___ 2800 DEERPARK (TN)
___ 3089 GOSHEN (TN)
___ 3001 GOSHEN (VLG)
___ 3003 FLORIDA (VLG)
___ 3005 CHESTER (VLG)
___ 3200 GREENVILLE (TN)
___ 3489 HAMPTONBURGH (TN)
___ 3401 MAYBROOK (VLG)
___ 3689 HIGHLANDS (TN)
___ 3601 HIGHLAND FALLS (VLG)
___ 3889 MINISINK (TN)
___ 3801 UNIONVILLE (VLG)
___ 4089 MONROE (TN)
___ 4001 MONROE (VLG)
___ 4003 HARRIMAN (VLG)
___ 4005 KIRYAS JOEL (VLG)
___ 4289 MONTGOMERY (TN)
___ 4201 MAYBROOK (VLG)
___ 4203 MONTGOMERY (VLG)
___ 4205 WALDEN (VLG)
___ 4489 MOUNT HOPE (TN)
___ 4401 OTISVILLE (VLG)
___ 4600 NEWBURGH (TN)
___ 4800 NEW WINDSOR (TN)
X 5089 TUXEDO (TN)
___ 5001 TUXEDO PARK (VLG)
___ 5200 WALLKILL (TN)
___ 5489 WARWICK (TN)
___ 5401 FLORIDA (VLG)
___ 5403 GREENWOOD LAKE (VLG)
___ 5405 WARWICK (VLG)
___ 5600 WAWAYANDA (TN)
___ 5889 WOODBURY (TN)
___ 5801 HARRIMAN (VLG)

CITIES

___ 0900 MIDDLETOWN
___ 1100 NEWBURGH
___ 1300 PORT JERVIS
___ 9999 HOLD

NO. PAGES 3 CROSS REF ____
CERT. COPY ____ AFFT. FILED ____

PAYMENT TYPE: CHECK ✓
CASH ____
CHARGE ____
NO FEE ____

CONSIDERATION $ 40,000.—
TAX EXEMPT ____

MORTGAGE AMT $ ____
DATE ____

MORTGAGE TYPE:
___ (A) COMMERCIAL
___ (B) 1 OR 2 FAMILY
___ (C) UNDER $10,000.
___ (E) EXEMPT
___ (F) 3 TO 6 UNITS
___ (I) NAT.PERSON/CR.UNION
___ (J) NAT.PER-CR.UN/I OR 2
___ (K) CONDO

Joan A. Macchi
JOAN A. MACCHI
Orange County Clerk

RECEIVED FROM: H.V. Abst

LIBER 4164 PAGE 234

STATE OF NEW YORK (COUNTY OF ORANGE) SS:
I, DONNA L. BENSON, COUNTY CLERK AND CLERK OF THE SUPREME AND COUNTY COURTS, ORANGE COUNTY, DO HEREBY CERTIFY THAT I HAVE COMPARED THE ORIGINAL THEREOF FILED OR RECORDED ON 1/6/95 AND THE SAME IS A CORRECT TRANSCRIPT THEREOF. IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND AFFIXED MY OFFICIAL SEAL.

Donna L. Benson
COUNTY CLERK & CLERK OF THE SUPREME COUNTY COURTS, ORANGE COUNTY DECEMBER 3, 2010

RECEIVED
DEC 06 2010
AECOM - Albany, NY

ORANGE COUNTY CLERKS OFFICE 956 MLV
RECORDED/FILED 01/06/95 02:52:34 PM

FEES 44.00 EDUCATION FUND 5.00
SERIAL NUMBER: 004381
DEED CNTL NO 50622 RE TAX 160.00

Standard N.Y.B.T.U. Form 8002 Bargain and Sale Deed, with Covenant against Grantor's Acts—Individual or Corporation (Single Sheet) Tuo-191

CONSULT YOUR LAWYER BEFORE SIGNING THIS INSTRUMENT—THIS INSTRUMENT SHOULD BE USED BY LAWYERS ONLY.

T1
1600

THIS INDENTURE, made the 29 th day of December , nineteen hundred and ninety-four

BETWEEN GEORGIA TECH FOUNDATION, INC., a corporation organized under the laws of the State of Georgia with organization office and a post office address at Atlanta, Georgia 30332, located at 225 North Avenue

party of the first part, and

RONALD IAZZETTI, residing at
(no number) Acoma Road
P.O. Box 515
Tuxedo Park, New York 10987

party of the second part,

WITNESSETH, that the party of the first part, in consideration of FORTY THOUSAND ($40,000.00) dollars and other valuable consideration paid by the party of the second part, does hereby grant and release unto the party of the second part, the heirs or successors and assigns of the party of the second part forever,

ALL that certain plot, piece or parcel of land, with the building and improvements thereon erected, situate, lying and being in the

SEE SCHEDULE A ATTACHED HERETO AND MADE A PART HEREOF.

This conveyance is made pursuant to a Resolution of the Board of Trustees of Georgia Tech Foundation, Inc. duly adopted on December 20, 1994.

BEING AND INTENDED TO BE the same premises conveyed to the party of the first part herein by deed dated December 12, 1977, made by HAZARD E. REEVES and recorded in the Orange County Clerk's Office on December 23, 1977, in Liber 2088, Page 70.

TOGETHER with all right, title and interest, if any, of the party of the first part in and to any streets and roads abutting the above described premises to the center lines thereof; TOGETHER with the appurtenances and all the estate and rights of the party of the first part in and to said premises; TO HAVE AND TO HOLD the premises herein granted unto the party of the second part, the heirs or successors and assigns of the party of the second part forever.

AND the party of the first part covenants that the paty of the first part has not done or suffered anything whereby the said premises have been encumbered in any way whatever, except as aforesaid.
AND the party of the first part, in compliance with Section 13 of the Lien Law, covenants that the party of the first part will receive the consideration for this conveyance and will hold the right to receive such consideration as a trust fund to be applied first for the purpose of paying the cost of the improvement and will apply the same first to the payment of the cost of the improvement before using any part of the total of the same for any other purpose.
The word "party" shall be construed as if it read "parties" whenever the sense of this indenture so requires.

IN WITNESS WHEREOF, the party of the first part has duly executed this deed the day and year first above written.

IN PRESENCE OF:

GEORGIA TECH FOUNDATION, INC.

By: VICE PRESIDENT

LIBER 4164 PAGE 235

STATE OF NEW YORK, COUNTY OF ss:

On the day of 19 , before me personally came

to me known to be the individual described in and who executed the foregoing instrument, and acknowledged that executed the same.

GEORGIA
STATE OF NEW YORK, COUNTY OF Fulton ss:

On the 29 day of December 19 94, before me personally came James M. Langley to me known, who, being by me duly sworn, did depose and say that he resides at No. 2347 Walton Place, Atlanta, Georgia, that he is the Vice President of GEORGIA TECH FOUNDATION, INC., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the board of directors of said corporation, and that he signed his name thereto by like order.

(Notary Public)
Notary Public, Fulton County, Georgia
My Commission Expires August 3, 1997

STATE OF NEW YORK, COUNTY OF

On the day of 19 , before me personally came

to me known to be the individual described in and who executed the foregoing instrument, and acknowledged that executed the same.

GEORGIA
STATE OF NEW YORK, COUNTY OF Fulton ss:

On the 27 day of December, 19 94, before me personally came James Patrick J. McKenna the subscribing witness to the foregoing instrument, with whom I am personally acquainted, who, being by me duly sworn, did depose and say that he resides at No. 845 Hindhead Lane, Tucker, Georgia that he knows James M. Langley to be the individual described in and who executed the foregoing instrument; that he, said subscribing witness, was present and saw him execute the same; and that he, said witness, at the same time subscribed his name as witness thereto.

(Notary Public)
Notary Public, Fulton County, Georgia
My Commission Expires August 3, 1997

Bargain and Sale Deed

WITH COVENANT AGAINST GRANTOR'S ACTS

TITLE NO. Tux-191

GEORGIA TECH FOUNDATION, INC.

TO

RONALD IAZZETTI

SECTION 9
BLOCK 1
LOT 13
COUNTY OR TOWN Town of Tuxedo

STANDARD FORM OF NEW YORK BOARD OF TITLE UNDERWRITERS
Distributed by
SECURITY TITLE AND GUARANTY COMPANY
CHARTERED 1928 IN NEW YORK

RETURN BY MAIL TO:

J. RICHARD VINGIELLO, ESQ.
Samsondale Professional Bldg.
West Haverstraw, N.Y. 10993
Zip No.

H.V. ABSTRACT CORP.
43 MAPLE AVENUE
NEW CITY, N.Y. 10956
914-634-8794/5

RESERVE THIS SPACE FOR USE OF RECORDING OFFICE

LIBER 4164 PAGE 236

Title No. TUX-191

SCHEDULE A

Policy No.

ALL that piece, parcel or plot of land, situate, lying and being in the Town of Tuxedo, County of Orange and State of New York, bounded and described as follows:

BEGINNING at a point being located at the northwesterly corner of Lot Number 535, as shown on a Map entitled "Map of Property of The Tuxedo Park Association, Inc.", dated August, 1947, and filed in the Orange County Clerk's Office as Map Number 2320 on February 15, 1968, and going thence, along the easterly Right of Way of New York State Route 17 on the following six (6) courses and distances:

(1) North 14° 17' 53" East, a distance of 224.37 feet to a point;

(2) North 25° 54' 35" East, a distance of 234.58 feet to a point;

(3) North 32° 49' 20" East, a distance of 137.45 feet to a point;

(4) North 40° 38' 20" East, a distance of 83.68 feet to a point;

(5) North 32° 51' 55" East, a distance of 105.96 feet to a point;

(6) North 25° 23' 25" East, a distance of 87.86 feet to a point; and thence, along lands now or formerly of Anthony Cucolo, Sr., on the following three (3) courses and distances:

(1) South 43° 54' 08" East, a distance of 299.04 feet to a point;

(2) South 59° 22' 10" West, a distance of 93.64 feet to a point;

(3) South 75° 39' 18" East, a distance of 250 feet more or less to a point; thence,

along the westerly right of way line of the Erie-Lackawanna Railroad Company on a curve to the south and east having a radius of 2914.43 feet and a length of 406.15 feet to a point, and going thence along lands of The Tuxedo Park Association, Inc., being on the westerly bank of the Ramapo River South 38° 32' 58" West, a distance of 240 feet more or less to a point located at the northeasterly corner of Lot Number 535, as shown on the aforesaid Map Number 2320, and going thence along the northerly line of Lot Number 535 North 75° 42' 07" West, a distance of 440 feet back to the point or place of BEGINNING.

LIBER 4164 PAGE 237

Standard N.Y.B.T.U. Form 8006-8-71 — Warranty Deed With Full Covenants — Individual or Corporation.

C55061

THIS INDENTURE, made the 7th day of October , nineteen hundred and eighty-five

BETWEEN THRUWAY ASPHALT CO., a co-partnership consisting of Frank D. Cooney, Jr., John T. Cooney and Edward Petrillo, both residing at 45 Main ST, Tarrytown, NY 10591

party of the first part, and

Renard A. Barone
Route 17 P.O. 656
Tuxedo, New York 10987

and Sarkis Khourouzian
7 Ann Place
Sloatsburg, New York

party of the second part,

WITNESSETH, that the party of the first part, in consideration of Fifty-Five Thousand ($55,000.00)---------- dollars, lawful money of the United States, paid by the party of the second part, does hereby grant and release unto the party of the second part, the heirs or successors and assigns of the party of the second part forever,

ALL that certain plot, piece or parcel of land, with the buildings ~~and improvements~~ thereon erected, situate, lying and being in the Town of Tuxedo, County of Orange, State of New York, lying on the easterly side of New York State Route 17 and being more particularly bounded and described as follows: BEGINNING at the northeasterly corner of a 1.375 acre parcel of land conveyed to PAUL BARTIE by the Tuxedo Park Association; Thence along the northeasterly line of said parcel and beyond, North 43 degrees 54' 08" West 260.67 feet to the easterly line of New York Route 17; Thence along the southeasterly line of New York State Route 17 on the following seven courses and distances: (1) North 31 degrees 01' 40" East 203.53 feet; (2) North 38 degrees 32' 10" East 193.33 feet; (3) North 18 degrees 07' 30" East 234.03 feet; (4) North 17 degrees 26' 40" East 75.98 feet; (5) North 15 degrees, 42' 30" East 232.41 feet; (6) North 13 degrees 14' 20" East 268.25 feet; (7) North 10 degrees 22' 10" West 175.00 feet; thence along lands to be retained by Tuxedo Park Association, North 83 degrees 11' 10" East 91.20 feet to the westerly line of the Erie Railroad Company; thence along the westerly line of the Erie Railroad Company on the following ten courses and distances: (1) South 10 degrees 12' 30" East 449.97 feet to a point of tangency; (2) On a curve to the right having a radius of 1383.00 feet for a distance of about 100.00 feet, the chord of said curve bears South 9 degrees 56' 20" East 100.00 feet; (3) A curve to the right having a radius of 1383.00 feet for a distance of about 97 feet, the chord of said curve bears South 6 degrees 47' 00" East 97.21 feet; (4) A curve to the right having a radius of 1383.00 feet for a distance of about 100 feet, the chord of said curve bears South 0 degrees 45' 30" West 100.45 feet; (5) A curve to the right having a radius of 1383.00 feet for a distance of about 171 feet, the chord of said curve bears South 0 degrees 36' 20" East 170.65 feet; (6) A curve to the right having a radius of 1383.00 feet for a distance of about 133 feet, the chord of said curve bears South 8 degrees 38' 20" West 133.15 feet; (7) A curve to the right having a radius of 1383.00 feet for a distance of about 153 feet, the chord of said curve bears South 14 degrees 27' 50" West 152.78 feet; (8) A curve to the right having a radius of 1383.00 feet for a distance of about 89 feet, the chord of said curve bears South 20 degrees 59' 10" West 88.51 feet; (9) A curve to the right having a radius of 1383.00 feet for a distance of about 138 feet, the chord of said curve bears South 24 degrees 14' 00" West 138.06 to a point of tangency; (10) South 25 degrees 43' 50" West 243.14 feet; thence along lands to be retained by Tuxedo Park Association North 76 degrees 31' 10" West 237.01 feet; thence North 30 degrees 37' 50" West 50.00 to the southeasterly line of lands now or formerly of Paul Bartie, thence along the southeasterly line of lands now or formerly of Paul Bartie, North 59 degrees 22' 10" East 81.85 feet to the point and place of beginning.

LIBER 2436 PG 77

TOGETHER with all right, title and interest, if any, of the party of the first part of, in and to any streets and roads abutting the above-described premises to the center lines thereof,

TOGETHER with the appurtenances and all the estate and rights of the party of the first part in and to said premises,

TO HAVE AND TO HOLD the premises herein granted unto the party of the second part, the heirs or successors and assigns of the party of the second part forever.

~~**AND** the party of the first part, in compliance with Section 13 of the Lien Law, covenants that the party of~~ the first part will receive the consideration for this conveyance and will hold the right to receive such consideration as a trust fund to be applied first for the purpose of paying the costs of the improvement and will apply the same first to the payment of the cost of the improvement before using any part of the total of the same for any other purpose.

AND the party of the first part covenants as follows:

FIRST.—That said party of the first part is seized of the said premises in fee simple, and has good right to convey the same;

SECOND.—That the party of the second part shall quietly enjoy the said premises;

THIRD.—That the said premises are free from incumbrances, except as aforesaid;

FOURTH.—That the party of the first part will execute or procure any further necessary assurance of the title to said premises;

FIFTH.—That said party of the first part will forever warrant the title to said premises.

~~The word "party" shall be construed as if it read "parties" whenever the sense of this indenture so requires.~~

IN WITNESS WHEREOF, the party of the first part has duly executed this deed the day and year first above written.

IN PRESENCE OF:

Thruway Asphalt, Co.

By Stanley W Cooley Jr

LIBER 2436 PG 78

RESERVE THIS SPACE FOR USE OF RECORDING OFFICE

RECEIVED
$ 220.00
REAL ESTATE
NOV 7 1985
TRANSFER TAX
ORANGE COUNTY

Orange County Clerk's Office, ss.
Recorded on the 7th
of Nov. 85 9:21
o'clock A.M. 24.36
and Examined.
Marion S. Murphy

STATE OF NEW YORK (COUNTY OF ORANGE) SS:
I, DONNA L. BENSON, COUNTY CLERK AND CLERK OF THE SUPREME AND COUNTY COURTS, ORANGE COUNTY, DO HEREBY CERTIFY THAT I HAVE COMPARED THE FOREGOING WITH THE ORIGINAL THEREOF FILED OR RECORDED IN MY OFFICE ON 11/7/85 AND THE SAME IS A CORRECT TRANSCRIPT THEREOF. IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND AFFIXED MY OFFICIAL SEAL.

Donna L. Benson
COUNTY CLERK & CLERK OF THE SUPREME COUNTY COURTS, ORANGE COUNTY DECEMBER 3, 2010

Title No. HA 5803

THRUWAY ASPHALT CO.

TO

BARONE & KHOUROUZIAN

Warranty Deed
WITH FULL COVENANTS.

The land affected by the within instrument lies in Section in Block on the Land Map of the County of

RECORDED AT REQUEST OF
And Return To:

BARONE & MACKAY, ESQS.
Tuxedo Square, P.O. Box 656
Tuxedo, New York 10987

Standard form of
NEW YORK BOARD
of
TITLE UNDERWRITERS

220-
17-
2-

STATE OF NEW YORK, COUNTY OF Westchester SS:

On the 7th day of October 1985, before me personally came Frank D Cocchia

to me known to be the individual described in and who executed the foregoing instrument, and acknowledged that executed the same.

James P. Donohue Jr.

JAMES P. DONOHUE JR.
Notary Public, State of New York
No. 66-4631181
Qualified in Westchester County
Commission Expires March 30, 1986

STATE OF NEW YORK, COUNTY OF SS:

On the day of 19 , before me personally came

to me known to be the individual described in and who executed the foregoing instrument, and acknowledged that executed the same.

STATE OF NEW YORK, COUNTY OF SS:

On the day of 19 , before me personally came to me known, who, being by me duly sworn, did depose and say that he resides at No. ; that he is the of , the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the board of directors of said corporation, and that he signed h name thereto by like order.

STATE OF NEW YORK, COUNTY OF SS:

On the day of 19 , before me personally came the subscribing witness to the foregoing instrument, with whom I am personally acquainted, who, being by me duly sworn, did depose and say that he resides at No. ; that he knows to be the individual described in and who executed the foregoing instrument; that he, said subscribing witness, was present and saw execute the same; and that he, said witness, at the same time subscribed h name as witness thereto.

Appendix B

Pre-Remedy Geologic Cross-Section (1988)

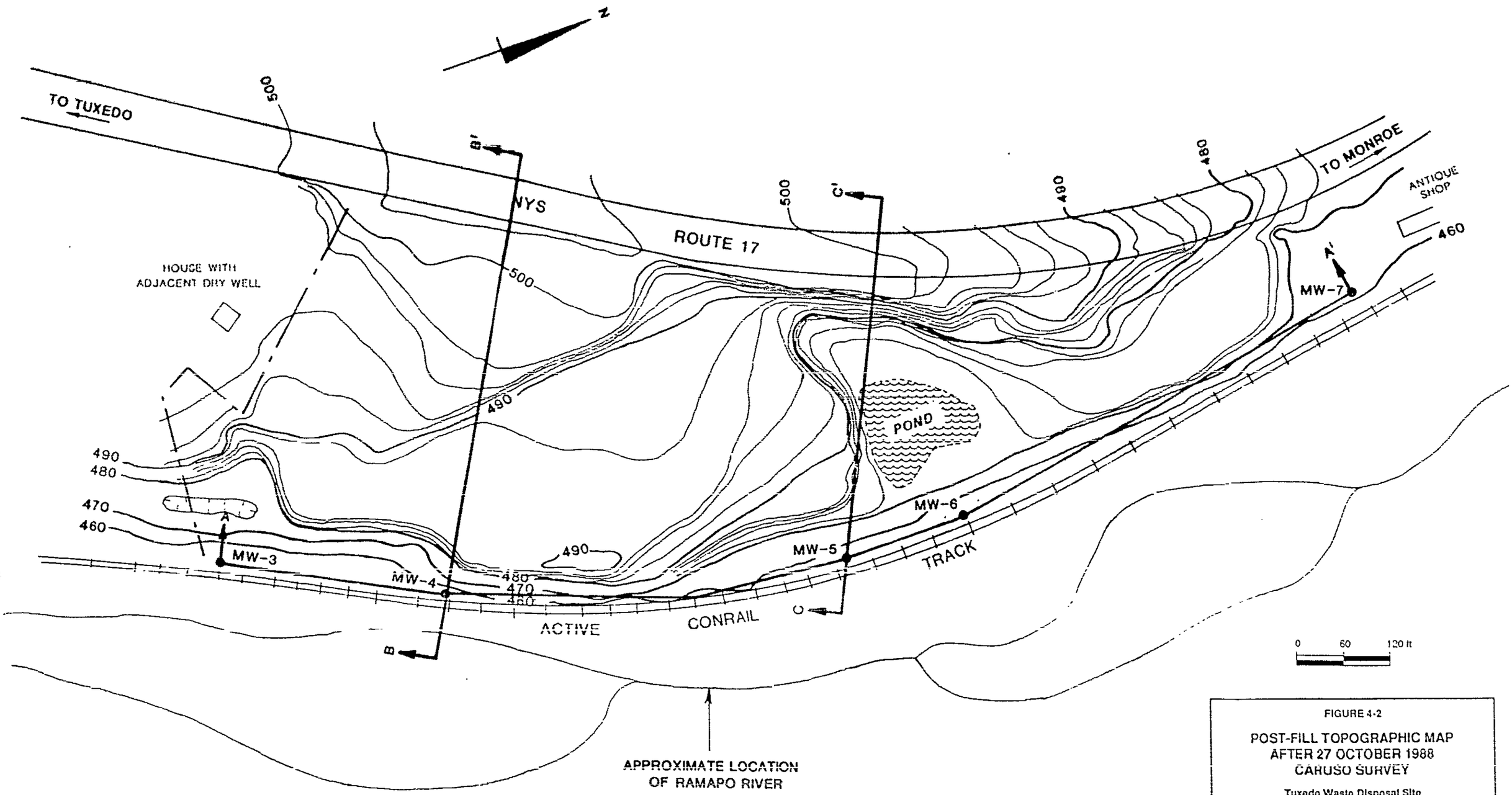
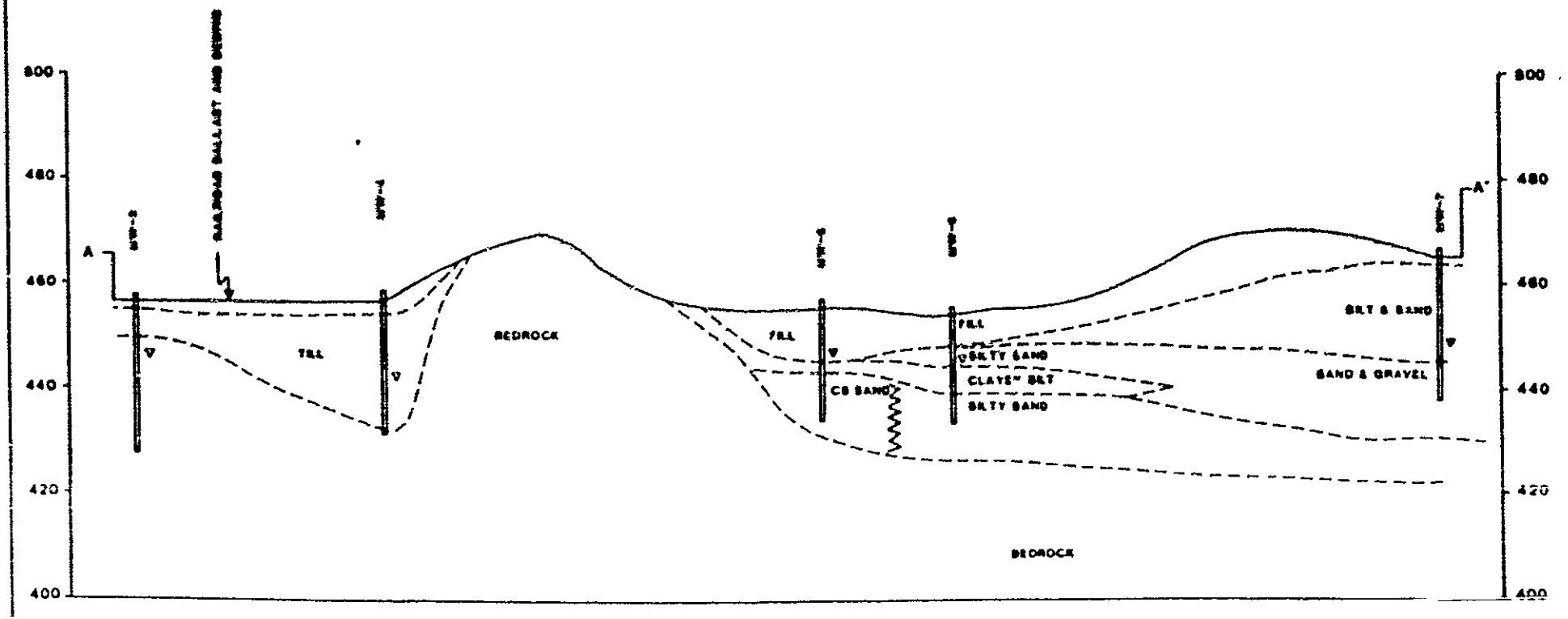


FIGURE 4-2

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



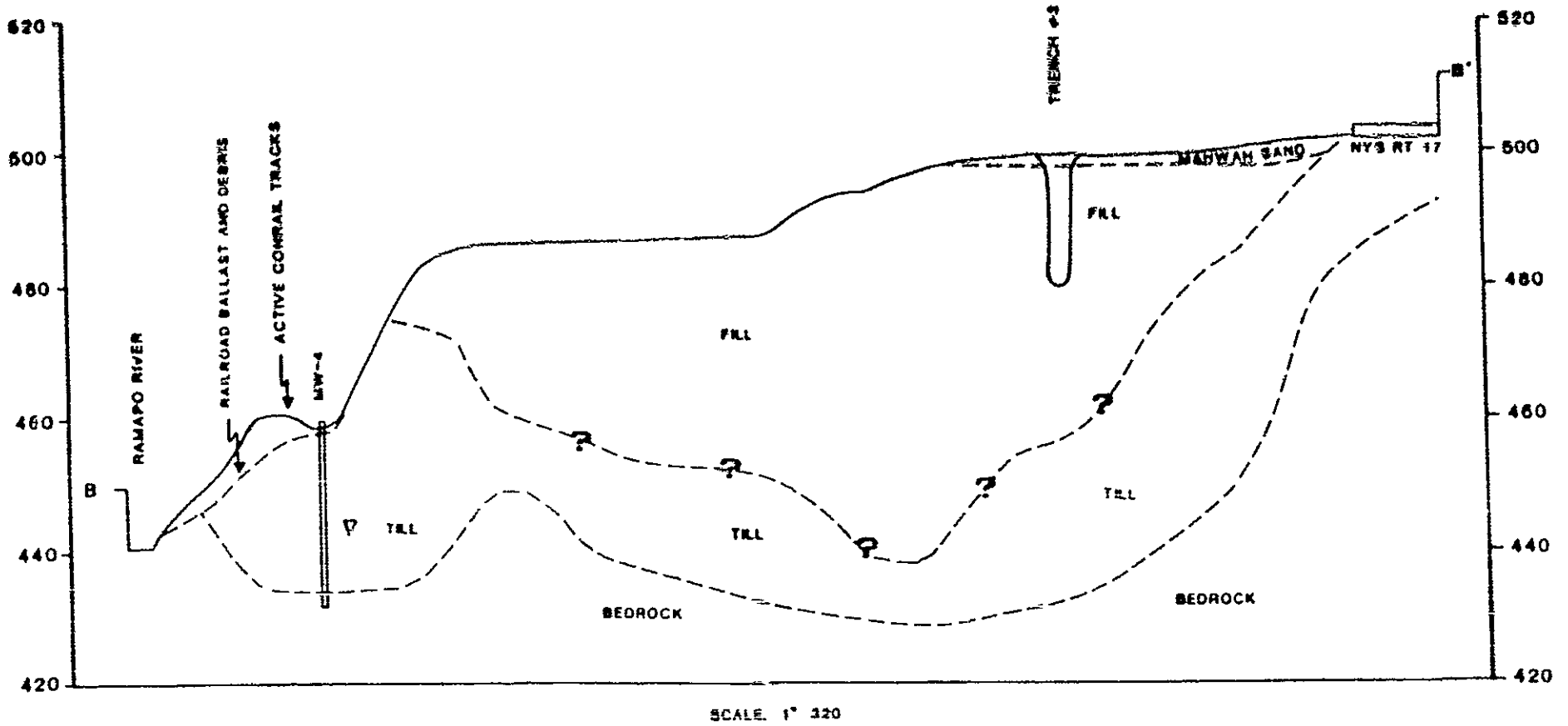
SCALE: 1" 370

FIGURE 4-3

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



SCALE 1" 320

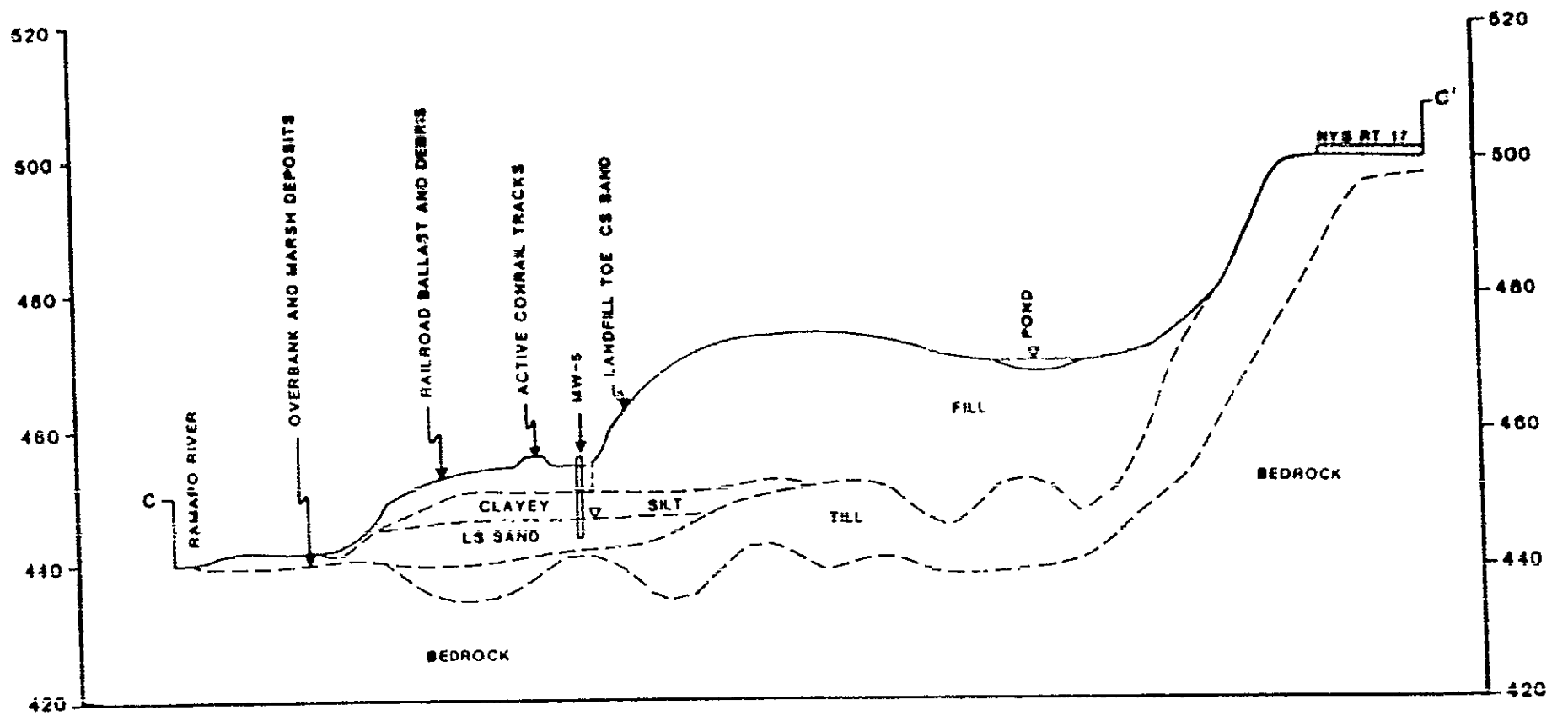
NOTE: Because of sand and gravel excavation, there are areas of fill and bedrock contact. Areas of saturated fill exist (see Section 3.2).

FIGURE 4-4

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 4-5

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

Appendix C

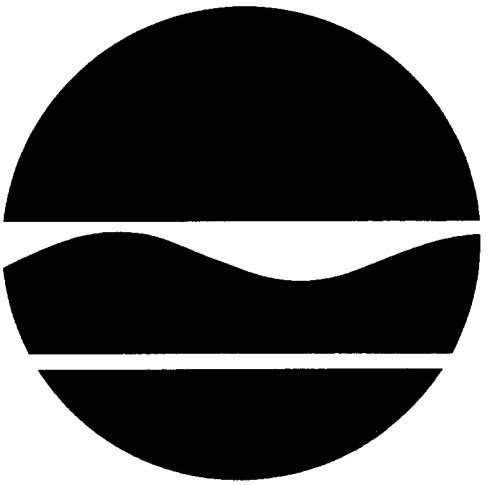
Record of Decision (1992)

Tuxedo Waste Disposal Site

Also Known As

Sacco/Barone Dump
I.D. Number 336035

Record of Decision



February 1992

PREPARED BY:

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION

RECORD OF DECISION

TUXEDO WASTE DISPOSAL SITE

ORANGE COUNTY, NEW YORK

ID NO. 336035

PREPARED BY

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FEBRUARY 1992

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Tuxedo Waste Disposal Site
Tuxedo Park
Orange County, New York
Site Code: 336035
Funding Source: 1986 Environmental Quality Bond Act

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Tuxedo Waste Disposal Site in Orange County, New York. The selection was made in accordance with the New York State Environmental Conservation Law (ECL), and is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"). This decision document summarizes the factual and legal basis for selecting the remedy for this site.

Exhibit A identifies the documents that comprise the Administrative Record for the site. The documents in the Administrative Record are the basis for the proposed remedial action.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision ("ROD") may present an imminent and substantial threat to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The major elements of the selected remedy include:

- o excavation of refuse (approximately 14,600 cubic yards) from the southeast corner of the site with consolidation into the main area and reclamation of the southeast corner;
- o design and installation of an engineered final cover in accordance with applicable regulations and guidance including a gas collection layer (a pilot program will be carried out to aid in the design of the gas collection and treatment system);
- o installation and operation of a passive gas collection and treatment system using activated carbon to remove hydrogen sulfide and volatile organic compounds;
- o design and construction of a surface water diversion system to reduce surface run-on, infiltration, and the subsequent generation of leachate;

- o site use restrictions to prevent any activities that could damage or compromise the integrity of the remedy; and

- o environmental monitoring of groundwater, surface water, surface water sediments, and air emission sources to determine the effectiveness of the remedial program.

DECLARATION

The selected remedy is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, and is cost effective. Waivers are justified for applicable or relevant and appropriate requirements that will not be met. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will not allow for unlimited use and unrestricted exposure within five years after commencement of remedial action, a five year policy review will be conducted. This evaluation will be conducted within five years after the commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

2/21/92
Date

Edward O. Sullivan
Deputy Commissioner
Office of Environmental Remediation
New York State Department of Environmental Conservation

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RECORD OF DECISION
TUXEDO WASTE DISPOSAL SITE (#336035)

I. SITE LOCATION AND DESCRIPTION

The Tuxedo Waste Disposal Site is located (latitude 41° 12' 36" N, longitude 74° 11' 02" W) in the Town of Tuxedo, Orange County, New York (see Figure 1). The site is approximately one mile north of Tuxedo Park, New York and lies between the east side of State Route 17 and an active passenger and freight rail line owned by Conrail. The Ramapo River lies immediately to the east of the rail line and the New York State Thruway lies another 500 feet to the east. The orientation of these major features, and the site itself, is predominantly north/south.

This 13 acre site contains approximately 500,000 cubic yards of wastes including construction and demolition (C&D) and non-C&D debris such as tires, railroad ties, auto parts, white goods, and building demolition debris. The "site" consists of wastes improperly deposited on portions of two privately owned parcels. The main parcel (12.2 acres owned jointly by R. Barone and S. Khourouzian; referred to below as the B/K parcel) is almost entirely covered with wastes and was formerly a sand and gravel mine. The approximate depth of the waste varies from three to perhaps seventy feet. The smaller parcel (7.9 acres owned by the Georgia Tech Foundation; see Figure 2) contains wastes in two locations. In the northwest corner of the Georgia Tech parcel is one-quarter acre of wastes that are connected with the main mass on the B/K parcel. In the northeast corner of the Georgia Tech parcel is one-half acre of wastes that are separate from the main mass and were placed in the final days of the disposal operation. This half-acre portion is uncovered whereas an interim cover exists over the wastes on the B/K parcel.

The topography of the site is characterized by three flat tiers of roughly equal area that drop off steeply along the eastern boundary of the site towards the rail line and the river (see Figure 3). The surface of the site is mostly open field covered with tall grasses along with some wooded areas along the eastern and western borders.

The nearest residences are approximately one-quarter mile south and southwest of the site. To the west, land rises approximately 300 feet along the Ramapo River valley wall. Buildings and residences comprising the Village of Tuxedo Park are approximately one-half mile west of the site.

Groundwater in the vicinity of the site travels from west to east and discharges into the Ramapo River. The nearest water supply well is associated with the antique shops directly to the north (sidegradient) but is not currently used as a source of drinking water. Drinking water for nearby residences comes from the local public water supply.

II. SITE HISTORY AND ENFORCEMENT STATUS

As described above, the "site" consists of two parcels. To avoid confusion, the discussion below generally addresses the site as a single unit even though some of the enforcement activities may technically apply to one or the other parcels due to the different owners involved.

Prior to being used for the improper disposal of solid and hazardous wastes, the site was a sand and gravel mine and included a bituminous concrete plant. In 1961, the Thruway Asphalt Company purchased what is now the B/K parcel and operated the asphalt plant in the southern end of the property. Aerial photographs of the region taken in 1948, 1968, and 1980 show the progression of activities at the site and document the removal of large amounts of overburden. The southern parcel, currently owned by the Georgia Tech Foundation, was deeded to the Foundation as a gift on December 12, 1977. The Foundation played no role in the disposal of hazardous waste at the site and is a "responsible party" solely by reason of its becoming an owner through a gift of land.

In 1985, the parcel was purchased by Messrs. Renard Barone and Sarkis Khourouzian who allowed a third party, Mr. Frank Sacco, to use the site purportedly as a construction and demolition debris landfill beginning in February 1987. Solid waste regulations in effect at that time allowed the disposal of inert, non-hazardous, nonputrescible construction and demolition debris at unpermitted sites for up to one year provided that certain conditions were met. Inspections beginning in March 1987 revealed that nonexempt wastes were being deposited at the site in violation of solid waste regulations. These wastes included auto parts, tires, plastics, paper, household garbage, railroad ties, hospital refuse, white goods, and other materials. Despite the issuance of multiple summonses, dumping continued leading the Department to refer the matter to the New York State Department of Law (NYSDOL) in the early fall of 1987. The Attorney General commenced a lawsuit against the owners and operators of the site in Orange County Supreme Court and obtained a temporary restraining order from the court on October 5, 1987. On October 7, 1987, Department law enforcement personnel arrested the site operator and halted activities. By that time, approximately 500,000 cubic yards of wastes were dumped at the site. Pursuant to the restraining order, cover material was placed on the site in an effort to control objectionable odors emanating from the site. Complaints of strong odors from local residents and travelers along Route 17 and the New York State Thruway began as early as April 1987. Subsequent analyses showed the the cover material, taken from an industrial site in Mahwah, New Jersey, was contaminated by low levels of polychlorinated biphenyls (PCBs).

Odors from the site are thought to result primarily from the decomposition of crushed wallboard (gypsum) resulting in the production of hydrogen sulfide with its characteristic "rotten eggs" odor.

In December 1987, the Department listed the site in the New York State Registry of Inactive Hazardous Waste Disposal Sites with a classification of "2a", indicating that the site was suspected of containing hazardous wastes and that further investigations were needed. The site owners were notified of this listing in January 1988. Between December 1987 and March 1988, various legal proceedings took place. The State Attorney General's Office pursued a preliminary and permanent injunction to continue the ban on further dumping, sought the assessment of civil penalties, and sought an order requiring the responsible parties to undertake investigations at the site and formulate a plan for remediation and closure of the site. A two-week hearing on these matters was conducted in late January and early February in the Orange County Supreme Court. In February 1988, the Attorney General's office

commenced a lawsuit against the owners and operators of the illegal landfill operated on the Georgia Tech parcel.

In March 1988, the court maintained the prohibition on further dumping and ordered the placement of additional cover (clean) material. The court also found that a public nuisance existed at the site. In addition, the court directed that the Department commence additional investigations at the site. In April, the Department notified site owners that a state funded Phase II investigation of the site would be carried out. Although the Georgia Tech Foundation agreed to fund the investigation of its parcel, owners of the B/K parcel did not. Therefore, in May 1988, the Department contracted with Lawler, Matusky, and Skelly Engineers to plan and carry out the investigation of the B/K parcel. This Phase II Investigation began in June 1988 and the final report was submitted in March 1989.

In July 1988, the Orange County Supreme court issued a permanent injunction barring operation of the B/K landfill and requiring the posting of a $4.5 million dollar bond to cover closure costs. The decision was upheld on appeal. To date, the bond has not been posted. However, Barone and Khourouzian have agreed to a State lien on their assets pending the outcome of the RI/FS. In November 1988, the Supreme Court found the operators of the site in contempt for failure to post the bond and penalties of $1,000 per day continue to accumulate. The Attorney General's office has docketed judgments based upon these penalties and has retained New Jersey counsel to pursue execution of these judgments in that State. In December 1991, the Supreme court granted summary judgment to the State against Eli Neuhauser, an operator of the Georgia Tech site.

The investigation included geophysical and soil gas surveys, excavation and sampling of test pits and trenches, installation and sampling of groundwater monitoring wells, permeability studies, surface water and sediment analyses (from the Ramapo River), and ambient air surveys. A number of conclusions resulted from the investigation. Groundwater beneath the site was found to be contaminated above standards with arsenic, iron, manganese, and selenium. A sample of fill material was found to be a characteristic hazardous waste by virtue of its possessing concentrations of leachable lead to levels in excess of the applicable limit. Soil gas data indicated the presence of petroleum-related constituents in the fill throughout the site with highest levels found in the central and south-central portion of the site. The presence of solvent wastes (e.g., trichloroethene, tetrachloroethene, dichloroethene) was also indicated. Additionally, the existence of a hydraulic connection between the site and the Ramapo River results in the discharge of groundwater contaminated with heavy metals to the river. Examining the results of the analyses of river water and sediment samples indicated that the impacts upon the river were marginal but noticeable, especially for aluminum and iron. Notable by their absence were volatile and semi-volatile organic compounds in the groundwater and surface water.

Based upon the results of the Phase II investigation, the site was reclassified to a Class "2" site indicating that the presence of hazardous waste had been confirmed and that action was required to mitigate threats to human health and the environment. Site owners and other potentially responsible parties were notified of the change in classification and were

given the opportunity to fund or participate in the funding of a remedial investigation and feasibility study (RI/FS) to further define the nature and extent of contamination at the site and identify the most feasible remedial alternative.

Other than the Georgia Tech Foundation, none of the potentially responsible parties consented to participating in the investigation or remediation of the site. In November of 1990, the Georgia Tech Foundation entered into a negotiated order on consent with the Department to satisfy its liability under the Environmental Conservation Law for contamination at the site. This included a nominal payment to help defray costs incurred by the Department in carrying out the investigations. Now that a remedy has been selected for the site, the potentially responsible parties will again be asked to participate in the process.

By August 1989, it was clear that the remaining responsible parties were unwilling or unable to participate in the RI/FS. Therefore, in November 1989, the Department tasked a standby consultant (Metcalf & Eddy of New York, Inc.) to plan and carry out the RI/FS. Scoping, work plan preparation, and contracting continued through the first half of 1990 and field work began in June of that year. The final RI/FS Report was completed in December 1991. The major elements of the RI/FS were as follows:

- installation of five additional groundwater monitoring wells to better define the horizontal and vertical distribution of contaminants;
- bedrock coring at seven locations along the eastern site perimeter to determine overburden and bedrock characteristics downgradient of the site;
- sampling and analysis of groundwater, river water, and river sediments;
- soil gas and ambient air sampling and analysis coupled with computer aided dispersion modelling to predict off-site concentrations of air contaminants released from the site;
- baseline risk assessment to identify the risks presented to human health by the site;
- identification and assessment of environmental habitat conditions in the vicinity of the site;
- performance of a number of interim remedial measures to improve site drainage and security; and
- performance of a feasibility study to develop a range of possible remedial alternatives for the site and identify the best option.

The results and conclusions of the RI/FS are summarized in the remainder of this decision document.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Throughout the course of the investigations, there has been a high degree of community involvement in the project. There have been a series of public meetings and additional meetings with officials of the Town of Tuxedo. The Town's Engineering Advisory Committee (EAC) has participated in the development of the various work plans and the review of the resultant reports. The following chronology summarizes these meetings:

April 28, 1988	Public meeting held to address concerns regarding health effects and describe the upcoming Phase II Investigation.
July 27, 1988	Meeting with Town EAC to discuss the status of the Phase II Investigation.
December 14, 1988	Meeting with Town Board to discuss project progress.
April 25, 1989	Public meeting to describe the results of the Phase II Investigation, the site reclassification, and the next steps in the program.
May 2, 1989	Meeting with Town EAC to discuss specifics of the Phase II Investigation results.
October 24, 1989	Meeting with Town EAC to discuss upcoming RI/FS.
January 30, 1989	Meeting with Town EAC to discuss scope of RI/FS.
February 9, 1990	Meeting with Town EAC to discuss RI/FS program.
March 21, 1990	Meeting with Town EAC to discuss RI/FS work plan.
May 10, 1990	Public meeting to describe RI/FS content and schedule.
August 6, 1991	Meeting with Town EAC to discuss results of RI and Phase I RI/FS Report.
August 8, 1991	Public meeting to present the results of the RI and the list of preliminary remedial alternatives under consideration.
November 6, 1991	Meeting with Town EAC to present conclusions of RI/FS.
January 21, 1992	Formal public meeting to present and receive comments on the Proposed Remedial Action Plan.

A Citizen Participation (CP) Plan was developed and implemented to provide concerned citizens and organizations with many opportunities to learn about and comment upon the investigations and studies. All major reports were placed in document repositories in the vicinity of the site and made available for public review. A public contact list was developed and used to distribute fact sheets and meeting announcements. Prior to each of the public meetings regarding the RI/FS program, a news release, legal notice, and fact sheets were issued to announce the meeting and its subject.

Additionally, mass mailings to approximately 1500 residences were sent out inviting all persons in the surrounding communities to the meetings.

Draft versions of the reports were provided to Town Officials who commented upon the documents. Several other meetings were held with representatives from over a dozen different local, county, state, and federal agencies during the development of a fire contingency plan. This plan is to be implemented if a fire were to occur at the site that was beyond the response capabilities of local agencies.

Inquiries and comments (written and verbal) were received and responded to throughout the course of the project from citizens, federal, state, county, and local officials, and special interest groups. Comments received regarding the Proposed Remedial Action Plan have been addressed and are documented in the Responsiveness Summary (Exhibit C).

IV. SCOPE AND ROLE OF RESPONSE ACTION

The remedial action selected in this decision document addresses the entire site and areas immediately surrounding the site. As discussed in more detail in Section V below, the media contaminated at the site include the disposed wastes and debris, soils, groundwater, surface water, sediments, and ambient air. Contaminants in the wastes leach into site soils and groundwater and volatilize into the air through the existing interim cover. Contaminated groundwater discharges into the adjacent Ramapo River where contaminants, primarily metals, are dispersed into the river water and sediments. The principal threat at the site is the contaminated debris which releases contaminants to the other media. Regarding threats to human health and the environment, volatilization of contaminants into the air and discharge of contaminated groundwater to the Ramapo River are the pathways of greatest concern.

Although it is not feasible to directly address the principal threat at the site, the remedy does address the pathways of greatest concern thereby mitigating the impacts of the principal threat. The installation of an engineered final cover system along with surface drainage improvements will significantly reduce the amount of water that infiltrates into the waste mass and eventually produces contaminated leachate. This should lessen the quantity of contaminated groundwater released which will then lessen the loadings to the Ramapo River. The inclusion of a landfill gas collection and treatment system will greatly reduce or eliminate the nuisance odor problem and will further reduce the emissions of volatile organic compounds.

V. SUMMARY OF SITE CHARACTERISTICS

The two main sources of descriptive information for the site are the Phase II Investigation Report and the RI/FS Report (see the Administrative Record, Exhibit A). A complete description of the site can be found in those documents.

As discussed above, the site has a footprint of 13 acres and contains approximately 500,000 cubic yards of mixed construction and demolition debris, municipal waste, and hazardous waste. The depth of the waste varies between three and 70 feet following the contours of the former gravel mine.

The following discussion addresses the characteristics of the site in terms of the major media of debris/soil, air/soil gas, groundwater, and surface water/sediments. Table 1 summarizes the contaminants of concern by media.

Debris/Soil

During the Phase II Investigation, five test pits and three test trenches were excavated to obtain information regarding the disposed wastes. The locations of the pits and trenches (see Figure 4) were selected to coincide with high concentrations of volatile organic compounds found during the soil gas survey (see Figure 5). Various wastes were observed during the excavations such as concrete, scrap metal, logs, auto parts, railroad ties, roofing, garbage, plastics, and white goods. Analyses of samples of the fill indicated the presence of elevated concentrations of semivolatile organic compounds and metals. Polycyclic aromatic hydrocarbons (PAHs) such as pyrene, fluorene, anthracene, benzo(a)pyrene, and chrysene were the most commonly encountered constituents. Total PAH concentrations ranged from 177,300 parts per billion (ppb) to 382,400 ppb. Examples of materials that contain PAHs are coal tars used to preserve railroad ties, roofing materials, and asphaltic wastes. Phthalate acid esters such as di-n-butylphthalate that are associated with plastic wastes were also found in relatively high concentrations (15,200 to 44,100 ppb). Total concentrations of semivolatile organic compounds were as high as 2,853,200 ppb.

In addition to searching for compounds on the so-called target compound list (TCL), attempts were made to identify the presence of other contaminants that could indicate the nature of the wastes. These tentatively identified compounds (TICs) ranged in concentration from 55,000 to 800,000 ppb and were present over large areas of the fill. A likely explanation for their presence is that these are petroleum related hydrocarbons associated with soils contaminated with fuel spills. Noting the presence of aromatic compounds (e.g., benzene, toluene, xylene) associated with gasoline that were found during soil gas surveys corroborates this hypothesis.

Tests to determine the presence of leachable metals in the wastes indicated the presence of arsenic, barium, chromium, and lead in most of the samples. One sample contained leachable lead at 8130 ppb which exceeds the limit of 5000 ppb used to classify a waste as a hazardous waste. The presence of lead may also be the result of the disposal of soil contaminated with leaded gasoline.

Volatile organic compounds (VOCs) were found in lower concentrations in the debris. The principal VOCs found were ketones (acetone, 2-butanone, and 4-methyl-2-pentanone), aromatics (benzene, toluene, ethylbenzene, and xylenes), and chlorinated ethenes (dichloroethene, trichloroethene, and tetrachloroethene). The total TCL VOC concentrations ranged from 588 to 2065 ppb with acetone found in the highest concentrations (up to 1700 ppb). A summary of the test pit analytical results is given in Table 2.

Polychlorinated biphenyls (PCBs) were found in low concentrations (670 to 1200 ppb) in the test pits. The pesticide dieldrin was found at very low concentrations (20-33 ppb). Tests for the family of compounds commonly referred to as dioxins showed insignificant levels of these contaminants.

The total concentration, expressed in terms of what is considered the most toxic congener (i.e., 2,3,7,8-tetrachlorodibenzo-para-dioxin), was 0.03 ppb.

Soil samples were taken during the Remedial Investigation (RI) along the eastern (downgradient) border of the site in conjunction with the bedrock boring program. Organic compounds were found at low levels. Total VOC concentrations were very low and ranged from 1.6 to 16.7 ppb. Total semi-volatile organic compound (SVOC) concentrations were low and ranged from 63 to 5412 ppb. These results reflect the low concentrations of VOCs in the debris and the lower mobility of the SVOCs. Except for one sample that contained a slightly elevated concentration of cadmium (5800 ppb at RIB-1), the concentrations of metals did not appear to be significantly higher than background. This reflects the low degree to which metals partition from groundwater onto soils where the soils have not been directly contaminated.

In summary, essentially all of the 500,000 cubic yards of disposed debris are considered to be contaminated with moderate to high levels of SVOCs, low levels of VOCs, and moderate levels of metals.

Air/Soil Gas

Air and soil gas are addressed as one media since soil gas is the source of the contaminants found in the ambient air. Chemicals present in the debris volatilize into the voids in the fill, are carried to the surface by diffusion and convection, and are released to the atmosphere. A variety of techniques have been used to characterize the identity and concentrations of contaminants.

Ambient air samples have been obtained and analyzed on at least five separate occasions. These episodes have focused on VOCs and/or hydrogen sulfide (H_2S). Typically, VOCs attributable to the site were found at very low levels or were not detected downwind of the site. H_2S was generally not detected off-site. When detected, the concentrations ranged from 1.91 to 2.88 $\mu g/m^3$ compared with the NYS standard of 13.9 $\mu g/m^3$. These values are not directly comparable since the samples were collected over eight hours in accordance with an ASTM sampling method and the standard is for one-hour periods.

Samples have also been taken at openings in the fill. These include cracks and fissures in the interim cover and at the ends of a drainage culvert that travels under the base of the site. A variety of VOCs (e.g., benzene, toluene, ethylbenzene, tetrachloroethene, trichloroethene, etc.) were found along with H_2S at these locations. Toluene was found in the highest concentrations (up to 16,000 $\mu g/m^3$). H_2S was found in concentrations up to approximately 300 parts per million (ppm) (equivalent to 416,000 $\mu g/m^3$). These results indicate that although there are some high strength sources, they are small enough that dilution results in very low or nondetectable concentrations off-site.

Soil gas sampling and analyses were performed to help characterize the nature of the debris and to provide data needed to estimate emission rates of volatile compounds into the atmosphere. Soil gas samples taken during the Phase II Investigation were taken below the interim cover and indicate the presence of petroleum-related VOCs throughout the fill with high levels

present in the central and south-central portion of the site. Ethene derivatives were found at relatively high levels in the south-central portion of the site (see Figure 5). H_2S was found throughout the site and in very high levels (>2000 ppm) in the south-central portion.

Soil gas surveys taken during the RI were designed to determine the effectiveness of the interim cover in inhibiting the release of these contaminants to the air. Therefore, samples were taken in the upper few feet of the cover and on the surface. Three techniques were used including extractive, sweep, and flux surveys. These techniques are described in the RI Report and were selected to provide different methods for obtaining estimates of the rate at which contaminants leave the surface (i.e., flux) and mix with the atmosphere.

Since soil gas is the source of contaminants released to the air, and soil gas concentrations are much more consistent than ambient air samples which are subject to a variety of meteorological conditions, soil gas data was used as the basis for estimating emission rates. Computerized dispersion models were then used to estimate off-site ambient concentrations. Conservative assumptions were made regarding the rate of gas generation in the fill and emission rates were calculated using the data sets showing the highest soil gas concentrations. The Industrial Source Complex (ISC) dispersion model was used to calculate the locations of the maximum and average off-site contaminant concentrations resulting from site emissions.

Results show that the only compound predicted to exceed an existing or proposed ambient air standard or guideline is hydrogen sulfide (H_2S). The maximum and average predicted off-site concentrations of H_2S were estimated to be 29.1 and 7.8 $\mu g/m^3$ respectively. The maximum value exceeds the one hour standard of 13.9 $\mu g/m^3$. The odor threshold for H_2S is reported to be approximately 7 $\mu g/m^3$. The three VOCs with the highest predicted ambient concentrations were toluene, xylenes, and 1,2-dichloroethene with maximum concentrations of 0.62, 0.56, and 1.5 $\mu g/m^3$ respectively. Since the contaminants are emitted at ground level, the highest ambient concentrations are found at the border of the site and decrease with distance from the site. The areal distribution of the air contaminants can be inferred from Figure 6.

Results also indicate that the predicted emission rates used in the dispersion modelling are very conservative. This can be seen by comparing the estimated rates with the actual surface flux emission rates found during the RI. This may not be true for hydrogen sulfide since the levels found in the fill exceeded the limits of the measuring techniques. There have been reports of H_2S odors in the community that indicate that the actual concentrations may be at or above those predicted by the model.

Groundwater

Twelve groundwater monitoring wells have been installed around the perimeter of the site. Six wells are screened in overburden, two at the overburden/bedrock interface, and four are screened in competent bedrock. Contaminated groundwater results when leachable contaminants in the debris come in contact with water, transfer into the water creating leachate, and the leachate percolates into groundwater. Water infiltrates into the site by

three mechanisms: precipitation entering through the cover; surface run-on that seeps through the cover and sides of the fill; and groundwater recharge.

The mining of sand and gravel and the deposition of waste materials has significantly altered the natural hydrogeology of the site. Natural overburden material is characterized as glacial till predominated by sand and gravel. The average hydraulic conductivity was estimated from slug test data to be 3.7×10^{-2} cm/sec. Overburden overlies fractured and competent bedrock consisting of various forms of granitic gneiss. Figure 7 shows a geologic cross section along the eastern border of the site. Observations that combine this cross section, aerial photographs, topographic maps constructed before and after the emplacement of wastes, and other site records indicate the existence of a pronounced hydraulic connection between the base of the site and the Ramapo River in the vicinity of MW-6/RI-2. Groundwater elevation data indicates that all groundwater eventually discharges to the river but the pre-fill base of the site was essentially part of the river flood plain. As the river level fluctuates, water flows between the river and the base of the fill in that area. This hydraulic connection is the most likely reason why MW-6 shows the highest concentration of contaminants.

Over the course of the investigations, the predominant groundwater contaminants have been metals (see Figure 8). The concentrations and particular metals involved varies with time with no particular trends noted. Metals that consistently appear over State standards or guidelines are iron, sodium, manganese, magnesium, and lead. Others found above standards or background include aluminum, arsenic, barium, cadmium, calcium, chromium, copper, mercury, nickel, potassium, and zinc. Iron, lead, and mercury have been found in upgradient wells above standards on at least one occasion.

Low levels of VOCs and SVOCs were detected in 1990 and 1991 (see Figure 9). Compounds detected above standards or guidance levels include benzene, chloroform, phenol, naphthalene, acenapthene, and chrysene. Benzene was detected twice in MW-5 at a maximum concentration of 1.0 ppb. The SVOC present at the highest concentration was acenapthene at 28 ppb (this was detected in the second round only). The reported concentrations of some of these contaminants (e.g. chloroform) include the influence of common laboratory contaminants and are not clearly site related.

Data taken between 1988 and 1991 do not indicate any significant trends. The results of the RI and Phase II Investigation indicate that most of the wastes lie above the permanent water table. This indicates the need to minimize the amount of water infiltrating the site to help reduce leachate production and subsequent groundwater contamination. Elevated groundwater temperatures in downgradient monitoring wells indicate ongoing biological activity (waste decomposition) in the waste mass.

Given the illegal nature of the filling operations, there is the possibility that the site contains drum nests or other concentrations of hazardous wastes. There is evidence of waste pits installed at the base of the fill in the south end of the site and allegations of drum burials. Although excavations to 20 feet and geophysical prospecting did not reveal these wastes, this type of site always presents the possibility of future releases of unexpected contaminants or changes in contaminant concentrations.

Surface Water/Sediments

As discussed above, site contaminants that enter groundwater are eventually released to the Ramapo River. Although organic contaminants have not been detected in the water column, the metals aluminum, calcium, iron, lead, magnesium, and sodium were detected in marginally greater concentrations in samples alongside and downstream of the site. Although current discharges do not result in the exceedance of surface water standards or guidance values, the site is a source of metals to the river.

In the river sediments, 21 semi-volatile organic compounds were detected in concentrations that ranged from undetected to 6600 ppb (phenanthrene, found upstream). Most of the compounds are polycyclic aromatic hydrocarbons (PAHs). Four of these PAHs were present in sediments at levels above sediment guidelines but these occurred in samples taken upstream of the site. This may indicate contributions from runoff from the railroad and the highways. Based upon samples taken near where site groundwater is known to discharge to the river, there is evidence of PAH loadings to the river.

Five volatile organic compounds (VOCs: methylene chloride, acetone, 2-butanone, toluene, benzene) were detected in sediments but the concentrations found were influenced by common laboratory contaminants found in blank samples. Given the concentrations of VOCs found in groundwater, the impacts of VOCs from the site on the river appear insignificant.

VI. SUMMARY OF SITE RISKS

In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300), a baseline risk assessment has been completed as one component of characterizing the site. The results of the baseline risk assessment are used to help identify potential remedial alternatives and select a remedy. The components of the baseline risk assessment for this site are as follows:

- a review of the site environmental setting;
- identification of site-related chemicals and media of concern;
- an evaluation of the toxicity of the contaminants of concern;
- identification of the possible exposure routes and pathways;
- incremental cancer risks and hazard indices for noncarcinogens; and
- an evaluation of the impacts of the site upon the environment.

Exposure routes are the mechanisms by which contaminants enter the body (e.g., inhalation, ingestion, absorption). Exposure pathways are the environmental media (e.g., soil, groundwater, air, etc.) through which contaminants are carried.

The risk assessment for this site (Chapter 7 of the Remedial Investigation Report) indicates that the most significant exposure mechanism

is the inhalation of air containing contaminants that have volatilized from site wastes. To estimate emission rates, it was assumed that carbon dioxide and methane are generated in the fill at rates similar to those found in municipal landfills and that these gases carry site contaminants out of the fill into the air. Since the site consists predominantly of nondegradable C&D debris, this is a conservative assumption.

The site was divided into 10 sections and emission rates were estimated using data from field measurements that showed the highest concentration of contaminants for that subsection. The gaussian dispersion computer model called "Industrial Source Complex (ISC)" was used to calculate the dispersion coefficients and estimate contaminant concentrations at varying distances around the site. Contaminants were divided into the two categories of possible/probable carcinogens and those that may cause noncancer health effects (noncarcinogens or systemic toxicants). Toxicity data was obtained from the Integrated Risk Information (IRIS), Health Effects Assessment Summary Table (HEAST), and Risk Assessment Guidance for Superfund (RAGS).

The results of the assessment indicate that left unremediated, the maximum and average incremental risk of developing cancer as a result of exposure to site contaminants would be 3.0 and 2.4 per million respectively of exposed population. That is, if one million persons occupied the off-site locations that present the highest concentration of carcinogens for 24 hours/day over 70 years, a maximum of three of those persons would be predicted to develop some form of cancer (see Figure 6). The contaminants contributing the most to this risk are benzene and trichloroethene. Since contaminants are emitted at ground level, concentrations and risks are predicted to be greatest at the site borders and decrease with distance from the site.

The risks associated with exposure to noncarcinogenic contaminants are determined using the "Hazard Index" approach. A Hazard Index is the ratio of predicted exposure levels to acceptable exposure levels. A Hazard Index greater than one indicates that adverse noncarcinogenic effects may occur, while a value below one indicates that such effects are unlikely to occur. At this site, the total Hazard Index for exposure to noncarcinogenic related contaminants is much less than one, suggesting that adverse noncarcinogenic effects are not likely to occur.

There are a number of assumptions, uncertainties, and limitations associated with these estimates that are addressed in the Feasibility Study. In general, the main sources of uncertainty include:

- actual location and density of receptor population over time;
- VOC emission rates;
- modelling of exposure levels;
- accuracy of toxicological data; and
- the complex interaction of the uncertainty elements.

The mathematical models used to estimate the concentrations of contaminants at receptors contain many assumptions that can affect results. The measured data entered into the models (e.g. meteorological data) also have uncertainties that influence the final results. Much of the toxicological data used to estimate human impacts is extrapolated from animal

studies. Often these studies are performed at high concentrations and produce results that may not occur at lower levels. Additionally, these and other uncertainty factors combine in ways that can increase the overall uncertainty of the results. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters and emission rates throughout the assessment. As a result, the risk assessment provides upper bound estimates of the risks to populations around the Site, and is unlikely to underestimate actual risks related to the Site.

The results of the baseline risk assessment indicate a small increased risk of cancer due to exposure to site contaminants emitted to the atmosphere. It also predicts the likelihood for exceedances of the one-hour ambient air standard for hydrogen sulfide (a noncarcinogen). This in combination with concerns regarding exceedances of groundwater standards and impacts upon surface water indicate the need to implement a remedy to mitigate these concerns to the extent feasible. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Groundwater beneath the site is contaminated with a variety of metals (predominantly iron, sodium, manganese, magnesium, and lead) at relatively high concentrations and organic compounds in low concentrations. Groundwater discharges to the Ramapo River but the concentrations and flow rates are evidently not high enough to cause exceedances of surface water standards. There is a possibility for a complete exposure pathway since there are drinking water supply wells near the banks of the Ramapo River downstream of the site. It is has been stated that some of these wells pump at rates high enough to induce flow from the river itself rather than drawing from the regional aquifer which discharges into the Ramapo. Since significant levels of contaminants were not found in the Ramapo River, the risk assessment focused mainly on the air pathway.

As part of the investigation of the site, an environmental assessment referred to as a Habitat Based Assessment (HBA) was completed. The objectives of the HBA included identifying any significant biological resources or habitats on or immediately adjacent to the site, evaluating the effects of past waste disposal activities on plant and animal life, and providing information needed for the evaluation of potential remedial alternatives. This was accomplished by completing field surveys of wildlife, preparing vegetation cover maps, reviewing available published information, and identifying any applicable or relevant and appropriate environmental standards. As a result of this review, it was determined that there was no evidence of threatened or endangered species or habitats in the area. A list of the observed vegetation and wildlife on and around the site is included in Appendix C of the Remedial Investigation Report.

VII. DESCRIPTION OF THE REMEDIAL ALTERNATIVES

To determine the most appropriate method for remediating the site, the feasibility study completed a process that took place in three parts. The first step identified and "screened" a large number of technologies that could be employed at the site to treat, contain, or dispose of the

contaminants. Technologies that passed the initial screening phase were then grouped into different combinations to form remedial alternatives for further evaluation. After an initial analysis to identify the most promising alternatives, a detailed analysis was performed to serve as the basis for selecting a preferred alternative.

To identify technologies useful in addressing the contamination at the site, the three progressively more specific categories of "general response actions," "remedial technologies," and "process options" were identified. For example, regarding debris/soil, one of the general response actions considered was containment. This was then narrowed into the remedial technology of capping which was further subdivided into the process options of synthetic, asphaltic, and layered caps. A summary of the general response actions, remedial technologies, and process options considered is given in Table 3.

The initial screening process evaluates all of the identified process options against the single criterion of technical implementability. This also includes the evaluation of the "No Action" alternative which is carried through the entire process to demonstrate the need for remediation at the site and as a requirement of the NCP. A detailed discussion and evaluation of the initial screening process can be found in Section 4 of the Feasibility Study.

The remedial technologies and process options that passed the screening process were then assembled into different combinations or remedial alternatives. Theoretically, an immense number of combinations are possible but the NCP provides guidance (40 CFR 300.430(e)(3)) on how to assemble suitable technologies into alternative remedial actions for evaluation. Three sets of alternatives are described: (1) a range of alternatives that remove or destroy contaminants to the maximum extent feasible and eliminate or minimize to the degree possible, the need for long-term management; (2) "other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed;" and (3) "one or more alternatives that involve little or no treatment, but provide protection of human health and the environment primarily by preventing or controlling exposure to ... contaminants, through engineering controls" and other methods to "assure continued effectiveness of the response action."

Since the wastes buried in the northeast corner of the Georgia Tech parcel are physically separated from the rest of the wastes, two groups of remedial alternatives were formulated. Seven alternatives were evaluated for the Barone/Khourouzian (B/K) parcel and four were evaluated for the wastes in the northeast corner of the Georgia Tech (GT) parcel. Each alternative is described in terms of the technologies proposed to address each of the four major media (i.e., debris/soil, soil gas/air, groundwater, and surface water/sediments). Since direct remediation of the Ramapo River and river sediments is not needed, each alternative includes a component for monitoring surface water/sediments.

The alternatives can be grouped into the three major categories of no action, containment, or excavation with treatment. The alternatives

described below are numbered as they appear in the feasibility study. Present worth is the amount of money needed now (in 1991 dollars and assuming a discount rate of 5% before taxes and after inflation) to fund the construction, operation, and maintenance (O&M) of the alternative for 30 years. Capital cost mainly reflects initial construction costs and annual O&M reflects an average over 30 years of the money needed to operate and maintain the alternative for one year. Time to implement mainly refers to the time needed to construct the alternative. All costs and implementation times are estimates.

No Action Alternatives

B/K Alternative 1: No action + monitoring.

Present Worth:	**$1,972,000**	**Annual O&M:**	**$111,000**
Capital Cost:	**$ 39,000**	**Time to Implement:**	**Immediate**

The costs and activities associated with this alternative all deal with monitoring. Samples of groundwater, river water, sediments, soil gas, and ambient air would be taken on a quarterly basis for the first two years and annually thereafter. Groundwater, surface water, and sediments would be analyzed for volatiles, semi-volatiles, and metals. Groundwater wells that monitor discharges to the Ramapo River (MW-4 and MW-6) would be used to monitor for the full Target Compound List (TCL) of contaminants on an annual basis. Soil gas levels of H_2S, methane/nonmethane hydrocarbons, and combustible gases would be determined and ambient levels of volatile organic compounds and H_2S would be monitored.

Five perimeter soil gas monitoring wells would be installed to monitor the migration of landfill gases. The annual O&M cost estimate includes a provision for periodically replacing these monitoring wells over the 30 year monitoring period. The actual monitoring costs incurred will depend upon the number of wells routinely sampled, the analytical parameters selected, and the sampling frequencies. These parameters are affected by the variability of the contaminant concentration trends.

GT Alternative 1: No action.

Present Worth:	**$0**	**Annual O&M:**	**$0**
Capital Cost:	**$0**	**Time to Implement:**	**0 years**

Since the site monitoring provisions of B/K Alternative 1 would adequately address the needs for the GT parcel, no separate activities or costs are included in this alternative.

Containment Alternatives

B/K Alternative 2: Non-vented Cap + monitoring.

Present Worth:	**$5,917,000**	**Annual O&M:**	**$160,000**
Capital Cost:	**$3,040,000**	**Time to Implement:**	**1 year**

This alternative includes the installation of a final cover system that would minimize the infiltration of precipitation but would not provide for

the collection or treatment of landfill gases. From top down, the design calls for a vegetated cover, a barrier protection layer, and the barrier. Eighteen perimeter passive gas monitoring points would also be installed so that subsurface migration of landfill gases could be monitored. Applicable New York State regulations (6 NYCRR 360-7) call for this type of design for the closure of construction and demolition debris landfills.

A surface water diversion program would be included to aid in the minimization of leachate production. Currently, a significant amount of run-off from a drainage area west of the site runs onto the site. Although a drain pipe runs under the site to carry this run-on to the Ramapo River, this pipe is damaged and allows an undetermined amount of water to enter the waste mass and potentially produce leachate. This water would be diverted to a newly installed 36 inch culvert to be installed under Route 17 south of the site and subsequently discharged to the Ramapo.

The environmental monitoring provisions of B/K Alternative 1 would also be included in this alternative. No provisions for groundwater collection or treatment are included.

B/K Alternative 3: Vented cap + passive gas collection and treatment + monitoring.

Present Worth:	**$8,168,000**	**Annual O&M:**	**$203,000**
Capital Cost:	**$4,604,000**	**Time to Implement:**	**1 year**

This would be the same as B/K Alternative 2 with the following exceptions: the final cover would include a gas collection layer; up to 19 interior passive gas vents/monitoring points would be installed; and up to 12 granular activated carbon (GAC) treatment units (3 canisters per unit) would be installed to treat gases from the perimeter and interior vents. The GAC would be used to remove H_2S and volatile organic compounds of concern (e.g., benzene, trichloroethene) so that they would not be emitted to the atmosphere.

B/K Alternative 3 would then include the installation of the following elements:

- engineered final cover to minimize the amount of infiltration into the waste mass and the amount of leachate produced;
- inclusion of a gas collection layer in the base of the cover connected to interior and perimeter gas vents;
- passive collection of soil gas from interior and perimeter vents;
- treatment of collected gases using granular activated carbon;
- construction of a surface water diversion system to reduce surface run-on, infiltration, and the subsequent generation of leachate; and
- environmental monitoring of groundwater, surface water, sediments, soil gas, and ambient air.

O&M activities would include maintenance of the cap, periodic replacement of the GAC, and periodic replacement of the gas vents. The environmental monitoring provisions of B/K Alternative 1 and the surface water diversion program of B/K Alternative 2 are also included. No provisions for groundwater collection or treatment are provided. A pilot program will be completed during the design phase of the remedy to confirm that passive gas collection and treatment will be adequate.

B/K Alternative 4: Vented cap + active gas collection and treatment + monitoring.

Present Worth:	**$8,914,000**	**Annual O & M:**	**$220,000**
Capital Cost:	**$5,069,000**	**Time to Implement:**	**1 year**

The difference between B/K Alternatives 3 and 4 is the method of gas collection. Alternative 4 would actively collect soil gas by connecting all of the interior vents to a blower which creates a vacuum over and inside the waste mass. Collected gases would then be treated before release to the atmosphere. This method would be preferable to passive collection and treatment if the site is found to generate high concentrations and large volumes of contaminants after the venting system is installed. The reason for this is that heavy contaminant loadings would necessitate an impractical replacement frequency for the carbon canisters envisioned for the passive system. O&M activities include maintaining the cap and the gas collection equipment, periodically replacing the GAC (or maintaining other gas treatment units if selected), and environmental monitoring. This option would not include groundwater collection or treatment.

B/K Alternative 5: Vented cap + active gas collection and treatment + downgradient vertical barrier + groundwater collection and treatment + monitoring.

Present Worth:	**$23,992,000**	**Annual O&M:**	**$583,000**
Capital Cost:	**$ 9,570,000**	**Time to Implement:**	**1 year**

This alternative includes all of the elements of B/K Alternative 4 plus a component to directly treat groundwater and indirectly treat surface water and sediments. As discussed above, contaminated groundwater beneath the site currently discharges into the Ramapo River. This could be minimized by installing vertical barriers between the ground surface and bedrock at the two locations where the bulk of site related groundwater discharges into the river. To prevent overtopping of the barriers, groundwater extraction wells would be installed behind the barriers. Collected groundwater would be treated and released to the river. This would essentially cut off the source of contamination from the site to the Ramapo and thereby indirectly address river contamination.

Three types of vertical barriers were evaluated in the feasibility study. The most promising of these is the so-called concrete diaphragm wall. Combined, the two walls would be approximately 1,000 feet long, two feet wide, and would average 50 feet deep. They would be installed on the eastern (downgradient) side of the site roughly between MW-3 and MW-4 and between MW-5 and RI-4.

It is estimated that four extraction wells would be needed to collect the estimated 21,000 gallons per day of water that would build up behind the walls. This water could be treated by an ion exchange system to remove metals. The low levels of organic compounds found in groundwater do not warrant treatment prior to release to the river.

O&M activities would include those listed under Alternative 4 plus those associated with the operation and maintenance of the groundwater extraction and treatment system. This includes periodic replacement of extraction wells, maintenance of pumps and piping, and purchase/disposal of regenerant chemicals and waste products.

GT Alternative 2: Excavation + deposition on B/K parcel + backfill.

Present Worth:	**$367,000**	**Annual O&M**	**$0**
Capital Cost:	**$367,000**	**Time to Implement:**	**<1 year**

Since the wastes in the northeast corner of the Georgia Tech parcel are separate and distinct, they can be removed and combined with the main waste mass on the B/K parcel for subsequent treatment or disposal. Approximately 14,600 cubic yards of waste would be excavated and moved onto the B/K parcel. Clean fill would be imported to grade and revegetate the excavated area. The wastes in the northwestern corner of the GT parcel would be managed as part of the main waste mass on the B/K parcel.

Excavation with Treatment Alternatives

B/K Alternative 6: Excavation + off-site incineration + groundwater extraction and treatment and monitoring.

Present Worth:	**$1,049,256,000**	**Annual O&M:**	**$376,000**
Capital Cost:	**$ 991,592,000**	**Time to Implement:**	**7 years**

This alternative dramatically differs from those described above. In this case, all wastes would be completely removed from the parcel, transported to off-site permitted incinerators, and destroyed. The resulting ash would be land buried. Additionally, groundwater under the site would be extracted and treated until it met applicable standards.

Under this scenario, it is assumed that all of the 476,500 cubic yards of waste in the site would need to be removed from the site and incinerated (e.g., rotary kiln). This would take seven years. In a subset of this alternative, it was assumed that only 25% of the wastes would require off-site incineration and the rest could be decontaminated, placed back into the site, and properly covered for permanent closure. The present worth of this "sub-alternative" was estimated to be $295,971,000.

A groundwater extraction and treatment system would be installed and operated to remediate groundwater and prevent contaminant releases to the Ramapo River. It is assumed that 15 years would be needed to reduce concentrations in groundwater beneath the site to acceptable levels. Since a vertical barrier would not be included in this case, the amount of water collected and treated would significantly increase (perhaps double) due to the influence of the Ramapo River.

Surface water/sediments would be indirectly remediated by the groundwater program. Environmental monitoring of surface water/sediments and ambient air would occur to determine if the remedial action itself was not creating unacceptable damage or threats of damage.

After the completion of the excavation/treatment components, O&M activities associated with groundwater treatment and environmental monitoring are projected to continue until 30 years from the start of remediation.

B/K Alternative 7: Excavation + on-site incineration + groundwater extraction and treatment + monitoring.

Present Worth:	**$246,869,000**	**Annual O&M:**	**$431,000**
Capital Cost:	**$226,048,000**	**Time to Implement:**	**5 years**

An optional permanent treatment/disposal method associated with excavation is on-site incineration. The advantages include no need for long distance transportation, dedicated incineration capacity, and reduced ash disposal costs. The disadvantages include the need for on-site residuals disposal, creation of local air emission sources, and concerns about effectiveness. Since metals are present at significant concentrations in the debris and incineration would not remove significant quantities from the resulting residuals, the ash would need to be stabilized to immobilize the metals. Uncertainties in the long-term effectiveness of this method raises the possibility of future contamination release problems.

The scenario analyzed in the feasibility study envisions the use of three on-site incinerators. In this case, it is projected to take five years to complete the treatment process and another 10 years to complete the groundwater treatment program. Using more or fewer incinerators would proportionately lessen or extend the time needed to complete the remedy.

As with B/K Alternative 6, the possibility that only 25% of the debris would need to be incinerated was investigated. The present worth of the remedy in this case was estimated to be $93,675,000. The remainder of the activities (i.e., groundwater extraction and treatment, environmental monitoring, etc.) would be similar to Alternative 6.

GT Alternative 3: Excavation + off-site incineration.

Present Worth:	**$41,544,000**	**Annual O&M:**	**$0**
Capital Cost:	**$41,544,000**	**Time to Implement:**	**1 year**

In this case, the wastes deposited in the northeast corner of the GT parcel would be excavated and transported off-site for incineration. The resulting excavation would be graded and revegetated as in GT Alternative 2. Since all of the wastes would be removed, no O&M would be necessary. The wastes in the northwest corner would be managed as part of the B/K parcel.

GT Alternative 4: Excavation + on-site incineration.

Present Worth:	**$12,753,000**	**Annual O&M:**	**$0**
Capital Cost:	**$12,753,000**	**Time to Implement:**	**1 year**

The difference between GT Alternatives 3 and 4 is that in Alternative 4, wastes would be incinerated on site in conjunction with B/K Alternative 7. As with GT Alternative 3, all of the wastes in the northeast corner would be removed so that O&M would not be needed after the construction was completed. Monitoring would be carried out in conjunction with the B/K parcel.

Refer to the discussion of B/K Alternative 7 above for more information about this alternative.

VIII. SUMMARY OF THE COMPARATIVE ANALYSIS OF THE ALTERNATIVES

The remedial alternatives developed for this site, and described above, have been grouped into three categories; (1) no action (B/K Alternative 1 and GT Alternative 1), (2) containment (B/K Alternatives 2, 3, 4, & 5 and GT Alternative 2), and (3) excavation and treatment (B/K Alternatives 6 & 7 and GT Alternatives 3 & 4). This comparative analysis will focus upon these three groups rather than address each individual alternative. Where specific differences between the alternatives are relevant, they are mentioned.

The site specific goals for remediating this site can be summarized in general as follows:

- o prevent unacceptable health risks to exposed populations from airborne contaminants;
- o prevent unacceptable environmental risks due to exposure to site related contaminants;
- o close the site in conformance with applicable regulations;
- o protect surface water and sediments from contamination which would adversely affect its uses;
- o eliminate the odor nuisance emanating from the site.

The criteria used to compare the potential remedial alternatives are defined in the National Contingency Plan (40 CFR 300.430). For each of the criteria, a brief description is given followed by an evaluation of the alternatives against that criterion.

Threshold Criteria - The first two criteria must be satisfied in order for an alternative to be eligible for selection.

1. **Protection of Human Health and the Environment**--This criterion is an overall and final evaluation of the health and environmental impacts to assess whether each alternative is protective. This evaluation is based upon a composite of factors assessed under other criteria, especially short/long-term impacts and effectiveness and compliance with ARARs (see below).

If the no-action alternative were implemented, the threat to human health and the environment could be estimated from the results of the baseline risk assessment described above in Section VI. Although the risks are not large, it is prudent to determine what steps can be taken to minimize

those risks to the extent practicable. As with other sites where the exact composition of the wastes is uncertain, the possibility of future releases of currently unidentified contaminants has also been considered.

The containment alternatives would provide protection by limiting the amount of contaminated groundwater generated and released, and in the case of alternatives with gas collection and control, would also limit the release of hazardous constituents to the atmosphere. By monitoring groundwater, surface water/sediments, and air releases, changes in the nature of the releases from the site would be detected and mitigating measures could be taken. By the addition of a vertical groundwater barrier and groundwater treatment, B/K Alternative 5 would directly prevent the release of contaminated groundwater to the river.

The excavation/treatment alternatives would provide protection by treating, and in the case of B/K Alternative 6, removing all of the hazardous wastes from the site. Wastes would be incinerated to destroy organic contaminants and chemically treated to immobilize the remaining heavy metals in the ash. The treated ash would be land buried either on or off-site. Groundwater would be collected and treated until the level of contamination was reduced to levels below standards.

Although the excavation/treatment alternatives would likely offer the highest overall protection of human health and the environment after completion of the action, there are factors that diminish the differences between the alternatives regarding this criterion. Specifically, the process of excavating and handling the wastes at the site would result in the release of potentially significant quantities of volatile contaminants to the atmosphere. Depending upon the effectiveness of engineering controls such as vapor suppression, the resulting exposures could be significant. The feasibility study estimates that the cancer risks to the community associated with excavating the site would be 17 times higher than for baseline conditions. Both sets of alternatives also implicitly contain the possibility that a subsurface fire could begin at the site resulting in the release of significant quantities of air contaminants. The risk of this occurring in conjunction with the containment alternatives is considered to be low. Because of their intrusive nature, the risk of fire may be greater with the excavation/treatment alternatives but these risks are difficult to quantify with any certainty.

2. **Compliance with Applicable or Relevant and Appropriate New York State and Federal Requirements (ARARs)**--ARARs are divided into the categories of chemical-specific (e.g. groundwater standards), action-specific (e.g. design of a landfill), and location-specific (e.g. protection of wetlands). Certain policies and guidance that do not have the status of ARARs that are considered to be important to the remedy selection process are identified as To-Be-Considered (TBC) criteria. A compilation of federal and state ARARs/TBCs are included in Table 4. If the implementation of a remedy results in one or more ARARs not being met, a waiver of the ARAR must be justifiable based upon one of the six reasons specified in the NCP (40 CFR 300.430(f)(1)(ii)(C)).

The key ARARs associated with this site are the requirements for site closure (i.e. installation of a final cover system) under the hazardous and

solid waste regulations, ambient air standards, surface water quality standards, groundwater standards, and land disposal restrictions (40 CFR Part 268). Since the no-action alternative would not address these requirements and complete waivers could not be justified, no-action is not eligible for selection.

The containment alternatives that include gas collection and treatment would meet the key ARARs except regarding on-site groundwater standards. To meet these standards, the wastes themselves would have to be removed or treated so that they no longer served as a source of contaminants to the groundwater. If public monies are used to remediate the site, an applicable waiver of the on-site groundwater standard would be that taking the extraordinary steps needed to attain the ARAR would not provide a balance between the need for protection of human health and the environment at the site and the availability of public monies to respond to other sites that may present a threat to human health and the environment. Also, as discussed above, it is possible that the excavations needed to treat all of the wastes may result in the creation of a greater overall threat by resulting in the release of volatile chemicals.

The excavation/treatment alternatives would likely meet the key ARARs except for the possible exceedances of ambient air standards or guidelines during the five to seven years it would take to complete the remedy. Closure requirements would be met by removing the wastes or properly containing treated wastes on-site. Groundwater standards would be met by removing the source and treating groundwater until standards were met. In the long-term, ambient air standards and guidelines would be met by removing and destroying the volatile contaminants. Surface water quality standards will be maintained by reducing the release of contaminants to the Ramapo River.

Land disposal restrictions would prohibit the excavation and reburial of certain hazardous wastes without appropriate treatment. Incineration was evaluated as an appropriate treatment technology but the resulting ash may also require treatment (i.e., stabilization) before land burial would be permitted. Constructing a lined land burial facility may be impracticable.

Primary Balancing Criteria - The next five "primary balancing criteria" are used to weigh major trade-offs among the different hazardous waste management strategies.

3. **Short-term Impacts and Effectiveness**--The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment is evaluated. The length of time needed to achieve the remedial objectives is estimated and compared with other alternatives.

Because they are less intrusive, result in adequate protection, and can be implemented in a short amount of time (approximately one year), the containment alternatives are preferable to the excavation/treatment alternatives in regard to this criterion. Although less intrusive, the containment alternatives do involve a limited amount of waste excavation. This is necessary to achieve stable final slopes, to remove wastes deposited in the railroad right-of-way, and to consolidate the wastes in the northeast corner of the Georgia Tech parcel onto the B/K parcel. Engineering controls will be applied to minimize the release of volatile compounds. As described

above, the excavation/treatment alternatives are predicted to result in greater risks than the no-action alternative.

4. **Long-term Effectiveness and Permanence**--If wastes or residuals will remain at the site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude and nature of the risk presented by the remaining wastes; 2) the adequacy of the controls intended to limit the risk to protective levels; and 3) the reliability of these controls.

It is generally preferable to implement remedies that will permanently eliminate any significant threats to human health or the environment, that will minimize or eliminate the need to manage residuals, and will minimize other operation and maintenance functions. The excavation/treatment alternatives provide these characteristics by treating all of the hazardous wastes at the site. They would not, however, provide the highest degree of permanence because unlike liquid wastes, significant quantities of residual wastes would remain in the form of stabilized ash. Wherever finally disposed, the ash would have the potential of eventually leaching out metals and producing contaminated groundwater.

Although only small amounts of the total waste mass would be treated, the containment alternatives would provide an adequate degree of long-term effectiveness and permanence. The magnitude and nature of the risks presented by the remaining wastes would be acceptable given the adequacy and reliability of the controls used to limit these risks. If the type or volume of contaminants released by the site were to significantly change over time, mitigative measures could be taken to address any new threats.

For example, if highly toxic compounds not currently detected at the site were found in groundwater that discharges to the Ramapo River, a groundwater collection and treatment system similar to that described in B/K Alternative 5 could be installed that would prevent the release of these contaminants. If the type or volume of gas emissions were to significantly change, modifications could be made to the gas collection/treatment system to address those problems. This could include conversion from a passive to an active collection system or the use of an alternate treatment system. Other technical and administrative solutions would also be available as described in the RI/FS Report.

5. **Reduction of Toxicity, Mobility, or Volume**--Preference is given to alternatives that permanently, and by treatment, significantly reduce the toxicity, mobility, or volume of the wastes at the site. This includes assessing the fate of the residues generated from treating the wastes at the site.

The excavation/treatment alternatives would significantly reduce the toxicity, mobility, and volume of the wastes whereas the containment alternatives would only reduce the mobility of the wastes. The excavation/treatment alternatives would reduce the toxicity of organic contaminants by thermal destruction. Mobility would be reduced by chemically treating the resulting ash to prevent the release of heavy metals. Volume would be reduced by segregating out non-hazardous wastes and incinerating the rest.

The containment alternatives would reduce the mobility of the wastes by minimizing the production of leachate and by collecting and treating landfill gases (except for B/K Alternative 2 which does not include a gas collection or treatment component). Both sets of alternatives would generate residues. Excavation/treatment would produce air emissions, treated ash, and groundwater treatment residues. The containment alternatives would generate gas and water treatment residues (e.g. spent activated carbon, metals sludges, depending on the actual method employed).

6. **Implementability**--The technical and administrative feasibility of implementing the alternative is evaluated. Technically, this includes the difficulties associated with the construction and operation of the alternative, the reliability of the technology, and the ability to effectively monitor the effectiveness of the remedy. Administratively, the availability of the necessary personnel and materiel is evaluated along with potential difficulties in obtaining special permits, rights-of-way for construction, etc.

Even though all of the potential alternatives are technically implementable, there are significant differences in the level of difficulty to construct and operate the remedies. Although the capping activities anticipated for the containment alternatives are well established, the physical nature of the wastes could present difficulties in establishing the final grades of the slopes. Minimizing the release of contaminants during these activities would require special attention. The installation of the gas extraction vents would be difficult due to the problems encountered when drilling through construction and demolition debris. The installation methods for a geomembrane as the impermeable component of the final cover are well established but requires special techniques and experienced personnel. The materials and personnel needed would be readily available.

The greatest challenges to implementing the excavation/treatment alternatives would be materials handling and the availability of incinerator capacity. Unlike liquids and some soils, the wastes at this site would need to be highly processed before they could be incinerated. Items such as reinforced concrete, railroad ties, structural steel, and white goods (e.g. refrigerators) would need to be either segregated and decontaminated or crushed into small pieces before being incinerated. Nearly all of the 500,000 cubic yards of waste would require some form of preparation. This process would exacerbate the release of volatile compounds.

The implementability of the on-site incineration/ash burial sub-alternative is uncertain since there is a good possibility that before redeposition, a liner system with leachate collection capabilities would need to be installed. Without removing all wastes from the site, the liner would have to be installed in small segments as the bottom of the site is exposed. This may not be feasible.

The very large quantities of waste to treat would monopolize scarce incinerator resources. If additional capacity was needed, a significant delay would be realized while the siting, design, construction, and permitting process was completed. The use of on-site incinerators could face administrative feasibility problems if projected air emissions were thought

to be unacceptable or there was significant local resistance to the installation and operation of multiple incinerators in the community.

7. Cost--Capital and operation and maintenance costs are estimated for the alternatives and compared on a present worth basis. Although cost is the last criterion evaluated, where two or more alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for final selection.

To simplify the presentation of the cost analysis, the B/K and GT alternatives are grouped into likely combinations and the resulting costs are added together. Each of the alternatives includes a monitoring component which is not stated explicitly in the following definitions. These alternatives are designated by Roman numerals and are defined below:

Estimated Costs (Present Worth) of Alternatives

Alt. I: No action = B/K 1 + GT 1.....$1,972,000

Alt. II: Non-vented cap = B/K 2 + GT 2.....$6,284,000

Alt. III: Vented cap + passive gas collection and treatment = B/K 3 + GT 2.....$8,535,000

Alt. IV: Vented cap + active gas collection and treatment = B/K 4 + GT 2.....$9,281,000

Alt. V: Vented cap + active gas collection and treatment + vertical groundwater barrier + groundwater collection and treatment = B/K 5 + GT 2.....$24,359,000

Alt. VI: Excavation + off-site incineration and disposal + groundwater collection and treatment = B/K 6 + GT 3..$1,040,080,000

Alt. VII: Excavation + on-site incineration and treatment + groundwater collection and treatment = B/K 7 + GT 4....$259,622,000

Modifying Criterion - This final criterion is taken into account after evaluating those above. It is focused upon after public comments on the proposed remedial action plan have been received.

8. Community Acceptance--Concerns of the community regarding the RI/FS Reports and the Proposed Remedial Action Plan are evaluated. The Responsiveness Summary (Exhibit C) for this project identifies those concerns and presents the Department's responses to those concerns.

IX. SELECTED REMEDY

The remedy selected for the site by the NYSDEC was developed in accordance with the New York State Environmental Conservation Law (ECL) and is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC Section 9601, et. seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Based upon the results of the Remedial Investigation and Feasibility Study (RI/FS), and the criteria for selecting a remedy, the NYSDEC has selected a combination of B/K Alternative 3 and GT Alternative 2 to remediate the site (vented cap + passive gas collection and treatment + consolidation of GT wastes + monitoring). The estimated cost to implement the remedy (present worth) is $8,535,000. The cost to construct the remedy is estimated to be $4,971,000 and the average annual operation and maintenance cost is estimated to be $203,000.

The elements of the selected remedy are as follows (see also Figure 10):

1. A **remedial design program** to verify the components of the conceptual design and provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program. A **gas collection and treatment pilot study** will be carried out as part of the design program to verify the adequacy of the proposed gas collection and treatment system.

2. **Excavation and consolidation of wastes** to minimize the final size of the site. Wastes in the northeast corner of the Georgia Tech parcel will be excavated and used to grade the main site. Clean fill will be imported as necessary to stabilize and revegetate this corner. Wastes currently encroaching along the railroad right-of-way along the eastern border of the site will be removed and redeposited on the site.

3. Installation of a **vented final cover** to minimize the infiltration of precipitation and collect gases generated by the wastes. An adequate number of gas collection points will be installed around the perimeter and interior of the site to prevent the uncontrolled release of gases to the atmosphere. The major elements of the final cover will include vegetated top soil, a barrier protection layer, a drainage layer, a gas/water barrier (e.g. geomembrane), and a gas collection layer.

4. Installation and operation of a **passive gas collection and treatment system**. Gases collected in the final cover system will be conveyed through suitable piping to treatment modules containing regenerable activated carbon. Appropriate carbon will be selected so that both hydrogen sulfide and volatile organic compounds will be removed.

5. A **surface water diversion program** will be completed to reduce the run-on of precipitation to the extent feasible. This will help to reduce the amount of water that infiltrates the site and produces leachate. After an appropriate design program is completed, water currently running onto the southwestern portion of the site from the west side of State Route 17 will be diverted to the south and eventually to the Ramapo River. This will likely require the installation of an additional culvert under Route 17 to accommodate the increased flow. Additional improvements will be made as needed along the western and southern sides of the site to minimize the amount of run-on.

6. **Restrictions on the use of the site** will be put into place to ensure that the integrity of the remedy is not damaged or compromised. This will include restrictions on excavations into the cover or any other

activities that would reduce the effectiveness of the remedy (e.g. interfering with the gas collection/treatment system).

7. An **environmental monitoring program** to evaluate the performance of the remedial program.

The performance standards to be obtained by implementing the remedy include the following:

1. Prevent off-site exceedances of the one-hour ambient air standard for hydrogen sulfide of 0.01 parts per million (ppm).

2. Prevent off-site concentration exceedances of volatile organic compounds in ambient air that would result in an added risk of cancer of greater than one in one million or a hazard index greater than one (for noncarcinogens) at the nearest receptor.

3. Prevent the release of contaminated groundwater to the Ramapo River that would result in exceedances of surface water quality standards downstream of the site.

X. STATUTORY DETERMINATIONS

The following discussion describes how the remedy complies with the decision criteria in the laws and regulations.

1. Protection of Human Health and the Environment

The selected remedy will control risks to human health and the environment by reducing the release of contaminants to the groundwater, surface water, and air pathways. The combination of an impermeable cover along with the diversion of run-on will reduce the amount of water that infiltrates the site and subsequently produces contaminated groundwater. Since the release of contaminated groundwater is the mechanism for the contamination of surface water and sediments, reducing the release of groundwater will directly reduce the contaminant loadings to the river. The installation and operation of a passive gas collection and treatment system will reduce the release of contaminants to the air and the associated risks. No unacceptable short-term risks or cross-media impacts will be caused by implementation of the remedy.

2. Compliance with ARARs

The implementation of the selected remedy should result in compliance with all ARARs except for the attainment of on-site groundwater standards. The requirements for site closure will be met by the installation of an engineered final cover system as described above. Ambient air standards will be attained by the installation of a gas collection and treatment system. Surface water quality standards will be met by reducing the release of contaminants to the Ramapo River.

If public monies are used to remediate the site, an applicable waiver of the on-site groundwater standard would be that taking the extraordinary steps needed to attain the ARAR would not provide a balance between the need for

protection of human health and the environment at the site and the availability of public monies to to respond to other sites that may present a threat to human health and the environment. Also, as discussed above, it is possible that the excavations needed to treat all of the wastes may result in the creation of a greater overall threat by resulting in the release of volatile chemicals.

3. Cost-Effectiveness

Of the alternatives that can achieve the remedial goals and meet the threshold evaluation criteria, the selected remedy has the lowest cost.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable.

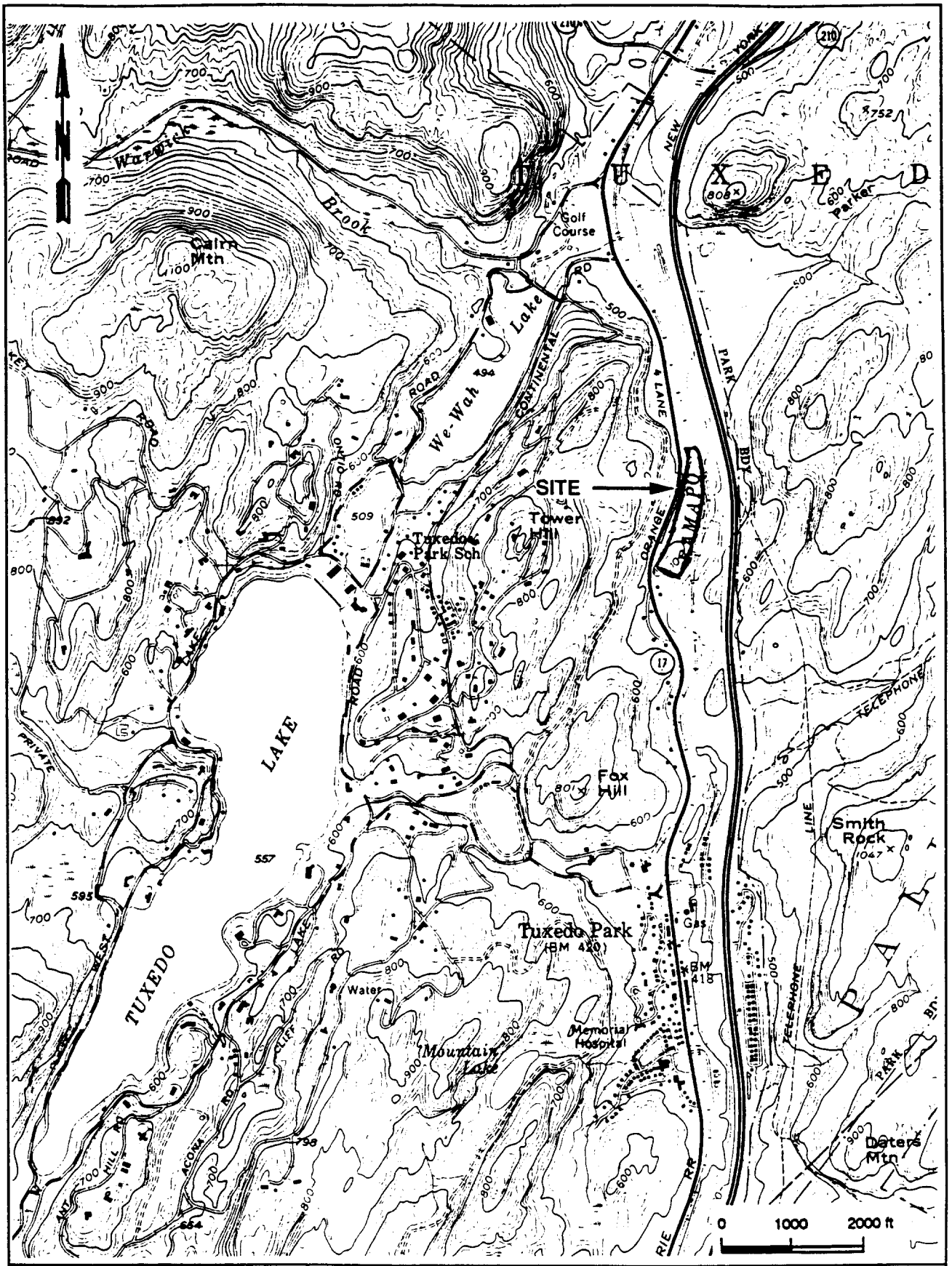
The NYSDEC has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the State has determined that this remedy provides the best balance of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume, short-term impacts and effectiveness, implementability, and cost, also considering the statutory preference for treatment as a principal element.

While the selected remedy does not offer as high a degree of long-term effectiveness and permanence as the excavation/treatment alternatives, it will significantly reduce the inherent hazards posed by the release of air and groundwater contaminants. Additionally, the incineration options, while resulting in fewer residuals requiring long-term management, would nonetheless require land burial of the metal contaminated ash. The selected remedy can be implemented more quickly, with less difficulty and at less cost than the excavation/treatment alternatives and provides the best balance and versatility among the containment alternatives. Therefore, the selected remedy is determined to be the most appropriate solution for the site.

5. Preference for Treatment as a Principal Element

Although the overall amount of contaminants released by the site is reduced and soil gases released by the site are treated using regenerable activated carbon, the principal element of the remedy is containment, not treatment. Therefore, the statutory preference for remedies that employ treatment as a principal element is not completely satisfied. However, in accordance with the analysis given above, it has been determined that this preference has been satisfied to the extent practicable given the conditions at the site and the extraordinary measures needed to incorporate treatment as a principal element.

FIGURES



Metcalf & Eddy of New York, Inc.	TUXEDO WASTE DISPOSAL SITE ORANGE COUNTY, NEW YORK	FIGURE 1 SITE LOCATION MAP

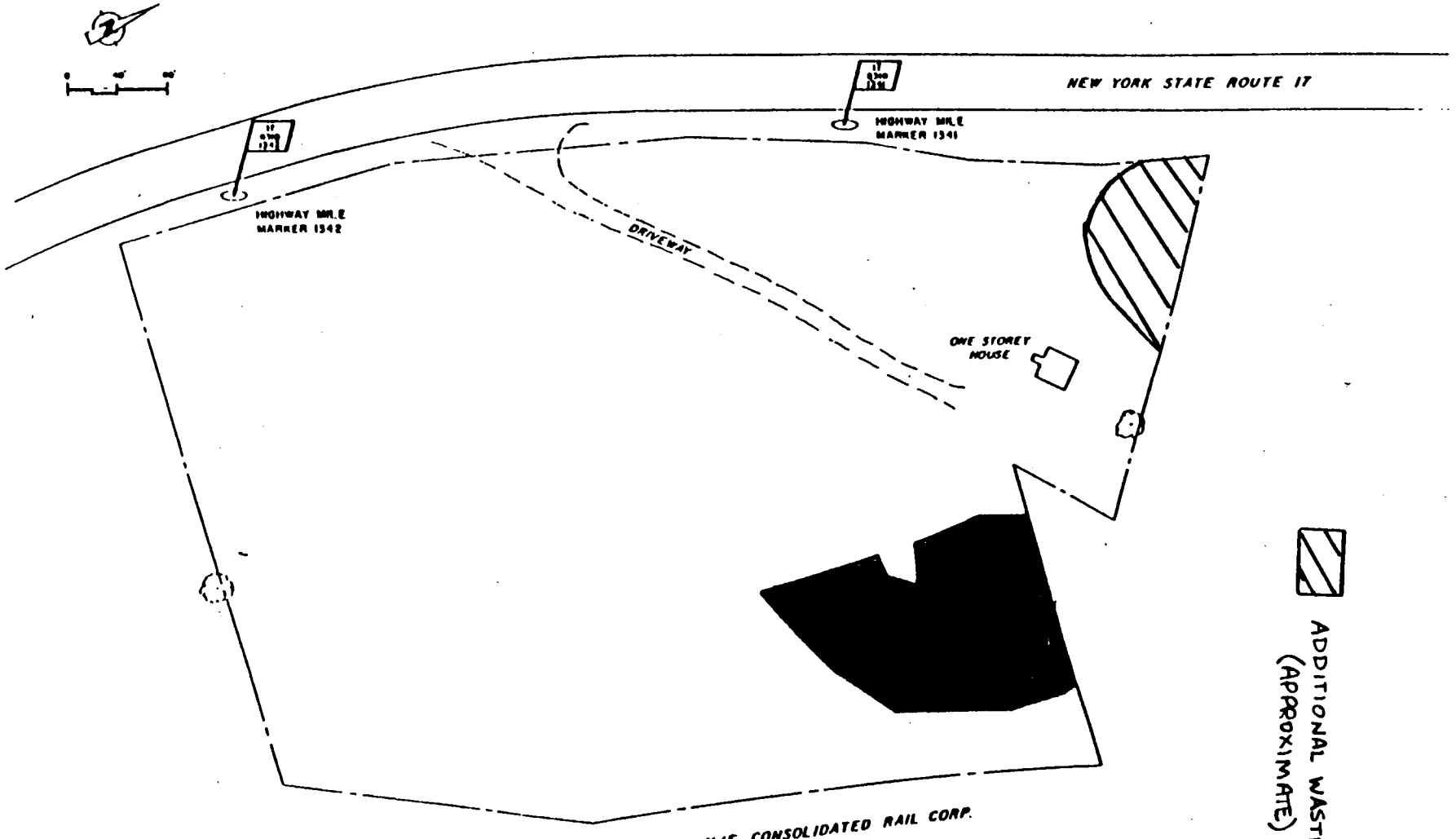
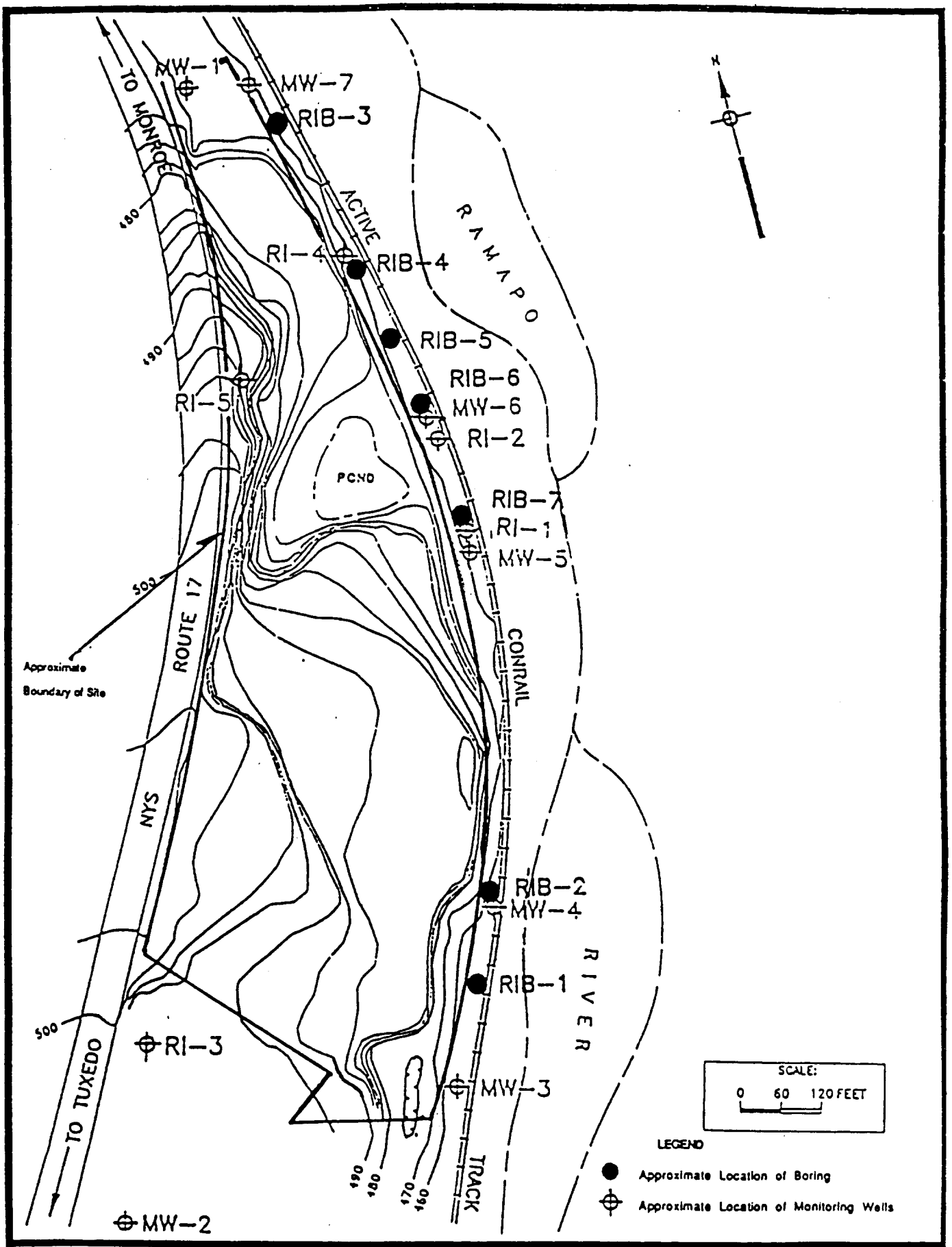


Figure 2
GEORGIA TECH FOUNDATION
Tuxedo, New York

CRA

2464 1/09/88 1 D 1



M&E Metcalf & Eddy	TUXEDO WASTE DISPOSAL SITE ORANGE COUNTY, NEW YORK	FIGURE 3 SOIL BORING AND MONITORING WELL LOCATION MAP

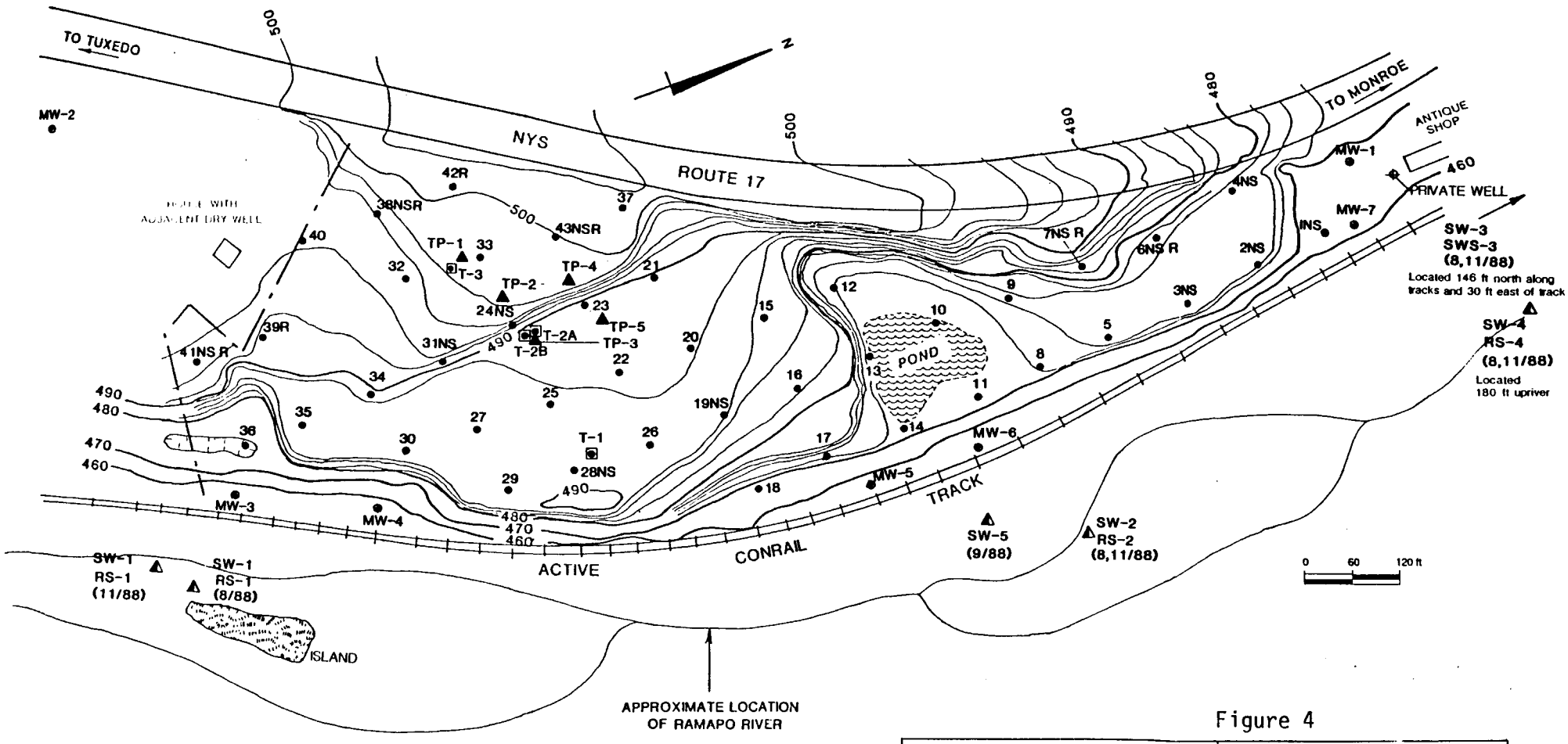


Figure 4

LEGEND		SOIL GAS, TRENCH, TEST PIT, MONITORING WELL, SURFACE WATER, AND SEDIMENT LOCATION MAP
● Soil survey point	▲ Surface water sediment	Tuxedo Waste Disposal Site NYSDEC I.D. No. 336035 1988 NYSDEC PHASE II INVESTIGATION
▣ Trench location	NS Not surveyed (location approx.)	
● Monitoring well	R Rotusal, point could not be installed	LAWLER, MATUSKY & SKELLY ENGINEERS Pearl River, New York
▲ Test pit		

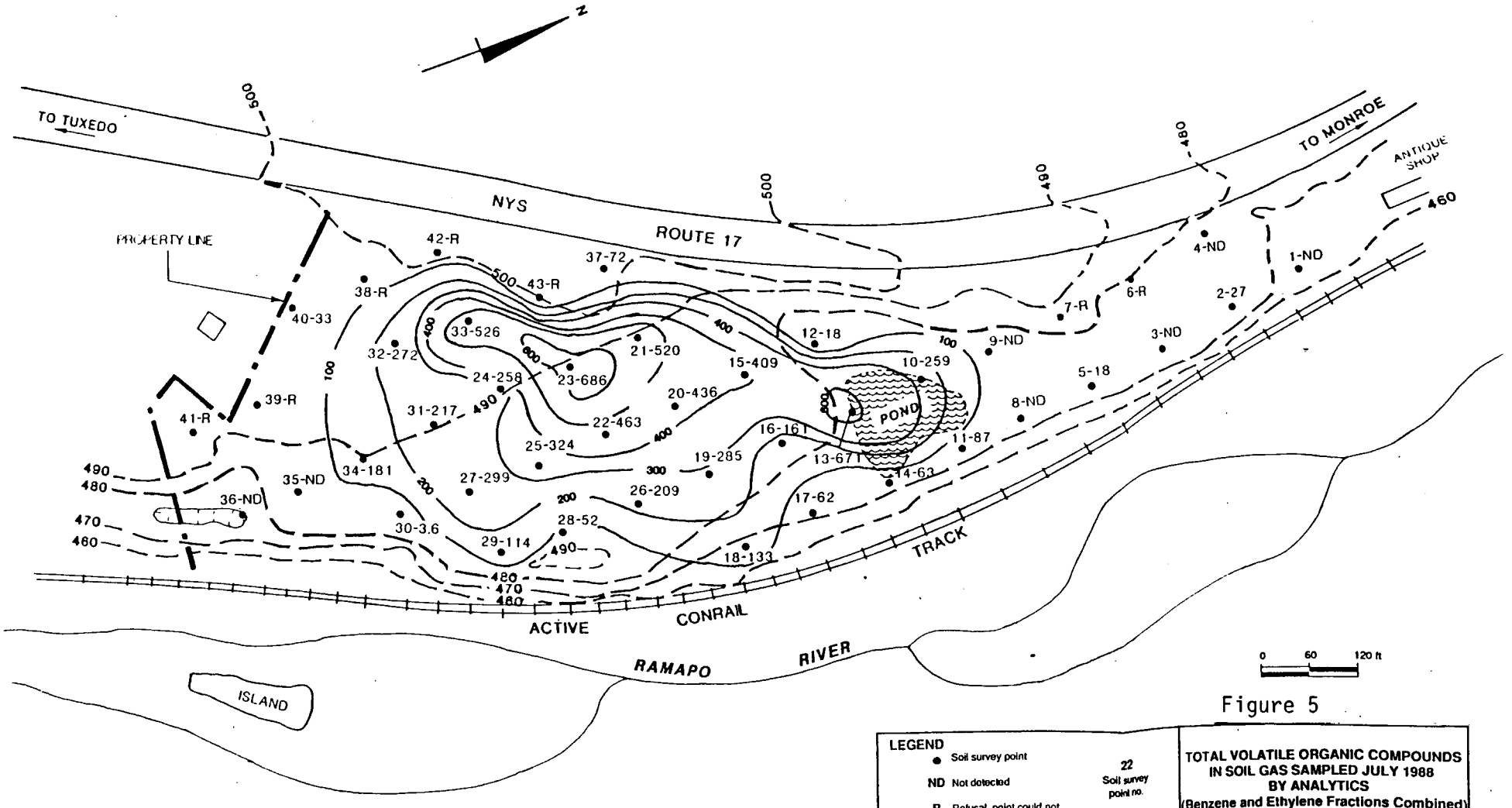


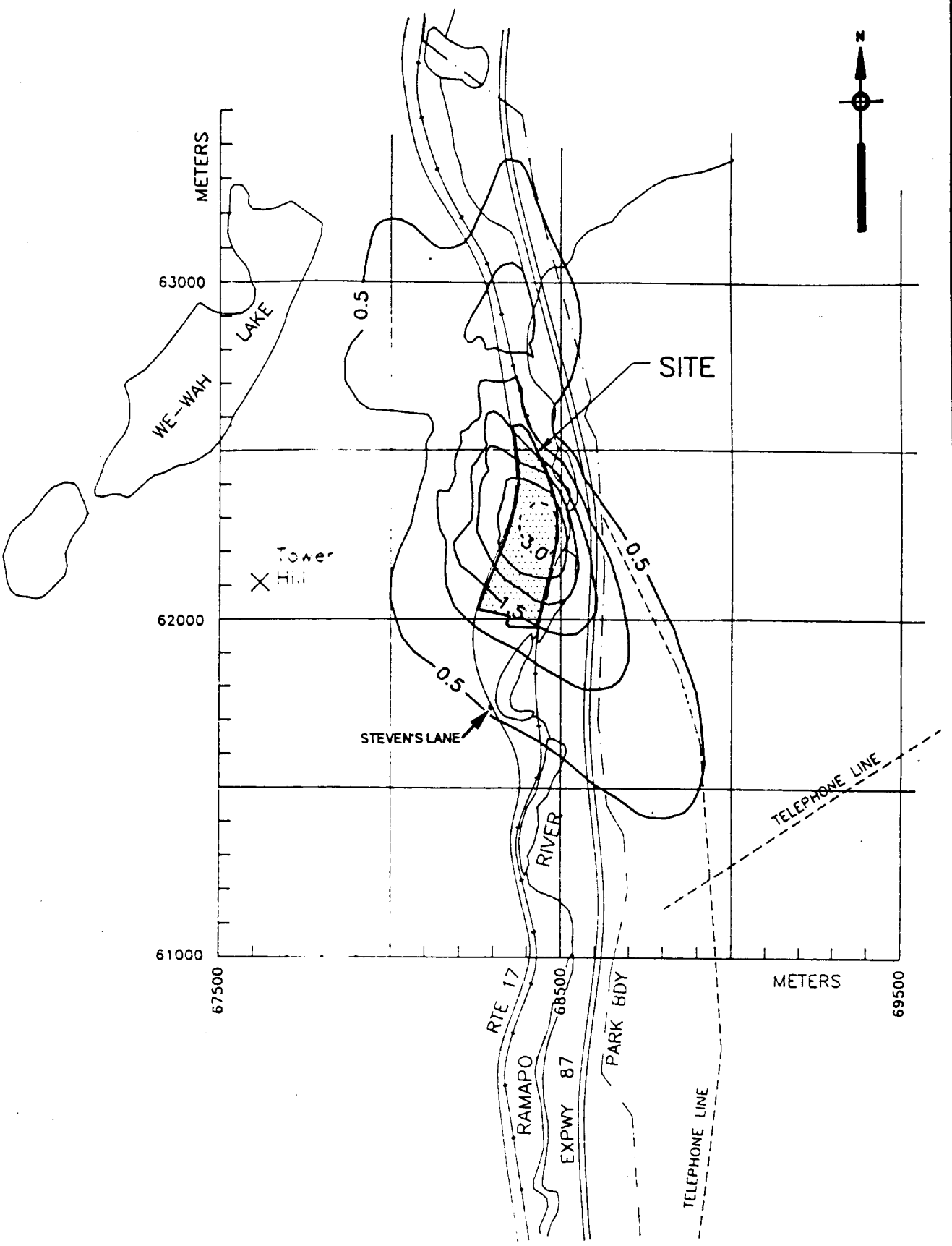
Figure 5

LEGEND

- Soil survey point
- ND Not detected
- R Refusal, point could not be installed
- Topography contours
- Concentration (ppm) contours
- 22 Soil survey point no.
- 350 Concentration (ppm)

TOTAL VOLATILE ORGANIC COMPOUNDS IN SOIL GAS SAMPLED JULY 1988 BY ANALYTICS
(Benzene and Ethylene Fractions Combined)
Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION

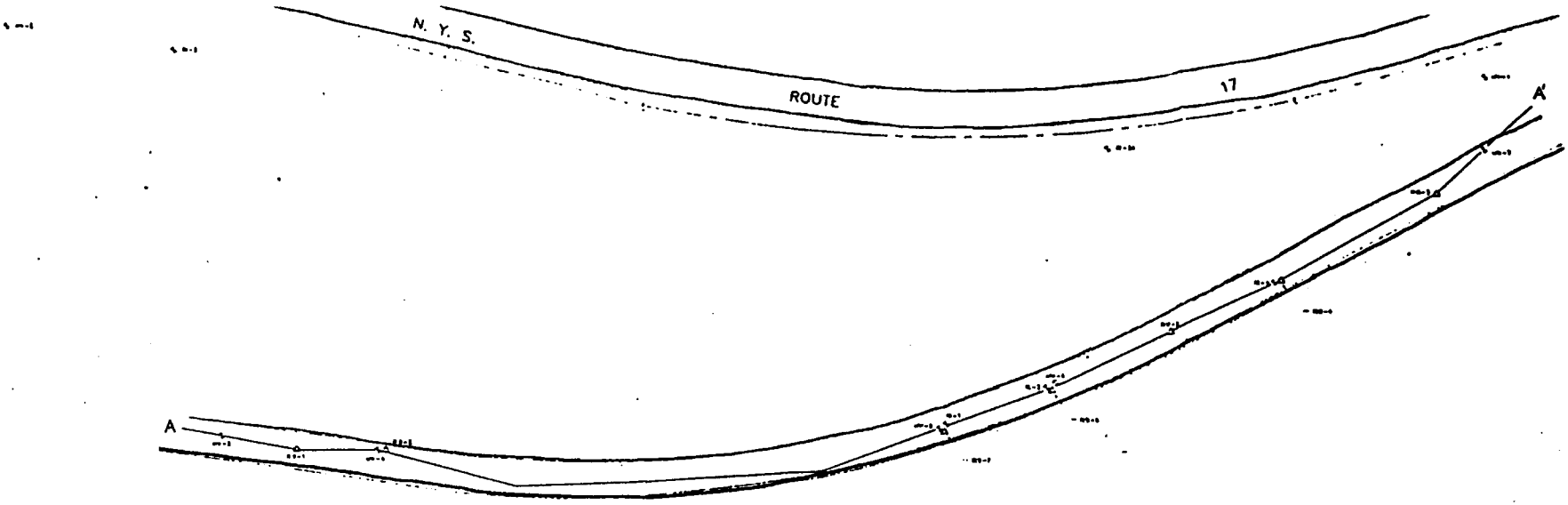
LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

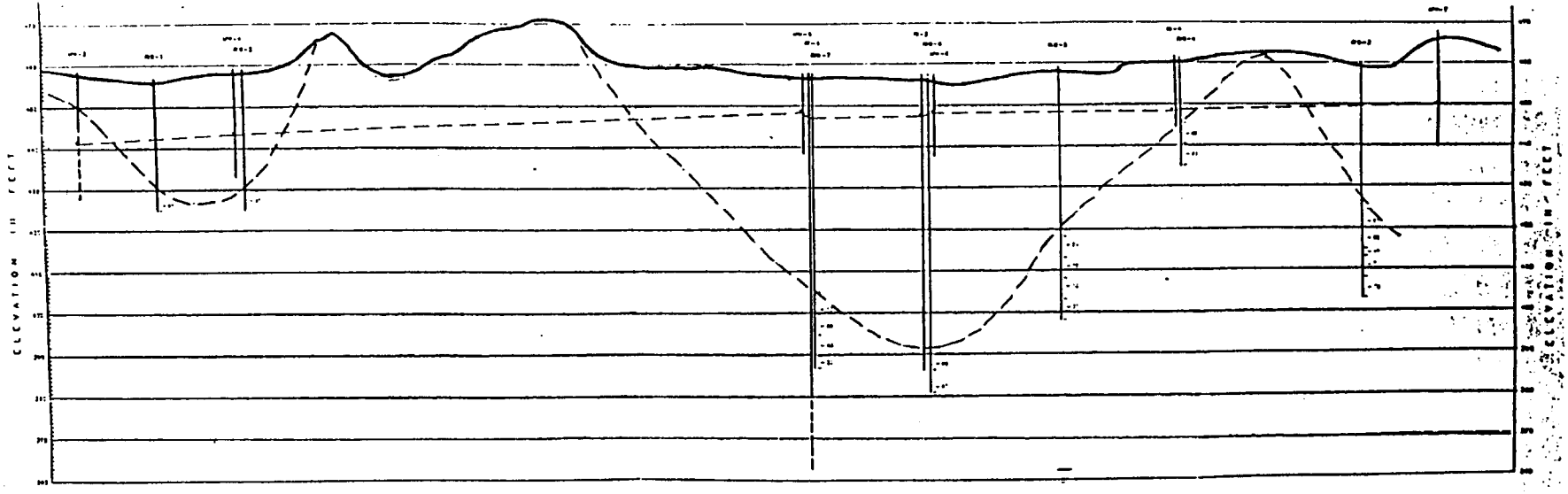


M&E
Metcalf & Eddy

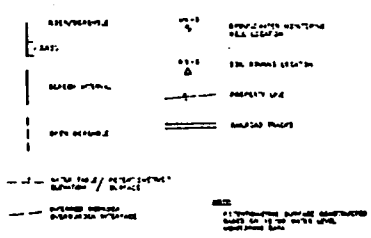
TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

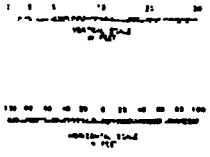
FIGURE 6
AIR EXPOSURE MODEL MAXIMUM
POTENTIAL CANCER PER MILLION





LEGEND



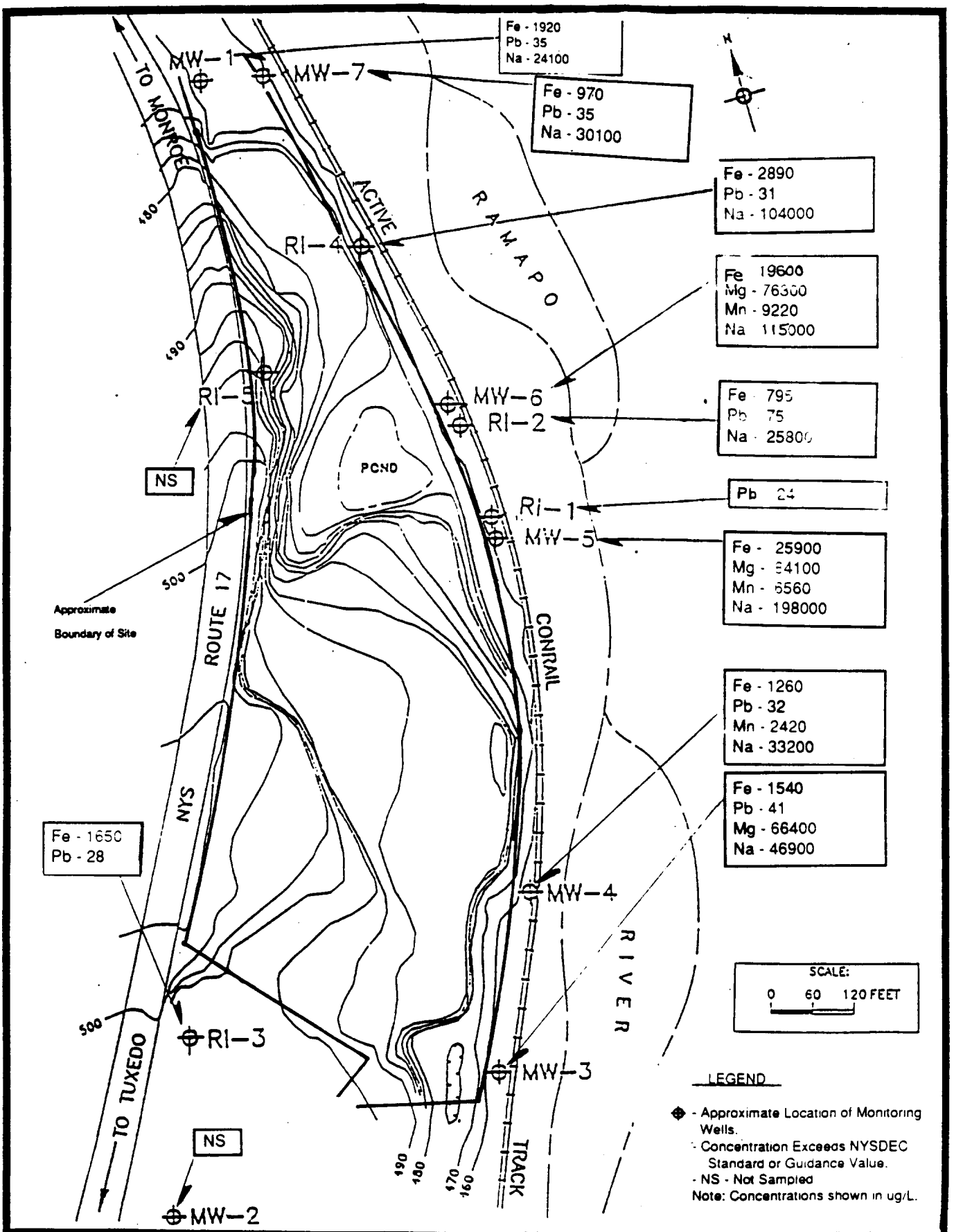


M&E

TUTHILL WASTE DISPOSAL SITE

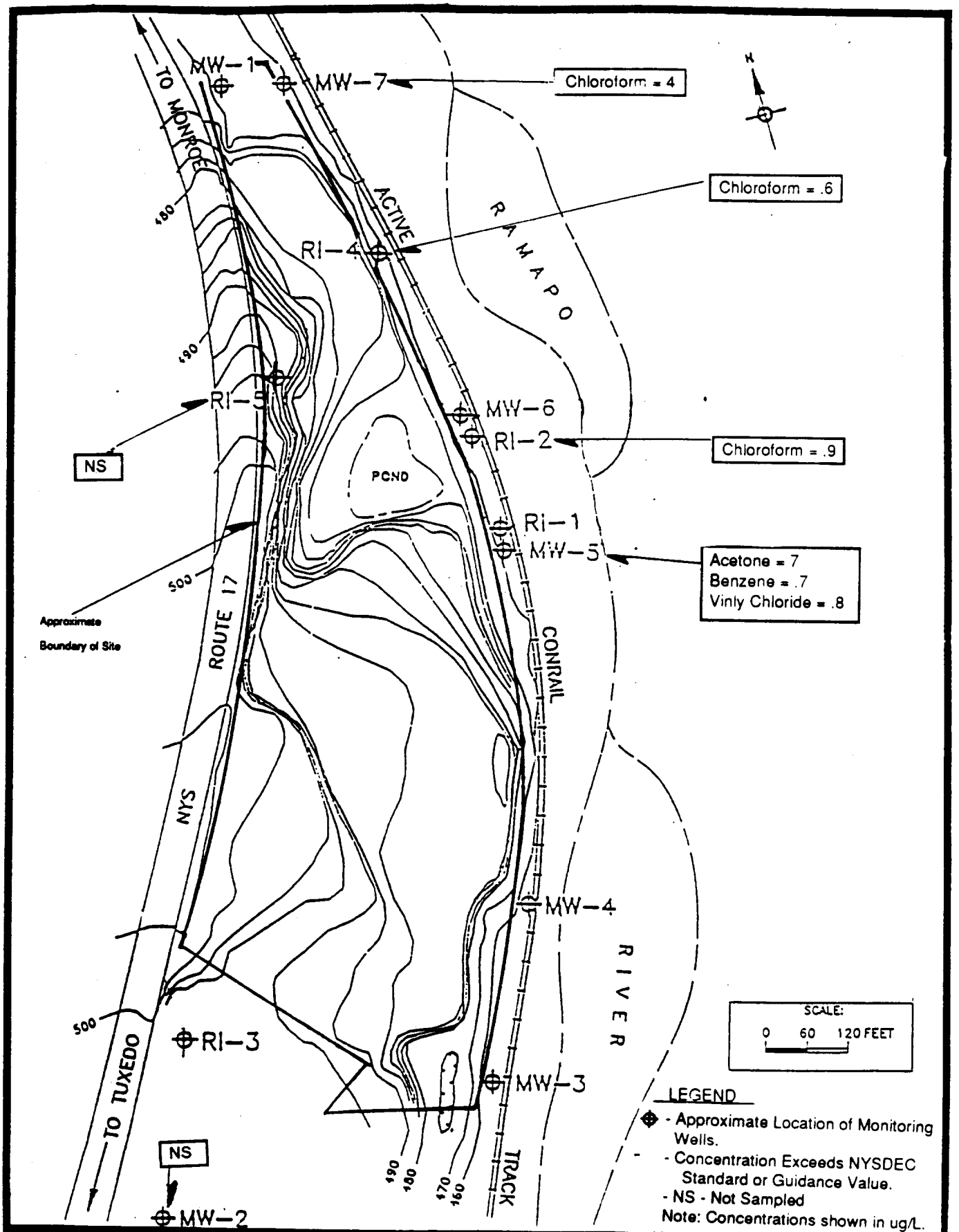
FIGURE 7

GEOLOGIC CROSS SECTION A-A'



Metcalf & Eddy of New York, Inc.

FIGURE 8
WELLS CONTAINING METAL CONCENTRATIONS EXCEEDING NEW YORK STATE STANDARDS AND GUIDANCE VALUES (1991)



Metcalf & Eddy of New York, Inc.

FIGURE 9
ORGANIC COMPOUNDS DETECTED IN MONITORING WELLS (1991)

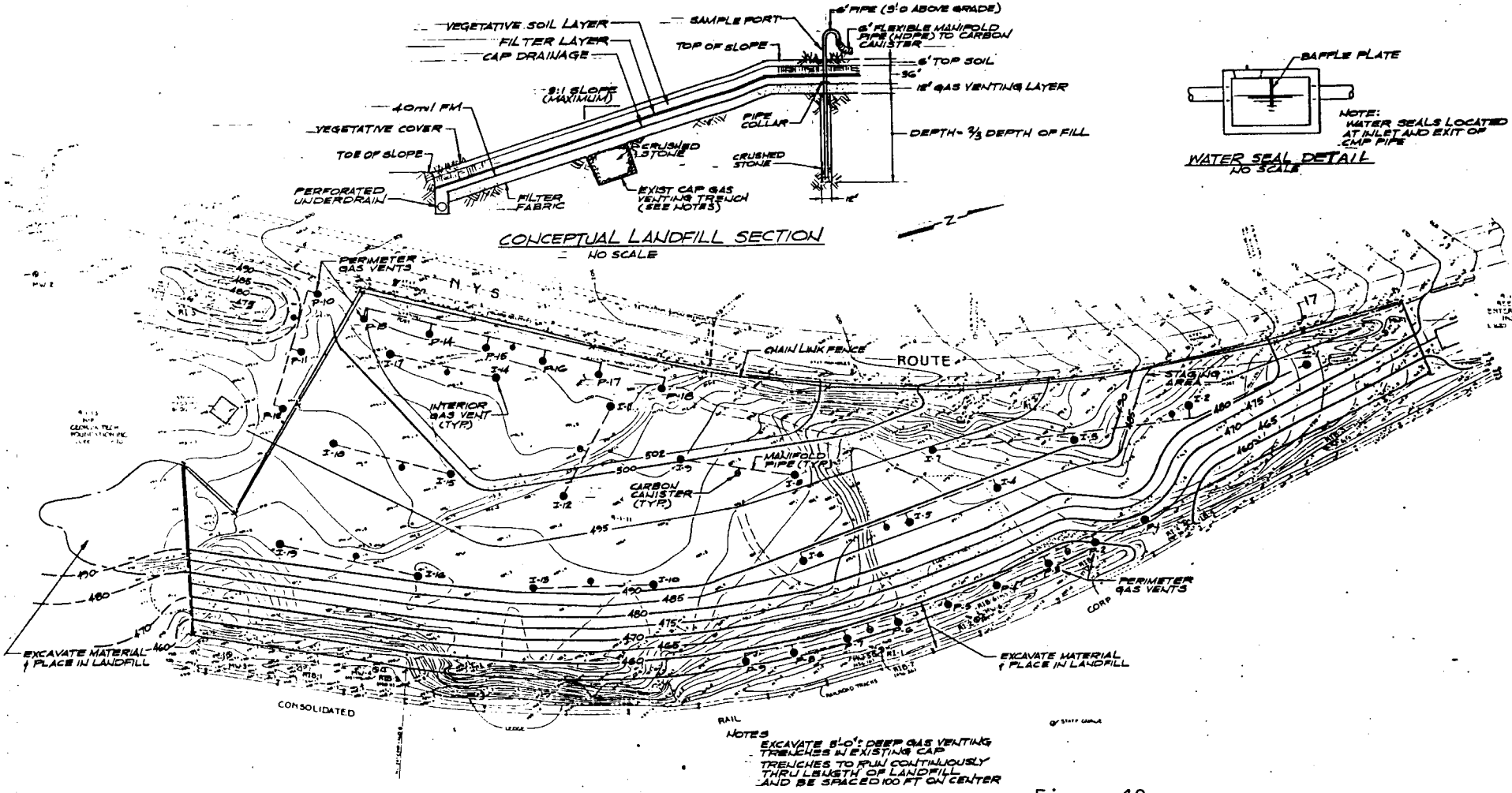


Figure 10

CONCEPTUAL LANDFILL CLOSURE PLAN
TUXEDO WASTE DISPOSAL SITE, ORANGE CO. N.Y.

50 0 50 100
SCALE IN FEET

M&E Metcalf & Eddy

TABLES

TABLE 1

MEDIA AND CONTAMINANTS OF CONCERN
TUXEDO WASTE DISPOSAL SITE

Contaminants of Concern	Media				
	Air/ 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			

Volatile Organic Compounds:

Toluene
Trichloroethylene
Carbon tetrachloride*
1-2 dichloroethane
Xylene
Benzene
Ethyl benzene
Freon 113
Chloroform

Semi-Volatile Organic Compounds:

Fluoranthene
Pyrene*
Chrysene
Phenols
Naphthalene
2-methylnaphthalene
Acenapthene
Dibenzofuran
Fluorene
Phenanthrene
Bis (2-ethylhexyl)phthalate
Benzo(a) anthracene
Benzo(b) fluoranthene
Benzo(a) pyrene

Metals:

Aluminum
Arsenic
Cadmium
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Sodium
Selenium*
Silver
Zinc

* Listed based on prior investigations The M&E Remedial Investigation did not find contaminant at levels of concern.

TABLE 2 (Page 1 of 7)

TUXEDO PHASE II 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	32B	95	9J	77	44	NR	110
Acetone	1,300E	870	190	570B	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	39000D	13000
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND
Fluorene	10000	ND	4000	2800	52000	48000D	17000
Phenanthrene	56000	9700	26000	18000	220000	200000D	53000E
Anthracene	12000	2000	5200	3800	42000	40000D	15000
Di-n-butylphthalate	ND	2400	ND	ND	ND	9600JB	2400
Fluoranthene	59000	13000	25000	24000	140000	160000D	50000E
Pyrene	44000	11000	22000	19000	120000	87000D	42000E
Butylbenzylphthalate	5700J	31000	5200	2200	67000	58000D	3200
Benzo(a)anthracene	25000	5500	9400	8900	34000	34000D	15000
Bis(2-ethylhexyl)phthalate	52000	28000B	20000	550008E	21000	18000JD	22000B
Chrysene	22000	5100	10000	8200	33000	35000D	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.

TABLE 2 (Page 2 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A		3B
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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
C12H1602 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.

TABLE 2 (Page 3 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

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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	ND	ND	ND	ND	ND	ND
Unknown hydrocarbon	ND	10400J (2)	ND	73600J (9)	ND	ND	55400J (4)
Unknown ketone	ND	13200J (2)	ND	ND	ND	ND	12200J (2)
Unknown PAH	ND	6000J (2)	ND	ND	ND	ND	39800J (2)
Unknown substituted benzene	ND	1400J	ND	ND	ND	ND	11000J
5-Hexen-2-one, 5-methyl	ND	ND	ND	9300J	ND	ND	ND
3-Heptanone,2,4-dimethyl	ND	ND	ND	2600J	ND	ND	ND
Limonene	ND	ND	ND	1300J	ND	ND	ND
1,2-Ethanediol, monoacetate	ND	ND	ND	1300J	ND	ND	ND
1,4-Methanonapthalene, 1,4-	ND	ND	ND	2000J	ND	ND	ND
Heptadecane, 2,6-dimethyl	ND	ND	ND	3200J	ND	ND	ND
Pentatriacontane	ND	ND	ND	20000J	ND	ND	ND
Heptadecane, 2,6-dimethyl	ND	ND	ND	12000J	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.

TABLE 2 (Page 4 of 7)

TUXEDO PHASE II 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	SH336035-26MS	SH336035-26MSD	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	290000	3700	1100J	ND	29000	14000	2200	3600
Phenanthrene	300000E	2300000	17000	5600	4500	26000E	85000	1300	26000
Anthracene	60000	480000	2500	1900J	ND	54000	21000	2700	4900
Di-n-butylphthalate	ND	98000JDB	990J	ND	1100	ND	2500J	4300	4100
Fluoranthene	360000E	3000000	23000	11000	6600	28000E	90000	16000	37000E
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.

TABLE 2 (Page 5 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo MD 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	SH336035-26MS	SH336035-26MSD	SH3360-36MS	SH3360-36MSD
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	350000	43000BE	13000	46000BE	13000	18000	87000BE	160000BE
Chrysene	140000	1100000	11000	5000	3300	93000	30000	6500	17000
Benzo(b)fluoranthene	200000X	200000XD	12000	6900X	3700	150000X	46000X	6500	17000
Benzo(k)fluoranthene	200000X	200000XD	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	29000	310000	4200	ND	1500	26000	13000	2700	6700
Dibenzo(a,h)anthracene	11000J	9000JD	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
C12H1602 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.

TABLE 2 (Page 6 of 7)

TUXEDO PHASE II 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	SH336035-26MS	SH336035-26MSD	SH3360-36MS	SH3360-36MSD
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	19000J	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	28F	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.

TABLE 2 (Page 7 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo MD 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	27200	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	39800000	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	48300	55200
Zinc	890000E*	1410000E*	531000E*	1450000E*	1560000E*	534000E*	738000E*	1180000E*	210000E*	3440000E*
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.

TABLE 3

PRELIMINARY SCREENING
FILL WASTE/SOIL TREATMENT ALTERNATIVES

Response Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability
Fill Waste/Soil (Tuxedo Site)	Institutional	None	Not applicable	May not achieve remedial action objectives.	None related to specific GRA
		Access Restriction	Fencing	Effective in restricting access to exposed areas of contamination. May not achieve remedial action objectives.	Readily implementable using locally available materials and equipment. Susceptible to vandalism. Requires maintenance and monitoring.
		Land Use Restrictions	Deed restrictions	Effectiveness dependant upon continued future implementation. Does not reduce contamination.	Dependent upon legal requirements and authority. Difficult to implement. Requires owner's consent.
	Containment	Surface Cap	Layered soil	Effective in providing a physical barrier between fill waste and surface when properly maintained and implemented in conjunction with institutional GRAs. Least susceptible to cracking. May not meet remedial action objectives alone.	Readily implementable using conventional construction requirements. Materials and equipment available.
			Asphalt	Effective in providing a physical barrier between fill waste and surface when properly maintained. Susceptible to cracking. May not meet remedial action objectives alone.	Implementability dependant upon availability of materials. Soil gas collection system may be needed.
			Synthetic material	Effective in providing a low permeability barrier between fill waste and surface. Increased effectiveness when implemented in conjunction with alternate process options. May not meet remedial action objectives alone. Does not reduce volume or toxicity of waste alone.	Readily implementable. Soil gas collection system probably necessary.

TABLE 3 (continued)

PRELIMINARY SCREENING
FILL WASTE/SOIL TREATMENT ALTERNATIVES

Response Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability
Fill Waste/Soil (Tuxedo Site) Continued	Removal	Excavation	Excavation/Transportation/ Disposal	Effective in removing source of contamination. Short-term exposure risks high. May achieve remedial action objectives. Massive potential risks if accident occurs while transporting untreated material off-site. Does not reduce volume or toxicity of waste alone.	Questionable implementability made difficult by presence of combustible gases, unknowns within the landfill, off site exposure hazards and active railway. Requires on-site treatment prior to disposal or identification of suitable TSD facility for disposal of fill waste/soil.
			Excavation/ Treatment/Disposal (Transportation - if off-site treatment)	Same as above with treatment options. See "Off-site Incineration" below.	Similar potential operational hazards as above.
	Treatment	Thermal	Incineration (on-site)	Effective in removal and destruction of certain contaminants. Reduction of volume through incineration of fill waste. Increase in metals toxicity through concentration in ash residue.	Implementability moderately difficult. May need prior crushing and grinding. Disposal of incinerator bottom and fly ash required. Permits may be required and difficult to meet limits. Requires construction of processing unit and staging areas on site. Disposal of ash may be a problem due to metals content
			Incineration (off site)	Same as above with transportation to TSD facility.	Difficult to implement due to off-site facility's ability to take this type of material with these types and levels of contaminants. May need prior crushing and grinding.
		Stabilization (on site)	Various	Effective in reducing mobility of certain contaminants by combining with stabilizing agents. Large increase in volume of waste through addition of stabilizing agent. May not be suitable for certain types of waste.	Moderate implementability. Need to construct processing and staging areas on site. May need prior crushing and grinding. Volume of treated material may not be landfilled due to lack of landfill space.

TABLE 3 (continued)

PRELIMINARY SCREENING
FILL WASTE/SOIL TREATMENT ALTERNATIVES

Response Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability
Georgia Tech Fill Waste	No action	None	Not applicable	Does not achieve remedial action objective.	Readily implementable
	Institutional	Access/Land Use Restrictions	Fencing/deed restriction	See "Institutional GRA" under fill waste/soil response media.	See "Institutional GRA" under fill waste/soil response media.
	Containment	Surface Cap	Layered soil asphalt synthetic material	See "Containment GRA" under fill/waste soil response media.	Difficult to implement due to slope problems, proximity of property to rail line, and drainage problems.
	Relocation	Excavation	Conventional construction	Effective in relocating fill waste from Georgia Tech property to Tuxedo Site fill waste area.	Readily implementable but may require special equipment to excavate materials.
	Removal	Excavation	Excavation/ Transportation/ Disposal	See "Removal GRA" under fill waste/soil response media. However, short-term risk is lower than B/K Parcel.	Smaller volumes involved may make landfill disposal feasible.
	Treatment	Thermal	Incineration (Off-Site)	See "Treatment GRA" under fill waste/soil response media.	Smaller volumes involved may make off-site incineration more feasible.
			Incineration (On-Site)	See "Treatment GRA" under fill waste/soil response media.	Practical only if performed together with Tuxedo fill waste.
		Stabilization	Various (On-Site)	See "Treatment GRA" under fill waste/soil response media.	Most practical if performed together with Tuxedo fill waste, but could be done separately.

TABLE 4

ARARS ASSOCIATED WITH THE TUXEDO WASTE DISPOSAL SITE

Statute, Regulation, or Program	Pertinence	Specificity
CERCLA/NCP/SARA	Applicable to remedial actions taken at CERCLA sites. While the site is not an EPA-designated CERCLA site, applicable regulations will be applied.	• Action-specific
RCRA Subtitle C/HSWA/NY HW Mgmt. Regs.	Applicable to the treatment, storage, transportation and disposal of hazardous wastes and wastes per 40 CFR 260-264 and 6 NYCRR Part 370-373.2. These regulations are applicable to the site's remedial actions. Certain RCRA regulations have been delegated to NYS.	• Action-specific
RCRA Subtitle D/ NY Solid Waste Mgmt. Regs.	Pertains to the management and disposal of solid wastes. The site contains RCRA Subtitle D construction and demolition waste. 6 NYCRR Part 360 is relevant and appropriate. Regulations regarding site closure will be applied. Certain RCRA regulations have been delegated to NYS.	• Action-specific
TSCA	Applicable to disposal of PCB-contaminated items. The bottom layer of the site's cover has low levels of PCB contamination.	• Action-specific • Contaminant-specific
SDWA	Applicable to surface water and area wells which may be utilized for public drinking water. One known private well is in the vicinity of the site. An adjacent water body, the Ramapo River, is a public water supply in New Jersey.	• Contaminant-specific • Action-specific • Location-specific
CAA	Applicable where remedial activities will impact the ambient air quality. Remedial activity options may impact air quality.	• Action-specific • Contaminant-specific

TABLE 4 (Continued)

ARARS ASSOCIATED WITH THE TUXEDO WASTE SITE

Statute, Regulation, or Program	Pertinence	Specificity
CWA	Applicable for alternatives involving all treatment with point-source discharges to surface water.	• Action-specific
OSHA	Applicable to workers and the work place throughout implementation of remedial measures.	• Action-specific • Location-specific
Haz. Materials Transportation	Applicable to the off-site transport of hazardous materials.	• Action-specific
Fish & Wildlife Coordination Act	Applicable to fish and wildlife in the vicinity of any proposed remedial actions, particularly on-site.	• Location-specific
NY Water Quality Regulations	Applicable to sources of potable water supply and for alternatives involving treatment with point source discharges to the waters of NY.	• Action-specific
NY Uniform Procedures Act	Applicable to projects needing an SPDES permit and to the construction/operation of hazardous waste treatment facilities. The site will not require a SPDES permit but will need to comply with the substantive requirements thereof.	• Action-specific

EXHIBITS

EXHIBIT A
ADMINISTRATIVE RECORD
TUXEDO WASTE DISPOSAL SITE (#336035)

A. Reports and Work Plans:

1. "Record of Decision; Tuxedo Waste Disposal Site; Orange County, New York; ID No. 336035," prepared by the New York State Department of Environmental Conservation, dated February 1992.

2. "Proposed Remedial Action Plan; Tuxedo Waste Disposal Site; AKA Barone/Sacco Dump," prepared by the New York State Department of Environmental Conservation, dated January 1992.

3. "Remedial Investigation and Feasibility Study Report; Tuxedo Waste Disposal Site; Site ID No. 3-36-035," three volumes, prepared by Metcalf & Eddy of NY, Inc.

   Volume I: Remedial Investigation Report, dated November 1991.
   Volume II: Remedial Investigation Report Appendices, dated November 1991.
   Volume III: Feasibility Study Report, dated December 1991.

4. "Fire Contingency Plan; Tuxedo Waste Disposal Site; Town of Tuxedo, Orange County, New York; NYSDEC Site ID No. 3-36-035; Standby Contract Work Assignment No. D002406," prepared by Metcalf & Eddy of NY, Inc., dated, May 1991.

5. Remedial Investigation/Feasibility Study Work Plan (seven volumes): prepared by Metcalf & Eddy of NY, Inc.

   Volume 1: Memorandum Report on Health and Safety Reconnaissance; dated April 1990.
   Volume 2: Summary NYSDEC Phase II Report and Related Information; dated April 1990.
   Volume 3: Summary Analysis Potential Remedial Alternatives; dated April 1990.
   Volume 4: Final Work Plan; dated June 1990.
   Volume 5: Field Activities Plan: Appendix I; dated April 1990.
   Volume 6: Health and Safety Plan: Appendix II; dated April 1990.
   Volume 7: Quality Assurance Project Plan: Appendix III; dated April 1990.

6. Modifications to RI/FS Work Plan:

   Letter dated July 24, 1990 from A. English (NYSDEC) to M. Kittinger (M&E of NY, Inc.) Re: changes to IRMs;
   Letter dated September 14, 1990 from A. English (NYSDEC) to M. Kittinger (M&E of NY, Inc.) Re: changes to sampling procedures;
   Letter dated December 13, 1990 from A. English (NYSDEC) to M. Kittinger (M&E of NY, Inc.) Re: cancellation of pump tests;

7. Data Validation Reports; prepared by NYTEST Environmental, Inc:

   June 3, 1991: SDG046;
   June 1, 1990: SDG043, SDG044;

April 19, 1991:	SDG046;
April 15, 1991:	SDG043, SDG044;
March 13, 1991:	SDG040, SDG041, SDG042;
February 25, 1991:	SDG040, SDG041, SDG042;
January 22, 1991:	SDG045;
November 27, 1990:	SDG042;
November 5, 1990:	SDG040, SDG041.

8. "Phase II Investigation Report; Tuxedo Waste Disposal Site No. 336035," four volumes, prepared by Lawler, Matusky & Skelly Engineers, dated March 1989.

B. Court Orders and Miscellaneous:

1. Temporary Restraining Order; dated October 5, 1987.

2. Preliminary Injunction; dated March 21, 1988.

3. Permanent Injunction; dated July 22, 1988.

4. Result of Appeal; dated October 19, 1989.

5. NYSDEC Reclassification Document determining that the site presents a significant threat to human health or the environment, dated March 27, 1989.

6. Letters from W. Reiss (NYSDEC) to Potentially Responsible Parties requesting commitments to perform needed investigations and remedies, all dated March 30, 1989.

   Recipients: R. Barone, F. Sacco, S. Khourouzian, L. Sacco, Material Transport Services - Dart Construction Company, Inc., E. Neuhauser.

7. Order on Consent between the NYSDEC and the Georgia Tech Foundation, Index # C3-0001-90-04, dated November 19, 1990.

8. Work Assignment to Metcalf & Eddy of NY, Inc. directing the performance of a Remedial Investigation/Feasibility Study at the Tuxedo Waste Disposal Site; letter dated October 30, 1989 to C. Velsor (M&E) from P. D. Smith (NYSDEC).

C. Correspondence:

1. Letter dated January 31, 1992 from William R. Sovak (Village of Sloatsburg) to Mr. Andrew English (NYSDEC), Re. inadequacy of proposed remedy.

2. Letter dated January 28, 1992 from Commissioner T. Jorling (NYSDEC) to Congressman B. Gilman, Re. response to December 4, 1991 request for information.

3. Letter dated January 21, 1992 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final RI/FS Report.

4. Letter dated January 19, 1992 from H.E. Nimke (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final FS Report and Proposed Remedial Action Plan.

5. Memorandum dated January 18, 1992 from E.L. Huston (Town of Tuxedo Engineering Advisory Committee) to J. Hofmann (Town of Tuxedo EAC) copied to A. English (NYSDEC), Re. comments on draft final FS Report.

6. Letter dated January 11, 1992 from I.H. Conloy to NYSDEC, Re. alternative remedy.

7. Letter dated December 4, 1991 from Congressman B. Gilman to Commissioner T. Jorling (NYSDEC), Re. request for information.

8. Letter dated November 19, 1991 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. concerns about preferred remedial alternative.

9. Letter dated August 14, 1991 from A. English (NYSDEC) to A. Dorozynski (Town of Tuxedo), Re. Phase I RI/FS Report.

10. Letter dated August 8, 1991 from A. English (NYSDEC) to R. Murphy (Orange County Legislator), Re. progress and status of investigations.

11. Letter dated July 21, 1991 from R. Murphy (Orange County Legislator) to A. English (NYSDEC), Re. progress and status of investigations.

12. Letter dated July 18, 1991 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. Phase I RI/FS Report.

13. Letter dated July 7, 1991 from H. E. Nimke (Town of Tuxedo) to A. English (NYSDEC), Re. Phase I RI/FS Report.

14. Letter dated June 6, 1990 from A. English (NYSDEC) to A. Dorozynski (Town of Tuxedo), Re. RI/FS Work Plan.

15. Letter dated April 17, 1990 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. RI/FS Work Plan.

16. Letter dated March 16, 1989 from M. Komoroske (NYSDEC) to H. E. Nimke (Town of Tuxedo), Re. Phase II Investigation Report.

17. Letter dated January 9, 1989 from H. E. Nimke (Town of Tuxedo) to M. Komoroske (NYSDEC), Re. Phase II Investigation Report.

18. Letter dated July 11, 1988 from E. L. Huston (Tuxedo EAC) to A. Dorozynski (Town of Tuxedo), Re. Phase II Investigation Work Plan.

19. Letter dated July 28, 1988 from M. Chen (NYSDEC) to A. Dorozynski (Town of Tuxedo), Re. Phase II Investigation Work Plan.

20. Letter dated December 26, 1987 from H. E. Nimke (Town of Tuxedo) to J. Proudfit (NYS Department of Law), Re. Site status.

21. Letter dated November 13, 1987 from H. E. Nimke (Town of Tuxedo) to T. Jorling (NYSDEC), Re. Site status.

D. **Public Participation Documents:**

1. "Citizen Participation Plan; Tuxedo Waste Disposal Site," prepared by the New York State Department of Environmental Conservation, updated July 1990.

2. Public meeting transcript; meeting date - January 21, 1992.

3. Public Notice for January 21, 1992 public meeting to present the Proposed Remedial Action Plan.

4. Public Notice for August 8, 1991 public meeting to present the results of the Remedial Investigation and Phase I of the feasibility study.

5. Public Notice for May 10, 1990 public meeting to present the proposed RI/FS work plan.

6. Information Sheet: Tuxedo Waste Disposal Site; Remedial Investigation and Feasibility Study, prepared by the NYSDEC, dated May 1990.

7. Fact Sheet: Tuxedo Landfill Update; prepared by the NYS Department of Health (NYSDOH); dated May 1990.

8. Public Notice for the April 25, 1989 public meeting to present the results of the Phase II Investigation.

9. Information Sheet: Tuxedo Waste Disposal Site; prepared by the NYSDEC, dated April 1989.

10. Fact Sheet: Tuxedo Park; prepared by the NYS Department of Health (NYSDOH); dated April 1988.

EXHIBIT B
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION
INACTIVE HAZARDOUS WASTE DISPOSAL REPORT

CLASSIFICATION CODE: 2 REGION: 3 SITE CODE: 336035
EPA ID: NYD982531832

NAME OF SITE : Tuxedo Waste Disposal Site
STREET ADDRESS: Route 17
TOWN/CITY: Tuxedo
COUNTY: Orange
ZIP: 10987

SITE TYPE: Open Dump-X Structure- Lagoon- Landfill- Treatment Pond-
ESTIMATED SIZE: 12+ Acres

SITE OWNER/OPERATOR INFORMATION:
CURRENT OWNER NAME....: ** Multi - Owner Site **
CURRENT OWNER ADDRESS.: * * * * *
OWNER(S) DURING USE...: Multiple owners during use
OPERATOR DURING USE...: Material Transport Service
OPERATOR ADDRESS.....: 1025 Saw Mill River Road, Yonkers, NY
PERIOD ASSOCIATED WITH HAZARDOUS WASTE: From 3/87 To 10/87

SITE DESCRIPTION:
The site lies east of NYS Route 17 and west of the Ramapo River, separated by an active Conrail track. Construction and demolition material mixed with hazardous waste were dumped into this former gravel mine in 1987. Air releases have caused community complaints.
There are approximately 500,000 cubic yards of fill material with depths ranging to 70 feet. Based on the findings of the completed Phase II investigation, the presence of hazardous waste in the fill has been confirmed. The source can be attributed to the dump operators most likely accepting waste contaminated with petroleum products and industrial solvents.
The Ramapo River is a Class A stream at this location and a direct hydraulic connection exists between the dump and the Ramapo River and groundwater releases threaten the river.
A State Superfund RI/FS is in progress. The NYSDEC will be pursuing a full remedial program.

HAZARDOUS WASTE DISPOSED: TYPE	Confirmed-X	Suspected- QUANTITY (units)
PCBs		Unknown
Benzene		Unknown
Toluene		Unknown
Xylene		Unknown
Solvents		Unknown
Lead contaminated waste		Unknown

SITE CODE: 336035

ANALYTICAL DATA AVAILABLE:
Air-X Surface Water-X Groundwater-X Soil-X Sediment-X

CONTRAVENTION OF STANDARDS:
Groundwater-X Drinking Water-X Surface Water- Air-

LEGAL ACTION:

TYPE..: Consent Order State- X Federal-
STATUS: Negotiation in Progress- X Order Signed-

REMEDIAL ACTION:

Proposed- Under design- In Progress- Completed-
NATURE OF ACTION:

GEOTECHNICAL INFORMATION:
SOIL TYPE: Gneiss Bedrock overlain by unconsolidated Glacial dep.
GROUNDWATER DEPTH: 9.5 - 19.5 feet in the overburden

ASSESSMENT OF ENVIRONMENTAL PROBLEMS:

Metals leaching from the fill material have been documented to violate class GA drinking water standards. Based on Ramapo River water and sediment sampling, there is a slight heavy metal contamination attributed to the dump. The site is within 2.5 miles of a mapped primary aquifer.

ASSESSMENT OF HEALTH PROBLEMS:

EXHIBIT C
RESPONSIVENESS SUMMARY
PROPOSED REMEDIAL ACTION PLAN
TUXEDO WASTE DISPOSAL SITE - ID NO. 336035
AKA SACCO/BARONE DUMP SITE

The issues addressed below were raised during a public meeting held on January 21, 1992 at the George F. Baker High School in Tuxedo Park, New York and in various letters received from commentors. The purpose of the meeting was to present the Proposed Remedial Action Plan (PRAP) for the site and receive comments on the PRAP for consideration during the final selection of a remedy. The transcript from the meeting and copies of the written comments are included in the administrative record for the site (Appendix A) and is available for public review. The public comment period for the PRAP extended from January 3, 1992 to February 3, 1992.

The following written comments were received regarding the proposed remedy:

1. Letter dated January 31, 1992 from William R. Sovak (Village of Sloatsburg) to Mr. Andrew English (NYSDEC), Re. inadequacy of proposed remedy.

2. Letter dated January 21, 1992 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final RI/FS Report.

3. Letter dated January 19, 1992 from H.E. Nimke (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final FS Report and Proposed Remedial Action Plan.

4. Memorandum dated January 18, 1991 from E.L. Huston (Town of Tuxedo Engineering Advisory Committee) to J. Hofmann (Town of Tuxedo EAC) copied to A. English (NYSDEC), Re. comments on draft final FS Report.

5. Letter dated January 11, 1992 from I.H. Conloy to NYSDEC, Re. alternative remedy.

6. Letter dated December 4, 1991 from Congressman B. Gilman to Commissioner T. Jorling (NYSDEC), Re. request for information.

7. Letter dated November 19, 1991 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. concerns about preferred remedial alternative.

Where the same or similar issues were raised either in writing or verbally during the public meeting, they have been grouped together and are addressed once. The remaining issues are addressed individually. The issues raised have been grouped into the following general categories: (I) Comments in Opposition to the Proposed Remedy; (II) Comments in Support of the Proposed Remedy; and (III) Miscellaneous. Of the three general response actions considered (i.e., no action, containment, and excavation/treatment), the vast majority of the comments received opposed the proposed remedy (containment) and preferred a remedy involving the complete excavation and removal of wastes from the site.

I. <u>Comments in Opposition to the Proposed Remedy:</u>

Issue #1: The proposed containment remedy should not be selected because it would maintain an intolerable financial liability upon the Town of Tuxedo.

Response: The Town of Tuxedo is neither an owner or an operator of the site, therefore, it is unclear what liability needs to be addressed by the Town. In addition, it has not been stated or suggested that the Town risks liability exposure under the Environmental Conservation Law, or any other authority, as a potentially responsible party (PRP) for the site. However, even if the Town were considered a PRP, or was found to be liable in any way for the site, the State is constitutionally prohibited from giving a gift or loaning the "credit of the State" to any public corporation or association (N.Y. Const. art. VII, § 8). The State would violate that constitutional prohibition if it were to grant the Town unlimited indemnification for some unknown liability the Town may face in the future. Therefore, the State cannot indemnify or hold harmless the Town of Tuxedo for future financial liability of the site.

Issue #2: The proposed remedy does not adequately address the long-term potential for adverse impacts to the Ramapo River.

Response: The commentors correctly observe that the Ramapo River is important not only for its status as a Class (A) trout stream but primarily as an indirect source of water for users in both New York and New Jersey. A number of water supply wells exist in aquifers influenced by the river and in some cases, water withdrawal rates exceed aquifer discharge flows into the river. In these wells, it is asserted that up to 50% of the extracted water comes indirectly from the river. Since groundwater contaminated by the site clearly discharges into the Ramapo, the need to protect the water supply from site impacts is obvious. The Department completely acknowledges and supports the goal of protecting the state's water supplies. In fact, a great deal of the Department's regulatory structure and initiatives primarily boil down to water resource protection, development, and restoration.

Achieving this goal on a statewide basis clearly calls for a rational, reasoned approach that balances available resources, available technology, the problem to be faced, and the needs of the citizens of New York State and citizens of other states where they are influenced by actions taken in New York. The alternative to taking a balanced approach is irresponsibility and ineffective stewardship.

Issue #2 can be rephrased to express the concern that there is a good chance that sometime in the future, significant quantities of toxic contaminants will be released from the site into the river where they will cause serious impacts upon downstream users of the river. The short response to this issue is that the evidence indicates that this is relatively unlikely. Nevertheless, if significant releases of contaminants were to occur, feasible, reasonable actions can be taken to prevent significant impacts. Also, removing the wastes would present increased health risks and would divert funding from tens or hundreds of sites in the state that present similar or greater threats. These negative consequences are essentially intolerable.

A more complete response takes into account the issues and questions addressed in the RI/FS. Six major questions are identified: 1) What is the **nature** and **extent** of the known threat? 2) What are the **effects** of the threat? 3) What are the available **remedies**? 4) What are the **advantages** and **disadvantages** of implementing the remedies? 5) What is the **likelihood** that there will be significant new releases in the future? and 6) What are the **options/consequences** for addressing this possibility? Any rational analysis must be based upon an understanding of actual conditions. The potential consequences of unknown but conceivable hazards can then be considered and addressed in terms of risk management.

These questions have been considered and addressed for all site related exposure pathways but the issue raised specifically addresses the surface water (i.e., Ramapo River) pathway. The **nature** of the threat is that groundwater contaminated with metals (particularly iron, sodium, manganese, magnesium, and lead) and very low levels of organic compounds (benzene, phenol, naphthalene, acenapthene, and chrysene) discharges into the river. The concentrations of the metals and the release rate is not high enough to cause any significant impact upon the river. The presence of the discharge and a marginal influence can, however, be detected in the major discharge area adjacent to the site. Therefore, the **extent** of the known threat is limited to the portion of the river alongside the site. Although conditions in the river have the potential for being quite variable, the characteristics of the source of the discharge, that is site groundwater, has been found to be relatively consistent.

The **effects** of the actual threat are essentially nil since impacts on the river downstream of the site are not detectable. Therefore, conducting a baseline risk assessment to assess the affects on site contamination or downstream users would be entirely speculative.

Since we have determined that the existing threat is marginal to nil, then no action would be an appropriate response to the threat posed to the Ramapo River. Evaluating other pathways and legal requirements (i.e., the air pathway and closure requirements), however, led to the conclusion that action is necessary. Fortuitously, this action (site containment), benefits the river by reducing already low releases.

The potentially **available remedies** fall into the three categories of no action, containment, and excavation/treatment. Three levels of analysis of the available remedies have been performed (i.e. screening, detailed, and comparative). Detailed analyses were performed of potential remedies that would influence the interactions between the site and the river. While the potential remedies focused upon the site as the source of the threat, technologies that focused upon the river were also screened. These included in-situ processes such as sediment excavation, treatment (e.g., bubbler aeration), and treatment at withdrawal points.

The **advantages** and **disadvantages** of the potential remedies are addressed in the detailed and comparative analyses in the Feasibility Study. The selected remedy (containment) was found to be the best solution because it adequately addresses the threat, can be completed

relatively quickly, and is cost effective (see the response to Issue #5 for a discussion of time and cost considerations). The excavation/treatment remedies would address the threat but would take much longer, present greater risk from the air pathway, and has no realistically available funding source. Dedicating the money needed to fund this option would necessitate ignoring tens or hundreds of other sites across the state that present similar or greater risks.

Determining the **likelihood** of significant new releases in the future is more difficult to address because there is no basis for formulating a reasonable exposure scenario in terms of contaminants, concentrations, release durations, or other factors needed to assess risk. In lieu of a quantitative assessment, the approach selected was to envision a scenario where currently undetected compounds of high toxicity were released into the river and remained in the river at concentrations that would adversely impact downstream users.

Although conceivable, this scenario is considered very unlikely because of the way the site was constructed. Considering the hydraulics of the site, it is likely that if significant quantities of toxic materials were present at the base of the site, at least traces would be detectable after four years with little to no restrictions on water infiltration. The site is completely unlined and little to no care was taken during waste emplacement that would lengthen the lifetime of containers. The most plausible scenario includes toxic wastes buried at the base of the dump, some of which is only slightly above (or perhaps below) the water table. Multiple excavations in the upper 20 feet of the dump where soil gas concentrations were highest also yielded no evidence of this type of disposal.

Even so, if the worst were to occur, what could be done (**options**)? The first and most direct step would be to treat extracted water at the affected withdrawal point(s). This is a common practice across the state, is easily implemented, and is reliable. After an adequate understanding of the situation was achieved, a decision could be made to upgrade the remedy at the site to prevent releases from the site to the river. This could include the installation of a vertical groundwater barrier and a groundwater extraction and treatment system. This was evaluated as B/K Alternative #5 in the feasibility study. Technical difficulties would be encountered in implementing this process option but it is feasible with existing technology.

The remaining concern is whether or not the monitoring network would serve as an adequate alarm system. The proposed monitoring program takes into account release points, release rates, quantities of saturated waste, time scales (of leachate generation, groundwater contamination, and groundwater release), the likelihood of release, and existing requirements for routine sampling/analysis at withdrawal points. Further details of the monitoring program are discussed in response to Issue #9F.

The proposed containment remedy, therefore, goes beyond what is needed to properly address the known threat and adequately takes into account the possibility of future releases by having identified and evaluated contingencies that could be implemented. The proposed remedy and the

contingencies, which are protective of human health and the environment, can be implemented in less time, with less risk, and at a small fraction of the cost of even the least expensive excavation/treatment alternative.

Issue #3: The entire contents of the site should be excavated and removed from the site because of the uncertainties associated with the health effects resulting from chronic exposures to low concentrations of contaminants.

Response: The comment reflects the concern that what we don't know about the wastes in the site and the health effects of long-term exposure may be more significant than what we do know. The commentor cites a newspaper article that summarizes the conclusions of a National Research Council (NRC) report that discusses this and other issues. The point appears to be that billions of dollars may be wasted in cleanup programs across the country by either not doing enough or overreacting due to an inadequate understanding of the hazards presented by these sites to the public. The article notes that millions of dollars are being spent in research to increase our understanding of these problems and interactions.Acknowledging that these uncertainties exist, the Department is faced with the task of making reasonable decisions based upon existing knowledge and understanding balanced by a realistic assessment of the consequences of making incorrect assumptions. This process led to the selection of the remedy for this site.

The concern raised in this issue focuses on what the health risk is from exposure to site related contaminants, both identified and unidentified. The key to assessing this risk is the concept of an exposure pathway. An exposure pathway refers to the environmental media (i.e., air, water, soil) through which contaminants travel to a receptor. Exposure routes are the ways that contaminants enter the receptor (e.g., inhalation, ingestion, dermal absorption, injection). To create a health effect, there must be a complete exposure pathway and a complete exposure route (which also implies the existence of a receptor).

The RI/FS process showed that this site presents two exposure pathways of concern. These include the air pathway and the groundwater/surface water pathways. For the air pathway, the exposure route of concern is inhalation. For the water pathway, the route of concern is ingestion. As discussed in the response to Issue #2, the proposed remedy adequately addresses the water pathway.

The results of the air pathway analysis suggested that the cancer and non-cancer health impacts on the community are also marginal. The most significant problem appears to be presented by hydrogen sulfide which causes a nuisance odor. It is predicted that the concentration of hydrogen sulfide will occasionally exceed the one-hour ambient air standard for the compound near the site. Even so, an argument could be made for selecting the no-action alternative to address the air pathway. This would result in a remedial action that did not include a landfill gas collection/treatment component.

New York State, however, takes the position that risks should be minimized to the extent feasible. After evaluating the criteria used to determine feasibility, gas collection/treatment is shown to be feasible, beneficial, and effective. Also, the uncertainties regarding the analysis of the air pathway are greater than the water pathway creating the need to be especially conservative even if it results in being significantly overprotective.

The question is raised, is complete waste removal the only option available for achieving this protectiveness? Since gas collection/treatment cuts off the air pathway thereby essentially eliminating that exposure, then waste removal is not the only possible solution. To the contrary, the high concentrations of contaminants that would be released by the excavation/treatment/ removal process is predicted to present a greater overall risk to the community than doing nothing at all. This is contrary to intuition but shows how high concentrations over a short period can be more significant than low concentrations over a long period. The legal requirement that the actions taken by the Department must be commensurate with the threat presented makes the decision even clearer.

Finally, the need for additional study must always be balanced by the need to take responsible action in a timely manner. Recognizing that much needs to be learned about contaminant behavior and health effects, we cannot succumb to the "paralysis of analysis" and not act in the hope of gaining new information in the future.

Issue #4: The data and analysis methods used to produce conclusions about the site are inadequate. The remedy selection process, therefore, if flawed and the conclusions cannot be supported.

Response: This is an understandable concern that results from differing perceptions of the quantity and quality of information that is needed for making decisions. This dilemma is faced each time a remedial investigation/feasibility study is designed and carried out. In this case, two particular criticisms were noted regarding the baseline risk assessment performed for the site. The first comment stated that the distribution of the atmospheric stability classes assumed during the dispersion modelling was too optimistic. The second concern was that a cancer potency factor for a particular compound was ignored.

The approach taken by the Department to respond to these issues was to first evaluate the validity of the concerns and then to evaluate how changing the conditions or assumptions would affect the selection of a remedy. In both cases, the issues were found to be arguable but making changes would not affect the remedy selection process. Since making the changes would have resulted in delays and increased costs, a decision was made to not revise the reports in this case.

If, however, the Department had concluded that a no-action remedy was appropriate for the site, then these issues could have been critical and would have received more scrutiny.

Issue #5: The estimates of how much it would cost and how long it would take to completely remove and redispose of site wastes are unrealistic.

Response: Since no information or data was submitted to contradict the cost estimates in the feasibility study, this issue appears to be a matter of perception. Unsupported statements assert that the site operator earned approximately $3 million (gross or net profit?) by dumping wastes at the site over a seven month period. Intuition has it that removing the wastes should be commensurate in terms of costs and time. This ignores, however, the realities of the situation. Unfortunately, the Department was ineffective in adequately communicating these realities.

There are many factors that result in final cost and time estimates. These are listed in Appendix A of the Feasibility Study Report and are described in the body of the report. In summary, the major factors that result in cost estimates that range from approximately $100 million to $1 billion include: 1) a prohibition on hazardous waste excavation and redisposal off-site without treatment to certain levels; 2) the limited number of feasible treatment technologies applicable to site wastes; 3) immense materials handling and waste preparation problems that would be faced before the wastes could be treated; 4) the scale of the task would strain current national treatment capacity necessitating additional time; 5) capacities of existing secure disposal facilities are limited; 6) siting new land burial facilities is extremely difficult and time consuming; 7) the process of excavating the dump would necessitate the imposition of worker/community protection measures that are costly and time consuming; 8) transportation costs would be significant; 9) various types of approvals and authorizations would be needed from many public and private agencies that could present significant delays; and 10) waste segregation and analysis would be difficult and expensive.

The goal for the accuracy of these estimates was that they be within +50 percent and -30 percent of what would be the actual cost of implementing the remedy. For example, if the actual cost of a remedy was $10 million, the initial cost estimates should be no higher than $15 million and no less than $7 million. It is preferable to initially overestimate costs rather than underestimate them. Reasonable people could certainly argue about the estimates selected but the point is that the cost of excavation/treatment would be astronomical in comparison to the problem and the available resources. It is also important to understand that the containment principles incorporated into the selected remedy apply to all materials in the site, whether they are all identified or not.

Issue #6: The wastes in the northeast corner of the Georgia Tech parcel should not be consolidated onto the main part of the site.

Response: The stated basis for this issue is that the consolidation would be prohibited. In general, restricted hazardous wastes cannot be land buried without appropriate treatment nor can the be disposed in an unacceptable facility. This is why site wastes could not be removed and dumped somewhere else or placed in a secure facility without treatment. In this case, the "site" consists of both the Barone/Khourouzian parcel and the Georgia Tech parcel. Therefore the movement of wastes would be a consolidation and not off-site disposal. The USEPA has ruled (OSWER Directive 9347.1, "Policy for Superfund

Compliance With RCRA Land Disposal Restrictions," (4/17/89)) that consolidation without treatment does not constitute "placement."

Also, it would be very difficult and expensive to cover these wastes in their current location due to the proximity to the railroad and the slopes involved. Consolidation is clearly the best solution to this problem and brings the added benefit of providing material that can be used to grade the main part of the site.

Issue #7: It is unrealistic to think that the threats posed by the site will go away in 30 years.

Response: No attempt has been made to imply that the wastes will disappear in 30 years. The costs to operate and maintain the potential remedial alternatives for 30 years are evaluated for comparison purposes and to comply with regulatory requirements for such evaluations. It is important to note that if properly designed, constructed, and maintained, the cover system could last for hundreds of years. Unlike a liner system, if defects develop in a cover system, they can be repaired.

Issue #8: The removal option was not adequately investigated or given an honest appraisal. Also, the proposed remedy ignores the concept of the Environmental Conservation Law (ECL) 27-1313 relative to returning a dump site to its "original state."

Response: This language does not appear in ECL 27-1313. The comment may be a reference to ECL 27-1313(5)(d) which says, "[t]he goal of any such remedial program shall be a complete cleanup of the site through the elimination of the significant threat to the environment posed by the disposal of hazardous wastes at the site..." Therefore the goal is not to return all dumps to their "original state" (even if that could be adequately defined), but is to eliminate significant threats. The ECL also says (27-1313(5)(c)) that, "[t]he costs incurred by the department in developing and implementing such a program shall be in an amount commensurate with the actions the department deems necessary to eliminate such danger" (emphasis added). The law continues on to give criteria for determining if a remedy is cost effective including whether "limited actions" would eliminate the danger and the "extent to which the actions would reduce such danger to human health or the environment." These criteria were addressed in the RI/FS process.

The goals of remedial actions are further discussed and defined in the "Draft Cleanup Policy and Guidelines" report prepared by the Department (dated October 1991) and currently under public review. This document states, "[t]he Department's goal for any remedial activity is to achieve pre-release conditions or environmental media standards and criteria, whichever are more stringent." It goes on to state that "[i]t is recognized that the goal of cleanup to pre-release conditions may not always be feasible." The example used to illustrate this case is the closure of landfills. The third category of remedial actions given in the report is "Regulation Closure for Landfills." This concept acknowledges that except for very small landfills, remedial programs for these sites consist mainly of containment technologies. The focus of RI/FS investigations can then be on determining if limited

excavations make sense and what types of containment components are needed to eliminate the significant threat.

The assertion that the entire contents of the site must be removed to eliminate the significant threat posed by the site is contrary to the actual mandate of the law because it does not consider the consequences of the action or consider whether other more cost effective alternatives are available. Given the actual conditions at the site and the likelihood that those conditions will significantly change over time, implementing a removal remedy would be gross overkill. Removal would likely expose the community to greater risk, take five to seven times longer, and cost 10 to 100 times more than the proposed remedy. It would also deplete limited financial resources needed to address similar or greater threats at hundreds of other sites across the state. The selected remedy is protective, implementable, and cost effective.

As with Issue #4, there are differing perceptions of how much information is needed to make informed, responsible decisions. In the feasibility study, the same level of analysis (if not greater) was devoted to considering the excavation/removal options as the containment and no-action alternatives. Since there were no comments from the public requesting a more thorough analysis of the no-action alternative, the implication is that the commentors are dissatisfied with the results of the process rather than the process itself. This makes it difficult to respond because evidently no response would be adequate except to respond with a proposal to remove the wastes from the site regardless of the consequences, logic, statutory compliance, or feasibility of the action.

II. Comments in Support of the Proposed Remedy:

Issue #9: The proposed remedy will adequately insure the health and safety of Tuxedo residents and should be implemented without delay.

This commentor modified the supporting comment with statements that are best addressed as sub-issues.

Issue #9A: Land ownership and consequent liabilities must remain exclusively with the current owners.

Response: Although the State cannot force a land owner to retain a parcel if they desire and are able to sell it, the State has no intention of obtaining ownership of the parcels.

Issue #9B: Benefits from any future land use must be used to reduce remediation costs without diminishing responsibility for potential future liabilities.

Response: The ECL gives the Department authority to recover costs from responsible parties (including landowners) as well as money damages and penalties. With the assistance of the Department of Law, the DEC will seek to have responsible parties fund the remedy to the extent possible and recover already incurred costs.

Issue #9C: The residential use of either parcel should be prohibited.

Response: Where there are wastes on either parcel, this is prudent. Where a structure would not interfere with remedy, this should be evaluated on a case-by-case basis.

Issue #9D: DEC must also guarantee that should air or groundwater tests show a trend of increasing contamination, additional remedial measures will be taken expeditiously.

Response: If monitoring indicates the occurrence of releases that could cause adverse impacts, the DEC's response would be to determine the cause of the problem, identify the best solution, and implement the solution expeditiously.

Issue #9E: The 30-year monitoring period must be viewed as only a basis for comparisons among the alternatives.

Response: Agreed, see response to Issue #7.

Issue #9F: Monitoring should continue on a quarterly basis until one year after a declining trend for each and every target compound is established.

Response: The Department agrees that the monitoring program must serve as an adequate "alarm system." The proposed remedy contains a conceptual design for a monitoring system which in actual practice will be flexible. If unusual events or trends are noted, sampling/analysis frequencies will be increased. Since the target compound list (TCL) contains well over one hundred compounds and less than two dozen are of concern at this site, it would not be cost effective to analyze for the full TCL on a quarterly basis. Rather, select compounds will be searched for quarterly and the TCL used on perhaps an annual basis. Since some compounds exist naturally at levels above standards (e.g., iron), a declining trend will never be observed for all compounds.

Issue #9G: Monitoring should continue on an annual basis until the concentration of each and every target compound falls two orders of magnitude below the Standard and Guidance values. Monitoring should thereafter be conducted on a five year basis indefinitely. Exceptions should be made for floods, earthquakes, or other conditions which could reasonably be expected to alter the site. Monitoring should then occur within three months of such an event.

Response: A monitoring program based upon a one hundred fold decline would not be practicable. Limitations in analytical detection limits, background concentrations, and natural variance would make it impossible to ever achieve this criterion. Indefinite monitoring is likely, however, but the actual frequency is uncertain at this time. A five year cycle seems reasonable. The monitoring program will be flexible enough to respond to site altering conditions.

Issue #9H: Local and county government must be held harmless from liabilities created by the existence of the site.

Response: See response to Issue #1.

III. **Miscellaneous:**

Issue #10: Releases from the site have already resulted in intolerable health effects in the community.

Response: Health studies have been performed around several sites in the Hudson Valley area that are similar to the Tuxedo site. These studies have found a correlation between emissions from the dumps and health effects such as respiratory irritation and other effects, and nausea. These effects have been reported around the Tuxedo site. Health effects beyond these have not been documented. (Response provided by the NYS Health Department.)

Issue #11: The responsible parties should be forced to pay for the cleanup. Specific potentially responsible parties were mentioned.

Response: As discussed in the response to Issue #9B, the DEC will recover costs to the extent possible.

Issue #12: The DEC is lying.

Response: The commentor did not substantiate the accusation or suggest what possible motivation DEC staff would have to "lie" to the public.

Issue #13: Site wastes should be processed in a recycling plant funded by the responsible parties rather than containing the site.

Response: Unfortunately, very little of the waste in the site is recyclable. Also, the problems with excavation and redisposal discussed above would be encountered.

Appendix D

Post-Closure Monitoring and Maintenance Manual (Revised, 1998)

NEW YORK STATE SUPERFUND CONTRACT

POST-CLOSURE MONITORING AND MAINTENANCE MANUAL

TUXEDO WASTE DISPOSAL SITE
SITE NO. 3-36-035
WORK ASSIGNMENT NO. D002676-3

Date: February, 1996
Final

Revised March, 1996
Revised August, 1996

CHA Project No. 3366.07.51

Prepared For:

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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APPENDICES

1.0 INTRODUCTION

1.1 PROJECT:

The Tuxedo Waste Disposal Site is located in the Town of Tuxedo, Orange County, New York. The site is approximately one mile north of Tuxedo Park, New York, and is located between State Route 17 and a rail line owned by Conrail. The site consists of an old sand and gravel mine where construction and demolition debris (C&D) wastes were improperly disposed of between March and October, 1987. Both a Phase II Investigation and a Remedial Investigation and Feasibility Study have been completed for the site in support of determining the course of action regarding remediation of the site. Based on these studies, closure of the site in accordance with 6 NYCRR Part 360 requirements was deemed suitable for remedial action.

1.2 PURPOSE OF MONITORING AND MAINTENANCE MANUAL:

This Monitoring and Maintenance Manual is intended to serve as a summary and guide for all post-closure monitoring and maintenance at the Tuxedo Waste Disposal Site that shall be conducted for a minimum of thirty years. This manual describes all aspects of and supporting procedures for groundwater and gas monitoring as well as site inspection and maintenance procedures that shall be performed after final closure of the site in accordance with 6 NYCRR Part 360. Outlines for all resulting reports and records to be generated are also included in the plan. A budget estimate for costs associated with monitoring and maintenance of the site is included in Appendix D of this manual.

2.0 SITE DESCRIPTION

2.1 HISTORY:

The Tuxedo Waste Site is located within an old sand and gravel mine. Approximately 500,000 cubic yards (cy) of C&D and other waste was improperly disposed of on the site from March to October 1987. The waste was improperly disposed of primarily on a 12.2 acre parcel jointly owned by R. Barone and S. Khourouzian (B-K parcel). A smaller portion of waste (approximately one acre) was deposited on adjacent lands, which were at the time, owned by the Georgia Tech Foundation. This land which was owned by the Georgia Tech Foundation was purchased by Mr. Ronald Iazzetti in December, 1994.

2.2 HYDROGEOLOGY:

Groundwater in the vicinity of the site travels from west to east and discharges into the Ramapo River. The nearest water supply well is associated with the antique shop located directly to the north (sidegradient), but the well is currently not used as a source of drinking water. Drinking water for nearby residences originates from the local public water supply. The Ramapo River, however, is used as a source of drinking water downstream of the site, and the remedial action is intended to protect the river by minimizing leachate flows from the waste mass.

2.3 AIR QUALITY:

Emissions of hydrogen sulfide from the waste mass have previously resulted in numerous complaints regarding offensive odors. Gas surveys performed during the Phase II Investigation and the Remedial Investigation also indicated releases of volatile organic compounds. Although emission of hydrogen sulfide and the volatile organic compounds appears to have receded, the remedial action includes provisions for treating gas that vents from the waste mass.

3.0 SITE REMEDIAL ACTION

3.1 DESCRIPTION OF REMEDIAL ACTION:

3.1.1 Overview:

The remedial action for the Tuxedo Waste Disposal Site included the following elements:

- Excavation of waste from the southeast corner on the Georgia Tech parcel and east side of the site near the Conrail tracks and relocation to the center of the site within the B-K property limits.
- Design and construction of an engineered final cover system in accordance with 6 NYCRR Part 360 requirements.
- Construction and operation of a passive gas venting and treatment system using activated carbon to remove hydrogen sulfide and volatile organic compounds.
- Design and construction of a surface water diversion system to reduce run-on, infiltration, and subsequent generation of leachate.

3.1.2 Closure Design:

The closure design for the Tuxedo Waste Disposal Site includes three major elements. These elements are the closure cover system, the gas control system, and the surface runoff control system.

The closure cover system design is based on 6 NYCRR Part 360 requirements. The system includes a twelve inch soil gas venting layer, a high density polyethylene geomembrane barrier, a geosynthetic drainage layer, a 24 inch soil barrier protection layer, and a six inch topsoil layer. Reference the Record Drawings included in Appendix F of this Manual for more detail of the cover system.

The gas control system design includes deep passive gas vents that are interconnected with deep and shallow stone trenches and plastic piping. Specific groupings of gas vents are connected to carbon canister gas treatment units that filter the gas before it vents to the atmosphere. The system has been designed to enable its conversion to an active gas control system if deemed necessary at a future date. Reference the Record Drawings in Appendix F for more detail of the gas control system.

The surface runoff control system for the site includes various components including but not limited to drainage swales, catch basins, culverts, stone outfalls, and erosion control mats. The combination of these types of control devices has been designed to control surface run-on and runoff at the site and on surrounding lands resulting from the 100 year 24 hour storm event. Reference the Record Drawings included in Appendix F of this manual for complete details of the surface runoff control system.

3.2 GOALS OF REMEDIAL ACTION:

The ultimate goal of the remedial action is to limit negative environmental impacts of the waste fill on the environment. The main focus of the remediation is limiting groundwater contamination. This is facilitated by construction of the cover system over the waste mass to reduce infiltration of precipitation into the waste, thereby reducing leachate generation. Infiltration and subsequent leachate generation will be further reduced with construction of the run-on diversion system that will prevent most of over-land flow from entering the waste mass. Control of gasses generated within the waste is also a goal of the remediation. The gas venting and treatment system will control underground migration of gases away from the site, and control odors and treat gases that are vented to the atmosphere. The final goal of the remedial activities is to monitor and maintain the closed site to ensure the effectiveness of all the constructed components of the remedial action.

4.0 MONITORING, TESTING, AND RECORDS

4.1 MONITORING PLAN:

4.1.1 Elements of Monitoring Plan:

There are four key elements of the monitoring plan for the Tuxedo Waste Disposal Site. These elements consist of the environmental or field monitoring, the analytical program, the evaluation of monitoring results, and record keeping. These elements are each discussed in detail within Section 4 of this manual. These elements make up a program that will be followed to evaluate all environmental impacts of the Tuxedo Waste Disposal Site upon completion of the remedial action.

4.1.2 Basis of Monitoring Plan:

The basis for the development of the monitoring plan is the work completed during the Phase II Investigation and the Remedial Investigation for the Tuxedo Waste Disposal Site. Based on these studies, a monitoring plan that is sensitive to the specific characteristics of the site has been developed.

4.2 ENVIRONMENTAL MONITORING:

4.2.1 General:

Section 4.2 of this Post-Closure Monitoring and Maintenance Manual describes in detail the environmental or field monitoring portion of the monitoring plan. Included are descriptions of procedures for groundwater and leachate sampling and gas monitoring.

4.2.2 Sampling Program:

A sampling program will be followed by a contracted organization at the Tuxedo Waste Disposal Site that is consistent with 6 NYCRR Part 360. Environmental monitoring will initially consist of annual sampling for a one-year period to establish a historical baseline. Monitoring will continue one additional year thereafter, after which the monitoring program will be evaluated. The checklist provided in Appendix E provides a list of sampling equipment required for each sampling event.

4.2.3 Groundwater Sampling & Procedures:

Groundwater sampling locations (four upgradient and eight downgradient monitoring wells) are shown on the as-built grading plan for the site included in Appendix F. The graphic logs for these 12 monitoring wells are included in Appendix G. Sampling of groundwater monitoring wells will generally proceed from the upgradient to the downgradient wells. Dedicated bailers or polyethylene tubing and foot valves will be used to sample each well. Before removing well caps, ambient air quality will be measured using an HNu meter. Air quality will also be measured in each well. All measurements will be recorded on a groundwater sampling field data sheet.

The depth of each well and the water level measurement from each well will be recorded before sampling. All equipment used for taking measurements will be decontaminated before proceeding to the next well. All sampling procedures utilized will minimize cross contamination. The volume of water in each well will be calculated in order to determine the volume of water to be purged prior to sampling. A minimum of three well volumes shall be purged prior to sampling. Purge water can be disposed of directly to the ground surface in a downgradient direction/location.

Parameters consisting of temperature, pH, specific conductance, and turbidity will be measured at the start of sampling and during purging to establish purging efficiency and stabilization of the well water. Samples will be collected for analysis of iron, manganese magnesium, and lead. If turbidity levels greater than 50 Nephelometric Turbidity Units (NTU) are unavoidable, filtered metals samples will be obtained in addition to unfiltered samples for analysis.

All observations and measurements will be recorded on a groundwater sampling field data sheet. At the end of each day of sampling, collected samples will be shipped in overnight mail following chain-of-custody procedures to the contract laboratory.

4.2.4 Leachate Sampling & Procedures:

Any leachate seeps that are observed on or adjacent to the site will be sampled. The procedures described in Section 4.2.4 of this manual shall be used for collection of leachate samples as applicable. The leachate samples will be shipped in overnight mail following chain-of-custody procedures to the contract laboratory for analysis of iron, manganese, magnesium, and lead.

4.2.5 Gas Monitoring & Procedures:

A post-closure gas monitoring program will be initiated to verify that decomposition gases generated at the Tuxedo Waste Disposal Site are controlled by the gas venting and treatment system to avoid hazards to health, safety, or property. The gas monitoring program will include measurement of the concentrations of methane or other explosive gasses, hydrogen sulfide, and volatile organic compounds.

Upon detection of methane or other explosive gas levels exceeding the lower explosive limit for the gases at or beyond the property boundary, the New York State Department of Environmental Conservation shall be notified immediately in order to take all steps necessary to ensure the safety and protection of health and property.

If possible, the explosive gas investigation shall be conducted when wind conditions are at a minimum and when the atmospheric pressure is low. These conditions maximize the potential for gas migration from the site and help to insure its detection, if applicable. At least one of the quarterly explosive gas investigations shall be conducted during the winter months when a frost layer exists, and when there is the potential for snow cover on the ground. The gas investigation should be conducted, however, on a day when temperatures are above freezing and within the operating range of the gas detection instruments utilized.

The explosive gas investigation shall utilize a portable gas detection instrument designed to detect the presence of methane or other specified combustible decomposition gases in air. This instrument shall be calibrated prior to its use, using the appropriate calibration gas, and following the meter manufacturer's specifications. The gas readings around the perimeter of the waste and around the property edge shall be taken by advancing a probe into the ground to a depth below frost level at 200 foot intervals. Immediately upon extracting the probe from the hole formed, a gas collection tube attached to the gas meter aspirator adaptor shall be inserted into the ground. A gas reading shall be taken from the gas detection instrument after aspiration. Should any reading exceed 25% of the lower explosive limit for gases on site, additional readings shall be taken at twenty-five (25) foot intervals along the perimeter of the waste, property edge, or edge of pavement in both directions as well as perpendicular to the edge of the site. This shall be done for the purpose of defining the areal extent of the high concentration of explosive gas. This method shall not be used over the capped portion of the site.

In addition to the explosive gas survey previously described, sampling of the landfill gas both before and after the activated carbon units in the gas vents will be conducted. Monitoring will consist of field screening using a flame ionization detector (FID), Photoionization detector (PID), combustible gas indicator (CGI), and Hydrogen Sulfide (H_2S) meter to monitor the perimeter and interior gas vents. The readings will be obtained by inserting the detector probes of the instruments into the vents. As previously mentioned, all instruments shall be calibrated following manufacturers' specifications. The results from all monitoring events will be evaluated and adjustments of the gas venting system, treatment system, or monitoring program will be made as required to ensure that the vented gas is being properly treated.

Ambient explosive gas, hydrogen sulfide, and volatile organic gas concentration will also be measured along the property line on the upwind side of the landfill. Upon detection of methane or other explosive gas levels exceeding the lower explosive limit for the gases or upon detection of volatile organic or hydrogen sulfide gases above their baseline or action levels at or beyond the property boundary, the New York State Department of Environmental Conservation shall be notified immediately in order to take all steps necessary to ensure the safety and protection of health and property.

All gas monitoring data will be recorded on a copy of the Record Site Plan which is included in Appendix F. A baseline emission level will be established for both H_2S and VOC's during the initial post-closure monitoring programs for comparison with subsequent monitoring event result. Health and safety action levels for gases are located in Section 9.3.1.

4.3 ANALYTICAL PROGRAM:

As previously noted, the frequency of the analytical program will be annually for the first two years after closure. The analytical laboratory performing the analyses will hold current Environmental Laboratory Approval Program (ELAP) certification to perform the analyses required for the post-closure monitoring analytical program. The ELAP program is administered by the New York State Department of Health. Groundwater and leachate samples shall be analyzed for iron, manganese, magnesium, and lead. The analyses for each sampling event shall be performed according to the most recent version of the New York State Department of Environmental Conservation Analytical Services Protocol (ASP). The reporting and deliverables package for each sampling event shall include instrument detection limits, calculated as specified by the most recent version of

the New York State Department of Environmental Conservation ASP; results summaries on analytes and tentatively identified compounds (TICs); and total ion chromatograms (i.e., Category B deliverable package). The Quality Assurance/Quality Control (QA/QC) samples shall include one matrix spike and one matrix spike duplicate per groundwater sampling event as well as appropriate laboratory QA/QC samples as dictated by the New York State Department of Environmental Conservation ASP protocol. Due to the fact that dedicated sampling equipment shall be used, a field blank shall not be collected and submitted for analysis as part of the analytical program for this project.

Existing baseline groundwater quality shall be established for each groundwater monitoring well. All future groundwater data shall be compared to the baseline data.

4.4 EVALUATION OF MONITORING RESULTS:

The contract laboratory will transmit the results of each sampling and monitoring event to the organization contracted to carry out the monitoring program. The contract organization will then evaluate all test results and formulate a written report for each sampling and monitoring event. The report will include a summary of all field procedures, field reports, field data sheets, test results, and conclusions drawn regarding the continuing impact of the waste disposal site on the environment.

4.5 RECORDS:

Copies of all reports generated for each sampling event shall be transmitted to the New York State Department of Environmental Conservation Main Office in Albany, New York. Reports shall be kept in a permanent file at this office and the project document repositories.

5.0 SITE MAINTENANCE

5.1 MAINTENANCE ACTIVITIES:

5.1.1 Site Fence:

The site perimeter fencing, including gates, shall be inspected regularly to ensure it is secure. Any damage that is observed shall be recorded and repaired immediately by restoration or replacement of the damaged materials. Any disturbed or eroded soil below the fence line shall be filled and vegetation restored to ensure security of the site.

5.1.2 Signs:

All signs posted on the site shall be inspected regularly. Any signs that are determined to be missing shall be replaced immediately. Any sign that has been damaged beyond legibility shall be replaced immediately. If it is determined that a new sign is necessary at the site, the sign shall be posted as soon as possible. All damage to signage shall be promptly repaired.

5.1.3 Cover:

Areas over the cover system where loss of cover soils or vegetation is noted shall be repaired by replacing and compacting the eroded soil and re-establishing the vegetative cover. Siltation controls such as hay bales shall be temporarily placed around these restored areas. Periodic mowing of the vegetative cover shall be conducted. The grass cover shall be mowed when its height exceeds 12 inches. The grass shall not be allowed to exceed 18 inches. Based on these guidelines and observations made during the regular site inspections, the Department shall be notified when mowing is required. The Department will utilize its own staff for mowing of the grass cover. It is expected that mowing will be required at least twice a year during the growing season. Hand held or lightweight equipment shall be used to avoid the creation of ruts and other damage to the cover system surface.

Records shall be kept of all observed damage to the cover system, as well as all subsequent repairs to the cover system.

5.1.4 Runoff Control Structures:

All runoff control structures shall be inspected regularly to identify any erosion, siltation, settlement, or any other restriction of flow that would impede their effectiveness. All eroded or settled areas within drainage courses shall be repaired by replacing and compacting eroded material or placing additional compacted material, followed by reseeding to prevent additional erosion. In areas where drainage courses are rip-rap lined, additional lining material may be required. Excess silt or other materials found to be causing blockage in drainage courses, culverts, or other structures shall be removed to allow free passage of flow.

5.1.5 Settlement and Subsidence Control:

The surface of the cover system shall be regularly inspected for areas of settlement and subsidence. These areas shall be noted and repaired immediately to prevent ponding of water on the cover system. These areas shall be repaired by placing and compacting additional fill materials to create a uniformly sloping surface with the surrounding grade. Newly placed soils shall be fertilized, seeded, and mulched, and temporary erosion control devices such as hay bales shall be used until vegetation is re-established.

It should be noted that where smaller and deeper areas of settlement are found, the geomembrane barrier shall be inspected as described in Section 5.1.6. All areas of settlement shall be recorded and visually monitored after repair.

5.1.6 Flexible Membrane Liner Repairs:

The Tuxedo Waste Disposal Site has been closed with a geomembrane cover system. This cover system shall be inspected regularly for damage to the geomembrane barrier. In areas where cracks or depressions are discovered in the cover system, the geomembrane shall be exposed to determine its integrity. If damage is noted, the geomembrane shall be repaired prior to replacing and compacting cover soils and seeding. Repair of the geomembrane shall be completed by qualified personnel. Records shall be kept of all geomembrane repairs, including appropriate QC/QA testing results.

5.1.7 Groundwater Monitoring System:

The Groundwater Monitoring System consists of the monitoring wells located at various locations on and around the site. These wells shall be periodically inspected to ensure that they have

not been damaged. Typically, monitoring well surface seals, protective casings, caps, and locks shall be checked for damage and repaired immediately as required. Care shall be taken to insure that hazardous materials, such as glue solvents, are not introduced into the wells during repair work.

5.1.8 Gas Venting System:

Regular inspection of the gas venting system shall include checking all vents for any physical damage, blockages inside the vents, and settlement or movement of the vent riser pipes and checking the integrity and security of the screened fence and access gates around each gas treatment unit. Any physical damage to a gas vent shall be repaired by replacement of the damaged part or section. Blockages in a vent shall be cleared by use of a non-metallic snake tool. When settlement or movement of a gas vent riser is observed, the geomembrane barrier in the vicinity of the gas vent shall be inspected as outlined in Section 5.1.6. Any damage to the screened fence and gates around the treatment units shall be repaired to ensure the integrity and security of the treatment units.

The gas treatment system units shall be tested for performance during routine monitoring and maintenance of the gas venting system. A baseline emission level will be established for both H_2S and VOC's during the initial post-closure monitoring program using the appropriate equipment. Subsequent maintenance testing will monitor for increases in concentration above this baseline. A continued increase in the concentration of contaminants following subsequent sampling events will indicate poorly performing or spent carbon filters. Initial remedial actions will include the replacement of spent carbon, or resizing of carbon filters based on flow and concentration. Spent caustic activated carbon treatment units will be tested for 6 NYCRR Part 371 parameters to determine if they can be disposed of at a permitted solid waste management facility or if they must be disposed of at a permitted hazardous waste management facility. Untreated carbon units shall be returned to the manufacturer for regeneration. Conversion from passive to active gas treatment will be evaluated by the New York State Department of Environmental Conservation should the passive system prove to be ineffective for treating the landfill gas.

Routine monitoring and maintenance of the gas venting system will also include measuring concentrations of H_2S and VOC's at a point in line just prior to the carbon treatment units. If this monitoring reveals insignificant levels of H_2S and VOC's, the New York State Department of Environmental Conservation will evaluate the possibility for the elimination of the carbon treatment units.

5.1.9 Vermin and Vector Observations:

The closed site shall be inspected and treated for vermin and vectors on a regular schedule by a qualified professional exterminator.

5.1.10 Access Road:

The site access road shall be inspected regularly to ensure its integrity. The most likely problems with the roads over the site include rutting of the road surface and erosion of road materials. When rutting advances to the point where standing water is observed on the roadways, the surface shall be regraded and compacted until firm and uniform. Areas where road materials have eroded shall be repaired by placing, grading, and compacting additional soil material.

5.1.11 Leachate Seepage:

The surface of the landfill cover system and the lands immediately adjacent to the cover system shall be inspected regularly for leachate seepage. If excessive leachate seepage is observed, the cover system in the vicinity of the seep shall be inspected for erosion, settlement, and possible damage to the geomembrane barrier. Should damage to the geomembrane be confirmed, the damaged area shall be repaired by qualified personnel, and the leachate seep shall be monitored. If no geomembrane damage is confirmed or if leachate seepage does not discipate after repair of any geomembrane damage, the leachate shall be sampled during the regular environmental monitoring events, and the seepage intensity monitored. The New York State Department of Environmental Conservation will evaluate subsequent analytical data and site inspection reports to determine what corrective actions should be taken. If necessary, the leachate shall be collected and disposed off site.

5.1.12 Maintenance Schedule:

The maintenance activities included in Section 5.1 shall be performed routinely. Following is an outline of the schedule to be followed at the Tuxedo Waste Disposal Site upon closure:

ACTIVITY	FREQUENCY
Site Gate Inspection	Monthly
Signage Inspection	Monthly
Cover Inspection, Grass Mowing	Quarterly, (Seasonal)

ACTIVITY	FREQUENCY
Runoff Control Structures Inspection	Monthly
Flexible Membrane Liner Repairs Inspection	Quarterly
Groundwater Monitoring System Inspection	Quarterly
Gas Venting System Inspection	Monthly
Vermin and Vector Observations	Annually
Vehicles Access Road	Annually
Leachate Seepage	Monthly

5.2 INSPECTION AND MAINTENANCE:

5.2.1 Monthly Check List:

The following check list corresponds with the maintenance activities schedule listed in Section 5.1.10. These items shall be completed on a monthly basis. Findings shall be recorded on the Site Inspection Checklist Form included in Appendix H. Records shall be kept for every month for a minimum of 30 years after final closure of the site. The monthly check list is as follows:

- Inspection of Site Gate
- Inspection of Signage
- Inspection of Runoff Control Structures
- Inspection of Gas Venting System
- Inspection of Site for Leachage Seepage

5.2.2 Quarterly Check List:

The quarterly check list also corresponds with the maintenance activities listed in Section 5.1.10. These items shall be completed on a quarterly basis. Findings shall be recorded on the Site Inspection Checklist Form included in Appendix H. Records shall be kept for every quarter for a minimum of 30 years after final closure of the site. The quarterly check list is as follows:

- Cover Inspection
- Flexible Membrane Liner Inspection
- Groundwater Monitoring System Inspection

5.2.3 Yearly Check List:

The yearly check list also corresponds with the maintenance activities listed in Section 5.1.10. These items shall be completed on a yearly basis. Findings shall be recorded on the Site Inspection Checklist Form included in Appendix H. Records shall be kept of all inspections. The yearly check list is as follows:

- Vermin and Vector Inspection
- Vehicle Access Road Inspection

5.3 DISPOSAL OF USED MATERIAL AND WASTE:

If it becomes necessary to dispose of scrap material or waste as a result of maintenance procedures, these materials shall be taken off-site and disposed of in accordance with all applicable New York State Department of Environmental Conservation requirements.

6.0 REPORTS

6.1 MONTHLY REPORTS:

A report shall be generated by the end of each month that summarizes the findings of each respective monthly site inspection. The report shall include general information including but not limited to the date and time of inspection, personnel involved in the inspection, and climatic conditions.

The report shall also include a specific summary of all inspections and monitoring and maintenance activities conducted for the month. Summaries of monitoring activities shall include field data (i.e., pH, turbidity, field instrument calibrations, etc.), chain-of-custody forms, and laboratory reports as applicable. The inspections and activities include those listed in Section 5.1.10 and are specifically the site gate inspection, signage inspection, runoff control structure inspection, and the gas venting system inspection. All maintenance activities carried out as a result of the findings of the monthly inspections shall be summarized in detail in the report including materials and equipment used and the costs incurred to carry out such activities.

Copies of the monthly reports shall be filed with the New York State Department of Environmental Conservation.

6.2 QUARTERLY REPORTS:

A report shall be generated at the end of every quarter that summarizes the findings of all site inspections, monitoring results, and maintenance activities performed in each respective quarter. The quarterly report shall include the same type of information as required for the monthly reports.

Specific inspections and maintenance activities to be discussed are as shown in Section 5.1.10 and include the cover inspection, flexible membrane liner repairs inspection, and the groundwater monitoring system inspection. Monitoring activities to be summarized include groundwater, surface water, sediment, leachate, and gas monitoring that take place during a particular quarter. Summaries of monitoring activities shall include field data (i.e., pH, turbidity, field instrument calibrations, etc.), chain-of-custody forms, and laboratory reports as applicable. All maintenance activities carried out as a result of the findings of the quarterly inspections shall be summarized in detail in the report, including materials and equipment used and the costs incurred to carry out such activities.

The quarterly reports shall also be filed with the New York State Department of Environmental Conservation.

6.3 YEARLY REPORTS:

A report shall be generated at the end of every year that summarizes all inspections and monitoring and maintenance that was performed during a particular year. The level and type of information included in this report shall be similar to that of the monthly and quarterly reports. Specific yearly inspections include the vehicle access road inspection and the vermin and vector observation inspection.

In addition, the yearly report shall include a summary of any other types of occurrences that take place during the year with regard to the site that are not covered by the criteria for the monthly and quarterly reports. The report will include, but not be limited to, a summary of all monitoring results, maintenance activities carried out, including materials used and associated costs, and any other findings noted during any of the site inspections. Summaries of monitoring activities shall include field data (i.e., pH, turbidity, field instrument calibrations, etc.), chain-of-custody forms, and laboratory reports as applicable.

Copies of the yearly reports shall be filed with the New York State Department of Environmental Conservation.

6.4 FIVE YEAR REVIEW REPORT:

The five year review report shall be generated at the end of the fifth year after final closure of the site. This report shall consist of a summary of all inspections, monitoring, and maintenance that have taken place at the site during this five year period. The report will include, but not be limited to, a summary of all monitoring results, maintenance activities carried out, including materials used and associated costs, and any other findings noted during any of the site inspections. Summaries of monitoring activities shall include field data (i.e., pH, turbidity, field instrument calibrations, etc.), chain-of-custody forms, and laboratory reports as applicable.

The five year review report shall be prepared in order to evaluate monitoring and maintenance procedures with regard to their effectiveness, and to determine if any changes to the monitoring and maintenance plan are warranted.

The report shall be kept on file with the New York State Department of Environmental Conservation.

7.0 CITIZEN PARTICIPATION

7.1 O&M CITIZEN PARTICIPATION PLAN:

The New York State Department of Environmental Conservation will, at the request of the Town of Tuxedo, attend a Tuxedo Town Meeting to inform the residents of the Town of Tuxedo of the post-closure monitoring and maintenance activities that have been conducted at the Tuxedo Waste Disposal Site since closure of the site or the previous informational meeting. The New York State Department of Environmental Conservation will attend the Town meetings if requested by the Town on a quarterly basis when results of each quarter's monitoring become available.

7.2 CONTACT LIST:

The list of phone numbers below has been included to serve as a quick reference of New York State Department of Environmental Conservation, the Town of Tuxedo, and local emergency personnel in case of emergency or other inquiries in reference to the Tuxedo Waste Disposal Site.

NYSDEC Division of Hazardous Waste Remediation, Bureau of Hazardous Site Control	(518) 457-0927
Spill Hotline	(800) 457-7362
Town of Tuxedo, Town Hall	(914) 351-2265
Fire Department	(914) 351-4741
Ambulance Service	(914) 351-4741
Hospital	(914) 357-3300
Police Department	(914) 351-4741

8.0 PERSONNEL

8.1 ORGANIZATION/CHAIN OF COMMAND:

The New York State Department of Environmental Conservation has ultimate authority over the Tuxedo Waste Disposal Site. Upon closure of the site, the New York State Department of Environmental Conservation will let contracts for post closure monitoring and maintenance of the site. It is anticipated that two organizations may be contracted; one to conduct all site inspections and monitoring duties, and the other to carry out all maintenance activities at the site. The New York State Department of Environmental Conservation will coordinate activities between the contracted organizations as they relate to one another.

8.2 PERSONNEL REQUIREMENTS:

Each organization that is contracted by the New York State Department of Environmental Conservation to carry out specific portions of the post closure monitoring and maintenance plan will be required to employ the required personnel with sufficient experience in performing the respective duties. Each contracted organization shall be capable of performing satisfactory work in a timely manner in order to maintain accordance with all schedules outlined in the Monitoring and Maintenance Manual. It is anticipated that one person will be required to conduct site inspections, and two people will be required to carry out gas and water sampling procedures at the site. The number of people that will be required to carry out maintenance activities at the site will depend on the nature of the maintenance being performed. It is estimated that one to four people would be required.

8.3 RESPONSIBILITIES AND DUTIES:

Generally, it shall be the responsibility of the organization contracted to perform all site inspections and monitoring to follow the guidelines set forth in Section 4.0 and 5.0 regarding inspections and monitoring. The organization contracted to carry out maintenance activities at the site shall be responsible to perform all site maintenance activities outlined in Section 5.0 of this manual. All contracted organizations shall be responsible for following all other applicable sections of this manual regarding procedural, reporting, and recordkeeping responsibilities.

8.4 QUALIFICATIONS:

The organizations that are contracted to carry out portions of the post-closure monitoring and maintenance plan will be required by the New York State Department of Environmental Conservation to provide a record of their qualifications to perform the tasks for which they have been contracted to complete. The New York State Department of Environmental Conservation shall have the sole determination of qualified organizations, and shall continuously evaluate the performance of contracted organizations.

8.5 TRAINING (INCLUDING HEALTH AND SAFETY):

All personnel from the organizations contracted to perform parts of the post-closure monitoring and maintenance plan will be required to have all applicable training required to perform their respective duties. Records of all such training shall be submitted to the New York State Department of Environmental Conservation for approval.

In addition, all personnel that will be on-site at the Tuxedo Waste Disposal Site shall have the OSHA 40 Hour Hazardous Waste Operations Training Certification and be instructed on the procedures contained in the health and safety procedures discussed in Section 9.0 of this manual.

9.0 HEALTH AND SAFETY PROCEDURES

Based upon available information, following is a discussion of health and safety issues concerning potential chemical and physical hazards which should be taken into consideration during the post-closure monitoring program. Personnel performing monitoring and maintenance activities shall be informed of these potential hazards, given special instructions as needed, and issued safety equipment, as necessary, in conformance with OSHA requirements. Only personnel properly trained and wearing/utilizing designated health and safety equipment will be allowed in the work zone during the execution of monitoring and maintenance operations. A Site Health & Safety Office shall be designated to conduct all site activities.

9.1 TRAINING:

All personnel performing portions of the post-closure monitoring and maintenance program will be required to maintain all applicable training required to perform their respective duties. Records of all such training shall be submitted to the New York State Department of Environmental Conservation for approval.

In addition, all personnel that will be on-site at the Tuxedo Waste Disposal Site shall have OSHA 40 Hour Hazardous Waste Operations and Emergency Response Training (HAZWOPER) certification. All training will have been certified and conducted in accordance with OSHA regulations outlined in 29 CFR 1910.120.

9.2 MEDICAL SURVEILLANCE:

All personnel working in hazardous waste operations shall have had a medical surveillance physical consistent with OSHA regulations in 29 CFR 1910.120 and performed by a qualified occupational health physician. These medical examinations shall be conducted, at a minimum, annually. All personnel performing monitoring and maintenance operations at the Tuxedo Waste Disposal Site shall be determined medically fit by the occupational health physician to perform their respective tasks.

9.3 HAZARD EVALUATION & RESPONSE:

9.3.1 Chemical Hazards and Action Levels:

The following chemical substances are known to be on-site as the result of previous investigations. Also indicated below are the OSHA permissible exposure limits (PEL) for each substance and the monitoring and maintenance activity where contact with the substance could potentially occur.

CHEMICAL HAZARD	OSHA PEL	M&M ACTIVITY
Tetrachloroethane *	25 ppm	Groundwater sampling
Benzene *	1 ppm	Groundwater sampling
Ethylbenzene *	100 ppm	Groundwater sampling
Toluene *	100 ppm	Groundwater sampling
Carbon disulfide	4 ppm	Groundwater sampling
1,2-Dichloroethane *	200 ppm	Groundwater sampling
Hydrogen sulfide	10 ppm	Gas monitoring
Methane	NA	Gas monitoring

The following action levels have been established to indicate when on-site monitoring justifies a field change in health and safety procedures. Should action levels be exceeded, work operations should cease and an assessment performed. The assessment will include, at a minimum, a review of engineering controls and use of personal protective and monitoring equipment to ensure the health and safety of on-site personnel.

Volatile organic compounds (*) - consistent HNu readings of >5 ppm or any frequent movement of the needle.

Hydrogen sulfide - 10 ppm

Methane - >10% LFL

9.3.2 Physical Hazards:

Explosion/Fire: In the event of an explosion and/or fire all site personnel shall assemble at a safe distance upwind of the involved area. The response procedures outlined in the Fire Contingency Plan shall be implemented including, at a minimum, notification of emergency services.

Personal Injury: Conditions such as slippery surfaces and uneven terrain may cause trip/fall injuries. In addition, injuries may result from electrical sources (shock) and mechanical equipment (cuts, amputations). All lock-out, tag-out procedures consistent with 29 CFR 1910 shall be followed (see Appendix A). In the event of a personal injury occurring on-site, appropriate first-aid shall be initiated and, if necessary, contact shall be made for an ambulance and with the designated medical facility. If the injury increases the risk to others, site activities will stop until the added risk is removed or minimized.

Chemical or Toxic Exposure: Engineering controls and the personal protective equipment (PPE) designated in Section 9.4 will limit the exposure of the workers to any contaminant releases that may occur. Should an exposure occur emergency medical information relative to the chemical substances known to be on-site are listed on the material safety data sheets which are included in Appendix B. Emergency services shall be notified.

Temperature: Ambient temperature should be monitored throughout the work day for the potential for heat or cold stress. Personnel performing inspections, maintenance, and sampling activities will be advised of the potential for severe weather conditions and necessary precautions to be taken to effectively avoid heat/cold stress conditions. A description of these precautions is presented in Appendix C.

9.3.3 Biological Hazards:

Biological hazards can cause skin irritation, rash, allergic reaction, as well as poisoning. To assist in preventing exposure to biological hazards, personnel should wear long pants, tuck pant legs inside socks, wear boots, wear long sleeves when possible, and use insect repellant. Examples are listed below.

Animal: Animal bites - rabies; snake bites - skin irritation, poisoning.

Insects: Bees - allergic reaction, skin irritation; deer ticks - Lyme Disease; mosquitos and miscellaneous insects - skin irritation.

Plants: Poison ivy and poison oak- skin irritation, allergic reaction.

9.4 PERSONAL PROTECTIVE EQUIPMENT

Based on the evaluation of the potential hazards at the site, the current conditions noted at the site, and the extent of the monitoring and maintenance activities expected to be performed, the initial levels of personal protective equipment (PPE) have been designated as Modified Level D. Modified Level D consists of, at a minimum, hard hat, safety glasses, chemical resistant gloves, and work boots. In addition, regular tyvek may be worn at the worker's discretion for the purpose of keeping clothing and skin clean should operations require it. Should action levels be reached, work shall cease and further evaluations shall be performed by the Site Safety Officer. Should monitoring equipment and further investigation indicate an upgrade in PPE is warranted, this shall be accomplished. Work shall not continue until a safe work environment is established.

In the event that air-purifying respirators are authorized, organic vapor/acid gas cartridges are the appropriate canister for use with the involved substances. All respirators shall be approved by NIOSH and/or MSHA and their use shall be consistent with OSHA regulations in 29 CFR 1910.134. All on-site personnel wearing a respirator shall have respirator-use clearance from a qualified occupational health physician. This clearance shall state that the person wearing the respirator has been deemed medically fit to wear a respirator. Filter cartridges used shall be of the same manufacturer as the respirator and shall be changed on a daily basis at a minimum and/or if breathing becomes difficult. Following is a table illustrating PPE levels and guidelines.

9.5 DECONTAMINATION:

Should Level C or a higher level PPE be utilized during site monitoring and maintenance operations, decontamination procedures shall be instituted. Alconox and water shall be used as the decontamination solution. Decontamination equipment consisting of large wash tubs, scrub brushes, plastic sheeting, distilled water, plastic garbage bags, trash barrels, and respirator wipes are required.

Heavy equipment if applicable may be decontaminated by steam cleaning on a protective sheath. Protective covers may be placed over other equipment and removed and discarded with other potentially contaminated items after use.

9.6 EMERGENCY MEDICAL CARE:

Provided below is emergency services information:

PERSONAL PROTECTIVE EQUIPMENT GUIDE

PROTECTIVE EQUIPMENT	PROTECTION LEVELS			
	A	B	C	D
Pressure demand, full face-piece, self-contained breathing apparatus (SCBA), or pressure-demand supplied air respirator with escape SCBA approved by NIOSH	•	•		
Totally-encapsulating chemical protective suit	•			
Full-face or half-mask, air purifying, canister equipped respirators (NIOSH approved)			•	
Escape mask (optional, as applicable)			•	•
Coveralls				•
Coveralls (optional, as applicable)	•	•	•	
Long underwear (optional, as applicable)	•			
Gloves (optional, as applicable)				•
Gloves, outer, chemical-resistant	•	•	•	
Gloves, inner, chemical-resistant	•	•	•	
Boots, outer, chemical-resistant, steel toe & shank		•	•	
Boots, chemical-resistant, steel toe & shank	•			
Boots, outer, chemical-resistant (disposable, as applicable)				•
Boot-covers, outer, chemical-resistant (disoosable optional)		•	•	
Boots/shoes, chemical-resistant steel toe & shank				•
Hard hat (under suit, optional, as applicable)	•			
Hard hat		•	•	•
Disposable protective suit, gloves, and boots (may be worn over totally-encapsulating suit)	•			
Two-way radios (inside encapsulating suit, or under outside protective clothing for Level C)	•	•	•	
Face shield (optional, as applicable)		•	•	•
Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls)		•		
Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls)			•	
Safety glasses or chemical splash goggles				•

9.6.1 Hospital:

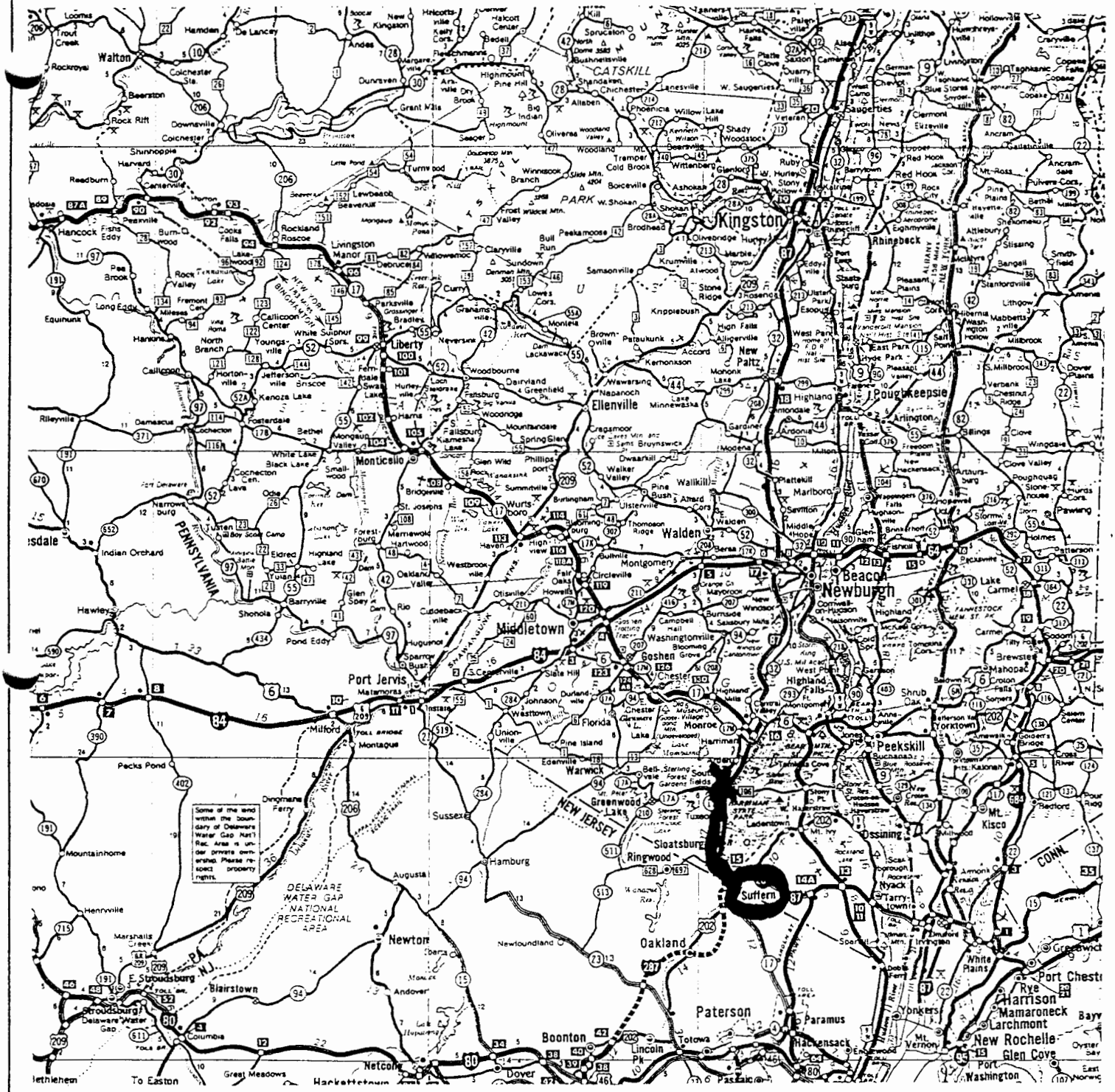
Name:	Good Samaritan Hospital
Address:	Route 59, Suffern, New York
Emergency Phone #:	(914) 357-3300
Directions From Site:	Route 17 south to Orange Turnpike to Route 59 East. Follow signs for hospital. Refer to attached map.
Travel Time From Site:	20 minutes

9.6.2 Emergency Phone Numbers:

Fire:	(914) 351-4741
Police:	(914) 351-4741
Ambulance:	(914) 351-4741
NYSDEC Bureau of Hazardous Site Control:	(518) 457-0927

9.6.3 On-Site First-Aid:

First-aid equipment such as a first-aid kit and distilled water for flushing wounds and eyes should be available in the field vehicle.



NORTH

CLOUGH, HARBOUR & ASSOCIATES
ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS

Route to Hospital

10.0 RECORDS

10.1 OPERATING/INSPECTION:

All records of post-closure operations (maintenance activities) and site inspections shall be kept on file with the New York State Department of Environmental Conservation. The records shall include all field data collected during inspections, all subsequently generated reports (monthly, quarterly, yearly, five year summary), and all data including costs, equipment used, and materials for all maintenance activities that have taken place at the site.

10.2 MONITORING:

Records shall be kept of all monitoring that takes place at the site upon final closure. Monitoring records shall consist of all monitoring well sampling, leachate, gas, sediment and surface water sampling field data, chain-of-custody forms, laboratory analysis of all samples, and subsequently generated reports. All site monitoring records shall be kept on file with the New York State Department of Environmental Conservation.

10.3 MAINTENANCE:

As briefly described in Section 10.1, all maintenance activities that take place at the site shall be recorded. Records shall include field data, manufacturers' data (if applicable), equipment utilized, materials used, and costs associated with all maintenance activities. Maintenance activities for which records shall be kept shall include but not be limited to all those included in Section 5.0 of this manual.

10.4 MAINTENANCE COSTS:

Records of maintenance cost shall be kept on file with the New York State Department of Environmental Conservation. These records shall include expenses of all materials purchased, equipment used, and labor necessary for all maintenance activities that take place at the Tuxedo Site.

11.0 EMERGENCY CONTINGENCY PLAN

11.1 EMERGENCY SPILL RESPONSE:

11.1.1 Containment:

After a spill, immediate action(s) shall be taken to control the source of the release, if possible. In conjunction, procedures shall be initiated to contain or at least minimize the migration of any released materials. Proper personal protective equipment shall be donned and any applicable reference books shall be consulted. Reference Section 9.4 of this manual for personal protective equipment requirements.

Containment procedures include but are not limited to:

1. Shutting down the particular transfer operation in progress.
2. Verify that all controlled drainage in the affected area are closed.
3. Prevent potential flow into adjacent uncontrolled drainage by employing readily available adsorbent materials or siltation fences.
4. Utilize adsorbent materials to "dike off" spilled materials to minimize their migration.

The Site Health & Safety Officer shall be responsible for supervising these procedures and determining if these actions are adequately protecting the environment. If the situation cannot be controlled, a local Emergency Response HazMat Team shall be contracted for additional support.

11.1.2 Cleanup:

Once the release or spill has been contained and all appropriate authorities have been notified, cleanup operations shall be initiated under the supervision of the Site Health & Safety Officer. A local HazMat Team shall be contracted when support is required to complete cleanup activities or support on-site personnel.

Cleanup procedures as applicable shall include but are not limited to:

1. Deployed adsorbent materials shall be swept or shoveled from the edge of migration, if possible, towards a control point. These materials shall be placed in Department of Transportation approved containers for off-site disposal.

2. Vacuum truck(s) supplied by an outside contractor shall be used to retrieve free flowing product, if any, in conjunction with absorbent materials for temporary dikes. Once the maximum quantity of materials are vacuumed, absorbent materials shall be broadcasted on the area and retrieved as in Step 1 above.

3. If required, the area shall be washed down with a pressurized hose and water source to further dilute any spill or refuse. This wash water shall be collected, contained, and disposed of in approved containers at a permitted facility.

11.1.3 Disposal:

All waste associated with a release of hazardous materials shall be placed in appropriate containers for disposal off-site. These materials shall be classified as hazardous or non-hazardous waste so that they can be disposed of in the proper facility.

11.1.4 Notification:

Should a release of pollutants occur, the following agencies and key personnel shall be notified and briefed of the contingency situation.

- New York Department of Environmental Conservation Spill Hotline (800) 457-7362
- New York Department of Environmental Conservation Division of Hazardous Waste Remediation - Bureau of Hazardous Site Control (518) 457-0927

11.2 FIRE/EXPLOSION:

The response procedures outlined in Section 9.3.2 of this manual shall be implemented in the event of a fire or explosion.

11.3 PERSONAL INJURY:

Section 9 of this manual outlines the training and equipment that shall be utilized by on-site personnel to prevent personal injury. The procedures outlined in Section 9.3.2 of this manual shall be followed if an injury does occur.

11.4 TOXIC EXPOSURES:

The personal protective equipment designated in Section 9.4 of this manual will limit workers exposure to any contaminant release that may occur. Emergency procedures outlined in the Section 9.3.2 of this manual shall be followed in the event of an exposure.

11.5 PUBLIC NOTIFICATION:

The procedures for public notification outlined in the Fire Contingency Plan shall be utilized for all emergencies that may warrant this response.

11.6 EMERGENCY TELEPHONE NUMBERS:

See Section 9.6 of this manual.

12.0 RECORD DRAWINGS

The as-built record drawings of the landfill closure cover system for the Tuxedo Waste Disposal Site are included in Appendix F of this manual. These drawings are to be referenced as necessary for all maintenance activities to take place at the site. A copy of these drawings will also be kept on file with the New York State Department of Environmental Conservation.

APPENDIX A

LOCKOUT/TAGOUT PROCEDURES

LOCKOUT/TAGOUT

Energy runs machines and moves their parts. This energy can be electrical, mechanical, hydraulic, or pneumatic. Sometimes the energy is stored, as in springs, steam, or as pressurized air or liquids. Any type of energy, however, can be a serious safety hazard, especially if it comes on or is released unexpectedly while you are servicing or maintaining equipment. As a result, lockout/tagout procedures have been developed and are regulated to prevent the sudden release of energy.

The following procedures will help make sure that you, or anyone working on equipment, isn't electrocuted, hit, cut, crushed, or otherwise hurt during machinery service or repair.

To do maintenance or repair, you first **TURN OFF THE MACHINE.** Before doing anything else, you need to "**LOCK OUT**" danger by making sure that the energy "within the machine" is fully drained and that the machine cannot be accidentally turned on or restarted. If the machine starts up or parts move unexpectedly, you or others could be seriously hurt, even killed.

Proper lockout prevents accidents and saves lives. Here are **three key steps to proper lockout**. Remember to use them every time you service or maintain equipment:

1. **SHUT OFF** and lock out electricity.
2. **RELEASE** and lock out energy.
3. **DRAIN** and lock out material.

After all the energy has been shut off and drained, lockout is the safest method of keeping you from getting hurt. **LOCKOUT** means putting a lock on the part of the machine that controls the energy. For example, a circuit breaker, switch, block, valve, etc. It locks the energy control device in an "off" position. This prevents the machine from starting up or releasing energy

accidentally. The law requires you to lock out machine power whenever possible. Only when you can't lock out do you use tagout - a warning label.

There are requirements for the **TYPES OF LOCKS** that can be used. Lockout locks can have a key or a combination. But it **can't** be a lock that is used for any other purpose than lockout. A lockout lock has to be:

- Durable enough for heat, cold, humidity, or corrosiveness in the area where it is used, for as long as it is needed.
- Standardized by color, shape, or size throughout the facility.
- Strong enough so it can't be removed without heavy force or tools like bolt cutters.
- Identified by the name of the employee who installs and removes it.

In order to perform lockout procedures and to remove locks or tags, you must be **AUTHORIZED**. Only specially trained people are **authorized**. However, if you work with equipment, even if you do not perform lockout procedures, you are **AFFECTED** by what is going on. **Affected employees** need to understand why lockout/tagout is important, how the procedures work, and the importance of not attempting to repair or service machinery without going through proper procedures for lockout/tagout. **Affected employees** also need to be familiar with lockout/tagout procedures, and know the importance of not trying to restart locked or tagged equipment. Unless these employees are also **authorized**, they cannot perform lockout procedures or remove locks or tags.

The most important thing you have to know is this: **NEVER TRY TO START MACHINES OR EQUIPMENT THAT ARE LOCKED OR TAGGED OUT**. Only the person who performed the lockout/tagout can do that. Someone might be injured or killed if you do.

Lockout is a very specific procedure. An authorized employee has to follow certain steps, and they are:

1. **Prepare for shutdown**. Know what type of energy the machine uses. Identify its potential hazards.

2. **Let affected employees know** you will be locking or tagging out the equipment and why.

3. **Turn off** the machine or equipment.

4. **Locate and isolate** all energy sources. Get rid of any stored energy, as in springs, hydraulic systems, or air pressure.

5. **Lock out the switches** or other energy controls. Attach a lock that holds them in an "off" or "safe" position.

6. **Test the operating controls**. Make sure the power does not go on and that the equipment will not operate.

7. **Put operating controls** back in the "off" or "safe" position.

8. **Perform** necessary service or maintenance.

Some equipment cannot be locked out. But that doesn't mean that it cannot be dangerous if it starts or is energized accidentally. That is where tagout comes in. **TAGOUT** means using special tags that warn people of the danger of starting up the machine. A tag has a printed warning about what could happen if the equipment starts up. And it will catch your attention with warnings like: "**Do Not Start**", or "**Do Not Open**", or "**Do Not Operate**". But remember, tags alone do not prevent equipment from starting up. They are only warnings. So if you are using a tag system, you have to be extra careful.

Special tags are required for tagging out. And they have to meet all the standards that locks do. They have to be durable, strong, standardized, and show the identity of the authorized employee doing the work. Tags have to meet other standards too:

- Print and format that are the same throughout the facility.
- Easy to read and understand, even if used in areas that are dirty, corrosive, or damp.
- Tough enough so they cannot be removed accidentally.

Tags have to be attached with something like a nylon cable that: cannot be reused; can be attached by hand; and are self-locking.

Attach and remove tags following the same steps, in the same order, as locks. But remember, **TAGS DON'T LOCK OUT ENERGY. They only provide a warning about the dangers**.

Sometimes a group of employees is required to perform service or maintenance. They still have to follow lockout/tagout procedures. However, each authorized group member puts his or her own lock or tag on during the group lockout.

When maintenance or service is done, only the same authorized employee who installed the lock may remove it.

There are special procedures for removing locks and tags:

- All employees must be a safe distance from equipment.
- Remove tools from machine or equipment.
- Reinstall any machine guards.
- Remove lockout devices.
- Turn on energy.
- Notify other employees that the machines are working again.

IT IS UP TO YOU TO FOLLOW ALL SAFETY PROCEDURES:

- Never remove, ignore, or bypass locks or tags you find on machinery.
- Always use your own lock and key.
- Never remove anyone else's lock or permit anyone to do so.
- Report lost keys to your supervisor immediately and have the lock destroyed.

APPENDIX B

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet

from Genium's Reference Collection

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 677

1,1,2,2-TETRACHLOROETHANE

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name: 1,1,2,2-TETRACHLOROETHANE

Description (Origin/Uses): Used as a solvent primarily for cleaning and extraction procedures and as a chemical intermediate in the manufacture of trichloroethylene and tetrachloroethylene; and as an analytic reagent by textile manufacturers in polymer characterization tests.

Genium

Other Designations: Acetylene Tetrachloride; *sym*-Tetrachloroethane; $CHCl_2CHCl_2$; CAS No. 0079-34-5

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS

H	2	R	1
F	0	I	4
R	0	S	–
PPG*		K	–

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
1,1,2,2-Tetrachloroethane, CAS No. 0079-34-5	Ca 100	**OSHA PEL (Skin*)** 8-Hr TWA: 1 ppm, 7 mg/m³ **ACGIH TLV (Skin*), 1988-89** TLV-TWA: 1 ppm, 7 mg/m³ **Toxicity Data**** Human, Oral, TD_{Lo}: 30 mg/kg Human, Inhalation, TC_{Lo}: 1000 mg/m³ (30 Mins) Rat, Oral, LD_{50}: 800 mg/kg

*This material can be absorbed through intact skin, which contributes to overall exposure.
**See NIOSH, *RTECS* (KI8575000), for additional data with references to reproductive, tumorigenic, and irritative effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 295°F (146°C)
Melting Point: -47°F (-44°C)
% Volatile by Volume: Ca 100
Vapor Pressure: 6 Torrs at 77°F (25°C)*
Molecular Weight: 168 Grams/Mole
Solubility in Water (%): Insoluble
Specific Gravity (H_2O = 1): 1.58658 at 77°F (25°C)

Appearance and Odor: A colorless, nonflammable, heavy, mobile liquid; sweetish, suffocating, characteristic chloroform odor. The odor recognition threshold is reported to be less than 3 ppm.

*At 77°F (25°C) the concentration of 1,1,2,2-tetrachloroethane in saturated air is approximately 7900 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature*	LEL*	UEL*

Extinguishing Media: *1,1,2,2-Tetrachloroethane does not burn. Use extinguishing agents that will put out the surrounding fire. **Unusual Fire or Explosion Hazards:** None reported. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode to protect against the effects of the nearby fire.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: 1,1,2,2-Tetrachloroethane is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hazardous reactions between 1,1,2,2-tetrachloroethane and 2,4-dinitrophenyl disulfide, nitrogen tetroxide, chemically active metals such as potassium; and strong caustics such as potassium hydroxide, sodium, sodium-potassium alloy, hot iron, aluminum, and zinc in the presence of steam are reported. **Conditions to Avoid:** Prevent exposure to the incompatible chemicals listed above. Contact with water causes appreciable hydrolysis that will degrade and decompose this liquid. **Hazardous Products of Decomposition:** Thermal-oxidative degradation of 1,1,2,2-tetrachloroethane can produce highly toxic gases such as carbon monoxide (CO) and oxides of chlorine (ClO_x).

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: NIOSH lists 1,1,2,2-tetrachloroethane as a carcinogen.
Summary of Risks: 1,1,2,2-Tetrachloroethane is absorbed through intact skin in significant amounts; one human fatality has been attributed to this route of exposure. This liquid is considered to be one of the most toxic of the common chlorinated hydrocarbons, particularly with respect to the liver. Severely acute exposure causes depression of the central nervous system (CNS), which can cause death within 12 hours. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, CNS, gastrointestinal system, liver, and kidneys. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** The initial symptoms of exposure are lacrimation, salivation, and irritation of the nose and throat; continued exposure can lead to nausea, vomiting, and narcosis. Also, low blood pressure and cardiac rhythm abnormalities; respiratory depression; nausea, vomiting, burns of the esophagus, and diarrhea; and anesthesia with dizziness leading to loss of consciousness and coma; plus possible transient liver and kidney changes. **Chronic Effects:** The two sets of manifestations are (1) malaise, drowsiness, decreased appetite, then nausea and retching, a bad taste in the throat, constipation, headache, pale stools, jaundice, and dark urine, as well as mental confusion, stupor, and coma; and (2) hand

SECTION 6. HEALTH HAZARD INFORMATION, cont.

tremors, sensation of deafness, numbness in hands and feet, a decrease in reflexes, headache, and nausea. FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. Skin. Rinse the affected areas with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Keep the exposed person warm and at rest until medical help is available. **Ingestion.** Unlikely. Should this type of exposure occur, give the exposed person 3 glasses of water to drink and induce vomiting, then repeat this procedure. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Workers exposed to this liquid should be evaluated with a full battery of tests for the liver, kidneys, and CNS systems, as well as the blood.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, and provide adequate ventilation. Cleanup personnel must be properly clothed and equipped to protect the skin and eyes against any contact with the liquid as well as inhalation of its vapor (see sect. 8). Vacuum the spilled 1,1,2,2-tetrachloroethane and pump it into suitable containers for disposal. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Waste, No. U209
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a); and the Resource Conservation and Recovery Act (RCRA), § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of this liquid is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent skin contact with this liquid. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale 1,1,2,2-tetrachloroethane vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store 1,1,2,2-tetrachloroethane in closed, airtight containers in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5). **Special Handling/Storage:** Provide storage areas with adequate ventilation to prevent concentrations of the vapor from building up beyond the occupational exposure limits cited in section 2.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Tetrachloroethane
DOT Hazard Class: ORM-A
ID No. UN1702
DOT Packaging Requirements: 49 CFR 173.620
DOT Packaging Exceptions: 49 CFR 173.505

IMO Shipping Name: 1,1,2,2-Tetrachloroethane
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II

References: 1, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by: PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

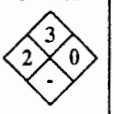
Section 1. Material Identification

32

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA



HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8
Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
%Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	Autoignition Temperature: 928 °F (498 °C)	LEL: 1.3% v/v	UEL: 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[107]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection **References:** 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta* & *para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m³)
15-min STEL: 125 ppm (545 mg/m³)
Action Level: 50 ppm (217 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m³)
STEL: 125 ppm (545 mg/m³)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m³)
STEL: 125 ppm (545 mg/m³)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m³)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.(179)

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm

Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0768 lb/ft³ or 1.2298 kg/m³

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	**Autoignition Temperature:** 810 °F (432 °C)	LEL: 1.0% v/v	UEL: 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm^2/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 µg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detatched storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) **Exceptions:** 173.150
b) **Non-bulk Packaging:** 173.202
c) **Bulk Packaging:** 173.242

Quantity Limitations
a) **Passenger Aircraft or Railcar:** 5L
b) **Cargo Aircraft Only:** 60 L

Vessel Stowage Requirements
a) **Vessel Stowage:** B
b) **Other:** —

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:
Sheet No. 317
Toluene
Issued: 8/79 Revision: E, 9/92

Section 1. Material Identification

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA

HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m³)
15-min STEL: 150 ppm (560 mg/m³)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m³)
STEL: 150 ppm (560 mg/m³)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m³)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m³)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D

Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft³ or 1.2 kg/m³): 0.0797 lb/ft³ or 1.2755 kg/m³
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	Autoignition Temperature: 896 °F (480 °C)	LEL: 1.27% v/v	UEL: 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm²/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and kidney dystrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend. **FIRST AID Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 100 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 200 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene
DOT Hazard Class: 3
ID No.: UN1294
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) **Exceptions:** 150
b) **Non-bulk Packaging:** 202
c) **Bulk Packaging:** 242

Quantity Limitations
a) **Passenger Aircraft or Railcar:** 5L
b) **Cargo Aircraft Only:** 60L

Vessel Stowage Requirements
Vessel Stowage: B
Other: --

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

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Material Safety Data Sheets Collection:

Sheet No. 350
Carbon Disulfide

Issued 11/77 Revision: D, 3/92

Section 1. Material Identification

Carbon Disulfide (CS_2) Description: Prepared industrially by heating charcoal with vaporized sulfur or by reaction of natural petroleum fractions with sulfur. Used in manufacturing soil disinfectants, electronic vacuum tubes, viscose rayon, cellophane, flotation agents, ammonium salts and carbon tetrachloride; in insecticides, chemical analysis, electroplating, fumigation, oil extraction, dry cleaning and degreasing; and as a solvent for lipids, sulfur, rubber, oils, resin and waxes.
Other Designations: CAS No. 75-15-0, carbon bisulfide, dithiocarbonic anhydride, sulphocarbonic anhydride, Weeviltox.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.
Cautions: Carbon disulfide is a highly flammable, dangerous explosion hazard. It is irritating to eyes, skin, and mucous membranes, and toxic to the central nervous (CNS), peripheral nervous (PNS), and cardiovascular (CVS) systems.

‡ The NFPA health rating of "2" is misleading due to the severity of this material's toxicity to the CNS, CVS, and PNS and its chronic effects. A "3" is more appropriate.

HMIS
H 3*
F 4
R 0
PPG†
* Sec. 6, Chronic Effects
† Sec. 8

NFPA‡

R 1
I 4
S 3§
K 4
§Skin absorption

Section 2. Ingredients and Occupational Exposure Limits

Carbon disulfide, ca 99% (major impurities are sulfur compounds)

1990 OSHA PELs (Skin)
8-hr TWA: 4 ppm (12 mg/m³)
15-min STEL: 12 ppm (36 mg/m³)

1990 NIOSH RELs
TWA: 1 ppm (10 mg/m³)
STEL: 10 ppm (30 mg/m³)

1990 IDLH Level
500 ppm

1991-92 ACGIH TLV (Skin)
TWA: 10 ppm (31 mg/m³)

1990 DFG (Germany) MAKs
TWA: 10 ppm (30 mg/m³)
Peak Exposure Limit: 20 ppm/30 min /4 x/shift, momentary value
Half-life: <2 hr

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 40 mg/m³/91 weeks produced paternal effects (spermatogenesis)
Human, inhalation, LC_{Lo}: 2000 ppm/5 min; no toxic effects noted
Human, oral, LD_{Lo}: 14 mg/kg; toxic effects not yet reviewed
Rat, oral, LD_{50}: 3188 mg/kg

* See NIOSH, *RTECS* (FF6650000), for additional mutation, reproductive and toxicity data.

Section 3. Physical Data

Boiling Point: 115 °F (46.5 °C)
Freezing Point: -168 °F (-110.8 °C)
Vapor Pressure: 300 mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 2.64
Coefficient of Viscosity: 0.363 at 68 °F (20 °C)
Molecular Weight: 76.13
Specific Gravity: 1.2632 at 68 °F (20 °C)
Water Solubility: Slightly, 220 mg/100 cc water at 71.6 °F (22 °C)
Other Solubilities: Soluble in alcohol, benzene and ether
Refraction Index: 1.66232 at 77 °F (25 °C)

Appearance and Odor: Clear, colorless to slightly yellow liquid with a sweet, chloroform-like odor when pure and a foul, rotten egg smell as the commercial product. The odor threshold is 0.1 to 0.2 ppm.
Comments: From both health effect and fire/explosion perspectives, this liquid's very high vapor pressure at room temperature indicates that airborne concentrations can build quickly to dangerous levels. Take precautions to ensure safety (Sec. 8).

Section 4. Fire and Explosion Data

Flash Point: -22 °F (-30 °C), CC	Autoignition Temperature: 194 °F (90 °C)	LEL: 1.5% v/v	UEL: 50% v/v

Extinguishing Media: Foams are more effective in carbon disulfide fires than previously believed, when water and dry chemical were the preferred extinguishing agents. Four foams tested are listed in order of increasing effectiveness: high-expansion, aqueous film-forming, fluoroprotein, and protein. If foam is unavailable, rely on carbon dioxide (CO_2) or water spray. Do not scatter material with more water than necessary to put out fire.
Unusual Fire or Explosion Hazards: Carbon disulfide's burning rate is 2.7 mm/min. Vapor may travel to an ignition source and flash back. Container may explode in heat of fire. CS_2 poses a vapor explosion hazard indoors, outdoors, and in sewers. Carbon disulfide can be ignited by friction, rusted or hot steam pipes, and may accumulate static electricity. Heat from an ordinary light bulb is enough to cause ignition.
Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is ineffective for fires involving carbon disulfide. Apply cooling water to sides of tanks until long after fire is extinguished. Stay away from ends of tanks. Immediately withdraw from area if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Carbon disulfide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Carbon disulfide will decompose to its elements in contact with mercury fulminate. It is incompatible with alkali metals, chlorine and other halogens, nitrogen oxide, metal azides, oxidants, aluminum, ethylene diamine and zinc. Carbon disulfide reacts exothermically with phenyl copper-triphenylphosphine complexes.
Conditions to Avoid: Exposure to ignition sources and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of carbon disulfide can produce carbon monoxide (CO), carbon dioxide (CO_2), and toxic sulfur oxides (SO_x)

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[142] and OSHA[164] do not list carbon disulfide as a carcinogen. **Summary of Risks:** CS_2 enters the body primarily via the lungs (inhalation) but can be absorbed via skin. It is irritating to skin, eyes, and mucous membranes and can cause serious damage to CVS, CNS, and PNS. CS_2 is cardiotoxic (toxic to heart), thrombotoxic (adversely affecting blood-clotting ability), and arrythmagenic (causing irregular heartbeat). A Parkinsonian-like effect is sometimesobserved. Exposure to 60 to 100 ppm for a short time can result in severe intoxication and death. Exposure to 5000 ppm is rapidly fatal. 70 to 90% of CS_2 is metabolized, with lungs and kidney excreting the rest. **Medical Conditions Aggravated by Long-Term Exposure:** Coronary heart disease and CNS disorders. **Target Organs:** Skin, CNS, PNS, CVS, eyes, liver, kidney.

Continue on next page

Section 6. Health Hazard Data, *continued*

Primary Entry Routes: Inhalation and skin contact/absorption. **Acute Effects:** CS_2 is irritating and corrosive to the eyes, skin, and mucous membranes. Introduction into eyes causes burning pain, red and swelling lids, and conjunctivitis. Skin contact with liquid may lead to burning and second- or third-degree burns. CS_2 defats tissue and skin sensitization may occur. Skin absorption can result in peripheral nerve damage. Other symptoms from inhalation or skin absorption include headache, dizziness, euphoria, convulsions, nausea, vomiting, muscle weakness, and in severe cases may lead to death by respiratory failure. **Chronic Effects:** Chronic exposure to carbon disulfide may increase the risk of arteriosclerosis as well as cause delirium, psychosis, bad dreams leading to insomnia, CNS damage, peripheral neuropathies (abnormal and usually degenerative state of the nerves causing pain and unstimulated sensations), appetite loss, tremors, gastric disturbances, liver dysfunction, optical neuritis, and retinal hemorrhages. In women, chronic exposure to carbon disulfide can cause menstrual disorders. Spontaneous abortions and premature births are reported.

FIRST AID

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting with 1 to 2 tablespoons of Ipecac (adult dose). After patient vomits, give 2 tablespoons activated charcoal in 8 oz. of water to drink.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Since effects may be delayed, keep victim under observation. The iodine-azide test is useful in detecting degree of exposure and hypersusceptibility of exposed workers. I.V. urea 0.5 to 1.5 g/kg is recommended to inactivate free carbon disulfide in the blood. Vitamin B6 in large doses is recommended. Obtain CBC, EKG, urinalysis, and electrolyte balance.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Plan and design appropriate emergency-response procedures prior to carbon disulfide spills or leaks.* Immediately notify safety personnel, isolate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should wear fully encapsulating, vapor-protective clothing to protect against contamination. If possible, detoxify material before cleanup. For small spills, take up with earth, sand, vermiculite or other absorbent, noncombustible material and place in clean, dry containers with a secure lid for later disposal. For large spills, flush liquid to a special retention basin where it can collect under a layer of water (to prevent ignition or explosion) for disposal or reclamation. Perform all cleanup operations with nonsparking tools. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to water, carbon disulfide should volatilize with a half-life of 2.6 hr (according to model river plan) and should not bioconcentrate significantly in aquatic organisms. In the atmosphere, CS_2 reacts with atomic oxygen and photochemically produced hydroxyl radicals with a half-life of 9 days. **Environmental Toxicity Values:** Sunfish, LC_{100}, 100 µg/L/hr; trout, LC_{100}, 500 µg/L/0.1 hr. **Soil Absorption/Mobility:** Carbon disulfide is highly mobile and volatilizes or leaches into soil. **Disposal:** Large amounts of CS_2 may be distilled for reclamation and packaged for reuse. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. P022

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001 and CWA 311(b)(4)]

Listed as a SARA Extremely Hazardous Substance (40 CFR 355)

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For 10 ppm, use any chemical cartridge respirator with organic vapor cartridges. For 50 ppm, air-purifying respirator with organic vapor cartridges and a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Suggested materials for protective clothing include polyvinyl alcohol (PVA) and polyethylene with breakthrough times of 8 and 4 hr, respectively. **Ventilation:** Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local explosion-proof exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Protect containers from physical damage. Store in iron, glass, porcelain or steel containers. Keep small quantities in cool, dry, well-ventilated area away from incompatibles (Sec. 5). Store large quantities in tanks; add water or inert gas (such as nitrogen) to fill emptying tanks. Submerge tanks in water or locate them above concrete basins large enough to hold the tanks' contents. Equip storage facilities with automatic sprinklers and test regularly. Outside or detached storage is preferred.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. To prevent static sparks, electrically ground all system parts including piping, valves, and moveable containers. Prohibit electrical installations and heating facilities in or near storage areas. Never transfer carbon disulfide by means of air pressure; use pump, water, or inert gas. Use wooden sticks (no spark potential) to measure the contents of CS_2 tanks and containers.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers that emphasize eyes, skin, CNS, PNS, CVS, and reproductive system, and perform electrocardiograms.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Carbon bisulfide or Carbon disulfide
DOT Hazard Class: Flammable liquid
ID No.: UN1131
DOT Label: Flammable liquid
DOT Packaging Exceptions: None
DOT Packaging Requirements: 173.121

IMO Shipping Name: Carbon disulphide
IMO Hazard Class: 3.1
ID No.: UN1131
IMO Label: Flammable liquid, Poison
IMDG Packaging Group: I

MSDS Collection **References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 140, 149, 153, 159, 162, 163, 164
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH, **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
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GENIUM PUBLISHING CORP.

No. 359
ETHYLENE DICHLORIDE
(Formerly 1,2-Dichloroethane)
(Revision C)
Issued: November 1978
Revised: August 1987

SECTION 1. MATERIAL IDENTIFICATION

CHEMICAL NAME: ETHYLENE DICHLORIDE (Changed to reflect common industrial practice)

DESCRIPTION (Origin/Uses): Made from acetylene and HCl. Used as a degreaser, a scavenger in leaded gasoline, as an intermediate in the manufacture of vinyl chloride, in paint removers, in wetting and penetration agents, in ore flotation processes, as a fumigant, and as a solvent for fats, oils, waxes, and gums.

OTHER DESIGNATIONS: 1,2-Dichloroethane; *sym*-Dichloroethane; Dutch Liquid; Dutch Oil; EDC; Ethane Dichloride; Ethylene Chloride; 1,2-Ethylene Dichloride; Glycol Dichloride; $C_2H_4Cl_2$; NIOSH *RTECS* KI0525000; CAS #0107-06-2

MANUFACTURERS/SUPPLIERS: Available from several suppliers, including:
Dow Chemical USA, 2020 Dow Center, Midland, MI 48640; Telephone: (517) 636-1000

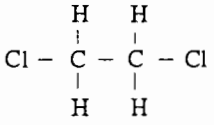
HMIS	
H	1
F	3
R	0
PPE*	
R	1
I	4
S	2
K	4

* See Sect. 8

COMMENTS: Ethylene dichloride is a flammable, toxic liquid.

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Ethylene Dichloride, CAS #0107-06-2; NIOSH *RTECS* #KI0525000	100	ACGIH Values 1987-88 TLV-TWA: 10 ppm, 40 mg/m^3 OSHA PEL* 1986-87 8-Hr TWA: 50 ppm; Ceiling: 100 ppm (15 Min.) NIOSH REL 1986-87 10-Hr TWA: 1 ppm Ceiling: 2 ppm (15 Min.) Toxicity Data Man, Inhalation, TC_{Lo}: 4000 ppm/1 Hr Human, Oral, TD_{Lo}: 428 mg/kg Man, Oral, TD_{Lo}: 892 mg/kg Man, Oral, LD_{Lo}: 714 mg/kg Rat, Oral, LD_{50}: 670 mg/kg



*The maximum allowable peak concentration (above the ceiling level value) of ethylene dichloride is 200 ppm for 5 minutes in any 3-hour period.

COMMENTS: Additional data concerning toxic doses and tumorigenic, reproductive, and mutagenic effects is listed (with references) in the NIOSH *RTECS* 1983-84 supplement, pages 865-66.

SECTION 3. PHYSICAL DATA

Boiling Point ... 182.3°F (83.5°C)
Vapor Pressure ... 87 Torr at 77°F (25°C)
Water Solubility ... Soluble in about 120 Parts Water
Vapor Density (Air = 1) ... 3.4
Evaporation Rate (n-BuAc = 1) ... Not Listed
Specific Gravity ... 1.2569 at 69°F (20°C)
Freezing Point ... -31.9°F (-35.5°C)
Molecular Weight ... 98.96 Grams/Mole

Appearance and odor: Colorless, clear liquid. Sweet, chloroformlike odor is typical of chlorinated hydrocarbons. The recognition threshold (100% of test panel) for ethylene dichloride is 40 ppm. Odor detection probably indicates an excessive exposure to vapor. High volatility and flammability, coupled with its toxicity and carcinogenic potential, make this material a major health hazard.

COMMENTS: Ethylene dichloride is miscible with alcohol, chloroform, and ether.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
See Below	775°F (413°C)	% by Volume	6.2	15.9

EXTINGUISHING MEDIA: Use chemical, carbon dioxide, alcohol foam, water spray/fog, or dry sand to fight fires involving ethylene dichloride. Direct water sprays may be ineffective extinguishing agents, but they may be successfully used to cool fire-exposed containers. Use a smothering effect to extinguish fires involving this material. UNUSUAL FIRE/EXPLOSION HAZARDS: Ethylene dichloride is a dangerous fire and explosion hazard when exposed to sources of ignition such as heat, open flames, sparks, etc. Its vapors are heavier than air and can flow along surfaces to distant, low-lying sources of ignition and flash back. If it is safe to do so, remove this material from the fire area. Ethylene dichloride burns with a smoky flame.

SPECIAL FIRE-FIGHTING PROCEDURES: Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode.

COMMENTS: Flash Point and Method: 56°F (13°C) CC; 65°F (18°C) OC.

OSHA Flammability Class (29 CFR 1910.106): IB. DOT Flammability Class (49 CFR 173.115): Flammable Liquid

SECTION 5. REACTIVITY DATA

Ethylene dichloride is stable. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES include strong oxidizing agents. Explosions have occurred with mixtures of this material and liquid ammonia or dimethylaminopropylamine. Finely divided aluminum or magnesium metal may be hazardous in contact with ethylene dichloride.

CONDITIONS TO AVOID: Eliminate sources of ignition such as excessive heat, open flames, or electrical sparks, particularly in low-lying areas, because the explosive, heavier-than-air vapors will concentrate there.

PRODUCTS OF HAZARDOUS DECOMPOSITION can include vinyl chloride, chloride fumes, and phosgene. Phosgene is an extremely poisonous gas. Products of thermal-oxidative degradation (i.e., fire conditions) must be treated with appropriate caution.

SECTION 6. HEALTH HAZARD INFORMATION

Ethylene dichloride is listed as an anticipated human carcinogen by the NTP and as a probable human carcinogen (Group 2B), by the IARC. It was found to be an animal-positive carcinogen by the IARC. NCI reported positive results (mouse, rat) from its carcinogenesis bioassay. SUMMARY OF RISKS: Ethylene dichloride is considered to be one of the more toxic of the common chlorinated hydrocarbons. Deaths from accidental ingestion of this material have been reported. Inhalation of vapors reportedly caused three fatalities. Excessive inhalation of ethylene dichloride vapors can cause respiratory irritation, intoxication, narcotic and anesthetic effects, vomiting, dizziness, depression, and diarrhea. The hepatoxic (injurious to liver) effects of this material are significant. The systemic effects from overexposure can appear in the liver, kidneys, digestive tract, blood, lungs, adrenal glands, and the central nervous system. Tests on animals have revealed reproductive failure and fetal resorption. There may be increased risk to nursing infants of exposed mothers. TARGET ORGANS: Central nervous system, eyes, kidneys, liver, heart, adrenal glands, and skin. PRIMARY ENTRY: Inhalation, absorption through skin, oral, or eye contact. ACUTE EFFECTS: Skin contact causes irritation, defatting, and, if repeated or prolonged, burning. Eye contact causes irritation and serious injury (clouding of the cornea) if it is not removed promptly. CHRONIC EFFECTS: Injuries to the liver (hepatoxicity) and kidneys, weight loss, low blood pressure, jaundice, oliguria (reduced excretion of urine), or anemia. MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Persons taking anticoagulants could experience an increase in tendency to bleed. Persons taking insulin face an increased risk of lowered blood sugar. FIRST AID: Be prepared to restrain a hyperactive victim. EYE CONTACT: Flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Immediately flush the affected area with water. Wash thoroughly with soap and water. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment. Get medical help.* INHALATION: Remove victim to fresh air; restore and/or support his breathing as needed. Get medical help.* INGESTION: Never give anything by mouth to someone who is unconscious or convulsing. Rinse victim's mouth with water. Oxygen and artificial respiration may be needed. Get medical help.* * GET MEDICAL ASSISTANCE = IN PLANT, PARAMEDIC, COMMUNITY. Get prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Before using ethylene dichloride, it is essential that proper emergency procedures be established and made known to all personnel involved in handling it. Notify safety personnel of ethylene dichloride spills or leaks and implement containment procedures. Remove and eliminate all possible sources of ignition such as heat, sparks, and open flames from the area. Cleanup personnel should use protection against inhalation of vapors and contact with liquid. Contain spills by using an absorbent material such as dry sand or vermiculite. Use nonsparking tools to mix waste material thoroughly with absorbent and place it in an appropriate container for disposal. Flush trace residues with large amounts of water. Do not flush waste to sewers or open waterways. WASTE DISPOSAL: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Waste may be burned in an approved incinerator equipped with an afterburner and a scrubber. Follow Federal, state, and local regulations.

Ethylene dichloride is designated as a hazardous substance by the EPA (40 CFR 116.4). Ethylene dichloride is reported in the 1983 EPA TSCA Inventory.

EPA Hazardous Waste Number (40 CFR 261.33): U077

EPA Reportable Quantity (40 CFR 117.3): 5000 lbs (2270 kgs)

Aquatic Toxicity Rating, TLm 96: 1000 - 100 ppm

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Always wear protective eyeglasses or chemical safety goggles. Ethylene dichloride is particularly harmful to the eyes, and direct contact results in corneal opacity (permanent clouding of the eye). GLOVES: Wear impervious rubber gloves to prevent skin contact. RESPIRATOR: Use a NIOSH-approved respirator per the NIOSH *Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. Any detectable concentration of ethylene dichloride requires an SCBA, full facepiece, and pressure-demand/positive-pressure modes. Warning: Air-purifying respirators will not protect workers from oxygen-deficient atmospheres. OTHER: Wear rubber boots, aprons, and other protective clothing suitable for use conditions to prevent skin contact. Remove contaminated clothing and launder it before wearing it again. Discard contaminated shoes. VENTILATION: Provide maximum explosion-proof local fume exhaust ventilation systems to maintain the airborne concentrations of ethylene dichloride vapors below the exposure limits cited in section 2. Install properly designed hoods that maintain a minimum face velocity of 100 lfm (linear feet per minute). SAFETY STATIONS: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. SPECIAL CONSIDERATIONS: Vapors are heavier than air and will collect in low-lying areas. Eliminate sources of ignition in these areas and again provide good ventilation there. COMMENTS: Practice good personal hygiene. Keep materials off of your clothes and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Immediately remove ethylene dichloride-saturated clothing to avoid flammability and health hazards. Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store ethylene dichloride in tightly closed containers in a cool, dry, well-ventilated area away from sources of ignition. Protect containers from physical damage and from exposure to excessive heat. Avoid direct physical contact with strong acids, bases, oxidizing agents, and reducing agents. SPECIAL HANDLING/STORAGE: Use nonsparking tools. Outside or detached storage is preferred. Store and handle ethylene dichloride in accordance with the regulations concerning OSHA class IB flammable liquids. ENGINEERING CONTROLS: During transfer operations involving ethylene dichloride, the liquid and its vapors must not be exposed to nearby sources of ignition from engineering systems that are not explosion proof. Preplan emergency response procedures.

TRANSPORTATION DATA (per 49 CFR 172.101-2):

DOT Hazard Class: Flammable Liquid

DOT Label: Flammable Liquid

IMO Class: 3.2

DOT Shipping Name: Ethylene Dichloride

DOT ID No. UN 1184

IMO Label: Flammable Liquid, Poison

References: 1-9, 12, 19, 21, 26, 43, 47, 73, 87-102. CK

Approvals JO. Accocco

Indust. Hygiene/Safety DW 11-18-87

Medical Review Geoff Goldsmith 11-30-87

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Material Safety Data Sheets Collection:

Sheet No. 52
Hydrogen Sulfide

Issued: 7/79 Revision: B, 9/92

Section 1. Material Identification 39

Hydrogen Sulfide (H_2S) Description: Formed as a byproduct of many industrial processes (breweries, tanneries, slaughter houses), around oil wells, where petroleum products are used, in decaying organic matter, and naturally occurring in coal, natural gas, oil, volcanic gases, and sulfur springs. Derived commercially by reacting iron sulfide with dilute sulfuric or hydrochloric acid, or by reacting hydrogen with vaporized sulfur. Used in the production of various inorganic sulfides and sulfuric acid, in agriculture as a disinfectant, in the manufacture of heavy water, in precipitating sulfides of metals; as a source of hydrogen and sulfur, and as an analytical reagent.

R 2
I 4
S 3
K 3

NFPA

HMIS
H 3
F 4
R 0
PPE*
* Sec. 8

Other Designations: CAS No. 7783-06-4, dihydrogen monosulfide, hydrosulfuric acid, sewer gas, stink damp, sulfuretted hydrogen, sulfur hydride.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Hydrogen sulfide is a highly flammable gas and reacts vigorously with oxidizing materials. It is highly toxic and can be instantly fatal if inhaled at concentrations of 1000 ppm or greater. Be aware that the sense of smell becomes rapidly fatigued at 50 to 150 ppm, and that its strong rotten-egg odor is not noticeable even at very high concentrations.

Section 2. Ingredients and Occupational Exposure Limits

Hydrogen sulfide: 98.5% *technical*, 99.5% *purified*, and CP *(chemically pure grade)*

1991 OSHA PELs
8-hr TWA: 10 ppm (14 mg/m³)
15-min STEL: 15 ppm (21 mg/m³)

1990 IDLH Level
300 ppm

1990 NIOSH REL
10-min Ceiling: 10 ppm (15 mg/m³)

1992-93 ACGIH TLVs
TWA: 10 ppm (14 mg/m³)
STEL: 15 ppm (21 mg/m³)

1990 DFG (Germany) MAK
TWA: 10 ppm (15 mg/m³)
Category V: Substances having intense odor
Peak exposure limit 20 ppm, 10 min momentary value, 4/shift

1985-86 Toxicity Data*
Human, inhalation, LC_{Lo}: 600 ppm/30 min; toxic effects not yet reviewed
Man, inhalation, LD_{Lo}: 5700 µg/kg caused coma and pulmonary edema or congestion.
Rat, intravenous, LD_{50}: 270 µg/kg; no toxic effect noted

* See NIOSH, *RTECS* (MX1225000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: -76 °F (-60 °C)
Freezing Point: -122 °F (-86 °C)
Vapor Pressure: 18.5 atm at 68 °F (20 °C)
Vapor Density (Air = 1): 1.175
pH: 4.5 (freshly prepared saturated aqueous solution)
Viscosity: 0.01166 cP at 32 °F/0 °C and 1 atm
Liquid Surface Tension (est): 30 dyne/cm at -77.8 °F/-61 °C

Molecular Weight: 34.1
Density: 1.54 g/L at 32 °F (0 °C)
Water Solubility: Soluble*; 1g/187 mL (50 °F/10 °C), 1g/242 mL (68 °F/20 °C), 1g/ 314 mL (86 °F/30 °C)
Other Solubilities: Soluble in ethyl alcohol, gasoline, kerosine, crude oil, and ethylene glycol.
Odor threshold: 0.06 to 1.0 ppm†

Appearance and Odor: Colorless gas with a rotten-egg smell.

* H_2S solutions are not stable. Absorbed oxygen causes turbidity and precipitation of sulfur. In a 50:50 mixture of water and glycerol, H_2S is stable.
† Sense of smell becomes rapidly fatigued and can not be relied upon to warn of continuous H_2S presence.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: 500 °F (260 °C)	LEL: 4.3% v/v	UEL: 46% v/v

Extinguishing Media: Let small fires burn unless leak can be stopped immediately. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** H_2S burns with a blue flame giving off sulfur dioxide. Its burning rate is 2.3 mm/min. Gas may travel to a source of ignition and flash back. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is not effective for fires involving H_2S. If possible without risk, stop leak. Use unmanned device to cool containers until well after fire is out. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: H_2S is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hydrogen sulfide attacks metals forming sulfides and is incompatible with 1,1-bis(2-azidoethoxy) ethane + ethanol, 4-bromobenzenediazonium chloride, powdered copper + oxygen, metal oxides, finely divided tungsten or copper, nitrogen trichloride, silver fulminate, rust, soda-lime, and all other oxidants. **Conditions to Avoid:** Exposure to heat and contact with incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of hydrogen sulfide can produce toxic sulfur dioxide .

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list hydrogen sulfide as a carcinogen. **Summary of Risks:** H_2S combines with the alkali present in moist surface tissues to form caustic sodium sulfide, causing irritation of the eyes, nose, and throat at low levels (50 to 100 ppm). Immediate death due to respiratory paralysis occurs at levels greater than 1000 ppm. Heavy exposure has resulted in neurological problems, however recovery is usually complete. H_2S exerts most of it's toxicity on the respiratory system. It inhibits the respiratory enzyme cytochrome oxidase, by binding iron and blocking the necessary oxydo-reduction process. Electrocardiograph changes after over-exposure have suggested direct damage to the cardiac muscle, however some authorities debate this. **Medical Conditions Aggravated by Long-Term Exposure:** Eye and nervous system disorders. **Target Organs:** Eyes, respiratory system and central nervous system. **Primary Entry Routes:** Inhalation, eye and skin contact. **Acute Effects:** Inhalation of low levels can cause headache, dizziness, nausea, cramps, vomiting, diarrhea, sneezing, staggering, excitability, pale

Continued on next page

Section 6. Health Hazard Data, *continued*

complexion, dry cough, muscular weakness, and drowsiness. Prolonged exposure to 50 ppm, can cause rhinitis, bronchitis, pharyngitis, and pneumonia. High level exposure leads to pulmonary edema (after prolonged exposure to 250 ppm), asphyxia, tremors, weakness and numbing of extremeties, convulsions, unconsciousness, and death due to respiratory paralysis. Concentrations near 100 ppm may be odorless due to olfactory fatigue, thus the victim may have no warning. Lactic acidosis may be noted in survivors. The gas does not affect the skin although the liquid (compressed gas) can cause frostbite. The eyes are very susceptible to H_2S keratoconjunctivitis known as 'gas eye' by sewer and sugar workers. This injury is characterized by palpebral edema, bulbar conjunctivitis, mucous-puss secretions, and possible reduction in visible capacity. **Chronic Effects:** Chronic effects are not well established. Some authorities have reported repeated exposure to cause fatigue, headache, inflammation of the conjunctiva and eyelids, digestive disturbances, weight loss, dizziness, a grayish-green gum line, and irritability. Others say these symptoms result from recurring acute exposures. There is a report of encephalopathy in a 20 month old child after low-level chronic exposure. **FIRST AID Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water. Treat with boric acid or isotonic physiological solutions. Serious exposures may require adrenaline drops. Olive oil drops (3 to 4) provides immediate treatment until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing and rinse with flooding amounts of water. For frostbite, rewarm in 107.6°F (42 °C) water until skin temperature is normal. *Do not* use dry heat. **Inhalation:** Remove exposed person to fresh air and administer 100% oxygen. Give hyperbaric oxygen if possible. **Ingestion:** Unlikely since H_2S is a gas above -60 °C. **Note to Physicians:** The efficacy of nitrite therapy is unproven. Normal blood contains < 0.05 mg/L H_2S; reliable tests need to be taken within 2 hr of exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Use water spray to cool, dilute, and disperse vapors. Neutralize runoff with crushed limestone, agricultural (slaked) lime, or sodium bicarbonate. If leak can't be stopped in place, remove cylinder to safe, outside area and repair or let empty. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, TLm = 0.0448 mg/L/96 hr at 71.6 °F/22 °C; fathead minnow, TLm = 0.0071 to 0.55 mg/L/96 hr at 6 to 24 °C. **Environmental Degradation:** In air, hydrogen sulfides residency (1 to 40 days) is affected by temperature, humidity, sunshine, and the presence of other pollutants. It does not undergo photolysis but is oxidated by oxygen containing radicals to sulfur dioxide and sulfates. In water, H_2S converts to elemental sulfur. In soil, due to its low boiling point, much of H_2S evaporates quickly if spilled. Although, if soil is moist or precipitation occurs at time of spill, H_2S becomes slightly mobile due to its water solubility. H_2S does not bioaccumulate but is degraded rapidly by certain soil and water bacteria. **Disposal:** Aerate or oxygenate with compressor. For in situ amelioration, carbon removes some H_2S. Anion exchanges may also be effective. A potential candidate for rotary kiln incineration (1508 to 2912 °F/820 to 1600 °C) or fluidized bed incineration (842 to 1796 °F/450 to 980 °C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U135
SARA Toxic Chemical (40 CFR 372.65): Not listed
Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 500 lb
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001 & CWA, Sec. 311 (b)(4)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A & Z-2)
Listed as a Process Safety Hazardous Material (29 CFR 1910.119), TQ: 1500 lb

ection 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 100 ppm, use a supplied-air respirator (SAR) or SCBA. For < 250 ppm, use a SAR operated in continuous-flow mode. For < 300 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: a written program, medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polycarbonate, butyl rubber, polyvinyl chloride, and neoprene are suitable materials for PPE. **Ventilation:** Provide general & local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in steel cylinders in a cool, dry, well-ventilated area away from incompatibles (Sec. 5). Install electrical equipment of Class 1, Group C. Outside or detached storage is preferred. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to keep levels as low as possible. Enclose processes and continuously monitor H_2S levels in the plant air. Keep pipes clear of rust as H_2S can ignite if passed through rusty pipes. Purge and determine H_2S concentration before entering a confined area that may contain H_2S. The worker entering the confined space should have a safety belt and life line and be observed by a worker from the outside. Follow applicable OSHA regulations (1910.146) for confined spaces. H_2S can be trapped in sludge in sewers or process vessels and may be released during agitation. Calcium chloride or ferrous sulfate should be added to neutralize process wash water each time H_2S formation occurs. Control H_2S emissions with a wet flare stack/scrubbing tower. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers emphasizing the eyes, nervous and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Hydrogen sulfide, liquefied
DOT Hazard Class: 2.3
ID No.: UN1053
DOT Packaging Group: --
DOT Label: Poison Gas, Flammable Gas
Special Provisions (172.102): 2, B9, B14

Packaging Authorizations
Exceptions: --
Non-bulk Packaging: 304
Bulk Packaging: 314, 315

Vessel Stowage Requirements
Vessel Stowage: D
Other: 40

Quantity Limitations
Passenger, Aircraft, or Railcar: Forbidden
Cargo Aircraft Only: Forbidden

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 140, 148, 149, 153, 159, 163, 164, 168, 171, 180
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection:

Sheet No. 440
Methane

Issued: 7/80 Revision: A, 8/89

Section 1. Material Identification 29

Methane Description: Widely distributed in nature, methane comprises 0.00022% by volume of the earth's atmosphere. American natural gas is mostly methane (85%). At temperatures greater than 2012 °F (1100 °C), pure carbon combines with pure hydrogen to form methane. Above 2732 °F (1500 °C), the amount of methane produced increases with temperature. Obtained from sodium acetate and sodium hydroxide or from aluminum carbide and water. Commercially prepared from natural gas or by fermentation of cellulose and sewage sludge. Constituent of illuminating and cooking gas. Used in the manufacture of hydrogen, hydrogen cyanide, ammonia, acetylene, formaldehyde, and many other organics.
Other Designations: Fire damp; marsh gas; methyl hydride; CH_4; CAS No. 0074-82-8.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I -
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NFPA

HMIS
H 1
F 4
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Methane, ca 100%*

OSHA PEL	ACGIH TLV, 1988-89	NIOSH REL	Toxicity Data†
None established	None established	None established	Not listed

* Check with your supplier to determine the exact composition of the purchased methane. Possible contaminants are ethane (C_2H_6), propane (C_3H_8), butane (C_4H_{10}), higher molecular weight alkanes, carbon dioxide (CO_2), nitrogen (N_2), and oxygen(O_2).
† Monitor NIOSH, *RTECS* (PA1490000), for future toxicity data.

Section 3. Physical Data

Boiling Point: -259 °F (161.6 °C)
Vapor Density (Air = 1): 0.544 at 32 °F (0 °C)
Molecular Weight: 16 g/mol
Water Solubility: Slight*
Melting Point: -296.5 °F (-182.5 °C)

Appearance and Odor: A colorless, odorless, tasteless, extremely flammable gas. Commercial methane's trace amounts of a suitable mercaptan compound give it natural gas's familiar rotten egg smell.

*Soluble in alcohol and ether.

Section 4. Fire and Explosion Data

Flash Point: -213 °F (-136.11 °C)	Autoignition Temperature: 999 °F (537 °C)	LEL: 5% v/v*	UEL: 15% v/v*

Extinguishing Media: Methane's extreme flammability, extensive explosibility range, and very low flash point represent dangerous fire and explosion risks. *Treat any fire situation involving rapidly escaping and burning methane gas as an emergency.* Extinguish methane fires by shutting off the source of the gas. Use water sprays to cool fire-exposed containers and to protect the personnel attempting to seal the source of the escaping gas.
Unusual Fire or Explosion Hazards: Methane gas is very flammable with an extensive explosibility range. The best fire-fighting technique may be simply to let the burning gas escape from the pressurized cylinder, tank car, or pipelines. Never extinguish the burning gas without first locating and sealing its source. Otherwise, the still leaking gas could explosively re-ignite without warning and cause more damage than if it burned itself out.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

* The loudest methane-air explosions occur when 1 volume of methane is mixed with 10 volumes of air (or 2 volumes of oxygen). **Warning:** Air with more than 14% by volume methane burns *noiselessly*. Methane burns with a pale, faintly luminous, not always easily detected flame.

Section 5. Reactivity Data

Stability/Polymerization: Methane is stable at room temperature in closed, pressurized containers during routine operations. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Genium reference 84 reports that methane can react violently with bromine pentafluoride, chlorine, chlorine dioxide, nitrogen trifluoride, liquid oxygen, and oxygen difluoride.
Conditions to Avoid: Never expose methane to ignition sources such as open flame, lighted cigarettes or pipes, uninsulated heating elements, or electrical or mechanical sparks. Prevent any accidental or uncontrollably rapid release of methane gas from high-pressure cylinders, tank cars, or pipelines.
Hazardous Products of Decomposition: Thermal oxidative degradation of methane can produce carbon dioxide and toxic carbon monoxide (CO).

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists methane as a carcinogen. **Summary of Risks:** As a simple asphyxiant, methane does not cause significant physiological responses, but it can displace the minimum required atmospheric oxygen level. Significant displacement results in an oxygen-deficient atmosphere with no adequate warning properties. Asphyxiation can occur especially in confined, poorly ventilated, undisturbed spaces infrequently entered by workers. Frostbite (cryogenic damage) can result from contact with liquid methane's extremely low temperature. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** None reported. **Primary Entry:** Inhalation. **Acute Effects:** The initial symptoms of simple asphyxiant gases's effects are rapid respiration and air hunger, diminished mental alertness, and impaired muscular coordination. Continuing lack of oxygen causes faulty judgement, depression of all sensations, rapid fatique, emotional instability, nausea, vomiting, prostration, unconsciousness, and finally, convulsions, coma, and death. **Chronic Effects:** None reported.

FIRST AID

Skin: (Liquid methane): Promptly flush the affected area with lots of tepid/lukewarm water to reduce freezing of tissues. Never apply direct heat to frostbitten areas. Loosely apply dry, bulky dressings to protect the area from further injury. Get treatment from qualified medical personnel. **Inhalation:** Rescuers must consider their own safety when entering confined, poorly ventilated, oxygen-deficient areas. Self-contained breathing equipment must be readily available. Rescuers must use nonsparking tools and equipment; e.g., floodlights lowered into any incident area must be electrically grounded and bonded, shatter-resistant, and sparkproof. **After first aid, get appropriate in-plant, paramedic, or community medical attention and support for inhalation exposures in oxygen-deficient atmospheres.** Seek prompt medical assistance for further observation and treatment.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a methane spill control and countermeasure plan (SCCP).* When a leak occurs, notify safety personnel, eliminate heat and ignition sources, evacuate unnecessary personnel, provide maximum explosion-proof ventilation, and implement the SCCP. Use only nonsparking tools and equipment. Locate and seal the source of the leaking gas. Use water sprays to protect the personnel attempting this shutoff. Large methane releases can result in spectacular explosions. If attempts to shut off the leaking gas are unsuccessful, evacuate the likely explosion area. **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Remove leaking or defective cylinders to a safe, outside, posted, discharge location. Let the methane gas discharge at a moderate rate. When it is empty, return the cylinder to the supplier after it is properly tagged, labelled, or stenciled MT (empty) or defective.

OSHA Designations

Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). **Gloves:** To prevent skin contact, workers handling liquid methane should wear appropriate insulating gloves, safety glasses, and splash aprons, as required by the particular work conditions. **Respirator:** Wear a NIOSH-approved respirator if necessary. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres; use self-contained breathing equipment there. **Ventilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the 5% v/v LEL (Sec. 4). Local exhaust ventilation is preferred since it prevents methane dispersion into the work area by eliminating it at its source (Genium ref. 103). Give special attention to proper ventilation of enclosed areas. **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, washing facilities, fire extinguishers, and oxygen bottles for emergency first-aid. **Contaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment. **Other:** If appropriate, consider installing automatic sensing equipment that warns workers of oxygen-deficient atmospheres or of potentially explosive air-gas mixtures. All engineering systems in any methane gas storage, handling, or processing area must be explosion-proof so they have no spark potential or hot spots. Pressurized systems must use only approved valves, manifolds, flanges, and flame arrestors. **Comments:** Methane gas presents dangerous fire, explosion, and reactivity risks. Regularly inspect and service all the piping systems which transport methane gas in production and storage areas. Before use, thoroughly test methane lines with nitrogen gas for leaking, especially in enclosed areas.

Section 9. Special Precautions and Comments

Storage Requirements: Store methane in closed, pressurized cylinders, tank cars, pipelines, or other containers in a cool, dry, well-ventilated, fireproof area away from heat and ignition sources and incompatible chemicals (Sec. 5). Protect these containers from physical damage and heat. Shield them from direct sunlight. **Special Handling/Storage:** Electrically ground and bond all containers, tanks, cylinders, tank cars and pipelines used in methane shipping, receiving, or transferring operations. Never smoke in any work area where the possibility of exposure to methane gas (fire hazard) exits. Recommended storage containers include steel.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Methane
DOT Hazard Class: Flammable gas
DOT ID No. : UN1971
DOT Label: Flammable gas
DOT Packaging Requirements: 49 CFR 173.302
DOT Packaging Exceptions: 49 CFR 173.306

IMO Shipping Name: Methane, compressed
IMO Hazard Class: 2.1
IMO Label: Flammable gas

***MSDS Collection* References:** 1, 6, 7, 84-94, 100, 116, 117, 119, 120, 122
Prepared by: PJ Igoe, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD FS

APPENDIX C

HEAT STRESS MONITORING GUIDE

HEAT STRESS MONITORING

MONITORING

Monitoring frequencies should increase as the ambient temperature increases or as slow recovery rates are observed. Heat stress monitoring should be performed by a person with a current first aid certification who is trained to recognize heat stress symptons. For monitoring the body's recuperative abilities to excess heat, one or more of the following techniques will be used. Other methods for determining heat stress monitoirng, such as wet bulb globe temperature (WBGT) index from American Conference of Governmental Industrial Hygienists (ACGIH) TLV booklet can be used.

To monitor the worker, measure:

1. Heart rate: Count the radial pulse during a 30-second period as early as possible in the rest period.
   - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest period the same.
   - If the heart rate exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one third.

2. Oral Temperature: Use a clinical thermometer, three minutes under the tongue, or similar device to measure the oral temperature at the end of the work period (before drinking).
   - If oral temperature exceeds 99.5°F (37.6°C), shorten the next work cycle by one third without changing the rest period.

- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one third.
- Do not permit a worker to wear a semi-permeable or impermeable garment when oral temperature exceeds 100.6°F (38.1°C).

PREVENTION OF HEAT STRESS

Proper training and preventative measures will aid in averting loss of worker productivity and serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat-related illness. To avoid heat stress the following steps should be taken:

1. Adjust work schedules.
   - Modify work/rest schedules according to monitoring requirements.
   - Mandate work slowdowns as needed.
   - Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.

2. Provide shelter (air conditioned, if possible) or shaded areas to protect personnel during rest periods.

3. Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., eight fluid ounces of water must be ingested for approximately every eight ounces of

weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:

- Maintain water temperature at 50° to 60°F (10° to 16.6°C).
- Provide small disposable cups that hold about 4 ounces.
- Have workers drink 16 ounces of fluid (preferably water or dilute drinks) before beginning work.
- Urge workers to drink a cup or two every 15 to 20 minutes or at each monitoring break. A total of 1 to 1.6 gallons of fluid per day are recommended, but more may be necessary to maintain body weight.

4. Train workers to recognize the symptons of heat-related illnesses.

COLD STRESS MONITORING

MONITORING

Thermal injury due to cold exposure can become a problem for field personnel. Systemic cold exposure is referred to as hypothermia. Local cold exposure is generally labeled frostbite. Hypothermia is defined as a decrease in the patient core temperature below 96°F. The body temperature is normally maintained by a combination of central (brain and spinal cord) and peripheral (skin and muscle) activity. Interferences with any of these mechanisms can result in hypothermia. Symptoms of hypothermia include shivering, apathy, listlessness, sleepiness, and unconsciousness. Frostbite is both a general and a medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 20°F. Symptoms of frostbite are a sudden blanching or whitening of the skin; the skin has a waxy or white appearance and is firm to the touch; tissues are cold, pale, and solid.

To monitor the worker start oral temperature recording at job sites:

1. At the Field Team Leader's discretion when suspicion is based on changes in worker's performance or mental status.
2. At worker's request.
3. As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind chill <20°F or wind chill <30°F with precipitation).
4. As a screening measure whenever any one worker on the site develops hypothermia.
5. Any person developing moderate hypothermia (a core temperature of 91°F) cannot return to work for 48 hours.

PREVENTION OF HEAT STRESS

1. Educate worker to recognize the symptoms of frostbite and hypothermia.
2. Identify and limit known risk factors such as prohibit phenothiazine use and identify/warn/limit beta blocker use.
3. Assure the availability of enclosed, heated environment on or adjacent to the site.
4. Assure the availability of dry changes of clothing.
5. Develop capability for temperature recording at the site.
6. Assure the availability of warm drinks.

APPENDIX D

OPERATIONS AND MAINTENANCE COST ESTIMATES

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

PER YEAR O&M COSTS - YEARS 1-5

ITEM	COST	#/YEAR	COST/YEAR
Equipment Rental & Misc. Exp.	$ 1,750	4	$ 7,000
Well Sampling (12)	$ 2,500	4	$ 10,000
Surface Water Sampling (5)	$ 550	4	$ 2,200
Sediment Sampling (5)	$ 550	4	$ 2,200
Laboratory Analysis	$ 10,910	4	$ 43,640
Gas Survey	$ 2,500	4	$ 10,000
Gas Sampling	$ 300	4	$ 1,200
Gas System Maintenance (14)	$ 36,400	1	$ 36,400
Mowing	$ 500	4	$ 2,000
General Repairs	$ 10,000	--	$ 10,000
Site Inspections	$ 1,150	12	$ 13,800
Monthly Inspection Reports	$ 1,500	12	$ 18,000
Quarterly O&M Reports	$ 2,600	4	$ 10,400
Yearly O&M Report	$ 3,200	1	$ 3,200
Total Cost Per Year			$170,040

NOTES:
(1) Cost Estimate in 1996 Dollars
(2) Cost Estimate Assumes Quarterly Environmental Monitoring Required by the NYS Department of Environmental Conservation

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

PER YEAR O&M COSTS - YEAR 6-30

ITEM	COST	#/YEAR	COST/YEAR
Equipment Rental & Misc. Exp.	$ 1,750	1	$ 1,750
Well Sampling (12)	$ 2,500	1	$ 2,500
Surface Water Sampling (5)	$ 550	1	$ 550
Sediment Sampling (5)	$ 550	1	$ 550
Laboratory Analysis	$ 10,910	1	$ 10,910
Gas Survey	$ 2,500	1	$ 2,500
Gas Sampling	$ 300	1	$ 300
Gas System Maintenance (14)	$ 36,400	1	$ 36,400
Mowing	$ 500	4	$ 2,000
General Repairs	$ 10,000	--	$ 10,000
Site Inspections	$ 1,150	12	$ 13,800
Monthly Inspection Reports	$ 1,500	12	$ 18,000
Quarterly O&M Reports	$ 2,600	4	$ 10,400
Yearly O&M Report	$ 3,200	1	$ 3,200
Total Cost Per Year			$ 112,860

NOTES:
(1) Cost Estimate in 1996 Dollars
(2) Cost Estimate Assumes Annual Environmental Monitoring will be allowed by the NYS Department of Environmental Conservation six years after final closure

APPENDEX E

SAMPLING SUPPLIES CHECKLIST

SAMPLING CHECKLIST

PROJECT_____ SAMPLER_____
PROJECT NO._____ DATE_____

GENERAL

Chain-of-custody _____
Sample bottles _____
Coolers & Ice _____
Kem wipes _____
Paper towels _____
Tackle box _____
Tool kit _____
Beakers _____
Buckets _____
Wash bottles _____
DI water _____
Field book & pen _____
Equip rent sheet _____
Field Data Sheet _____
Garbage bags _____
HASP _____
First aid kit _____
Alconox _____
Rain gear _____
WD-40 _____
Marking paint _____
Insect repellant _____
Camera _____
Flagging _____
Wood stakes _____
100'tape/6'rule _____
Auger/pick/shovel _____

SAFETY EQUIPMENT

Tyvek suits _____
Rubber boots _____
Tyvek boot covers _____
Respirator _____
Cartridges _____
Neoprene gloves _____
Latex gloves _____
Hard hats & liners _____
Safety glasses _____
Ear plugs _____
Duct tape _____
Harness & rope _____
PAPR system _____
Scott air packs _____
Dust masks _____

METERS

Turbidity & Standards _____
pH & buffers _____
Conductivity _____
Solinst _____
Data Logger _____
Particulate _____
Scott Alert S101 _____
Scott Alert S105 _____
Scott Alert S109 _____
Gas Tester Methane _____
HNu/580S _____
Radiation Survey _____
Draeger Kit _____
Draeger tubes _____
ISCO pump _____
ISCO Composite sampler _____
Extension probe _____
Charger _____
Calibration gases _____

GROUNDWATER SAMPLING

Bailers _____
Polycord _____
Filters _____
Filter hand pump _____
Waterra pump _____
Waterra hand pump _____
HDPE tubing _____
Foot valves _____
Generator _____

DECON EQUIPMENT

Wash tubs _____
Scrub brushes _____
Plastic sheeting _____
Respirator wipes _____

APPENDIX F

RECORD DRAWINGS

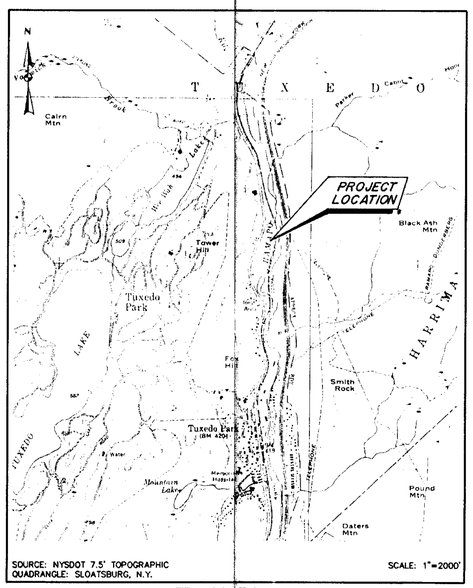
NEW YORK STATE SUPERFUND CONTRACT
REMEDIAL CLOSURE DESIGN
TUXEDO WASTE DISPOSAL SITE NO. 3-36-035
ORANGE COUNTY, NEW YORK

LEGEND

- 500 — PROPOSED CONTOURS
- 505 x PROPOSED SPOT ELEVATION
- PROPOSED STONE LINED DRAINAGE DITCH
- PROPOSED GRASS LINED DRAINAGE DITCH
- DRAINAGE CHANNEL TRANSITION
- EXISTING CONTOURS
- EXISTING SPOT ELEVATION
- PROPOSED ACCESS ROAD
- EXISTING ACCESS ROAD
- PROPERTY LINE
- EXISTING LIMIT OF WASTE
- FINAL LIMIT OF WASTE
- CENTERLINE OF ROAD
- EXCAVATION TRENCH LOCATIONS
- WASTE EXCAVATION
- MW-3 GROUNDWATER MONITOR WELL LOCATION
- PROPOSED GAS VENT WITH WELL & LATERAL DIRECTION
- PROPOSED GAS VENT IN TRENCH & LATERAL DIRECTION
- UTILITY POLE
- MH MANHOLE
- EDGE OF ASPHALT PAVEMENT
- OVERHEAD WIRES
- RAILROAD TRACKS
- GUIDE RAIL
- TP-20 475 94 TEST PIT WITH ELEVATION
- RIB-2 B-2 SOIL BORING LOCATIONS
- W W WATER MAIN
- EXISTING CULVERT
- LEDGE

4 / G-5 — DETAIL IDENTIFICATION NO. / SHEET NO. WHERE DETAIL IS SHOWN

4 / G-2 DETAIL TITLE — DETAIL IDENTIFICATION NO. / SHEET NO. WHERE DETAIL IS CALLED OUT



SOURCE: NYSDOT 7.5' TOPOGRAPHIC QUADRANGLE: SLOATSBURG, N.Y.

SCALE: 1"=2000'

SITE LOCATION MAP

GENERAL CLOSURE NOTES:

1. THE SITE IS CLASSIFIED AS CLASS 2 HAZARDOUS WASTE SITE BY THE NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION. ALL WORK ON SITE SHALL BE PERFORMED IN ACCORDANCE WITH OCCUPATIONAL SAFETY AND HEALTH ACT REGULATIONS. THE WORK SHALL BE SCHEDULED TO PROCEED CONTINUOUSLY UNTIL COMPLETION. IF THE WORK IS STOPPED BECAUSE OF ADVERSE WEATHER OR OTHER CONDITIONS, ALL EXPOSED GEOTEXTILES, GEOCOMPOSITE DRAINAGE NETTING AND OTHER MATERIALS SHALL BE COVERED FROM EXPOSURE AND PROTECTED FROM DAMAGE.
2. EXISTING CONTOURS AND PLANIMETRIC FEATURES ARE BASED ON A FIELD SURVEY COMPLETED ON JULY 17, 1990 AND UPDATED IN AUGUST, 1993 BY YEC, INC. IT IS RECOMMENDED THAT THE CONTRACTOR INSPECT THE SITE PRIOR TO BID SO THAT THE EXTENT OF VARIANCE OF ACTUAL GROUND FEATURES WITH THOSE SHOWN ON THE PLANS MAY BE REFLECTED IN THE BID. THE LANDFILL HAS BEEN INACTIVE SINCE OCTOBER, 1987.
3. ALL ELEVATIONS SHOWN ARE BASED ON A BENCHMARK ESTABLISHED ADJACENT TO THE SITE, REFERENCE THE TOPOGRAPHIC BASEMAP, DWG. NO. G-2.
4. ALL MATERIALS USED, AND ALL CONSTRUCTION METHODS EMPLOYED FOR WORK WITH REFERENCE TO NYSDOT ITEMS SHALL BE IN ACCORDANCE WITH THE "MATERIALS" AND "CONSTRUCTION DETAILS" SECTIONS OF THE NEW YORK STATE DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS" OF JANUARY 2, 1990, LATEST ADDENDA.
5. ALL WORK ON CONRAIL PROPERTY SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OUTLINED IN THE CONRAIL TEMPORARY LICENSE AGREEMENT PERMITTING ENTRY (TLAPE) ON PROPERTY.
6. CONTRACTOR SHALL LIMIT THE PLAN AREA OF THE WASTE EXCAVATION AND FILL LOCATIONS AS REQUIRED TO MINIMIZE ODORS AND THE RELEASE OF VOLATILE ORGANIC COMPOUNDS.
7. A MINIMUM OF 6 INCHES OF DAILY COVER SHALL BE PLACED ON ANY EXPOSED OR DISTURBED WASTE AT THE END OF EACH WORK DAY.
8. PROTECT ALL EXISTING MONITORING WELLS FROM DAMAGE DURING CONSTRUCTION. ANY DAMAGED WELL MUST BE IMMEDIATELY REPORTED TO THE ENGINEER AND THE DEPARTMENT AND WILL BE REPLACED BY THE CONTRACTOR IN ACCORDANCE WITH NYSDEC PROTOCOL AT NO ADDITIONAL COST TO THE DEPARTMENT. THE NEWLY CONSTRUCTED WELL MUST MEET THE APPROVAL OF THE ENGINEER AND THE DEPARTMENT.
9. THE SURFACE OF THE LANDFILL SHALL BE GRADED AS SHOWN ON THE WASTE GRADING PLAN DWG. G-3 TO PROVIDE FOR RUNOFF AND TO PREVENT PONDING OF WATER OVER THE LANDFILL SURFACE.
10. FINAL PREPARATION OF THE TOP AND SIDE SLOPES OF THE EXISTING LANDFILL SHALL CONSIST OF THE COMPACTION OF THE REGRADED SURFACE, PLACEMENT OF 6 INCHES OF DAILY COVER AND PLACEMENT OF A GEOTEXTILE TO BE COVERED WITH A MINIMUM OF 12 INCHES OF SELECT GRANULAR MATERIAL. THE SELECT GRANULAR MATERIAL SHALL HAVE A PERMEABILITY OF 5×10^{-3} CM/SEC OR GREATER.
11. A GEOMEMBRANE BARRIER SHALL BE PLACED IN DIRECT CONTACT WITH THE PREVIOUSLY PLACED SELECT GRANULAR MATERIAL. THE SYNTHETIC BARRIER MATERIAL SHALL CONSIST OF A SIXTY (60) MIL. "VLDPE" GEOMEMBRANE WITH A MAXIMUM COEFFICIENT OF PERMEABILITY EQUAL TO 1×10^{-12} CM/SEC. THE MATERIAL SHALL BE PLACED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS AND MANUFACTURERS RECOMMENDATIONS. THE GEOMEMBRANE INSTALLED ON SLOPES EQUAL TO OR GREATER THAN 25 PERCENT SHALL BE TEXTURED ON BOTH SIDES.
12. A GEONET/GEOTEXTILE COMPOSITE SHALL BE PLACED DIRECTLY ABOVE THE BARRIER LAYER (GEOMEMBRANE) ON SLOPES EQUAL TO OR GREATER THAN 25 PERCENT AND IN ACCORDANCE WITH THE CLOSURE DETAILS AND PROJECT SPECIFICATIONS. THE COMPOSITE SHALL CONSIST OF AN HDPE GEONET WITH A GEOTEXTILE ADHERED TO BOTH SIDES. MATERIAL REQUIREMENTS SHALL CONFORM TO THOSE INCLUDED IN THE PROJECT SPECIFICATIONS.
13. THE BARRIER PROTECTION LAYER OF THE CAP CONSTRUCTED ABOVE THE BARRIER LAYER (GEOMEMBRANE) SHALL CONSIST OF 12 INCHES OF BARRIER PROTECTION FILL, PLACED BELOW 12 INCHES OF SELECTED FILL. THE MATERIALS SHALL MEET THE REQUIREMENTS OUTLINED IN THE TECHNICAL SPECIFICATIONS, PLACED AND COMPACTED IN SUCH A MANNER TO NOT DAMAGE THE UNDERLYING DRAINAGE NET OR GEOMEMBRANE BARRIER. THE BARRIER PROTECTION FILL OF THE BARRIER PROTECTION LAYER SHALL BE FREE OF SHARP STONES AND OTHER FOREIGN OBJECTS. THE BARRIER PROTECTION LAYER SHALL BE COVERED BY A SIX (6) INCH LIFT OF TOPSOIL MATERIAL WHICH SHALL BE CAPABLE OF SUPPORTING VEGETATIVE GROWTH TO COMPLETE THE CLOSURE CAPPING SYSTEM.
14. THE SELECT GRANULAR MATERIAL (GAS VENTING LAYER), THE SELECTED FILL AND BARRIER PROTECTION FILL PLACED FOR CAP CONSTRUCTION SHALL BE COMPACTED TO A DENSITY OF 90 PERCENT OF THE MAXIMUM DENSITY OF THE RESPECTIVE MATERIALS AS DETERMINED BY STANDARD PROCTOR TEST ASTM D-698.
15. DRAINAGE SHALL BE COLLECTED IN SEEDED DITCHES OR SWALES LOCATED AT THE TOE OF THE LANDFILL SLOPES. STONE FILL SHALL BE USED WHERE SHOWN TO PROTECT THE DRAINAGE DITCHES AND ADJACENT SLOPES FROM EROSION.
16. GEOTEXTILE BENEATH ACCESS ROAD AND FOR RIP-RAP DRAINAGE DITCHES AND OUTFALLS SHALL BE A WOVEN GEOTEXTILE AS SPECIFIED AND ALL OTHER GEOTEXTILES SHALL BE A NON-WOVEN GEOTEXTILE AS SPECIFIED UNLESS OTHERWISE STATED ON THE DRAWINGS OR IN THE SPECIFICATIONS.
17. SEED SHALL CONFORM TO THE FOLLOWING SPECIFICATIONS:

    CREEPING RED FESCUE (40%), WHITE CLOVER (5%), KENTUCKY BLUEGRASS (15%), TALL FESCUE (30%), AND PERENNIAL RYE (10%). SEED SHALL BE APPLIED AT A RATE OF 4 POUNDS/1000 SQUARE FEET. FERTILIZER SHALL BE TYPE 5-10-5 (50% ORGANIC), NON-LEACHING, APPLIED AT A RATE OF 20 POUNDS/1000 SQUARE FEET.
18. MULCH MATERIAL SHALL CONSIST OF CLEAN STRAW, FREE FROM NOXIOUS WEEDS OR OTHER UNDESIRABLE MATERIAL. THE MULCH SHALL BE SPREAD EVENLY AND UNIFORMLY OVER THE DESIGNATED AREAS TO ATTAIN 75 PERCENT GROUND COVERAGE AND AT LEAST 1-1/2 INCH LOOSE DEPTH. CHEMICAL MULCH BINDERS MAY BE ACCEPTABLE PROVIDED THE REQUIREMENT OF NYSDOT STANDARD SPECIFICATIONS, SECTION 713-12, ARE MET.
19. HAY BALES FOR EROSION CONTROL SHALL BE TIGHTLY BOUND, FRESH HAY. NO ROTTED OR MILDEWED HAY OR BINDING WILL BE ACCEPTED. BALES SHALL BE SPACED AT 100 FEET INTERVALS IN DRAINAGE SWALES AND AS DIRECTED BY THE ENGINEER.
20. ALL CONSTRUCTION WILL BE PERFORMED UNDER THE OBSERVATION OF A CLOUGH, HARBOUR AND ASSOCIATES (CHA) REPRESENTATIVE. A CHA PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NEW YORK WILL PREPARE A CONSTRUCTION DOCUMENTATION REPORT TO INCLUDE THE RESULTS OF ALL QUALITY ASSURANCE/QUALITY CONTROL TESTING.
21. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF COVER SYSTEM STABILITY, EROSION CONTROL, DAMAGE, AND ESTABLISHMENT OF VEGETATIVE GROWTH FOR 12 MONTHS AFTER FINAL COMPLETION OF CONSTRUCTION.
22. CONTRACTOR SHALL INSTALL TEMPORARY ENCLOSURE FENCE AROUND ENTIRE SITE IN ACCORDANCE WITH SECTION "TEMPORARY FACILITIES" PRIOR TO CONSTRUCTION.
23. CONTRACTOR SHALL CONSTRUCT FIRE LINE AND ASSOCIATED STRUCTURES PRIOR TO OTHER CONSTRUCTION AT THE SITE.
24. SHOULD CONTAINERIZED MATERIAL OR UNCONTAINERIZED POSSIBLE HAZARDOUS WASTE, AS DETERMINED BY THE ENGINEER OR THE DEPARTMENT, BE ENCOUNTERED DURING WASTE RELOCATION, IT SHALL BE FIELD CHARACTERIZED. IF DETERMINED TO BE A HAZARDOUS WASTE, IT SHALL BE DISPOSED OF TO AN APPROVED FACILITY. THE FIELD TESTS FOR DRUM SAMPLING SHALL BE LIMITED TO 1.) ph. 2.) CYANIDES, 3.) FLASHPOINT, 4.) WATER SOLUBILITY AND 5.) PEROXIDES.
25. IN THE EVENT OF AN ON-SITE FIRE DURING REMEDIAL CONSTRUCTION IT WILL BE THE COMPLETE RESPONSIBILITY OF THE CONTRACTOR TO ELIMINATE THE FIRE AND MINIMIZE HAZARDS TO HUMAN HEALTH OR THE ENVIRONMENT.

DRAWING INDEX

RECORD DRAWING
JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
RECORD DRAWING	M.C.	M.A.A	6/18/96

Designed By: C.S.H. Date: 3/94
Drawn By: J.D.F. Date: 3/94
Checked By: L.S.K. Date: 3/94

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ENGINEERS, SURVEYORS & PLANNERS
III WINNERS CIRCLE - ALBANY, NEW YORK - 12205
P.O. BOX 5269 518-453-4500
CHA Project No. 3366.07

NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

TITLE, GENERAL NOTES, AND LEGEND

Drawing No. G-1

SCALE: AS SHOWN | DATE: MARCH, 1994 | SHEET 1 OF 11

9-1-14.2
N/F
TUXEDO PARK
ASSOCIATES

9-1-13
N/F
GEORGIA TECH
FOUNDATION, INC
L.2088 P.70

9-1-10
N/F
REEVES
ENTERPRISES,
INC.

9-1-8
N/F
REEVES
ENTERPRISES,
INC.

9-1-9
JOHNSON

N.Y.S. ROUTE 17

CORP RAIL

CONSOLIDATED RAIL

RAILROAD TRACKS

1 STORY MASONRY BLDG

FRAME BLDG

MACADAM PARKING

PIT

EDGE OF FILLED IN POND

EDGE OF RIVER

RAMAPO RIVER

BRIDGE

BRIDGE ABUTMENT

CONC. ABUTMENT

U.S.G.S. BENCHMARK #456.4
CHISELED BOX CUT ON BRIDGE
ABUTMENT ELEV. 456.331

LEGEND

- MW-3 — GROUNDWATER MONITOR WELL LOCATION
- MH — MANHOLE
- PROPERTY LINE
- CENTERLINE OF ROAD
- SPOT GRADE
- UTILITY POLE
- EDGE OF ASPHALT PAVEMENT
- OVERHEAD WIRES
- RAILROAD TRACKS
- GUIDE RAIL
- RIB-2 — SOIL BORING LOCATIONS
- TP-22 496-66 — TEST PIT WITH ELEVATION
- 493 84 93 — LIMIT OF WASTE EXCAVATION WITH ELEVATION
- 441 52 SW/SED-1 — SURFACE WATER/ SEDIMENT SAMPLE WITH ELEVATION
- LEDGE

SURVEY NOTES

1. PROPERTY LINES ARE APPROXIMATE FROM DEEDS OF RECORD, FIELD MONUMENTATION AND TAX MAP.
2. CONTOUR INTERVAL: 2 FEET.
3. TOPOGRAPHY COMPLETED IN FIELD ON JULY 17, 1990. ADDITIONAL SURVEY PERFORMED IN AUGUST 1993, BY YEC, INC.
4. VERTICAL DATUM: U.S.G.S. FROM BENCHMARK #456.4, A CHISELED SQUARE ON RAILROAD BRIDGE NO. 38.18 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 DECEMBER 13, 1990.
7. WATER MAIN APPROXIMATELY LOCATED FROM "RELOCATION OF A PORTION OF VILLAGE OF TUXEDO PARK WATER MAIN FROM S.W. CORNER OF BARONE-KHOUROUZIAN PROPERTY TO STATE HIGHWAY R.O.W.", JUNE 13, 1983.
8. LOCATION OF UTILITIES ARE APPROXIMATE. CONTRACTOR SHOULD FIELD VERIFY ALL UTILITIES.
9. RIV[illegible]LEV[illegible]ONS WERE MEASURED DURING THE AUGUST 1993, SURVEY.

RECORD DRAWING
JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
RECORD DRAWING	M.C.	M.A.A.	6/18/96

Designed By: Date:
Drawn By: Date:
Checked By: Date:

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111 WINNERS CIRCLE - ALBANY, NEW YORK - 12205
P.O. BOX 5269 518-453-4500
CHA Project No. 3366.07

NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

TOPOGRAPHIC BASEMAP

SCALE: 1"=60' DATE: MARCH, 1994

Drawing No. G-2

SHEET 2 OF 11

LEGEND

- GROUNDWATER MONITOR WELL LOCATION (MW-3)
- MANHOLE
- PROPERTY LINE
- EXISTING LIMIT OF WASTE
- FINAL LIMIT OF WASTE
- CENTERLINE OF ROAD
- SPOT GRADE
- UTILITY POLE
- EDGE OF ASPHALT PAVEMENT
- OVERHEAD WIRES
- RAILROAD TRACKS
- GUIDE RAIL
- SOIL BORING LOCATIONS (RIB-2)
- WATER MAIN
- WASTE EXCAVATION
- LEDGE
- TEST PIT WITH ELEVATION (TP-20 475.94)
- EXCAVATION TRENCH LOCATIONS

SURVEY NOTES

1. PROPERTY LINES ARE APPROXIMATE FROM DEEDS OF RECORD, FIELD MONUMENTATION AND TAX MAP.
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3. TOPOGRAPHY COMPLETED IN FIELD ON JULY 17, 1990. ADDITIONAL SURVEY PERFORMED IN AUGUST 1993, BY YEC, INC.
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8. LOCATION OF UTILITIES ARE APPROXIMATE. CONTRACTOR SHOULD FIELD VERIFY ALL UTILITIES.
9. RIVER ELEVATIONS WERE MEASURED DURING THE AUGUST 1993, SURVEY.

GRADING NOTES:

1. ANY WASTE EXCAVATED FROM AREAS INDICATED AND FROM LANDFILL REGRADING TO BE PLACED WHERE NECESSARY TO MEET THE DESIGN GRADES PRIOR TO CAPPING.
2. DAILY COVER SHALL BE PLACED OVER ANY DISTURBED OR EXPOSED WASTE AT THE END OF EACH WORK DAY.
3. CLEAR AND GRUB AS NECESSARY.
4. NO WASTE IS TO BE PLACED BEYOND THE FINAL LIMIT OF WASTE.
5. ELEVATIONS SHOWN REPRESENT COVER SYSTEM SUBGRADE. SUBGRADE TO BE PREPARED IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS PRIOR TO COVER SYSTEM CONSTRUCTION.
6. DEPARTMENT TO OBTAIN NECESSARY STORMWATER DISCHARGE AND GENERAL CONSTRUCTION PERMISSION/EASEMENTS FROM ADJACENT LANDOWNERS PRIOR TO CONSTRUCTION.
7. WORK WITHIN CONRAIL RIGHT OF WAY SHALL BE PERFORMED IN ACCORDANCE WITH REQUIREMENTS OUTLINED IN THE CONRAIL TEMPORARY LICENSE AGREEMENT AND ONLY WHEN CONRAIL FLAGMEN ARE ON SITE AS REQUIRED.
8. CONTRACTOR TO PROTECT ALL MONITORING WELLS DURING CONSTRUCTION.
9. CONTRACTOR SHALL EXCAVATE TRENCHES ACROSS THE FACE OF THE LANDFILL PRIOR TO PLACING WASTE OR FILL MATERIALS. THE TRENCHES SHALL BE AT A MINIMUM OF 5 FEET DEEP, 5 FEET WIDE AND PENETRATE THE EXISTING INTERMEDIATE COVER. TRENCHES SHALL BE BACKFILLED WITH ON-SITE WASTE AFTER EXCAVATION. 100' LONGITUDINAL GRID DEPICTS LOCATION OF TRENCHES.
10. CONTRACTOR TO NOTIFY UUCC (1-800-245-2828) A MINIMUM OF 72 HOURS PRIOR TO COMMENCING WORK ON SITE. UTILITIES SHOWN ARE APPROXIMATE. CONTRACTOR SHOULD FIELD VERIFY ALL UTILITIES.
11. IN AREAS WHERE WASTE IS REMOVED, ENGINEER WILL SURVEY THE AREAS AFTER WRITTEN NOTICE OF COMPLETION. ENGINEER WILL PROVIDE GRADING PLAN AND GENERATE PAYMENT QUANTITIES FOR CUT/FILL AND PLACEMENT OF CLEAN FILL AS NECESSARY. THE GRADING PLAN AND PAYMENT QUANTITIES WILL BE PREPARED 30 WORKING DAYS FROM RECEIPT OF WRITTEN NOTIFICATION.
12. "NO TRESPASSING" SIGNS TO BE ERECTED AT SITE GATE AND EVERY 400 FEET NORTH AND SOUTH OF GATE ALONG NYS ROUTE 17 PROPERTY BOUNDARY PRIOR TO CONSTRUCTION.

RECORD DRAWING
JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
RECORD DRAWING	M.C	M.A.A	6/1996

Designed By:	Date:
C.S.H.	3/94
Drawn By: M.C.	3/94
Checked By: L.S.K.	3/94

UNAUTHORIZED ALTERATION OR ADDITION TO THIS DOCUMENT IS A VIOLATION OF SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

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III WINNERS CIRCLE - ALBANY, NEW YORK - 12205
P.O. BOX 5269 518-453-4500

CHA Project No. 3366.07

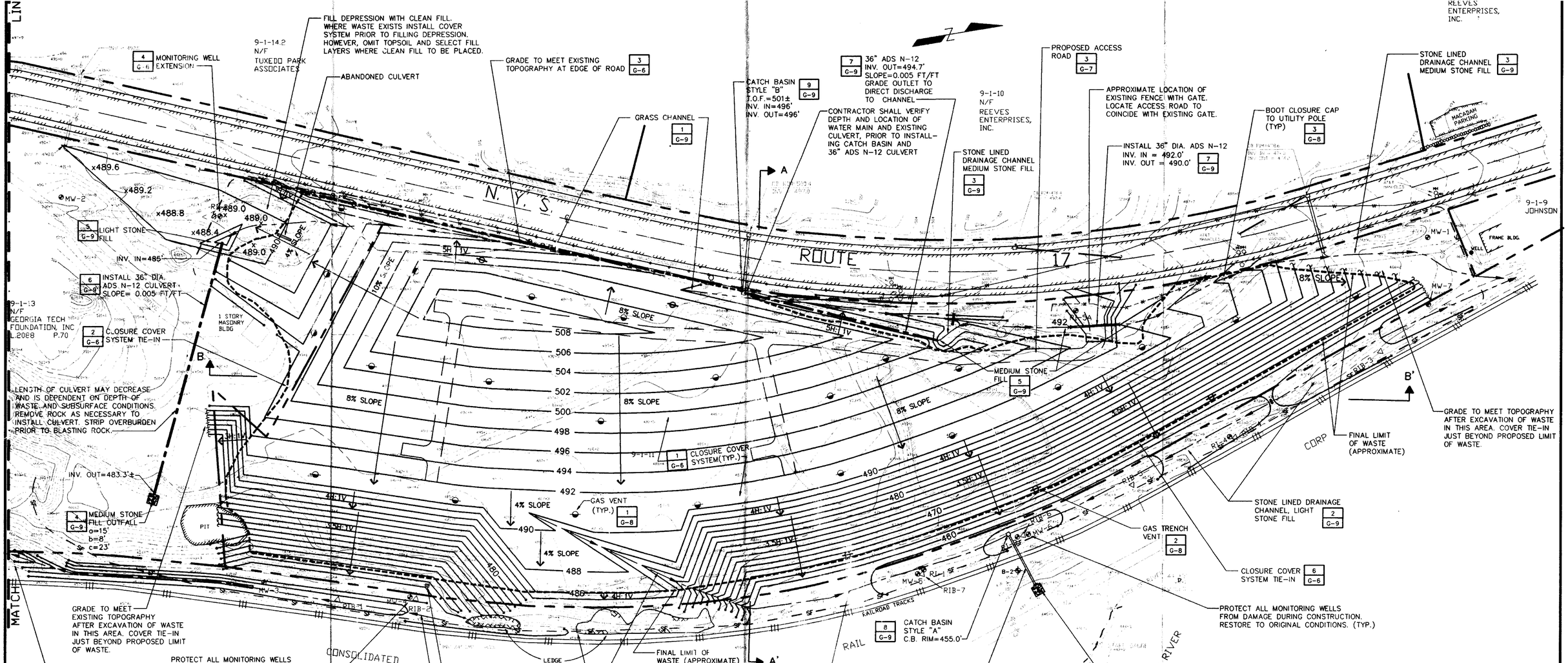
NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

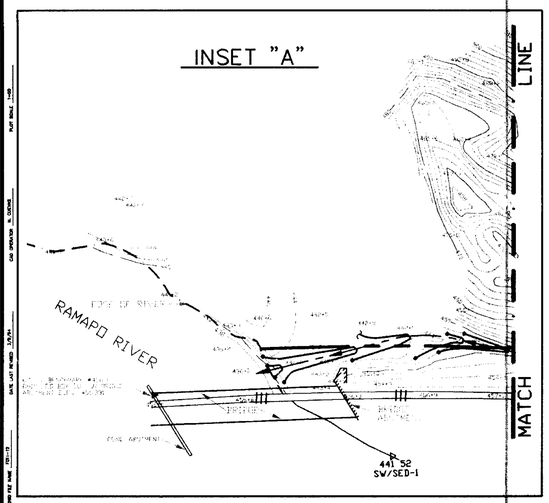
WASTE GRADING PLAN

Drawing No. G-3

SCALE: 1"=50' | DATE: MARCH, 1994 | SHEET 3 OF 11



INSET "A"



LEGEND

- MW-3 — GROUNDWATER MONITOR WELL LOCATION
- PROPOSED GAS VENT WITH WELL (& LATERAL DIRECTION)
- PROPOSED GAS VENT IN TRENCH (& LATERAL DIRECTION)
- PROPERTY LINE
- FINAL LIMIT OF WASTE
- CENTERLINE OF ROAD
- SPOT ELEVATION
- UTILITY POLE
- EDGE OF ASPHALT PAVEMENT
- OVERHEAD WIRES
- RAILROAD TRACKS
- GUIDE RAIL
- RIB-2 — SOIL BORING LOCATIONS
- WATER MAIN
- DRAINAGE CHANNEL TRANSITION
- SF — LOCATION OF SILT FENCE

SURVEY NOTES

1. PROPERTY LINES ARE APPROXIMATE FROM DEEDS OF RECORD, FIELD MONUMENTATION AND TAX MAP.
2. CONTOUR INTERVAL: 2 FEET.
3. TOPOGRAPHY COMPLETED IN FIELD ON JULY 17, 1990. ADDITIONAL SURVEY PERFORMED IN AUGUST 1993, BY YEC, INC.
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12. "NO TRESPASSING" SIGNS TO BE ERECTED AT SITE GATE AND EVERY 400 FEET NORTH AND SOUTH OF GATE ALONG NYS ROUTE 17 PROPERTY BOUNDARY PRIOR TO CONSTRUCTION.

RECORD DRAWING
JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
RECORD DRAWING	M.C.	M.A.A	6/14/96

STATE OF NEW YORK — CARSTEN H. FLORIE — 061261 — PROFESSIONAL ENGINEER

Designed By:	Date:
C.S.H.	3/94
Drawn By:	Date:
M.C.	3/94
Checked By:	Date:
L.S.K.	3/94

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CHA Project No. 3366.07

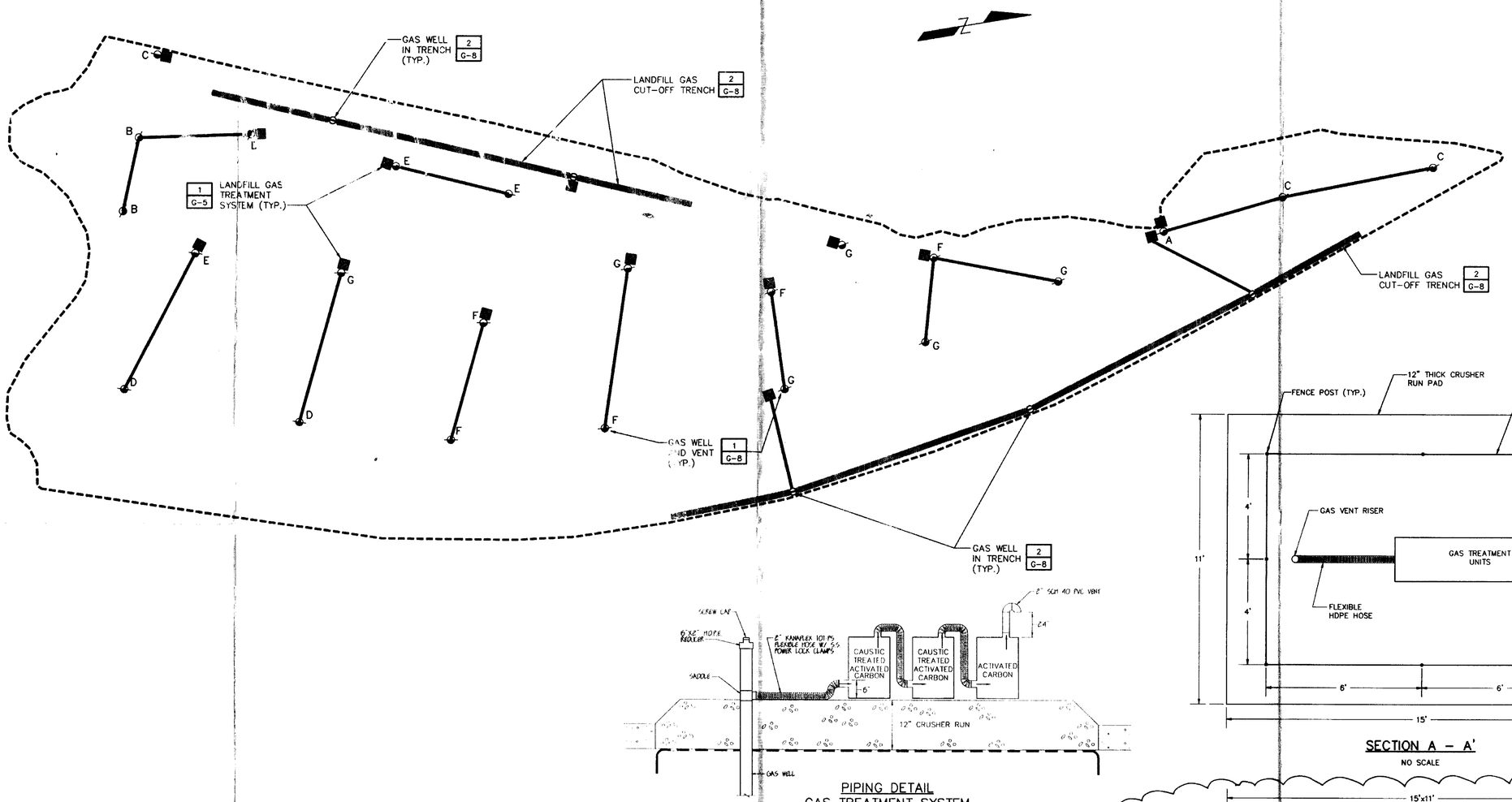
NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

FINAL GRADING PLAN

Drawing No. G-4

SCALE: 1"=50' DATE: MARCH, 1994 SHEET 4 OF 11

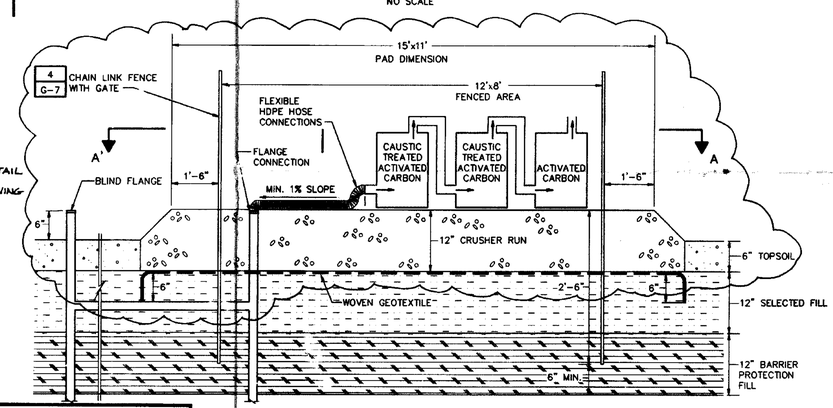


SECTION A – A'

NO SCALE

PIPING DETAIL
GAS TREATMENT SYSTEM

NO SCALE



SEE PIPING DETAIL ABOVE FOR RECORD DRAWING REVISIONS.

1 G-5 GAS TREATMENT SYSTEM & PAD

NO SCALE

LEGEND

- PROPOSED GAS VENT WITH WELL AND LATERAL DIRECTION
- PROPOSED GAS VENT IN TRENCH AND LATERAL DIRECTION
- LANDFILL GAS TREATMENT SYSTEM
- PROPOSED GAS TREATMENT SYSTEM HEADER PIPES
- PROPOSED LANDFILL GAS CUT-OFF TRENCH
- FINAL LIMIT OF WASTE

NOTES:

1. ONE TREATMENT UNIT IS COMPRISED OF THREE CANISTERS IN SERIES.
2. EACH CANISTER IS A 55-GALLON DRUM CONSTRUCTED OF OR LINED WITH A MATERIAL COMPATIBLE WITH THE CONTAMINANTS.
3. THE FIRST TWO CANISTERS WILL EACH CONTAIN 200 POUNDS OF CAUSTIC TREATED CARBON. THE CAUSTIC TREATED CARBON WILL BE CAPABLE OF TREATING 20% OF ITS WEIGHT OF HYDROGEN SULFIDE.
4. THE THIRD CANISTER WILL CONATAIN 200 POUNDS OF I" TREATED CARBON.
5. THE CARBON IN ALL CANISTERS WILL BE SUITABLE FOR VAPOR PHASE TREATMENT.

GAS VENT INSTALLATION SCHEDULE	
GAS VENT	WELL DEPTH *
A	5'
B	10'
C	15'
D	20'
E	25'
F	30'
G	35'

*DEPTH MEASURED FROM BOTTOM OF GAS VENT LAYER.

RECORD DRAWING JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
⚠ RECORD DRAWINGS - PIPING DETAILS	M.C.	M.A.A.	6/18/96

STATE OF NEW YORK LICENSED PROFESSIONAL ENGINEER 061361

Designed By:	Date:
M.A.	3/94
Drawn By:	Date:
M.C.	3/94
Checked By:	Date:
L.S.K.	3/94

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CHA Project No. 3366.07

NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

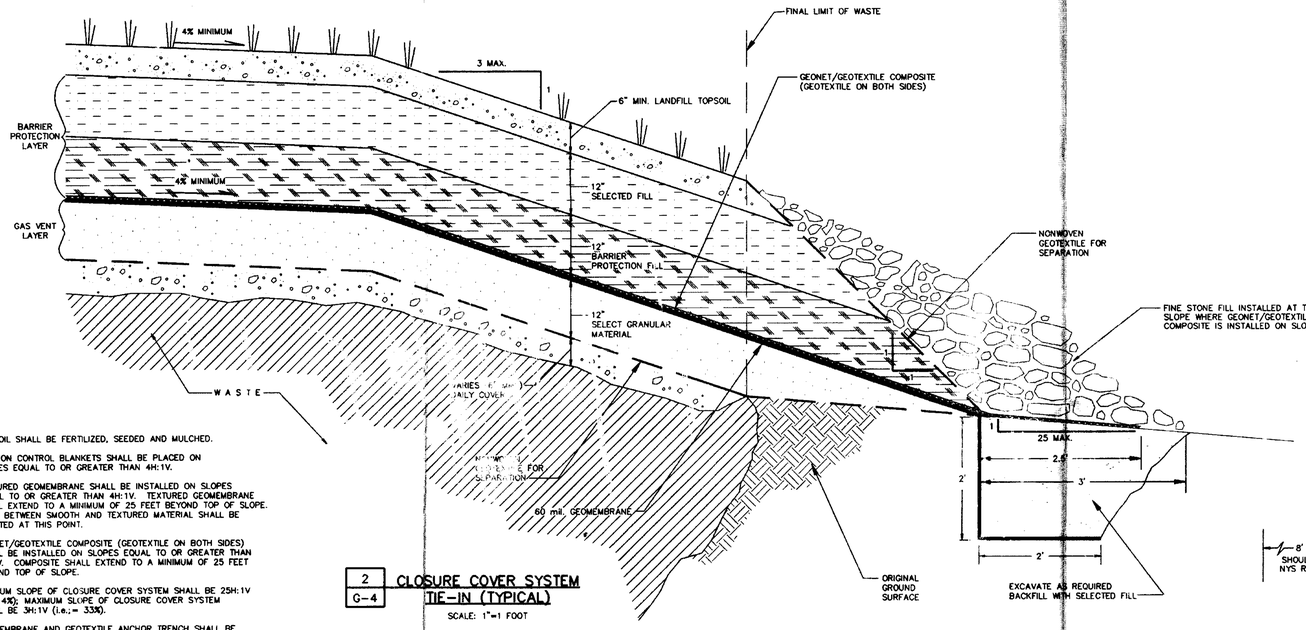
REMEDIAL CLOSURE DESIGN

GAS VENTING SYSTEM

SCALE: 1"=50' DATE: MARCH, 1994

Drawing No. G-5

SHEET 5 OF 11

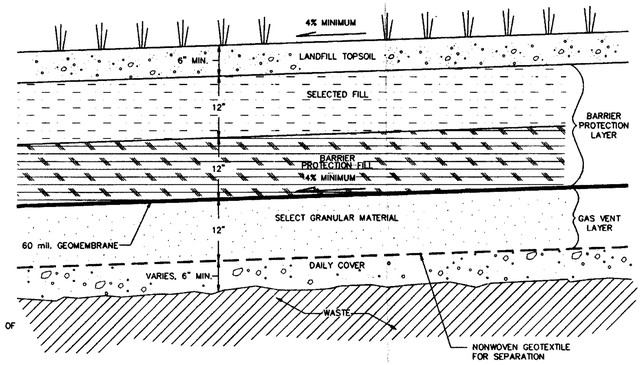


2 G-4 CLOSURE COVER SYSTEM TIE-IN (TYPICAL)

SCALE: 1"=1 FOOT

NOTES:

1. TOPSOIL SHALL BE FERTILIZED, SEEDED AND MULCHED.
2. EROSION CONTROL BLANKETS SHALL BE PLACED ON SLOPES EQUAL TO OR GREATER THAN 4H:1V.
3. TEXTURED GEOMEMBRANE SHALL BE INSTALLED ON SLOPES EQUAL TO OR GREATER THAN 4H:1V. TEXTURED GEOMEMBRANE SHALL EXTEND TO A MINIMUM OF 25 FEET BEYOND TOP OF SLOPE. SEAM BETWEEN SMOOTH AND TEXTURED MATERIAL SHALL BE LOCATED AT THIS POINT.
4. GEONET/GEOTEXTILE COMPOSITE (GEOTEXTILE ON BOTH SIDES) SHALL BE INSTALLED ON SLOPES EQUAL TO OR GREATER THAN 4H:1V. COMPOSITE SHALL EXTEND TO A MINIMUM OF 25 FEET BEYOND TOP OF SLOPE.
5. MINIMUM SLOPE OF CLOSURE COVER SYSTEM SHALL BE 25H:1V (i.e.; 4%); MAXIMUM SLOPE OF CLOSURE COVER SYSTEM SHALL BE 3H:1V (i.e.; = 33%).
6. GEOMEMBRANE AND GEOTEXTILE ANCHOR TRENCH SHALL BE COMPACTED WITH SELECTED FILL.



1 G-4 CLOSURE COVER SYSTEM (TYPICAL)

SCALE: 1"=1 FOOT

NOTES:

1. TOPSOIL SHALL BE FERTILIZED, SEEDED AND MULCHED.
2. EROSION CONTROL BLANKETS SHALL BE PLACED ON SLOPES EQUAL TO OR GREATER THAN 4H:1V.
3. TEXTURED GEOMEMBRANE SHALL BE INSTALLED ON SLOPES EQUAL TO OR GREATER THAN 4H:1V. TEXTURED GEOMEMBRANE SHALL EXTEND TO A MINIMUM OF 25 FEET BEYOND TOP OF SLOPE. SEAM BETWEEN SMOOTH AND TEXTURED MATERIAL SHALL BE LOCATED AT THIS POINT.
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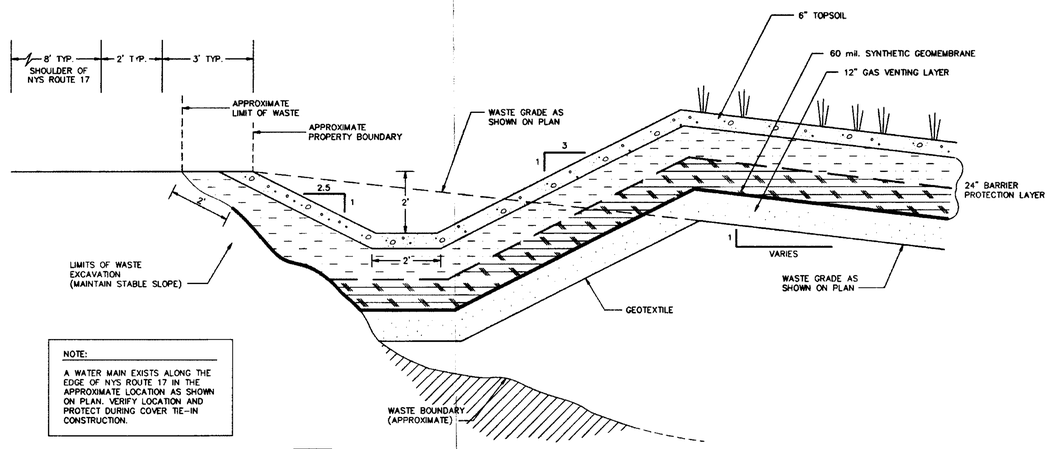
5. MINIMUM SLOPE OF CLOSURE COVER SYSTEM SHALL BE 25H:1V (i.e.; 4%); MAXIMUM SLOPE OF CLOSURE COVER SYSTEM SHALL BE 3H:1V (i.e., 33%)

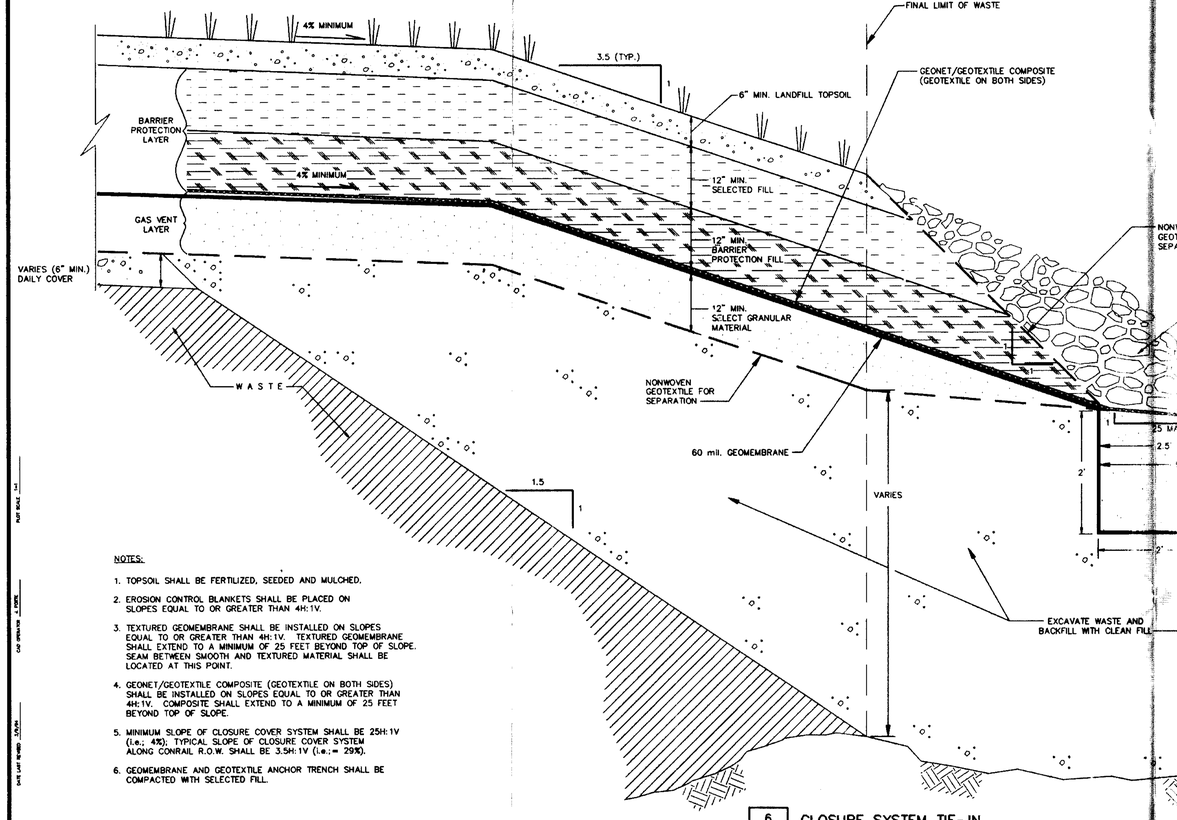


NOTE:

A WATER MAIN EXISTS ALONG THE EDGE OF NYS ROUTE 17 IN THE APPROXIMATE LOCATION AS SHOWN ON PLAN. VERIFY LOCATION AND PROTECT DURING COVER TIE-IN CONSTRUCTION.

3 G-4 TIE-IN AT EDGE OF ROUTE 17

SCALE: 1"=2 FEET



NOTES:

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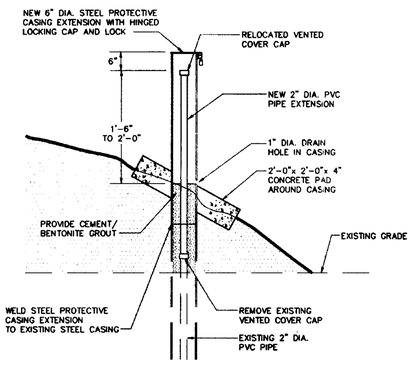
5. MINIMUM SLOPE OF CLOSURE COVER SYSTEM SHALL BE 25H:1V (i.e.; 4%); TYPICAL SLOPE OF CLOSURE COVER SYSTEM ALONG CONRAIL R.O.W. SHALL BE 3.5H:1V (i.e.; = 29%).
6. GEOMEMBRANE AND GEOTEXTILE ANCHOR TRENCH SHALL BE COMPACTED WITH SELECTED FILL.

6 G-4 CLOSURE SYSTEM TIE-IN AT CONRAIL R.O.W.

SCALE: 1"=1 FOOT



4 G-4 MONITORING WELL EXTENSION DETAIL

NO SCALE

NOTES:

1. HANDTAMP EMBANKMENT WITHIN A RADIUS OF 2'-0" OF THE WELL.
2. USE FLUSH COUPLE 2" DIA. PVC PIPE TO EXTEND WELLS.
3. DO NOT USE PVC GLUE TO CONNECT PVC PIPE COUPLING OR EXTENSIONS. ALL JOINTS TO BE THREADED.
4. PVC TO BE SCHEDULE 40.
5. SURVEY ELEVATION OF TOP OF PVC BEFORE AND AFTER EXTENSION.

RECORD DRAWING JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
RECORD DRAWINGS	M.C.	M.A.A	6/18/96

STATE OF NEW YORK — CARSTEN H. FLOOR — 061201 — LICENSED PROFESSIONAL ENGINEER

Designed By:	Date:
C.S.H.	3/94
Drawn By:	Date:
J.D.F.	3/94
Checked By:	Date:
L.S.K.	3/94

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ENGINEERS, SURVEYORS & PLANNERS
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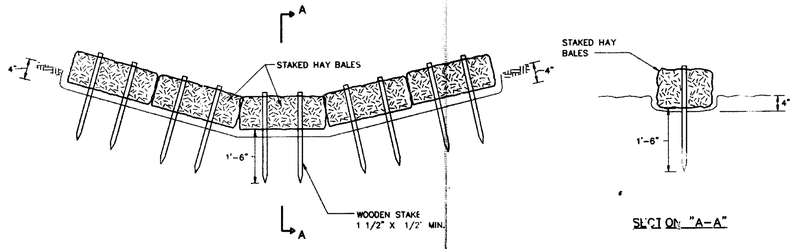
NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

GENERAL DETAILS - COVER

Drawing No. G-6

SCALE: AS SHOWN DATE: MARCH, 1994 SHEET: 6 11



ELEVATION

SECTION "A-A"

HAY BALE SILTATION CONTROL

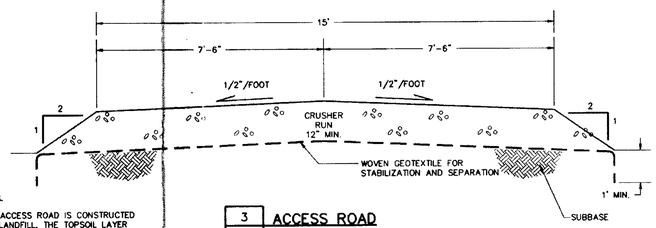
1 / –

(PER NEW YORK GUIDELINES FOR URBAN EROSION AND SEDIMENT CONTROL)

NO SCALE

NOTES:

1. BALES SHALL BE PLACED AT THE TOE OF A SLOPE OR ON THE CONTOUR AND IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF (4) INCHES, AND PLACED SO THE BINDINGS ARE HORIZONTAL. BACKFILL OVER-EXCAVATION WITH ON-SITE MATERIAL.
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE-BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
4. INSPECTION SHALL BE FREQUENT AND REPAIR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
5. ENGINEER WILL DIRECT CONTRACTOR TO PLACE ADDITIONAL HAYBALE SILTATION CONTROLS AS DEEMED NECESSARY.
6. BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

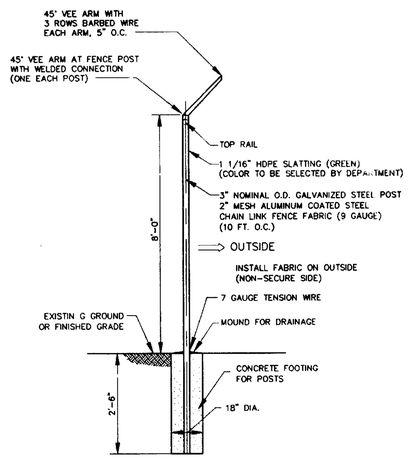


NOTES:

1. WHEN ACCESS ROAD IS CONSTRUCTED OVER LANDFILL, THE TOPSOIL LAYER BENEATH THE ACCESS ROAD SHALL BE REPLACED WITH SIX (6) INCHES OF SELECTED FILL
2. WHERE ROAD IS OVER CULVERT INCREASE THICKNESS OF CRUSHER RUN TO 24 INCHES AND GRADE TO MEET EXISTING TOPOGRAPHY.

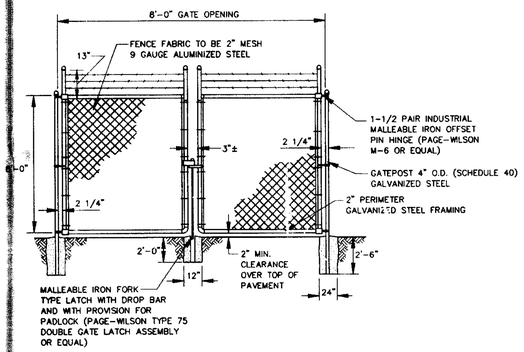
3 / G-4 ACCESS ROAD (TYPICAL)

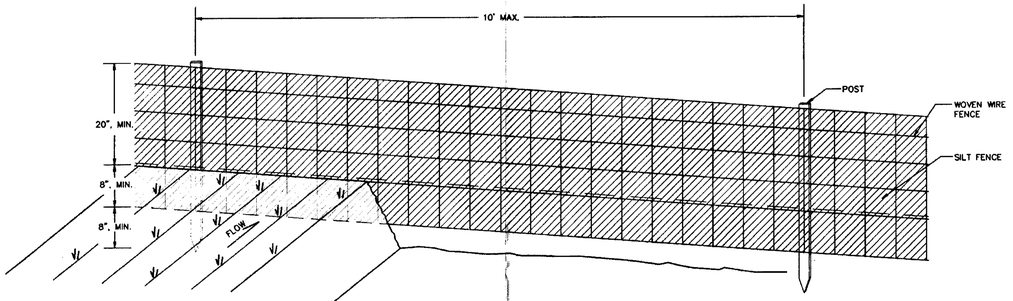
SCALE: 1"=2'

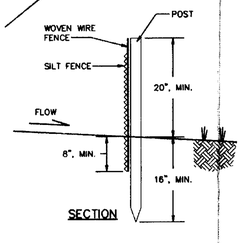


4 / G-5 CHAIN LINK FENCE AND GATE DETAIL

NO SCALE







SECTION

NOTES:

1. POSTS SHALL BE EITHER "T" OR "U" TYPE STEEL POSTS OR 2"x2" HARDWOOD POSTS.
2. WOVEN WIRE FENCE SHALL BE 14 1/2 GAUGE WITH A MAXIMUM MESH OPENING OF 6"x6". WOVEN WIRE FENCE SHALL BE SECURELY ATTACHED TO POSTS WITH WIRE TIES OR STAPLES.
3. SILT FENCE SHALL BE SECURELY ATTACHED TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID-SECTION.
4. SILT FENCE SHALL BE OVERLAPPED AND FOLDED TOGETHER WITH ADJACENT SILT FENCE.
5. SILT FENCE SHALL BE MIRAFI 100X OR APPROVED EQUAL.
6. ENGINEER WILL DIRECT CONTRACTOR TO INSTALL ADDITIONAL SILT FENCE AS DEEMED NECESSARY.
7. CONTRACTOR SHALL MAINTAIN SILT FENCE FOR DURATION OF PROJECT AND REMOVE WHEN NECESSARY AS DIRECTED BY THE ENGINEER.

2 / G-4 SILT FENCE

(PER NEW YORK GUIDELINES FOR URBAN EROSION AND SEDIMENT CONTROL)

SCALE: 1"=1 FOOT

RECORD DRAWING
JUNE 1996

Revisions	Drawn By:	App'd. By:	Date:
RECORD DRAWINGS	M.C.	M.P.A.	6/18/96

STATE OF NEW YORK — CARSTEN H. PETERSEN — 061261 — LICENSED PROFESSIONAL ENGINEER

Designed By:	Date:
C.S.H.	3/94
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J.D.F.	3/94
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L.S.K.	3/94

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CHA Project No. 3366.07

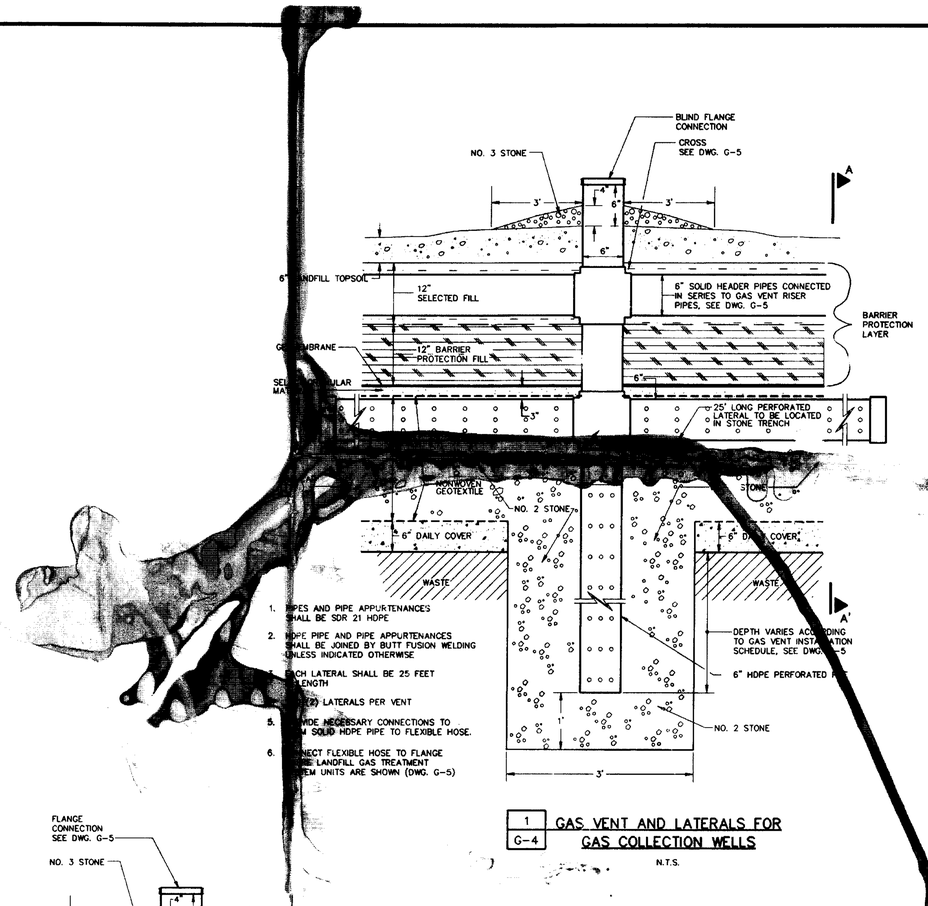
NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

GENERAL DETAILS - EROSION CONTROL

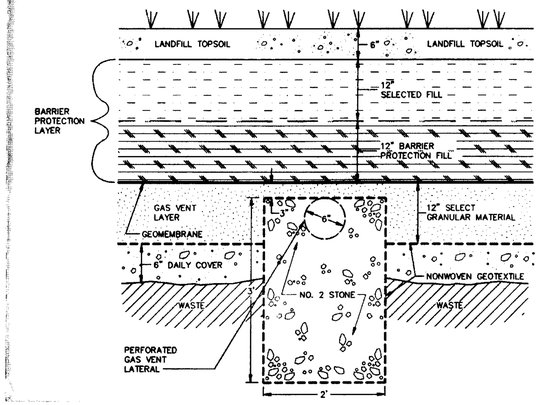
Drawing No. G-7

SCALE: AS SHOWN | DATE: MARCH, 1994 | SHEET 7 OF 11

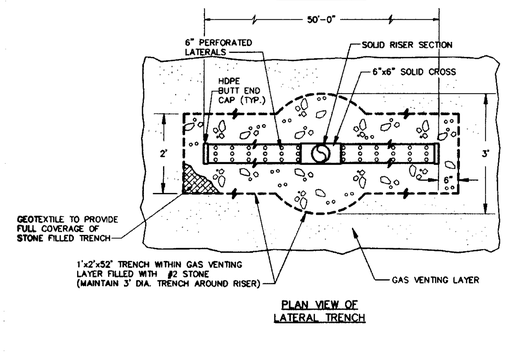


1 G-4 GAS VENT AND LATERALS FOR GAS COLLECTION WELLS

N.T.S.



CROSS SECTION OF LATERAL TRENCH SECTION A – A'



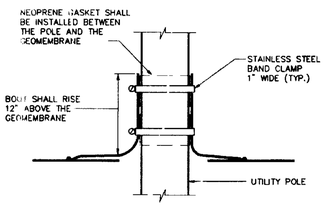
PLAN VIEW OF LATERAL TRENCH

2 G-4 LANDFILL GAS CUT-OFF TRENCH

N.T.S.

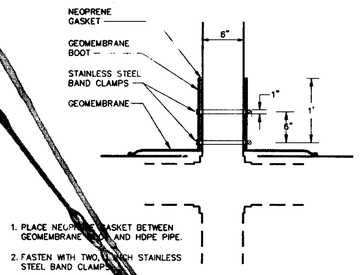
LANDFILL GAS CUT-OFF TRENCH SECTION B-B'

N.T.S.



3 G-4 UTILITY POLE TIE-IN TO MEMBRANE DETAIL

N.T.S.



4 – GAS VENT/GEOMEMBRANE TIE-IN

N.T.S.

RECORD DRAWING JUNE 1996

Revisions:	Drawn By:	App'd. By	Date:
RECORD DRAWING	M.C	M.AR	6/16/96

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Checked By:	Date:
L.S.K.	3/94

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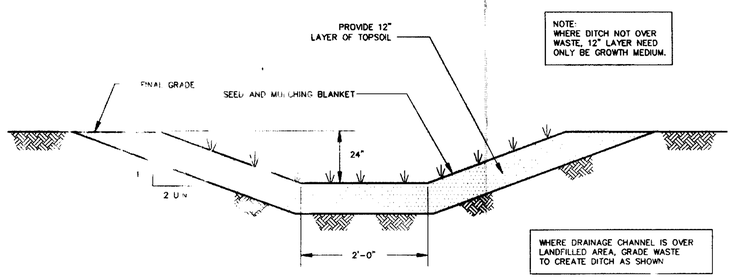
NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

GENERAL DETAILS – GAS VENTING

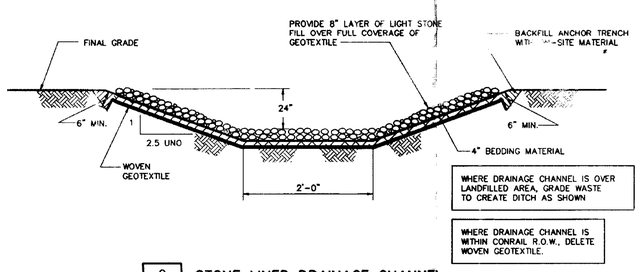
Drawing No. G-8

SCALE: AS SHOWN | DATE: MARCH, 1994 | SHEET 8 OF 11



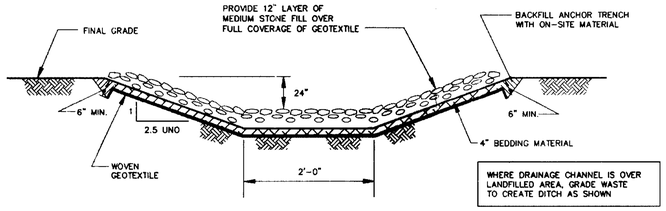
1 G-4 TYPICAL GRASS LINED DRAINAGE CHANNEL DETAIL

NO SCALE



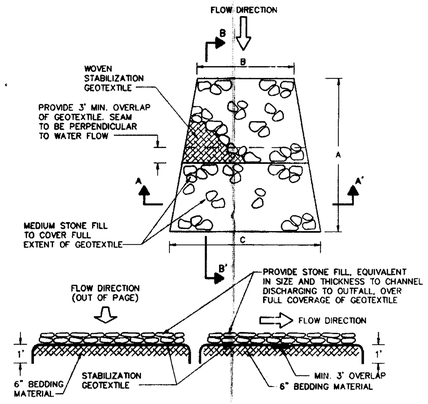
2 G-4 STONE LINED DRAINAGE CHANNEL LIGHT STONE FILL

NO SCALE



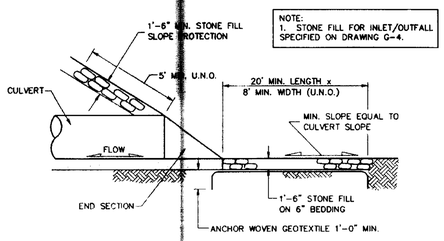
3 G-4 STONE LINED DRAINAGE CHANNEL MEDIUM STONE FILL

NO SCALE



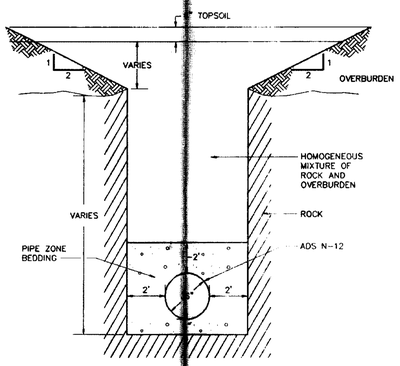
4 G-4 TYPICAL STONE FILL OUTFALL DETAIL

NO SCALE



5 G-4 TYPICAL CULVERT OUTFALL DETAIL

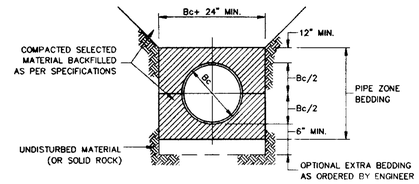
NO SCALE



1. CONTRACTOR SHALL PROTECT EXCAVATIONS BY SHORING, BRACING, SHEETING OR OTHER METHODS TO ENSURE THE STABILITY OF THE EXCAVATION, AND SHALL COMPLY WITH APPLICABLE OSHA REQUIREMENTS.
2. PIPE SHALL HAVE A MINIMUM SLOPE OF 0.005 FT/FT
3. PIPE SHALL BE ADS N-12 OR EQUAL.

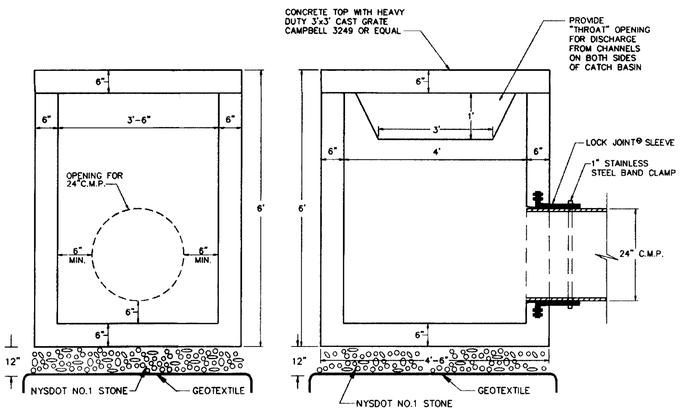
6 G-4 CULVERT THROUGH ROCK

NO SCALE



7 G-4 PIPE LAYING DETAIL

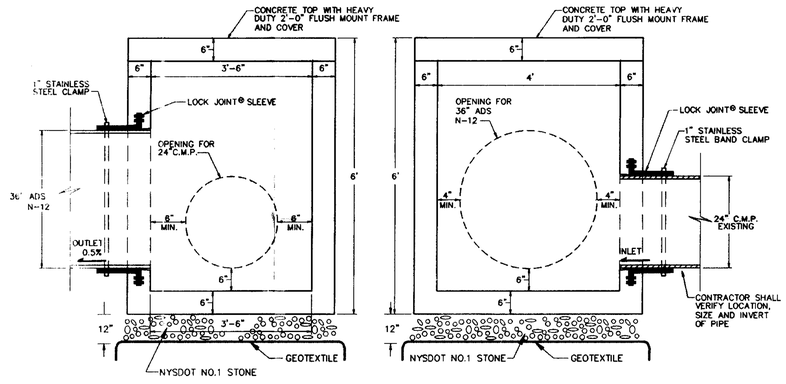
NO SCALE



VIEW OF EAST SIDE OF CATCH BASIN STYLE "A" VIEW OF SOUTH SIDE OF CATCH BASIN STYLE "A"

8 G-4 CATCH BASIN STYLE "A"

NO SCALE



VIEW OF WEST SIDE OF CATCH BASIN STYLE "B" VIEW OF NORTH SIDE OF CATCH BASIN STYLE "B"

RECORD DRAWING JUNE 1996

9 G-4 CATCH BASIN STYLE "B"

NO SCALE

Revisions:	Drawn By:	Ann'd. By:	Date:
RECORD DRAWING	M.C.	M.A.A.	6/16/96

STATE OF NEW YORK GARTEN H. FOX 061261 LICENSED PROFESSIONAL ENGINEER

Designed By:	Date:
S.H.	3/94
[illegible]	Date:
J.C.	3/94
Checked By:	Date:
L.S.K.	3/94

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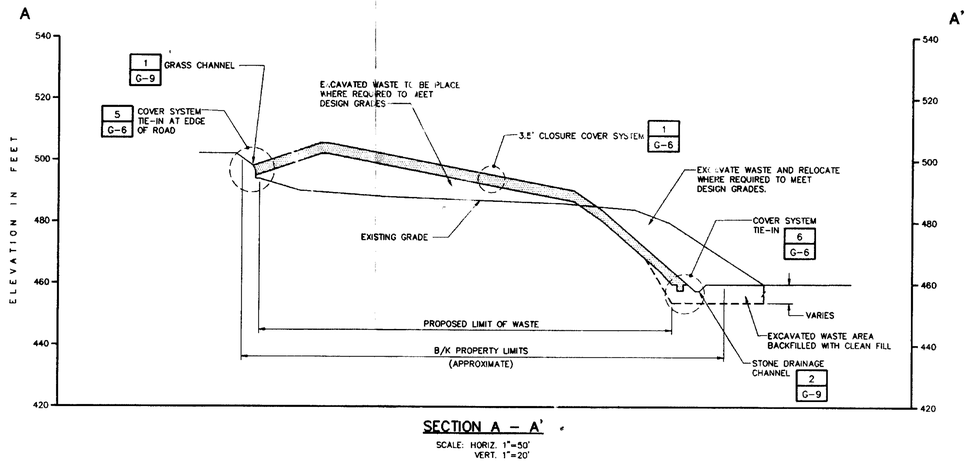
NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

GENERAL DETAILS - DRAINAGE

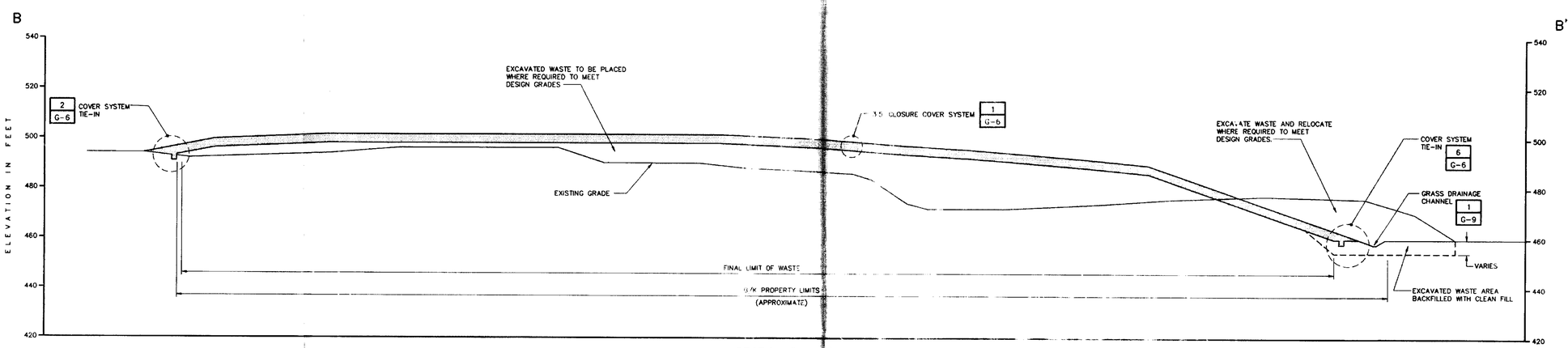
Drawing No. G-9

SCALE: AS SHOWN DATE: MARCH, 1994 SHEET 10 OF 11



SECTION A – A'

SCALE: HORIZ. 1"=50'
VERT. 1"=20'



SECTION B – B'

SCALE: HORIZ. 1"=50'
VERT. 1"=20'

RECORD DRAWING
JUNE 1996

Revisions:	Drawn By:	App'd. By:	Date:
RECORD DRAWING	M.C.	M.A.A	6/18/96

STATE OF NEW YORK — CARSTEN H. FLUEGEL — 061261 — PROFESSIONAL ENGINEER

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Drawn By:	Date:
M.C.	3/94
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NEW YORK STATE SUPERFUND CONTRACT
TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

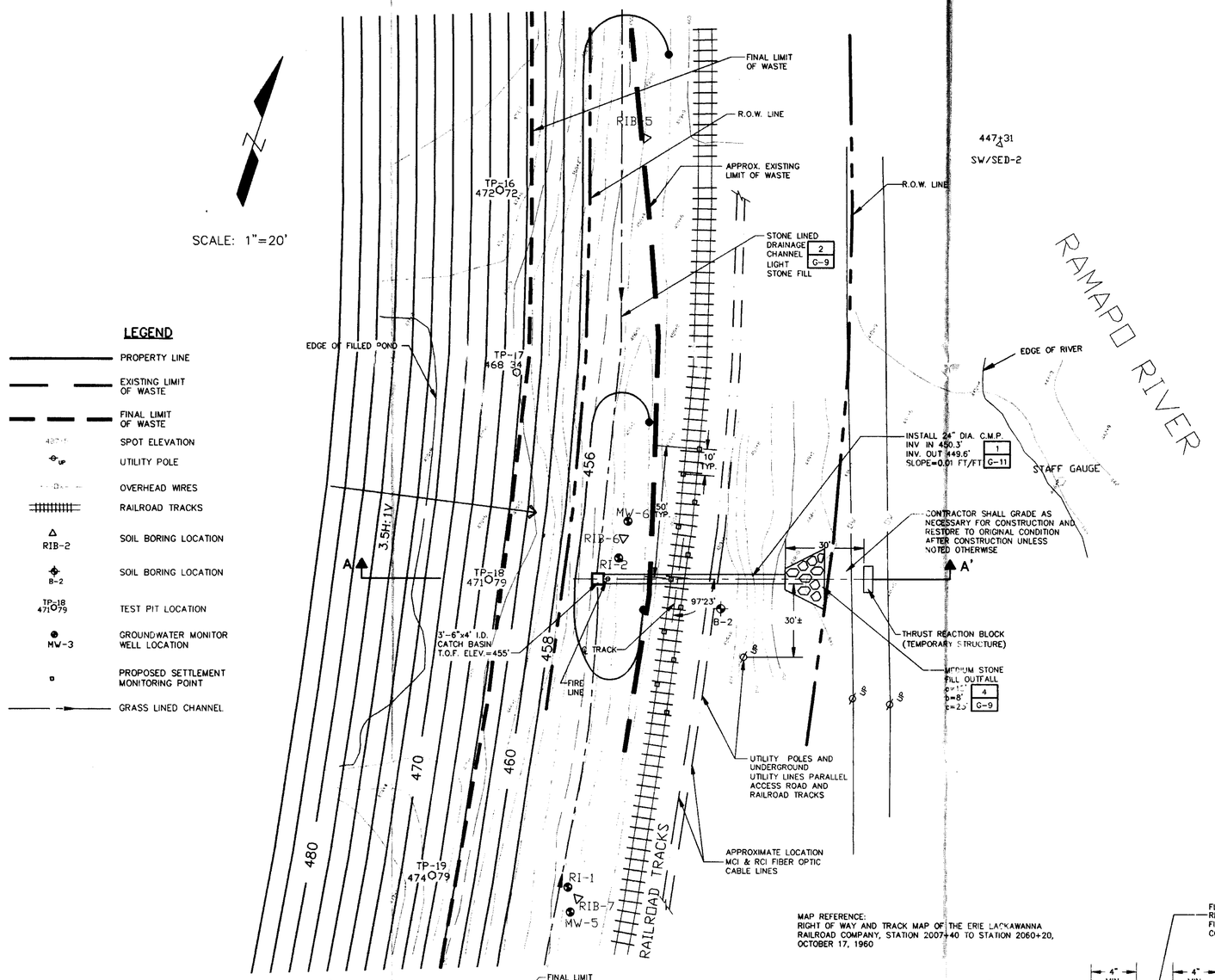
REMEDIAL CLOSURE DESIGN

CROSS SECTIONS

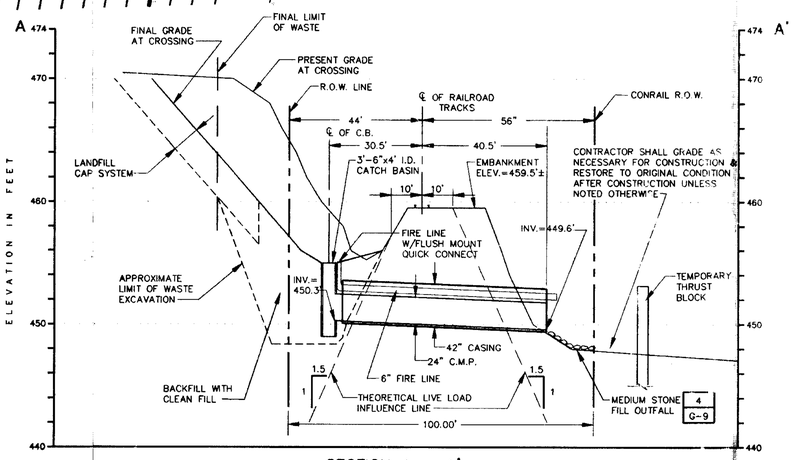
Drawing No. **G-10**

SCALE: AS SHOWN | DATE: MARCH, 1994 | SHEET 10 OF 11

File: Tuxedo 3-36-035



MAP REFERENCE:
RIGHT OF WAY AND TRACK MAP OF THE ERIE LACKAWANNA RAILROAD COMPANY, STATION 2007+40 TO STATION 2060+20, OCTOBER 17, 1960



SECTION A – A'

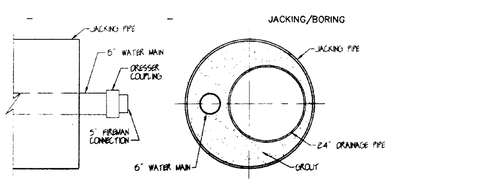
SCALE: HORIZ. 1"=20'
VERT. 1"=5'

CONSTRUCTION NOTES FOR JACKING

1. THE CONTRACTOR SHALL SUBMIT DETAILS OF THE METHOD OF INSTALLATION, THE SHEETING AND BRACING SYSTEM, AND THE REACTION BLOCK SYSTEM TO THE ENGINEER AND CONRAIL FOR APPROVAL.
2. ALL WORK SHALL CONFORM TO THE CONDITIONS OF THE TEMPORARY LICENSE AGREEMENT WITH CONRAIL, AND IN ACCORDANCE WITH THE SPECIFICATIONS. THE AGREEMENT WILL BE OBTAINED BY THE ENGINEER. THE CONTRACTOR SHOULD UNDERSTAND AND STRICKLY ADHERE TO THE CONDITIONS OF THE AGREEMENT.
3. CONTRACTOR SHALL INSTALL CASING AND CARRIER PIPES FROM EAST SIDE OF CONRAIL TRACK AND ACCESS ROAD.
4. UNLESS OTHERWISE ORDERED BY THE ENGINEER, JACKING OPERATIONS SHALL BE CONTINUOUS AND WITHOUT INTERRUPTION (24 HOURS PER DAY) UNTIL COMPLETED.
5. SHEETING TO EXTEND 4' ABOVE ORIGINAL GROUND ON ALL SIDES AND MINIMUM 10' RETURNS ON SIDES UNLESS OTHERWISE NOTED ON THE DRAWING.
6. THE CONTRACTOR SHALL PROVIDE A 4' HIGH SAFETY FENCING AROUND ALL PITS.
7. FILL ANNULAR SPACE AROUND CARRIER PIPE WITH PEA STONE, SAND OR GROUT.
8. ENDS OF CASING SHALL BE BULKHEADED WITH BRICK AND MORTAR OR APPROVED EQUAL AND FURNISHED WITH WEEP HOLES AT LOWER ENDS.
9. THE JACKING AND RECEIVING PITS SHALL BE BACKFILLED WITH SELECTED FILL TO 1'-0" OVER THE TOP OF PIPE. THE REMAINDER OF THE BACKFILL SHALL BE SUITABLE EXCAVATED SOIL MATERIAL.
10. UTILITIES ARE SHOWN IN THEIR RELATIVE POSITION AND FOR INFORMATION ONLY. THEIR EXACT LOCATION SHALL BE DETERMINED PRIOR TO ANY CONSTRUCTION.
11. CONTRACTOR SHALL NOT EXCAVATE OR DISTURB MATERIALS WITHIN THEORETICAL LIVE LOAD INFLUENCE ZONE.
12. EXCAVATIONS THAT DISTURB SURFACE MATERIALS AND SUBBASES ADJACENT TO EXISTING TRACK AND ACCESS ROAD SHALL BE REPLACED WITH LIKE MATERIALS OF THE SAME THICKNESS.
13. CONTRACTOR SHALL PROVIDE AND MAINTAIN DEWATERING SYSTEM AS NEEDED TO MAINTAIN WATER LEVEL 2 FEET BELOW CONSTRUCTION ACTIVITIES.
14. CONTRACTOR IS RESPONSIBLE TO NOTIFY CONRAIL PERSONNEL TO INSURE TEMPORARY TRACK SUPPORTS ARE INSTALLED IN ACCORDANCE WITH CONRAIL SPECIFICATIONS PRIOR TO STARTING BORING OPERATION. CONTRACTOR SHALL PROVIDE TRACK SUPPORTS FOR INSTALLATION BY CONRAIL.
15. ANY WORK OR INVESTIGATION MADE ON CONRAIL PROPERTY SHALL BE PERFORMED UNDER THE SUPERVISION OF CONRAIL
16. CONTRACTOR SHALL MONITOR THE RAILROAD TRACK FOR SETTLEMENT. MONITORINGS SHALL BE CONDUCTED DURING BORING OPERATIONS, FOR THREE DAYS PRIOR TO BORING OPERATIONS, AND FOR TEN DAYS AFTER TRACK SUPPORTS ARE REMOVED. SETTLEMENT POINTS SHALL BE ESTABLISHED 10 FEET APART FOR 50 FEET ON EACH SIDE OF THE CROSSING. SETTLEMENT MONITORING SHALL BE CONDUCTED ONCE PER HOUR WHEN THE HORIZONTAL BORING IS OCCURING AND TWICE DAILY WHEN BORING IS NOT BEING CONDUCTED.

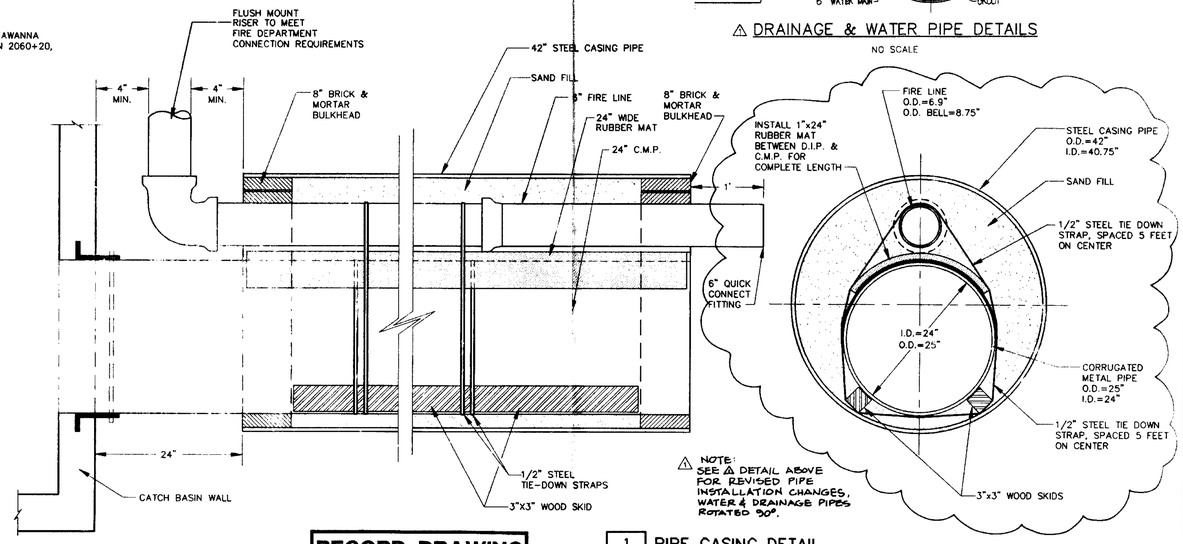
PIPE CROSSING DATA SHEET

	CARRIER PIPE 1	CARRIER PIPE 2	CASING PIPE
CONTENTS TO BE HANDLED	STORMWATER RUNOFF	WATER FROM RAMAPO RIVER	N/A
NORMAL OPERATING PRESSURE	ATMOSPHERIC	SUCTION LINE (110 psi)	N/A
NOMINAL SIZE OF PIPE	24"	6"	42"
O.S. DIAMETER	–	6.90"	42"
I.S. DIAMETER	–	6.28"	40.75"
WALL THICKNESS	14 GAUGE	0.31"	0.625"
WEIGHT PER FOOT	50 lbs.	20.4 lbs.	276.2 lbs.
MATERIAL	CORRUGATED STEEL	DUCTILE IRON PIPE	STEEL
PROCESS OF MANUFACTURE	HELICAL CORRUGATIONS	CENTRIFUGALLY CAST	STRAIGHT SEAM WELD
SPECIFICATION	–	ANSI/AWWA - C151/A21.51	ASTM A-139
GRADE OR CLASS	–	CLASS 52	B
TEST PRESSURE	NONE	150 psi	NONE
TYPE OF JOINT	HUGGER BAND	RESTRAINED MECHANICAL	WELDED
TYPE OF COATING	CONTECH FIBER W/ BITUMINOUS COATING	BITUMINOUS COATING	NONE
DETAILS OF CATHODIC PROTECTION	NONE	NONE	NONE
DETAILS OF SEAL OR PROTECTION AT ENDS OF CASING	N/A	N/A	BRICK/MORTAR
METHOD OF INSTALLATION	–	–	JACKING/BORING



⚠ DRAINAGE & WATER PIPE DETAILS

NO SCALE



⚠ NOTE:
SEE ⚠ DETAIL ABOVE FOR REVISED PIPE INSTALLATION CHANGES, WATER & DRAINAGE PIPES ROTATED 30°.

RECORD DRAWING JUNE 1996

1 G-4 PIPE CASING DETAIL

NO SCALE

Revisions:	Drawn By:	App'd. By:	Date:
⚠ RECORD DRAWING - PIPE INSTALLATION REV.	M.C.	M.A.P.	6/18/96

Designed By: C.S.H. Date: 3/94
Drawn By: M. Date: 3/94
Checked By: L.S.K. Date: 3/94

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TUXEDO WASTE DISPOSAL SITE
SITE ID NO. 3-36-035
TOWN OF TUXEDO ----- ORANGE COUNTY
STATE OF NEW YORK

REMEDIAL CLOSURE DESIGN

CONRAIL PIPE CROSSING

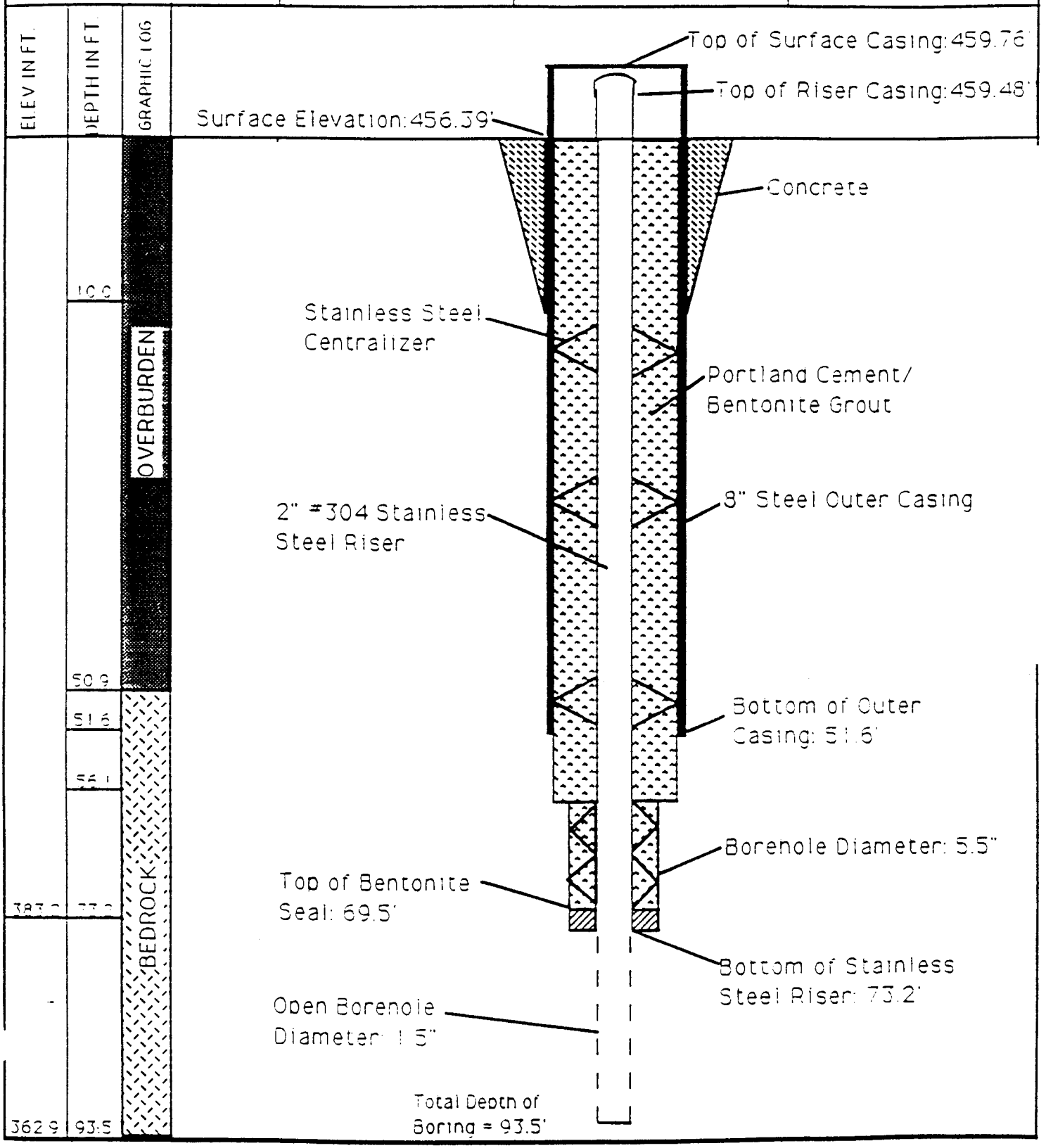
Drawing No. G-11

SCALE: AS SHOWN DATE: MARCH, 1994 SHEET 11 OF 11

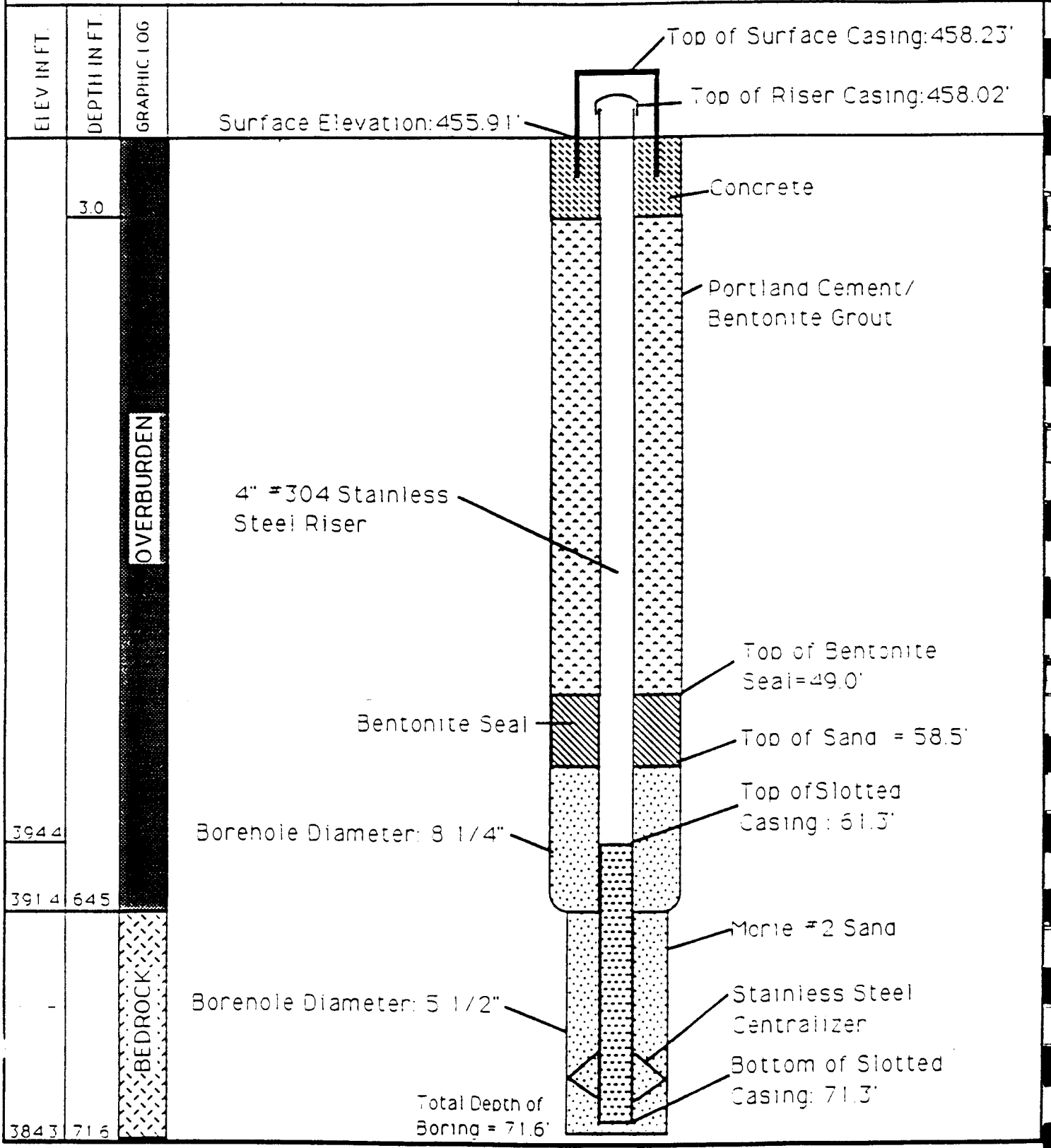
APPENDEX G

MONITORING WELL LOGS

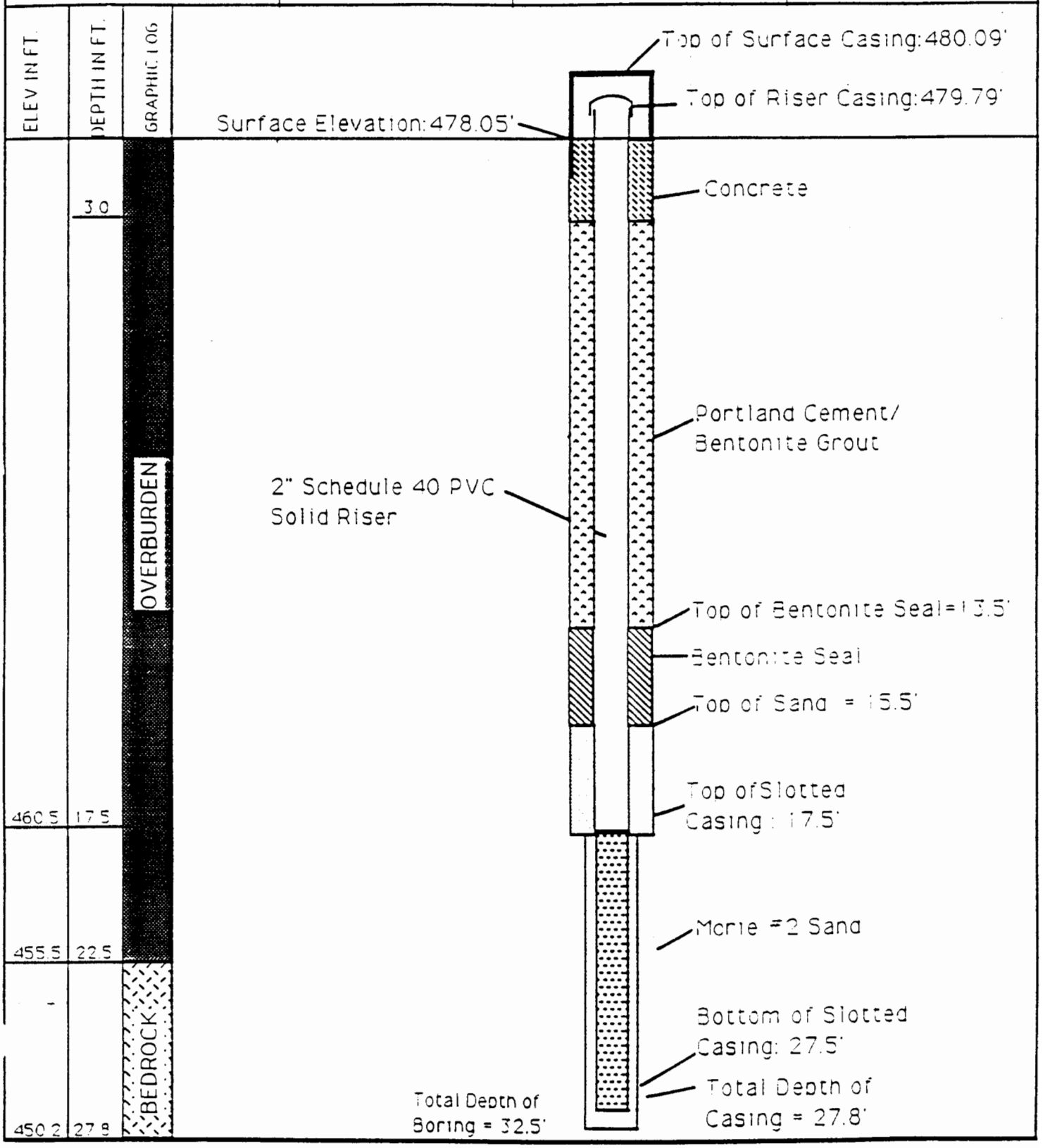
BORING/WELL NO. RI-1	DRILLING DATE START: 8/15/90 FINISH: 8/17/90	FIELD GEOLOGIST M. LACAPRARO CHECKED BY:	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO NY	WELL CASING TYPE 2" #304 STAINLESS STEEL	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 305040	SURFACE ELEV 456.39'	WELL ELEV (TOC) 459.48'	DRILLING METHOD 8 1/4" ID HSA/ 4" CORE



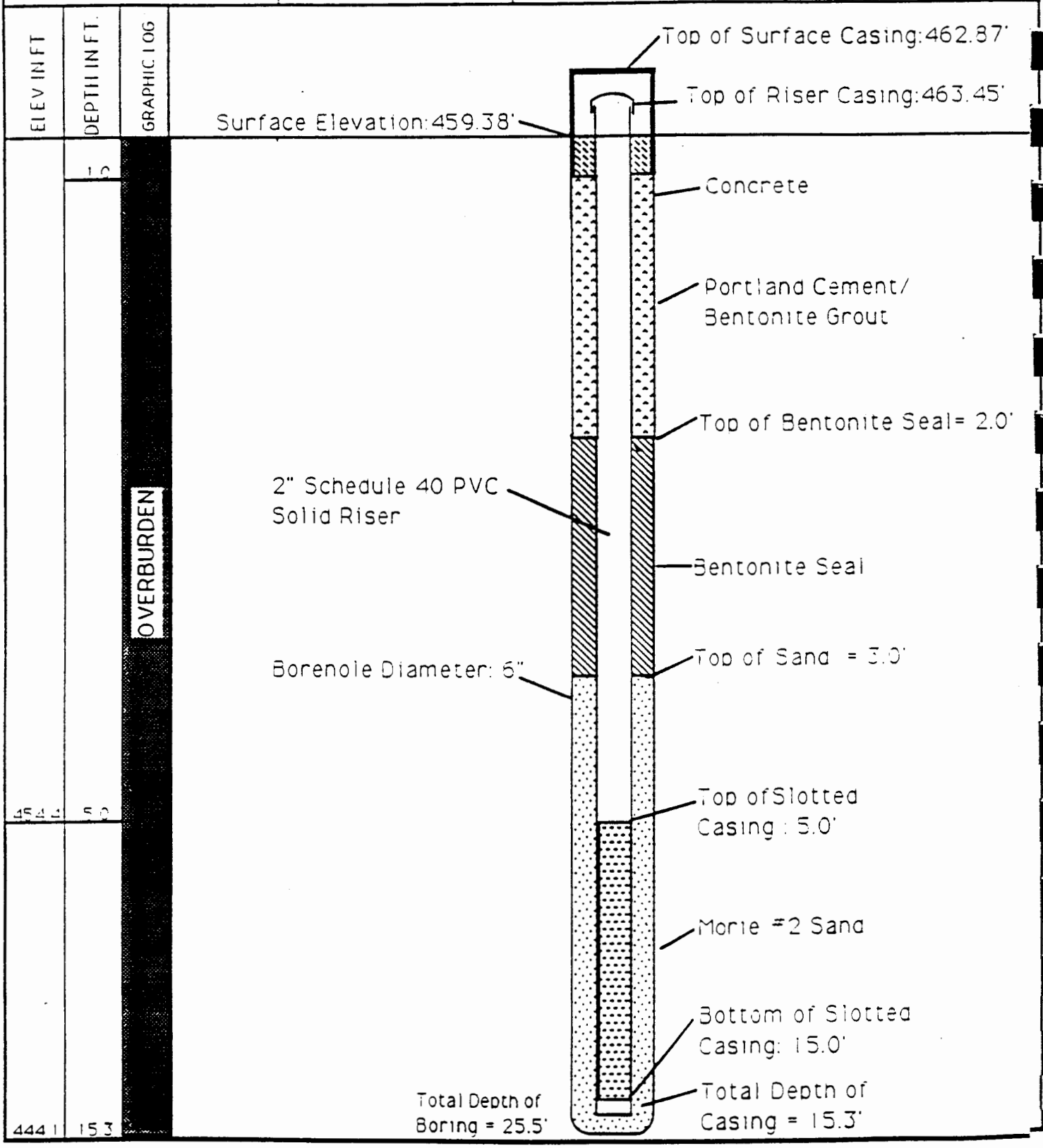
BORING/WELL NO. RI-2	DRILLING DATE START 8/05/90 FINISH 8/08/90	FIELD GEOLOGIST M. JACAPRARO CHECKED BY:	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N.Y.	WELL CASING TYPE 4" #304 STAINLESS STEEL	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 005040	SURFACE ELEV. 455.91'	WELL ELEV. (TOC) 458.02'	DRILLING METHOD HOLLOW STEM AUGER



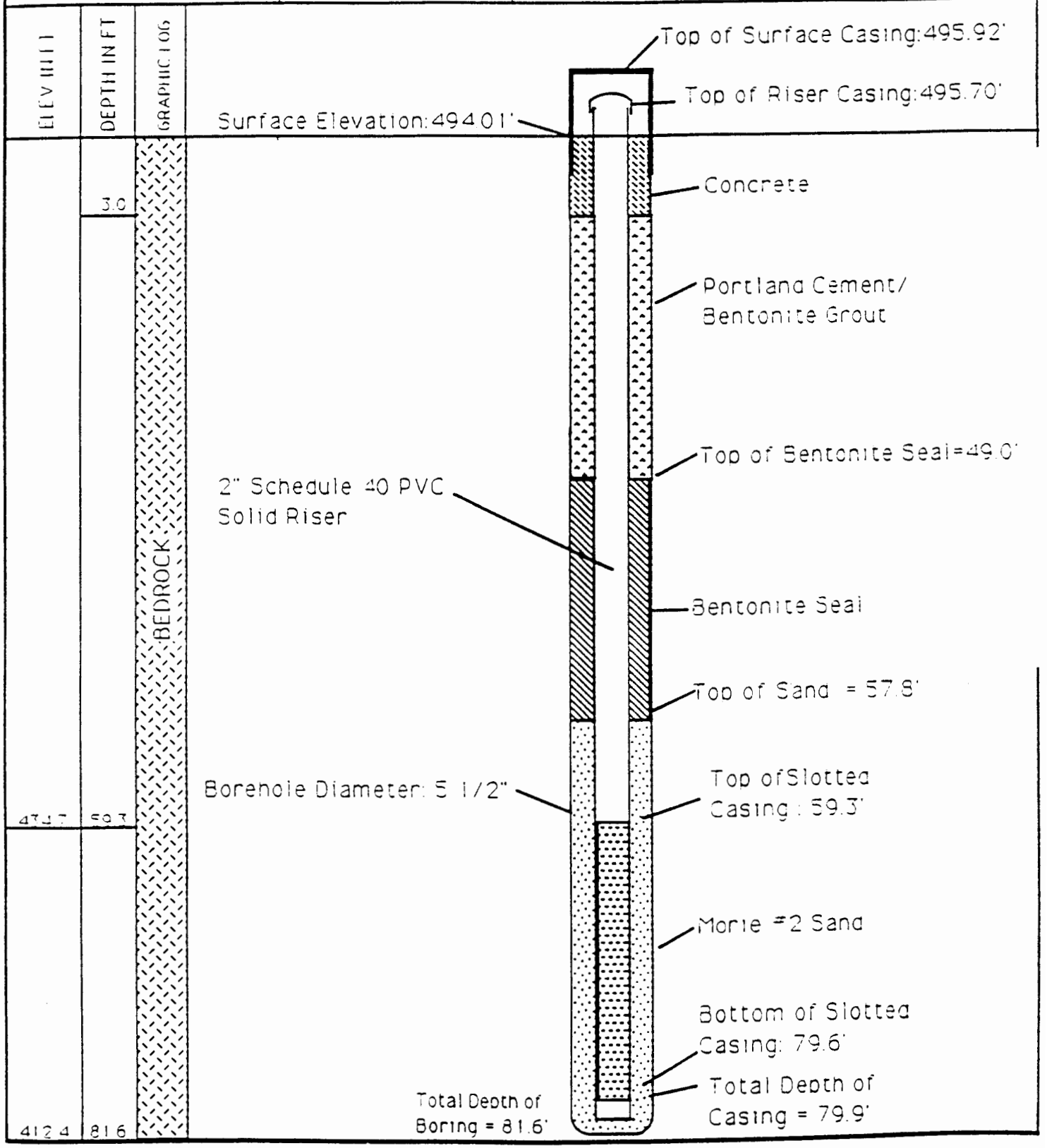
BORING/WELL NO.	DRILLING DATE	FIELD GEOLOGIST	METCALF & EDDY
RI-3	START 8/13/90 FINISH: 8/18/90	M. JACAPRARO CHECKED BY:	
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N.Y.	WELL CASING TYPE 2" FLUSH SCHEDULE 40 PVC	DRILLER GENERAL BORINGS, INC.
PROJECT NUMBER 305040	SURFACE ELEV. 478.05'	WELL ELEV. (TOC) 479.79'	DRILLING METHOD 4 1/4" ID HSA / NQ CORE



BORING/WELL NO.	DRILLING DATE	FIELD GEOLOGIST	METCALF & EDDY
RI-4	START: 8/03/90 FINISH: 8/03/90	M. JACAPRARO CHECKED BY:	
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N.Y.	WELL CASING TYPE 2" FLT. 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 305040	SURFACE ELEV 494.01'	WELL ELEV. (TOC) 495.70'	DRILLING METHOD 4 X 5 1/2" CORE BARREL



Well No. MW-1
Project No. 576-018

Project Name Tuxedo C+D

Client NYSOEC

Location Tuxedo, NY

Date Drilled 7-19-88

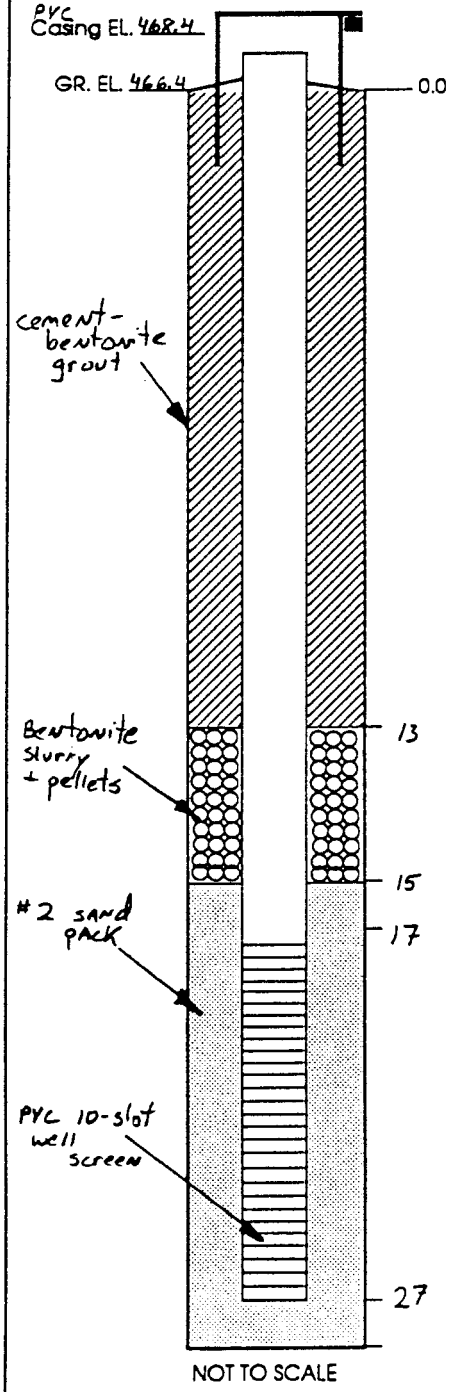
Date Developed 7-20-88

Developing Method bailer

Well Construction Completed 7-20-88

MONITORING WELL COMPLETION LOG

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness & John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 19.48' Date 7-20-88
Measuring Point (M.P.) Top of casing
Total Depth of Well 27'
Total Depth of boring 27'

Drilling Method
Type Hollow Stem Auger Diameter 7"
Casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lb. Fall 30"
Interval

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 20' Joint Type threaded flush

Screen
Material PVC sch 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened SAND

Filter Pack
Sand X Gravel ____ Natural ____
Grade #2
Amount ____ Interval 27-15'

Seal(s)
Type Bentonite slurry Interval 15-13'
Type + pellets Interval
Type ____ Interval

Locking Casing ☒ Yes ☐ No
Notes:

Well No. MW-2
Project No. 576-018

Project Name Tuxedo C&D

Client NYSDEC

Location Tuxedo, NY

Date Drilled 8-26 thru 8-29-88

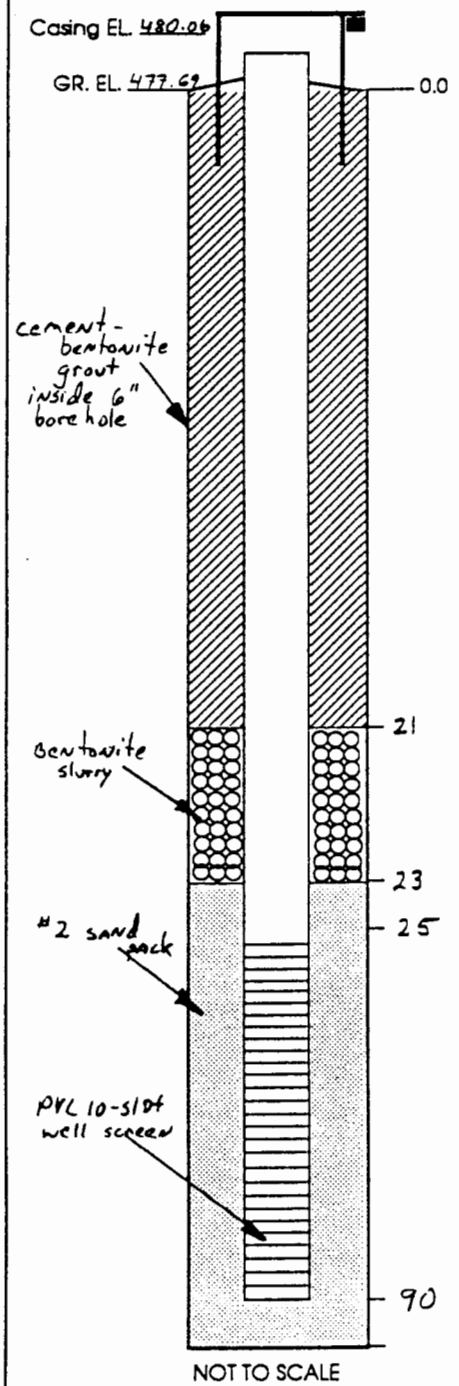
Date Developed 9-1-88

Developing Method bailed

Well Construction Completed 8-29-88

MONITORING WELL COMPLETION LOG

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness
Drilling Contractor Kendrick Drilling

Type of Well Open hole bedrock
Static Water Level 24.78' Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 90'
Total Depth of boring 90'

Drilling Method
Type Air rotary Diameter 6"
Casing

Sampling Method
Type none Diameter
Weight Fall
Interval

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 25' Joint Type Threaded flush

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 65'
Stratigraphic Unit Screened bedrock

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 90-23

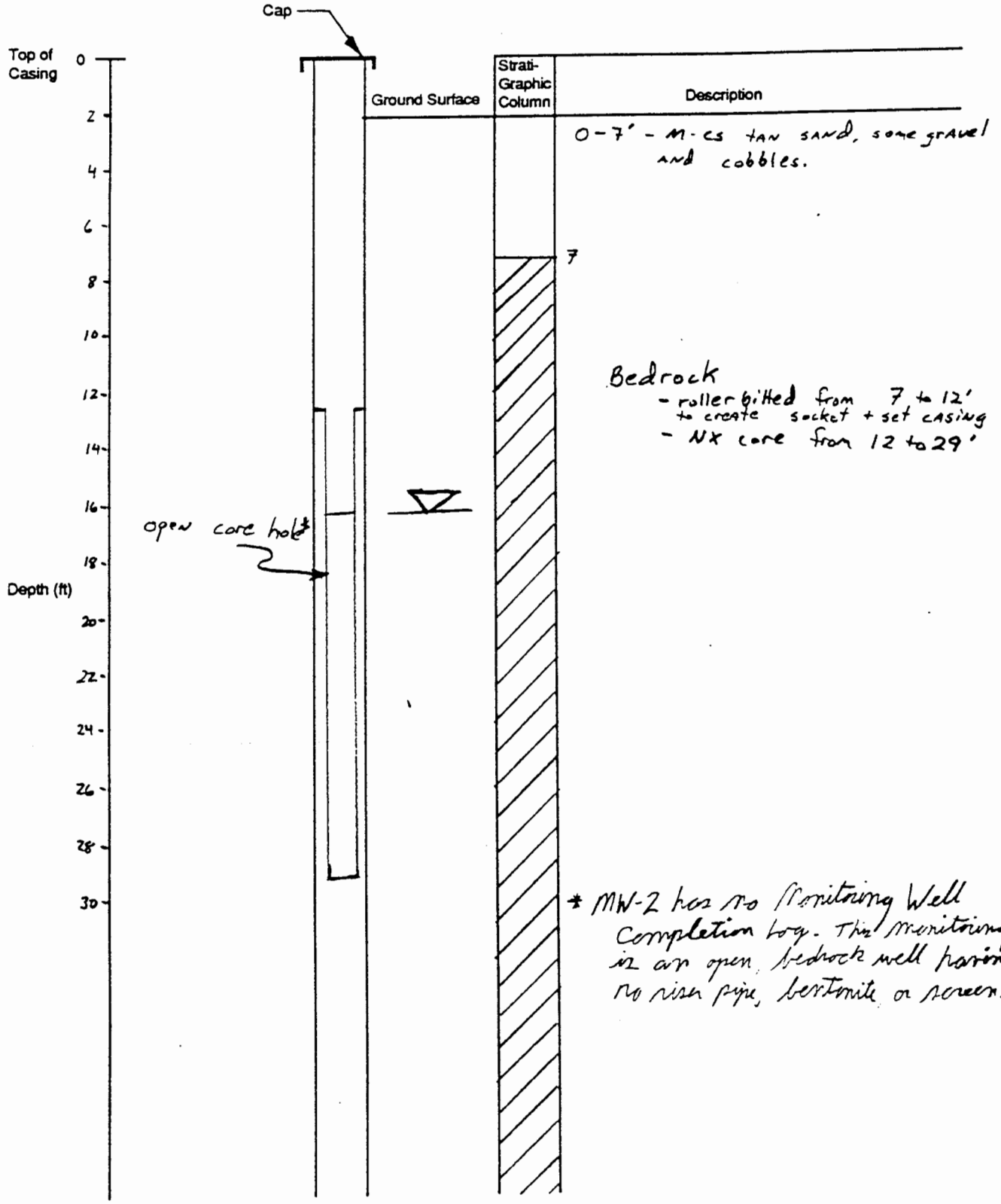
Seal(s)
Type Bentonite slurry Interval 23-21
Type Interval
Type Interval

Locking Casing ☒ Yes ☐ No
Notes:

LMS WELL DRILLING LOG

Client: NYSOEC
Well No.: MW-3
Drilling Completed: 7-27-88
Developing Method/Completed: 7-27-88
Yeild (Date): -
Total Depth: 29
Screened Interval: -
Aquifer: bedrock
Depth of Casing: -

Project No.: 576-018
Permit No.: -
SWL (Date): 16.33' 9-1-88
Elevation of Ground Surface: 457.20
Elevation of Top of Casing: 459.0
Latitude: -
Longitude: -
Hole Diameter: 3"
Geologist: Kevin McGuinness

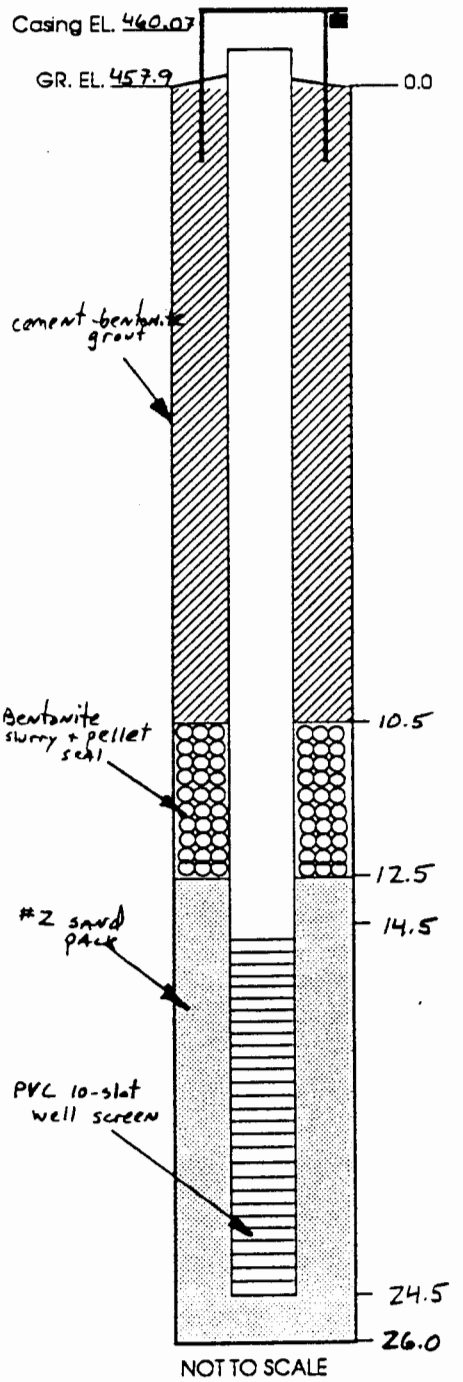


Well No. MW-4
Project No. 576-018

MONITORING WELL COMPLETION LOG

Project Name Tuxedo C+D
Client NYSDEC
Location Tuxedo NY
Date Drilled 7-27-88
Date Developed 7-28-88
Developing Method bailer
Well Construction Completed 7-27-88

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness + John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 16.72' Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 24.5'
Total Depth of boring 26.0'

Drilling Method + roller bit
Type Hollow-stem Auger Diameter 7"
Casing spun casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lbs Fall 30"
Interval continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 14.5' Joint Type flush threaded

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10
Stratigraphic Unit Screened Till

Filter Pack
Sand X Gravel ____ Natural ____
Grade #2
Amount ____ Interval ____

Seal(s)
Type bentonite slurry Interval ____
Type + pellets Interval ____
Type ____ Interval ____

Locking Casing ☒ Yes ☐ No
Notes:

LAWLER, MATUSKY SKELLY ENGINEERS

Well No. MW-5
Project No. 576-018

Project Name Tuxedo C+D

Client NYSDEC

MONITORING WELL COMPLETION LOG

Location Along RR tracks

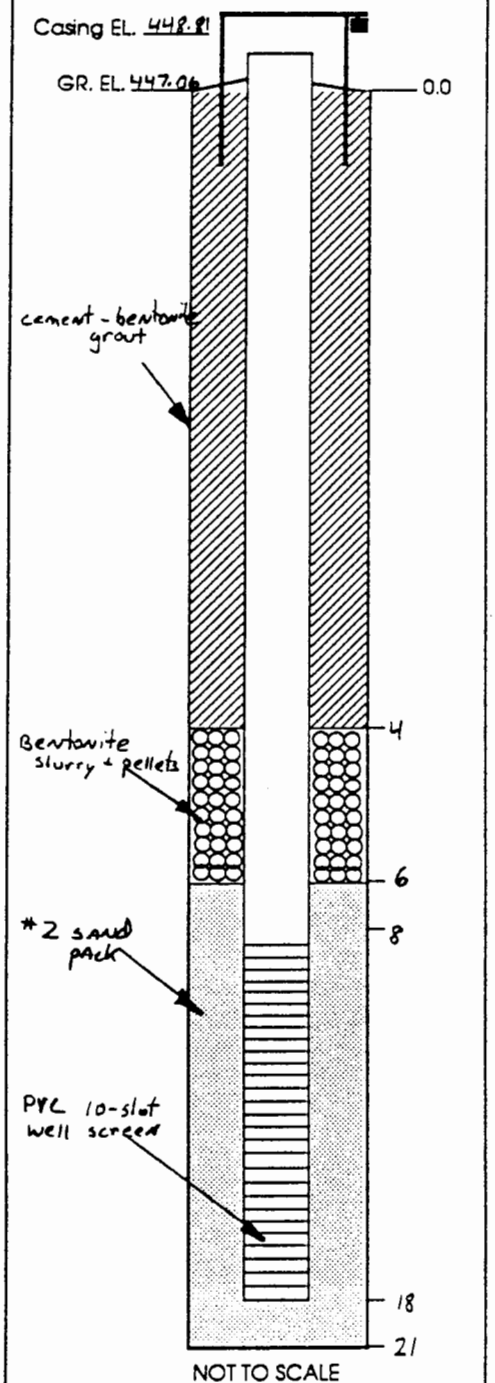
Date Drilled 7-25-88

Date Developed 7-26-88

Developing Method bailed

Well Construction Completed 7-25-88

WELL CONSTRUCTION DETAIL



NOT TO SCALE

Inspector Kevin McGuinness + John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 9.24 Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 18'
Total Depth of boring 21'

Drilling Method
Type Hollow-stem Auger Diameter 7"
Casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lb. Fall 30"
Interval Continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 8' Joint Type Flush threaded

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened sand + gravel

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 27-15

Seal(s)
Type bentonite slurry Interval 15-13'
Type + pellets Interval
Type Interval

Locking Casing ☒ Yes ☐ No
Notes:

LAWLER, MATUSKY SKELLY ENGINEERS

Well No. MW-6
Project No. 576-018

Project Name Tuxedo C+D

Client NYSDEC

MONITORING WELL COMPLETION LOG

Location Tuxedo NY

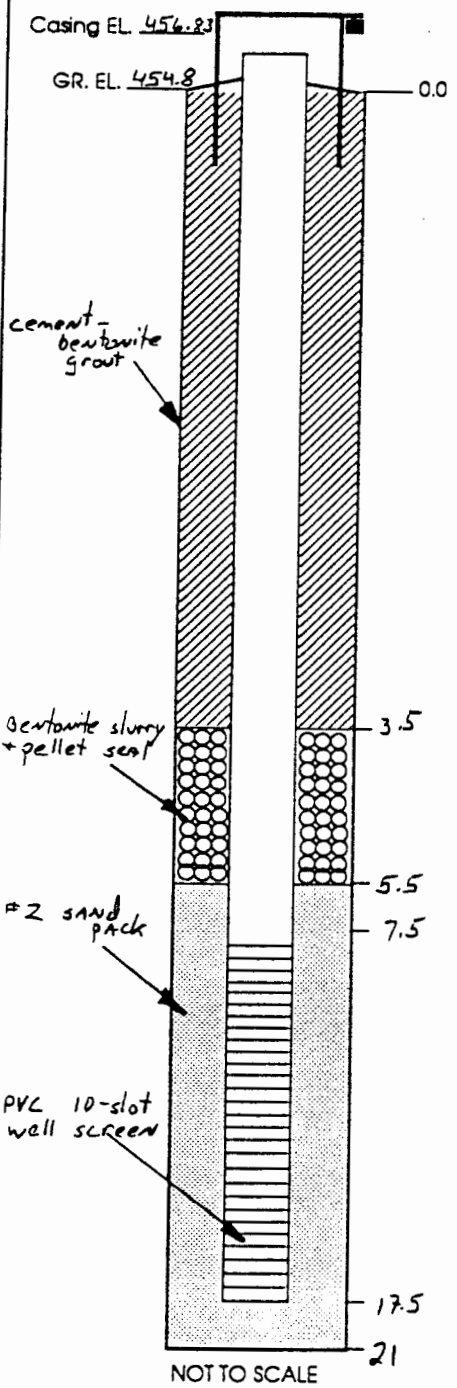
Date Drilled 7-24-88

Date Developed 7-25-88

Developing Method bailer

Well Construction Completed 7-24-88

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness - John Gutewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 9.82 Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 17.5'
Total Depth of boring 21'

Drilling Method
Type Hollow-stem Auger Diameter 7"
Casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lbs. Fall 30"
Interval continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 7.5' Joint Type flush-threaded

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened silty-sand

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 17.5 - 5.5

Seal(s)
Type Bentonite slurry Interval
Type + pellets Interval 5.5 - 3.5
Type Interval

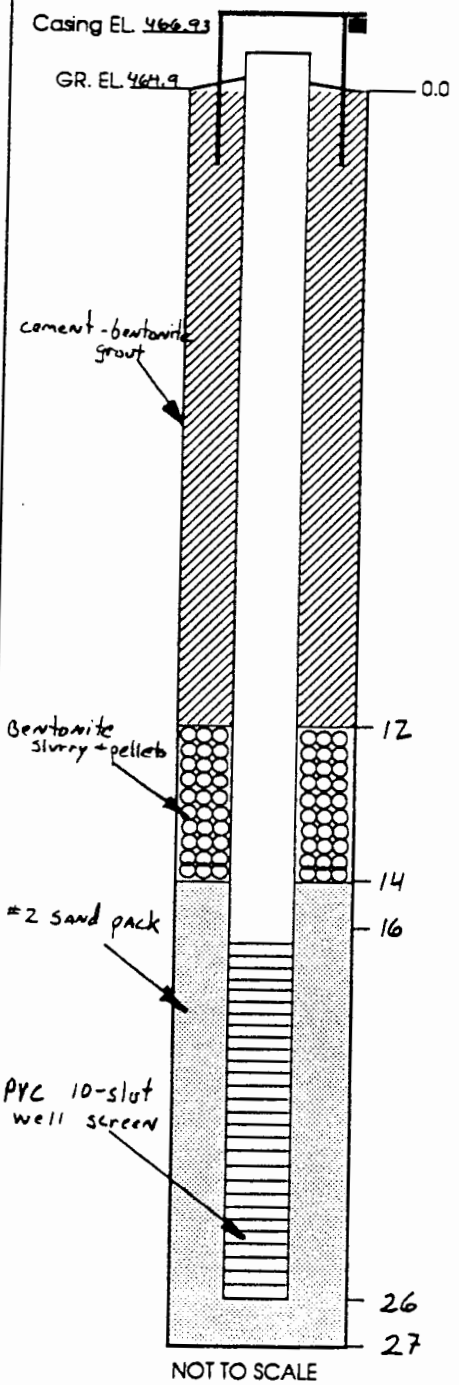
Locking Casing ☒ Yes ☐ No
Notes:

Well No. MW-7
Project No. 576-018

MONITORING WELL COMPLETION LOG

Project Name Tuxedo C+D
Client NYSDEC
Location Tuxedo NY
Date Drilled 7-22-88
Date Developed 7-23-88
Developing Method Bailer
Well Construction Completed 7-22-88

WELL CONSTRUCTION DETAIL



NOT TO SCALE

Inspector Kevin McGuinness + John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 18.36 Date 9-1-88
Measuring Point (M.P.) Top of Casing
Total Depth of Well 26'
Total Depth of boring 27'

Drilling Method
Type Hollow-stem Auger Diameter 7"
Casing

Sampling Method
Type Split spoon Diameter 1 3/8"
Weight 140 lb. Fall 30"
Interval Every 5' to water then continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 16' Joint Type threaded flush

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened sand.

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 27-15'

Seal(s)
Type Bentonite slurry Interval 15-13'
Type "pellets Interval
Type Interval

Locking Casing ☒ Yes ☐ No
Notes:

APPENDEX H

SITE INSPECTION CHECKLIST FORM

Tuxedo Waste Disposal Site
Site Inspection Checklist Form
Site Number 3-36-035

Checklist Items	Acceptable	Not Acceptable	Remarks / Location
Site Gate (monthly)			
Signage (monthly)			
Runoff Control Structures (monthly)			
Gas Venting System (monthly)			
Leachate Seepage (monthly)			
Cover Inspection (quarterly)			
Geomembrane Barrier (quarterly)			
Groundwater Monitoring System (quarterly)			
Vermin and Vectors (yearly)			
Vehical Access Road (yearly)			

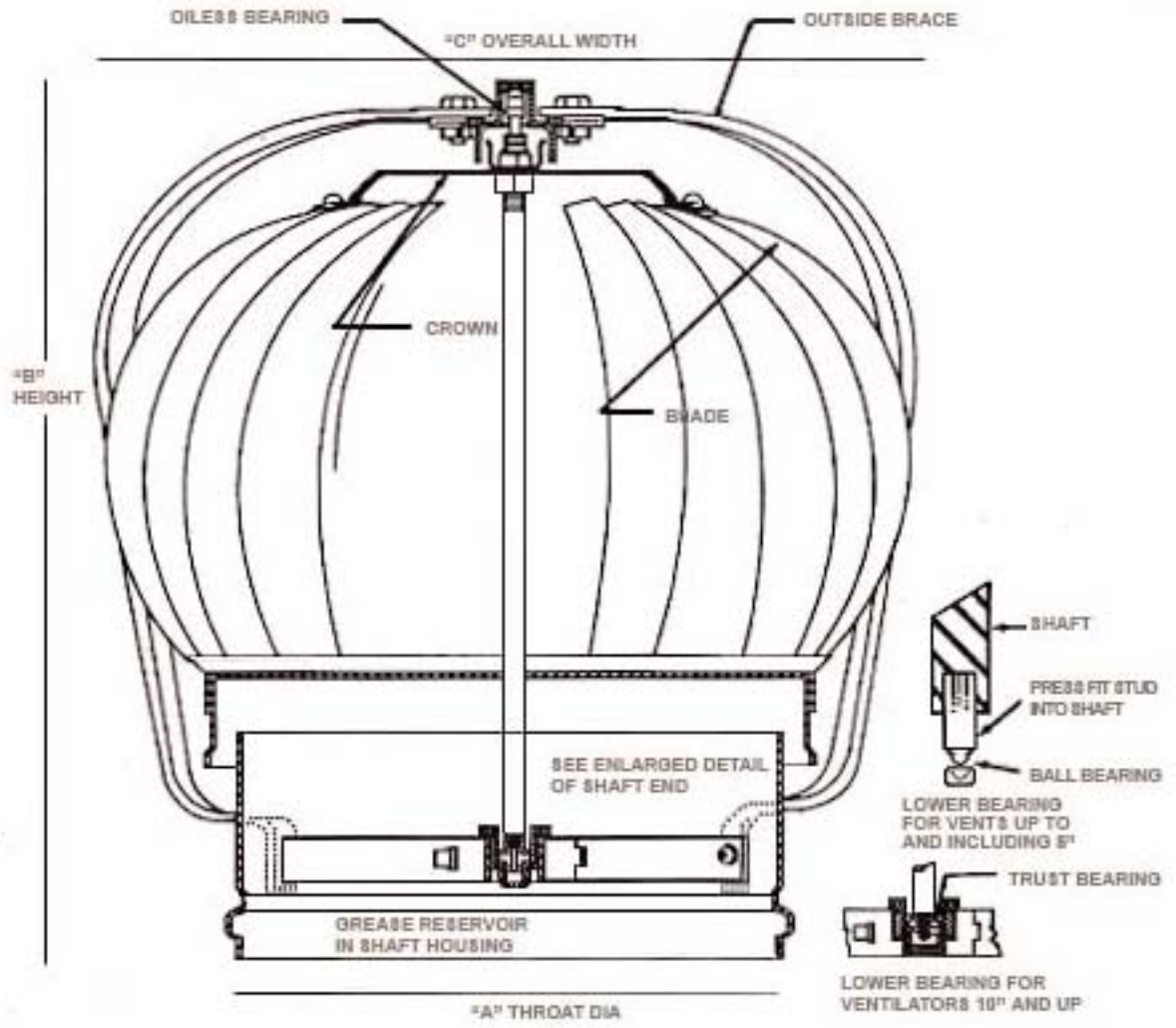
Appendix E

Turbine Ventilator Specifications

EMPIRE
VENTILATION EQUIPMENT CO., INC.

TOP OF THE LINE VENTILATORS
FOR BOTTOM LINE RESULTS

TURBINE VENTILATORS



CONSTRUCTION SPECIFICATIONS

"A" THROAT SIZE	GUAGE			NO. OF BRACES	BRACE MATERIAL
	CROWN GALV.	BLADE GALV.	THROAT GALV.		
4	24	28	26	3	ALUMINUM
6	24	28	26	3	ALUMINUM
8	24	28	26	3	ALUMINUM
10	24	28	26	3	ALUMINUM
12	24	28	24	3	ALUMINUM
14	22	26	24	3	ALUMINUM
16	22	26	24	3	STEEL
18	22	26	24	4	STEEL
20	20	26	24	4	STEEL
24	20	26	22	4	STEEL

DIMENSIONAL AND PERFORMACE DATA

"A" THROAT SIZE	"B" HEIGHT	"C" OVERALL WIDTH	EXHAUSTED CAPACITY*	APPROX. SHIPPING WEIGHT
4	12	10 1/4	125	5
6	14 1/2	12 3/4	147	7
8	15	14 1/4	255	8
10	16 1/4	16 1/4	425	11
12	17	19	631	13
14	19 3/4	22 3/4	700	21
16	21 3/4	25 1/2	950	31
18	24	29	1200	38
20	25 1/4	31 5/8	1700	46
24	28 1/4	35 3/4	2350	58

*4 MPH WIND CFM

Eveco Ventilators
Insul-Ventilators
Syphon Ventilators
Turbine Ventilators
1/2“ Mesh Screens
Insect Screens
Dampers For Syphon or Eveco
Dampers For Turbine Ventilators
Adjustable Bases
Economy Bases
Standard Mounting Bases
• Flat Bases
• Ridge Roof Bases
• Curb Bases
• Slope Roof Base
Booster Fans
Cast Aluminum Ventilators
Extruded Aluminum Ventilators
Flange Extruded Ventilators
Flush-Flange Louvers
Roof Louvers
Soffets
Strip Ventilators
Spring Register

Ventilators > Turbine Ventilators

LARGER IMAGE

Turbine Ventilators

Outside Braced

The Empire Turbine Ventilator is a dependable rotary that works automatically, continuously and silently without operating or maintenance costs. It is outside braced for strength, safety and perfect alignment. Ventilators up to and including 14” are aluminum braced. Larger sizes are steel braced for additional strength.

Operation is simple and sure. When the slightest breeze touches the scientific blade construction it causes the turbine to rotate. The centrifugal force caused by the revolving turbine creates a partial vacuum within the turbine. This vacuum is then replaced by a strong upward draft of air. A powerful exhaust is thus achieved.

Precision Built With Ball Bearings

The lower thrust bearing is a hardened steel ball riding in a hardened steel concave seat (in sizes up to 8”) for extreme sensitivity and wearability. In larger sizes, thrust type ball bearings are used. Upper bearings on all ventilators are bronze oilless.

The rigid construction of these stormproof ventilators assures years of efficient service. No adjusting or servicing is required.

Empire Turbine Ventilators are sold through leading distributors everywhere. Available in galvanized steel, aluminum, copper or stainless steel, all which are servicable.

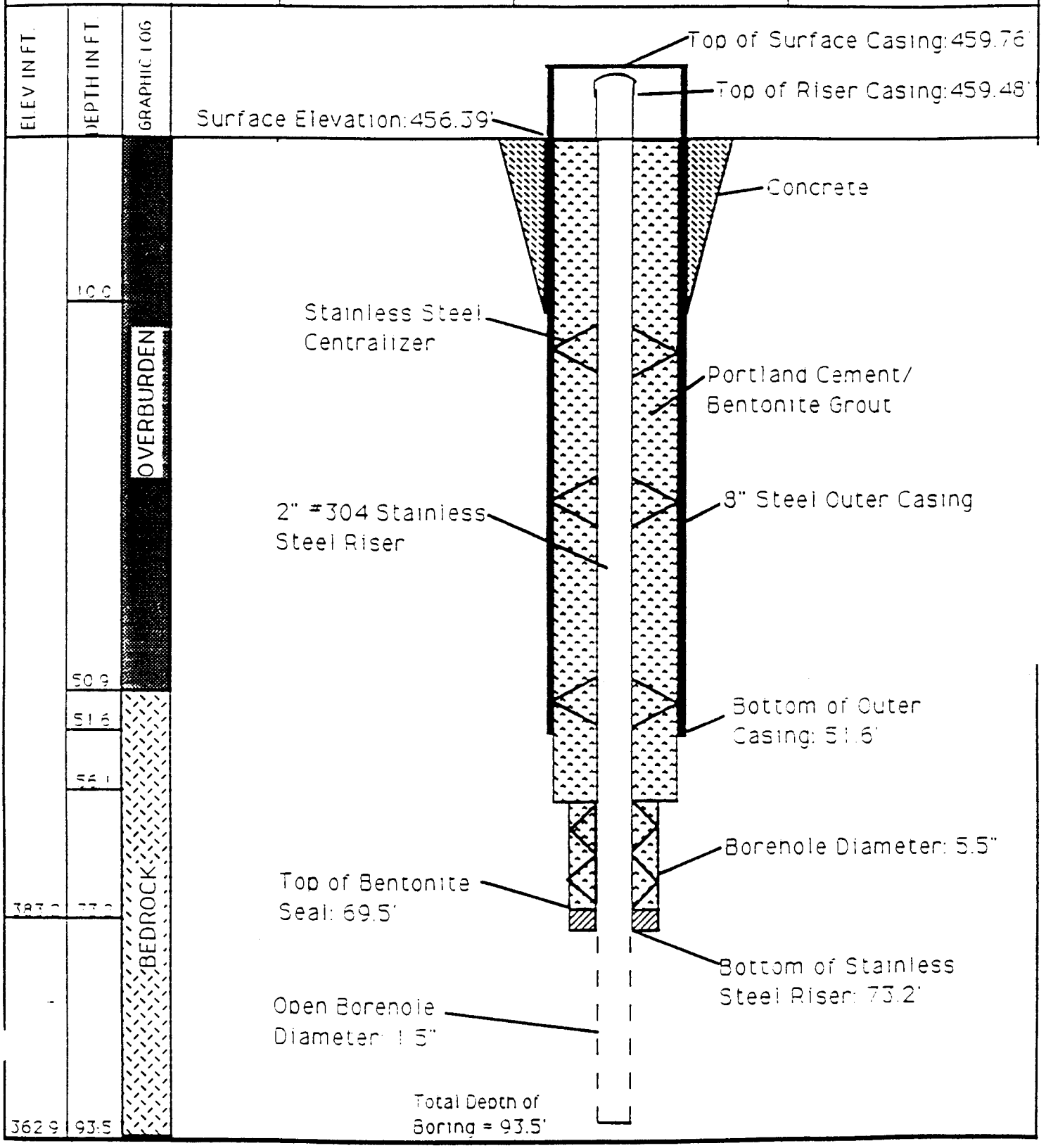
1. **12” Turbine Ventilator Installation Instructions(English)**
   - *Web Page Version*
   - *Adobe PDF Version*
2. **12” Turbine Ventilator Installation Instructions(Spanish)**
   - *Web Page Version*
   - *Adobe PDF Version*
3. **12” Turbine Ventilator Installation Instructions(French)**
   - *Web Page Version*
   - *Adobe PDF Version*
4. **Construction Specifications & Dimensional and Performace Data**
   - *Web Page Version*
   - *Adobe PDF Version*

• Eveco Ventilators
• Insul-Ventilators
• Syphon Ventilators
• Turbine Ventilators

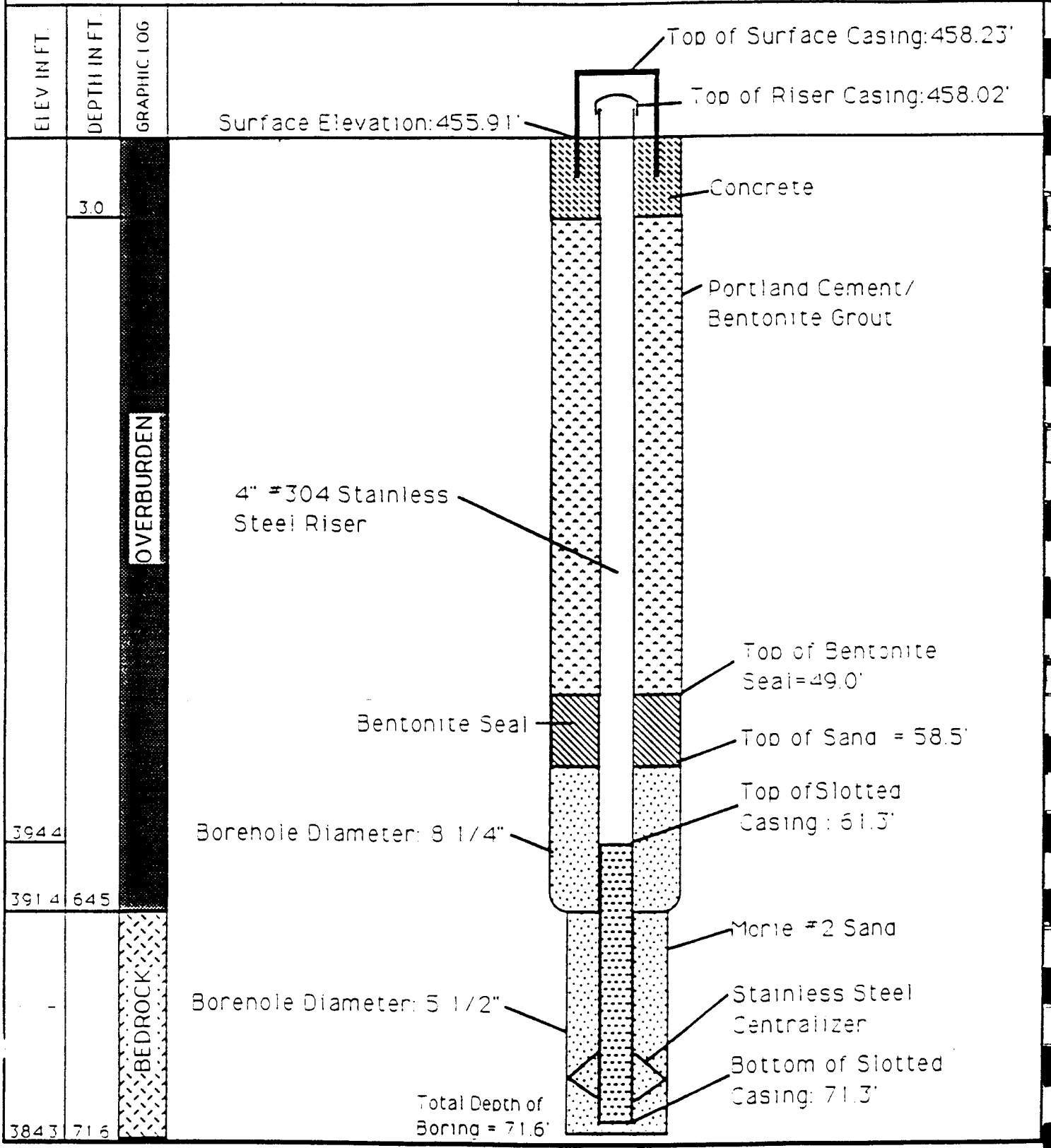
Appendix F

Well Construction Diagrams

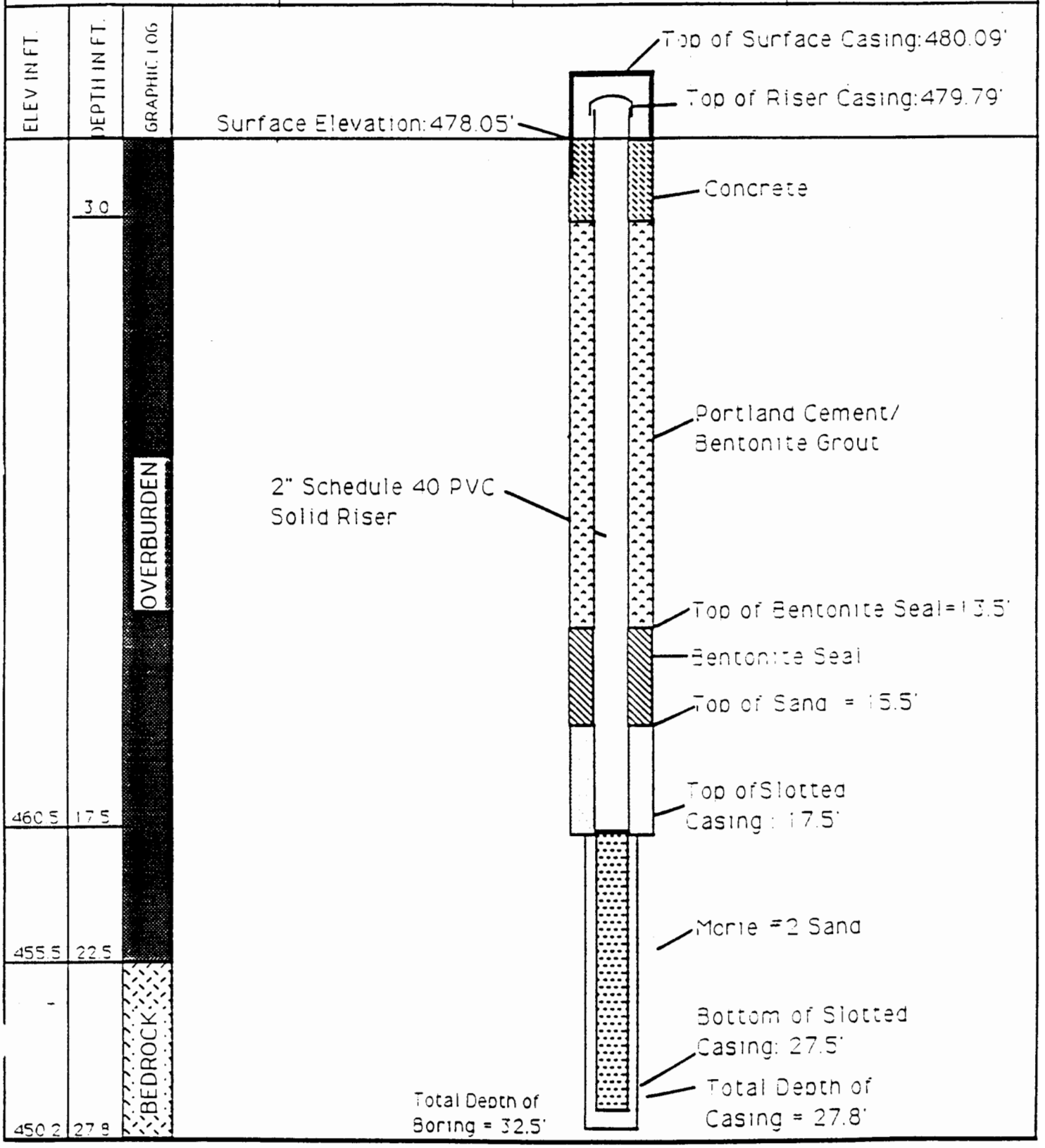
BORING/WELL NO. RI-1	DRILLING DATE START: 8/15/90 FINISH: 8/17/90	FIELD GEOLOGIST M. LACAPRARO CHECKED BY:	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO NY	WELL CASING TYPE 2" #304 STAINLESS STEEL	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 305040	SURFACE ELEV 456.39'	WELL ELEV (TOC) 459.48'	DRILLING METHOD 8 1/4" ID HSA/ 4" CORE



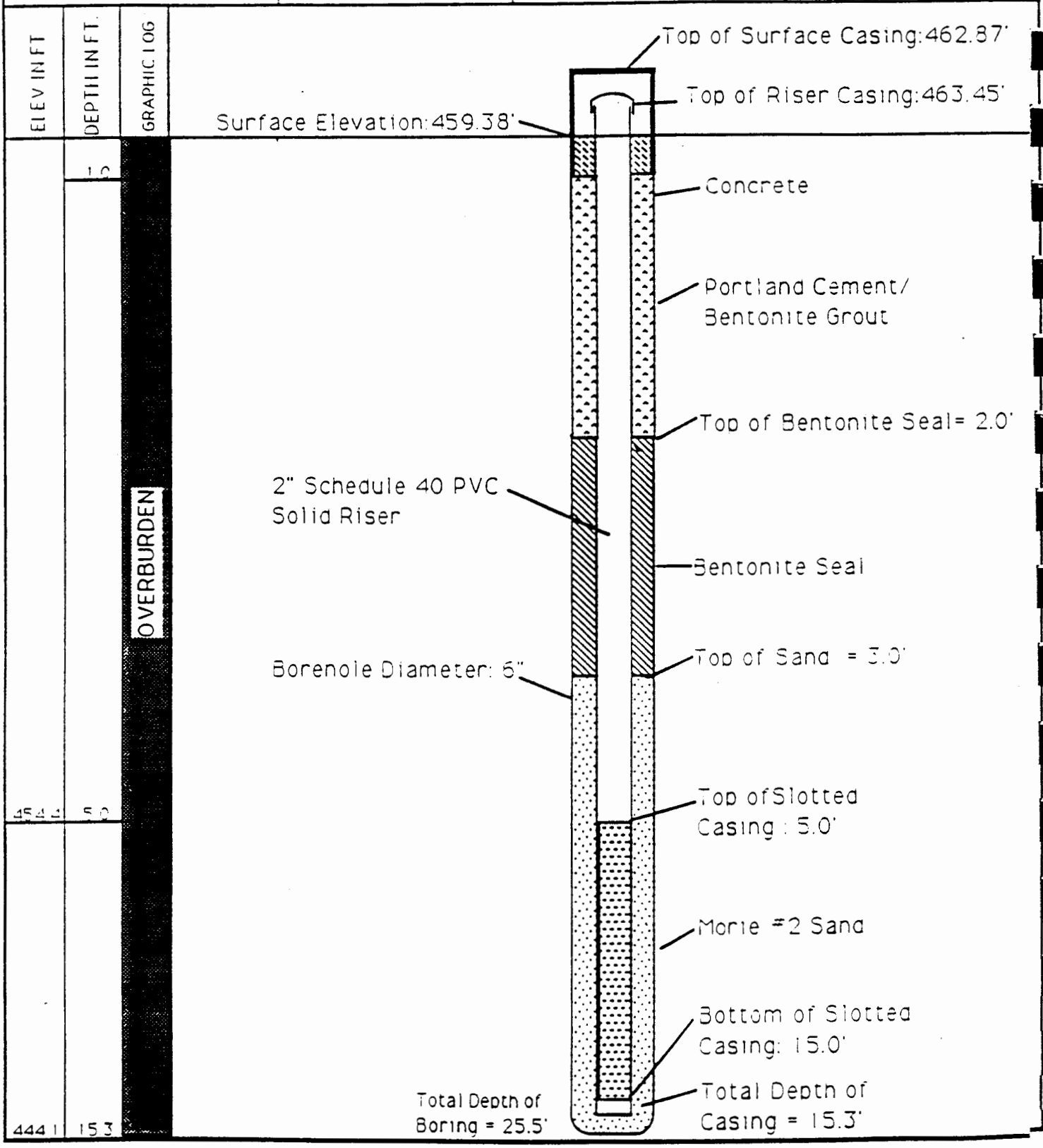
BORING/WELL NO. RI-2	DRILLING DATE START 8/05/90 FINISH 8/08/90	FIELD GEOLOGIST M. JACAPRARO CHECKED BY:	METCALF & EDDY
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N.Y.	WELL CASING TYPE 4" #304 STAINLESS STEEL	DRILLER GENERAL BORINGS, INC
PROJECT NUMBER 005040	SURFACE ELEV. 455.91'	WELL ELEV. (TOC) 458.02'	DRILLING METHOD HOLLOW STEM AUGER



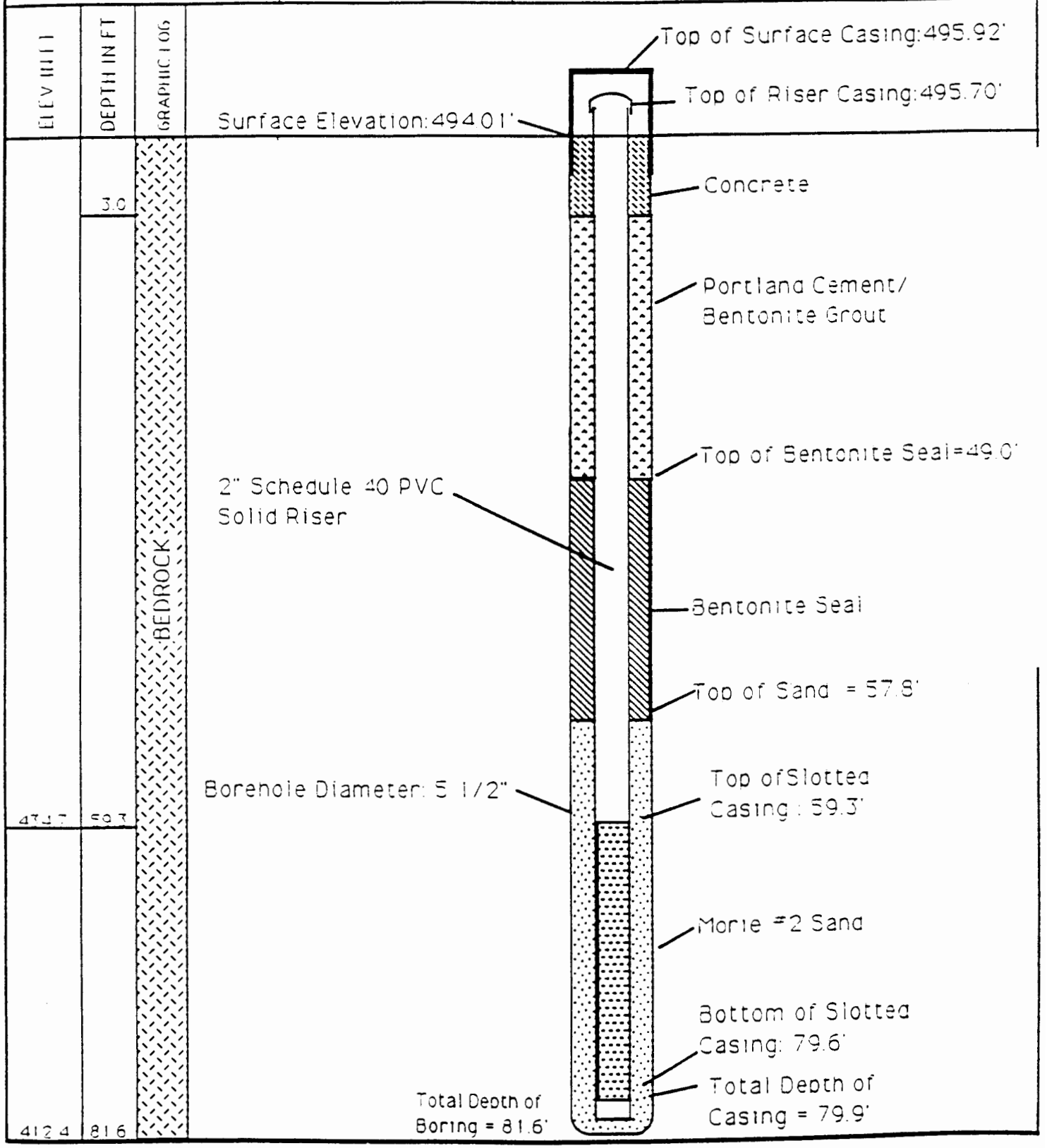
BORING/WELL NO.	DRILLING DATE	FIELD GEOLOGIST	METCALF & EDDY
RI-3	START 8/13/90 FINISH: 8/18/90	M. JACAPRARO CHECKED BY:	
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N.Y.	WELL CASING TYPE 2" FLUSH SCHEDULE 40 PVC	DRILLER GENERAL BORINGS, INC.
PROJECT NUMBER 305040	SURFACE ELEV. 478.05'	WELL ELEV. (TOC) 479.79'	DRILLING METHOD 4 1/4" ID HSA / NQ CORE



BORING/WELL NO.	DRILLING DATE	FIELD GEOLOGIST	METCALF & EDDY
RI-4	START: 8/03/90 FINISH: 8/03/90	M. JACAPRARO CHECKED BY:	
PROJECT TITLE TUXEDO WASTE DISPOSAL SITE	LOCATION ROUTE 17, TUXEDO N.Y.	WELL CASING TYPE 2" FLT. 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 305040	SURFACE ELEV 494.01'	WELL ELEV. (TOC) 495.70'	DRILLING METHOD 4 X 5 1/2" CORE BARREL



Well No. MW-1
Project No. 576-018

Project Name Tuxedo C+D

Client NYSOEC

Location Tuxedo, NY

Date Drilled 7-19-88

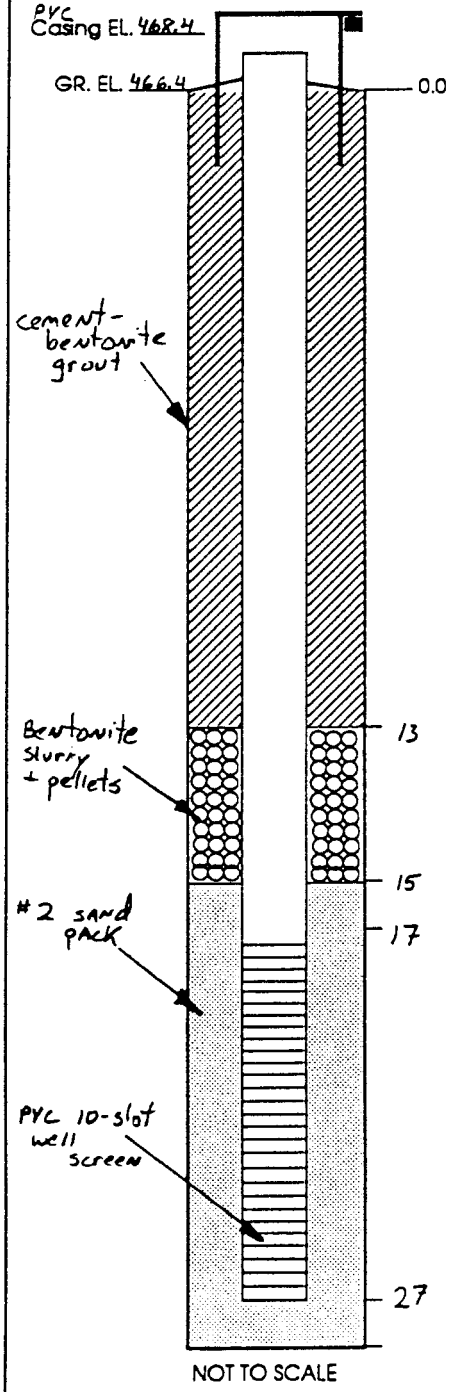
Date Developed 7-20-88

Developing Method bailer

Well Construction Completed 7-20-88

MONITORING WELL COMPLETION LOG

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness & John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 19.48' Date 7-20-88
Measuring Point (M.P.) Top of casing
Total Depth of Well 27'
Total Depth of boring 27'

Drilling Method
Type Hollow Stem Auger Diameter 7"
Casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lb. Fall 30"
Interval

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 20' Joint Type threaded flush

Screen
Material PVC sch 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened SAND

Filter Pack
Sand X Gravel ____ Natural ____
Grade #2
Amount ____ Interval 27-15'

Seal(s)
Type Bentonite slurry Interval 15-13'
Type + pellets Interval
Type ____ Interval

Locking Casing ☒ Yes ☐ No
Notes:

Well No. MW-2
Project No. 576-018

Project Name Tuxedo C&D

Client NYSDEC

Location Tuxedo, NY

Date Drilled 8-26 thru 8-29-88

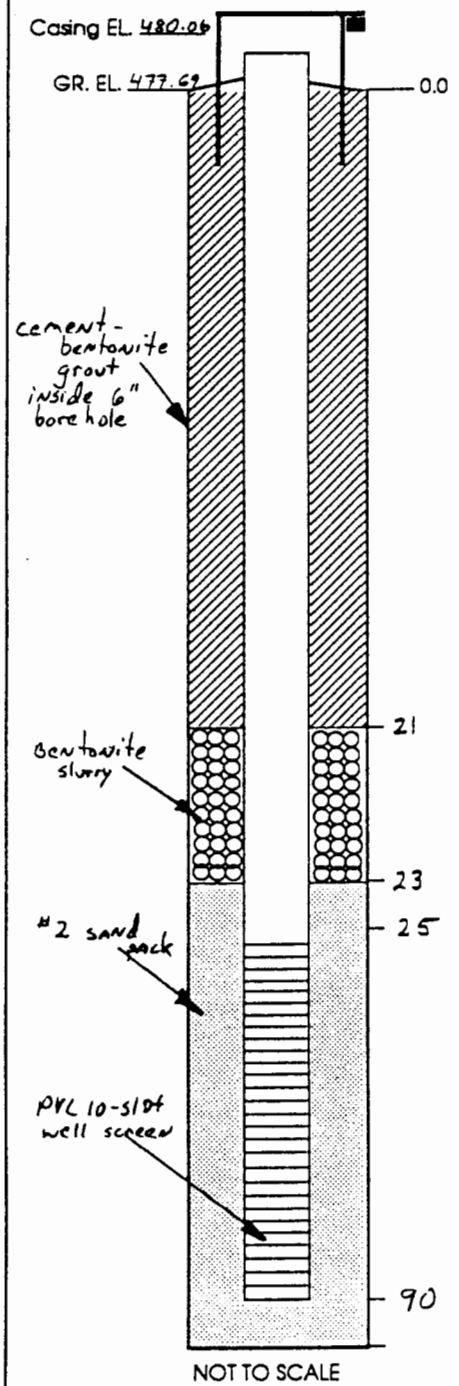
Date Developed 9-1-88

Developing Method bailed

Well Construction Completed 8-29-88

MONITORING WELL COMPLETION LOG

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness
Drilling Contractor Kendrick Drilling

Type of Well Open hole bedrock
Static Water Level 24.78' Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 90'
Total Depth of boring 90'

Drilling Method
Type Air rotary Diameter 6"
Casing

Sampling Method
Type none Diameter
Weight Fall
Interval

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 25' Joint Type Threaded flush

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 65'
Stratigraphic Unit Screened bedrock

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 90-23

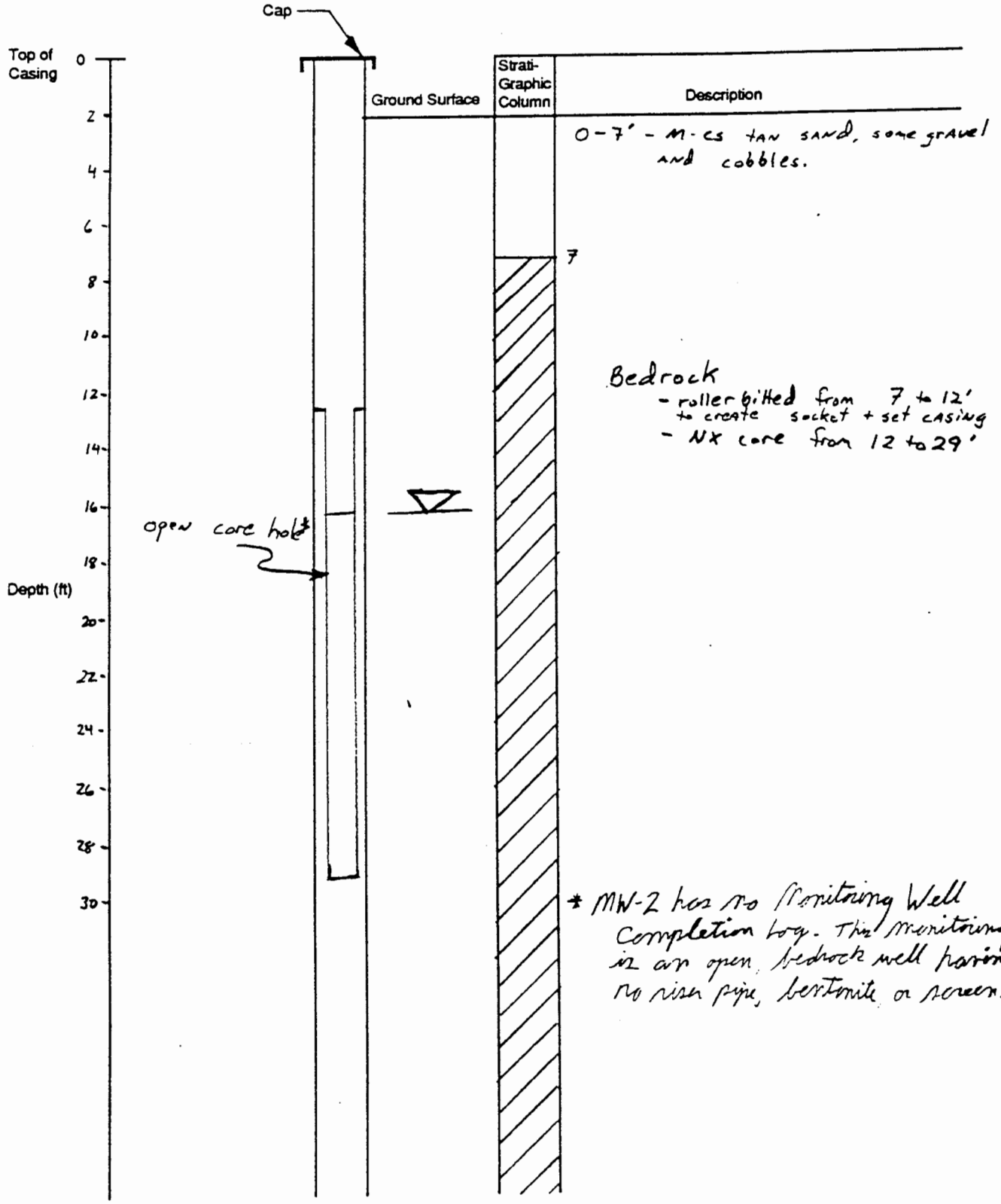
Seal(s)
Type Bentonite slurry Interval 23-21
Type Interval
Type Interval

Locking Casing ☒ Yes ☐ No
Notes:

LMS WELL DRILLING LOG

Client: NYSOEC
Well No.: MW-3
Drilling Completed: 7-27-88
Developing Method/Completed: 7-27-88
Yeild (Date): -
Total Depth: 29
Screened Interval: -
Aquifer: bedrock
Depth of Casing: -

Project No.: 576-018
Permit No.: -
SWL (Date): 16.33' 9-1-88
Elevation of Ground Surface: 457.20
Elevation of Top of Casing: 459.0
Latitude: -
Longitude: -
Hole Diameter: 3"
Geologist: Kevin McGuinness

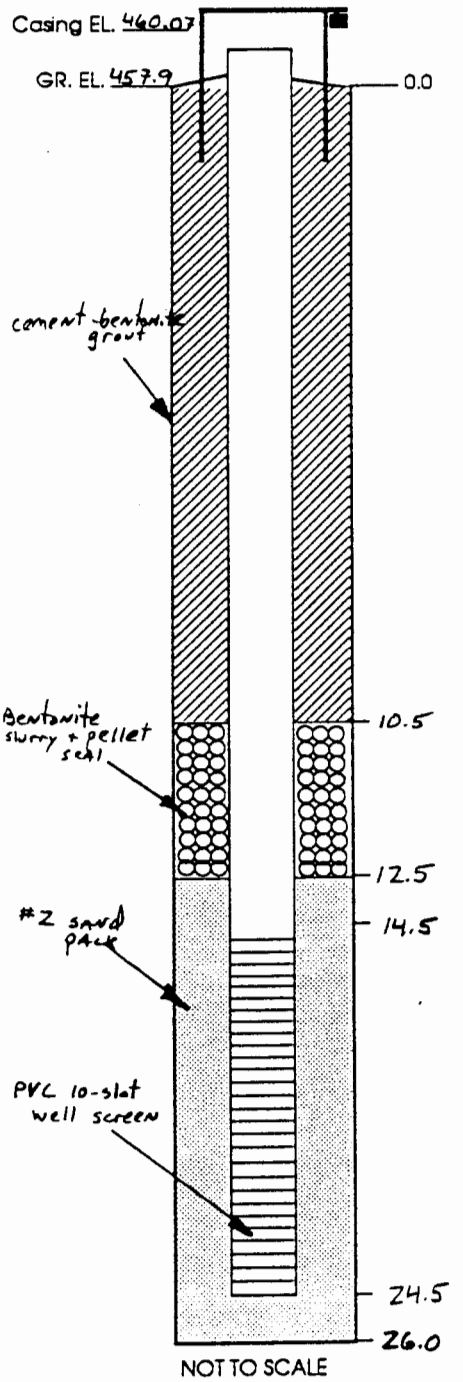


Well No. MW-4
Project No. 576-018

MONITORING WELL COMPLETION LOG

Project Name Tuxedo C+D
Client NYSDEC
Location Tuxedo NY
Date Drilled 7-27-88
Date Developed 7-28-88
Developing Method bailer
Well Construction Completed 7-27-88

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness + John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 16.72' Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 24.5'
Total Depth of boring 26.0'

Drilling Method + roller bit
Type Hollow-stem Auger Diameter 7"
Casing spun casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lbs Fall 30"
Interval continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 14.5' Joint Type flush threaded

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10
Stratigraphic Unit Screened Till

Filter Pack
Sand X Gravel ____ Natural ____
Grade #2
Amount ____ Interval ____

Seal(s)
Type bentonite slurry Interval ____
Type + pellets Interval ____
Type ____ Interval ____

Locking Casing ☒ Yes ☐ No
Notes:

LAWLER, MATUSKY SKELLY ENGINEERS

Well No. MW-5
Project No. 576-018

Project Name Tuxedo C+D

Client NYSDEC

MONITORING WELL COMPLETION LOG

Location Along RR tracks

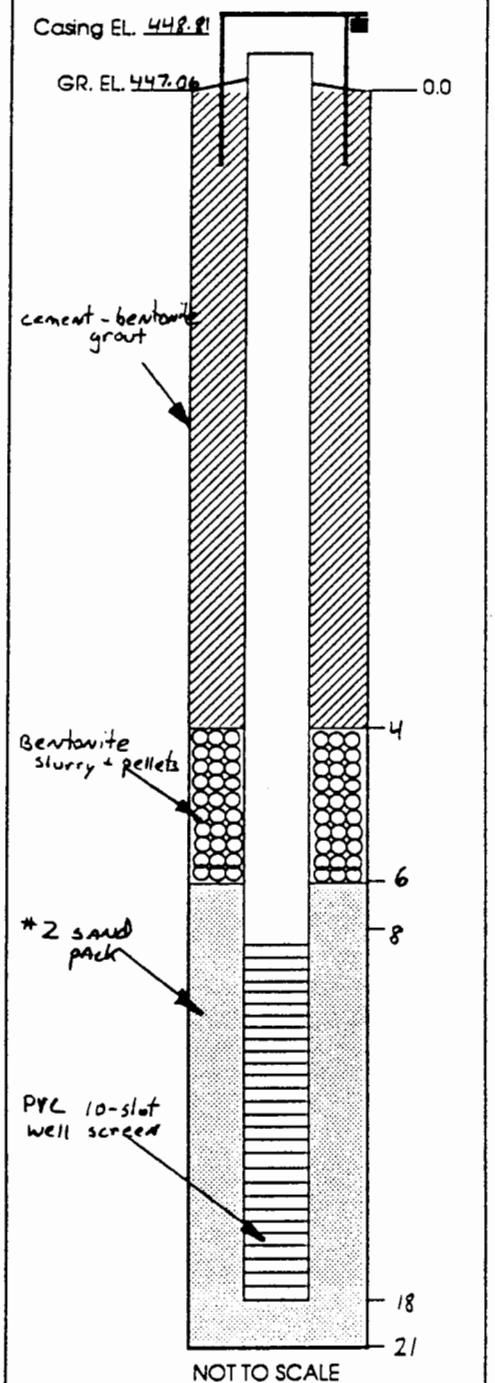
Date Drilled 7-25-88

Date Developed 7-26-88

Developing Method bailed

Well Construction Completed 7-25-88

WELL CONSTRUCTION DETAIL



NOT TO SCALE

Inspector Kevin McGuinness + John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 9.24 Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 18'
Total Depth of boring 21'

Drilling Method
Type Hollow-stem Auger Diameter 7"
Casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lb. Fall 30"
Interval Continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 8' Joint Type Flush threaded

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened sand + gravel

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 27-15

Seal(s)
Type bentonite slurry Interval 15-13'
Type + pellets Interval
Type Interval

Locking Casing ☒ Yes ☐ No
Notes:

LAWLER, MATUSKY SKELLY ENGINEERS

Well No. MW-6
Project No. 576-018

Project Name Tuxedo C+D

Client NYSDEC

MONITORING WELL COMPLETION LOG

Location Tuxedo NY

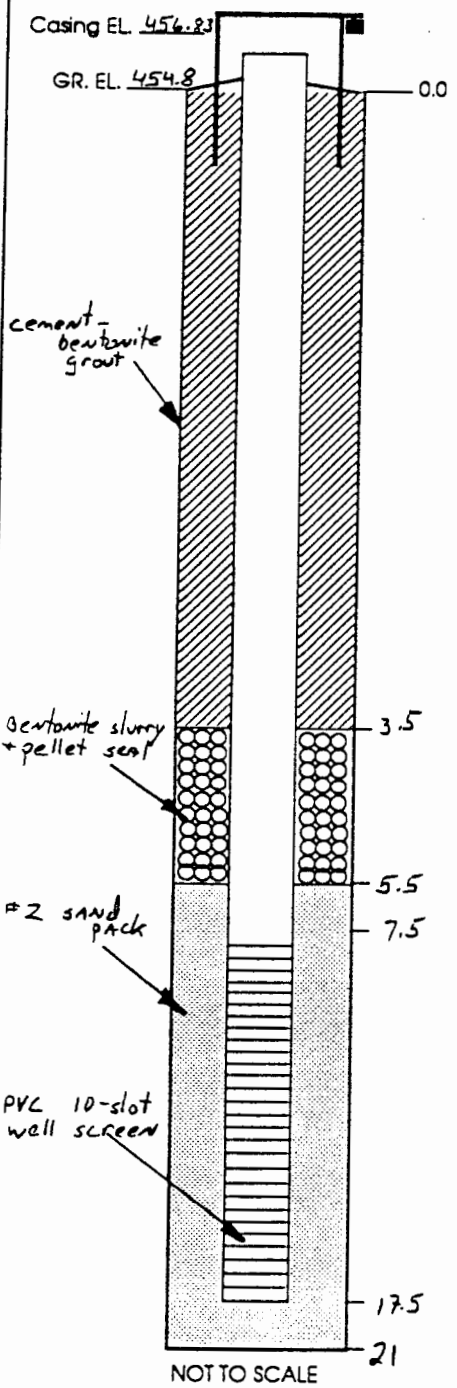
Date Drilled 7-24-88

Date Developed 7-25-88

Developing Method bailer

Well Construction Completed 7-24-88

WELL CONSTRUCTION DETAIL



Inspector Kevin McGuinness - John Gutewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 9.82 Date 9-1-88
Measuring Point (M.P.) Top of PVC
Total Depth of Well 17.5'
Total Depth of boring 21'

Drilling Method
Type Hollow-stem Auger Diameter 7"
Casing

Sampling Method
Type split spoon Diameter 1 3/8"
Weight 140 lbs. Fall 30"
Interval continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 7.5' Joint Type flush-threaded

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened silty-sand

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 17.5 - 5.5

Seal(s)
Type Bentonite slurry Interval
Type + pellets Interval 5.5 - 3.5
Type Interval

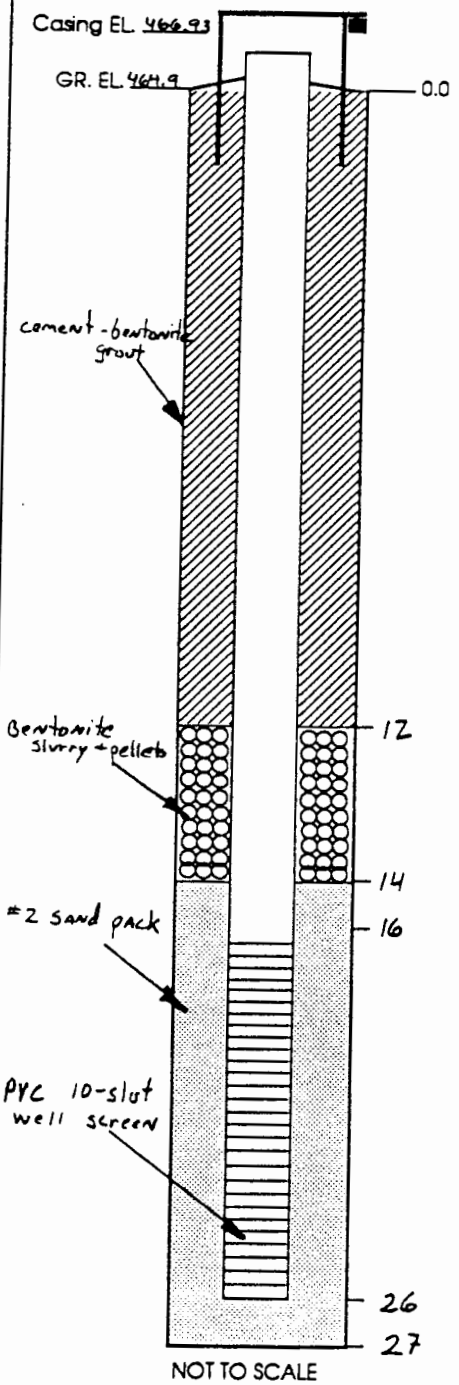
Locking Casing ☒ Yes ☐ No
Notes:

Well No. MW-7
Project No. 576-018

MONITORING WELL COMPLETION LOG

Project Name Tuxedo C+D
Client NYSDEC
Location Tuxedo NY
Date Drilled 7-22-88
Date Developed 7-23-88
Developing Method Bailer
Well Construction Completed 7-22-88

WELL CONSTRUCTION DETAIL



NOT TO SCALE

Inspector Kevin McGuinness + John Guzewich
Drilling Contractor Buffalo Drilling Co.

Type of Well overburden
Static Water Level 18.36 Date 9-1-88
Measuring Point (M.P.) Top of Casing
Total Depth of Well 26'
Total Depth of boring 27'

Drilling Method
Type Hollow-stem Auger Diameter 7"
Casing

Sampling Method
Type Split spoon Diameter 1 3/8"
Weight 140 lb. Fall 30"
Interval Every 5' to water then continuous

Riser Pipe Left in Place
Material PVC sch. 40 Diameter 2"
Length 16' Joint Type threaded flush

Screen
Material PVC sch. 40 Diameter 2"
Slot Size 10 Length 10'
Stratigraphic Unit Screened sand.

Filter Pack
Sand X Gravel Natural
Grade #2
Amount Interval 27-15'

Seal(s)
Type Bentonite slurry Interval 15-13'
Type "pellets Interval
Type Interval

Locking Casing ☒ Yes ☐ No
Notes:

Appendix G

Field Forms and Documents

Monitoring Well Purging / Sampling Form

Project Name and Number: _____

Monitoring Well Number: _____ Date: _____

Samplers: _____

Sample Number: _____ QA/QC Collected? _____

Purging / Sampling Method: _____

1. L = Well Depth:	_____	feet
2. D = Riser Diameter (I.D.):	_____	feet
3. W = Depth to Water:	_____	feet
4. C = Column of Water in Well:	_____	feet
5. V = Volume of Water in Well = $C(3.14159)(0.5D)^2(7.48)$	_____	gal
6. 3(V) = Target Purge Volume	_____	gal

D (inches)	D (feet)
1-inch	0.08
2-inch	0.17
3-inch	0.25
4-inch	0.33
6-inch	0.50

Conversion factors to determine V given C

D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch
V (gal / ft)	0.041	0.163	0.37	0.65	1.5

Water Quality Readings Collected Using _____

Parameter	**Units**	**Readings**						
Time	24 hr							
Water Level (0.33)	feet							
Volume Purged	gal							
Flow Rate	mL/min							
Turbidity (+/- 10%)	NTU							
Dissolved Oxygen (+/- 10%)	%							
Dissolved Oxygen (+/- 10%)	mg/L							
Eh / ORP (+/- 10)	MeV							
Specific Conductivity (+/- 3%)	mS/cm^c							
Conductivity (+/- 3%)	mS/cm							
pH (+/- 0.1)	pH unit							
Temp (+/- 0.5)	C°							
Color	Visual							
Odor	Olfactory							

Comments:

Combustible Gas Monitoring/Sampling Form

Date: _____

Project Name and Number: _____

Inspector's Name: _____

Job Title of Inspector: _____

Description of Work Performed: _____

Purge Duration: _____

Station No.	Combustible Gas	
Gas Vent Station	CH_4 %	H_2S (ppm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Station No.	Combustible Gas	
Perimeter Monitoring Point	CH4 %	H_2S (ppm)
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Combustible Gas Measurements Using: GEM™ 2000 Landfill Meter; ppbRAE PID

Comments:

Action Levels (applies to PMPs only):
Monitoring action level for Methane is defined as 10% of LEL (0.51% on the gas meter).
Monitoring action level for Hydrogen Sulfide is defined as 10 parts per million (ppm) on the gas meter.

AECOM

Annual Site-Wide Inspection Checklist

Purpose of the Checklist

The site inspection checklist provides a useful method for collecting important information during the annual Site-Wide Inspection. The checklist serves as a reminder of what information should be gathered and provides the means of checking off information obtained and reviewed, or information not available or applicable. The checklist is divided into sections as follows:

I. Site Information
II. Interviews
III. On-site Documents & Records Verified
IV. O&M Costs
V. Access and Institutional Controls
VI. General Site Conditions
VII. Landfill Covers
VIII. Vertical Barrier Walls
IX. Groundwater/Surface Water Remedies
X. Other Remedies
XI. Overall Observations

Some data and information identified in the checklist may or may not be available at the site depending on how the site is managed. Sampling results, costs, and maintenance reports may be kept on-site or may be kept in the offices of the contractor or at State offices. In cases where the information is not kept at the site, the item should not be checked as "not applicable," but rather it should be obtained from the office or agency where it is maintained. If this is known in advance, it may be possible to obtain the information before the site inspection.

The checklist may be completed and attached to the annual Site-Wide Inspection report to document site status. Please note that the checklist is not meant to be completely definitive or restrictive; additional information may be supplemented if the reviewer deems necessary. Also note that actual site conditions should be documented with photographs whenever possible.

Using the Checklist for Types of Remedies

The checklist has sections designed to capture information concerning the main types of remedies for hazardous waste sites. These are groundwater and surface water remedies (Section VII of the checklist). The primary elements and appurtenances for these remedies are listed in sections which can be checked off as the facility is inspected. The opportunity is also provided to note site conditions, write comments on the facilities, and attach any additional pertinent information. If a site includes remedies beyond these, such as soil vapor extraction or soil landfarming, the information should be gathered in a similar manner and attached to the checklist.

Considering Operation and Maintenance Costs

Unexpectedly widely varying or unexpectedly high O&M costs may be early indicators of remedy problems. For this reason, it is important to obtain a record of the original O&M cost estimate and of annual O&M costs during the years for which costs incurred are available. Section IV of the checklist provides a place for documenting annual costs and for commenting on unanticipated or unusually high O&M costs. A more detailed categorization of costs may be attached to the checklist if available. Examples of categories of O&M costs are listed below.

Operating Labor - This includes all wages, salaries, training, overhead, and fringe benefits associated with the labor needed for operation of the facilities and equipment associated with the remedial actions.

Maintenance Equipment and Materials - This includes the costs for equipment, parts, and other materials required to perform routine maintenance of facilities and equipment associated with a remedial action.

Maintenance Labor - This includes the costs for labor required to perform routine maintenance of facilities and for equipment associated with a remedial action.

Auxiliary Materials and Energy - This includes items such as chemicals and utilities which can include electricity, telephone, natural gas, water, and fuel. Auxiliary materials include other expendable materials such as chemicals used during plant operations.

Purchased Services - This includes items such as sampling costs, laboratory fees, and other professional services for which the need can be predicted.

Administrative Costs - This includes all costs associated with administration of O&M not included under other categories, such as labor overhead.

Insurance, Taxes and Licenses - This includes items such as liability and sudden and accidental insurance, real estate taxes on purchased land or right-of-way, licensing fees for certain technologies, and permit renewal and reporting costs.

Other Costs - This includes all other items which do not fit into any of the above categories.

Please note that "O&M" is referred to throughout this checklist. At sites where Long-Term Response Actions are in progress, O&M activities may be referred to as "system operations" since these sites are not considered to be in the O&M phase while being remediated under the Superfund program.

Annual Site-Wide Inspection Checklist

"N/A" refers to "not applicable."

I. SITE INFORMATION	
Site name:	**Date of inspection:**
Location and Region:	**Site ID:**
Agency, office, or company leading the annual review:	**Weather/temperature:**
Remedy Includes: (Check all that apply) ☐ Monitored natural attenuation ☐ Access controls ☐ Institutional controls ☐ Groundwater containment ☐ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Other_____ _____	
Attachments: ☐ Inspection team roster attached ☐ Site map attached	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** _____ _____ _____ Name Title Date Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____ Problems, suggestions; ☐ Report attached _____ _____	
2. **O&M staff** _____ _____ _____ Name Title Date Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____ Problems, suggestions; ☐ Report attached _____ _____	

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☐ O&M manual — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ As-built drawings — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Maintenance logs — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

2. **Site-Specific Health and Safety Plan** — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Contingency plan/emergency response plan — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

3. **O&M and OSHA Training Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Effluent discharge — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Other permits_____ — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

5. **Gas Generation Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

6. **Settlement Monument Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

7. **Groundwater Monitoring Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

8. **Leachate Extraction Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Water (effluent) — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks_____

10. **Daily Access/Security Logs** — ☐ Readily available — ☐ Up to date — ☐ N/A

    Remarks_____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other_____
_____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐ Breakdown attached

Total annual cost by year for review period if available

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: _____
_____
_____
_____
_____
_____

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A

Remarks_____
_____

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks_____
_____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _____
Frequency _____
Responsible party/agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☐ N/A
Other problems or suggestions: ☐ Report attached
_____
_____
_____
_____

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks_____
_____
_____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident
Remarks_____
_____

2. **Land use changes on site** ☐ N/A
Remarks_____
_____

3. **Land use changes off site** ☐ N/A
Remarks_____
_____

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A
Remarks_____
_____

B. Other Site Conditions

Remarks _____
_____
_____
_____
_____
_____

VII. LANDFILL COVERS ☐ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____
   _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____
   _____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks_____
   _____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____
   _____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____
_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent_____
Remarks_____
_____

B. Benches ☐ Applicable ☐ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

C. Letdown Channels ☐ Applicable ☐ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____
_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____
_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____
_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____
_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____
_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____
_____

D. Cover Penetrations ☐ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks_____
_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks_____
_____

E. Gas Collection and Treatment ☐ Applicable ☐ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____
   _____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____
   _____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs Maintenance ☐ N/A
   Remarks_____
   _____

F. Cover Drainage Layer ☐ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks_____
   _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks_____
   _____

G. Detention/Sedimentation Ponds ☐ Applicable ☐ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   ☐ Siltation not evident
   Remarks_____
   _____

2. **Erosion** Areal extent_____ Depth_____
   ☐ Erosion not evident
   Remarks_____
   _____

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks_____
   _____

4. **Dam** ☐ Functioning ☐ N/A
   Remarks_____
   _____

H. Retaining Walls ☐ Applicable ☐ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks_____
   _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks_____
   _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☐ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks_____
   _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Discharge Structure** ☐ Functioning ☐ N/A
   Remarks_____
   _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☐ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored
   Frequency_____ ☐ Evidence of breaching
   Head differential_____
   Remarks_____
   _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks_____
_____
_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_____
_____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☐ N/A

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_____
_____

C. Treatment System ☐ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☐ Carbon adsorbers
☐ Filters_____
☐ Additive (*e.g.*, chelation agent, flocculent)_____
☐ Others_____
☐ Good condition ☐ Needs Maintenance
☐ Sampling ports properly marked and functional
☐ Sampling/maintenance log displayed and up to date
☐ Equipment properly identified
☐ Quantity of groundwater treated annually_____
☐ Quantity of surface water treated annually_____
Remarks_____
_____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks_____
_____

4. **Discharge Structure and Appurtenances**
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

5. **Treatment Building(s)**
☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks_____
_____

6. **Monitoring Wells** (pump and treatment remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

D. Monitoring Data

1. Monitoring Data
☐ Is routinely submitted on time ☐ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. _____ _____ _____ _____ _____ _____ _____ _____ _____