United States
Environmental Protection
Agency

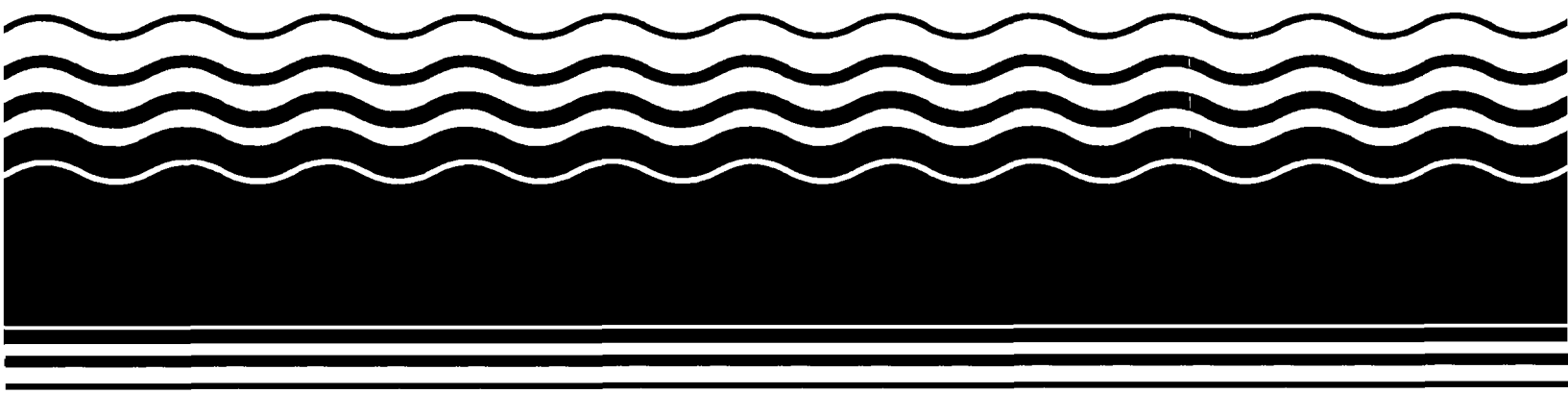
Office of
Emergency and
Remedial Response

EPA/ROD/R02-93/199
March 1993

EPA

Superfund Record of Decision:

Monroe Township Landfill, NJ



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REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R02-93/199	2.	3. Recipient's Accession No.

4. Title and Subtitle
SUPERFUND RECORD OF DECISION
Monroe Township Landfill, NJ
First Remedial Action - Final

5. Report Date 03/31/93

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

10 Project Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered
800/800

14.

15. Supplementary Notes
PB94-963811

16. Abstract (Limit: 200 words)

The 86-acre Monroe Township Landfill site is a municipal landfill located in Monroe Township, Middlesex County, New Jersey. Land use in the area is predominantly residential, with woodlands to the east, south, and west. The nearest residences are to the north within a 1-mile radius of the site. From the mid-1950s to 1968, Monroe Township operated the landfill until it was leased to Princeton Disposal Service, who continued operations until 1978. In 1978, the State ordered the site closed when leachate seeped onto residential property. In 1979, the State required construction and operation of a leachate collection and storage system, which discharged to a POTW, and construction of a clay and soil cap. In 1986, additional remedial measures included upgrading the soil erosion and sediment control systems; fencing and closing the leachate storage lagoon; constructing an underground leachate storage tank; and installing of gas vents. These remedial systems have proven effective for adequately protecting human health and the environment; therefore there are no contaminants of concern affecting this site.

The selected remedial action for this site is no further action, with ground water and surface water monitoring, because the Baseline Risk Assessment has shown that the site

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Monroe Township Landfill, NJ
First Remedial Action - Final
Contaminated Medium: None
Key Contaminants: None

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 76
	20. Security Class (This Page) None	22. Price

Abstract (Continued)

poses no unacceptable risk to human health and the environment. The estimated present worth cost for this remedial action is $2,482,000, which includes an unspecified estimated O&M cost of $6,000,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Not applicable.

ROD FACT SHEET

SITE	
Name	Monroe Township Landfill
Location/State	Monroe Township, Middlesex County, N.J.
EPA Region	2
HRS Score (date)	42.37
ROD	
Date Signed	3/31/93
Remedy	No Further Action with Monitoring
Capital Cost	none this ROD
O & M/year	$6 Million over 30 years
Present worth	$2,482,000
LEAD	Remedial State Lead
Primary contact	Haiyesh Shah, NJDEPE (609) 633-1455
Secondary contact	John Osolin, EPA (212) 264-9301
Main PRP(s)	Browning Ferris Industries
PRP Contact (phone)	Gordon Spradley, (713) 870-7054
WASTE	
Type	inorganics and organics
Medium	soil, g.w.
Origin	Leachate from Municipal Landfill
Est. quantity	No Estimate

31 MAR 1993

Honorable Scott A. Weiner
Commissioner
State of New Jersey
Department of Environmental Protection and Energy
401 East State Street, CN 402
Trenton, New Jersey 08625-0402

Re: Record of Decision (ROD)
Monroe Township Landfill Site
Monroe Township, Middlesex County, New Jersey

Dear Commissioner Weiner:

The United States Environmental Protection Agency, Region II (EPA) has reviewed the draft ROD dated March 1993, for the Monroe Township Landfill Site (Site) located in Monroe Township, Middlesex County, New Jersey.

EPA concurs with the "No Further Action, with Maintenance and Monitoring" alternative, and has determined that the draft ROD is consistent with Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), based on the administrative record for the Site. This finding shall not affect EPA's right to conduct five-year reviews of the Site, or to take or require appropriate action pursuant to such review, in accordance with Section 121(c) of CERCLA and EPA further reserves the right to take response and enforcement actions pursuant to Sections 104, 106 and 107 of CERCLA with respect to the remedy and any additional future work at the Site.

Sincerely,

William J. Muszynski, P.E.
Acting Regional Administrator

SUPERFUND RECORD OF DECISION

MONROE TOWNSHIP LANDFILL SITE
MONROE TOWNSHIP, MIDDLESEX COUNTY
NEW JERSEY

PREPARED BY: N.J. DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
SITE REMEDIATION PROGRAM
BUREAU OF FEDERAL CASE MANAGEMENT
APRIL 1993

MONROE TOWNSHIP LANDFILL SITE
RECORD OF DECISION

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DECLARATION STATEMENT
RECORD OF DECISION
MONROE TOWNSHIP LANDFILL SITE

Site Name and Location

Monroe Township Landfill Site
Monroe Township, Middlesex County, New Jersey

Statement of Basis and Purpose

This decision document, prepared by the New Jersey Department of Environmental Protection and Energy (NJDEPE) as lead agency, presents the selected remedy for the Monroe Township Landfill Site. The selected remedy was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Re-authorization Act of 1986 (SARA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal basis for selecting the remedy for this site. This decision is based on the administrative record for this site. The attached index identifies the items that comprise the administrative record.

The United States Environmental Protection Agency (USEPA), support agency for this site, concurs with the selected remedy and has provided a concurrence letter to that effect which is attached to the responsiveness summary section of this document.

Description of the Selected Remedy

This Record of Decision (ROD) sets forth the selected final remedy for the Monroe Township Landfill Site. The ROD addresses all environmental media and all operable units at the Site. The selected remedy is "No Further Action with Maintenance and Monitoring".

The major components of the selected remedy include:

- Maintenance of existing source control measures (leachate collection and management system, emergency power supply, clay cutoff wall, protective cover systems, surface water drainage systems, and passive gas venting system), maintenance of the control measure (security fencing), and upgrading of the passive gas vent system which will be monitored under a Post-Closure Operation and Maintenance Plan; and

- Ground water monitoring, which will include a sentinel ground water monitoring well system as well as site perimeter monitor wells to detect potential migration of contaminants from the site.

This remedy complies with the NJDEPE Ground Water Quality Standards as well as with the NJDEPE policy as outlined in the proposed NJDEPE Cleanup Standards through natural attenuation.

Declaration of Statutory Determinations

The No Further Action with Maintenance and Monitoring remedy has been selected based on the results of the Baseline Risk Assessment, which has shown the remedy to be protective of human health and the environment.

Because this remedy will result in hazardous substances remaining on the site, a review will be conducted within five (5) years after execution of the ROD to ensure that the remedy continues to provide adequate protection of human health and the environment. In accordance with CERCLA, NCP and state requirements, NJDEPE has determined that no further action is necessary to ensure protection of public health and the environment at the Monroe Township Landfill Site. NJDEPE has determined that its response at this site is complete. Therefore, the site now qualifies for inclusion in the Construction Completion List.

Signature

4-23-93
Date

Scott A. Weiner, NJDEPE Commissioner

DECISION SUMMARY
RECORD OF DECISION
MONROE TOWNSHIP LANDFILL SITE

Site Name, Location, and Description

The Monroe Township Landfill is located on an 86-acre site in Middlesex County, New Jersey as shown on Figure 1. The site is bordered by woodlands made up mostly of deciduous trees to the east, south, and west. Most of the area north of the site is also wooded, but is comprised largely of conifers. Bordering the northeast corner of the site is a residential neighborhood (Lani and Lori Streets). Approximately 1,800 people live within a mile radius of the site. Access to the site is from the northwest via Spotswood Gravel Hill Road. Figure 2 identifies the location of the site and important features.

The landfill is situated on a regional high point. Surface drainage at the site runs primarily to the north and south away from the crown of the landfill. A shallow drainage channel exists on the landfill and along the eastern edge of the site.

Low-lying areas occur adjacent to the site at the southeast corner, and in the off-site areas north and south of the center of the site. An intermittent stream begins at an off-site location near the southeast corner of the site and flows further off-site toward the south.

The geology/hydrogeology at the site consists of clean sands which grade to silty sand and clay at increasing depth within two major water bearing formations, the Merchantville and the Magothy formations. The Merchantville Formation (thickness 30 to 50 feet) directly underlies a majority of the landfill. Ground water flow in the Merchantville is generally in an easterly or south easterly direction. The Magothy Formation lies directly below the Merchantville in the north and southeast. At the northeast corner of the site, where the Merchantville is absent, a perched zone lies twenty feet above the Magothy Formation. Ground water flow in the Magothy Formation is generally toward the east.

Site History and Enforcement Activities

Monroe Township was the original owner and operator of the landfill and continues to own the property. The Township operated the landfill from the mid-1950s until 1968 when it was leased to Princeton Disposal Service for operation under the service contract to Monroe Township. Browning-Ferris Industries of South Jersey (BFISJ) acquired Princeton Disposal Service in 1972 and operated the landfill until 1978. The NJDEPE ordered the site closed in 1978 when leachate outbreaks seeped onto Lani Street. Based on the NJDEPE documentation, only municipal and household waste was placed in the landfill.

Following closure of the site, an Administrative Consent Order (ACO) was signed by BFISJ and the NJDEPE on October 19, 1979. The ACO established methods and schedules for designing and implementing a closure plan. Remedial measures required under the closure

plan were completed in 1984. The site was proposed for inclusion on the National Priority List (NPL) in December 1982 and was included on the NPL in September 1983. BFISJ and the NJDEPE entered into a second ACO effective December 29, 1986, to determine the effectiveness of the closure and remedial measures implemented.

In accordance with the 1979 Consent Order, the following three remedial measures have been implemented:

- o installation of a 7,000-foot long compacted clay cutoff wall circumscribing most of the site;

- o construction and operation of a leachate collection and storage system which discharges to a Publicly Owned Treatment works (POTW) under a New Jersey Pollutant Discharge Elimination System (NJPDES) permit; and

- o construction of a protective clay cap covering the northern portion of the landfill and a soil cap covering the remainder of the landfill.

The clay cutoff wall could not be installed on the northern portion of the landfill due to the absence of a clay layer base required to key in the clay cutoff wall. On this portion of the landfill, a clay cap was installed having a maximum permeability of 10^{-7} cm/sec to minimize infiltration of precipitation. The clay cap was installed in accordance with the New Jersey State Solid Waste Management Act and meets current State and Federal standards for solid waste covers.

The soil cap was also installed in accordance with the New Jersey Solid Waste Management Act and meets current State and Federal standards (2 feet of clean top soil and vegetation). The soil cap prevents erosion from occurring and allows the percolation of rain water through the landfill. Any leachate generated from this percolation is collected in the leachate collection system and treated. Figure 2 identifies areas of the landfill with the clay cap, cutoff wall, leachate collection system and the soil cap.

The following additional remedial measures were completed between 1987 and 1991 in accordance with the 1986 ACO:

- o upgrading the soil erosion and sediment control systems by replacing former channels with rip-rap lined channels, and upgrading the sedimentation basin;

- o installation of a seven foot high chain-link fence surrounding the landfill to limit unauthorized access;

- o closure of the previous leachate storage lagoon and construction of an underground leachate storage tank;

- o installation of an emergency power generator as a contingency for the leachate collection system in case of power failure; and

- o installation of 13 landfill gas vents for gas ventilation under a New Jersey Air Pollution Control Permit.

These remedial systems have proven to be effective as source control measures.

Highlights of Community Participation

A briefing for Township officials was held on August 10, 1989 to discuss a proposal for replacing the on-site leachate storage lagoon with an underground storage tank and installing a standby power generator. The Remedial Investigation (RI) and Baseline Risk Assessment (BRA), forwarded to the public repositories in September 1992 as well as the Proposed Plan, forwarded to the public repositories on November 1, 1992 for the Monroe Township Landfill Site were released to the public for comments on November 2, 1992. These documents were made available to the public for review at the NJDEPE office (Trenton, New Jersey), the Monroe Township Municipal Complex (Jamesburg, New Jersey), and the Jamesburg Library (Jamesburg, New Jersey). The notice of availability for these documents was published in the Home News on November 2, 1992. A public comment period on the documents was held from November 2, 1992 to December 1, 1992. In addition, a public meeting was held on November 9, 1992. At this meeting representatives from the NJDEPE presented the preferred remedy and answered questions about the site and the remedy under consideration. A response to comments received during this period and the public meeting is included in the Responsiveness Summary, which is part of this ROD.

Scope and Role of Response Action

The selected remedy for the site is No Further Action with Maintenance and Monitoring. This remedy will include the maintenance and upgrading of existing control measures and ground water monitoring. The NJDEPE evaluated the feasibility of possible alternatives for the treatment of the contaminants in ground water monitor well B-21R. Based on the evaluation, it was determined that ground water treatment was impractical and unnecessary.

This remedy addresses the protection of human health and the environment as explained below:

- o The No Further Action with Monitoring remedy complies with the NJDEPE Ground Water Quality Standards as well as with the policy outlined in the proposed NJDEPE Cleanup Standards through natural attenuation.

- o Based on the BRA, there is no current or future risk to public health greater than the carcinogenic risk range of 10^{-4} to 10^{-6}, or the non-carcinogenic Hazard Index

criteria of one (1) established by USEPA. Also, based on the BRA, there is no unacceptable current or future risk to the environment.

- Landfill contamination is being contained by the compacted clay cutoff wall, the leachate collection system, and the clay cap and soil cover systems.

- The landfill cover systems and enhanced surface water drainage control measures are effective in reducing leachate generation. The entire site is surrounded by security fencing which restricts unauthorized entries to the site and potential direct contact exposures.

- Ground water modeling at the site has shown that contaminants will travel down gradient a distance of less than 800 feet in 100 years conservatively assuming no natural attenuation.

- There are no known users of the Magothy Formation ground water within 3000 feet of the site. Down gradient residences are connected to the Monroe Township Municipal Water Supply. There are two residential wells located at a single residence on block # 148, lot # 36.02. These wells are located upgradient of the site ground water flow direction and are hand dugout shallow wells (installed in quaternary deposits located above the Merchantville Formation) having less than 30 feet depth. These wells were sampled during the RI and determined not to be of concern because the results were below the applicable regulatory standards.

- There is no potential for the ground water to be used as a potable source in the vicinity of the site in the future based on written documentation obtained from the Township concerning the potential ground water uses for a 25 year horizon. A Township Ordinance requires that all existing and planned dwellings located within 200 feet of a water supply be connected to the Township Water Supply.

- Potential migration of contaminants detected in on-site monitoring wells will be monitored by a sentinel well system which is currently in-place and located down gradient of the potential source areas. The monitoring will be performed in accordance with the NJDEPE policy as outlined in the proposed NJDEPE regulations which are designed to be conservative in terms of protection of public health and the environment.

- If contaminants are confirmed to be present in the sentinel well system at concentrations above promulgated State and Federal drinking water standards or the NJDEPE Ground Water Quality Standards, the need for additional remedial action(s) will be reevaluated.

- The existing remedial systems (compacted clay cutoff wall; leachate collection system and storage tank; emergency power supply; multi-layer clay cap and soil cover

systems; surface water, sediment and soil erosion control measures; landfill gas vent systems; and site security) are effective and will be maintained through a post-closure operation and maintenance plan to ensure their proper operation and continued effectiveness.

o The existing landfill gas venting system will be upgraded by installing approximately eleven (11) additional landfill gas vents on the northern portion of the site. These passive gas vents will be installed to minimize the potential gas pressure build up in the subsurface. The approximate locations of the proposed passive gas vents are identified on Figure 2.

Summary of Site Characteristics

The Remedial Investigation (RI) is comprised of several environmental investigations performed in accordance with the 1979 and 1986 Administrative Consent Orders. The RI developed a conceptual model of the site geology and hydrogeology and assessed the nature and extent of contamination in various environmental media including ground water, surface water, surface soil, stream sediments and landfill gas. The RI was carried out in a phased approach which initially focused upon ground water and then addressed other environmental media. The significant findings of the RI are summarized below.

A. Ground Water

A hydrogeologic study of the site during the RI field investigation was performed in 1987 and included drilling of borings through the Merchantville and Magothy Formation, and the collection of soil samples to evaluate site stratigraphy. Piezometers and monitoring wells were installed in the borings through Merchantville Formation, Magothy Formation and the perched zones within the Magothy Formation. Water samples were collected from 13 monitor wells in the Merchantville Formation (including 6 EFP wells, MW-1S through MW-6S), 15 wells in the Magothy Formation and four (4) wells (one well was dry, B-55) in the perched zones of the Magothy Formation at the site as well as two (2) residential wells and analyzed for Target Compound List/Target Analyte List (TCL/TAL) parameters. Ground water sampling was conducted for four quarters from July 1987 to February 1989. A fifth round of samples was collected when data from the first round were determined to be invalid. Figure 2 identifies the locations of the ground water monitor wells.

Chemicals of concern in the Magothy Formation ground water at the site exceeding the respective regulatory standards are listed in the table below. The table includes the maximum concentrations of chemicals of concern detected in the Magothy Formation ground water at the site in parts per billion (ppb), respective NJDEPE Ground Water Quality Standards and the respective Federal Maximum Contaminant Levels (MCL).

CHEMICALS OF CONCERN IN THE MAGOTHY FORMATION GROUND WATER	MAXIMUM CONCENTRATION DETECTED (PPB)	NJDEPE QUALITY STANDARD (PPB)	FEDERAL MCL (PPB)
Cadmium	16	4	5
Lead	10.9	10	15
Nickel	226	100	100
Benzene	3.7	1	5
Chlorobenzene	14	4	100
1,2-Dichloroethane	16.9	2	5
1,1-Dichloroethene	4	2	7
Vinyl chloride	13.7	5	2
Arsenic	10.1	8	50

Arsenic levels in ground water are attributed to natural background based on the results of site upgradient monitor wells results. Contaminants were also detected in the Merchantville Formation and the perched water zone within the Magothy Formation ground water. The range of these contaminant concentrations along with a comparison to the NJDEPE Ground Water Quality Standards and the Federal MCLs is presented in Table 1. Based on the BRA, there is no current or future unacceptable risk to public health or the environment related to ground water exposures as discussed in the Summary of Site Risks section of this ROD.

B. Surface Water

Surface water samples were collected for quantitative chemical analyses at five locations that included an off-site intermittent stream beginning at the southeastern corner of the site, a low-lying area on the southern border of the site, and the sedimentation pond. The samples were analyzed for volatile organic compounds, semi-volatile organic compounds, TAL inorganic compounds, and pesticides/Polychlorinated Biphenyls (PCBs). The following is a list of chemicals of concern with maximum concentration detected in the surface water along with State and the Federal Criteria. Figure 2 identifies the locations of the surface water samples.

CHEMICALS OF CONCERN IN SURFACE WATER	MAXIMUM CONCENTRATION DETECTED (PPB)	STATE CRITERIA (PPB)	FEDERAL ACUTE CRITERIA (PPB)	FEDERAL CHRONIC CRITERIA (PPB)
Arsenic	2.3	50	360	190
Beryllium	0.2	Not Available	130	5.3
Copper	9.4	Not Available	18	12
Lead	47.1	50	82	3.2
Mercury	0.3	2	2.4	0.012
Nickel	19.1	Not Available	1400	160
Zinc	65.8	Not Available	120	110
Methylene chloride	2.0	Not Available	Not Available	Not Available

Concentrations of chemicals of concern detected in the surface water samples were determined not to be of concern in the BRA as discussed in the Summary of Site Risks section of this ROD.

C. Surface Soil

Surface soil samples were collected for quantitative chemical analyses at nine locations on the capped portion of the site. The samples were analyzed for volatile organic compounds, semi-volatile organic compounds, TAL inorganic compounds, and pesticides/PCBs. Concentrations of contaminants detected in the soil samples were below NJDEPE's most recent general guidance on contaminant cleanup levels as found in the "Cleanup Standards for Contaminated Sites" which appeared in the February 3, 1992 New Jersey Register except for arsenic. Arsenic was detected in the soil samples at a maximum concentration of 29.2 parts per million (ppm) which is above NJDEPE's general guidance of 2.0 ppm. Arsenic concentrations in the soil are attributed to natural background (typically 1-40 ppm based on the results of the regional studies, James Dragun, 1988 as well as Shacklette and Boerngen, 1984). Concentrations of contaminants detected in surface soil were determined not to be of concern in the BRA as discussed in the Summary of Site Risks section of this ROD. Figure 2 identifies the locations of the surface soil samples. The following is a list of chemicals of concern with maximum concentration detected in the surface soil and NJDEPE's most recent general guidance on contaminant cleanup levels as found in the "Cleanup Standards for Contaminated Sites" which appeared in the February 3, 1992 New Jersey register:

CHEMICALS OF CONCERN IN SURFACE SOIL	MAXIMUM CONCENTRATION DETECTED (MG/KG, PPM)	PROPOSED NJDEPE CLEANUP STANDARD (MG/KG, PPM)
Arsenic	31.3	2.0
Fluoranthene	0.110	2,300
Benzoic acid	16.0	Not Available
Heptachlor	0.098	0.15
DDD	0.420	3.0
Phenanthrene	0.085	Not Available
DDE	0.430	2.0
Pyrene	0.100	1,700
DDT	0.610	2.0

D. Sediment

Sediment samples were collected for quantitative chemical analyses at nine locations that included the sedimentation pond, the sedimentation pond discharge channel, a low-lying area to the northeast of the sedimentation pond, a channel along the eastern border of the site, a low-lying area near the southeastern corner of the landfill, a location along the southern boundary of the site, and the leachate pond. The samples were analyzed for volatile organic compounds, semi-volatile organic compounds, TAL inorganic compounds, and pesticides/PCBs. The following is a list of chemicals of concern with maximum concentration detected in the sediments and the respective Quality Criteria:

CHEMICALS OF CONCERN IN SEDIMENTS	MAXIMUM CONCENTRATION DETECTED (MG/KG,PPM)	EFFECT RANGE MEDIAN (ER-M)* (MG/KG, PPM)
Anthracene	0.390	0.960
Arsenic	34.2	85
Benzo(a)pyrene	0.190	2.5
Benzo(b)fluoranthene	0.210	Not Available
Benzo(g,h,i)perylene	0.160	Not Available
Chrysene	0.310	2.8
DDD	0.084	Not Available
DDE	0.130	Not Available
DDT	0.230	Not Available
Fluoranthene	0.480	3.6
Fluorene	0.078	Not Available
Indeno(1,2,3-c,d)pyrene	0.170	Not Available
Naphthalene	0.056	Not Available
Phenanthrene	0.530	1.380
Pyrene	0.350	2.200

* ER-M = A reference number used to identify the presence of contamination exceeding levels potentially harmful to aquatic life. The values referenced are from NOAA, 1990, "The Biological Effects of Sediments-Sorbed Contaminants Tested in the National Status and Trends Program".

Concentrations of contaminants detected in sediments were determined not to be of concern in the BRA as discussed in the Summary of Site Risks section of this ROD. Figure 2 identifies the locations of the sediment samples.

E. Air

Air samples were collected for quantitative chemical analyses at three of the 13 landfill gas vents on three separate occasions. Volatile organic compounds detected in these samples

were within the existing Air Pollution Control Permit limits. Figure 2 identifies the locations of the air samples collected from the gas vents. The following is a list of chemicals of concern with maximum concentration detected in the gas vents and the respective limits under the New Jersey Air Pollution Control Permit (NJAPCP):

CHEMICALS OF CONCERN IN AIR	MAXIMUM CONCENTRATION DETECTED (MG/M^3) (ESTIMATED RELEASE IN lB/HR IN PARENTHESES)	NJAPCP LIMITS
Carbon tetrachloride	110 (0.00029)	Total release not to exceed 0.1 lb/hr
Trichloroethylene	15 (0.00039)	Total release not to exceed 0.1 lb/hr
Tetrachloroethylene	15 (0.00039)	Total release not to exceed 0.1 lb/hr

Chemicals of concern detected in the air were determined not to be of concern in the BRA as discussed in the Summary of Site Risks section of this ROD.

Summary of Site Risks

Based upon the results of the RI, a BRA was conducted to estimate the risks to human health and the environment associated with current and future site conditions under hypothetical reasonable maximum exposure scenarios. The BRA estimated the human health and ecological risks which could potentially result from the site if no further remedial actions were taken.

A. Human Health Risk Assessment

A four step process is utilized for assessing site-related human health risks for a reasonable maximum exposure scenario:

- Hazard Identification--identifies the chemicals of concern at the site based on several factors such as toxicity, frequency of occurrence, and concentration.

- Exposure Assessment--estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (e.g.,ingesting contaminated well water) by which humans are potentially exposed.

- o Toxicity Assessment--determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response).

- o Risk Characterization--summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative (e.g., one-in-a-million excess cancer risk) assessment of site-related risks.

Hazard Identification

Chemicals of concern were selected based upon the frequency of detection in each medium (e.g., soil, ground water, etc.), adequacy and representativeness of the analytical results, toxicity, comparison to site or area-specific background concentrations, and comparison to lab results for blank samples. The chemicals of concern for each medium include metals (including antimony, arsenic, cadmium, lead, mercury, and thallium), volatile organic compounds (including acetone, benzene, 2-butanone, chlorobenzene, methylene chloride, and vinyl chloride), semi-volatile organic compounds (including benzoic acid, bis(2-ethylhexyl) phthalate, 1,2-dichlorobenzene and phenol), and pesticides (DDD, DDE, and DDT). A summary of all contaminants detected in all ground water monitor wells is included in Table 1. Table 2 provides a summary of ground water aquifer zones at the site and monitor wells within the aquifer zones evaluated in the BRA. Table 3 provides a summary of the chemicals of concern in the Magothy Formation ground water as well as range of detected concentrations. A summary of all contaminants detected in surface water, soil, sediment and air is included in Tables 4 through 7. A summary of chemicals of concern in surface water, soil, sediments, and air is included in Tables 8.

Exposure Assessment

Potential human health effects associated with exposure to the chemicals of concern were estimated quantitatively through the development of hypothetical exposure pathways. These pathways were developed to reflect the potential for exposure to chemicals of concern based on the current uses and potential future uses. The assumptions for exposure frequency and duration and the equations to calculate exposure concentrations along with the resulting exposure point concentrations using the reasonable maximum exposure scenario are presented and discussed in the BRA.

Under current site conditions, exposure to chemicals of concern might potentially occur via inhalation of emissions from landfill gas vents, direct contact with surface soil, direct contact with surface water, and direct contact with sediment. Current exposure to ground water was considered to be an incomplete exposure pathway because there are no known users of the Magothy Formation ground water within 3,000 feet of the site and because the overlying aquitard (Merchantville Formation) is naturally unsuitable, and is currently not being used as a source of potable water. As mentioned earlier there are two, less than 25 feet deep, residential wells located at the single residence on block # 148, lot # 36.02. These wells

are upgradient of the site ground water flow direction and determined to be not of concern based on the sampling results and the BRA.

Populations which are potentially exposed to surface water, surface soil, sediment and air under current site conditions considered in the BRA include off-site residents, trespassers, and site workers. Off-site residents were assumed to inhale chemicals of concern emitted from the landfill gas vents, and children were assumed to be exposed to sediment and surface water during play. A trespasser was assumed to inhale chemicals of concern emitted from landfill gas vents and to be exposed to chemicals of concern in surface soil. A site worker was assumed to inhale chemicals of concern emitted from landfill gas vents and to have direct contact with chemicals of concern in soil and sediment.

Under future conditions, in addition to the exposure scenarios outlined above, hypothetical recreational use of the site as a play area or park and subsequent exposure to surface water, surface soil, sediment, and air were considered as possible future exposure scenarios. In addition, because future use of the Magothy Formation as a potable water source cannot be absolutely precluded, direct human exposure to chemicals of concern in ground water via ingestion and bathing was assessed. Future use of the Magothy Formation as a water supply source in the vicinity of the site is highly unlikely because a township ordinance requires that all dwellings must be connected to the public water supply. This ordinance would preclude any future homes from using private wells in the area.

Future potential direct and indirect exposures to the Merchantville Formation ground water are not considered to be a complete pathway because:

- the Merchantville Formation is naturally unsuitable as a source of potable water primarily due to its classification as an aquitard;
- the Merchantville Formation has a low vertical ground water migration rate of $9X10^{-4}$ ft/day such that vertical recharge to the Magothy Formation is negligible; and
- the leachate collection system controls ground water from flowing through the Merchantville silty sand seam into the Quaternary deposits.

There are two residential wells installed in the quaternary deposit located above the Merchantville formation at the single residence located on block # 148, lot # 36.02. These wells are far from the landfill, upgradient of the site ground water flow direction and determined to be not of concern based on the sampling results performed on these wells during the RI. The BRA provides expanded discussions of the potential current and future ground water exposure scenarios at the site. A summary of all potential exposure pathways for all media is included in Table 9.

Toxicity Assessment

Cancer potency factors (CPFs) and reference doses (RfDs) have been developed by USEPA for estimating excess lifetime cancer risks for the carcinogenic chemicals of concern at the site and for indicating adverse health effects from non-carcinogenic chemicals of concern at the site, respectively. The BRA presents and discusses these numerical factors used for the calculation of human health risks at the site. A reference calculation of intakes of the chemicals of concern in ground water, surface water, soil, sediment and air is included in Table 10 while a summary of exposure assumptions is included in Tables 11 through 13. Tables 14 through 16 includes reference doses and slope factors for chemicals of concern for all media.

Risk Characterization

Current federal guidelines for acceptable exposures are individual lifetime excess carcinogenic risk in the range of 10^{-4} to 10^{-6}. This can be interpreted to mean that an individual may have a one in ten thousand to a one in a million increased chance of developing cancer as a result of a site related exposure to a carcinogen under specific exposure conditions.

The calculations of carcinogenic risk numbers for the site indicated that, for all pathways evaluated, the risk is well within or below acceptable range. The highest potential carcinogenic risk calculated was $2X10^{-5}$, which was associated with the future recreational use scenario of an individual incidently ingesting site soils.

Current federal guidelines for acceptable exposures for non-carcinogens are a maximum health Hazard Index of 1.0. A hazard index greater than one (1.0) indicates that the exposure level exceeds the protective level for that particular chemical.

Of all the pathways evaluated for non-carcinogenic risk, none exceeded the acceptable limit of hazard index of 1.0. The highest hazard index calculated was 0.69, which was associated with the future use scenario of an individual ingesting ground water from local wells in the Magothy Formation.

The State of New Jersey general guidelines on contaminant cleanup levels as found in the "Cleanup Standards for Contaminated Sites" which was published in the February 3, 1992 New Jersey Register. These guidelines are protective to 10^{-6}. There were three different pathways for which the cancer risks associated with incidental ingestion of site soils were above the NJDEPE guidelines of 10^{-6}. These risks, $4x10^{-6}$, $3x10^{-6}$, and $2x10^{-5}$ were calculated for current trespasser, current site workers and the future on-site recreational population. These risks were attributable to background concentration of arsenic in the soil. There was no cancer risk associated with the site ground water above the NJDEPE guidelines of 10^{-6}.

The results of the BRA indicate that the current and potential future risks, both carcinogenic and non-carcinogenic, associated with the chemicals of concern for all media at the site are within or below acceptable limits and that there is no unacceptable risk to the public health. A summary of non-carcinogenic and carcinogenic risks for current and hypothetical future use of the site is included in Table 17.

B. Ecological Risk Assessment

In the Ecological assessment, a reasonable maximum environmental exposure is evaluated utilizing a four step process for assessing site-related ecological risks. These steps are: Problem Formulation - development of the objectives and scope of the ecological assessment; description of the site and ecosystems that may be impacted; identification of chemicals of concern. Exposure Assessment - identification of potential ecological receptors and exposure pathways; quantitative evaluation of exposure pathways; fate and transport mechanisms for contaminants. Ecological Effects Assessment - literature reviews, field studies and toxicity tests, linking contaminant concentrations to effects on ecological receptors. Risk Characterization -measurement or estimation of both current and future adverse effects on ecological receptors.

The environmental evaluation was completed in accordance with the requirements outlined in the risk assessment work plan approved by the NJDEPE and USEPA which included the following:

- an inventory of on-site flora and fauna;
- an estimate of site vegetative cover;
- identification of threatened and endangered species in the area;
- determination of likely exposure pathways for organisms in the area;
- identification and sampling of surface water runoff areas; and
- identification and sampling of ground water discharge areas.

The analytical results for soil, sediment, ground water, and surface water samples collected at the site were also reviewed with respect to potential ecological impacts.

A number of State, Federal, and Local government agencies, private organizations, and local experts were contacted to obtain information on the flora, fauna, aquatic biota, historical water quality data, soils, topography, and listed threatened, endangered, or sensitive species in the area of the site. A two-day reconnaissance of the landfill and surrounding area was conducted on July 8-9, 1991, during which surface drainage patterns, areas devoid of vegetation, wetlands, and other pertinent site features were identified and recorded. Signs

of animal usage or presence on or near the site were also recorded. Animal species were identified through direct observation or ancillary evidence (e.g., tracks or nests).

As determined from the two-day reconnaissance of the site, no visual evidence of impacts on plant or animal species was determined for the site or wetland areas surrounding the site. No federal or state listed endangered species were observed on the site, although some listed or endangered species have been recorded as being in the area. The most likely exposure pathways for the flora were determined to be uptake via water and sediments in the wetlands adjacent to the site. The most likely exposure pathways for fauna were determined to be ingestion of surface water and sediment in the wetlands, and dermal adsorption from water in the wetlands.

Surface water drainage on the northern part of the site is directed to the sedimentation basin. Surface water discharged from the sedimentation basin is tested in accordance with its NJPDES permit. Another permitted outfall exists at the northeast corner of the site. The permit discharge limits and testing requirements are designed to be protective of aquatic life. Samples of the discharge have historically been within the approved permit limits. Surface water on the southern portion of the landfill flows via sheet flow into three wetlands located on the southern boundary of the landfill. Based upon a review of the surface water data and the fact that the cap is effectively preventing contaminants from entering the surface water, the surface water runoff from the landfill should not have any adverse effects on the water quality of the streams draining these areas.

The clay cutoff wall forms an effective barrier between the leachate contained in the landfill and the surrounding Quaternary deposits east and south of the landfill which contain freshwater wetlands. The leachate collection system hydraulically controls the migration of any impacted ground water from the landfill into the wetlands. Therefore, wetlands will not be affected by impacted water from the site.

To further assess potential ecological impacts, surface water and sediment quality data for samples obtained from low lying areas on and off-site and from an off-site intermittent stream, were compared to federal ambient surface water quality criteria and state sediment criteria. These criteria were developed to be protective of ecological systems. This assessment showed that the majority of constituents detected in surface water samples were below the applicable criteria and that the few constituents detected in surface water samples were found at concentrations typical of background concentrations in the area. Only total mercury (0.0003 ppm) and total lead (0.047 ppm) exceeded surface water quality criteria, 0.000012 ppm and 0.0032 ppm respectively. These concentrations were determined to be not of concern as they are comparable to background concentrations found in surrounding areas. No chemicals in sediment samples exceeded the respective Effect Range-Median criteria. Effect Range-Median (ER-M) criteria is a reference number used to identify the presence of contamination exceeding levels potentially harmful to aquatic life. These ER-M values are referenced in "The Potential Biological Effects of Sediments-Sorbed Contaminants Tested in the National Status and Trends Program", NOAA, 1990.

Based on the on and off-site chemical data and information on the source of contaminants reported in the RI, the results of the two-day reconnaissance, physical characteristics of the site, species population and ecology, animal and plant toxicity data, and operation of the existing remedial measures, it is unlikely that there will be adverse impacts on the flora and fauna of the area, on the wetlands communities as a whole, or on potential threatened and endangered species in the vicinity of the site.

Description of the "No Further Action with Maintenance and Monitoring" Remedy

The NJDEPE has selected the No Further Action with Maintenance and Monitoring remedy for the Monroe Township Landfill Site. This remedy was selected after evaluating the feasibility of treating contaminants in ground water monitor well B-21R. The USEPA concurs with the selected remedy based on the RI and BRA. A description of the selected remedy is presented below.

- The source control measures which are currently in place at the site, including the landfill cover systems, site security fencing, leachate collection and management system, emergency power supply, landfill gas vent system, and surface water, sediment and erosion control are effective and will be maintained under a post-closure operation and maintenance plan.

- The continued effectiveness of the existing source control measures will be assessed through a ground water monitoring program in accordance with the proposed NJDEPE Natural Remediation Compliance Program (NRCP) which will include a sentinel well system to monitor the ground water quality. The NRCP includes 20 consecutive quarters (5 years) worth of ground water quality data collected from the monitoring wells which track the degradation and attenuation of contaminants in the ground water. The ground water at the site is determined to be in compliance with the NRCP after 5 years of monitoring if: 1) Contaminant concentrations have not been increasing in site monitor wells; 2) Contaminant concentrations have been steadily decreasing in source control monitor wells; and 3) No contamination above the applicable ground water quality standard is detected in the sentinel well system. If contaminants are confirmed to be present in the sentinel well system at concentrations above promulgated State and Federal drinking water standards or the NJDEPE Ground Water Quality Standards, the need for additional remedial action(s) will be reevaluated.

- The sentinel well system for the Magothy Formation will, at a minimum, consist of monitoring wells B-56 and B-48. It is expected that the sentinel well system for the perched zone within the Magothy Formation will, at a minimum, consist of monitoring wells B-1R-SS and B-46P, and that sentinel monitoring of the Merchantville Formation will consist of both hydrogeologic and contaminant monitoring. Water levels will be measured in the monitoring wells and piezometers in the Merchantville Formation along the southern boundary of the site and

contaminants will be monitored in well B-52. The expected sentinel monitoring point locations are shown on Figure 2.

- The sentinel ground water monitoring wells will be sampled on a quarterly basis beginning within six (6) months of signing the ROD and continuing for a minimum of five (5) years. The monitoring frequency and parameters of analyses may be modified during the five year period based on the ground water quality results. The ground water samples will be analyzed for TCL volatile and semi-volatile organic compounds and TAL metals.

- Landfill gas emissions will continue to be monitored in accordance with the existing air pollution control permit (APC plant ID No. 15949 Stack 001 and 002). In addition, approximately eleven new passive gas vents will be installed and monitored through modification of the existing air pollution control permit.

- Surface water discharge from the sedimentation pond will continue to be monitored in accordance with the current NJPDES/Discharge to Surface Water (DSW) permit (NJPDES Permit No. 0099988). The leachate collection and discharge to the POTW will continue to be monitored in accordance with the current NJPDES permit (NJPDES Permit No. 0099988).

The requirements for the Natural Remediation Compliance Program, and the Operation and Maintenance Plan for the source control measures will be specified in the Post-Closure Monitoring and Maintenance Plan to be prepared after the ROD has been signed. The Post-Closure Monitoring and Maintenance Plan will also include monitoring of selected perimeter monitor wells on a semi-annual basis for the first five years and on a yearly basis thereafter using TCL/TAL parameters. BFISJ will be responsible for this monitoring and will also be responsible for the maintenance of the landfill and control measures.

Because this remedy will result in hazardous substances remaining on-site, a review will be conducted within five years after signing the Record of Decision to ensure that the remedy continues to provide adequate protection of human health and the environment.

Documentation of Significant Changes

There is no change from the Preferred Remedy described in the Proposed Plan and the selected remedy described in this ROD.

ADMINISTRATIVE RECORD INDEX
MONROE TOWNSHIP LANDFILL SUPERFUND SITE
MONROE TOWNSHIP, MIDDLESEX COUNTY, NEW JERSEY

1. Administrative Consent Order (ACO) between Browning-Ferris Industries of South Jersey (BFISJ) and the New Jersey Department of Environmental Protection and Energy (NJDEPE), 1979.

2. Remedial Action Plan, Wehren Engineering, March 17, 1980.

3. Phase 1 Remedial Action Completion Certification Report, Wehren Engineering, May 29, 1981.

4. Monroe Township Water Supply Master Plan, Charles J. Kupper, Inc., April 1983.

5. Phase 2 Remedial Action Completion Certification Report, Wehren Engineering, September 5, 1984.

6. Community Relations Plan for Monroe Township Landfill Site, NJDEPE, September 1986.

7. Groundwater Quality Analysis Plan and Potable Well Inventory, BFISJ, October 16, 1986.

8. ACO between BFISJ and the NJDEPE, December 29, 1986.

9. Hydrogeologic Data Compilation, Analysis and Reporting, P.C. Rizzo Associates (Rizzo), October 23, 1987.

10. New Jersey Pollutant Discharge Elimination System (NJPDES) DSW/SIU permit # NJ0099988 issuance to BFISJ on November 1, 1988.

11. Comprehensive Evaluation of Chemical Analysis Results, Rizzo, June 1989.

12. Air Pollution Control Permit for Plant ID # 15949 Stack # 001 for 13 Gas Vents, Issued to BFISJ on March 6, 1989.

13. Air Pollution Control Permit for Plant ID # 15949 Stack # 002 for Underground Storage Tank (UST) Vent, Issued to BFISJ on April 2, 1990.

14. Treatment Works Approval, Permit # 89-3542-4L for the UST and 30 Kilowatt Standby Generator (Alternate Power Station), Issued to BFISJ on July 25, 1990.

15. Supplemental Hydrogeologic Investigation Work Plan, Rizzo, August 1990.

16. Soil Erosion and Sediment Control Plan, Rizzo, September 1990.

17. Risk Assessment (RA)/Feasibility Study (FS) Work Plan, Rizzo, November 16, 1990.

18. Sampling and Analysis Plan for Soil, Sediment and Surface Water, Rizzo, January 23, 1991.

19. Soil Erosion and Sediment Control Certification Report, Earth Sciences Consultants (ESC), June 1991.

20. Leachate Lagoon Closure Plan, ESC, September 9, 1991.

21. Supplemental Environmental Investigation report, Rizzo, January 1992.

22. Leachate Lagoon Closure Certification Report, ESC, May 11, 1992.

23. Baseline Risk Assessment Report, Industrial Compliance/Golder Associates, July 1992.

24. Proposed Plan, NJDEPE, November 1992.

25. November 9, 1992 Public Meeting Proceedings Transcript, Schulman, Ciccarelli & Wiegmann, December 1992.

RESPONSIVENESS SUMMARY
RECORD OF DECISION
MONROE TOWNSHIP LANDFILL SUPERFUND SITE

OUTLINE:

This Responsiveness Summary is divided into the following sections:

A. Overview
B. Background on Community Involvement and Concerns
C. Summary of Comments Received During the Public Meeting and Comment Period and Agency Responses
D. Community Relations Activities at the Monroe Township Landfill Site

A. OVERVIEW

This is a summary of the public's comments and concerns regarding the Proposed Plan for the remediation of the Monroe Township Landfill Superfund Site and the New Jersey Department of Environmental Protection and Energy's (NJDEPE) responses to those comments. The comments which were received in writing are attached to this section.

The public comment period extended from November 2, 1992 through December 1, 1992 to provide interested parties the opportunity to comment on the Proposed Plan, Remedial Investigation (RI), Baseline Risk Assessment (BRA) and other supporting documents for the Monroe Township Landfill Site. During the comment period, the NJDEPE held a public meeting on November 9, 1992 at 7:00 PM at the Monroe Township Municipal Building to discuss the results of the RI and BRA and to present the preferred remedy.

On the basis of the information contained in the RI, BRA and supporting documents, NJDEPE has selected the following remedy for the Monroe Township Landfill Site: No further action with Maintenance and Monitoring.

B. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

Community involvement at the Monroe Township Landfill site was greatly intensified after a June 1978 leachate overflow from the then active landfill onto Lani Street into a nearby residential area. NJDEPE ordered the Landfill closed after this incident. In the Spring of 1979, Monroe Township hired its own consultant to evaluate public health and safety at the landfill. In June of 1979 NJDEPE initiated potable well water sampling at six homes; one well was closed as a result. Mayor Peter Garibaldi of Monroe Township requested that NJDEPE conduct further sampling. Although well samples taken on July 3 and 15, 1979 did not reveal the levels of contamination seen in the previous sampling, NJDEPE recommended that the well water in this area not be considered safe. As a result, Mayor

Garibaldi requested that army water tanks be placed in this neighborhood as a temporary source of potable water.

The extensive use of ground water as the only available source of potable water in the Outcalt section of Monroe Township prompted Mayor Garibaldi to place a building moratorium in this area in August of 1979 until problems were corrected or other permanent water sources were supplied. A water line for the Outcalt residents was constructed in the winter of 1979/1980.

NJDEPE forwarded sampling results to the Monroe Township Environmental Commission in June 1981 and May 1983 and to the Middlesex County Health Department in April 1984 in response to requests from these agencies. Township concerns were also reflected in a letter from Mayor Garibaldi requesting a status update pertaining to NJDEPE's Superfund application. Community involvement subsided significantly in 1984 after the installation of the water line and implementation of the landfill closure plan.

NJDEPE held a Public Meeting at the Monroe Township Municipal Building on April 22, 1987 to discuss initiation of the Hydrological Study to evaluate ground water quality in the vicinity of the landfill and evaluate effectiveness of the landfill closure measures. Approximately seventy people attended this meeting and generally expressed satisfaction with the closure operations to that point and concerns for when the site would be opened to public use, perhaps as a park or recreation area.

NJDEPE held a briefing for Monroe Township officials at the Monroe Township Municipal Building on August 10, 1989 to discuss planned improvements to the leachate collection system. At the request of the officials, letters were sent to property owners adjacent to the landfill discussing this work when it was initiated in the summer of 1990.

C. SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND AGENCY RESPONSES

Concerns raised during the Monroe Township Landfill Superfund Site Public Meeting held on November 9, 1992 are summarized below. Responses to two written comments received during the comment period which extended from November 2, 1992 through December 1, 1992 are also included.

1. **Comment:** A representative of the Middlesex County Sewage Authority asked who were the responsible parties for contamination of the site.

   Response: Browning Ferris Industries is the responsible party. All costs of the cleanup are being paid by Browning Ferris Industries at no cost to the tax payer under the terms of an Administrative Consent Order (ACO) with NJDEPE.

2. **Comment:** The Chairperson of the Monroe Township Environmental Commission expressed concern about 1) arsenic levels in the soil being attributed to natural background levels, 2) the source of materials for capping the landfill and 3) responsibility for monitoring and maintaining the landfill in the future. One of the letters received also included these concerns, indicating that the proposed plan stated that arsenic was present in the cap material and why was the cap material not tested?

Response: Naturally occurring soils in the vicinity of the Monroe Township Landfill have been shown to contain as much as 40 parts per million (ppm) of arsenic (based on the results of the regional studies, James Dragun, 1988 as well as Shacklette and Boerngen, 1984). Based on the BRA which considered an exposure to arsenic in the soil, there is no current or future unacceptable risk to public health and the environment. The discussion on arsenic in the proposed plan refers to arsenic present in the soil at the landfill before the cap material was brought in, not to the cap material itself. Soil used to cap the site was purchased from a source certified to be free of contamination. The cap material itself was not tested because the source area was fully evaluated and determined to be clean. Browning Ferris Industries is required to maintain the site after signing the Record of Decision for a period of at least thirty (30) years, and thereafter for as long as leachate is being generated.

3. **Comment:** The Chairperson of the Environmental Commission asked if the Department of Health would be doing studies to determine if there were any health risks associated with the landfill.

Response: The New Jersey Department of Health (NJDOH) published a Site Review and Update for the Monroe Township Landfill in August of 1992 which concluded that the site did not pose a health threat. The Superfund law requires that site health assessments be updated periodically. NJDEPE has provided a copy of the August 1992 NJDOH report to the environmental commission.

4. **Comment:** The owner of a residential property adjacent to the landfill whose wells had been sampled on various occasions during the site investigations requested the sampling results. Also a writer asked the status of the same residential well sampling results and requested more information concerning status of the current residential wells surrounding the landfill area.

Response: NJDEPE has mailed the sampling results to the resident's home address. The results show that the wells met all NJDEPE drinking water standards. There are no known users of the Magothy Formation ground water within 3000 feet of the site and that residents are currently connected to the public water supply system. Local ordinance requires that all existing and planned dwellings located within 200 feet of a water supply be connected to the Township Water Supply System.

5. **Comment:** A resident stated that he has observed considerable numbers of hunters at the landfill over the years and wanted to know if there is a health threat from eating deer killed at the site.

   Response: The remediation measures that have been taken to date at the site have been effective in isolating contaminants from the top soil, water and vegetation at the site. Since the food and water sources for the deer are not contaminated, the deer should not be contaminated.

6. **Comment:** A Rutgers University professor asked who was analyzing site samples for heavy metals.

   Response: ETC Labs, Edison, New Jersey.

7. **Comment:** A potential purchaser of a residence adjacent to the landfill asked if a stream at the southeastern corner of the landfill was contaminated.

   Response: Test results have not shown contamination in this stream.

8. **Comment:** A commenter stated that carcinogenic risks in this area are said to be high if (the site) were used for recreational purposes and asked what are the risks and for how long a duration?

   Response: Based on the Baseline Risk Assessment which considered future recreational use scenarios, the highest cancer risk calculated was $2x10^{-5}$ which was associated with incidental ingestion of site soils and the highest non-carcinogenic risk calculated was Hazard Index of 0.44 which was also associated with incidental ingestion of site soils.

   Current federal guidelines for acceptable exposures are individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6}. The highest cancer risk calculated for the future recreational site use ($2x10^{-5}$) is within the acceptable range.

   Current federal guidelines for acceptable exposures for non-carcinogens are a maximum health Hazard Index of 1.0. The highest non-carcinogenic risk calculated for the future recreational site use (Hazard Index = 0.44) is well below the maximum allowable Hazard Index.

9. **Comment:** Several individuals asked for more information on future monitoring at the site including type of monitoring, duration (will it really continue for thirty years), and future actions if test results are not acceptable.

   Response: Maintenance and monitoring will be continued for a minimum of thirty years as specified in the Proposed Plan and Record of Decision. Source control

measures (cap, slurry wall, leachate collection system, underground storage tank, generator and fence) will be maintained for an indefinite period. Quarterly monitoring of sentinel system will continue for five years. Semi-annual ground water monitoring of perimeter wells will continue for five years with annual monitoring after that. Surface water, landfill leachate and gas vents will be monitored in accordance with NJPDES and Air Pollution Control Permits. If testing indicates leachate is still being generated after thirty years monitoring will be extended. If test results are not acceptable, the need for additional remedial action(s) will be reevaluated.

10. **Comment:** A writer asked when the landfill and surrounding properties can be improved.

Response: Since there is no current or future unacceptable risk to public health and the environment from the landfill, the surrounding properties are not impacted by the landfill. The site property itself will improve over a period of time as the waste decomposes.

11. **Comment:** A writer stated that "Misuse of any landfill is possible, particularly during the years before regulations. Waste could have been dumped that was not specified for the Monroe Landfill before the DEPE monitoring. As a result, problems could arise in the future that could go undetected due to lack of monitoring or further remediation."

Response: NJDEPE agrees that such problems could and have occurred, in fact that is why the landfill was ordered closed and why extensive remediation activities have already been completed. Monitoring will be initiated after the Record of Decision is signed and any future problems indicated by the monitoring will be fully addressed.

D. Community Relations Activities at the Monroe Township Landfill Site

NJDEPE prepared a Community Relations Plan (September 1986).

NJDEPE established information repositories at the following locations:

Monroe Township Municipal Complex
Perrineville Road P.O.
Jamesburg, NJ 08831 Phone # (908) 521-4400

Jamesburg Public Library
229 Gatzmer Road
Jamesburg, NJ 08831 Phone # (908) 521-0440

New Jersey Department of Environmental Protection and Energy
Bureau of Community Relations
401 East State Street, CN 413
Trenton, NJ 08625
(609) 984-3081
Contact: George Tamaccio

NJDEPE held a public meeting to discuss initiation of the Hydrogeologic Study at the Monroe Township Landfill Site at the Monroe Township Municipal Building (April 22, 1987).

NJDEPE held a briefing with local officials to discuss improvements to the leachate collection system on site at the Monroe Township Municipal Building (August 10, 1989).

NJDEPE mailed letters to property owners adjacent to the landfill announcing initiation of construction activities for leachate collection system improvements (August 1990).

NJDEPE held a public comment period from November 2, 1992 to December 1, 1992 and a public meeting at the Monroe Township Municipal Building on November 9, 1992 to discuss site work to date and the Proposed Plan for final site remediation.

Perry Diamantis
13 Watchung Rd.
East Brunswick, NJ 08816
November 29,1992

Ms. G.L Singer
Bureau of Community Relations
Department of Environmental Protection
and Energy
CN 413
Trenton, NJ 08625

Dear Ms Singer:

As a potential resident of Monroe Township, I am concerned about the DEPE's action to remove the Monroe Township Landfill from the National Priorities List.

As I am sure you are aware, the DEPE's proposal calls for no further action or monitoring of the landfill if no further leachate is generated. With the plans for additional residential dwellings near the landfill site and the resulting added strain on the environment (i.e. drainage) an extra measure of caution is needed. I hope the DEPE's proposals have taken this into account.

In addition, misuse of any landfill is possible, particularly during the years before regulations. Waste could have been dumped that was not specified for the Monroe landfill before the DEPE monitoring. As a result, problems could arise in the future that could go undetected due to a lack of monitoring or further remediation. Does the DEPE proposal consider this?

I urge the DEPE to be prudent in the disposition of the Monroe Township Landfill, so that present and future residents of Monroe are protected from any hazards.

Sincerely,

Perry Diamantis

302H Gravel Hill/Spotswood Rd
Jamesburg, N.J. 08831
908-521-4997
November 27, 1992

Grace L. Singer, Chief
Bureau of Community Relations
N.J Department of Environmental
Protection and Energy
CN 413
Trenton, N.J. 08625-0413

Dear Ms. Singer:

I'm writing my comments in response to the NJDEPE meeting in Monroe Township on November 9, 1992. This meeting concerned the "Monroe Township Landfill Superfund Site."

First, just let me say that the meeting was conducted in a very professional and friendly manor. The presentation was well planned and all participants were prepared well.

Although I'm writing these concerns on behalf of myself, the contents will be shared with the Monroe Township Republican Committee of which I hold the positions of Committee Secretary and Committeeman.

The concerns I have are:
1) a) The arsenic levels being higher then normal: What are the immediate and long range effects? What impact does this have on surrounding properties? When can this property be improved? Can the surrounding properties be improved and if so when?

b) It is stated in your hand out that the arsenic was detected in the surface soil of the cap material which was brought from an outside source. Why wasn't this soil checked for contamination by the NJDEPE before utilization as cap material. Aren't you responsible for this condition?

2) Local ordinances prevent wells in the area for future housing. What about the current wells in this area now? At least one resident said he has a well in the immediate area. He also said the state has tested his well, but never notified him of the results. If this is correct, I find this incredible and totally irresponsible of the NJDEPE. The gentleman in question testified the night of meeting and should be part of the record. I'm most interested in your comments on this matter.

(3) The carcinogenic risks in this area are said to be high if used for recreational purposes. What are these risks and for how long a duration? If property improvements are made in this surrounding area in the future, what are the recreational impacts that the Township may be faced with?

(4) I was told at the meeting that the monitoring will continue for the next 30 years, yet the handout I received at the meeting does not stated this fact. Can you clarify this question?

(5) What events in testing will take place in the next 30 years at this site? What happens if the test are not acceptable? What happens after 30 years?

Thank you for given me the opportunity to address these questions to you and to your department.

Sincerely yours

James A. Soden

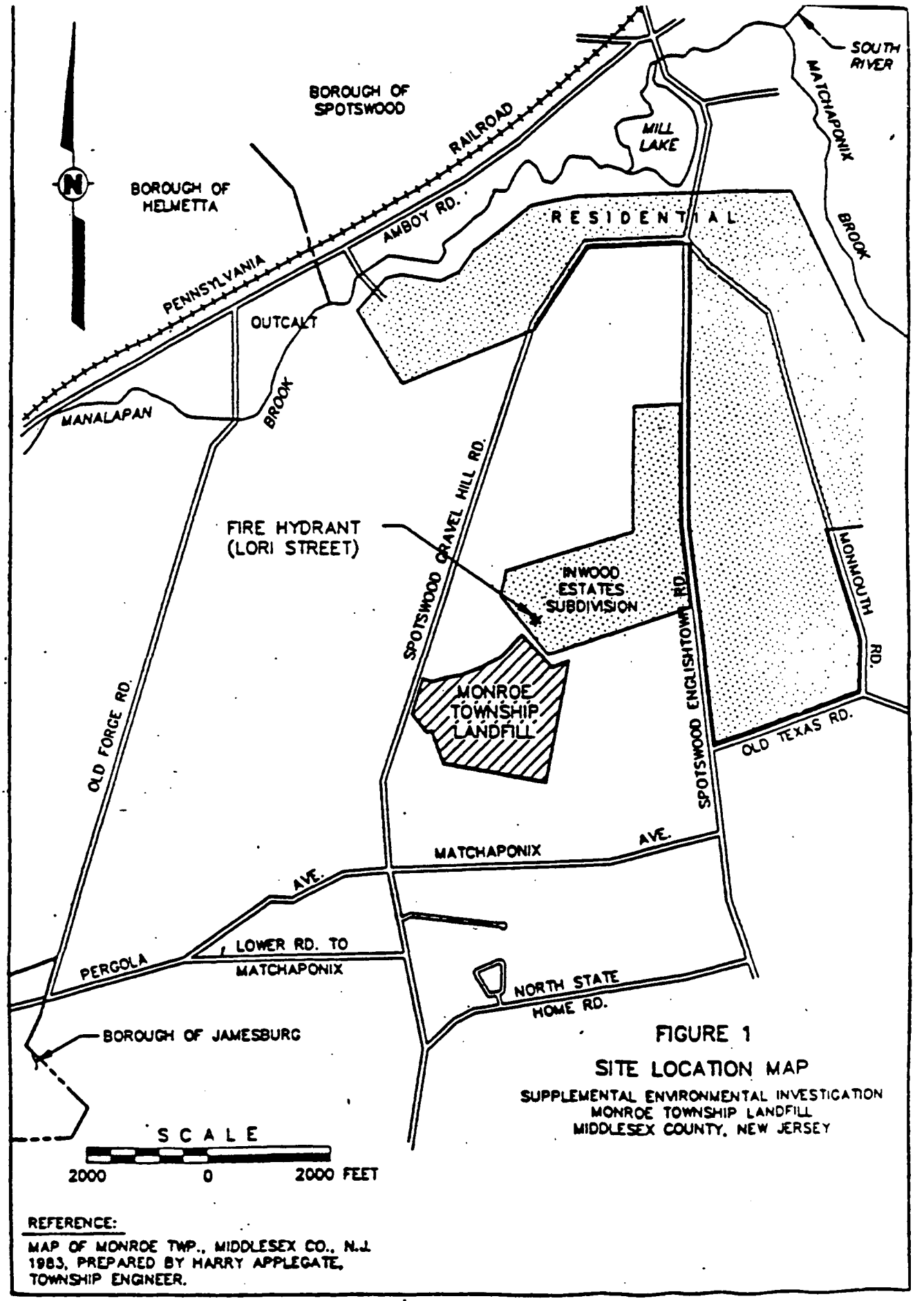


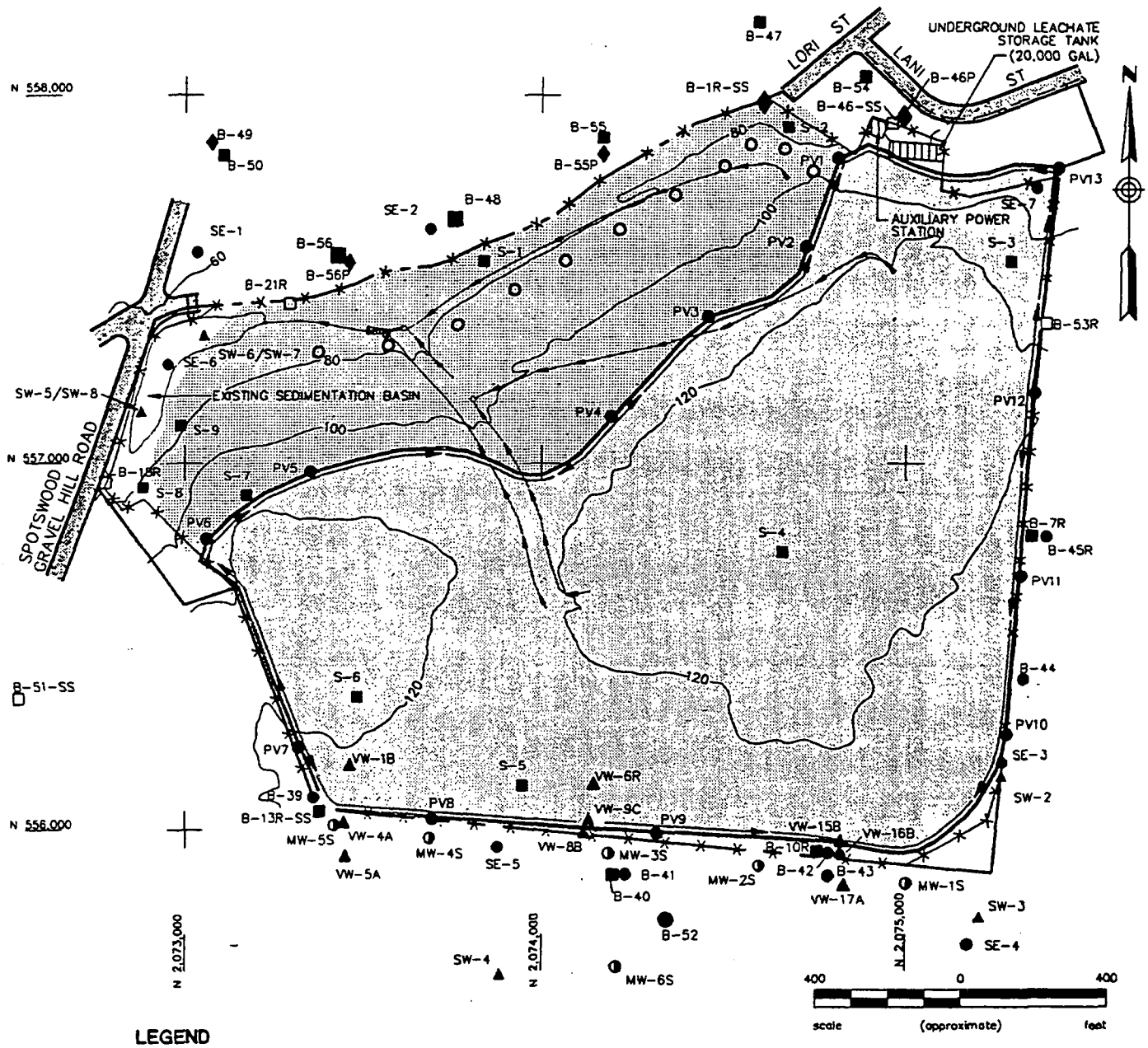
FIGURE 1

SITE LOCATION MAP

SUPPLEMENTAL ENVIRONMENTAL INVESTIGATION
MONROE TOWNSHIP LANDFILL
MIDDLESEX COUNTY, NEW JERSEY

REFERENCE:

MAP OF MONROE TWP., MIDDLESEX CO., N.J. 1983, PREPARED BY HARRY APPLEGATE, TOWNSHIP ENGINEER.



LEGEND

- SENTINEL MONITORING POINTS
- SENTINEL PIEZOMETER
- MAGOTHY FORMATION MONITORING WELL
- MONITORING WELL WITHIN PERCHED WATER ZONE OF THE MAGOTHY FORMATION
- MERCHANTVILLE FORMATION MONITORING WELL
- MERCHANTVILLE FORMATION MONITORING WELL (SCHEDULE 40 PVC)
- PASSIVE GAS VENT
- PROPOSED PASSIVE GAS VENTS
- SOIL SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION
- PROTECTIVE CLAY CAP
- PROTECTIVE SOIL CAP
- LEACHATE COLLECTION SYSTEM
- COMPACTED CLAY CUTOFF WALL
- SURFACE DRAINAGE CHANNEL WITH RIP RAP
- LANDFILL PROPERTY BOUNDARY LINE
- SEWER CONNECTION
- 7 FT HIGH SECURITY FENCE

FIGURE 2

MONROE TOWNSHIP LANDFILL

Table 1

COMPARISON OF DETECTED CONSTITUENT CONCENTRATIONS TO NJDEPE GROUNDWATER QUALITY STANDARDS AND FEDERAL MCLs. MONROE TOWNSHIP LANDFILL MONROE, NEW JERSEY

PARAMETERS	MAGOTHY FORMATION, CLASS IIA, RANGE OF DETECTED CONCENTRATIONS (ug/L)	PERCHED ZONES WITHIN MAGOTHY FORMATION, RANGE OF DETECTED CONCENTRATIONS (ug/L), (2)	MERCHANTVILLE FORMATION, CLASS IIIA, RANGE OF DETECTED CONCENTRATIONS (ug/L), (3)	NJDEPE GROUNDWATER QUALITY STANDARDS (ug/L)	FEDERAL MCLs (ug/L)
I. METALS					
Aluminum	67.5–44,300	1,710–5,220	119.0–7,520	200	NS
Antimony	2.6–3.7	3.7–3.7	2.1–2.1	20.0	6.0
Arsenic	0.5–10.1	1.5–7.8	1.2–41.4	8.0	50.0
Barium	19.5–258.0	21.0–52.9	23.3–1,650	2,000	2,000
Beryllium	0.4–3.7	0.4–0.6	0.2–1.2	20.0	4.0
Cadmium	0.2–16.0	0.7–1.3	0.34–11.0	4.0	5.0
Calcium	1,800–67,900	11,100–60,600	285.0–80,100	NS	NS
Chromium	0.4–31.9	5.7–6.2	1.5–70.0	100.0	100.0
Cobalt	4.5–172.0	9.8–30.5	5.5–38.3	NS	NS
Copper	2.8–27.0	2.1–20.0	2.1–18.0	1000	NS
Iron	2,120–168,000	286.0–34,500	345.0–300,000	300	NS
Lead	0.5–10.9	1.8–8.2	0.44–30.0	10.0	15.0
Magnesium	1,750–17,000	3,990–19,400	2,090–100,000	NS	NS
Manganese	116.0–918.0	627.0–3,240	171.0–4,220	50.0	NS
Mercury	0.1–0.3	0.1–2.0	0.08–0.2	2.0	2.0
Nickel	5.0–226.0	12.0–65.0	3.2–93.0	100.0	100.0
Potassium	983.0–35,500	1,630–7,420	886.0–14,600	NS	NS
Selenium	1.5–1.9	ND	0.72–3.1	50.0	50.0
Silver	2.6–3.9	ND	1.1–4.3	NS	NS
Sodium	1,320–145,000	1,520–29,200	4,120–25,100	50,000	NS
Thallium	1.1	1.2–1.2	1.5–1.5	10.0	2.0
Vanadium	5.4–67.2	16.1–16.1	8.3–65.4	NS	NS
Zinc	4.9–884.0	93.9–281.0	7.3–160.0	5,000	NS
Cyanide	ND	ND	ND	200.0	200.0
II. VOLATILE ORGANICS					
Acetone	5.0–63.0	15.0–32.0	8.0–1,950	700.0	NS
Acrylonitrile	9.9	ND	ND	50.0	NS
Benzene (1)	2.0–3.7	2.0–22.1	1.0–12.0	1.0	5.0
2-Butanone	ND	ND	46.0–3,200	NS	NS
Chlorobenzene (1)	6.4–14.0	2.0–2.0	2.9–2.9	4.0	100.0
Chloroethane	5.3	ND	6.9–6.9	NS	NS
Dichlorodifluoromethane	ND	ND	103.0–292.0	NS	NS
1,1-Dichloroethane (1)	13.4–19.6	ND	9.42–13.1	70.0	NS
1,2-Dichloroethane (1)	11.1–16.9	ND	ND	2.0	5.0
1,1-Dichloroethene (1)	1.3–4.0	ND	ND	2.0	7.0

Table 1 (contd)

COMPARISON OF DETECTED CONSTITUENT CONCENTRATIONS TO
NJDEPE GROUNDWATER QUALITY STANDARDS AND FEDERAL MCLs.
MONROE TOWNSHIP LANDFILL
MONROE, NEW JERSEY

PARAMETERS	MAGOTHY FORMATION, CLASS IIA, RANGE OF DETECTED CONCENTRATIONS (ug/L)	PERCHED ZONES WITHIN MAGOTHY FORMATION, RANGE OF DETECTED CONCENTRATIONS (ug/L), (2)	MERCHANTVILLE FORMATION, CLASS IIIA, RANGE OF DETECTED CONCENTRATIONS (ug/L), (3)	NJDEPE GROUNDWATER QUALITY STANDARDS (ug/L)	FEDERAL MCLs (ug/L)
1,2-Dichloroethene (total) (1)	1.5-3.9	18.0-264.0	ND	10 (cis), 100 (trans)	70.0(cis)
Ethylbenzene	ND	ND	3.36-4.2	700.0	700.0
2-Hexanone	ND	ND	570.0-570.0	NS	NS
Methylene Chloride	2.1-58.8	1.0-4.9	1.96-670.0	2.0	5.0
4-Methyl 2-Pentanone	91.0	ND	390.0	400.0	NS
1,1,2,2-Tetrachloroethane	2.0	ND	ND	2.0	NS
Toluene	2.0-57.0	ND	0.7-19.8	1,000	1,000
Trichloroethene	ND	ND	1.0	1.0	5.0
Trichlorofluoromethane	0.8-11.2	ND	0.85-7.4	NS	NS
Vinyl Chloride (1)	8.4-13.7	4.3-33.8	ND	5.0	2.0
III. SEMIVOLATILE ORGANICS					
Benzoic Acid	ND	ND	580.0-580.0	NS	NS
Bis(2-ethylhexyl)phthalate	9.8	0.4-179.0	ND	30.0	6.0
Di-N-Butylphthalate	0.4	0.2-0.2	0.3-0.3	900.0	NS
Di-N-Octylphthalate	3.4	10.9-10.9	4.4-4.4	NS	NS
1,2-Dichlorobenzene (1)	3.0-5.1	ND	ND	600.0	600.0
2,6-Dinitrotoluene	36.5	46.3-46.3	32.8-32.8	NS	NS
Phenol	ND	ND	78.8-1,000	4,000	NS

NOTES:

N/A - not available for this constituent
ND - constituent not detected in the medium indicated
NS - no NJDEPE Groundwater Quality Standard or Federal MCL exist
(1) - Constituent concentrations (which were not eliminated as Constituents of Interest in the Baseline Risk Assessment due to suspect laboratory contamination, present in blank samples or detection in 5% or fewer samples) were found above the NJDEPE Groundwater Quality Standard or Federal MCL only in monitoring well 21-R and were eliminated in the Baseline Risk Assessment due to incomplete exposure.
(2) - Constituent concentrations in the Perched Zone within Magothy Formation were found above the NJDEPE Groundwater Quality Standard or MCL only in monitoring wells B-1R-SS and B-46P.
(3) - Constituent concentrations found in Merchantville Formation above the NJDEPE Groundwater Quality Standards or MCLs in monitoring wells B-39, B-41, B-42, B-43 and B-45.

Table 2

SUMMARY OF GROUND WATER AQUIFER ZONES AND MONITOR WELLS WITHIN THE AQUIFER ZONES EVALUATED IN THE RISK ASSESSMENT

Table 1 includes a list of all contaminants detected in monitor wells installed in three zones of the ground water aquifer system at the site. The three zones of the ground water aquifer system at the site. are: Merchantville Formation (Total 13 Wells: B-39, B-41, B-42, B-43, B-44, B-45, B-52, MW-1S,MW-2S, MW-3S, MW-4S, MW-5S and MW-6S), Magothy Formation (Total 15 Wells: B-40, B-46SS, B-47, B-48, B-50, B-51SS, B-7R, B-10R, B-13RSS, B-18R, B-21R, B-53R, B-54, B-55 and B-56) and perched zones within the Magothy Formation (Total 5 Wells: B-1RSS, B-46P, B-49, B-55P and B-56P). Ground water data collected from the monitor wells of Merchantville Formation and the perched zones within the Magothy Formation were not evaluated in the Risk Assessment (RA). The Merchantville formation was removed from consideration in the RA because the current remedial system (cap, clay cut-off wall and the leachate collection system) is effectively containing contamination within the zone on-site, the exposure pathway is incomplete due to the public water supply serving the residents, and the water quality is naturally poor (high Iron, high Chloride and low PH). The perched zones within the Magothy Formation were also removed from consideration in the RA due to lack of production and because they are not representative of the Magothy Formation ground water quality.

Current use of the Magothy Formation ground water was considered incomplete because the ground water contamination in the Magothy Formation is contained on-site and the residents are connected to the public water supply system. Ground water data collected from ten (10) monitor wells were evaluated in the RA for future off-site residential use scenario. The following is a summary of all wells in the Magothy Formation with reasons for retaining or removing them from further consideration in the RA:

MONITOR WELL	RETAINED	REMOVED	REASON
B-40	X		Downgradient
B-7R	X		Downgradient
B-10R	X		Downgradient
B53-R	X		Downgradient
B-46SS	X		Downgradient
B-54	X		Downgradient
B-47	X		Downgradient
B-55	X		Downgradient
B-48	X		Downgradient
B-56	X		Downgradient
B-50		X	Upgradient
B-18R		X	Upgradient
B-51SS		X	Upgradient

Table 2 (contd)

B-13RSS		X	Interference of naturally occurring geologic materials and water chemistry
B-21R		X	Situated directly beneath a specific source *

* USEPA Risk Assessment Guidance for Superfund, Vol. I (Pg 6-26 to 6-27) states that "In a few situations, however, it may not be reasonable to assume that water will be drawn from directly beneath a specific source (e.g. a waste management unit such as a landfill) in the future. In these cases, it should be assumed that water could be drawn from directly adjacent to the source". Well B-21R is situated directly beneath a specific source and was dropped out. Well B-56 which is nearest to the source area was included in the RA.

Table 3

SUMMARY OF CHEMICALS OF CONCERN IN GROUND WATER AND RANGE OF CONCENTRATIONS DETECTED

The following is a list of potential chemicals of concern and range of concentrations detected in ten (10) monitor wells (Refer to Table 2 for a discussion of monitor well selection for evaluation in the RA) of the Magothy Formation ground water:

CHEMICAL	TIME DETECTED/SAMPLES ANALYZED	RANGE OF CONCENTRATION DETECTED MG/L (PPM)
INORGANICS		
Aluminum	10/10	0.14-44.3
Antimony	1/29	0.0037
Arsenic	13/29	0.0005-0.0101
Barium	22/23	0.0195-0.2580
Beryllium	10/29	0.0005-0.0037
Cadmium	7/29	0.0005-0.0160
Chromium	18/29	0.0004-0.0319
Cobalt	6/10	0.0067-0.1720
Copper	7/29	0.0028-0.0270
Iron	10/10	2.16-86.30
Lead	14/29	0.0006-0.0109
Magnesium	10/10	1.75-17.00
Manganese	10/10	0.1160-0.9180
Mercury	2/29	0.0001-0.0003
Nickel	16/28	0.0050-0.2260
Selenium	1/29	0.0015
Silver	2/22	0.0026-0.0028
Thallium	1/29	0.0011
Vanadium	8/10	0.0054-0.0672
Zinc	28/29	0.0049-0.8840
VOLATILE ORGANICS		
Acetone	4/10	0.0050-0.0630
Acrylonitrile	1/24	0.0099
Methylene chloride	13/24	0.0021-0.0100
4-Methyl 2-pentanone	1/10	0.0910
Tetrachloroethane (1,1,2,2,-)	1/34	0.0020-0.0020

Table 3 (contd)

Toluene	1/33	0.0570
Trichlorofluromethane	7/24	0.0018-0.0112
SEMI-VOLATILE ORGANICS		
Di-N-butyl phthalate	1/34	0.0004
Di-N-octyl phthalate	1/34	0.0034
Dinitrotoluene (2,6,-)	1/34	0.0365

The potential chemicals of concern were screened further in accordance with the USEPA Risk Assessment Guidance to select the final chemicals of concern to be used for evaluation in the Risk Assessment. The following chemicals were eliminated because they were detected in less than 5% of the samples:

Antimony
Thallium
Tetrachloroethane (1,1,2,2,-)
Di-N-octyl phthalate
Toluene
Selenium
Acrylonitrile
Di-N-butyl phthalate
Dinitrotoluene (2,6,-)

The following chemicals were eliminated on the basis that they are essential nutrients:

Iron Magnesium Zinc

The following chemicals were eliminated because they were also detected in the blank samples:

Acetone Methylene chloride

The following chemicals were eliminated because their presence is attributable to the natural background conditions:

Arsenic Beryllium

Although detected only once, 4-methyl 2-pentanone was retained as a chemical of concern- due to its relatively higher concentration in ground water and the uncertainty associated with measurements when there are relatively few samples available for evaluation.

The following is the list of final chemicals of concern found in ten (10) monitor wells of the Magothy Formation groundwater which was used in the Risk Assessment:

Aluminum	Barium
Cadmium	Chromium
Cobalt	Copper
Lead	Manganese
Mercury	Nickel
Silver	Vanadium
4-Methyl 2-pentanone	Trichlorofluromethane

Table 4
Summary of Surface Water Data

Chemical	Times Detected/Samples Analyzed	Average Concentration (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)
Inorganics				
Aluminum	7/7	0.751	0.1280	1.22
Arsenic	1/7	0.002	0.0023	0.0023
Barium	7/7	0.024	0.0107	0.0279
Beryllium	1/7	0.0002	0.0002	0.0002
Calcium	7/7	29.9	4.0400	47.8
Cobalt	4/7	0.0139	0.0123	0.0139
Copper	4/7	0.0094	0.0076	0.0094
Iron	7/7	1.20	0.2980	2.44
Lead	1/7	0.0471	0.0471	0.0471
Magnesium	7/7	8.71	2.4300	12.1
Manganese	7/7	0.935	0.0694	1.56
Mercury	2/7	0.0003	0.0003	0.0003
Nickel	4/7	0.0191	0.0179	0.0191
Potassium	7/7	2.85	0.9830	3.91
Sodium	7/7	4.78	2.2000	5.97
Zinc	7/7	0.0455	0.0184	0.0658
Volatile chemical				
Methylene chloride	1/7	0.002	0.002	0.002

Table 5

Summary of Soil Data

Chemical	Times Detected/Samples Analyzed	Average Concentration (mg/kg)	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)
Inorganics				
Aluminum	9/9	16,800	6,520	23,100
Arsenic	9/9	19.7	6.8	31.3
Barium	9/9	75.1	14.7	131
Beryllium	9/9	0.767	0.300	1.00
Chromium	9/9	27.9	19.1	42.5
Cobalt	9/9	4.26	2.80	5.80
Copper	9/9	19.6	6.40	32.0
Iron	9/9	28,900	20,200	37,600
Lead	9/9	31.1	8.10	93.4
Manganese	9/9	165	61.5	267
Mercury	7/9	0.154	0.080	0.200
Nickel	9/9	6.92	3.90	11.7
Selenium	1/9	0.700	0.700	0.700
Vanadium	9/9	48.2	33.1	69.1
Zinc	9/9	45.5	28.9	66.0
Cyanide	5/9	0.240	0.500	0.500
Volatile chemicals				
Acetone	2/9	0.022	0.014	0.030
Semivolatile chemicals				
Benzoic acid	1/9	16.0	16.0	16.0
Phenanthrene	3/9	0.071	0.062	0.085
Fluoranthene	2/9	0.104	0.097	0.110
Pyrene	2/9	0.088	0.076	0.100
Pesticides/PCBs				
4,4'-DDE	6/9	0.205	0.031	0.430
4,4'-DDD	1/9	0.420	0.420	0.420
4,4'-DDT	6/9	0.310	0.022	0.610
Heptachlor	1/9	0.098	0.098	0.098

Table 6
Summary of Sediment Data

Chemical	Times Detected/Samples Analyzed	Average Concentration (mg/kg)	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)
Inorganics				
Aluminum	7/7	15,600	6,260	36,200
Arsenic	7/7	21.3	6.20	34.2
Barium	7/7	69.6	25.7	183
Beryllium	7/7	0.614	0.200	1.60
Chromium	7/7	32.0	14.4	53.2
Cobalt	7/7	4.69	2.10	9.60
Copper	7/7	23.5	7.00	50.2
Iron	7/7	36,200	14,300	66,300
Lead	7/7	30.0	7.50	44.5
Manganese	7/7	174.0	69.1	578
Mercury	3/7	0.113	0.0400	0.200
Nickel	6/7	9.07	3.30	18.6
Selenium	2/7	0.800	0.800	0.800
Vanadium	7/7	66.6	25.6	121
Zinc	7/7	59.5	26.6	112
Cyanide	6/7	0.133	0.100	0.200
Volatile chemical				
Acetone	1/7	0.0240	0.0240	0.024
Semivolatile chemicals				
Anthracene	4/7	0.211	0.0730	0.390
Benzo(a)anthracene	3/7	0.166	0.0570	0.260
Benzo(a)pyrene	2/7	0.165	0.140	0.190
Benzo(b)fluoranthene	2/7	0.154	0.0970	0.210
Benzo(g,h,i)perylene	1/7	0.160	0.160	0.160
Chrysene	3/7	0.191	0.0630	0.310
Fluoranthene	5/7	0.247	0.0740	0.450
Fluorene	2/7	0.075	0.0710	0.078
Indeno(1,2,3-c,d)pyrene	1/7	0.170	0.1700	0.170
Naphthalene	1/7	0.056	0.0560	0.056
Phenanthrene	5/7	0.269	0.0760	0.530
Pyrene	5/7	0.184	0.0550	0.350
Pesticides/PCBs				
4,4'-DDE	4/7	0.085	0.0310	0.130
4,4'-DDD	4/7	0.056	0.0260	0.084
4,4'-DDT	3/7	0.136	0.0690	0.230

Table 7

2.5 Air

Three of 13 air vents located at the site were sampled for the presence of organic chemicals in June 1988. Of the 3 vents sampled, only vent 11 had a measurable emissions of identifiable organic chemicals. Carbon tetrachloride, trichloroethylene, and tetrachloroethylene were detected in air samples collected on 3 consecutive days from vent 11. The results are presented below. "Unspecified suspected freons" were also detected in vent 11 at concentrations 1 to 2 orders of magnitude greater than the identified chemicals.

Chemical	Air Concentration in mg/m^3 (estimated release in lb/hr in parenthesis)		
	Day 1	**Day 2**	**Day 3**
Carbon tetrachloride	64 (0.0017)	110 (0.00029)	54 (0.0014)
Trichloroethylene	15 (0.00039)	15 (0.00039)	8 (0.00021)
Tetrachloroethylene	7 (0.00018)	15 (0.00039)	8 (0.00021)
Unspecified suspected freons	(0.024)	(0.071)	(0.044)

Table 8

Summary of Chemicals of Concern and the Range of Detected Concentrations

Chemical	Surface Water (mg/L)	Surface Soil (mg/kg)	Sediment (mg/kg)	Air (mg/m3)
Inorganics				
Aluminum	0.128 - 1.22	-	-	-
Arsenic	-	6.8 - 31.3	6.2 - 34.2	-
Barium	-	-	-	-
Beryllium	-	-	-	-
Cadmium	-	-	-	-
Chromium	-	-	-	-
Cobalt	-	-	-	-
Copper	-	-	-	-
Lead	-	-	-	-
Manganese	0.069 - 1.56	-	-	-
Mercury	0.0003	-	-	-
Nickel	-	-	-	-
Silver	-	-	-	-
Vanadium	-	-	-	-
Organic chemicals				
Anthracene	-	-	0.0730 - 0.390	-
Benzo[a]anthracene	-	-	0.0570 - 0.260	-
Benzo[a]pyrene	-	-	0.140 - 0.190	-
Benzo[b]fluoranthene	-	-	0.0970 - 0.210	-
Benzo[g,h,i]perylene	-	-	0.16	-
Benzoic acid	-	16	-	-
Carbon tetrachloride	-	-	-	54 - 110
Chrysene	-	-	0.063 - 0.310	-
DDD	-	0.42	0.026 - 0.084	-
DDE	-	0.031 - 0.430	0.031 - 0.130	-

Table 8

(contd)

Chemical	Surface Water (mg/L)	Surface Soil (mg/kg)	Sediment (mg/kg)	Air (mg/m3)
DDT	-	0.022 - 0.610	0.069 - 0.230	-
Fluoranthene	-	0.097 - 0.110	0.074 - 0.480	-
Fluorene	-	-	0.071 - 0.078	-
Heptachlor	-	0.098	-	-
Indeno[1,2,3-c,d]pyrene	-	-	0.17	-
4-Methyl 2-pentanone	-	-	-	-
Naphthalene	-	-	0.056	-
Phenanthrene	-	0.062 - 0.085	0.076 - 0.530	-
Pyrene	-	0.076 - 0.100	0.055 - 0.230	-
Tetrachloroethylene	-	-	-	7 - 15
Trichloroethylene	-	-	-	8 - 15
Trichlorofluoromethane	-	-	-	-

- *not a chemicals of concern for reasons described in Sections 2.2, 2.3, 2.4, and 2.5 or because of lack of detection*

Table 9

Potential Exposure Pathways

Potentially Exposed Population	Exposure Medium, Route, and Exposure Point	Pathway Selected for Examination?	Reason for Selection or Exclusion
Current Off-Site Residents			
	Groundwater Ingestion of groundwater from local wells located off-site	No	Nearby residents are supplied with public water. The NJDEPE designates the Merchantville Formation as a Class III-A aquitard, unsuitable for public use, due to natural hydrogeologic conditions.
	Inhalation of volatile chemicals released during showering/bathing.	No	No known use of the Merchantville Formation is currently being made. There are no known users of the Magothy Formation within 3000 feet of the Site. Current remedial
	Dermal absorption of chemicals in groundwater during showering/bathing	No	systems (clay cap, leachate collection and clay cut-off wall) are protective of the surrounding surficial deposits.
	Air Inhalation of vapor phase chemicals transported off-site	Yes	Chemicals have been detected in landfill vents. These chemicals may be transported off-site by prevailing winds.
	Inhalation of particulate transported off-site	No	The site is almost entirely covered by grass, greatly reducing the potential for creation of significant amounts of dust
	Sediment Incidental ingestion while at play	Yes	Children may play in low-lying areas adjacent to the site
	Dermal contact with sediment while at play	Yes	Children may play in low-lying areas adjacent to the site
	Surface Water Dermal contact with water while at play	Yes	Children may play in streams formed during rainy periods
Current Trespasser	Air Inhalation of vapor phase chemicals released on-site	Yes	Chemicals have been detected in air released from landfill vents

Table 9 (contd)

Potentially Exposed Population	Exposure Medium, Route, and Exposure Point	Pathway Selected for Examination?	Reason for Selection or Exclusion
Current Trespasser (contd)			
	Soil		
	Incidental ingestion of site soils	Yes	Persons may be exposed to soil during unauthorized activities at the site
	Dermal contact with site soils	Yes	Persons may be exposed to soil during unauthorized activities at the site
	Inhalation of particulate produced on-site	Yes	Motorcyclists may create dusts while riding on-site
Current Site Workers			
	Air		
	Inhalation of vapor phase chemicals transported off-site	Yes	Chemicals have been detected in landfill vents.
	Inhalation of particulate produced on-site	Yes	Maintenance activities such as mowing may produce dusts from surface soil.
	Soil		
	Incidental ingestion of site soils	Yes	Workers may be exposed to site soils during maintenance activities (grass mowing, etc.)
	Dermal contact with site soils	Yes	Workers may be exposed to site soils during maintenance activities (grass mowing, etc.)
	Sediment	Yes	It is possible (although unlikely) that maintenance work will bring workers in contact with sediments
	Incidental ingestion during maintenance activities		
	Dermal contact with sediment	Yes	It is possible (although unlikely) that maintenance work will bring workers in contact with sediments
	Surface Water		
	Dermal contact with surface water	No	It is unlikely that maintenance work will involve contact with surface water

Table 9 (contd)

Potentially Exposed Population	Exposure Medium, Route, and Exposure Point	Pathway Selected for Examination?	Reason for Selection or Exclusion
Future Off-Site Residents	Groundwater Ingestion of groundwater from local wells	Yes, exposure limited to the Magothy Formation	While future use of Magothy Formation groundwater is highly improbable, because future use cannot be absolutely precluded, exposure to groundwater from the Magothy Formation is considered a potential exposure pathway. Solute transport calculations indicate that there should be no adverse impacts from constituents detected in B-21R to any potential receptors above the proposed NJDEPE groundwater cleanup standards for 100 years. Therefore, there are no complete exposures to groundwater constituents monitored in well B-21R. In regard to the Merchantville Formation, hydrogeologic conditions, in conjunction with current remedial systems, indicate that potential lateral migration of leachate constituents in the Merchantville Formation is controlled. Hydrogeologic analyses also indicate that vertical migration of leachate constituents to the Magothy Formation should not occur for over 100 years. Therefore, there are no complete exposure routes to Merchantville Formation groundwater.
	Inhalation of volatile chemicals released during showering/bathing.	Yes, exposure limited to the Magothy Formation	
	Dermal absorption of chemicals in groundwater during showering/bathing	Yes, exposure limited to the Magothy Formation	
	Air		
	Inhalation of vapor phase chemicals transported off-site	Yes	Chemicals have been detected in landfill vents. These chemicals may be transported off-site by prevailing winds.
	Inhalation of particulate transported off-site	No	The site is almost entirely covered by grass, greatly reducing the potential for creation of significant amounts of dust

Table 9 (contd)

Potentially Exposed Population	Exposure Medium, Route, and Exposure Point	Pathway Selected for Examination?	Reason for Selection or Exclusion
Future Off-Site Residents (contd)			
	Sediment		
	Incidental ingestion while at play	Yes	Children may play in low-lying areas adjacent to the site
	Dermal contact with sediment while at play	Yes	Children may play in low-lying areas adjacent to the site
	Surface Water		
	Dermal contact with water while at play	Yes	Children may play in streams formed during rainy periods
Future On-Site Recreational Population			
	Air		
	Inhalation of vapor phase chemicals released on-site	Yes	Chemicals have been detected in air released from landfill vents.
	Soil		
	Incidental ingestion of site soils	Yes	Children at play may ingest soil
	Dermal contact with site soils	Yes	Children at play may contact soil
	Inhalation of particulate produced on-site	Yes	Children at play may inhale dust particles
	Sediment		
	Incidental ingestion while at play	Yes	Children may play in low-lying areas adjacent to the site
	Dermal contact with sediment while at play	Yes	Children may play in low-lying areas adjacent to the site
	Surface Water		
	Dermal contact with water while at play	Yes	Children may play in streams during rainy periods

Table 10

Calculation of Intakes of the Chemicals of Concern in Air, Soil, Sediment, Groundwater, and Surface Water

Exposure Pathway	Exposure Equation	Exposure variables
Air Inhalation of vapor phase chemicals	$\frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$	CA = Concentration in air (mg/m3) IR = Inhalation rate (m3/hour or m3/day) ET= Exposure time (hours/day; this variable not needed when IR is expressed in m3/day) EF = Exposure Frequency (days/year) ED = Exposure duration (years) BW =Body weight (kg) AT =Averaging time (period over which exposure is averaged (for non-carcinogens: ED x 365 days/year; for carcinogens: 70 years x 365 days/year)
Inhalation of particulate phase chemicals	$\frac{C \times PC \times IR \times RF \times ET \times EF \times ED \times CF}{BW \times AT}$	C = Concentration of chemical in particulate (mg/kg) IR = Inhalation Rate (m3/hour) PC = Particulate Concentration in Air (mg/m3) RF = Respirable Fraction (unitless) ET= Exposure Time (hours/day) EF = Exposure Frequency (days/year) ED = Exposure Duration (years) CF = Conversion Factor (10^{-6} kg/mg) BW = Body Weight (kg) AT =Averaging Time (period over which exposure is averaged (for non-carcinogens: ED x 365 days/year; for carcinogens: 70 years x 365 days/year)
Soil or Sediment Ingestion of soil or sediment	$\frac{CS \times IR \times FI \times EF \times ED \times CF}{BW \times AT}$	CS = Chemical concentration in soil (mg/kg) IR = Ingestion rate (mg soil/day) FI = Fraction ingested from contaminated source EF = Exposure frequency (days/year) ED = Exposure duration (years) CF= Conversion factor (1×10^{-6} kg/mg) BW = Body weight (kg) AT =Averaging time (period over which exposure is averaged (for non-carcinogens: ED x 365 days/year; for carcinogens: 70 years x 365 days/year)

Table 10
(contd)

Exposure Pathway	Exposure Equation	Exposure variables
Groundwater or Surface Water Ingestion of groundwater	$\frac{CW \times IR \times EF \times ED}{BW \times AT}$	CW = Chemical concentration in water (mg/L) IR = Ingestion rate (liters/day) EF = Exposure Frequency (days/year) ED = Exposure duration (years) BW =Body weight (kg) AT =Averaging time (period over which exposure is averaged (for non-carcinogens: ED x 365 days/year; for carcinogens: 70 years x 365 days/year)
Dermal contact with groundwater or surface water	$\frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$	CW = Chemical concentration in water (mg/L) SA = Skin surface area available for contact (cm2) PC = Dermal permeability constant (cm/hr) ET = Exposure time (hours/day) EF = Exposure frequency (days/year) ED = Exposure duration (years) CF = Volumetric conversion factor for water (1 L/1000 cm3) BW = Body weight (kg) AT =Averaging time (period over which exposure is averaged (for non-carcinogens: ED x 365 days/year; for carcinogens: 70 years x 365 days/year)

Table 11

Summary of Exposure Assumptions: Ingestion of Chemicals in Groundwater

Population	Receptor	Body Weight (BW) (kg)	†Ingestion Rate (IR) (liters of groundwater ingested per day)	†Exposure Frequency (EF)	†Exposure Duration (ED) (years)
Future resident	Adult	70[a]	1.4/2[a]	350 days per year [a]	9/30[c]

Table 3-10

Summary of Exposure Assumptions: Dermal Absorption of Chemicals in Groundwater and Surface Water

Population	Receptor	Body Weight (BW) (kg)	Exposed Skin Surface Area (SA) (cm^2)	†Exposure Time (ET)	†Exposure Frequency (EF)	†Exposure Duration (ED) (years)
Groundwater Future residents-bathing	Adult	70[a]	18,150[b]	0.2 hours per day[c]	350 days per year[a]	9/30[c]
Surface Water Current residents-wading	Child	37[b]	3000[b]	1/2.6 hours per day[c]	7/20 days per year	7
Future recreational child-wading	Adult	15[a]	2300[b]	1/2.6 hours per day[c]	7/20 days per year	6[a]

†Exposure parameters for which an average exposure case (AEC) and reasonable maximum exposure (RME) assumptions are selected are designated by a slash mark (/). The AEC assumption precedes the slash mark and the RME value follows it.
References for exposure parameters: (1) EPA, 1991a; (2) EPA, 1989(b); (3) EPA, 1989(a); all unlabeled parameters-empirically derived

Table 12

Summary of Exposure Assumptions: Ingestion of Chemicals in Soil and Sediment

Population	Receptor	Body Weight (BW) (kg)	†Ingestion Rate (IR) (mg of soil or sediment ingested per day)	Fraction ingested from contaminated source (FI) (unitless)	†Exposure Duration (ED) (years)	†Exposure Frequency (EF)
Soil						
Current trespasser	Child	37[b]	50/100[d,a]	1	7	25/90 events per year
Current site workers	Adult	70[a]	25/50[d,a]	1	25[a]	26/78 days per year
Future recreational population	Child	15[a]	91/200[d,a]	1	6[a]	30/120 events per year
Sediment						
Current residents	Child	37[b]	50/100[d,a]	1	7	20/60 events per year
Current site workers	Adult	70[a]	25/50[d,a]	1	25[a]	26/78 days per year
Future recreational population	Child	15[a]	91/200[e,a]	1	6[a]	20/60 events per year

†Exposure parameters for which an average exposure case (AEC) and reasonable maximum exposure (RME) assumptions are designated by a slash (/). The AEC assumption precedes the slash and the RME value follows it.

References for exposure parameters: (a) EPA, 1991a; (b) EPA, 1989(b); (c) EPA, 1989(a); (d) LaGoy, 1987; (e) Thompson and Burmaster, 1991; all unlabeled parameters are empirically derived

Table 13

Summary of Exposure Assumptions: Inhalation of Chemicals in Air

Population	Receptor	Body Weight (BW) (kg)	†Inhalation Rate (IR)	Fraction of Particulate Respirable (RF) (unitless)	†Exposure Time (ET)	†Exposure Frequency (EF)	†Exposure Duration (ED) (years)
Inhalation of Vapor Phase Chemicals[1]							
Current residents	Adult	70[a]	20 m^3 per day[a]	-	-	350 days per year[a]	9/30[c]
Current trespasser	Child	37[b]	1 m^3/2.1 m^3 per hour[b]	-	1/3 hours per day	25/9 days per year	7
Current site workers	Adult	70[a]	20 m^3 per work day[a]	-	-	26/78 days per year[a]	25[a]
Future resident inhaling chemicals while showering	Adult	70[a]	0.96 m^3/hr[b]	-	0.20 hour per day[c]	350 days per year[a]	9/30[c]
Future on-site recreational population	Child	15[a]	0.6 m^3/1.5 m^3 per hour[b]	-	3 hours per day	30/120 days per year	6[a]
Inhalation of Particulate Phase Chemicals[2]							
Current residents	Child	37[b]	1 m^3/2.1 m^3per hour[b]	0.5	0.5/3 hours per day	25/90 days per year	7
Current site workers	Adult	70[a]	20 m^3 per day[a]	0.5	-	26/78 days per year	25[a]
Current on-site workers	Child	15[a]	0.6 m^3/1.5 m^3per hour[b]	0.5	3 hours per day	30/120 days per year	6[a]

1Exposure concentrations of vapor phase chemicals in air are modeled using the methods described in Appendix C. Exposure concentrations in air during a shower are calculated using the method described in GRI (1988)

2Exposure concentrations of particulate phase chemicals in air are calculated by assuming a particulate concentration in air of 0.10mg/m^3 and that air particulates are exclusively composed of dust generated from site surface soil for future residents but with no more than 1/2 of this material being comprised of resuspended site soil for off-site residents. Given these assumptions, exposure concentrations may be calculated by multiplying 0.10 mg/m^3 by the concentration of the chemical in soil in mg of chemical per mg of soil (mg chemical/1,000,000 mg soil).

†Exposure parameters for which an average exposure case (AEC) and reasonable maximum exposure (RME) assumptions are selected are designated by a slash mark (/). The AEC assumption precedes the slash mark and the RME value follows it.

- Parameter not applicable

References for exposure parameters: a EPA, 1991(a); b EPA, 1989(b); c EPA, 1989(a); all unlabeled parameters empirically derived

Table 14

Inhalation Reference Doses and Slope Factors for Chemicals of Concern

Chemical	Reference Doses					Slope Factors		
	Non-carcinogenic Effects	RfD Subchronic (mg/kg/day)	Safety Factor	RfD Chronic (mg/kg/day)	Safety Factor	Carcinogenic Effects	Slope Factor (mg/kg/day)-1	EPA Group
Aluminum	-	DI	NA	DI	NA	NA	NA	-
Arsenic	NA	ND	NA	ND	NA	Respiratory tract tumors	5.00E+01	A
Barium	Fetotoxicity	1.00E-03	100	1.00E-04	1000	NA	NA	-
Beryllium	NA	ND	NA	ND	NA	Lung tumors	8.40E+00	B2
Cadmium (water)	Cancer	NA	NA	NA	NA	Respiratory tract tumors	6.10E+00	B1
Chromium (III)	-	ND	NA	ND	NA		NA	-
Chromium (VI)	-	ND	NA	ND	NA	Respiratory tract tumors	4.10E+01	A
Cobalt	-	ND	NA	ND	NA	NA	NA	-
Copper (mg/l)	NA	ND	NA	ND	NA	NA	NA	-
Lead	NA	ND	NA	ND	NA	NA	ND	B2
Manganese	Respiratory symptoms and psychomotor disturbances	1.14E-04[a]	900	1.14E-04[a]	900	NA	NA	-
Mercury	Neurotoxicity	8.57E-05[a]	30	8.57E-05[a]	30	NA	NA	-
Nickel	Cancer	ND	NA	ND	NA	Respiratory tract tumors	1.70E+00	A
Silver	NA	ND	NA	ND	NA	NA	NA	-
Vanadium	NA	ND	NA	ND	NA	NA	NA	-
Anthracene	NA	ND	NA	ND	NA	NA	NA	-
Benzo[a]anthracene	NA	ND	NA	ND	NA	NA	6.10E+00	B2
Benzo[a]pyrene	NA	ND	NA	ND	NA	Respiratory tract tumors	6.10E+00	B2
Benzo[b]fluoranthene	NA	ND	NA	ND	NA	NA	6.10E+00	B2
Benzo[g,h,i]perylene	NA	ND	NA	ND	NA	NA	6.10E+00	B2
Benzoic Acid	NA	ND	NA	ND	NA	NA	NA	-

Table 14

(contd)

Chemical	Reference Doses					Slope Factors		
	Non-carcinogenic Effects	RfD Subchronic (mg/kg/day)	Safety Factor	RfD Chronic (mg/kg/day)	Safety Factor	Carcinogenic Effects	Slope Factor (mg/kg/day)-1	EPA Group
Carbon Tetrachloride	NA	ND	NA	ND	NA	Liver tumors	1.30E-01	B2
Chrysene	NA	DI	NA	DI	NA	NA	6.10E+00	B2
DDD	NA	ND	NA	ND	NA	NA	NA	B2
DDE	NA	ND	NA	ND	NA	NA	ND	B2
DDT	NA	ND	NA	ND	NA	Liver tumors	3.40E-01	B2
Fluoranthene	NA	ND	NA	ND	NA	NA	NA	-
Fluorene	NA	ND	NA	ND	NA	NA	NA	-
Heptachlor	NA	ND	NA	ND	NA	Liver tumors	4.50E+00	B2
Indeno[1,2,3-c,d]pyrene	NA	ND	NA	ND	NA	NA	6.10E+00	B2
4-Methyl-2-Pentanone (Methylisobutyl ketone)	Liver and kidney effects	2E-1	100	2E-2	1000	NA	NA	-
Naphthalene	NA	ND	NA	ND	NA	NA	NA	-
Phenanthrene	NA	DI	NA	DI	NA	NA	NA	-
Pyrene	NA	ND	NA	ND	NA	NA	NA	-
Tetrachloroethylene[b]	NA	ND	NA	ND	NA	Leukemia, liver tumors	1.82E-03[b]	B2
Trichloroethylene	NA	ND	NA	ND	NA	Lung tumors	1.70E-02	B2
Trichlorofluoromethane	Elevated BUN, lung lesions	2.00E+00	1000	2.00E-01	10000	NA	NA	-

DI = Data Inadequate; ND = Not Determined; NA = Not Applicable; Taken from IRIS or the US EPA Health Effects Assessment Summary Tables (1992)

[a]Converted to mg/kg/day from RfC (mg/m^3) using the formula: $\text{RfC} \times \frac{20\ m^3/day}{70\ kg} = \text{RfD}$

[b]Converted to (mg/kg/day)$^{-1}$ from unit risk factor ($\mu g/m^3$)$^{-1}$ using the formula: unit risk factor $\times \frac{70\ kg \times 1000\ \mu g/mg}{20\ m^3}$ = slope factor

Table 15

Oral Reference Doses and Slope Factors for Chemicals of Concern

Chemical	Reference Doses					Slope Factors		
	Non-carcinogenic Effects	RfD Subchronic (mg/kg/day)	Safety Factor	RfD Chronic (mg/kg/day)	Safety Factor	Carcinogenic Effects	Slope Factor (mg/kg/day)-1	EPA Group
Aluminum	NA	DI	NA	ND	NA	NA	NA	-
Arsenic	Keratosis and hyper-pigmentation	3.00E-04	1	3.00E-04	1	Skin tumors	a1.75E+01	A
Barium	Increased blood pressure	5.00E-02	100	5.00E-02	100	NA	NA	-
Cadmium (water)	Renal damage	ND	NA	5.00E-04	10	NA	NA	-
Chromium (III)	Hepatotoxicity	1.00E+01	100	1.00E+00	1000	NA	NA	-
Chromium (VI)	ND	2.00E-02	100	5.00E-03	500	NA	NA	-
Cobalt	NA	ND	NA	ND	NA	NA	NA	-
Copper	Local GI irritation	1.30 mg/L	NA	1.30 mg/L	NA	NA	NA	-
Lead	CNS effects	ND	NA	ND	NA	NA	ND	B2
Manganese	No effect	1.00E-01	1	1.00E-01	1	NA	NA	-
Mercury	Kidney effects	3.00E-04	1000	3.00E-04	1000	NA	NA	-
Nickel	Reduced body and organ weight	2.00E-02	300	2.00E-02	300	NA	NA	-
Silver	Argyria	3.00E-03	2	3.00E-03	2	NA	NA	-
Vanadium	None observed	7.00E-03	100	7.00E-03	100	NA	NA	-
Anthracene	No effects	3.00E+00	300	3.00E-01	3000	NA	NA	-
Benzo[a]anthracene	NA	ND	NA	ND	NA	NA	5.80E+00	B2
Benzo[a]pyrene	NA	ND	NA	ND	NA	Stomach tumors	5.80E+00	B2

Table 15
(contd)

Chemical	Reference Doses					Slope Factors		
	Noncarcinogenic Effects	RfD Subchronic (mg/kg/day)	Safety Factor	RfD Chronic (mg/kg/day)	Safety Factor	Carcinogenic Effects	Slope Factor (mg/kg/day)-1	EPA Group
Benzo[b]fluoranthene	NA	ND	NA	ND	NA	NA	5.80E+00	B2
Benzo[g,h,i]perylene	NA	ND	NA	ND	NA	NA	5.80E+00	B2
Benzoic Acid	Irritation, malaise	4.00E+00	1	4.00E+00	1	NA	NA	-
Carbon Tetrachloride	Liver lesions	7.00E-03	100	7.00E-04	1000	Liver tumors	5.80E-00	B2
Chrysene	NA	DI	NA	DI	NA	NA	5.80E+00	B2
DDD	NA	ND	NA	ND	NA	Liver tumors	2.40E-01	B2
DDE	NA	ND	NA	ND	NA	Liver tumors	3.40E-01	B2
DDT	Liver lesions	5.00E-04	100	5.00E-04	100	Liver tumors	3.40E-01	B2
Fluoranthene	Liver weight changes, hematological changes	4.00E-01	300	4.00E-02	3000	NA	NA	-
Fluorene	Decreased RBC	4.00E-01	300	4.00E-02	3000	NA	NA	-
Heptachlor	Increased liver weight	5.00E-04	300	5.00E-04	300	Liver tumors	4.50E+00	B2
Indeno[1,2,3-c,d]pyrene	NA	ND	NA	ND	NA	NA	5.80E+00	B2
4-Methyl-2-Pentanone (Methylisobutyl ketone)	Liver and kidney effects	5.00E-1	100	5.00E-2	1000	NA	NA	-
Naphthalene	Decreased body weight gain	4.00E-02	1000	4.00E-03	10000	NA	NA	-
Phenanthrene	NA	DI	DI	DI	NA	NA	NA	-
Pyrene	Renal effects	3.00E-01	300	3.00E-02	3000	NA	NA	-
Tetrachloroethylene	Hepatotoxicity	1.00E-01	100	1.00E-02	1000	Liver tumors	5.10E-02	B2
Trichloroethylene	NA	ND	NA	ND	NA	Liver tumors	1.10E-02	B2
Trichlorofluoromethane	Mortality	7.00E-01	1000	3.00E-01	1000	NA	NA	-

DI = Data Inadequate; ND = Not Determined; NA = Not Applicable or Not Available; Taken from IRIS or the US EPA Health Effects Assessment Summary Tables (1992)

[a]The following calculation was performed to derive an oral slope factor for arsenic: $\frac{5 \times 10^{-5}\ L}{\mu g} \times \frac{day}{2L} \times 70\ kg \times \frac{1000\ \mu g}{mg} = 1.75\ (mg/kg/day)^{-1}$

Table 16

Dermal Reference Doses for Chemicals of Concern

Chemical	Gastrointestinal absorption factor[a]	Chronic Dermal Reference Dose[b]
Aluminum	0.005	-
Barium	0.07	2.08E-03
Cadmium	0.05	3.46E-03
Chromium	0.11	1.44E-03
Cobalt	0.3	-
Manganese	0.04	4.00E-03
Mercury	0.15	4.50E-05
Nickel	0.05	5.46E-03
Silver	0.18	5.86E-04
Vanadium	0.03	1.40E-02
4-Methyl 2-Pentanone	1	1.43E-04
Trichlorofluoromethane	1	8.87E-05

[a]Gastrointestinal (GI) absorption factors are from the ATSDR Toxicological Profiles for Aluminum and Compounds, Barium, Cadmium, Chromium, Cobalt, Manganese, Mercury, Nickel, and Vanadium. The GI absorption factor for silver is from the Handbook of The Toxicology of Metals, Volume II (1986) Friberg, Nordberg, and Vouk, editors. Although no GI absorption factors were available for 4-methyl 2-pentanone and trichlorofluoromethane, it was assumed that absorption would likely be complete.

[b]Dermal reference doses were calculated by multiplying the oral reference dose by the gastrointestinal absorption factor.

Table 17

Summary of Noncarcinogenic and Carcinogenic Risks for Current and Hypothetical Future Site Conditions

Potentially Exposed Population	Exposure Media, Pathways, and Points of Exposure	[a]Hazard Index	[a]Lifetime Cancer Risk
Current Off-Site Residents			
	Air		
	• Inhalation of vapor phase chemicals transported off-site	-	3E-06
	Sediment		
	• Incidental ingestion while at play	5.0E-02	3E-06
	Surface Water		
	• Dermal contact with water while at play	6.8E-03	-
Current Trespasser			
	Air		
	• Inhalation of vapor phase chemicals released on-site	-	3E-06
	Soil		
	• Incidental ingestion of site soils	6.7E-02	4E-06
	• Inhalation of particulates produced on-site	-	9E-08
Current Site Workers			
	Air		
	• Inhalation of vapor phase chemicals on-site	-	3E-07
	Soil		
	• Incidental ingestion of site soils	1.5E-02	3E-06
	• Inhalation of particulates produced on-site	-	5E-07
	Sediment		
	• Incidental ingestion	1.8E-02	4E-06

Table 17
(contd)

Potentially Exposed Population	Exposure Media, Pathways, and Points of Exposure	[a]Hazard Index	[a]Lifetime Cancer Risk
Future Off-Site Residents			
	Groundwater		
	• Ingestion of groundwater from local wells	6.9E-01	-
	• Inhalation of volatile chemicals released during showering/bathing.	1.1E-04	-
	• Dermal absorption of chemicals in groundwater during showering/bathing	3.6E-02	-
Future On-Site Recreational Population			
	Air		
	• Inhalation of vapor phase chemicals released on-site	-	5E-07
	Soil		
	• Incidental ingestion of site soils	4.4E-01	2E-05
	• Inhalation of particulates produced on-site	-	2E-07
	Sediment		
	• Incidental ingestion while at play	2.5E-01	1E-05
	Surface Water		
	• Dermal contact with water while at play	1.3E-02	-

[a]For the sake of conservatism and clarity, only reasonable maximum exposure (RME) case risk estimates are presented in this table

Note: Cancer risk was not calculated for the future off-site residential use scenario associated with the ground water for the following reasons:

1. Inhalation Route: Cancer slope factors are available only for cadmium, chromium and nickel out of the final chemicals of concern listed in Table 2. Since these metals are not expected to volatilize, cancer risk was not calculated.

2. Oral (ingestion) and Dermal (direct contact) Routes: No cancer slope factors are available for the final chemicals of concern listed in Table 3.

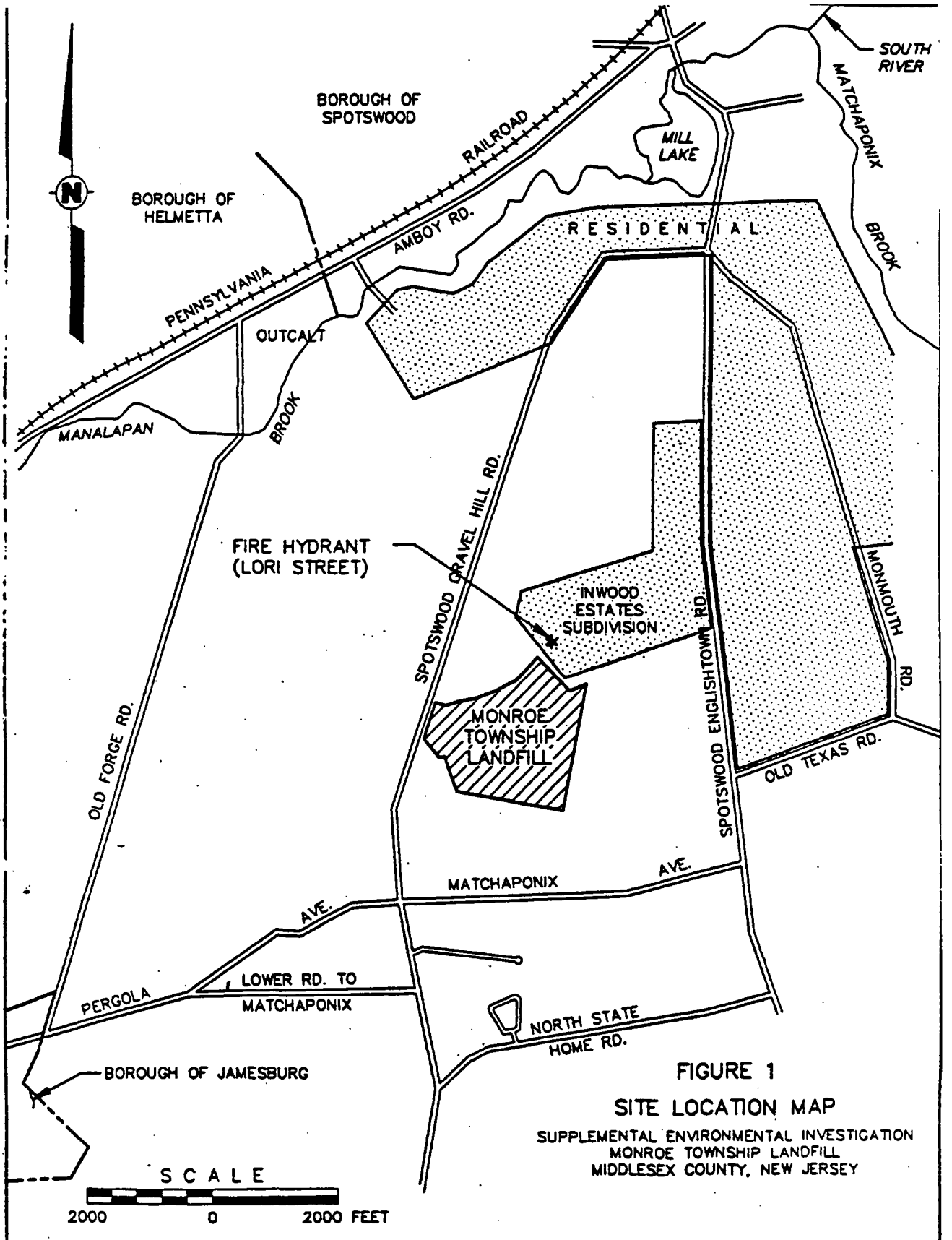


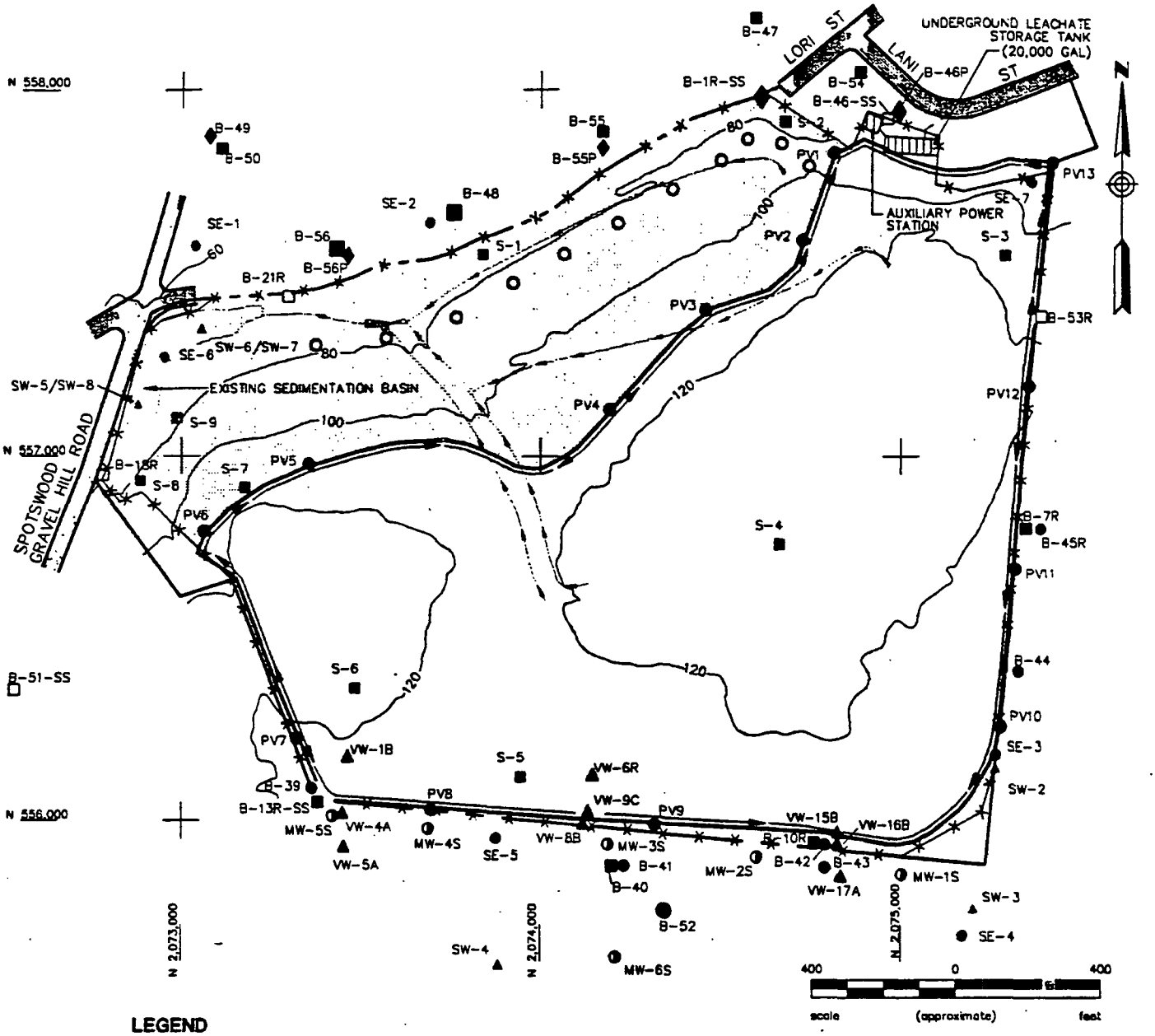
FIGURE 1

SITE LOCATION MAP

SUPPLEMENTAL ENVIRONMENTAL INVESTIGATION
MONROE TOWNSHIP LANDFILL
MIDDLESEX COUNTY, NEW JERSEY

REFERENCE:

MAP OF MONROE TWP., MIDDLESEX CO., N.J. 1983, PREPARED BY HARRY APPLEGATE, TOWNSHIP ENGINEER.



LEGEND

- SENTINEL MONITORING POINTS
- SENTINEL PIEZOMETER
- MAGOTHY FORMATION MONITORING WELL
- MONITORING WELL WITHIN PERCHED WATER ZONE OF THE MAGOTHY FORMATION
- MERCHANTVILLE FORMATION MONITORING WELL
- MERCHANTVILLE FORMATION MONITORING WELL (SCHEDULE 40 PVC)
- PASSIVE GAS VENT
- PROPOSED PASSIVE GAS VENTS
- SOIL SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION
- PROTECTIVE CLAY CAP
- PROTECTIVE SOIL CAP
- LEACHATE COLLECTION SYSTEM
- COMPACTED CLAY CUTOFF WALL
- SURFACE DRAINAGE CHANNEL WITH RIP RAP
- LANDFILL PROPERTY BOUNDARY LINE
- SEWER CONNECTION
- 7 FT HIGH SECURITY FENCE

FIGURE 2
MONROE TOWNSHIP LANDFILL

TABLE 1

COMPARISON OF DETECTED CONSTITUENT CONCENTRATIONS
TO PROPOSED NJDEPE GROUNDWATER CLEANUP STANDARDS AND FEDERAL MCLs.
MONROE TOWNSHIP LANDFILL
MONROE, NEW JERSEY

PARAMETERS	MAGOTHY FORMATION, CLASS IIA, RANGE OF DETECTED CONCENTRATIONS (ug/L)	PERCHED ZONES WITHIN MAGOTHY FORMATION, RANGE OF DETECTED CONCENTRATIONS (ug/L), (2)	MERCHANTVILLE FORMATION, CLASS IIIA, RANGE OF DETECTED CONCENTRATIONS (ug/L), (3)	PROPOSED NJDEPE GROUNDWATER CLEANUP STANDARDS (ug/L)	FEDERAL MCLs (ug/L)
I. METALS					
Aluminum	57.5–44,300	1,710–5,220	119.0–7,520	NS	NS
Antimony	2.6–3.7	3.7–3.7	2.1–2.1	20.0	6.0
Arsenic	0.5–10.1	1.5–7.8	1.2–41.4	8.0	50.0
Barium	19.5–258.0	21.0–52.9	23.3–1,650	2,000	1,000*
Beryllium	0.4–3.7	0.4–0.6	0.2–1.2	20.0	4.0
Cadmium	0.2–16.0	0.7–1.3	0.34–11.0	4.0	5.0
Calcium	1,800–67,900	11,100–60,600	285.0–80,100	NS	NS
Chromium	0.4–31.9	5.7–6.2	1.5–70.0	100.0	100.0
Cobalt	4.5–172.0	9.8–30.5	5.5–38.3	NS	NS
Copper	2.8–27.0	2.1–20.0	2.1–18.0	NS	NS
Iron	2,120–168,000	286.0–34,500	345.0–300,000	NS	NS
Lead	0.5–10.9	1.8–8.2	0.44–30.0	10.0	15.0
Magnesium	1,750–17,000	3,990–19,400	2,090–100,000	NS	NS
Manganese	116.0–918.0	627.0–3,240	171.0–4,220	NS	NS
Mercury	0.1–0.3	0.1–2.0	0.08–0.2	2.0	2.0
Nickel	5.0–226.0	12.0–65.0	3.2–93.0	100.0	100.0
Potassium	983.0–35,500	1,630–7,420	886.0–14,600	NS	NS
Selenium	1.5–1.9	ND	0.72–3.1	50.0	50.0
Silver	2.6–3.9	ND	1.1–4.3	20.0	NS
Sodium	1,320–145,000	1,520–29,200	4,120–25,100	NS	NS
Thallium	1.1	1.2–1.2	1.5–1.5	10.0	2.0
Vanadium	5.4–67.2	16.1–16.1	8.3–65.4	NS	NS
Zinc	4.9–884.0	93.9–281.0	7.3–160.0	5,000	NS
Cyanide	ND	ND	ND	200.0	200.0
II. VOLATILE ORGANICS					
Acetone	5.0–63.0	15.0–32.0	8.0–1,950	700.0	NS
Acrylonitrile	9.9	ND	ND	20.0	NS
Benzene (1)	2.0–3.7	2.0–22.1	1.0–12.0	1.0	5.0
2-Butanone	ND	ND	46.0–3,200	300.0	NS
Chlorobenzene (1)	6.4–14.0	2.0–2.0	2.9–2.9	5.0	100.0
Chloroethane	5.3	ND	8.9–8.9	NS	NS
Dichlorodifluoromethane	ND	ND	103.0–292.0	NS	NS
1,1-Dichloroethane (1)	13.4–19.6	ND	9.42–13.1	70.0	NS
1,2-Dichloroethane (1)	11.1–16.9	ND	ND	2.0	5.0
1,1-Dichloroethene (1)	1.3–4.0	ND	ND	2.0	7.0

TABLE 1

COMPARISON OF DETECTED CONSTITUENT CONCENTRATIONS
TO PROPOSED NJDEPE GROUNDWATER CLEANUP STANDARDS AND FEDERAL MCLs.
MONROE TOWNSHIP LANDFILL
MONROE, NEW JERSEY

PARAMETERS	MAGOTHY FORMATION, CLASS IIA, RANGE OF DETECTED CONCENTRATIONS (ug/L)	PERCHED ZONES WITHIN MAGOTHY FORMATION, RANGE OF DETECTED CONCENTRATIONS (ug/L), (2)	MERCHANTVILLE FORMATION, CLASS IIIA, RANGE OF DETECTED CONCENTRATIONS (ug/L), (3)	PROPOSED NJDEPE GROUNDWATER CLEANUP STANDARDS (ug/L)	FEDERAL MCLs (ug/L)
1,2-Dichloroethene (total) (1)	1.5-3.9	18.0-264.0	ND	10.0	70.0(cis)
Ethylbenzene	ND	ND	3.36-4.2	700.0	700.0
2-Hexanone	ND	ND	570.0-570.0	NS	NS
Methylene Chloride	2.1-58.8	1.0-4.9	1.96-670.0	30.0	5.0
4-Methyl 2-Pentanone	91.0	ND	390.0	400.0	NS
1,1,2,2-Tetrachloroethane	2.0	ND	ND	2.0	NS
Toluene	2.0-67.0	ND	0.7-19.6	1,000	1,000
Trichloroethene	ND	ND	1.0	1.0	5.0
Trichlorofluoromethane	0.8-11.2	ND	0.85-7.4	NS	NS
Vinyl Chloride (1)	8.4-13.7	4.3-33.8	ND	2.0	2.0
III. SEMIVOLATILE ORGANICS					
Benzoic Acid	ND	ND	580.0-580.0	NS	NS
Bis(2-ethylhexyl)phthalate	9.8	0.4-179.0	ND	30.0	6.0
Di-N-Butylphthalate	0.4	0.2-0.2	0.3-0.3	900.0	NS
Di-N-Octylphthalate	3.4	10.9-10.9	4.4-4.4	100.0	NS
1,2-Dichlorobenzene (1)	3.0-5.1	ND	ND	600.0	600.0
2,6-Dinitrotoluene	36.5	46.3-46.3	32.8-32.8	10.0	NS
Phenol	ND	ND	78.8-1,000	4,000	NS

NOTES:

ND - constituent not detected in the medium indicated
NS - no NJDEPE proposed cleanup standard or Federal MCL exist
(1) - Constituent concentrations (which were not eliminated as Constituents of Interest in the Baseline Risk Assessment due to suspect laboratory contamination, present in blank samples or detection in 5% or fewer samples) were found above the NJDEPE proposed cleanup standard or Federal MCL only in monitoring well 21-R and were eliminated in the Baseline Risk Assessment due to incomplete exposure.
(2) - Constituent concentrations in the Perched Zone within Magothy Formation were found above the NJDEPE Proposed Cleanup Standard or MCL only in monitoring wells B-1R-SS and B-46P.
(3) - Constituent concentrations found in Merchantville Formation above the Proposed NJDEPE Cleanup Standards or MCLs in monitoring wells B-39, B-41, B-42, B-43 and B-45.
* - MCL for Barium proposed to be increased to 2.0 mg/L, January 1, 1993