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Superfund Record of Decision:

Warwick Landfill, NY

50272-101

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 13-acre Warwick Landfill is an inactive municipal and industrial waste disposal site in the Town of Warwick, Orange County, New York. Land use in the area is predominantly residential, and the site is surrounded by woodlands and wetlands. The estimated 3,000 people who reside approximately 1.5 miles northeast of the site use residential wells as a source of drinking water. From 1898 until its closure in 1978, the Warwick Landfill accepted municipal and industrial wastes and sludge. Landfill contamination is attributed to the unpermitted and illegal disposal practices conducted by waste haulers and trespassers. As a result of reports of illegal onsite dumping in 1979, and an inspection after a property transfer in 1984, State investigations were conducted, and revealed soil, sediment, ground water, and surface water contamination throughout the site. This Record of Decision (ROD) addresses the contaminant source, the onsite landfill, and provides an interim ground water remedy for the first operable unit (OU1). The final remedy for ground water (OU2) will be addressed in a subsequent ROD. The primary contaminants of concern affecting the soil, and ground water are VOCs including benzene, TCE, toluene, and

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Warwick Landfill, NY
First Remedial Action
Contaminated Media: soil, gw
Key Contaminants: VOCs (benzene, TCE, toluene, xylenes), other organics (PAHs, phenols), metals (arsenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 98
	20. Security Class (This Page) None	22. Price

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Warwick Landfill, NY
First Remedial Action

Abstract (Continued)

xylenes; other organics including PAHs and phenols; and metals including arsenic, chromium, and lead.

The selected remedial action for this site includes regrading the landfill mound, capping the landfill with a 22-acre multi-layer cover, and installing with a gas venting system; installing and maintaining point-of-use treatment systems consisting of granular activated carbon units at contaminated residential wells until a final ground water remedy can be evaluated; sampling residential wells; monitoring ground water and air; evaluating wetlands adjacent to the property in an effort to mitigate potential threats from the site; and implementing institutional controls including deed restrictions, and site access restrictions such as fencing. The estimated present worth cost for this remedial action is $14,279,600, which includes an annual O&M cost of $526,300 for years 0-3 and $422,900 for years 4-30.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific ground water cleanup goals will be addressed in the final remedial action but water at the point of use must meet Federal MCLs.

ROD FACT SHEET

SITE

Name:	Warwick Landfill
Location/State:	Warwick, Orange County, New York
EPA Region:	II
HRS Score (date):	29.41 (March 1989)
NPL Rank (date):	1022 (February 1991)

ROD

Date Signed: June 27, 1991

Selected Remedy

*Capping of landfill in accordance with 6 NYCRR Part 360 closure requirements;
*Residential well sampling program;
*Provision of point-of-use treatment systems to select residential wells;
*Groundwater monitoring program;
*Landfill gas venting;
*Fencing around perimeter of Site;
*Recommendations that ordinances be established or restrictions imposed on deed to ensure integrity of cap; and,
*Measures to mitigate potential disturbance of adjacent wetlands.

Capital Cost:	$ 7,442,000
O & M:	$ 526,000(yrs 1-3)
	422,900(yrs 4-30)
Present Worth:	$ 14,279,600

LEAD

Remedial, EPA
Primary Contact (phone): Julia E. Allen (212-264-8476)
Secondary Contact (phone): Douglas Garbarini (212-264-0109)

WASTE

Type and media:

Soil-
*VOCs- benzene, ethylbenzene, xylenes, chlorobenzene,
*Inorganics- arsenic, barium, lead, chromium.
Groundwater-
*VOCs- trichloroethane, chloromethane, benzene, xylenes, ethylbenzene, isopropyl benzene, 1,4-dichlorobenzene,
*Inorganics- antimony, barium, lead, chromium, arsenic.

Origin: Pollution originated as a result of illegal disposal of hazardous wastes at this location.

RECORD OF DECISION

WARWICK LANDFILL SITE
TOWN OF WARWICK
ORANGE COUNTY, NEW YORK

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

NEW YORK

DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

Warwick Landfill, Town of Warwick, Orange County, New York

Statement of Basis and Purpose

This decision document presents the selected remedial action for the first operable unit ("OU1") for the Warwick Landfill site ("the Site"), located in the Town of Warwick, Orange County, New York, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601-9675, as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300. This decision document explains the factual and legal basis for selecting the remedy for the Site. The information supporting this remedial action decision is contained in the administrative record for the Site. The administrative record index is attached (Appendix III).

The New York State Department of Environmental Conservation ("NYSDEC") concurs with the selected remedy (Appendix IV).

Assessment of the Site

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

Description of the Selected Remedy

This operable unit represents the first of two operable units planned for the Site. It addresses the principal threats posed by the Site through controlling the source of contamination and provides an interim measure to ensure that area residents have a potable water supply. The second operable unit (OU2) will further characterize the fate and transport of the contaminants emanating from the Site and will serve as the basis for the decision on a final groundwater remedy.

The major components of the selected remedy include:

* Capping of the landfill in accordance with 6 NYCRR Part 360 closure requirements for New York State solid waste landfills;

* Development and monitoring of landfill gas vents throughout the landfill mound;

* Development and implementation of a residential well sampling program;

* Provision of point-of-use treatment systems to local residental wells, as needed;

* Development and implementation of a groundwater monitoring program using existing monitoring wells as well as additional groundwater monitoring wells installed within the landfill mound;

* Construction of fencing around the perimeter of the 25-acre leasehold;

* Recommendations that ordinances be established or restrictions imposed on the deed to ensure that future use of the Site property will maintain the integrity of the cap; and

* Measures to mitigate potential disturbance of adjacent wetlands.

Declaration

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. However, because treatment of the principal threats of the Site was not found to be practicable under OU1, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. The size of the landfill, and the fact that the remedial investigation did not identify on-site hot spots that represent the major sources of contamination, preclude a remedy in which contaminants could be excavated and treated effectively.

Because this action does not constitute the final remedy for the groundwater portion of the Site, the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element will be addressed at the time of the final response action. Subsequent actions are planned to address fully the threats posed by groundwater contamination.

This remedy will result in hazardous substances remaining on-site above health-based levels, thus a review will be conducted no later than five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Constantine Sidamon-Eristoff
Regional Administrator

6/27/91
Date

DECISION SUMMARY
WARWICK LANDFILL SITE

TOWN OF WARWICK
ORANGE COUNTY, NEW YORK

United States Environmental Protection Agency
Region II, New York

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ATTACHMENTS

SITE NAME, LOCATION AND DESCRIPTION

The Warwick Landfill site (the "Site") is located approximately one and one-half miles northeast of the Village of Greenwood Lake in the Town of Warwick, Orange County, New York. The Site is approximately three-fourths of a mile north of State Route 17A and fronts Penaluna Road on its western boundary between Old Tuxedo Road and Old Dutch Hollow Road **(see Figure 1)**. No buildings exist on the landfill property except for a substantially demolished brick structure. The landfill mound transects a small valley and occupies approximately 13 acres of a former 25 acre leasehold area. This leasehold is a portion of a 64 acre parcel of property.

The Village of Greenwood Lake is a semi-rural residential community located approximately forty miles northwest of New York City. Total population of the Village of Greenwood Lake is estimated to be 3,000. The Town of Warwick has a population of approximately 25,000.

Elevations within one mile of the Site range from 700 feet to a little more than 1300 feet MSL; relief is moderate. Broad upland areas are generally underlain by massive rocks. Valleys represent zones of less resistant bedrock and shearing along faults. The dominant features comprising the Site consist of a north-south trending wetlands valley spanned by the northeast trending landfill mound. Maximum relief throughout the Site is approximately 60 feet.

The area surrounding the Site is generally wooded with clusters of residential homes, all of which utilize private wells as their source of drinking water. The two homes closest to the Site are approximately 250 feet southwest of the landfill boundary and 300 feet northeast of the landfill boundary, respectively.

The landfill mound is sparsely vegetated with grasses and small shrubs supporting small mammals (rats, cottontail rabbits and opossum) and some avifauna (bluebirds, robins). Contiguous to the landfill mound are two wetland areas: an emergent marsh/scrub-shrub wetland, approximately nine acres in size, in the southeast; and a smaller, palustrine, forested scrub-shrub, deciduous wetland, approximately three to four acres in size, to the northwest. Upland habitats surround both wetlands.

An unnamed intermittent stream drains the small wetlands area on the northwest side of the Site and flows north into a creek that flows westward and then southward into Greenwood Lake. Another stream, located on the landfill's southeast side, flows southward into the larger wetlands area which is drained by an unnamed perennial stream that flows south and west into Greenwood Lake. Greenwood Lake is designated a Class "A" waterbody by the New York State Department of Environmental Conservation ("NYSDEC").

The wetlands and streams draining the site area do not support fishing or other recreational activities. However, it is a suitable habitat for small aquatic wildlife, such as frogs and turtles.

Two aquifers exist beneath the Site. The overburden aquifer is an unstratified drift deposit consisting of a mixture of clay, silt, sand, gravel, and boulders which widely range in size, shape, and permeability. The bedrock aquifer generally consists of moderately fractured quartz-plagioclase gneiss, hornblende-feldspar gneiss, and amphibolite.

A review of existing flood insurance maps indicated that no portions of the Site are located in either the 100- or 500- year flood zone.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Site was owned and farmed by the Penaluna family from 1898 to the mid-1950s, when the Town of Warwick leased the property from the Penaluna family and utilized it as a refuse disposal area. The facility accepted waste from the Town of Warwick, which includes the Villages of Florida, Warwick and Greenwood Lake, and other surrounding towns in Orange County. Evidence indicates that there was some industrial waste disposed of at the landfill during this time. The Town of Warwick operated the landfill until 1977.

In April 1977, the Site was leased from the property owner, Mrs. Millie Mae Penaluna, by Grace Disposal and Leasing, Ltd. ("Grace Disposal"), Harriman, New York. On July 15, 1977, Grace Disposal was granted a permit to operate the refuse disposal area by the Orange County Department of Health ("OCDOH"). Under Grace Disposal's operation, municipal wastes and industrial wastes/sludges were disposed of in the landfill.

In 1978, the State of New York took over the regulation of landfills from the counties. In February, 1978, Grace Disposal submitted an application to NYSDEC to operate the Warwick Landfill. A Draft Environmental Impact Statement ("DEIS") was compiled for a NYSDEC Solid Waste Management Facility operation permit at the Site by P. Joseph Corless, Consulting Engineers, Inc. on December 27, 1978. The DEIS findings indicated that approximately 300,000 cubic yards of refuse per year were handled at the landfill for an unspecified duration. It also concluded that leachate and surface run-off generated at the Site did not measurably affect surface water and groundwater in the area, and also, that the water quality of the stream which drains the wetland area south of the Site was in compliance with New York State Surface Water Standards. However, the NYSDEC requested additional information from the applicant which included the

drilling and water sampling of on-site monitoring wells and boring and analyses of on-site soils.

In 1979, in response to concerns of local citizens who had reported observations of suspicious dumping activities at the landfill, the NYSDEC and the EPA collected and analyzed two leachate samples at the Site. The results indicated the presence of heavy metals, phenols, and various volatile organic compounds, some of which exceeded the New York State Drinking Water Standards and the USEPA National Primary Drinking Water Regulations.

Based on the results of these samples and that Grace Disposal did not perform the additional tasks necessary for the submittal of an adequate DEIS within a reasonable time period, the application to operate the landfill was denied by NYSDEC on September 4, 1979, and the landfill was ordered to be closed.

Pursuant to a New York State court order, the Site was covered, graded, and closed by Grace Disposal. On June 11, 1980, NYSDEC was notified that a Certificate of Dissolution had been filed by Grace Disposal.

In 1984, ownership of the property was transferred to Orange County for non-payment of back taxes. It was conveyed from Orange County to Newburgh N.Y. Developers in November 1986. In 1987, the property was transferred to the current owners, L and B Developers, Inc.. On March 22, 1991 a federal lien was filed at the Orange County Courthouse, Goshen, New York which secures payment to the United States of all costs and damages for which L and B Developers, Inc. is liable to the United States pursuant to Section 107(a) of CERCLA, 42 U.S.C. §9607(a).

In March 1985, a field investigation program was performed by Woodward-Clyde Consultants, Inc. for the NYSDEC. The information generated was utilized to prepare a Hazard Ranking System ("HRS") assessment of the Site. Based upon the HRS score, the Site was proposed for inclusion on EPA's National Priorities List ("NPL") of uncontrolled hazardous waste sites in 1985 and was added to the NPL in March 1989.

On December 28, 1988, special notice letters were sent to fourteen entities who were determined at that time to be potentially responsible parties ("PRPs") at the Site. These entities were: All County Environmental Services Corporation; All County Resource Management Corporation; Ford Motor Company; Grace Disposal & Leasing, Ltd.; Instrument Systems Corporation/Lightron Corporation; International Paper; I.S.A. of New Jersey, Inc.; L & B Developers; Jones Chemicals; Nepera, Inc.; New York University Medical Center; Reichold Chemicals, Inc.; Round Lake Sanitation Corporation; and Union Carbide Corporation. The special notice letters informed these parties

of their potential liability at the Site and offered them the opportunity to undertake the RI/FS for the Site. The PRPs were given sixty days from receipt of notice to submit a good faith offer.

Since EPA did not receive any good faith proposals from the PRPs to undertake or finance the Remedial Investigation/Feasibility Study ("RI/FS"), EPA contracted Ebasco Services, Incorporated to perform the RI/FS using monies from the Superfund ("the Fund"). Field work for the RI/FS began in August 1989 and was completed in February 1991.

Based upon information received through responses to information request letters, EPA sent general notice letters on February 27, 1991 to Georgia Pacific Corporation and the Town of Warwick, informing them of their status as PRPs.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS reports and the Proposed Plan ("PP") for the Site were released for public comment on February 25, 1991. These documents were made available to the public in the administrative record file at the EPA Docket Room in Region II, New York and the information repositories at the New York State Department of Environmental Conservation, Albany, New York, the Warwick Town Hall, Warwick, New York and Greenwood Lake Village Hall, Greenwood Lake, New York. A press release announcing the availability of these documents was issued on February 25, 1991. The public comment period was set by EPA to end on March 26, 1991.

Two extensions to the public comment period were requested by the Dutch Hollow Homeowners' Association ("DHHA"), the Technical Assistance Grant ("TAG") recipient, at the Site. First, a thirty day extension to the public comment period was granted. Second, a two week extension was granted. These extensions were granted to afford the DHHA's technical advisor sufficient opportunity to review and comment on the RI/FS and PP. The public comment period closed on May 9, 1991.

During the public comment period EPA held a public meeting to present the RI/FS reports and the Proposed Plan, answer questions, and accept both oral and written comments. The public meeting was held in the cafeteria of the Greenwood Lake Middle School, Greenwood Lake, New York on April 22, 1991. At this meeting, representatives from the EPA, the NYSDEC and the New York State Department of Health ("NYSDOH") answered questions about problems at the Site and the remedial alternatives under consideration and received comments from the local citizens and the Technical Advisor Grant ("TAG") consultants. Responses to the comments received during the public comment period are

included in the Responsiveness Summary (see Appendix V).

SCOPE AND ROLE OF OPERABLE UNIT

EPA has divided the remedial work necessary to mitigate both off-site and on-site contamination stemming from the Site into two operable units. The first operable unit addresses the control of the source of contamination at the Site and is the focus of this document.

The purpose of the response action under OU1 is to: 1) minimize the infiltration of rainfall and snow melt into the landfill, which will reduce the quantity of water percolating through the landfill materials and leaching out contaminants; 2) eliminate the risk to area residents associated with contaminated groundwater ingestion and exposure; 3) minimize any further contamination of the wetlands and drainage channels which feed into Greenwood Lake; and 4) reduce the movement and toxicity of the contaminated landfill leachate, thereby reducing downgradient migration of contaminants.

Although the results of the RI/FS indicate the possible need for on-site groundwater remediation, the extent and direction of the groundwater plume could not be delineated. The second operable unit ("OU2") will allow for further characterization of the fate and transport of the contaminants emanating from the Site and will serve as the basis for the decision on a final groundwater remedy. In addition, the impacts of site contamination on the adjacent wetlands will be monitored and a detailed environmental assessment will be performed under OU2.

This response action will utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. However, because the treatment of the principal threats of the Site is not practicable, this response action does not satisfy the statutory preference for treatment as a principal element of the remedy. The size of the landfill, and the fact that the RI did not identify on-site hot spots in the soil that represent the major sources of contamination, preclude a remedy in which contaminants could be excavated and treated effectively.

SUMMARY OF SITE CHARACTERISTICS

The Warwick Landfill was used for the disposal of municipal solid waste (MSW) from the late 1950s until its closure in 1980. During the late 1970s, according to observations of surrounding landowners, suspicious dumping activities, including disposal of hazardous wastes, took place at the Site. Information available to EPA indicates that hazardous wastes were disposed of at the Site.

Upwards to 60 feet of landfill material exists in some areas of the Site. Under the Town of Warwick's operation, it is estimated that 300,000 cubic yards of refuse per year were disposed of at the Site. Aerial photographs show that the landfill increased significantly in size under Grace Disposal's operation of the landfill in the late 1970s.

The study area for the RI/FS of OU1 was divided into environmental areas presenting on-site, background, upgradient, and downgradient locations, with background conditions not considered to be within the groundwater flow path as related to the Site. The locations of these sampling stations are graphically displayed in **Figure 2.**

Groundwater

As part of the groundwater investigation, a total of fifteen monitoring wells were installed. Eight wells were installed in the overburden aquifer and seven in the bedrock aquifer. Three rounds of groundwater sampling were conducted. The groundwater samples were analyzed for volatile organics, semi-volatile organics, pesticides and PCBs, inorganics and standard water quality parameters. Contaminants in the groundwater exceeding federal and/or State maximum contaminant levels are summarized in **Table 1.**

Because of the complex nature of the geology at the Site, which includes both fractured and weathered bedrock, the direction of groundwater flow was not fully ascertained under OU1. Groundwater in both the overburden and bedrock aquifers appears to discharge into the southeastern wetlands which lies adjacent to the landfill.

Overburden Aquifer

Eight volatile compounds were detected in the overburden aquifer. Well depths in the overburden aquifer ranged from six feet (WL-7Sa) to 72 feet (WL-7Sb). The maximum concentrations were detected at monitoring well WL-2S (well depth 10 feet) which is located immediately adjacent to the northwest boundary of the landfill. At this location the highest levels were detected for chloromethane and trichloroethene, both exceeding State maximum contaminant levels ("MCLs"). No pesticide/PCB compounds were detected in any of the overburden wells. Semi-volatile contamination was limited to the phthalate compounds and did not exceed MCLs.

Ten of the twenty-two metals detected in the overburden wells exceeded State MCLs. Additionally, two metals (antimony and beryllium) exceeded Federal proposed maximum

contaminant level goals ("MCLGs") and nickel exceeded the Federal Proposed MCL. The maximum concentrations of 15 of the 22 metals detected were observed in the third round sample collected at monitoring well WL-7Sa (well depth six feet) which is located northwest of the landfill. Concentration levels similar to those at WL-7Sa third round data were also observed in the third round sample collected at WL-8S (well depth 47 feet) which is located west of the landfill. Additional sampling will be conducted in these wells as part of the OU2 investigation.

Bedrock Aquifer

Thirty volatile compounds were detected in the on-site and downgradient bedrock groundwater. Well depths in the bedrock aquifer ranged from 33 feet (WL-3D) to 120 feet (WL-8D). Benzene, chloromethane, 1,4-dichlorobenzene, ethylbenzene, isopropylbenzene and total xylenes exceeded MCLs. No pesticide/PCB compounds were detected. Three semi-volatile contaminants were detected; two in the on-site downgradient groundwater (BEHP and 2-methylnaphthalene) and one in the background groundwater (di-n-butylphthalate). None were at levels above MCLs. Six metals: barium, chromium, iron, lead, manganese and mercury exceeded State MCLs; antimony exceeded the federal MCLG of 3.0 ug/l and nickel exceeded the federal proposed MCL of 100 ug/l.

Residential wells

A total of forty-two area residential wells were sampled by EPA and NYSDOH. The results identified contamination above state and/or federal MCLs in three residential wells located geographically northeast of the Site. All wells are believed to be bedrock wells drilled to significant depths (>200 feet). RW-04, which is within 300 feet of the northeastern edge of the Site, showed the highest level of residential well contamination and exceeded state MCLs for 1,1,1-trichloroethane and 1,1-dichloroethane, and both the state and federal MCL for 1,1-dichloroethene. Although it has not been determined whether the residential well contamination is site-related, the pumping of residential wells may induce the flow of contaminants from the landfill towards these wells through bedrock fractures.

Surface Water

The highest levels of organic compound contamination in the Site surface water were observed at sampling locations in the vicinity of the landfill which included on-site leachate samples L-1, L-2, L-3, and surface water sample SW-1. Eighteen volatile organic compounds were detected, of which 16 were detected in the on-site

samples and 6 in the downgradient samples. Chlorobenzene, in particular, was detected at a concentration greater than the 5.0 ug/l NY Class "A" Standard for surface waters at every location except leachate sample location L-3. Phenol and 4-methyl phenol, ranging in concentration from 4.0 ug/l to 65 ug/l, were also detected above the 5.0 ug/l NY Class "A" Standard at leachate sample location L-3.

Of the pesticide/PCB compounds analyzed, only a single detection of aldrin was observed at on-site leachate sample location L-3, exceeding the 0.001 ug/l NY Class "C" Standard. Nine metals exceeded NY Class "A" or "C" Standards in the on-site surface water, including aluminum, barium, cobalt, iron, lead, magnesium, manganese, vanadium and zinc. A summary of contaminants exceeding legally applicable or relevant and appropriate requirements ("ARARs") is found in **Table 2**.

Sediments

Sediment sampling, as for surface water, focused in the area surrounding the Site in order to evaluate horizontal migration of contamination off-site. Sediment contamination was limited to phthalate and PAH compounds. A total of 18 PAH compounds were detected, of which 9 are considered carcinogenic and 9 are non-carcinogenic. Concentrations were observed to be highest in the downgradient sediments. This observation is suspected to be the result of road re-surfacing operations in the vicinity of the sample locations. Background concentrations of PAHs, when totalled, exceeded on-site sediment concentration. All on-site wetland metal results exceeded site background concentrations. **Table 3** presents a summary of the analytical results.

Soils

Soil sampling data is divided into the unsaturated and saturated zone soils to evaluate the vertical migration of contamination emanating from the Site into the groundwater. Three of the soil borings were drilled into the landfill mound. **Table 4** presents a summary of the contaminants of concern detected in the landfill soils.

Several volatile compounds were detected in landfill soil samples in both the saturated and unsaturated zones. Landfill soil boring SB-14, located in the north-central area of the landfill mound, was observed to have the highest concentration of these compounds. Three polychlorinated dibenzo-p-dioxins (PCDDs) and 3 poly-chlorinated dibenzofurans (PCDFs) compounds were detected in the landfill unsaturated zone samples at below health based risk levels. The congener exhibiting the highest human health risk (2,3,7,8-TCDD) was not detected. Metals in the landfill soils

generally exceeded off-site background concentrations. Antimony and lead were seen in highest concentrations in SB-14 (antimony: 15.6 mg/kg and lead: 176 mg/kg).

GEOPHYSICAL INVESTIGATION

A geophysical investigation, which included a magnetic gradiometer survey and terrain conductivity screening, was conducted at the Site to identify areas within the landfill where buried drums might be present. Based on the results of this investigation, three test pits were excavated to observe the landfill material. Nothing other than debris typical of municipal landfills was observed in the fill material excavated. No buried drums were located.

The potential for direct human exposure as well as the potential for further contaminant migration to groundwater and surface water exists at the Site. There are no permanent controls in place to prevent contaminant migration.

SUMMARY OF SITE RISKS

EPA conducted a baseline Risk Assessment to evaluate the potential risks to human health and the environment associated with the Warwick Landfill Site in its current state. The Risk Assessment focused on contaminants in the groundwater, surface water, sediment and soil which are likely to pose significant risks to human health and the environment. The summary of the contaminants of concern (COC) in sampled matrices is listed in **Table 5.**

EPA's Risk Assessment identified several potential exposure pathways by which the public may be exposed to contaminant releases at the Site under current and future land-use conditions. Groundwater, surface water and sediment exposure were assessed for both potential present and future land use scenarios. These exposure pathways were evaluated separately for adults and children. In addition, exposure to soils for on-site residents and workers, in the future event of residential development and/or construction activities on the landfill, was evaluated. A total of nine exposure pathways were evaluated under possible on-site future land use conditions. The exposure pathways considered under future uses are listed in **Table 6.** Two estimates were developed, corresponding to reasonable maximum and reasonable average exposures.

Under current EPA guidelines, the likelihood of carcinogenic (cancer causing) and non-carcinogenic effects due to exposure to site chemicals are considered separately. It was assumed that the toxic effects of the site-related chemicals would be additive. Thus, carcinogenic and non-carcinogenic risks

associated with exposures to individual compounds of concern were summed to indicate the potential risks associated with mixtures of potential carcinogens and non-carcinogens, respectively.

Non-carcinogenic risks were assessed using a hazard index ("HI") approach, based on a comparison of expected contaminant intakes and safe levels of intake (Reference Doses). Reference doses ("RfDs") have been developed by EPA for indicating the potential for adverse health effects. RfDs, which are expressed in units of mg/kg-day, are estimates of daily exposure levels for humans which are thought to be safe over a lifetime (including sensitive individuals). Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) are compared with the RfD to derive the hazard quotient for the contaminant in the particular medium. The hazard index is obtained by adding the hazard quotients for all compounds across all media.

A hazard index greater than 1 indicates that the potential exists for non-carcinogenic health effects to occur as a result of site-related exposures. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. The reference doses for the compounds of concern at the Warwick Landfill site are presented in **Table 7.** A summary of the non-carcinogenic risks associated with these chemicals across various exposure pathways is found in **Table 8.**

It can be seen from **Table 8** that the HI for non-carcinogenic effects from ingestion of the groundwater (reasonable maximum exposure for children) is 31, therefore, non-carcinogenic effects may occur from the exposure routes evaluated in the Risk Assessment. The non-carcinogenic risk was attributable to several compounds including arsenic, manganese and antimony detected in the overburden aquifer in the on-site monitoring wells and not the residential wells.

Potential carcinogenic risks were evaluated using the cancer potency factors developed by EPA for the compounds of concern. Cancer slope factors (SFs) have been developed by EPA's Carcinogenic Risk Assessment Verification Endeavor for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes the underestimation of the risk highly unlikely. The SF for the compounds of concern are presented in **Table 9.**

For known or suspected carcinogens, EPA considers excess upper bound individual lifetime cancer risks of between 10^{-4} to 10^{-6} to be acceptable. This level indicates that an individual has not greater than a one in ten thousand to one in a million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year period under specific exposure conditions at the Site. At present, New York State is supplying three residences with bottled water and has attached carbon filtration units to their wells because of the elevated levels of volatile organics detected in their wells. The maximum potential total excess lifetime cancer risk for a child using the highest levels of contaminants detected in the contaminated residential wells is 1.99×10^{-5}; the HI for this pathway is 3.91, which is unacceptable.

The cumulative upper bound cancer risk at the Warwick Landfill site is 4.98×10^{-4}. Hence, the risks for carcinogens at the Site are at the high end of the acceptable risk range of 10^{-4} to 10^{-6} **(see Table 10)**. The estimated total risks are primarily due to ingestion of unfiltered groundwater, which contributed 3.94×10^{-4} to the carcinogenic risk calculations and was attributable to beryllium and 1,1-dichloroethene. The calculations were based on the contaminants detected in on-site monitoring wells, and not the residential wells. It was assumed that in the future, these wells would be used for residential purposes. Exposure of residents to groundwater volatiles while showering, utilizing reasonable maximum exposure conditions, contributed 9.79×10^{-5} to the total cancer risk. Reasonable maximum adsorption conditions due to wading in the surface water contributed 3.60×10^{-6} and ingestion of the landfill soils by children playing on the Site contributed 5.06×10^{-7} to the total cancer risk. These estimates were developed by taking into account various conservative assumptions about the likelihood of a person being exposed to these media. For example, it was assumed that the Site contaminant plume will migrate downgradient to residential wells.

Uncertainties

The procedures and inputs used to assess risks in this evaluation, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- environmental chemistry sampling and analysis
- environmental parameter measurement
- fate and transport modeling
- exposure parameter estimation
- toxicological data

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media

sampled. Consequently, there is significant uncertainty as to the actual levels present. Based on a detailed review of the Warwick Site groundwater data for representativeness, precision, completeness, comparability and accuracy as per EPA's Guidance document Data Usability in Risk Assessment (October 1990), one sample, the third round inorganic analysis of well WL-7Sa was eliminated from this risk assessment because it did not accurately reflect the site characteristics based on the two previous sampling efforts. Environmental chemistry analysis error can stem from several sources including the errors inherent in the analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the chemicals of concern, the period of time over which such exposure would occur, and in the models used to estimate the concentrations of the chemicals of concern at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the Risk Assessment provides upper bound estimates of the risks to populations near the Landfill, and is highly unlikely to underestimate actual risks related to the Site.

More specific information concerning public health risks, including a quantitative evaluation of the degree of risk associated with various exposure pathways, is presented in the RI Report.

Actual or threatened releases of hazardous substances from this site, if not addressed by the selected alternative or one of the other remedial measures considered, may present an imminent and substantial endangerment to the public health, welfare, and the environment through the continued leaching of contaminants from the landfill.

ENVIRONMENTAL ASSESSMENT

The environmental assessment evaluated potential exposure routes of the Site contamination to terrestrial wildlife and aquatic life. However, because of the low concentrations of contaminants detected, lack of potential bioaccumulation, absence of fishing and other recreational activity, the environmental assessment was not quantified. The wetlands in the vicinity of the Site were delineated. The need to minimize the disturbance of these

wetlands habitats via migration of contaminants from the landfill, as well as via any future remediation activities, was identified as an important factor to be considered in both the selection and design of the Site remedy. Further environmental efforts, including studies of the emergent vegetation portion of the southeastern wetlands and a full delineation of the northwestern wetlands, will be performed under OU2 for the Site and before the commencement of remediation activities at the Site.

DESCRIPTION OF ALTERNATIVES

Following a screening of remedial technologies in accordance with the NCP, the following remedial alternatives were developed for the Site. The alternatives were further screened based on technical considerations such as effectiveness, implementability, and cost. The time to implement reflects only the actual construction or implementation time. It does not include the time required to negotiate with PRPs, procure design and construction contracts and design the selected remedy, all of which may take from 18 to 30 months.

These alternatives are:

Alternative 1: No Action

Capital Cost: $6,800
O & M Cost: $55,500/yr
Present Worth Cost: $887,800
Time to Implement: 1 month

The Superfund program requires that the no-action alternative be considered as a baseline for comparison with the other alternatives. The no-action alternative does not include any physical remedial measures that address the contamination at the Site.

This alternative would consist of a long-term groundwater monitoring program that would provide data for the assessment of the impact of leaving contaminated materials on-site on the underlying groundwater. This program would utilize existing wells which were installed during the remedial investigation at the Site. Groundwater samples would be taken on a quarterly basis.

In addition, the no-action alternative would include the development and implementation of a public awareness and education program to enhance the community's knowledge of the conditions existing at the Site. This alternative would require the involvement of the local government, various health departments and environmental agencies.

Under this alternative, the Site would be reviewed no less often than each five years pursuant to CERCLA requirements. Using data from the groundwater sampling program, these five year reviews would include the reassessment of health and environmental risks due to the contaminated material left on-site. If justified by the review, remedial actions may be implemented to remove or treat the wastes.

Alternative 2: Limited Action/Point of Use Treatment

Capital Cost: $223,300
O & M Cost: $176,100/yr (yrs 1-3),
$ 62,700/yr (yrs 4-30)
Present Worth Cost: $1,523,800
Time to Implement: 4-6 months

As with Alternative 1, the limited-action alternative would include a groundwater monitoring program and a public awareness program. However, this alternative would also provide for restricted site access and controlled point-of-groundwater-use treatment.

A chain link fence would surround the perimeter of the Site, thereby restricting access. Warning signs would be placed that would caution the public as to the Superfund status of the Site. We would recommend that institutional controls in the form of local ordinances be developed to restrict future use of the land because of the threat of contamination.

A residential well survey and sampling plan would be undertaken in the immediate site area. Point-of-use treatment systems would be installed on to residential wells where contaminants detected above allowable drinking water standards are found in the well water. Based on the previous results of the residential well samples collected by EPA and the New York State Department of Health ("NYSDOH") during the RI, small, low flow granular activated carbon treatment units would be used. This would allow for the removal of organics and would be installed in the well pump discharge piping before the water enters into domestic use.

For the purposes of developing a conservative cost estimate, it has been assumed that 42 residential wells would receive carbon filtration units and be sampled on a semi-annual basis for three years. The actual monitoring plan would be coordinated with the OU2 groundwater investigation. As noted above, the OU2 investigation would serve as the basis for the final remedy for the treatment of contaminated groundwater and provision of a potable drinking water supply, if necessary.

As with Alternative 1, a review of the Site's status would be conducted no less often than each five years.

Alternative 3: Capping/Point of Use Treatment

Capital Cost: $7,442,000
O & M Cost: $526,300/yr (yrs 1-3),
$422,900/yr (yrs 4-30)
Present Worth Cost: $14,279,600
Time to Implement: 18-24 months

The major feature of Alternative 3 would be the construction of a multi-layer closure cap over the landfill mound. This would minimize the infiltration of rainfall or snow melt into the landfill and reduce the movement of the contaminated leachate to the groundwater.

The landfill mound surface area, including the side slopes, is estimated to be 22 acres. It is currently covered with less than 6 inches of soil. This layer is beginning to show the effects of erosion and previously buried materials are starting to become exposed. Prior to construction of the cap, the landfill mound would have to be regraded and compacted to provide a stable foundation for placement of the various layers of the cap.

The design of the cap would comply with the standards of Title 6, New York State Compilation of Rules and Regulations (NYCRR), Part 360, which addresses New York State Solid Waste Management Facilities and landfill closure requirements. The main feature of landfill closure is the placement of a highly impermeable cap over the landfill to reduce the infiltration of water into the fill. The cap would include allowances for the installation of gas vents necessary for the escape of methane generated by the decomposition of landfill materials. The use of an active or passive landfill venting system would be determined during the remedial design. The cap would also provide for groundwater monitoring wells within the landfill mound. These wells would be utilized to provide groundwater samples for analyses to clearly show the effect of groundwater flow through the saturated portion of the landfill materials on the surrounding aquifers.

The surface of the constructed cap would be graded to allow for precipitation and snow melt runoff to be directed to the existing drainage channels around the perimeter of the landfill mound. These natural channels should have adequate capacity to handle the extra flow. These intermittent streams follow differing routes, but eventually feed into the Greenwood Lake drainage basin.

As mentioned, groundwater monitoring wells would be installed within the landfill mound. Groundwater samples would be collected for analyses to evaluate the effect of the cap on the groundwater flow through the saturated portion of the landfill materials on the surrounding aquifer. Emissions from landfill gas vents would also be monitored.

This alternative would also include the supply of point-of-use treatment systems, the installation of a security fence surrounding the perimeter of the Site, institutional controls restricting future use of the Site, and the implementation of a groundwater monitoring program (see Alternative 2). In addition, a review of the Site's status would be conducted no less often than each five years.

Alternative 4: Capping/Groundwater Pumping and Treatment/Chemical Precipitation/Carbon Adsorption/Point of Use Treatment

Capital Cost: $8,779,900
O & M Cost: $759,000/yr (yrs 1-3),
$645,600/yr (yrs 4-30)
Present Worth Cost: $19,013,100
Time to Implement: 2 - 2 1/2 Years

This alternative is identical to Alternative 3, with the addition of an extensive groundwater pumping system within the landfill mound to control leachate migration.

The groundwater extraction system would consist of a series of pumping wells installed around the inside of the landfill perimeter. The groundwater pumping wells would extend through the landfill material and end at bedrock. They would be screened through the entire saturated length. It is estimated that approximately 21 extraction wells would be required to provide optimum capture of the contaminated groundwater beneath the landfill. These wells would produce an estimated total removal rate of 20 gallons per minute or 28,800 gallons per day. These estimates, presented in detail in the FS report, would be field verified via performance of an aquifer pumping test during the remedial design.

The groundwater collected would be treated in an on-site treatment system. This treatment system would use chemical precipitation and flocculation followed by sedimentation to remove metals and suspended solids. A carbon adsorption system would be utilized to remove organic compounds.

The organic compounds and metals present in the extracted groundwater would be treated to concentrations which are below the site-specific surface water discharge standards which would be determined in accordance with the New York State Pollutant Discharge Elimination System ("SPDES"). It is expected that the effluent groundwater would be discharged to the adjacent wetlands unless detrimental impacts would result from such an action. Other discharge options, such as reinjection, would be evaluated during the design of the remedy.

Under Alternative 4, solids are expected to accumulate at a rate of approximately 500-510 pounds per day, wet weight, for a total

annual accumulation of 92 tons. Treatment residues generated would be disposed of in accordance with Resource Conservation and Recovery Act ("RCRA") Land Disposal Restriction requirements.

This alternative would also include the supply of point-of-use treatment systems, the installation of a security fence surrounding the perimeter of the Site, institutional controls restricting future use of the Site, and the implementation of a groundwater monitoring program (see Alternative 2). In addition, a review of the Site's status would be conducted no less often than each five years.

Alternative 5: Capping/Subsurface Barrier/Groundwater Pumping and Treatment/Chemical Precipitation/Carbon Adsorption/Point of Use Treatment

Capital Cost: $15,811,300
O & M Cost: $1,032,000/yr (yrs 1-3),
$ 918,600/yr (yrs 4-30)
Present Worth Cost: $30,241,300
Time to Implement: 2 - 2 1/2 years

This alternative is similar to Alternative 4, with the addition of a subsurface barrier.

The subsurface barrier would consist of a grout curtain along the northeast section of the landfill and a slurry wall used in combination with a grout curtain to enclose the remainder of the landfill. The grout curtain northeast of the landfill would extend approximately 100 feet into bedrock. The remainder of the grout curtain would extend approximately twenty feet into the rock; fifteen feet into weathered bedrock and five feet into competent rock.

The slurry wall would be placed above the shallow (approximately twenty feet deep) grout curtain within the overburden material adjacent to the landfill mound. The slurry wall would be constructed as a vertical trench, typically a mixture of soil-bentonite or cement-bentonite backfill.

Groundwater pumping would be conducted inside the slurry wall perimeter to create an upward hydraulic gradient to prevent dissolved contaminants from migrating downward into deeper aquifer zones. The groundwater would then be treated for removal of heavy metals through a chemical precipitation process prior to treatment with activated carbon and discharge to the adjacent wetlands, in accordance with SPDES requirements. Treatment residuals would be handled in the same manner as those generated under Alternative 4.

This alternative would also include the supply of point-of-use treatment systems, the installation of a security fence

surrounding the perimeter of the Site, institutional controls restricting future use of the Site, and the implementation of a groundwater monitoring program (see Alternative 2). In addition, a review of the Site's status would be conducted no less often than each five years.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

All remedial alternatives were evaluated in detail utilizing nine criteria as set forth in the NCP and OSWER Directive 9355.3-01. These criteria were developed to address the requirements of Section 121 of CERCLA to ensure all important considerations are factored into remedy selection decisions.

The following "threshold" criteria are the most important and must be satisfied by any alternative in order to be eligible for selection:

Threshold Criteria
- Overall protection of human health and the environment; and
- Compliance with applicable or relevant and appropriate requirements.

The following "primary balancing" criteria are used to make comparisons and to identify the major trade-offs between alternatives:

Primary Balancing Criteria
- Long-term effectiveness and permanence;
- Reduction in toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

The following "modifying" criteria are considered fully after the formal public comment period on the Proposed Plan is complete:

Modifying Criteria
- State/support agency acceptance; and
- Community acceptance.

The nine criteria are summarized below:

1. Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with ARARs addresses whether or not a remedy would meet all of the applicable or relevant and appropriate requirements of federal and state environmental statutes and requirements or provide grounds for invoking a waiver.

3. Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of a remedial technology, with respect to these parameters, that a remedy may employ.

5. Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation periods until cleanup goals are achieved.

6. Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed.

7. Cost includes estimated capital and operation and maintenance costs, and the present worth costs.

8. State acceptance indicates whether, based on its review of the RI/FS and the Proposed Plan, the State supports, opposes, and/or has any identified reservations with the preferred alternative.

9. Community acceptance refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports. Factors of community acceptance to be discussed include support, reservation, and opposition by the community.

A comparative analysis of these alternatives based upon the evaluation criteria noted above, are as follows:

Overall Protection of Human Health and the Environment

Alternatives 1 and 2 do not favorably address the remedial action objectives developed for the Site and do not contain any measures for mitigation of groundwater or surface water contamination. In addition, Alternative 1 does not provide any protection for human health and the environment. Alternative 2, as well as Alternatives 3, 4 and 5, would reduce groundwater exposure risk to local residents via private water supply treatment units, and

would be protective of human health for the current water users.

The closure cap system of Alternatives 3, 4 and 5 provides a partial solution to the problems at the Site because the cap would eliminate infiltration of rainfall or snow melt into the landfill, thus reducing the quantity of water percolating through the landfill materials and leaching out contaminants. The cap would also eliminate existing leachate seeps and prevent the formation of contaminated surface leachate seeps emanating from within the landfill mound, flowing into the natural drainage channels and contaminating nearby surface water. Alternative 3 does not include any direct groundwater control or remediation measures; therefore, the contaminated groundwater would remain unaffected. However, the private treatment units proposed in Alternatives 2 - 5 would eliminate current risks associated with contaminated groundwater ingestion and exposure. The monitoring of these units would be coordinated with the OU2 groundwater investigation.

The extensive extraction and treatment system of Alternatives 4 and 5 would provide a reduction in the quantity of contaminated groundwater generated, via the cap, and would control the movement and toxicity of the contaminated landfill leachate groundwater by pumping out and treating this water and preventing its downgradient migration.

The impermeable subsurface barrier recommended in Alternative 5 would divert overburden groundwater flow around the contaminated material, thereby reducing the volume of groundwater coming into contact with the contaminant source while minimizing migration of contaminants into the overburden and bedrock aquifers.

Compliance with ARARs

Alternative 1 would not meet any of the chemical-specific ARARs, because it does not include any contaminant mitigation or control measures. Alternatives 2 and 3 include treatment only for private potable water supplies, thereby providing potable water in compliance with drinking water standards. Alternatives 3, 4, and 5 will comply with New York State Part 360 closure requirements.

The groundwater pumping, treatment and discharge system of Alternatives 4 and 5 would meet the action-specific ARARs for discharge of the treated groundwater. These alternatives would not address chemical specific ARARs, such as MCL/MCLGs, in the groundwater; these will be addressed under the OU2 groundwater investigation. All location-specific ARARs would be complied with during implementation of any of the alternatives. Disposal of residuals under Alternatives 4 and 5 would comply with all ARARs related to off-site transport, handling and disposal.

Long-Term Effectiveness and Permanence

Alternatives 4 and 5 would reduce the continued migration of contaminants into the groundwater. Although the groundwater treatment facility could be designed for continuous long-term use, there are concerns regarding the effectiveness of the pumping and treatment of the groundwater due to the fractured bedrock and complex hydrogeological conditions existing beneath the Site.

The monitoring and replacement of the point-of-use treatment units in Alternatives 2 - 5 would ensure that residents would have a potable water supply until a decision on a final groundwater remedy is made under OU2. The OU2 investigation will evaluate the need for and methods of restoring the aquifers to their best beneficial use.

The closure cap proposed in Alternatives 3, 4 and 5 is a permanent technology that would be maintained at regular intervals to ensure its structural integrity and impermeability. In addition, the cap would provide for long-term elimination of stormwater and snow melt infiltration into the landfill.

Alternative 2 would provide for private potable water supply well treatment, but includes no further measures to control or remediate site contamination. Alternative 1 does not include any measures for containing, controlling or eliminating any of the on-site contamination, or reducing the potential of exposure to the contaminated landfill materials.

Reduction in Toxicity, Mobility, or Volume

Alternatives 1 and 2, the no-action and limited-action alternatives, do not contain any remedial measures which would reduce the toxicity, mobility or volume of the groundwater contamination. However, the limited-action alternative addresses measures for reduction of risk to residents related to exposure to contaminants in the groundwater via filtration units.

Alternatives 3, 4, and 5 provide measures to reduce the mobility of contaminants by reducing the amount of water infiltrating into the landfill. The formation of contaminated surface leachate seeps, which have caused nearby surface water contamination, would be eliminated.

Implementation of Alternatives 4 and 5 would have the greatest impact on the toxicity, mobility and volume of the contaminated groundwater by preventing precipitation infiltration and extracting the groundwater beneath the landfill mound and subjecting it to treatment. These alternatives would remove the contaminated groundwater from within the vicinity of the landfill, thereby reducing the volume of the hazardous compounds.

The subsurface barrier proposed in Alternative 5 would provide additional reduction of the mobility of the contaminants into the overburden aquifer by installation of the slurry wall surrounding the perimeter of the landfill. The grout curtain would limit the transport of the contaminants into the bedrock aquifer.

Short-Term Effectiveness

Alternative 1 would not include any physical construction measures and therefore would not present a risk to the community as a result of its implementation. Alternative 2 would require a minimal amount of site activity during installation of the fence. Risks to the community and site workers would also be insignificant.

The remaining alternatives involve major construction activities at the Site and the use of heavy earthmoving equipment. Potential hazards to the surrounding community and environment will include adverse traffic conditions, airborne dust and particulate emissions, an increase in noise levels, and adverse impacts to the wetlands area. All of these impacts, due to implementation of either Alternative 3, 4 or 5, could be mitigated in part through the employment of proper construction techniques and operational procedures. In addition to risks to the public, the potential for worker exposure to contaminated media is greater as a result of the amount of construction activity taking place. These risks would be minimized by proper health and safety training and the use of personal protective equipment.

The treatment system of Alternatives 4 and 5 would require storage and handling of hazardous materials. These activities may be accomplished with minimal health risk to workers by the development and implementation of safe operating and maintenance practices and precautions. Compliance with applicable regulations will ensure proper hazardous waste transportation procedures and disposal of drummed process sludge at an approved off-site RCRA facility.

The construction of the subsurface barrier under Alternative 5 could cause adverse environmental impacts to the adjacent wetlands. Excavation would be necessary in the vicinity of the wetlands and would cause sedimentation and disruption of the ecosystem. Restoration or replacement of the wetlands would be necessary if these areas were impacted due to implementation of Alternative 5.

Implementability

Technical Feasibility

Alternatives 1 and 2 would involve minimal on-site activity;

fence installation and groundwater monitoring are easily implemented and supply of individual filtration units to nearby residents is also readily available. The construction procedures, materials and earthworking equipment required for the implementation of Alternatives 3, 4 and 5 are conventional and are used extensively in standard commercial and industrial applications.

The treatment system for Alternatives 4 and 5 would utilize standard unit operations and water treatment equipment that will be well-suited for this application and are technically reliable under typical site conditions. However, based on information obtained during the remedial investigation of OU1, the direction of the groundwater plume was not fully characterized due to the complex hydrogeological conditions existing at the Site. Therefore, it would be difficult to determine the technical feasibility of designing a pumping and treatment system for groundwater remediation under this operable unit.

The transportation and disposal of the de-watered process sludge generated under Alternatives 4 and 5 involves easily implementable practices and the use of commercially available facilities. Excavation activities necessary for the subsurface barrier of Alternative 5 would require specialized operations.

The slurry wall proposed under Alternative 5 would ensure against lateral migration of contamination in the overburden aquifer. However, the effectiveness of this alternative may be limited due to the heavily fractured nature of the bedrock.

Administrative Feasibility

All of these alternatives would involve some degree of institutional management. Alternative 1 would require administrative coordination of the groundwater monitoring program and the five year site status reviews, along with the development of the public education program. Alternative 2 would require a similar level of control for those activities, and also for maintenance of the security fence and distribution/installation of filtration units to residents.

The administrative requirements for Alternatives 3, 4 and 5 include the groundwater monitoring program, filtration unit supply, and the security fence inspection. In addition to these activities, the structural integrity and impermeability of the closure cap and subsurface barrier must be maintained through a program of periodic surveillance and necessary repairs. Because of the large land area of the landfill, this item would be fairly substantial.

In addition, Alternatives 4 and 5 require an extensive monitoring program, as well as the operation and maintenance of the

groundwater treatment facility. The administrative elements of this are extensive because they include equipment maintenance schedules, system effluent monitoring to comply with the SPDES permit and to adjust operating parameters, and transportation and disposal of hazardous process residuals in compliance with regulations.

Availability of Services and Materials

Most services and materials required for implementation of any of these potential remedial alternatives are readily available. Standard construction equipment and practices can be employed for the fence installation of Alternatives 2 - 5 and the extensive site work activities of Alternatives 3, 4 and 5. Most of the materials and equipment required for these alternatives may be obtained local to the Site. However, excavations necessary for the installation of the subsurface barrier (Alternative 5) may require that specialized operations and equipment be obtained from non-local sources.

Because the work would be taking place on a Superfund site, all on-site personnel must have approved health and safety training. Many companies are available to provide this training to contractors. The engineering and design services required for implementation of Alternatives 3, 4 and 5 may be obtained from many vendors. Hazardous waste transportation and disposal is also commercially available.

Cost

Cost estimates were calculated for each of the five alternatives. Present worth cost estimates consider a 5% discount rate and a 30-year operational period. The costs are as follows:

Alternative	Capital Cost ($)	O&M Cost ($)/yr	Present Worth ($)
1	6,800	55,500	887,800
2	223,300	176,100(yrs 1-3) 62,700(yrs 4-30)	1,523,800
3	7,442,000	526,300(yrs 1-3) 422,900(yrs 4-30)	14,279,600
4	8,779,900	759,000(yrs 1-3) 645,600(yrs 4-30)	19,013,100
5	15,811,300	1,032,000(yrs 1-3) 918,600(yrs 4-30)	30,241,300

State Acceptance

The State of New York, through the NYSDEC, concurs with EPA's selected remedy. See Appendix IV.

Community Acceptance

EPA believes that the selected remedy has the support of the affected community, with the exception that the community would prefer that a permanent source of alternative water be supplied under OU1. As noted above, the need for a permanent alternate water supply will be evaluated in the second operable unit. Community comments can be reviewed in the public meeting transcript which is included in the administrative record. A Responsiveness Summary which summarizes all comments received during the public comment period and answers the questions and concerns raised at the public meeting on April 22, 1991 is attached as Appendix V to this document.

SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, public comments, and NYSDEC's comments, EPA has determined that Alternative 3, Capping and Point-of-Use Treatment Systems, is the appropriate remedy for Operable Unit One of the Warwick Landfill site.

The selected alternative for OU1 will achieve substantial risk reduction through source control and an interim groundwater remedy. A further characterization of the fate and transport of the contamination emanating from the Site will be studied under OU2 and will serve as the basis for the decision on a final groundwater remedy.

The major components of the selected remedy are as follows:

* Construction of an approximately 22 acre multi-layer cap consistent with New York State Part 360 solid waste landfill closure requirements;

* Regrading and compaction of landfill mound to provide a stable foundation for the placement of the cap prior to its construction;

* Construction of a gas venting system following the testing and characterization of landfill gas emissions;

* Performance of air monitoring prior to, during, and following construction at the Site, to ensure that air emissions resulting from the cap construction meet the applicable or relevant and appropriate requirements;

* Installation of groundwater monitoring wells within the landfill mound to observe the effect of groundwater flow patterns through the saturated portion of the landfill and to monitor the movement of contaminants beneath the landfill;

* Quarterly groundwater monitoring program using existing groundwater monitoring wells and newly installed wells within the mound;

* Construction of fencing around the perimeter of the 25-acre leasehold;

* Recommendations that ordinances be established or restrictions imposed on the deed to ensure that future use of the Site property will maintain the integrity of the cap;

* Implementation of a residential well sampling program of area residential wells;

* As an interim measure, fitting and maintenance of granular activated carbon units on residential wells where contaminant levels found exceed either federal or state maximum contaminant levels ("MCLs") or on those residential wells which are threatened by potential contamination in exceedance of MCLs based on the results of the residential well sampling program and the OU2 investigation. The units will be maintained until the decision on a final groundwater remedy is evaluated under OU2; and

* Evaluation and delineation of the northwestern and southeastern wetlands and the drainage channels flowing through these wetlands adjacent to the landfill.

REMEDIATION GOALS

The purpose of this response action is to reduce the present risk to human health and the environment due to contaminants leaching from the landfill mound. The capping of the landfill will prevent the infiltration of rainfall and snowmelt into the landfill, thereby reducing the potential for contaminants leaching from the landfill and negatively impacting the wetlands habitat and groundwater quality.

This response action will also ensure that, until a decision on a final groundwater remedy is made in OU2, the area residents are protected from drinking contaminated groundwater by the installation of point-of-use treatment systems on residential

wells. In addition, a full evaluation of the two adjacent wetlands will be performed prior to remediation activities to determine any measures which may be necessary to mitigate potential negative impacts to the wetlands. No residual management is needed.

STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibilities at Superfund sites is to undertake remedial actions that achieve protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes, as available. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

Alternative 3 is considered to be fully responsive to this criterion and to the identified remedial response objectives. Capping the landfill protects human health and the environment by reducing the mobility of contaminated materials off-site. The leaching of contaminants into the wetlands and aquifers will be significantly reduced. The carcinogenic and non-carcinogenic risks associated with groundwater ingestion and inhalation will be eliminated for current groundwater users with the provision of point-of-use treatment systems on residential wells.

Compliance with ARARs

Attainment of chemical-specific ARARs for groundwater will be hastened due to reduced leaching following construction of the cap. Final groundwater remediation, however, will be addressed in the second operable unit. Point-of-use treatment systems will allow attainment of chemical-specific ARARs at residential wells. The source of surface water contamination (leachate seeps) will be eliminated. Action- and location-specific ARARs will be complied with during implementation.

Action-specific ARARs:

* New York State Solid Waste Management Facilities 6

NYCRR Part 360

* National Emissions Standards for Hazardous Air Pollutants (NESHAP)

* 6 NYCRR Part 257 Air Quality Standards

Chemical-specific ARARs:

The selected remedy will enable drinking water MCLs to be met at the groundwater point of use by installation of domestic granular activated carbon units on residential wells.

* SDWA Maximum Contaminant Levels (MCLs)

* 6 NYCRR Part 703.5 Groundwater Quality Regulations

* 6 NYCRR Part 702 Surface Water Standards

* 10 NYCRR Part 5 State Sanitary Code

Location-specific ARARs:

* Clean Water Act Section 404, 33 USC 1344

* Fish and Wildlife Coordination Act 16 USC 661

* Wetland Executive Order 11990

* National Historic Preservation Act 16 USC 470

* New York State Freshwater Wetlands Law ECL Article 24, 71 in Title 23

* New York State Freshwater Wetlands Permit Requirements and Classification 6 NYCRR 663 and 664

* New York State Endangered and Threatened Species of Fish and Wildlife Requirements 6 NYCRR 182

Other Criteria, Advisories, or Guidance To Be Considered:

* SDWA MCL Goals (40 CFR Parts 141.50 - 141.51) provide goals for toxic compounds for public drinking systems

* New York Guidelines for Soil Erosion and Sediment Control

* New York State Sediment Criteria December 1989

* New York State Air Cleanup Criteria January 1990

Cost-Effectiveness

The selected remedy provides overall effectiveness proportional to its cost. The total capital and present worth costs for the remedy are estimated to be $7,442,000 and $14,279,600, respectively. A detailed breakdown of the estimated costs of this remedy is provided in Table 11.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected remedy represents the best balance of trade-offs among the alternatives with respect to the evaluation criteria. The State and the community also support the selected remedy, with the exception that the community requests a permanent water supply under OU1.

With the construction of the landfill cap, the direct contact risk to the soils will be eliminated. Point-of-use treatment systems installed on residential wells where contamination exceeds federal and/or state MCLs will eliminate exposure to well water contamination.

No short-term adverse impacts and threats to human health and the environment are foreseen as the result of implementing the selected remedy. However, to minimize and/or prevent potential worker exposure to contaminants during construction of the landfill cap, personal protection equipment will be utilized.

The selected remedy will require construction of a landfill cap. No technological problems should arise since the technologies are readily available.

Preference for Treatment as a Principal Element

The statutory preference for remedies that employ treatment as a principal element cannot be satisfied, because treatment of the principal threats of the Site is not practicable under this operable unit. The size of the landfill and the fact that there are no identified on-site hot spots that represent the major sources of contamination preclude a remedy in which contaminants could be excavated and treated effectively.

DOCUMENTATION OF SIGNIFICANT CHANGES

There are no significant changes from the preferred alternative presented in the Proposed Plan.

APPENDIX I

FIGURES

Figure 1 - SITE LOCATION

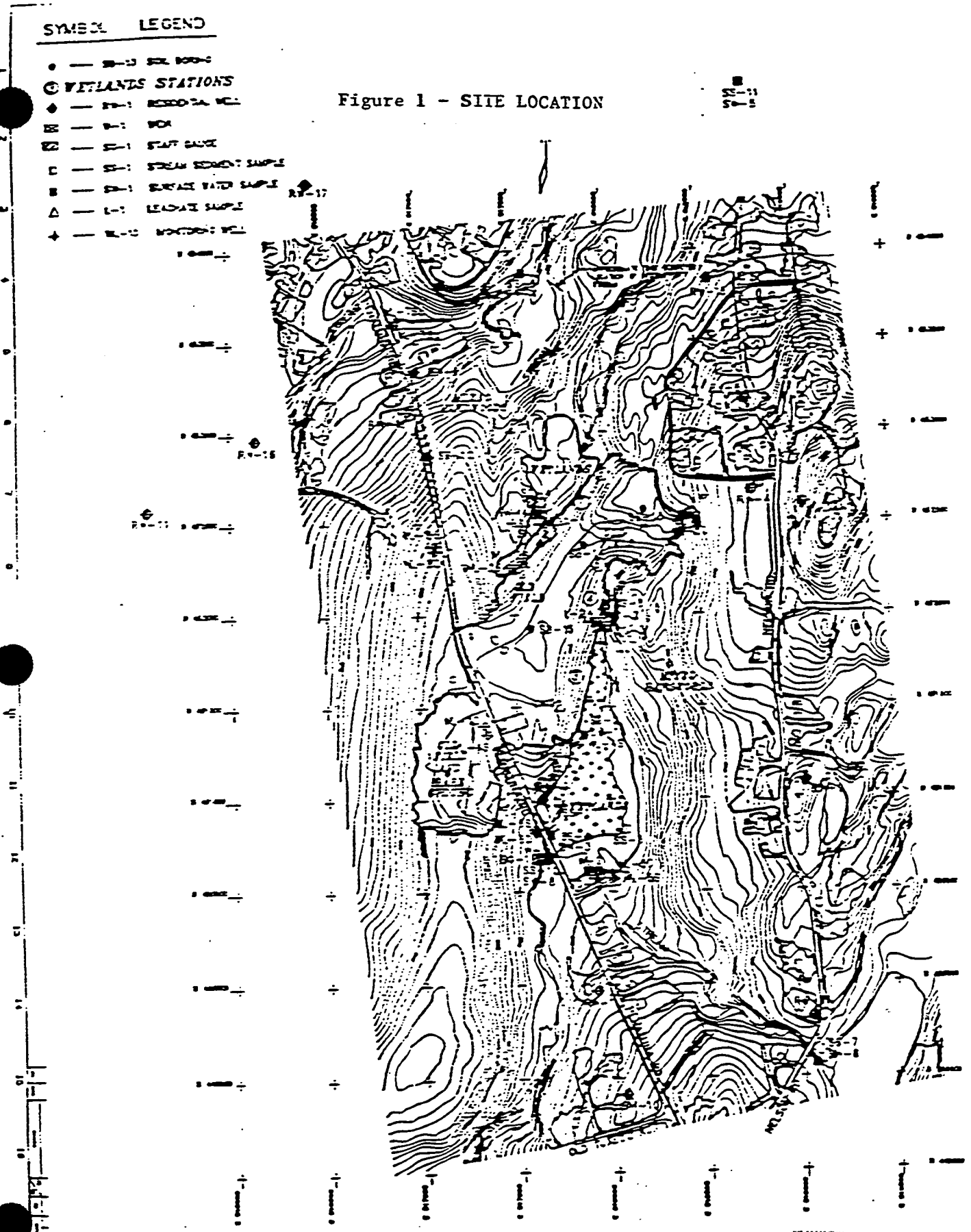
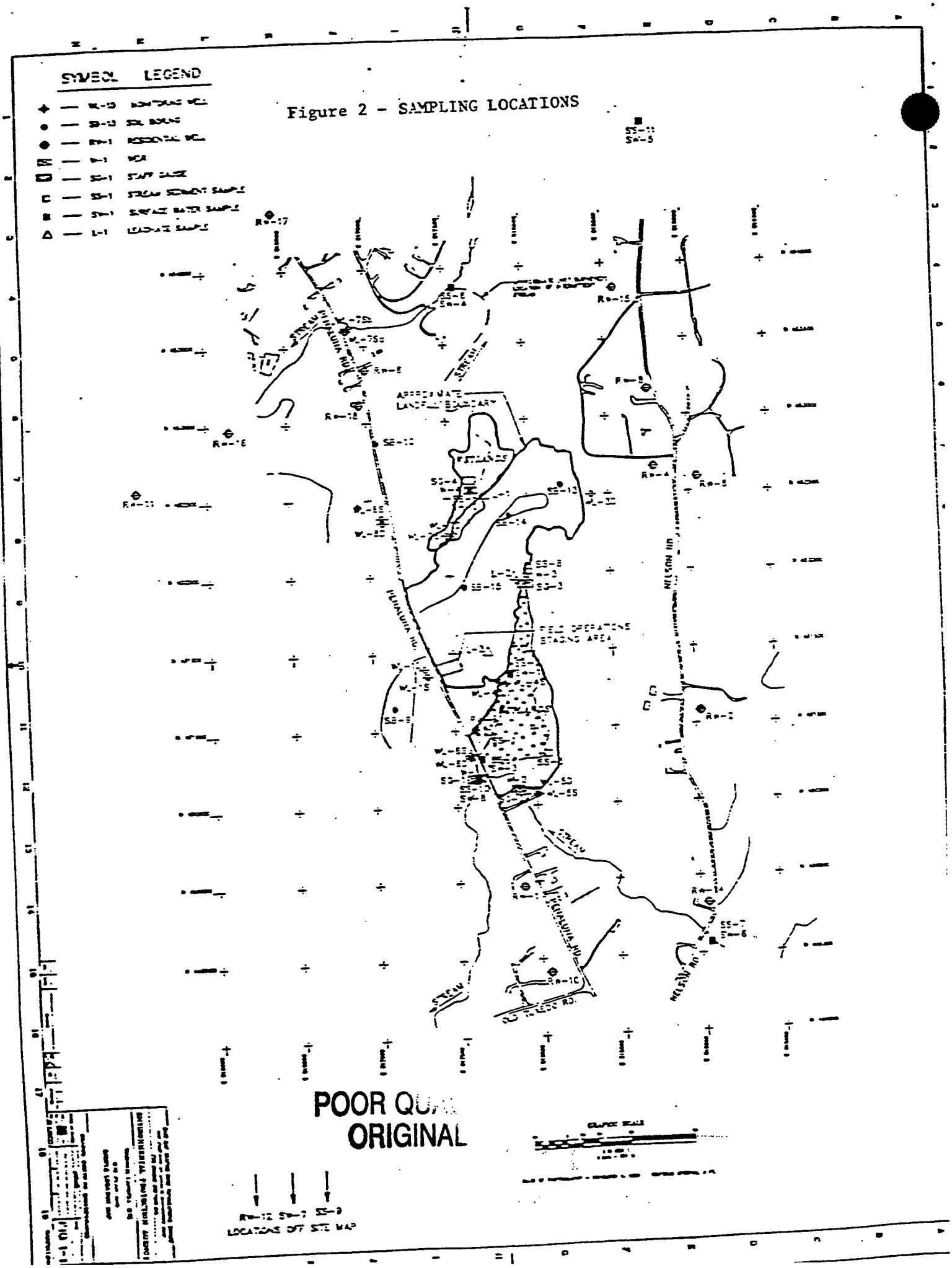


Figure 2 - SAMPLING LOCATIONS



APPENDIX II

TABLES

Table 1- Contaminants Exceeding ARARS in Overburden Groundwater				
Chemical Name	Frequency	Arithmetic Mean(ug/l)	Range of Concentrations(ug/l)	Most Stringent ARAR (ug/l)
ORGANICS Volatiles: (ug/l)				
Chloromethane	2/21	6.5	6.0 - 27.0	5.0 (10 NYCRR Part 5)
Trichloroethane	2/21	1.7	1,6 - 18.0	5.0 (10 NYCRR Part 5)
INORGANICS Total Metals: (ug/l)				
Antimony	9/20	27.5	18.0 - 210.0	3.0 (Fed. Prop. MCLG)
Arsenic	15/20	14.7	1.1 - 200.0	25.0 (NY Class GA)
Barium	20/20	609.0	10.0 - 7,370.0	1,000 (10 NYCRR Part 5)
Beryllium	9/20	3.6	1.2 - 99.0	1.0 (Fed. Prop. MCLG)
Cadmium	6/20	1.9	2.0 - 482.0	10.0 (10 NYCRR Part 5)
Chromium	19/20	191.9	11.1 - 2,270.0	50.0* (10 NYCRR Part 5)
Copper	19/20	165.3	4.0 - 1,970.0	1,000.0 (10 NYCRR Part 5)
Iron	14/14	19,900	199.0 - 1,170.000.0	300.0 (10 NYCRR Part 5)
Lead	12/13	82.2	5.1 - 450.0	25.0 (NY Class GA)
Manganese	19/19	8,849.6	4.3 - 89,100.0	300.0 (10 NYCRR Part 5)
Mercury	5/20	0.28	0.2 - 33.8	2.0 (10 NYCRR Part 5)
Nickel	18/20	214.2	22.2 - 3,700.0	100.0 (Fed. Prop. MCL)
Zinc	16/16	251.9	5.7 - 6,290	5,000.0 (10 NYCRR Part 5)

* ARAR value for hexavalent Chromium (CR VI)

Table 1 (Continued) - Contaminants Exceeding ARARS in Bedrock Groundwater				
Chemical Name	Frequency	Arithmetic Mean(ug/l)	Range of Concentrations(ug/l)	Most Stringent ARAR (ug/l)
ORGANICS Volatiles: (ug/l)				
Chloromethane	2/22	10.6	1.9 - 65.0	5.0 (10 NYCRR Part 5)
Benzene	2/22	1.2	7.6 - 10.0	5.0 (10 NYCRR Part 5)
Ethylbenzene	2/22	1.1	1.0 - 5.5	5.0 (10 NYCRR Part 5)
M & P Xylenes	3/22	2.4	6.0 - 20.1	5.0 (10 NYCRR Part 5)
O-Xylenes	3/22	1.4	2.2 - 12.0	5.0 (10 NYCRR Part 5)
Isopropyl benzene	2/22	X	0.1 - 6.0	5.0 (10 NYCRR Part 5)
1,4-Dichlorobenzene	4/22	1.0	1.6 - 6.0	5.0 (10 NYCRR Part 5)
INORGANICS Total Metals: (ug/l)				
Antimony	4/20	11.6	20.4 - 25.0	3.0 (Fed. Prop. MCLG)
Barium	20/23	185.5	2.3 - 1500.0	1,000 (10 NYCRR Part 5)
Chromium	18/23	40.5	4.1 - 223.0	50.0* (10 NYCRR Part 5)
Iron	16/16	7975.6	43.1 - 43,600.0	300.0 (10 NYCRR Part 5)
Lead	9/17	9.9	3.1 - 48.8	25.0 (NY Class GA)
Manganese	20/23	2372.6	23.0 - 17,300.0	300.0 (10 NYCRR Part 5)
Mercury	1/23	0.2	2.9	2.0 (10 NYCRR Part 5)
Nickel	19/23	33.8	5.0 - 102.0	100.0 (Fed. Prop. MCL)

* ARAR value for hexavalent Chromium (CR VI)

Table 1 (Continued) - Contaminants Exceeding ARARS in Northeast Residential Wells				
Chemical Name	Frequency	Arithmetic Mean(ug/l)	Range of Concentrations(ug/l)	Most Stringent ARAR (ug/l)
ORGANICS Volatiles: (ug/l)				
1,1 - Dichloroethene	1/5	2.20	9.0	5.0 (10 NYCRR Part 5)
1,1 - Dichloroethane	2/5	3.72	0.1 - 17.0	5.0 (10 NYCRR Part 5)
1,1,1 - Trichloroethane	3/5	17.26	0.1 - 85.0	5.0 (10 NYCRR Part 5)
M & P Xylenes	3/5	3.08	1.4 - 9.7	5.0 (10 NYCRR Part 5)
INORGANICS Total Metals: (ug/l)				
Iron	5/5	4253.8	106.0 - 16,600.0	300.0 (10 NYCRR Part 5)
Manganese	4/5	379.18	8.4 - 867.0	300.0 (10 NYCRR Part 5)

Table 2- Contaminants Exceeding ARARS in On-Site Surface Water				
Chemical Name	Frequency	Arithmetic Mean(ug/l)	Range of Concentrations(ug/l)	Most Stringent ARAR (ug/l)
ORGANICS				
Volatiles (ug/l)				
Chlorobenzene	5/7	11.8	0.7 - 20.0	5.0 (NY Class "A" Standard)
1,3-Dichlorobenzene	1/1	5.7	5.7	5.0 (NY Class "A" Standard)
1,4-Dichlorobenzene	1/2	2.9	5.2	5.0 (NY Class "A" Standard)
Semivolatiles (ug/l)				
o BNA				
Hexachlorobutadiene	1/7	X	3.0	1.0 (NY Class "A" Standard)
Phenol	2/9	12.6	33.0 - 44.0	5.0 (NY Class "A" Standard)
4-Methyl phenol	3/9	11.2	4.0 - 65.0	5.0 (NY Class "A" Standard)
Bis(2-ethylhexyl)pthalate	2/9	4.3	6.0 - 14.0	0.6 (NY Class "A" Standard)
o Pesticides/PCBs				
Aldrin	1/9	0.028	0.043	0.001 (NY Class "A" Standard)
INORGANICS: Total Metals (ug/l)				
Aluminum	6/6	13,966.0	348.0 - 72,100.0	100 (NY Class "A" Standard)
Arsenic	2/6	3.4	4.9 - 9.6	190 (NY Class "A" Standard)
Barium	8/8	539.0	116.0 - 2,660.0	1,000 (NY Class "A" Standard)

Table 2 (continued) - Contaminants Exceeding ARARs in On-Site Surface Water				
Cadmium	2/6	2.6	1.3 - 9.4	0.3-9.4 (Calc. - NY Class "A" Standard)
Chromium	4/7	31.1	7.3 - 150.0	47.0-1,875 (Calc. - NY Class "A" Standard)
Cobalt	5/8	19.4	8.9 - 76.0	5.0 (NY Class "A" Standard)
Copper	4/8	23.2	10.0 - 97.2	2.5-118.0 (Calc. NY Class "A" Standard)
Iron	8/8	296,704.0	5,430.0 - 1,940,000.0	300.0 (NY Class "A" Standard)
Lead	8/8	116.5	4.5 - 655.0	0.3-97.0 (Calc. NY Class "A" Standard)
Magnesium	8/8	50,688.0	22,200.0 - 99,700.0	35,000 (NY Class "A" Standard)
Manganese	6/6	2,234.2	420.0 - 7,880.0	300 (NY Class "A" Standard)
Nickel	7/8	35.4	12.5 - 103.0	24-739 (Calc. NY Class "A" Standard)
Vanadium	5/8	36.0	3.6 - 208.0	14.0 (NY Class "A" Standard)
Zinc	4/4	1,478.3	53.0 - 4,960.0	30.0 (NY Class "A" Standard

* On-site surface water includes surface water and leachate sampling stations: SW01, L-1, L-2, (and its duplicate L-4) and L-3).

TABLE 1 - Comparison of Sediments with Background and Reference Values

EMICAL NAME	RANGE OF ON-SITE WETLAND[1/] CONCENTRATIONS	RANGE OF DOWNGRADIENT[1/] CONCENTRATIONS	RANGE OF BACKGROUND CONCENTRATIONS	REFERENCE VALUES
GANICS				
Volatiles: (ug/kg)				
Acetone	420.0	ND	57.0	None
Chloroform	2.0	ND	1.0	
2-Butanone	3.0-570.0	5.0	44.0	
Methylene Chloride	7.0-16.0	6.0	4.0	
Total Xylenes	3.0-8.0	ND	ND	
Semivolatiles: (ug/kg)				
o BNAs				
1,4-Dichlorobenzene	ND	57.0	ND	None
4-Chloro-3-methylphenol	ND	100.0	ND	
4-Methylphenol	900.0	ND	ND	
Benzoic Acid	80.0-230.0	82.0	94.0	
Bis(2-ethylhexyl)phthalate	240.0-850.0	150.0-410.0	97.0-160.0	
Di-n-Butylphthalate	ND	54.0	ND	
(PAHs)				
Noncarcinogens:				
Naphthalene	150.0	73.0-120.0	100.0-190.0	
2-Metylnaphthalene	60.0	100.0	110.0-220.0	
Acenaphthylene	ND	78.0	48.0-140.0	
Acenaphthene	75.0-180.0	62.0-370.0	570.0-1,800.0	
Dibenzofuran	230.0	160.0-700.0	270.0-870.0	
Fluorene	170.0-350.0	74.0-1,900.0	680.0-1,900.0	
Anthracene	120.0-440.0	100.0-3,600.0	77.0-2,400.0	
Fluoranthrene	190.0-5,700.0	1,700.0-26,000.0	860.0-20,000.0	
Pyrene	130.0-3,700.0	2,000.0-24,000.0	800.0-17,000.0	
Carcinogens:				
Phenanthrene	100.0-2,000.0	59.0-10,000.0	540.0-17,000.0	
Benzo(a)anthracene	200.0-2,100.0	700.0-8,600.0	350.0--8,100.0	
Chrysene	230.2-2,100.0	800.0-9,200.0	400.0-7,600.0	
Benzo(b)fluoranthene	180.0-1,800.0	580.0-6,800.0	220.0-6,300.0	
Benzo(k)fluoranthene	230.0-1,900.0	2,500.0-4,800.0	370.0-6,600.0	
Benzo(a)pyrene	220.0-2,100.0	710.0-8,400.0	350.0-6,300.0	
Indeno[1,2,3-CD]pyrene	320.0-1,000.0	330.0-3,500.0	1,700.0-2,500.0	
Dibenzo[A,H]anthracene	150.0-410.0	100.0-1,400.0	590.0-1,100.0	
Benzo[G,H,I]perylene	130.0-1,000.0	340.0-3,400.0	1,700.0-2,700.0	
o Pesticides/PCBs				
Beta-BHC	ND	ND	100.0	None

TABLE 3 (Continued)

CHEMICAL NAME	RANGE OF ON-SITE WETLAND[1] CONCENTRATIONS	RANGE OF DOWNGRADIENT[1] CONCENTRATIONS	RANGE OF BACKGROUND CONCENTRATIONS	REFERENCE VALUES
INORGANICS				
o Total Metals (mg/kg)				
Aluminum	5,510.0-30,800.0	7,950.0-17,000.0	9,000.0-11,400.0	10,000 - 300,000 (Dragun, J. 1988)
Antimony	9.2-24.3	5.7	6.3-6.9	0.6 - 10 (Dragun, J. 1988)
Arsenic	0.9-6.6	2.1-5.6	1.8-4.7	10 - 40 (Dragun, J. 1988)
Barium	42.3-257.0	26.2-217.0	27.5-42.1	100 - 3,500 (Dragun, J. 1988)
Beryllium	0.6-3.9	1.1-2.7	0.6-1.4	1 - 2 (Glacial Till; Kabata-Pendios 1984)
Cadmium	0.48-1.2	0.20-0.71	0.16-0.48	0.01 - 7 (Dragun, J. 1988)
Calcium	1,720.0-23,900.0	804.0-10,600.0	718.0-14,200.0	100 - 400,000 (Dragun, J. 1988)
Chromium	7.7-29.3	10.7-14.1	10.4-15.8	10 - 80 (Dragun, J. 1988)
Cobalt	5.9-17.1	6.8-24.6	6.0-9.1	3 - 15 (Glacial Till; Kabata-Pendios 1984)
Copper	8.9-33.6	7.4-15.0	1.6-14.1	2 - 100 (Dragun, J. 1988)
Iron	12,200.0-215,000.0	17,000.0-36,300.0	20,200.0-29,500.0	7,000 - 550,000 (Dragun, J. 1988)
Lead	16.7-98.4	13.0-25.3	11.6-17.6	3 - 30 (Dragun, J. 1988)
Magnesium	2,180.0-7,550.0	2,940.0-9,200.0	2,570.0-9,700.0	6 - 6,000 (Dragun, J. 1988)
Manganese	104.0-1,320.0	220.0-6,370.0	133.0-840.0	100 - 4,000 (Dragun, J. 1988)
Mercury	0.14-0.97	0.29	ND	0.02 - 0.36 (Glacial Till; Kabata-Pendios 1984)
Nickel	9.2-39.3	14.5-21.8	13.3-21.9	10 - 30 (Glacial Till; Kabata-Pendios 1984)
Potassium	475.0-2,490.0	461.0-844.0	423.0-1,050.0	400 - 30,000 (Dragun, J. 1988)
Sodium	123.0-3,410.0	44.9-666.0	34.0-524.0	750 - 7,500 (Dragun, J. 1988)
Vanadium	16.1-33.8	15.1-25.5	12.3-21.9	20 - 500 (Dragun, J. 1988)
Zinc	68.7-220.0	57.2-125.0	54.7-110.0	10 - 300 (Dragun, J. 1988)
Radioactive Isotopes:				
Radiocarbon ^{14}C (uCi/g sediment)	ND	ND	NA	None
Tritium ^{3}H (uCi/ml water)	ND	ND	NA	None

1/ Please refer to Table 4.0-3 for sample groupings.
ND Non detect.
NA Not analyzed for.
R Denotes all values rejected as a result of data validation.

TABLE 4

WARWICK LANDFILL SITE
CONTAMINANTS OF CONCERN EXISTING IN SOILS (ug/kg)[1/]

Chemical Name	Unsaturated Zone[1/]	Saturated Zone[2/]
Benzene	2.0	4.0
Chlorobenzene	--	28.0
Ethylbenzene	79.0	220.0
Xylenes	25.0	49.0
Arsenic	4.6	4.6
Barium	111.0	66.5
Beryllium	0.91	1.0
Chromium	18.0	24.6
Cobalt	12.5	12.5
Iron	23,900	25,700
Lead	176.0	136.0
Manganese	661.0	646.0
Mercury	0.5	0.44
Nickel	21.5	22.7
Vanadium	16.8	19.5
Zinc	127.0	314.0

1/ Maximum detected concentrations.
-- Not detected.

Table 5

WARNER LAMBERT SI
SUMMARY OF SELECTED CHEMICALS OF [illegible]IAL CONCERN
IN SAMPLED MATRICES
USED FOR QUANTITATIVE EVALUATION

CHEMICAL NAME	SOIL				GROUNDWATER		Surface Water		Sediment	
	On-Site		Downgradient		On-Site and Downgradient					
	Unsaturated	Saturated	Unsaturated	Saturated	Overburden	Bedrock	On-Site	Downgradient	On-Site	Downgradient
Volatiles:										
Acetone	--	--	--	--	--	--	--	--	--	--
Benzene	X	X	--	--	--	X	X	--	--	--
2-Butanone	--	--	--	--	--	--	X	--	X	--
Carbon Disulfide	--	--	--	--	X	X	--	--	--	--
Chlorobenzene	--	--	--	--	--	X (-)	X	--	--	--
Chloroethane	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	X	--	--	X	--
Chloromethane	--	--	--	--	--	X	--	--	--	--
1,1-Dichloroethene	--	--	--	--	X	X	--	--	--	--
1,1-Dichloroethane*	--	--	--	--	--	X (-)	--	--	--	--
Cis-1,2-Dichloroethene*	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	X	X	--	--	--	X	X	--	--	--
2-Hexanone*	--	--	--	--	--	--	--	--	--	--
Isopropylbenzene	--	--	--	--	--	X	--	--	--	--
Methylene Chloride	--	--	--	--	--	--	X	--	--	--
N-propylbenzene*	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene*	--	--	--	--	--	--	--	--	--	--
Styrene	X	--	--	--	--	--	--	--	--	--
Tetrachloroethene	X	X	--	--	--	--	--	--	--	--
Toluene	X	X	X	X	--	X	X	--	--	--
Trichloroethene	--	--	--	--	X	--	--	--	--	--
1,1,1-Trichloroethane	--	--	--	--	--	X (-)	--	--	--	--
1,3,5-Trimethylbenzene*	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene*	--	--	--	--	--	--	--	--	--	--
m & p xylenes Total	X	X	--	--	--	X	X	--	--	--
o-xylenes	--	--	--	--	--	X	--	--	--	--
Semi-Volatiles:										
Bis(2-ethylhexyl)phthalate	X	X	--	X	--	X	--	X	X	X
Butylbenzyl phthalate	--	--	--	--	--	--	X	--	--	--
Diethyl phthalate	--	--	--	--	--	--	X	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	X	--	--	X
Di-n-octyl phthalate*	--	--	--	--	--	--	--	--	--	--
Carcinogenic PAHs*	--	X	--	--	--	--	--	--	--	--
Noncarcinogenic PAHs	X	X	--	--	--	--	X	--	X	X
Benzoic Acid	--	--	--	--	--	--	X	X	X	--
Benzyl alcohol	--	--	--	--	--	--	X	--	--	--
1,3-Dichlorobenzene*	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	X	X	--	--	--
Hexachlorobutadiene	--	--	--	--	--	--	X	--	--	--
4-Methyl phenol	--	--	--	--	--	--	X	X	--	--
Phenol	--	--	--	--	--	--	X	X	--	--
Aldrin	--	--	--	--	--	--	X	--	--	--
Dioxin/Furan:										
Dioxin	X(-)	--	--	--	--	--	--	--	--	--
Furan	X	--	--	--	--	--	--	--	--	--
Total Metals:										
Antimony	X(-)	X(-)	--	X(-)	X	X	X	--	--	--
Arsenic	--	--	--	--	X	X	X	X	--	--
Barium	--	--	--	--	X	X	X	X	--	--
Beryllium	--	--	--	--	X	X	X	X	--	--
Cadmium	--	--	--	--	X	X	X	--	--	--
Chromium	--	--	--	--	X	X	X	X	--	--
Cobalt*	--	--	--	--	--	--	--	--	--	--
Copper	--	--	--	--	X (-)	--	X	X	--	--
Iron*	--	--	--	--	--	--	--	--	--	--
Lead*	--	--	--	--	--	--	--	--	--	--
Manganese	X	X	X	X	X	X	X	X	--	--
Mercury	X(-)	X(-)	X(-)	X(-)	X	X	X	--	--	--
Nickel	--	--	--	--	X	X	X	X	--	--
Selenium	--	--	--	--	X	X	--	--	--	--
Silver	--	--	--	--	X	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--	--
Vanadium	--	--	X(-)	X(-)	X	X	X	X	--	--
Zinc	--	--	--	--	[illegible]	X (-)	X	X	--	--

● Not selected
Selected

Table 6

WARWICK LANDFILL SITE

SUMMARY OF EXPOSURE PATHWAYS AND CURRENT AND FUTURE LAND USE

Exposure Medium	Exposure Pathway	Evaluation	Potentially Exposed Population
o Air	o Inhalation of volatiles	o Air monitoring photoionization analyzer (HNU) did not reveal the presence of volatile organics above leachate seeps (Woodward and Clyde Consultant, 1985)	o NA
o Soil	o Inhalation of Fugitive Dust; Dermal Contact; and Ingestion	o Ground is covered with vegetation. Future construction on-site is possible. In addition, low contamination levels were detected in the 0-2 ft zone. Therefore saturated and unsaturated soils are evaluated only as potential sources to ground- and surface water contamination and if Construction takes place in the future.	o Residents Site Workers
o Groundwater	o Inhalation of volatiles while showering; Dermal contact while showering; and Ingestion	o Groundwater is used as potable water	o Residents
o Surface Water	o Dermal contact while wading; and incidental Ingestion	o Surface water bodies do not support fishing or other recreation activities	o Residents
o Sediment	o Dermal contact while wading	o Surface water bodies do not support fishing or other recreation activities	o Residents

Table 7

WARWICK LANDFILL SITE
TOXICITY DATA FOR NONCARCINOGENIC EFFECTS
OF CHEMICALS OF POTENTIAL CONCERN
DOSE RESPONSE EVALUATION -IRIS[1/], AUGUST 1990

CHEMICAL NAME	NONCARCINOGENS, CHRONIC REFERENCE DOSES	
	Oral RfD (mg/kg-day)	Inhalation RfD (mg/kg-day)
ORGANICS		
Volatiles		
Acetone	1.00E-01	ND
Benzene	ND	ND
2-Butanone	5.00E-02	9.00E-02
Carbon Disulfide	1.00E-01	-
Chlorobenzene	2.00E-02	5.00E-02
Chloroform	1.00E-02	ND
1,1-Dichloroethene	9.00E-03	ND
Ethylbenzene	1.00E-01	-
Isopropyl benzene	4.00E-02	9.30E-03
Methylene Chloride	6.00E-02	3.00E+00 (Heast)
1,1,1-Trichloroethane	9.00E-02	3.00E+00
Toluene	2.00E-01	2.00E+00
Chloroethane	-	-
1,1-Dichloroethane	1.00E-01(Heast)	1.00E-01 (Heast)
Trichloroethene	-	-
Xylenes, mixed	2.00E+00	3.00E-01 (Heast)
Tetrachloroethene	1.0E-02	-
Styrene	2.0E-01	
Semivolatiles		
o EPA		
Benzoic Acid	4.00E+00	-
Phenol	6.00E-01	-
4-Methylphenol	5.00E-02	-
Hexachlorobutadiene	2.00E-03	-
Bis (2-ethylhexyl) phthalate	2.00E-02	-
Butyl benzyl phthalate	2.00E-01	-
Diethyl phthalate	8.00E-01	-
Di-n-butyl phthalate	1.00E-01	-
Benzyl alcohol	3.00E-01 (Heast)	ND
1,4-Dichlorobenzene	-	7.00E-01 (Heast
Noncarcinogenic PAHs**	4.00E-03 (Heast)	-
Carcinogenic PAHs	-	-
o Pesticides		
Aldrin	3.00E-05	-
INORGANICS		
Total Metals		
Antimony	4.00E-04 (Heast)	-
Arsenic	1.00E-03 (Heast)	-
Barium	7.00E-02	1.00E-04
Beryllium	5.00E-03	-
Cadmium	5.00E-04 (Water)	-
	1.00E-03 (Food)	-
Chromium	1.00E+00	-
Copper	3.70E-02	1.00E-02
Manganese	1.00E-01	-
Mercury	3.00E-04 (Heast)	-
Nickel	2.00E-02 (Heast)	-
Selenium	3.00E-03	-
Silver	3.00E-03	-
Thallium (chloride)	8.00E-05	-
Vanadium	9.00E-03	-
Zinc	2.00E-01	-

1/ Integrated Risk Information System otherwise Fourth Quarter HEAST 1990 where noted.

ND: Pending.
-: Not Available

DOSE RESPONSE EVALUATION -HEAST, FOURTH QUARTER, 1990

CHEMICAL NAME	NONCARCINOGENS, SUBCHRONIC REFERENCE DOSES	
	Oral RfD (mg/kg-day)	Inhalable (mg/kg-d
ORGANICS		
Volatiles		
Ethylbenzene	1.00E-01	-
Styrene	2.00E-01	-
Toluene	4.00E-01	2.00E-00
Tetrachloroethene	1.00E-01	-
Xylenes (total)	4.00E-01	3.00E-01
Semivolatiles		
PAHs (noncarc)**	4.00E-03	-
INORGANICS		
Total Metals		
Antimony	4.00E-04	-
Manganese	5.00E-01	3.00E-04
Mercury	3.00E-04	3.00E-04

-: Not Available
**: PAHs which have no carcinogenic effects considered in this risk assessment are: anthracene, fluoranthrene, naphthalene, and pyrene. The subchronic oral RfD for naphthalene is used for the noncarcinogenic PAH exposure because it is more conservative.

WARWICK LANDFILL SITE
SUMMATION OF HUMAN HEALTH RISK ESTIMATIONS
ACROSS PATHWAYS FOR RESIDENTS
UNDER PRESENT/FUTURE LAND USE

Table 8

Exposure Pathway	Hazard Index for Noncarcinogenic Effects			
	Adults		Children	
	Average Case	Maximum Reasonable Case	Average Case	Maximum Reasonable Case
♦ 1) Exposure to Groundwater				
Ingestion of Chemicals in Groundwater	21*	21*	21*	31*
Dermal Adsorption of Chemicals in Groundwater	1.60E-04	2.77E-04	1.86E-04	3.25E-04
Inhalation of Groundwater Volatiles	6.98E-04	1.28E-03	1.49E-03	2.73E-03
Total	21.0	21.0	21.0	31.0
2) Recreational Use of Surface Water Bodies				
Incidental Ingestion of Chemicals in Surface Water	3.95E-3*	1.58E-2*	2.93E-2*	0.12*
Dermal Adsorption of Chemicals in Surface Water	8.41E-03	0.13	3.75E-04	0.59
Dermal Adsorption of Chemicals in Sediments	6.47E-07	4.05E-03	2.88E-04	1.83E-02
Total	1.24E-02	0.15	3.00E-02	0.73
3) Exposure to Soils				
Ingestion of Chemicals in Soils	5.98E-04	6.06E-11	2.80E-03	2.90E-09
Dermal Adsorption to Chemicals in Soils	2.23E-05	3.20E-04	5.91E-05	3.12E-04
Inhalation of Chemicals in Soils	1.04E-07	1.13E-06	2.23E-07	2.26E-06
Total	6.20E-04	3.21E-04	2.86E-03	3.14E-04
4) Worst Case Exposure To All Exposure Scenarios (Total 1, 2 and 3)	21.0	21.15	21.0	31.763

Exposure Pathway	Hazard Index for Noncarcinogenic Effects	
	Average Case	Reasonable Maximum Case
✓ 1) Exposure to Soils		
Exposure to Chemicals in Soils	2.55E-04	8.97E-04
Dermal Adsorption of Chemicals in Soils	9.51E-05	4.80E-04
Inhalation of Chemicals in Soils	1.28E-06	1.46E-05
Total	3.52E-04	1.39E-03

♦ Summarizes greatest risks of all aquifers assessed.

✓ Potential future land-use risks only.

WARWICK LANDFILL SITE
TOXICITY DATA FOR POTENTIALLY CARCINOGENIC EFFECTS
OF CHEMICALS OF POTENTIAL CONCERN
DOSE RESPONSE EVALUATION -IRIS 1/, AUGUST 1990

CHEMICAL NAME	CARCINOGENS: SLOPE FACTORS			
	Oral SF (mg/kg-day)$^{-1}$	Weight of Evidence	Inhalation SF (mg/kg-day)$^{-1}$	Weight of Evidence
ORGANICS				
Volatiles				
Acetone	-	D	-	D
Benzene	2.90E-02	A	2.90E-02	A
2-Butanone	-	D		D
Carbon Disulfide		-	-	-
Chlorobenzene	ND		ND	
Chloroform	6.10E-03	B_2	8.10E-02	B_2
1,1-Dichloroethene	6.00E-01	C	1.70E+00	C
Ethylbenzene	-	D	-	D
Isopropyl benzene		-		-
Methylene Chloride	7.50E-03	B_2	1.40E-02	B_2
1,1,1-Trichloroethane		D		D
Toluene		D		D
Chloromethane	1.30E-02 (Heast)	C	6.30E-03 (Heast)	C
1,1-Dichloroethene	-	C	ND	
Trichloroethene	1.10E-02 (Heast)	B_2	1.70E-02 (Heast)	B_2
Xylenes, mixed		D		D
Tetrachloroethene	5.10E-02	B_2	3.00E-03	B_2
Styrene	3.00E-02	B_2	2.00E-03	B_2
Semivolatiles				
o BNA				
Benzoic Acid	-	D	-	D
Phenol	ND		ND	
4-Methylphenol	ND		ND	
Hexachlorobutadiene	7.80E-02	C	7.80E-02	C
Bis (2-ethylhexyl) phthalate	1.40E-02	B_2	-	B_2
Butyl benzyl phthala	-	C	-	C
Diethyl phthalate	-	D		D
Di-n-butyl phthalate		D		D
Benzyl alcohol	ND		ND	
1,4-Dichlorobenzene	2.40E-02 (Heast)	B_2	ND	
Noncarcinogenic PAHs	-		-	
Carcinogenic PAHs	11.5	B_2	6.1	B_2
o Pesticides				
Aldrin	1.70E+01	B_2	1.70E+01	
INORGANICS				
Total Metals				
Antimony	-	-	-	-
Arsenic		-		1.5 E+01
Barium		-		-
Beryllium	4.30E+00	B_2	8.40E+00	
Cadmium	-		-	-
	-	B_1		6.10E+00
Chromium	-	-		-
Copper	-	-		-
Manganese	-	D		-
Mercury	-	-		
Nickel	-	A		1.70E+00
Selenium	-	-		-
Silver		D		
Thallium (chloride)	-	-		-
Vanadium	-	-		-
Zinc	-	-		-

1/ Integrated Risk Information System otherwise Fourth Quarter HEAST 1990 where noted.

EPA Weight of Evidence Classifications are as follows:

Group A = Human Carcinogen. Sufficient evidence from epidemiologic studies to support a casual association between exposure and cancer.
Group B1 = Probable Human Carcinogen. Limited evidence of carcinogenicity in humans from epidemiological studies.
Group B2 = Probable Human Carcinogen. Sufficient evidence of carcinogenicity in animals. Inadequate evidence of carcinogenicity in humans
Group C = Possible Human Carcinogen. Limited evidence of carcinogenicity in animals.
Group D = Not classified. Inadequate evidence of carcinogenicity in animals.

ND: [illegible]
-: [illegible] available.
*: [illegible] which have carcinogenic effects considered in this risk assessment are: Benzo(a)anthracene, Benzo(a)pyrene, [illegible]

Table 10

WARWICK LANDFILL SITE
SUMMATION OF HUMAN HEALTH RISK ESTIMATIONS
ACROSS PATHWAYS FOR RESIDENTS
UNDER PRESENT/FUTURE LAND USE

Exposure Pathway	Excess Lifetime Cancer Risk			
	Adults		Children	
	Average Case	Maximum Reasonable Case	Average Case	Maximum Reasonable Case
♦ 1) Exposure to Groundwater				
Ingestion of Chemicals in Groundwater	1.18E-04	3.94E-04	7.87E-05	1.18E-04
Dermal Adsorption of Chemicals in Groundwater	2.32E-07	1.33E-06	1.79E-07	3.13E-07
Inhalation of Groundwater Volatiles	1.61E-05	9.79E-05	2.30E-05	4.21E-05
Total	1.34E-04	4.93E-04	1.02E-04	1.60E-04
2) Recreational Use of Surface Water Bodies				
Incidental Ingestion of Chemicals in Surface Water	3.34E-08	4.43E-07	1.65E-07	6.61E-07
Dermal Adsorption of Chemicals in Surface Water	6.91E-08	3.60E-06	1.98E-07	3.28E-06
Dermal Adsorption of Chemicals in Sediments	5.29E-12	1.10E-09	1.51E-07	9.96E-10
Total	1.03E-07	4.05E-06	3.63E-07	3.91E-06
3) Exposure to Soils				
Ingestion of Chemicals in Soils	1.61E-08	5.41E-07	6.50E-08	5.06E-07
Dermal Adsorption to Chemicals in Soils	6.05E-11	2.90E-09	1.07E-10	7.04E-10
Inhalation of Chemicals in Soils	2.15E-11	7.77E-10	3.07E-11	3.11E-10
Total	1.62E-08	5.45E-07	6.51E-08	5.07E-07
4) Worst Case Exposure To All Exposure Scenarios (Total 1, 2 and 3)	1.34E-04	4.98E-04	1.02E-04	1.64E-04

WARWICK LANDFILL SITE
SUMMATION OF HUMAN HEALTH RISK ESTIMATIONS
ACROSS PATHWAYS FOR CONSTRUCTION WORKERS
UNDER FUTURE LAND USE

Exposure Pathway	Excess Lifetime Cancer Risk	
	Average Case	Reasonable Maximum Case
√ 1) Exposure to Soils		
Exposure to Chemicals in Soils	7.71E-09	8.12E-08
Dermal Adsorption of Chemicals in Soils	2.90E-11	4.34E-10
Inhalation of Chemicals in Soils	2.93E-11	1.00E-09
Total	7.77E-09	8.26E-08

♦ Summarizes greatest risks of all aquifers assessed.
√ Potential future land-use risks only.

TABLE D-3

ALTERNATIVE 3: CAPPING/POINT OF USE TREATMENT

CAPITAL COST ESTIMATES (1991 DOLLARS)

LITY/CONSTRUCTION	ESTIMATED QUANTITIES	MATERIAL ($) UNIT PRICE	MATERIAL ($) COST	INSTALLATION ($) UNIT PRICE	INSTALLATION ($) COST	DIRECT CONSTRUCTON COST* ($)
. SUPPORT FACILITIES						
1. Office Trailers	2	9,400	18,800	INCL		18,800
2. Decontamination Trailers	2	18,000	36,000	INCL		36,000
3. Parking and Equipment Area	5,000 sy	9.20	46,000	2.65	13,250	59,300
I. GROUNDWATER MONITORING WELLS	6	2,000	12,000	2,200	13,200	25,200
I. SECURITY FENCING/SIGNS	4,750 ft	(From Table D-2; Item III)				113,000
V. GRADE AND COMPACT LANDFILL SURFACE	21.6 acres	INCL		3,015	65,124	65,100
V. MULTI-LAYER CAP	21.6 acres					
1. Clay Layer	52,270 cu yd	31.25	1,633,430	INCL		1,633,400
2. Sand/Soil Layer	69,760 cuyd	38.75	2,703,200	INCL		2,703,200
3. Topsoil Cover	17,440 cu yd	31.55	550,232	INCL		550,200
4. Seeding	21.6 acres	3,900	84,240	INCL		84,200
I. GRADE CAP SURFACE	21.6 acres	INCL		1,500	32,400	32,400
I. PASSIVE LANDFILL GAS CONTROL SYSTEM	18	3,700	66,640	4,520	81,360	149,400
I. PRIVATE WATER SUPPLY TREATMENT UNITS	42	(From Table D-2; Item IV.)				41,600

Total Direct Construction Cost (TDCC)	$ 5,512,600
Contingency @ 20% of TDCC	$ 1,102,500
Planning/Engineering @ 10% of TDCC	$ 551,300
Legal and Administrative @ 5% of TDCC	$ 275,600
Total Construction Cost	$ 7,442,000

All numbers are rounded to nearest hundred.

Table 11

TABLE D-8

ALTERNATIVE 3: CAPPING/POINT OF USE TREATMENT

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES (1991 DOLLARS)

	Basis of Estimate	Annual O&M Cost Estimate** ($)	Years
SITE MONITORING PROGRAM			
1. Water Sampling	2 Persons @ $30/hr-160 hrs/yr	4,000	1-30
2. Water Laboratory Analysis (15 samples quarterly)	60 samples @ $1200/sample	72,000	1-30
3. Gas Laboratory Analysis	72 samples @ $700/sample	50,000	1-30
4. Report	1 person @ $60/hr-60 hrs/yr	3,600	1-30
4. Residential Well Sampling (2 samples semi-annual)	2 persons @ $30/hr - 240 hrs/yr	7,200	1-3
5. Residential Well Sampling (42 wells by semi-annual)	84 water samples @ $1200/sample	100,000	1-3
MAINTENANCE			
1. Wells, Gas Vents, Cap, Fencing	5% of capital cost of each	267,000	1-30
2. Residential Water Filters	42 units @ $100/yr each	4,200	1-30
ANNUAL O&M COST		510,000 402,000	1-3 4-30
CONTINGENCY	5% of annual O&M cost	25,500 20,100	1-3 4-30
TOTAL ANNUAL O&M COST		536,300 422,900	1-3 4-30
SITE STATUS REVIEWS AND PUBLIC AWARENESS PROGRAMS	$10,000 per review		5, 10, 15, 20, 25 & 30
Present Worth of Reviews	$27,000		
Present Worth Annual Costs	$6,009,000		
TOTAL PRESENT WORTH* INCLUDING TDCC, O&M AND REVIEWS	$14,279,600		

Table 11 (cont.)

Present worth analysis based on 30-year period and 5.00% discount rate.
All numbers rounded to nearest hundred.

APPENDIX III

ADMINISTRATIVE RECORD INDEX

Document Number: WAR-001-0578 To 0580 Date: 06/03/83

Title: (Letter forwarding the results of the Preliminary Investigation)

Type: CORRESPONDENCE
Author: Ganser, Donald R.: Woodward-Clyde Consultants
Recipient: Nosenchuck, Norman H.: NY Dept of Environmental Conservation
Attached: WAR-001-0581

Document Number: WAR-001-0581 To 0950 Parent: WAR-001-0578 Date: 09/30/83

Title: Engineering Investigations at Inactive Hazardous Waste Sites in the State of New York - Phase I - Preliminary Investigation, Warwick Landfill

Type: PLAN
Author: none: Woodward-Clyde Consultants
Recipient: none: NY Dept of Environmental Conservation

Document Number: WAR-001-0024 To 0577 Date: 03/01/85

Title: Engineering Investigations at Inactive Hazardous Waste Sites in the State of New York - Phase II Investigations - Warwick Landfill Site, Town of Warwick, Orange County, New York

Type: PLAN
Author: none: Woodward-Clyde Consultants
Recipient: none: NY Dept of Environmental Conservation

Document Number: WAR-001-0001 To 0023 Date: 08/01/88

Title: Aerial Photographic Analysis of the Warwick Landfill Site - Greenwood Lake, New York

Type: GRAPHIC
Author: none: US EPA
Recipient: none: US EPA

Document Number: WAR-001-0954 To 1186 Parent: WAR-001-0951 Date: 01/01/89

Title: Final Field Operations Plan, Remedial Investigation and Feasibility Study, Warwick Landfill Site, Warwick, New York

Type: PLAN
Author: none: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-002-0210 To 0234 Parent: WAR-002-0208 Date: 01/01/89

Title: Final Community Relations Plan, Warwick Landfill Site, Town of Warwick, Orange County, New York

Type: PLAN
Author: Marshall, Sydne B.: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-001-0951 To 0953 Date: 01/31/89

Title: (Letter submitting the Final Field Operations Plan (FOP) for the Warwick Landfill site)

Type: CORRESPONDENCE
Author: Sachdev, Dev R.: Ebasco Services
Recipient: Alvi, M. Shaheer: US EPA
Attached: WAR-001-0954

Document Number: WAR-002-0208 To 0209 Date: 01/31/89

Title: (Letter forwarding the Community Relations Plan for the Warwick Landfill site)

Type: CORRESPONDENCE
Author: Sachdev, Dev R.: Ebasco Services
Recipient: Wing, Robert: US EPA
Attached: WAR-002-0210

Document Number: WAR-001-1205 To 1381 Date: 05/01/89

Title: Final Work Plan, Remedial Investigation and Feasibility Study, Warwick Landfill Site, Warwick, New York

Type: PLAN
Author: none: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-002-0200 To 0207 Parent: WAR-002-0199 Date: 06/01/89

Title: Preliminary Health Assessment - Warwick Landfill - Orange County, Warwick, New York

Type: PLAN
Author: none: NY Dept of Health
Recipient: none: US EPA

Document Number: WAR-002-0199 To 0199 Date: 07/12/89

Title: (Letter forwarding a copy of the Preliminary Health Assessment for the Warwick Landfill)

Type: CORRESPONDENCE
Author: Nelson, William: Agency for Toxic Substances & Disease Registry (ATSDR)
Recipient: Wing, Bob: US EPA
Attached: WAR-002-0200

Document Number: WAR-002-0405 To 0448 Date: 08/01/89

Title: Superfund Update - Warwick Landfill Site, Town of Warwick, Orange County, New York - Fact Sheet #1

Type: PLAN
Author: none: US EPA
Recipient: none: none

Document Number: WAR-002-0388 To 0396 Parent: WAR-002-0387 Date: 08/07/89

Title: Summary of Issues Raised - EPA Public Availability Session, August 7, 1989 - Warwick Town Hall, Warwick, New York

Type: PLAN
Author: none: Ebasco Services
Recipient: none: none

Document Number: WAR-002-0387 To 0387 Date: 08/15/89

Title: (Memo forwarding a summary of issues raised during the EPA Public Availability Session held in Warwick, New York, on August 7, 1989)

Type: CORRESPONDENCE
Author: Marshall, Sydne B.: Ebasco Services
Recipient: Lozada, J.: Ebasco Services
Attached: WAR-002-0388

Document Number: WAR-001-2331 To 2349 Date: 01/01/90

Title: Results of Stage 1A Cultural Resources Survey, Warwick Landfill Site, Town of Warwick, Orange County, New York

Type: PLAN
Author: Fiedel, S.: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-002-0385 To 0386 Date: 04/27/90

Title: (Memo regarding) Meeting with Dutch Hollow Homeowner's Association

Type: CORRESPONDENCE
Author: Rychlenski, Ann: US EPA
Recipient: Garbanni, Doug: US EPA

Document Number: WAR-001-1187 To 1204 Date: 05/31/90

Title: (Letter forwarding the attached revised Field Change Request Form, SAS request, and parameter table for three additional leachate samples to be scanned for full dioxin)

Type: CORRESPONDENCE
Author: Sielski, Mark: Ebasco Services
Recipient: Gupta, Rahul: US EPA

Document Number: WAR-002-0397 To 0404 Date: 10/01/90

Title: Fact Sheet - Warwick Landfill: Private Well Water Sampling Results

Type: PLAN
Author: none: NY Dept of Health
Recipient: none: none

Document Number: WAR-001-2354 To 2357 Date: 10/01/90

Title: Superfund Update - Warwick Landfill Site, Town of Warwick, Orange County, New York

Type: CORRESPONDENCE
Author: none: US EPA
Recipient: none: none

Document Number: WAR-002-0198 To 0198 Date: 12/19/90

Title: (Letter requesting a written statement indicating whether any endangered or threatened species are present in the project area)

Type: CORRESPONDENCE
Condition: MISSING ATTACHMENT
Author: Hargrove, Robert W.: US EPA
Recipient: Corin, Leonard P.: US Fish & Wildlife Service

Document Number: WAR-002-0197 To 0197 Date: 01/17/91

Title: (Letter responding to a December 19, 1991 letter requesting information on the presence of federally listed or proposed endangered or threatened species in the vicinity of the site)

Type: CORRESPONDENCE
Author: Corin, Leonard P.: US Fish & Wildlife Service
Recipient: Hargrove, Robert W.: US EPA

Document Number: WAR-001-1384 To 1737 Parent: WAR-001-1382 Date: 02/01/91

Title: Final Remedial Investigation Report, Warwick Landfill Site, Warwick, New York, Volume I of III

Type: REPORT
Author: none: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-001-1738 To 2316 Date: 02/01/91

Title: Final Remedial Investigation Report, Warwick Landfill Site, Warwick, New York, Volume II of III

Type: REPORT
Author: none: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-001-2317 To 2330 Date: 02/01/91

Title: Final Remedial Investigation Report, Warwick Landfill Site, Warwick, New York, Volume III of III

Type: REPORT
Author: none: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-001-2352 To 2353 Date: 02/01/91

Title: (Letter outlining the NYSDEC's preferred alternative and stating objections to EPA's Alternative No. 5)

Type: CORRESPONDENCE
Author: Chen, Marsden A.: NY Dept of Environmental Conservation
Recipient: Pavlou, George: US EPA

Document Number: WAR-002-0002 To 0185 Parent: WAR-002-0001 Date: 02/01/91

Title: Final Feasibility Study Report, Warwick Landfill Site, Warwick, New York

Type: REPORT
Author: none: Ebasco Services
Recipient: none: US EPA

Document Number: WAR-002-0186 To 0196 Date: 02/01/91

Title: Superfund Proposed Plan - Warwick Landfill Site, Town of Warwick, Orange County, New York

Type: PLAN
Author: none: US EPA
Recipient: none: none

Document Number: WAR-001-1382 To 1383 Date: 02/11/91

Title: (Letter submitting the Final Remedial Investigation (RI) Report for the Warwick Landfill site)

Type: CORRESPONDENCE
Author: Verdibello, Mario: Ebasco Services
Recipient: Allen, Julia: US EPA
Attached: WAR-001-1384

Document Number: WAR-002-0001 To 0001 Date: 02/11/91

Title: (Letter submitting the Final Feasibility Study (FS) Report for the Warwick Landfill site)

Type: CORRESPONDENCE
Author: Verdibello, Mario: Ebasco Services
Recipient: Allen, Julia: US EPA
Attached: WAR-002-0002

Document Number: WAR-001-2350 To 2351 Date: 02/22/91

Title: (Letter forwarding attached table containing amendments to risk assessment spreadsheets, Chromium III vs. Chromium VI)

Type: CORRESPONDENCE
Author: Sielski, Mark: Ebasco Services
Recipient: Allen, Julia: US EPA

Document Number: WAR-002-0235 To 0384 Date: 04/25/91

Title: (Transcript of) Public Meeting for the Warwick Landfill Superfund Site, Town of Warwick, Orange County, New York

Type: LEGAL DOCUMENT
Author: Guardiano, Ellen L.: Meister Reporting Services
Recipient: none: US EPA

APPENDIX IV

NYSDEC LETTER OF CONCURRENCE

McCabe

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233 -7010

Thomas C. Jorling
Commissioner

MAY 2 0 1991

Ms. Kathleen C. Callahan
Director
Emergency & Remedial Response Division
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10278

Dear Ms. Callahan:

Re: Record of Decision
Warwick Landfill ID No. 336014

The New York State Department of Environmental Conservation has reviewed your Record of Decision, received May 9, 1991, for the Warwick Landfill Site and finds it to be acceptable.

Please contact Mr. Jonathan Greco, of my staff, at (518) 457-3976 if you have any questions regarding this matter.

Sincerely,

Edward O. Sullivan
Deputy Commissioner

cc: J. Allen, USEPA, Region II

APPENDIX V

RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY
WARWICK LANDFILL SUPERFUND SITE
WARWICK, NEW YORK

The U.S. Environmental Protection Agency ("EPA") held a public comment period from February 25, 1991 to May 9, 1991 to receive comments from interested parties on the Remedial Investigation and Feasibility Study ("RI/FS") reports and Proposed Plan for the Warwick Landfill Superfund site ("Site").

A public participation meeting was conducted by EPA on April 22, 1991 at the Greenwood Lake Middle School, Greenwood Lake, New York to discuss remedial alternatives, to present EPA's preferred remedial alternative, and to provide an opportunity for the interested parties to present oral comments and questions to EPA.

This responsiveness summary provides a synopsis of citizens' comments and concerns about the Site as raised during the public comment period, and EPA's responses to those comments. All comments summarized in this document were considered in EPA's final decision for selection of the remedial activities for remediation of the Warwick Landfill Superfund site.

This responsiveness summary is divided into the following sections:

I. Responsiveness Summary Overview - This section briefly describes the background of the Warwick Landfill Superfund site and summarizes the proposed and selected alternatives.

II. Background on Community Involvement and Concerns - This section provides a brief history of community interests and concerns regarding the Warwick Landfill Superfund site.

III. Summary of Public Comments and EPA's Responses - This section summarizes comments expressed verbally at the public meeting, and also, those received through written correspondence, and provides EPA's responses to these comments.

IV. Appendices - This section includes a copy of the agenda for the public meeting (Appendix A) and the public meeting sign-in sheets (Appendix B).

I. RESPONSIVENESS SUMMARY OVERVIEW

Site Background

The Site is located approximately one and one-half miles northeast of the Village of Greenwood Lake in the Town of Warwick, Orange County, New York. The Site is approximately three-fourths of a mile north of State Route 17A and fronts Penaluna Road on its western boundary between Old Tuxedo Road and Old Dutch Hollow Road. No buildings exist on the landfill property except for a substantially demolished brick structure. The landfill mound transects a small valley and occupies approximately 13 acres of a 25 acre leasehold area of land.

The area surrounding the Site is generally wooded with clusters of residential homes, all of which utilize private wells as their source of drinking water. The two homes closest to the Site are approximately 250 feet southwest of the landfill boundary and 300 feet northeast of the landfill boundary, respectively.

The Site was owned and farmed by the Penaluna family from 1898 to the mid-1950s, when the Town of Warwick leased the property from the Penaluna family and utilized it as a refuse disposal area. The facility accepted municipal wastes from the Town of Warwick, which includes the Villages of Florida, Warwick and Greenwood Lake, and other surrounding towns in Orange County. The Town of Warwick operated the landfill until 1977.

In April 1977, the Site was leased from the property owner, Mrs. Millie Mae Penaluna, by Grace Disposal and Leasing, Ltd. ("Grace Disposal"), Harriman, New York. On July 15, 1977, Grace Disposal was granted a permit to operate the refuse disposal area by the Orange County Department of Health.

In the spring of 1979, in response to concerns of local citizens who had reported observations of suspicious dumping activities at the landfill, New York State Department of Environmental Conservation ("NYSDEC") and EPA collected and analyzed two leachate samples at the Site. The results indicated the presence of heavy metals, phenols, and various volatile organic compounds, some of which exceeded the New York State Drinking Water Standards and the USEPA National Primary Drinking Water Regulations.

Based on the results of these samples and that Grace Disposal did not perform the additional tasks necessary for the submittal of an adequate draft environmental impact statement, the application to operate the landfill was denied by NYSDEC on September 4, 1979 and the landfill was ordered closed.

Pursuant to a New York State court order, the Site was covered, graded, and closed by Grace Disposal. On June 11, 1980, NYSDEC was notified that a Certificate of Dissolution had been filed by Grace Disposal. In 1984, ownership of the property was transferred to

Orange County for non-payment of back taxes. It was conveyed from Orange County to Newburgh. N.Y. Developers in November 1986. In 1987, the property was transferred to the current owners, L and B Developers.

In March 1985, a field investigation, based on the findings of a September 1983 site investigation, was performed by Woodward-Clyde Consultants, Inc. for the NYSDEC. The information generated was utilized to prepare a Hazard Ranking System ("HRS") assessment of the Site. Based upon the HRS, the Site was proposed for inclusion on EPA's National Priorities List ("NPL") of uncontrolled hazardous waste sites in 1985 and was added to the NPL in March 1989.

On December 28, 1988, Special Notice letters were sent to fourteen entities who were determined at that time to be potentially responsible parties ("PRPs") at the Site. The Special Notice letters informed these parties of their potential liability at the Site and offered them the opportunity to undertake the RI/FS for the Site. The PRPs were given sixty days from receipt of notice to submit a good faith offer.

Since EPA did not receive any good faith proposals from the PRPs to undertake or finance the RI/FS, EPA contracted with Ebasco Services, Incorporated to perform the RI/FS pursuant to monies from the Superfund ("the Fund").

Field work for the RI/FS began in August 1989 and was completed in February 1991.

On February 27, 1991, EPA sent general notice letters to Georgia Pacific Corporation and the Town of Warwick, informing them of their status as PRPs. These entities were designated PRPs following a response received from Georgia Pacific to a 104(e) information request letter.

Summary of Proposed and Selected Remedial Alternative

The remedial alternatives considered for the Site are described in the RI/FS and Proposed Plan for this first operable unit ("OU1"). All alternatives considered are listed below:

- **Alternative 1** - No Action
- **Alternative 2** - Limited Action/ Point of Use Treatment
- **Alternative 3** - Capping/ Point of Use Treatment
- **Alternative 4** - Capping/ Groundwater Pumping/ Chemical Precipitation/ Carbon Adsorption/ Point of Use Treatment

- **Alternative 5** - Capping/ Subsurface Barrier/ Groundwater Pumping/ Chemical Precipitation/ Carbon Adsorption/ Point of Use Treatment

EPA, with the concurrence of NYSDEC, chose a remedy which addresses the principal threats posed by the Site through capping of the landfill and supplying point of use treatment systems to area residents, as needed.

II. BACKGROUND OF COMMUNITY INVOLVEMENT

Community interest in the Site has been high throughout the RI/FS process. The community has been kept aware of activities at the Site through local newspaper articles, fact sheets, press releases, public notices and public information meetings.

The Dutch Hollow Homeowners' Association ("DHHA") was awarded a Technical Assistance Grant ("TAG") in February 1991. Two extensions to the public comment period were requested by DHHA to afford the DHHA's technical advisor sufficient opportunity to review and comment on the RI/FS reports and the Proposed Plan.

III. SUMMARY OF PUBLIC COMMENTS AND EPA'S RESPONSES

The comments detailed below include those expressed at the public meeting on April 22, 1991 and those received in writing during the public comment period. The major concern expressed by the community is the potential migration of contaminants from the landfill into their private residential wells. A residential well sampling program conducted by EPA and New York State Department of Health ("NYSDOH") identified volatile organic contamination in exceedance of New York State and/or Federal drinking water standards in three residential wells northeast of the Site.

All comments received have been summarized and organized into five main categories: the Proposed Plan, the Remedial Investigation/Feasibility Study Reports, Other Concerns, the Superfund Process, and Operable Unit Two.

THE PROPOSED PLAN

COMMENT: The technical advisor to the DHHA commented that because the fate and transport of contaminants from the landfill has not been determined with certainty, conservative assumptions are needed on which to base measures to protect area residents.

RESPONSE: EPA agrees with this comment and developed the Risk Assessment for the Site using conservative assumptions. The Risk Assessment identified the cumulative upper bound cancer risk at the Site, using reasonable maximum exposure conditions for adults, at 4.98×10^{-4}, which is at the high end of the acceptable cancer risk range of 10^{-4} to 10^{-6}. The major contributor to this number is from the ingestion of groundwater from on-site monitoring wells, assuming the wells were used in the future for drinking water purposes. The selected remedy includes point-of-use treatment systems, namely granular activated carbon ("GAC") units, to minimize the risk of contaminated groundwater ingestion for the homeowners in the vicinity of the Site. To date, sampling conducted by EPA and NYSDOH has identified three residences that require point-of-use treatment systems. These residences have already been provided with point-of-use treatment systems by NYSDEC. The residential wells receiving point-of-use treatment systems will be determined following an extensive and ongoing residential well sampling program. Because the fate and transport of contaminants from the landfill was not fully characterized under OU1, EPA has determined that a second operable unit ("OU2") is necessary to determine a final groundwater remedy.

*Carbon Filtration Units

COMMENT: The technical advisor to the DHHA commented that EPA's interim measure of only providing carbon filtration units for residential drinking water supplies is not enough to protect residential well users until a final groundwater remedy is determined under OU2.

RESPONSE: A total of forty-two residential wells were sampled by EPA and NYSDOH during the remedial investigation. The results identified contamination in exceedance of New York State and/or Federal maximum contaminant levels ("MCLs") in three residential wells located geographically northeast of the Site. The contaminants detected above MCLs are volatile organics which can be removed through the use of carbon filtration units attached to the homeowners' wells. Based on the levels of contamination detected, these units are capable of reducing the concentrations of contaminants in the drinking water to below drinking water standards, thus ensuring protection of human health for the current water users. In addition, the levels of contaminants detected in residential wells, although above New York State drinking water standards, present risks which are within EPA's acceptable risk range.

COMMENT: The technical advisor to the DHHA commented that carbon filtration units have a number of disadvantages including: 1) they require continuous monitoring and maintenance; and 2) the carbon canisters have a limited life and must be replaced.

RESPONSE: The carbon filtration units are designed to provide an interim measure of protection to the current users of residential wells where contaminants in exceedance of New York State and/or Federal drinking water standards have been detected. Provisions have been included in the ROD for operation and maintenance of these filters, in

conjunction with a semi-annual residential well sampling program. As part of the operation and maintenance program, the carbon filters will be replaced, as necessary. The carbon units are well-suited for the types and concentrations of contaminants identified in the residential wells.

COMMENT: A number of residents inquired about which homes will be getting carbon filtration units and the maintenance program associated with the units. In addition, questions were raised as to how long EPA believes that carbon filtration units would be used until a permanent remedy is finalized under OU2.

RESPONSE: A residential well sampling program of the homes in the vicinity of the Site will be enacted during the remedial design phase of OU1. Based on the results of this sampling program, homes with contamination above Federal and/or New York State MCLs will receive granular activated carbon units. For cost estimating purposes, it was assumed that 42 residences will require filters. A semi-annual monitoring program will be performed for at least three years. The results will aid in the development of an equipment maintenance and/or replacement program.

In the event that the potentially responsible parties do not undertake the Remedial Design and Remedial Action ("RD/RA") for OU1, EPA will initially pay for the installation and operation and maintenance of the filters using monies from the Fund until a final remedy for alternate water is selected, if necessary, and implemented. EPA will ultimately seek to recover its costs from the PRPs in a cost recovery action.

The RI/FS for OU2 should be completed and another Record of Decision ("ROD") will be signed within the three year period in which the residential well sampling program is taking place. Should the final remedy selected in the second operable unit call for the use of carbon filters rather than an alternate water supply, New York State would be responsible for long term operation and maintenance of these filters.

COMMENT: The technical advisor to the DHHA stated that the proposed semi-annual sampling for only three years and the review of the Site's status every five years is inadequate. Selection of Alternative 3, which calls for attachment of GAC units on contaminated residential wells is not a permanent measure to remediate the Site and the potential exists for future spread of contamination.

RESPONSE: The use of GAC units on selected residential wells, based on the findings of the residential well sampling program, is an interim remedial measure to minimize the risk to current users of contaminated residential wells. EPA will conduct an extensive groundwater investigation on the hydraulic forces in the landfill area which will include the study of contaminant transport conditions at the Site. This will provide the necessary data to select a final groundwater remedy under OU2 within a three year period.

COMMENT: A resident asked if wells that have no contamination would receive carbon

filters.

RESPONSE: No, residential wells with no contamination and those that are not in the potential pathway of a contaminant plume emanating from the landfill will not receive carbon filters.

COMMENT: A resident inquired as to whether carbon filters have already been installed on contaminated wells.

RESPONSE: Under a recommendation made by NYSDOH, NYSDEC has installed carbon filtration units on the three residential wells where contaminants were detected in exceedance of New York State and/or Federal drinking water standards.

*Alternative Water Supply

COMMENT: The technical advisor commenting on behalf of the DHHA urged that a permanent source of alternative water be found as soon as possible and this requirement be specified in the Record of Decision. EPA should consider the economic and psychological (stress) burdens placed on the area residents by an extended period of uncertainty. The main justification for delaying a provision of alternate water to residents near the landfill must be cost.

RESPONSE: At this time, the source of contamination in the residential wells located northeast of the Site has not been positively linked to the contamination emanating from the landfill. Additional hydrogeological studies, including the investigation of groundwater flow patterns beneath the Site, is necessary under OU2 to determine a final groundwater remedy. At that time, the need for a permanent alternate water supply will be determined. Community acceptance will be factored into the remedy selection.

COMMENT: A resident expressed concern that the flow of water in the vicinity of the Site might not ever be known due to the fractured bedrock in the area and complex hydrogeological conditions. Because of this, he believes that an alternative water supply should be provided at the earliest date possible. Another resident questioned the efficiency of remediation solutions when so many unknowns exist.

RESPONSE: EPA has chosen a two operable unit approach to the Site. EPA's strategy is conservative, yet moves ahead using a time table which does not jeopardize public health and the environment. Under the first operable unit, the landfill cap will reduce the quantity of water percolating through the landfill and leaching out contaminants. The installation of point-of-use treatment systems, although not a permanent remedy, will protect the current users from the risk of contaminated groundwater ingestion. OU2 will satisfy the need for additional site investigations to determine a final groundwater remedy and evaluate the need for and feasibility of an alternate water supply. Therefore, EPA's prudent course of action, that is, performing a second operable unit is in the best interest

of the overall protection of human health and the environment.

*Bottled Water

COMMENT: The technical advisor to the DHHA questioned whether a more protective interim measure should consist of both carbon filtration units and bottled water because carbon filtration is not an effective treatment for all classes of contaminants detected in the monitoring wells around the landfill.

RESPONSE: EPA agrees that carbon filtration units are not an effective treatment for all classes of contaminants detected in groundwater monitoring wells. However, EPA is most concerned with protecting the current users of residential wells where contaminants are in exceedance of New York State and/or Federal drinking water standards. The proposed semi-annual residential well sampling program is designed to identify contaminated residential wells. In the event that contaminants which cannot be removed through carbon filtration are detected above MCLs in residential wells, then EPA will provide an alternative means to protect these well users.

COMMENT: A resident inquired whether bottled water should be provided for shower users since skin cells may absorb contaminated water.

RESPONSE: Based on the risk analysis performed during the remedial investigation, exposure of those residents currently utilizing the northeast residential wells to groundwater volatiles while showering, under reasonable maximum exposure conditions, contributed 9.79×10^{-5} to the total cancer risk and 0.005 to the total noncarcinogenic risk. These northeast residential wells are those wells where contaminants were found in exceedance of MCLs. Because these risk calculation numbers falls within the acceptable risk range as set forward in the National Contigency Plan ("NCP"), EPA does not have reason to believe that bottled water is necessary to minimize exposure to volatile organics while showering. Furthermore, the installation of carbon filters on the residential wells will effectively remove any volatile organic contaminants present in the well water.

*Residential Well Sampling Program

COMMENT: A consultant to one PRP commented that the analytical parameters and the frequency for the proposed residential well sampling program should be reviewed at the end of the first year. Because residential well sampling is potentially one of the most sensitive aspects of the remedial investigation process, the responsibilities and responses associated with the sampling program should be defined and understood prior to initiating sampling activities.

RESPONSE: The residential well sampling program will be developed to determine which area residential wells require point-of-use treatment systems. EPA believes that sampling selected area residential wells for the full Target Compound List ("TCL") parameters on

a semi-annual basis until a final groundwater remedy is determined under OU2 is necessary to ensure the effectiveness of the treatment systems and the protection of the residential well users. EPA will evaluate the need to design a one-year review of the residential well sampling program during the remedial design.

*Groundwater Monitoring

COMMENT: A consultant to one PRP stated that the long-term groundwater monitoring program should be reviewed after the first year of quarterly monitoring. This would allow for the deletion of analytical parameters, as appropriate, and reduce unnecessary costs. The proposed long-term monitoring program should initially be designed for years one through five. Continued sampling should be conducted only as necessary based on the review at the end of five years.

RESPONSE: The results of the monitoring program will be evaluated periodically and could potentially result in modification to the plan. However, EPA believes that any reduction in sampling frequencies or parameters tested for is not in the best interest of the local community at this time. Additionally, modifying the proposed long-term monitoring program from thirty years to five years is unwarranted. Furthermore, the 6 NYCRR Part 360 closure rules require that a post-closure monitoring and maintenance operations manual be developed and followed for a minimum of thirty years after the landfill cap is constructed.

*Landfill Gas

COMMENT: The technical advisor to the DHHA stated that the composition of the landfill gases should be characterized before designing the venting system for the landfill cap.

RESPONSE: The testing and characterization of landfill gas emissions will be further defined during design of the remedial action under OU1. A gas venting system, either passive or active, will be designed and constructed following the characterization of landfill gas emissions.

*Landfill Cap

COMMENT: A resident inquired as to what the normal life of a cap is.

RESPONSE: The normal life of a landfill closure cap is approximately thirty years. The selected remedy, as stated in the Record of Decision, requires an annual operation and maintenance program to evaluate the integrity of the cap in conformance with 6 NYCRR Part 360 standards for a minimum of thirty years following closure. In addition, effectiveness of the containment remedy in protecting human health and the environment will be evaluated every five years.

COMMENT: A resident asked what the difference was between the existing cap on the landfill and the proposed cap which will be developed in accordance with 6 NYCRR Part 360 rules. Another resident questioned whether the proposed cap would include a synthetic membrane component.

RESPONSE: The existing cap is a mixture of sand and gravel. At the time of construction, it was upwards to two feet in thickness. At present, garbarge is exposed at the surface in some areas of the landfill. At other locations, only a few inches of sand and gravel still remain. The design of the proposed cap would comply with the standards of 6 NYCRR Part 360. At a minimum the cap must consist of: 1) a bottom layer allowing for a gas venting system; 2) a low permeability barrier layer and a barrier protection layer; and, 3) a topsoil layer. The inclusion of a synthetic membrane component is allowable under 6 NYCRR Part 360 and will be decided upon during the remedial design.

COMMENT: A resident asked whether any portion of the landfill is below the groundwater level. If this is the case, capping the landfill would not eliminate the hydrologic forces causing lateral migration.

RESPONSE: Hydrologic data gathered during the RI indicate that a portion of the landfill does lie in the saturated zone beneath the groundwater table. EPA agrees that capping the landfill might not eliminate all hydrologic forces causing lateral migration. This issue will be investigated further under OU2.

COMMENT: A consultant to one PRP commented that the proposed landfill cap design described in Alternative 3 of the Proposed Plan and Feasibility Study report can be constructed in a more cost-effective manner in accordance with the requirements of 6 NYCRR Part 360. The recommended design variations for Alternative 3 could result in an estimated cost savings of up to $1.9 million.

RESPONSE: The Feasibility Study report, Proposed Plan and ROD provide conceptual plans for the landfill cap design. EPA will evaluate variations for construction of the landfill cap during the remedial design. The remedial design report will outline the thickness and composition of all layers of the cap, and the drainage and gas collection specifications, as necessary to comply with 6 NYCRR Part 360 closure rules. The costs outlined in the Feasibility Study are estimates and will be refined during the remedial design.

COMMENT: A resident asked whether it would be cheaper to remove the landfill material from the landfill and haul it away rather than monitor the landfill for many years.

RESPONSE: The removal of materials from the Warwick Landfill would entail the involvement of enormous and unmanageable quantities of material, approximately 800,000 - 1,000,000 cubic yards and 1,000,000-1,500,000 tons of waste. This amount of material would require extensive treatment, such as incineration, stabilization, or a combination of both, for disposal at a RCRA landfill at substantial costs. In addition, the logistical and

regulatory parameters associated with this undertaking would be extensive and cost-prohibitive.

COMMENT: A resident commented that a study should be performed on the effect of the increased run-off from the landfill following cap construction into nearby drainage channels. The cap will likely encroach on existing wetlands resulting in the loss of wetlands. A consultant to one PRP commented that costs associated with the wetlands were not considered in the cost evaluation and should be estimated as part of the evaluation of remedial alternatives.

RESPONSE: The disposition of the stream flow and resultant run-off from construction of the cap will be determined during the remedial design. The two wetlands, northwest and southeast of the Site, will be fully delineated and the impacts of the cap construction on these wetlands will be analyzed. Engineering designs will attempt to maintain current steady state conditions. Included in the capital costs for the landfill cap construction, as outlined in the FS report, are funds available for environmental monitoring and impact evaluations.

COMMENT: A resident questioned whether the cap will have an effect on flow to area residential wells and whether there were any known examples of other landfill areas where neighboring residential wells were affected by landfill cap construction.

RESPONSE: Although the construction of the landfill cap could affect the local hydrological conditions in the area, the current domestic water supplies draw water from a more regional area and are not dependent on infiltration through the present landfill to recharge the aquifers. In addition, the majority of groundwater from the Site appears to be discharging into the overburden and/or wetlands area. Downward hydraulic gradients indicating flow into the bedrock from the landfill were not observed in any of the adjacent cluster monitoring wells. The EPA is not aware of a change in area residential well flow rates in the vicinity of a landfill following the placement of a closure cap over the landfill.

THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORTS

*Remedial Investigation

COMMENT: A resident inquired whether stream samples were collected under passive or active conditions during field activities, that is, whether they were collected during quiet flow conditions and after a heavy rainfall.

RESPONSE: The two rounds of stream samples taken during the RI were collected several weeks apart to provide data regarding the contaminant load in the stream during high flow and low flow conditions. However, samples were not collected immediately after

a heavy rainfall. In general, contaminants detected in streams are typically lower under high flow conditions due to dilution from rainfall as opposed to low flow condition during which groundwater is entering the stream. Results of stream samples over two rounds indicated non-detectable levels of contaminants at downstream locations (near Greenwood Lake).

COMMENT: A reporter asked whether other radioactive materials other than tritium-3H and radiocarbon-14 were tested for in groundwater monitoring wells and any residential wells because Union Carbide, a designated PRP for the Site, ran a nuclear reactor facility in Sterling Forest for many years.

RESPONSE: The former Union Carbide facility in Sterling Forest, known as Union Carbide's Corporate Research Laboratory or Medical Products Division, is presently owned by Cintichem, Inc.. The facility produces radio-pharmaceuticals for the diagnosis of human illnesses. Only tritium-3H and radiocarbon-14 were analyzed for in the groundwater monitoring wells because they are the longest lived radioactive isotopes typically found in hospital wastes.

COMMENT: A consultant for one of the PRPs stated that the constituents detected in leachate samples from the Warwick Landfill are consistent with those detected in other municipal landfill leachate samples and that the concentrations found at the Site are generally less than those reported for other municipal landfills.

RESPONSE: The above comment was based on a paper written by G.J. Farquhar in the Canadian Journal of Engineering, Vol. 16, No. 3, (1989) on the study of nine Wisconsin landfills. While it may be true that the results of the limited leachate sampling at the Warwick Landfill site (two rounds at three locations) showed contamination no greater than other municipal landfills, contamination in the groundwater monitoring wells above MCLs indicate that hazardous substances are present at the Site which warrant remediation under the Superfund program.

COMMENT: A resident asked what was the farthest distance from the landfill where contamination was detected. Another resident asked at what rate does groundwater flow in the area surrounding the landfill.

RESPONSE: Based on the results of the remedial investigation, the furthest distance from the landfill where volatile organic contamination was detected was in monitoring well WL-6D approximately 800 feet southwest of the landfill mound.

In general, movement of contamination is calculated using two variables: 1) the rate at which contamination leaches into the groundwater system, and 2) the rate of groundwater flow. Based on the groundwater investigation under OU1, groundwater is assumed to flow at a rate of approximately 41 ft/yr south and 70 ft/yr north of the landfill in the overburden and 59 ft/yr south and 3,139 ft/yr north of the landfill in the bedrock.

Additional groundwater flow studies will be a major focus of OU2 and will involve the development of a hydrogeochemical model which calculates the extent of contamination emanating from the Warwick Landfill.

COMMENT: A resident asked whether residential well 1 ("RW-1") is contaminated.

RESPONSE: Volatile organic contamination did not exceed New York State and/or Federal drinking water standards in RW-1. However, based on the September 1989 sampling by EPA, 56 ppb lead was detected. NYSDOH took two samples from the outside faucet in in February 1991. The first draw sample contained copper at 2010 ppb, iron at 6150 ppb, both above New York State secondary drinking water standards and lead at 319 ppb, above New York State and Federal primary drinking water standards. The second sample, taken after running the tap, contained only iron in excess of New York State secondary drinking water standards. The secondary drinking water standard for iron has been established at 300 ppb for aesthetic (taste, odor, cleaning quality) purposes only. There are no health concerns associated with elevated levels of iron. NYSDOH concluded that the sampling results are evidence that the source of metals in the tap water is the household plumbing.

COMMENT: A resident questioned whether another well further downstream from WL-6D, the farthest well location from the landfill where contaminants have been detected, should have been installed to monitor groundwater.

RESPONSE: EPA plans on installing additional monitoring wells to determine the extent of contamination as part of the second operable unit.

COMMENT: A resident questioned why the owners of property on which a monitoring well is installed were not notified if contaminants were detected in the sampling results from that monitoring well.

RESPONSE: As a courtesy, EPA should have notified the owners of the property on which a monitoring well is installed of test results and is in the process of doing so.

COMMENT: A resident inquired about the extent of wetland studies and bioaccumulation studies performed under the first operable unit.

RESPONSE: The EPA conducted an environmental risk assessment to evaluate the potential ecological impacts associated with the contamination identified at the Warwick Landfill. However, because of the low concentrations of contaminants detected, lack of potential bioaccumulation, absence of fishing and other recreational activity, the environmental assessment was not quantified. However, a functional analysis using the Army Corps of Engineer's Wetland Evaluation Technique was performed on the southeastern wetland.

The two wetland areas are contiguous to the landfill mound and consist of emergent marsh/scrub-shrub wetland to the southeast, approximately nine acres in size, and a smaller, palustrine, forrested/scrub-shrub, deciduous wetland, approximately three and one-half acres, to the northwest. EPA delineated these wetlands using the Federal multi-parameter methodology. The slow waters of the scrub/shrub area allow time for settling of particulates, and subsequent biological and chemical degradation. The wetlands act as filters and long-term storage compartments that improve water quality. This is particularly important for the downstream communities.

The need to minimize the disturbance of these wetland habitats via migration of contaminants from the landfill, as well as via any future remediation activities, will be considered in the design of the Site remedy.

*Glycol Ethers and Antimony Contamination in Groundwater

COMMENT: The technical advisor to the DHHA expressed concern that two classes of contaminants, antimony and glycol ethers, have been found in the landfill monitoring wells. These contaminants are not effectively treated by carbon filtration. There is presently no reliable residential well data for antimony and glycol ethers in the remedial investigation. All analyses for antimony were rejected in residential well samples and EPA's method for detecting glycol ethers is not very sensitive and can severely underestimate their true concentrations.

RESPONSE: Upon review of the appropriate data validation report, the cause of the antimony rejection was found to be poor Contract Required Detection Limit (CRDL) standard recovery. To verify the linearity of the calibration curve near the CRDL for inorganic contaminant analysis, a two times the CRDL standard concentration is analyzed at the beginning and end of each analysis run. USEPA Region II data validation criteria states that if the CRDL standard recovery is less than 50% recovery, all data within the nondetect to 240 ug/l range should be rejected. The recoveries for the antimony CRDL standard for residential well samples were 73.0% for the initial standard and 38.5% for the final standard. This poor recovery of antimony is inherent in the method as antimony is easily lost by volatilization from the hydrochloric acid media in the digestion procedure.

In considering the validation report, it can be discerned that any concentration of antimony above 240 ug/l would not be affected. Because the recovery for one of the standards was less than 50%, all values were rejected and this indicates that all concentrations were below 240 ug/l. The Federal proposed MCLG is 3 ug/l. Future residential well sampling by EPA will include analysis for antimony. If antimony is present, EPA will consider appropriate action to ensure the protection of human health and the environment.

Unless specific information is available which indicates that a particular compound (or class of compounds) is present at a site that warrants the use of a particular analytical

method, the methods selected for use at sites are based upon types of compounds which are commonly found in environmental samples. The analytical methods utilized by EPA for organic contaminants at the Warwick Landfill examine a set of target compounds commonly found in environmental samples (the TCL), which if present could be positively identified.

If compounds other than those on the TCL are present, and if the analytical equipment utilized is sensitive to these compounds, the method will also search through a library of greater than 50,000 organic compounds in an attempt to match "fingerprints" for these non-TCL compounds. This is done for up to 20 compounds which the instrument records as being present in the greatest amounts. The method does not include internal standards for the "library" search compounds which could be utilized to positively identify their presence. Therefore, these compounds are called "tentatively identified compounds" ("TICs"), although under appropriate circumstances, one could make a strong argument that particular TICs are indeed present. It should also be noted that it would be virtually impossible to develop a method which could be specific enough to clearly identify the 50,000 plus chemicals formerly or presently in use, while simultaneously being sensitive enough to detect the low level concentrations which are of concern for many chemicals.

It is true that glycol ethers were tentatively identified in samples collected at four of the fifteen monitoring wells and these compounds may not be effectively removed by carbon treatment units. However, these compounds were not even tentatively identified in the residential well sampling performed by EPA. Furthermore, the contamination found at the residential wells has not been positively linked to the Site itself and might be the result of a localized release of contaminant (e.g. via a septic system). Even if the contamination present in some of the residential wells can eventually be attributed to the Site, EPA presently has no reason to believe that these glycol ether compounds, although water soluble and thus mobile, will ever migrate to the residential wells. Therefore, EPA believes that the use of carbon treatment units is an appropriate and effective interim means of providing potable water to affected residents. In addition EPA will also perform some sampling and analysis to specifically investigate glycol ether contamination. The objective of this effort would be to provide positive identification of glycol ethers if they should be present in the groundwater at or around the Site, and the extent of their presence.

*Risk Assessment

COMMENT: The technical advisor to the DHHA commented that the effect of capping on air emissions was not addressed in the health risk assessment.

RESPONSE: EPA plans to evaluate health-based risk levels as a result of air emissions from the landfill during the remedial design.

COMMENT: The technical advisor to the DHHA stated that it is inappropriate to assume that current contaminant concentrations in the groundwater provide a conservative

estimate of potential future contaminant concentrations. The existence of additional sources of groundwater contaminants within the landfill cannot be ruled out with any degree of confidence. In addition, because areas of high and lower contaminant concentrations may be hydrologically connected, the concentrations reaching domestic water wells could exceed those predicted from current on-site and off-site measurements.

RESPONSE: EPA believes that the Risk Assessment contained in the RI does use appropriately conservative procedures for estimating contaminant concentrations to which persons might be exposed under current and future use conditions at the Site. In addition, it must be realized that contaminant concentrations may decrease over time due to chemical and biological degradation of some contaminants.

COMMENT: The technical advisor to the DHHA questioned whether using showering as the only scenario under which a resident would be likely to inhale volatile contaminants in the domestic water supply is appropriate.

RESPONSE: While EPA realizes that showering is not the only route through which a resident is exposed to volatile contaminants, EPA believes that the approach taken was conservative. For the Site, the reasonable maximum exposure scenario for shower exposure estimated that a person is exposed for 19.8 minutes per day to volatile contaminants not the 12 minutes suggested by the Exposure Factors Handbook. As previously mentioned, the exposure of those using the northeast residential wells to groundwater volatiles while showering, under reasonable maximum exposure conditions, contributed 9.79×10^{-5} to the total cancer risk and 0.005 to the total noncarcinogenic risk. These calculation is within the acceptable ranges as set forward in the NCP.

COMMENT: The technical advisor to the DHHA stated that the Risk Assessment incorrectly identifies lead as a compound for which toxicity data are not adequate to support quantitative risk assessment. The problem posed in assessing risks of lead is that the procedures employed by EPA for non-cancer risk assessment are invalid for lead.

RESPONSE: The actual choice of words concerning lead may have misled the reviewer. The statement from Chapter 6 of the RI report, "Toxicity Data are not adequate to support a quantitative Risk Assessment" was based on EPA's Risk Assessment Guidance (RAGS 1989) and EPA Region II protocol. A contaminant at a site, such as lead, that does not have an accepted EPA slope factor or reference dose, cannot be quantitatively assessed in the Risk Assessment for a Superfund site. However, the contaminants potential risk must be addressed qualitatively in the Risk Assessment as to its potential health concerns. It is then left to EPA to decide whether a potential health impact may occur from that contaminant.

COMMENT: The technical advisor to the DHHA believes that, in general, the discussion of the concept of "threshold" present in the Risk Assessment is somewhat misleading.

RESPONSE: EPA believes that the discussion of "threshold" in the Risk Assessment follows the general consensus within the scientific community.

COMMENT: The technical advisor to the DHHA commented that for some toxicants, the total dose received over an extended period is a better indicator of toxicity than average daily dose (chronic daily intake in the terminology of the current assessment).

RESPONSE: EPA Risk Assessment protocols and accepted models examine exposure based on average daily dose not total dose.

COMMENT: The technical advisor to the DHHA pointed out that the toxicity of chromium is discussed only in the trivalent form, while measurements on-site appear to represent total chromium.

RESPONSE: The discussion of chromium has been amended in the Risk Assessment of the RI to include hexavalent chromium. The health-based risk numbers have been re-calculated for chromium and incorporated into the ROD.

COMMENT: The technical advisor to the DHHA commented that actual grouping of chemicals by target organs in the Risk Assessment is too narrow, and does not fully represent the degree of overlap in the pattern of toxicity exhibited by each chemical.

RESPONSE: EPA agrees with this comment. However, we do not believe that it affects the conclusions reached in the Risk Assessment.

COMMENT: The technical advisor to the DHHA believes that the report should be more explicit and forceful in reminding the reader that the lack of a toxic hazard value (Reference Dose = RfD or Slope Factor = SF) for a substance does not in any way imply a lack of hazard. While the Risk Assessment presents only oral RfDs for styrene, ethylbenzene, and perchloroethylene, these chemicals are toxic by inhalation as well.

RESPONSE: Inhalation slope factors are presented for styrene and perchloroethylene while ethylbenzene has no EPA approved inhalation toxicity indices. The lack of inhalation RfDs for styrene and perchloroethylene point towards the fact that these contaminants either do not elicit a non-carcinogenic response or there is not enough data available in the literature to derive an appropriate toxicity index via this exposure pathway. However, since inhalation slope factors exist they will show a potential carcinogenic response through this exposure pathway.

For ethylbenzene no carcinogenic response has been shown and it does not appear to elicit a noncarcinogenic response through inhalation based on the current toxicological literature.

COMMENT: The technical advisor to the DHHA stated that there is a significant

misstatement regarding the nature of the risk estimates provided by the Superfund risk assessment process. While slope factors derived from animal studies are upper-bound estimates of the slope of the dose-response function, the corresponding risk estimates are not upper-bound estimates, because the exposure (dose) estimates are not upper-bound estimates. In fact, for cases where slope factors are estimated from human rather than animal data, the slope factors themselves are "best estimates", rather than upper bound estimates.

RESPONSE: EPA disagrees with this comment. Page 8-6 of RAGS 1989 states, "Because the slope factor is often an upper 95th percentile confidence limit of the probability of response based on experimental animal data used in the multistage model, the carcinogenic risk estimate will generally be an upper bound estimate. This means that EPA is reasonably confident that the 'True Risk' will not exceed the risk estimate derived through use of this mode and is likely to be less than that predicted".

COMMENT: The technical advisor to the DHHA noted that the author of the Risk Assessment has chosen not to add non-cancer risks for childhood exposure to those for adult exposure. This ignores the reasonable maximum exposure case of 17 years of childhood residence followed by 13 years of residence in adulthood (i.e. 30 years total residence).

RESPONSE: EPA calculates noncarcinogenic exposures (intakes) by averaging over the shortest exposure period for acute toxicants (e.g. exposure event or a day) and averaging intakes over the period of exposure for longer term exposure. EPA only considers carcinogenic exposures cumulative since RfDs are estimates of the daily exposure to the human population of a chemical which is likely to be without appreciable risk of deleterious effects during a lifetime or portion thereof. The exposure scenarios used in this Risk Assessment for noncarcinogenic exposures are based on a daily exposure for 17 years for children and 70 years for an adult.

COMMENT: The technical advisor to the DHHA commented that in the toxic hazards descriptions the terminology employed changes from chemical to chemical. In addition, much of the material appears to be old "boilerplate" that might benefit from review.

RESPONSE: The toxicity profiles used are those found in the latest EPA Integrated Risk Information System ("IRIS") database.

COMMENT: The technical advisor to the DHHA noted that the term "Chronic Daily Intake" (CDI) is applied to the results of two distinct calculations. "Average Daily Dose" (ADD) is appropriate for calculating non-cancer risks (Hazard Quotients and Hazard Indices), while "Lifetime Average Daily Dose" (LADD) is used to calculate cancer risks.

RESPONSE: The terminology suggested by the commentor is part of the Exposure Factors Handbook and not part of RAGS (1989). The Warwick Landfill site Risk

Assessment follows Superfund convention.

COMMENT: The technical advisor to the DHHA believes that the presentation of risk values with three significant digits (e.g. 1.18×10^{-4}) is misleading.

RESPONSE: EPA does not believe that the use of three significant digits is misleading because it provides the reader more information regarding the potential risk level at a site than reporting risks as 1×10^{-4}, 1×10^{-5} or 1×10^{-6}. In addition, if one were to convert 1.18×10^{-4} to one significant figure (e.g. 1×10^{-4}) the rounding error encountered in risk assessments would be enormous and could seriously misinterpret the potential site risks when examining cumulative risks across pathways.

*Feasibility Study

COMMENT: The technical advisor to the DHHA stated that the most serious problem with this RI/FS is that the FS did not sufficiently reflect the data gaps and uncertainties in the RI report or address all of the risks identified in the baseline risk assessment.

RESPONSE: EPA believes that the FS does identify the data limitations as outlined in Chapter 7 of the RI report and addresses the risks identified in the baseline risk assessment. Because of the recognized data limitations under OU1, which include: 1) identifying the contaminant source of the three residential wells; 2) defining the vertical and horizontal extent of the groundwater plume; and 3) evaluating landfill air emissions, a second operable unit is necessary.

COMMENT: The technical advisor to the DHHA commented that the key deficiency of the FS report is that it fails to address the fact that there are significant risks associated with inorganic contaminants and strongly hydrophilic contaminants in groundwater at and near the Site. The carbon filters only address organic chemical contamination and might be ineffective in removing inorganic contaminants that the RI identifies as presenting a significant risk.

RESPONSE: Inorganic contamination in exceedance of New York State and/or Federal drinking water standards was detected in on-site groundwater monitoring wells. Inorganic contamination (lead) was detected in one residential well which was attributed to the household plumbing system rather than the landfill. This was the only residential well which exhibited inorganic contamination above drinking water standards. The strongly hydrophilic contaminants referred to in the above comment are the tentatively identified compounds ("TICs") known as the glycol ether compounds in a few of the groundwater monitoring wells and leachate samples. These glycol ethers were not identified as TICs in residential wells.

At this time, the assessment of TIC compounds must be qualitative because of the tentative identification, uncertainties about precise concentrations, and limited information

about the toxic effects of these compounds. EPA plans to conduct sampling specific to the identification of glycol ether compounds in OU2. In addition, the residential well samples will be analyzed for the full Target Compound List. Should contaminants be identified, which cannot be effectively removed by carbon filters, in exceedance of MCLs in residential wells, EPA will consider alternative measures to protect the health of the current well users.

COMMENT: A consultant to one of the PRPs commented that certain major cost items have not been included in the total capital cost items of Alternative 3. These items not costed under Alternative 3 include: mobilization costs; temporary erosion control measures; health and safety planning and implementation; wetland assessment and mitigation; and surface runoff control measures. The additional items could add approximately $1,000,000 to the capital costs listed in the referenced tables of the FS report.

RESPONSE: It is true that the above mentioned comments are not specifically outlined in the cost estimates for Alternative 3. The cost of many of these items, such as mobilization costs, temporary erosion control measures, health and safety planning and implementation and surface runoff control measures are incorporated into the landfill cap construction cost estimates. A detailed cost breakdown will be provided during remedial design.

OTHER CONCERNS

COMMENT: A resident asked whether Greenwood Lake would ever be monitored under the Superfund program.

RESPONSE: Based on results of samples taken near the lake during the RI for the first operable unit, EPA sees no reason to sample the waters of Greenwood Lake under the Superfund program. Additional environmental monitoring during OU2 in the wetlands adjacent to the landfill will determine whether there is a need for further testing downstream.

COMMENT: A resident inquired whether there would be any consideration of seeing methane used to recoup some of the money spent during remediation of the Site.

RESPONSE: The results of the air monitoring using portable HNu and OVA meters during the summer months of the field investigation indicated methane levels of less than 40 ppm. In addition, excessive methane levels were not encountered when digging the three landfill soil borings. These results, combined with the size and age of the landfill, are reasons to believe that there is not sufficient methane generated to warrant methane collection from an economic perspective.

COMMENT: A reporter asked why a health survey had not been performed on the residents in the vicinity of the Site.

RESPONSE: In July 1989, NYSDOH under a cooperative agreement with the Agency for Toxic Substances and Disease Registry prepared a preliminary health assessment for the Site which can be found in the Administrative Record for the Site. The assessment concluded that the Site does represent a potential public health threat and recommended continued monitoring of private residential wells. To date, 42 area residential wells have been sampled. A comprehensive residential well sampling program will be established during remedial design of this first operable unit. This information as well as information provided in the RI/FS indicates that a health survey is not warranted.

COMMENT: A resident asked whether it could be determined the quantity and classification of hazardous substances produced by companies in the Warwick Landfill area to deduce what materials might be disposed of at the Site.

RESPONSE: The manifest system under the Resource Conservation and Recovery Act allows for the tracking of chemicals from generation to ultimate disposal. However, because disposal practices at this Site took place from 10 to 35 years ago at a time when documentation of waste disposal was less regulated, it is difficult to quantify the wastes generated by area companies and disposed of at the Warwick Landfill. To date, EPA has identified 16 PRPs which include: generators of hazardous substances transported to the Site; transporters disposing of waste at the Site; the landfill operators; and the current owner of the Site.

COMMENT: A resident asked which government agency he should contact if he would like his residential well sampled.

RESPONSE: If the resident would like his well sampled at the earliest date possible, he should contact the NYSDOH which has been conducting the residential well sampling program in the vicinity of the Site. In addition, he should send a letter to EPA requesting that his well, provided it is among the 42 residential wells in the vicinity of the Site, be included in the residential well sampling program during the remedial design.

COMMENT: An area resident inquired if EPA has any provisions for purchasing his property. He states that he has not been able to sell it because those outside of the regulatory authorities have deemed his water supply unsatisfactory, yet contamination has not been detected in exceedance of New York State and/or Federal drinking water standards.

RESPONSE: Under the law, the EPA can only reimburse property owners for property it acquires to implement a Federal project. However, the Agency's actions should not stop individuals from exploring whether they have a cause of action against those responsible parties for diminution of their property values.

*Future Contaminant Releases

COMMENT: A resident expressed concern that contaminants might continue to leach out of the landfill for twenty years and EPA may no longer be in existence to protect the public's health and the environment.

RESPONSE: The Superfund is funded primarily by taxes on crude oil and petroleum products and on certain chemicals and is therefore atypical of other EPA programs which rely on tax revenues. Barring no reauthorization of the CERCLA statute, the Fund is expected to have sufficient monies and provisions necessary to ensure that remedies which involve containment of waste continue to be protective of human health and the environment. In fact, because hazardous substances will remain on-site as outlined in the ROD, the Site will be reviewed every five years to ensure that this is the case, pursuant to CERCLA requirements. The State of New York, or possibly the PRPs with State and Federal oversight, will be responsible for operating the landfill to maintain the effectiveness of the closure system.

COMMENT: A resident expressed concern that there could be drums in the landfill which will not break down for another 20 years.

RESPONSE: Drums constructed of plastics or metal (that is not exposed to water) may not degrade within a twenty year time period. However, buried drum materials, if present at the Site, have been exposed to infiltrating rainwater, perched water, and perhaps groundwater within the landfill for over ten years and such exposure could cause the rusting and disintegration of metal containers. It is possible that there are buried hazardous wastes in the landfill that have not leached into the groundwater and have yet to form a contaminant plume. For this reason, the Superfund program requires that the Site be reviewed every five years for at least thirty years. In addition, the groundwater monitoring program, as specified in the selected remedy, will enable changes in contaminant levels to be detected. In the event of a significant increase in contamination stemming from the Site posing a threat to human health and the environment, the EPA would develop plans to remediate the situation in a timely manner. In addition, the second operable unit will evaluate the need to implement a final remedy for the groundwater at the Site. If the remedy calls for treatment of the groundwater, then the likelihood that significant contamination would leave the landfill would be further reduced.

In February 1991, a geophysical investigation, which included a magnetic gradiometer survey and terrain conductivity screening, was conducted at the Site to identify areas within the landfill where buried drums might be present. Based on the results of this investigation, three test pits were excavated to observe landfill material. No buried drums were located.

THE SUPERFUND PROCESS

COMMENT: The technical advisor to the DHHA questioned the delay of the decision on a residential water supply. The advisor stated that it should be given top priority, in accordance with Section 118 of CERCLA, as amended. The issues that are of most concern to the members of DHHA, the extent of contamination and the safety of residential water supplies, have been delayed until a future date.

RESPONSE: At present, contaminants have been detected in three residential wells in exceedance of New York State and/or Federal drinking water standards. Because of the complex hydrogeological conditions at the Site and the limited field investigation under OU1, EPA believes that a second operable unit is necessary to characterize Site hydrogeological conditions and the fate and transport of contaminants emanating from the landfill. The Warwick Landfill site is listed on the National Priorities List ("NPL") and is accordingly a top priority site for the EPA Superfund Program.

COMMENT: A resident inquired about the date when EPA will finalize the Record of Decision and when remedial action at the Site will begin.

RESPONSE: EPA plans on finalizing the ROD in June 1991. Following the signing of the Record of Decision, EPA will send a General Notice letter with an attached Consent Decree to the PRPs informing them of their responsibilities. The negotiation process will be expected to conclude in early September 1991. If negotiations prove successful, EPA will enter into a Consent Decree with the PRPs which must undergo public comment prior to entry by the Court. This process could take several months. In the alternative, EPA could elect to issue a unilateral order to the PRPs to do the RD/RA. It is roughly estimated that, either by Consent Decree or unilateral order, the PRPs would not be expected to commence RD/RA until the beginning of 1992. Whether or not the PRPs or the Superfund finances the RD/RA, the remedial action will begin approximately 18 months after the start of the remedial design.

COMMENT: A reporter inquired about the cost of the Ringwood alternate water supply system developed for the community surrounding the Ringwood Mines Superfund site in New Jersey and whether it is the same situation at the Warwick site.

RESPONSE: An alternate water supply system was not developed under the Superfund program for the Ringwood Mines Superfund site. The potable wells surrounding the Site did not show levels of contamination exceeding MCLs. At present, EPA is overseeing the operation and maintenance program conducted by the PRP for the Ringwood Mines site.

COMMENT: A resident inquired about how much importance the EPA places on the community's input during the public comment period before the Record of Decision is signed.

RESPONSE: The selected remedy in the ROD is not finalized until the public comment period is closed and EPA has had the opportunity to review and address the community's concerns. Community acceptance is one of the nine evaluation criteria developed by EPA to address the technical and policy considerations that are important for selecting among potential remedial alternatives. The other eight criteria are: overall protection of human health and the environment; compliance with legally applicable or relevant and appropriate requirements; long term effectiveness; reduction of toxicity, mobility or volume; short term effectiveness; implementability; cost; and state acceptance. The preferred alternative provides the best balance among all nine criteria based on available information. Barring substantial opposition during the public comment period or the addition of new and relevant information calling for a change in remediation alternatives, the preferred alternative becomes the selected remedy in the ROD.

OPERABLE UNIT TWO

COMMENT: The technical advisor to the DHHA recommended that future site investigations include analyses of capture zones resulting from residential well use.

RESPONSE: EPA plans to address the dynamic aspects of groundwater hydraulics at the Site. The work will be performed under OU2 and will include pumping test(s) and analyses of capture zones from residential wells, more extensive groundwater monitoring using additional well installations and existing wells, and the development of a site hydrogeochemical model. The OU2 work plan will outline the investigation for the second operable unit.

COMMENT: A resident inquired about the cost of OU2 and development of a final groundwater remedy.

RESPONSE: At this time, EPA estimates that the costs for the OU2 remedial investigation and feasibility study will be approximately $500,000. The cost of a final groundwater remedy cannot be determined until a remedy is chosen after the RI/FS is complete.

COMMENT: A resident asked what water supply system would take the place of the residential wells.

RESPONSE: Pending the outcome of the additional hydrogeological investigation, EPA anticipates investigating several alternative water supply remedies under OU2. Remedies investigated would include but not be limited to: 1) installing another residential well at another location and depth elsewhere on each homeowner's property; 2) a community well system servicing the residents surrounding the Site; and, 3) connecting residential water lines to the Village of Greenwood Lake's municipal water supply. The FS for OU2 is also expected to evaluate alternatives for containing/treating site groundwater.

APPENDIX A

PUBLIC MEETING AGENDA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

JACOB K. JAVITS FEDERAL BUILDING

NEW YORK, NEW YORK 10278

PUBLIC MEETING FOR THE WARWICK LANDFILL SUPERFUND SITE, TOWN OF WARWICK, ORANGE COUNTY, NEW YORK

MONDAY, APRIL 22, 1991
7:00 P.M.

GREENWOOD LAKE MIDDLE SCHOOL
GREENWOOD LAKE, NEW YORK

A G E N D A

Welcome & Introduction	Ann Rychlenski Community Relations Coordinator, U.S. EPA, Region 2
Overview of the Superfund Process	Doug Garbarini, Chief Eastern NY/Caribbean Superfund Section 1 U.S. EPA, Region 2
Presentation of the Remedial Investigation/Feasibility Study Report	Julia Allen, Project Manager U.S. EPA, Region 2
Presentation of the Proposed Plan	Julia Allen, Project Manager U.S. EPA, Region 2

Question & Answer Period

APPENDIX B

PUBLIC MEETING SIGN-IN SHEETS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

JACOB K. JAVITS FEDERAL BUILDING

NEW YORK, NEW YORK 10278

SIGN IN SHEET

WARWICK LANDFILL SUPERFUND SITE PUBLIC MEETING
MONDAY, APRIL 22, 1991
GREENWOOD LAKE MIDDLE SCHOOL, GREENWOOD LAKE, NEW YORK

PLEASE PRINT YOUR NAME AND ADDRESS CLEARLY SO THAT WE CAN MAINTAIN ACCURATE MAILING LISTS. THANKS.

NAME	ADDRESS
LEWIS & YOLANDA PERRY	P.O. BOX 937 GREENWOOD LAKE NY 10925
KENNETH A. FREITAS	RR4 BOX 635 LAKES RD 10950
Tom Vinton	Box 37 Bellvale N.Y. 10912
Kathi Wittek	Box 11 Hewitt, NJ 07421
Bonnie Kessler	HR1-Box 470 Greenwood Lake NY 10925
CEN ENRIGHT	RR4 BOX 499 MONROE. NY. 10950.
Colleen Knast	RR4 Box 502 Monroe 10950
Tommy O'Brien	37 Pumpkin Hill Rd Warwick
Anne Pasternack	Box 156 Pine Island, N.Y. 10969
JOE RAMPE	60 MAIN ST. WARWICK NY 10990
JERRY MELAY	Box 1021 Greenwood Lake NY 10925
Tony Houston	1 Harvest Cir Warwick NY 10990
Alicia Adams	33 Lake Ave Highland Mills 10930

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NAME	ADDRESS
KAI KABINOFF	Penelva Rd. Box 92, Chester 10918
Tom Sheehan	RD 4 Box 500 Monroe N.Y. 10950
S. BUTFILOWSKI	BOX 1844 GREENWOOD LAKE NY 10925
A. Ventura Feeman	PO Box 163 Greenwood NY 10925
K. Amuzano	Old Tuxedo Rd. Greenwood Lk NY 10925
Kelly Brennan	RD 4 Box 350 Lakes Rd Monroe NY 10950
Robert Brennan	RD 4 Box 352 Lakes Rd Monroe NY 10950
L. TAVERLY A. KRAFT	RD 4 BOX 735 MONROE N.Y. 10950
Mr. & Mrs. Donald Heim	P.O. Box 735 Tuxedo 10987 (17 Pendleton Road)
Madeline Hurley	RD 4 Box 424 Monroe NY 10950
Norma Van Winkle	P.O. Box 504 Greenwood Lake NY 10925
Loraine Whaley	RR 4 Rt 201 Nelson Rd
Regina Martinez	NELSON Road
Reginald Wittock	32 Cedar Hill Dr, Warwick 10990
John C. MURPHY	RR#4, Box 197 Monroe N.Y.
Valerie Lesser	RD 4 Box 705 Monroe NY 10950

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NAME	ADDRESS
Jonathan Grece	50 Wolf Rd. Albany N.Y. 12233 (NYSDEC)
Nina Knapp	2 University Place Rm 240 Albany NY 12203 (NYSDOH)
Don Miles	2 University Place Rm 205 Albany NY 12203
Dave Nagelli	17 Shoemaker Ave. Waldwick NJ. 07463
DeeAnna L. Kotarski	RD 4 Box 508 Monroe NY 10950
Grace Kelly	F/ CongressMan Gilman - Middletown NY 10940
Ray McCann	RR 4 Box 438 Monroe N.Y. 10950
[redacted]	
Betty Lee	1661 Bath Ave Brklyn N.Y. 11214
Gustava Lee	" " " "
Steve Alexander	22 Collins Ave Spring Valley NY 10977
Rob. J. Fisher	766 Nelson Rd Monroe N.Y. 10950
Brad Sherman	10 Dogwood Court, Highland Mills, N.Y 10930
Carolyn Miranda	Box 325 RD 4 Monroe NY 10950
UNA Pesant	RD 1 Box 621A Monroe, N.Y. 10950
Margi Ley	RR 4 Box 505 Monroe N.Y 10950
Bob. Ley	RR 4 Box 505 Monroe N.Y 10950

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NAME	ADDRESS
MARY SUTPHIN	RD 4 BOX 506 Monroe
Susan A Fenn	RR4 - Box 437 Monroe
Karen Bernie	P.O. Box 1316 GWL
Ginny Welchman	RD #4 Box 501 Monroe N.Y.
Chris Brown	Box 160 G.L. 10925
B. Wiesenfeld	RD 4 Box 757 Monroe 10950
Ernst von Hamm	Box 838 Greenwood
Rod Stack	RD 4 Box 487A Monroe NY 10950
Ruth Stack	" " " "
Bob Baker	PO Box 1563 Greenwood Lk NY. 10925
Kurt Meshirer	RR 4 Box 7131 Monroe
Karen M. Hill	RR4 Box 672B Monroe NY 10950
Eileen Brady	R.R. 4 - Box 685 Monroe, N.Y. 10950
Willie Hurley	RD 4 Box 424 Monroe NY 10950
P. Christakos	Nelson Rd.
A Christakos	Nelson Rd
Debbie Kozinski	RD 4 Box 477 Monroe NY 10950
Mary Vulpis	P.O. Box 735 Greenwood Lake NY 10925

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NAME	ADDRESS
[illegible]	RD 4 Box 501 Monroe N.Y.
Jay Jean Polvillo	RD 4 Box 455 Monroe NY
Mr. Mrs. [illegible]	P.O. Box 656 Lake St Greenwood Lake N.Y.
[illegible]	
Gary Monroe	RR 4 Box 486 Monroe NY
Carol Munsey-Strawder	RR 4 Box 786 Monroe NY 10950
John Frankenfeld	PO Box 1272 Greenwood Lk N.Y. 10925
Paul Valenti	RD 1 Box 38 Monroe N.Y. 10950
Michael Broich	RD 4 Box 684A Monroe, NY 10950
Erik Schroeder	RD 4 Box 728 Monroe, N.Y. 10950
Genevieve Winstanley	PO Box 1195 Greenwood Lake NY 10925
Bernard Winstanley	PO Box 1195 Greenwood Lake NY 10925
Angela Geehern	Box 430 R.D. #4 Monroe NY 10950
Harold A Hartman	PO 114 Greenwood Lake NY 10925
Tom Cinco	85 Golden Hill Goshen NY 10924
JOHN CHIECCIA	RFH 4 Box 503 MONROE NY 10950