NUS CORPORATION

Park West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

R-31-5-3-13
CF-5-F

39864

REMEDIAL ACTION MASTER PLAN

COMBE FILL SOUTH SITE
WASHINGTON AND CHESTER TOWNSHIPS
NEW JERSEY

EPA WORK ASSIGNMENT
NUMBER 01-2V56.0
CONTRACT NUMBER 68-01-6699

NUS PROJECT NUMBER 0701.37

DECEMBER 1983

SUBMITTED FOR NUS BY:

Linda S. Paul

LINDA S. PAUL, P.E.
RAMP AUTHOR

APPROVED:

301527

E. Dennis Escher

E. DENNIS ESCHER, P.E.
MANAGER, REMEDIAL PLANNING

CONTENTS

CONTENTS (CONTINUED)

301529

TABLES

FIGURES

EXECUTIVE SUMMARY

Introduction

The Remedial Action Master Plan (RAMP) for the Combe Fill South Site is prepared in accordance with the rules of the National Contingency Plan (NCP) published pursuant to Section 105 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

The Combe Fill South Site RAMP has been prepared exclusively from existing material obtained from the files of the U. S. Environmental Protection Agency (USEPA), Region II; the New Jersey Department of Environmental Protection (NJDEP); the New Jersey Department of Health (NJDOH); the Washington and Chester Township Boards of Health; and the NUS Corporation Region II Field Investigation Team (FIT) office. Information from local private groups, including the Upper Raritan Watershed Association (URWA) and Help Avoid a Landfill Tragedy (HALT) groups, was also used.

The Site

The Combe Fill South Site is a 60 to 100 acre tract of land located in Washington and Chester Townships, Morris County, New Jersey. The site has been operated as a municipal refuse and solid waste disposal landfill since the 1940s. It has accepted household and industrial wastes, dead animals, sewage sludge, septic tank wastes, chemicals and waste oils. No records are available to indicate the specific types or volumes of industrial wastes disposed of at the site.

The landfill was operated by Filiberto Sanitation, Inc., from 1971 to 1972. No records exist to confirm the identity of the operator prior to 1970. In 1972, Chester Hills, Inc., received a "Certificate of Registration" to operate the site for disposal of nonhazardous municipal and solid wastes. This action marked the first state regulatory control over the landfill operation. The site was purchased and operated by Combe Fill Corporation in 1978, who operated the facility until

September 1981. Reclamation activities, however, apparently continued until mid-1982. The property is currently controlled by a bankruptcy trustee.

The Combe Fill South Site is bordered on the east and south by Parker Road. To the north lies a forested area, then private properties on Schoolhouse Lane and East Valley Brook Road. A 50-acre hardwood wetland lies to the west-southwest of the landfill and is the origin of West Branch Trout Brook, a tributary of the Lamington River.

Environmental Setting

The landfill is situated in a partially wooded, rural-residential area and is bordered on the west-southwest by a wetland area. Some landfill operations may have extended into the wetland. The East and West Branches of Trout Brook flow southward from the site, meet south of Parker Road, and flow to the Lamington River. Tanners Brook to the northwest also drains a small portion of the site and flows northeast to the Lamington River. Another small tributary stream to the Lamington River drains minor portions of the site to the northeast.

The gently rolling to hilly terrain is composed of residual soils overlying granitic gneiss bedrock which has a highly fractured pattern. The superficial sediments consist of a thin layer of topsoil overlying a silty/sandy zone of increasing rock fragment content down to bedrock. The depth to unweathered bedrock may range from 2 feet to over 100 feet due to the nature of weathering and the pinnacled bedrock surface in this region.

Two groundwater flow systems are assumed to be present in this area: a minor shallow groundwater zone perched on the fragipan in the wetland adjacent to the site; and the deeper bedrock groundwater zone. The shallow groundwater zone perched on the fragipan adjacent to the site is small and relatively insignificant for this investigation.

The deep groundwater zone that occurs in fractured bedrock is the most important zone for this investigation. The depth to the water table may range from 30 feet to over 100 feet depending on the surface topographic position. No recent groundwater table measurements from monitoring wells or boring logs were available.

The existing monitoring well system is insufficient to determine the direction in which groundwater is flowing. The groundwater flow direction may depend mainly on the joints and fractures in the bedrock. Experience indicates that groundwater may flow in a radial direction from the landfill area.

Most wells in the area are located on the lower valley slopes or valley bottoms and obtain water from the deep groundwater zone. Many residential wells are located adjacent to the site on Schoolhouse Lane, and Parker and East Valley Brook Roads. Elevated levels of organics have been detected in residential wells in the surrounding area.

Environmental Concentrations and Adequacy of Existing Data Base

Air monitoring at the site was limited and consisted of organic vapor monitoring (OVM) using flame ionization detectors (FID) and photoionization detectors (PID) by NUS FIT Region II personnel in April 1983. Readings of 2 to 3 ppm on the OVM-PID were obtained while the OVM-FID detected organics in excess of 100 ppm. While these results suggest that organic vapors other than methane are present at the site at low concentrations, additional air surveys are required to fully evaluate conditions at the landfill.

No soil analyses were available but localized soil contamination is evident where seeps discharge from the landfill. It is recommended that surface soil samples be taken at the site as well as sediment samples from the adjacent streams to determine the extent and depth of contamination.

Groundwater monitoring indicates elevated levels of organics in both shallow and deep-water wells. Discrepancies in monitoring well locations and inadequate quality assurance data reduce the value of this data for enforcement purposes and shift its value to a more qualitative aspect. A more comprehensive and controlled groundwater monitoring program is necessary to better define and update the extent of groundwater contamination.

Surface water sampling of Trout Brook and the East Branch Trout Brook indicates elevated levels of organics and inorganics. Visible signs of contamination of these waters and of Tanners Brook have also been observed. Additional sampling should be performed on Trout Brook, East and West Branches Trout Brook, Tanners Brook, the intermittent leachate streams discharging from the landfill, and the Lamington River to determine the extent of contamination of surface waters.

Public Health Concerns

The primary health concern associated with the Combe Fill South Site is contamination of residential wells. Past sampling efforts indicate the potential for elevated levels of organics in nearby wells. Further analyses should be conducted to quantify these data.

Dermal contact with contaminated surface waters, seeps, and sediments could present some concern to members of the surrounding communities. Waters downstream of the site should be sampled to determine the extent of waste migration from the site and the potential for public contact with contaminated waters and sediments.

The poor quality of cover material as observed upon visual inspection may allow for the discharge of toxic, explosive, or noxious odors from the site. No evidence of a methane gas venting system was observed in the field or indicated in the site literature.

Health and Safety Procedures

During previous site investigations, Level D Health and Safety protection was used. Until more qualitative and quantitative air measurements are made to determine the actual organic vapor content, supplied air respiratory protection (Level B), is recommended for future work. The level of respiratory protection may be reduced from Level B to full-face air purifying respirators or lower levels (C and D), once the level of air contamination has been fully quantified.

Dermal protection necessary during sampling is another major health and safety requirement. Suitable coveralls, boots, and gloves will provide adequate protection from possible dermal exposures.

Remedial Planning Recommendations

Remedial measures to be implemented at a site are identified based on the specifics of the given site conditions and the extent and seriousness of the threat to the public posed by the site. Initial remedial measures (IRMs) are urgent responses implemented to prevent actual or potential exposure to a significant environmental or public health problem. One IRM has been identified at the Combe Fill South Site: the posting of signs to warn unauthorized entrants of the potentially harmful nature of the site. At present, the site can be easily accessed on foot. Access should be restricted due to public health effects associated with contaminated leachate or organic vapors.

Long-term remedial measures are appropriate to situations which are not immediately threatening but where significant concentrations of hazardous substances still remain at the site and may have the potential for further migration to the environment. Long-term remedial measures are required, after IRM hazards have been addressed, to systematically provide for a safe and economic site cleanup. Long-term measures may be viewed as source control remedial measures, which are implemented at the site; or as offsite remedial measures, which are implemented to minimize or mitigate contamination which has entered the environment. Potential source control remedial measures which may be implemented at the Combe Fill South Site include:

- Capping of the waste disposal site
- Surface regrading, revegetation, and drainage control
- Contaminated soil and waste removal
- Groundwater collection and treatment

- Leachate/surface water collection and treatment
- Gas venting and monitoring
- Installation of impermeable groundwater barriers

Based on existing data, offsite remedial measures at the site would be oriented to mitigation of groundwater contamination. These offsite remedial measures may include the installation of temporary individual residential water treatment units, the permanent replacement of contaminated private drinking water supplies, or groundwater collection and treatment.

The remedial investigation, as described herein, has been outlined to provide adequate data to characterize the extent of contamination at the site and to evaluate the appropriate remedial measures for the Combe Fill South Site.

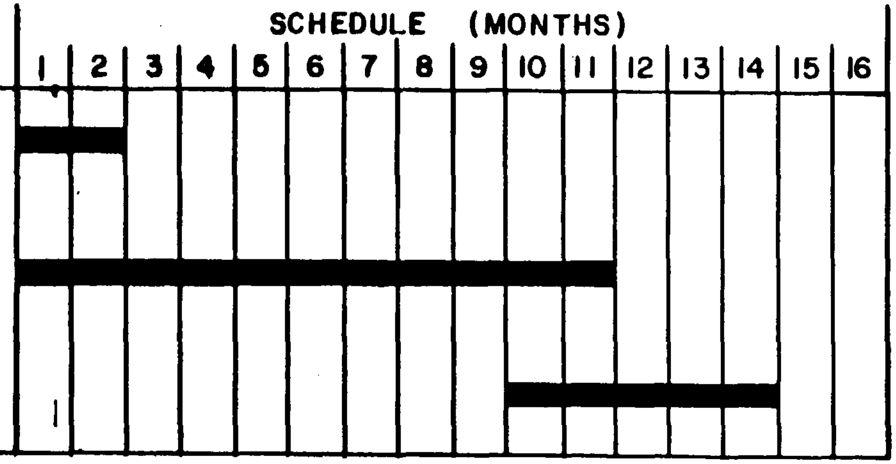
Schedule and Cost Summary

Schedule and cost planning estimates for the remedial investigation and feasibility study for the Combe Fill South Site are presented in Table ES-1. These estimates reflect the scope of work necessary to characterize the site and to evaluate the appropriate remedial actions. These estimates were determined using unit costs (Means, 1983). Lump sum estimates were used when necessary.

A contingency to the costs has been shown to reflect the variation which may be associated with this estimate. This variation may be caused by such intangibles as weather and specific site conditions. For costing purposes it has been assumed that a minimal level of health and safety protection (Levels C and D) will be required during onsite activities. If additional air monitoring does indicate that more extensive protective measures are required for site remedial activities, costs will increase significantly.

A more detailed cost breakdown of the proposed remedial measures is included in Appendix C.

COST (JANUARY, 1983 DOLLARS)	
INITIAL REMEDIAL MEASURE	13,000
REMEDIAL INVESTIGATION	429,000
FEASIBILITY STUDY	74,000



COSTS DO NOT INCLUDE CLP ANALYTICAL COSTS

TABLE ES-1

COST AND SCHEDULE SUMMARY
COMBE FILL SOUTH SITE
WASHINGTON & CHESTER TOWNSHIPS, NJ

NUS CORPORATION
A Halliburton Company

1.0 INTRODUCTION

This Remedial Action Master Plan (RAMP) is prepared in accordance with the rules of the National Contingency Plan (NCP) (F. R., Vol. 47, No. 137, July 16, 1982) published pursuant to Section 105 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980. Remedial actions are those responses at sites on the National Priorities List that require long-term efforts consistent with permanent site remedy to prevent or mitigate the migration of a release of hazardous substances. The specific aspects of remedial actions are presented as Phase VI, Section 300.68 of the NCP.

This RAMP will be the basis of a scoping decision to be made by the lead agency (EPA or other agency) for requesting funding for remedial measures, feasibility studies, and other onsite or offsite remedial measures. In addition, this RAMP and subsequent revisions will serve as the basis of the workscope under the U. S. EPA - State agreements or contracts and as the primary planning document for all remedial measures at the site and related enforcement activities.

RAMPs are prepared exclusively from existing information. This information may include sampling results; maps and topographical information; generator, hauler, and site operator records; and previous regulatory and remedial actions.

This RAMP contains three major sections: (1) compilation of existing data, contained in Sections 2 through 4; (2) evaluation of data, Sections 4 through 6; and (3) remedial planning, Sections 7 and 8. A site chronology, work plan outlines, detailed planning cost estimates, and other pertinent information are appended.

2.0 THE SITE

2.1 Location

Combe Fill South Landfill is a 60 to 100 acre, inactive, sanitary landfill which is located in Chester and Washington Townships, Morris County, New Jersey (Figure 2-1). The entrance to the site, as shown in Figure 2-2, is located along Parker Road, one mile west of the Chester Township Municipal Building. The approximate center of the site can be located at 40°46'17" north latitude and 74°44'29" west longitude.

The site and surrounding area may be found on the U.S.G.S. Chester, Gladstone, Califon, and Hackettstown, New Jersey 7.5 minute series topographic maps. The site is located approximately 2.5 miles southwest of the community of Chester and approximately 8.0 miles southwest of the town of Succasunna.

2.2 Site Layout

The Combe Fill South Site is situated in a partially wooded, rural-residential area. The eastern third of the landfill is located in Chester Township and the remaining western two-thirds in Washington Township. The site is bordered to the east and south by Parker Road, to the north by the private properties on Schoolhouse Lane and East Valley Brook Road, and to the west-southwest by a 50-acre tract, described as a hardwood wetland. This wetland constitutes the headwaters of Trout Brook, a tributary to the Lamington River. Surface site runoff drains to both the East and West Branches of Trout Brook.

Beyond Parker Road to the southeast lies Hacklebarney State Park, a popular recreational facility. Tanners Brook is located to the west and northwest of the site beyond East Valley Brook Road. This brook, which also drains part of the site, flows northeast to the Lamington River. Another small tributary draining minor portions of the northern site area, flows to the northeast beyond Schoolhouse Lane to the Lamington River.

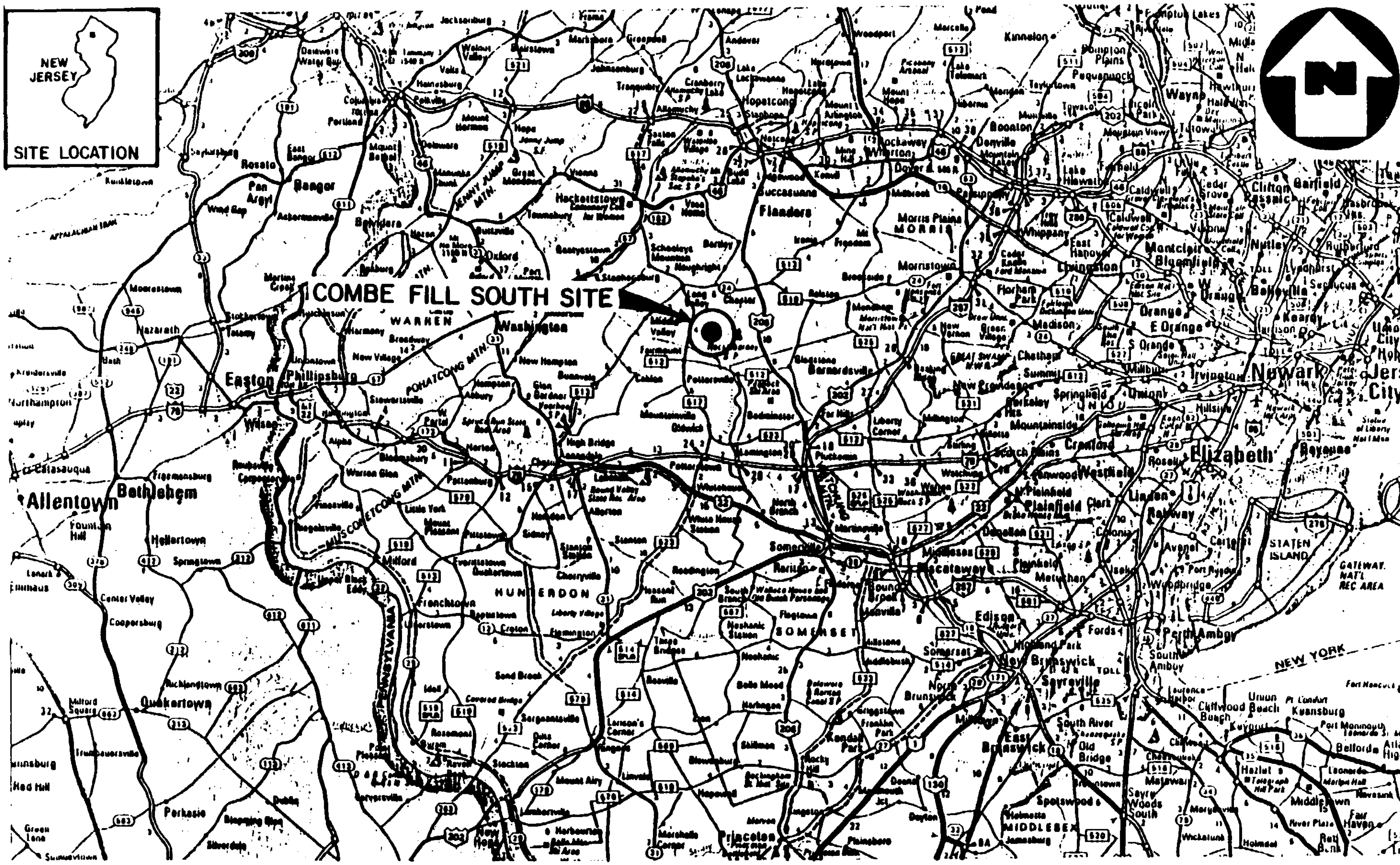
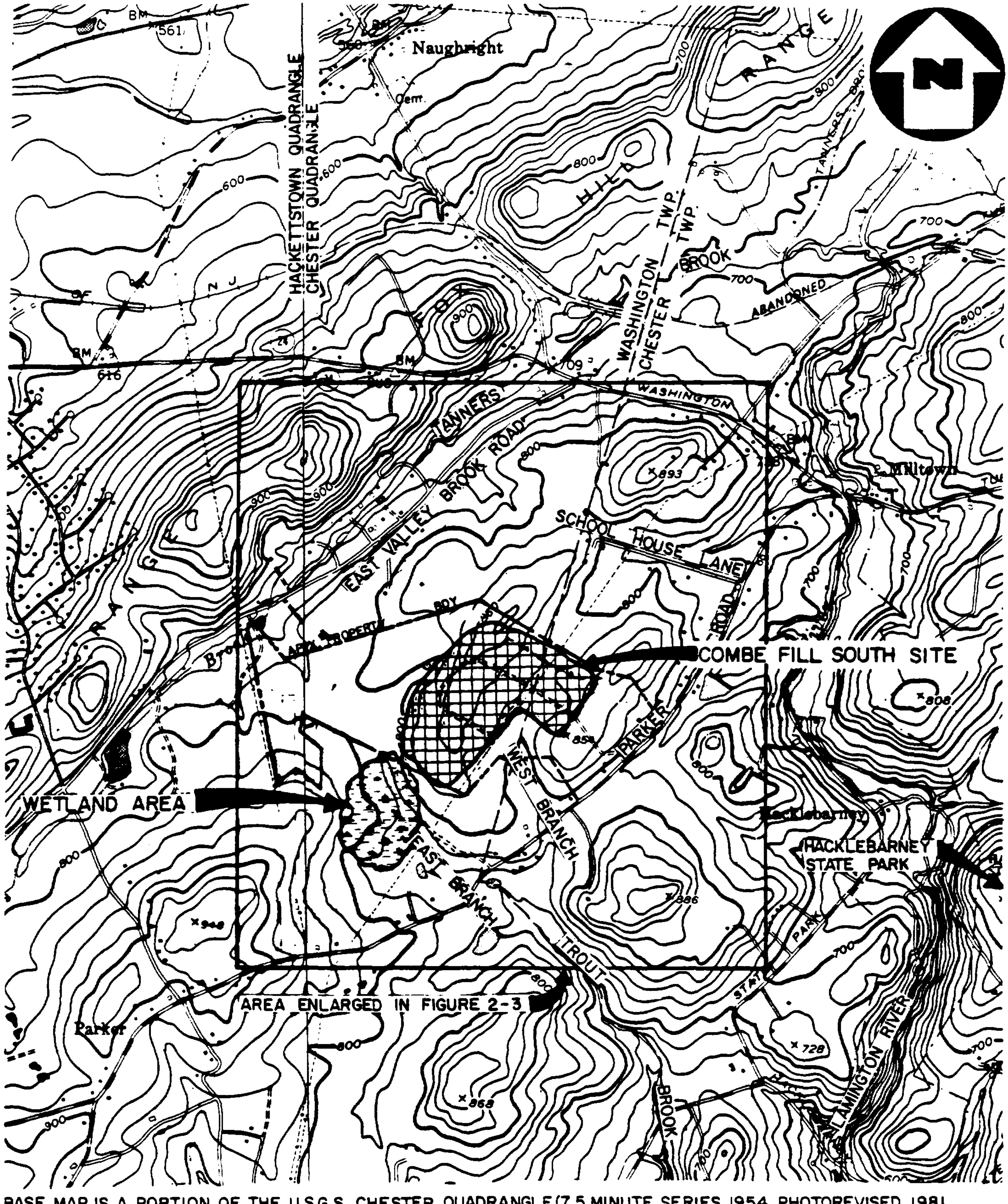


FIGURE 2-1

NUS CORPORATION
A Halliburton Company

VICINITY MAP
COMBE FILL SOUTH SITE, WASHINGTON & CHESTER, NJ
SCALE: 1" = 8 1/3 MI.

301540



BASE MAP IS A PORTION OF THE U.S.G.S. CHESTER QUADRANGLE (7.5 MINUTE SERIES, 1954, PHOTOREVISED 1981, CONTOUR INTERVAL 20') AND THE HACKETTSTOWN, NJ QUADRANGLE (7.5 MINUTE SERIES, 1953, PHOTOREVISED 1971, CONTOUR INTERVAL 20'). DATUM IS MEAN SEA LEVEL.

FIGURE 2-2

301541

LOCATION MAP OF COMBE FILL SOUTH SITE,
WASHINGTON & CHESTER TOWNSHIPS, NJ

SCALE: 1" = 2000'

NUS CORPORATION
A Halliburton Company

The site consists of three areas of concern for investigation: the old fill area, the new landfill, and two open fields. A schematic of the site is shown in Figure 2-3.

The old landfill consists of two areas, totaling approximately 30 acres, separated by the New Jersey Power and Light Company (NJPLC) power line easement (Elam and Popoff Engineering Associates, 1971). These areas extend 600 to 1000 feet to either side of the easement and extend 800 feet south of the northern property line. The main access road, running east to west, traverses these two older landfill areas. The older landfill areas were filled and partially reclaimed before State certification in 1972 and may contain refuse disposed during the 1940s. No record exists of the type of wastes disposed of in the old landfill. The present extent and configuration of the old landfill areas need to be confirmed.

The new landfill areas are located to the south and west of the older landfill areas. The new landfill extends west for 1000 to 1600 feet from the NJPLC easement to the wetland. Some landfilling operations may have been conducted in the wetland area. Another small area along the access road near the site entrance may also have been used for waste disposal. Use of this area could not be fully documented. The new landfill was closed and regraded shortly after Combe Fill Corporation, the site owner and operator, filed for bankruptcy in September 1981. Existing cover material consists of coarse and permeable local soils and crushed bedrock. Severe sheet erosion has occurred on the steep slopes at the western and southern edges of the landfill where vegetation has not been established. Numerous brownish-black stained seep areas are present both at the base of the landfill and on the side slopes. The original design for development of the new landfill areas was completed by Elam and Popoff Engineering Associates in 1971. Based on more current information, it has been determined that the original design drawings do not adequately define the exact extent and configuration of the new landfill.

In addition to the landfill operation, two open fields near the site may be of importance. One field is located at the southeast corner of the new landfill. The other field is located generally at the northwest corner of the landfill and is reportedly used for soybean cultivation. Local residents have suggested that both areas have been used in the past for unauthorized dumping of refuse, chemical wastes, and industrial wastes (Pfieffer, 1983).

The new landfill design, as developed by Elam and Popoff Engineering Associates and approved by the NJDEP in 1972, specified the trench method of waste disposal. It is believed that this technique was also used in the old landfill. The normal procedure was to excavate trenches, approximately 70 feet wide and of variable length, to competent bedrock or to a depth five feet above the seasonal high water table. Backfilling first with a minimum of two feet of compacted residual soil was recommended when bedrock was exposed. Past inspection reports by the NJDEP, however, indicate that waste material was placed directly onto bedrock. Several lifts of compacted refuse and solid waste, three to five feet deep, were then to be deposited in the trench. A minimum of one foot of residual soil was spread over the waste at the end of each working day. The trenches were advanced to the west and south of the old fill area.

There are presently at least two dozen 55-gallon steel drums scattered along the perimeter of the landfill. It is suspected that the majority of these drums contained lubricants and fuel used at the landfill. The landfill equipment facility is located on the northwest corner of the landfill.

NJDEP site inspection reports have indicated that leachate collection basins were located on the west side of the landfill (Markewicz, 1973). These basins were not observed during the NUS site inspection in April 1983 for preparation of this RAMP. A small triangular impoundment was observed on West Branch Trout Brook near the southwest corner of the site.

Entrance to the site is controlled by Filiberto, Incorporated, at the main access road. Mounds of soil deposited on the site access road restrict vehicular access to the new fill area. The site is not fenced, however, and can be entered on foot from the adjoining properties. Personal contacts, from local residents to the township health offices, indicate that this has occurred.

2.3 Site History

The site, now known as Combe Fill South, has been operated as a municipal refuse and solid waste disposal facility since the 1940s. Early NJDEP registration records indicate that Filiberto Sanitation, Incorporated, a local waste hauling firm, operated the landfill on property owned by the Filiberto family before 1972. No records were found to confirm the operator of the site prior to 1970.

On December 12, 1972 the NJDEP issued a "Certificate of Registration" to Chester Hills, Inc., a firm owned and controlled by the Filiberto family. The certificate accepted the new landfill design submitted by Elam and Popoff Engineering Associates in 1971 and approved the site for disposal of nonhazardous municipal and solid waste.

On September 5, 1978 an "Application of Notification of Change in Ownership" was submitted to the NJDEP. Approval of the application transferred the assets of Chester Hills, Inc., to Combe Fill Corporation. The details of this transaction, including property boundaries and ownership/operator status with the Filiberto family, could not be fully determined.

Combe Fill Corporation operated the landfill until September 1981 when state regulatory actions by the NJDEP forced it to discontinue waste disposal activities. Reclamation activities apparently continued until mid-1982. The property is currently controlled by a bankruptcy trustee (Villoresi, 1983).

2.4 Potential Sources of Contamination

The Combe Fill South Landfill was approved for the disposal of municipal waste, industrial waste, sewage sludge and septic tank wastes, chemicals, and waste oils (Kaplan, 1982). No records are available which provide any indication of the types or volumes of industrial and chemical wastes disposed of at the site.

Although there are no records or verifiable accounts of uncontrolled hazardous waste disposal at the site, recent testing programs have documented the occurrence of toxic organic chemicals and metals in surface and groundwater sources in the site area. On one occasion in 1981, Combe Fill Corporation reported the acceptance for disposal of pharmaceutical wastes (Draeger, 1981) and fiber drums which supposedly had previously contained organic chemicals (Molchan, 1981). NJDEP had stated that these wastes were to be disposed of off site. The pharmaceutical wastes were subsequently termed nonhazardous. Local residents contend, however, that other wastes were disposed of in fields adjacent to the site and that after-hours dumping of unauthorized wastes occured at the landfill.

The Combe Fill South Landfill has been a suspected source of toxic discharges since 1973 when NJDEP officials observed foul-smelling, discolored fluids discharging from a large leachate collection basin at the site. These discharges were identified as the probable cause of a fish kill in Trout Brook (Markewicz, 1973).

Past site operational activities most probably contributed to the potential for contamination. The operators of the landfill engaged in the practice of placing refuse in direct contact with fractured bedrock without the benefit of intervening clean fill or synthetic liners. In 1979, runoff from exposed waste was observed to be entering fractures in the bedrock (Markewicz, 1979). This situation resulted from the excavation of unconsolidated overburden and highly fractured bedrock from the trenches to increase storage capacity. This practice provided a direct pathway to the groundwater system. Many residential water supply wells are located within a one-mile radius of the site.

There is visible evidence of leachate generation including numerous reddish and brownish-black seeps issuing from the faces of the old and the new fill areas. Cover soils, which were derived from excavated spoil material, are very coarse, stony, and permeable. Based upon visual inspection, these soils appear to be insufficient to provide a barrier to infiltration of rain water. The southern and western portions of the new landfill area have not been revegetated. There is no current evidence of leachate control measures, such as impermeable liners or collection systems, to prevent the movement of leachate off site. This uncontrolled discharge of leachate provides the potential for both groundwater and surface water contamination.

Sample analyses show that Trout Brook and many nearby private water supply wells are contaminated with volatile organics and toxic heavy metals. Additional analyses are required to determine if the water supply wells have been contaminated by the landfill. Groundwater samples taken at or immediately adjacent to the site have shown indications of contamination (see Section 4).

The East and West Branches of Trout Brook are receiving streams for leachate and surface flow from the landfill. Fish kills have been documented in Trout Brook although the exact cause is not known (Markewicz, 1973).

Heavy sediment deposits at the base of the landfill and in drainage-ways indicate severe erosion problems at the site. Given that the surface of the landfill is stained by leachate, it is reasonable to assume that some of this sediment may be contaminated.

Airborne organic contaminants have been measured at the site by NUS Corporation personnel during the site inspection for preparation of this RAMP. The contribution of methane gas to these readings was not determined. A follow-up air monitoring survey by the Region II FIT team also detected organic contamination but showed a wide discrepancy between monitoring instruments which did and did not detect methane (see Section 4).

2.5 Response Actions to Date

Leachate problems at the site were brought to attention in 1973 when the Division of Fish and Game reported a fish kill in Trout Brook. The NJDEP was requested to investigate the site. Follow-up reports (Markewicz, 1973 and George and Lustig, 1973) confirmed the release of septic leachate to surface waters and groundwaters in the area. The NJDEP subsequently recommended the installation of groundwater monitoring wells at the site (Dalton, 1974; Markewicz, 1975; Tylutki, 1977). No additional wells were installed, however, until 1977 (Dahlgren, 1979).

Chester Hills, Inc., installed a leachate collection and recycling system in 1973 following the incident on Trout Brook (George & Lustig, 1973). The remains of this system include a sump well located near the southeast corner of the landfill, under the powerline, and a four-inch recirculation pipe running up the east face of the new landfill. The sump and recirculation pipe were used to transfer leachate collected at the base of the landfill to leachate-spreading basins atop the fill. These basins were not observed during the NUS site inspection. This leachate collection and recycling system is not functional at the present time.

Several violations were issued to Combe Fill Corporation for inadequate cover and littering from 1979 to May 1981. Public concern over the landfill operations began to increase in 1980 and 1981 when Combe Fill Corporation attempted to extend the landfill operations. These extensions included realignment of the access road and landfilling in the wetland. The problem was aggravated when Combe Fill North, another Morris County landfill, closed in January 1981 and waste shipments to Combe Fill South increased.

In January and February of 1981, Combe Fill Corporation began clearing portions of the wetland at the head of West Branch Trout Brook in preparation for waste disposal. On March 3, 1981, Chester and Washington Townships brought suit in Superior Court to stop operations in the wetland. Numerous complaints were filed with the NJDEP from environmental activist groups and township leaders. Judge Reginald Stanton issued an order suspending Combe Fill Corporation activities in the wetland for two weeks (Coakley, 1981). Waste material may have been landfilled in the wetland area prior to the suspension.

On March 19, 1981, NJDEP responded to landfilling operations in the wetland by issuing an "Order Modifying Registration." This order required the immediate suspension of activities in the wetland and required Combe Fill Corporation to submit revised design plans with a method for secure disposal in the wetland (Londres, 1981a). Concurrently, the U.S. Environmental Protection Agency cited Combe Fill Corporation foı violation of Section 301 of the Clean Water Act, and required an application to the Army Corps of Engineers for a sediment and erosion control (404) permit.

In a final ruling on March 25, 1981, Judge Stanton mandated that (Pereira, 1981):

- NJDEP stake out boundaries of the wetland and designate areas suitable for filling;

- The sediment and erosion control (404) permit was not applicable;

- NJDEP designate an impartial project manager to oversee problems and complaints; and

- NJDEP and Combe Fill Corporation decide whether wetland dumping was permissible.

In April 1981 the NJDEP and the Upper Raritan Watershed Association (URWA) took samples from monitoring wells and surface water sources in the landfill area (Caputo, 1981). In June 1981, Help Avoid Landfill Tragedy (HALT), a local citizens group, in cooperation with Washington and Chester Townships, organized a sampling and analysis program of approximately 90 local residential wells for organic contaminants.

On July 17, 1981, the NJDEP Division of Water Resources conducted tests on water supplies of households on Parker Road, Schoolhouse Lane, and Valley Brook Road (Hamill, 1982). These programs supplemented Chester Township's private well testing program which was conducted from January through July of 1981 (Klimkowsky, 1981).

On August 20, 1981, the New Jersey Public Utilities Commission began hearings on a rate increase request by Combe Fill Corporation. Rate increases were sought to cover environmental protection measures and to provide an escrow account for proper closure of the landfill (Connel, Foley, and Geiser, 1981). It appears that the landfill closed before a decision was rendered.

Based on results of the water quality monitoring programs noted above, NJDEP concluded that groundwater contamination existed on site which may pose a threat to water supplies. As a result NJDEP issued a second "Order Modifying Registration" on September 18, 1981. This order required Combe Fill Corporation to discontinue waste disposal operations upon completion of the existing lift (Londres, 1981e). Landfilling operations at the site were discontinued in September. Reclamation activities were apparently not completed until May 1982.

On March 15, 1982 NJDEP proposed a permanent water monitoring program for the local area (Toder, 1982). In June 1982 the NJDEP authorized and evaluated filter systems for the water supplies at the Ling, Baltycki, and Tucker residences, and for the Early Childhood Development Center (Hamill, 1982b). According to Bureau results, these measures were effective in mitigating contamination of these water supplies.

Site investigations continued from June through August 1982. A geologic reconnaissance at the Combe Fill South Site was conducted by the NJDEP on June 29, 1982 (Germine, 1982). Terrain conductivity surveys were conducted by NJDEP in August 1982 to determine the extent of groundwater pollution (Canace, 1982). The Mitre Ranking Form was submitted by NJDEP to the USEPA on August 12, 1982 (Sadat, 1982).

3.0 ENVIRONMENTAL SETTING

3.1 Landforms

The site is located in an area of rolling hills of moderate topographic relief, formed by the weathering and decomposition of the igneous and metamorphic bedrock of the region. The hills have a somewhat rectangular appearance and tend to be elongated in a northeast/southwest direction, parallel to the direction of foliation within the bedrock.

The landfill is situated atop a hill. Portions of the landfill appear to extend above the pre-existing ground surface. Surface elevation of the site ranges from 800 to about 880 feet above Mean Sea Level.

3.2 Surface Waters

The Combe Fill South Site occupies an upland area which is the headwaters for a number of local streams (Figure 2-2 and 2-3). Surface runoff from the western and southwestern slopes of the fill flows to a hardwood wetland. This 50-acre tract of land is characterized by low relief, marshy vegetation, and a number of springs and seeps. In an undisturbed condition this area may have been the discharge area for shallow groundwater which was perched on more impermeable subsoils (Markewicz, 1973).

The wetland is drained by the West Branch Trout Brook. The East Branch Trout Brook originates under the power line to the east of the new landfill. Flow in the East Branch is seasonal. The confluence of the East and West Branches is approximately one-half mile south of the site. Trout Brook joins the Lamington River approximately three miles south of the site in Hacklebarney State Park. Trout Brook had been designated as a high quality fishing stream. Past reports have indicated that reaches of Trout Brook were devoid of aquatic life (Markewicz, 1973). The East and West Branches of Trout Brook drain the majority of the site.

Another unnamed tributary of the Lamington River drains a small portion of the northern part of the old landfill area. This stream flows northeast past Schoolhouse Lane and joins the Lamington River approximately one mile northeast of the site.

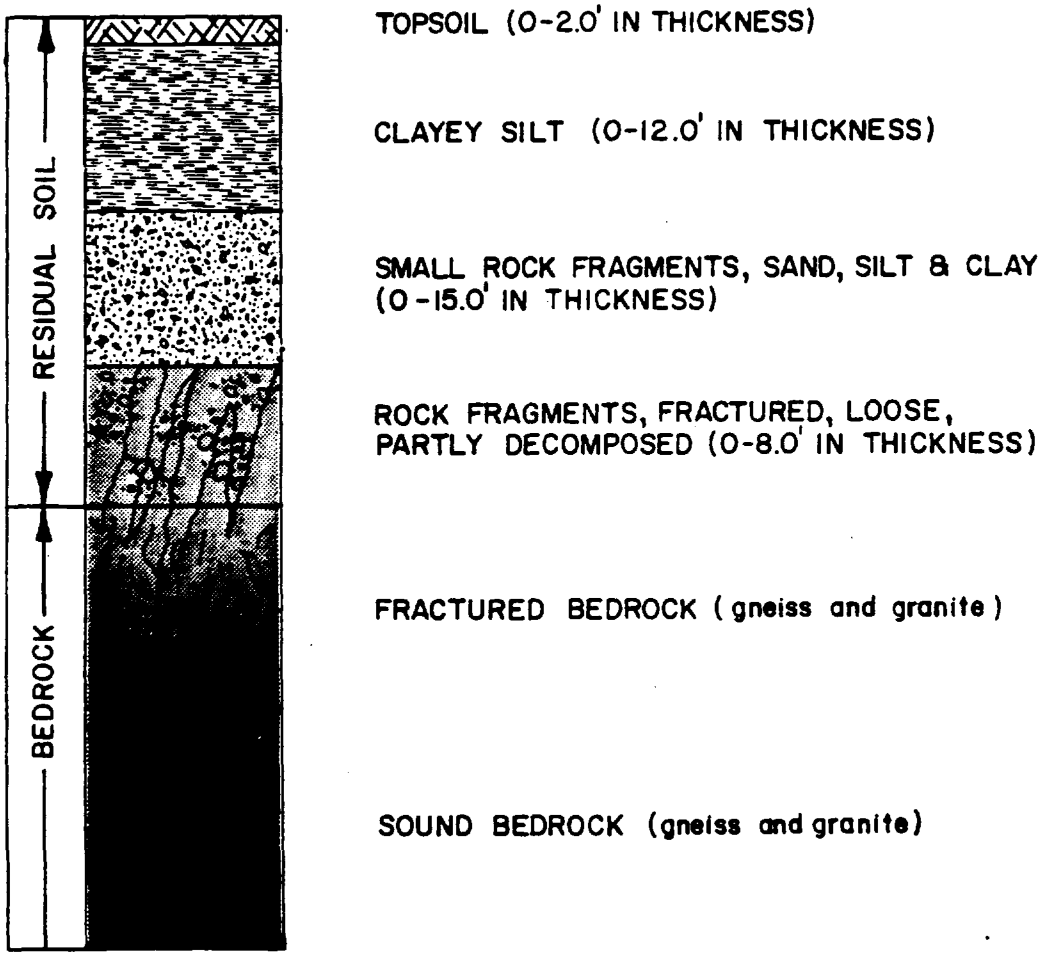
Tanners Brook is located northwest of the site along East Valley Brook Road. This stream flows northeast toward its confluence with the Lamington River approximately one and one-half miles from Combe Fill South. The Tanners Brook drainage basin receives direct runoff from only a very small segment of the site.

The Lamington River is part of the Raritan River drainage basin. At Bound Brook, New Jersey, the Elizabethtown Water Company draws water from the Raritan River to provide drinking water to over a million New Jersey residents. The Lamington River flows southwest through the Black River Wildlife Management Area upstream from the site and is the chief recreational attraction in Hacklebarney State Park The proximity of this wildlife area to the park has created local interest in maintaining the integrity of the hardwood wetland adjacent to the site.

3.3 Geology and Soils

The soil classifications described herein are based on soil borings and test pit logs from Combe Fill South (Elam and Poppoff Engineering Associates, 1971), interpretation of these logs by NJDEP (Kaplan, 1982), and a field reconnaissance of the site by NUS personnel on April 7, 1983. The rock geology is based on observations and data collected during a field investigation of Combe Fill South Landfill and vicinity by the NJDEP (Germine, 1982).

The gently rolling to hilly terrain is composed of residual soils overlying granitic gneiss bedrock. The bedrock is characterized by a complicated fracture pattern. A generalized geologic profile of the study area is shown in Figure 3-1. The profile of the natural soils from the ground surface to competent bedrock can be typified as follows:



301552

FIGURE 3-1

GENERALIZED GEOLOGIC PROFILE
COMBE FILL SOUTH SITE
WASHINGTON AND CHESTER TOWNSHIPS, NJ
NOT TO SCALE

NUS CORPORATION
A Halliburton Company

- Topsoil of minimal thickness

- Clayey silt from 0 to 12 feet in thickness

- Small rock fragments, with sand, silt, and clay from 0 to 15 feet in thickness

- Rock fragments, partly decomposed, from 0 to 8 feet in thickness

The silty zone can contain fragipans which commonly restrict water and root penetration. The fragipans are best developed in the swales and broad flat areas where they serve to perch downward infiltrating groundwater causing the "wetland" character of these areas. When dry, the silty material of the fragipan appears to be indurated (hardened), but the apparent induration disappears upon moistening. The Unified Soil Classification System designations for this zone are ML and CL-ML. The silt zone is the most well-developed in the shallow swales and other broad, relatively low-lying areas of the upland.

Beneath the silty layer the soil contains gradually increasing amounts of rock fragments which can range in size from gravel at the middle of the stratum to boulder size at the top of the bedrock.

The depth to unweathered bedrock can range from 2 feet to over 100 feet due to the degree of weathering in this region. Weathering of the bedrock usually occurs preferentially along joints and fracture planes, predominantly in the vertical direction. This vertical orientation to weathering produces a pinnacled effect in the subsurface where the bedrock surface is highly irregular. Along this pinnacled surface, competent rock can be encountered at depths of 2 feet at one location, while nearby, highly weathered rock and soil may occur at great depths.

Generally, the topographically high areas contain the shallowest rock with the most pronounced pinnacled effects. The relatively flat, shallow swales that occur between the topographic highs contain deeper and more well developed soil profiles. The natural soil profile described above has been totally disturbed within the limits of the landfill proper.

During a geologic reconnaissance of the Combe Fill South Landfill and surrounding area by NJDEP personnel on June 29, 1982 the following four (4) rock types were noted (Germine, 1982):

- Alaskite gneiss - buff-colored, strongly foliated gneiss principally composed of elongated streaks of smoky quartz, plagioclase (oligoclase), feldspar, hornblende and opaques, and traces of monazite. Prominent parting is along foliation.

- Hornblende granite - buff to pink-colored, weakly to moderately foliated granite containing quartz, oligoclase, feldspar, and hornblende.

- Alaskite - dark gray, buff to brown weathering alaskite. Foliation weakly developed to absent. Composed of quartz, oligoclase, and feldspar, with accessory hornblende and opaques.

- Amphibolite - foliated rock containing hornblende and plagioclase. Occurs as thin bands in other rock units. A distinct band of amphibolite was reportedly excavated in the southwestern portion of the landfill and backfilled with garbage.

Foliation is consistent throughout the mapped area, averaging N50°E, 80°SE. Fairly well developed joints within the landfill area belong to three groups (Germine, 1982):

- Foliation set - present throughout the area but particularly well developed in the granite outcrop in the northern portion of the landfill. Appears to be a predominantly near-surface feature.

- Conjugate shear sets - a pair of steeply dipping to vertical sets trending at about N10°W and N45°W. Poorly to moderately well developed on the landfill site. Not noted elsewhere.

- Sheeting - more or less horizontal fractures which are most pronounced in the upper 5 or 10 feet below the soil interface. Noted only in the northern sector of the landfill.

3.4 Groundwater

The interpretation of site hydrogeology is hindered by a scarcity of data, even though a system of five (5) monitoring wells has been installed at the site. The existing monitoring well system is insufficient to determine the extent of the contaminated groundwater plumes or the direction in which groundwater is flowing. No groundwater table measurements were available from the monitoring wells. A description of these five wells has been included in Table 3-1 and approximate locations are shown in Figure 4-1. Several conflicts exist in the site information which reports the locations of Well Nos. 1, 2, and 3. The best estimates have been used in reporting the locations in Table 3-1.

The groundwater system of the study area consists of the very shallow groundwater that is perched on the fragipan in small areas adjacent to the site, and the groundwater contained in the rock fractures beneath and around the site. The shallow groundwater perched on the fragipan is limited to the swales where the perching causes the "wetland" characteristics. The perched groundwater occurs seasonally and dries during periods of low rainfall. The perched groundwater often discharges laterally as springs and seeps, or it eventually percolates through the fragipan into the joints and fractures of the bedrock. This shallow groundwater is a relatively minor component of the groundwater flow system in this area. In the low flat areas, the water table perched on the fragipan was encountered in test borings at depths of four (4) to ten (10) feet. In the higher areas, no groundwater was encountered within the test holes which extended to a maximum depth of 20 feet (Elam and Popoff, 1971).

TABLE 3-1

SUMMARY OF MONITORING WELLS USED FOR QUARTERLY MONITORING AT COMBE FILL SOUTH SITE*

Well Number	Location	Date of Drilling	Depth of Boring (feet)	Material
1	At landfill garage near Parker Road	NA	Possibly 100-200 feet	Steel
2	At crest of hill near landfill	NA	Possibly 100-200 feet or deeper	Steel
3	At Filiberto, Sr., house on Parker Road	NA	Possibly 100-200 feet or deeper	Steel
4	Near power line ROW on NE side of landfill	1977	150	6" steel casing cemented at 100' depth.
5	Near power line ROW on south side of landfill	1977	30	PVC screen set 20-30'. Gravel packed and grouted above.

NA - Not Available.

*Source: January 12, 1981 letter from W. Burshtin, NJDEP, to R. Klimkowski, Morris County Board of Health.

The deep groundwater zone is the most important to this investigation and occurs in the fractured bedrock. The depth to the water table may range from 30 to over 100 feet depending on the surface elevation. Most water wells in the area are situated on the lower valley slopes or valley bottoms and obtain groundwater from the deep groundwater wells. Yields range from 0-30 gpm. Groundwater appears to move exclusively through fractures in the rock. The direction of groundwater flow in the study area generally depends on the directions of the joints and fractures. Experience suggests that groundwater may flow radially from the landfill near the upper zone of weathering.

An electromagnetic terrain conductivity geophysical survey was performed along the perimeter of the landfill site by the NJDEP in August 1982 to delineate zones of groundwater contamination. This survey was interpreted to indicate that groundwater contamination occurs in the bedrock near the northeast and southwest corners of the landfill, and along the western perimeter of the site. Other interpretations of the data may be possible.

In the area of the landfill, the soils have been excavated and removed, and the wastes placed on the underlying bedrock. The crushed bedrock and soil from the excavation were used to cover waste material. At the Combe Fill South Site, minimal provisions have been made to prevent leachate from traveling to and mixing with both surface and groundwater. Therefore, it is necessary to investigate surface water and groundwater quality in the study area, and the directions of groundwater flow.

3.5 Climate and Meteorology

The climate of north-central New Jersey is moderate. Normal monthly temperatures range from a low of 30.2°F in January to a maximum of 74.0°F in July. The normal annual temperature is 51.7°F. Precipitation is affected by storms from both the Great Lakes Region and off the Atlantic shore. Rainfall occurs 120 days out of the year and, on the average, is the heaviest and most evenly distributed during the warm months. Snowfall normally occurs between October 15 and April 20 (Dunlap, 1967).

Precipitation totals in the Combe Fill South area are among the highest in the state, usually averaging over 48 inches per year (Dunlap, 1967). The normal distribution of precipitation measured at the Long Valley Station, located approximately 5 miles west of the Combe Fill South Site, is shown in Table 3-2.

3.6 Land Use

The land immediately surrounding Combe Fill South Landfill is approximately 40% forested and 60% open land. Based on untitled zoning summaries included with the site information, there are 50 zoned lots within a one-quarter mile radius of the site in both Chester and Washington Townships. Of these, 38 are residential and 4 are vacant. The remaining 5 lots in Washington Township are zoned for agricultural use. Three lots in Chester Township are industrial.

Within a one-half mile radius of the site there are an additional 96 lots, 79 of which are residential and 11 of which are vacant. One industrial lot and 5 vacant lots are located in Washington Township. The Borough of Chester is located 2.5 miles to the northeast.

Other major land uses in this area include: Hacklebarney State Park, a popular fishing area along the Lamington River 1 mile southeast of the site; and the Black River Wildlife Management Area, also along the Lamington River, approximately 4 miles northeast of the site. A transmission line corridor crosses the site in a northeast-southwest direction (see Figure 2-2).

3.7 Water Use

Local surface waters are used for recreational purposes. Trout Brook, which drains most of the site area, was identified by the NJDEP as trout production waters. From reports it appears the quality of Trout Brook has declined and it may no longer support fish populations. Trout Brook flows to the Lamington River which supports fishing and other recreational activities. Hacklebarney State Park is located along the Lamington River (see Figure 2-2).

TABLE 3-2

NORMAL PRECIPITATION FOR LONG VALLEY, MORRIS COUNTY, NEW JERSEY
(DUNLAP, 1967)

Month	Precipitation (in.)
January	3.54
February	3.02
March	4.28
April	3.97
May	4.17
June	4.13
July	5.20
August	5.06
September	3.92
October	3.57
November	4.25
December	3.79
Total	48.90

The wooded wetland adjacent to the site may provide a swamp or marshy environment for wildlife. The public filed numerous complaints when Combe Fill Corporation attempted to clear the wetland for waste disposal operations. The Black River Wildlife Management Area is located 4 miles northeast (upgradient) of the site on the Lamington River.

The nearest surface water drinking source is located at Bound Brook, New Jersey, approximately 50 river miles downstream of the site on the Raritan River. Approximately 90 residential drinking water supply wells are located within a one-half mile radius of the site.

4.0 ENVIRONMENTAL CONCENTRATIONS

The environmental concentrations of contaminants found at the Combe Fill South Site are described below.

4.1 Environmental Concentrations

4.1.1 Air

No ambient air quality measurements were found in the site literature. NUS personnel completed organic vapor monitoring (OVM) measurements using a flame ionization detector (FID) during a site reconnaissance in April 1983. Readings of 5-10 ppm were obtained throughout most of the site perimeter. Higher readings of 40-50 ppm were measured in the northwestern corner of the site near the location of the dismantled storage building.

The contribution of methane gas to the OVM-FID readings was not determined. Random surface expressions of methane gas at the site would be expected since the site has been operated for 30-40 years, the cover soils appear to be relatively permeable, and no evidence of the installation of a gas venting system was found. A strong, noxious odor was present at the landfill during the NUS site inspection. Local residents have frequently complained of foul odors from the site in the past.

Based on the OVM-FID readings from the site reconnaissance, an additional air monitoring survey was completed by the Field Investigation Team (FIT) Region II Office on April 14 and 15, 1983. The site area was divided into grids and surveyed. Air quality measurements were taken by both photo ionization detectors (OVM-PID) and flame ionization detectors (OVM-FID) instruments. The OVM-PID, which does not detect methane and some other organics, obtained average readings of 2-3 ppm at the site. The OVM-FID, which does detect methane, obtained readings in excess of 100 ppm at some locations. The gas chromatograph (GC) mode was not used on the OVM-FID to distinguish the specific organic vapors present on site. The disparity in readings between the two instruments suggests that high measurements of organic vapors on site may be due primarily to emissions of methane gas.

4.1.2 Soil

No records of soil sampling analyses were found from which an evaluation of soil contamination could be made. As the entire disposal site appears to have been covered with approximately one (1) foot of soil, surface soil contamination would be expected to be minimal. Localized sources of soil contamination may be found where seeps discharge from the landfill and along drainage paths to the tributaries of Trout Brook. Sediments within Trout Brook and the East and West Branches may also be contaminated. Leachate from the site was observed discharging to West Branch Trout Brook during the NUS site reconnaissance in April 1983 and during other previous field investigations. No references were found in the literature of chemical wastes being disposed of directly onto surface soils.

Residents have reported that wastes were disposed of in the fields adjacent to the site. A white powdery material was encountered in the soybean field (northwest) during installation of a monitoring well. Soil contamination may be present in these fields.

4.1.3 Groundwater

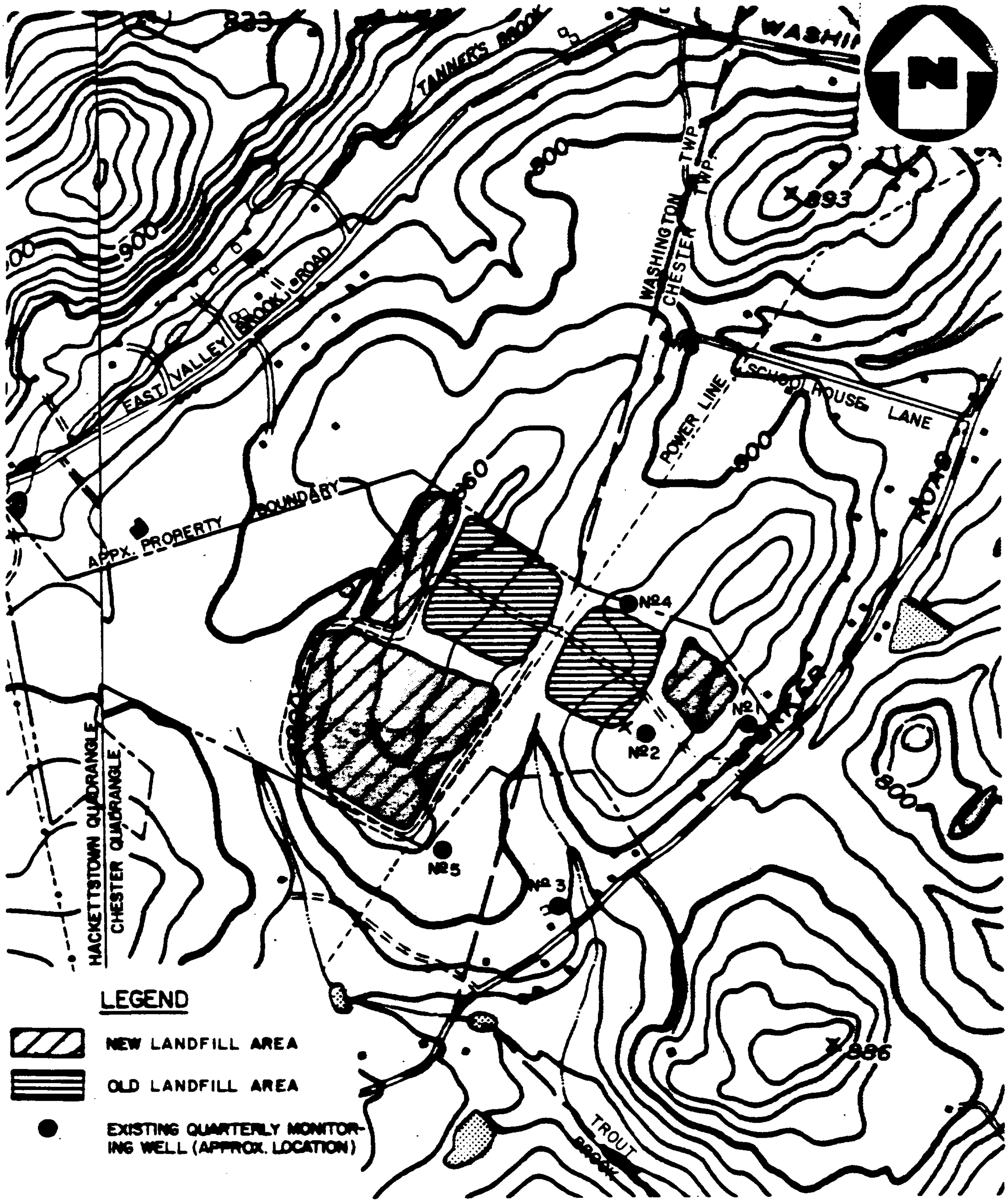
Groundwater sampling and analysis has been performed in the vicinity of the landfill since 1973. These analyses include quarterly and annual monitoring completed by Chester Hills, Inc., and the Combe Fill Corporation for the site, as well as other discrete samplings. Interpretation of this information, however, was hampered by conflicts in the literature regarding the actual locations of the various monitoring points. Some assumptions were necessary in locating sample points for the evaluation of earlier onsite groundwater monitoring analyses.
Results of the quarterly monitoring analyses were found from January 1977 to May 1981 from both Chester Hills, Inc., and the Combe Fill Corporation. Five sample locations were used. Although some discrepancy exists in the reported well locations, their locations are best determined as follows:

Well No. 1	Located at the landfill garage.
Well No. 2	Located in the eastern landfill area at the crest of the hill near the access road.
Well No. 3	Located at the Filiberto, Sr., house on Parker Road.
Well No. 4	Located near the northern property line to the northeast of the powerline easement.
Well No. 5	Located 200 feet south of the southern property line along the powerline easement.

The approximate location of the quarterly monitoring wells are shown in Figure 4-1. Wells No. 4 and 5 were incorporated into the subsequent sampling and analysis program by the Upper Raritan Watershed Association and the NJDEP as described below.

A summary of the quarterly monitoring well analyses is shown in Table 4-1. With the exception of phenols, no organic analyses were included in the program. Some substances were found in elevated concentrations in the wells. Phenols and COD levels were higher in some wells during the first year of sampling. Cadmium and iron were measured in some wells, as well as the presence of chromium, lead, mercury, and coliform.

In March 1981, a monitoring program was conducted by the Upper Raritan Watershed Association (URWA) and the NJDEP to assess the degree of surface and groundwater contamination at the site (Caputo, 1981). Two deep and two shallow wells were installed. Samples were collected by Allied Biological Control Corporation and analyzed by Princeton Testing Laboratory. Figure 4-2 illustrates the locations of these sampling points. The sampling points included two shallow wells ($\pm$ 25 feet deep), two deep wells, and a deep control well located some distance from the landfill (not shown). Seven surface water samples were also included in this program. Surface waters are discussed in the following subsection.



BASE MAP IS AN ENLARGEMENT OF A PORTION OF THE U.S.G.S. CHESTER, NJ QUADRANGLE (7.5 MINUTE SERIES, 1954, PHOTOREVISED 1981, CONTOUR INTERVAL 20') AND THE HACKETTSTOWN, NJ QUADRANGLE (7.5 MINUTE SERIES, 1953, PHOTOREVISED 1971, CONTOUR INTERVAL 20').

FIGURE 4-1

LOCATION OF QUARTERLY MONITORING WELLS
COMBE FILL SOUTH SITE
WASHINGTON & CHESTER TOWNSHIPS, NJ
SCALE: 1" = 1000'

301564

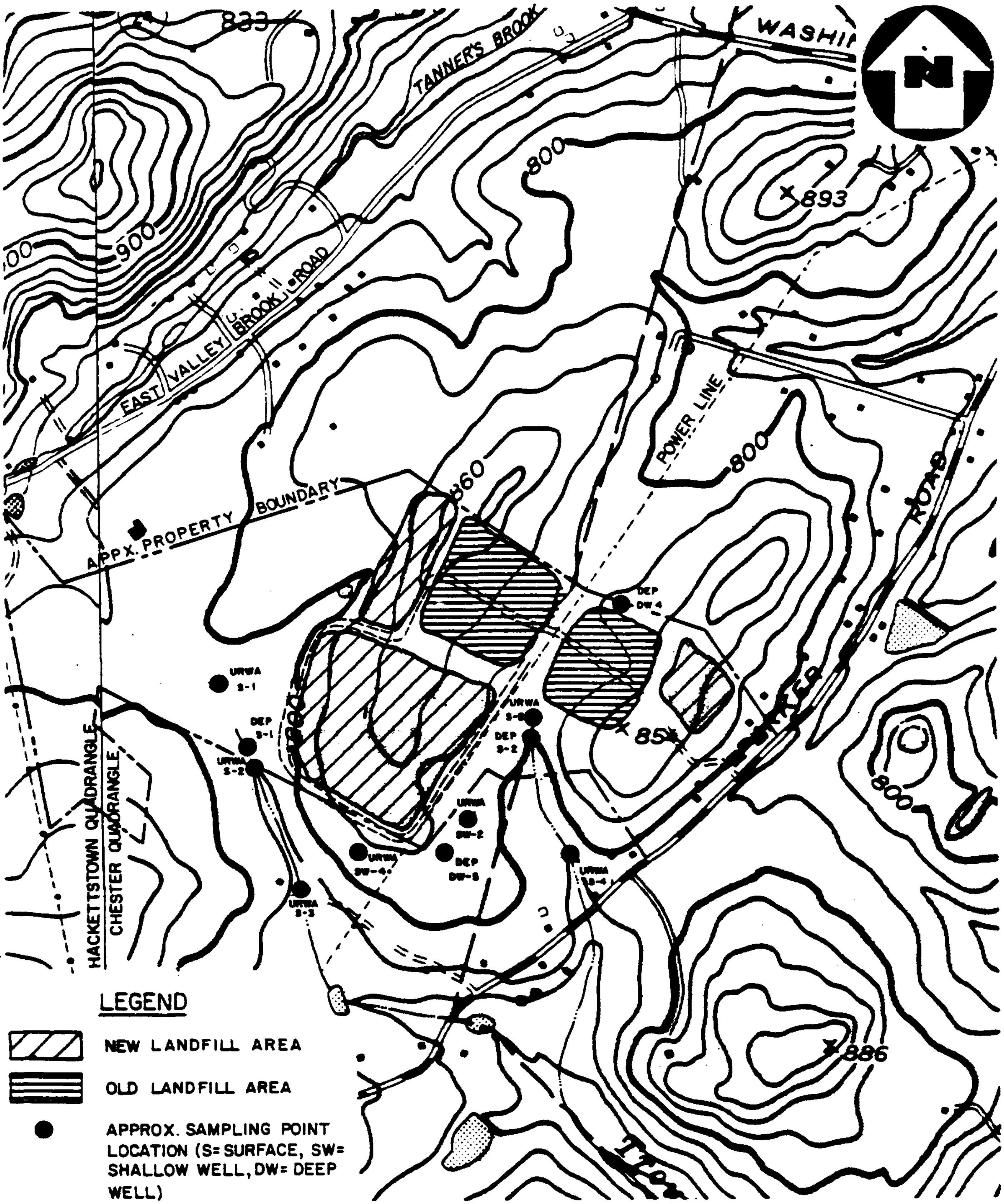
NUS CORPORATION
A Halliburton Company

TABLE 4-1

RESULTS OF QUARTERLY MONITORING WELL ANALYSIS
COMBE FILL SOUTH SITE
RANGE OF CONCENTRATIONS FOUND
(mg/l EXCEPT WHERE OTHERWISE NOTED)

	#1	#2	#3	#4	#5
BOD_5	<1-13	<1-42	<1.0-17	0.4-29	<1-14
Total Coliform	<10-<100	0-<100	<10-<100	3-<100	1-<100
TDS	72.5-380	35.8-439	59-167	31**-230	80-470
Hardness	52-236**	12-132**	17-200	20-152**	32-175
COD	<4-320**	1.3-290	<4.0-440	2.7-200**	2.0-760**
Phenols	<0.001-0.10	<0.001-0.06	0.001-<0.4	<0.001-<0.4	<0.001-0.01
Nitrate (as N_2)	0.3**-3.3	0.15**-4.0	0.04-4.4	0.05-1.0	0.05-0.9
Chloride	10-162**	3.7-160	3-88**	2-82**	5.9-108**
Arsenic	<0.002-<0.05	<0.002-<0.05	<0.002-<0.05	<0.002-<0.05	<0.005-<0.05
Cadmium	<0.001-0.13	<0.001-5	<0.001-0.22	<0.001-0.14	0.003-0.01
Chromium	<0.001-0.04	<0.001-0.05	<0.001-0.05	<0.001-<0.05	<0.003-0.04
Copper	<0.001-0.028	<0.001-0.2	0.03-1.5	<0.001-0.1	<0.001-0.02
Iron	0.003-1.815	0.010-11.5	0.01-0.94	0.062-7.0	0.02-58
Lead	<0.02-0.12	0.005-0.05	0.009-0.06	0.01-0.11	0.008-0.08
Manganese	<0.001-0.06	0.001-0.1	<0.001-0.2	<0.003-0.05	0.01-0.12
Mercury	<0.001-0.002	<0.0001-<0.001	<0.0001-<0.001	<0.0001-0.002	0.0001-0.008
Selenium	<0.002-<0.01	<0.01-<0.002	<0.002-<0.01	<0.002-<0.01	<0.01

*Results were summarized from quarterly monitoring analyses from January 1977 to May 1981 by Chester Hills, Inc. and Combe Fill Corporation.
**Unfiltered Sample



LEGEND

NEW LANDFILL AREA

OLD LANDFILL AREA

APPROX. SAMPLING POINT LOCATION (S= SURFACE, SW= SHALLOW WELL, DW= DEEP WELL)

BASE MAP IS AN ENLARGEMENT OF A PORTION OF THE U.S.G.S. CHESTER, NJ QUADRANGLE (7.5 MINUTE SERIES, 1954, PHOTO-REVISED 1981, CONTOUR INTERVAL 20') AND THE HACKETTSTOWN, NJ QUADRANGLE (7.5 MINUTE SERIES, 1953, PHOTOREVISED 1971, CONTOUR INTERVAL 20').

301566

FIGURE 4-2

LOCATION OF URWA & DEP SAMPLE POINTS
COMBE FILL SOUTH SITE
WASHINGTON & CHESTER TOWNSHIPS, NJ
SCALE: 1" = 1000'

NUS CORPORATION
A Halliburton Company

URWA/DEP samples were analyzed for substances known to occur in similar landfills investigated by the NJDEP. These substances included biological parameters, metals, volatile organics, pesticides, PCBs, acid extractable and base/neutral extractable organics, and radioactive compounds. The results of substances found in the samples are shown in Table 4-2 for the organics and Table 4-3 for the inorganics. The data show concentrations of iron in the two deep wells, manganese in one shallow well, and COD readings in all wells.

Twelve organic compounds were detected. The two deeper wells had total organic concentrations of over 100 ppb. Carbon tetrachloride was found in concentrations exceeding 100 ppb in both deep wells. Deep well DEP DW-4, located along the northern property boundary, appeared the most contaminated of the groundwater samples, with concentrations of carbon tetrachloride at 338 ppb, tetrachloroethylene (PCE) at 100 ppb, and heptane at 256 ppb. Trichloroethylene (TCE), 1,2 dichloroethane, and 1,4 dichlorobutane were also detected in sample DEP DW-4. The shallow wells evidenced lower total organic concentration levels. Some doubt exists as to the validity of the shallow wells as indicators of groundwater contamination due to their method of installation. Surface water contamination may have affected results of the shallow wells.

As a supplement to the URWA analysis and report, a radioactivity survey for gross alpha and gross beta contamination was conducted on surface and groundwaters at and adjacent to the landfill area and was compared to that of a control well off site. The location of the control well was not specified. One of the test wells was located near the Filiberto residence. The location of the other well could not be determined.

The site is located in a geologic area of naturally elevated radioactivity from thorium. This study did not determine if the radioactivity measured near the site was caused by natural activities, natural activities aggravated by landfilling, or by radioactive substances present in the landfill. Levels of background radioactivity in this geologic setting were not presented adequately in this investigation. The actual radioactive substances measured were not reported either.

TABLE 4-2

SUMMARY OF ORGANICS FOUND IN WELLS DURING URWA/DEP SAMPLING PROGRAM AT COMBE FILL SOUTH SITE (MARCH 1981) (ppb)

	URWA SW-2*	URWA SW-4	DEP DW-4*	DEP DW-5	URWA Control Well
Dichloromethane (methylene chloride)	-	-	-	-	-
Carbon tetrachloride	-	-	338	135	-
Dibromochloromethane	-	-	-	-	-
1,1 Dichloroethane	8	11	-	-	-
1,2 Dichloroethane (ethylene dichloride)	14	22	12	-	-
Trans-1,2-Dichloroethene	35	-	-	-	-
Tetrachloroethylene (PCE)	-	-	100	-	-
Trichloroethylene (TCE)	-	-	46	-	-
Tetrachloroethene	-	6	-	-	-
1,4-Dichlorobutane	-	-	10	-	-
Heptane	-	-	256	15	-
Nonane	-	-	-	-	-
Xylene (m,p)	-	-	-	-	-
Xylene (o)	-	-	-	-	-
Toluene	13	4	-	-	-
Benzene	-	-	-	-	-
Chlorobenzene	<2	-	-	-	-
Ethyl benzene	10	-	-	-	-
Propyl benzene	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-
Naphthalene	-	-	-	-	-
Diethyl phthalate	-	-	-	-	-
Bis(2-ethyl hexyl) phthalate	-	-	-	-	-
Endosulfan (alpha)	-	-	-	-	-
Unknowns (2)	-	-	-	-	-
Unknowns (6)	-	-	-	-	-
Total Organic Chemicals	80	43	762	150	0

*SW signifies shallow well
DW signifies deep well

301568

TABLE 4-3

SUMMARY OF INORGANICS FOUND IN WELLS DURING URWA/DEP SAMPLING PROGRAM AT COMBE FILL SOUTH SITE (MARCH 1981)
(ppm except where otherwise noted)

	URWA SW-2*	URWA SW-4	DEP DW-4*	DEP DW-5	URWA Control Well
BOD_5	5.7	<1.0	10.3	18	<1.0
COD	65	55	40	76	15
TOC	28	14	NA	NA	10
Dissolved O_2	NA	NA	5.0	8.1	NA
Total Coliform (MPN/100 mL)	0	22	<2	2	0
Fecal Coliform (MPN/100 mL)	0	60	<2	<2	0
Fecal Streptococci (MPN/100 mL)	0	0	<2	<2	0
TDS	472	96	NA	NA	97
Suspended Solids	NA	NA	13	304	NA
Total Solids	NA	NA	116	428	NA
Total Kjeldahl N_2	1.4	<0.5	NA	NA	0.35
Nitrite	0.015	<0.01	NA	NA	<0.01
Nitrate	<0.5	0.77	NA	NA	4.3
Total Hardness (as $CaCO_3$)	279	28	46	64	46
Arsenic	0.02	<0.01	0.005	0.013	0.03
Aluminum	NA	NA	0.274	18.29	NA
Cadmium	0.01	<0.01	0.001	0.001	<0.01
Chloride	99	8.7**	4	21	1.9
Chromium	0.02	<0.01	0.005	0.093	<0.02
Copper	NA	NA	0.014	0.018	NA
Cyanide	<0.01	<0.01	0.004	0.001	<0.01
Iron	NA	NA	8.215	9.515	NA
Lead	<0.02	0.02	0.013	0.005	<0.02
Manganese	9.4	0.02	NA	NA	<0.02
Mercury	<0.002	<0.002	0.0005	0.0005	<0.002
Zinc	NA	NA	0.028	0.045	NA
Phenol	0.16	<0.10	NA	NA	0.18

*SW - Shallow well
DW - Deep well
** Chlorine
NA - Data Not Available

The control well showed readings of 1.05 picocuries per liter gross alpha and 2.56 picocuries per liter gross beta. Levels of both gross alpha and gross beta radiation in the two test wells were 2 to 3 times higher than those of the control well. Radioactivity levels were lower, generally, in the groundwater samples than the surface water samples.

Additional studies would be required to fully evaluate any health hazards associated with radioactivity at the Combe Fill South Site. Gross activity levels and specific elements and/or isotopes must be determined. This survey should be conducted during initial site activities.

In May and June 1981, the West Morris H.A.L.T. (Help Avoid a Landfill Tragedy) organized an extensive sampling program of approximately 90 residential wells in the landfill area and beyond. The samples were tested by Industrial Corrosion Management of Randolph, New Jersey for 32 organics. The analyses were funded by the property owners. Eleven organics were positively identified. In addition, unknown substances were found in 24 of the wells tested. Concentrations of the unknown organics ranged from less than 1 ppb to less than 100 ppb. Results from 36 of the wells tested indicated some type of contamination. The most significant contamination occurred in residences along Parker Road, East Valley Brook Road, Schoolhouse Lane, East Gate Road and State Park Road. Results for those wells found to be contaminated at these locations are shown in Table 4-4. In addition, 14 wells located at some distance from the landfill were also found to be contaminated. The analytical results from the wells generally indicated total organic concentrations of from 1 to 20 ppb, except for one well recorded at 42.5 ppb.

A joint program by URWA and Washington and Chester Townships in June 1981 found selenium and lead in 4 test wells. Results are listed in Table 4-5. These wells are located on Parker Road and East Valley Brook Road.

An electromagnetic conductivity geophysical survey (EM) was conducted at the Combe Fill South Site in 1982 under direction of the NJDEP to delineate zones of possible groundwater contamination. The survey was performed along the

TABLE 4-4

ORGANIC WELL CONTAMINANTS FOUND IN H.A.L.T. PROGRAM (MAY - JUNE, 1981)(ppb)

	Parker Road Residences				East Valley Brook Road Residences	
	Shernce	Price	Howe	Whitehead	Albano	Harding
Chloromethane	-	-	-	-	-	-
Bromomethane	-	-	-	-	-	-
Dichlorofluoromethane	-	-	-	-	-	-
Vinyl Chloride	-	-	-	-	-	-
Chloroethane	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	-	-
Trichlorofluoromethane	-	187	-	-	-	-
1,1-Dichloroethylene	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	2.5
t-1,2-Dichloroethylene	-	-	-	-	-	-
Chloroform	-	-	14.9	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	11.0
t-Butylmethyl Ether	-	-	-	-	-	-
Carbon Tetrachloride	-	-	-	-	-	-
Bromodichloromethane	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-
t-1,3-Dichloropropene	-	-	-	-	-	-
Trichloroethylene (TCE)	-	-	<1.0	-	-	-
Dibromochloromethane	-	-	-	-	-	-
Benzene	-	-	-	-	-	-
Diisopropyl Ether	-	-	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-
c-1,3-Dichloropropene	-	-	-	-	-	-
2-Chloroethylvinyl Ether	-	-	-	-	-	-
Bromoform	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-
Tetrachloroethylene (PCE)	3.5	-	1.2	-	1.6	-
Toluene	-	-	<1.0	-	<1.0	-
Chlorobenzene	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-
Heptane	-	-	-	-	-	-
Total Organics*	< 18.5	187	<28.1	<100	<41.67	<18.5

*Includes concentrations of unknown organic substances.

TABLE 4-4
ORGANIC WELL CONTAMINANTS FOUND IN H.A.L.T. PROGRAM (MAY – JUNE, 1981) (ppb)
PAGE TWO

	East Valley Brook Road Residences					
	Crostley	Scrivens	Baltycki	MacDonnell	Nast	Eitner
Chloromethane	–	–	–	–	–	–
Bromomethane	–	–	–	–	–	–
Dichlorofluoromethane	–	–	–	–	–	–
Vinyl Chloride	–	–	–	–	–	–
Chloroethane	–	–	–	–	–	–
Methylene Chloride	–	–	–	–	–	–
Trichlorofluoromethane	–	–	–	–	–	–
1,1-Dichloroethylene	–	–	–	–	–	–
1,1-Dichloroethane	–	–	5.6	–	4.0	–
t-1,2-Dichloroethylene	–	–	–	–	–	–
Chloroform	–	7.2	–	5.5	–	–
1,2-Dichloroethane	–	–	–	–	–	–
1,1,1-Trichloroethane	–	–	20.3	–	13.2	–
t-Butylmethyl Ether	–	–	–	–	–	–
Carbon Tetrachloride	–	–	–	–	–	–
Bromodichloromethane	–	–	–	–	–	–
1,2-Dichloropropane	–	–	–	–	–	–
t-1,3-Dichloropropene	–	–	–	–	–	–
Trichloroethylene (TCE)	–	–	–	–	–	–
Dibromochloromethane	–	–	–	–	–	–
Benzene	–	–	–	–	–	–
Diisopropyl Ether	–	–	–	–	–	–
1,1,2-Trichloroethane	–	–	–	–	–	–
c-1,3-Dichloropropene	–	–	–	–	–	–
2-Chloroethylvinyl Ether	–	–	–	–	–	–
Bromoform	–	–	–	–	–	–
1,1,2,2-Tetrachloroethane	–	–	–	–	–	–
Tetrachloroethylene (PCE)	–	–	–	–	–	1.67
Toluene	–	–	–	–	–	–
Chlorobenzene	–	–	–	–	–	–
Ethylbenzene	–	–	–	–	–	–
Heptane	–	–	–	–	–	–
Total Organics*	<5	<17.2	25.9	<10.5	17.2	<41.67

*Includes concentrations of unknown organic substances.

TABLE 4-4
ORGANIC WELL CONTAMINANTS FOUND IN H.A.L.T. PROGRAM (MAY – JUNE, 1981) (ppb)
PAGE THREE

	East Gate Road Residences		Schoolhouse Lane Residences			
	Jones	Dilliot	Hoffman	Ram	Perry	Knutsen
Chloromethane	–	–	–	–	–	–
Bromomethane	–	–	–	–	–	–
Dichlorofluoromethane	–	–	–	–	–	–
Vinyl Chloride	–	–	–	–	–	–
Chloroethane	–	–	–	–	–	–
Methylene Chloride	–	–	–	–	–	–
Trichlorofluoromethane	–	–	–	–	–	–
1,1-Dichloroethylene	–	–	–	–	–	–
1,1-Dichloroethane	–	–	–	–	–	–
t-1,2-Dichloroethylene	–	–	–	–	–	–
Chloroform	<1.0	–	–	57.3	14.0	18.5
1,2-Dichloroethane	–	–	–	–	–	–
1,1,1-Trichloroethane	<1.0	–	–	–	–	–
t-Butylmethyl Ether		–	–	–	–	–
Carbon Tetrachloride	–	–	–	–	–	–
Bromodichloromethane	–	–	–	–	–	–
1,2-Dichloropropane	–	–	–	–	–	–
t-1,3-Dichloropropene	–	–	–	–	–	–
Trichloroethylene (TCE)	–	–	<1.0	1.7	5.8	1.5
Dibromochloromethane	–	–	–	–	–	–
Benzene	–	–	1.1	–	–	–
Diisopropyl Ether	–	–	–	–	–	–
1,1,2-Trichloroethane	–	–	–	–	–	–
c-1,3-Dichloropropene	–	–	–	–	–	–
2-Chloroethylvinyl Ether	–	–	–	–	–	–
Bromoform	–	–	–	–	–	–
1,1,2,2-Tetrachloroethane	–	–	–	–	–	–
Tetrachloroethylene (PCE)	<1.0	–	5.9	3.9	–	<1.0
Toluene	<1.0	–	4.2	–	–	<1.0
Chlorobenzene	–	–	–	–	–	–
Ethylbenzene	–	–	–	–	–	–
Heptane	–	–	–	–	–	–
Total Organics*	<19	<10	<67.2	62.9	19.8	<38.0

*Includes concentrations of unknown organic substances.

TABLE 4-4
ORGANIC WELL CONTAMINANTS FOUND IN H.A.L.T. PROGRAM (MAY - JUNE, 1981) (ppb)
PAGE FOUR

	State Park Road Residences			
	Murphy	Suhl	Ruff	Stefani
Chloromethane	-	-	-	-
Bromomethane	-	-	-	-
Dichlorofluoromethane	-	-	-	-
Vinyl Chloride	-	-	-	-
Chloroethane	-	-	-	-
Methylene Chloride	-	-	-	-
Trichlorofluoromethane	-	-	-	-
1,1-Dichloroethylene	-	-	-	-
1,1-Dichloroethane	-	-	-	-
t-1,2-Dichloroethylene	-	-	-	-
Chloroform	-	-	-	7.6
1,2-Dichloroethane	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-
t-Butylmethyl Ether	-	-	-	-
Carbon Tetrachloride	-	-	-	-
Bromodichloromethane	-	-	-	-
1,2-Dichloropropane	-	-	-	-
t-1,3-Dichloropropene	-	-	-	-
Trichloroethylene (TCE)	-	-	-	-
Dibromochloromethane	-	-	-	-
Benzene	-	-	-	-
Diisopropyl Ether	-	-	-	-
1,1,2-Trichloroethane	-	-	-	-
c-1,3-Dichloropropene	-	-	-	-
2-Chloroethylvinyl Ether	-	-	-	-
Bromoform	-	-	-	-
1,1,2,2-Tetrachloroethane	-	-	-	-
Tetrachloroethylene (PCE)	-	2.7	2.4	2.9
Toluene	-	-	-	<1.0
Chlorobenzene	-	-	-	-
Ethylbenzene	-	-	-	-
Heptane	-	-	-	-
Total Organics*	<5	<7.7	2.4	<21.5

*Includes concentrations of unknown organic substances.

TABLE 4-5

URWA/WASHINGTON & CHESTER TOWNSHIPS WELL RESULTS*

	Selenium (ppm)	Lead (ppm)
Center for Early Childhood Education, Parker Road	0.015	
Mr. Sawdust, Parker Road	0.026	0.07
Labash, E. Valley Brook Road	0.038	
Ling, E. Valley Brook Road	0.02	

*Samples received 6/12/81

perimeter of the landfill, partially on site and partially off site. Conductivity anomalies to depths of approximately 15 and 30 meters were noted in two areas: near the southwest and northeast corners of the landfill. These anomalies were interpreted by NJDEP personnel to be likely contaminant plumes. NJDEP suggested that additional EM surveys be conducted.

4.1.4 Surface Water

Periodic sampling of surface waters since 1973 has indicated pollution of the West Branch Trout Brook, the East Branch Trout Brook, and small streams on private property in the area. Various visual signs of contamination have been noted in the past, including discoloration of the water, precipitates in the stream bed, and thick growths of organic matter and sludge deposits (Markewicz, 1973). More recent inspections indicate that signs of contamination are greatly reduced. Strong odors also have been noted coming from Trout Brook.

The monitoring program conducted by the Upper Raritan Watershed Association and the NJDEP in March 1981 provides the most current surface water data. The results of the seven surface water samples are shown in Tables 4-6 and 4-7 for inorganics and organics, respectively. Locations of surface water samples are shown in Figure 4-2. As shown in Table 4-6, surface water samples contained coliform, total dissolved solids, nitrate, hardness, iron, lead, and manganese.

Various levels of 19 known organic compounds and 8 unknown organic compounds were found among the seven samples as shown in Table 4-7. Five of the seven samples had total organic concentrations greater than 100 ppb. Individual organic contaminants present in surface waters at levels above 100 ppb included dichloromethane, carbon tetrachloride, trans-1,2-dichloroethene, nonane, and 1,1-dichloroethane.

TABLE 4-6

SUMMARY OF INORGANICS FOUND IN SURFACE WATERS DURING URWA/DEP SAMPLING PROGRAM AT COMBE FILL SOUTH SITE (MARCH 1981)

(ppm except where otherwise noted)

	URWA S-1	URWA S-2	URWA S-3	URWA S-4	URWA S-5	DEP S-1	DEP S-2
BOD_5	5.1	<1.0	<1.0	1.2	8.3	8.5	92
COD	22	17	25	50	105	46	305
TOC	15	12	8	26	46	NA	NA
Dissolved Oxygen	NA	NA	NA	NA	NA	9.0	4.9
Total Coliform (MPN/100mL)	8	14	0	0	0	79	1600
Fecal Coliform (MPN/100 mL)	0	46	0	0	0	2	22
Fecal Streptococci (MPN/100 mL)	0	0	0	0	0	<2	49
TDS	581	107	221	359	552	NA	NA
Suspended Solids		NA	NA	NA	NA	NA	2054
Total Solids	NA	NA	NA	NA	NA	70	946
Total Kjeldahl N_2 1.05	<0.5	4.2	34.0	7.0	NA	NA	
Nitrite	<0.01	<0.01	<0.01	0.25	1.0	NA	NA
Nitrate	8.9	<0.5	1.9	13.3	37.7	NA	NA
Total Hardness (as $CaCO_3$)	384	45	190	163	232	86	356
Arsenic	<0.01	<0.01	<0.01	0.01	0.02	0.008	0.002
Aluminum	NA	NA	NA	NA	NA	1.418	0.071
Cadmium	<0.01	<0.01	<0.01	0.01	0.01	0.001	0.001
Chloride	106[a]	13.6[a]	13.6[a]	91	109	18	132
Chromium	0.05	<0.01	0.1	<0.02	0.02	0.005	0.016
Copper	NA	NA	NA	NA	NA	0.007	0.016
Cyanide	<0.01	<0.01	<0.01	0.03	0.07	0.005	0.006
Iron	NA	NA	NA	NA	NA	0.952	33.73
Lead	0.02	0.02	0.13	0.03	0.02	0.005	0.006
Manganese	4.98	0.27	0.44	1.2	1.35	NA	NA
Mercury	<0.002	<0.002	<0.002	<0.002	<0.002	0.0005	0.0005
Zinc	NA	NA	NA	NA	NA	0.031	0.107
Phenol	<0.10	<0.10	<0.10	<0.10	<0.10	NA	NA

a - Chlorine

NA - Data Not Available

TABLE 4-7

SUMMARY OF ORGANICS FOUND IN SURFACE WATERS DURING URWA/DEP SAMPLING PROGRAM AT COMBE FILL SOUTH SITE (MARCH 1981) (ppb)

	URWA S-1	URWA S-2	URWA S-3	URWA S-4	URWA S-5	DEP S-1	DEP S-2
Dichloromethane (methylene chloride)	-	280	-	-	-	-	-
Carbon tetrachloride	-	-	-	-	-	128	184
Dibromochloromethane	-	-	-	-	-	-	78
1,1 Dichloroethane	-	160	12	-	11	-	-
1,2 Dichloroethane (ethylene dichloride)	-	-	-	-	-	-	-
Trans 1,2 Dichloroethene	-	-	-	120	21	-	-
Tetrachloroethylene (PCE)	-	-	-	-	-	-	-
Trichloroethylene (TCE)	-	-	-	-	-	-	-
Tetrachlorethene	-	<2	<2	-	-	-	-
1,4 Dichlorobutane	-	-	-	-	-	-	20
Heptane	-	-	-	-	-	18	21
Nonane	-	-	-	-	-	-	252
Xylene (m, p)	-	-	-	-	-	-	19
Xylene (o)	-	-	-	-	-	-	22
Toluene	-	9	-	-	-	-	2
Benzene	-	-	-	11	-	-	7
Chlorobenzene	-	-	-	-	-	-	-
Ethyl benzene	-	-	-	-	-	-	-
Propyl benzene	-	-	-	-	-	-	11
1,4 Dichlorobenzene	-	-	-	-	-	9	-
Naphthalene	-	10	-	-	-	-	-
Diethyl phthalate	-	54	-	-	-	-	-
Bis (2-ethyl hexyl) phthalate	-	-	-	-	90	-	-
Endosulfan (alpha)	1	-	-	-	-	-	-
Unknowns (2)	-	200	10-20	-	-	-	-
Unknowns (6)	-	10-20	-	-	-	-	-
Total Organic Chemicals	0	1005	54	131	122	155	616

Some inconsistencies appear in the data. One sample (URWA S-2) from a seep discharging to the West Branch Trout Brook evidenced a concentration of total organics of 1005 ppb. Another sample (DEP S-1), however, taken at the same location, showed an organic concentration of 155 ppb. Twelve organics were detected in sample URWA S-2, while three organics were found in sample DEP S-1. Similarly, a total concentration of 616 ppb was found in sample DEP S-2 at the head of the East Branch Trout Brook. Ten organic compounds were identified. A second sample at the same location, URWA S-5, evidenced a total concentration of 122 ppb from 3 organic constituent sources. Inconsistencies in the data may have resulted from samples being collected at different times and by different organizations. Sample collection and analytical procedures may also have varied between sampling periods.

Levels of radioactivity in the surface water were generally higher than those of the control well for both alpha and beta particles. Readings which were the most elevated above the control well sample were found on the West Branch Trout Brook on property adjacent to the site for both gross alpha and beta particles, and at the head of East Branch Trout Brook for gross beta particles. More information is needed about the isotopes in the water, normal background levels of radioactivity, and the naturally occurring isotopes in the area to further quantify and evaluate any public health threat created by radioactivity.

4.1.5 Biota

The older landfill areas are covered with vegetation. Vegetative cover on the more recent landfill areas is variable. Grass and scrub brush cover the northern and eastern site slopes, but the southern and western slopes are unvegetated. This lack of vegetation may be due to the stony quality of the soil used for cover material as seen during the NUS site reconnaissance.

Previous reports have indicated that water quality in Trout Brook has been adversely affected by the Combe Fill South Site and that the fish population has also been affected (Markewicz, 1973). No distressed vegetation was noted adjacent to the brook during the NUS site visit in April 1983.

4.2 Adequacy of Existing Data Base

The data currently available indicate that groundwater and surface water contain hazardous contaminants in the area of the Combe Fill South Landfill. The extent of air and soil contamination has not yet been determined. Additional field monitoring programs are needed to determine the extent of contamination to all aspects of the environment and to confirm existing data. Areas of uncertainty include the location of historic sampling points and the level of quality assurance applied to historic data. Without clarification of these issues, data from previous site work are not adequate for further planning.

4.2.1 Air

The only air monitoring data available for the site are that provided by the FIT Region II Office using both OVM-FID and OVM-PID surveys, and periodic OVM-FID readings taken by NUS personnel during a site reconnaissance in preparation of this RAMP. While the results of the FIT survey suggest that organic vapors occur at the site and that unconfined releases of methane gas are possibly present, additional air monitoring surveys would be required to fully evaluate site conditions.

Additional air monitoring data are required to develop a complete health and safety plan for onsite personnel, to evaluate the potential hazards to the public, to determine the presence of explosive gas concentrations, particularly during drilling operations, and to locate concentrations of methane gas releases for design of a gas venting system. Air monitoring samples would be taken in areas identified as containing organic air contaminants during a site reconnaissance. Chemical analyses of the samples should reveal the contaminants present and their concentrations.

4.2.2 Soil

No soil analyses were available in the files. It is recommended that soil/sediment samples be taken from streams and leachate seeps near the site where removal of contaminated soil/sediment may be necessary. In addition, soil samples may be required to verify the existence of any buried wastes in the fields adjacent to the site. Geophysical surveys may be used to identify possible locations of buried drums and to place any borings or test pits as required in future investigations to evaluate soil contamination.

4.2.3 Groundwater

Groundwater samples of residential wells and those on landfill property indicate contamination of both shallow and deep-water wells. The most comprehensive analyses include the quarterly monitoring analyses at the site, the H.A.L.T. analysis, and the URWA/DEP monitoring program.

While the quarterly monitoring analyses by the landfill operator were regular and covered a period of several years, they do not include testing for organic contaminants. The H.A.L.T. monitoring program (May-June 1981) provided extensive residential well analyses but only for organic compounds. The URWA/DEP program (March 1981) monitored both organics and inorganics but only used 2 shallow and 2 deep wells. No evaluation of data quality is possible as quality assurance information is not available. The method of installation of the shallow wells used in the URWA/DEP program limits their use for further determination of groundwater quality and flow directions.

Essentially no data exist on groundwater levels in the site area from which flow directions can be determined. Only a few groundwater level readings were available from test pits installed by Elam and Popoff in 1971 during the landfill site design.

A more comprehensive and current monitoring program is needed to define and update the extent of groundwater contamination and the direction of flow.

4.2.4 Surface Water

Surface waters sampled during the URWA/DEP program in 1981 at seven locations provide the most current and complete data. Both organic and inorganic analyses were completed; however, the lack of any data regarding quality assurance or sampling procedures limits the usefulness of these data.

Reports dating from 1973 describe the waters of Trout and Tanners Brooks as being contaminated based on visual observation. It should be determined whether contamination exists downstream in the Lamington River, and whether the contamination noted is a result of surface runoff and/or groundwater discharge. No analyses of the seeps which discharge to Trout Brook (and also to the groundwater) were found in the literature.

Additional sampling of East and West Branches of Trout Brook, Tanners Brook, and the Lamington River should be completed under quality assured procedures. Samples of the seeps and intermittent streams which discharge from the landfills should also be analyzed and compared to results of the surface streams noted above. Such data are necessary for the finalization of remedial action plans.

4.2.5 Biota

The information on biota is limited and mostly exists in the form of observations rather than formal studies. The effect of contamination on downstream aquatic communities is not known. Further quantitative work to assess this situation could be correlated with stream quality analytical data.

5.0 PUBLIC HEALTH CONCERNS

5.1 Hazardous Substances

The Combe Fill South Site is a 60 to 100 acre landfill located in Morris County, New Jersey. The site layout, including new and old areas of disposal, was shown in Figure 2-2. Wastes disposed of at the Combe Fill South Site include household and industrial wastes, dead animals, sewage sludge, septic tank wastes, chemicals, and waste oils (Kaplan, 1982). Individual trenches measuring 70 feet wide and several hundred feet long, were excavated into the existing soils and often into the highly fractured portion of the underlying bedrock. The fill was then covered with crushed bedrock and soil. It is not known in what form the wastes were buried. A few drums were seen at the surface along the site perimeter during the NUS inspection in April 1983. The specific areas of waste disposal have not been identified.

Various organics and inorganics were found in groundwater and surface water samples taken at or nearby the site. A summary of the substances found and their concentrations is provided in Section 4, Environmental Concentrations. No records or manifests were found regarding the types or quantities of hazardous wastes disposed of at the site. Only through an evaluation of groundwater and surface water analyses can the degree of contamination be determined.

Of the substances recorded in samples taken at or near the site, seven are listed as known carcinogens by the USEPA. Carcinogenic substances found at the Combe Fill South Site include arsenic, benzene, carbon tetrachloride, chloroform, dichloromethane, tetrachloroethylene, and trichloroethylene.

5.2 Air Pollution

Air monitoring was performed by NUS during the RAMP site reconnaissance using an Organic Vapor Analyzer (OVA). Readings of 5-10 ppm were obtained on the site, except for an elevated reading of 40-50 ppm near the abandoned storage building. It is not known what specific organics vapors were measured. Since the site was operated as a municipal landfill, it can be expected that methane was among those vapors measured.

A subsequent survey by the Region II FIT Office measured air contamination with both OVA and HNU instruments. The OVA, which detects methane, obtained readings in excess of 100 ppm at some locations. The HNU, which does not detect methane, obtained average readings of 2-3 ppm. Although no specific air contaminants were determined, the disparity in readings between the two instruments suggests that high measurements of organic vapors on site may be due primarily to emissions of methane gas.

Noxious odors emanating from the landfill are a general nuisance to the public. Local residents have often complained of foul odors coming from the landfill. Strong odors were prevalent during the NUS site reconnaissance which occurred approximately two years after site closure. The lack of both appropriate cover soil on the new landfill areas and a gas collection/venting system promotes continued escape of noxious odors.

The threat to the public health from air contamination cannot be fully evaluated until air samples have been analyzed for specific contaminants. Onsite remedial investigation personnel would be subject to the most severe exposure. Natural dispersion in the air and the distance of residences from the site should mitigate the effects on nearby residents. If onsite air contamination is confirmed, off-site monitoring may be necessary to quantify the extent to which air contamination may affect the general public.

5.3 <u>Soil Contamination</u>

Although no soil analyses were performed, NUS personnel noted leachate seeps throughout the landfill area. There were two or three rust-colored seeps on the old portions of the landfill, which were covered prior to 1972, and many seep areas from the new landfill. These seeps are concentrated along the western and southern borders of the new landfill area.

It is expected that the wastes contained in these seeps have or will penetrate and contaminate the cover soils on the site as well as offsite soils in established flow paths. Sampling and analysis of surface soils should be performed to determine if they are contaminated and hazardous. Inadvertent ingestion and dermal absorption of contaminants may result from direct contact with contaminated soils. Warning signs should be placed to discourage site access.

No evidence was found to suggest that bulk wastes were disposed of on surface soils at or near the site. Wastes may have been disposed of in the fields adjacent to the site. Soil contamination in these areas should be investigated. Based on existing information, the threat to the public from soil contamination appears minimal.

5.4 Groundwater Contamination

According to the information presented from the H.A.L.T. program in June 1981, thirty-six of the ninety residential wells in the Combe Fill South area showed some organic contamination at levels in excess of 1 ppb. Results of the analyses in the H.A.L.T. program were shown in Table 4-4. Higher levels of contamination were found in samples from residences along Parker Road, East Valley Brook Road, Schoolhouse Lane, East Gate Road and State Park Road. Wells beyond these areas showed generally lower levels of contamination.

Eleven (11) known and twenty-four (24) unknown organics were found in the residential well samples. Tetrachloroethylene (PCE) and chloroform were the most common. Both substances have been identified as potential carcinogens by the EPA and were measured at levels which may constitute a risk from ingestion of the water.

The NJDEP Bureau of Potable Waters has determined that it would recommend discontinuing use of single residential water wells with a total organic concentration of over 100 ppb for drinking water purposes. Two wells out of ninety tested during the H.A.L.T. program exceeded or approached this limit. The Price well on Parker Road evidenced a concentration of 187 ppb, all trichlorofluoromethane. The Whitehead well, also on Parker Road, had a concentration of an unknown organic at approximately 100 ppb. Total organic contaminant levels of other wells were significantly less.

Samples taken in shallow and deep wells from the URWA/DEP sampling and analysis program at the Combe Fill South Site in the Spring of 1981 indicate that there may be more significant levels of groundwater contamination present at the landfill than indicated by residential well results. Thus the potential may exist for more significant levels of contamination to reach residential wells with time. Deep well samples at the site showed total organic concentrations in excess of 100 ppb. A total organic concentration of 762 ppb was found in deep well DW-4 near the northern property line. A total organic concentration of 150 ppb was found in deep well DW-5 to the south along the East Branch Trout Brook. Shallow well samples showed concentrations of less than 100 ppb. Significant contaminants found in groundwater samples from the URWA/DEP program include heptane (256 ppb), carbon tetrachloride (338 ppb), toluene (13 ppb), 1,2 dichloroethane (22 ppb), trichloroethylene (46 ppb), tetrachloroethylene (100 ppb), and ethyl benzene (10 ppb). All of these except toluene and heptane have been recognized by the USEPA as known carcinogens. Toluene and heptane can be associated with various physiological side effects in humans.

Due to the lack of recent data and the potential for continued migration of contaminants off site, a follow-up monitoring program should be implemented to determine whether any residential wells in the area are presently unsuitable for drinking purposes.

5.5 Surface Water Contamination

The waters of Trout Brook and Tanners Brook were noted as being contaminated based on visual observation during previous site inspections. This contamination included the reddish tint typical of iron concentrations, and thick moss and vegetative growths. Leachate from the Combe Fill South Landfill was observed discharging to the West Branch Trout Brook during a site reconnaissance by NUS personnel in April 1983. Monitoring done during the URWA/DEP program and by the Chester Township Board of Health in 1981 found levels of lead, coliform, and nitrates in the surface water samples. In addition, the organic analysis showed five of the seven surface water sampling locations as having total organic concentrations in excess of 100 ppb.

Trout Brook flows south to join the Lamington River at Hacklebarney State Park. It is possible that contamination could migrate further from the site via surface waters. While the volatile organics may dissipate with the flow, the metals tend to bioaccumulate.

The Lamington River is used for fishing at Hacklebarney State Park. However, the threat to aquatic life and public health may be minimized due to the effect of dilution. Surface water and sediment samples should be analyzed at the Lamington River to determine if migration of contaminants has occurred.

5.6 Fire and Explosion

No record exists of any explosive substances being deposited at the site. Methane gas may be generated through the anaerobic decomposition of municipal wastes. Although this is a possibility due to the nature of the site, the potential for fire and explosion is minimal. The organic contaminant readings are well below explosive methane levels and are expected to remain that way due to normal dilution and dispersion of any gases or vapors.

5.7 General Risk Assessment

The risks to public health through soil and air contamination are unknown, but appear to be minimal. Air contamination would most directly affect onsite investigative personnel. The site can be easily accessed by the public and should be posted to discourage access. Surface water contamination of Trout Brook, Tanners Brook, and the Lamington River may threaten wildlife in the area and any humans exposed to contact with the water through recreation. Contaminant levels are generally low, however, and significant exposure is not likely.

The greatest threat to the public is through consumption of contaminated groundwater. Residential wells in the area contain organics and inorganics, some of which are carcinogenic and toxic. It is recommended that further sampling be done in the area to quantify the extent and amount of contamination in groundwater aquifers.

6.0 HEALTH AND SAFETY PROCEDURES

6.1 Personal Health and Safety Protection

Contaminants have been measured in the air on and around the Combe Fill South Site, in surface waters and groundwater. Personal protection is required to protect site investigators from exposure by these pathways. A lack of knowledge about specific contaminants and their concentrations in the air is the most serious data need. Until air samples can be taken and analyzed, supplied-air respiratory protection is needed. Based on the time since closure of the fill, the amount of earth used, and the potential for methane production, the elevated OVA readings taken at the site may be indicative of methane being generated and not emission of other toxic chemicals. Safe operations, however, dictate the need to proceed cautiously until data are available. Previous investigations were conducted at Level D health and safety protection.

Dermal protection is required for sampling of soils and waters. Coveralls, boots, and gloves will provide adequate protection from possible dermal exposures. Soil contamination has not been adequately determined and a high level of protection is needed until data are available.

6.2 Health and Safety Monitoring

Monitoring of the site for air and soil contamination is needed to characterize site contamination and determine routes of exposure. Air contaminants should be sampled at several on and offsite locations, with the samples analyzed for organics and particulates (dust). Particulates may be analyzed for inorganics and chlorinated organics.

Likewise, samples from the stream beds and onsite and offsite soils should be taken and analyzed for organic and inorganic pollutants. Substances and their concentrations found can be evaluated for the potential harm to site investigators, the general public, and the environment. Groundwater monitoring is necessary to evaluate the quality of residential water supplies.

Previous health and safety monitoring has included air scans with OVA and HNU instruments, surface water analyses, and groundwater analyses.

7.0 REMEDIAL PLANNING ACTIVITIES

7.1 Objectives and Criteria

Remedial clean-up activities will be conducted at Combe Fill South to reduce or eliminate the impact of wastes disposed at the site on the public health and the environment. Remedial field investigation activities have been outlined to be implemented at the site to identify the contaminant hazards present at, or resulting from, the site. These remedial investigation activities are more fully outlined in Appendix B. Based on available data, preliminary remedial measures are proposed for implementation at the site to contain and control waste migration and to mitigate adverse effects to the public health or environment. The list of potential remedial measures will be evaluated and revised as data from the field investigations suggest.

Both surface water and probably groundwater contamination have resulted from past operating practices and conditions at the Combe Fill South Landfill. Lack of appropriate cover promotes high surface infiltration and the resulting uncontrolled discharge of leachate to local surface waters. No current facilities exist for the collection and treatment of leachate. The lack of appropriate cover also contributes to random discharges of methane gas and other organic vapors. Access to the site is unrestricted to entrants on foot. Unauthorized entrants may be exposed to harmful effects from organic vapors or direct contact with contaminated seeps.

Highly fractured bedrock underlies the site area. Weathered rock, the size of boulders, and stony soil overlies the bedrock. The trench and cover method of past landfill operations has included the excavation of weathered rock to bedrock. This practice of placing waste material in direct contact with fractured bedrock without placing an impermeable liner allowed for the migration of leachate to the groundwater.

Analyses of groundwater wells at or near the site and of residential wells in the site vicinity have shown signs of contamination. Insufficient data exists concerning the types of waste disposed of at the site, groundwater flow directions, and the degree of contamination of surface and groundwaters. This lack of data complicates the determination of environmental and public health threats resulting from the site. Additional data are needed to evaluate pathways of contaminant releases from the site and to evaluate remedial control measures at the site.

The lead agency will select the most technically sound remedial measure(s) to be implemented at the site. Remedial measure design and implementation, as well as post-closure maintenance and monitoring, will follow.

7.2 Identification of Remedial Measures

Potential remedial measures for a site are identified based on site-specific conditions and the extent and seriousness of the existing or potential health threat posed by the materials disposed of at the site. Remedial activities may be identified as:

- Initial remedial measures (IRMs): measures determined to be feasible and necessary to limit exposure to a significant environmental threat.

- Long-term remedial responses: detailed investigations and studies used to evaluate and implement source control and off-site remedial measures.

IRMs may be appropriate when straightforward solutions are available for relatively simple problems. They may also be required to limit either actual or potential exposure to a significant health or environmental problem. Factors to be considered in determining whether initial remedial measures are warranted include: the potential for human contact with wastes, amount and form of the hazardous substances, hazardous properties of the waste, fire and explosion threat, and others.

Long-term remedial measures, which include source control and offsite measures, may be appropriate if substantial concentrations of hazardous substances remain at or near the area where they were originally located, or if the substances are inadequately contained from migration into the environment. Examples of source control measures include grout curtains, leachate collection and treatment, and excavation and offsite disposal of contaminated substances. Offsite remedial measures may be enacted to minimize and mitigate the threat to the environment of hazardous substance migration. Examples include providing permanent drinking water supplies, controlling a contaminated aquifer, and relocating affected populations.

7.2.1 Initial Remedial Measures

Initial remedial measures (IRMs) are implemented to alleviate the threat created by a significant environmental hazard. One IRM has been identified for the Combe Fill South Site:

- Posting of signs which warn of the potentially hazardous nature of materials found on site.

At present, the landfill site is easily accessible on foot. The nature of seeps and vapors emanating from the site have not been adequately determined. The posting of signs is recommended to limit access to the site by unauthorized entrants and prevent contact with these possible sources of contamination. The design and implementation of the proposed IRM are described in Appendix B.

7.2.2 Source Control Remedial Measures

Source control measures are appropriate for treatment of hazardous substances which remain at or near the original disposal area. Based on review of existing data as presented in Sections 2.0 through 4.0, a preliminary list of source control remedial measures has been identified to mitigate onsite contamination. These measures include:

- Capping of the waste area
- Surface regrading, revegetation, and drainage control
- Contaminated soil and waste removal

- Groundwater collection and treatment
- Leachate/surface water collection and treatment
- Gas venting and monitoring
- Installation of impermeable groundwater barriers

Visible inspection of the condition of existing soil cover and continued references in field inspections to leachate discharges and noxious odors suggest the need for surface treatment at the landfill. A surface cap of synthetic or natural impermeable materials may be utilized to prevent infiltration of surface runoff into the fill. Leachate discharges to ground and surface waters should be limited by decreasing the contribution provided by infiltration of rainfall and runoff. Surface regrading with soil cover and revegetation will control surface runoff and provide a protective cover for the liner against weather and erosion. Drainage control will include the construction of drainage channels to divert runoff away from the landfill.

Treatment of collected surface runoff or persistent leachate seeps may be utilized instead of or in conjuction with capping of the waste area. Treatment requirements will be determined from water quality analytical data. Discharges will comply with appropriate regulations.

Installation of a gas venting and monitoring system may be incorporated with capping of the landfill. This system will provide for the regulated discharge and/or treatment of methane and other organic vapors, if necessary.

Many residents in the site vicinity use groundwater sources for drinking water supplies. The fractured nature of the bedrock at the site and the past practice of placing waste material in contact with permeable weathered bedrock and directly on bedrock has provided a vehicle for long-term discharge of leachate to the groundwater. The validity of remedial measures which would encapsulate the site and prevent subsurface discharges will be investigated. These measures may include the construction of slurry walls or other vertical barrier walls, and the injection of grouts or slurries, to seal a horizontal layer below the site. The collection and treatment of groundwater may be utilized if specific contaminant plumes can be identified.

Based on the area of the site, the volume of municipal wastes disposed of at the site, and the risks associated with waste removal, removal of large areas of the landfill may be infeasible. This remedial measure has been suggested primarily as an option if chemical waste disposal has been identified in confined locations in the two fields adjacent to the landfill, or if specific waste disposal locations are defined within the landfill.

7.2.3 Off-Site Control Remedial Measures

Off-site control measures are to be implemented when the contaminants have migrated from the original disposal area. Additional data are required to determine the actual extent to which off-site contamination has resulted from the Combe Fill South Landfill. Results of chemical water quality analyses for residential water supplies indicate that contamination of the aquifer has occurred. If the site is found to have contributed to offsite contamination, remedial measures may include:

- Installation of temporary individual residential water treatment units
- Permanent replacement of contaminated private drinking water supplies
- Groundwater collection and treatment

7.3 Remedial Investigation/Feasibility Study

A remedial investigation (RI) will be conducted at Combe Fill South to characterize the type and extent of soil, groundwater, and surface water contamination and to identify potential remedial measures. A feasibility study (FS) will be designed to evaluate long-term remedial responses which may be implemented for mitigation of hazardous effects.

7.3.1 Remedial Investigation

A remedial field investigation will be conducted at the Combe Fill South Landfill to prepare a complete site assessment. This remedial investigation will provide the basis for the engineering feasibility study. Objectives of the remedial investigation include determining:

- The physical and chemical characteristics of buried wastes
- The location and depth of buried wastes
- The extent of groundwater contamination
- The extent of surface water contamination
- The hydrogeologic properties of the aquifer
- The extent of soil/sediment/air contamination
- The appropriate remedial measures to be investigated

A total of 21 tasks have been identified for the remedial investigation to evaluate the site characteristics. The tasks are fully outlined in Appendix B. The remedial investigation will be conducted in two phases. Phase I, initial activities, help to further define the scope of work and lay the groundwork for the onsite activities. Phase II encompasses the actual field activities. A summary of the remedial investigation is provided below.

<u>Initial Activities</u>

- Work plan preparation
- Health, safety, and general site reconnaissance
- Collection and evaluation of existing data
- Site-specific health and safety plan
- Site-specific quality assurance plan
- Site-specific sampling plan
- Field equipment mobilization
- Subcontractor procurement
- Permits, rights of entry, and authorizations
- Community relations

Site Remedial Investigation Activities

- Topographic Map
- Ground Survey
- Residential Well Sampling and Analyses
- Geophysical Surveys
- Groundwater Investigation
- Test Pits
- Sampling and Analyses
- Data Evaluation
- Objectives and Criteria for Remedial Action
- Proposed Remedial Measures
- Remedial Investigation Report

7.3.2 Feasibility Study

The purpose of the feasibility study is to identify and evaluate long-term remedial measures, select the cost-effective remedial measures to be implemented at the site, and produce a conceptual design of the selected remedial measure(s). The feasibility study will be based on existing site information and information obtained during the remedial investigation. A draft feasibility report will be prepared with several remedial measures. The lead agency will use this report as the basis for selecting the remedial measure(s) to be implemented. A detailed conceptual design will then be prepared for the selected remedial measure(s).

A total of 4 tasks have been identified for completion of the feasibility study. These tasks, which are described in Appendix B, include:

- Treatability study work plan
- Evaluation of remedial measures and preliminary report
- Conceptual design
- Final report

7.4 Future Remedial Activities

Future remedial activities to be conducted for the site include preparation of construction design drawings and specifications, the implementation of the selected remedial measures at the site, and post-closure maintenance and monitoring.

7.4.1 Remedial Measure Design

Design of the selected remedial measure will include the development of detailed construction plans and specifications. The design will be based on the findings of the remedial investigation and the feasibility study.

The design will include detailed drawings and specifications. The remedial investigation reports will be companion documents to the design. These reports will contain site information needed for construction such as test boring logs, borehole testing data, groundwater conditions, soil, waste, and rock sample descriptions, and the results of analyses.

The design plan will include the following:

- Site topographic map with ground control data
- Detailed drawings of selected remedial action
- Typical geologic and design cross sections
- Typical design details
- Design report with supporting calculations
- Erosion and sedimentation control plan
- Construction health and safety plan
- Cost estimates
- Schedules
- Specifications
- Permit requirements

7.4.2 Remedial Measure Implementation

The remedial measure design will be used as the basis for implementation of remediation activities at the site. The lead agency will review the design and select a contractor through the government procurement process. Once construction is started, the lead agency will assume or contract for construction inspection and contract administration.

7.4.3 Post-Closure Maintenance and Monitoring

Maintenance and monitoring will be conducted to determine the long-term effectiveness of the remedial measures implemented at the site.

Maintenance procedures will depend on the specific remedial measures implemented at the site. Maintenance might involve regular inspection of the monitoring wells and gas venting system, plus any remedial earthwork.

Monitoring will consist of collection and analysis of samples from monitoring wells, residential wells, and the adjacent streams. The frequency and duration of sample collection and the parameters to be analyzed for will be based on results of the remedial investigation and the monitoring program itself as it progresses. The monitoring program will initially be recommended for 10 years and should be reviewed on a regular basis.

7.5 Master Site Schedule

The schedule for the implementation of all remedial activities recommended for the Combe Fill South Landfill Site is shown in Figure 7-1.

This schedule begins following lead agency approval of this RAMP and work authorization from the lead agency to an approved contractor. Lead agency reviews are included where appropriate.

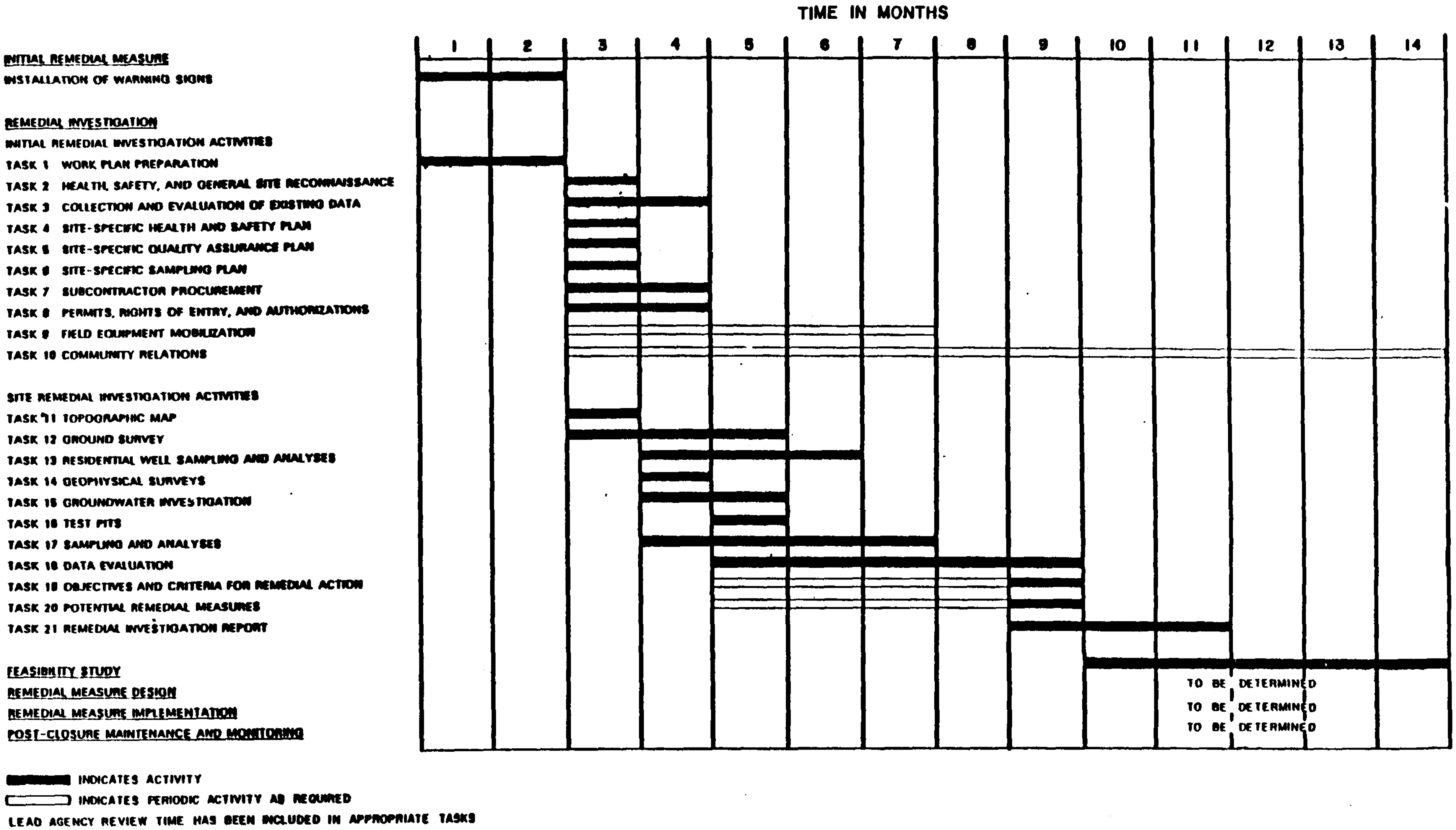


FIGURE 7-1

NUS CORPORATION

REMEDIAL ACTION SCHEDULE

COMBE FILL SOUTH SITE, WASHINGTON & CHESTER TOWNSHIPS, NJ

It is emphasized that the schedule in Figure 7-1 is only a preliminary planning schedule and it should only be used for general planning purposes.

7.6 Cost Summary

The costs for the Initial Remedial Measures (IRMs), the remedial investigation, and the feasibility study are shown in Table 7-1. Preliminary remedial measure design and implementation costs and post-closure maintenance and monitoring costs will be prepared during the engineering feasibility study.

The estimates presented in this section were prepared using unit costs. Lump sum estimates were used when necessary. The actual cost of any remedial measure can vary from the estimates provided here due to factors such as weather and specific site conditions, or other intangibles.

The EPA Contract Laboratory Program (CLP) will be used for the analysis of hazardous wastes, surface water, groundwater, and soil. If special testing or quick turnaround of analytical results is required, non-CLP laboratories might be utilized. Non-CLP laboratories will also be used for treatability studies, where possible.

All of the costs in Table 7-1 assume a minimal amount of personal health and safety protection (Level C & D) during all on-site activities. If it is found that more extensive protection measures are required, costs will increase significantly.

A more detailed cost breakdown of the proposed remedial measures is included in Appendix C.

TABLE 7-1

COMBE FILL SOUTH
WASHINGTON AND CHESTER TOWNSHIP, NEW JERSEY
PLANNING COST ESTIMATES FOR REMEDIAL ACTIONS

(JANUARY 1983 DOLLARS)

A.	Initial Remedial Measures			
	1.	IRM Install Warning Signs		
		a. Total IRM (excluding CLP)	$	13,000
		b. CLP Lab Analysis		0
B.	Remedial Investigation (RI)			
	1.	Total RI (excluding CLP)	$	429,000
	2.	CLP Lab Analysis	$	125,000
C.	Feasibility Study (FS)			
	1.	Total FS (excluding CLP)	$	74,000
	2.	CLP Lab Analysis		0
D.	Remedial Measure Design			*
E.	Remedial Measure Implementation			*
F.	Annual Maintenance and Monitoring			*

*These costs will be developed in the Feasibility Study.

8.0 COMMUNITY RELATIONS

A draft Community Relations Plan (CRP) for the Combe Fill South Site has been submitted to EPA Region II as a separate work assignment. Preparation of the CRP included a review of project files from the EPA, the State, local governments, and citizen groups. Telephone interviews with state and local officials were also conducted. The CRP was prepared to relate the concerns of the community to the project. At the Combe Fill South Site, these concerns included quality of the private drinking water supplies, degradation of surface waters and downstream recreational areas, and decreasing property values.

APPENDIX A

SITE CHRONOLOGY
COMBE FILL SOUTH SITE
CHESTER AND WASHINGTON TOWNSHIPS
MORRIS COUNTY, NEW JERSEY

Date	Event
1970 - 1971	Landfill operated by Filiberto Sanitation, Incorporated.
1972	Fish kill in Trout Brook prompts Division of Fish and Game to request geologic investigation.
December 12, 1972	"Certificate of Registration" issued to Chester Hills Incorporated for sanitary landfill operation on Parker Road in Chester Township.
February, 1973	Analyses by Washington Township completed for samples of 2 springs on the Tingue property.
May 19, 1973	Investigation of Trout Brook headwaters by New Jersey Department of Environmental Protection.
June, 1973	Site inspection by NJDEP of Trout Brook and Tingue well. High bacterial counts were found in Trout Brook.
July, 1973	Chester Hills, Incorporated, installs leachate collection and recirculation system.

November 15, 1973	Water samples taken from Trout Brook by NJDEP.
July 26, 1974	New Jersey Department of Health samples tributaries and ponds.
August 6, 1974	NJDEP proposes locations of first four monitoring wells.
1977	After much discussion, Chester Hills installs two observation wells.
September 5, 1978	Combe Fill, Incorporated, submits "Application of Notification of Change in Ownership" to Solid Waste Administration.
September 26, 1979	Combe Fill Corporation cited for exceeding maximum allowable width of operating face, for inadequate daily cover, and for excavation of previously deposited refuse at Combe Fill South Landfill.
May 12, 1980	Chester Township files civil complaint against Combe Fill Corporation seeking to stop construction of a new access road. Judge Reginald Stanton issues restraining order against use of road.
December, 1980	Local citizens discover clearing of trees in preparation for filling in wetland area to west of site.
January 31, 1981	Combe Fill North Landfill closes, increasing truck traffic and aggravating problems at Combe Fill South Landfill.

February 6, 1981 - February 19, 1981	Local citizens, township leaders, and environmental activist groups file protest with NJDEP director because of Combe Fill Corporation's activities in the wetland.
February 23, 1981	Chester and Washington Townships seek injunction against Combe Fill Corporation in Superior Court to prevent company from advancing fill into wetland area. Judge Stanton orders Combe Fill to halt wetland operations for two weeks.
March 8, 1981	Court reverses restraining order and permits clearing of wetland and other preparations but prohibits waste disposal in wetland for 30 days.
March 19, 1981	NJDEP issues an "Order Modifying Registration" requiring the suspension of operations in the wetland until Combe Fill Corporation submits a revised design showing use of clean fill in the wetland, leachate collection systems, impermeable barriers, and additional monitoring wells which would provide for secure disposal.
March 19, 1981	U.S. Environmental Protection Agency issues citation to Combe Fill Corporation for violation of Section 30(a) of the Clean Water Act, orders them to cease wetland activities, and requires them to obtain a Section 404 permit.
March 25, 1981	In a final ruling Judge Stanton orders that:
	1) NJDEP designate areas suitable for fill;

2) Sediment erosion permits under CWA are not applicable;
3) NJDEP appoint an impartial project manager to oversee problems and complaints; and
4) That NJDEP and Combe Fill Corporation decide whether wetland dumping is permissible.

April, 1981	Joint NJDEP-URWA (Upper Raritan Watershed Association) water quality sampling of surface and groundwater at Combe Fill South Landfill finds elevated levels of organics and inorganics.
May 10, 1981	Combe Fill Corporation cited for failure to control littering, for improper grading, and for insufficient thickness of daily cover at Combe Fill South.
May 13, 1981	NJDEP sets forth procedures for delineating wetland.
June 1981	HALT completes volatile organic scan of approximately 90 wells in Chester and Washington townships, finding the most elevated levels on Parker Road and Schoolhouse Lane.
June 8, 1981	Combe Fill Corporation cited for failure to control littering and for inadequate daily cover at Combe Fill South Landfill.
July 17, 1981	NJDEP tests private residential wells on Parker Road and Schoolhouse Lane.
July 28, 1981	Combe Fill Corporation cited for inadequate cover at Combe Fill South.

August 17, 1981	Combe Fill Corporation attorneys announce rate increase hearings with NJPUC scheduled for August 18-21 and September 8-10, 1981.
September 18, 1981	Based on groundwater sampling on and around Combe Fill South Landfill, NJDEP issues a second "Order Modifying Registration" stating that groundwater contamination exists at the landfill and is likely to contaminate local water supplies. NJDEP orders that: 1) Combe Fill Corporation submit revised engineering design including plan for proper closure and groundwater monitoring; 2) Combe Fill South Landfill operation cease acceptance of all waste upon filling to elevations as marked by SWA; 3) Combe Fill Corporation ensure that revised design meets requirements of revised Solid Waste Management Act.
September, 1981	Combe Fill South Landfill ceases acceptance of waste.
October 13, 1981	Combe Fill South cited for failure to apply adequate cover.
December 18, 1981	Combe Fill South cited for failure to limit size of working face, failure to control littering, and failure to apply adequate cover.
May 10, 1982	Combe Fill South cited for failure to control litter and failure to apply final cover.

June 8, 1982	NJDEP Division of Water Resources testing performed on households equipped with water filters.
June 29, 1982	Geologic reconnaissance at Combe Fill South.
August, 1982	Terrain conductivity investigation at Combe Fill South.
August 12, 1982	Mitre Ranking Form submitted by NJDEP to U.S. EPA.
December 22, 1982	Combe Fill Corporation bankruptcy hearing.
March 10, 1983	Leachate samples collected by Chester Township Board of Health.

APPENDIX B

WORK PLAN OUTLINE(S)
COMBE FILL SOUTH SITE
MORRIS COUNTY, NEW JERSEY

INTRODUCTION

Included in Appendix B are work plan outlines and descriptions for one Initial Remedial Measure (IRM) and the remedial investigation and feasibility study for the Combe Fill South Site. The outlines presented herein are preliminary and general in nature. It is possible that modifications to these tasks and/or additional tasks may be identified during the development of more detailed work plans.

Remedial action design, remedial action implementation, and post-closure maintenance and monitoring program work plans will be prepared following the engineering feasibility study.

The following work plan outlines are provided:

- Initial Remedial Measure (IRM)
- Remedial Investigation and Feasibility Studies (RI/FS)

Initial Remedial Measure (IRM)

<u>**IRM1 - Installation of Warning Signs Around Site Perimeter**</u>

Signs, warning of the hazardous nature of substances contained onsite, will be installed. These signs will serve as an additional deterrent to unauthorized access to the Combe Fill South Site. A Remedial Investigation and a Feasibility Study are not required. The contractor will proceed directly to design and implementation.

Task 1 - Determination of Sign Locations

The location of warning signs will be determined during an inspection of the Combe Fill South Site. These locations will be marked in the field and used by the contractor during installation.

Task 2 - Determination of Sign Contents

The size, wording, color, and materials to be used by the sign contractor will be determined.

Task 3 - Sign Construction and Installation

The contractor will manufacture the signs according to specifications and will install them at the approved locations.

Remedial Investigation and Feasibility Study (RI/FS)

Following is the preliminary work plan outline for the Remedial Investigation and Feasibility Study (RI/FS) to be conducted at the Combe Fill South Site. Not provided in this preliminary work plan are Health and Safety, Quality Assurance, and Sampling Plans which will be provided in the detailed work plan to be submitted by the contractor following project authorization by the lead agency.

Sections 1, Work Plan Summary; 2, Background Information; 4, Management Plan; and 5, Costs and Schedule will be developed by the contractor in the detailed work plan. Only outlines for these sections are presented. Preliminary tasks have been outlined for Section 3.0, Technical Approach. Greater detail will be provided by the contractor in the detailed work plan.

1.0 WORK PLAN SUMMARY

1.1 Objective of Remedial Investigation/Feasibility Study

1.2 Scope of Work

1.3 Manpower Estimate and Costs

1.4 Schedule

2.0 BACKGROUND INFORMATION

2.1 Site History and Description

2.2 Nature and Extent of the Problem

2.3 Previous Investigation and Evaluation of Existing Data

2.4 Proposed Response

3.0 TECHNICAL APPROACH

3.1 Introduction

The purpose of the remedial investigation/feasibility study (RI/FS) at the Combe Fill South Site is to characterize the type and extent of soil, groundwater, and surface water contamination and to identify and evaluate long-term remedial responses. The RI/FS has been divided into two major phases:

- Remedial Investigation
- Feasibility Study

The two phases have been subdivided into a total of 25 detailed tasks for the purpose of budget control and scheduling.

3.2 Remedial Investigation

3.2.1 Initial Remedial Investigation Activities

A total of 10 tasks have been identified during the preliminary remedial investigation activities phase (Phase I of the remedial investigation). These activities are required before the tasks in the remedial investigation can be initiated.

Task 1 - Work Plan Preparation

The work plan is a project control document prepared prior to onsite activities in order to establish project scope of work, schedule and budget. The work plan will be prepared for the remedial investigation and feasibility study to define the project organization, task assignments, personnel and resource requirements, project schedule, budget, costs, procurement, interface, and training requirements. Revisions might be required following lead agency review and comment.

Task 2 - Health, Safety, and General Site Reconnaissance

An initial site reconnaissance will be conducted by an investigation team to fully evaluate the existing site conditions. Several objectives have been identified for the site reconnaissance:

- Perform a health and safety reconnaissance
- Collect air samples for laboratory analysis
- Identify physical hazards and features
- Perform geologic and hydrologic field reconnaissance
- Inspect and evaluate the existing monitoring wells
- Evaluate site conditions for location of initial surface water, sediment, and soil sampling points
- Evaluate proposed monitoring well locations.

The investigation team will conduct a reconnaissance and inspection to assess potential health and safety hazards. Air-monitoring will be used to assess the level of protection for site personnel and to evaluate the potential health effects to the nearby residents from off-site migration of air contaminants at the site. An initial air-monitoring scan with an organic vapor monitors will be used to identify "hot spot" areas of significant contamination. Based on the results of the initial scan, air samples for laboratory analysis will be collected at selected onsite and/or perimeter locations to determine the nature of air contaminants. In addition, background air samples and downwind air samples will be collected to evaluate the degree to which air contamination may be migrating off site. Approximately 5 air samples will be collected for chemical analysis. The meteorological data for the site on the sampling day will be obtained.

In addition, water samples will be collected and analyzed for radioactivity. The specific element and the levels of concentration will be determined. Samples will be taken along the West Branch Trout Brook and from a control stream within the same geologic region. Radioactivity testing is recommended based on previous testing during the URWA/DEP program. Higher levels of radioactivity were found along the West Branch Trout Brook than other nearby surface water or groundwater sources. Any indication of radioactivity should be evaluated at the onset of site activities. This includes a radiation scan of the site area, a background scan in an area of bedrock outcrop of the same formation as that at the site, and an area where the bedrock has been disturbed such as that found at the site.

The team will locate physical hazards and features on a preliminary field plan drawing and will document the features photographically. The site, nearby terrain, and downgradient surface water discharge areas will be inspected visually for contamination, including signs of water pollution, vegetation stress, and effects on wildlife.

Topographic and surface conditions, soils, geology, and surface water and groundwater information will also be recorded. Regional geologic patterns (bedrock outcrops) will be observed. Surface water flow rates will be estimated. Evidence of buried wastes, such as surface disturbances, will be noted. Existing monitoring wells will be inspected to determine their usefulness in subsequent monitoring activities. An inspection for possible sampling locations also will be completed.

Much of this information might be available from records not available at this time. However, verification of the data, updating site conditions, and retrieval of additional information will be required.

Task 3 – Collection and Evaluation of Existing Data

It will be necessary to collect and evaluate additional information which was not available for the preparation of this work plan. This information will help fill data gaps. Possible sources of information include:

- State and local agencies dealing with the environment or natural resources
- U.S.G.S. and State Geologic Survey
- Climatological and hydrologic data, including flood plain maps
- Soil Conservation Service soil and agricultural data
- Studies from local colleges or universities
- Local well drilling companies
- Local water company
- Aerial photographic contractors
- Local historical societies

Data obtained from these or other sources will be used to assist in the site investigation.

Task 4 – Site-Specific Health and Safety Plan

A site-specific Health and Safety Plan will be developed based on the available site information, guidelines established in the contractor's Health and Safety Manual, and EPA's Occupational Health and Safety Manual.

The purpose of the plan will be to:

- Provide minimum safety protection requirements and procedures for onsite field crews and subcontractors.
- Ensure adequate training and equipment to perform expected tasks.
- Provide ongoing site monitoring to verify preliminary safety requirements and revise specific protection levels as required.
- Protect the general public and the environment.

Task 5 – Site-Specific Quality Assurance Plan

A site-specific Quality Assurance Plan will be developed based on the available site information and the guidelines established in the contractor's Quality Assurance Manual.

The Quality Assurance Plan will be designed to incorporate the following objectives:

- To maintain the evidentiary value of the data produced
- To ensure the integrity of the results of site investigations, laboratory analyses, and technical reports
- To provide assurance that remedial designs and assessments are properly prepared and reviewed

- To control the activity of subcontractors, consultants and support agencies or organizations to ensure that they maintain the same quality standards applied to the NUS activities.

Task 6 - Site-Specific Sampling Plan

A site-specific sampling plan will be developed. The sampling plan will be integrated with the Quality Assurance Plan and will include procedures for sampling the various media (surface water, groundwater, etc.) both on site and off site.

The sampling plan will outline sampling locations, test parameters, and sampling techniques. Sampling locations will be based on data obtained during the field reconnaissance and from detailed review of existing reference sources. Data from initial samplings, remedial investigation activities, and field measurements will be used to refine the sampling plan at a later date for the location of test pits and monitoring wells to be installed.

Task 7 - Subcontractor Procurement

Competitive bids will be solicited from prequalified firms for each task to be subcontracted. The process of advertising for and evaluating bids will begin upon receipt of EPA authorization. The Contractor will review the bids and select the subcontractor. The EPA Contracting Officer will review and approve the subcontractor selection prior to award of the subcontract.

The following elements of work are under consideration for subcontracting:

- Topographic map and ground surveys
- Borings and monitoring well installation
- Geophysical surveys
- Test pit excavation

Task 8 - Permits, Right of Entry, and Authorizations

Tax records will be examined to determine ownership of the Combe Fill South Landfill and surrounding properties. Any right-of-way or utility easements will also be determined. Permits for remedial investigation activities, installation of proposed monitoring wells, and onsite treatability studies will be identified where necessary.

The need for Right of Entry to the Combe Fill South Site or surrounding properties, or other permits or authorizations, will be identified to EPA by the contractor. Access to affected properties must be obtained by the EPA.

Task 9 - Field Equipment Mobilization

The equipment needed during the remedial investigation will be mobilized by the contractor or subcontractors. The following equipment might be needed at the Combe Fill South Site during the remedial investigation:

- Field office trailer
- Surveying equipment
- Magnetometer
- Sampling tools and equipment
- Health and safety equipment
- Decontamination equipment

Equipment may be stored on site in a secure field office trailer. The placement of the trailer will be specified in the site-specific health and safety plan.

Task 10 - Community Relations

The primary role of the contractor in this program will be one of support for the community relations activities planned and conducted by the EPA. The support activities will fall into two main categories: logistical support for the planning and execution of the activities, and technical support to ensure that all information is accurate and current.

Due to the nature of public involvement, the Community Relations Program will be flexible to accommodate fluctuations in citizen interest.

3.2.2 Site Remedial Investigation Activities

The purpose of the site remedial investigation activities (Phase II of the remedial investigation) is to gather site-specific information concerning the type and extent of contamination at the site so that appropriate remedial measures can be evaluated during the feasibility study.

Task 11 - Topographic Map

Aerial photogrammetry will be used to prepare an accurate base map of the site area. The aerial mapping subcontractor will provide both the map and ground control necessary for map preparation. The map is to be used as a general planning and location map for the remedial investigation and as a conceptual design drawing in the feasibility study.

The site will be flown, in suitable weather and visibility, by the contractor or approved subcontractor. Specific flight parameters such as speed, number of flight lines, photographic exposure interval, and flight altitude will be controlled by the photogrammetrist to provide for a proper and completely finished topographic map.

Any vertical ground survey support, such as locating vertical and horizontal control points, will be provided by the subcontractor. Permanent benchmarks will be placed in the field for later use.

The topographic map will be a scribed, double matte, 3 mil, washoff mylar with reversed image. The map will show the site and adjacent areas and will have a horizontal scale of 1 inch = 200 feet and a contour interval of 5 feet. The map will encompass an area of approximately 800 acres and will include the site area and surrounding residences. A grid coordinate system will be established and will be referenced to the state plane coordinate system, or U.S.G.S. monuments.

In addition, it is recommended that concurrent with preparation of this map, that aerial photography of the site area, approximately 100 acres, be flown at an altitude capable of producing a topographic map to the scale of 1 inch = 50 feet with 2-foot contours. This map may be prepared at a later date for use as a final design drawing.

Task 12 - Ground Survey

Additional ground control survey activities are necessary to supplement the remedial investigation and feasibility study planning activities.

Remedial Investigation Baseline and Grid Survey

A baseline will be established on site for the purpose of providing horizontal control for geophysical surveys as well as for locating soil, sediment, and surface water sampling locations. The final location of the baseline will be determined following an inspection of site conditions. Stakes will be set at 50-foot intervals and will be marked with stations and elevations. A grid system will be surveyed and staked for the magnetometer survey.

Monitoring Well and Test Pit Survey

Following the installation of new monitoring wells and test pits, all wells and test pits will be located horizontally and vertically with respect to the site grid and datum. These elevations and locations are necessary to determine the hydrogeologic conditions beneath the site.

Task 13 - Residential Well Sampling and Analyses

Based on previous samplings by the H.A.L.T. group it is recommended that follow-up sampling be completed on private residential water supply wells near Combe Fill

South to determine the current extent of contamination. Based on review of the H.A.L.T. data it is recommended that residences along Parker Road, East Valley Brook Road, and Schoolhouse Lane be retested. Should these tests indicate that contamination has increased significantly from the 1981 results, additional sampling beyond these locations may be necessary.

It is proposed that 20 homes be included in the residential well sampling program. Costs presented in the remedial investigation represent sampling and analysis at 20 locations. Should review of the data by the lead agency indicate additional sampling is warranted, costs will increase.

Those homes to be sampled will be identified from review of existing monitoring data and from review of geologic data indicating primary groundwater flow paths, for example, fracture trace analysis. Homeowners will be identified from tax maps. The lead agency will notify residents by letter of participation in the monitoring program and provide follow-up contact.

At the time of sampling, additional data will be collected at each residence to evaluate use of individual residential wells in the overall groundwater monitoring program. This data will be collected through an interview with the owner. Additional data to be collected may include but is not limited to:

- well diameter
- type of casing
- depth of well
- driller
- pump capacity
- existence of water treatment units
- type of plumbing
- accessibility to the well

Where possible, water level measurements and depth of well readings will be taken. The well will be purged prior to sampling at the permission of the owner. Samples will be taken from the well system at locations prior to flow through water treatment units where possible.

Residential wells will be evaluated for their potential use as a groundwater flow monitoring point throughout the remedial investigation. Approximately five (5) wells may be identified for such use. Additional water level readings may be required in these wells as well as a drawdown test to determine hydraulic conductivity of the aquifer. Residents will be questioned for their willingness to participate in subsequent groundwater flow monitoring.

Task 14 - Geophysical Surveys

Purpose

The object of geophysical investigations will be two-fold:

- To identify the location of any buried objects in the fields adjacent to the site.
- To identify depths of groundwater inflow into boreholes drilled for monitoring wells..

Geophysical investigations will be conducted in two (2) tasks.

Magnetometer Survey

A magnetometer survey (± 0.1 gamma sensitivity) will be conducted in order to define areas of buried metal. A coarse grid (50-foot centers) will be surveyed over portions of the two fields located at the northeast and southwest corners of the landfill. These fields have been identified by local residents as possible waste disposal areas. During installation of monitoring wells by URWA, a white powdered material was uncovered in one field. Areas for survey will be identified by visual inspection and review of aerial photographs. Any anomalies will be investigated with test pits.

Borehole Logging

The borings should be logged with the following tools:

- SP (spontaneous potential)
- Short and long normal electrical logs
- caliper
- gamma ray

The logs will be run in all new monitoring wells. The logging will be used to identify groundwater levels within the borings.

Task 15 - Groundwater Investigation

Approach

Determining the impact of landfill leachate on the groundwater system and the remedial actions to correct that impact require a thorough understanding of the groundwater flow system beneath the site. The landfill is situated on an upland area where groundwater infiltration tends to migrate along joints and fractures in the granitic bedrock. The direction and effective depth of penetration of the groundwater flow depends on the depth, orientation, and spacing of the fractures. In general, the groundwater flow may occur radially from the site, although flow may occur in a few preferential directions and be concentrated along a few pathways. Therefore, characterization of the groundwater flow system and the impact of the landfill on that system will require:

- Identification of directions and locations of preferential pathways of groundwater flow.

- Estimation of the effective depth of groundwater flow beneath and adjacent to the site.

- Determination of the groundwater quality adjacent to the site.

Identification of Potential Groundwater Pathways

Identification of preferential directions and pathways of groundwater flow will be accomplished by:

- Conducting a fracture trace analysis using the stereographic aerial photographs. U.S.G.S topographic mapping photographs flown prior to surface disturbance by the landfill will be used for the analysis, as well as any EPA aerial photography available.

- Identifying potential preferred directions by studying the relationship between topography and rock jointing, foliation, and faulting, if any occurs.

- Evaluating the water quality data from the residential wells.

- Drilling by air rotary and rock coring methods, conducting borehole geophysics, and constructing monitoring wells to assess the nature of the fractures, groundwater levels, and the hydraulic conductivity of the rock.

- Drilling in two phases, with the second phase contingent upon the findings of the first.

Estimation of the Effective Depth of Groundwater Flow Adjacent to the Site

Assessment of the effective depth of groundwater flow adjacent to the site is important for delineating the potential zone of contamination and for designing possible remedial measures. Since groundwater flow in the rock is through joints and fractures, water-producing fractures will be encountered in the boreholes. The depth to these water-producing zones will be determined in each borehole. Although the depth of the water zones in any one boring will not be representative of the entire site, the composite data from all the borings should produce a reasonable estimate of the effective depth of groundwater flow adjacent to the site. The effective depth will vary at different locations, and the variation will aid in inferring groundwater flow directions. Methods to be used to estimate the effective depth of groundwater flow are:

- Examination of the nature of fracturing and depth of weathering in the rock core from diamond core drilling.

- Delineation of water-producing zones during air rotary drilling.

- Delineation of probable water-producing zones using borehole geophysics, specifically, electrical and spontaneous potential, and caliper logging of the boreholes.

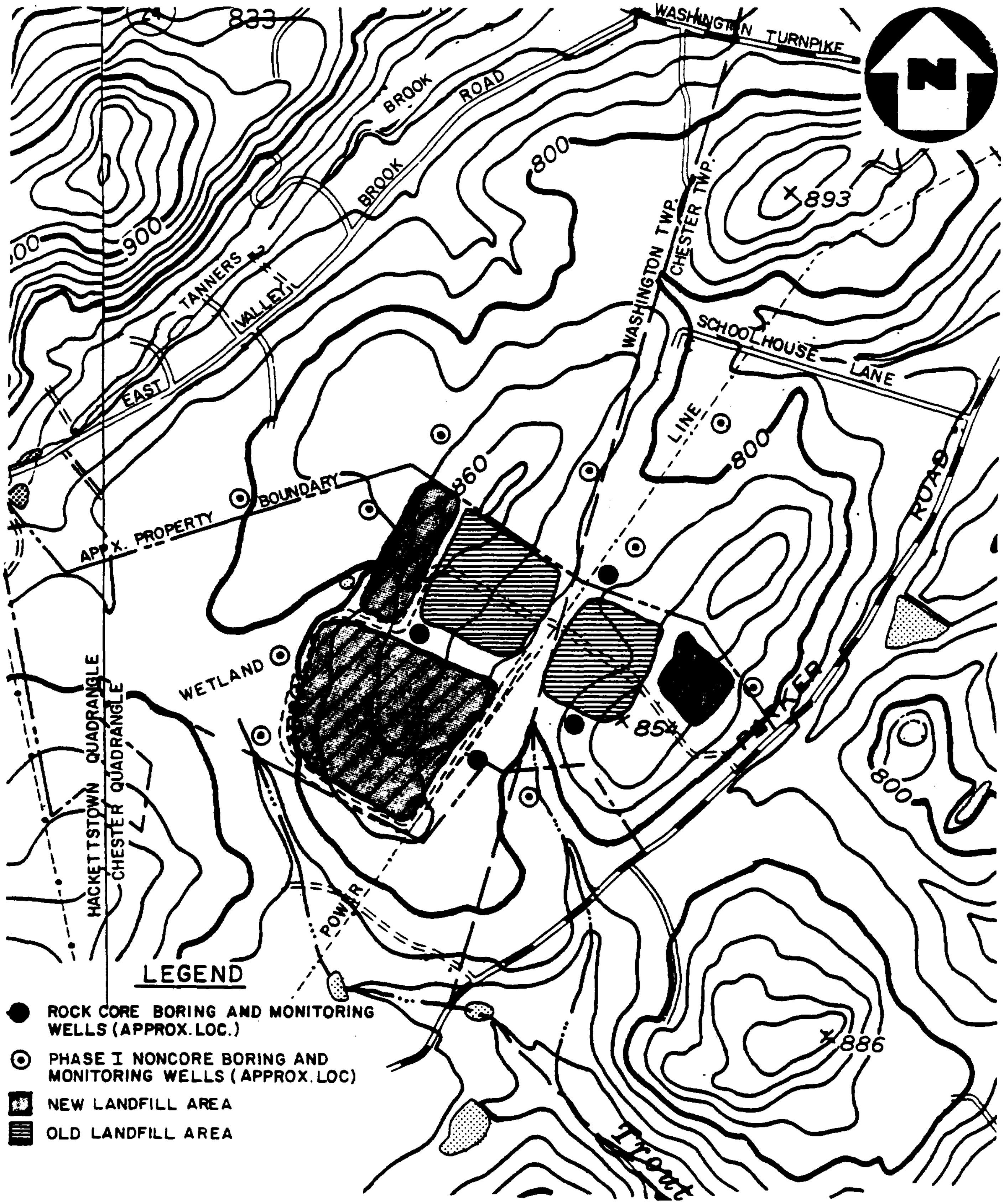
Determination of Groundwater Quality Adjacent to the Site

Groundwater quality data are required to establish the impact of the leachate on the groundwater and the associated risk. Combining the water quality analysis with knowledge of the general groundwater flow paths provides the background for preparing a risk assessment and for planning of remedial actions. Groundwater sampling will be accomplished by sampling residential wells, existing monitoring wells that are properly constructed and documented, and monitoring wells installed as part of this investigation.

Drilling and Location of Monitoring Wells

The drilling program will be conducted in two phases to be more cost-effective. Figure B-1 shows the approximate location of Phase I borings and well installations. The actual locations will be determined by a preliminary assessment of the groundwater flow system using several of the techniques described above. These work items include:

- Fracture trace analysis.
- Studying rock joint and fracture patterns versus topography.
- Evaluating existing water quality data from residential wells.



THIS MAP IS AN ENLARGEMENT OF A PORTION OF THE U.S.G.S. CHESTER, NJ QUADRANGLE (7.5 MINUTE SERIES, 1954, PHOTOREVISED 1981) AND THE HACKETTSTOWN, NJ QUADRANGLE (7.5 MINUTE SERIES, 1953, PHOTOREVISED 1971) CONTOUR INTERVAL 20', FOR BOTH.

301626

FIGURE B-1

PHASE I MONITORING WELLS
COMBE FILL SOUTH SITE,
WASHINGTON & CHESTER TOWNSHIPS, NJ

SCALE: 1" = 1000'

NUS CORPORATION
A Halliburton Company

The first phase of drilling, sampling, and sample analysis will yield the data upon which the second phase of drilling will be based. Phase II will be used to supplement the data from Phase I to refine the evaluation of the nature and extent of groundwater contamination and to analyze potential remedial measures.

Drilling and Monitoring Well Installation

The following is the recommended drilling and monitoring well program for the Remedial Investigation:

- Phase I - Drilling and Monitoring Wells

  Four borings will be drilled at locations adjacent to the site. These locations are estimated to represent different subsurface conditions adjacent to the site. These rock core borings will be used to identify the fracture pattern within the bedrock adjacent to the site, to identify preferential groundwater flow paths from the site and to determine the condition of bedrock adjacent to the site as data for the remedial measure evaluation. The borings have been located in both the hilltop areas and in swales between the hilltops to evaluate fracturing in both topographic locations. These topographic locations most likely correspond with the degree of weathering along fractures in the pinnacled surface of the bedrock below. The borings were located adjacent to the site so that if the use of impermeable groundwater barriers is to be evaluated, the preferential groundwater pathways at the site can be determined. In addition, data collected from the borings would be used to evaluate other potential remedial measures. If subsurface methods, such as grout curtains, would be employed to contain waste migration, the nature and condition of the bedrock adjacent to the site must be evaluated.

  These borings will be drilled into rock using diamond core drilling methods with water as the drilling fluid. Casing will probably have to be drilled into rock in the upper portion of these borings due to the large rock fragments and broken rock zones occuring in the weathered rock zone.

Continous rock cores will be taken using N-series sized rock coring tools. Soil zones will be sampled from the ground surface and in soft zones between rock fragments using a split-barrel sampler and Standard Penetration Techniques. The split-barrel samples will be screened in the field with an organic vapor monitor. Those samples which evidence high reading will be sent to a laboratory for analysis for volatile organics. The rock core borings are estimated to be about 150 feet deep.

Each rock core boring will be utilized as a monitoring well. Geophysical logging (electrical, caliper, spontaneous potential) will be conducted on these boreholes.

Approximately 10 air rotary, cable tool, or pneumatic borings will be drilled at locations established during the preliminary assessments. These wells will be approximately six to eight inches in diameter and will be used to locate water-bearing zones. Well casing will have to be drilled into the unweathered rock to prevent caving in the broken rock zones. Geophysical logging will be performed for each well as described above.

Each of these borings will be established as a monitoring well. Isolation of a water-producing zone may be desirable in some of these wells.

Ten wells at 100 feet depth are assumed.

- Phase II - Drilling and Monitoring Wells

  - Drilling and Monitoring Wells

    The second phase of drilling would be implemented if data from Phase I indicates more information is required. The same depth and construction criterion used for Phase I rotary air, cable tool, or pneumatic borings were assumed. Five additional wells were used for cost estimating purposes.

- Well Development

  All monitoring wells will be developed to permit groundwater to flow easily into the well and provide access to fresh groundwater samples. Removal of the drill cuttings and other fines from the formation in the well will allow for proper groundwater sampling. The water will not be turbid or contain suspended matter, which can easily interfere with chemical analysis. The development process will be accomplished by using surge blocks and a bailer.

Task 16 - Test Pits

Test pit excavations will be used to verify results of the magnetometer survey and to survey the fields located near the site for buried wastes. Test pits installed beyond those necessary for the magnetometer survey will be located by visual inspection or review of historical aerial photographs. Approximately ten (10) test pits will be excavated. Soils will be sampled where indicated by organic vapor scans or visual inspection.

Test pit excavations will be logged and photographed, and the soils and wastes therein shall be collected and sampled. Data from the test pit investigation will be plotted on the site grid map.

Backhoe activities will be carefully monitored for toxic and explosive gases to ensure worker and resident safety. Appropriate safety procedures will be implemented as needed. All test pits will be closed within eight to ten hours of opening, and activities will be restricted to prevent residential exposure.

Task 17 - Sampling and Analyses

The purpose of the sampling and analysis program is to:

- Evaluate the extent of surface water and sediment contamination.

- Evaluate the extent of groundwater contamination.

- Assess the extent of soil contamination and the location of buried wastes in fields adjacent to the site.

- Provide a data base for evaluation of groundwater contaminant flow paths and for evaluation of potential remedial measures.

Surface Water and Sediment Sampling

Several potential sources of surface water and sediment contamination are located near the site. These include streams as well as intermittent leachate seeps discharging from the site. Fifteen sample locations are proposed as follows:

- 2 West Branch Trout Brook (one near wetland)
- 2 East Branch Trout Brook
- 2 Lower Trout Brook
- 2 Tanners Brook
- 1 Lamington River
- 6 Leachate Seeps

Both surface water and sediment samples will be collected at all locations. Actual locations will be chosen using field screening techniques.

Samples will be analyzed for:

- Volatile organic priority pollutants
- Base/neutral extractable priority pollutants
- Pesticide/PCB priority pollutants
- Acid extractable priority pollutants
- Heavy metal priority pollutants
- Total organic halogens (TOH)
- pH
- Oil and grease

Groundwater Sampling

Sampling and analysis of groundwater will be conducted to search for indications of contaminant migration. Groundwater samples will be taken from suitable existing wells and new monitoring wells. Two sampling periods will be included within the scope of this Remedial Investigation.

For the first sample period, the well will be pumped or bailed until the well is thoroughly flushed of standing water. Each well will be pumped or bailed until three (3) well volumes have been removed. The second sample period will be taken approximately 2 to 3 months later to verify the original samples and to obtain additional data. To obtain the second sample, each well will be pumped for a long period of time and then sampled. The pumping time will be determined based on the apparent hydraulic conductivity in the borehole. The purpose of the extended pumping for the second sampling is to extend the radius of influence of the sampling so contamination within the vicinity of the monitoring well is sampled. The follow-up test results will be evaluated to determine the increase or decrease in contaminant levels with pumping. This evaluation may indicate groundwater flow paths and be used to assess groundwater pumping alternatives.

All nineteen (19) new wells and any existing wells (assume 2) which were determined to be useful in the monitoring program will be sampled. Samples will be analyzed for:

- Volatile organic priority pollutants
- Base/neutral extractable priority pollutants
- Pesticide/PCB priority pollutants
- Acid extractable priority pollutants
- Heavy metal priority pollutants
- Total organic halogens (TOH)
- pH
- Total dissolved solids (TDS)

Soil Sampling

Soils within the test pits which provide a positive indication on the organic vapor scan or appear visually to be contaminated will be chemically analyzed. A composite sample will be drawn at all indicated locations. Samples will be obtained by using hand augers while standing at the top of the test pit. No person will be permitted in test pits. Analyses of samples will be used to determine soil contamination resulting from disposal of bulk or containerized wastes. If results are positive, appropriate remedial measures will be evaluated. Approximately twenty (20) samples are estimated to be needed at this time. Samples at leachate seeps from the landfill have been included under Surface Water and Sediment Sampling. Soil samples from the test pits will be analyzed for:

- Volatile organic priority pollutants
- Base/neutral extractable priority pollutants
- Pesticide/PCB priority pollutants
- Acid extractable priority pollutants
- Heavy metal priority pollutants
- Total organic halogens (TOH)
- Oil and grease

In addition, soil samples will be collected from the rock core borings in the Phase I drilling and monitoring well installation program. Samples will be identified by screening the split barrel samples in the field with an organic vapor monitor. The samples will be analyzed for volatile organic priority pollutants. It is assumed that approximately eight (8) samples will be collected for analysis.

Air Sampling

Daily air monitoring will be completed throughout the remedial investigation for health and safety protection. All earth-moving operations will be continuously monitored for volatile organics and explosive gases. Air samples will be analyzed during the initial health and safety reconnaissance to evaluate health and safety criteria and to assess public health impacts.

Task 18 - Data Evaluation

Data gathered during the field investigations will be reviewed throughout the course of the investigation to assess its accuracy, verify chemical analytical results, and refine the scope of the remedial investigation when necessary. Evaluation of data will also provide information on the appropriate remedial measures to be investigated at the site during the Feasibility Study.

Task 19 - Objectives and Criteria for Remedial Action

The selection of objectives for evaluation of remedial measures must be based on public health protection and site-specific conditions. The selection of objectives and criteria will consider:

- Nature and extent of waste migration and type of media contamination (air, water, soil).

- Future site use considerations.

- Local land use and protection of investigative teams and construction crews.

- EPA and NJDEP Hazardous Waste Regulations, including National Contingency Plan, Subpart F.

Specific objectives will be determined after completion of the remedial investigation. However, based on available information, the following preliminary objectives have been established:

- Public Health and Safety Assurance

  This includes protection of local residents, field crews, and future land users from the waste toxicity and physical damage hazards including inhalation, oral and dermal toxicities, and explosion and fire potentials. Both short- and long-term hazards are considered.

- Surface Water Protection Control

  The migration of wastes caused by surface water flow, erosion, and flooding must be controlled.

- Groundwater and Drinking Water Protection

  The degradation of existing and potential groundwater drinking water supplies will be addressed.

- Air Quality Protection

  The offsite migration of air contaminants from the site and the release of contaminants into the air during all phases of remedial action will be addressed.

Criteria for evaluation of remedial measure alternatives must provide a standard of judgment for testing the suitability of the candidate remedial measures. Standard criteria for evaluation will include the following:

- Technical Feasibility

  This will consider the feasibility of implementing and maintaining the remedial measure. Construction and management of the remedial measure will be considered. Past performance of the remedial measures in similar site circumstances will be investigated.

- Social/Legal Feasibility

  This will address the legal status of the site, the liabilities of the owner(s) and waste haulers, public opinion and opposition, and any constraints imposed by public officials or authorities.

- Risk

  This includes the potential for environmental contamination, such as spills or air emissions, in the implementation of the remedial measures, as well as risks to the safety and health of the site investigation teams.

- Effectiveness

  This will address the degree to which the remedial measure will reduce long-term environmental impact including air, surface and groundwater contamination, biological degradation, and impacts upon human health. The reliability of post-closure monitoring systems will be included.

  The ranking of relative effectiveness will depend largely on past performance of similar remedial measures. Best engineering judgment based on thorough knowledge of site conditions will be used where past experience is deficient.

- Costs

  This will include all capital expenditures and annual operating and maintenance costs associated with the remedial measure. Annual cost comparisons for each method will be performed by amortizing capital over a selected time period to determine equivalent annual costs. Present-worth costs will be used.

As with the selection of objectives, the site investigation findings will be used to develop evaluation weighting. Additional criteria are not anticipated; however, each of the criteria can be weighted to reflect the requirements of site-specific conditions. For instance, technical feasibility might carry more weight than risk, and this relative weighting can be reflected in the evaluation process.

Decisions on remedial action objectives and the weighting of evaluation criteria can be made after the site investigations have been completed and evaluated. Review meetings with the lead agency will serve to develop the final objectives and criteria.

Task 20 - Potential Remedial Measures

Appropriate remedial technologies will be identified for the determined site objectives. These technologies will be evaluated singly and in combination to determine how well they meet the established project criteria. One or more appropriate remedial technologies will be grouped together as required to constitute the remedial measure.

The identification process for remedial technologies will take into account the type of media contamination, the site-specific conditions (soils, geology, etc.), public health and safety concerns, and the existing EPA and NJDEP hazardous waste and related regulations.

The remedial measures listed below represent a preliminary list of options based on the existing site information. This list will be reduced or augmented, depending on the results of the site investigations. Potential source control remedial measures include:

- Surface Controls

  Surface controls are those remedial measures designed to reduce surface water infiltration and to control runoff at waste disposal sites. Examples of surface control measures are capping, grading, revegetation, and runoff diversion/collection. Capping of the waste site with impermeable materials may be necessary due to the poor condition of cover soils on portions of the fill. Capping would prevent release of gases and would greatly reduce the degree of infiltration of surface runoff. Decreasing infiltration would reduce the recharge to the groundwater from the site area and reduce leaching of contaminants to the groundwater. Grading, revegetation, and runoff diversion/collection would be used to protect the cap and to divert runoff from the site.

- Contaminated Soil and Waste Removal and Disposal

  Contaminated soil and waste might be removed from the site. Disposal methods will depend on the type and extent of contamination. This option would be applicable to surface soils contaminated by leachate, specific waste disposal areas identified in the fields adjacent to the site, or localized areas of waste disposal identified within the landfill.

- Groundwater Collection and Treatment

  Groundwater may be collected at or adjacent to the site and treated. Pumping wells may be located in the direction of the most significant plumes or along fractures which may provide primary pathways for groundwater flow. Treatment technologies may include air stripping, carbon adsorption, or other methods which would be evaluated during the feasibility study.

- Leachate Collection and Disposal or Treatment

  Leachate might be collected and safely disposed of or treated. Collection methods include vertical cutoff drains, dewatering wells, and horizontal drains. Collection points might be on-site or downgradient. Surface controls such as regrading might be required.

  Leachate collection may be confined to specific areas of the fill, such as the southwestern corner, where it was observed flowing to Trout Brook.

- Gas Venting and Monitoring

  A gas venting and monitoring system may be installed in conjunction with capping of the site to provide for the collection and controlled discharge of methane or organic vapors from the site. A system for teatment of gases may be employed if indicated by the monitoring system.

- Impermeable Groundwater Barriers

  Methods such as installation of grout curtains may be used to create a barrier to groundwater flow. These barriers may be placed near prominent flow paths or in the direction of more significant contamination of residential wells.

Potential offsite remedial measures include:

- Treatment of a Contaminated Aquifer

  Contaminated groundwater might be pumped to the surface and treated, treated in-situ by biological degradation, or treated by a combination of these methods.

- Dredging of Contaminated Sediments

  The presence of gross contamination or environmentally persistent contaminants in the stream sediments might necessitate the dredging and removal of the contaminated sediments. This option might be applicable to sediments along the East and West Branches of Trout Brook.

- Permanent Replacement of Drinking Water Supplies

  If groundwater supplies for drinking water are found to be significantly contaminated, drinking water supplies may need to be permenently replaced, and alternate water supplies provided. Replacement of water supplies may include extension of municipal water supply lines or drilling of deeper groundwater wells.

- Installation of Residential Water Treatment Units

  The installation of treatment units may be applied to individual residences where elevated contaminant levels have been found. Treatment may include carbon adsorption units. Installation of the treatment units would provide a temporary means of mitigating contamination until a more permenent solution has been defined.

This list of remedial technologies will be modified as necessary following site investigations. The final list of selected remedial technologies will be developed in close consultation with the lead agency. Candidate remedial measures will be evaluated as the Remedial Investigation progresses. One or a combination of technologies might be necessary to define the candidate remedial measures for further evaluation. The no-action alternative will also be considered.

Task 21 - Remedial Investigation Report

After completion of the field investigations, all pertinent field and laboratory data will be assembled into a detailed report of the site. The report will include detailed descriptions of the following:

- Objectives of the remedial investigations
- A site description, including environmental setting
- Geologic conditions, including soil and rock type and depth
- Hydrogeologic conditions at and in the immediate vicinity of the site, including depth of the aquifer(s) and the rates and directions of groundwater flow

- Extent of groundwater contamination

- Extent of surface water contamination

- Extent of buried wastes in the fields adjacent to the site

- Supporting data such as boring logs, hydraulic conductivity test data, chemical analyses reports, and monitoring well water level readings

- Conclusions and recommendations of the study, including preliminary objectives and remedial measures to be considered for the feasibility study

Maps, figures, cross-sections, and tables will be prepared to support the text. Photographs will be included, where applicable.

3.3 Feasibility Study

The purpose of the feasibility study is to identify and evaluate appropriate remedial measures and prepare a conceptual design of the selected alternative. The feasibility study will be based on existing site information and information obtained during the remedial investigation. Figure 7-1 does not detail the tasks contained below. They are presented herein for further detail.

Task 22 - Treatability Study Work Plan

After the remedial investigation has been completed and the remedial alternatives have been identified, it may be necessary to conduct pilot or bench-scale treatability studies. This work would include any studies required to evaluate the effectiveness of remedial technologies and to establish engineering criteria necessary for design and implementation.

Because these studies are linked directly to the prior performance of tasks listed above, a separate Work Plan for any proposed Treatability Studies will be submitted to the lead agency for approval. Costs presented for this task include preparation of the Work Plan only.

Task 23 - Evaluation of Remedial Measures and Preliminary Report

Evaluation and ranking of the candidate remedial measures will result in presentation to the lead agency of the most desirable alternatives. The remedial alternatives will be evaluated for each project objective using the final criteria developed during the remedial investigation findings.

Evaluation and ranking of each remedial measure for each project objective will be performed through a decision matrix. A ranking system may be developed in which each remedial measure is given a point score and compared on a quantitative basis.

The evaluation criteria may also be weighted to reflect a ranking within the group. For instance, one evaluation criteria, for example technical feasibility, might carry more weight than others and would be given a higher relative ranking number. Decisions about the definition and ranking of evaluation criteria will be made before the remedial measure evaluation during the review meetings with the lead agency.

All information specific to the remedial measure evaluation will be summarized and presented in a preliminary report. This report, together with the remedial investigation report, will be used by the lead agency to select the final remedial measure(s). It will also provide the basis for the conceptual design of the selected remedial measure.

Information to be included in the remedial evaluation report will include:

- Supporting references on the feasibility of the remedial measures chosen for evaluation.

- Specific procedures and supporting data used to rank each remedial measure for the evaluation criteria.

- Design calculations used in evaluating each remedial measure.

- Preliminary design drawings and sketches used to evaluate each remedial measure.

- The cost estimates for each remedial measure with appropriate references provided.

The report will be prepared in a format that will be agreed upon in the preliminary review meetings. All documents collected in the remedial measure evaluation will be organized in a project file and will be available for later reference.

The report will be reviewed by the lead agency and then by the public at a community meeting. Following this, the lead agency will select the remedial measure for implementation.

Task 24 – Conceptual Design

A conceptual design of the selected remedial measure will be prepared for later use in development of detailed construction plans. The design will be based on the findings of the remedial investigations and the remedial measures evaluation.

The conceptual design plan will include general arrangement drawings and suggestions for inclusion in the construction specifications. The site investigation reports will be companion documents with the conceptual design plan. These reports will contain site information needed for construction design, such as test boring logs, borehole testing data, groundwater conditions, and analytical data.

The conceptual design plan will include the following:

- General arrangement drawings
- Any special implementation requirements
- Applicable design criteria

- Budget cost estimates for construction, operation, and maintenance
- Operation and maintenance requirements

Task 25 - Final Report

A final report will be prepared for submission to the lead agency which will summarize the activities conducted during the remedial investigation and feasibility study. The report will supply the back-up to support the chosen remedial measure(s) and will include the conceptual design drawings and data. The report will include but not be limited to:

- Summary of the assessment of site contamination
- Summary of remedial measure evaluation
- Site topographic map with ground control data
- General arrangement drawings and supporting data for remedial measure(s)
- Typical geologic and design cross-sections
- Typical design details
- Data for treatability studies necessary for final design
- Preliminary cost estimates

4.0 MANAGEMENT PLAN

4.1 Project Organization and Staffing

4.1.1 Project Manpower Plan

4.1.2 Interface Requirements

4.1.3 Field Office Operations

4.2 <u>Project Reports</u>

4.2.1 Project Status Reports

4.3 <u>Procurement</u>

4.4 <u>Change Orders</u>

4.5 <u>Community Relations</u>

4.6 <u>Quality Assurance</u>

4.7 <u>Health and Safety</u>

5.0 COSTS AND SCHEDULE

5.1 <u>Project Schedule</u>

5.2 <u>Costs and Budget</u>

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WASTE MANAGEMENT

HAZARDOUS SITE MITIGATION ADMINISTRATION

CN 028, Trenton, N.J. 08625

JACK STANTON
DIRECTOR

19 OCT 1983

Mr. John Frisco, Chief
Hazard Remediation Section
Hazardous Waste Site Branch
USEPA - Region II
26 Federal Plaza
New York, New York 10278

Dear Mr. Frisco,

Our office has completed its review [illegible] the Draft Combe Fill [illegible] Remedial Action Master Plan (RAMP). [illegible] our comments [illegible] listed below. These comments, as well as other incidental remarks, were discussed in [illegible] recent meetings between Mr. Robert Goltz of your staff and Mr. Donald [illegible] of my staff on October 6, 1983.

1. Recent inspections and sampling performed by the [illegible] indicate that small business may be contributing [illegible] water contamination problem in this vicinity. Therefore, these [illegible] should be considered when locating possible sources of contamination [illegible] investigation.

2. Please explain how the total organics were calculated in Table [illegible]. When all identified organics are added they do not equal the total organics expressed in the appropriate table.

3. The RAMP mentions inconsistencies in surface water sampling [illegible] the landfill vicinity (see pg. 4-17). It should be noted that the samples taken by the Upper Raritan Watershed and DEP were not split samples. These samples were taken at different times and locations so [illegible] in sampling results are expected.

4. With regard to sampling residential potable wells it is recommended that [illegible] these wells (depth of well, accessibility to the [illegible] pump capacity, [illegible]) should be obtained prior to sampling. [illegible] sampling 20-25 residential wells, as opposed to 80 recommended [illegible] RAMP, [illegible] sufficient information on ground water quality [illegible]. Where [illegible] these wells should be used to determine [illegible] flow.

5. [illegible] the geophysical investigation [illegible] areas of [illegible]

301645

6. An additional goal of the ground water investigation should ... determine the a real and vertical extent of ground water contaminati...

7. Previous sampling results have indicated that portions of Trout Brook and Rhinehart Brook are contaminated. However, if future sampling results of Trout Brook downstream show no evidence contamination it would not be necessary to sample the Lamington River.

8. As a source control measure the RAMP indicates that it would be infeasible to undertake a large waste removal operation. However, if small areas of hazardous wastes are identified away from the main fill areas excavation and removal may be required.

9. As part of the drilling program it is proposed that 4" rock core ... wells should be relocated to improve ground water monitoring coverage of the site perimeter. Since fracture patterns in the bedrock are ... and ground water contamination may move in several directions ... a larger number of wells monitoring ground water at the site perimeter ... be more advantageous.

Another alternative may be to use these four well locations to monitor ground water off-site. Presently, there is only ... well proposed off-site. Rock coring, however, would be done in four ... on-site wells. ... the above alternatives are implemented for relocating the four rock core/monitor wells, the additional wells the RAMP proposes in the Phase II drilling program may not be needed. Fracture trace analysis should be used to help select monitoring well locations.

10. In the first paragraph under Phase I "Drilling and Monitoring ..." the RAMP states split barrel soil samples will be performed ... between rock fragments. If odors are noticed or organic vapors are detected by a photoionization detector, the split spoon samples should ... analyzed for organic chemical contamination. Split spoon sampling probably will be difficult in most areas of the site, however, ... be suitable for split spoon sampling and test pit excavati...

11. The RAMP recommends that 20 test pits will be necessary. It ... our feeling that ten test pits would be sufficient. If extensive amounts of wastes ... detected in the unfilled portions of the site additional test pits will ... considered.

12. An additional off-site remedial measure should include installing ... wells (200-300 ft.). These wells may be cost effective when compared to individual carbon treatment units since carbon replacement would not be necessary.

13. Air quality sampling locations should be added to the objectives ... site reconnaissance.

14. The RAMP states that "Air monitoring samples would be ... identified as containing organic air contaminants during a site reconnaissance." It is our feeling that a more extensive air ... required at this site therefore this statement must be amended ... to ... air sampling program.

301646

15. The RAMP indicates that the landfill is bordered on the west-southwest by a wetland area. This wetland area actually extends onto the landfill site. It should be [illegible] in the RAMP that disturbance of this area may require a 404 permit [illegible] the Army Corps.

16. The streams in the vicinity of the landfill have been incorrectly identified in the RAMP. Rhinehart Brook is not a tributary [illegible] Brook. It is a separate stream which runs east-northeast from the landfill, crossing Schoolhouse Lane (see enclosed map).

Should you have any questions regarding this site, please contact Mr. Donald Lynch, P.E. at (609) 984-5923.

Sincerely yours,

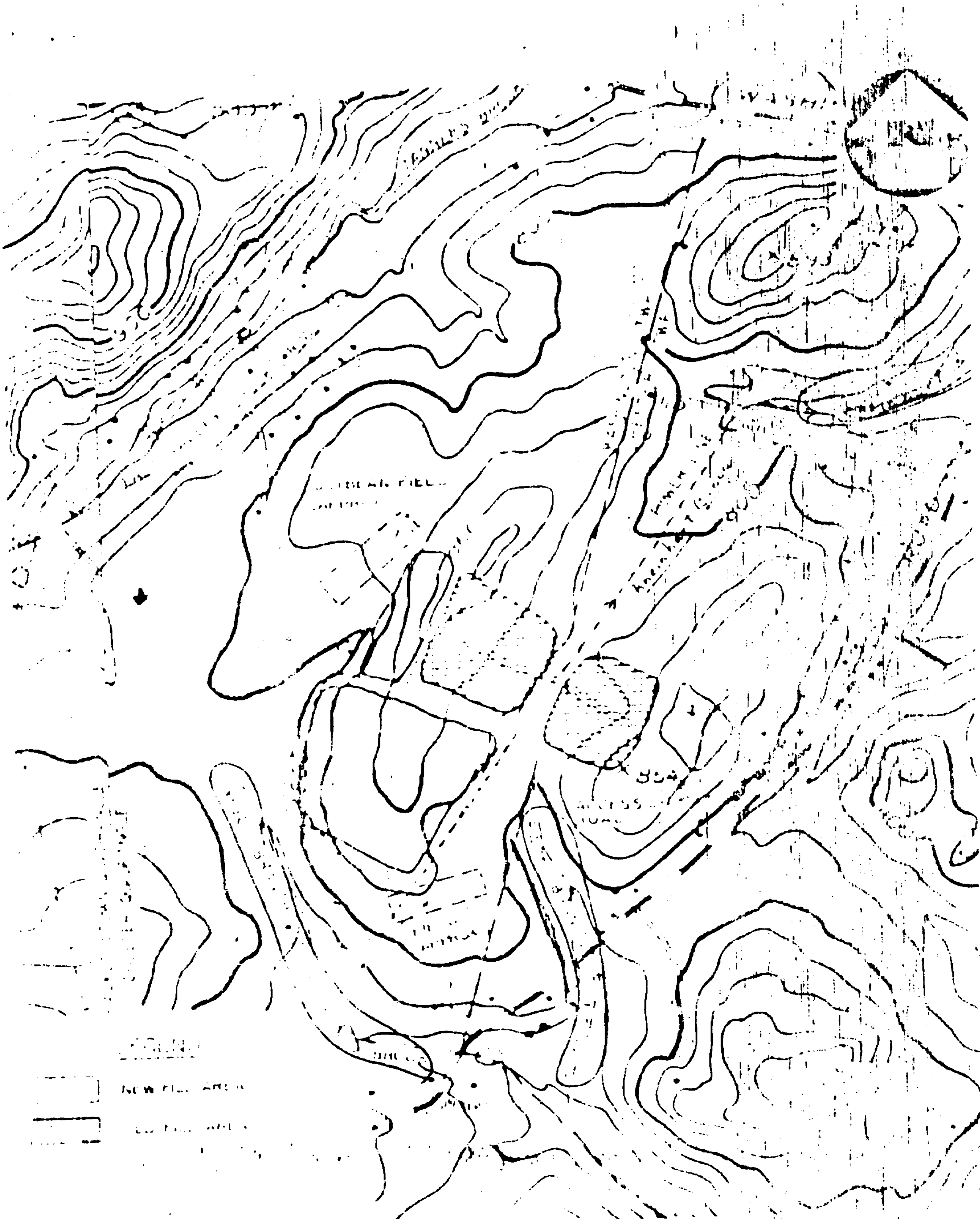
Leonard Romino

Leonard Romino, P.E.
Section Chief
Bureau of Site Management

9S39:elw
Enclosure

c: Robert Goltz, EPA

301647



301648